APPENDIX C

Environmental Condition of Property Documentation

- **2024 PSS Update**
- **2013 Pre-Construction Site Assessment**
- **2023 Operational Range Assessment Report**
- **2013 McCrady MPMG Range MEC Survey Report**

The State of South Carolina
Military Department

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MAJOR GENERAL

OFFICE OF THE ADJUTANT GENERAL

1 NATIONAL GUARD ROAD

COLUMBIA, S. C. 29201-4752

9 August 2024

SUBJECT: Preconstruction Site Selection (PSS), Environmental Condition of Property (ECP), MTA McCrady Training Site Multi-Purpose Machine Gun Range (MPMG) MILCON PN 450377

1. This memorandum documents an update to the 2013 Pre-Construction Assessment (PCA) that was prepared by South Carolina Army National Guard Environmental Professionals (Mark Mohr, Deputy Conservation Manager) in support of the proposed military construction (MILCON) of a Multi-Purpose Machine Gun Range (MPMG). The PCA was prepared per the requirements of the Army National Guard's "Environmental Condition of Property Process Handbook" (ARNG June 2011). This memorandum incorporates ASTM International's standard E1527-21 and the Policy Memorandum "Updated Policy/Supplemental Guidance for ARNG ECP Documentation" (ARNG 2023).

2. SITE RECONNAISSANCE
    a. A site reconnaissance was conducted by Virginia (Geni) Theriot on 9 July 2024. The site reconnaissance did not indicate any substantial changes to the ECP of the property since the 2013 PCA. Photographs from the site reconnaissance are attached.
    b. Ms. Theriot is the SCARNG NEPA/ECP Manager and an environmental professional with a Masters in Environmental Resource Management, more than twelve years of full-time relevant experience, and meets the definition of Environmental Professional as defined in 40 CFR 312.10.

3. DOCUMENT REVIEW
    a. A search of the following was conducted on 9 July 2024: South Carolina Department of Environmental Services, EPA NEPAssist, Richland County GIS Tax Parcels, a search of environmental cleanup liens, and a search of historical aerial photographs. The most recent, 2023 aerial photograph, Figure 1, is included as an attachment.
    b. According to the most recent Operational Range Assessment (ORA) Cycle Advanced Assessment Report–Fort Jackson / McCrady Training Center (MTC), South Carolina (United States (U.S.) Army Fiscal Year (FY) 18-22), the 62 ranges on Fort Jackson consist

of firing ranges, small arms ranges, and training areas totaling 14,895 acres. Based on data collected during the 2008 Phase I Assessment, the 2014 Phase II Assessment and the 2023, ORA, the proposed MPMG construction will occur in an area of operational ranges at MTC. The ORA concluded that 51 ranges (including the proposed MPMG), including impact areas, medium and large caliber firing ranges, small arms ranges, and training areas that either contain artillery or mortar firing points or known or suspected dudded areas or have received heavy historical munitions usage, were categorized as Inconclusive. Ranges are categorized as inconclusive to indicate the need of further analysis through Phase II Quantitative Assessment. All ranges classified as inconclusive will be included in the FY23-27 cycle of ORA's to meet DoDI requirements. The ORA is attached.

c. The document review did not indicate any substantial changes to the ECP of the property and/or property use limitations since the 2013 PCA.

4. INTERVIEWS
   a. An interview with Mr. Jim Cook, MTC Sustainable Range Program Manager, was conducted on 11 July 2024. Documentation of the interview is attached.
   b. The interview did not indicate any historic known or suspected releases or any substantial changes to the ECP of the property since the 2013 PCA.

5. CONCLUSION – The South Carolina Army National Guard (SCARNG) has had a license for the MTC since August 1986. It is believed the SCARNG had a real estate agreement before 1986 but the only documentation found to support that is an outgrant dated 1969.
   a. The site reconnaissance/document review did not indicate any substantial changes since the 2013 PCA. SCARNG has sufficient in-house expertise to validate the PCA and concludes that additional expenditure of funds for this effort is not warranted at this time.
   b. As discussed in the 2013 PCA, in accordance with Department of Defense (DoD) policy defining the classifications, the target property has been overall classified as Category I with UXO areas classified as Category III. All UXO areas will be cleared by USACE before the beginning of construction. Therefore, the SCARNG has determined the subject property to be suitable for the proposed MPMG construction.

6. The point of contact for this memorandum is the undersigned and can be reached at 803-730-2178 or virginia.theriot@scmd.sc.gov. Questions or concerns can be directed to the undersigned.

Virginia Theriot

Virginia Theriot
SCARNG
NEPA/ECP Manager

Interview
Mr. Jim Cook
McCrady Training Center Sustainable Range Program Manager
July 11, 2024

1. Are you aware of any environmental cleanup liens against the subject property that are filed or recorded under local, State, or Federal law? Answer: None, there is no known environmental cleanup liens on the proposed MPMG construction site. USACE will conduct UXO clearance prior to the start of construction.
2. Are you aware of any engineering controls, land use restrictions, or institutional controls that are in place at the site and/or have filed or recorded under local, State or Federal law? Answer: Storm water retention control measure are maintained throughout McCrady Training Center. During construction, compliance with the National Pollution Discharge Elimination System (NPDES) construction permit and a project-specific Storm Water Pollution Prevention Plan (SWPPP) will ensure sedimentation effects are minimized. There are no documented land use restrictions for this location. Institutional controls measures are as follows; Spill Prevention, Control and Countermeasure (SPCC) Plan, Hazardous Waste Hazardous Material Management Plan (HWHMMP) and applicable Hazardous Materials/Waste programs for current operations.
3. Do you know of any past uses of the subject property indicative of releases or threatened releases? Answer: No uses indicative or releases or threatened releases. The proposed MPMG range would be located, within the existing impact area, on an existing active range complex managed by Fort Jackson. The Impact Area is an existing area where weapons, bombs, explosive munition, etc. have been and can be fired or detonated. Fort Jackson has conducted field artillery operations in the range complex since World War I.
4. Do you know of specific chemical releases that have taken place at the subject property? Answer: There are no known chemical releases that have taken place on the subject property.
5. Do you know of spills or other chemical releases that have taken place at the subject property? Answer: There are no known spills that have taken place on the subject property.
6. Do you know of any environmental cleanups that have taken place at the subject property? Answer: There have been no known environmental cleanups that have taken place on the subject property. The closes Solid Waste Management Unit on McCrady Training Center is over 5 miles from the proposed MPMG construction.
7. Are there any obvious indicators that point to the presence or likely presence of contamination at the subject property? Answer: No, there are no obvious indicators of the presence or likely presence of chemical contamination or other spills at the subject property.

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Fort Jackson / McCrady Training Center, South Carolina

May 2023

Background

DoD uses and manages operational ranges to support national security objectives and maintain the high state of operational readiness essential to its mission requirements. The Department conducts non-regulatory, proactive, and comprehensive operational range assessments (ORAs) to support the long-term sustainability of these ranges while protecting human health and the environment. The purpose of an ORA is to determine if there is a release or substantial threat of a release of munitions constituents (MC) from an operational range to an off-range area that exceeds an applicable regulatory standard or creates a potential unacceptable risk to human health or the environment.

The Army ORA effort was developed to address DoD requirements detailed in DoD Directive 4715.11 (10 May 2004) and DoD Instruction 4715.14 (15 November 2018). The overall objective of the ORA is to assess operational ranges/range complexes to determine if an off-range MC release or substantial threat of an off-range MC release exists; if an off-range MC release exists, does it exceed an applicable regulatory reporting standard; and if an MC release or substantial threat of a release exists, determine whether it creates a potentially unacceptable risk to off-range human health or the environment. Army ORAs assess potential off-range migration of MC along surface water system and groundwater migration pathways.

Range Overview

The combined Fort Jackson / McCrady Training Center installation boundary encompasses approximately 51,961 acres in Richland County, South Carolina. The South Carolina Army National Guard (SCARNG) holds a nonexclusive license for training operations on approximately 15,267 acres of the eastern portion of Fort Jackson. The ORA-eligible ranges within Fort Jackson and McCrady Center included 166 operational

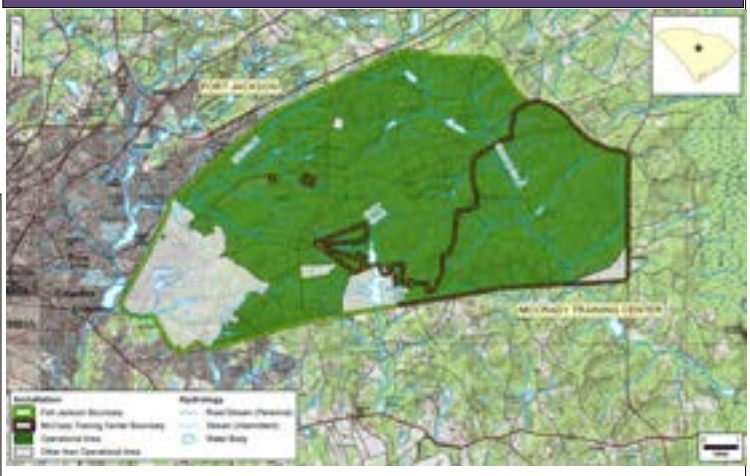
Operational Range Assessment Findings (05/2023)

Based on updated sampling data, an off-range release currently exists with potentially unacceptable risk to off-range ecological receptors from lead in surface water on Fort Jackson. Ranges associated with the Mill Creek watershed should be recategorized as Referred. Also, given low water hardness, metals detection in blank samples, and data qualification of non-detected values, the non-detections of metals in the dataset are considered uncertain and therefore the remaining ranges should be recategorized from Unlikely to Inconclusive.

Next Steps

Additional sampling should be considered to assess the source of elevated metals concentrations in Mill Creek surface water on Fort Jackson. In addition, Fort Jackson and McCrady Training Center's operational ranges should be included in the FY23-27 cycle of ORAs to meet DoD Policy (DoDI 4715.14) re-assessment requirements.

Map of Range/Range Area



Range Overview (continued)
ranges covering 44,370 acres, which include 132 maneuver/training areas, 10 firing ranges, 22 small arms ranges and 2 impact areas. Additionally, there is a non-operational cantonment area consisting of 7,591 acres.

Previous ORA Investigations
Fort Jackson and McCrady Training Center were evaluated in 2008 under separate Phase I ORA Qualitative Assessments that consisted of collecting, evaluating, and presenting available data to establish if there was a potential interaction between the on-range sources of MCOC and off-range receptors (source/receptor interaction). The Phase I ORA evaluated 62 operational ranges at McCrady Training Center and 104 operational range areas at Fort Jackson. The Phase I ORA identified small, medium, and large caliber munitions, pyrotechnics/obscurants, and other munitions as the primary MCOC sources at Fort Jackson and McCrady Training Center.

At McCrady Training Center, 14 ranges were categorized as Unlikely that a source/receptor interaction could occur because no potential source/pathway receptor interactions were identified. The other 48 ranges at McCrady Training Center were categorized as Inconclusive. Training conducted at the Inconclusive ranges included munitions which constituted a source of MCOC. Potential surface water system migration pathways were identified that originated from three primary watersheds: Colonels Creek Watershed, Gills Creek Watershed, and Cedar Creek Watershed. Potential groundwater migration pathways included the Middendorf aquifer, which was widely used for drinking water.

At Fort Jackson, 53 ranges at Fort Jackson were categorized as Unlikely because no potential source/pathway receptor interactions were identified. The ORA concluded that 51 ranges were categorized as Inconclusive. Training conducted at the Inconclusive ranges constituted a source of MCOC. Potential surface water system migration pathways were identified within five primary watersheds: Colonels Creek Watershed, Gills Creek Watershed, Wildcat Creek Watershed, Mill Creek Watershed and Cedar Creek Watershed. Potential groundwater migration pathways

Previous ORA Investigations (continued)
from the Inconclusive ranges included groundwater in the shallow, perched aquifer.

The Inconclusive ranges were recommended for further evaluation through a Phase II.

Previous Phase II ORA
The 2014 Phase II assessment was combined for Fort Jackson and McCrady Center as the installations were immediately adjacent. The Phase II Assessment evaluated 163 operational range areas that occupied a total of 51,961 acres between both Fort Jackson and McCrady Training Center. The Phase II multi-season sampling event was conducted from 2009 to 2013. The investigation included surface water and sediment samples from five downstream and three reference locations within Colonels Creek Watershed, Cedar Creek Watershed, and Gills Creek Watershed. Surface water was analyzed for metals, propellants, and explosives and sediment was analyzed for metals and explosives. Additionally, benthic macroinvertebrate surveys were conducted to characterize overall stream health. Surface water, sediment, and benthic macroinvertebrate sampling data indicated MCOC were not migrating off-range via Colonels Creek or Cedar Creek. Because Cedar Creek surface water and sediment sampling data were considered conservatively representative of Mill Creek conditions, these data also indicated MCOC were not likely migrating off-range via Mill Creek. Surface water and sediment sampling data from the Gills Creek watershed included lead and copper concentrations exceeding project action limits (PALs). Based on these results, a Screening Level Ecological Risk Assessment (SLERA) was performed to better assess the conditions. The SLERA performed on the results from Gills Creek indicated that the potential for adverse ecological health effects from exposure to sediment in Gills Creek at the operational range boundary is likely low. However, based on the low pH in surface water and low total organic carbon in sediment, these metals may become mobile and bioavailable.

Groundwater sample results showed that concentrations of cyclotrimethylenetrinitramine (RDX) were present in groundwater and had migrated to

Previous Phase II ORA (continued)

monitoring wells near the operational range and installation boundary, upgradient of off-range wells used for drinking water. It could not be determined if RDX had migrated off the operational range area. A separate subsequent investigation outside of ORA was launched and is ongoing under the Installation Restoration Program to address this issue.

Advanced Assessment Overview

The 2023 Advanced Assessment for Fort Jackson and McCrady Training Center refined the CSM through the collection of updated source, pathway, and receptor data and included a review of existing analytical results from previous investigations. Recent data showed there are 148 operational ranges covering 51,322.78 acres, which include 55 maneuver/training areas, 56 firing ranges, 4 dudded impact areas, 15 non-dudded impact areas, and 18 historic impact areas. Additionally, there are approximately 7,591 acres of non-operational cantonment area.

Surface water and sediment samples were collected under the Advanced Assessment to address data gaps identified in the updated CSM. Seven total samples were collected from Mill Creek, Colonels Creek (Upper and Lower), and Jumping Run Creek. Surface water was analyzed for dissolved metals, explosives, perchlorate, and Biotic Ligand Model parameters. Sediment was analyzed for metals, explosives, and simultaneously extracted metals (SEM)/acid volatile sulfide (AVS)

The worst-case scenario for groundwater was designated in Cedar Creek Watershed with the RDX source. The watershed was not sampled as it is now covered under the Installation Restoration Program with an ongoing Feasibility Study and Proposed Plan.

Due to a combination of higher detection limits associated with the analytical method (USEPA SW6020A versus 1669), low water hardness, and laboratory blank metals contamination, the majority of surface water metals results were non-detect at levels above screening values or qualified as non-detect. Therefore, the potential migration of metals MCOC via surface water within the Upper Colonels Creek, and Lower Colonels Creek (including Jumping Run Creek) should be recategorized as Inconclusive.

The surface water metals results that did not qualify as non-detect included lead detections that exceeded the reference level and the USEPA freshwater ecological screening value at two locations in Mill Creek; therefore, the Mill Creek watershed was determined to be Referred. Low-level detections of perchlorate in surface water were less than the reference level and screening value. There were no detections of explosives in surface water. Sediment results indicated there is no migration of metals from source areas at Fort Jackson/McCrady Training Center and no detections exceeded screening values. No explosives were detected in sediment.

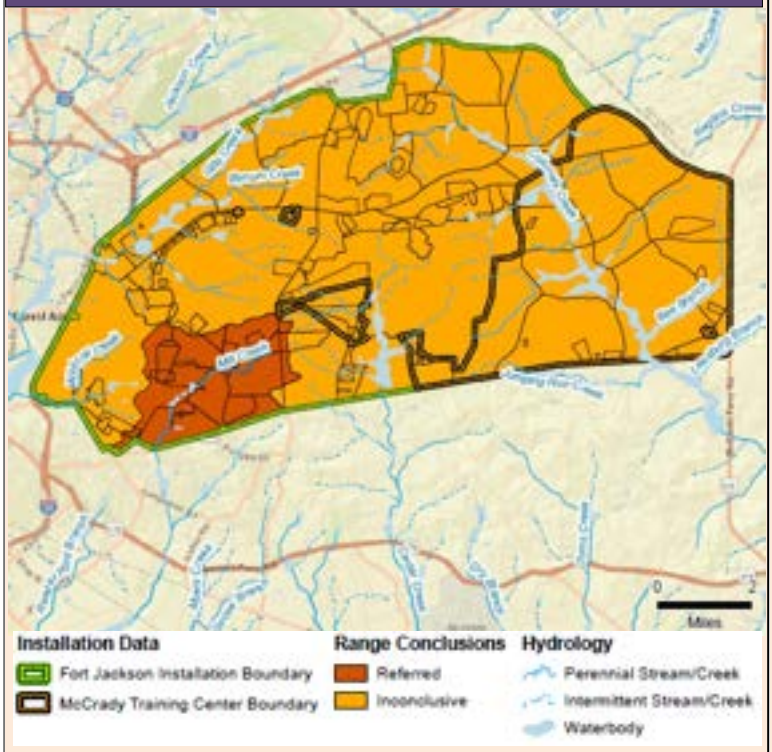
Based on the Inconclusive results of the surface water samples for metals MCOC, this Advanced Assessment recommended the source area ranges, consisting of 53 firing ranges, 4 dudded impact areas, 14 non-dudded impact areas, 39 maneuver and training areas, and 16 historic impact areas, totaling 46,950.56 acres, should be re-categorized as Inconclusive.

The remaining ranges, including the entirety or portions of the 3 firing ranges, 1 non-dudded impact area, 2 historical impact areas, and 16 maneuver and training areas within the Mill Creek Watershed of Fort Jackson, encompassing 4,372.22 acres, be categorized as Referred due to the migration of lead MC off-range in surface water at concentrations exceeding the state standard and that potentially pose an unacceptable risk to off-range ecological receptors.

The Army and Fort Jackson/McCrady Training Center will determine appropriate further analysis to better characterize the risk posed by these ranges and monitor MC migration off-range.

All ranges at Fort Jackson and McCrady Training Center should be included in the Fiscal Year 2023-2027 cycle of ORAs.

Advanced Assessment Conclusions



For more information on Fort Jackson, contact [(803) 751-5327]
For more information on the DoD Operational Range Assessment Program visit https://www.denix.osd.mil/orap/home/

FINAL
CAMP McCRADY, SC
MULTI-PURPOSE MACHINE GUN (MPMG) RANGE
MEC SURVEY REPORT
PROJECT NO. 450377

Prepared by:

United States Army Engineering and Support Center, Huntsville

March 26, 2013

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ACRONYM LIST

AOI – Area(s) of Interest
APP – Accident Prevention Plan
CD – Cultural Debris
CEHNC – Corps of Engineers, Huntsville Center
DA – Department of the Army
DMM – Discarded Military Munitions
GIS – Geographical Information System
GPS – Global Positioning System
HE – High Explosive
IGE – Independent Government Estimate
MD – Munitions Debris
MEC – Munitions and Explosives of Concern
MIMID – Miniature Mine Detector
MPMG – Multi-Purpose Machine Gun
OE – Ordnance and Explosives
OESS – Ordnance and Explosives Safety Specialist
PDA – Personal Digital Assistant
ROM – Rough Order of Magnitude
RRD – Range Related Debris
RTLP – Range and Training Lands Program
UXO – Unexploded Ordnance

1.0 GENERAL DISCUSSIONS

1.1 INTRODUCTION

1.1.1 In an effort to support the Sustainable Range Program (SRP), the Ordnance and Explosives (OE) Directorate Corps of Engineers Huntsville Center (CEHNC) conducted a Munitions and Explosives of Concern (MEC) reconnaissance survey on the proposed Multi-Purpose Machine Gun (MPMG) Range at Camp McCrady, SC. The survey served to gather information that determines the location, extent and quantity of surface MEC and estimates the extent and quantity of subsurface MEC on the area of interest (AOI) for the planned RTLP project. This report will recommend response actions based on observations and data collected.

1.2 PROJECT OBJECTIVES

1.2.1 The objectives of the ordnance survey are as follows:

1) Gather sufficient data to adequately characterize the nature of MEC at the AOI designated by Camp McCrady;
2) Categorize AOI into a low, medium or high risk area(s) by determining the potential that individuals performing work on the site will encounter MEC;
3) Gather sufficient data in order to define clearance footprints;
4) Gather sufficient data to produce rough order of magnitude (ROM) estimate for MEC response action activities.

1.3 SCOPE OF MEC RECON SURVEY

1.3.1 CEHNC mobilized one 2-person team to traverse the AOI at the MPMG Range. The site was overlain with transects and uploaded to a Thales Mobile Mapper (TMM) personal digital assistant (PDA) with an integrated global positioning system (GPS) to guide the teams throughout the surveys. The transect path is designed to provide a uniform site coverage which will demonstrate meaningful site models. The uploaded transect paths were followed throughout the survey. The transect paths can be viewed in Appendix A maps.

1.3.2 During fieldwork, the team photographed significant munitions related items, terrain, vegetation, quality control functions and other pertinent visual opportunities that would aid in the understanding of the potential for explosive hazards at the site. All site photos can be viewed in Appendix B.

1.3.3 Historical documentation is sought for each site that is slated for a MEC recon survey. No site historical information was recovered. Appendix C has been left as a place holder in the event that historical information is revealed during the project.

1.3.4 Data quality is the most essential element of the MEC recon survey. A functionality test strip was swept twice daily to insure proper equipment function, battery strength, data quality and proper techniques are being applied by the operators. The test strip is established prior to

fieldwork. A MEC simulant was swept in the morning and at the end of the day. The QC log can be viewed in Appendix D.

1.3.5 The survey was an instrument assisted qualitative and quantitative reconnaissance that logged items encountered on the surface as well as quantities of detected subsurface anomalies. Items logged may include unexploded ordnance (UXO), munitions debris (MD), discarded military munitions (DMM), Range Related Debris (RRD), berms, craters, targets and any other notable ordnance related features. Complete definitions of munitions related terms can be found in Appendix E. The survey enables the CEHNC GIS team to generate quantitative and qualitative site models that display MEC related characteristics of the site, improves the accuracy of a MEC response action government estimate and provides data to MEC contractors for accurate response action proposals.

1.3.6 The actual field data collected is weighted heavily in the conclusions and recommendations of the MEC survey. Constant vigilance is imperative to collecting reliable data. The two primary factors that decrease the accuracy of MEC surveys are vegetation and speed of collection. No vegetation removal is executed prior to MEC surveys. Also, many miles of transect must be traversed to cover the large range areas in a small amount of time. A balance of walking pace and adequate detection sweeping must be negotiated by the detection equipment operator. 8.5 miles of transect was covered in order to attain the necessary site coverage. 253 data points were collected. The OESS, using an analog magnetometer, swept a one meter wide swath and reported the counts to the data collector every 50 meters. The surface count encompassed a three meter wide swath. All counts were inventoried every 50 meters. The data collector kept the team on the projected path and informed the OESS when the next point had been reached. The field team leader monitors detection quality being achieved. If quality issues are observed, the field team leader is responsible for correcting the problem. The collection data can be viewed in Appendix F.

1.4 TECHNICAL APPROACH

1.4.1 The CEHNC team developed a survey coverage strategy using Geographical Information System (GIS) files. The CEHNC team created an addendum to the programmatic work plan (PWP) to meet the data quality objectives of the project.

1.4.2 Camp McCrady provided GIS data and/or information necessary to locate and development a comprehensive plan that would guide the recon team throughout the survey. The CEHNC GIS team created an overlay of transects for the survey team to follow while in the field.

1.4.3 A test plot was implemented at the site. A simulant was utilized at the test plot to verify equipment function. Coordinates were taken of the item for documentation. The test plot is a quality control (QC) matrix utilized to demonstrate proper function of the detection equipment and competence of the detection equipment operators. A Schiebel Miniature Mine Detector (MIMID) Electromagnetic (EM) all metals detector was used for quantitative subsurface anomaly counts. Detection of the simulants was verified each day at the site before and after survey activities.

1.4.4 The CEHNC GIS technician uploaded data files to the TMM to provide guidance in the field. While in the field the GIS technician guided the team as close to the proposed transects as possible. The team logged all surface and subsurface contacts at the end of a 50 meter increment along the transect. Data collection points were established every 50 meters along the transect for the entire survey route.

1.4.5 One 2-man survey team followed the planned transects, logged observed surface UXO, DMM, MD, and CD, recorded physical features that would indicate MEC related activity, terrain, geology, targets and logged the number of subsurface ferrous anomalies detected. The team progressed along the projected transects with the OE safety specialist (OESS) in the lead. His primary mission was to cover a one meter wide strip with the MIMID and note the number of subsurface anomalies detected, count notable surface items and ensure any surface UXO on the path was avoided by the team. The TMM operator followed entering all ordnance related observations. The OESS covered a minimum one meter wide swath for subsurface contacts. An effective 3 meter wide swath was covered for visual identification of surface items. All munitions related items were logged at the data collection points.

1.5 SITE LOCATION

Camp McCrady is the National Guard contingent located on Fort Jackson, SC. The site is located at Range 24 on the west side of the East Impact Area.

1.6 SITE DESCRIPTION

The MPMG is approximately 166 acres in surface area. The terrain is flat to rolling with a few abrupt changes in elevations. The vegetation is primarily wooded with oaks. The soil is very sandy.

1.7 MEC RELATED SITE HISTORY

The site is within the current delineated impact area. An active range exists to the north which the footprint overlaps down range. Numerous ordnance appears to have been used on the current range. Historic range fans for 105mm and 155mm Howitzer are displayed in the 2005 historical review previously conducted by Malcolm Pirnie. The historical review can be view in Appendix C. The historical range fans were geo-referenced and overlaid with the range footprint. The overlaid footprint can be viewed in Appendix A Figure 7.

1.8 PERSONNEL

1.8.1 Project Manager

Ken Hewitt is the project manager and is responsible for execution of all aspects of the MEC survey.

1.8.2 Technical Manager

Jason Burcham is the technical manager and is responsible for all technical issues that affect project implementation, quality, and feasibility.

1.8.3 GIS Analyst Team

Dustin Ray is the GIS specialist and is responsible for project GIS deliverables.

1.8.4 OE Safety Specialist

Michael Slovak was the OESS during field work. He was responsible for the safety of the team in the field, identification of ordnance, the abbreviated accident prevention plan (APP), assist in quality control, operation of detection equipment, and reporting MEC related data to the data collector.

1.8.5 Field Team Leader

Jason Burcham was the field team leader. He was responsible for creation and adherence to the project work plan and work plan addendum, adequate collection of data at the sites, quality control, field coordination with range control, and development of the MEC survey report.

1.8.6 Camp McCrady POC

Major Moyer was the primary points of contact (POC) during the survey.

2.0 TECHNICAL DISCUSSION

2.1 INITIAL COORDINATION - The team arrived at Fort Jackson range control at 0700 on Sunday November 11, 2012. The survey team was given clearance to occupy then proceeded to the site. The team surveyed transects until coverage was complete. The project progressed as follows in Table 1.

2.2 FIELDWORK PROGRESSION - Fieldwork progressed very efficiently throughout the survey. The team completed the site within schedule and collected the data needed for analysis of the site. The time spent performing fieldwork on the site can be viewed in Table 1.

TABLE 1
Fieldwork Progression

Site	Date	Type of Investigation	Begin	End	Complete
MPMG	**11/11/12**	**Survey**	**0730**	**1730**	**No**
MPMG	**11/12/12**	**Survey**	**0730**	**1430**	**Yes**

2.3 TEST PLOT - An area offsite was swept by an OESS and determined free of subsurface anomalies. An ordnance simulant item was placed on the surface and swept in order to fulfill the QC matrix for equipment function and operator competence. The test plot was swept at the beginning and end of fieldwork each day. The coordinates of each offsite location are provided in Table 2. A Schiebel MIMID was tested at the beginning and end of field activities at the site. It underwent and passed all functionality checks. Detection was observed and noted. Detection devices were inspected for any damage that may impair its functionality.

TABLE 2
Simulant Locations

AOI	Simulant	Depth	Coordinates, WGS84 UTM Zone 17N (X,Y)
MPMG	MEC Simulant	0	513152, 3764582

2.4 FIELD ACTIVITIES
One 2-person team traversed the site on November 11-12, 2012. A test strip was created offsite for equipment functionality checks. After functionality checks were complete, the survey commenced. The team traversed separate transects delineated north-south across the site. The transects were spaced 100 meters apart across the 166 acre site. The effective coverage was 262 acres due to transects that exceeded the limits of the MPMG footprint. See Figure 2 of Appendix A for a graphic representation of site coverage. The MEC survey team proceeded with the OESS sweeping a one meter wide swath with a Schiebel MIMID on high setting. Metallic subsurface anomalies in the path were counted and logged at predetermined data collection points (Every 50m). The data collector guided the team between data points. The team counted surface items and the OESS identified munitions related items. UXO, MD, RRD and CD were logged during the survey. Old hard targets were observed on the site. High quantities of ordnance is present on the northern portion of the site (See Appendix A).

2.5 SUMMARY OF FINDINGS – 4093 MD items were observed which consisted of HE fragments, 81mm Illumination Mortars, 105mm TP Projectiles. Two MEC items were observed which consisted of a 75mm HE Projectile and a 90mm HEAT Projectile. Several targets exist as well as high quantities of small arms bullets/debris.

TABLE 3
Summary of Findings

Site	MEC Observed	RRD Observed	MD Observed	MEC Response Needed
MPMG	2	456	4093	Yes

3.0 MAP REFERENCES, ARCHIVAL REFERENCES AND DISCUSSIONS

3.1 Overall MPMG Location - The location is displayed in Figure 1, Appendix A, Overall Location Map. The site is located at Range 24 west of the impact area. Figure 1 provides a visual reference of the site in relation to the installation.

3.2 MPMG Recon Survey Coverage - The proposed coverage of the site is generated at the CEHNC prior to fieldwork. The coverage is an unbiased uniform coverage of the site. Actual survey coverage may vary in the field due to installation instructions, dangerous terrain features, and/or field revision based MEC encountered. Typically the survey coverage delineated in the office is followed in the field to the greatest extent practical. The proposed coverage thoroughly covered the boundaries of the MPMG Range. The MPMG Range Site coverage can be viewed in appendix A, Figure 2.

3.3 Subsurface Contact Distribution
Subsurface anomalies were observed at the site. A Schiebel MIMID EM analog metal detector was used to gather subsurface quantitative data. All metallic anomalies are detectable by the instrument. The subsurface contacts indicate subsurface metallic densities. Anomaly densities

were developed to demonstrate the subsurface metallic characteristics of the sites. The densities reported are typically lower than the anomaly densities that will be encountered during a removal action. The subsurface density contours can be viewed in Appendix A, figure, 3.

3.4 Surface Density
Metallic surface items were logged during the recon. The surface density map demonstrates quantitative metallic surface characteristics of the site. The densities reported are typically lower than the anomaly densities that will be encountered during a removal action. The surface density maps can be viewed in Appendix A, figure 4.

3.5 Munitions Item Map
A munitions related surface item map was created to demonstrate significant findings of the reconnaissance survey. The item map can be viewed in Appendix A, figure 5.

3.6 Risk of Encountering MEC - A map that demonstrates areas of high, medium, and/or low risk of encountering MEC has been created based on the data collected. The map does not denote the hazard severity of the items encountered, but the probability of encountering explosive hazards throughout the AOI based on all known information. The map can be viewed in Appendix A, Figure 6.

3.7 Historic Analysis – A historical analysis was completed from a 2005 historical review report produced by Malcolm Pirnie. The historic map pertaining to the project site was geo-referenced and overlain onto the MPMG footprint. The map can be viewed in Appendix A Figure 7. The historical report can be viewed in Appendix C. Figure 4-9 in the report was overlain onto the footprint.

3.8 Data Tables - The determinations made in this report rely heavily upon the field data collected while traversing the site. Constant vigilance and awareness of the munitions related site characteristics must be maintained at all times in order to collect reliable data. At each data point a thorough data collection checklist is evaluated to determine munitions related quantitative and qualitative characteristics of the segment that was traversed. Typical data collection point spacing is approximately 50 meters. This regimen of data collection was performed 253 times at the MPMG. The data collection tables can be viewed in Appendix F.

4.0 MEC SURVEY CONCLUSIONS

Two MEC items were discovered during the survey. Evidence of MEC related site use exists throughout a large portion of the site. Numerous HE fragments were observed. The site exhibits areas with low, medium and high probability of encountering explosive hazards. Figure 6, Appendix A conveys the risk of encountering MEC probability map.

5.0 MEC SURVEY RECOMMENDATIONS

A subsurface clearance is recommended in the medium and high risk areas. Standby construction support is recommended in the low risk areas.

This report accurately depicts the survey team's evaluation of the extent of UXO contamination at the site but likely underreports the nature of contamination. The actual conditions experienced during a removal action will differ significantly from the conditions reported herein for a number of reasons. For example, the site was not cleared of vegetation prior to the survey; therefore this hampered the survey efforts which most likely resulted in an under reporting of surface and sub-surface anomaly density. Also, the speed at which the surveyor moved across the site and the fact that no QA followed will inherently result in an underestimation of the anomalies to be encountered in an actual removal action. Also an anomaly as reported herein is an area which demonstrates elevated geophysical instrument response and not the number of metallic items to be encountered at the site. Given that removal teams often define an anomaly as a metallic item as opposed to an anomalous area it is certain that the anomaly density reported by removal teams will exceed the anomaly density reported herein. The type of geophysical instrument and settings used by removal teams will certainly differ from those used by the survey team thereby creating differences between reported and actual number of geophysical anomalies at the site. The survey transect spacing is relatively wide compared to the small size of the construction features (targets, road corridors, etc) and it is likely that the survey missed high anomaly density areas that may be part of the clearance area. These and other factors will cause the report to underestimate the conditions at the site. The use of the data provided as the basis of estimate requires an experienced understanding of how the data of this type is collected, analyzed, interpreted, and presented and requires an understanding of the limitations of the data provided by assessments of this type. Therefore this information shall not be used by bidders in preparation of their pricing proposals. Bidders who do utilize this information shall accept full and sole responsibility for identifying and considering all factors that may affect the cost to execute the work use the data presented herein at their own risk.

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SITE MAPS

APPENDIX B
PHOTOGRAPHS

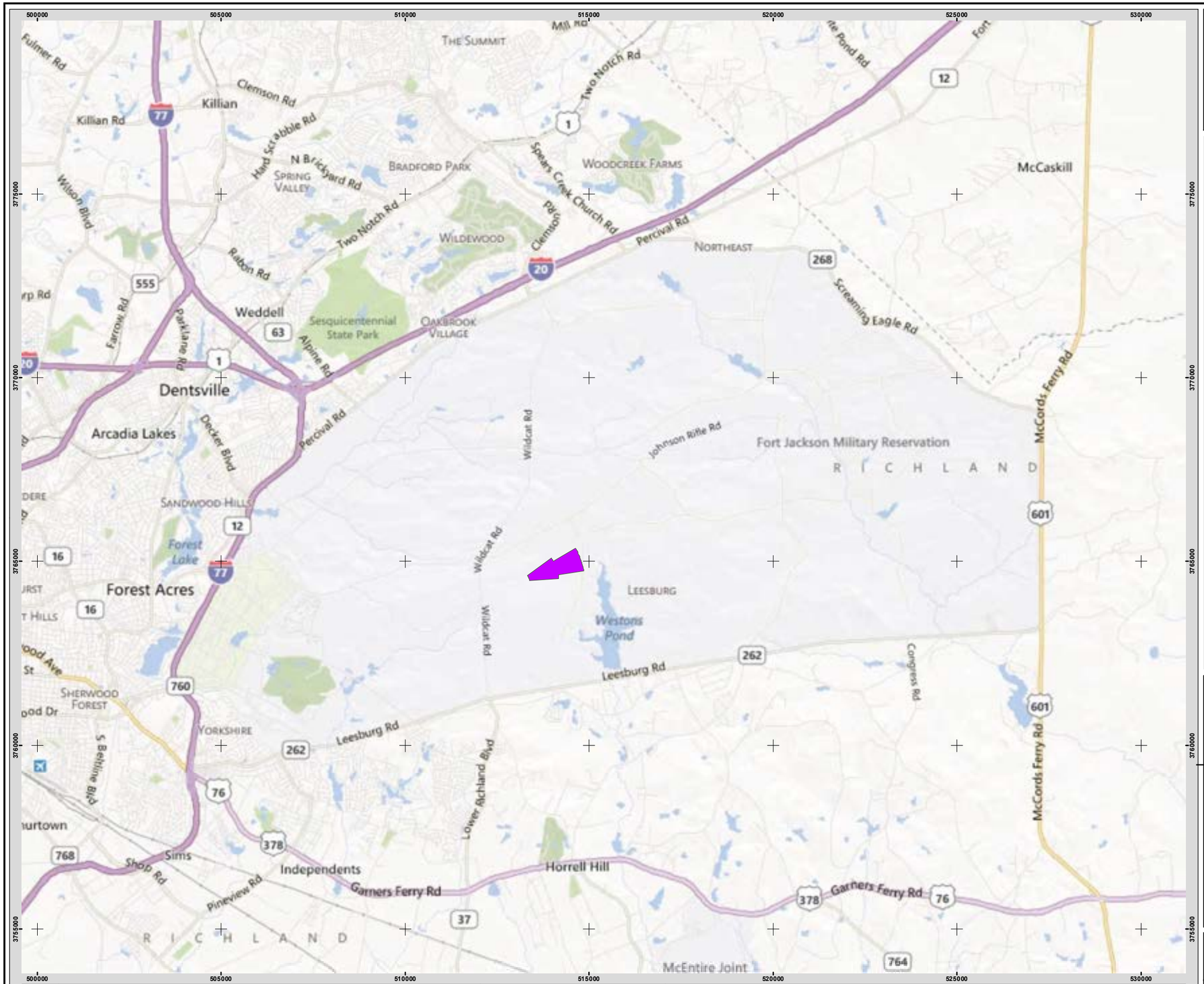
APPENDIX C
HISTORICAL DOCUMENTATION & PREVIOUS INVESTIGATIONS

APPENDIX D
QC LOG

APPENDIX E
Munitions Related Terms

APPENDIX F
DATA TABLES

Figure 1
Overall Location
MPMG
Fort Jackson/Camp McCrady, SC



Legend

Project Location

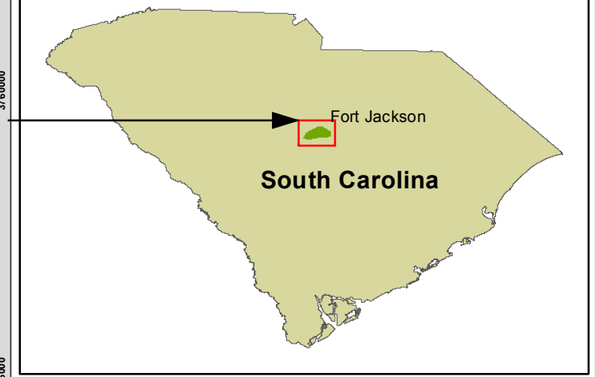


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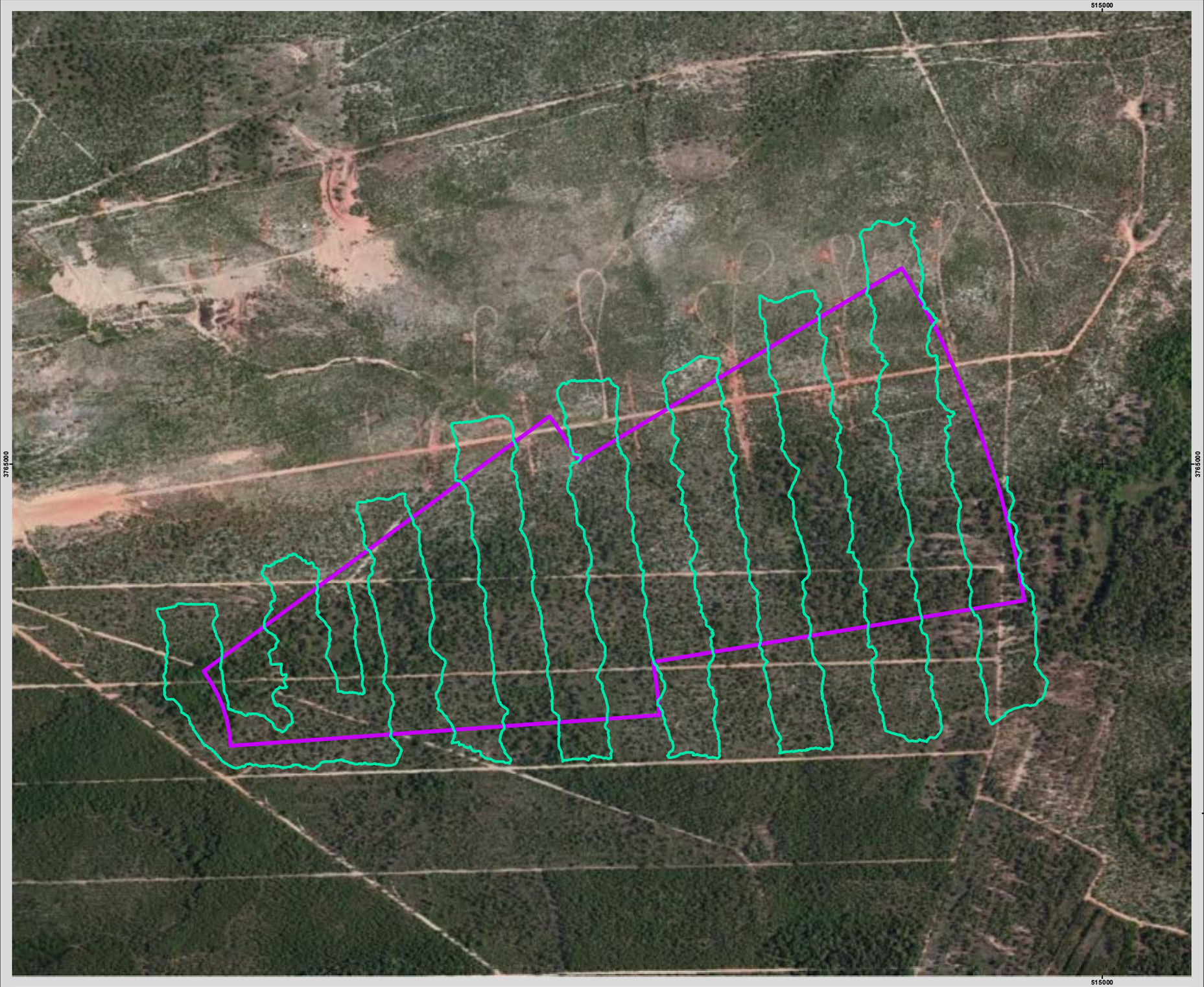
Figure 2
Recon Survey Coverage
MPMG
Camp McCrady/Fort Jackson, SC



Legend

- Proposed MPMG Boundary (166 Acres)
- Walked Path (8.5 Miles)

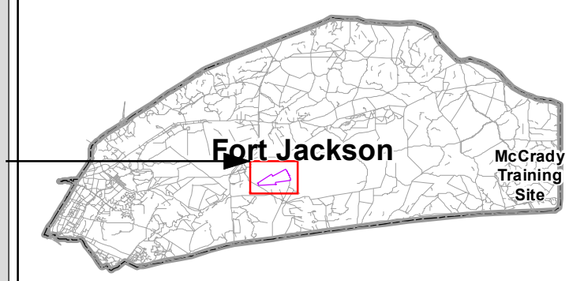


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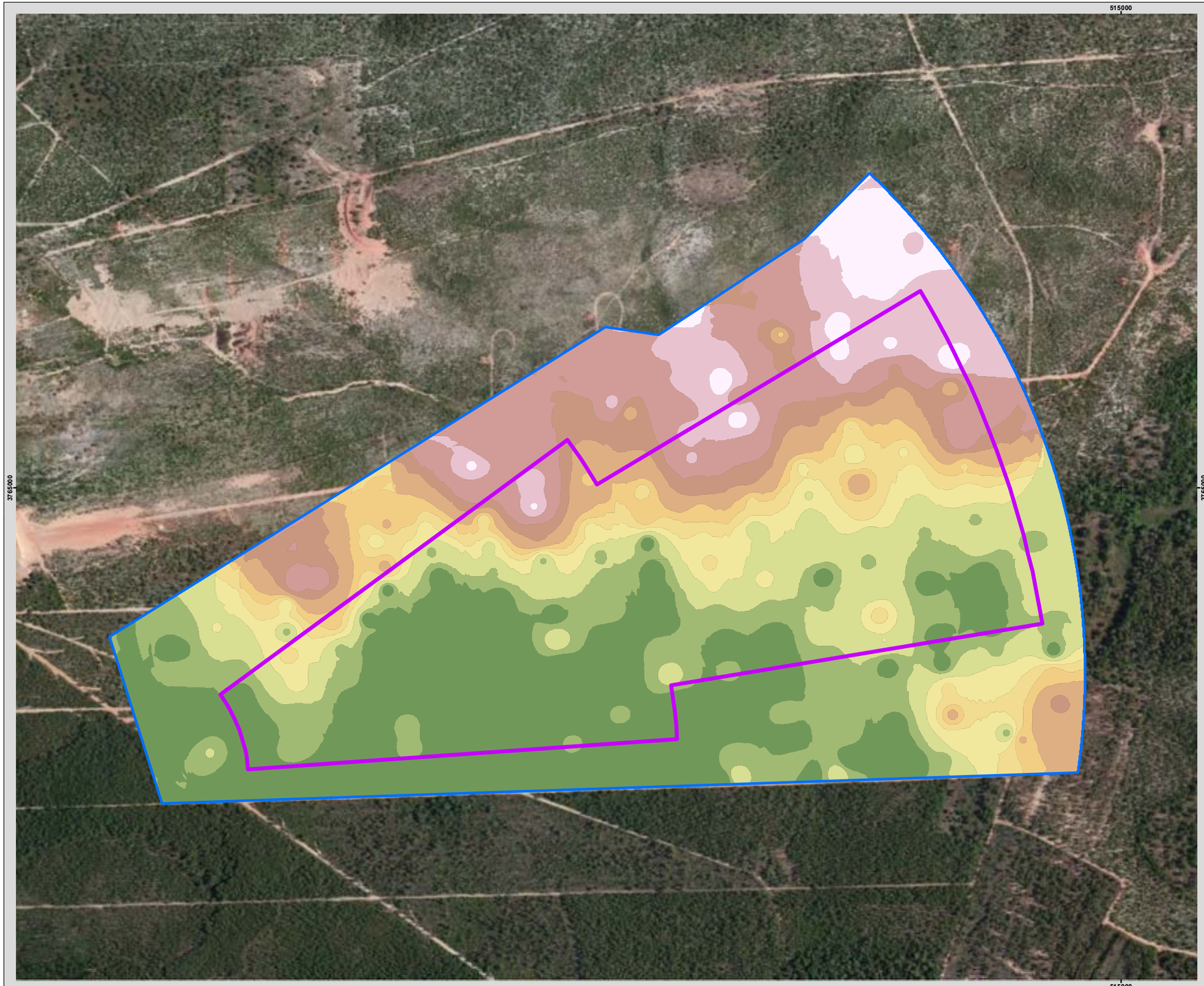
Figure 3
Subsurface Density
MPMG
Camp McCrady/Fort Jackson, SC



Legend

- Proposed MPMG Boundary (166 Acres)
- Analysis Boundary (325.9 Acres)

Subsurface Density

Density per Acre (Acres)

- 0 - 50 (86.4)
- 50 - 100 (43.5)
- 100 - 200 (41.4)
- 200 - 300 (21.0)
- 300 - 400 (15.8)
- 400 - 500 (13.4)
- 500 - 750 (19.7)
- 750 - 1000 (17.4)
- 1000 - 1500 (35.8)
- 1500 - 2000 (21.3)
- 2000 - 2630 (10.1)

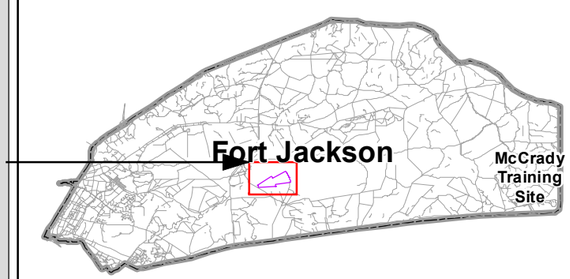


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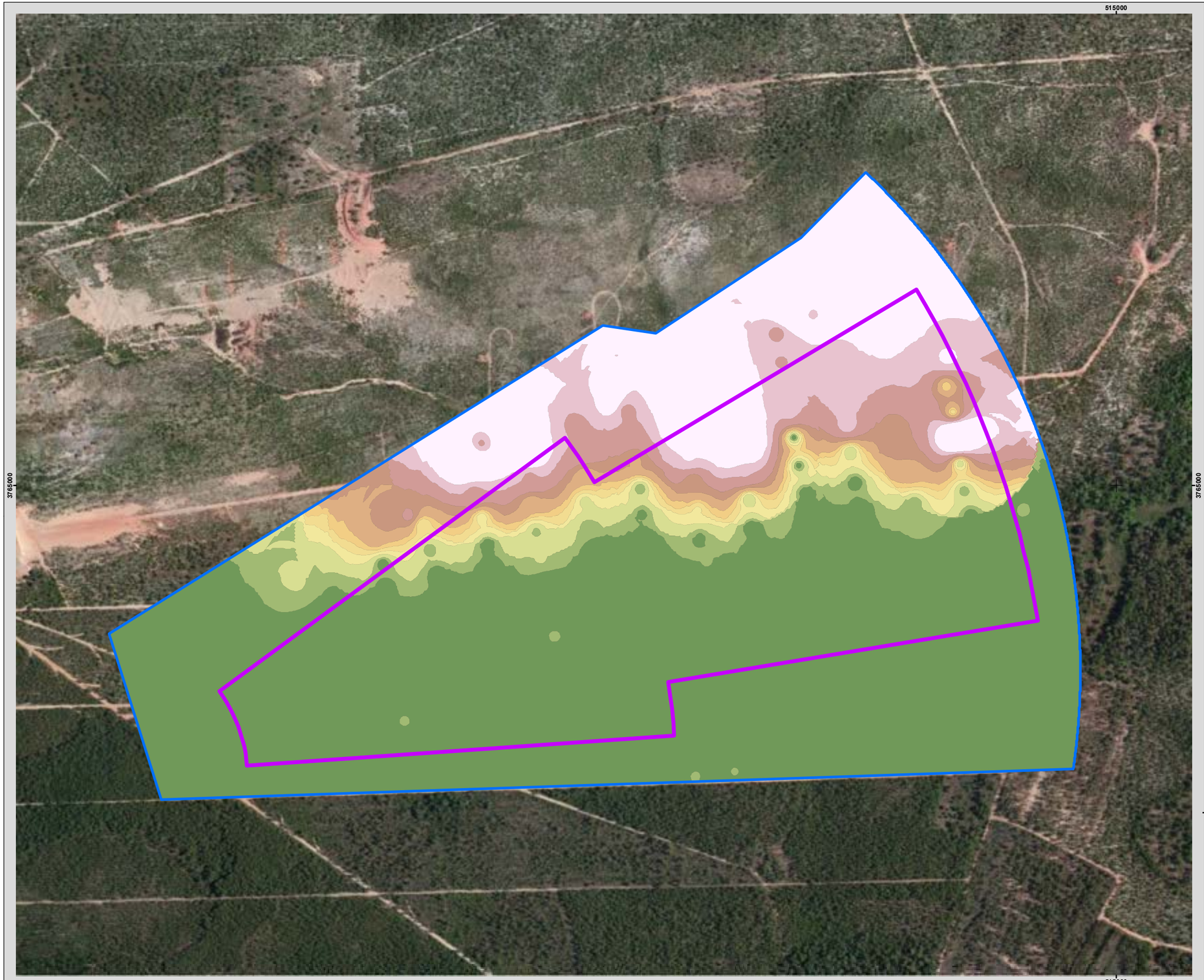
Figure 4
Surface Density
MPMG
Camp McCrady/Fort Jackson, SC



Legend

- Proposed MPMG Boundary (166 Acres)
- Analysis Boundary (325.9 Acres)

Surface Density

Density per Acre (Acres)

- 0 - 50 (189.5)
- 50 - 100 (12.3)
- 100 - 200 (10.4)
- 200 - 300 (5.5)
- 300 - 400 (4.3)
- 400 - 500 (3.6)
- 500 - 750 (8.3)
- 750 - 1000 (8.0)
- 1000 - 1500 (13.1)
- 1500 - 2000 (20.9)
- 2000 - 6183 (49.8)

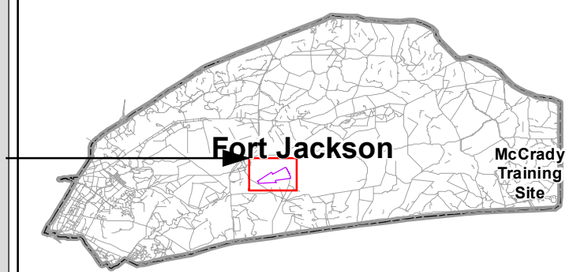


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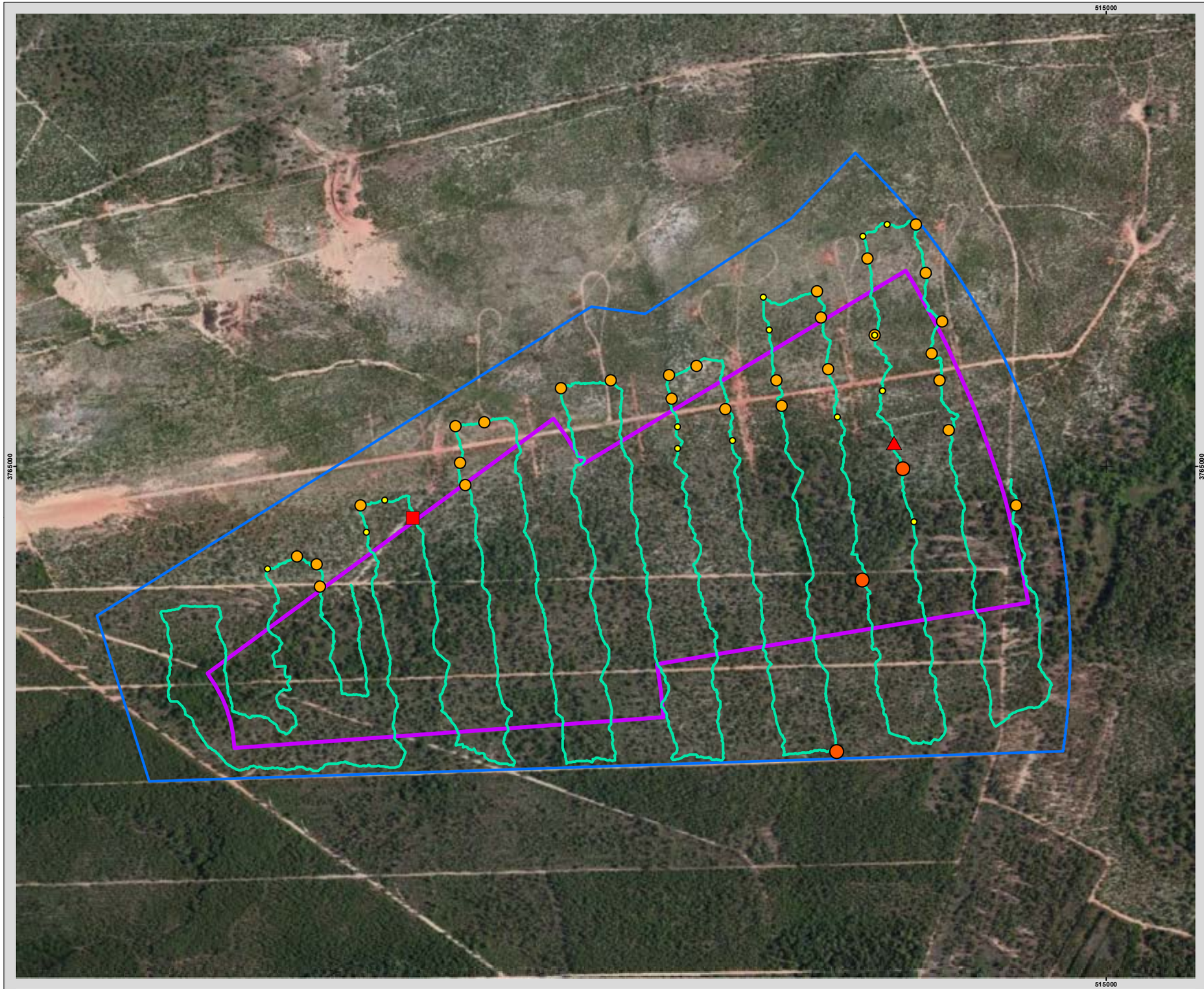
Figure 5
Munitions Discoveries
MPMG
Camp McCrady/Fort Jackson, SC



Legend

- Proposed MPMG Boundary (166 Acres)
- Analysis Boundary (325.9 Acres)
- Walked Path (8.5 Miles)

Significant MEC Items Found

- 75mm HE
- 90mm HE

Other Significant MD

- Light Frag
- Medium Frag
- Heavy Frag

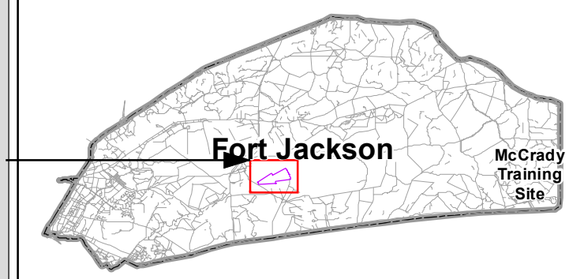


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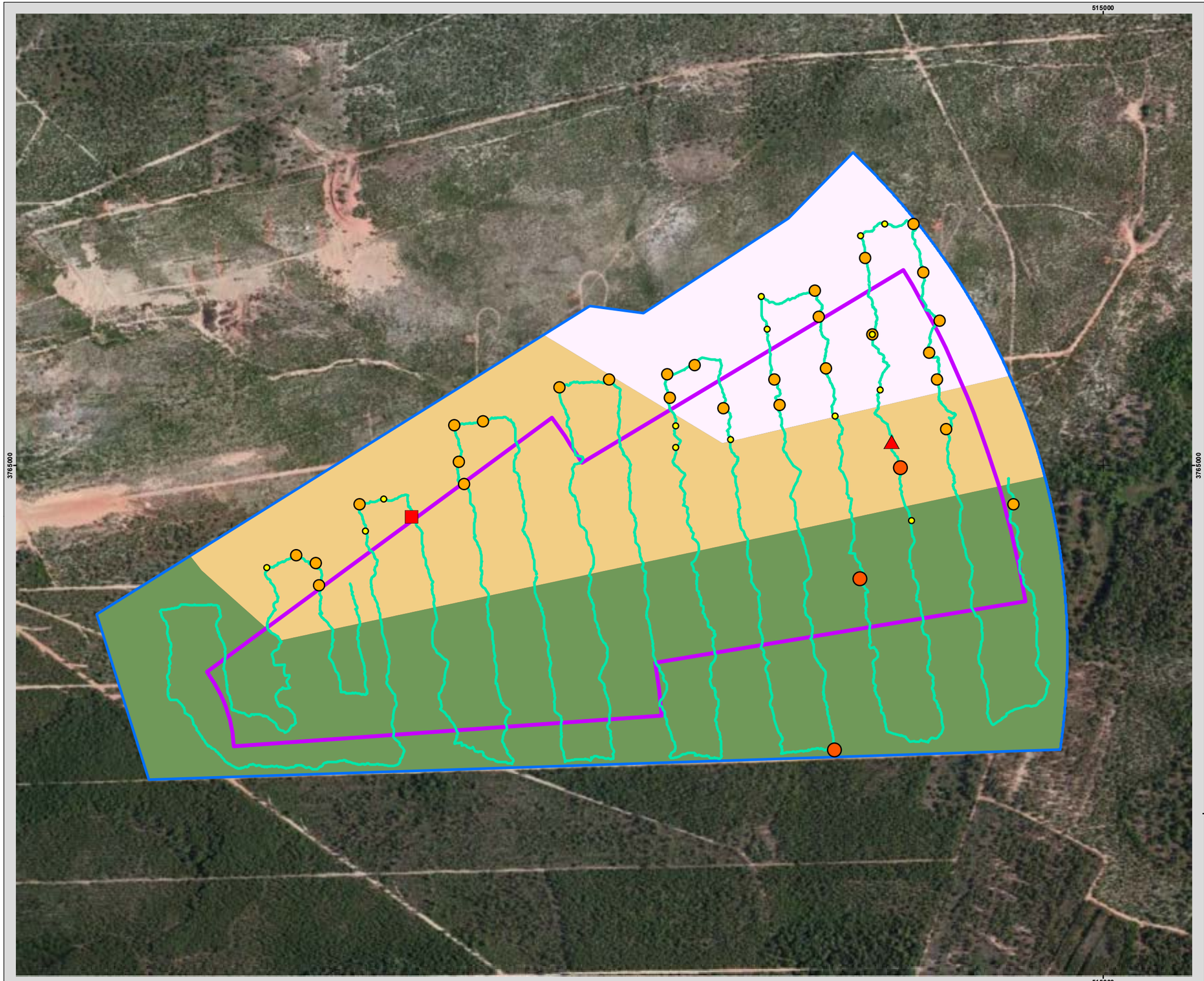
Figure 6
Risk of Encountering MEC
MPMG
Camp McCrady/Fort Jackson, SC



Legend

- Proposed MPMG Boundary (166 Acres)
- Analysis Boundary (325.9 Acres)
- Walked Path (8.5 Miles)

Significant MEC Items Found

- 75mm HE
- 90mm HE

Other Significant MD

- Light Frag
- Medium Frag
- Heavy Frag

Risk Area (Acres)

- High Risk (57.2)
- Medium Risk (104.6)
- Low Risk (164)

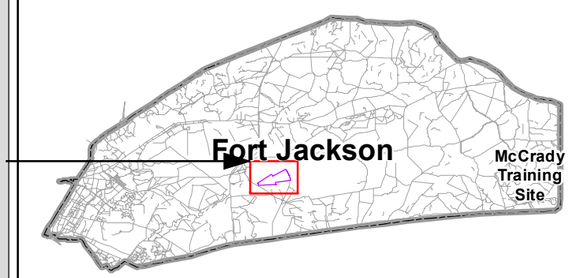


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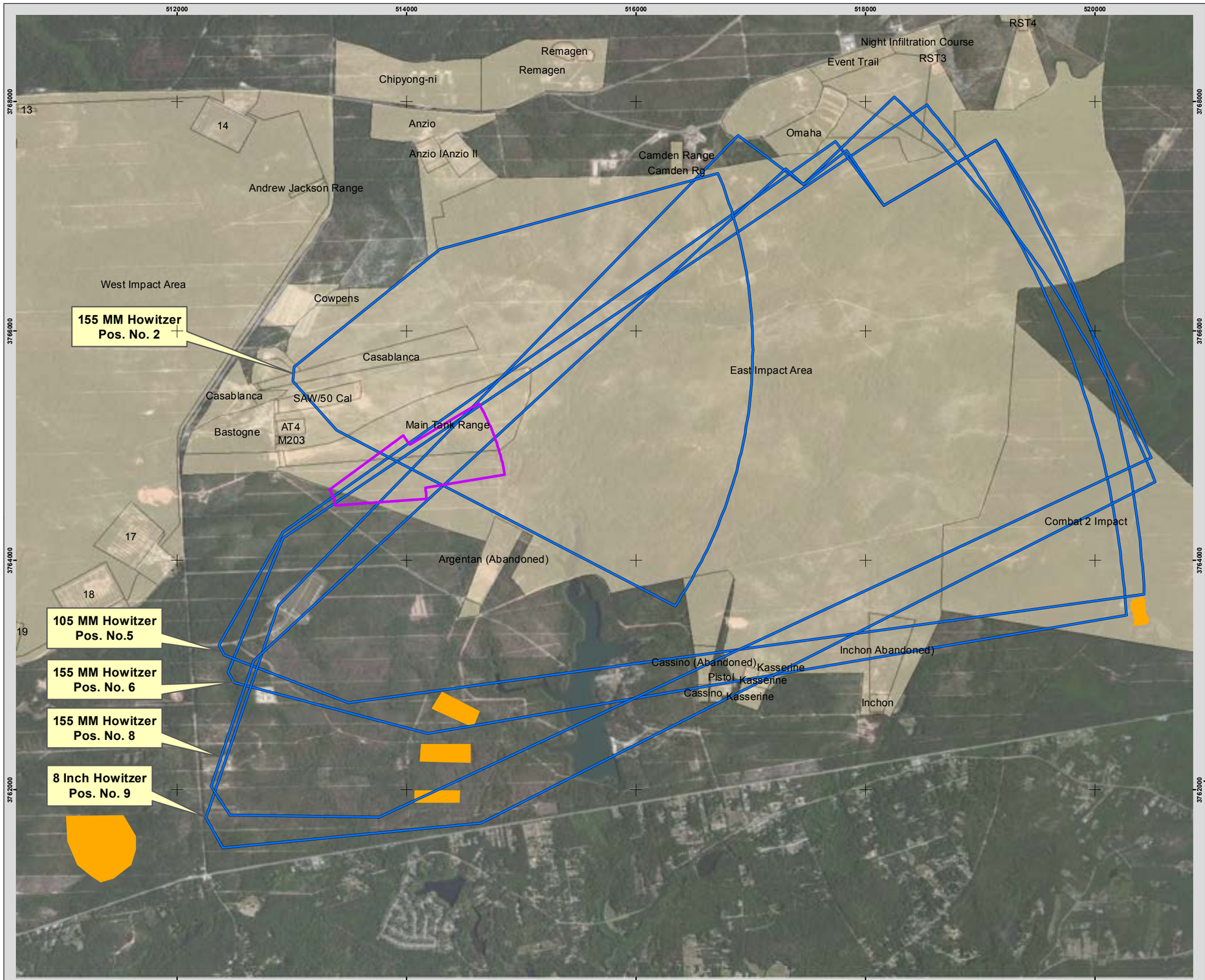
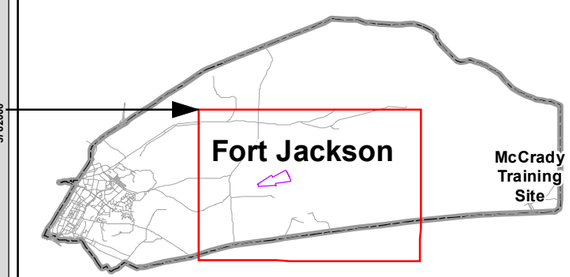
Figure 7
Historical/Active Ranges
MPMG
Camp McCrady/Fort Jackson, SC



Legend

- Proposed MPMG Boundary (166 Acres)
- Howitzer Ranges
- Suspected Dudded Ranges
- Military Live Fire Area



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FINAL
HISTORICAL RECORDS REVIEW
FORT JACKSON
COLUMBIA, SOUTH CAROLINA

MARCH 2005

Prepared for:

U.S. ARMY CORPS OF ENGINEERS, BALTIMORE DISTRICT
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Baltimore, Maryland 21203-1715

Prepared by:

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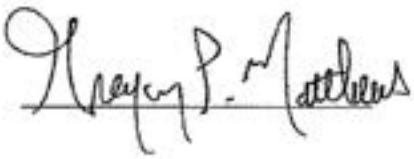
1300 East 8th Avenue
Tampa, Florida 33605

FINAL

HISTORICAL RECORDS REVIEW
FORT JACKSON
COLUMBIA, SOUTH CAROLINA

DoD Contract Number: DACW41-02-D-0003

Reviewed and Approved by:



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Malcolm Pirnie, Inc. prepared this report at the direction of the U.S. Army Corps of Engineers (USACE). This document should be used only with the approval of the USACE. This report is based, in part, on information provided in other documents and is subject to the limitations and qualifications presented in the referenced documents.

MARCH 2005

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TABLE OF ACRONYMS

Acronym	Definition
AEC	Army Environmental Center
Army	United States Army
ARS	Advance Range Survey
As	Arsenic
ASR	Archives Search Report
bgs	Below Ground Surface
CA	Corrective Action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CS	Confirmatory Sampling
CSM	Conceptual Site Model
CTT	Closed, Transferring, and Transferred
Cu	Copper
DERP	Defense Environmental Restoration Program
DMM	Discarded Military Munitions
DNT	Dinitrocellulose
DoD	Department of Defense
EOD	Explosive Ordnance Disposal
Fe	Iron
FJFC	Fort Jackson Flight Club

TABLE OF ACRONYMS

Acronym	Definition
Frag	Fragmentation
FUDS	Formerly Used Defense Site
FY	Fiscal Year
HE	High Explosive
HRR	Historical Records Review
ICRMP	Integrated Cultural Resources Management Plan
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
LAW	Light Anti-tank Weapon
MC	Munitions Constituents
MD	Maryland
MEC	Munitions and Explosives of Concern
Mg	Magnesium
mm	Millimeter
MMRP	Military Munitions Response Program
MRS	Munitions Response Site
MWR	Morale, Welfare, and Recreation
NARA	National Archives and Records Administration
NFA	No Further Action
No.	Number

TABLE OF ACRONYMS

Acronym	Definition
NR	Number
NRHP	National Registry of Historic Places
PA	Preliminary Assessment
Pb	Lead
PIRS	Project Information Retrieval System
RAC	Risk Assessment Code
R/C	Radio-controlled
RCRA	Resource Conservation and Recovery Act
RDX	Cyclotrimethylenetrinitramine
RFA	RCRA Facility Assessment
RFI	Request for Information
RG	Record Group
RI	Remedial Investigation
RMIS	Restoration Management Information System
SARA	Superfund Amendment and Reauthorization Act
Sb	Antimony
SC	South Carolina
SI	Site Inspection
Sn	Tin
Sr	Strontium

TABLE OF ACRONYMS

Acronym	Definition
SSG	Staff Sergeant
SWMU	Solid Waste Management Unit
TNT	Trinitrotoluene
TRADOC	U.S. Army Training and Doctrine Command
U.S.	United States
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
UXO	Unexploded Ordnance
VA	Virginia
WAA	War Assets Administration
WP	White Phosphorus
Zn	Zinc
°F	Degrees Fahrenheit

GLOSSARY OF TERMS

Closed Range – A military range that has been taken out of service as a range and that either has been put to new uses that are incompatible with range activities or is not considered by the military to be a potential range area. A closed range is still under the control of a Department of Defense (DoD) component.

Defense Site – All locations that are or were owned by, leased to, or otherwise possessed or used by the DoD. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used or was permitted for the treatment or disposal of military munitions.

Discarded Military Munitions (DMM) – Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations.

Explosive Ordnance Disposal (EOD) – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded explosive ordnance. It may also include explosive ordnance that has become hazardous by damage or deterioration.

Explosives Safety – A condition where operational capability and readiness, personnel, property, and the environment are protected from the unacceptable effects of an ammunition or explosives mishap.

Formerly Used Defense Site (FUDS) – A DoD program that focuses on compliance and cleanup efforts at sites that were formerly used by the DoD. A FUDS property is eligible for the Military Munitions Response Program if the release occurred prior to October 17, 1986;

the property was transferred from DoD control prior to October 17, 1986; and the property or project meets other FUDS eligibility criteria.

Military Munitions – All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the Department of Defense, the U.S. Coast Guard, the U.S. Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives, and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components of the above. The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, other than non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 have been completed.

Munitions and Explosives of Concern (MEC) – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means unexploded ordnance, DMM, or munitions constituents (e.g., Trinitrotoluene [TNT], Cyclotrimethylenetrinitramine [RDX]) present in high enough concentrations to pose an explosive hazard.

Munitions Constituents (MC) – Any materials originating from unexploded ordnance, DMM, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions.

Operational Range – A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities or, although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities.

Other than Operational Range – Encompasses closed, transferred, and transferring ranges.

Range – A designated land or water area set aside, managed, and used for range activities of the DoD. Ranges include firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access and exclusionary areas, and airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration.

Transferred Range – A range that is no longer under military control and had been leased by the DoD, transferred, or returned from the DoD to another entity, including federal entities. This includes a military range that is no longer under military control, but that was used under the terms of an executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager. Additionally, property that was previously used by the military as a range, but did not have a formal use agreement, also qualifies as a transferred range.

Transferring Range – A range that is proposed to be leased, transferred, or returned from the DoD to another entity, including federal entities. This includes a military range that was used under the terms of a withdrawal, executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager or property owner. An active range will not be considered a transferring range until the transfer is imminent (generally defined as the transfer date is within 12 months and a receiving entity has been notified).

Unexploded Ordnance (UXO) – Military munitions that have been primed, fused, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and remain unexploded either by malfunction, design, or any other cause.

1 INTRODUCTION

The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address DoD sites with unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) located on current and former military installations. Properties classified as operational military ranges, permitted munitions disposal facilities or operating munitions storage facilities are not eligible for the MMRP, nor are sites that had releases after September 30, 2002. The United States (U.S.) Army's (Army) inventory of closed, transferring, and transferred (CTT) military ranges and defense with UXO, DMM, or MC has identified sites eligible for action under the MMRP. Ten closed ranges (also referred to as sites) were identified during the inventory at Fort Jackson, located in the City of Columbia, Richland County, South Carolina (SC). A Site Inspection (SI) is currently ongoing at these sites. This report presents the results of the SI Historical Records Review (HRR).

The DoD is currently establishing policy and guidance for munitions response actions under the MMRP. However, key program drivers developed to date conclude that munitions response actions will be conducted under the process outlined in the National Contingency Plan (40 Code of Federal Regulations 300) as authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 United States Code (U.S.C.) 9605, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), Pub. L. 99-499 (hereinafter CERCLA). While it is the DoD's goal to address MMRP sites under the CERCLA, the Army recognizes that some installations (including Fort Jackson) will need to address these sites under the Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) program.

The Final Phase 3 CTT Range Inventory Report (CTT Range Inventory) for Fort Jackson, dated June 2003, marked the completion of the Preliminary Assessment (PA) phase of work under CERCLA and the RCRA Facility Assessment (RFA) phase of work under the RCRA CA program. The next step in the process is the SI (CERCLA terminology), which

corresponds with the Confirmatory Sampling (CS)/RCRA Facility Investigation (RFI) Phase I under RCRA. The work at Fort Jackson will be implemented under the MMRP SI program, which utilizes CERCLA terminology for programmatic documents. As such, the documents developed for the Fort Jackson MMRP SI, including the HRR, will use CERCLA terminology. It is understood that the following RCRA CA program terminology is implied:

Table 1-1: CERCLA and RCRA Terminology

CERCLA	RCRA
Preliminary Assessment (PA)	RCRA Facility Assessment (RFA)
Site Inspection (SI)	Confirmatory Sampling (CS)/RCRA Facility Investigation (RFI) Phase I
Remedial Investigation (RI)	RFI

1.1 PURPOSE/SCOPE

The purpose of the Site Inspection HRR is to perform a limited-scope records search to document historical and other known information for MMRP sites at Fort Jackson, to supplement the CTT Range Inventory information, and to facilitate decisions on what information is needed to determine the next steps in the CERCLA/RCRA process. The SI is part of the CERCLA process and will be conducted following completion of the HRR report. As noted in the previous section, the SI corresponds with the CS/RFI Phase I.

1.2 PROJECT DRIVERS

The regulatory structure for managing MMRP sites at Fort Jackson is guided by a mixture of federal, state, and local laws, as well as DoD and Army regulations and guidance. The picture is further complicated by debates at the national level between the DoD and the United States Environmental Protection Agency over key issues that include uncertainty of the final structure of the MMRP. However, key legislative and administrative precedents to date will undoubtedly influence the final regulatory framework for the MMRP. The key legislative, administrative, and historic precedents include the following:

Defense Environmental Restoration Program (DERP) Management Guidance (September 2001)

The DERP Management Guidance establishes a MMRP element for UXO, DMM, and MC defense sites. The history of DERP dates back to the SARA of 1986. The scope of the DERP is defined in 10 U.S.C. §2701(b), which states that the:

> Goals of the program shall include the following: … (1) The identification, investigation, research and development, and cleanup of contamination from hazardous substances, pollutants, and contaminants. (2) Correction of other environmental damage (such as detection and disposal of unexploded ordnance) which creates an imminent and substantial endangerment to the public health or welfare or to the environment.

National Defense Authorization Act (Fiscal Year [FY] 02) (Sections 311-312)

Sections 311-312 of the National Defense Authorization Act of FY02 reinforced the DoD's 2001 DERP Management Guidance by tasking the DoD to develop and maintain an inventory of defense sites that are known or suspected to UXO, DMM, or MC. Section 311 requires the DoD to develop a protocol for prioritizing defense sites for response activities in consultation with the states and Tribes. Section 312 requires the DoD to create a separate program element to ensure that the DoD can identify and track munitions response funding.

The September 2001 Management Guidance for the DERP and the Defense Authorization Act FY02, described above, established the MMRP. The DERP and the MMRP provide guidance and methods for conducting a baseline inventory of defense sites containing, or potentially containing, UXO, DMM, or MC.

1.3 BACKGROUND

As stated above, the CTT Range Inventory for Fort Jackson is considered to mark the completion of the PA phase of work under the CERCLA. The SI is the next phase in the CERCLA process and will complete the PA/SI requirements for the MMRP sites. As noted in the beginning of this section, the HRR uses CERCLA terminology. It is understood that RCRA CA program terminology is implied. The following paragraphs summarize the results

of the CTT Range Inventory at Fort Jackson and present the primary goals of performing a SI.

1.3.1 Inventory

The Army Range Inventory program was conducted in three phases. The first phase (Phase 1) involved a data call issued through the Army Environmental Center (AEC) requesting general information about ranges on various installations under each U.S. Army Major Command. The Phase 1 Inventory was conducted using a questionnaire called the Advance Range Survey (ARS). The ARS allowed the Army to meet the short-term data goal of supporting the DoD preparation of Senate Report 106-50.

Mr. James Wyatt, Range Officer, completed the ARS Phase 1 Inventory survey for Fort Jackson in November 2000. Three records for CTT ranges at Fort Jackson were found in the database. The CTT ranges listed in the ARS included the Old Hand Grenade Range #3, Old Small Arms Range #3, and a World War II Rifle Range Complex #6, all of which were considered closed. The Fort Jackson ARS data was submitted to AEC and compiled into a master database of Army installations.

The ARS allowed the Army to meet its short-term needs; however, the Army's long-term needs required a more detailed inventory of its ranges that was not achievable based on the information in the ARS. For management and budgetary reasons, the Army divided the detailed follow-up inventory into two phases. The Phase 2 Inventory addressed operational ranges, while Phase 3 covered CTT ranges and sites with UXO, DMM, or MC. During the Fort Jackson Phase 2 Inventory, completed in the winter of 2000, 44,028 acres were classified as operational range areas. The results were documented in a range inventory binder that was submitted to Fort Jackson and its major command, the U.S. Army Training and Doctrine Command (TRADOC).

The Phase 3 Inventory was completed for Fort Jackson in June 2003. Ten closed ranges were identified at Fort Jackson. Additional information regarding the results of the Phase 3 CTT Range Inventory is discussed in Sections 2.2 and 3.3.

1.3.2 Site Inspection

The primary goal of the MMRP SI is to collect information necessary to make one or more of the following decisions: 1) determine whether a RI/Feasibility Study is required at a site; 2) determine whether an immediate response is needed; or 3) determine whether the site qualifies for no further action (NFA). The installation-wide SI at Fort Jackson will address both munitions and explosives of concern (MEC), which include UXO and DMM, and MC issues for the MMRP sites. The secondary goals of the SI are to include collecting data to prepare better Cost to Complete estimates and site prioritization for the MMRP sites.

1.4 REPORT ORGANIZATION

This HRR has the following sections:

- Section 1 – Introduction
- Section 2 – Site Description
- Section 3 – Data Collection and Document Review Process
- Section 4 – Summary of Findings
- Section 5 – Conceptual Site Model (CSM)
- Section 6 – Conclusions

The following supporting information and analyses are appended to this HRR:

- Archives Searched/Data Sources (Appendix A)
- Archive Documents (Appendix B)
- Interview Records (Appendix C)
- Munitions Technical Data Sheets (Appendix D)

2 SITE DESCRIPTION

2.1 INSTALLATION DESCRIPTION

Fort Jackson (also referred to as the "installation") is located in the eastern section of Columbia, SC, in Richland County near the center of the state. The inset on Map 2-1 shows the location of the installation within SC. The installation occupies approximately 52,000 acres, which includes a cantonment area, training and maneuver areas, live fire zones, and impact areas. The cantonment area, which contains the majority of the facility housing, administrative buildings, and industrial operations, is located in the southwestern portion of the installation. Recreational areas at Fort Jackson include the Fort Jackson Flight Club (FJFC) (a radio-controlled [R/C] airplane field) and the Weston Lake Recreation Area. The remainder of the installation, which is primarily undeveloped and consists of moderate to dense pine woodlands, is used for military training.

Fort Jackson was originally established in 1917 (referred to as Camp Jackson at that time) as an infantry training center. For a brief period of time (1921-1925), the installation was inactive. From 1925 to 1939, it was controlled by SC and used as an encampment and training area for National Guard troops. In 1939, the facility was transferred to the Federal Government, designated as Fort Jackson, and re-established as an infantry training center. The current and primary mission of Fort Jackson is to train initial entry recruits for duty as soldiers for Army units. To support this mission, Fort Jackson currently houses Army training brigades and serves as a reception station that processes newly inducted and prior service personnel forwarded to the installation from recruiting and induction stations.

2.2 MMRP SITE DESCRIPTIONS

Ten MMRP sites were identified at Fort Jackson during the CTT Range Inventory. These sites included the following:

- 1000-Yard Range
- 600-Yard Range

- Andrew Jackson Range
- FJFC
- Hand Grenade Court Number No. 2
- Live Hand Grenade Court 2
- Machine Gun Range
- Mortar Range
- Rifle Grenade Range Number NR 2
- Submachine Gun Area

The site locations are illustrated on Map 2-1, and the sites are discussed in detail in Section 3.3. The information obtained and descriptions of these sites that resulted from the CTT Range Inventory are presented in the following paragraphs:

1000-Yard Range: The 1000-Yard Range (Army Environmental Database-Restoration [AEDB-R] Site ID: FTJA-001-R-01) was a former rifle range located in the current cantonment area near Washington Road and Ivy Road (more accurately described as near Hartsville Guards Road and Chesnut Road). The approximately seven-acre range was listed on a 1919 map adjacent to the 600-Yard Range (also included in the CTT Range Inventory). The range was used from 1918 to 1920. Documentation indicated that the 1000-Yard Range included intermediate targets and was used as a 100-, 200-, 300-, 600-, and 1000-yard range. Today, the area is adjacent to base housing, streets, and a school. However, the area where the former 1000-Yard Range was located and the immediate area surrounding the range are undeveloped. During the CTT Range Inventory, the Range Control Officer and the data collection team visited the area where the ranges were located. Signs of a former rifle range were not observed. The team did not locate records of UXO sightings, incidents, or clearances related to the 1000-Yard Range.

600-Yard Range: The 600-Yard Range (AEDB-R Site ID: FTJA-002-R-01) was a former rifle range located directly adjacent to and south of the 1000-Yard Range in the cantonment area near Hartsville Guards Road and Chesnut Road. The 19-acre range was listed on a 1919 map. The range had a series of targets located at 100, 200, 300, 500 and 600 yards. The dates of use (1918 to 1920) of the 600-Yard Range are assumed to be identical to the dates for the 1000-Yard Range. Today, the area is adjacent to base housing, streets, and a school. However, the area where the former 600-Yard Range was located and the immediate area surrounding the range are undeveloped. During the CTT Range Inventory, the Range Control Officer and the data collection team visited the area surrounding the former rifle range and did not observe signs of the former rifle range. The team did not locate records of UXO sightings, incidents, or clearances related to the 600-Yard Range.

Andrew Jackson Range: The Andrew Jackson Range (AEDB-R Site ID: FTJA-003-R-01) is currently a morale, welfare, and recreation (MWR) area used for recreational small arms target practice. The range is open to the military, dependents, and civilian employees and is managed by the MWR program at Fort Jackson. The range is located just off of Wildcat Road within the current boundaries of the West Impact Area. The range area consists of approximately 15 acres. The recreational pistol range was established in the early to mid 1980s. The area was formerly part of the surface danger zone for the M-1 Transition Range NR 3, which was shown on several maps from the 1940s. The area was also in the buffer of several overlapping range fans (small arms ranges) from the 1950s. For the CTT Range Inventory, the area was identified as a closed range because it was not operational and had a former range use.

FJFC: The FJFC (AEDB-R Site ID: FTJA-004-R-01) was an approximately 54-acre area located east of Wildcat Road just north of Shenandoah Road. The area was used as a machine gun range in the 1950s, 1960s, and 1970s. The FJFC land consists of a flat, cleared, level area surrounded by forest and grassland. The flat, cleared portion of the site has been used as an airstrip for R/C small recreational type model aircraft since the late 1980s. The improvements to the site for the airstrip include a gravel parking area, sun shade, a picnic area, a grounds maintenance storage building, and a set of bleachers for spectators to watch

the R/C model plane operations. The area was considered a closed range for the purposes of the inventory because it was not operational and had a former range use.

Hand Grenade Court No. 2: The Hand Grenade Court No. 2 (AEDB-R Site ID: FTJA-005-R-01) was located in the northern part of the Weston Lake Area southwest of the Mortar Range. The period of use (1944 to 1950) and types of grenades reported for the inventory are approximate. Using a conservative approach, it was assumed for the CTT Range Inventory that live, as well as practice, grenades may have been used on the range. It is important to note that the team did not locate records of UXO sightings, incidents, or clearances related to the Hand Grenade Court No. 2. The three-acre area shown on Map 2-1 is a 100-meter by 100-meter square representing the approximate size and location of the former hand grenade impact area. The range is closed. It lies within the boundary of the Weston Lake Area. The area adjacent to Weston Lake is used for camping, picnics, and other recreational activities. However, the former hand grenade court has not been improved with recreational facilities (e.g., camp sites, trails, etc.) and is in a remote location not easily accessible by people using the Weston Lake Area recreational facilities.

Live Hand Grenade Court 2: The Live Hand Grenade Court 2 (AEDB-R Site ID: FTJA-006-R-01) was listed on a 1949 map of Fort Jackson. The approximate period of use for this range was 1940 to 1950. The period of use and types of grenades reported for the inventory were approximated based upon maps reviewed and the history of the installation. It was assumed that live, as well as practice, grenades may have been used on the range. The team did not locate records of UXO sightings, incidents, or clearances related to the former Live Hand Grenade Court 2. The range is closed. The three-acre area shown on the Map 2-1 is a 100-meter by 100-meter square representing the approximate size and location of the former hand grenade impact area. The area is close to the Pierce Terrace base housing complex, which is located just off of Chesnut Road. The immediate area of the former hand grenade range is undeveloped. This area was also used for field fortification training in the 1970s and 1980s.

Machine Gun Range: The Machine Gun Range (AEDB-R Site ID: FTJA-007-R-01) was in the current cantonment area near Hartsville Guards Road and Chesnut Road. The former three-acre range was just south of the 1000-Yard Range and the 600-Yard Range. It is also assumed that this range was used only between 1918 and 1920. Today, the area is adjacent to base housing, streets, and a school. However, the area where the former machine gun range was located and the immediate area surrounding the range are undeveloped. The Range Control Officer and the data collection team visited the area surrounding the former range and did not observe signs of the former range.

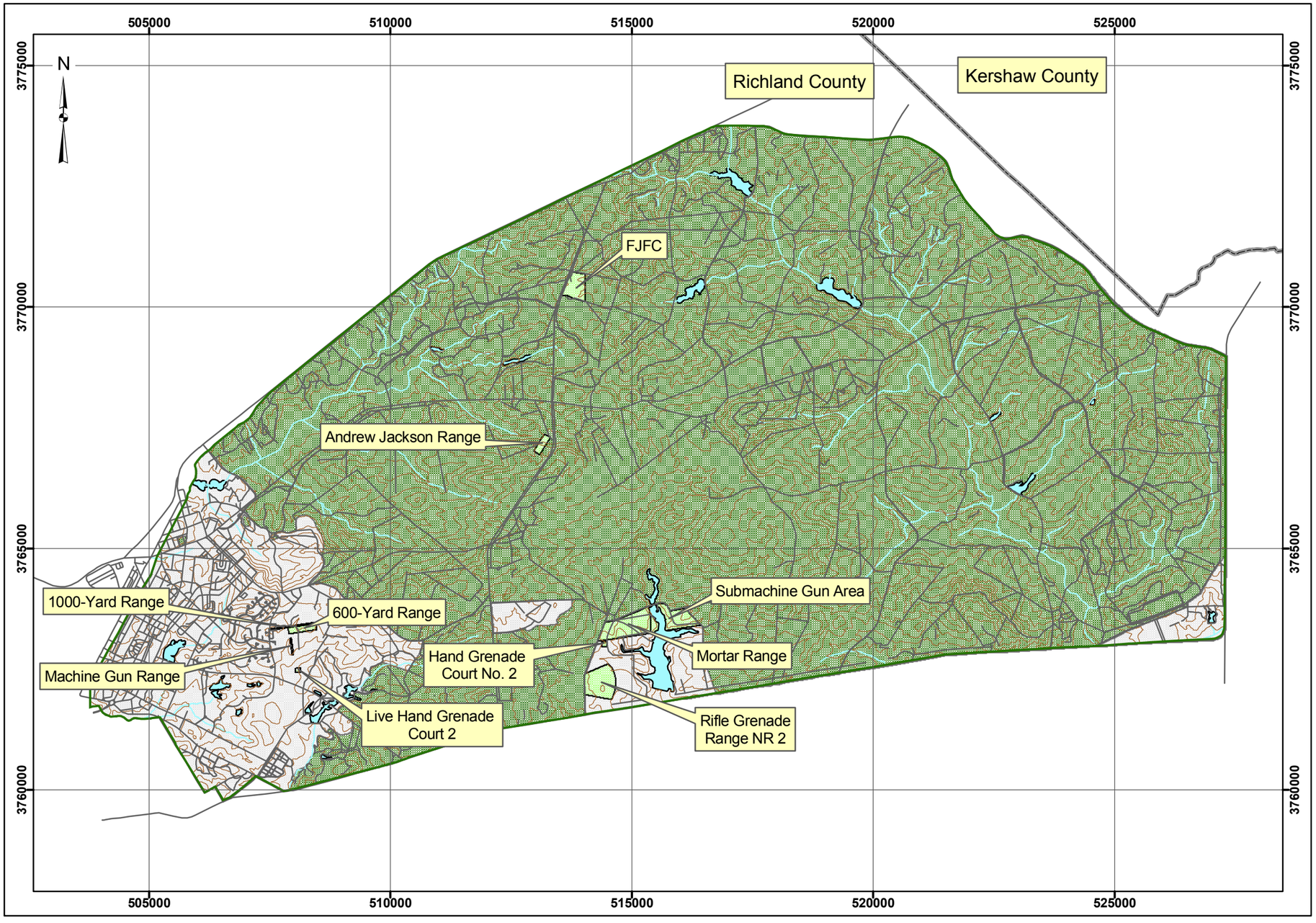
Mortar Range: The Mortar Range (AEDB-R Site ID: FTJA-008-R-01) was located in the northern section of the Weston Lake Area, with the Hand Grenade Court Number No. 2 to the southwest and the Submachine Gun Area to the east. The approximately 112-acre area was once part of a buffer for a mortar range in the 1940s. In addition, in 1969, other ranges overlapped the area, including 105-millimeter (mm), 155-mm, and 8-inch Howitzer ranges. The Submachine Gun Area also overlapped the area. The range is closed and is now part of the Weston Lake Area. However, the Mortar Range area has not been improved by recreational facilities (e.g., camp sites, trails, etc.) and is located about 1/4 mile north of the main recreation facilities at the Weston Lake Area. The team did not locate records of UXO sightings, incidents, or clearances related to the Mortar Range.

Rifle Grenade Range NR 2: The Rifle Grenade Range NR 2 (AEDB-R Site ID: FTJA-009-R-01) was estimated to be used from the 1940s through the 1960s. The range was used for firing rifle grenades and was also listed on a 1993 map reviewed at the installation with the hand written title "Explosive Ordnance Impact Areas". The map depicted several different explosive ordnance impact areas on Fort Jackson that were drawn in by hand. The range is closed and is now part of the Weston Lake Area. The 90-acre area has not been improved with recreational facilities (e.g., camp sites, trails, etc.) and is located approximately 1/2 mile west of the main recreation facilities of the Weston Lake Area. A dirt road runs close to the site (Washington Light Infantry Road), which is accessible by vehicle from the installation, but not from the Weston Lake Area. There is the potential that practice and live high explosive (HE) rifle grenades were fired on the former Rifle Grenade

Range NR 2. In 1969, the area appeared to be in the buffer areas for 155-mm and 8-inch Howitzer ranges. The impact area associated with the artillery ranges was not located in close proximity to the 90-acre Rifle Grenade Range NR 2 area.

Submachine Gun Area: The Submachine Gun Area (AEDB-R Site ID: FTJA-010-R-01) was located in the northern part of the Weston Lake Area extending into the East Impact Area. The area reported in the inventory occupied 101 acres and consisted of three separate ranges listed on a 1949 map of Fort Jackson. The three ranges included the Dismounted Submachine Gun No. 1 Range, the Moving Vehicle Submachine Gun Range, and the Dismounted Submachine Gun No. 2 Range. All three ranges were adjacent to each other, and their range fans overlapped. The ranges were situated so that the direction of fire was to the north into the East Impact Area. The Submachine Gun Area is closed and is now part of the Weston Lake Area. However, the range area has not been improved by recreational facilities (e.g., camp sites, trails, etc.) and is located approximately 1/4 mile north of the main recreation facilities at the Weston Lake Area. The team did not locate records of UXO sightings, incidents, or clearances related to the range.

Historical Records Review
Fort Jackson, SC



Map 2-1
Range Inventory Data

Legend

- Installation Boundary
- Roads
- Counties
- Contours
- Streams
- Waterbodies

CTT Range Area (Range Inventory)

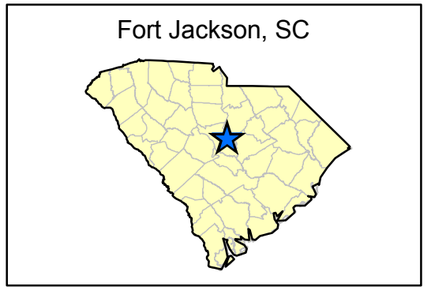
- Operational Ranges
- Closed
- Transferring
- Transferred
- Non Range, Non UXO-DMM-MC Area

0 1 2 3 Miles

Data Source: Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005



3 DATA COLLECTION AND DOCUMENT REVIEW PROCESS

Five primary sources of information were researched as part of the data collection effort for the HRR. The types of data included:

1) National and regional archives record group (RG) search
2) Installation site visits
3) Review of existing Archives Search Reports (ASRs) and administrative records for adjacent Formerly Used Defense Sites (FUDS) associated with Fort Jackson
4) Interviews
5) Review of the CTT Range Inventory and backup data

3.1 DATA COLLECTION METHODS

3.1.1 National and Regional Archives

Relevant archival record repositories and RGs were selected based on guidance set forth in the *Technical/Regulatory Guideline for Munitions Response Historical Records Review,* prepared by the Interstate Technology & Regulatory Council Unexploded Ordnance Team and based on the process developed by the U.S. Army Corps of Engineers (USACE) for performing ASRs (guidance provided at http://www.mvs.usace.army.mil/engr/ed-p/asr.htm). Only the record repositories that have historically proved to be most useful were searched. The archival repositories and RGs that were searched for this HRR are listed below. The archival data reviewed are presented by RG and source in Appendix A.

- National Archives, National Archives & Records Administration (NARA), College Park, Maryland (MD)
    - RG 18: Army Air Forces
    - RG 51: Bureau of Budget
    - RG 71: Bureau of Yards and Docks
    - RG 77: Chief of Engineers

  - RG 92: Quartermaster General
  - RG 111: Office of the Chief Signal Officer
  - RG 114: Natural Resources Conservation Service
  - RG 145: Agricultural Stabilization and Conservation Service
  - RG 156: Office of Chief of Ordnance
  - RG 168: National Guard Bureau
  - RG 270: War Assets Administration (WAA), Real Property Disposal Files
  - RG 319: Army Staff
  - RG 337: Headquarters, Army Ground Forces
  - RG 338: U.S. Army Commands
  - RG 373: Defense Intelligence Agency
  - RG 393: U.S. Army Continental Commands, 1821-1920
  - RG 394: U.S. Army Continental Commands, 1920-1942
  - RG 407: Adjutant General

- Library of Congress Prints & Photographs Division

- Library of Congress Geography and Map Division

- Library of Congress Main Reading Room

- Library of Congress Manuscript Division

- Regional Archives, NARA Southeast Region, East Point (Atlanta), Georgia

  - RG 77: Chief of Engineers
  - RG 156: Office of Chief of Ordnance
  - RG 270: WAA, Real Property Disposal Files

3.1.2 Web Search

In addition to the data sources listed above, Malcolm Pirnie also conducted research on the Internet to supplement the archival data and information received from the installation. The

list below presents the web sites that were searched for information on Fort Jackson. The search was conducted on June 28, 2004 and June 30, 2004. Information collected from the web search is presented in Section 3.2.

- Department of Defense Archives, http://www.defenselink.mil/pubs/archive.html
- DoD Explosives Safety Board, http://www.ddesb.pentagon.mil/
- National Imagery and Mapping Agency, Bethesda, MD, http://www.nima.mil/
- U.S. Army Center of Military History, Fort McNair, Washington, District of Columbia, http://www.army.mil/cmh-pg/
- USACE Office of History, Alexandria, Virginia (VA), http://www.hq.usace.army.mil/history/
- USACE Topographic Engineering Center, Alexandria, VA, http://www.tec.army.mil/
- U.S. Army Technical Center for Explosives Safety, McAlester, Oklahoma, http://mcalestr-www.army.mil/
- U.S. Army Test and Evaluation Command, http://www.atec.army.mil/
- Environmental Restoration Information System Database Queries, https://aerp.apgea.army.mil/pls/aerp/aecportal.home
- U.S. Army Training Center, Fort Jackson, SC, http://www.jackson.army.mil/Area/aboutFtJ.htm
- U. S. Army Training Center, Fort Jackson, SC, http://one-six-one.fifthinfantrydivision.com/161pg141b.htm
- U.S. Army Training Center, Fort Jackson, SC, http://www.jackson.army.mil/Area/FtJHis.htm
- Global Security, http://www.globalsecurity.org/military/facility/fort-jackson.htm
- Project Information Retrieval System (PIRS), https://fudspirs.mvr.usace.army.mil/Login.cfm

3.1.3 Site Visit

An initial site visit to Fort Jackson was conducted on May 4 and 5, 2004, by Malcolm Pirnie team members Ms. Susan Burtnett, Ms. Leigh Blake, and Mr. Jonathan Sperka. Ms. Burtnett, Ms. Blake, and Mr. Dan Hains conducted a follow-up site visit on June 16 through 18, 2004. Additional data was reviewed during a third site visit conducted by Ms. Burtnett and Ms. Blake on July 7 and 8, 2004. The site visits were conducted to review relevant installation records to complete the HRR and to develop the CSMs for the Fort Jackson sites. While on-site, Ms. Burtnett and Ms. Blake reviewed environmental reports and documents for Fort Jackson at the Environmental/Natural Resources Office, Fort Jackson Museum, and Range Control. Interviews with relevant personnel were also conducted. A summary of the applicable information collected during the site visit is presented in Sections 3.2.1 through 3.2.4. Results of the interviews are presented in Section 3.2.5.

3.1.4 Existing ASR and FUDS Information Review

Malcolm Pirnie obtained a copy of the *Archives Search Report, Findings for the Former Pontiac Precision Bombing Range. May 1995. U.S. Army Corps of Engineers, Rock Island District and U.S. Army Defense Ammunition Center and School* and other FUDS related documents for the Pontiac Precision Bombing Range (I04SC003701) from the PIRS website referenced in Section 3.1.2. Malcolm Pirnie also obtained a copy of the *Archives Search Report, Findings for Columbia Army Air Base and Associated Sites. June 1994. U.S. Army Corps of Engineers, Huntsville District* and other FUDS related documents for the Columbia Army Air Base (I04SC044503) and Lake Murray Bombing Ranges (I04SC004001) from the PIRS website. Although the documents were prepared for the FUDS properties located outside of Fort Jackson, the documents were reviewed for information relating to Fort Jackson training activities. These documents provided no relevant information on munitions use at Fort Jackson.

3.2 ARCHIVAL/HISTORICAL AND OTHER RECORDS COLLECTED

The following subsections present the data collected from the various sources outlined in Section 3.1. Although additional records may have been reviewed from the sources presented above, the records listed in this section represent the data that was determined to be applicable to the development of the HRR and CSMs for Fort Jackson.

3.2.1 Documents/Reports

The following table is a list of documents that provided relevant information for the former range and training areas within Fort Jackson.

Table 3-1: Summary of Documents and Relevant Information.

Document Name	General History	General Installation Information	Munitions Use	MC
Confirmatory Sampling Report for Solid Waste Management Units 5, 11, 18, 19, 24, 27, 29, 31, 32, 33, 34, 35, 38, 39, 40 and Area of Concern C, Ft. Jackson, South Carolina. Ecology and Environment, Inc. July 1997.	X	X		
Soil Background Study Report for the Fort Jackson Military Installation, Columbia, South Carolina. Ecology and Environment, Inc. January 2001.	X			
Supplemental Confirmatory Sampling Report for Solid Waste Management Units 5, 11, 29, 33, 34, 38 and Area of Concern C, Fort Jackson, South Carolina. Ecology and Environment, Inc. April 2001.		X		
Fort Jackson, South Carolina Integrated Cultural Resources Management Plan (ICRMP). United States Army Environmental Center. June 2000, Revised April 2002.	X	X		
Revised Final Phase II RCRA Facility Investigation Report for Wonsan (SWMU 12) and Inchon (SWMU 17) Explosive Ordnance Disposal Sites, Fort Jackson, South Carolina. U.S. Army Corps of Engineers Savannah District. March 2003.		X		

Document Name	General History	General Installation Information	Munitions Use	MC
Final U.S. Army Closed, Transferring and Transferred Range/Site Inventory for Fort Jackson, SC. Malcolm Pirnie, Inc. June 2003.	X	X	X	X
Phase 2 RCRA Facility Investigations Report for Solid Waste Management Unit 23, Fort Jackson, South Carolina. Ecology and Environment, Inc. July 2003.	X	X		
RCRA Facility Investigation SWMU 1, Fort Jackson, Phase II RFI Report. CH2MHill. March 2004.	X	X		
Integrated Natural Resources Management Plan and Environmental Assessment 2004-2008. Gene Stout and Associates. April 2004.	X	X		
Fort Jackson Range Architectural Inventory. Construction Engineering Research Laboratory. April 2004.	X			
The Cold War in South Carolina, 1945-1991 – An Inventory of Department of Defense Cold War Era Cultural and Historical Resources in the State of South Carolina – Second Interim Report. U.S. Army Environmental Legacy Program.	X			

3.2.2 Archival Records

3.2.2.1 Correspondence (Historical)

The following correspondence was obtained from the National Archives. Copies have been included in Appendix B.

- Correspondence regarding Small Arms Firing Manual, September 18, 1917
- Correspondence regarding Small Arms Target Ranges for Divisional Training, October 11, 1917
- Correspondence regarding Depopulation of Area Beyond Target Range, December 17, 1917

- Correspondence regarding Completion Report of Camp Jackson, Constructing Quartermaster, Camp Jackson, January 17, 1918

- Correspondence regarding Final Report of Plans and Descriptions of Camp and Camp Utilities, January 19, 1918

- Correspondence regarding Report on Small Arms Range, Camp Jackson, F. H. French, Brigadier General, July 23, 1918

- Correspondence regarding Firing on Machine Gun Range, Thomas Ryan, 2nd Lieutenant, F.A., September 23, 1918

- Memorandum regarding General Completion Report on North Camp Jackson as abandoned February 28, 1919, H. J. MacDonald, Captain, Quartermaster Corps, Constructing Quartermaster, February 28, 1919

- Correspondence regarding Daily Bulletin No. 32, February 11, 1920

- Correspondence regarding Daily Bulletin No. 39, February 19, 1920

- Correspondence regarding Daily Bulletin No. 42, February 24, 1920

- Correspondence regarding Daily Bulletin No. 47, March 3, 1920

- Correspondence regarding Daily Bulletin No. 77, April 15, 1920

- Correspondence regarding Daily Bulletin No. 96, May 10, 1920

- Correspondence regarding Daily Bulletin No. 105, May 22, 1920

- Correspondence regarding Answers to Questionnaire, Harry R. Lee, Colonel, Infantry, Commanding, June 29, 1920

- Correspondence regarding Rifle Range, Maurice E. Barker, Captain, C.A.C., June 25, 1923

- Correspondence regarding Rifle Range, Maurice E. Barker, Captain, C.A.C., June 25, 1923

- Memorandum to the Assistant Chief of Staff, C. M. Roberts, Ordnance Officer, August 1, 1923

- Correspondence regarding Construction of Training Aids, R. W. Strickland, 1st Lieutenant, A.G.D., Assistant Adjutant General, February 24, 1941

- Memorandum regarding Training Facilities, February 24, 1941
- Correspondence regarding General Orders Number 36, F. V. M. Dyer, Lieutenant Colonel, Infantry, Adjutant, June 11, 1941
- Memorandum regarding Platoon Combat Firing Proficiency Tests, Training Memorandum Number 33, F. R. Keeler, Lieutenant Colonel, Adjutant General's Department, May 26, 1942
- Correspondence regarding Training Aids, J. V. V. Shufelt, Colonel, General Staff Corps, Director, Operations and Training Division, October 5, 1942
- Correspondence regarding Post Range Regulations, General Orders Number 63, A. T. Murphey, Colonel, F.A., Adjutant, December 3, 1942
- Correspondence regarding Moving Vehicle Range, Stuart Lewis, Lieutenant Colonel, G.S.C., Chief, Training Branch, December 10, 1942
- Correspondence regarding Safety Limits of Ranges, Headquarters Army Ground Forces, Army War College, December 15, 1942
- Correspondence regarding Post Range Regulations, General Orders Number 25, A. T. Murphey, Colonel, F.A., Adjutant, July 8, 1943
- Correspondence regarding Post Range Regulations, General Orders Number 18, Joseph P. O'Hara, Major, A.U.S., Adjutant, March 16, 1944
- Report regarding Analysis of Fort Jackson, SC, Post War Utilization Studies, September 1945
- Correspondence regarding Estimate of Funds, Lynden R. Anderson, Major, Ordnance Department, Assistant S-4, February 18, 1947
- Correspondence regarding Construction of Ranges, John R. Lucas, Captain, Infantry Range Officer, April 25, 1947
- Correspondence regarding Historical Report and 1949 Fort Jackson Range Regulations, G. H. Decker, Major General, Commanding, June 17, 1949
- Memorandum regarding 1950 Fort Jackson Range Regulations, F. J. Reese, Lieutenant Colonel, A.G.D., Adjutant, April 15, 1950
- Correspondence regarding Training Report, 31st Infantry Division, Lother B. Sibert, Lieutenant Colonel, G.S.C., April 10, 1951

- Correspondence regarding Supply Status, 31st Infantry Division, Clifford P. Morrison, Lieutenant Colonel, G.S.C., 10 April 1951

3.2.3 Maps/Drawings

The following maps and drawings were obtained from the National Archives:

- Cantonment Realty Company, July 18, 1917
- General Layout, Camp Jackson, Columbia, SC, September 1917
- Location Map, Camp Jackson, Columbia, SC, 1918
- Key Map of Property, Camp Jackson, SC, June 1918
- Special Military Map, Camp Jackson, SC, 1920
- Jackson National Forest, SC, December 1926
- Annex No. 1 Firing Ranges, 1946

The following maps and drawings were obtained from Fort Jackson:

- General Map, Camp Jackson, SC, March 1919
- Fort Jackson and Vicinity, 1949
- Location Map, Fort Jackson, SC, 1952
- Training Facilities Map, February 17, 1955
- Training Facilities Map NR 2, January 3, 1956
- Basic Information for Master Plan: Range and Training Areas Map, Fort Jackson, SC, June 1957
- Master Plan, Fort Jackson, SC, August 1969
- Forestry Field Map, Fort Jackson, SC, May 1993
- DLE-PSESD Installation Field Map, Fort Jackson, SC, September 2000
- DLE-ENRD Installation Field Map of Fort Jackson, SC, July 2001

- Military Installation Map, Fort Jackson, SC, May 2003

3.2.4 Photographs/Aerial Photographs

a) Photographs

The following photographs were obtained from the National Archives:

- Salerno Range, Fort Jackson, SC, October 25, 1965
- Saint Lo, Fort Jackson, SC, October 25, 1965
- Combat Support Training, Fort Jackson, SC, September 15, 1969

b) Aerial Photographs

The following aerial photographs were obtained from the National Archives:

- RG145 SC302, 1938
- RG145 SC307, 1939
- RG145 SC313, 1939
- RG145 4583, June 1943

The following aerial photographs were obtained from Fort Jackson:

- 93 VV 11PTV M348 311RW, October 3, 1947
- 129 VV 11PTV M384 311RW, October 3, 1947
- 131 VV 11PTU M384 311RW, October 3, 1947
- 134 VV HPTV M348 311RW, October 3, 1947
- ATA-2P-42, March 1955
- ATA-2P-46, March 1955
- ATA-5AA-192-L, 1959
- ATA-5AA-197-L, 1959

- ATA-5AA-22-R, 1959
- ATA-1GG-39, February 1966
- ATA-1GG-43, February 1966
- ATA-1MM-165, November 1970
- ATA-1MM-199, November 1970
- ATA-1MM-265, November 1970
- ATA-1MM-193, December 1970
- ATA-1MM-198, December 1970

3.2.5 Interviews

The following interviews were conducted to collect information for the HRR. Interview records from these interviews are included in Appendix C.

Fort Jackson Environmental Department – The data collection team interviewed Mr. Lahiri Estaba, the Installation Restoration Program (IRP) Manager, on June 16, 2004, while at the installation for the site visit. Mr. Estaba is an on-site contractor and has worked at Fort Jackson for over nine years. Mr. Estaba is responsible for the installation's RCRA permit and Solid Waste Management Units (SWMUs) that are undergoing corrective action. He was familiar with the locations of the IRP sites and their soil and groundwater data, and provided information regarding those sites in relation to nearby MMRP sites. This information has been incorporated into site descriptions in this report. Information is also shown on Map 3-1, included at the end of Section 3. The IRP sites that were discussed included SWMU 1, SWMU 17, SWMU 21, and SWMU 34. In addition, the installation has completed surface and near-surface soil background studies. Mr. Estaba provided the data collection team with copies of these reports.

The data collection team also interviewed Mr. James McCracken, the installation's National Environmental Policy Act Coordinator, on June 18, 2004, while at the installation for the

site visit. Mr. McCracken has been at the installation for more than 15 years and provided historical information regarding the MMRP sites. Additional range uses in the cantonment area were discussed, including the numerous small arms ranges used over the years. He noted that the FJFC was also used as a 40-mm practice grenade range. Mr. McCracken was also familiar with the hand and rifle grenade range use near the Weston Lake Recreation Area. Mr. McCracken provided a copy of an historical installation map showing the cantonment area (Cantonment Area, Ft. Jackson, SC, Sheet 1 of 3, September 1945 Army Map, SVC War Department).

Fort Jackson Range Control – The data collection team interviewed Mr. Wyatt, the Range Officer, on June 18 and July 8, 2004, while at the installation for the site visit. Mr. Wyatt provided maps and documents regarding the MMRP ranges. The team discussed the historical range uses and range locations in the cantonment area. Mr. Wyatt noted that the area where the Live Hand Grenade Court 2 was depicted on maps had been extensively disturbed during the 1970s and 1980s when the area was used for field fortification training. Mr. Wyatt also discussed the hand grenade and rifle grenade ranges near Weston Lake. He agreed that the locations of the sites vary on different installation maps and that it appeared both hand grenade and rifle grenade use may have occurred at the Hand Grenade Court No. 2 and the Rifle Grenade Range NR 2. Mr. Wyatt provided copies of relevant documents, maps, and range fans sketches for the team's use.

The data collection team interviewed Staff Sergeant (SSG) Mark Wood on June 17, 2004, while at the installation for the site visit. SSG Wood escorted Malcolm Pirnie personnel to the FJFC Range and the Hand Grenade Court No. 2 and Rifle Grenade Range NR 2 Ranges located in the Weston Lake Area. SSG Wood provided a general description of the current uses in the vicinity of the closed ranges. SSG Wood could not provide much historical information on the ranges because he had only been stationed at Fort Jackson for three years.

Fort Jackson Forestry Office – The data collection team interviewed Mr. John Maitland, the Lead Forester, on June 16, 2004, while at the installation for the site visit. Mr. Maitland was familiar with the ranges, especially the Hand Grenade Court No. 2 and Rifle Grenade NR 2 Range near the Weston Lake Area. He noted that there were inconsistencies in how these ranges were shown on installation maps over the years. Mr. Maitland is responsible for managing the forestry resources at the installation. As such, he has been at the sites for logging purposes. Recently, longleaf pines have been planted adjacent to the FJFC. Logging has taken place at the rifle and hand grenade ranges near Weston Lake. Mr. Maitland noted that these areas have been surface cleared. He also provided aerial photographs of the installation for review. Relevant sections of the aerials were copied while at the installation, and they served as a primary source of site-specific information for the HRR.

Fort Jackson Engineering Office - The data collection team interviewed Mr. James Murphy, Engineering Technician, on July 28, 2004 via telephone. Mr. Murphy was contacted about the June 1, 1957 Basic Information for Master Plan, Range and Training Areas Map that he provided to us during the CTT Range Inventory data collection. The map legend was faded in several areas, and information was needed for the HRR. Mr. Murphy referred the team to the Fort Jackson Museum for a copy of the map.

Fort Jackson Museum – The data collection team interviewed Ms. Bessie Williams and Mr. Fred DeMag. Both were helpful in identifying historical maps showing the ranges.

Fort Jackson Real Property Office - The data collection team interviewed Mr. Thomas Peel, the Real Property Officer, on July 28, 2004 via telephone about real property records for range use and closure dates. Mr. Peel stated that the team would need to speak to Mr. Wyatt of Range Control for information. He stated that he does not receive information on range use, but noted that there have been no property boundary changes associated within the team's areas of interest.

Fort Jackson Wildlife Office - The data collection team interviewed Mr. Mark Dutton, the Natural Resource Specialist, on June 16, 2004, while at the installation for the site visit. Mr. Dutton provided maps showing cultural resource sites near the MMRP ranges. Other than a cemetery located north of the Hand Grenade Court No. 2 and Rifle Grenade Range NR 2 near Weston Lake, no cultural resources were identified in the other than operational areas.

3.3 PHASE 3 ARMY RANGE INVENTORY RESULTS

The purpose of the *Closed, Transferring, and Transferred Range/Site Inventory Report for Fort Jackson, South Carolina,* Malcolm Pirnie, June 2003, was to identify CTT ranges that are not within the operational training areas at Fort Jackson. The specific requirements of this investigation included: mapping CTT ranges and sites with UXO, DMM, or MC; collecting and preparing the data for inclusion in the Army Range Inventory Database; conducting an assessment of explosive safety risk using the Risk Assessment Code (RAC) on each CTT range or site; and determining which sites potentially qualify for the MMRP.

The CTT Range Inventory identified ten closed ranges totaling 407 acres within the installation's boundaries. The ranges and associate acreage are identified as follows: 1000-Yard Range (seven acres), 600-Yard Range (19 acres), Andrew Jackson Range (15 acres), FJFC (54 acres), Hand Grenade Court No. 2 (three acres), Live Hand Grenade Court 2 (three acres), Machine Gun Range (three acres), Mortar Range (112 acres), Rifle Grenade Range NR 2 (90 acres), and Submachine Gun Area (101 acres). The inventory summaries for these ranges are presented in Section 2.2.

The RAC process required the completion of a worksheet that consisted of a series of questions regarding each CTT range or site. Based on the results of the worksheet, a relative score (RAC score) for each area was assigned. The RAC score is an estimate of the relative explosives safety risk, which was reported as a number from one (high explosives safety risk) to five (negligible explosives safety risk). The RAC scores for the ranges/sites evaluated during the CTT Range Inventory are summarized in Table 3-2. The RAC scores

were developed based on the findings during the CTT Range Inventory and do not reflect new or additional information regarding these ranges/sites obtained during the HRR.

Table 3-2: CTT Range Inventory Range/Site RAC Scores

Range/Site Name	Munitions Type	RAC Score
1000-Yard Range	Small arms	5
600-Yard Range	Small arms	5
Andrew Jackson Range	Small arms	5
FJFC	Small arms	5
Hand Grenade Court No. 2	MEC	2
Live Hand Grenade Court 2	MEC	3
Machine Gun Range	Small arms	5
Mortar Range	MEC	2
Rifle Grenade Range NR 2	MEC	2
Submachine Gun Area	Small arms	5

3.4 SUMMARY OF OTHER PREVIOUS INVESTIGATIONS

Based on the data repositories reviewed for the HRR, the following previous investigations were identified which contained information pertaining to munitions use and/or relevant environmental data at Fort Jackson.

Confirmatory Sampling Report for Solid Waste Management Units 5, 11, 18, 19, 24, 27, 29, 31, 32, 33, 34, 35, 38, 39, 40 and Area of Concern C, Ft. Jackson, South Carolina - July 1997

This report describes CS investigations performed at 14 SWMUs and one area of concern. The report was written to meet the requirements of Fort Jackson's RCRA permit issued in October 1991. The report provides an historical overview of Fort Jackson and describes its environmental setting. The majority of the SWMUs evaluated in this report are in the

cantonment area, including SWMU 34, which is located near MMRP sites/ranges in the cantonment area.

SWMU 34 is the former location of a 30-foot by 30-foot concrete wash pad and a 400-gallon capacity oil/water separator that received vehicle wash water containing oil and grease. This unit is located on the eastern side of the cantonment area north of Semmes Road and approximately 250 feet northwest of the sanitary landfill. This area is in close proximity to the Transition Range located in the cantonment area, which is discussed in Sections 4 and 5 of this HRR. No significant contamination was found at SWMU 34. Some metals were present at concentrations that slightly exceeded the maximum background levels measured at Fort Jackson.

Supplemental Confirmatory Sampling Report for Solid Waste Management Units 5, 11, 29, 33, 34, 38 and Area of Concern C - April 2001

The results of this supplemental investigation combined with the results of the previous CS efforts performed in July 1997 (discussed above) were used to decide if further actions were needed at any of these sites. With respect to SWMU 34, the supplemental CS was conducted to determine if contamination was present in this area that was associated with high Organic Vapor Analyzer readings recorded during the 1995 CS investigation. This supplementary CS recommended NFA at SWMU 34. This report also provided limited historical information on Fort Jackson.

Soil Background Study Report for the Fort Jackson Military Installation Columbia, South Carolina - January 2001

This report presents the procedures, methodologies, and data from the Background Soil Study for the Fort Jackson Military Installation. The objective of this study was to develop comprehensive data sets characterizing levels of metals in the soil at Fort Jackson. The report concluded the following:

1. Sample depth (at least within a range significant for risk analysis) does not appear to be a meaningful discriminator of background soil concentrations.

2. Sample location (undeveloped versus developed) and soil type, or some combinations thereof, do appear to be discriminators for background soil concentrations.
3. Three sets of background soils are needed for Fort Jackson: sandy soils of developed areas, sandy soils of the undeveloped areas, and clayey soils combining both areas.

This report also provided a brief background and history of Fort Jackson, as well as an environmental sampling history.

Integrated Cultural Resources Management Plan (ICRMP*)* - June 2000, Revised April 2002

This report was written to meet the legal compliance requirements of federal historic preservation laws and regulations. The ICRMP establishes priorities for the identification of and standards for the evaluation of historic properties on Fort Jackson and provides a schedule designed to accomplish program objectives during a five–year period. The vast majority of land on Fort Jackson has been inventoried for cultural resources and historic properties. The ICRMP reported that a total of 662 archaeological sites have been identified at Fort Jackson to date. With the exception of 11 cemeteries recorded as archaeological sites, these resources require no further management consideration. Twelve sites are considered eligible for the National Registry of Historic Places (NRHP). Ninety-six sites have been recommended as potentially eligible for the NRHP. These resources must be preserved in place until their exact NRHP status is determined. There are no eligible or potentially eligible NRHP sites located on the sites being evaluated as part of the MMRP.

The ICRMP reported that one federally listed animal species exists on Fort Jackson: the Red-cockaded Woodpecker. The bird nests in aging pines, lives in family groups and inhabits park-like territories or clusters of 1,500-foot radii. There are 13 active clusters and 39 inactive clusters on the Fort Jackson installation. This population is routinely monitored, and the surrounding forest is managed to encourage survival of the groups. One cluster is located within close proximity to the Weston Lake Area, including the Rifle Grenade Range NR 2.

Revised Final Phase II RFI Report for Wonsan (SWMU 12) and Inchon (SWMU 17) Explosive Ordnance Disposal Sites - March 2003

The purpose of this report was to present the additional information collected during the 1999 and 2000 Phase II RFI activities, incorporate the new data, and perform an updated human health and ecological risk assessment of the two EOD sites, Wonsan (SWMU 12) and Inchon (SWMU 17). The Submachine Gun Range and the Mortar Range, which are being evaluated in the MMRP, are located in the Weston Lake Area. SWMU 17 is located approximately one and one-half miles east of Weston Lake. This report was helpful in providing general information about the Weston Lake Area. This document also reported that two federal and/or state listed threatened and endangered species are present at Fort Jackson: the Rough-leaved Loosestrife and the Red-cockaded Woodpecker.

Final U.S. Army Closed, Transferring and Transferred Range/Site Inventory for Fort Jackson, SC - June 2003

The objective of this report was to present the CTT Range Inventory for Fort Jackson. In preparation of this report, historical research was conducted to identify CTT ranges and sites subject to the inventory and their locations, periods of use, and associated types of UXO, DMM, or MC. This report contains a historical background of Fort Jackson and installation summary and is discussed further in Section 3.3.

RCRA Facility Investigation SWMU 1 Phase II RFI Report - March 2004

SWMU 1, also known as the former Sanitary Landfill No. 3, is closed and is located north of Semmes Road and east of Chesnut Road within the cantonment area. SWMU 1 is also located within the Transition Range's safety/buffer area. Phase II sampling for SWMU 1 was completed in 2003; data sets collected during the Phase I and Phase II efforts were combined to complete the RFI. This document reported that ten compounds (chromium, dieldrin, acetone, methylene choride, benzo(a)anthracene, 2,4-Dinitrotoluene, n-nitroso-di-n-propylene, 4-Chloro-3-methylphenol, 4-Nitrophenol, and pentachlorophenol) were present in soil samples at concentrations that exceeded their respective site-specific screening levels. However, these chemicals were considered not to represent a significant threat to shallow

groundwater. Therefore, further investigation to evaluate the potential for migration to groundwater was not recommended.

2004-2008 Integrated Natural Resources Management Plan (INRMP) and Environmental Assessment – April 2004

The purpose of the INRMP is to guide the implementation of the natural resources program for Fort Jackson from 2004 to 2008. The program is designed to conserve Fort Jackson's land and natural resources and helps to ensure compliance with environmental laws and regulations. The INRMP helps to endure the maintenance of quality training lands to accomplish Fort Jackson's critical military mission on a sustained basis and to ensure that natural resources conservation measures and Army military mission activities are integrated and consistent with federal stewardship requirements. The INRMP provided thorough descriptions with respect to Fort Jackson's historical background, cultural resources, physical environmental setting, biological resources, and natural resources. The INRMP is referenced throughout this HRR.

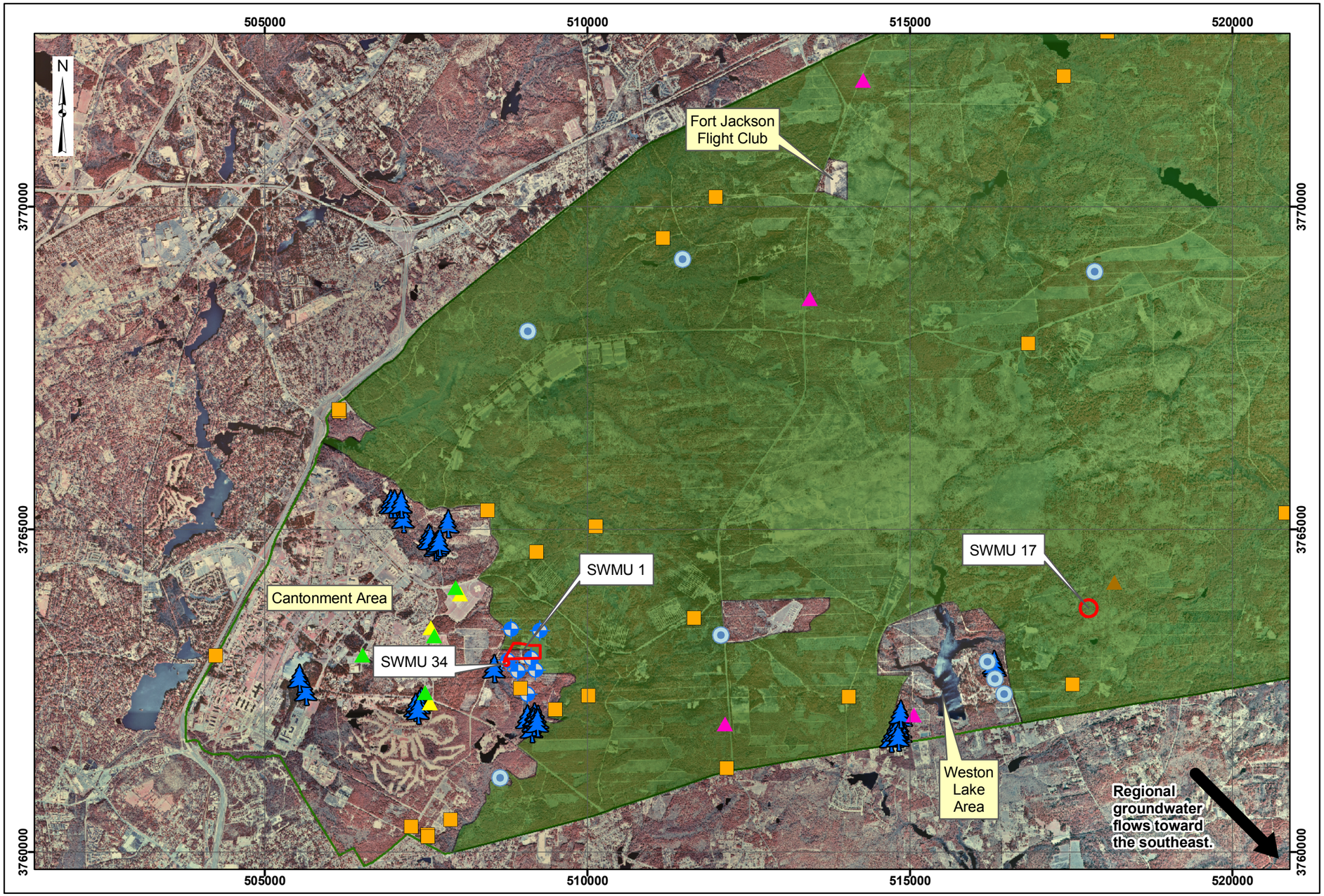
Fort Jackson Range Architectural Inventory Construction Engineering Research Laboratory, April 2004

This document is an Historic American Buildings Level IV Survey prepared to determine eligibility for inclusion on the NRHP for the following buildings and landscapes: 41 ranges, three bivouac regions, and 29 buildings in the Fort Jackson cantonment area and two structures neither on the ranges nor in the cantonment area. This report concluded that none of the ranges, buildings, or landscape elements evaluated in this report at Fort Jackson are eligible for the NRHP under any of the National Register Criterions. Other than the Andrew Jackson Range, none of the MMRP sites were discussed in this report. However, the report did include maps showing ranges and range fans for the installation for 1946 and 1949. These maps were utilized as source data for the HRR.

The Cold War in South Carolina, 1945-1991 – An Inventory of Department of Defense Cold War Era Cultural and Historical Resources in the State of South Carolina – Second Interim Report U.S. Army Environmental Legacy Program

This report provided a detailed chronological historical background of events and activities conducted at Fort Jackson from 1917 through 1992. Pertinent information from this report has been incorporated into the HRR.

Historical Records Review
Fort Jackson, SC



Map 3-1
Relevant IRP Data

Legend

- Installation Boundary
- Operational Range Area
- Solid Waste Management Units
- Cemetery

Endangered Species

- Red-cockaded Woodpecker Habitat

Wells

- Drinking Water Wells
- Monitoring Wells

Sampling Locations

- Soil Boring Location
- 1995 Background Surface Soil Sample Location
- 2000 Developed Area Background Soil Sample Location
- 2000 Undeveloped Area Background Soil Sample Location

0 0.5 1 1.5 2 Miles

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1999
Fort Jackson South, SC, 1999
Messers Pond, SC, 1999
Congaree, SC, 1999
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

4 SUMMARY OF FINDINGS

4.1 IN DEPTH CHRONOLOGICAL HISTORY OF INSTALLATION

The installation dates back to 1917 when it was first opened as Camp Jackson. Camp Jackson was originally constructed on a 1,200-acre tract of land donated to the Federal Government by the citizens of the City of Columbia. In addition to the 1,200 acres donated by the City of Columbia, the Army purchased additional land bringing the total area of Camp Jackson to 22,000 acres. By 1918, approximately 45,000 military personnel were actively training at the installation, which was named in honor of Major General Andrew Jackson (seventh President of the U.S.). Camp Jackson remained active until July 27, 1921, when it was abandoned.

A wrecking company was called in to dismantle the camp after it was abandoned. The wrecking company was still at work tearing out sewer and water lines when, in 1925, the War Department decided to use the post again as a training camp for the SC National Guard. From 1925 to 1939, the facility was controlled by the state and was used as an encampment area for National Guard troops.

In 1939, the demands of war brought the area again under federal control. The facility was designated as Fort Jackson and was organized as an infantry training center. In 1940, the installation was enlarged, by land purchase, to 52,000 acres. During that time, four firing ranges and more than 100 miles of road were constructed. In 1946, Fort Jackson became an Army replacement training center when Camp McClellan was closed. During the 1950s, Fort Jackson served as an active duty headquarters for Alabama and Mississippi National Guard units and was occupied by various infantry divisions.

In 1968, the installation area was annexed into the City of Columbia. It was re-designated as an Army training center in 1973. The current and primary mission of Fort Jackson is to train initial entry recruits for duty as soldiers for Army units. Throughout the years, the

installation has grown to its current size of 52,000 acres. A chronological list of significant historical events is provided in Table 4-1.

Table 4-1: Timeline of Significant Events

Time Period	Significant Events
1900-1920	• 1917: Installation first opened as Camp Jackson. • 1918: Approximately 45,000 military personnel were training at the installation.
1920-1940	• 1921: Camp Jackson was abandoned. • 1925 - 1939: Installation was controlled by the state and used as an encampment for National Guard troops. • 1939: Installation was designated as Fort Jackson and was organized as the infantry training center.
1940-1950	• 1946: Fort Jackson became an Army replacement training center.
1950-1960	• 1950s: Fort Jackson served as an active duty headquarters for Alabama and Mississippi National Guard units.
1960-present	• 1968: Installation area was annexed into the City of Columbia. • 1973: Fort Jackson was re-designated as an Army training center.

4.2 MMRP SITE FINDINGS

Information not previously identified regarding the cantonment area, FJFC, and the Weston Lake Area sites was obtained through the research performed for this HRR. This information resulted in modifications to the original MMRP site descriptions and boundaries formulated during the CTT Range Inventory, which are presented in Section 2.2. The locations of the cantonment area, FJFC, and Weston Lake Area are shown on Map 4-1.

Based on the information obtained during the HRR, additional MMRP sites were identified within the cantonment area. These sites, as well as the sites identified during the CTT Range Inventory, are discussed in Section 4.2.1. Additional munitions types, including MEC, were identified for the FJFC. The westernmost portion of the FJFC was determined to have had no historical range use, thereby reducing the total acreage for the FJFC. Details regarding these findings are included in Section 4.2.2. Additional munitions types and acreage changes were identified for the Weston Lake Area sites. This information is provided in Section 4.2.3.

The CTT Range Inventory listed the Andrew Jackson Range as one of the ten MMRP sites. The Andrew Jackson Range was originally a military small arms range that had been closed. The site has been turned over to the Fort Jackson MWR Department for operation as a recreational small arms shooting range. Because of its current activity and the ongoing releases that have occurred there after September 30, 2002, it was determined that this site is not eligible for evaluation as part of the Fort Jackson SI.

4.2.1 Cantonment Area Ranges/Sites

The cantonment area, which is located in the western portion of Fort Jackson, contains three MMRP sites. Four ranges (i.e., the 1000-Yard, 600-Yard, Machine Gun, and Live Hand Grenade Court No. 2 ranges) were discussed in the CTT Range Inventory. Thirteen additional sites were identified during the preparation of the HRR. Due to a change of the operational range boundary, seven of these sites were determined to not be eligible for evaluation as part of the Fort Jackson SI. Map 4-2 shows the cantonment area range details.

For the purposes of this report, the cantonment area MMRP sites have been combined into the following range groups: Camp Jackson Ranges, Small Arms Ranges East of Chesnut Road, and Live Hand Grenade Court 2. The findings and modifications with respect to each site identified in the CTT Range Inventory, as well as the additional sites identified in the HRR, are presented in the following subsections. Map 4-3, included at the end of Section 4, shows the differences in the CTT Range Inventory and HRR range locations. Map 4-4, also included at the end of Section 4, highlights the cantonment area MMRP sites.

4.2.1.1 Camp Jackson Ranges

The Camp Jackson Ranges occupy 81 acres and include the following five small arms ranges: 1000-Yard Range, 600-Yard Range, 300-Yard Range, Machine Gun Range, and Pistol Range. The 1000-Yard, 600-Yard, and Machine Gun Ranges were identified in the CTT Range Inventory, whereas the 300-Yard and Pistol Range were identified in the HRR.

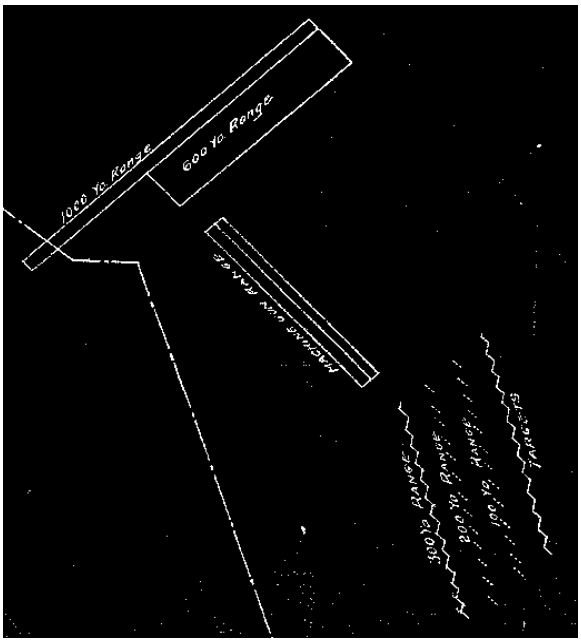


Figure 4-1: 1918 Location Map

The CTT Range Inventory reported that Camp Jackson had five rifle ranges in 1918, including 100-, 200-, 300-, 600-, and 1000-yard ranges. Based on information obtained during the CTT Range Inventory, these five ranges appeared to be located in a single range complex, with the 600-Yard and 1000-Yard Ranges located adjacent to each other and the 100-, 200-, and 300-yard ranges co-located within the 600-Yard Range boundary. During the HRR, a 1918 map (Figure 4-1) was obtained from the National Archives that showed the 300-Yard Range south of the 1000-Yard and 600-Yard Ranges. The 300-Yard Range included the 100- and 200-yard ranges. The 1918 map also depicts the Machine Gun Range. The Pistol Range is shown on a 1920 map. The Camp Jackson Ranges were used from 1918 through 1920 for small arms training.

1000-Yard Range

The 1000-Yard Range is described in the CTT Range Inventory as a former rifle range located near Washington Road and Ivy Road. During the research for this HRR, information was obtained that more accurately described the location and layout of the 1000-Yard Range. Based on review of historical maps, the 1000-Yard Range was located in the eastern portion of the cantonment area, just east of Chesnut Road and south of Hartsville Guards Road. This location is north of the 600-Yard Range and the Machine Gun Range, as identified in the CTT Range Inventory.

Historical correspondence indicated that construction of the 1000-Yard Range began in 1917, with the first operational use in early 1918. According to July 23, 1918 correspondence, the 1000-Yard Range had six targets located at 800 and 1000 yards. Based on historical documentation (i.e., letters, memorandums, and maps) the direction of fire was from west to east. Maps for Fort Jackson from 1918 (Figure 4-1) and 1919 depict the outline and configuration of the 1000-Yard Range. The 1920 Special Military Map depicts multiple gun emplacements, one of which is located in the general area of the 1000-Yard Range. Three ground targets and what appear to be two berms are also located in this area. Based on the range features shown on the 1920 map, the location of the 1000-Yard Range appears to be slightly north of where the CTT Range Inventory identified this range. Map 4-3 shows the CTT Range Inventory location of this range, as well as the revised location as determined by this HRR. The December 1926 Jackson National Forest Map does not depict the 1000-Yard Range. Based on the history of Fort Jackson, world events (e.g., end of World War I), and the documents and maps reviewed, it appears the range was used between 1918 and 1920.

600-Yard Range

The 600-Yard Range is described in the CTT Range Inventory as a former rifle range. As with the 1000-Yard Range, information was obtained during the HRR that more accurately described the location and layout of the 600-Yard Range. The range is located east of Chesnut Road and south of Hartsville Guards Road in the eastern portion of the cantonment

area. This location is south of the 1000-Yard Range and north of the Machine Gun Range, as identified in the CTT Range Inventory.

Historical correspondence indicates construction of the 600-Yard Range began in 1917, with the first operational use in early 1918. According to July 23, 1918 correspondence, the 600-Yard Range had a series of 200 targets located at 100, 200, and 300 yards (listed as short range targets) and 34 targets located at 500 and 600 yards (listed as mid range targets). The direction of fire was from west to east. Maps for Fort Jackson from 1918 (Figure 4-1) and 1919 depict the outline and configuration of the 600-Yard Range. The 1920 Special Military Map shows gun emplacements located in the general area of the 600-Yard Range. Three ground targets and what appear to be two berms located in the direction of fire are visible. Based on the locations of the gun emplacements, targets, and berms, the location of the 600-Yard Range appears to be slightly north of where the CTT Range Inventory identified this range.

Map 4-3 shows the CTT Range Inventory location of this range, as well as the revised location as determined by this HRR. The December 1926 Jackson National Forest Map does not depict the 600-Yard Range. Based on the history of Fort Jackson, world events (e.g., end of World War I), and the documents and maps reviewed, the range was used between 1918 and 1920.

300-Yard Range

The 300-Yard Range was a rifle range located south of the Machine Gun Range and north of the Live Hand Grenade Court 2. The 300-Yard Range included 100-, 200-, and 300-yard ranges. The 300-Yard Range is first shown on the June 1918 map and then again on the 1920 Special Military Map. The December 1926 Jackson National Forest Map is the last map to depict the 300-Yard Range.

A Completion Report of Camp Jackson, dated January 17, 1918, noted that the 300-Yard Range was located east of the cantonment area on a strip of land 13,200 feet wide and

42,000 feet long. A portion of this land, which was part of the 22,000 acres comprising Camp Jackson, was used for small arms training. The land configuration at the 300-Yard Range would not permit shooting directly from the firing trench to the target trench without danger of the bullets passing over the property line. Therefore, trenches were constructed in echelon (see Figure 4-1) to take advantage of the ridges/hills that were not parallel to the property line. This allowed for an easterly firing direction. The 50th Anniversary History 1917-1967 for Fort Jackson, prepared by the U.S. Army Training Center, includes a picture of the 300-Yard Range taken between 1917 and 1918. The picture shows the echelon configuration of the range, with target trenches and berms in the background (Figure 4-2).

Figure 4-2: 300-Yard Range

An October 11, 1917 Army memorandum written by the Adjutant General indicated that the 300-Yard Range was used for pistol firing. Camp Jackson's daily bulletins dated May 10 and 22, 1920 also indicated that there was pistol firing, confirming pistol use at the 300-Yard Range. An aerial photograph from 1959 (Figure 4-3) shows the remains of the 300-Yard Range echelon target area. Based on historical documents and correspondence, the 300-Yard Range was used from 1918 through 1920 by the Army and from 1920 through at least 1926 by SC National Guard troops.

Figure 4-3: 1959 Aerial Photograph

Machine Gun Range

The Machine Gun Range is described as a 1000-inch range. During the research for this HRR, information was obtained that more accurately described the location of the Machine Gun Range as east of Chesnut Road and south of Hampton Parkway in the eastern portion of the cantonment area. This location is south of the 1000- and 600-Yard Ranges, as identified in the CTT Range Inventory.

The Machine Gun Range is shown on the 1918 Location Map (Figure 4-1), the June 1918 map, the March 1919 General Map, and the 1920 Special Military Map. Historical correspondence indicates the construction of the Machine Gun Range began in 1917, with the first operational use in early 1918. According to July 23, 1918 correspondence, the Machine Gun Range had a series of 72 targets located on carriages that would be drawn on tracks toward the machine gun firing line during training exercises. The 50th Anniversary History 1917-1967 for Fort Jackson includes a picture of the Machine Gun Range taken between 1917 and 1918 (Figure 4-4). The direction of fire, as confirmed by historical documentation (i.e., letter, memorandums, and maps), was from west to east. The Machine Gun Range is not depicted on the December 1926 Jackson National Forest Map. Based on the history of Fort Jackson, world events (e.g., end of World War I), and the documents and maps reviewed, the range was used between 1918 and 1920.

Figure 4-4: Machine Gun Range

According to the *AR 750-10 Range Regulations for Firing Ammunition in Time of Peace,* typically light and/or heavy machine guns may have been used on 1000-inch rolling target machine gun ranges. The firing line was positioned 1000 inches in front of the targets. Probable ammunition used at the machine gun range includes 0.30-caliber, M1/5, (500-yard maximum range); 0.30-caliber, M2/3, (450-yard maximum range); and 0.50-caliber (7,500-yard maximum range).

Pistol Range

Evidence of this range was found on the 1920 Special Military Map. Gun emplacements (i.e., the firing point) were shown west of the Machine Gun Range. A backstop berm, which appears to be adjacent to a target area, is located north of the Machine Gun Range. Based on the configuration shown on the 1920 map, the direction of fire was northeast across the northernmost portion of the Machine Gun Range. A portion of the 1920 Special Military Map depicting the Pistol Range is shown in Figure 4-5. Because the range is only depicted on the 1920 map, it was likely constructed and used between 1919 and 1920.

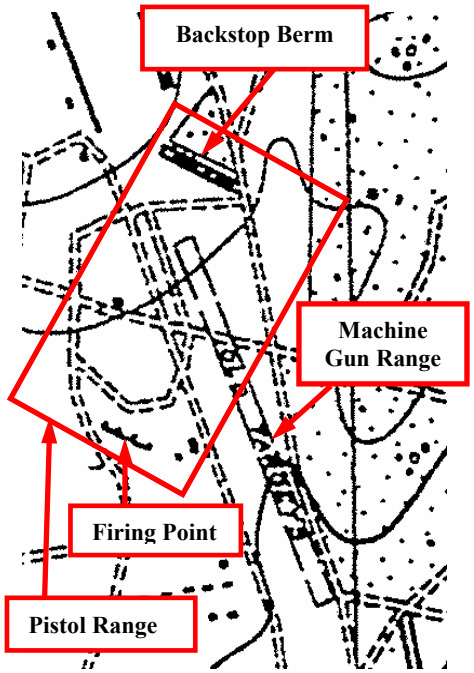


Figure 4-5: 1920 Special Military Map

Table 4-2, on the following page, summarizes historical use and overlapping range information for the Camp Jackson Ranges.

Table 4-2: Camp Jackson Ranges Historical Use Summary

MMRP Ranges/Sites	1918 Map	1919 Map	1920 Map	1926 Map	Historical Use	Overlapping Ranges
Camp Jackson Ranges						
1000-Yard Range	X	X			Small arms	Transition Range
600-Yard Range	X	X			Small arms	Transition Range
300-Yard Range	X		X	X	Small arms	Transition Range, Live Hand Grenade Court 2, Pistol Range NR 2
Machine Gun Range	X	X	X		Small arms	Pistol Range, Transition Range, Pistol Range NR 2
Pistol Range			X		Small arms	Machine Gun Range, Transition Range, Pistol Range NR 2

4.2.1.2 Small Arms Ranges East of Chesnut Road

The Small Arms East of Chesnut Road include the following four ranges: Transition Range; 1000-Inch Range Nos. 14, 15, 16; Pistol Range NR 2; and the Landscape Target Range. These ranges, which comprise 546 acres, were discovered as a result of the research performed for this HRR. These ranges were generally used during time period of 1946 to 1970 and are discussed below.

Transition Range

The Transition Range was located east of Chesnut Road, north of Semmes Road, and south of Red Diamond and Hartsville Guards Roads. The firing direction was from west to east. The Transition Range and its associated range fan overlapped the majority of the CTT-identified cantonment area ranges (i.e., the 1000-Yard Range, 600-Yard Range, Machine Gun Range, and Live Hand Grenade Court 2). Additionally, the Transition Range and its associated range fan overlapped portions of the following HRR-identified ranges: the 300-Yard Range; Pistol Range; Pistol Range NR 2; 1000-Inch Range Nos. 14, 15, 16; and the Landscape Target Range.

Correspondence regarding range construction, dated April 25, 1947, indicates that the Transition Range originally was to consist of 11 lanes with the firing line located on the western portion of the range. This correspondence also states that range construction was to be completed by June 23, 1947. Range Regulations, dated May 24, 1949, indicate that there were 15 firing lines at that time. Targets were located at the following distances: six lanes had targets at 200, 300, and 500 yards; four lanes targets at 250, 300, 350, 400, 450, and 500 yards; one lane had targets at 100 yards; and four lanes had targets from five to 70 yards. The type of weapon fired at this range was identified in the Range Regulations as the M1 .30 Caliber Rifle.

The Transition Range, which is shown on both the 1946 and 1949 maps, was extended south to encompass the Live Hand Grenade Court 2 sometime between 1946 and 1949 (this coincides with the increase in firing lanes from 11 to 15 described in the historical correspondence). The 1946 map shows the Live Hand Grenade Court 2 located just south of the southwestern corner of the Transition Range, where as the 1949 map (Figure 4-6) shows the Live Hand Grenade Court 2 located within the southwestern corner of the Transition Range. A 1952 Location Map shows the Transition Range firing line (identified on the map as M-1 Trans #1 Range), but does not include the range fan. The 1955 Training Facilities Map and the 1956 Training Facilities Map NR 2 also shows the Transition Range.

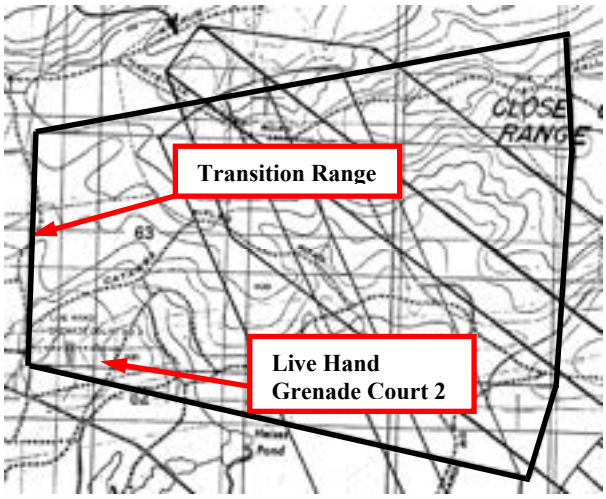


Figure 4-6: 1949 Fort Jackson and Vicinity Map

A Fort Jackson Basic Information Range Training Area Map, dated June 1, 1957, does not show the Transition Range. However, this map does show a Platoon Tactical Training Area (identified on the map as No. 309), Night Compass Course (No. 306), and Flame Thrower Area (No. 305) located just east of Chesnut Road where the westernmost portion of the

Transition Range was located. These three areas are only identified on the 1957 map (see Figure 4-7). Based on the historical correspondence and maps reviewed for the HRR, the period of use for the Transition Range was from 1947 to 1956.

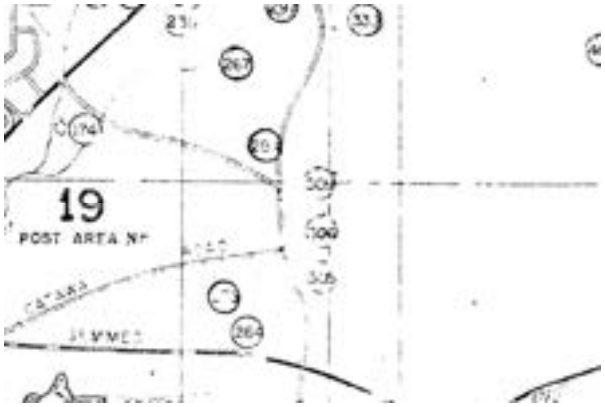


Figure 4-7: 1957 Basic Information Map

The *AR 750-10, Range Regulations for Firing Ammunition in Time of Peace* and *TM 9-855, Targets, Target Material, and Training Course Lay-outs* describe four general types of transition ranges used during the 1940s and 1950s. The first type of transition range was set up with firing lanes that had a single firing point and pop-up targets set at 200, 300, and 500 yards; each firing lane was approximately 60 yards wide. The second type of transition range was set up with firing lanes that had a single firing point and six stationary targets placed at random distances ranging from 200 to 500 yards; each firing lane was approximately 50 yards wide. The third type of transition range was set up without a limit of advance. This type of range consisted of up to ten firing lanes (each approximately 20 yards wide) that offered unique firing positions (i.e., fox holes, logs, etc.) and personnel transitioned along the firing line shooting from the various positions. Targets were placed at random distances out to 500 yards. The fourth type of transition range was set up with a limit of advance (typically no farther than 90 yards down range). This range utilized firing lanes in which personnel transitioned down-range while engaging pop-up targets positioned at various locations. Each lane was approximately 25 yards wide with earthen berms constructed between the firing lanes. Based on the historical documents reviewed, it appears that the Transition Range included a combination of these types of transition ranges.

1000-Inch Range Nos. 14, 15, 16

The 1000-Inch Range Nos. 14, 15, 16 is shown on the 1949, 1955, and 1956 maps. The 1949 map shows the 1000-Inch Range Nos. 14, 15, 16 located southeast of Golden Arrow Road and along the northeast side of Hartsville Guards Road, except for a small portion on the southwest side of Hartsville Guards Road. The firing point is located northeast of Hartsville Guards Road, with the direction of fire to the southeast. With the exception of a small area near the southern portion of the firing line, this range is overlapped by the Transition Range. When comparing the 1949 and 1956 maps, it was noted that the location of this range was shifted slightly to the south in the 1956 map. Map 4-2 illustrates the portion of this range that lies within the cantonment area.

Pistol Range NR 2

The Pistol Range NR 2 is shown on the 1952, 1955, and 1956 maps. This range is located east of Chesnut Road within the area identified as the Transition Range on the 1949 map. An aerial photograph from 1959 (Figure 4-8) shows the Pistol Range NR 2. Five berms that run in an east/west direction are visible in the photograph. These berms divided the range into separate firing areas. The firing points were located on the west side of the range with a target area located on the east side. A backstop berm located east of the firing lanes is also visible in the photograph. The Transition Range located north of the Pistol Range NR 2 is also visible in this aerial photograph.

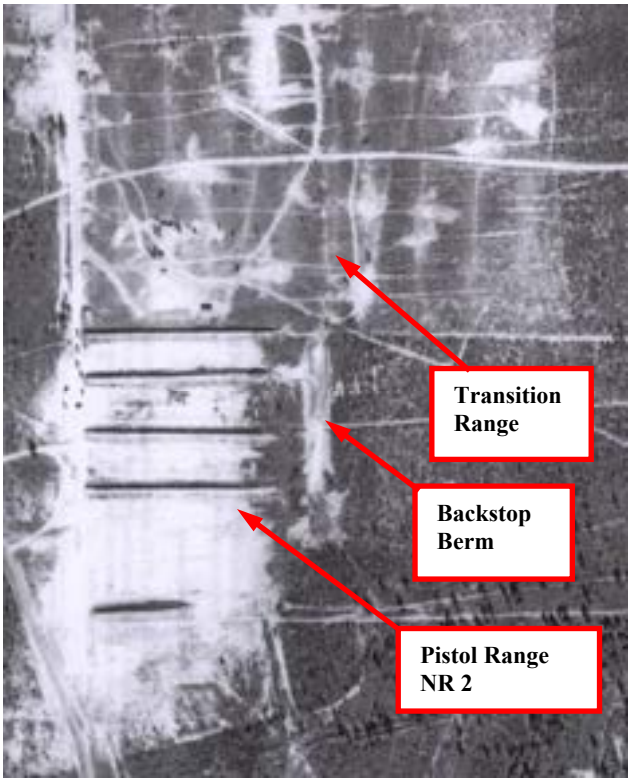


Figure 4-8: 1959 Aerial Photograph

Landscape Target Range

The Landscape Target Range is shown on the 1946 and 1949 maps. The maps show this range located south of Hartsville Guards Road, with a portion of the fan extending north across Hartsville Guards Road (Figure 4-9). The firing line was located southeast of the cantonment area, with the direction of fire to the northwest. The range fan extended northwest into the cantonment area. The Transition Range and 1000-Inch Range Nos. 14, 15, 16 overlap the portion of the Landscape Target Range that is located within the other than operational area.

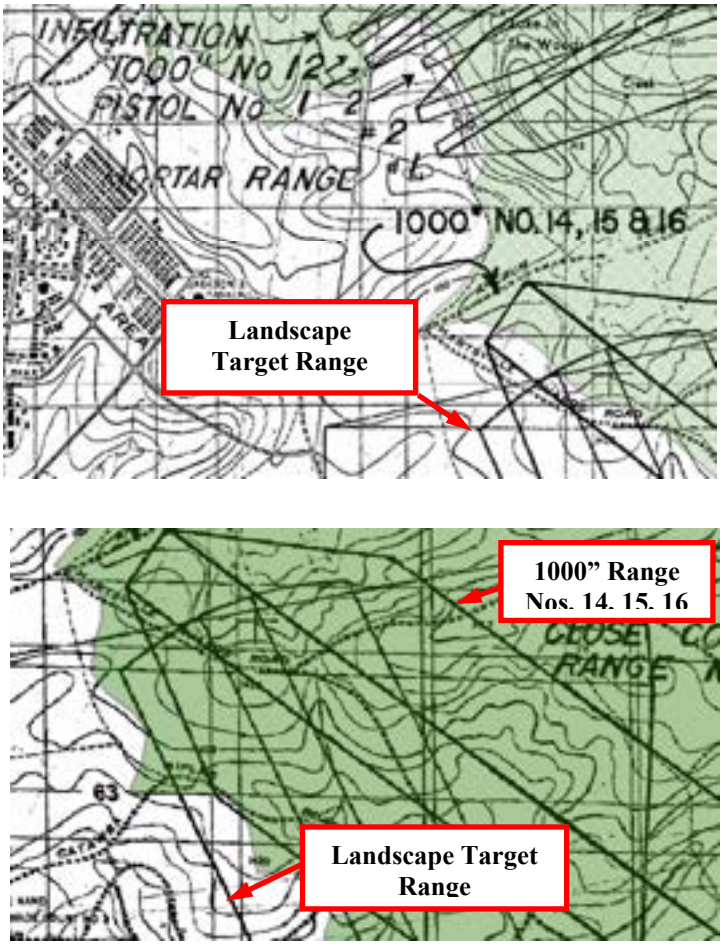


Figure 4-9: 1949 Fort Jackson and Vicinity Map with CTT Operational Boundary and Revised Operational Boundary

Based on information provided in the *AR 750-10, Range Regulations for Firing Ammunition in Time of Peace* and *TM 9-855, Targets, Target Material, and Training Course Lay-outs*, landscape targets were used for rifle practice on this type of 1000-inch range. The target set consisted of five black and white paper landscape targets that together made a panoramic picture of a landscape. The size of the panoramic picture was such that the features were recognizable at a distance of 1000 inches. Typically, .22 caliber weapons were fired at a Landscape Range and .30 caliber weapons were fired at a 1000-inch range.

Table 4-3 on the following page summarizes the historical use and overlapping range information for the Small Arms Ranges East of Chesnut Road.

Table 4-3: Small Arms Ranges East of Chesnut Road Historical Use Summary

MMRP Ranges/Sites	1946 Map	1949 Map	1952 Map	1955 Map	1956 Map	Historical Use	Overlapping Ranges
Small Arms Ranges East of Chesnut Road							
Transition Range	X	X	X	X	X	Small arms	300-Yard Range, Pistol Range, Pistol Range NR 2, 1000-Inch Range Nos. 14, 15, 16, Landscape Target Range, Live Hand Grenade Court 2
1000-Inch Range Nos. 14, 15, 16		X		X	X	Small arms	Transition Range, Pistol Range NR 2, Landscape Target Range
Pistol Range NR 2			X	X	X	Small arms	Transition Range, Machine Gun Range, 300-Yard Range, Live Hand Grenade Court 2, 1000-Inch Range Nos. 14, 15, 16, Landscape Target Range
Landscape Target Range	X	X				Small arms	Transition Range, 1000-Inch Range Nos. 14, 15, 16, Pistol Range NR 2

4.2.1.3 Live Hand Grenade Court 2

The three-acre Live Hand Grenade Court 2 is described in the CTT Range Inventory as a former hand grenade training range. The Live Hand Grenade Court 2 is located east of Chesnut Road and north of Semmes Road in the eastern portion of the cantonment area. This range is located southwest of the Machine Gun Range as identified in the CTT Range Inventory. According to the CTT Range Inventory, the approximate period of use of the Live Hand Grenade Court 2 was from 1940 to 1950. Practice, as well as live, grenades may have been used on the range. The Live Hand Grenade Court 2 was first depicted on the Annex No. 1 Firing Ranges Map dated 1946 and last depicted on the Fort Jackson and Vicinity Map dated 1949 (see Figure 4-6). During the 1970s and 1980s, the area where the Live Hand Grenade Court 2 was located was used for field fortification training.

Based on descriptions included in the *AR 750-10, Range Regulations for Firing Ammunition in Time of Peace* and *TM 9-855, Targets, Target Material, and Training Course Lay-outs*, a typical live hand grenade court used during the 1940s consisted of a trench with targets and an impact area approximately 25 yards to the front of the throwing line. Targets consisted of a circular outline, a crater, and/or a foxhole. A danger area of approximately 600 feet would have been established around the entire range. The 1949 map shows several parallel lines running north to south that may indicate throwing lines and trenches. Based on the orientation of these lines, grenades were most likely thrown to the east and/or west.

Table 4-4 summarizes historical use and overlapping range information for the Live Hand Grenade Court 2.

Table 4-4: Live Hand Grenade Court 2 Historical Use Summary

MMRP Ranges/Sites	1946 Map	1949 Map	1952 Map	1955 Map	1956 Map	Historical Use	Overlapping Ranges
Live Hand Grenade Court 2	X	X				Practice/live grenade training	300-Yard Range, Transition Range, Pistol Range NR 2

4.2.1.4 Ranges North of Hampton Parkway

The Ranges North of Hampton Parkway (which are northeast of Golden Arrow Road) include the following seven ranges: 1000-Inch Range No. 11, 1000-Inch Range No. 12, Pistol Range No. 1, Pistol Range No. 2, Mortar Range NR 1, Mortar Range NR 2, and the Infiltration Course. Several of these ranges can be seen in Figure 4-9. According to the operational range boundary used for the CTT Range Inventory, small portions of these ranges are located within the other than operational range area. These ranges, which comprise 32 acres, were identified as a result of the research performed for this HRR. These ranges were generally used during the time period of 1946 to 1957. During review of the draft HRR, additional mapping sources were identified that more accurately identified the operational range boundary. Based on this revised boundary, the Ranges North of Hampton Parkway are located within the operational range area and are not eligible for evaluation as part of the Fort Jackson SI. Details regarding these ranges are provided in the following paragraphs for informational purposes only.

1000-Inch No. 11

This small arms range was shown on the 1949, 1952, 1955, and 1956 maps. The 1000-Inch No. 11 Range is shown within the operational area on the 1949 map; however, the remainder of the maps show small portions of this range (near the firing points) located within the other than operational area. The direction of fire for this range was to the northeast.

1000-Inch No. 12

Small portions of this small arms range (near the firing points) were shown to be located within the other than operational area on the following maps: 1949, 1952, 1955, and 1956. The direction of fire was to the northeast.

Pistol Range No. 1

Small portions of this small arms range (near the firing points) were shown to be located within the other than operational area on the following maps: 1949, 1955, 1957, and 1969.

It is noted that this range was not shown on the 1956 map. The direction of fire was to the northeast.

Pistol Range No. 2

Small portions of this small arms range (near the firing points) were shown to be located within the other than operational area on the 1949 map. The 1946 map shows a range similar in size and location to the Pistol Range No. 2; however, it is only labeled as "Pistol". The direction of fire for the Pistol Range No. 2 was to the northeast.

Mortar Range NR 1

This range was shown on the 1949, 1952, 1955, and 1956 maps. Small portions of the Mortar Range NR 1 (near the firing line) are shown within the other than operational area on the 1949, 1955, and 1956 maps. Information on the Mortar Range NR 1, including firing line location and type of munition fired (i.e., 4.2-inch mortar), were described the April 15, 1950 Range Regulations. The range regulations indicate that the 4.2-inch mortar had a maximum range of 1,800 yards. The direction of fire for the Mortar Range NR 1 was to the northeast.

Mortar Range NR 2

Small portions of this range (near the firing line) were shown to be located within the other than operational area on the following maps: 1949, 1955, and 1956. The Mortar Range NR 2 was located south of, and overlapped portions of, Mortar Range NR 1. The direction of fire for this range was also to the northeast.

Infiltration Course

This range is shown on the following maps: 1949, 1952, 1955, 1956, 1957, and 1969. The entire Infiltration Course is shown within the operational area on the 1949 map; however, the remainder of the maps show small portions of the range (mainly near the firing points and the area of the range where the course would have been set up) located within the other than operational area. The direction of fire for the range was to the northeast. The 1957 map also

lists an Infiltration Course No. 2, with a location immediately south of the Infiltration Course. Since the 1957 map is the only reference for the Infiltration Course No. 2 and it is located immediately south of the Infiltration Course, this range is grouped together with the Infiltration Course.

According to the *AR 750-10, Range Regulations for Firing Ammunition in Time of Peace* and TM *9-855, Targets, Target Material, and Training Course Lay-outs*, an infiltration course was set up in a level area with logs and small mounds of dirt for personnel to roll over. The ground would have contained shell holes, trenches, slit trenches, wire entanglements, stumps, sparse brush, and other obstacles. Machine guns were typically fired from fixed platforms at the front of the range and reduced charges of explosives were placed in craters throughout the course to create realistic conditions during training.

Table 4-5 summarizes the historical use and overlapping range information for the Ranges North of Hampton Parkway.

Table 4-5: Ranges North of Hampton Parkway Historical Use Summary

MMRP Ranges/Sites	1946 Map	1949 Map	1952 Map	1955 Map	1956 Map	1957 Map	1969 Map	Historical Use	Overlapping Ranges
Ranges North of Hampton Parkway									
1000-Inch No. 11		X	X	X	X			Small arms	Ranges North of Hampton Parkway
1000-Inch No. 12		X	X	X	X			Small arms	Ranges North of Hampton Parkway
Pistol Range No. 1		X		X		X	X	Small arms	Ranges North of Hampton Parkway
Pistol Range No. 2	X	X						Small arms	Ranges North of Hampton Parkway
Mortar Range NR 1		X	X	X	X			Mortar	Ranges North of Hampton Parkway

MMRP Ranges/Sites	1946 Map	1949 Map	1952 Map	1955 Map	1956 Map	1957 Map	1969 Map	Historical Use	Overlapping Ranges
Mortar Range NR 2		X		X	X			Mortar	Ranges North of Hampton Parkway
Infiltration Course		X	X	X	X	X	X	Small arms Explosives	Ranges North of Hampton Parkway

Table 4-6 provides a summary of the historical time-line analysis for the ranges located in the cantonment area based on the maps reviewed.

Table 4-6: Cantonment Area Map Summary

Date of Map	Map Title	Map Observations
1918-1926	1918 Location Map 1918 Key Map of Property 1919 General Map 1920 Special Military Map 1926 National Forest Map	The ranges observed during this time frame include the following: 1000-, 600-, and 300-Yard Ranges, Machine Gun Range, and the Pistol Range. The 1000- and 600-Yard Ranges are only shown on the 1918 and 1919 maps. The Pistol Range is only shown on the 1920 map.
1946-1957	1946 Annex No. 1 Map 1949 Fort Jackson and Vicinity Map 1952 Location Map 1955 Training Facilities Map 1956 Training Facilities Map NR 2 1957 Master Plan Map	The ranges observed during this time frame include the following: Live Hand Grenade Court 2, Transition Range, 1000-Inch Range Nos. 14, 15, 16, and the Ranges North Hampton Parkway. The 1946 and 1949 maps depict the Live Hand Grenade Court 2 and the Transition Range. The Transition Range was extended to the south to encompass the Live Hand Grenade Court 2 between 1946 and 1949. The Ranges North of Hampton Parkway include the following: 1000-Inch No. 11 and 12 Ranges, Infiltration Course, Pistol Ranges No. 1 and 2, and the Mortar Ranges NR 1 and NR 2.
1969	1969 Master Plan	This map shows three range fans overlapping the other than operational area: the Pistol No. 1 Range, the South Carolina Range, and an unlabeled/unidentified range fan. In each case, only small portions of each range fan overlap the other than operational area, and these areas are included in other ranges/range fans previously identified in the maps reviewed above.

4.2.2 Fort Jackson Flight Club

The FJFC is a 54-acre area located east of Wildcat Road just north of Shenandoah Road. The western portion of the FJFC has been improved for recreational R/C model airplane use. Data obtained during the CTT Range Inventory indicated that the FJFC area was used as a machine gun range from 1955 to 1979. Information not previously identified regarding the FJFC area was obtained through the research performed for this HRR. Based on the data reviewed, the area on the western-most portion of the FJFC did not have a historical range use. As such, the MMRP sites do not include this area. The FJFC MMRP sites include the FJFC Salerno Ranges (15 acres) and the FJFC Small Arms Ranges (27 acres). Map 4-5 and Map 4-6 at the end of this section show the revised HRR site boundary, as well as the various ranges/range fans that overlap the FJFC. Map 4-7 shows the FJFC MMRP sites.

Since no evidence of range activity is indicated on the 1946 Annex No. 1 Firing Ranges Map, it was assumed that range activities were initiated at the FJFC area in the time period between 1946 and 1949. The 1949 Fort Jackson and Vicinity Map depicts two ranges that overlap the FJFC. The Field Firing Machine Gun range and safety fan are oriented to the southeast and cover the majority of the northern and eastern portions of the FJFC. The safety fan for the Close Combat No. 2 range extends into the southeastern corner of the FJFC, as shown on Figure 4-10. The machine gun range is labeled on the 1952 Fort Jackson Location Map as MG Field Firing #1 (Figure 4-11) and is in the same general location as shown on the 1949 map.

Figure 4-10: 1949 Fort Jackson and Vicinity Map with FJFC Overlay

Figure 4-11: 1952 Fort Jackson Location Map with FJFC Overlay

Based on the maps reviewed, the machine gun range usage continued through 1955 and 1956. However, the range fan is significantly larger as depicted on the 1955 and 1956 Training Facilities Maps when compared with that on the 1949 and 1952 maps. The 1955 and 1956 (Figure 4-12) maps both show the presence of an unlabeled smaller range located within the Machine Gun Field Firing Range NR 1. The range fan shape indicates that it may have also been used as a machine gun range.

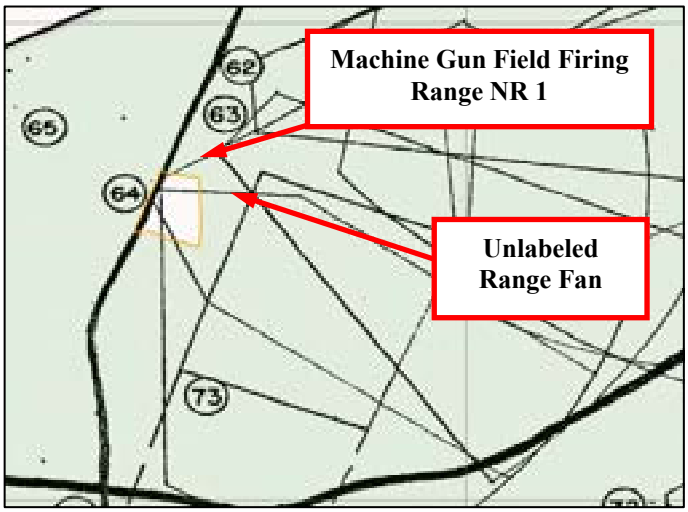


Figure 4-12: 1956 Training Facilities Map with FJFC Overlay

The 1957 map identifies a Technique of Rifle Fire w/ Distrib. and an M-1 Night Firing range that overlap the FJFC. The Technique of Rifle Fire w/ Distrib. range fan covers the northern and eastern portions of the FJFC. The M-1 Night Firing range covers the southern and eastern portions of the FJFC. The 1969 Master Plan Map (Figure 4-13) shows three range fans intersecting the FJFC. The two northern-most range fans are labeled Technique of Rifle Fire Range Salerno and the southern-most range fan is labeled Night Fire and Vision Range Saint Lo. The 1969 map uses the terms "Salerno" and "Saint Lo" for the first time to identify the ranges overlapping the FJFC.

Figure 4-13: 1969 Master Plan Map with FJFC Overlay

Information from a notebook located in the Range Control Office provided additional information on the usage of the Salerno and Saint Lo ranges during the 1960s and 1970s. A

sketch labeled Salerno Demonstration Overlay shows the relative location of four ranges: an M-60 machine gun range, an M-79 grenade launcher range, an M-72 Light Anti-tank Weapon (LAW) rocket launcher range, and an M18A1 mine range. A table attached to the sketch lists ammunition used at the Salerno range as of two dates. The January 3, 1964 entry lists .30-caliber and 7.62-mm ammunition. The April 9, 1970 entry lists LAW rockets, 40-mm grenades, and anti-personnel mines. This table also provides ammunition information for the Saint Lo range, with a January 3, 1964 entry indicating the use of .30-caliber and 7.62-mm ammunition. A historical photograph obtained from the National Archives depicts Army personnel training at an M-60 machine gun range (Figure 4-14). Fort Jackson personnel indicated that use of the Salerno and Saint Lo ranges ceased in 1973 and that the FJFC was established after 1982.

Figure 4-14: Firing at the M-60 range in 1969

The 1993 Forestry Field Map shows the presence of an "M79+40mm" rifle grenade range located in the northeastern-most portion of the FJFC. This location is shaded and labeled in the legend as "previous duds believed to have been cleared".

Aerial photographs from 1949 through 1970 were reviewed for evidence of training in the FJFC area. Disturbed areas were first visible on the 1955 aerial photograph. These areas were identified on other aerial photographs reviewed that were dated through 1970. The most evident land disturbance was shown in the 1955 aerial photograph (Figure 4-15).

Figure 4-15: Ranges Shown on 1959 Aerial Photograph

Table 4-7 below summarizes the historical time-line analysis of former range activities at the FJFC based on the maps reviewed.

Table 4-7: FJFC Map Summaries

Date of Map	Map Title	Map Observations
1946	Annex No. 1 Firing Ranges Map	No training was evident at the FJFC area.
1949	Fort Jackson and Vicinity Map	The Field Firing Machine Gun range and safety fan cover the majority of the northern and eastern portions of the FJFC. The Close Combat Range No. 2 safety fan extends into the southeastern corner of the FJFC.
1952	Location Map	The MG Field Firing #1 range location coincides with the Field Firing Machine Gun range shown on the 1949 map.
1955	Training Facilities Map	The Machine Gun Field Firing No. 1 range covers the majority of the FJFC. A smaller unlabeled range fan extends across the central portion of the FJFC.
1956	Training Facilities Map NR 2	The Machine Gun Field Firing Range NR 1 intersects the majority of the FJFC (same as 1955 map). The smaller unlabeled range fan shown on the 1955 map is also shown on the 1956 map.
1957	Basic Information for Master Plan Map	The Technique of Rifle Fire w/ Distrib. range fan covers the northern and eastern portions of the FJFC. The M-1 Night Firing range overlaps the Technique of Rifle Fire w/ Distrib. range and covers the southern and eastern portions of the FJFC. The Technique of Rifle Fire w/ Distrib. range is to the north of the M-1 Night Firing range and has a wider fan.
1969	Master Plan Map	Three range fans are shown that intersect the FJFC. The two northern range fans are labeled Technique of Rifle Fire Range Salerno. The southern-most range fan is labeled Night Fire and Vision Range Saint Lo.
1993	Forestry Field Map	A shaded area in the northeastern portion of the FJFC is labeled “M79+40mm”. The legend identifies this area as “previous duds believed to have been cleared”.

4.2.3 Weston Lake Area Ranges/Sites

The Weston Lake Area, located in the south-central portion of the installation, contains four closed ranges that were identified in the CTT Range Inventory (i.e., the Mortar Range, Hand Grenade Court No. 2, Rifle Grenade Range NR 2, and Submachine Gun Area). Due to a change of the operational range boundary, two of these sites (Hand Grenade Court No. 2 and Rifle Grenade Range NR 2) were determined to not be eligible for evaluation as part of the Fort Jackson SI. The findings and modifications based on information obtained during the HRR, including additional munitions types identified and acreage changes, are presented in the following subsections. Map 4-8 shows the Weston Lake Area range details. Map 4-10 shows the differences in the CTT Range Inventory and HRR range locations. Map 4-11 shows the Weston Lake Area MMRP sites.

4.2.3.1 Mortar Range

The 306-acre Mortar Range is located in the northern section of the Weston Lake Area, north of the Hand Grenade Court No. 2 and west of the Submachine Gun Area. According to the CTT Range Inventory, this area (identified as Mortar Range No. 8) was a buffer (safety) area for a mortar range that was used in the 1940s. The CTT Range Inventory also indicated that other ranges overlapped this area, including 8-inch, 105-mm, and 155-mm Howitzer ranges. The Submachine Gun Area also overlapped the Mortar Range. For acreage reporting purposes, the CTT Range Inventory depicted the Mortar Range and the Submachine Gun Area as a contiguous area divided in half, with the west side designated as the Mortar Range (112 acres) and the east side designated the as Submachine Gun Area (101 acres). However, based on the 1955 and 1956 Training Facilities Maps, the Mortar Range actually covers both the Mortar Range and most of the Submachine Gun Area reported in the CTT Range Inventory. For the HRR, the MMRP site boundary and acreage associated with the Mortar Range was increased to encompass the entire portion of the Mortar Range in the other than operational area, where as the Submachine Gun Area was decreased to include only the area not overlapped by the Mortar Range.

The 1952 Fort Jackson Location Map shows an area labeled "MTR #8" approximately 0.3 mile west of Washington Light Infantry Road. It is assumed that this is the location of the firing points, which are in an operational area. The 1955 and 1956 Training Facilities Maps show the Mortar Range No. 8 in the same location and oriented from west to east. Additionally, the 1955 map indicates the mortar range had 12 firing points. Both training maps depict a larger range fan almost directly overlapping Mortar Range No. 8. This fan is not labeled on either map and has not been identified on other maps reviewed. The majority of the 306 acres associated with the Mortar Range identified during this HRR consist of the portion of Mortar Range No. 8 that falls within the other than operational area at the Weston Lake Area. The remainder of the former Mortar Range No. 8, including the impact area, falls within the operational area. Mortar Range No. 8 was not identified on maps prior to 1952.

The 1955 Training Facilities Map shows two additional mortar range fans, Mortar Range No. 7 and Mortar Range No. 5A, overlapping the Mortar Range. Only the farthest extents away from the firing points of these two mortar range fans overlap the Mortar Range. The 1956 Training Facilities Map shows the same overlapping range fans; however, they are not labeled. The relationship of the three mortar range fans is depicted in Figure 4-16.

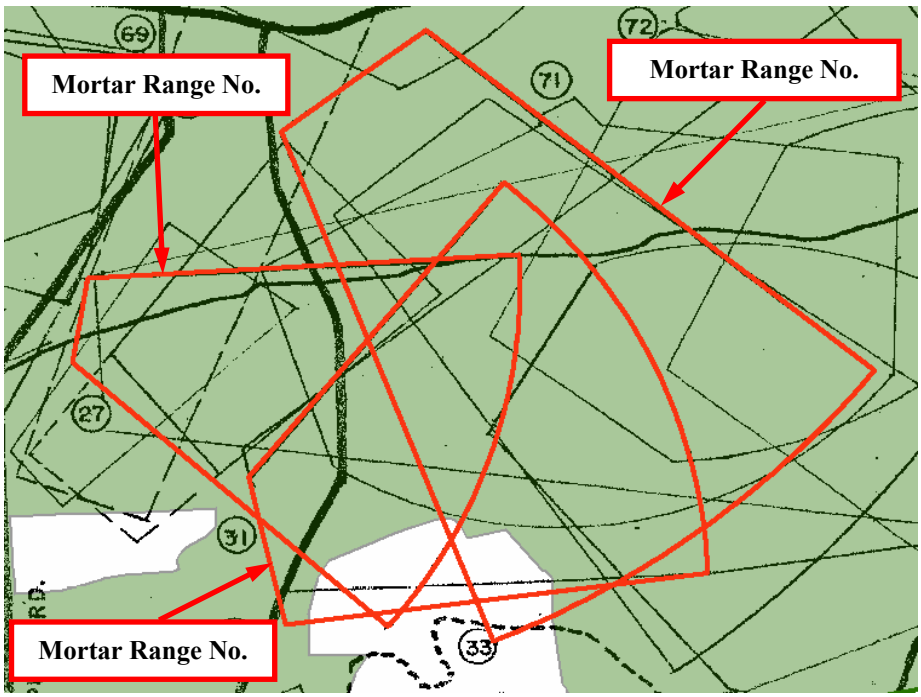


Figure 4-16: 1956 Training Facilities Map with Weston Lake Area Overlay

The 1957 Basic Information Map shows a mortar training area south of the eastern portion of the Mortar Range. However, no associated range fan was identified. The 1957 map also shows the Machine Gun Field Firing Range No. 1 and Machine Gun Field Firing Range No. 2 overlapping the eastern portion of the Mortar Range. These two ranges originate southeast of the Mortar Range, and only the surface danger zones associated with these ranges overlap the Mortar Range.

The 1969 Master Plan Map shows several range fans that overlap the Mortar Range. These range fans are identified as follows: 105-mm Howitzer Position No. 5; 155-mm Howitzer Position No. 2; 155-mm Howitzer Position No. 6; 155-mm Howitzer Position No. 8; and 8-inch Howitzer Position No. 9. These range fans originate from the west and overlap the entire Mortar Range. Map 4-9 shows the Howitzer range fan configurations. According to installation personnel, even though the Howitzer range fans overlap the Mortar Range, Howitzer-associated MEC are not likely to be found on the Mortar Range or other Weston Lake Area ranges because the firing points and impact areas of the Howitzer ranges were not located on or near the Weston Lake Area ranges. Review of the 1950 Fort Jackson Range Regulations and associated map overlays indicated that the Howitzer firing positions were located west of Washington Light Infantry Road and the impact area was northeast of the Weston Lake Area. Based on historical research, Howitzer ranges were operated by range personnel so that gun crews could restrict the gun's elevation and select the amount of propellant charge to control the downrange distance and hit the targets/impact areas. Short rounds are not anticipated at the Howitzer ranges based on the standard operating procedures. Because neither the firing points nor the impact areas for the Howitzer ranges lie in the other than operational range areas, these ranges were not evaluated under this HRR.

The 1969 map also shows the Machine Gun Field Fire No. 1, Cassino Range that originates from the south and overlaps the eastern portion of the Mortar Range. The Rifle Squad in Technique of Rifle Fire Range RSTT No. 1 originates from the north and overlaps the northeastern portion of the Mortar Range. Five additional range fans overlap the eastern

portion of the Mortar Range; however, these range fans are not labeled. No other maps reviewed show these unlabeled range fans.

The 1949 Fort Jackson and Vicinity Map does not show the Mortar Range; however, it does show the Dismounted Submachine Gun Range Nos. 1 and 2 fans and the farthest extent of the Close Combat Range No. 1 fan overlapping the Mortar Range. Neither the Mortar Range nor the Close Combat Range No. 1 appears on the 1946 Annex No. 1 Firing Ranges Map. This indicates that the Mortar Range was used in the 1950's rather than the 1940s as indicated in the CTT Range Inventory.

Aerial photographs from 1949 through 1970 were reviewed for evidence of mortar training in the Weston Lake Area. The portion of the Mortar Range in the other than operational area associated with the Weston Lake Area includes the safety fan, but not the firing points or impact areas of the Mortar Range. Evidence of mortar training in the Weston Lake Area was not observed in the aerial photographs, as expected based on the area being within the safety fan. Review of historical correspondence dating back to 1941 indicates that the Weston Lake (historically Weston Pond) Area was designated as off-limits for training. Based on the historical correspondence, the area surrounding Weston Lake has been used for recreational purposes since the 1940s.

4.2.3.2 Hand Grenade Court No. 2

The 18-acre Hand Grenade Court No. 2 is located in the northern portion of the Weston Lake Area, south of the Mortar Range. The CTT Range Inventory estimated that the period of use for this range was from 1944 to 1950. The acreage associated with the Hand Grenade Court No. 2 in the CTT Range Inventory was three acres. Based on additional information obtained during the research conducted for the HRR, the acreage associated with hand grenade training was increased to 18 acres. During review of the draft HRR, additional mapping sources were identified that more accurately identified the operational range boundary. Based on this revised boundary, the Hand Grenade Court No. 2 is located within the operational range area and is not eligible for evaluation as part of the Fort Jackson SI.

The following information obtained during the HRR is included for informational purposes only.

The Hand Grenade Court No. 2 is labeled on the 1952 Fort Jackson Location Map and is shown approximately 0.6 mile south of the Mortar Range No. 8. The location of Hand Grenade Court No. 2 appears to be just on the west side of Washington Light Infantry Road, which is an operational area. No associated range fan is shown on the 1952 map. Based on the review of historical documents and aerial photographs, it appears that hand grenade training occurred on both sides of Washington Light Infantry Road. However, research performed for this HRR focused only on the other than operational area, which is east of Washington Light Infantry Road.

The 1955 Training Facilities Map shows the location of the Hand Grenade Court No. 2 with an associated range fan on the east side of Washington Light Infantry Road (Figure 4-17). The 1956 Training Facilities Map only shows the reference number associated with the Hand Grenade Court No. 2, but does not show the range location.

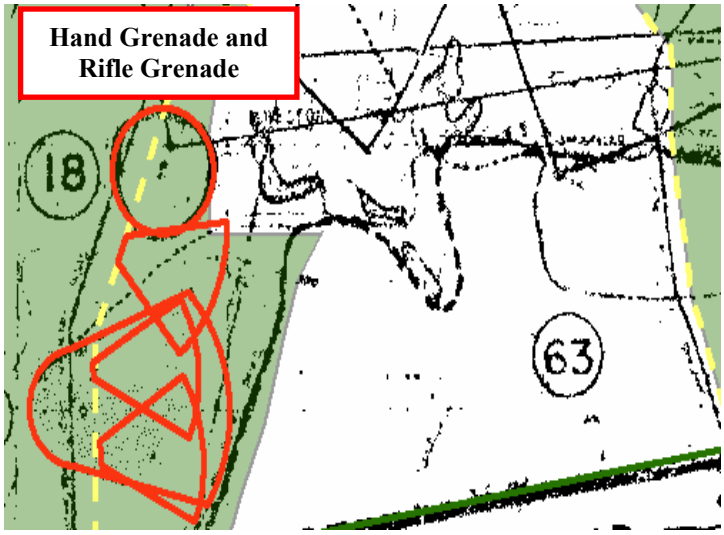


Figure 4-17: 1955 Training Facilities Map

An aerial photograph dated October 3, 1947 shows the land disturbed along the east side of Washington Light Infantry Road where rifle grenade and hand grenade training activities are assumed to have occurred. Aerial photography from March 29, 1955 shows a closer view of the same disturbed areas. A 1959 aerial photograph shows a firing line and a disturbed area that appears to be a hand grenade pit (impact area). The portion of this aerial photograph showing the Hand Grenade Court No. 2 is included as Figure 4-18. The aerial photograph confirms the use of the areas east and west of Washington Light Infantry Road for training purposes. Based on the maps and aerial photographs reviewed, it is assumed that both rifle grenades and hand grenades were used at this site.

Figure 4-18: Hand Grenade Court No. 2 shown on 1959 Aerial Photograph

4.2.3.3 Rifle Grenade Range NR 2

The 109-acre Rifle Grenade Range NR 2 is located in the southwestern portion of the Weston Lake Area. According to the CTT Range Inventory, this range was located south of the Hand Grenade Court No. 2 and was shown on several maps from the 1940s through the 1960s as a rifle grenade range. The Hand Grenade Court No. 2 is located in the northern portion of the Weston Lake Area, south of the Mortar Range. The CTT Range Inventory estimated that the period of use for the Rifle Grenade Range NR 2 was from 1944 to 1950. The acreage associated with the Rifle Grenade Range NR 2 in the CTT Range Inventory was 90 acres. Based on additional information obtained during the HRR, the acreage was increased to 109 acres to include the additional areas identified that were used in conjunction with the range. During review of the draft HRR, additional mapping sources were identified that more accurately identified the operational range boundary. Based on this revised boundary, the Rifle Grenade Range NR 2 is located within the operational range area and is not eligible

for evaluation as part of the Fort Jackson SI. The following information obtained during the HRR is included for informational purposes only.

The 1949 Fort Jackson and Vicinity Map shows three range fans identified as Hand Grenade & Rifle Grenade No. 2 (Figure 4-19). The ranges are oriented in an easterly/southeasterly direction and are located on the east side of Washington Light Infantry Road. These ranges are not shown on the 1946 Annex No. 1 Firing Ranges Map.

Figure 4-19: 1949 Fort Jackson and Vicinity Map

The Rifle Grenade Range NR 2 is shown on the 1952 Fort Jackson Location Map in approximately the same location as the 1949 map. However, the 1952 map depicts the range fan originating on the west side of Washington Light Infantry Road and extending across the road to the east. The 1955 and 1956 Training Facilities Maps also show the location of the Rifle Grenade Range NR 2 with the range fan originating on the west side of Washington Light Infantry Road. Based on review of historical maps, it appears that the administrative area of the range may have been located on the west side of Washington Light Infantry Road. This would indicate that the firing points were located on the east side of the road. The 1952, 1955, and 1956 maps show the majority of the range fan extending east of Washington Light Infantry Road. These maps do not show other ranges or range fans overlapping the Rifle Grenade Range NR 2.

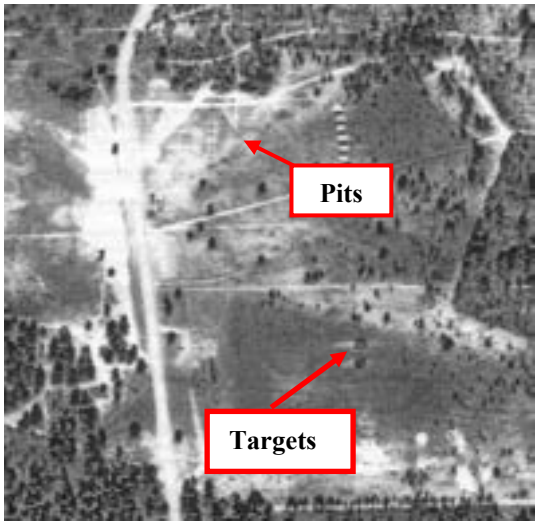


Figure 4-20: Rifle Grenade Range NR 2 shown on 1959 Aerial Photograph

Based on review of aerial photographs, two distinct training areas on the east side of the road are evident, just before the Washington Light Infantry Road turns to the northeast. Range use is visible on the east side of the road in the 1959 aerial photograph (Figure 4-20). Hand grenade pits and rifle grenade targets are visible in the photograph. Based on the information obtained for the HRR, it is assumed that both rifle and hand grenades were used at this site. The Rifle Grenade Range NR 2 is also identified on a 1993 Forestry Field Map as a "Known Dud Area".

4.2.3.4 Submachine Gun Area

The 17-acre Submachine Gun Area is located in the northern part of the Weston Lake Area. According to the CTT Range Inventory, this area is made up of three separate ranges, including the Dismounted Submachine Gun No. 1, the Moving Vehicle Submachine Gun, and the Dismounted Submachine Gun No. 2 ranges. These range fans overlap, with the direction of fire to the north/northwest into the East Impact Area. As discussed in the Mortar Range section above, the CTT Range Inventory depicted the Mortar Range and the Submachine Gun Area as a contiguous area divided in half, with the west side designated the Mortar Range (112 acres) and the east side designated the Submachine Gun Area (101 acres). However, based on the 1955 and 1956 Training Facilities Maps, the Mortar Range actually covers both the Mortar Range and the Submachine Gun Area reported in the CTT Range Inventory.

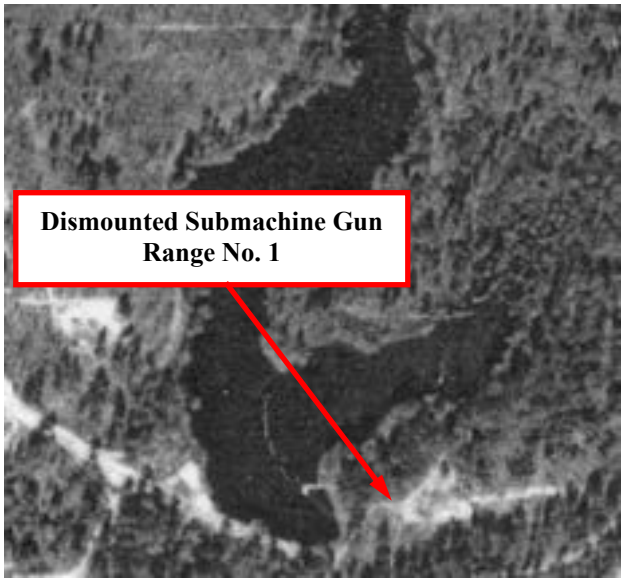


Figure 4-21: 1966 Aerial Photograph of Dismounted Submachine Gun Area

For the HRR, the Submachine Gun Area site boundary and acreage were reduced to include only the area not overlapped by the Mortar Range. As such, the acreage for the Submachine Gun Area was reduced from 101 acres to 17 acres. This area is shown on the 1966 aerial photograph included as Figure 4-21. For the HRR, aerial photography from 1949 to 1970 was also reviewed. The aerial photographs show that the Dismounted Submachine Gun Range firing points and target areas were located on a finger of land adjacent to Weston Pond. During the 1970s, the Weston Ponds were expanded to form Weston Lake. The firing points and target areas for this site are currently located on the shoreline of Weston Lake.

The 1946 Annex No. 1 Firing Ranges Map shows the Dismounted Submachine Gun No. 1 range with what appears to be firing points at three locations (two points at each of the three locations). The Dismounted Submachine Gun No. 2 range is located east of the Dismounted Submachine Gun No. 1 range and also has the same range layout. The Moving Vehicle Submachine Gun range is located between the Dismounted Submachine Gun No. 1 and No. 2 ranges. The Dismounted Submachine Gun No. 2 and the Moving Vehicle Submachine Gun range firing points are located in the operational area. However, the range fans extend into the other than operational area. According to the map, the direction of fire for all three ranges was north/northwest with the range fans covering an area from west of Washington Light Infantry Road to east of Timmonsville Guard Road.

The 1949 Fort Jackson and Vicinity Map shows the same general locations of the Dismounted Submachine Gun Nos. 1 and 2 and Moving Vehicle Submachine Gun ranges as the 1946 map; however, the range fans on the 1949 map are positioned slightly farther southwest. Additionally, the 1949 map shows the farthest extent of the Close Combat Range No. 1 fan overlapping the Submachine Gun Area.

The 1950 Fort Jackson Range Regulations include information regarding the Dismounted Submachine Gun No. 1 range. The 1949 map shows the range location, safety fan, and danger area, as described in these range regulations. Figure 4-22 shows a schematic for the range that was included in the range regulations. The range regulations state that there were three firing points located on this range. The regulations also note the type of weapons fired at the range included the M3A1 .45 caliber submachine gun and the Thompson M1928A1 .45 caliber submachine gun.

The 1957 Basic Information Map shows the Machine Gun Field Firing Range No. 1 and Machine Gun Field Firing Range No. 2 overlapping the Submachine Gun Area. Both of these ranges originate southeast of the Submachine Gun Area. The 1957 map does not show the Dismounted Submachine Gun Nos. 1 and 2 or the Moving Vehicle Submachine Gun ranges. This indicates that the ranges were no longer being used in 1957.

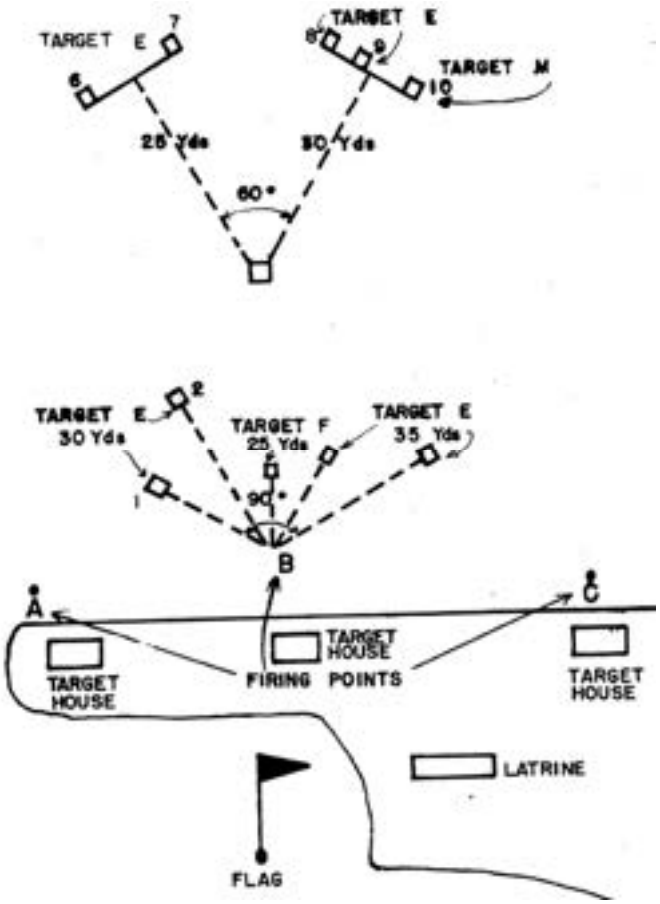


Figure 4-22: Dismounted Submachine Gun Range No. 1 Schematic Diagram

Table 4-8 summarizes the historical use and overlapping range information obtained for the Weston Lake Area ranges.

Table 4-8: Weston Lake Area Ranges Historical Use Summary

MMRP Ranges/Sites	1946 Map	1949 Map	1952 Map	1955 Map	1956 Map	1957 Map	Historical Use	Overlapping Ranges
Weston Lake Area								
Mortar Range			X	X	X		Mortar training	Submachine Gun Area, Hand Grenade Court No. 2, Howitzer Safety Fans
Hand Grenade Court No. 2		X	X	X	X		Hand/rifle grenade training	Mortar Range, Howitzer Safety Fans
Rifle Grenade Range NR 2		X	X	X	X		Hand/rifle grenade training	Howitzer Safety Fans
Submachine Gun Area	X	X					Small arms	Mortar Range, Howitzer Safety Fans

Table 4-9 provides a summary of the time-line analysis and map observations made for the Weston Lake Area ranges that are discussed in the previous sections.

Table 4-9: Weston Lake Area Map Summaries

Time Frame	Map Titles	Map Observations
1918-1926	1918 Location Map 1918 Key Map of Property 1919 General Map 1920 Special Military Map 1926 National Forest Map	No information on the Weston Lake Area MMRP sites was located on the 1918-1926 maps reviewed. In the Weston Lake Area, the installation boundary during 1918-1926 was approximately 5,000 feet north of the present boundary, so many of these locations would have been outside Camp Jackson and would not have had range use.

Time Frame	Map Titles	Map Observations
1946-1957	1946 Annex No. 1 Map 1949 Fort Jackson and Vicinity Map 1952 Location Map 1955 Training Facilities Map 1956 Training Facilities Map NR 2 1957 Basic Information Map	The ranges observed during this time frame include the following: Mortar Range No. 8, Mortar Range No. 7, Mortar Range No. 5A, Close Combat Range No. 1, Dismounted Submachine Gun No. 1, Dismounted Submachine Gun No. 2, Moving Vehicle Machine Gun, Rifle Grenade Range NR 2, Machine Gun Field Firing Range No. 1, and Machine Gun Field Firing Range No. 2.
1969	1969 Master Plan Map	The 1969 map does not show any of the areas identified as MMRP sites. However, the following 11 overlapping fans were identified: 105-mm Howitzer Position No. 5, 155-mm Howitzer Position No. 2, 155-mm Howitzer Position No. 6, 155-mm Howitzer Position No. 8, and 8-inch Howitzer Position No. 9, Machine Gun Field Fire No. 1 (Cassino Range), Rifle Squad in Technique of Rifle Fire Range RSTT No. 1, and five unlabeled range fans.

4.3 POTENTIAL MEC AND MC

Table 4-10 on the following page presents the potential MEC and the associated MC that are expected to be found at the Cantonment Area, FJFC, and Weston Lake Area ranges. The table includes information for each Munitions Response Site (MRS) and the associated sub areas. This information is based on the findings of the research conducted for the HRR.

Table 4-10: Summary of Potential MEC and MC

MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
***Camp Jackson Ranges* (includes 1000-Yard Range, 600-Yard Range, 300-Yard Range, Machine Gun Range, and Pistol Range)**	Firing Points/Lines Target Areas Overlapping Range Fans: Small Arms Ranges East of Chesnut Road (Transition No. 1, M-1 Transition only), and Live Hand Grenade Court 2 (overlaps the 300-Yard Range only)NR1, and Pistol Range NR2	.30-/.45-/.50-caliber	Munitions firing, potentially from the following guns: Springfield Model 1903, M1909 Revolver (.45 Colt caliber), M1917 Revolver, Enfield M1917 Rifle, Browning .30 caliber M1917 Machine Gun, Mk 2 .50 Machine Gun	None (small arms use only)	Black powder (potassium nitrate, sulfur, and charcoal) Smokeless powder (nitrocellulose, dinitrocellulose [DNT], dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Lead (Pb), Antimony (Sb), Arsenic (As), Copper (Cu), Tin (Sn), Zinc (Zn), Iron (Fe), Strontium (Sr), Magnesium (Mg), and lead styphnate/lead azide

MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
Live Hand Grenade Court 2	Impact Area Overlapping Range Fans: Camp Jackson Ranges (300-Yard Range only) and Small Arms Ranges East of Chesnut Road	Hand grenades: MK2 Fragmentation (Frag), MK II Practice, M26/61 Frag, M30/62 Practice, M48E1 Smoke, M69 Practice, M18 Smoke, M26A2 Frag, M57 Frag, M34 Smoke, M59/68 Frag	Munitions firing (throwing)	Non-functioned grenades/fuzes	Black powder (potassium nitrate, sulfur, and charcoal) Smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Composition B TNT Octol RDX White Phosphorous (WP)

MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
Small Arms Ranges East of Chesnut Road **(Includes Transition Range, Pistol Range NR 2, Landscape Target Range, and 1000-Inch Range Nos. 14, 15, 16)**	Firing Points/Lines Target Areas Overlapping Range Fans: Camp Jackson Ranges and Live Hand Grenade Court 2	.30-caliber .45-/.22-caliber	Munitions firing, potentially from the following guns: Springfield Model 1903, M1909 Revolver (Colt .45 caliber), M1917 Revolver, Enfield M1917 Rifle, M-1 Garand Rifle, M-1 Carbine, M1911 and M19111A1 .45-caliber pistol	None (small arms use only)	Black powder (potassium nitrate, sulfur, and charcoal) Smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide

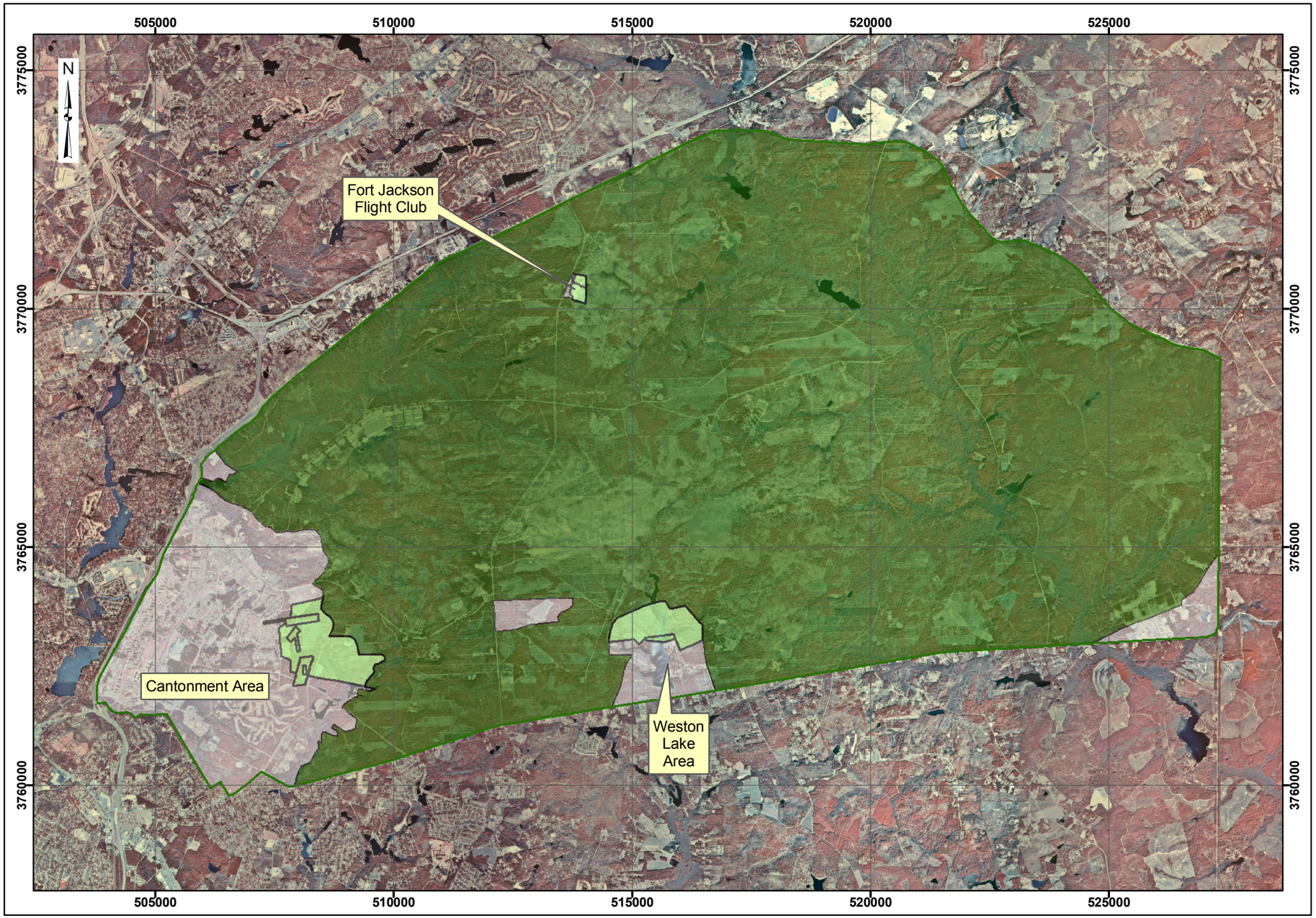
MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
FJFC Salerno Ranges	Firing lines and impact areas for the Salerno Ranges (M-72, M-79, and M18A1) Overlapping Range Area for the Field Firing Machine Gun Range NR 1, Technique of Rifle Fire Range, Night Fire and Vision Range (Saint Lo), and Salerno Range (M-60 only)	66-mm rockets, rocket grenades, 40-mm grenades, 35-mm sub-caliber rockets, M18A1 anti-personnel mines, practice grenades 30-/.50-caliber, 7.62-mm, 5.56-mm	M79 Grenade Launcher, M72 LAW, 3.5-in Rocket Launcher, M18A1 Claymore Mine Browning .30 M1917 Machine Gun, Mk 2 .50 Machine Gun M-60 Machine Gun Springfield Model 1903, Enfield M1917 Rifle, M-1 Garand Rifle, M-1 Carbine, M14 Rifle, M16 Rifle	Non-functioned ordnance, including rockets, rocket grenades, and anti-personnel mines (refer to potential munitions)	Composition B TNT Octol RDX WP C-4 Smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide

MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
FJFC Small Arms Ranges	Firing lines and target areas for the Field Firing Machine Gun Range NR 1, Technique of Rifle Fire Range, Night Fire and Vision Range (Saint Lo), and Salerno Range (M-60 only) Overlapping Range Area: Close Combat No. 2 Range	30-/.50-caliber, 7.62-mm, 5.56-mm	Browning .30 M1917 Machine Gun, Mk 2 .50 Machine Gun M-60 Machine Gun Springfield Model 1903, Enfield M1917 Rifle, M-1 Garand Rifle, M-1 Carbine, M14 Rifle, M16 Rifle	None (small arms use only)	Smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide

MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
Mortar Range	Area between the firing points and targets (safety fan) Overlapping Range Fan Area: Submachine Gun Area, Artillery Range Safety Fans, Close Combat Range, Machine Gun Ranges, Rifle Range, Hand Grenade Court No. 2	3-in stokes, 4.2-in stokes, 60-mm, and 81-mm mortar rounds .30-/.45-/.50-caliber, live and practice grenades	Mortar and Munitions firing	Non-functioned ordnance, including mortar shells and grenades	Black powder (potassium nitrate, sulfur, and charcoal) Smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide RDX Octol Illumination Mix (flare) Composition B TNT WP

MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
Submachine Gun Area	Firing points and safety fan Overlapping Range Fan Area: Artillery Range Safety Fans	.45-caliber submachine gun ammunition	Munitions firing, potentially from the following guns: M1A1 Thompson, M1928 Thompson, M3, M3A1 (grease gun)	None (small arms use only)	Black powder (potassium nitrate, sulfur, and charcoal) Smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide

Historical Records Review
Fort Jackson, SC



Map 4-1
Area Location Map

Legend

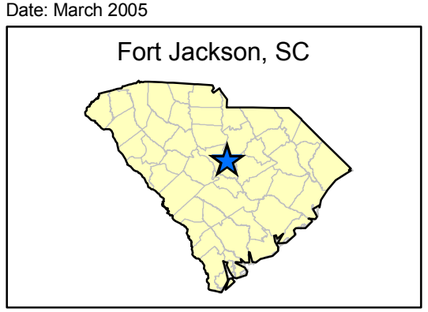
- Installation Boundary
- Operational Range Area
- MMRP Sites
- Fort Jackson Non-Range Property

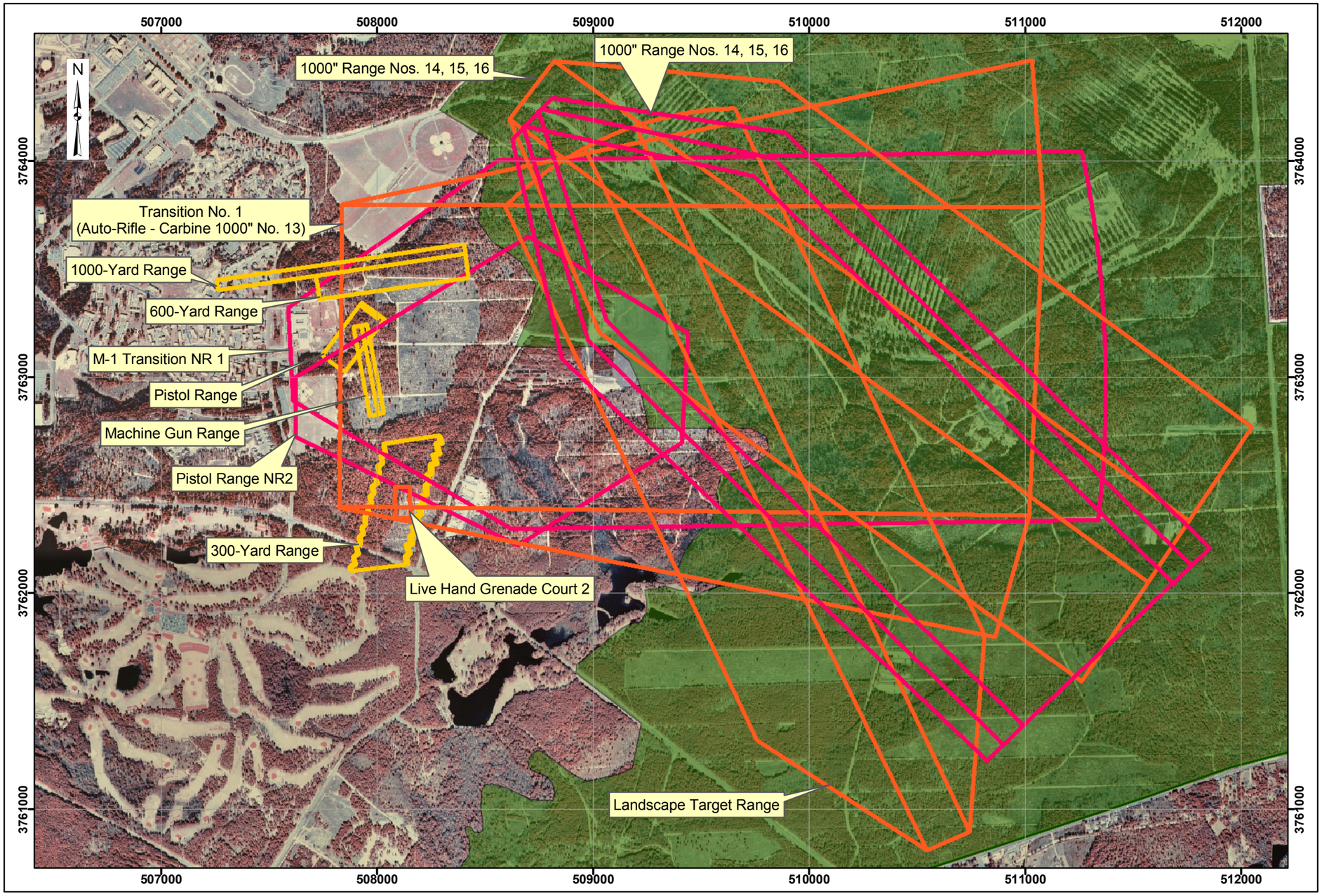
0 1 2 3 Miles

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1997
Fort Jackson South, SC, 1982
Messers Pond, SC, 1995
Congaree, SC, 1987
Leesburg, SC, 1995
Eastover, SC, 1982
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005





Historical Records Review
Fort Jackson, SC

MALCOLM PIRNIE

Map 4-2
Cantonment Area:
Range Details

Legend

- Installation Boundary
- Operational Range Area

Historical Ranges

Source Document

- 1920 Map
- 1949 Map
- 1956 Map

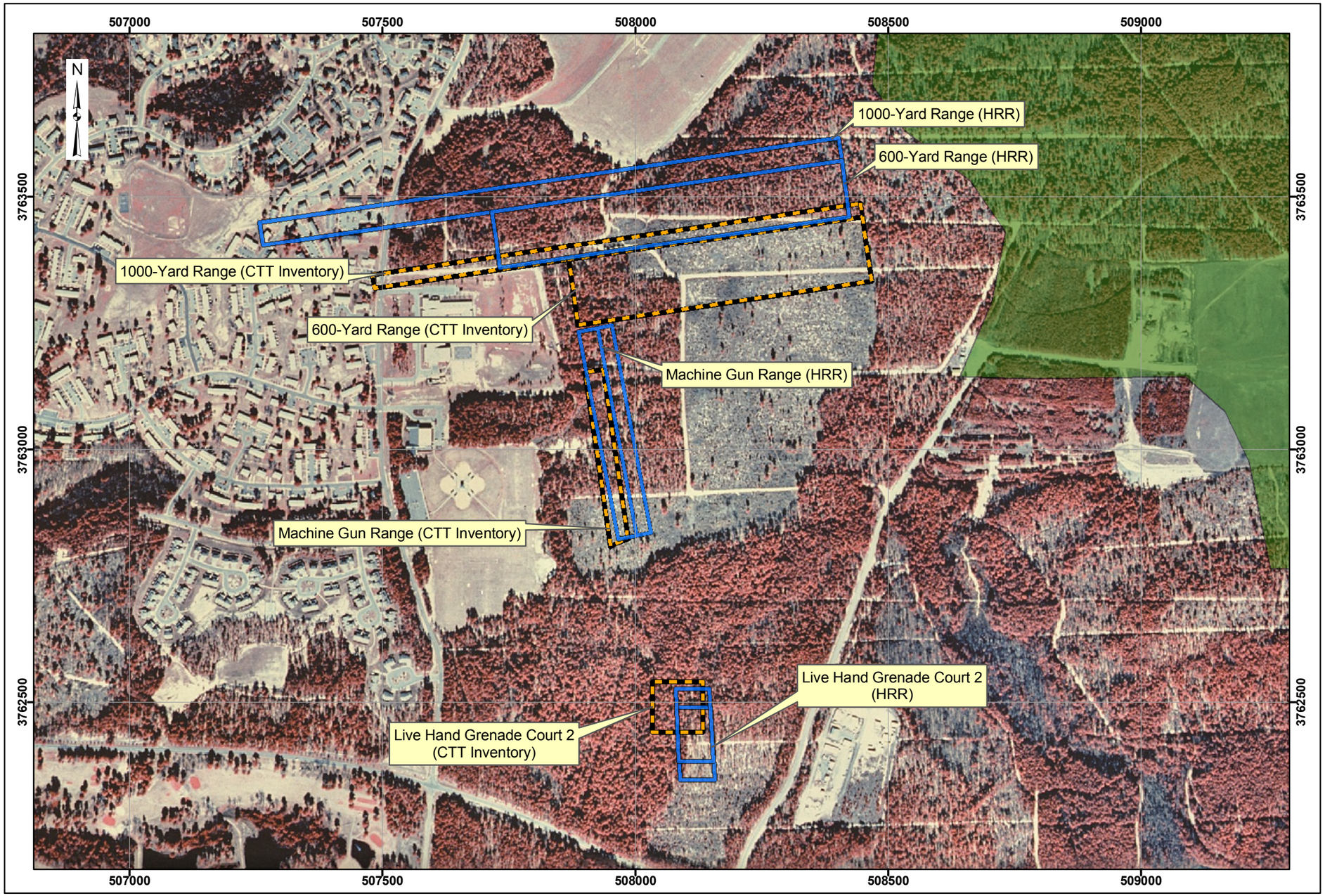
0 250 500 750 1,000 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1996
Fort Jackson South, SC, 1996
Congaree, SC, 1996
Messers Pond, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

Historical Records Review
Fort Jackson, SC



Map 4-3
Cantonment Area:
CTT Range Inventory as compared to
Historical Records Review (HRR)

Legend

- Operational Range Area
- Range Boundary (CTT Range Inventory)
- Range Boundary (HRR)

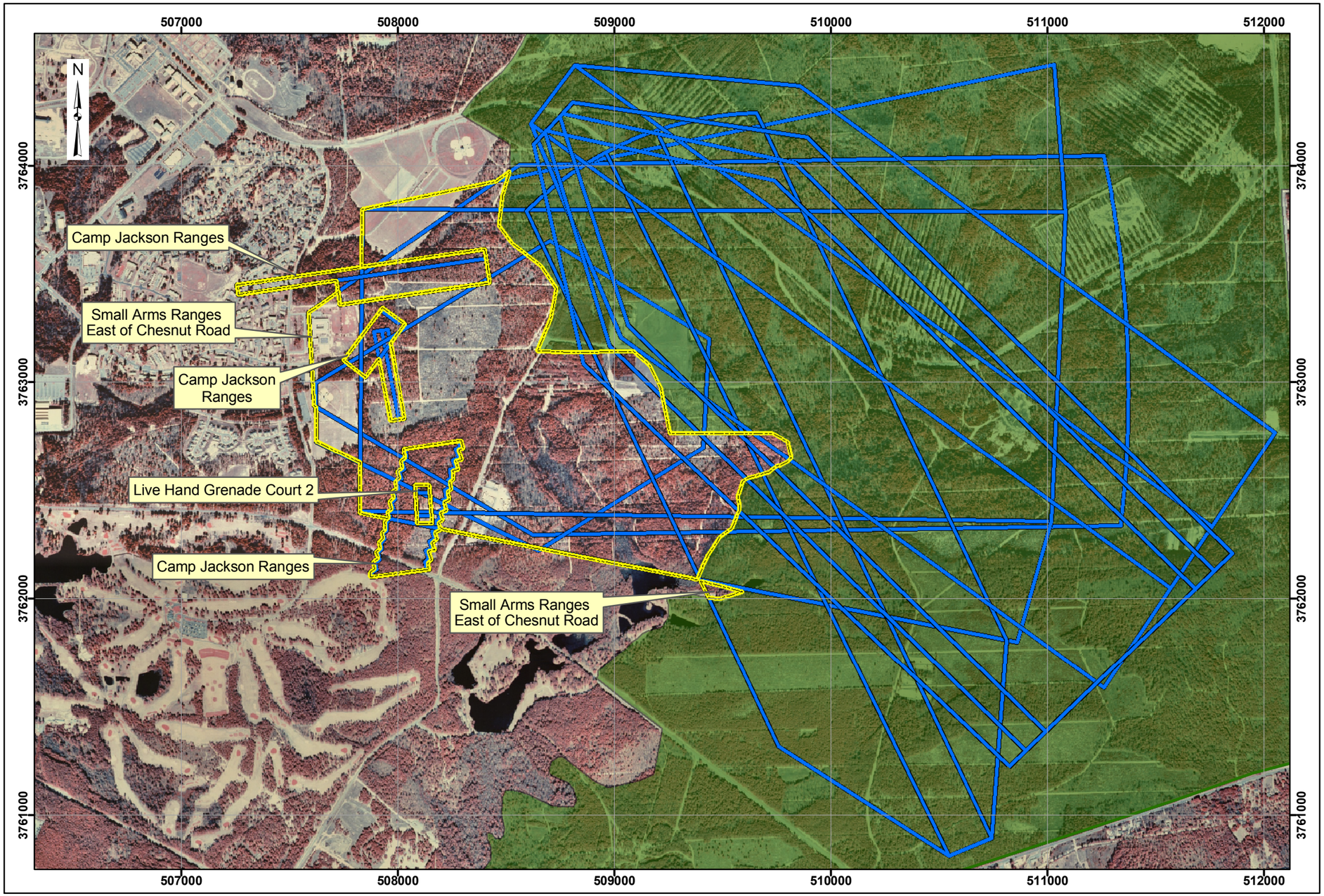
0 100 200 300 400 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

Historical Records Review
Fort Jackson, SC



Map 4-4
Cantonment Area:
MMRP Sites

Legend

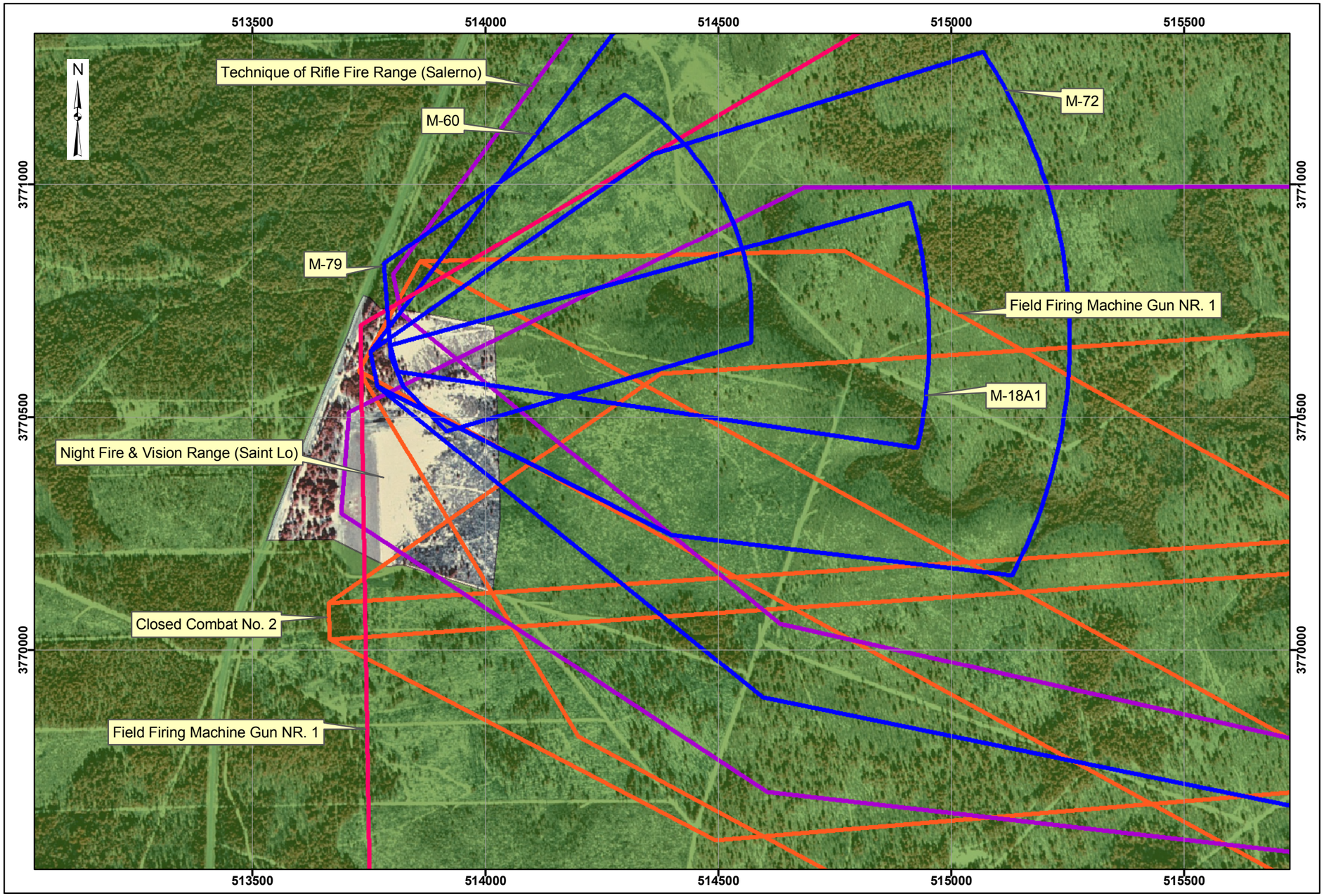
- Installation Boundary
- Operational Range Area
- MMRP Sites
- Historical Ranges

0 250 500 750 1,000 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1996
Fort Jackson South, SC, 1996
Messers Pond, SC, 1996
Congaree, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005



Historical Records Review
Fort Jackson, SC

MALCOLM PIRNIE

Map 4-5
Fort Jackson Flight Club:
Range Details

Legend

Operational Range Area

Historical Ranges

Source Document

- 1949 Map
- 1956 Map
- 1969 Map
- Salerno Demonstration Overlay

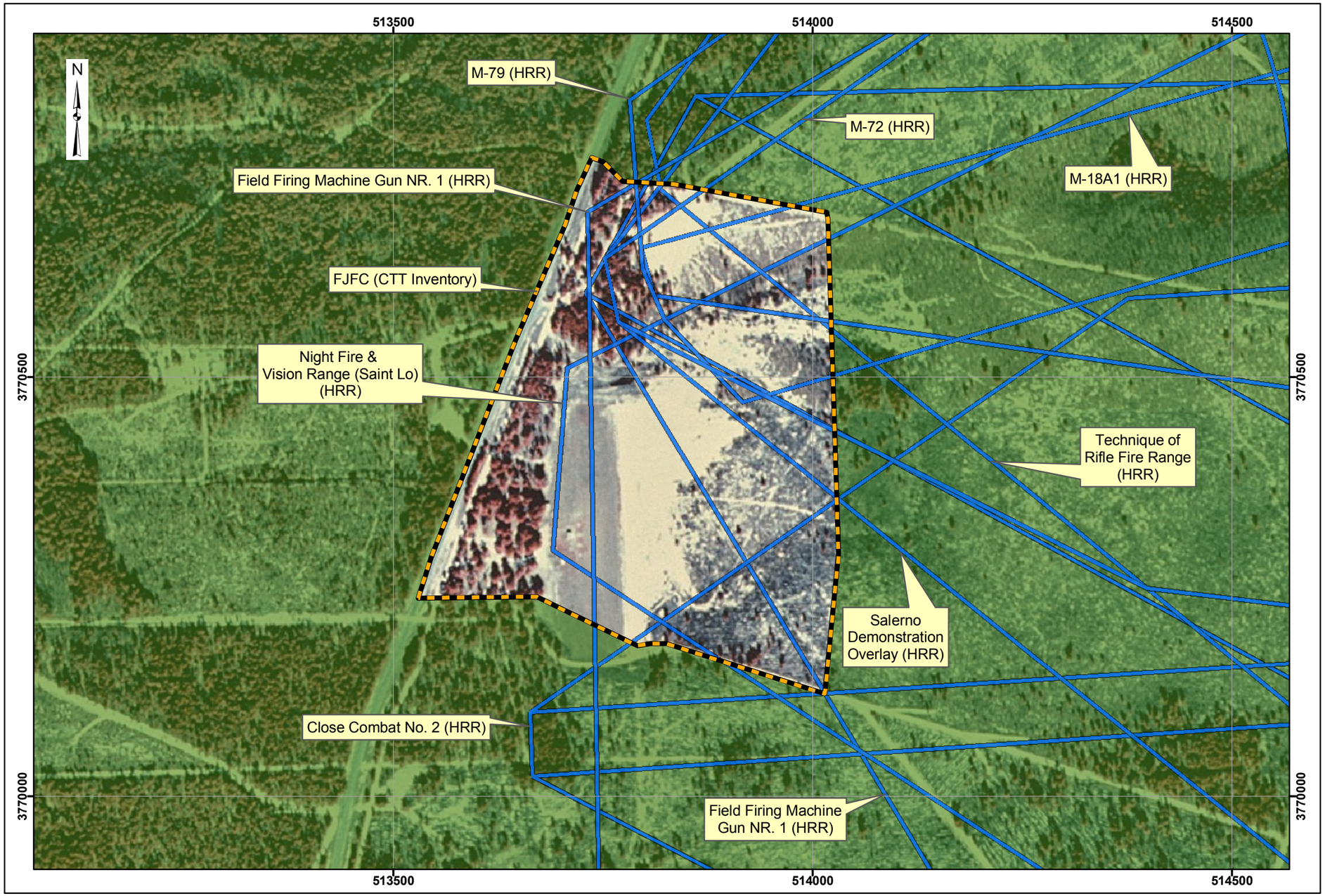
0 100 200 300 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

Historical Records Review
Fort Jackson, SC



MALCOLM PIRNIE

Map 4-6
Fort Jackson Flight Club:
CTT Range Inventory as compared to Historical Records Review (HRR)

Legend

- Operational Range Area
- Range Boundary (CTT Range Inventory)
- Range Boundary (HRR)

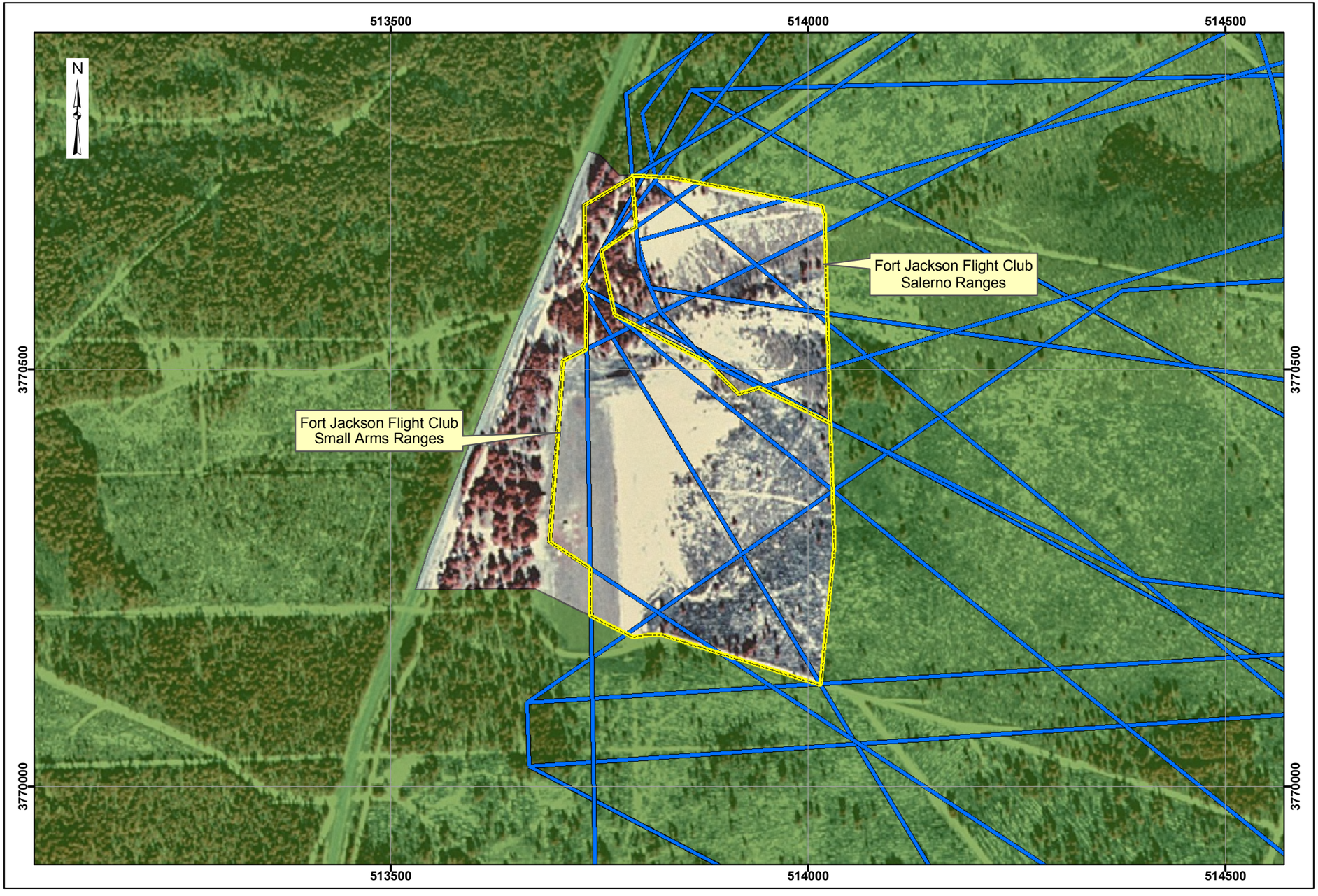
0 100 200 300 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

Historical Records Review
Fort Jackson, SC



Map 4-7
Fort Jackson Flight Club:
MMRP Sites

Legend

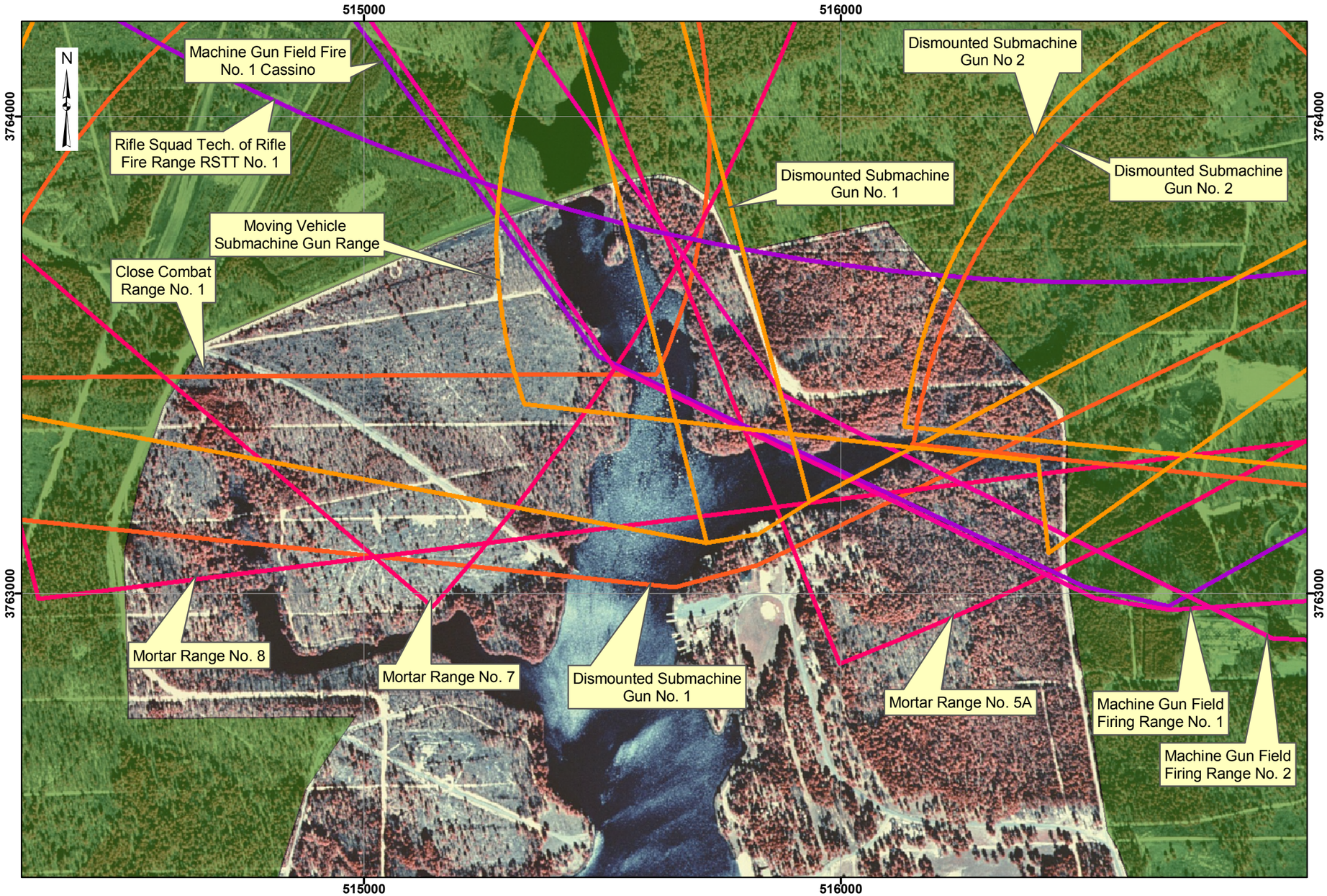
- Operational Range Area
- MMRP Sites
- Historical Ranges

0 100 200 300 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005



Historical Records Review
Fort Jackson, SC

MALCOLM PIRNIE

Map 4-8
Weston Lake Area:
Range Details

Legend

Operational Range Area

Historical Ranges

Source Document

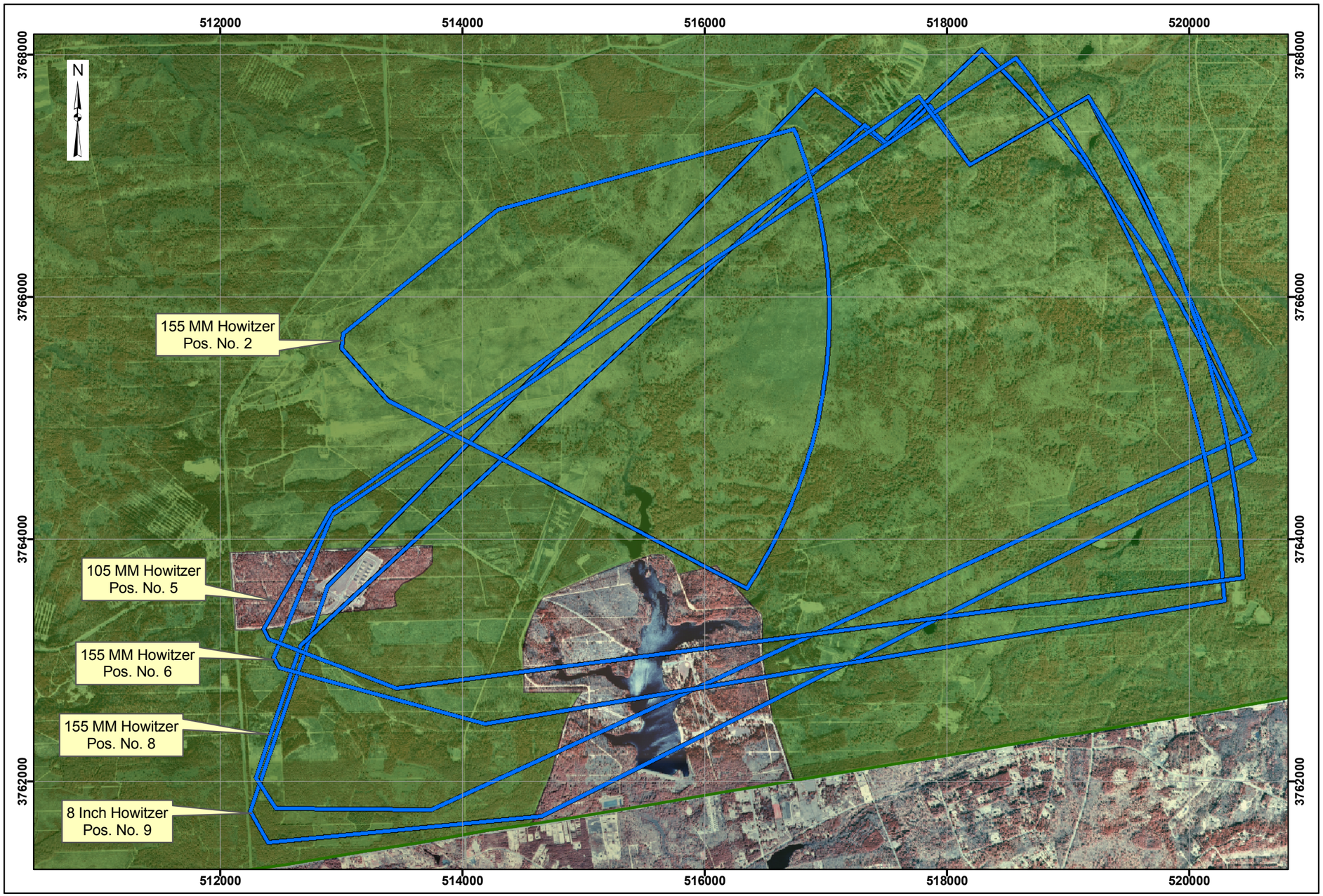
- 1946 Map
- 1949 Map
- 1956 Map
- 1957 Map
- 1969 Map

0 100 200 300 400 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Congaree, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005



Historical Records Review
Fort Jackson, SC

MALCOLM PIRNIE

Map 4-9
Weston Lake Area:
Howitzer Range Details

Legend

- Installation Boundary
- Operational Range Area

Historical Ranges

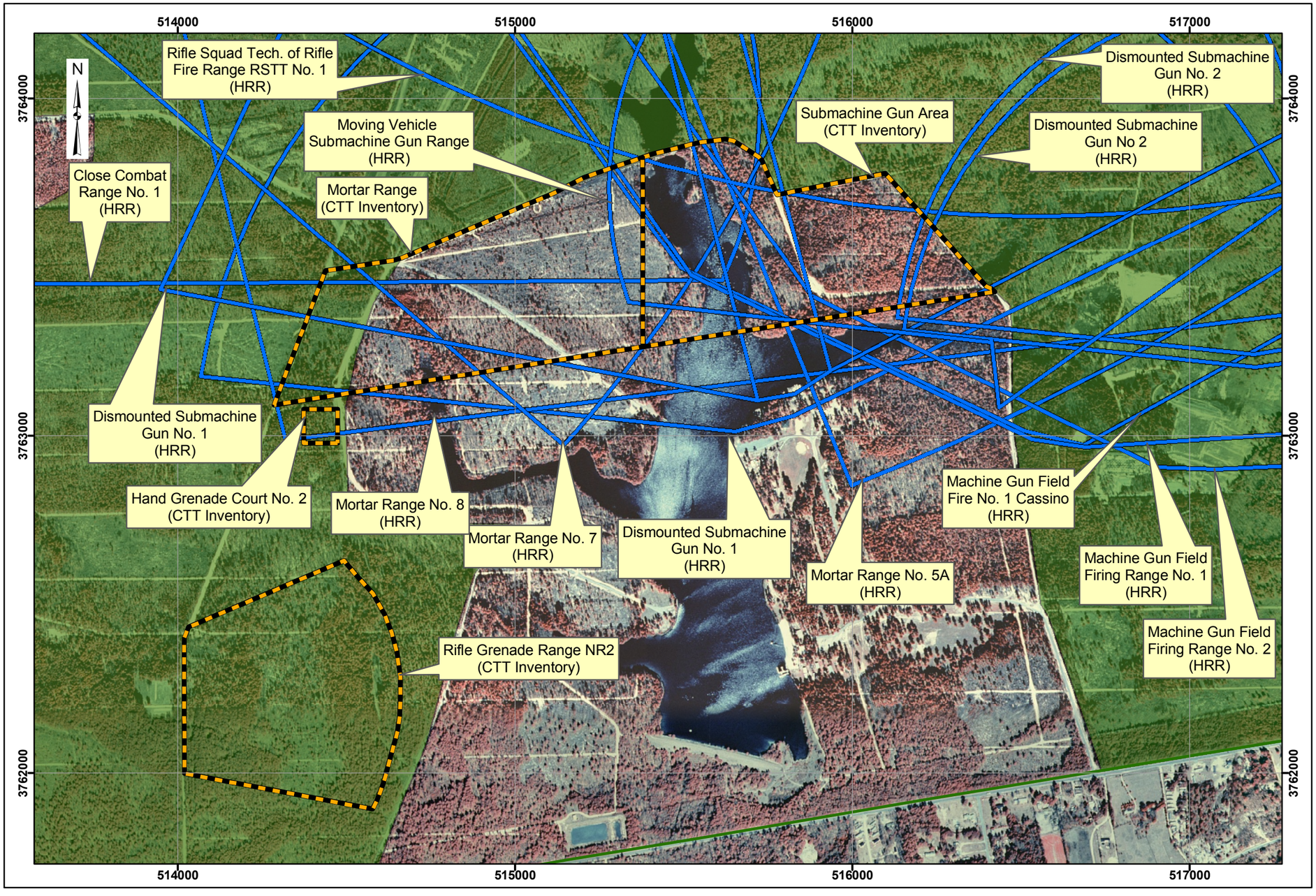
- Howitzer Ranges

0 500 1,000 1,500 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Fort Jackson North, SC, 1996
Congaree, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005



Historical Records Review
Fort Jackson, SC

MALCOLM PIRNIE

Map 4-10
Weston Lake Area:
CTT Range Inventory as compared to Historical Records Review (HRR)

Legend

- Installation Boundary
- Operational Range Area
- Range Boundary (CTT Range Inventory)
- Range Boundary (HRR)

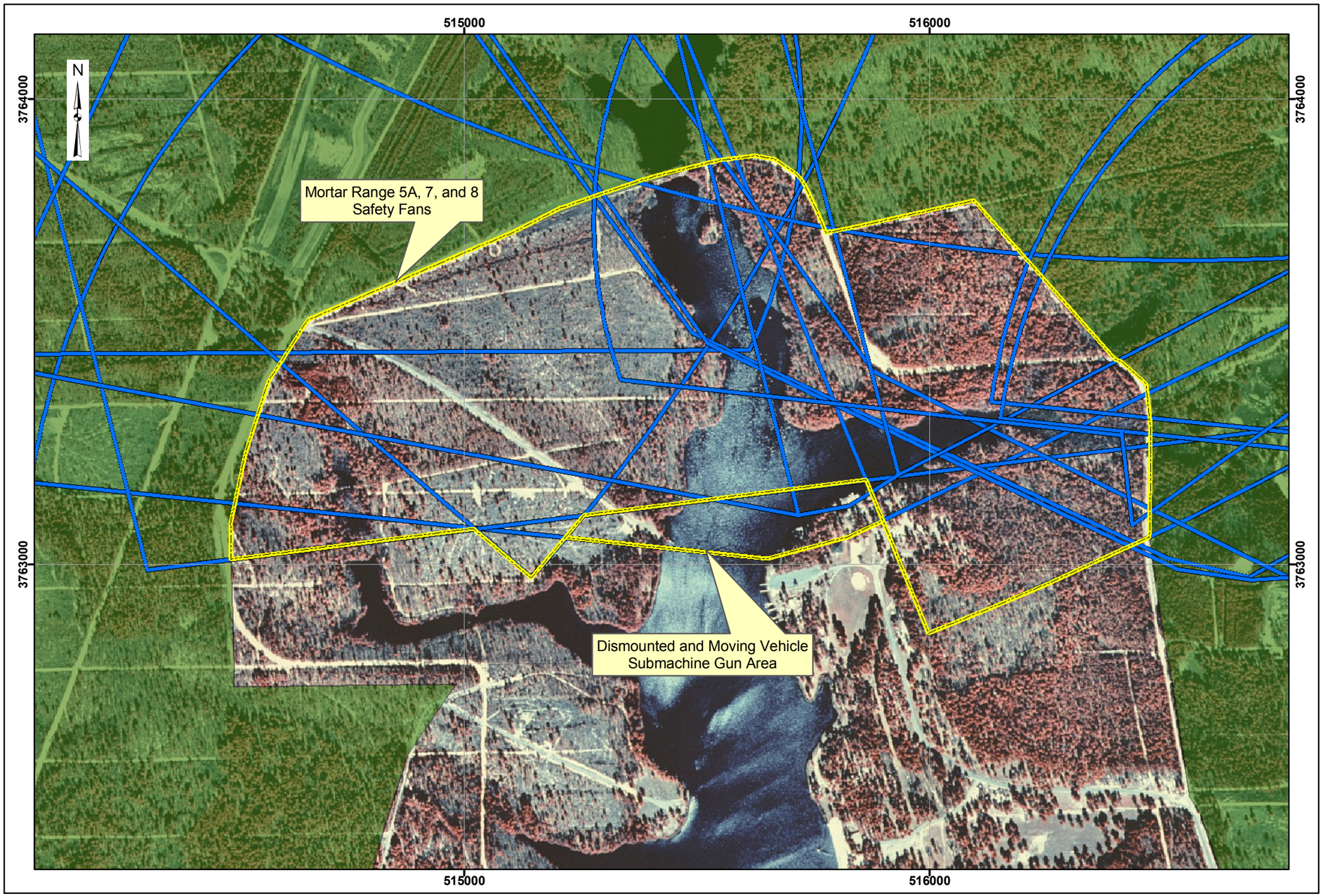
0 200 400 600 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Congaree, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

Historical Records Review
Fort Jackson, SC



Map 4-11
Weston Lake Area:
MMRP Sites

Legend

- Operational Range Area
- MMRP Sites
- Historical Ranges

0 100 200 300 400 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Congaree, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

5 CONCEPTUAL SITE MODEL

5.1 CANTONMENT AREA RANGES/SITES

5.1.1 MMRP Site Profile

5.1.1.1 Area and Layout

The cantonment area is located on the western portion of the installation. A total of 10 ranges located within the cantonment area are evaluated in this HRR. Four of these ranges were identified in the CTT Range Inventory (1000- and 600-Yard Ranges, Machine Gun Range, and the Live Hand Grenade Court 2). Six additional ranges were identified during the preparation of this HRR. Based on geographical location and period of use, the cantonment area ranges have been grouped into the following three MMRP sites: Camp Jackson Ranges, Small Arms Ranges East of Chesnut Road, and the Live Hand Grenade Court 2.

The Camp Jackson Ranges comprise 81 acres and consist of the 1000-Yard Range, 600-Yard Range, 300-Yard Range, Machine Gun Range, and Pistol Range. The Small Arms Ranges East of Chesnut Road occupy 546 acres and consist of the Transition Range; 1000-Inch Range Nos. 14, 15, 16; Pistol Range NR 2; and the Landscape Target Range. The Live Hand Grenade Court No. 2 covers 3 acres.

Geographical features of the Camp Jackson Ranges are as follows:

- The 1000-Yard Range is located just northeast of the center of the cantonment area in between Hartsville Guards Road and Semmes Road. The 1000-Yard Range is long, narrow, and rectangular-shaped and runs in an east-west direction.

- The 600-Yard Range is located immediately south of the 1000-Yard Range. The 600-Yard Range is also rectangular in shape, but is not as narrow as the 1000-Yard Range. The long axis of the range is also oriented in an east-west direction.

- The 300-Yard Range is located on the eastern portion of the cantonment area, south of the 1000- and 600-Yard Ranges and east of the Machine Gun Range. The 300-Yard Range is generally trapezoidal in shape and is oriented in a general north-south direction.

- The Machine Gun Range is located south of the 1000- and 600-Yard Ranges and east of Chesnut Road. The Machine Gun Range has a narrow rectangular shape and is oriented with its long axis in a north-south direction.

- The Pistol Range is located east of Chesnut Road. The range is rectangular in shape and is generally orientated in a southwest-northeast direction.

The Camp Jackson Ranges cover 81 acres in the cantonment area. All of the Camp Jackson Ranges were used for small arms training. They are not all contiguous. The 1000- and 600-Yard Ranges are contiguous, and the Pistol Range and Machine Gun Range overlap.

Geographical features of the Small Arms Ranges East of Chesnut Road are as follows:

- The Transition Range is located east of Chesnut Road between Hartsville Guards Road and Semmes Road. This range is generally rectangular in shape and overlaps the majority of the 1000-Inch Range Nos. 14, 15, 16. The Transition Range is oriented in an east-west direction.

- The 1000-Inch Range Nos. 14, 15, 16 is located southeast of Golden Arrow Road and along the northeast side of Hartsville Guards Road. The range is generally rectangular in shape, with its range fan directed to the southeast.

- The Pistol Range NR 2 is located southwest of the Machine Gun Range. The range is generally rectangular in shape, with its range fan directed to the east.

- The Landscape Target Range is located near the southeastern portion of the cantonment area. The firing direction for this range is northwesterly, and the

Transition Range overlaps the portions of the Landscape Target Range's fan that fall within the other than operational area.

The Small Arms Ranges East of Chesnut Road cover approximately 546 acres in the cantonment area.

The Live Hand Grenade Court 2 consists of approximately three acres and is located south of the Machine Gun Range. Based on historical maps, the throwing lines and trenches were oriented north and south with grenades most likely thrown east and west. The Live Hand Grenade Court 2 represents the approximate size and location of the former hand grenade court throwing lines and impact areas.

5.1.1.2 Structures

Base housing exists on the western-most portion of the 1000-Yard Range. The remaining area of the former 1000-Yard Range, the 600-Yard Range, the 300-Yard Range, and the Live Hand Grenade Court 2 and their immediate surrounding areas are undeveloped. The former Machine Gun and Pistol Ranges are located just west of a school; however, the area of the Machine Gun Range is undeveloped. The southwestern portion of the Pistol Range appears to overlap portions of the schoolyard. The majority of the Transition Range and the 1000-Inch Range Nos. 14, 15, 16 are undeveloped; however, it appears that a recreational area, which consists of a baseball field, football field, and a youth sports center, is located near the western portion of the former Transition Range. A school is located north of the recreational area and could also be located on portions of the former Transition Range.

5.1.1.3 Utilities

A school, base housing, and Chesnut Road are located in close proximity to the western boundaries of the following former ranges: 1000- and 600-Yard Ranges, Pistol Range, Machine Gun Range, Transition Range, and Pistol Range NR 2. The 1000-Yard Range has power lines on portions of it. The school area (which contains overhead electrical lines) and associated recreational area may also be located on portions of the former Transition Range.

Additionally, the Live Hand Grenade Court 2 area is located off of Chesnut Road, which is close to the Pierce Terrace base housing complex. There is potential that underground utilities could exist on range areas that are located in close proximity to cantonment facilities. It has not been determined whether there are utilities located in the area of the 1000-Inch Range Nos. 14, 15, 16.

5.1.1.4 Boundaries

Table 5-1 displays the boundaries of the MMRP sites in the cantonment area.

Table 5-1: Cantonment MMRP Site Boundaries

MMRP Site	Range	Western Boundary	Eastern Boundary	Northern Boundary	Southern Boundary
Camp Jackson Ranges	1000-Yard Range	Undeveloped land	Undeveloped land	Undeveloped land	School, recreational facility, 600-Yard Range
	600-Yard Range	Undeveloped land	Undeveloped land	School, recreational facility, 1000-Yard Range	Undeveloped land
	300-Yard Range	Undeveloped land	Undeveloped land	Undeveloped land	Undeveloped land
	Machine Gun Range	Undeveloped land	Undeveloped land	Undeveloped land	Undeveloped land
	Pistol Range	Undeveloped land	Undeveloped land	Undeveloped land	Undeveloped land
Live Hand Grenade Court 2		Undeveloped land	Undeveloped land	Undeveloped land	Undeveloped land
Small Arms Ranges East of Chesnut Road	Pistol Range NR 2	Undeveloped land	Chesnut Road	Undeveloped land	Undeveloped land
	1000-Inch Range Nos. 14,15,16	Undeveloped land	Undeveloped land	Undeveloped land	Undeveloped land
	Transition Range	School, recreational facility, Chesnut Road, and base housing	Undeveloped land	Undeveloped land	Undeveloped land
	Landscape Target Range	Undeveloped land	Undeveloped land	Undeveloped land	Just north of installation boundary

5.1.1.5 Security

The cantonment area MMRP sites are located within the boundaries of the Fort Jackson installation. The majority of the cantonment area has been enclosed by security fencing and access is controlled at guarded gates. Outside the fenced area, access is limited by gates and/or roadblocks on all roads leading into the installation. Access to the installation is restricted to Army personnel, authorized civilian personnel, contractors, and visitors. Security personnel routinely patrol the cantonment area by vehicle. The individual ranges within the cantonment area ranges are not fenced.

5.1.2 Physical Profile

5.1.2.1 Climate

Fort Jackson is in a humid continental area. Predominant climatic factors are the installation's location in the lower latitudes and its proximity to the Appalachian Mountains to the west, which block the approach of unseasonable cold weather in winter. This southern temperate region can experience temperatures ranging from below freezing to greater than 100 degrees Fahrenheit (ºF); however, there is a relatively narrow annual temperature range, from a mean daily temperature of 81ºF in July to 44ºF in January.

The Bermuda high, a semi-permanent high pressure cell centered in the Atlantic Ocean, dominates summer weather. The influx of warm moist air from the south causes days to be hot and humid. The average high temperature in July, the hottest month of the year, is 91ºF. Temperatures greater than 90ºF are experienced an average of 66 days per year. Winters are generally mild, and January, the coldest month, has an average daily minimum temperature of about 32ºF. Temperatures below freezing are experienced an average of 61 days a year. The frost-free growing season is about 190 days, with the first frost occurring in late October and the last frost usually occurring in mid-April.

The average annual precipitation is 46 inches, with summer rains constituting 39% of annual rainfall. Average monthly rainfall for July and August is five to six inches. Minimum

amounts of rainfall occur during October and November, when monthly averages are about three inches. About every five years an ice storm occurs, severe enough to cause some timber damage. Every few years a tropical storm will cause heavy rains for two or three days. In extremely rare instances, storm winds will come inland far enough to cause damage, such as occurred during Hurricane Hugo in 1989.

5.1.2.2 Geology

Fort Jackson is on the northwestern edge of the Atlantic Coastal Plain Province, a region of low to moderate relief and gently rolling plains, known as the Sand Hills. The Fall Line, a zone that marks the boundary between younger, softer sediments of the Province and ancient, crystalline rocks of the Piedmont Province, lies about four miles west of the cantonment area.

The principal geologic formation in the Sand Hills is the Tuscaloosa Formation, which consists of marine deposits of light-colored sands and kaolin clays. Most soils at Fort Jackson are formed from sediment of the Tuscaloosa Formation. A layer of Quaternary sand terrace overlies the Tuscaloosa Formation, which`, and arkosic sands. It lies unconformably on the peneplained surface of crystalline rocks.

5.1.2.3 Topography

Gently to moderately rolling, moderately dissected high plains occupy most of Fort Jackson. Flat to gently rolling low plains characterize the extreme western portion of the installation, including a major portion of the cantonment area and the alluvial plains occupied by southwesterly flowing Gills and Mill creeks. Local relief around the valley of Gills Creek and its tributaries is generally less than 60 feet. Slopes are predominately between zero and three percent on the alluvial plains, and slopes in the cantonment area are predominately between three and eight percent.

5.1.2.4 Soil

Soils at Fort Jackson range from nearly level to strongly sloping, characteristic of the Sand Hills. Principal soil map units occurring on Fort Jackson are the Lakeland, Vaucluse-Ailey-Pelion, and Pelion-Johnston-Valcluse. The installation also has Blanton soil series and

various soil-urban land complexes. These soils are typically well drained on high plains and side slopes and poorly drained in valleys. Surface soil layers in the Sand Hills are usually sandy with predominantly loamy subsoil.

Within the cantonment area, facilities are developed on moderately well drained, fine sands, silts, and clays, which are part of various soil-urban land complexes. Pelion urban land complex is the major soil series within the cantonment. Pelion soils occur on side slopes of ridges, with typical slopes of two to 15%. Pelion soils are loamy sands, very strongly acidic with moderately slow permeability.

5.1.2.5 Hydrogeology

Groundwater is generally plentiful at Fort Jackson. The Tuscaloosa Formation, of Upper Cretaceous age, underlies Fort Jackson and is the primary source of groundwater in the area. Small quantities of groundwater may be available in alluvial deposits along major streams.

The Tuscaloosa Formation is at the surface over most of Fort Jackson. This formation lies unconformably on a peneplained surface of older, crystalline rocks. The formation consists of interbedded, generally unconsolidated, fine to coarse sand and clay, causing groundwater to occur under both unconfined and confined (i.e., artesian) conditions. Groundwater occurs under water table conditions in the upper part of the zone of saturation. At a depth of about 99-251 feet, permeable sand zones are frequently overlain by less permeable clay zones, and the groundwater exists under artesian conditions.

Groundwater in the Fort Jackson area is suitable for human consumption; water quality is considered excellent. Total dissolved solids are generally less than 50 milligrams per liter. Water standards are occasionally exceeded by slight concentrations of iron and manganese. Fort Jackson is not located within a recharge area for the sole-source aquifer. A figure from a 1997 environmental sampling report shows an active water supply well located southwest of Heise Pond and south of Semmes Road. This well is located south of the Live Hand Grenade Court No. 2 and the Transition Range. This figure also shows three active water

supply wells located just east of Weston Lake and a water supply well located in the vicinity of the FJFC.

5.1.2.6 Hydrology

Five separate watersheds receive surface water runoff from the Fort Jackson installation. These watersheds are drained by Wildcat, Gills, Colonels, Mill, and Cedar Creeks. Wildcat Creek drains most of the cantonment area of Fort Jackson and flows west, where it enters the Gills Creek drainage area just below Lake Katherine. The Gills Creek drainage area is the second largest drainage area of the installation and is in the extreme northwest corner of Fort Jackson. This creek flows south along the installation's western boundary and enters the southeast-flowing Congaree River south of Columbia. Colonels Creek is the installation's largest drainage basin and drains the entire eastern one third of Fort Jackson. Colonels Creek flows southeast and off-post, eventually discharging into the Wateree River, a tributary of the Congaree River. Mill Creek drains the southwestern portion of the installation, flows off-post, and eventually discharges into the Congaree River. Cedar Creek drains an area along the installation's southern boundary. Drainage from this area flows southward, off-post, and also eventually discharges into the Congaree River

5.1.2.7 Vegetation

The area of Fort Jackson encompasses a wide variety of vegetative site conditions ranging from bottomland hardwood communities to xeric longleaf pine communities. In general, Fort Jackson can be classified into five primary terrestrial vegetative types: pine, pine/upland hardwood, upland hardwood, bottomland hardwood, and open field. There are no grassland areas on Fort Jackson, except for a small amount in the cantonment area and alongside roads.

Vegetation on Fort Jackson is diverse and abundant. Field investigations and surveys have identified over 750 species of flora on the installation. There are no farmlands within the installation boundary. Forest cover is the principal vegetative type and may be grouped into eight major forest types: Natural Pine, Pine Plantation, Pine-Scrub Oak, Pine-Hardwood, Scrub Oak, Upland Hardwood, Bottomland Hardwood, and Hardwood-Pine.

5.1.3 Land Use and Exposure Profile

5.1.3.1 Current Land Use / Activities

The former ranges within the cantonment area consist of undeveloped forested land. Fort Jackson manages the facilities forest resources with annual timber harvests. Timber located on some of the former ranges may be cut during the annual harvest. A school and its associated recreational facilities are located within the western portion of the Transition Range.

5.1.3.2 Current Human Receptors

With the exception of the western portion of the former Transition Range, which is occupied by a school and associated recreational area, the majority of the areas within the cantonment ranges are undeveloped woodland and largely inaccessible by vehicle. Human receptors are limited to authorized installation personnel, contractors, visitors, and trespassers. School children, teachers, and school officials would be the human receptors for the areas of the western portion of the Transition Range.

5.1.3.3 Potential Future Land Use

Currently there are no plans to develop the former cantonment area ranges. Potential land use will continue to be consistent with forest management (i.e., timber harvesting).

5.1.3.4 Potential Future Human Receptors

Potential future human receptors would be limited to current use receptors, to include authorized installation personnel, contractors, visitors, and trespassers.

5.1.3.5 Zoning/Land Use Restrictions

The majority of the MMRP site land areas have a land use class of Cantonment Open Space. Some ranges, located immediately east of Chesnut Road, overlap other land use classifications. The Transition Range, the Pistol Range, and the 600-Yard Range slightly overlap a Community Facility land use class, and the western portion of the Machine Gun

Range overlaps a Housing land use class. No zoning or land use restrictions have been identified for the land areas of the ranges located in the Cantonment Open Space land use class.

5.1.3.6 Beneficial Resources

As stated previously, the area of Fort Jackson encompasses a wide variety of vegetative site conditions ranging from bottomland hardwood communities to xeric longleaf pine communities. Natural Pine and planted pine are the most important forest types on the installation, which include all pine stands regardless of species. Timber is harvested annually at Fort Jackson. The annual harvest of timber products on Fort Jackson consists of sales ranging in size from 200 to 4,000 cords.

According to the Revised Final Phase II RFI Report for the Wonsan (SWMU 12) and Inchon (SWMU 17) Explosive Ordnance Disposal Sites, a variety of mammals and birds are likely to find suitable habitat on Fort Jackson, particularly in the adult, select cut, long-leaf pine forests adjacent to the active impact areas or within the adjacent scrub-brush habitat present on the active impact and ranges. It is noted that the SWMU 12 and SWMU 17 sites are located just east of the Weston Lake Area. This document also reported that a total of 78 federal and/or state listed threatened and endangered species have been identified within Richland County. However, only three species are present at Fort Jackson: the Rough-leaved Loosestrife, Smooth Coneflower, and the Red-cockaded Woodpecker. None of these species have been identified within the cantonment area.

Additionally, groundwater is generally plentiful at Fort Jackson. The Tuscaloosa Formation, of Upper Cretaceous age, underlies Fort Jackson and is the primary source of groundwater in the area. The Tuscaloosa Formation is at the surface over most of Fort Jackson. Groundwater in the Fort Jackson area is suitable for human consumption; water quality is considered excellent. However, according to a 2003 Phase II RFI report, groundwater is not used as a potable water source at Fort Jackson. Potable water is provided to Fort Jackson by the City of Columbia.

The following discussion pertains to Fort Jackson's cultural resources. According to the INRMP, Fort Jackson has completed a number of cultural resource surveys inventorying and documenting archaeological and historical resources. About 81% of Fort Jackson has been surveyed for archaeological resources. Known NRHP eligible or potentially eligible archaeological sites have occurred in fairly discrete clusters. Remaining portions of Fort Jackson that have not been examined are located in the main cantonment area and impact areas in outlying portions of the installation. The un-surveyed portion of the main cantonment area is expected to contain archaeological resource sites, some of which may be eligible for the NRHP. However, a letter from the South Carolina State Historic Preservation Office indicated that disturbed portions of the main cantonment area do not require survey (Cantonment Area, Fort Jackson, Richland County, South Carolina, letter from the State Historic Preservation Office dated December 15, 1993).

A total of 662 archaeological sites had been identified within Fort Jackson. Most have been preliminarily determined to be ineligible for the NRHP. With exception of the 11 cemeteries recorded as archaeological sites, these resources require no further management consideration. Twelve sites are considered eligible for the NRHP. NRHP-eligible resources must be preserved in place or subjected to appropriate data recovery investigations to prevent the loss of the significant information that is present. The remaining 96 sites have been determined to be potentially eligible for the NRHP. These sites contain components of the different cultural periods identified at Fort Jackson. These resources must be preserved in place until their eligibility for listing has been determined.

Numerous surveys have reviewed the historic qualities of the 1,700 structures at Fort Jackson, most of which have been built in the last 35 years. A review of all existing and demolished structures and all previous historic structure surveys concluded that only three structures were recommended as eligible for listing in the NRHP. One of these structures was subsequently mitigated and demolished. Remaining properties exhibited little integrity and are not considered NRHP-eligible (Panamerican Consultants, Inc., 1997).

Cemeteries are associated with families, churches, or communities that were present on installation lands prior to their acquisition by the Army. Cemeteries on Fort Jackson are enclosed by fences and maintained by the Army. None of Fort Jackson's cemeteries are considered eligible for NRHP inclusion, but all are protected. For management purposes, all cemeteries are treated in the same manner as NRHP-eligible cultural resources.

Fort Jackson has no properties listed on the NRHP, no identified access routes to or sites of religious or ceremonial rites of American Indians, no properties listed as National Historic Landmarks, and no properties listed on the World Heritage List. There may be properties potentially eligible for listing on the NRHP. There are 12 archaeological sites eligible for listing on the NRHP and 96 that are potentially eligible. Two structures remain eligible for the NRHP.

5.1.3.7 Demographics

Based on figures from the 2000 U.S. Census, the population of Richland County (in 2000) was 320,677. The population of the City of Columbia, Richland's largest city, was 116,278. With respect to Fort Jackson, soldiers, civilians, retirees, and family members make up the Fort Jackson community, which continues to grow. The installation instructs an average of 35,000 soldiers in basic and advanced training each year. An additional 19,000 attend courses at the Soldier Support Institute, Chaplain Center & School, and Drill Sergeant School. Fort Jackson employs 3,900 civilians and provides services for more than 100,000 retirees and their family members.

5.1.4 Ecological Profile

5.1.4.1 Habitat Type

According to the INRMP, forest cover is the principal vegetative type on Fort Jackson. The forest types are described in Section 5.1.2.7. Forest management has the most impact on wildlife management on Fort Jackson. Silvicultural treatments modify the landscape and associated wildlife habitats. To ensure silvicultural practices are performed in a manner that positively affects wildlife, all prescriptions are forwarded through the Wildlife Office for

review and comment. Most prescriptions result in beneficial impacts to many wildlife species, but some species may be negatively impacted by the operations in the short term. The only featured species designated for forested habitats is the Red-cockaded Woodpecker.

5.1.4.2 Degree of Disturbance

Disturbance of flora and fauna within the former ranges of the cantonment area is expected to be low to moderate during annual timber harvests.

5.1.4.3 Ecological Receptors

According to the June 2000 ICRMP, compiled by Mr. Jack Wynn (Heritage Program Manager for the Chattahoochee-Oconee National Forests) and Mr. Michael Harmon (Assistant Forest Archaeologist for the National Forests in North Carolina), only one federally listed endangered animal species exists on Fort Jackson: the Red-cockaded Woodpecker (*Piciodes borealis*). The bird nests in aging (greater than 70 year old) pines, lives in family groups or clans, and inhabits park-like territories or clusters of 1,500 radii. There are about 13 active clusters and 39 inactive ones on the installation. This population is routinely monitored, and the surrounding forest managed to encourage the survival of the groups. None of the bird nests or clusters are within the cantonment area ranges discussed in this section.

There are four candidate species for listing as threatened or endangered. They are Southeastern myotis (*Myotiss austroriparius*), Rafinesques's big-eared bat (*Plecotus rrafinequii*), Loggerhead shrike (*Lanius Ludovicianus*), and Bachman's sparrow (*Aimphila aestivalis*). They may be listed later if their populations drop. There are also two federally endangered plant species, rough-leaved loosestrife (*Lysimachia asperulaefolia*) and smooth coneflower (*Echnata laevigata*). Two candidate plants for listing are also found on the installation. They are the crested fringed orchid (*Pteroglossaspis ecristata*) and Piedmont milfoil (*Myriophyllulm laxum*). Endangered species monitoring plans have been prepared for listed species and are consulted prior to any activities that might cause disruptions.

According to the INRMP, the rough-leaved loosestrife is found on the eastern edge of the East (artillery) Impact Area. The smooth coneflower has been documented adjacent to Statue of Liberty Road in Training Area 29B. Neither of the endangered plant species is located within the cantonment area.

5.1.5 Munitions/Release Profile

5.1.5.1 Munitions Types and Release Mechanisms

Table 5-2 presents a summary of the types of munitions that were either identified during the limited visual survey or are expected to exist at the former cantonment area ranges based on information collected for this HRR. The mechanisms by which the munitions were released into the environment are also presented in this table. The typical release mechanisms for the former ranges are intentional activities, such as firing into a target area, and unintentional activities, such as rounds fired falling outside the target area or rounds discarded for various reasons at the firing point. It is noted that the majority of the ranges within the cantonment area were generally used for small arms training. Map 5-1, located at the end of Section 5, shows the horizontal extent of MEC for the cantonment area ranges. Only one range, the Live Hand Grenade Court 2, has the potential for MEC. As such, the primary concern for the cantonment ranges would be associated with MC.

Table 5-2: Summary of Potential Munition Types - Cantonment Area

MMRP Site	Potential Munitions	Primary Release Mechanism
Camp Jackson Ranges	.30-/.45-/.50-caliber	Munitions firing, potentially from the following weapons: Springfield Model 1903, M1909 Revolver, M1917 Revolver, Enfield M1917 Rifle, Browning .30 caliber M1917 Machine Gun, M2 .50-caliber Machine Gun
Live Hand Grenade Court 2	Hand grenades: MK 2 Frag, MK II Practice, M26/61 Frag, M30/62 Practice, M48E1 Smoke, M69 Practice, M18 Smoke, M26A2 Frag, M57 Frag, M34 Smoke, M59/58 Frag	Munitions firing (throwing) - hand grenades

MMRP Site	Potential Munitions	Primary Release Mechanism
Small Arms Ranges East of Chesnut Road	.22-/.30-/.45- caliber	Munitions firing, potentially from the following guns: Springfield Model 1903, M1909 Revolver, M1917 Revolver Enfield M1917 Rifle, M-1 Garand Rifle, M-1 Carbine, M1911 and M19111A1 Pistol

5.1.5.2 Maximum Probable Penetration Depth

The ranges located south of Hartsville Guards Road (the Camp Jackson Ranges, Live Hand Grenade Court 2, and Small Arms Ranges East of Chesnut Road) consist of nine small arms ranges and one hand grenade range. Small arms and hand grenades do not have an associated penetration depth. These and other MC components (such as spent shell casings and residual black or smokeless powder constituents) are expected to have been directly deposited on the soils surface.

5.1.5.3 MEC Density

MEC presence in the ranges located south of Hartsville Guards Road, with the exception of the Live Hand Grenade Court 2, is not anticipated because these ranges were used for small arms training. There is potential for MEC presence in the area of the Live Hand Grenade Court 2.

5.1.5.4 MEC Scrap/Fragments

No MEC scrap or fragments were identified at the Live Hand Grenade Court 2; however, a visual reconnaissance of the entire area was not performed for this HRR.

5.1.5.5 Associated Munitions Constituents

As noted in Table 4-10, the MC associated with the cantonment area ranges include the following: black powder (potassium nitrate, sulfur, and charcoal), smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine), double based propellant (nitrocellulose and nitroglycerin), Pb, Sb, As, Cu, Zn, Fe, Mg, lead styphnate/lead azide, RDX, and WP.

5.1.5.6 Transport Mechanisms / Migration Routes

The primary transport mechanisms identified for the former cantonment area ranges include the following:

Erosion: The majority of the cantonment areas are heavily vegetated. Thunderstorms often cause local flooding during the summer months; therefore, erosion could be a factor in transporting and migrating MC contaminated soil.

Soil Disturbance: Any surface or subsurface soil disturbance can cause both the transport and migration of MEC and MC. Surface and subsurface disturbances can lead to transport and migration of MC from one environmental media to another (soil to surface or groundwater or both) through surface water runoff and erosion. Since there is potential for timber harvesting to occur in some of the cantonment areas, the potential for soil disturbance exists.

Infiltration: Based on the generally sandy soils located within the cantonment area, the potential for MC to migrate from one environmental media to another (surface to subsurface soil to groundwater) through infiltration exists.

5.1.6 Pathway Analysis

5.1.6.1 MEC

A MEC pathway analysis was prepared for the Live Hand Grenade Court No. 2 (Figure 5-1). The Live Hand Grenade Court No. 2 is located east of Chesnut Road within the southwestern portion of the Transition Range. Since there is no penetration depth associated with hand grenades, MEC in the subsurface is not anticipated. The primary exposure pathway for human and ecological receptors is handle/tread underfoot of surface MEC. The potential for complete pathways exists between surface MEC and all receptors for the Live Hand Grenade Court No. 2.

5.1.6.2 MC

Due to the numerous ranges located within the cantonment area, similar ranges were grouped together to minimize the number of MC pathway analyses models. A pathway analysis figure was created for the Live Hand Grenade Court 2, Camp Jackson Ranges, and the Small Arms Ranges East of Chestnut Road. In summary, the following MC pathway analyses were prepared:

- Live Hand Grenade Court 2 (Figure 5-2)
- Camp Jackson Ranges - 1000-Yard, 600-Yard, 300-Yard, Machine Gun, and Pistol Ranges (Figure 5-3)
- Small Arms Ranges East of Chesnut Road – Transition Range, 1000-Inch Range Nos. 14, 15, 16, Pistol NR 2, and Landscape Target Ranges (Figure 5-4)

The three MC pathway analyses for the cantonment area ranges each show a potentially complete pathway for biota for the vegetation exposure route. Biota is the only receptor expected to ingest vegetation at the sites. Crops are not grown, and domestic animals are not raised on these sites. Biota has potentially complete pathways for contact with MC impacted vegetation. All other pathways for vegetation in the food chain are expected to be incomplete.

The pathways between game/fish/prey and authorized installation personnel, contractors, and visitors are incomplete because hunting is not permitted in the cantonment area and there are no water bodies overlapped by any HRR-identified ranges. Biota has potentially complete pathways through the potential ingestion of prey that may have fed on contaminated vegetation in these areas.

Potentially complete pathways for ingestion and dermal contact exist between surface water/sediment and all receptors at these sites because there is potential for erosion to enable the migration of MC to the water bodies located at the southern portion of the cantonment area; Heises Pond and Twin Lakes.

The groundwater exposure routes are expected to be potentially complete pathways for all potential receptors since there is an active water supply well located south of Semmes Road in the southern portion of the cantonment area. However, the City of Columbia supplies Fort Jackson with potable water.

Potentially complete pathways for all exposure routes for both surface and subsurface soil exist for all receptors. Since access to and activities in these areas are not restricted, the potential for soil disturbance to occur exists. Also, the subsurface pathways would be potentially complete for biota because they may nest or burrow in these areas.

Figure 5-1: MEC Exposure Pathway Analysis - Live Hand Grenade Court 2

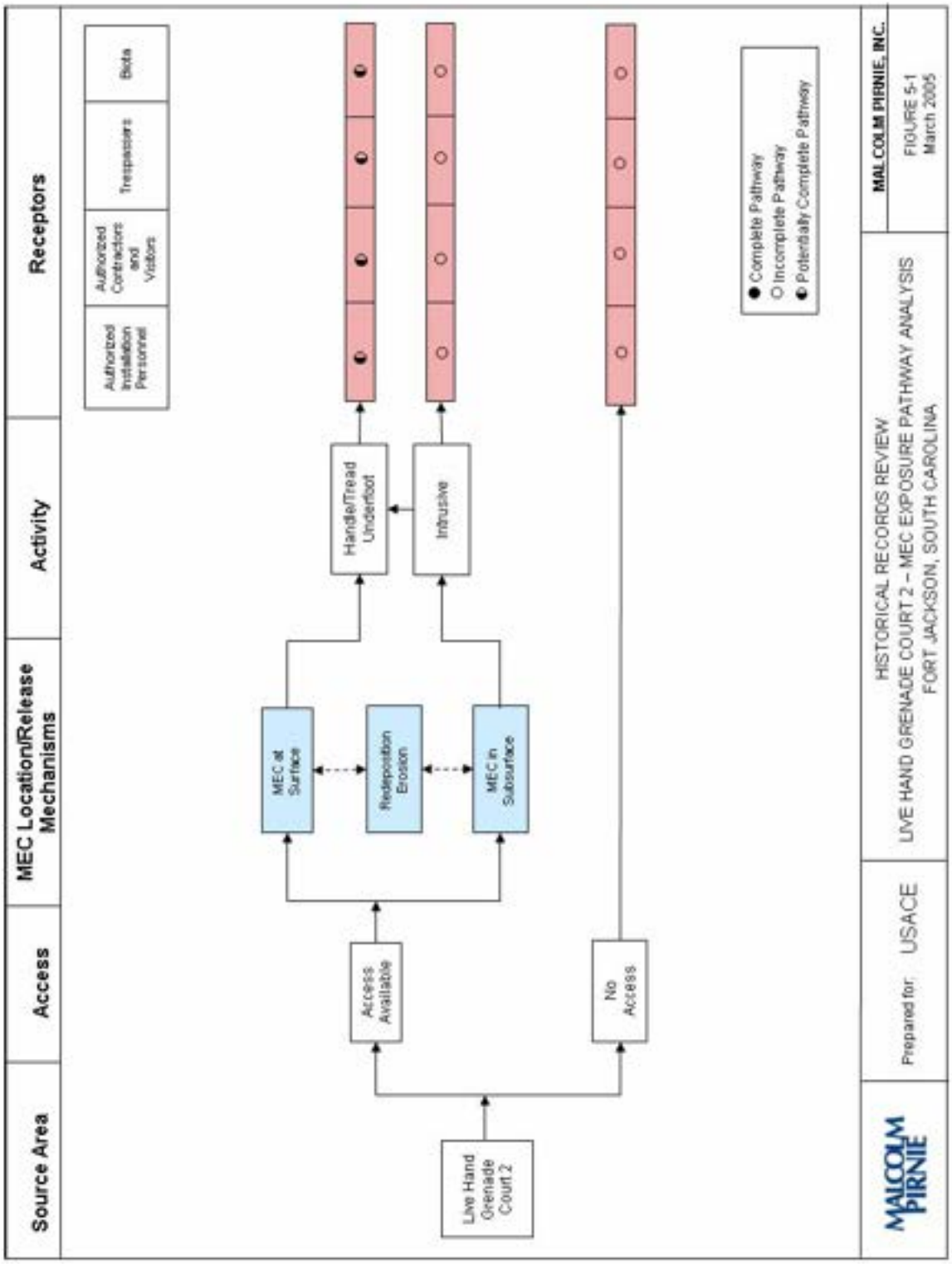


Figure 5-2: MC Exposure Pathway Analysis - Live Hand Grenade Court 2

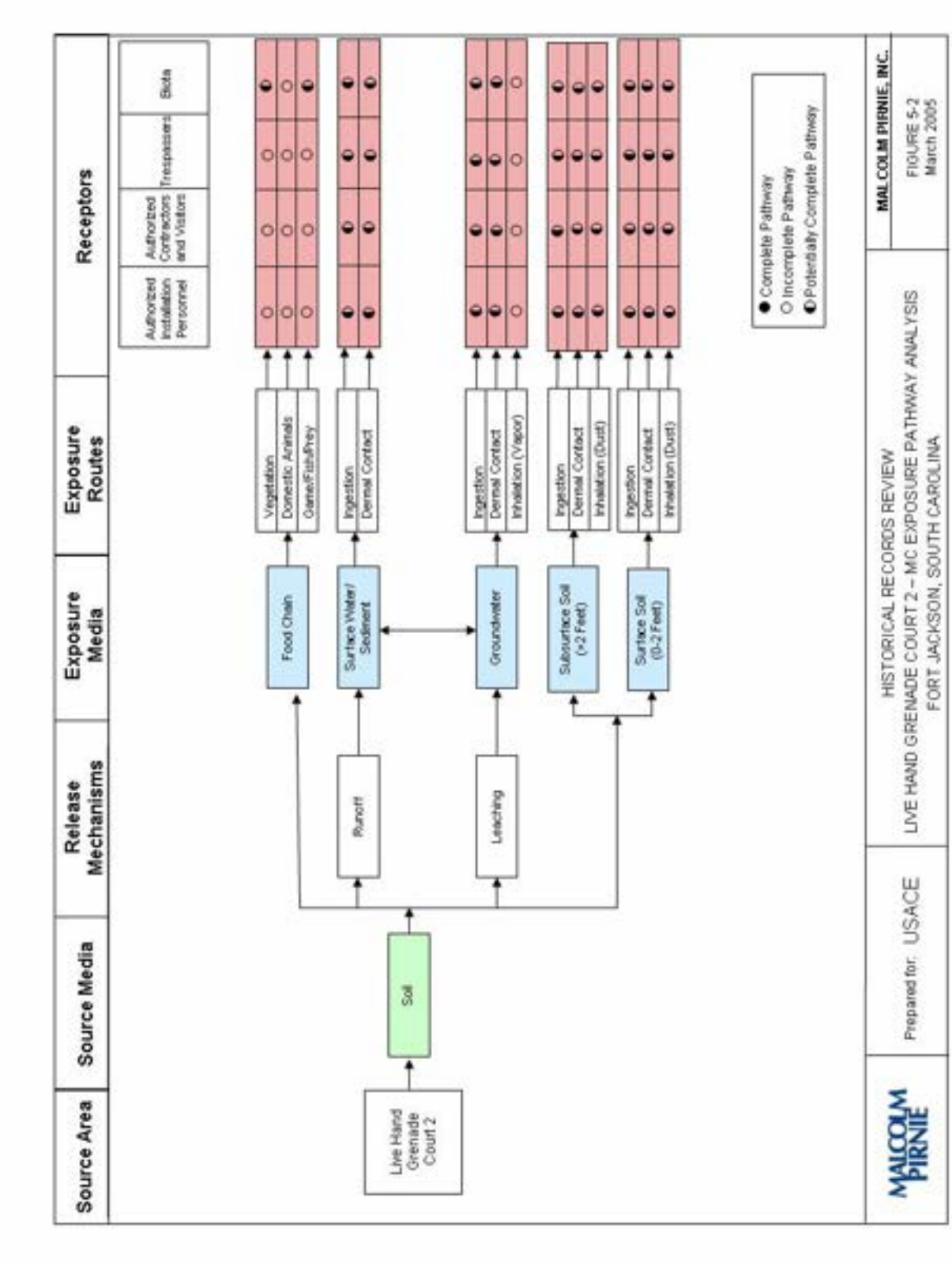


Figure 5-3: MC Exposure Pathway Analysis – Camp Jackson Ranges

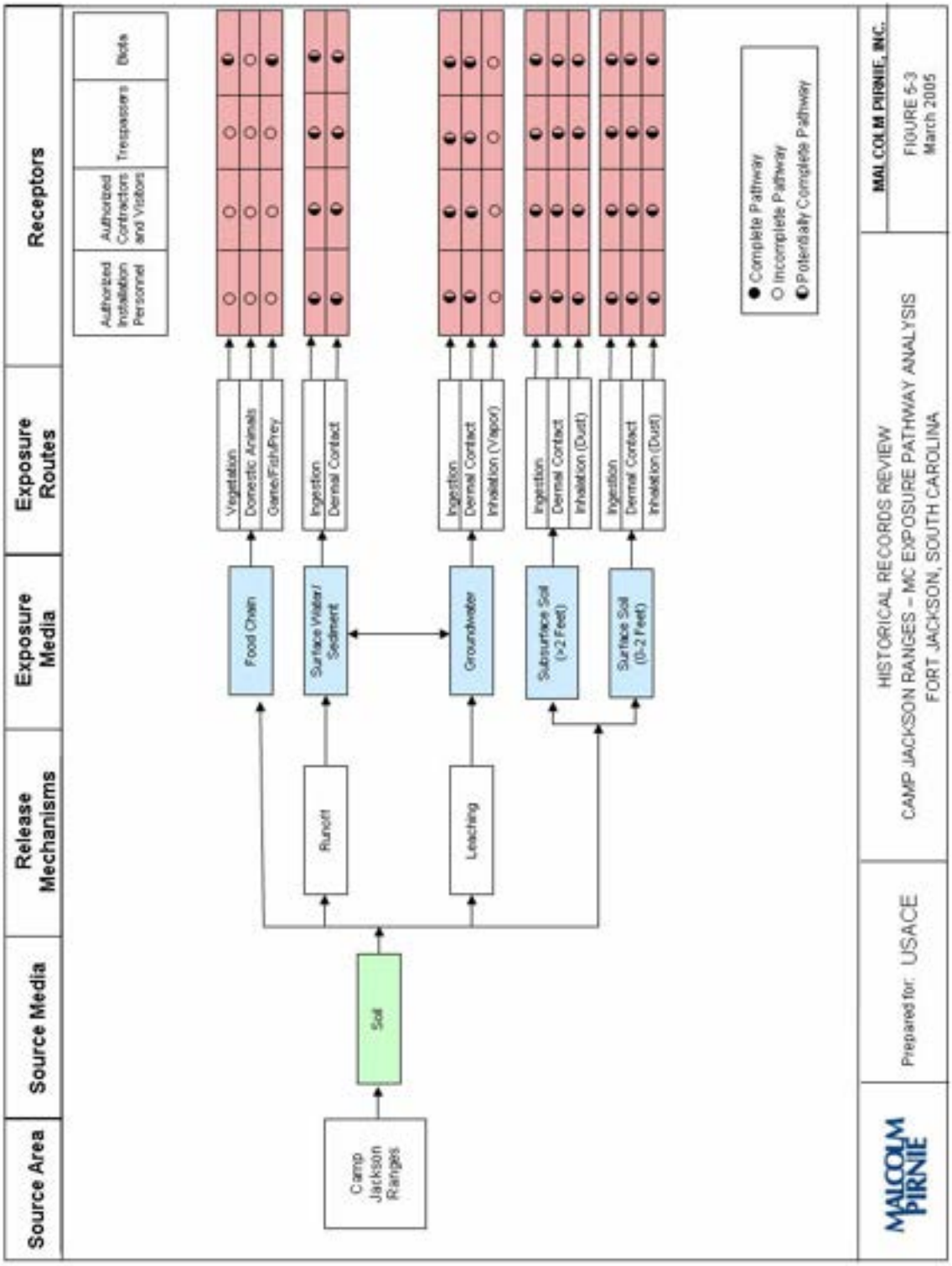
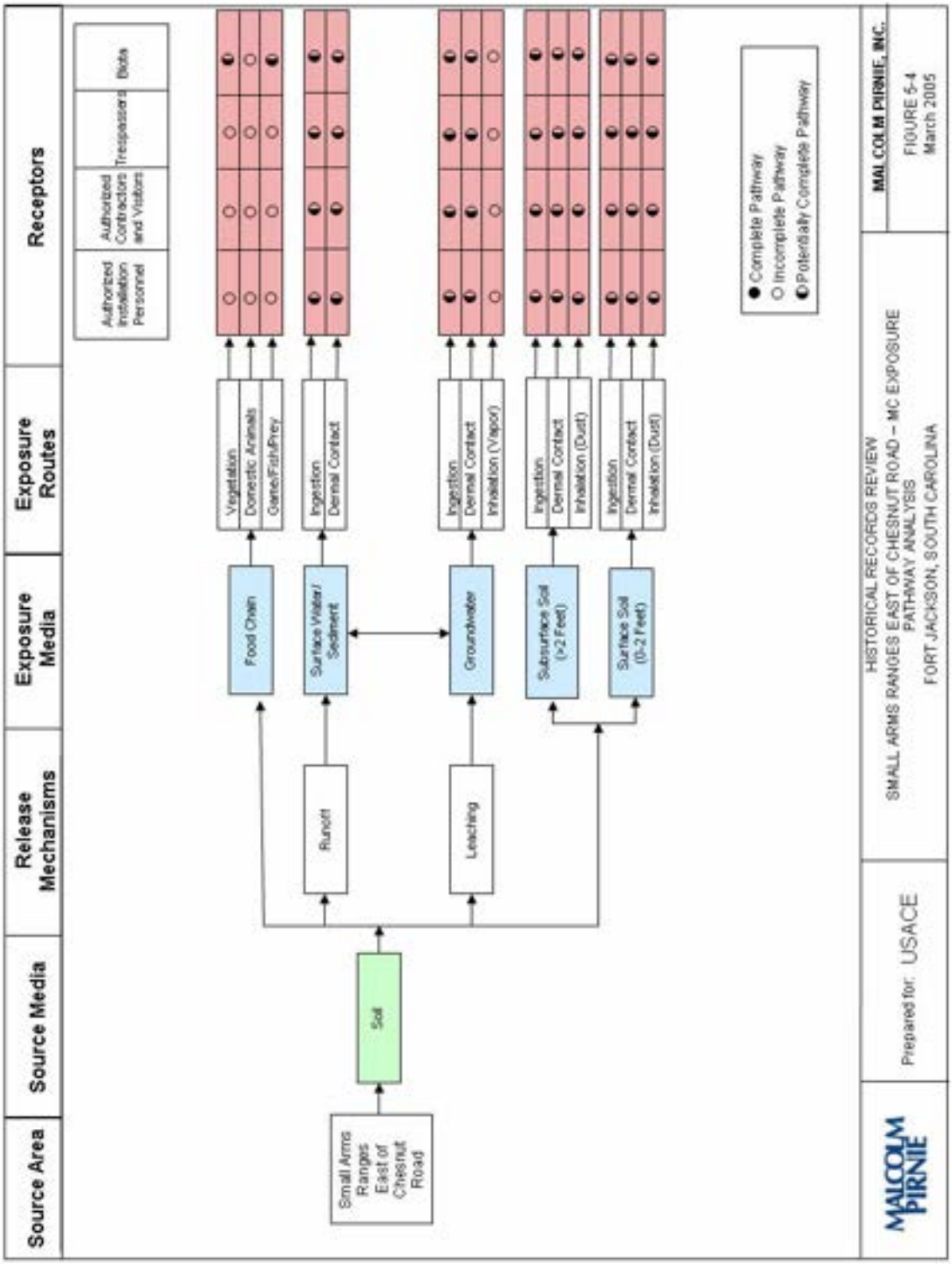


Figure 5-4: MC Exposure Pathway Analysis - Small Arms East of Chesnut Road



5.2 FORT JACKSON FLIGHT CLUB

5.2.1 MMRP Site Profile

5.2.1.1 Area and Layout

The FJFC is an approximately 54-acre area located east of Wildcat Road just north of Dixie Road, near the northwestern portion of the installation. The FJFC is quasi-rectangular in shape with a wider base than top. The westernmost portion of the FJFC did not have a historical range use. As such, the MMRP site acreage for the FJFC is 42 acres. This area has been divided into two MMRP sites: FJFC Salerno Ranges (which includes 15 acres that had MEC use) and FJFC Small Arms Ranges (which includes 27 acres).

5.2.1.2 Structures

The FJFC area contains a flat, clear, and level area surrounded by forest and grassland. The flat cleared portion of the site has been used by the Fort Jackson model airplane club as an airstrip for small recreational type R/C model aircraft. The improvements to the site include a level area for use as an airstrip, a gravel parking area, sun shelter and bleachers for spectators, a covered picnic area, and a storage building for maintenance equipment. No other structures are associated with this site.

5.2.1.3 Utilities

The only utilities associated with this area are electric lines running to street security lights.

5.2.1.4 Boundaries

The FJFC is bounded to the north and east by forest and grassland, to the south by Dixie Road, and to the west by Wildcat Road.

5.2.1.5 Security

The FJFC area is located within the boundaries of the Fort Jackson installation. Access to the installation is limited by gates and/or roadblocks on all roads leading into the installation.

Access to the installation is restricted to Army personnel, authorized civilian personnel, contractors and visitors. Security personnel routinely patrol the FJFC area by vehicle. The FJFC does not have separate fencing.

5.2.2 Physical Profile

5.2.2.1 Climate

Climate is general installation information and is presented in Section 5.1.2.1.

5.2.2.2 Geology

Geology is general installation information and is presented in Section 5.1.2.2. No specific geologic information for FJFC was available.

5.2.2.3 Topography

The FJFC is located at an elevation of approximately 400 feet above mean sea level. Topography within the FJFC is generally flat and slopes towards the east.

5.2.2.4 Soil

According to Figure 3.2.4 - Fort Jackson soils contained in the INRMP, the soil type located within the FJFC consists of Lakeland sand. Lakeland sand is a deep, excessively drained gentle sloping soil on convex ridge tops in the Sand Hills. The surface layer (three inches) consists of dark gray sand; the subsurface (107 inches) consists of yellow or brown sand. It has medium potential for urban development, primarily due to low water capacity. Lakeland sand is a predominant soil type found at Fort Jackson.

5.2.2.5 Hydrogeology

Hydrogeology is general installation information and is presented in Section 5.1.2.5.

5.2.2.6 Hydrology

Hydrology is general installation information and is presented in Section 5.1.2.6.

5.2.2.7 Vegetation

According to Figure 3.3.1.1 - Forest Types of Fort Jackson contained in the INRMP, the predominant forest types located within the FJFC are natural pine and scrub oak.

5.2.3 Land Use and Exposure Profile

5.2.3.1 Current Land Use

The flat cleared portion of the site has been used by the FJFC as an airstrip for R/C model aircraft since the late 1980s. There is a picnic area associated with the flying field.

5.2.3.2 Current Human Receptors

Current potential receptors of any MEC or MC present on the former FJFC include R/C aircraft operators (authorized visitors), authorized Fort Jackson personnel, authorized contractors, and trespassers.

5.2.3.3 Current Land Uses/Activities

Current activities include those associated with R/C aircraft recreational operations. Also, routine maintenance is performed on the airstrip, picnic, and spectator areas. Much of the FJFC area is undeveloped.

5.2.3.4 Potential Future Land Use

No changes to the current land use are planned for this area. Fort Jackson may increase the size of maintained area for the benefit of the FJFC.

5.2.3.5 Potential Future Human Receptors

The future human receptors are expected to remain the same as the current human receptors. There is no anticipated change in future site usage.

5.2.3.6 Zoning/Land Use Restrictions

No zoning or land use restrictions have been identified for this site.

5.2.3.7 Beneficial Resources

Beneficial factors for the Fort Jackson installation have been identified in Section 5.1.3.6. Additionally, slash pine has been planted in the former target/downrange hazard area. The slash pine, when mature, will provide beneficial habitat for the Red-cockaded Woodpecker, as well as a beneficial timber product.

5.2.3.8 Demographics

The demographics for the area of the installation are presented in Section 5.1.3.7.

5.2.4 Ecological Profile

5.2.4.1 Habitat Type

The habitat types are similar across the installation and are described in Section 5.1.4.1. Forest cover is the principal vegetative type on Fort Jackson. The primary forest cover type within the FJFC is slash pine and scrub oak; therefore, the habitat type would only be for small mammals (e.g., mice squirrels) and birds. The FJFC site contains maintained grass, sandy areas, and some planted slash pine forest that could provide a habitat for the Red-cockaded Woodpecker.

5.2.4.2 Degree of Disturbance

Minimal to moderate disturbance of flora and fauna species located in the FJFC area is expected due to the operation of R/C model aircraft and routine site maintenance.

5.2.4.3 Ecological Receptors

Potential rare, threatened, or endangered species and species of interest near and on Fort Jackson are discussed in Section 5.1.4.3. It is not likely that any of the species discussed in Section 5.1.4.3 would currently be found in the immediate area of the FJFC. However, it is possible that the slash pine forest will provide a future habitat for the Red-cockaded Woodpecker.

5.2.5 Munitions/Release Profile

5.2.5.1 Munitions Types and Release Mechanisms

Table 5-2 presents a summary of the types of munitions that would be expected based on information collected for this HRR. The mechanisms by which the munitions were released into the environment are also presented in this table. The typical release mechanisms for the former FJFC ranges are intentional activities, such as firing into a target area, and unintentional activities, such as rounds fired falling outside the target area or rounds discarded for various reasons at the firing point.

Table 5-3: Summary of Potential Munitions Types – FJFC

MMRP Site	Potential Munitions	Primary Release Mechanism
FJFC Salerno Ranges	40-mm grenades, Rocket grenades, 66-mm rockets, 35-mm sub-caliber rockets, 3.5-in rockets, M18A1 Anti-Personnel Mine, Practice grenades	Munitions firing, potentially from the following weapons: M79 Grenade Launcher M72 LAW 3.5-in Rocket Launcher M18A1 Anti-Personnel Mine
FJFC Small Arms Ranges	.30-/.50-caliber, 7.62-mm, 5.56-mm	Munitions firing, potentially from the following weapons: Browning .30 M1917 Machine Gun M2 .50 Machine Gun M-60 Machine Gun Springfield Model 1903 Enfield M1917 Rifle M-1 Garand Rifle M-1 Carbine

5.2.5.2 Maximum Probability Penetration Depth

MEC that may be present at the FJFC Salerno Ranges site include 66-mm LAW rockets and 40-mm rifle grenades. The expected depth of penetration in sand for the 66-mm rocket is 10.8 inches below ground surface (bgs), and the expected depth of penetration in sand for the 40-mm grenade is 2.4 inches bgs.

Small arms and hand grenades do not have an associated penetration depth. These and other MC components (such as spent shell casings and residual black powder components and wastes) are expected to have been directly deposited on the ground surface.

5.2.5.3 MEC Density

The greatest density of MEC is expected to be located in the northeast corner of the FJFC Salerno Ranges, since this area is most likely where the Salerno Demonstration M79 rifle grenade range and M72 LAW rocket launcher firing lines were located. The range for the 40-mm grenade was approximately 50 to 400 meters; therefore, the impact zone of the M79 rifle grenade range is within the current borders of the FJFC Salerno Ranges site. The effective range for the M72 LAW rocket is 170 to 220 meters, and its maximum range is 1000 meters; therefore, the impact zone of the M72 LAW is also expected to fall within the FJFC Salerno Ranges site.

5.2.5.4 MEC Scrap/Fragments

The majority of the MEC scrap/fragments are expected to have been deposited as a result of activities associated with the Salerno Demonstration Range, specifically, the M72 and M79 ranges. During the visual survey conducted at the FJFC on June 17, 2004, MEC including 40-mm grenades and 35-mm sub-caliber rockets were observed at the FJFC Salerno Ranges site.

5.2.5.5 Associated Munitions Constituents

As noted in Table 4-2, MC associated with the ranges formerly overlapping the FJFC include black powder (potassium nitrate, sulfur, and charcoal), smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine), double based propellant (nitrocellulose and nitroglycerin), Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide. No soil or groundwater samples have been analyzed for explosives within the FJFC; therefore, it is not known whether explosives are present at the FJFC site.

The primary MC of concern associated with the FJFC Small Arms Ranges is Pb. Other MC of concern that may be included in trace amounts are: Sb and Sn, which increase the hardness of bullets; As present in Pb; Cu present in the bullet core alloy; Cu and Zn present in the jacket alloy; Fe from the tips of penetrator rounds; Cu, Zn, Sr, and Mg present in tracer munitions; and lead styphnate/lead azide in the primer mixture.

5.2.5.6 Transport Mechanisms / Migration Routes

The primary transport mechanisms identified for the FJFC site include the following:

Erosion: Since thunderstorms are common during the summer months, erosion could be a factor in exposing buried MEC and in transporting and migrating MC contaminated soil to surface water bodies. Since the topography at the FJFC slopes to the east, it is expected that erosional migration of MEC and/or MC would be in the down slope direction.

Soil Disturbance: Surface and subsurface disturbances can lead to transport and migration of MC from one environmental media to another (soil to surface or groundwater or both) through surface water runoff and erosion. Known soil disturbance activities at the FJFC include land clearing and pine tree planting.

Infiltration: Since much of the FJFC is composed of sand, the potential for MC to migrate from one environmental media to another (surface to subsurface soil to groundwater) through infiltration exists.

5.2.6 Pathway Analysis

5.2.6.1 MEC

The MEC pathway analysis was prepared for the FJFC Salerno Ranges (Figure 5-5). The primary exposure pathway for human and ecological receptors is handle/tread underfoot of surface MEC. The potential for complete pathways exist between surface MEC and all receptors. The potential for complete pathways exist between subsurface MEC and

authorized installation personnel, contractors, and biota. Timber harvesting/planting in this area could lead to contact with subsurface MEC, and biota may nest or burrow in this area causing potential contact with subsurface MEC, as well.

5.2.6.2 MC

MC pathway analyses were prepared for the FJFC Salerno Ranges (Figure 5-6) and the FJFC Small Arms Ranges (Figure 5-7). These MC pathway analyses show a potentially complete pathway for biota for the vegetation exposure route. Biota is expected to ingest vegetation at the site and have a potentially complete pathway for vegetation in the food chain. All other pathways for vegetation in the food chain are expected to be incomplete. Crops are not grown on the site, and domestic animals are not raised on the site; therefore, no complete pathways exist for this exposure route. A potentially complete pathway through the game/fish prey exposure route exists only for biota.

Potentially complete pathways for ingestion and dermal contact exist between surface water/sediment and all receptors expected at the site. The groundwater exposure routes are expected to be potentially complete pathways for all potential receptors since there is an active water supply well located in close proximity to the FJFC.

Potentially complete pathways for all exposure routes for both surface and subsurface soil exist for all receptors. Since access and activities at the FJFC are not restricted, the potential for soil disturbance to occur exists. The subsurface pathway would also be potentially complete for biota because they may nest or burrow at the site.

Figure 5-5: MEC Exposure Pathway Analysis – FJFC Salerno Ranges

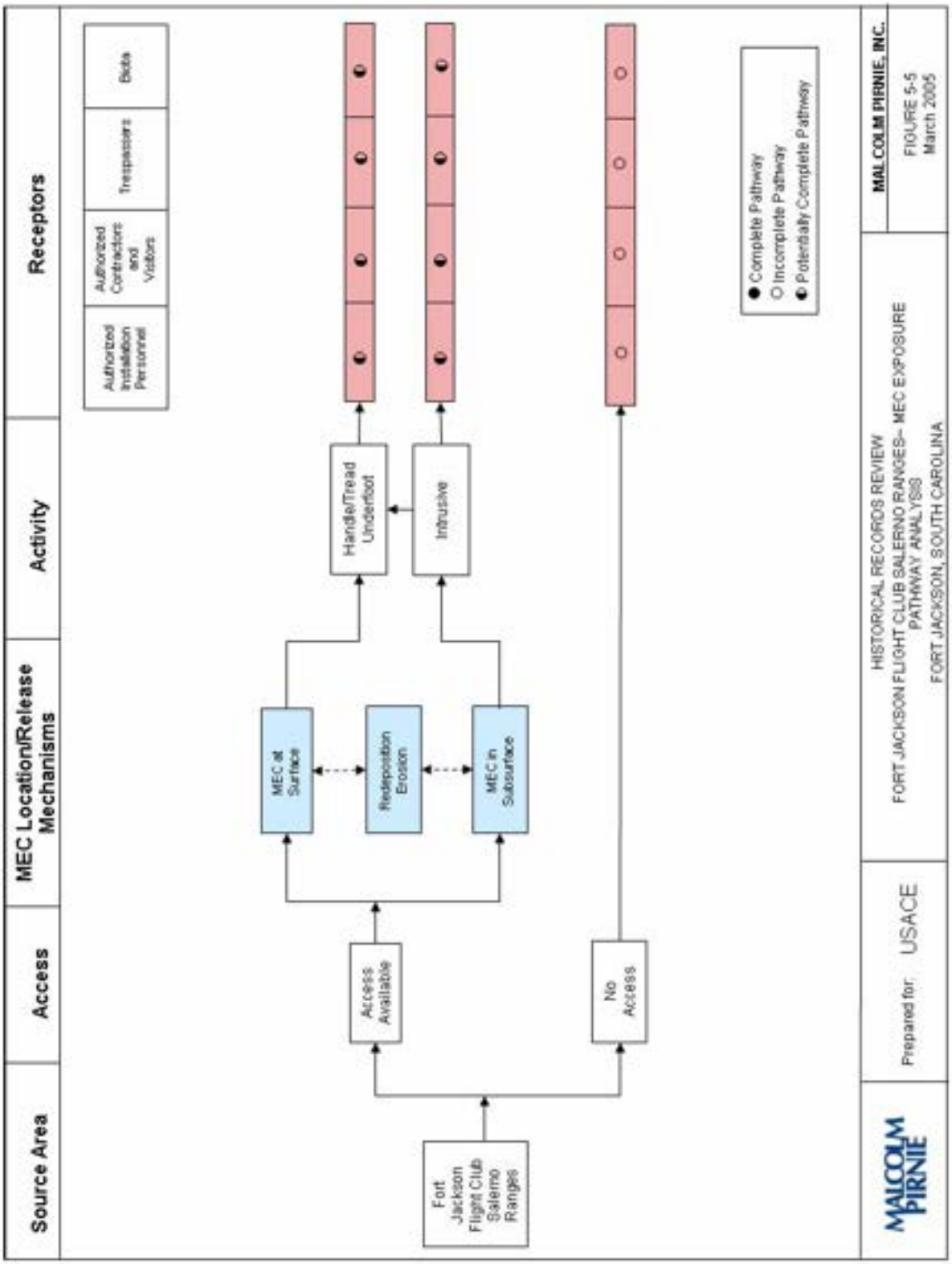


Figure 5-6: MC Exposure Pathway Analysis – FJFC Salerno Ranges

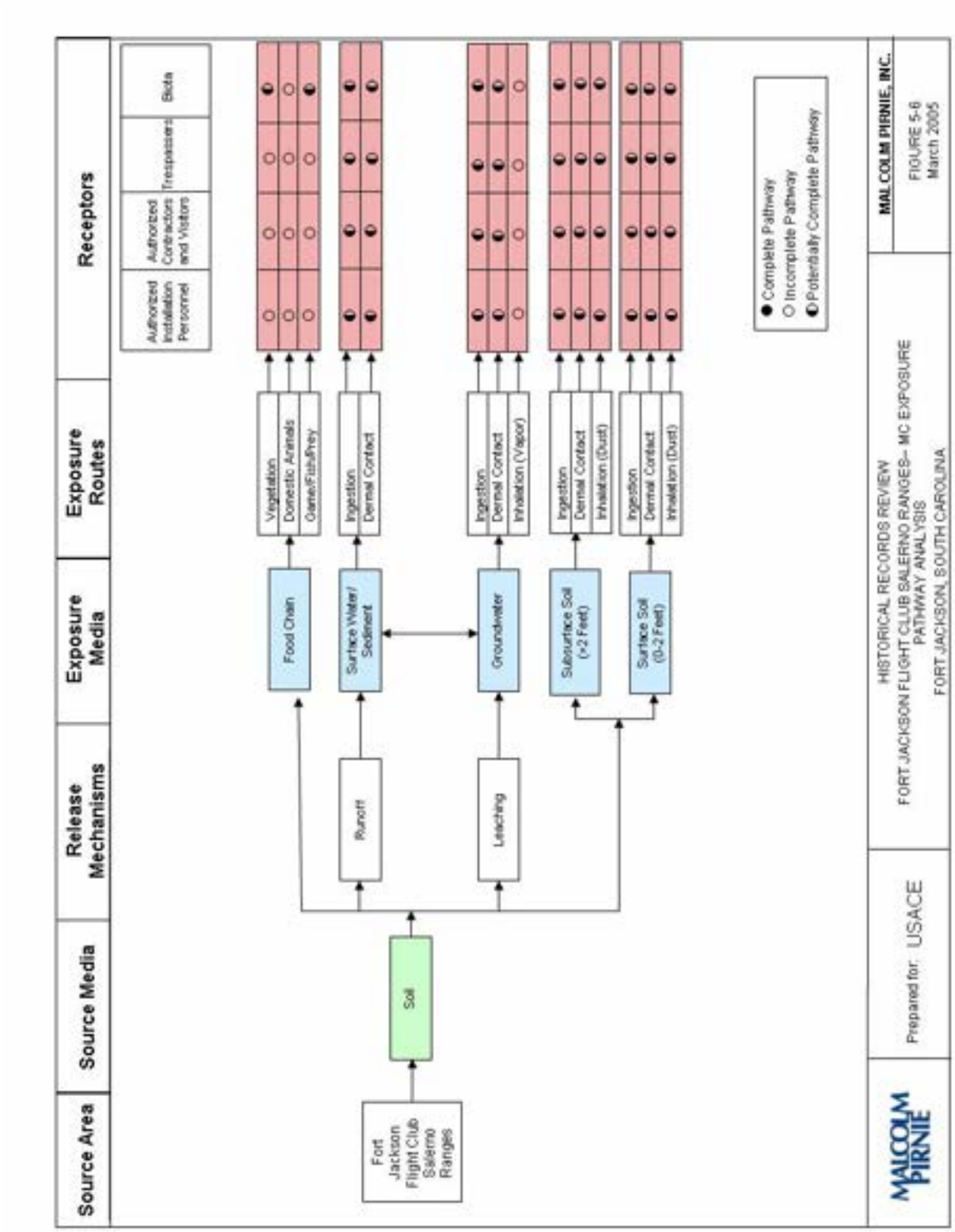
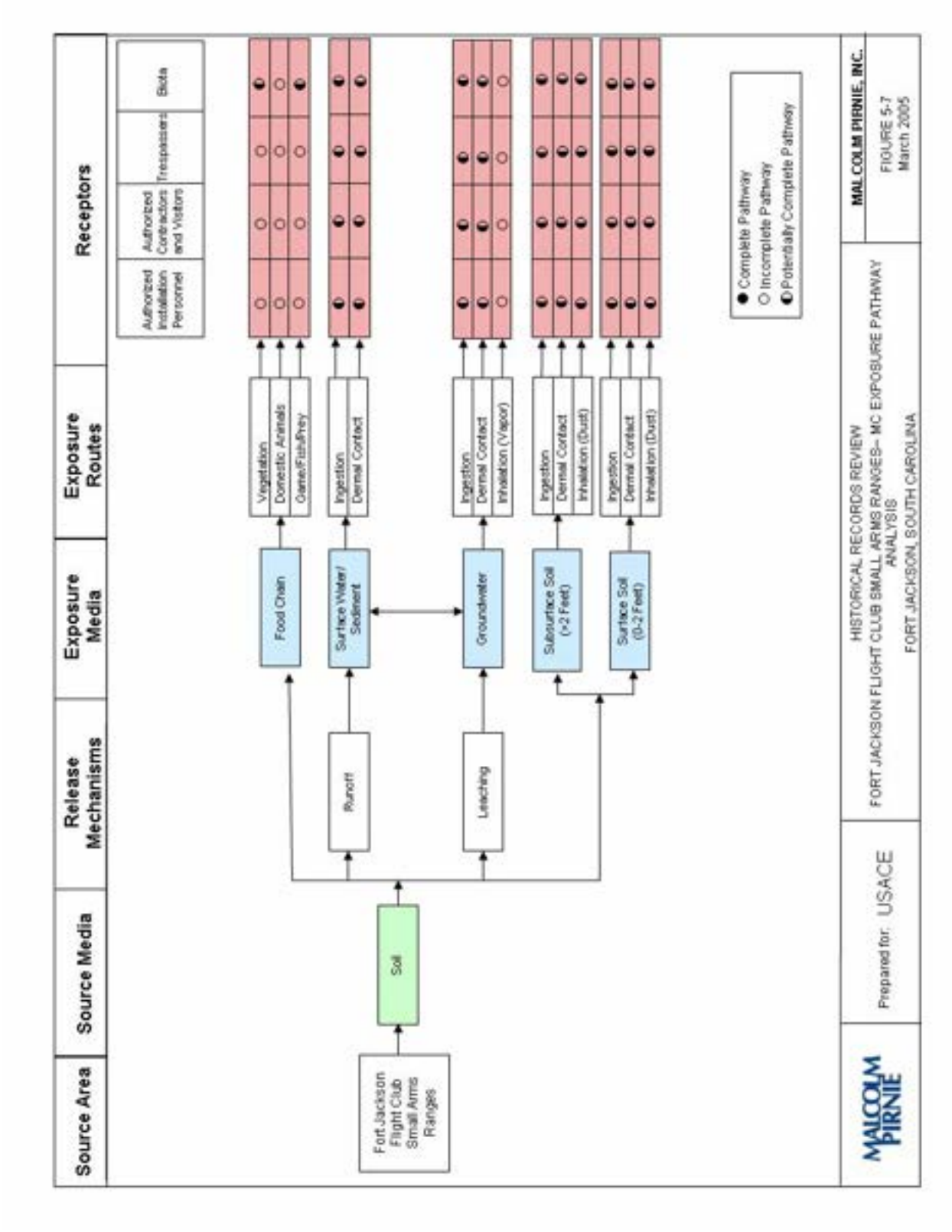


Figure 5-7: MC Exposure Pathway Analysis – FJFC Small Arms Ranges



5.3 WESTON LAKE AREA RANGES/SITES

5.3.1 MMRP Site Profile

5.3.1.1 Area and Layout

The Weston Lake Area is located on the southern, central portion of the installation. A total of two sites are located in this area. Geographical features of these sites are briefly described below:

- The Mortar Range (more specifically Mortar Range 5A, 7, and 8 Safety Fans) consists of a 306-acre area that is located in the northern section of the Weston Lake Area. The other than operational portion of the Mortar Range is somewhat trapezoidal in shape and includes the portion of the Submachine Gun Area that is overlapped by the Mortar Range.

- The Submachine Gun Area (more specifically the Dismounted and Moving Vehicle Submachine Gun Area) consists of an approximate 17-acre area located on the northern portion of the Weston Lake Area. The other than operational portion of the Submachine Gun Area is somewhat trapezoidal in shape. The 17-acre area includes only the portion of the Submachine Gun Area not overlapped by the Mortar Range.

5.3.1.2 Structures

The Mortar Range is located about 1/4 mile north of the main recreation facilities of the Weston Lake Area; however, it has not been directly improved by recreational facilities (e.g., camp sites or trails). There are no structures located at the Mortar Range. Portions of the Dismounted Submachine Gun No. 1 Range, the Moving Vehicle Submachine Gun Range, and the Dismounted Submachine Gun No. 2 Range extend across the eastern half of the Mortar Range.

The Submachine Gun Area primarily includes the firing points and target areas of the Dismounted Submachine Gun No. 1 Range. This area has been developed for recreational purposes and currently includes a picnic area, rental cabins, and a small boat launch area.

5.3.1.3 Utilities

There are no utilities located on the Mortar Range. However, the Submachine Gun Area has both overhead and buried utilities for the recreational area.

5.3.1.4 Boundaries

The Mortar Range is bounded to the north, west and east by undeveloped land and to the south by Weston Lake Area.

The Submachine Gun Area is bounded to the north and west by Weston Lake. Recreational facilities are located to the south and east.

5.3.1.5 Security

The Weston Lake Area is located within the boundaries of the Fort Jackson installation. Access to the installation is limited by gates and/or roadblocks on all roads leading into the installation. Access to the installation is restricted to Army personnel, authorized civilian personnel, contractors, and visitors. The Weston Lake Area MMRP sites are located within the Weston Lake Area. The individual sites within the Weston Lake Area are not fenced. However, the Mortar Range has not been directly improved with recreational facilities (e.g., camp sites, trails) and is in a remote location not easily accessible by visitors using the Weston Lake Area. Recreational facilities have been constructed at the Submachine Gun Area.

5.3.2 Physical Profile

5.3.2.1 Climate

Climate is general installation information and is presented in Section 5.1.2.1.

5.3.2.2 Geology

Geology is general installation information and is presented in Section 5.1.2.2.

5.3.2.3 Topography

General topographical information on the installation is given in Section 5.1.2.3.

5.3.2.4 Soil

General soil information for the Fort Jackson Installation is given in Section 5.1.2.4. According to Figure 3.2.4 - Fort Jackson Soils contained in the INRMP, the soil types located within the Mortar Range and Submachine Gun Area consist of Lakeland, Ailey, and Vauclose soils.

5.3.2.5 Hydrogeology

Hydrogeology is general installation information and is presented in Section 5.1.2.5.

5.3.2.6 Hydrology

Hydrology is general installation information and is presented in Section 5.1.2.6.

5.3.2.7 Vegetation

According to Figure 3.3.1.1 - Forest Types of Fort Jackson contained in the INRMP, the predominant forest type located within the Mortar Range is pine plantation. The Pine Plantation forest type is made up mostly of planted longleaf pine and slash pine (*Pinus elliottii*), which is not native to Fort Jackson.

According to Figure 3.3.1.1 discussed above, the predominant forest type located within the Submachine Gun Area is natural pine and pine hardwood. Natural pine includes all natural pine strands. In pine hardwood stands, hardwoods must constitute 21-49% of the overstory basal area, while the remainder is pine of any species.

5.3.3 Land Use and Exposure Profile

5.3.3.1 Current Land Use

The two Weston Lake Area MMRP sites are located in the Weston Lake Area, which is used by the general public for camping, picnics, and other recreational activities. However, the Mortar Range has not been directly improved with recreational facilities (e.g., camp sites) and is in a remote location not easily accessible by visitors using the Weston Lake Area. Recreational facilities have been constructed at the Submachine Gun Area.

5.3.3.2 Current Human Receptors

Current potential receptors of MEC or MC present on the Weston Lake Area ranges include authorized installation personnel, contractors, and visitors, as well as trespassers.

5.3.3.3 Current Land Uses/Activities

Current activities include recreational activities such as camping, swimming, fishing, biking, and hiking. However, the Mortar Range is in a remote location not easily accessible or frequented by visitors using the Weston Lake Area.

5.3.3.4 Potential Future Land Use

No changes to the current land use are planned for this area.

5.3.3.5 Potential Future Human Receptors

The future human receptors are expected to remain the same as the current human receptors. There is no anticipated change in access to the sites.

5.3.3.6 Zoning/Land Use Restrictions

No zoning or land use restrictions are present for this area.

5.3.3.7 Beneficial Resources

Fort Jackson encompasses a wide variety of vegetative site conditions, ranging from bottomland hardwood communities to xeric longleaf pine communities as noted in Section 5.1.3.6. The most predominant forest types on the ranges located within the Weston Lake Area are natural pine and pine plantation. Timber is harvested annually at Fort Jackson, and these ranges may provide a percentage of the annually harvested timber.

It is noted that the SWMU 12 and SWMU 17 sites are located just east of the Weston Lake Area. Additionally, the Red-cockaded Woodpecker is the only endangered animal species identified on the reservation. The Weston Lake Area includes habitat associated with the Red-cockaded Woodpecker. Informational signs (Figure 5-8) are located throughout the Weston Lake Area cautioning people of the potential presence of this endangered species.

Figure 5-8: Red-cockaded Woodpecker Habitat Sign

5.3.3.8 Demographics

The demographics for the area of the installation are presented in Section 5.1.3.7.

5.3.4 Ecological Profile

5.3.4.1 Habitat Type

The habitat types are general across the installation and are described in Section 5.1.4.1. Forest cover is the principal vegetative type on Fort Jackson. The most predominant forest types on the ranges located within the Weston Lake Area are natural pine and pine plantation; therefore, the habitat type would be for small mammals (e.g., mice and squirrels) and birds.

5.3.4.2 Degree of Disturbance

Disturbance of flora and fauna species located in the Weston Lake Area is expected to be moderate during annual timber harvests.

5.3.4.3 Ecological Receptors

Potential rare, threatened, or endangered species and species of interest near and on the Fort Jackson installation are discussed in Section 5.1.4.3. As stated previously, the Red-cockaded Woodpecker is the only endangered animal species identified on the reservation. Habitat exists within the Weston Lake Area.

5.3.5 Munitions/Release Profile

5.3.5.1 Munitions Types and Release Mechanisms

Table 5-3 presents a summary of the types of munitions that were either identified during the limited visual survey conducted at the Weston Lake Area sites or that would be expected based on information collected for this HRR. The mechanisms by which the munitions were released into the environment are presented in this table. The typical release mechanisms for the MMRP sites located in the Weston Lake Area include intentional activities, such as firing into a target area, and unintentional activities, such as rounds fired falling outside the target area or rounds discarded for various reasons at the firing point. It is important to note that in areas that were used for small arms training (i.e., the Submachine Gun Area), MEC are not expected, and the primary concern would be associated with MC.

Table 5-4: Summary of Potential Munition Types - Weston Lake Area

MMRP Site	Potential Munitions	Primary Release Mechanism
Mortar Range	60-mm, 81-mm, 3-in, 4.2-in mortar rounds .30-/.45-/.50-caliber, Live and practice grenades	Munitions firing, potentially from the following weapons: 60-mm, 81-mm, 3-in, 4.2-in mortar systems Overlapping Range Fan(s) weapons: M1A1 Thompson, M1928 Thompson, M3 and M3A1 (Grease) Submachine Gun .30-caliber machine gun .50-caliber machine gun M-1 rifle
Submachine Gun Area	.45-caliber	M1A1 Thompson, M1928 Thompson, M3 and M3A1 (Grease) Submachine Gun

5.3.5.2 Maximum Probability Penetration Depth

The expected depths for the various MEC items associated with the Weston Lake Area MMRP sites are presented in Table 5-5. These expected depths include values for sand, loam, and clay and were obtained from EM 1110-1-4009 Ordnance and Explosives Response, prepared by the USACE. These penetration depths are estimated on a worst-case scenario that assumes that the impact is perpendicular to ground surface and that the ordnance item does not deform upon impact. Small arms do not have an associated penetration depth. These and other MC components (such as spent shell casings and residual

black powder components and wastes) are expected to have been directly deposited on the ground surface.

Table 5-5: Summary of Expected MEC Penetration Depths

Ordnance Item/Weapon	Depth of Penetration (inches bgs)		
	Sand	Loam	Clay
60-mm mortar	13.2	18	27.6
81-mm mortar	32.4	42	64.8
4.2-in mortar	49.2	64.8	99.6

5.3.5.3 MEC Density

MEC presence in the Mortar Range, which includes three mortar range safety fans, is unknown. The other than operational area associated with the Mortar Range (i.e., safety fans) is undeveloped. As mentioned previously, five Howitzer range safety fans, two machine gun range safety fans, one rifle range, the Submachine Gun Area, and five unidentified range fans overlap the Mortar Range. Based on the number of overlapping fans, this area has the potential for MEC presence associated the Mortar Range and possibly from other overlapping ranges. However, MEC presence is expected to be minimal since the other than operational area associated with the Mortar Range lies within the safety fans (not within the direct line of fire) of the mortar ranges and overlapping ranges.

5.3.5.4 MEC Scrap/Fragments

During the June 17, 2004 site walk, MEC scrap and fragments were not observed at the Weston Lake Area MMRP Sites.

5.3.5.5 Associated Munitions Constituents

As noted in Table 4-3, MC associated with the Weston Lake Area MMRP sites include the following: black powder (potassium nitrate, sulfur, and charcoal), RDX, WP, illumination mix, smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine), double

based propellant (nitrocellulose and nitroglycerin), Composition B, TNT, Octol, Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide.

5.3.5.6 Transport Mechanisms / Migration Routes

The primary transport mechanisms identified for the Weston Lake Area MMRP sites include the following:

Erosion: Since thunderstorms are common during the summer months, erosion could be a factor in exposing buried MEC and in transporting and migrating MC contaminated soil to surface water bodies such as Weston Lake, located south of the Mortar Range/Submachine Gun Area.

Soil Disturbance: Since timber harvesting and recreational activities occur in this area, the potential for soil disturbance to occur exists. Any surface or subsurface soil disturbance can cause both the transport and migration of MEC and MC. Surface and subsurface disturbances can lead to transport and migration of MC from one environmental media to another (soil to surface or groundwater or both) through surface water runoff and erosion.

Infiltration: Based on the generally sandy soils located within the Weston Lake Area, the potential for MC to migrate from one environmental media to another (surface to subsurface soil to groundwater) through infiltration exists.

5.3.6 Pathway Analysis

5.3.6.1 MEC

The MEC pathway analysis was prepared for the Mortar Range (Figure 5-9). The primary exposure pathway for human and ecological receptors is handle/tread underfoot of surface MEC. The potential for complete pathways exists between surface MEC and all receptors. Since there is no penetration depth associated with hand grenades, MEC in the subsurface is not anticipated. The potential for complete pathways exists between subsurface MEC and

authorized installation personnel, contractors, and biota for the Mortar Range. Timber harvesting in this area could lead to contact with subsurface MEC, and biota may nest or burrow in these areas causing potential contact with subsurface MEC, as well.

5.3.6.2 MC

MC pathway analyses were prepared for the Mortar Range (Figure 5-10) and the Submachine Gun Area (Figure 5-11). The MC pathway analyses displayed show potentially complete pathways for biota for the vegetation exposure route. Biota is expected to ingest vegetation at the Weston Lake Area MMRP sites and have potentially complete pathways for vegetation in the food chain. All other pathways for vegetation in the food chain are expected to be incomplete. Crops are not grown on the sites, and domestic animals are not raised on the sites; therefore, no complete pathways exist for this exposure route. All receptors, except contractors, have potentially complete pathways through the game/fish prey exposure route. This is because the Weston Lake Area offers fishing for authorized installation personnel and their visitors.

Potentially complete pathways for ingestion and dermal contact exist between surface water/sediment and all receptors expected at the sites. The groundwater exposure routes are expected to be partially complete pathways for all potential receptors since there are three active water supply wells located just east of Weston Lake.

Potentially complete pathways for all exposure routes for both surface and subsurface soil exist for all receptors. Since access to and activities in these areas are not restricted, the potential for soil disturbance to occur exists. Also, the subsurface pathways would be potentially complete for biota because they may nest or burrow in these areas.

Figure 5-9: MEC Exposure Pathway Analysis - Mortar Range

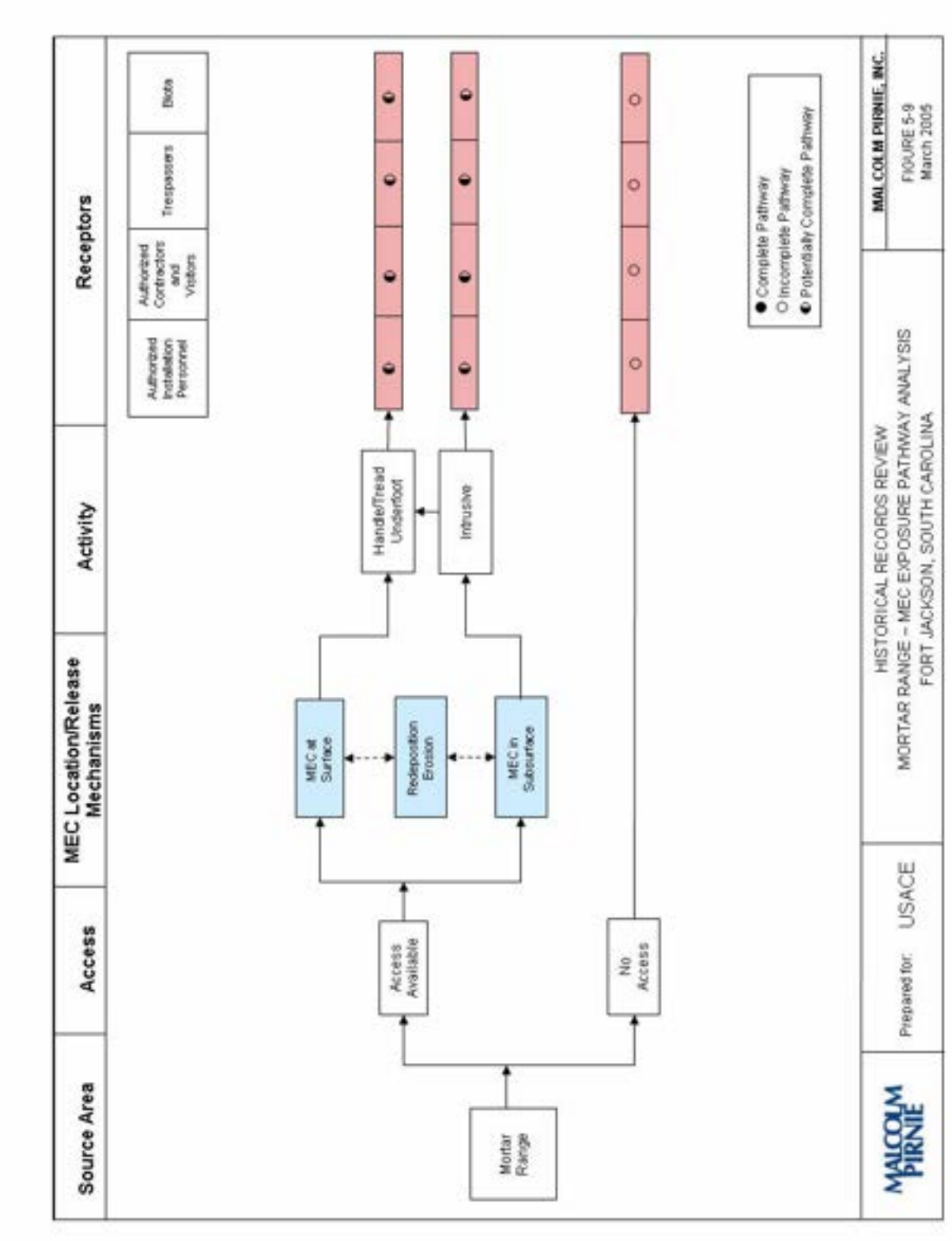


Figure 5-10: MC Exposure Pathway Analysis - Mortar Range

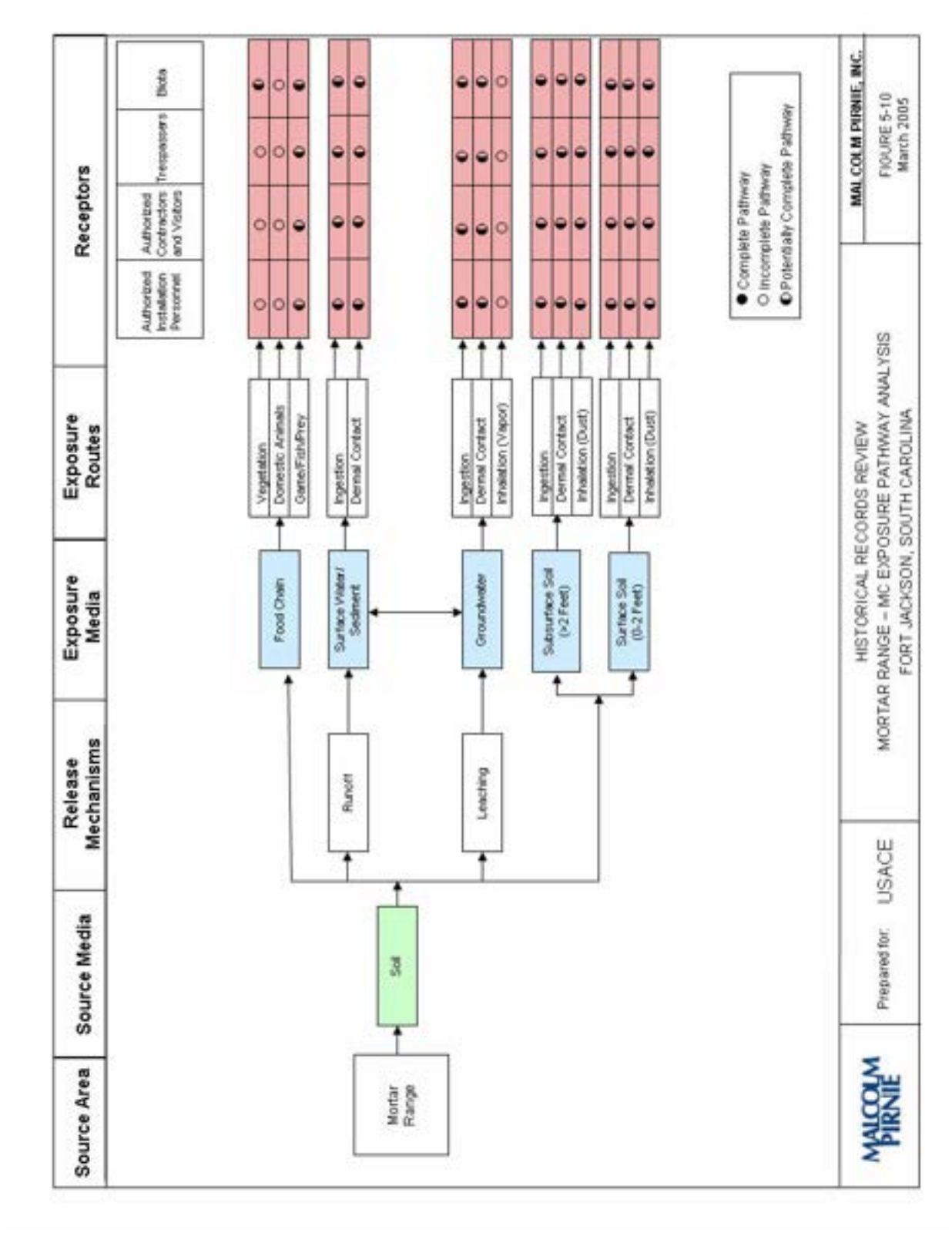
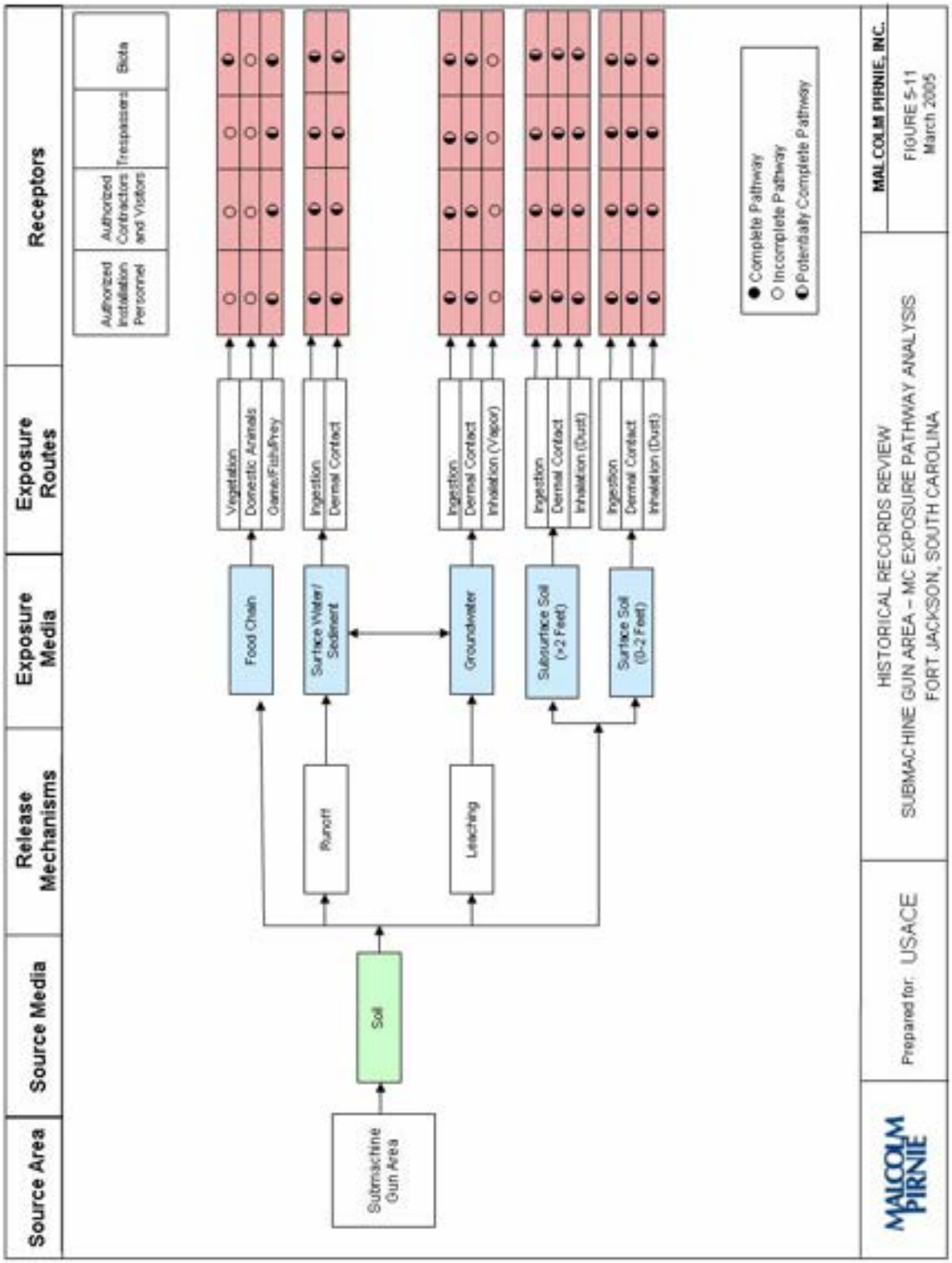
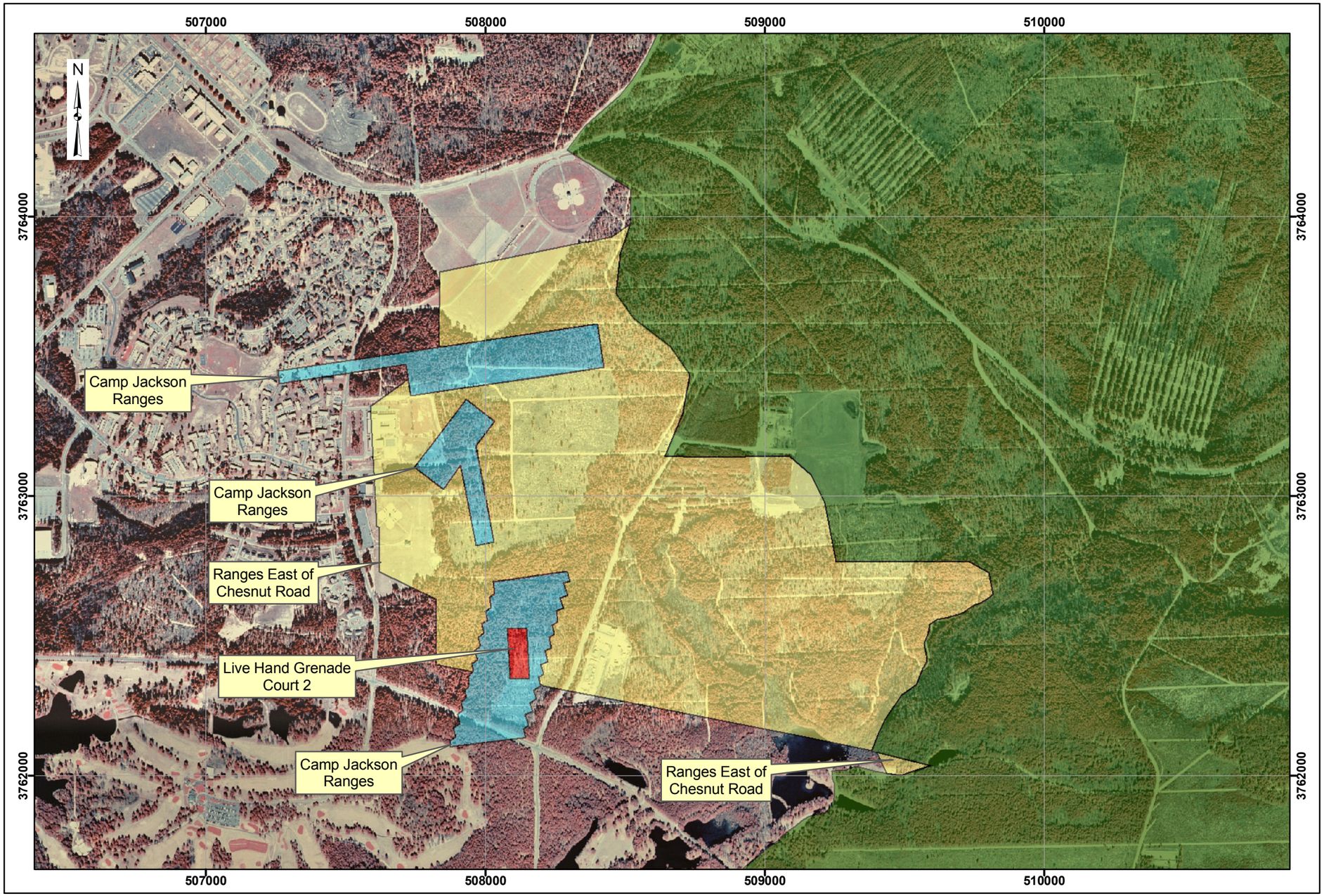


Figure 5-11: MC Exposure Pathway Analysis - Submachine Gun Area



Historical Records Review
Fort Jackson, SC



Map 5-1
Cantonment Area:
Horizontal Extent of MEC

Legend

- Installation Boundary
- Operational Range Area
- MEC Areas

MMRP Site

- Camp Jackson Ranges
- Live Hand Grenade Court 2
- Small Arms Ranges East of Chesnut Road

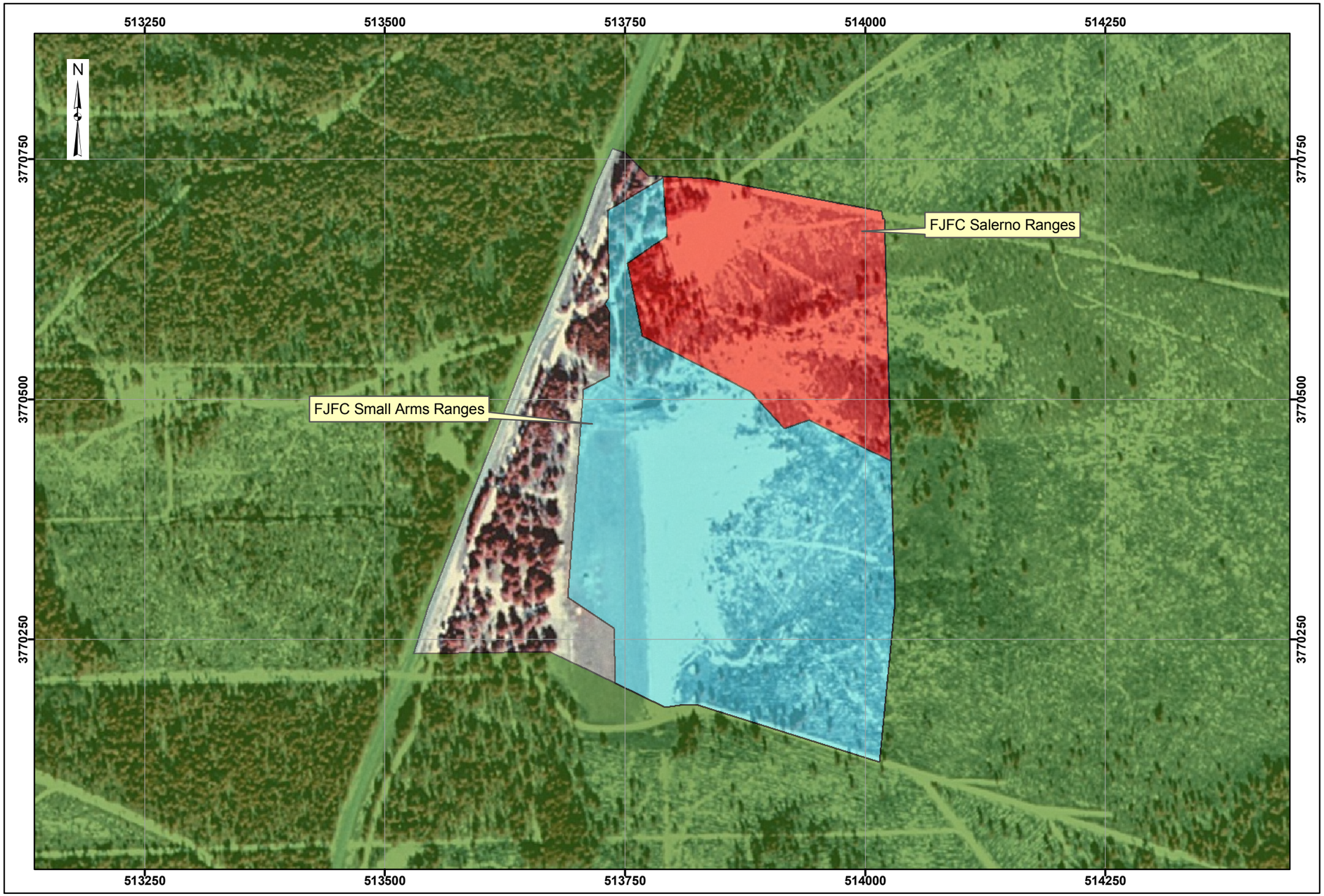
0 200 400 600 800 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1996
Fort Jackson South, SC, 1996
Congaree, SC, 1996
Messers Pond, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

Historical Records Review
Fort Jackson, SC



Map 5-2
Fort Jackson Flight Club:
Horizontal Extent of MEC

Legend

- Operational Range Area
- MEC Areas

MMRP Site

- FJFC Saint Lo Range
- FJFC Salerno Ranges

0 50 100 150 200 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
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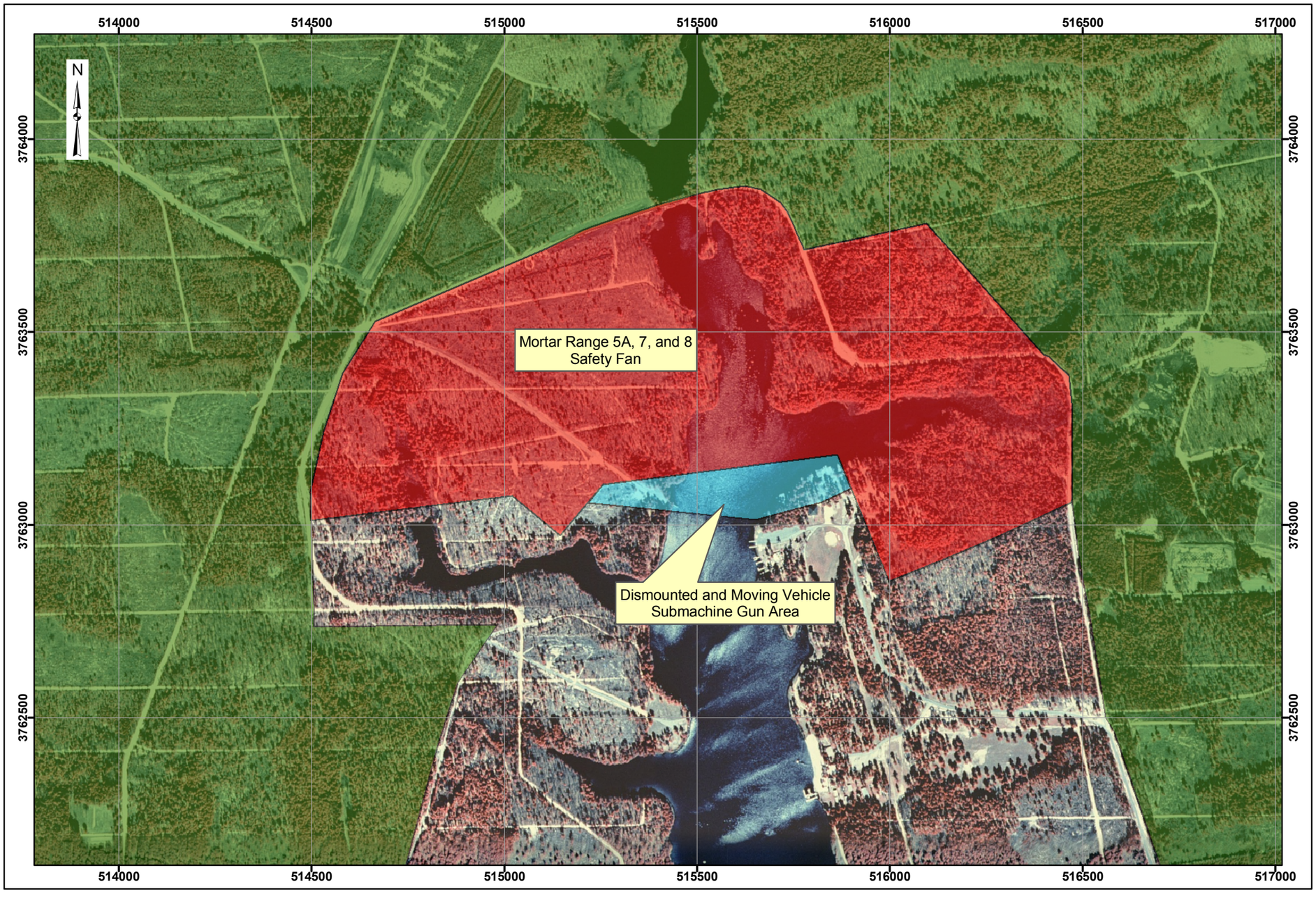

Historical Records Review
Fort Jackson, SC

Map 5-3
Weston Lake Area:
Horizontal Extent of MEC

Legend

- Operational Range Area
- MEC Areas

MMRP Site

- Submachine Gun Area
- Mortar Range Area

0 100 200 300 400 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Congaree, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

6 CONCLUSIONS

The following conclusions for the cantonment area, FJFC, and Weston Lake Area MMRP sites were made based on the information reviewed for this HRR.

6.1.1 Cantonment Area Ranges/Sites

The CTT Range Inventory identified four ranges in the cantonment area: the 1000-Yard Range, 600-Yard-Range, Machine Gun Range, and Live Hand Grenade Court 2. Based on maps and aerial photographs reviewed during the preparation of the HRR, the locations of the 1000-Yard Range and the 600-Yard Range were adjusted slightly to the north. The information reviewed for the HRR also revealed the following newly identified ranges:

- 300-Yard Range
- Pistol Range
- Transition Range
- Pistol Range NR 2
- Landscape Target Range
- 1000-Inch Range Nos. 14, 15, 16

In addition, seven other ranges were identified in the area north of Hampton Parkway (Ranges North of Hampton Parkway). Based on changes to the operational range boundary during the HRR review process, these ranges were determined not to be eligible for inclusion in the Fort Jackson SI because they are located in the operational range area.

The CTT Range Inventory listed the Andrew Jackson Range as one of the ten MMRP sites. The Andrew Jackson Range was originally a military small arms range that had been closed. The site has been turned over to the Fort Jackson MWR Department for operation as a recreational small arms shooting range. Because of its current activity and the ongoing

releases that have occurred after September 30, 2002, it was determined that this site is not eligible for evaluation as part of the Fort Jackson SI.

Based on the HRR conclusions, three MMRP Sites are located in the cantonment area. The ranges identified in the cantonment area have been grouped by period of use, type of use, and location to form these MMRP Sites. Although some of these ranges overlap, the range acreages are only counted for the MMRP Site in which they are grouped. A brief discussion of each MMRP Site follows:

The Camp Jackson Ranges include the 1000-Yard Range, 600-Yard Range, Machine Gun Range, 300-Yard Range, and the Pistol Range. These ranges cover an area of 81 acres and were used for small arms training from 1918 through 1920. As such, no MEC and only limited MC are anticipated at the Camp Jackson Ranges.

The Small Arms Ranges East of Chesnut Road include the Transition Range, Pistol Range NR 2, Landscape Target Range, and 1000-Inch Range Nos. 14, 15, 16. These ranges were used for small arms training in the 1940s through the 1970s. As such, no MEC and only limited MC are anticipated at these ranges.

The Live Hand Grenade Court 2 includes a three acre area that overlaps the 300-Yard Range. Acreage for this area has only been included for the Live Hand Grenade Court 2. This range only appears on the 1946 and 1949 source maps. Based on the historical maps, the range was used in the 1940s and possibly the 1950s. The Live Hand Grenade Court 2 is the only range with MEC potential; however, this area has been disturbed by field fortification training (e.g., trenching and using the area to teach fortification techniques) and forestry activities. MEC, if present, would be limited.

Table 6-1, on the following page, provides a summary of the cantonment area MMRP sites an associated sub areas (ranges).

Table 6-1: MMRP Site and Associated Sub Areas Conclusion Summary for Cantonment Area Ranges/Sites

Area	Size	Description
Camp Jackson Ranges 1000-Yard Range 600-Yard Range 300-Yard Range Machine Gun Range Pistol Range	81 acres	Small arms only
Small Arms Ranges East of Chesnut Road Transition Range 1000-Inch Range Nos. 14, 15, 16 Pistol Range NR 2 Landscape Target Range	546 acres	Small arms only
Live Hand Grenade Court 2	3 acres	MEC - Hand grenades

6.1.2 Fort Jackson Flight Club

Additional munitions types at the FJFC were identified during the research for this HRR. Historical maps revealed several overlapping range fans with associated munitions other than small arms. Both firing points/lines and target areas exist within the FJFC. The additional munitions types are associated with the following ranges: an M18AI anti-personnel mine range, an M-79 grenade launcher range, and an M-72 LAW rocket launcher range. During the visual survey conducted at the FJFC on June 17, 2004, possible MEC including 40-mm grenades and 35-mm sub-caliber rockets were observed. Review of HRR information also identified an area at the FJFC that is not overlapped by ranges/range fans. As such, the acreage for the FJFC was revised to only include the 42-area of the FJFC that has had range use. Based on range use, MEC may be anticipated in the northern portion of the FJFC; however, the southern portion of the range was used only for small arms training. As such, the FJFC has been split into two sites: FJFC Salerno Ranges and FJFC Small Arms Ranges. Table 6-2 provides a summary for the FJFC.

Table 6-2: MMRP Site Conclusion Summary for FJFC Ranges/Sites

Site Name	Size	Description
FJFC Salerno Ranges	15 acres	MEC - Rockets Rifle grenades Grenades Claymore mines
FJFC Small Arms Ranges	27 acres	Small arms

6.1.3 Weston Lake Area Ranges/Sites

The CTT Range Inventory identified four ranges in the Weston Lake Area: the Mortar Range, Hand Grenade Court No. 2, the Rifle Grenade Range NR 2, and the Submachine Gun Area. Based on maps and aerial photographs reviewed during the preparation of the HRR, the locations of these ranges were adjusted from the CTT Range Inventory to better represent the areas where the range use occurred. Based on changes to the operational range boundary during the HRR review process, the Hand Grenade Court No. 2 and the Rifle Grenade Range NR 2 were determined not to be eligible for inclusion in the Fort Jackson SI because they are located in the operational range area.

Based on the HRR conclusions, two MMRP Sites are located in the Weston Lake Area: the Mortar Range 5A, 7, and 8 Safety Fans (i.e., the Mortar Range in the CTT Range Inventory) and the Dismounted and Moving Vehicle Submachine Gun Area (i.e., the Submachine Gun Area in the CTT Range Inventory). The ranges have been grouped by period of use, type of use, and location to form these MMRP Sites.

For acreage reporting purposes, the CTT Range Inventory depicted the Mortar Range and the Submachine Gun Area as a contiguous area divided into the Mortar Range (western half) and the Submachine Gun Area (eastern half). However, based on the 1955 and 1956 Training Facilities Maps, the Mortar Range actually covers both the Mortar Range and the Submachine Gun Area reported in the CTT Range Inventory. For the HRR, the Dismounted and Moving Vehicle Submachine Gun Area was changed to include only the area not overlapped by the Mortar Range 5A, 7, and 8 Safety Fans (i.e., the acreage was changed

from 101 acres to 17 acres). The Mortar Range 5A, 7, and 8 Safety Fans acreage was increased from 112 acres to 306 acres to encompass the entire area that was associated in the past with mortar range use. The Mortar Range 5A, 7, and 8 Safety Fans is the only site with a potential for MEC based on historical range use. Table 6-3 provides a summary of the Weston Lake Area MMRP sites.

Table 6-3: MMRP Site Conclusion Summary for the Weston Lake Area Ranges/Sites

Site Name	Size	Description
Mortar Range	306 acres	MEC - Mortars Small arms
Submachine Gun Area	17 acres	Small arms only

Table 6-4, on the following page, summarizes the site identification number changes from the CTT Range Inventory through completion of this HRR. This information clarifies the AEDB-R Site Identification changes that resulted from the HRR conclusions.

Table 6-4: AEDB-R Site Identification Changes

MMRP Site (CTT Range Inventory)		MMRP Site (HRR)	
AEDB-R Site ID	Site Name	AEDB-R Site ID	Site Name
FTJA-001-R-01	1000-Yard Range	FTJA-001-R-01	Camp Jackson Ranges
FTJA-002-R-01	600-Yard Range	FTJA-002-R-01	Small Arms Ranges East of Chesnut Road
FTJA-003-R-01	Andrew Jackson Range	FTJA-003-R-01	Live Hand Grenade Court 2
FTJA-004-R-01	Fort Jackson Flight Club	FTJA-004-R-01	Fort Jackson Flight Club Salerno Ranges
FTJA-005-R-01	Hand Grenade Court No. 2	FTJA-005-R-01	Fort Jackson Flight Club Small Arms Ranges
FTJA-006-R-01	Live Hand Grenade 2	FTJA-006-R-01	Mortar Range 5A, 7, and 8 Safety Fans
FTJA-007-R-01	Machine Gun Range	FTJA-007-R-01	Dismounted and Moving Vehicle Submachine Gun Area
FTJA-008-R-01	Mortar Range	FTJA-008-R-01	Not used
FTJA-009-R-01	Rifle Grenade Range NR 2	FTJA-009-R-01	Not used
FTJA-010-R-01	Submachine Gun Area	FTJA-010-R-01	Not used

Appendix A: Archives Searched/Data Sources

ARCHIVE RESOURCES

The archival data reviewed for this HRR are presented by RG and source below. Items indicated with an asterisk (*) are items that provided useful information and are included in Appendix B.

National Archives, NARA, College Park, MD

RG 18, Army Air Forces

- Box 78, Central Decimal Files (Bulky), 1942-1944
    1. Aerial Photograph. Fort Jackson and Vicinity, SC, N3357-W8046*

- Box 116, Central Decimal Files, 1917-1938
    1. Memorandum. Subject: Progress made at Firing Central Fields, From W. P. Jernigan, Major, JMANA, 1 October 1918

- Box 2835, Central Decimal Files, 1917-1938
    1. Map. Location Map, Camp Jackson, Columbia, SC, 1918*

RG 51, Bureau of Budget

- Box 164, Entry 149-B (UD), War Project Unit, Inspection Reports
    1. Map. Columbia Army Air Base and Vicinity, Columbia, SC*

RG 77, Chief of Engineering

- Aerial Photograph
    1. Dents, SC, N3400-W8052.5/7.5, AMS, V046A*
    2. Messers Pond, SC, N3400-W8045/7.5, AMS, V046A*

- Maps (Topographic)
    1. Messers Pond, SC, N300-W8045/7.5, AMS, V846*

- Box 47, Entry 391, Construction Completion Reports, 1917-1943
    1. Memorandum. Subject: Completion Report of Fort Jackson, SC, From Steward A. Marshall, Jr., Major, Corps of Engineers, Area Engineer, Constructing Quartermaster, 16 December 1941

- Box 101, Entry 393, History Record of Buildings
    1. Memorandum. Subject: Post War Utilization Studies, From War Department, Office of the Chief of Engineers, Fort Jackson, SC, September 1945*

- Box 140, Entry 391, Construction Completion Reports, 1917-1943
    1. Memorandum. Subject: Completion Report of Camp Jackson, From Construction Quartermaster, Camp Jackson, 17 January 1918*

RG 92, Quartermaster General

- Box 18-52, Entry 1998, Real Estate Records, 1917-1922
    1. Photograph. Miniature Range Building, Camp Jackson, SC

- Box 52, Entry 1998, Real Estate Records, 1917-1922
    1. Photograph. General Layout, Camp Jackson, SC, October 1917
    2. Map. Key Map of Property, Camp Jackson, SC, June 1918*

- Box 117, Entry 1998, Real Estate Records, 1917-1922
    1. Correspondence. From Matthew R. Beals, 2 January 1918
    2. Map. Cantonment Realty Company, 18 July 1917*

- Box 118, Entry 1998, Real Estate Records, 1917-1922
    1. Memorandum. Subject: Claim of C. M. Dempsey, From C.F. Von Dem Bussche, Major QMD Chief, Real Estate Division, 1 September 1920

- Box 119, Entry 1998, Real Estate Records, 1917-1922
    1. Correspondence. Subject: Lease, From North Carolina Security Company, 1 July 1918
    2. Correspondence. Subject: Property Offer, From P.H. Norcross, Acquisition Agent, 4 June 1919
    3. Correspondence. From Edwin Bell, Lieut. Colonel, Infantry, 28 November 1919
    4. Correspondence. From Edwin Bell, Lieut. Colonel, Infantry, 24 March 1920
    5. Correspondence. From O.M. Marshburn, Executive Officer, Fiscal Branch, 17 June 1920
    6. Correspondence. From War Department Claims Board, Appraisal Section, 13 April 1921

- Box 120, Entry 1998, Real Estate Records, 1917-1922
    1. Correspondence. From Edwin Bell, Lieut. Colonel, Infantry, 5 December 1919
    2. Correspondence. From Edwin Bell, Lieut. Colonel, Infantry, 17 April 1920
    3. Correspondence. Subject: Submitting a claim against US Government, From L. W. Cass, Lieut. Colonel, U.S.A. Acting Chairman, 13 April 1921

- Box 136, Entry 1974-A, Completion Reports, 1917-1919
    1. Map. General Layout, Camp Jackson, Columbia, SC, September 1917*
    2. Memorandum. Subject: Completion Report of Camp Jackson, From Constructing Quartermaster, Camp Jackson, 17 January 1918*
    3. Correspondence. Subject: Final Report: Plans and Descriptions of Camp and Camp Utilities, Camp Jackson, SC, 19 January 1918*
    4. Map. Location Map, Camp Jackson, Columbia, SC*

- Box 209, Entry 1974-A, Completion Reports, 1917-1919
    1. Memorandum. Subject: General Completion Report on North Camp Jackson as abandoned 28 February 1919, From H. J. MacDonald, Captain, Q. M. Corps, Constructing Quartermaster, 28 February 1919*

- Box 720
    1. Correspondence. Subject: Government lands, From DuPont B. Lyon, Acting Division Adjutant, 12 May 1921

RG 111, Office of the Chief Signal Officer

- Box 54
    1. Photographs. Drill Sergeant signals all clear as Fort Jackson Basic Trainees prepare to fire M-16's from kneeling position, 20 January 1963, Sergeant Wesley Forman acts as gunner on a 4.3 inch mortar in an arms demonstration at the Bastogne Range, Fort Jackson, SC, 22 January 1963
    2. Photographs. An Advanced Infantry Trainee is instructed in the proper handling and firing of the flame thrower at Fort Jackson's Biak Range, 23 April 1963, Private B. W. Roland fires a short burst of ammo from the M-60 automatic weapon during Advanced Infantry Training at the Cassino Range, Fort Jackson, SC, 6 January 1963, Advanced Infantry Trainees practice the proper firing techniques of the M-60 machine gun under the careful supervisor of a range safety officer at Fort Jackson's Cassino Range, 17 April 1963, Mortarmen zero in their weapons during class, 20 January 1963

- Box 72
    1. Photograph. Aerial view of the football and baseball parks at the U.S. Army Training Center, Infantry, Fort Jackson, SC, 21 May 1956
    2. Photograph. Aerial view of Fort Jackson, SC, 31 May 1956
    3. Photograph. Aerial view of Headquarters, U.S. Army Training Center, Infantry, Fort Jackson, SC, 31 May 1956
    4. Photograph. Tank Hill and area overlooking the area of the 1st and 2nd Training Regiments, Fort Jackson, SC, 31 May 1956
    5. Photograph. Aerial view of Gate #1 Main Entrance to Fort Jackson, U.S. Army Training Center, Infantry, Fort Jackson, SC, 31 May 1956

- Box 100
    1. Photographs. Crew members getting ready to launch a radio controlled airplane target OQ-2A from catapult at the anti-aircraft range, The radio controlled airplane target OQ-2A taking off from catapult, 1 December 1943

- Box 108
    1. Photograph. Drill Sergeant John R. Corkin helps a Basic Combat Trainee get into the proper position to fire, Fort Jackson, SC, 8 October 1964

2. Photographs. Front view firing position of the M-60 Machine Gun, Privates Coatney and Brown prepare to fire the 106 Recoilless Rifle, 15 September, 1969*
3. Photograph. Basic Combat Trainee fires his M-14 rifle down range as he is scored by another trainee, Ft. Jackson, SC, 8 October 1964

- Box 137
  1. Photographs. Aerial view of Signal Battalion lined up for command field inspection, Aerial view of the 59th Signal Battalion lined up for command field inspection, 15 February 1943

- Box 155
  1. Photographs. Firing line at .45 Caliber Pistol Range, 23 April 1943, Major Irving B. Tietze at observation post conducting firing, 28 April 1943

- Box 165
  1. Photographs. Life of 18-19 year old soldier, Fort Jackson, SC, April 1943

- Box 167
  1. Photographs. Sgt. Ramsey demonstrates how one can overcome two in a bayonet duel, 15 October 1943

- Box 180
  1. Photographs. Aerial view of the central area of Fort Jackson showing the post and Division Headquarters, 4 April 1950

- Box 212
  1. Photographs. Pvt. Otis C. Dobbins, Co. H, 28th Inf. Regiment is shown at Station #9 of the new Proficiency Range that was recently put in effect in Fort Jackson, SC, 25 June 1951

- Box 283
  1. Photographs. Lt. Col. C. T. Gilbreath, Major J. G. Mann, Lt. Col. Kenneth N. Vickery, and Major R. A. Banister firing .45 caliber pistols at Fort Jackson's Leesburg Pistol Range #3, Brothers Lt. Col. John P. Booker and Lt. Col. L. R. Booker checking targets on Leesburg Pistol Range #3, 11 August 1954

- Box 290
  1. Photographs. Aerial view of Fort Jackson Post Aviation Section and Headquarters area, 4 June 1956

- Box 323
  1. Photographs. The effectiveness of a new concept of Army rifle training is being carefully watched at Fort Jackson, SC by officials of the experimental system called "Trainfire," 20 October 1955
  2. Photographs. Maj. Gen. Armistead D. Mead, Chief of Infantry, Continental Army Command, Fort Monroe, and Lt. Col. James H. Ritts, Special Project Officer,

Trainfire, observe firing under the Army's experimental rifle marksmanship project "Trainfire," during Gen. Mead's inspection of the project at Fort Jackson, 15 November 1956

- Box 380
    1. Photographs. 12th Battalion, Third Training Regiment firing the M-94 Rifle from the standing position at Fort Jackson, SC, 28 March 1963

- Box 389
    1. Photographs. Expert infantry badge candidate removing mine from danger area, 5 March 1965
    2. Photographs. Lieutenant Colonel Musa Eltassan firing the M79 Grenade Launcher at the Taejon Range, Argentina Superior School of War officers visiting Fort Jackson, 5 November 1962

- Box 390
    1. Photographs. Station #5 of the Hand Grenade Range and the practice live bay on the Hand Grenade Range at Fort Jackson, SC, 25 March 1965
    2. Photographs. The ready line of the live bay area of the Hand Grenade Range and Station #5 of the Hand Grenade Range at Fort Jackson, SC, 25 March 1965
    3. Photographs. Station #4 of the Hand Grenade Range at Fort Jackson, SC, 25 March 1965
    4. Photographs. Control tower for the live bay area of the Hand Grenade Range, Live bay area of the Hand Grenade Range, Fort Jackson, SC, 25 March 1965
    5. Photographs. The grenade sump of a live bay on the Hand Grenade Range, Live bays on the Hand Grenade Range, Fort Jackson, SC, 25 March 1965

- Box 396
    1. Photograph. Salerno Range, Fort Jackson, SC, 25 October 1965*
    2. Photograph. Field Firing Range at Fort Jackson, SC, 25 October 1965
    3. Photographs. 25 Meter Range, Target Detection Range, Fort Jackson, SC, 25 October 1965
    4. Photographs. Metz Range, Saint Lo, Salerno Range, Fort Jackson, SC, 25 October 1965*
    5. Photographs. Metz Range, Saint Lo, Fort Jackson, SC, 25 October 1965*
    6. Photograph. 25 Meter Range, Fort Jackson, SC, 25 October 1965
    7. Photograph. Target Detection Range, Fort Jackson, SC, 25 October 1965

- Box 397
    1. Photographs. Aerial view of Tactical Training Range #3, New Rifle Squad Tactical Training Range Complex at Wildcat and Dixie Roads, Aerial view of Tactical Training Range #4, New Rifle Squad Tactical Training Range Complex At Wildcat and Dixie Roads, 19 October 1965
    2. Photographs. Aerial view of Tactical Training Range #1, New Rifle Squad Tactical Training Range Complex at Wildcat and Dixie Roads, Aerial view of

Tactical Training Range #2, New Rifle Squad Tactical Training Range Complex at Wildcat and Dixie Roads, 19 October 1965

RG 156, Office of Chief Ordnance

- Box 818, Entry 368, Real Property Disposal Files, Account 53A592
    1. Correspondence. Subject: Extract Requisitions, From Roger Taylor, Colonel Ordnance Department, Commanding, 8 January 1940

RG 270, WAA, Real Property Disposal Files

- Box 240
    1. Map. Fort Jackson and Vicinity, SC, N3357.9-W8041.7/8.9 x 18.9*

RG 337, Headquarters Army Ground Forces

- Box 23, Entry 51-A, Subject File, 1941-1950
    1. Correspondence. Subject: Estimate of Funds, From Lynden R. Anderson, Major, Ordnance Department, Asst S-4, 18 February 1947*

- Box 31, Entry 108 (UD), AGG and AFF Installations
    1. Correspondence. From James E. Bowen Jr., Captain, 20th Infantry, Adjutant, 12 March 1940
    2. Correspondence. From F. V. M. Dyer, Lieutenant Colonel, Infantry, Adjutant, 11 June 1941*
    3. Correspondence. Subject: Post Range Regulations, General Orders Number 63, From A. T. Murphey, Colonel, FA, Adj., 3 December 1942*
    4. Correspondence. Subject: Post Range Regulations, General Orders Number 25, From A. T. Murphey, Colonel, FA, Adj., 8 July 1943*
    5. Correspondence. From A. T. Murphey, Colonel, FA, 20 July 1943
    6. Correspondence. Subject: Post Range Regulations, General Orders Number 18, From Joseph P. O'Hara, Major, AUS, Adjutant, 16 March 1944*
    7. Correspondence. Subject: Danger Area for Aircraft, From Joseph P. O'Hara, Major, AUS, Adjutant, 23 March 1945

- Box 34, Entry 108 (UD), AGG and AFF Installations
    1. Correspondence. Subject: Historical report regarding 1949 Range Regulations, From G.H. Decker, Major General, Commanding, 17 June 17 1949*
    2. Memorandum. Subject: 1950 Fort Jackson Range Regulations, From F. J. Reese, Lt. Colonel, AGD, Adjutant, 15 April 1950*
    3. Map. Fort Jackson and Vicinity, SC, N3357.9-W8041.7/8.9x18.9*

- Box 37, Entry 1, Inspection Reports, 1951
    1. Correspondence. Subject: Inspection Third Army, From Michael Dopudja, 1st Lt. G3 (83), 1951

2. Correspondence. Subject: Training Report, 31st Infantry Division, From Lother B. Sibert, Lt. Colonel, GSC, 10 April 1951*
3. Correspondence. Subject: Supply Status, 31st Infantry Division, From Clifford P. Morrison, Lt. Colonel, GSC, 10 April 1951*
4. Correspondence. Subject: Brief of Report on Third Army Command Inspection of 31st Infantry Division, Fort Jackson, SC, 14 June 1951
5. Memorandum for Chief of Army Field Forces. Subject: Report of Staff Visit to Fort Jackson, SC, From T. M. Ariail, Lt. Col. G.S., 23 October 1951
6. Disposition Form. Subject: Report of OCAFF Participation in 3rd Army Inspection of Units at Fort Jackson, SC, From Charles B. Smith, Lt. Colonel, Inspector of Infantry Section, 23 October 1951
7. Memorandum for Chief of Army Field Forces. Subject: Report of Staff Visit to Fort Jackson, SC, From T. M. Ariail, Lt. Colonel, GS, 23 October 1951
8. Correspondence. Subject: Report of Annual Inspection of Fort Jackson and Semi-annual Inspection of the 8th Infantry Division, Fort Jackson, SC, From C. B. Herndon, Colonel, GS, 5 November 1951

- Box 57, Entry 57, General Headquarters, General Correspondence, 1940-1942
    1. Memorandum for General McNair. Subject: Report of Inspection of National Guard Divisions inducted into Federal Service, From M. W. Clark, Lt. Colonel, Infantry, 11 October 1940

- Box 58, Entry 57, General Correspondence, 1940-1942
    1. Correspondence from Walter C. Short, Major General, U.S. Army, Commanding, 22 November 1940
    2. Memorandum for Chief of Staff. Subject: Inspection Trip to Fort Jackson, SC, From C. H. Gerhardt, Lt. Colonel, G.S.C., 1 February 1941

- Box 60, Entry 1, Inspection Reports
    1. Memorandum for Chief of Army Field Forces. Subject: Report of Routine Inspection of 31st Infantry Divisions, From F. W. Milburn, Lieutenant General, Chief Inspector, 23 January 1952
    2. Correspondence. Subject: Report of Semi-annual Inspection of the 8th Infantry Division, Fort Jackson, SC, From M. J. Lucree, Lt. Colonel, GS, 7 May 1952
    3. Memorandum for Chief of Army Field Forces. Subject: Report of Inspection of 108th Infantry Division, From Reserve Corps, 15 August 1952
    4. Correspondence. Subject: Data Sheet for Inspectors and Visiting Staff Officers, From Inspection Secretariat Office, 24 September 1952
    5. Memorandum for Chief of Army Field Forces. Subject: Report of Observation of Semi-Annual Inspection of 8th Infantry Division, From Third Army Inspection Team, 24 September 1952
    6. Correspondence. Subject: Report of Semi-annual Inspection of the 8th Infantry Division and Annual Command Inspection of Fort Jackson, From Headquarters Third Army, Fort McPherson, Georgia, 1 October 1952

- Box 78, Entry 1, AFF, Inspection Reports
    1. Memorandum for Chief of Army Field Forces. Subject: Report of Staff Visit to the 108th Infantry Division, North and South Carolina (USAR) and ORC in Field Training at Fort Jackson, SC, From Donald M. Macwillie, Colonel, GS, 9 September 1953
    2. Correspondence. Subject: Report of Semi-annual Inspection of the 8th Infantry Division (Training) and Annual Command Inspection of Fort Jackson (Post), 25 September 1953

- Box 178, Entry 30, Inspection Reports, 1942-1944
    1. Memorandum for Training. Subject: Movement of Division to the Field, From M. McClure, Colonel GSC, Chief of Staff, 14 July 1943
    2. Memorandum for the Assistant Chief of Staff. Subject: Observation During Visit to Camp Gordon, Camp Jackson, and Camp Butner, 20-21 July 1943, From E. H. J. Carns, Lt. Colonel, Calvary, 24 July 1943
    3. Memorandum for the Assistant Chief of Staff. Subject: Visit to Camp Gordon, Camp Jackson and Camp Butner, 20-22 July 1943, From L. L. Williams, Colonel, GSC, 26 July 1943
    4. Memorandum for the Chief of Staff. Subject: Visit to Camp Gordon, Fort Jackson, and Camp Butner, 20-22 July 1943, From W. B. Forse, Colonel, Infantry, 27 July 1943

- Box 1122, Entry 55, General Correspondence, 1942-1948
    1. Correspondence. Subject: Layout Plans and Cost Estimate for Ranges, From Ezra S. Settle, Lt. Col. Inf. Executive, 5 April 1943
    2. Correspondence. Subject: Training Aids, From J. V. V. Shufelt, Colonel, General Staff Corps, Director, Operations and Training Division, 5 October 1942*
    3. Correspondence. Subject: Moving Vehicle Range, From Stuart Lewis, Lt. Col., G. S. C., Chief, Training Branch, 10 December 1942*
    4. Correspondence. Subject: Safety Limits of Ranges, Headquarters Army Ground Forces, Army War College, 15 December 1942*

- Box 1123, Entry 55, General Correspondence, 1942-1948
    1. Correspondence. Subject: Construction of Ranges, From John R. Lucas, Captain, Infantry Range Officer, 25 April 1947*

RG 338, U.S. Army Commands

- Box 488, Entry 37042, Unit Records
    1. Correspondence. Subject: Danger Area at Small Arms Range, From W. H. Gill, Colonel, General Staff Corps, Chief of Staff, 2 May 1941

- Box 489, Entry 37042, Unit Records
    1. Memorandum. Subject: Training Memorandum, From M. J. Conway, Major, Adjutant General, 28 August 1940

2. Memorandum. Subject: Memorandum for Training, From M. J. Conway, Lt. Colonel, Adjutant General, 7 March 1941
3. Memorandum. Subject: Training Memorandum, From M. J. Conway, Lt. Colonel, Adjutant General, 28 May 1941
4. Memorandum. Subject: Master Schedule, 1 June 1941 to 27 December 1941
5. Memorandum. Subject: Training Memorandum, From F. R. Keeler, Lt. Col., Adjutant General, 24 March 1942
6. Memorandum. Subject: Training Memorandum, From A. B. Wood, Acting Adjutant General, 28 March 1942
7. Memorandum. Subject: Training Memorandum Number 33, From F. R. Keeler, Lt. Colonel, Adjutant General's Department, 26 May 1942*
8. Memorandum. Subject: Training Program, From F. R. Keeler, Lt. Colonel, Adjutant General, 29 June 1942
9. Memorandum. Subject: Training Memorandum, From F. R. Keeler, Lt. Colonel, Adjutant General, 13 July 1942

RG 393, U.S. Army Continental Commands, 1821-1920

- Box 13, Part V, Camp Jackson
    1. Correspondence. Subject: General Conditions, Camp Jackson, SC, From Commanding General, 4 November 1920

- Box 14, Part V, Camp Jackson
    1. Correspondence. Subject: Activities of Utilities for Month of September 1918, September 1918
    2. Correspondence. Subject: Report of Activities of the Utilities for the Month of December 1918, From George Peterson, Major, Quartermaster Corps, 20 January 1919
    3. Correspondence. Subject: Letter from Chief Clerk to Camp Jackson, Commanding Officer, Camp Jackson, 15 August 1919

- Box 16, Part V, Camp Jackson
    1. Correspondence. Subject: Report on Artillery Range at Camp Jackson, From Andrew Mosses, Commanding Officer, 156th Artillery Brigade, 26 March 1918
    2. Correspondence. Subject: Gas Training, From Frederick Swanson, Chief Gas Officer, July 1918

- Box 23, Part V, Camp Jackson
    1. Correspondence from Thos. D. Osborne, Colonel 59th F.A., Commandant, 11 October 1919

- Box 24, Part V, Camp Jackson
    1. Correspondence. Subject: Camp on Ancrum Ferry Road, From Geo. L. Peterson, Major, Q. M. C., Utilities Officer, 11 September 1918
    2. Correspondence. Subject: Guard for Small Arms Target Range, From A.C. Marsh, Capt. Ord. Dept., 27 January 1919

3. Correspondence. Subject: Answers to Questionnaire, From Harry R. Lee, Colonel, Infantry, Commanding, 29 June 1920*
4. Memorandum. Subject: Memorandum for Publication, From Robert McCleave, Executive Officer, 23 March 1921
5. Correspondence. Subject: Use of Target Range, From C. J. Symmonds, Chief of Staff, 2 September 1921
6. Correspondence. Subject: Correspondence, From Dupont B. Lyon, Acting Camp Adjutant, 21 September 1921
7. Correspondence. Subject: Letter, From W. T. Derieux, Secretary, Missions Commission to Quartermaster, Camp Jackson, SC, 27 October 1921

- Box 25, Part V, Camp Jackson
  1. Correspondence. Subject: Marking boundaries of target range, From Major, Division of Judge Advocate, 16 March 1918
  2. Correspondence. Subject: Safety of Artillery Range, From Andrew Moses, Colonel, Commanding, 19 March 1918
  3. Memorandum. Subject: Assignments made for drill and training purposes, From W. L. Luhn, Lieut. Colonel, Infantry, Adjutant, 18 June 1918
  4. Correspondence. Subject: Report on Small Arms Range, Camp Jackson, From F.H. French, Brigadier General, Commanding, 23 July 1918*
  5. Memorandum. From W. L. Luhn, Lieut. Col., Infantry, Acting Executive Officer, 27 August 1918
  6. Correspondence. Subject: Firing on Machine Gun Range, From Thomas Ryan, 2nd Lt., 23 September 1918*

- Box 26, Part V, Camp Jackson
  1. Correspondence. Subject: Condition of Fence, From Andrew Hero Jr., Colonel, Coast Artillery Corps, Commanding, 21 July 1921
  2. Correspondence. Subject: Recommendation for Change in Artillery Range, From Land Acquisition Agent, 26 June 1919

- Box 27, Part V, Camp Jackson
  1. Correspondence. Subject: Target Range Telephone System, From L. S. Carson, Assistant Adjutant, 9 May 1921

- Box 28, Part V, Camp Jackson
  1. Correspondence. Subject: Lease for Artillery Range, Camp Jackson, From W. P. Dewall, Major General, August 1917
  2. Correspondence. Subject: Condemnation of Land for Artillery and Rifle Ranges, From Department Commander, Southeastern Department, 14 September 1917
  3. Correspondence. Subject: Small Arms Target Range for Divisional Training, 11 October 1917*
  4. Correspondence. Subject: Depopulation of Area Beyond Target Range, 17 December 1917*
  5. Correspondence. Subject: Recommendation for Change in Artillery Range, From Camp Jackson, Land Acquisition Agent, 14 June 1919

6. Correspondence. Subject: Camp Jackson, From James E. Manierre, Major, Camp Adjutant, Not dated

- Box 30, Part V, Camp Jackson
    1. Correspondence. Subject: Condemnation of Land for Use as Target Range, From Brigadier General, 8 September 1917
    2. Correspondence. Subject: Small Arms Firing Manual, From Roger H. Williams, 18 September 1917*
    3. Correspondence. Subject: Camp Jackson, From W. L. Luhn, Lieut. Col., Infantry, Adjutant, 28 June 1918
    4. Correspondence. Subject: Daily Bulletin No. 32, 11 February 1920*
    5. Correspondence. Subject: Daily Bulletin No. 39, 19 February 1920*
    6. Correspondence. Subject: Daily Bulletin No. 42, 24 February 1920*
    7. Correspondence. Subject: Daily Bulletin No. 47, 3 March 1920*
    8. Correspondence. Subject: Daily Bulletin No. 77, 15 April 1920*
    9. Correspondence. Subject: Daily Bulletin No. 92, 3 May 1920
    10. Correspondence. Subject: Daily Bulletin No. 96, 10 May 1920*
    11. Correspondence. Subject: Daily Bulletin No. 105, 22 May 1920*
    12. Correspondence. Subject: Daily Bulletin No. 174, 1 September 1920
    13. Correspondence. Subject: Daily Bulletin No. 185, 17 September 1920

- Box 31, Part V, Camp Jackson
    1. Correspondence. Subject: Camp Jackson, From Herman Erlenkotter, Major, FA, NA, Adjutant, 19 July 1918

- Box 32, Part V, Camp Jackson
    1. Correspondence. Subject: Men to Fire on Target Range, From B.W. Brooks, C.O., 28 April 1921

RG 394, U.S. Army Continental Commands, 1920-1942

- Box 1, Entry 470, General Orders
    1. Correspondence. Subject: Camp Jackson, From Dupont B. Lyon, Acting Camp Adjutant, 14 February 1921
    2. Correspondence. Subject: General Orders No. 52, From Dupont B. Lyon, Acting Camp Adjutant, 24 March 1921
    3. Correspondence. Subject: Camp Jackson, From Dupont B. Lyon, Acting Camp Adjutant, 25 April 1921

- Box 234, Entry 123, 4th Corps Area
    1. Correspondence. Subject: Rifle Range, From Maurice E. Barker, Captain, CAC, 25 June 1923*
    2. Memorandum to the Assistant Chief of Staff. From C. M. Roberts, Ordnance Officer, 3 August 1923*
    3. Correspondence. Subject: Clearing on Camp Jackson Military Reservation for Field Artillery Fire, From Jas. C. Dozier, 24 May 1937

RG 407, Adjutant General

- Box 370, General Correspondence, 1946-1958
    1. Correspondence. Subject: Complaint Concerning Waste of Ammunition at Fort Jackson, SC, 28 July 1958
- Box 1065, Entry 37-A, Central Decimal Files, 1917-1925
    1. Correspondence. Subject: Report on Small Arms Range, From F. H. French, Brigadier General, Commanding, 23 July 1918*

- Box 1191, Entry 37-A, Project Files, 1917-1925
    1. Correspondence. Subject: Camp Jackson, From Clark S. Smith, 21 January 1922
    2. Correspondence. Subject: Report of Director of Small Arms Firing, R.O.T.C. Camp, From James A. Lynch, Colonel, Infantry Camp, 25 August 1920

- Box 2865, Entry 37, Central Files, 1926-1939
    1. Correspondence. Subject: Camp Jackson, From F. C. Reilly, Lt. Colonel, Adjutant, General's Department, 28 March 1934

- Box 2867, Entry 37, Central Files, 1926-1939
    1. Memorandum. Subject: Camp Jackson National Forest, From War Department, General Staff, 11 April 1928
    2. Map. Jackson National Forest, SC*
    3. Map. Special Military Map, Camp Jackson, SC*

- Box 2868, Entry 37, Central Files, 1926-1939
    1. Correspondence. Subject: Camp Jackson, From Jas. C. Dozier, Adjutant General, 1 April 1927
    2. Memorandum to Colonel Dunn and Major Cron. Subject: Camp Jackson National Forest, From U.S. Department of Agriculture, Forest Service, Eastern District, 9 April 1928
    3. Memorandum. Subject: Jackson National Forest, From J. M. Dunn, Lieut. Colonel, General Staff, 24 April 1928

- Box 3964, AAG, Entry 363-A, Decimal File, 1940-1945
    1. Correspondence. Subject: Construction of Training Aids, From R. W. Strickland, 1st Lieut., Assistant Adjutant General, 24 February 1941*
    2. Memorandum. Subject: Training Facilities, 24 February 1941*

- Box 4440, Entry 363, Unclassified Project Decimal Files, 1940-1945
    1. Correspondence. Subject: Request for Permission to have Marine Corps Officers inspect Rifle Range, Fort Jackson, SC, From E.A. Ostermann, 29 July 1941
    2. Correspondence. Subject: Fort Jackson, From C. H. Day, Capt., 4th F. A., Acting Assistant Adjutant General, 3 July 1940
    3. Correspondence. Subject: Fort Jackson, From Steward A. Marshall, Jr., Captain, Quartermaster Corps, Constructing Quartermaster, 25 October 1941

4. Correspondence. Subject: Fort Jackson, From Signal Corps, U.S. Army, War Department Message Center, 10 September 1940

Library of Congress, Prints and Photographs Division, Washington, D.C.

Aerial Photographs:

1. Camden No. 22, Fort Jackson and Vicinity, N3400-W8048/6, AMS V046M
2. Camden No. 23, Fort Jackson and Vicinity, N3400-W8042/6, AMS V046M
3. Fort Jackson North, SC, Sheet 4852 III SW, Second Edition, N3400-W8052.5/7.5, Series V046A*
4. Fort Jackson North, SC, Series V046A, Sheet 4852 III SW, Edition 3-AMS*
5. Messers Pond, SC, Series V064A, Sheet 4852 III SE, N3400-W8045/7.5*
6. Leesburg, SC, Fort Jackson and Vicinity, N3400-W8037.5/7.5, AMS V046A

Library of Congress, Geography and Map Division, Washington, D.C.

Maps (Topographic):

1. Fort Jackson North Quadrangle, SC, Richland County, SW/4 Killian 15' Quadrangle, N 3400-W8052.5/7.5*
2. Fort Jackson North Quadrangle, SC, Richland County, 34080-A8-TF-024*
3. Fort Jackson South Quadrangle, SC, Richland County, NW/4 Hopkins 15' Quadrangle
4. Hagood, SC, AMS, V746, N3400-W8030/15
5. Hagood, SC, Series V746, Sheet 4852 II, Edition 3-AMS
6. Hagood, SC, Series V746, Sheet 4852 II, Edition 4-AMS
7. Hagood, SC, Series V746, Sheet 4852 II, Edition 5-TCP
8. Hagood, SC, Series V746, Sheet 4852 II, Edition 7-DMATC
9. Killian, SC, Series V742, Sheet 4852 III, Edition 4-AMS*
10. Killian, SC, Series V746, Sheet 4852 III, Edition 5-TPC*
11. Killian, SC, Series V746, Sheet 4852 III, Edition 7-DMATC*
12. Leesburg Quadrangle, SC, N3400-W8037.5/7.5, SW/4 Hagood 15' Quadrangle
13. Messers Pond, SC, Series V846, Sheet 4852 III SE, N3400-W8045/7.5*
14. Messers Pond Quadrangle, SC, SE/4 Killian 15' Quadrangle, N3400-W8045/7.5*
15. Messers Pond Quadrangle, SC, AMS 4852 III SE, Series V846, N3400-W8045/7.5*

Regional Archives, NARA Southeast Region (Atlanta), East Point, Georgia

RG-77, Chief of Engineers

- Maps
    1. MIL Construction Drawings, 1950-1956, Tube 13, NARA-Atlanta

RG-156, Office of Chief of Ordnance

- Box 24, Real Property Disposal Files, Account 53A592
    1. Correspondence. Subject: Disposal Plan, From Lillian S. Boswell, Realty Specialist, 9 November 1964

RG 270, WAA, Real Property Disposal Files

- Box 24, Account 52A592
    1. Correspondence. Subject: Certificate of Clearance, From Joseph A. Bocelato, Captain, Corps of Engineers, 30 August 1950
    2. Memorandum. Subject: Fort Jackson Military Reservation, 24 May 1951
    3. Memorandum. Subject: Fort Jackson Military Reservation, Richland County, SC, D-SC-403, From Administrator, General Service Administration, 27 June 1951
    4. Correspondence. Subject: Quitclaim Deed, From Lloyd Gensel, Deputy Regional Director, Public Building Service, General Services Administration, 18 July 1951
    5. Correspondence. Subject: Quitclaim Deed, From Robert V. Christie, Regional Director, 10 March 1964
    6. Memorandum. Appraisal Report from District Engineer, U.S. Army Engineering District, Savannah, GA, 29 September 1964

- Box 177
    1. Correspondence. Subject: Request for approval of salvaging and dismantling the materials of all Theatre of Operation Type Construction on the Main Post, From H.W. Ehrgott, Colonel, Corps of Engineers Chief, Repairs and Utilities Division, 5 December 1946

Appendix B: Archive Documents

REPRODUCED AT THE NATIONAL ARCHIVE

Sept 18, 1917

BULLETIN, No. 12.

HEADQUARTERS 81ST DIVISION
CAMP JACKSON, COLUMBIA, S. C.

September 18, 1917.

The following proposed changes, Small Arms Firing Manual, are published for the information and guidance of this command:

"SMALL ARMS FIRING MANUAL.

CHANGES No. —.

WAR DEPARTMENT,
WASHINGTON, *August —, 1917.*

The following is added to Appendix II, Small Arms Firing Manual, 1913:

C. *Special Course when time or facilities for regular courses are not available.*

This course will be prescribed for the quick training of troops in rifle practice, when time or facilities for the regular courses are not available.

Success cannot be expected, nor can proficiency in rifle practice be attained by a company in this course, unless it has been thoroughly instructed, and each man should satisfactorily pass the prescribed tests before he fires a shot on the range. Without this thorough preliminary course, and satisfactorily passing these tests, it is a waste of ammunition to let the soldier fire ball cartridges on the range.

The soldier is first given a thorough course of preliminary practice as outlined in paragraphs 1 to 70, inclusive. He is then before being allowed to fire a shot on the target range, given the following tests:

Test I.

Nomenclature of the rifle in so far as is necessary for its efficient care and use.

Test II.

Assembling and dissembling of the rifle in so far as is necessary for its efficient care and use.

Test III.

Care of rifle.

Test IV.

Sight-setting: Normal and peep, with and without

Major Roger H. Williams
Inf.

RG 393, Army Cont Cmds, 1821-1920
Part V, Bulletins & Memoranda
Box 30

deflection. Maximum time limit of 10 seconds in each of not less than 5 consecutive trials.

Test V.

Firing Positions:

(a) Standing,
(b) Kneeling,
(c) Sitting,
(d) Prone,
(e) From parapet, wall top, or other under-rifle rest.
(f) From vertical edge of wall, door, window, tree, or similar position.

Test VI.

Loading from belt, pockets fastened, with a clip of dummy cartridges, in position.

Standing, Kneeling, Sitting, Prone — Maximum time limit of 10 seconds each in best 5 out of 7 consecutive trials.

Test VII.

Sighting: With rifle in sighting rest.

(Third sighting exercise, Par. 27.)

Normal Sight, Peep Sight — Proficiency required in 3 consecutive triangles of sighting with each. Distance 20 feet; no side of triangle to exceed 1-2 inch.

Test VIII.

Aiming combined with trigger squeeze.

Test by means of:

(a) Target machine,
(b) Aiming Rod device,
(c) Belgian aiming device, or
(d) Perforated bullseye over instructor's eye.

(Methods used to be noted by abbreviations M., R., B. and P., respectively.)

(a) Standing,
(b) Kneeling,
(c) Sitting, and
(d) Prone.

Test IX.

Rapid Loading, aiming and firing: Load from belt and simulate fire with two clips of dummy cartridges. Tested by means of:

(a) Aiming rod device, or
(b) Belgian aiming device, or
(c) Perforated bullseye over instructor's eye.

(Method used to be noted by abbreviations R., B. and P., respectively.)

In positions:

Standing,
Kneeling,
Sitting, and
Prone.

Time of each:

1 minute,
1 minute, 10 seconds,
1 minute, 10 seconds, and
1 minute, 20 seconds, respectively.

Test X.

Flinching:

In prone position. The rifle will be so manipulated by the instructor that the man under test does not know whether or not it is loaded. Service ammunition to be used.

Known Distance Practice.

An annual allowance of 150 rounds per man is authorized for Known Distance Practice, which includes Short Range Practice, Midrange Practice and Practice with Telescopic Sights.

Short Range Practice.

All firing from a typical trench, bayonet fixed except as noted, rifle resting on parapet.

REPRODUCED AT THE NATIONAL ARCHIVES

Instruction.

Table 1.—Slow Fire.

Range Yards	Time	Shots	Target	Position and Type of Trench	Sight
100	No Limit	10	A-4	Prone	Leaf
200	" "	10	A-4	Standing	5 leaf and 5 battle sight
300	" "	15	A-4	Standing	10 leaf and 5 battle sight.

(a) One-half of firing with leaf sight at this range will be with bayonet not fixed.

105 points out of possible 175 in slow fire at bullseye target necessary to advance to slow fire at figure target.

Table 2.—Slow Fire.

Range Yards	Time	Shots	Target	Position and Type of Trench	Sight
100	No Limit	5	Head	Prone	Leaf
200	" "	5	F	Standing	"
300	" "	5	F	"	"

9 hits out of possible 15 required to advance to rapid fire.

Table 3.—Rapid Fire.

Range Yards	Time	Shots	Target	Position and Type of Trench	Sight
100	One Minute	10-20 (b)	Head	Prone	Leaf
200	" "	10	F	Standing	"
300	" "	10	F	"	"

18 hits out of possible 40 required to advance to Record Practice.

Soldiers who fail to make the necessary points to advance are given further instruction practice to the limit of the ammunition allowance.

Record.

Table 4.—Rapid Fire.

Range Yards	Time	Shots	Target	Position and Type of Trench	Sight
100	One Minute	10-20 (b)	Head	Prone	Leaf
200	" "	10	F	Standing	"
300	" "	10	F	Standing	"

(b) At this range the soldier must fire 10 rounds; he may fire as many more as he can up to 20 rounds and receive credit for every hit he makes. Soldier is penalized 1 point for each round less than ten that he does not fire.

Total shots—130.

Mid Range Practice.

For all men who have made 25 hits or more in Record Practice.

Table 5.—Slow Fire.

Range	Time	Target	Shots	Position
500	No Limit	B	10	Prone
600	" "	B	10	Prone

Every effort will be made to teach the men the effect of wind, light and temperature, and the value of small changes in elevation and windage.

No report of this firing will be required, although a record of it will be kept in each company.

Practice With Telescopic Sights.

After Mid Range Practice has been completed, the four best enlisted shots of the company will fire as prescribed in Par. 117.

Combat Practice.

Combat Practice, individual and collective, will be fired by an organization after the completion of the Known Distance Practice.

REPRODUCED AT THE NATIONAL ARCHIVES

REPRODUCED AT THE NATIONAL ARCHIVES

An annual allowance of 50 rounds of ammunition per man, to be expended under the direction of the regimental commander, is authorized for this practice.

Targets.

Target A-4 is the A target, as described in Par. 258, cut down to 4 feet square. The rapid fire is conducted as at present prescribed under Procedure Rapid Fire, page 71, with the exception that at all ranges the soldier assumes the firing position before the command "Ready" is given.

The Head Target is the top of the E Target cut off 12 inches from the top. (C. S. A. F. M. No—, Aug.—, 1917.) (353.1, A. G. O.)

BY ORDER OF THE SECRETARY OF WAR:

TASKER H. BLISS,
Major General, Acting Chief of Staff.

OFFICIAL:
H. P. McCAIN,
Adjutant General.

Copy of O. O. File R-300. 8-4.
MG
CM"

BY COMMAND OF BRIGADIER GENERAL BARTH:

C. D. ROBERTS,
Lieut. Col., Inf., N. A.,
Chief of Staff.

OFFICIAL:
ADNA R. CHAFFEE,
Major, Inf., N. A.,
Division Adjutant.

Ed. Camp Jackson, Oct. 16, 1917.

684-Target Ranges.

[illegible]
[illegible], S.C.

October 11, 1917.

Department Commander.

Commanding General, Camp Jackson, Columbia, S.C.

Small Arms Target Ranges for Divisional Training Camps.

1. With reference to the circular letter (copy herewith) from the Adjutant General of the Army, [illegible], [illegible] 2nd, 1917, to the Commanding Generals of the several camps in reference to the above, information is requested as to the progress made in the selection of a suitable Rifle Range for Camp Jackson, Columbia, S.C.

[illegible]/[illegible]

[illegible]
Major General, U.S.A.

ADJUTANT GENERAL
In Absence of Department Commander.

1st Ind. CDS-C

HQ., 81st Div., Camp Jackson, S.C., October 17, 1917.—To Commanding General, Southeastern Department, Charleston, S. C.

1. A suitable small-arms range adjacent to this camp has been selected and surveyed and work of clearing has begun. Target material is either on hand or en route and the range will be ready for use before the troops are prepared to use it.

2. The range lies adjacent to the cantonment site, about a mile and a half east of the nearest barracks, and is part of the large tract, a three year lease hold of which is to be obtained under authority of the War Department, by condemnation proceedings. The U. S. Attorney is now engaged in the preliminary work of instituting legal proceedings, but the property owners of the tracts on which the range, proper, is situated have given their consent to the use of the land; and work was begun without waiting for the actual institution of condemnation proceedings.

3. The range will have 200 targets for 300-yard rifle practice, [illegible] machine-gun targets, 34 600-yard targets, and 6 1000-yard targets. All can be used simultaneously. Any part of the 300-yard range can be used for pistol targets and in addition good sites for pistol practice are available nearer camp.

FILE CANTONMENT RECORD

RG 393, US Army Cont. Cmds, 1821-1920
Part V, Camp Jackson
Gen corr, 1917-20
30X 28

4. The State has a 24 target 600-yard range at Styx, S. C., but it is fourteen miles from camp and not available for practice by this command, unless a camp were to be established there.

Major General, U. S. A.,
Commanding.

1 incl.

REPRODUCED AT THE NATIONAL ARCHIVES

REPRODUCED AT THE NATIONAL ARCHIVES

Dec. 17, 1917

684 - Target Ranges

HEADQUARTERS 306th ENGINEERS
CAMP JACKSON, COLUMBIA, SOUTH CAROLINA.
December 17th, 1917.

FROM: The Division Engineer, 81st Division.

TO: The Commanding General, 81st Division.

SUBJECT: Depopulation of area beyond target range.

1. In view of the fact that it is expected to begin target practice on the small arms range about January 1st, 1918, it is recommended that steps be taken for the removal of all inhabitants in the tract to the east of the range for a distance of three miles, and to post danger signals and signs on all roads leading in behind the butts for the same distance to the eastward.

Colonel Engineers N. A.

FILE

RG 393, Army Cont. Cmds, 1821-1920
Part II, Camp Jackson
Gen corr, 1917-20
Box 28

REPRODUCED AT THE NATIONAL ARCHIVES

Undated (ca. Dec 1917)

684 - Target Ranges.

ARC/O'N.

684 - Target Ranges

Acting Chief of Staff

Brigade Commanders and Commanding Officer 306th Engineers.

Small Arms Target Range.

1. The Commanding General desires that you be informed that the small arms target range will be ready for use on the 1st. of January. The Range Officer will assign on the 300 yards range, 24 targets to each infantry regiment, to the 316th Field Artillery, and 306th Engineers for purposes of instruction. The 316th Field Artillery will be grouped with the 161st. Inf. Brigade and its small arms practice carried on under the general supervision of the Commanding General of that Brigade. The Range Officer will apportion targets on the 600 and 100 yardsranges in such a manner as future developments may indicate best.

2. The Commanding General desires that the first week on the range be devoted to the instruction of officers. Brigade Commanders and Commanding Officer, 306th Engineers, will make necessary arrangements for systematic instruction. The known distance course for all men now in the command will be completed on or before the 7th of February, 1918, leaving the range free after that date for the instruction of men who may have joined in the interim.

3. Attention is invited to paragraph 4, G.O. 42, December 8th, these Headquarters, which gives the schedule of gas instruction for the command.

4. It has been stated that battery harness will not be available for National Army divisions before the first of March. We have applied by telegraph for harness for one battery, which there seems to be a probability of our receiving in the near future.

5. Infantry field equipment is not yet in sight. Bayonets for Enfield rifles will be available.

6. With the above considerations as to equipment for instructions and allotment of time for gas instruction and small arms practice, the Commanding General desires that you submit your programme for the month of January not later than the 25th instant, for approval.

Major, Inf., N.A.

FILE

Copy sent:
C.O. 306 Eng.
C.O. 161st Inf. Brig.
C.O. 162nd " "
C.O. 186th " " X
C.O. 156th " "

CANTONMENT RECORD

RG 393, Army Cont Cmds, 1821-1920
Part V, Camp Jackson
Gen corr, 1917-20
Box 28

January 19, 1918

COMPLETION REPORT

OF

CAMP JACKSON

Columbia, S. C.

William Couper, Major, Q.M., U.S.R.,

Constructing Quartermaster.

****

DECLASSIFIED
Authority NND 803038
By CO NARA Date 8-5-04

RG 77 Chief of Eng.
E. 391 Construction Completion Reports, 1917-43
Box 140

CONSTRUCTING QUARTERMASTER

CAMP JACKSON

Columbia, S. C.

January 17, 1918.

From: Constructing Quartermaster, Camp Jackson.
To: Officer in Charge of Cantonment Construction,
Washington, D. C.
-Completion Report-

1. In accordance with your letter of November 2nd, requesting report of operations during the construction of this cantonment, file 600.914 CR-C (General), the following is submitted:
We have the following recommendations to make for consideration in case additional cantonments are constructed:

2. TIMEKEEPING: The practice employed at this cantonment of having the Government keep the time is not in my opinion a proper one to use in future work. The principal objection to it is that the contractor loses a certain control over his men. I believe that the actual disadvantage of this system more than outweighs the slight additional cost of having the contractor keep his own time and having a smaller Government force check it. I consider the practice of having booths for checking the men in and out essential.

3. PAYROLL SIGNATURES: I respectfully call attention to the practice of requiring signatures on pay rolls. With laborers this resolves itself into a farce, as practically none of them sign their names, and in view of the fact that the making a mark is a prefunctory practice, I believe that in the interest of efficiency the requirement should be abolished, and the signatures omitted. This is the practice which practically all large contracting firms have adopted.

4. COMMISSARY: I believe more efficient results will be obtained by compelling the contractor to sublet his commissary so that he may be able to devote his entire time to the actual performance of the work. The practice of running the commissary for profit has become so general that it is difficult for contractors to form the idea that the commissary on these emergency projects should be run on a cost basis.

5. SECRET SERVICE AGENTS: Secret service agents should be assigned to each project, as soon as actual construction commences. We worked here several months without one and the work done by the agent after he arrived showed that his services were necessary.

6. NEWSPAPER ADVERTISMENTS: Contractors in signing the contracts should be given to understand that no newspaper advertisements shall be placed in localities where other emergency work is being performed. The same applies to solicitation of labor from other Government projects. We have had a great deal of difficulty from that source at this cantonment due to the fact that wages paid elsewhere have been very much higher and that distance does not prevent the men from going to a new job in view of the fact that their transportation is refunded.

DECLASSIFIED
Authority NND 803038
By CO NARA Date 3-24-04

2.00 and $3.00, the original being delivered to the employee and the duplicate being held by the time-keeper's office. In order to have a signed evidence of payment (although the payment was only in the nature of a commissary ticket) in case the employee made no more time than he used up in Commissary credit the checks were designed to show the signature of the employee to whom they were issued.

A form, Requisition for refund of Transportation, was used in cases where transportation was refunded employees who had been on the work one continuous week or more.

Two forms were used in conjunction in cases where there were complaints of shortage, in time.

Other forms used were: A card record of the monthly foreman,

An outside time checkers report, was used in a bound book of 100 pages each. The outside checking department also kept a complete check on livestock and equipment, same being reported on a separate form. This department also checked teams, reporting same on "Team report".

A Report of Discharge Checks issued for the information of the Superintendents, and showing the total number of discharge checks issued daily.

74. The property on which the rifle range is located is situated east of the Cantonment. It is a strip of land 13200 feet wide; it averages about 42000 feet in length, and contains 13093.81 acres. It is rolling sand hill country covered principally with scrub oak, of the black jack variety, interspersed with a few pine trees, and is very sparsely settled. This land was largely acquired by condemnation proceedings. In laying out the 300 yard rifle range it was found that the lay of the land would not permit of shooting directly from the firing trench to target trench without danger of the bullets going over the property line, and so in order to take advantage of the ridges, which do not lie parallel to the property line, it was necessary to construct the trenches in echelon. This required slightly more trenching work but formed a layout which was so much more practical that it was decided to do the work, and it was all completed prior to January 1st. The method used in constructing the trenches has already been described in Paragraph 6.

75. All of the field engineering at this Cantonment was handled by the Field Engineer, Mr. James E. Gibbons, and the Engineering and Inspecting force was recruited from all over the East. By forming our own engineering organization, we avoided the payment of any engineering fees excepting the salaries of the men themselves. The only exception to this was the contract with the Supervising Engineer, Mr. P. H. Norcross, who was paid on contract a salary of $7500, plus his expenses, for designing the sewer system, water system, etc.

76. Two of the Commissioned Officers mentioned in Paragraph 3, Captains Frisbe and Holmar, not being up to the Standard, were released about August 4th and were sent to other Camps. Captain Moore, who had been in charge of the property account, was ordered away for similar duty elsewhere, we were sorry to lose his services. The other three officers stayed on the job until its completion and formed a very well-balanced staff-- Capt. Crunden having charge of Administration, Capt. MacDonald supervising the building operations, fire protection and equipment installations, and Capt. Dinkins having charge of transportation. The faithfulness and ability of these men are largely responsible for the completion of the work.

77. In appendix B we have shown rates of pay of the various classes of labor employed at Camp Jackson.

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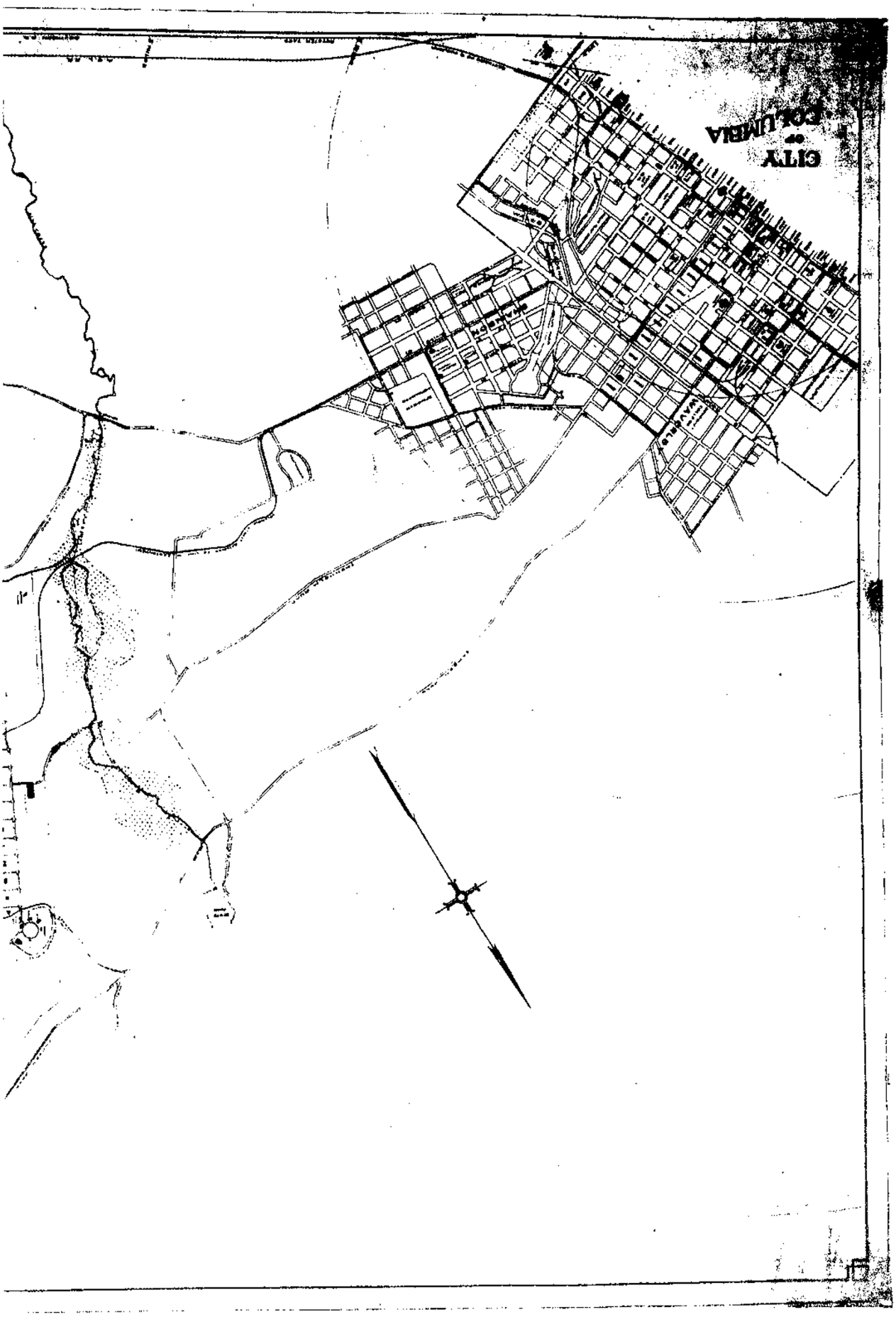
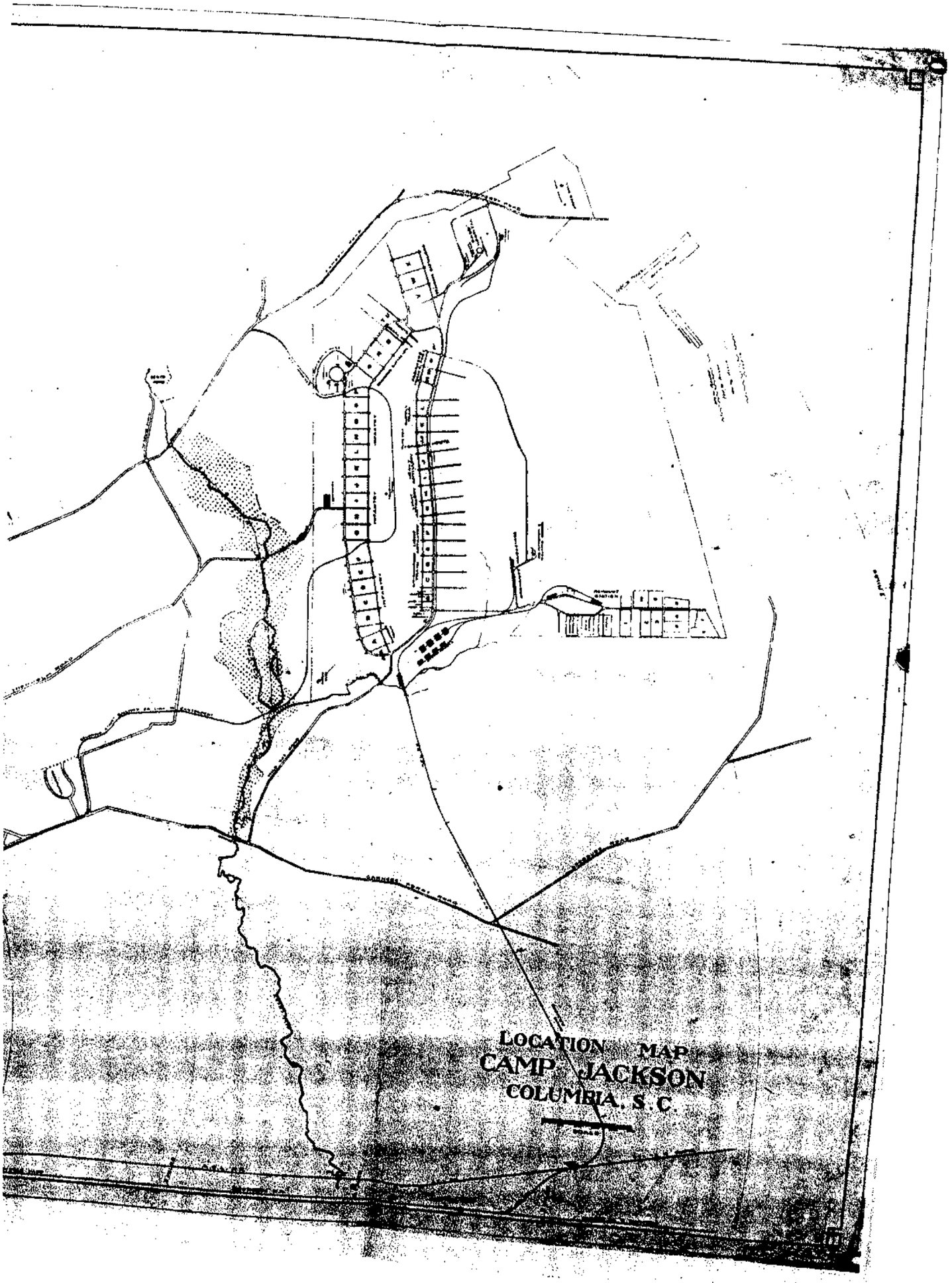
Authority NND 803038
By CORA Date 3-24-04

DECLASSIFIED
NND 803028
Authority
By CO NARA Date 3-4-04





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By CR NARA Date 3-24-04

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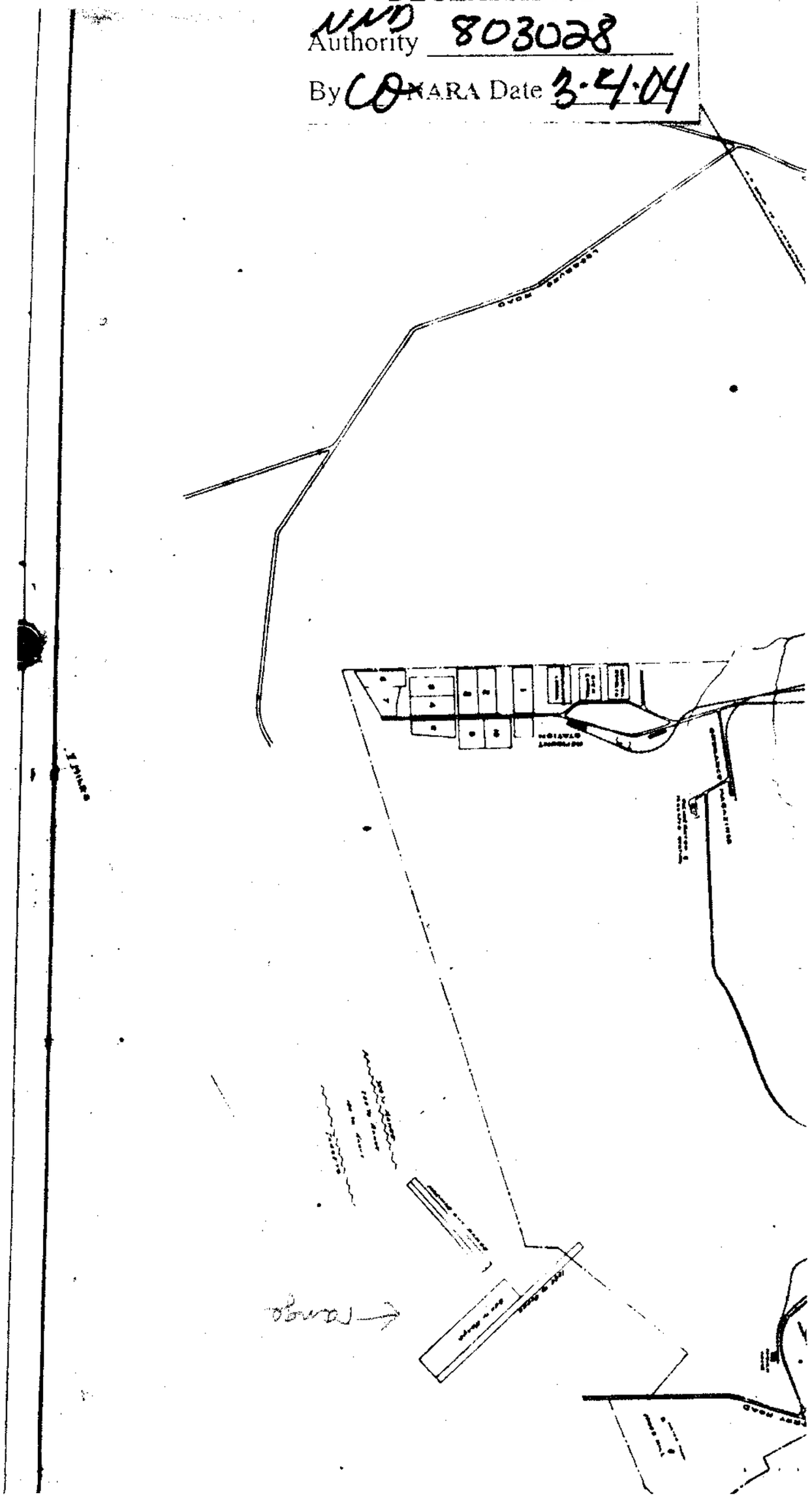
Authority NND 803028
By CO NARA Date 3-4-04



January 19 1918

FINAL REPORT

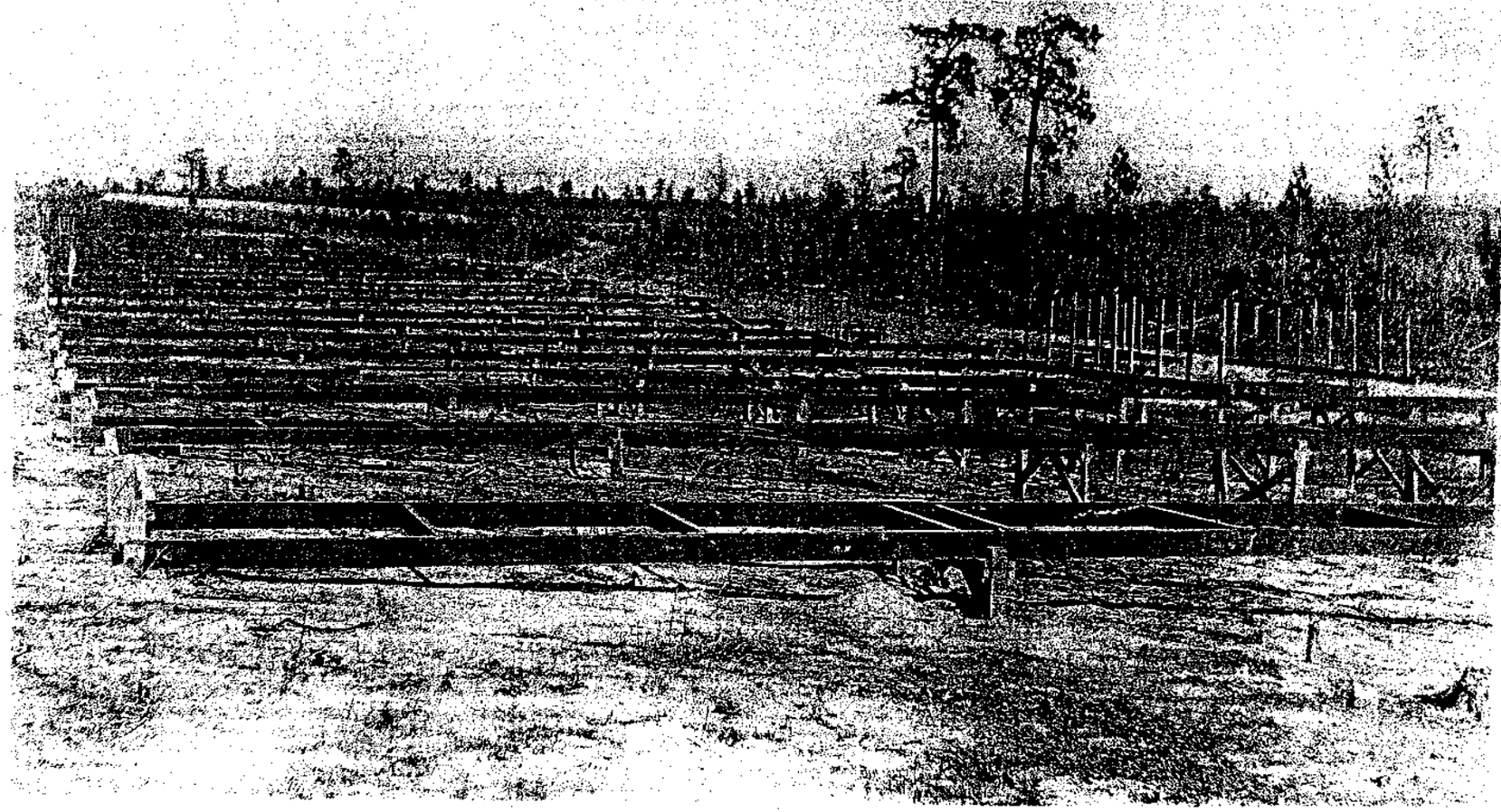
Plans and Descriptionof Camp and Camp Utilities

CAMP JACKSON? S. C.

Jan. 19, 1918.

RG 92. Quartermaster Gen'l
E. 97A A. Completion Repts, 1917-1919
Box 36

MACHINE GUN RANGE.



RIMLA RANGE.

July 23, 1918

No. 614 Camp Jackson

(Misc. Div.)

THE ADJUTANT GENERAL'S OFFICE

RECORD OF COMMUNICATION RECEIVED

From: C. G. Camp Jackson by letter *Dated:* July 23, 1918.

To: The Adjutant General *Rec'd A. G. O.* July 30, 1918.

Subject: Report on Small Arms Range, Camp Jackson, South Carolina.

Form No. 624, A. G. O.
Ed. Mar. 2-18—300,000.
6 8—4598

RG 407, AG, Entry 37A
Central Decimal Files 1917-25
Box 1065

HEADQUARTERS, CAMP JACKSON,

Columbia, S. C.,

614 (C) Misc. Div. July 23, 1918.

From: The Commanding General.

To: The Adjutant General of the Army, Washington, D. C.

Subject: Report on Small Arms Range, Camp Jackson, S. C.

1. Pursuant to instructions in letter from the Adjutant General's Office, War Department, Washington, D.C., July 13, 1918, the following report is submitted:

(a) There is one rifle range, four miles from the center of camp, with targets as follows: Short range (100, 200 and 300 yards), two hundred (200) targets. Mid range (500 and 600 yards) thirty-four (34) targets. Long range (800 and 1000 yards) six (6) targets.

(b) There is no pistol range. The short range for rifle firing can be used for pistol range by trimming paper targets to fit 4 x 4 foot frames.

(c) There are two machine gun ranges (1000 inch ranges) right in camp. One on the east side and one on the west side of Camp. These are small ranges and were used for the training of officers. One machine gun range (1000 inch range) of seventy-two (72) targets, on tracks, four miles from the center of camp.

(d) There are three Combat firing ranges for small arms and machine guns. Combat range No. 1 is four miles from center of camp. Combat Ranges Nos. 2 and 3 are five miles from center of Camp.

(e) Artillery range of 14000 by 6000 yards four miles from center of Camp with sufficient capacity for training one Brigade of Field Artillery.

2. The facilities are sufficient for the training of a division. The ranges reported upon were used by the 81st Division and were considered ample.

3. A map is submitted herewith showing location of ranges.

A. G. O. AUG 7 1918

Left with Secy G.S. & M.P.D.

F.H.FRENCH,
Brigadier General, U.S.A.,
Commanding.

WLL/jem

File

A. G.

RECEIVED
JUL 30

REPRODUCED AT THE NATIONAL ARCHIVES

July 13, 1918.

From: The Adjutant General of the Army.

To: The Commanding Officers of all Regular Army, National Guard, and National Army Camps and Cantonments.

Subject: Small Arms Ranges at Divisional Camps and Cantonments.

The Secretary of War directs that a report be submitted as to the facilities available at your camp for the instruction of troops in small arms and machine gun firing covering:

(a) Rifle ranges, distance and number of targets.
(b) Pistol ranges, number of targets.
(c) Machine gun ranges (1000 inch ranges), number.
(d) Combat firing ranges for small arms and machine guns.
(e) Artillery ranges.

The report should show the distance of the ranges from the center of the camp or garrison, and whether or not the facilities are sufficient for the training of a division. If possible, a map should be submitted. If the facilities of any class are not sufficient the report should show what measures are necessary in order to secure them.

Adjutant General.

REPRODUCED AT THE NATIONAL ARCHIVES

Sept 23, 1918

MACHINE GUN SCHOOL
10th REGIMENT, F. A. R. D.
Camp Jackson, S. C.

September 23, 1918.

From: Senior Instructor, Machine Gun School.

To: Camp Executive Officer, F.A.R.D., Camp Jackson, S. C.

Subject: Firing on Machine Gun Range.

1. Firing will take place from the old rifle butts to the southwest of the position now occupied by the incoming cavalry brigade. Firing will commence on Tuesday morning, September 24, 1918 and continue through Wednesday.

2. The positions will be at the south end of the rifle butt. The fire direction will be about 220 mills north of east, parallel with the southern mark of the butts as shown on the map made by the 306th Engineers.

Thomas C. Ryan
2nd Lt. F.A.

RG 393, Army Cont. Cards, 1821-1920
Part II, Camp Jackson
Gen corr, 1917-20
Box 25

GENERAL COMPLETION REPORT

ON

NORTH CAMP JACKSON

AS ABANDONED OF FEBRUARY 28, 1919.

H. J. Macdonald
CAPTAIN, Q. M. CORPS,
CONSTRUCTING QUARTERMASTER.

RG 92. Quartermaster Gen'l
E. 1974-A. Completion Rept's [illegible]
P. [illegible]

THE CONTRACT

The contract is the ordinary Government form for emergency work which in this case constituted the construction of an Artillery Cantonment near Camp Jackson, S. C. to be known as North Camp Jackson.

The contract was made and concluded the 2nd day of September, 1918, by and between the HARDAWAY CONTRACTING COMPANY, Columbus, Georgia, represented by B. H. Hardaway, it's President, party of the first part, hereinafter called "The Contractor", and the UNITED STATES OF AMERICA, by R. C. Marshall, Jr., Brigadier General, U. S. Army, acting by the authority of the Secretary of War, party of the second part, hereinafter known as "Contracting Officer."

On September 6th, 1918, in accordance with the approval of the Assistant Secretary of War under date of August 21st, 1918, authority was given the Constructing Quartermaster, North Camp Jackson, to proceed with the construction of a Field Artillery Cantonment.

The amount approved for this construction was Nine Million Dollars ($9,000,000).

The authorization number for the construction of the above named Artillery Cantonment was Project Number 6015-1.

THE PROJECT

LOCATION

Attached find Appendix "C" showing location of North Camp Jackson with respect to Camp Jackson and the City of Columbia, S. C. As is shown on this Appendix you will note that the two camps proper are distant by about two miles and North Camp Jackson is distant from Columbia by about seven miles.

The main highway connecting the City of Columbia and North Camp Jackson is known as the Two Notch Road or the highway connecting the City of Columbia and the City of Camden, S. C. Dents Pond, popular for its bathing, is located equidistant from the two sites. The main road to Camp comes off said Two Notch Road at what is known as Dents Station on the Sea Board Air Line Railway.

The site for the Artillery Camp was picked so that its drill ground lies on a very long high ridge forming the divide between two creeks - Jackson Creek being on the western side of the Camp and Gill Creek on the eastern side, both of which flow into the above spoken of Dents Pond.

The Constructing Quartermaster upon arrival on the site August 26th, 1918, found that about six hundred and eleven (611) acres, more or less, of the wood land had been cleared off by the forces of the Harry F. Hann Contracting Company who was the contractor on some improvements made at Camp Jackson and who anticipated the con-

tract for the construction of North Camp Jackson.

On September 4th, 1918, the work of clearing was turned over to the Contractor, The Hardaway Contracting Company, who finished same. Construction equipment and teams were requisitioned at once and on the above date construction had begun on a temporary spur track from the Sea Board Air Line Railroad serving the Camp.

RESERVATION AND BOUNDRIES

Attached find Appendix "D" showing the boundries of the reservation and the acreage contained in same. The letters shown on this plan refer to detailed plans which are shown on an attached Appendix lettered "D-1". Blue prints or original plans are on file in the office of the C.Q.M., Camp Jackson.

The parcel lettered "A" or the original Camp Jackson area contained eleven hundred and ninety two (1192) acres, Parcel "B" contains fifteen hundred and forty five (1545) acres, Parcel "F" the tract covered by North Camp Jackson contains five thousand seven hundred and sixty five (5765) acres. The total acquisition constitutes approximately thirty six thousand two hundred and forty five (36,245) acres, more or less.

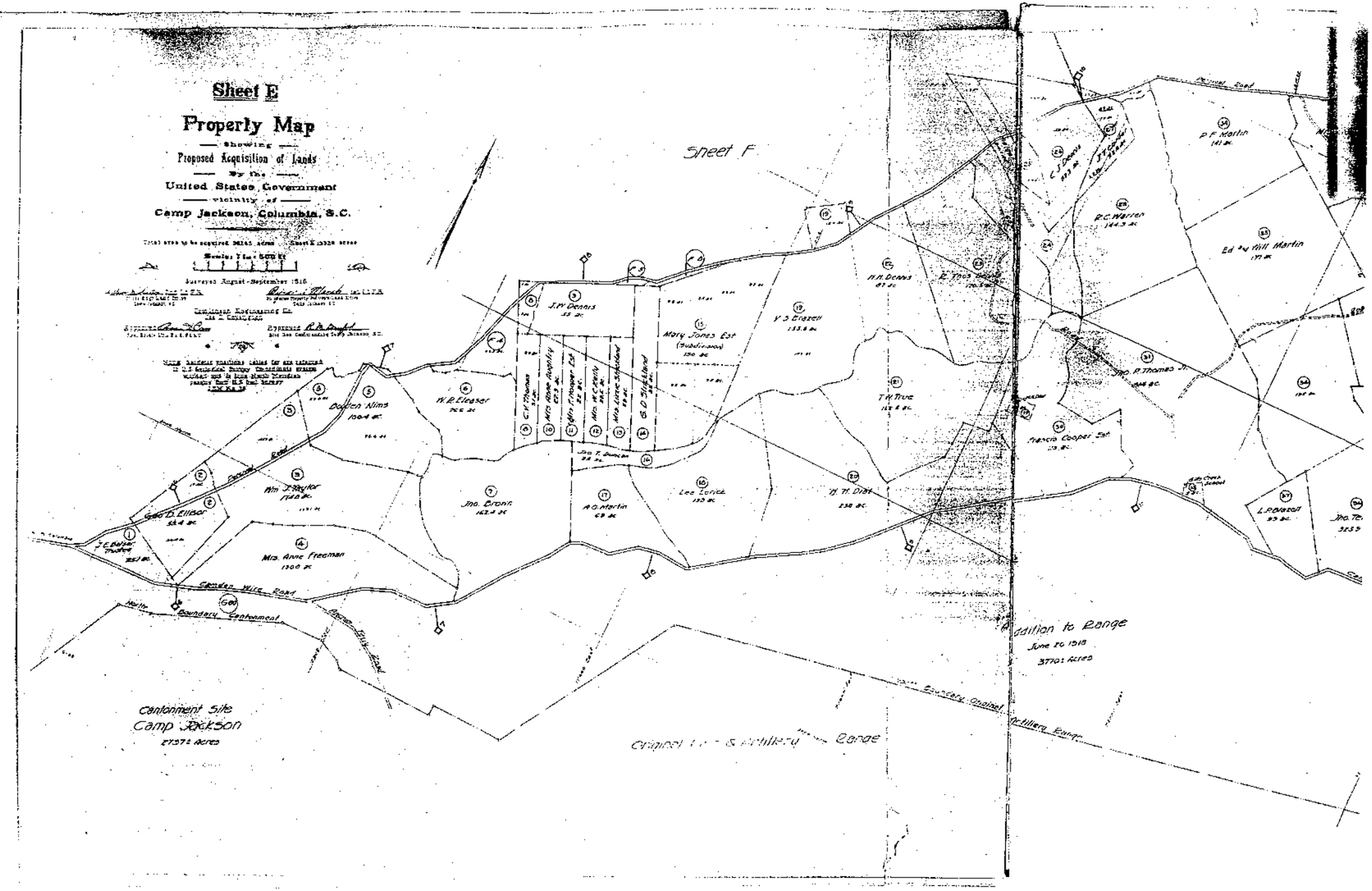
8

RAILROADS

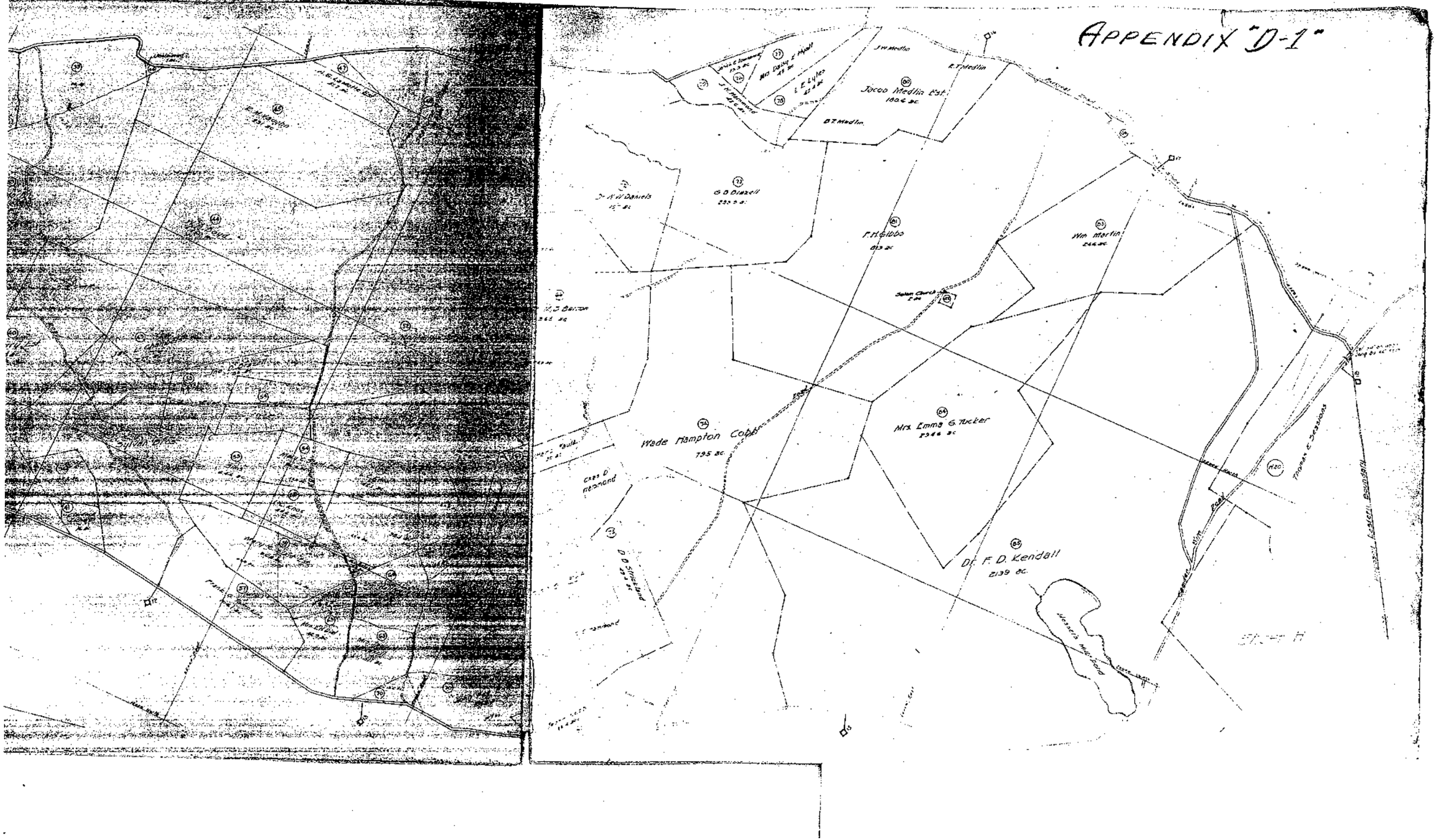
Attached find Appendix "J" showing railroad layout. The main line of the Sea Board Air Line Railroad forms the western boundary of the reservation. This being the only common carrier in the vicinity it was readily found necessary to construct a spur for the purpose of distributing the construction material in the construction area. The Supervising Engineer had already begun a location for this spur which in the opinion of the Constructing Quartermaster, was much larger and more expensive than was necessary. The second day on the site, the Constructing Quartermaster and a party reconnoitered and finally selected a location which proved to be at least a mile shorter and far less expensive. Three days later construction was begun on same and by September 16th, 1918, accommodation for 100 cars was made.

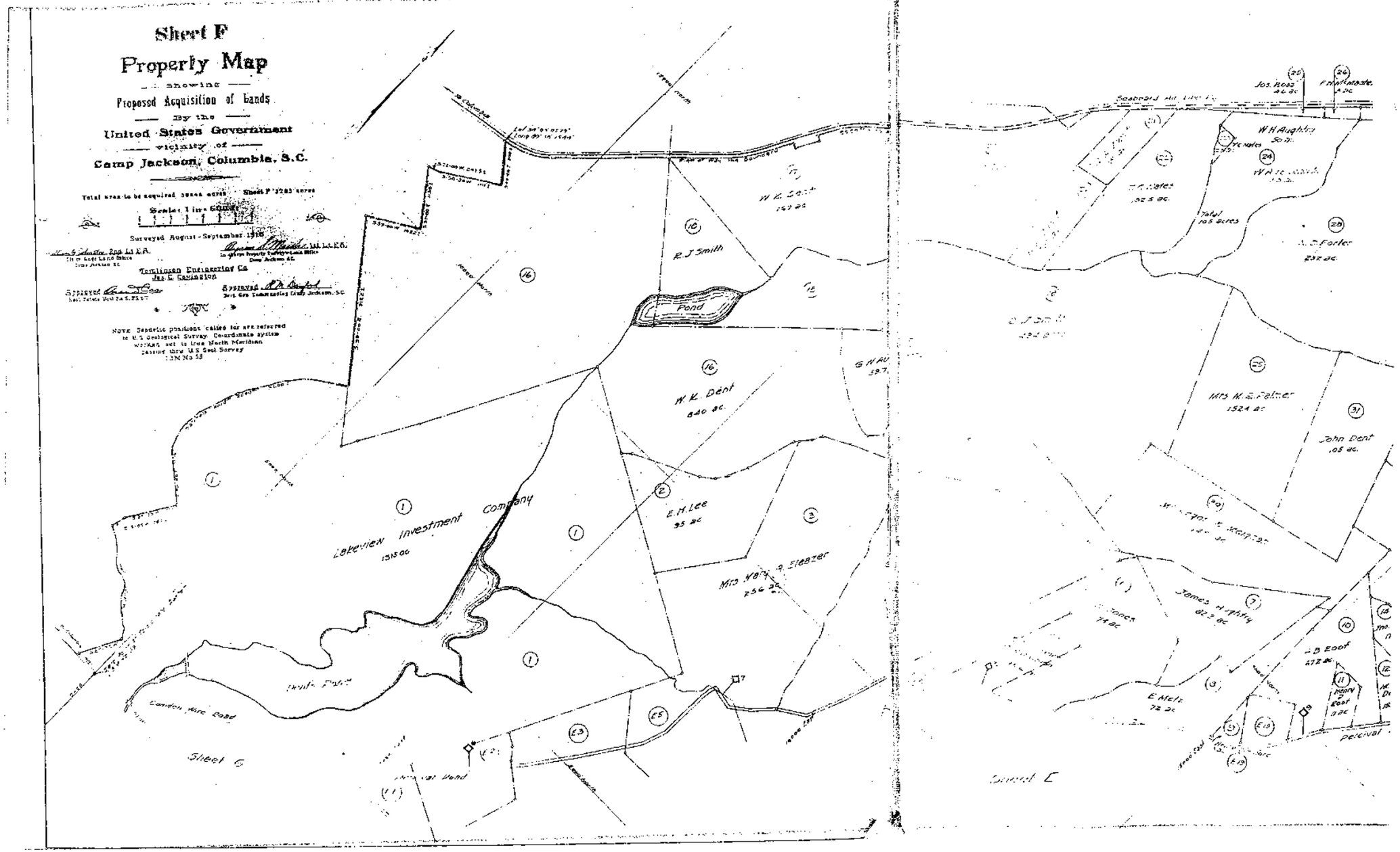
The only difficulty encountered was a swamp over which was built a fourteen foot (14') trestle about 400' long, a photograph of which is attached. This is known as the trestle crossing Jackson Creek. This temporary line is shown on Appendix "J". It was built on the shortest course (with a maximum allowable grade of 2%) to the drill grounds; thence down drill grounds giving as near as possible equal distribution of material to all construction. This constituted a length of 13786 lin. feet of which about 5300 lin. feet was used as permanent line, about 1500' being used in connection with track serving Quartermaster's

Original Rte. of Artillery
Bridge

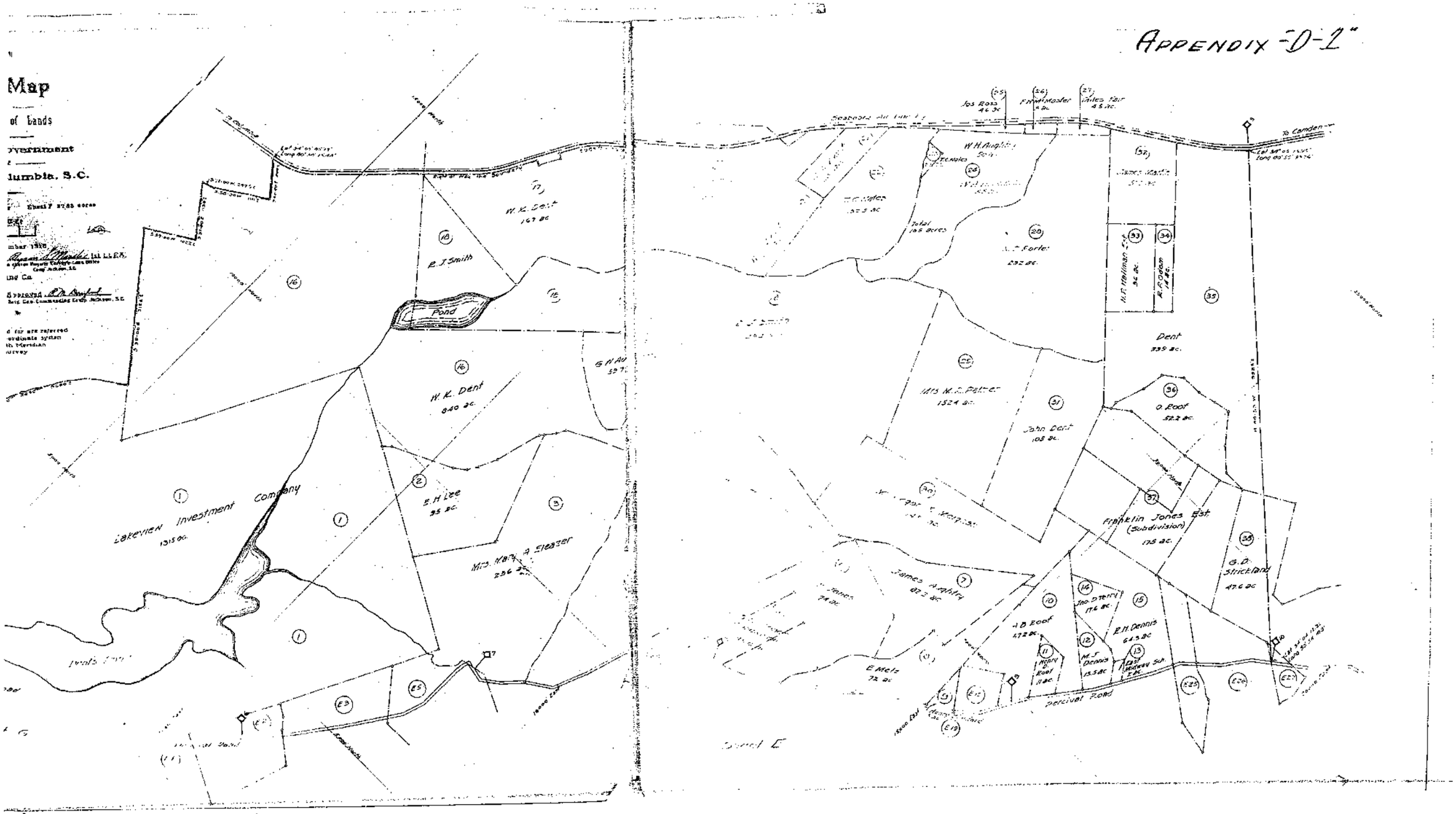

Sheet E
Property Map
Showing
Proposed Acquisition of Lands
By the
United States Government
vicinity of
Camp Jackson, Columbia, S.C.
Surveyed August-September 1918
Sheet F
Cantonment Site
Camp Jackson
2737± Acres
Addition to Range
June 20 1918
3770± Acres
Camden Wire Road
North Boundary Cantonment
Boundary Original Artillery Range
Mrs. Anne Freeman
Jno. Bronn
A.O. Martin
Lee Lorick
Mary Jones Est
(Subdivision)
Dodden Nims
W.R. Eleaser
J.W. Dennis
Y.S. Brazell
T.W. True
H.H. Dennis
R.C. Warren
P.F. Martin
Ed & Will Martin
Francis Cooper Est
L.P. Blazell
Jno. P. Thomas Jr.
Wm. J. Taylor
Geo. D. Ellison
J.E. Balser Trustee
Jno. T. Duncan
G.D. Strickland
Mrs. W.C. Kelly
Mrs. Lizzie Strickland
Mrs. Anne Aughtry
C.V. Thomas

APPENDIX "D-1"

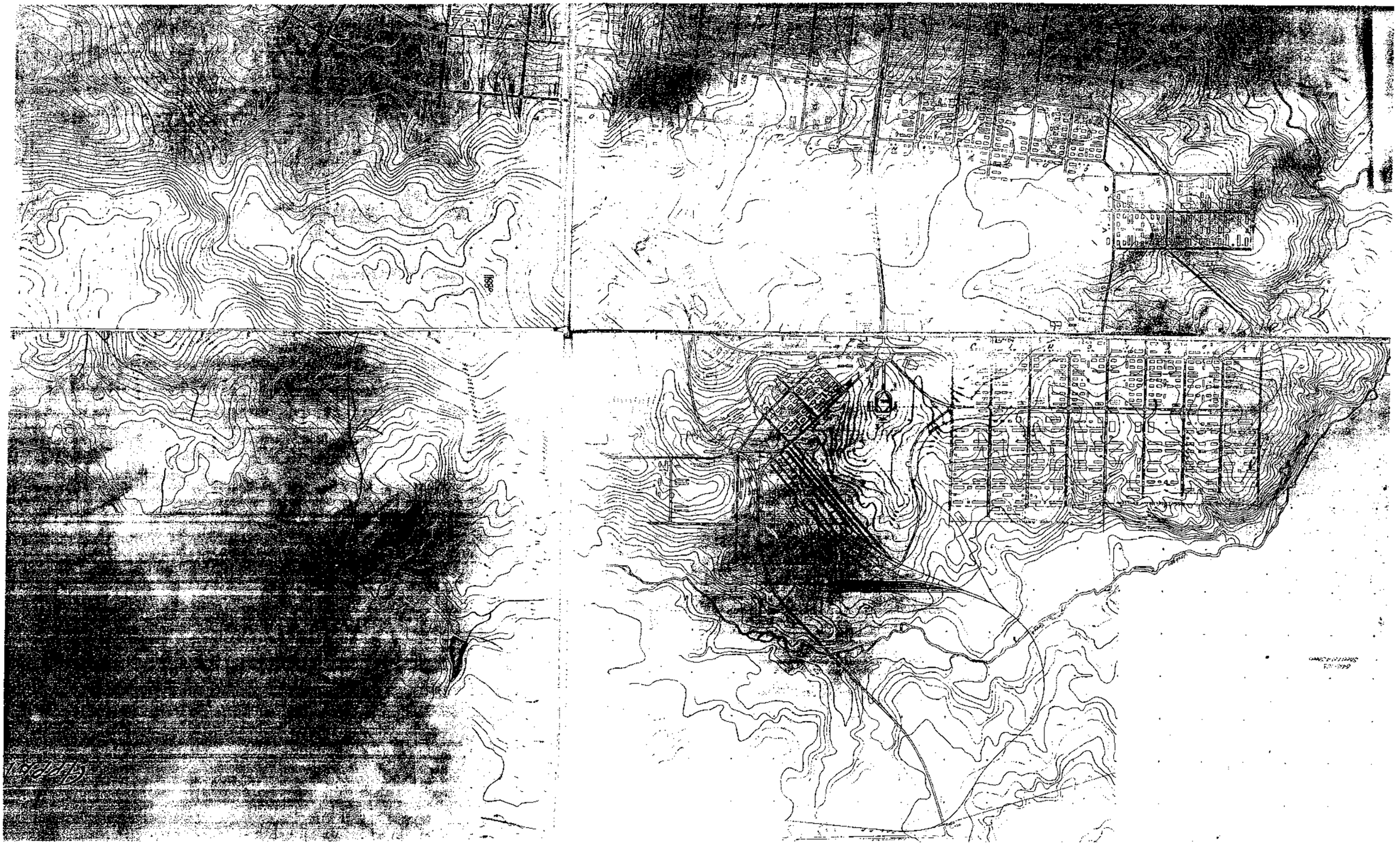

Jacob Medlin Est.
180.6 ac.
J.W. Medlin
B.T. Medlin
B.T. Medlin
G.D. Blazell
F.H. Gibbs
Wm. Martin
Wade Hampton Cobb
795 ac.
Mrs. Emma G. Tucker
Dr. F.D. Kendall
2139 ac.
Thomas E. Dickson
Sutton Creek
Cross Roads
Cross Roads
Cross Roads

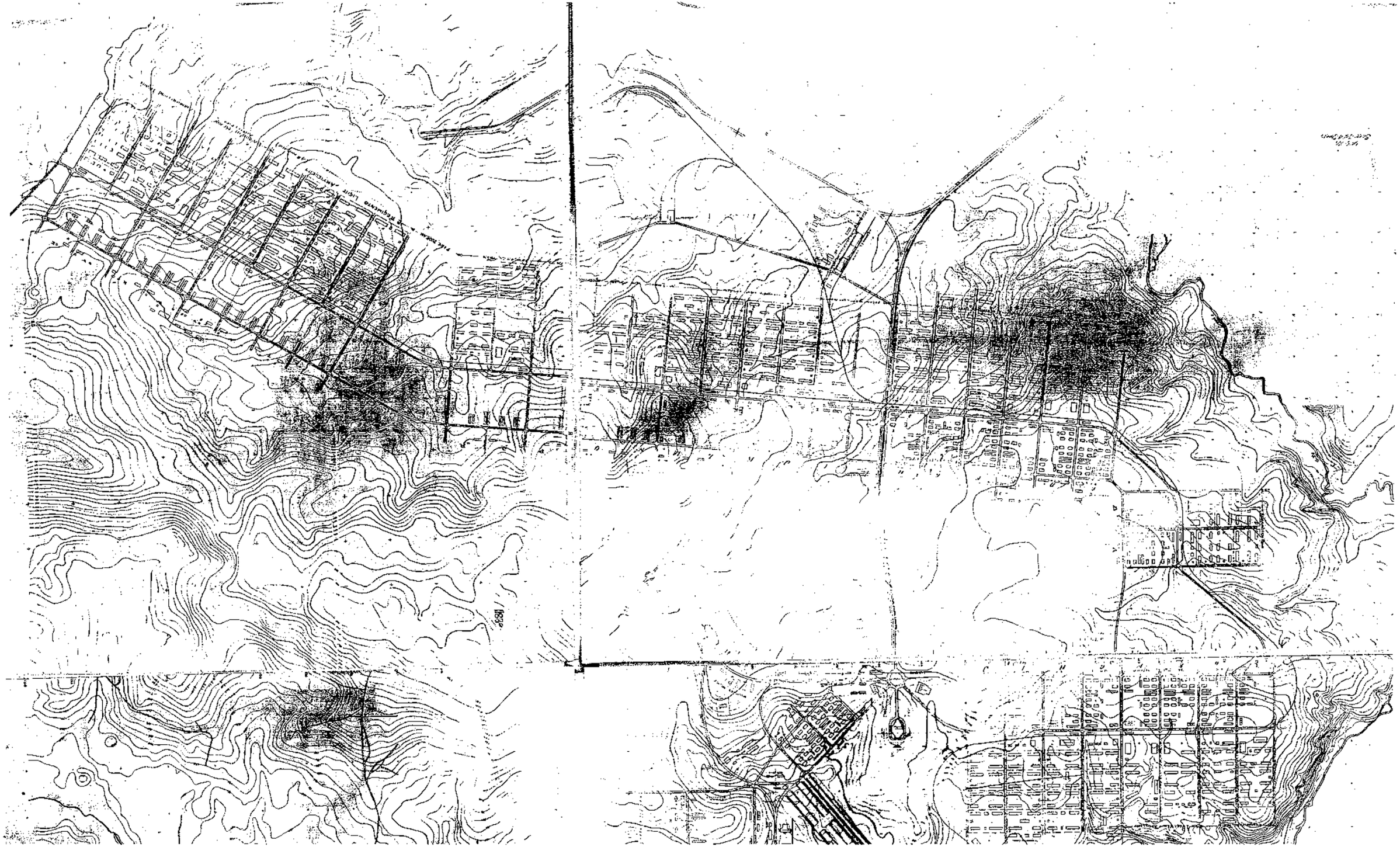

Sheet F
Property Map
showing
Proposed Acquisition of Lands
By the
United States Government
vicinity of
Camp Jackson, Columbia, S.C.
Total area to be acquired 3000 acres
Scale: 1 in = 600 ft
Surveyed August - September 1918
Tomlinson Engineering Co
Jas. E. Covington
Approved
Approved
Note Geodetic positions called for are referred to U.S. Geological Survey. Coordinate system worked out to true North Meridian passing thru U.S. Geol. Survey
Lakeview Investment Company
1315 ac
Pond
R. J. Smith
W. K. Dent
840 ac.
E. H. Lee
95 ac
Mrs Mary A. Eleazer
256 ac
Camden Wire Road
Sheet G
Sheet E
W. H. Aughtry
Total
105 acres
Mrs M. E. Palmer
1524 ac
John Dent
105 ac.
James Aughtry
E. Metz
72 ac
Percival

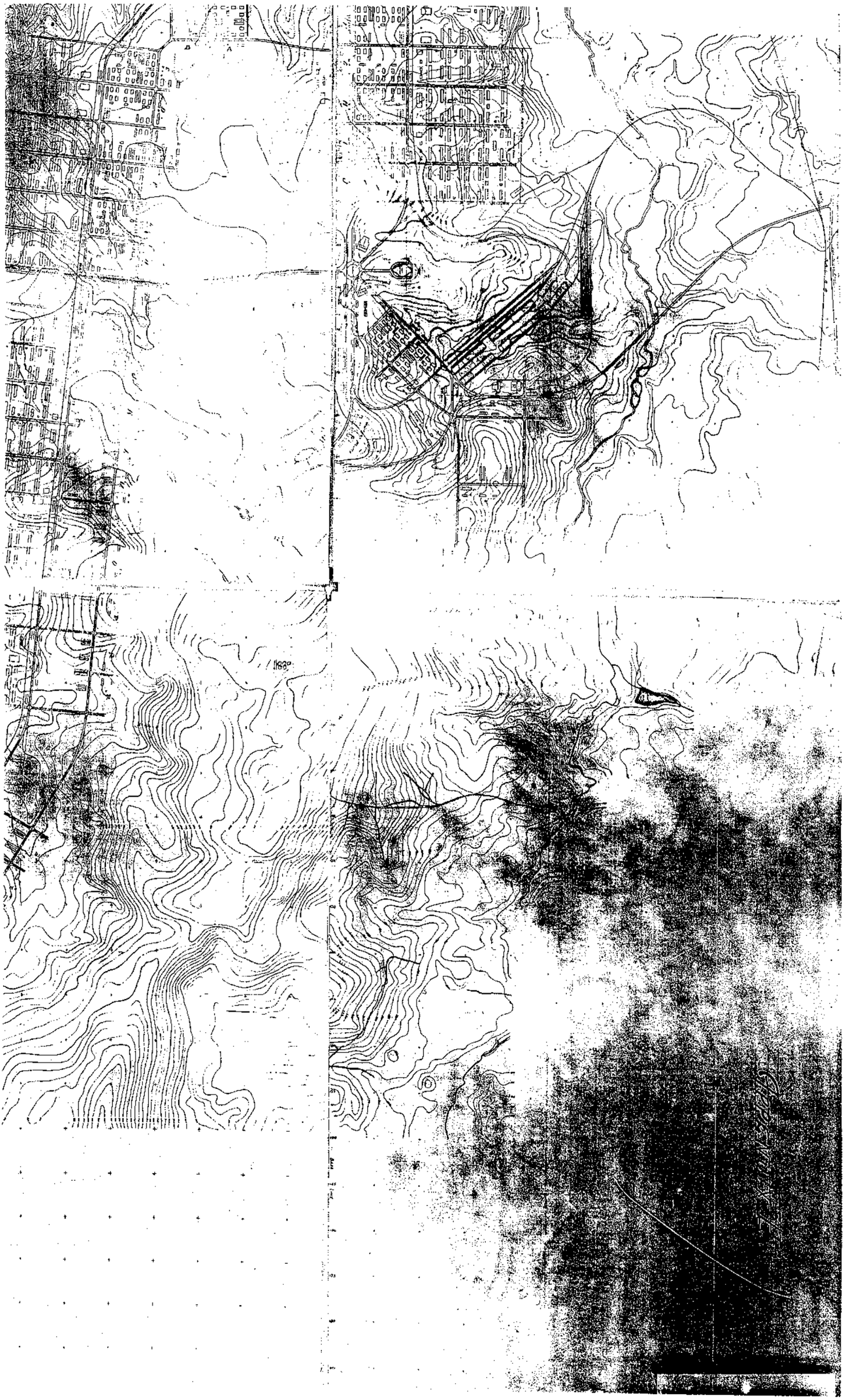
APPENDIX "D-1"



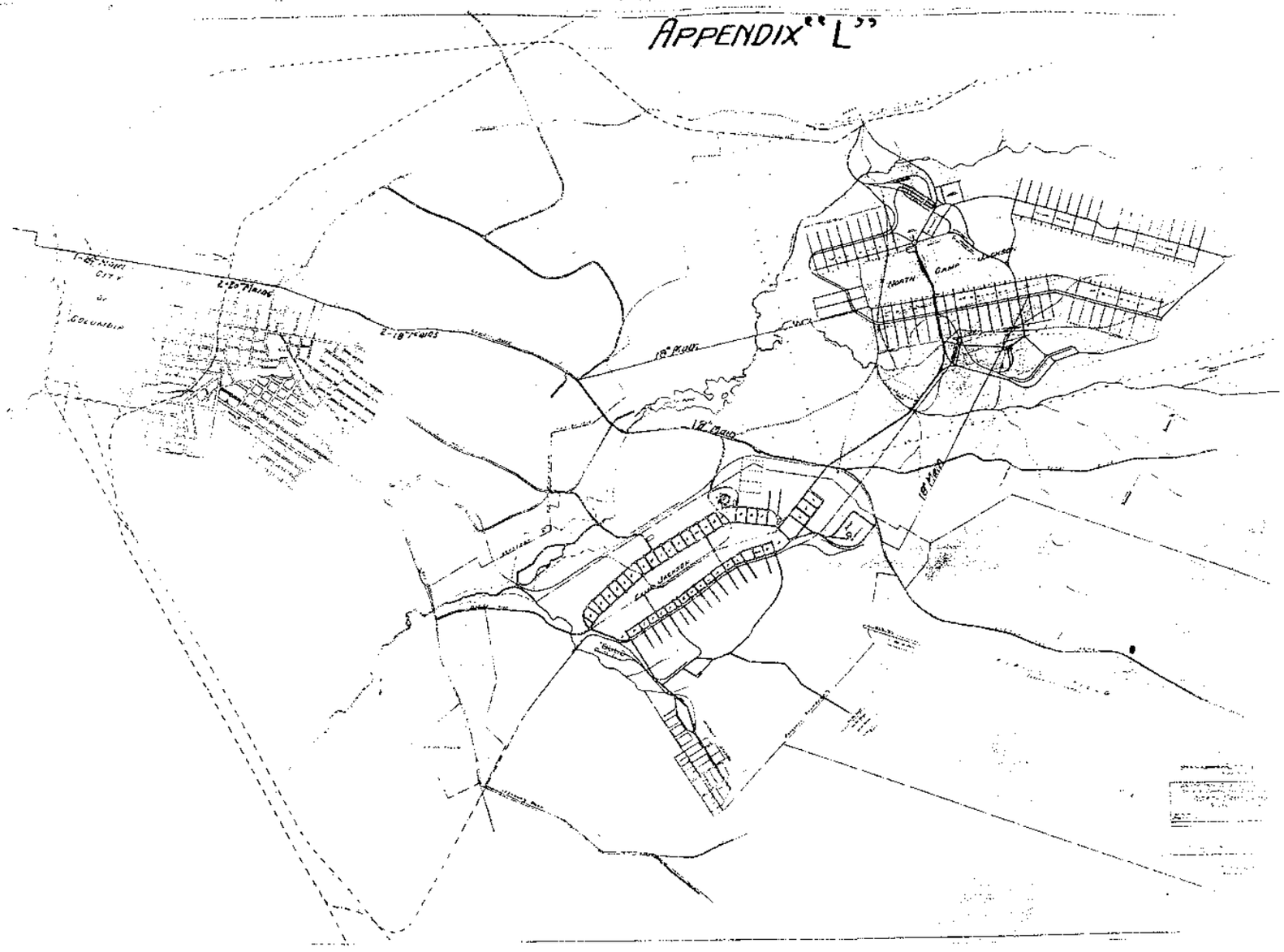
Map
of Lands
overnment
lumbia, S.C.
Lakeview Investment Company
1315 ac.
W. K. Dent
840 ac.
R. J. Smith
Pond
E. H. Lee
35 ac.
Mrs. Mary A. Eleazer
236 ac.
W. H. Aughtry
Total
165 acres
Mrs. M. R. Pelzer
1524 ac.
John Dent
105 ac.
Dent
339 ac.
O. Roof
52.2 ac.
Franklin Jones Est.
(Subdivision)
175 ac.
G. D. Strickland
47.6 ac.
James Aughtry
82.3 ac.
E. Metz
72 ac.
A. B. Roof
57.2 ac.
R. H. Dennis
64.3 ac.
M. J. Dennis
15.5 ac.
Percival Road
To Camden







APPENDIX "L"



HEADQUARTERS CAMP JACKSON,
Columbia, S. C.

DAILY BULLETIN NO. 32.

Wednesday, February 11, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE:- Organization commanders will be held responsible for the compliance by all members of their commands with all orders published in this Bulletin.

1. CAUTION! ! FIRING ON TARGET RANGE!

1. ON FRIDAY, FEBRUARY 13TH, FROM 8:00 TO 11:00 A. M., THERE WILL BE COMBAT FIRING EXERCISES ON THE SMALL ARMS TARGET RANGE, TWO MILES EAST OF CAMP. THE DIRECTION OF FIRE WILL BE FROM WEST TO EAST. ORGANIZATION COMMANDERS WILL CAUTION THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THAT DATE.

2. ECONOMIC USE OF LONG-DISTANCE PHONE CALLS.

1. In placing Long Distance Telephone Calls, the following instructions will govern:-

2. Unless it is especially desired to speak to some particular party at the other end, officers will not place a "Person to Person Call" but will place a"STATION TO STATION CALL" in the following manner:-

"Captain Jones, 123, Camp Jackson calling the Zone Supply Office (not officer) at Atlanta". Upon being questioned by Long Distance whom you wish to converse with, the reply will be "ANYBODY" and NOT "anybody who can talk business" or similar phrase.

3. The following form will be used only when it is necessary to converse with some particular person:-

"Captain Jones, 123, Camp Jackson calling Captain Smith, Zone Supply Office, Atlanta".

For this person to person service a higher rate is charged.

3. KAHN TAILORING COMPANY. BRANCH DISCONTINUED.

1. The Agency of the Kahn Tailoring Company which has been maintained at the Central Camp Exchange has been discontinued.

over.

REPRODUCED AT THE NATIONAL ARCHIVES

HEADQUARTERS CAMP JACKSON,
Columbia, S. C.

DAILY BULLETIN NO. 39

Thursday, February 19, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE:- Organization commanders will be held responsible for the compliance by all members of their commands with all orders published in this Bulletin.

1. ENLISTED MEN TO REPORT AT CAMP HEADQUARTERS.

1. Organization commanders will send all Enlisted Men of their units, who have served at Camp Jackson less than three months and who are not enrolled in any School to Camp Headquarters on TUESDAY, FEBRUARY 24TH, at 1:15 P.M., where they will be reported to the Director of Schools.

2. CAUTION! FIRING ON TARGET RANGE.

1. ON FRIDAY, FEBRUARY 20TH, from 8:00 TO 11:00 A.M. THERE WILL BE COMBAT FIRING EXERCISES ON THE SMALL ARMS TARGET RANGE, TWO MILES EAST OF CAMP. THE DIRECTION OF FIRE WILL BE FROM WEST TO EAST. ORGANIZATION COMMANDERS WILL CAUTION THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THAT DATE.

3. POST EXCHANGE MONTHLY INVENTORY AND CREDIT NOTES.

1. The inventory of the Post Exchange will be made on the 25th of the month, except that when that date falls on Sunday, inventory will be made on the following day.

2. Credit Notes may be issued to enlisted men by Company, Battery and Separate Detachment Commanders on any day of the month but the required report of such issue will be made to the Exchange Officer on the 25th of each month. Notes issued between the 25th and last day of the month will be reported on the 25th of the following month.

3. Special care will be exercised by above mentioned commanders to see that the correct amount of notes issued is reported in order to expedite the checking and cancelling of these notes on pay day.

4. Instructions contained in paragraph 2 of Daily Bulletin No. 12, these Headquarters, January 16, 1920, in conflict with the above are rescinded.

BY COMMAND OF MAJOR GENERAL READ:

W. D. BEACH,
Col., Cav., U.S.A.
Executive Officer.

OFFICIAL:
JAMES E. MANIERRE,
Major, A.G.D., U.S.A.
Camp Adjutant.

HEADQUARTERS CAMP JACKSON,
Columbia, S. C.

DAILY
BULLETIN
NO. 42.

Tuesday, February 24, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE:- Organization commanders will be held responsible for the compliance by all members of their command with all orders published in this Bulletin.

1. MEETING OF RANGE OFFICERS OF ALL ORGANIZATIONS.

1. A meeting is directed of the range officers of all organizations at the office of the Camp Signal Officer at 11:00 a. m. Wednesday, February 25, 1920.

2. Range Officers will find out from their organizations the number of men their organizations will have to fire on the range for 1920, the season to commence at an early date.

3. All range officers are advised of War Department letter of January 31, 1920 to Commanding General, Southeastern Department which states:-

"The Small Arms Firing Manual, 1913 1t 38mg revised.....Course "A" will be prescribed for all troops armed with the rifle as the principal weapon for offensive combat. This includes Infantry, Cavalry and Engineers. The Course provides for firing at 200, 300, 500 and 600 yards on Targets "A", "B", and "D".

Course "B" will be prescribed for all troops armed with the rifle as a weapon for defensive action only. This includes Motor Transport Companies, Balloon Companies, Headquarters Troops of Infantry Divisions, Coast Artillery Corps, and miscellaneous individuals armed with the rifle. This course provides for firing at 200 yards only on Target "A"."

4. Organizations of Camp enumerated to fire in this letter which have no range officer will send a representative to the meeting to act as such.

2. CAPTURED ENEMY MATERIAL.

1. Captured enemy material held by individuals or organizations in this camp which has not been reported to the Ordnance Department will be listed and the lists turned in to Camp Headquarters without delay.

(page one) over.

DIGITIZED AT THE NATIONAL ARCHIVES

HEADQUARTERS CAMP JACKSON
Columbia, S. C.

DAILY
BULLETIN
NO. 47.

Wednesday, March 3, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE: Organization commanders will be held responsible for the compliance by all members of their commands with all orders published in this Bulletin.

1. CAUTION! FIRING ON THE TARGET RANGE! ! !

ON FRIDAY, MARCH 5, 1920, FROM 8:00 TO 11:00 A. M. THERE WILL BE COMBAT FIRING EXERCISES ON THE SMALL ARMS TARGET RANGE, TWO MILES EAST OF CAMP. THE DIRECTION OF FIRE WILL BE FROM WEST TO EAST. ORGANIZATION COMMANDERS WILL CAUTION THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THAT DATE.

2. REPETITION OF WAR DEPARTMENT ORDERS REGARDING ARMY MUSICIANS.

1. Attention is again called to paragraph 261, A. R. It is reported that the provisions of the above regulation as to unlawful competition with local civilian musicians have been violated in specific instances since the publication of Paragraph 2, Daily Bulletin No. 43 these Headquarters.

2. Regimental commanders will take the action necessary to prevent their respective bands or any members thereof from furnishing music outside the limits of the reservation when the furnishing of such music places them in competition with local civilian musicians.

BY COMMAND OF MAJOR GENERAL READ:

W. D. BEACH,
Col., Cav., U.S.A.
Executive Officer.

OFFICIAL:
JAMES H. MANIERRE,
Major, A.G.D., U.S.A.
Camp Adjutant.

File
J.H.M.

HEADQUARTERS CAMP JACKSON,
Columbia, S. C.

DAILY BULLETIN NO. 77.

Thursday, April 15, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE:- Organization commanders will be held responsible for the compliance by all members of their commands with all orders published in this Bulletin.

1. CAUTION! FIRING ON THE TARGET RANGE.

1. THERE WILL BE FIRING ON THE SMALL ARMS TARGET RANGE SATURDAY, APRIL 17TH FROM 8:00 TO NOON. ORGANIZATION COMMANDERS WILL CAUTION MEMBERS OF THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THAT DATE.

2. REGARDING THE PURCHASE OF AUTOMOBILE EQUIPMENT.

1. Officers wishing to purchase automobile equipment from Motor Transport Corps at cost price will arrange to transact such business with the Motor Transport Supply Officer on WEDNESDAY mornings only, between the hours of 8:00 a. m. and 11:30 a. m. at the Motor Transport Corps Repair Shops. On account of the shortage of personnel no orders can be filled at times other than above mentioned.

3. NEW TELEPHONE DIRECTORIES.

1. All organizations and Seperate units will, upon receipt of New Telephone Directories, immediately destroy all old copies of both Camp and the City Directories.

4. LIST OF ENLISTED MEN TO BE SUBMITTED TO CAMP PERSONNEL ADJUTANT.

1. Regimental and sepamate unit commanders will submit to the Camp Personnel Adjutant not later than 5:00 p. m. April 16, 1920, a list of all enlisted men attached to their respective organizations in the following form:-

ENLISTED MEN ATTACHED TO_____

Rank	Name	Ser.No.	Ord. Corps or Branch of Service	Enlisted under Sec. V. Bull.22 W.D.1918 (Yes or No.)	Eligible for Furl. to Reserve by June 30 1920. (If No, so state. (If Yes give date of eligibility.)

Vacancies for N.C.O. by grades:-
Total vacancies (all ranks) in Organization:-

BY COMMAND OF MAJOR GENERAL READ:

OFFICIAL:

STEPHEN E. BULLOCK
Capt, F.A., U.S.A.
Acting Camp Adjutant.

W. D. BEACH,
Colonel Cav. U.S.A.
Executive Officer.

HEADQUARTERS CAMP JACKSON,
Columbia, S. C.

DAILY BULLETIN NO. 96.

Monday, May 10, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE: Organization commanders will be held responsible for the compliance by all members of their commands with all orders published in this Bulletin.

1. CAUTION! FIRING ON ARTILLERY RANGE!

THERE WILL BE SUB-CALIBER FIRING WITH 37MM GUNS ON THE ARTILLERY RANGE COMMENCING AT 9:00 A. M. TO LAST UNTIL 4:30 P. M. FROM MONDAY MAY 10TH TO FRIDAY 14TH, INCLUSIVE. THE DIRECTION OF THE FIRE WILL BE FROM WEST TO EAST ABOUT PARALLEL WITH THE ANGRUM FERRY ROAD AND TO THE NORTH OF IT. ORGANIZATION COMMANDERS WILL CAUTION THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THOSE DATES.

2. CAUTION! FIRING ON PISTOL RANGE!

1. THERE WILL BE FIRING ON THE PISTOL RANGE FROM 8:00 A.M. TO 5:00 P. M. EVERY DAY UNTIL MAY 19TH. THE DIRECTION OF THE FIRE WILL BE FROM WEST TO EAST. ORGANIZATION COMMANDERS WILL CAUTION THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THOSE DATES.

3. PRESENTATION OF CUP.

1. There will be a review of the 48th Infantry held on the 48th Infantry Drill Grounds at 5:30 P. M. TUESDAY, MAY 11TH. This ceremony will be modified as prescribed for the presentation of medals and will be for the purpose of presenting to the Headquarters Company, 48th Infantry, the Cup for best barracks and Mess room.

2. It is desired that as many members of the command as practicable be present to witness the ceremony.

Write report called for in Par 5 Date report and result.

L P K.

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HEADQUARTERS CAMP JACKSON,
Columbia, S. C.

DAILY BULLETIN NO. 105.

Saturday, May 22, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE:- Organization commanders will be held responsible for the compliance by all members of their commands with all orders published in this Bulletin.

1. CAUTION! FIRING ON PISTOL RANGE! SUNDAY AFTERNOON.

1. The following men have been granted permission to practice pistol shooting on the Pistol Range, SUNDAY May 23, 1920 from 1:00 p. m.

Regt'l Sgt. Maj. C. Hundertmark, 48th Inf.
1st Sgt. Thomas Guillfoyle, Hdqrs. Co. 48th Inf.
Sgt. Arve B. Baker, Co. "G", 48th Inf.

2. The range officer will furnish the necessary ammunition and targets.

2. CAUTION! FIRING ON ARTILLERY RANGE! KEEP OUT OF THIS AREA!

1. THERE WILL BE SUB-CALIBER FIRING ON THE ARTILLERY RANGE WITH 37MM GUNS FROM 9:00 A. M. UNTIL 4:30 P. M. EVERY DAY FROM MONDAY MAY 24TH TO FRIDAY MAY 28TH. THE DIRECTION OF THE FIRE WILL BE FROM WEST TO EAST ABOUT PARALLEL WITH THE ANCRUM FERRY ROAD AND TO THE NORTH OF IT. ORGANIZATION COMMANDERS WILL CAUTION MEMBERS OF THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THOSE DATES.

3. SCHOOL DUTIES MAY 24th & 25th.

1. School duties as outlined in Daily Bulletin No. 101, Paragraph 1, May 17, 1920, these Headquarters will be held on Monday and Tuesday, May 24th and 25th. The attendance of May 25th will be the last attendance of the year, excepting the Closing Exercises June 1st.

2. The Agricultural School and Animal Husbandry School will continue in operation.

BY COMMAND OF MAJOR GENERAL READ:

W. D. BEACH,
Colonel, Cavalry,
Executive Officer.

OFFICIAL:
J. R: BREWER,
Lt. Col., 46th Inf.
A. E. O. G-3

File

DISTRIBUTION: "A" "B" "C"

June 29, 1920

COPY

HEADQUARTERS CAMP JACKSON
COLUMBIA, S. C.

June 29, 1920.

FROM: Commanding Officer.

TO: Commanding General, Southeastern Department, Charleston, S. C.

SUBJECT: Answers to Questionnaire.

1. In compliance with paragraph 2, letter No. 600. 9- (Posts, Camps, and stations, S. E. Department) Headquarters, Southeastern Department, dated June 5, 1920, the following answers to the Questionnaire from the War Plans Division, General Staff, dated May 10th, 1920, is submitted:

1. Location and Area.

(a) Location

Camp Jackson is located approximately six (6) miles due east of Columbia, S.C.

(b) Area

21,946.6 Acres, or 34.29 square miles.

2. General characteristics of the reservation and surrounding territory in so far as these affect the training of troops. For training of what class of troops is reservation suitable - Infantry, cavalry, field artillery, coast artillery, engineers, tanks, etc.

(a) The country is rolling and covered with woods and undergrowth broken by many open spaces. There are many good camp sites and ample room for practice marches and maneuvers without danger of destruction to valuable crops or trespass on valuable farm land. There is an abundant supply of water for animals throughout the country roundabout. The topsoil is heavy sand; the subsoil is clay. There is little mud even during a rainy season as the water either drains off rapidly or is absorbed by the sandy soil. It is possible to drill troops within half an hour after a rain of twelve or more hours duration. The sand is but little shifted about by light winds and dust storms are infrequent. There are no prevailing high winds and no long seasons of rain.

RG 393 Army Cont. Cmds, 1821-1920
Part II, Camp Jackson
Gen Corr, 1917-1920
Box 24

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(b) The country is well suited for training of field artillery, infantry, engineers, and signal corps troops, there being suitable ground for unlimited target practice for these branches. For mounted troops the ground is easily gotten over but would prove heavy for drill ground work. Motorized heavy artillery finds considerable difficulty in moving heavy guns about, the ten-gun Holt tractors not having enough power to haul the guns, such as the 155 G.P.F. and the 8" Howitzer, where the sand is heavy. The same applies to tanks; the ground is favorable for the light tank but not for the others.

At present there is nt enough cleared ground in the vicinity of the barracks for dismounted and mounted drill. This defect can be remedied by clearing ground in close proximinity to the camp proper.

3. Amount and character of construction, capacity for troop shelter, permanent and temporary, for officers, enlisted men and animals. Show the data called for in this paragraph relative to permanent Construction listed separately from that pertaining to temporary Construction:

CONSTRUCTION

(a) Temporary Southern Army Cantonment:

Kind.	No.
Officers'	106
Barracks	358
Infirmaries	21
Mess and Kitchens	25
Administration	28
Offices	3
Guard Houses	19
Stable Guard	20
Bathhouses and Latrines	369
Stables	164
Storehouses	63
Sheds	96
Shops	25
Garages	6
Fire Stations	6
Heating Plants	3
Post Exchanges	18
Hospital Section	87
Theatre	1
Oil Filling Station	1
Laundry	1
Schools	7
Bakery	1
Septic Tank	1
Hotels	8
Stockade	1
Watch Towers	10

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(b)	Capacity men and Officers		47,860	
	Tent space for		22,000	
		Total	69,860	
	Capacity for Animals:			
	Camp Proper		8,320	
	Remount Area (Originally)		10,000	(now converted into Vocational Farm)
		Total	18,320	
(c)	Permanent Construction:			
	Grain Elevator	1		
	Magazines	4		
(d)	Hospital Capacity:			
	Beds	2,500		
	Personnel:			
	Nurses	200		
	Officers	200		
	Enlisted men	900		

4. Climatic conditions affecting training (number of outdoor working days by month for calendar year).

The annual rainfall is 45.7 inches. The mean temperature 65.4; lowest 24. In summer the temperature is at times so high that strenuous outdoor work is impracticable, but during the winter it is never too cold for such work. There are no prevailing high winds and no prolonged rainy season. For this reason, with the exception of a very few days in mid-summer, outdoor work can be carried on the entire year. Counting Sundays and holidays as working days the following working days by month can by counted on:

January - 31
February - 25 - 3 days of rain.
March - 31
April - 30
May - 25
June - 20 - 5 days of rain - 5 days of excessive heat.
July - 20 - 5 days of rain - 6 days of excessive heat.
August - 20 - 5 days of rain - 6 days of excessive heat.
September - 25 days
October - 31
November - 30
December - 31.

5. Communication within, to and from the area, including roads, railroads, trolley lines, telegraph, telephone, and available landing fields for airservice.

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Communications, etc.:

1. (Within Post Proper) Roads: Class A. - Concrete - 2.78 miles. Class A - Bituminous Macadam - 8.26 miles. Class C - Sand Clay - 6.62 miles. Total Class A Roads 10.98 miles. Total Class C Roads 6.62 miles.

1. (a) Within Reservation - Class C Roads - Sand Clay - 21.6 miles (exclusive of Post roads).

2. Miles of Railroad Track - 0.2 miles (This track is used jointly by the Atlantic Coast Line, Seaboard Air Line and Southern Railroads, operating through spur from Atlantic Coast Line Railroad).

3. Telegraphic Communications - Western Union and Postal Telegraph.

4. Telephone - Bell Long Distance and local to Columbia, S.C.

5. Current - Lighting, etc. Current is furnished by City of Columbia, S. C., through a 23,000 volt, 3 Phase Line, stepped down through transformers in Camp.

6. Water Supply - From mains from City Pumping Station.

Camp Storage Capacity is as follows: Concrete Reservoir of 1,300,000 gallons, 3 tanks of 200,000 gallons and 1 small tank of 50,000 gallons, giving a total storage capacity of 1, 950,000 gallons.

7. Communication with the Camp is effected by one well paved bituminous and concrete road and one sand-clay road and a trolley line leading directly from Columbia, S.C., to points east, north and south within the camp. There are three railroads leading to camp as follows: Atlantic Coast Line, Seaboard Air Line, and Southern, operating through joint spur as stated above.

8. Aviation Facilities - There is an aviation field, not owned by the Government, approximately two miles south of Camp, three fourths square mile in area. In addition there are several landing places scattered through-out Camp, large enough to accommodate at least two airplanes.

9. Existing target ranges for both infantry and artillery with possibilities of adaptation to musketry training (field firing) for infantry and service firing for field artillery.

(a) For small arms practice a complete range equipped with 65 targets, capable of expansion to 100 targets at all ranges with ideal spots adapted to musketry training. During the War there were 500 targets. Suitable ranges for the maximum number of troops that can be accommodated can be provided.

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(b) The Artillery range adjacent to and joining the Camp proper is approximately nine and one-half miles long and three and one-half miles wide, and affords facilities for every phase of artillery practice.

7. Additional tracts suitable for target ranges, infantry and field artillery, and their characteristics. Possibility of acquisition (a) for ordinary peace time training; (b) in an emergency requiring sudden expansion of peace time facilities. Distance from post and communications.

North of the Camden Road, immediately adjoining the present range and parallel thereto, is a large stretch of land similar in every respect to the present range, both as to size and characteristics, and suitable for infantry and field artillery target ranges.

POSSIBILITY OF ACQUISITION:

(a) For ordinary peace time training, -can be obtained only at exhorbitant cost.

(b) In an emergency requiring sudden expansion of peace time facilities - Can be obtained by lease, purchase of condemnation.

Distance from post and communications. - Tract is immediately adjoining present reservation on the North. Main road is the Camden Road running along the South side of the tract. This is an improved road at present in poor condition. Other roads throughout tract are merely trails, or unimproved roads.

8. Visitors Accommodations on reservation or in the immediate vicinity.

There are two large Y.W.C.A. houses in camp with limited facilities for the accomodation of visitors. There are also ten Y.M.C.A., two K. C., one Christian Science, and one Jewish Welfare buildings, with no sleeping quarters. There is one first class hotel in the City of Columbia, S. C., six miles distant and several second class hotels. All are expensive, generally crowded, and the service is poor. Accommodations with private families in Columbia are expensive and difficult to obtain.

9. Facilities for quartering families of troops on or near the reservation.

A number of families of Officers and enlisted men are at present occupying some of the temporary buildings not required for the use of the troops. Should these ever be required for troops there will be no accommodations in camp for families of troops.

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There are no other accommodations on the reservation, and in the city of Columbia accommodations are scarce and extremely expensive when obtainable.

10. Recreational facilities on or near the Reservation.

On the reservation there is one athletic field including a baseball diamond, one baseball field, one polo field, one large building, formerly belonging to the Y.M.C.A., suitable for a gymnasium, equipped with bowling alleys, but nothing else, and one Liberty Theatre, capacity 2200, in which moving pictures are shown and road shows presented. Six Service Clubs for enlisted men are in operation, and there is one Library.

Near the Reservation there is only the City of Columbia where the usual moving picture shows are in operation, and one public swimming pool on the outskirts of the city. The Y.W.C.A., the Y.M.C.A., the Knights of Columbus, and other fraternal organizations welcome enlisted men to their halls.

11. Formal capacity for training Purposes:

(a) Of Reservation Proper:
Officers and men in barracks - 47,860

Tent Space for	22,000
Total	69860

(b) Including adjacent ground now available for training purposes without cost to the Government.
None

12. Expansion Capacity:

(a) Including (11) above.

It is assumed that this question was intended to read, "Including (a) above". On this assumption, the numbers given in (a) above are considered to be the maximum capacity, viz., 69,860.

(b) Including ground in addition to (b) above that may be leased, purchased or condemned in the event of an emergency, using the ground formerly known as North Camp Jackson, just North and practically adjoining the Northwestern corner of the present reservation, which could be obtained through lease, purchase, and condemnation, in the event of an emergency the capacity could be expanded to 100,000 officers and men. Furthermore this tract lies adjacent to the main line of the Seaboard Air Line Railway.

13. A copy of each existing map of the reservation.
There are being forwarded under separate cover one blue print copy of each of twenty-four existing maps of the reservation.

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14. Any other information concerning the reservation which would be of interest in estimating its value as a training rendezvous for:

(a) The existing military establishment. Camp Jackson has ample facilities for housing and training at present 40,000 troops. Columbia, S. C., a town of 41,000, six miles distant, and connected with the Camp by a railroad spur, street car line, one macadam road in good condition, and one fair sand-clay road, is the junction point for three main southern railroads, viz., the Seaboard Air Line, the Atlantic Coast Line, and the Southern Railway. Training can be carried on outdoors practically the entire year round, due to the comparatively mild winter, and the absence of a prolonged rainy season. A noted winter resort, Camden, S. C., is thirty miles from Camp. Charleston, S. C., one of the most important ports of the South is only 128 miles distant.

Considerable repair work on the buildings would be necessary, however, for the carrying out of this project. Also, there would be no accommodation in camp for the families of officer and enlisted men with this number of troops, and the cost of rental of civilian quarters near the reservation would become prohibitive.

(b) A system of universal military training:

Owing to the number of railroads entering Columbia, S. C., and the excellent communication between the camp and the city, Camp Jackson with its present facilities would lend itself excellently to forming a part of such a training system.

(c) A mobilization and training of full man power of the nation (7,000,000 men program).

Owing to its location with reference to the three lines referred to, paragraph 14 (a) above, the ports of Charleston, S.C., and Savannah, Ga., and the possibilities of expansion of the present reservation, Camp Jackson, S.C., would form an important unit in the training and mobilization of the full man power of the nation. The possibilities of expansion are practically limited only by the capacity of the railroads for transportation of troops, material and supplies. The tracts referred to in preceding paragraphs as being available for are for the greater part uncultivated land and of small actual value, though held at a high price by the owners when the Government is in the market.

HARRY R. LEE,
COLONEL, INFANTRY,
Commanding.

MD:MP

REPRODUCED AT THE NATIONAL ARCHIVES

June 25, 1923

RECORD

RECORD

HEADQUARTERS EIGHTY-SECOND DIVISION
ORGANIZED RESERVES

OFFICE OF THE EXECUTIVE OFFICER
COAST ARTILLERY RESERVE COMPANIES

COLUMBIA, S. C.

MEB-RCM

JUL 17 1923

June 25, 1923.

Subject: Rifle Range.

To: C.O. IV Coast Artillery District.

1. It is recommended that a rifle Range for the use of Civilian Rifle Clubs and the instruction of citizens of military age, as outlined in paragraphs 1 and 2, Special Regulations No.109, W.D. 1920, be opened on the Military reservation at Camp Jackson, South Carolina.

2. If this range is opened I am willing to be appointed instructor in Rifle Marksmanship in addition to my other duties. This would include the care and responsibility for the government property involved. One enlisted assistant would be required.

3. It is recommended that this range be divided into two parts: viz, a small bore range and a service range. The small bore range should be constructed near the camp entrance and in close proximity to the car line. There is a suitable location available. This range could be constructed at a very reasonable cost. (About $100.00) There is a suitable range already constructed for service firing and a small expenditure would make this serviceable. This range is not easily accessable except by automobile, hence would not be used for small bore firing.

4. An initial issue of the following material would provide a working equipment; viz, 5 service rifles; 5 .22 caliber New Model Springfield Rifles; 1 Service Ramrod; 2 Ramrods for .22 caliber rifles; 5000 patches; 5000 rounds service ammunition; 25,000 rounds .22 long rifle cartridges; 1000 gallery targets; 200 targets A; 20,000 white pasters; 15,000 black pasters; cleaning material, preferable Hoppe's Nitro powder solvent; 200 yards of target cloth; suitable paste and gun oil. Considerable salvaged material could be used in this work.

5. In my opinion a large number of reserve officers would avail themselves of an opportunity to take this rifle instruction. There is a growing rifle club in Columbia that would expand to a considerable size. A general enthusiasm for shooting would be fostered and the army would secure much favorable comment as the result of such a range being established.

RECORD

RECORD

MAURICE E. BARKER,
Captain, C.A.C.

684 - Camp Jackson, S. C.

Benning, Ga. 1-6-22 10,000

RG 394, [illegible] Army [illegible] Mental [illegible]
E-123, 4th [illegible] Area, Adjtrs, [illegible]
Box 23[illegible]

REPRODUCED AT THE NATIONAL ARCHIVES

Hq. Fourth Coast Artillery District, Fort McPherson, Georgia, July 11, 1923 - To: Commanding Officer, Fourth Corps Area, Atlanta, Georgia.

1. Approved. I heartily approve of an increased interest among civilians in the matter of target practice. This is good and cheap propaganda. Gallery practice with modified Mausers was the greatest factor in stimulating German colonials and immigrants to foreign countries in maintaining their national spirit.

F.E. JOHNSTON,
Commanding.

2nd Ind. BB/M-jac.

HQ FOURTH CORPS AREA, Atlanta, Georgia, July 16, 1923 - To The Adjutant General of the State of South Carolina, Columbia, S. C.

For remark.

For the Corps Area Commander:

ROBT. WHITFIELD,
Assistant Adjutant.

1923

REPRODUCED AT THE NATIONAL ARCHIVES

August 1-3, 1923

State of South Carolina

ADJUTANT GENERAL'S OFFICE

Columbia

3rd Ind.

A.G.O., Columbia, S.C., August 1, 1923. To: Headquarters 4th Corps Area, The Corps Area Commander, Atlanta, Ga.

1. Returned, approved. I concur in the above indorsement.

2. The rifle range at Camp Jackson will be repaired in the near future and it will be the pleasure of the State of South Carolina to encourage and assist in every way possible and the use of the rifle range will be open at any specified time to the Civilian Club.

Robert U. Craig,
The Adjutant General.

REC/s

RG 394, U.S. Army Continental Commands
E. 123, 4th Corps Area, Hdqtrs. Corres, 1920-42
Box 234

REPRODUCED AT THE NATIONAL ARCHIVES

HEADQUARTERS I ARMY CORPS
~~HEADQUARTERS I CORPS~~
614 OFFICE OF THE CORPS COMMANDER HOC/lw
COLUMBIA, S. C.

February 24, 1941.

Subject: Construction of Training Aids.

To : Commanding General, First Army, Governors Island, New York.

1. Reference letter Headquarters First Army, file and subject as above, dated February 10, 1941, delays in the completion of range facilities have somewhat interfered with the progress of training. These delays, which have not been serious, were occasioned at Fort Jackson by the purchase of land, the time element incident to drawing of plans and specifications, and the letting of contracts.

2. Progress of Construction.

a. Fort Bragg, North Carolina

(1) 300-target Range:
(a) 70 completed by February 9th.
(b) 70 additional to be completed by March 1st.
(c) All to be completed by April 1st.

(2) 6 antitank sub-caliber ranges complete.
(3) 2 antiaircraft miniature ranges complete
(4) Moving target ranges, ample in operation.
(5) Sunken antitank ranges:
(a) 1 complete by March 15th.
(b) 2 additional to be completed by April 15th
(6) Infantry combat ranges one-third (1/3) complet by March 10th.
(7) Pistol range--200 complete by March 1st.

b. Fort Jackson, South Carolina.
(1) New ranges at Fort Jackson, South Carolina, will be in use about April 1, 1941, consisting of the following:

(a) 400-target Known-Distance Range.
(b) 8 - 1000" Moving Antitank.
(c) 4 - 1000" Antiaircraft.
(d) 200 - 1000" Bobbing Target.
(e) 20 sets, 1000" landscape.
(f) 200 pistol targets.

Incl. #4

REPRODUCED AT THE NATIONAL ARCHIVES

614 - Subject: Construction of Training Aids, Hq I Army Corps to Hq First Army, 2-24-41.

b. Fort Jackson, South Carolina (cont'd).

(2) Field Artillery.
(a) Artillery dugouts--bids to be opened February 28th.
(b) Range Telephone System--materials ordered and expected to arrive March 1st.

For the Commanding General:

RECEIVED - HQ FIRST ARMY (AGO) FEB 26 1941

Roy W. Strickland

R. W. STRICKLAND,
1st Lieut. A. G. D.,
Assistant Adjutant General

RECEIVED AT THE NATIONAL ARCHIVES

TRAINING FACILITIES

STATION	NATURE	WHEN REQUIRED	COMPLETE OR ESTIMATED DATE	ADEQUACY	REMARKS
I ARMY CORPS					
Fort Bragg, N.C.					
	Range, known distance	Current	April 1		25% complete Feby. 9th; 50% March 1st.
	Range, pistol	Current	March 1st		
	Range, combat	March	Not reported		33% complete March 1st.
	Range, anti-tank	Not reported	April 15		
	Range, anti-tank, sub-cal.	Current	Complete		
	Range, AA, miniature	Current	Complete		
Fort Jackson, S.C.					
	Range, known distance		April 1		
	Range, 1000"		April 1		
	Range, pistol		April 1		
	Range, telephone system		March 15		

Resume of report held in Hq 1st Army as of February 24, 1941.

Inc 1. #4

Inc 1. #4

June 11, 1941

HEADQUARTERS FORT JACKSON
Office of the Post Commander

Fort Jackson, S.C.
June 11, 1941.

GENERAL ORDERS)
:
NUMBER 36)

1. In order to efficiently maintain and operate the recreational center, Weston Pond - Forman Pond, this area is declared off-limits for all organizations and individuals of the command, except those specifically excepted by this headquarters.

2. The shaded portion of the attached sketch shows the delimited area.

For the Commanding Officer:

FRANK L. WHITTAKER,
Lieutenant Colonel, Cavalry,
Executive.

OFFICIAL:

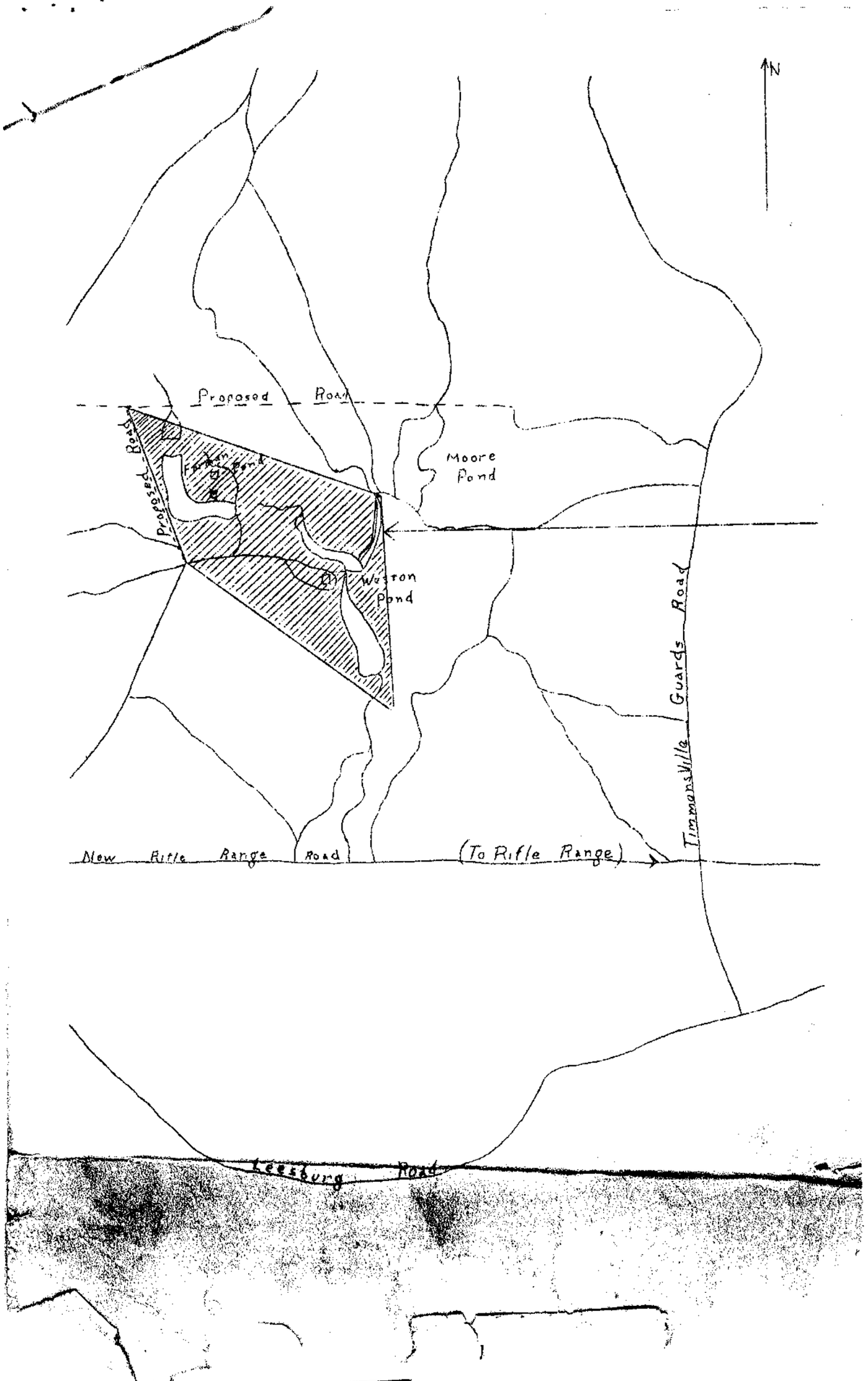
F. V. M. DYER.
Lieutenant Colonel, Infantry.
Adjutant.

1 Incl.
Sketch

Distribution: "A"

DECLASSIFIED
Authority NND 947030
By MD NARA Date 3/15/04

RG 337, Hq Army Ground Forces
E. 108 (A.D.) AGF + AFF Installs.
Box 31



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Authority NND 947030
By MD NARA Date 3/15/04

Reproduced at the National Archives

May 26 1942

EWG

HEADQUARTERS 8TH MOTORIZED DIVISION
Fort Jackson, South Carolina

May 26, 1942

TRAINING MEMORANDUM
Number 33

PLATOON COMBAT FIRING PROFICIENCY TESTS

Reference: 1. Training Memorandum number 10, Hq I Army Corps, CS.
2. Ltr. GHQ, 353/652-6 (10-30-41), Oct 30, 1941, Subject "Post Maneuver Training".

1. The platoon Combat Firing Proficiency Tests as directed by reference 2, above will be held for the platoons of this division during the period May 28 - June 13 as follows:

a. May 28, 29, 30, June 1, 2, 3, - 13th Infantry.

b. June 8, 9, 10, 11, 12, 13, - 28th and 121st Infantry.

2. Assignment of Ranges.

a. 13th Infantry (except 81mm Mortar Platoons) - Combat Range #5.

b. 28th Infantry (except 81mm Mortar Platoons) - Combat Range #5.

c. 121st Infantry (except 81mm Mortar Platoons)- Combat Range #6.

d. 81mm Mortar Platoons, all Regt's - Mortar Range #1

3. Place.

a. Units firing on Combat Range No. 5, will report to the testing board at RJ Camden Rd. - Percival Rd.

b. Units firing on Combat Range No. 6, will report to the testing board of RJ Percival Rd. - Unimproved Rd. to Combat Range No. 6.

c. Units firing on Mortar Range No. 1, will be notified of the place to report.

4. Time.

a. Units firing on Combat Ranges No. 5 and 6,
The first platoon to be tested each day will report at 6:30 AM. Other platoons will follow at one hour intervals until eight (8) platoons have reported.

b. Mortar Platoons
Mortar platoons will be notified of the time to report.

RG 338. US Army Commands
E. 37042 Unit Recs
Box 489

Authority NND889540
By MNARA Date 2/21/04

REPRODUCED AT THE NATIONAL ARCHIVES

5. Ammunition.

Unit Commanders are responsible that sufficient ammunition is available at the place of reporting. See Annex No. 11 for instructions relative to issuing ammunition.

By command of Major General MARLEY:

GEORGE D. SHEA,
Colonel, General Staff Corps,
Chief of Staff.

OFFICIAL:

F. R. Keeler

F. R. KEELER,
Lieutenant Colonel, Adjutant General's Department
Adjutant General.

ANNEXES:

#1. Situation and requirements, Rifle Platoon.
#2. Situation and requirements, Cal. .30 M.G. Platoon
#3. Situation and requirements, Weapons Platoon, Rifle Co.
#4. Situation and requirements, 81mm Mortar Platoon
#5. Scenario of Problems.
#6. Umpire Check list, Rifle Platoon
#7. Umpire Check list, Cal. .30 M.G. Platoon
#8. Umpire Check list, Weapons Platoon, Rifle Co.
#9. Umpire Check list, 81mm Mortar Platoon
#10. Umpire Control Signals
#11. General Instructions.

Distribution
A & EB
25 copies to G-3

NOTE: Annexes issued to units and individuals concerned only.

Authority NND 883940
By MNARA Date 2/21/04

October 5, 1942

COPY

HEADQUARTERS FOURTH SERVICE COMMAND
Services of Supply
Office of the Commanding General DK:TMH:ctd

AG 614-General

Post Office Building
Atlanta, Georgia.

October 5, 1942.

SUBJECT: Training Aids

TO: Commanding General, Fort Jackson, South Carolina.

1. This headquarters has been requested by the Commanding General, 2nd Army, to install the following training aids at your station:

1 Sub-machine Gun Range.
1 Moving Vehicle Range.
1 Grenade Court (Live).

2. An estimate of cost for each installation, together with a map showing the proposed location of the training aid to be installed, will be submitted to this headquarters as soon as practicable.

3. A negative report is desired if any of the above facilities exist at present at your station.

For the Commanding General:

/s/ J. V. V. SHUFELT
J. V. V. SHUFELT,
Colonel, General Staff Corps,
Director, Operations and Training Division

COPY

RG 337, Hq. Army Ground Forces
E. 55, Gen'l. Cortes.
Box 1122

Authority NND 947010
By JA NARA Date 7/23/94

HEADQUARTERS FORT JACKSON
Office of the Commanding General

Fort Jackson, S.C.
December 3, 1942.

GENERAL ORDERS)
NUMBER 63

POST RANGE REGULATIONS

1. General Order #39, this Headquarters, dated June 24, 1941 is rescinded.

2. General Information.

   a. The purpose of these regulations is to govern the use of firing ranges and to prescribe safety precautions to be observed in service firing.

   b. All firing on the Reservation will be EAST of TELEPHONE ROAD as follows:

      (1) LEESBURG AREA: Small Arms firing will be conducted on the Leesburg Rifle Range.

      (2) ARTILLERY AREA: Artillery firing will be conducted in the area EAST of TELEPHONE ROAD exclusive of the Leesburg area. Infantry combat and Anti-Tank Ranges in the Artillery Area will be under control of the Artillery Area.

   c. When firing is in progress, signals will be displayed as follows:

      (1) LEESBURG RANGE: Red streamers on poles in rear of firing lines on ranges C-H-R.

      (2) ARTILLERY AREA: Red streamer on Tower Wichks Hill-(13.4-13.7) or Tower on Hill (15.7-21.2) depending on whether ANCRUM FERRY ROAD or OLD CAMDEN ROAD is closed to traffic. Red flags will also be displayed in vicinity of all firing points.

   d. Persons entering the reservation EAST of TELEPHONE ROAD will inform themselves as to the firing scheduled or in progress. The current days firing will be posted on maps located as follows:

      (1) Artillery Range Central. (C.R. Ancrum-Ferry and Telephone Roads).

      (2) Leesburg Range Central.

      (3) Office of the Post Range Officer, Post Headquarters.

      (4) See par. 12.

3. Range Control.

   a. The Post Range Officer will control the Range and will coordinate all firing on the Fort Jackson Reservation.

      (1) LEESBURG RANGE:

         a. The Assistant Post Range Officer at Leesburg will represent the Post Range Officer, with direct charge of all firing on Small Arms Ranges in the Leesburg Area. An organization firing on the Small Arms Ranges will appoint a Range Officer who will contact the Assistant Post Range Officer to arrange for targets and other materials, also for posting Range Guards.

Authority NND 997030 By MD NARA Date 3/15/04

RG 337 Hq Army Ground Forces, E. 108 (U.S.), AGF - AFF Journals Box 31

(2) DIVISION ARTILLERY RANGE OFFICER.

a. The Divisions or similar units will detail one Field Artillery Officer as Assistant Range Officer for the period when the Artillery of the Division is firing on the Artillery Range. This officer will function as Assistant Post Range Officer with respect to Artillery firing of his Division. He will report to the Post Range Officer for instructions on the day when requests for Artillery Firing reach the Post Range Officer, and forty-eight (48) hours before each days firing.

4. Range Detachment.

a. A permanent detachment will operate under the orders of the Post Range Officer. The Range Detachment will operate the Post Range Communication System. It will establish sentinels, signs and road blocks as directed by the Range Officer and will keep range maps posted.

5. Governing Regulations.

a. The provisions of AR 750-10 will govern all firing. The provisions of appropriate Field Manuals will govern the firing of the particular weapon.

6. Range Telephone System:

a. Traffic diagram of the Range Telephone System is in the Office of the Post Range Officer.

b. Tapping of circuits on the Range Telephone System at other than installed terminal strips, or cutting or rearranging of any installed circuit, is forbidden.

c. Requests for special circuits will be submitted to Post Range Officer one (1) day in advance.

d. Damage to telephone cables or metallic circuits on Artillery Range will be reported to Artillery Range Central immediately; damage to installations on Leesburg Range to Leesburg Range Central.

e. Permanent pole lines of the range telephone system will not be used by troops.

f. All field wire will be disconnected at the conclusion of each day firing.

7. Assignment of Ranges.

a. The general assignment of the Small Arms Ranges and the Artillery Ranges will be announced by Post Headquarters.

(1) LEESBURG RANGE:

(a) The organization assigned the Leesburg Range will inform the Assistant Range Officer, Leesburg, of the calibers and ranges on which firing is to be conducted twenty-four (24) hours in advance, except in the case of 50 caliber Machine Gun, when forty-eight (48) hours notice will be required. (See Part II.)

(2) ARTILLERY AREA:

(a) In accordance with priorities prescribed by regulations and orders of these Headquarters, the Post Range Officer will assign firing areas, will prescribe the limitations on firing therein, the safety limits, and any other restrictions necessary for safety.

Authority NND 947630
By MD NARA Date 3/15/94

(b) When an organization has been assigned priority on the range, requests for firing areas approved by that Organization Headquarters will be acted on promptly in the order in which received, and the assignment made within twenty-four (24) hours after receipt of request. The Range Officer will approve requests as submitted, except where the limits of the requested area must be modified for safety reasons. In this event, the Range Officer will promptly confer with the organization Headquarters to arrange suitable modification.

(c) Units other than those normally assigned the Artillery Area, desiring to fire Special Problems will submit requests for firing areas to the Post Range Officer ten (10) days in advance of the proposed firing.

(d) 37-mm and 75-mm Anti-Tank Firing by units in areas involving both the Leesburg Area and the Artillery Area will be arranged by the Post Range Officer upon request.

(e) Sentinels for enclosing the danger area will be furnished by units conducting fire and will be posted by the Artillery Range Officer under the direction of the Post Range Officer.

8. Publication of Firing Memorandum:

a. A weekly Firing Memorandum is issued by Post Headquarters every Friday morning at 8:00 A.M. covering all firing for the succeeding week. Overlays will accompany requests for Artillery Ranges and will reach the Post Range Office in time to be checked and the information placed in the Firing Memorandum. It is necessary that this information be furnished the Post Range Officer. The Post Range Officer must know at all times what firing is being conducted, the position and danger areas.

b. The following form will be used to submit requests:

TO: POST RANGE OFFICER, HEADQUARTERS.

Request following Firing Memorandum:

(Signed by officer requesting Memorandum.)

(Submit only one copy)

FIRING MEMORANDUM NUMBER _____

DAY OF WEEK
DATE
HOURS OF FIRING
ORGANIZATION
CALIBER
AMMUNITION
TARGET AREA
OBSERVATION POST
GUN POSITION
RIGHT SECTOR LIMIT: GUN
LEFT SECTOR LIMIT: GUNS
MAXIMUM RANGE (YARDS)
DANGER LIMIT (YARDS)
RESPONSIBLE OFFICER
REMARKS

Authority NND 947030 By MD NARA Date 3/18/04

9. Duties of the Post Range Officer.

a. The Post Range Officer is responsible for the coordination of activities on the range and for the safety of the entire range.

b. When requests for firing positions are submitted, the Range Officer will adjust any conflicts as to areas, check safety provisions, and will issue a Firing Memorandum prescribing the safety limits for each position.

c. When request for an area is submitted, the Firing Memorandum will define the area assigned. The officer supervising the exercise will prescribe safety provisions for each position in compliance with paragraph 7, AR 750-10.

d. When required, in addition to the usual warning issue to personnel of the Post, announcement will be made in the daily papers.

e. The Post Range Officer is responsible for the posting of permanent signs on the reservation.

10. Duds:

a. The Post Ordnance Officer is charged with the destruction of "duds" on the Range.

b. "Duds" discovered on the Range will be marked by a stake and reported to the Post Range Officer. Reports will show type and caliber of each "dud" location by coordinates, and the name of any person familiar with its location. Artillery units conducting fire will report location of any suspected "duds" during the day's firing.

c. Officers in charge of Mortar Firing will police range for "duds" at the completion of firings and report the location of all duds to the Post Range Officer.

11. Permanent Installations:

a. Artillery firing will not be placed within 500 yards of permanent installations except dugouts.

b. All dugouts, except #5 dugout, are constructed to offer protection against caliber 105-mm and less. Dugout #5 offers protection against 37-mm and less.

c. Permanent roads, bridges and dams may be included in firing areas, but no adjustment will be made on such installations. Every precautions will be taken to prevent direct hits on such installations. Precautions will be taken to assure that firing will not endanger permanent telephone lines.

12. Danger Areas.

a. The size of the reservation and the nature of the terrain prevent the posting of guards to cover all approaches to danger areas. The danger areas will be marked by signs at points where sentinels are not posted. These signs will not be passed by personnel, except in the following cases:

(1) Personnel going to and from service firing on safe routes designated by the unit commander in charge of the firing.

(2) Officers and parties accompanied by an officer checking through the Range Central and signing the range book. In this case, the officer accepts responsibility for a complete knowledge of the danger areas and of all firing in progress.

Authority NND 947630 By MD NARA Date 3/15/04

13. Battery-Commander:

a. The Battery-Commander is responsible that:

(1) Safety precautions prescribed in AR 750-10 regarding handling of ammunition and service of the piece are complied with.

(2) A red flag is displayed in a conspicious place in the vicinity of the battery position during firing.

(3) That all personnel of the battery are properly instructed as to safety precautions in general, and in particular as to the location of adjacent gun positions and sector of fire.

(4) When the shell is fired other than with bore safe fuses, or fuses considered in the category of bore safe, all personnel within the danger limits are protected as prescribed in paragraph 14, AR 750-10.

(5) The Range Central is promptly notified on completion of firing.

(6) The area used will be policed at the end of practice.

14. Battery Executive:

a. The Battery Executive is responsible for safety of the personnel at the firing position, (AR 750-10). He will fire only when the safety officer indicates safe to fire.

15. Battery Safety Officer.

a. In all Artillery firing, the Battery Safety Officer will have no other duties. He will indicate safe to fire only when:

(1) The Range Officer indicates the range is clear.

(2) The Range visible to him is clear.

(3) The pieces are so laid as to fire inside the safety limits both for direction and for range as determined by the quadrant elevation corresponding to the maximum range designated in the Firing Memorandum.

PART II

SMALL ARMS RANGE, LEESBURG

16. General Information.

a. The duties of the Assistant Post Range Officer (SA) on the Leesburg Rifle Range, will be as follows:

(1) Maintain all ranges to insure proper operation.

(2) To furnish all target material the Table of Allowance provides.

(3) To turn over all camp property to Organization Range Officer, or Supply Officer.

(4) To see that the ranges are not abused and that all the Government property is taken care of and used properly.

(5) To ascertain that no changes are made in safety angles for any range.

(6) To allow no changes to be made by using troops in any of the ranges.

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(7) To permit the unauthorized use of weapons, [illegible] in weapons and ammunition not authorized for use on that particular range.

(8) Maintain and supervise the use of the camp and range utilities.

17. Duties of Organization (SA) Range Officer.

a. To take over the Leesburg Range and camping facilities, including all the property and return same at end of firing period to the Assistant Range Officer (SA) in good serviceable condition.

b. To assist all targets, quarters and facilities to the using troops.

c. To furnish guards and transportation and posting the necessary guard to keep the danger area clear of personnel during the hours of firing.

d. To act as representative for the using troops in which case all requests made by using troops will be made to him only.

e. Report to Post Range Officer any facilities assigned and not being used.

18. Location of Ranges:

a. Ranges are designated as follows from the most westerly range (A) through east to the most northerly range (Z)

(A) 100 Machine Targets, 30 caliber only

(B) 30 Pistol Target, 45 Caliber

(C) 1 AA Range, 22 Caliber

(D) 1 AA Range, 22 Caliber

(E) 100 Pistol Targets, 45 Caliber

(FG) 100 Rifle 200 yds., 30 Caliber

(HI) 100 Rifle 300 yds., 30 Caliber

(JK) 100 Rifle 300 yds., 30 Caliber

(LM) 100 Rifle 200 yds., 30 Caliber

(N) 4 sets Anti-Tank, 30 Caliber only.

(O) Trench Mortar.

(P) 100 Machine Gun, 30 Caliber and 50 caliber.
(NOTE: .50 caliber to be used only by arrangement with Post Range Officer.)

(Q) 35 Targets Pistol, 45 Caliber.

(R) 100 Target plain 1000", 30 Caliber

(S) 1 set AA Targets, 22 Caliber only.

(T) 1 set AA targets, 22 Caliber only.

(U) 8 sets of Landscape, 30 Caliber only.

(V) 25 Pistol Targets, 45 Caliber.

(W) 6 sets of Landscape, 22 Caliber only.

(X) 25 Pistol targets, 45 caliber.

(Y) 4 sets Anti-Tank, 22 Caliber.

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(Z) 4 sets Sub-Machine Gun targets, 45 Caliber.

b. Each range is distinctly marked by a large conspicuous, designating letter. Also the type of ammunition to be used.

19. Control and Safety Regulations:

a. Guards will be posted under the supervision of the Organization Range Officer, so as to provide safety during the hours of firing, unless otherwise requested.

b. When all guards are posted, red streamers will be raised on poles in rear of Ranges C-H and R. No firing will be started until these streamers are raised. All firing will cease when streamers are lowered. A change in these streamers will be preceded by a long blast on the siren located at the water tank connected to tower. With no streamer raised, the blast will indicate that the streamer is to be flown. A series of blast on the siren, after firing has begun will indicate that all ranges will cease firing immediately.

c. Each range will be operated under the senior officer in charge. Where pits are provided, the pits will be under the supervision of an officer. Range procedure will be followed as specified in training manuals, for the arm being fired.

d. Prior to firing, the officer in charge of a range will notify the pit officer who will order the streamer on the target line to be raised when the pit is clear. Thereafter, no person will be allowed to stray from the pits, or leave the pits except by the authorized tunnels. Pit details will be instructed to operate and travel under the shelter.

e. An overlay will be furnished by Post Range Officer from time to time as to the location of the range guards. As the situation warrants, the location of these guards will change.

f. It will be the duty of the using troops to furnish one (1) non-commissioned officer and the guard for the range, and the duty of the organization (SA) Range Officer to ascertain that they are properly posted and instructed.

g. Ranges have been constructed to conform to Army Regulations for safety. Ranges will be used only for the purpose for which they were constructed (see paragraph 1). Special problems may be fired by arrangement with the Post Range Officer.

h. On all Combat Ranges and other Ranges beyond hearing distance of the siren at the water tank, the officer in charge of firing will communicate with the Leesburg Range Office to determine whether the Range Guards are posted and whether the Range is clear. At most of the Ranges telephone communication is established with the Range Detachment. The officer in charge of firing will notify the Leesburg Range Detachment Officer when firing is concluded each day.

i. The Officer in charge of firing will be responsible that the Range he uses is properly policed, targets are properly pasted or replaced for the next day, and any repairs that cannot be made on the "spot" will be reported to the Range Detachment at the conclusion of the day's firing.

j. Combat Ranges 1-2-3-4-5-6 are designed for firing Infantry Squad and Platoon Problems with Caliber 30, ball ammunition. The safety limits are marked and the Officer in Charge of Firing will see that all firing is within the Safety Limits.

These ranges will not be used for Training Areas or "Dry Run Exercises" except by permission of the Post Range Officer.

No changes in the Range Installations will be made by troops using the ranges. No other than caliber 30 ammunition will be fired on Combat Ranges except by permission of the Post Range Officer.

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20. Range Supplies and Property:

a. Ranges will be released to units when their authorized representatives have taken over the range property. This property will be maintained in good operating condition by the using unit. (Exception - broken targets, frames, etc., will be turned into the Post Range House for replacement.)

21. Communication:

a. Phones for ranges will be turned over with the range. Phones may be exchanged for repair at Post Range House.

22. Administration: - Camp Area.

a. Requests for use of the Camp Area on the Small Arms Range will be submitted to the Post Range Officer.

b. When the Camp Area is assigned to an organization, the Commanding Officer of that organization or an officer designated by him will contact the Assistant Range Officer at Leesburg and will sign for all property on Memo Receipt. Obtain from the Assistant Range Officer a proposed administrative order to the using troops covering the interior economy of the camp.

They will inspect the camp area noting any deficiencies.

c. Assignments in camp area, will be made by Commanding Officer of using troops, and administrative arrangement for the camp area, will be made under the control of the units using the area. Senior officer will command for coordination of installations.

d. Before departure, organization will:

(1) Fasten down sides of tents and loosen ropes.

(2) Stack all cots in mess halls for check.

(3) Scrub kitchen and mess halls.

(4) Clean ice box and leave open.

(5) Skim grease trap.

(6) Remove all garbage.

(7) Scrub bath house.

(8) Scrub latrines, sprinkle lime in pits, and leave covers closed.

(9) Burn out and clean all latrines.

(10) Police area.

(11) Clean incinerator and haul rubbish to dump.

(12) Return property to Assistant Range Officer and get Memo Receipt.

e. When the Post Exchange is in operation in the Camping Area the Senior Officer will issue orders regulating the hours and arranging for police and sanitary conditions. Post Exchange Officer should be informed of important changes or requests.

23. Facilities:

a. Each unit commander will notify the Organization Range Officer when he has facilities that are assigned to him and which he does not need.

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b. All requests for additional facilities should be made to the Organization Range Officer.

c. Available targets and ranges will be assigned by the Organization Range Officer.

d. The following equipment and facilities for each company or similar unit are available:

(1) Mess hall and kitchen.
(2) Pyramidal tents.
(3) Cots, canvas, folding.
(4) One (1) bath house to three (3) mess buildings.
(5) One (1) latrine, pit type.
(6) Screens or pyramidal tents, for latrines and bath houses.
(7) Ice Box.

e. The following equipment must be furnished by using troops.

(1) Field range.
(2) Cooking utensils.
(3) Mess kits, complete.
(4) Bedding.
(5) Ligh Bulbs.

f. Water facilities are very limited. Arrangements must be made within organizations to conserve all that is possible and alternate the use of it between the kitchen and bath houses when necessary. No water will be used for sprinkling streets.

24. Sanitation. The Commanding Officer of troops is responsible for sanitation and will appoint the senior medical officer as medical inspector for the camp and range.

25. Range Regulations, Anti-Tank Range.

Request will be made to Post Range Officer in same manner as for Artillery Range.

a. For the present time, only the following will be fired.
75mm sand loaded and armour piercing.
37mm armour piercing, sand loaded, and sub-caliber.
50 caliber Machine Gun.

b. The motor car and target car will be operated by personnel of the Range Detachment and under no circumstances by units firing. The car operator will set the car in motion and then report to officer in charge of firing that the range is clear and ready to be fired on.

c. A flag pole is available on the firing line. A red streamer will be flown when the Range is being fired on. No firing will be permitted unless the red streamer is being flown. It will be the duty of the officer in charge of firing to cause the streamer to be hoisted and lowered. Before the car operator goes forward, the order cease firing and lower the flag will be given. Upon return from target car the operator will report to officer in charge that range is clear and ready to be fired on. The officer in charge will order the flag to be hoisted and command begin firing.

d. The officer in charge of firing will furnish transportation for car operator to go to and from the target car to eliminate so much lost time when adjustments are to be made on car and target.

e. There is a white post at each end of the firing line. Pieces that are to be fired will take up positions between these posts.

f. Pieces that are merely for tracking purposes may be placed on an extension of the firing line.

g. There are two white poles 800 yds out with pieces of target cloth attached to the top which are to be used as right and left [illegible] markers respectively.

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h. The car is able to operate at two speeds, slow speed which is 5-15 miles per hour. Fast speed is from 5-25 miles per hour. The car operator will set the car at either speed the officer in charge of firing so desires. No other speed will be used except the above listed, without permission of the Post Range Officer.

26. Range Fires:

a. The control of fires resulting from firing on the range is the responsibility of the Officer in Charge of Firing.

When a fire on the range is observed the Officer in Charge of Firing on that range will immediately contact the Post Range Officer or his Assistant to determine the danger area.

If the fire is located inside a danger area the Range Officer or the Assistant Range Officer will stop all firing in that area. The Officer in Charge of Firing will then proceed to extinguish the fire.

b. Unit Commanders in the vicinity of the fire will give assistance when called upon to do so.

c. There are tools available for fighting range fires at the Leesburg Range Headquarters Detachment.

d. During extremely dry weather when the danger of Range Fires is imminent Officers in Charge of Firing will inspect the impact areas of their ranges for fires at the conclusion of each days firing.

27. This General Order will be included in Post Regulations at a later date.

By command of Brigadier General BEEBE:

A. T. MURPHEY
Colonel, F.A.
Adjutant.

DISTRIBUTION: "A"

Authority NND 947030
By MD NARA Date 3/18/04

HQ, FT JACKSON, SC,
Dec 31 1942.

GENERAL ORDERS)

NUMBER 64)

REDESIGNATION OF UNITS.--1. Pursuant to instructions contained in letter AG 320.2 - Headquarters Fourth Service Command, Subject: "Consolidation and Redesignation of Detachments, Station Complement, Fourth Service Command", dated December 26, 1942, the following units of the Station Complement, this station, are redesignated as indicated, effective December 31, 1942.

Former Designation	New Designation
Service Detachment, Branch No. 1, Supply Division.	Section No. 1, Supply Detachment, Supply Division (with Chemical Warfare Service, Engineer, Ordnance, Quartermaster Corps and Signal Corps Sub-sections.)
*Service Detachment, Branch No. 2 Supply Division.	*Section No. 2, Supply Detachment, Supply Division.
*Service Detachment, DEML.	*Post Detachment.

2. The Arm or Service designation of enlisted personnel of Section No. 1, Supply Detachment, Supply Division, will be governed by the designation of the Section to which the individual is assigned to duty.

3. Final and initial rosters will be rendered on WD AGO Form No. 309 for the above redesignations, in compliance with Paragraphs 12 and 13, AR 345-900.

By command of Brigadier General REDHE:

A. T. MURPHEY,
Colonel, FA,
Adj.

* Negro personnel.

Amended by HQ 24 July 6, 1943

DISTRIBUTION "A"

Authority NND 947630
By MD NARA Date 3/15/94

December 10, 1942

AG 614 - General
(10-5-42)

8th Ind.

DK:SL:EMH:hwa

HEADQUARTERS FOURTH SERVICE COMMAND, Atlanta, Georgia; December 10, 1942
TO: Commanding General, Army Ground Forces, Washington, D. C.

1. The proposed layout for the moving vehicle range is considered satisfactory but attention is called to the following:

a. If 50 calibre ammunition is to be fired on this range, the danger area should be increased 1,000 yards to 3,600 yards.

b. If possible, more safety should be provided between this proposed range and the existing combat range #2. This may be accomplished by swinging the line of fire on the combat range to the east and/or moving the proposed vehicle range back closer to State Highway # 262.

2. Comment is requested as to number of installations of the types specified considered necessary for Fort Jackson; and as to estimated cost, which this Headquarters considers excessive.

For the Commanding General:

STUART LEWIS
Lt. Col., G. S. C.
Chief, Training Branch

4 Incls:
/1 Exhibit "A"-1
#2 " "A"-2
#3 " "A"-3
#4 " "C"

RG 337, Hq. Army Ground Forces -5-
E. 55, Gen'l. Corres.
Box 1122

340

Authority NND 947010
By JA NARA Date 7/23/14

December 15, 1942

32

HAWKINS:cjl
Ext.553
83665

684 - GNGCT/13428 (10-5-42) 9th Ind.

HEADQUARTERS ARMY GROUND FORCES, Army War College, Washington, D. C., To: Commanding General, Fourth Service Command, SOS, Atlanta, Georgia.

1. As long as sufficient land is available, it is not the policy of this headquarters to comment on the safety limits of ranges except insofar as it pertains to safety angles. It is believed that the depth of danger zones should be determined by the type of ammunition being used at the time.

2. It is considered necessary to have a total of the following type ranges at Fort Jackson in order to provide necessary training aids:

	Type	Number
a.	Live Grenade Courts	2
b.	Moving Vehicle Ranges	
	(1) MG (Page 100, FM 23-50)	1-(3 lanes)
	(2) Thompson Sub MG (Page 58, FM 23-40)	1
c.	Thompson Sub MG Range (dismounted)(Page 41, FM 23-40)	1-(12 firing points)

3. a. The construction of 2 a. above should be as simple as possible and should be independent of each other for operation.

b. Reference 2 b. (1) above, this range should provide three (3) adjacent lanes as indicated in FM reference. It is requested that this range be placed so that no other range lies within the area formed by drawing an angle of 45° to the outside of the two outside lanes. Obstacles on this range should be removable, so that firing may be conducted from either full track or wheeled vehicles.

c. Reference 2 b.(2) above and 2 c. above -- it is requested that the safety angle of 30° be used in this construction and that the twelve (12) firing points on the dismounted range be independent of each other.

4. There are no records available which would indicate the cost of the above construction but it is agreed that it should be as simple as possible.

For the COMMANDING GENERAL:

83665

Operations Division, AGF
12/15/42
Date

Incls - n/c

Basic: Ltr fr Hq Fourth Serv Comd, SOS, AG 614-General, October 5, 1942, Subject: Training Aids. To: CG, Ft. Jackson, South Carolina w/8 inds. and 4/incls. (Copy of basic in AG and G-3 files) - (Copy 8th Ind. in AG files)

RG 337, Hq. Army Ground Forces
E.55, Gen'l. Corres.
Box 1122

340

Authority NND 947010
By JA NARA Date 7/23/14

Memorandum for Record:

Basic fr Fourth Serv Comd requests CG, Ft. Jackson to submit plans for 1 sub-MG range, 1 Moving Vehicle Range, 1 Grenade Court (live). States CG, Second Army has requested installation of same.

1st Ind fr Hq., Ft. Jackson, SC, AG 614-General, Nov. 20, 1942 to CG, 4th Serv Comd submits detailed plans for the ranges in question. However, requests 4 grenade courts instead of 1, 5 moving vehicle ranges instead of 1.

2d Ind fr Hq, Fourth Serv Comd, AG 614-General,(10-5-42) dated Nov. 23, 1942 to CG, Ft. Jackson returns correspondence to Ft. Jackson requesting that safety angles and danger areas be checked.

3d Ind fr Hq Ft Jackson, AG 614-General (10-5-42) dated Nov. 25, 1942 to CG, 4th Serv Comd., returned correspondence with the requested corrections. Also states that full danger area is not shown because advantage is taken of a high hill to receive projectiles.

4th Ind fr Hq Fourth Serv Comd AG 614-General (10-5-42) dated Nov.27,1942 to CG, Ft. Jackson states that in order to comply with AR 750-10 it is desirable that danger areas be based on the maximum ranges for ammunition used.

5th Ind fr Hq Ft. Jackson, AG 614-General (10-5-42) dated Nov. 28, 1942 to Lt. Col. Chas D. Riley, Range Officer and President, Bd of Officers orders danger areas be provided as recorded above.

6th Ind. fr Office of the Range Officer, Ft Jackson, AG 614-General (10-5-42) dated Dec. 7, 1942 to CG, Ft Jackson states that danger areas have been surveyed as shown on exhibit.

7th Ind fr Hq Ft Jackson, AG 614-General dated Dec 7, 1942 to CG, 4th Serv Comd states that 4th Indorsement was complied with.

8th Ind fr Hq 4th Serv Comd, AG 614-General (10-5-42) dated Dec. 10,1942 to CG, AGF states that proposed layout is satisfactory. Invites attention to the fact that if .50 caliber ammunition is to be fired on this range, the danger area should be increased by 1000 yards. Request comment as to the number of installations of the type specified is considered necessary for Ft Jackson and as to the estimate cost which the 4th Serv Comd considers excessive.

This action outlines the ranges that are considered necessary for the proper training of the units stationed at Ft Jackson, taking into consideration the fact that it is contemplated that a cav mechanized regt will always be stationed at this post and that the post will be used by two divs. In this answer to the 4th Serv Comd reference is made to safety angle desired by the AGF. This has the concurrence of Maj. Coyle, Misc. Br. who is rewriting AR 750-10. The grouping of the moving ~~target~~ ranges has the concurrence of Col. Ennis, Tng Br. The number of ~~moving targets~~ needed is concurred in by Lt. Col. Carnes, Tng Br. The other numbers of ranges concerned has had the necessary concurrence of Tng Br.

340

Authority NND 947010
By JA NARA Date 7/23/94

Record

A COPY OF THIS GENERAL ORDER WILL BE INSERTED IN THE POST REGULATIONS AS APPENDIX "K".

HEADQUARTERS FORT JACKSON
Office of the Commanding General

Fort Jackson, S.C.
8 July 1943.

GENERAL ORDERS)
:
NUMBER 25)

POST RANGE REGULATIONS

1. General Order #63, this Headquarters, dated December 3, 1942 is recinded.

2. General Information:

a. The purpose of these regulations is to govern the use of firing ranges and to prescribe safety precautions to be observed in service firing.

b. All firing on the Reservation will be EAST OF TELEPHONE ROAD as follows:

(1) SMALL ARMS FIRING will be conducted on the Known Distance Ranges at Leesburg and other ranges especially constructed or designated for Small Arms Firing.

The following weapons will classify as Small Arms:

Pistol	Cal 50 Machine Guns
Carbine	37mm Guns
Rifle	60 & 81mm Mortars
Cal 30 Machine Gun	

(2) ARTILLERY FIRING will be conducted in the area EAST OF TELEPHONE ROAD exclusive of the Small Arms Ranges.

(3) HAND GRENADES: Live Hand Grenades will be discharged on Courts especially constructed for that purpose in the Training Areas.

(4) LARGE SIZE CANNON: By arrangements with the Post Range Officer 8 inch Cannon, or larger, may be fired from positions West of Telephone Road but the Impact Area must be to the East of Telephone Road.

c. When firing is in progress, signals will be displayed as follows:

(1) LEESBURG RANGE: Red Streamers on poles in rear of firing lines on Ranges C-H-R.

(2) ARTILLERY AREA: Red streamer on Tower Wiehrs Hill - (13.4-13.7) or Tower on Hill (15.7-21.2) depending on whether ANCRUM FERRY ROAD or OLD CAMDEN ROAD is closed to traffic. Red flags will also be displayed in vicinity of all firing points.

d. Persons entering the reservation EAST of TELEPHONE ROAD will inform themselves as to the firing scheduled or in progress. The current days firing will be posted on maps located as follows:

(1) Artillery Range Central. (C.R. Ancrum Ferry and Telephone Roads.)
(2) Leesburg Range Central.
(3) Office of the Post Range Officer, Post Headquarters.
(4) See par. 12.

3. Range Control:

a. The Post Range Officer will control the Range and will coordinate all firing on the Fort Jackson Reservation.

Authority NND 947620
By NARA Date 3/18/04

RG 337, Hq. Army Ground Force, E. 108 (U.S.) AGF + AFF Instruct. Box 31

(1) SMALL ARMS RANGES:

a. The Assistant Post Range Officer at Leesburg will represent the Post Range Officer, with direct cha ge of all firing on Small Arms Ranges in the Leesburg Area. An organization firing on the Small Arms Ranges will appoint a Range Officer who will contact the Assistant Post Range Officer to arrange for targets and other materials, also for posting Range Guards.

(2) DIVISION ARTILLERY RANGE OFFICER:

a. The Divisions or similiar units will detail one Field Artillery Officer as Assistant Range Officer for the period when the Artillery of the Division is firing on the Artillery Range. This officer will function as Assistant Post Range Officer with respect to Artillery firing of his Division. He will report to the Post Range Officer for instructions on the day when request for Artillery Firing reach the Post Range Officer, and forty-eight (48) hours before each days firing.

4. Range Detachment:

a. A permanent detachment will operate under the orders of the Post Range Officer. The Range Detachment will operate the Post Range Communicatio System. It will establish sentinels, signs and road blocks as directed by the Range Officer and will keep range maps posted.

5. Governing Regulations:

a. The provisions of AR 750-10 will govern all firing. The provisions of appropriate Field Manuals will govern the firing of the particular weapon.

6. Range Telephone System:

a. Traffic diagram of the Range Telephone System is in the Office of the Post Range Officer.

b. Tapping of circuits on the Range Telephone System at other than installed terminal strips, or cutting or rearranging of any installed circuit, is forbidden.

c. Requests for special circuits will be submitted to Post Range Officer one (1) day in advance.

d. Damage to telephone cables or metallic circuits on Artillery Range will be reported to Artillery Range Central immediately; damage to installations on Leesburg Range to Leesburg Range Central.

e. Permanent pole lines of the range telephone system will not be used by troops.

f. All field wire will be disconnected at the conclusion of each day firin

7. Assignment of Ranges:

a. The general assignment of the Small Arms Ranges and the Artillery Ranges will be announced by Post Headquarters.

(1) SMALL ARMS RANGE

a. The organization assigned a Small Arms Range will inform the Assistant Range Officer, Leesburg, of the calibers and ranges on which firing is to be conducted twenty-four (24) hours before firing is to begin.

Authority NND 947030
By MD NARA Date 3/15/04

(2) ARTILLERY AREA:

(a) In accordance with priorities prescribed by regulations and orders of this Headquarters, the Post Range Officer will assign firing areas, will prescribe the limitations on firing therein, the safety limits, and any other restrictions necessary for safety.

(b) When an organization has been assigned priority on the range, requests for firing areas approved by that Organization Headquarters will be acted on promptly in the order in which received, and the assignment made within twenty four (24) hours after receipt of request. The Range Officer will approve requests as submitted, except when the limits of the requested area must be modified for safety reasons. In the event, the Range Officer will promptly confer with the organization Headquarters to arrange suitable modification.

(c) Units other than those normally assigned the Artillery Area, desiring to fire Special Problems will submit requests for firing areas to the Post Range Officer ten (10 days in advance of the proposed firing.

(d) Firing at Moving Targets by units in areas involving both the Leesburg Area and the Artillery Area will be arranged by the Post Range Officer upon request.

(e) Sentinels for enclosing the danger area will be furnished by units conducting fire and will be posted by the Artillery Range Officer under the direction of the Post Range Officer.

8. Publication of Firing Memorandum:

a. A weekly Firing Memorandum is issued by Post Headquarters each Friday morning at 0800 covering all firing for the succeeding week. Overlays will accompany requests for Artillery Ranges and will reach the Post Range Officer in time to be checked and the information placed in the Firing Memorandum. It is necessary that this information be furnished the Post Range Officer. The Post Range Officer must know at all times what firing is being conducted, the position and danger area.

b. The following form will be used to submit requests:

TO: POST RANGE OFFICER HEADQUARTERS _____

Request following Firing Memorandum:

(Signed by officer requesting Memorandum

Submit only one copy

FIRING MEMORANDUM NUMBER _____

DAY OF WEEK
DATE
HOURS OF FIRING
ORGANIZATION
CALIBER
AMMUNITION
TARGET AREA
OBSERVATION POST
GUN POSITION
RIGHT SECTOR LIMIT: GUN
LEFT SECTOR LIMIT: GUN
MAXIMUM RANGE (YARDS)

Authority NND 947030 By MD NARA Date 3/15/04

9. Duties of the Post Range Officer.

a. The Post Range Officer is responsible for the coordination of activities on the range and for the safety of the entire range.

b. When requests for firing positions are submitted, the Range Officer will adjust any conflicts as to areas, check safety provisions, and will issue a Firing Memorandum prescribing the safety limits for each position.

c. When request for an area is submitted, the Firing Memorandum will define the area assigned. The officer supervising the exercise will prescribe safety provisions for each position in compliance with paragraph 7, AR 750-10.

d. When required, in addition to the usual warning issued to personnel of the Post, announcement will be made in the daily papers, and Daily Bulletins.

e. The Post Range Officer is responsible for the posting of permanent signs on the Reservation.

10. Duds:

a. The Post Ordnance Officer is charged with the destruction of "duds" on the Range.

b. "Duds" discovered on the Range will be marked by a stake and reported to the Post Range Officer. Reports will show type and caliber of each "dud" location by coordinates, and the name, organization, and telephone number of any person familiar with its location. Artillery units conducting fire will report location of any suspected "duds" during the day's firing.

c. Officers in charge of Mortar Firing will police range for "duds" at the completion of firings and report the location of all duds to the Post Range Officer.

11. Permanent Installations:

a. Artillery firing will not be placed within 500 yards of permanent installations except dugouts.

b. All dugouts, except #5, are constructed against caliber 105-mm and less. Dugout #5 offers protection against 37mm and less.

c. Permanent roads, bridges, mockups and dams may be included in firing areas, but no adjustment will be made on such installations. Every precaution will be taken to prevent direct hits on such installations. Precautions will be taken to assure that firing will not endanger permanent telephone lines.

12. Danger Areas:

a. The size of the reservation and the nature of the terrain prevents the posting of guards to cover all approaches to danger areas. The danger areas will be marked by signs at points where sentinels are not posted. These signs will not be passed by personnel, except in the following cases:

(1) Personnel going to and from service firing on safe routes designated by the unit commander in charge of the firing.

(2) Officers and parties accompanied by an officer checking through the Range Central and signing the range book. In this case, the officer accepts responsibility for a complete knowledge of the danger areas and of all firing in progress.

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By MD NARA Date 3/18/09

(1) Safety precautions prescribed in AR 750-10, regarding handling of ammunition and service of the piece are complied with.

(2) A red flag is displayed in a conspicious place in the vicinity of the battery position during firing.

(3) That all personnel of the battery are properly instructed as to safety precautions in general, and in particular as to the location of adjacent gun positions and sector of fire.

(4) When the shell is fired other than with bore safe fuses, or fuses considered in the category of bore safe, all personnel within the danger limits are protected as prescribed in paragraph 14, AR 750-10.

(5) The Range Central is promptly notified on completion of firing.

(6) The area used will be policed at the end of practice.

14. Battery Executive:

a. The Battery Executive is responsible for safety of personnel at the firing position, (AR 750-10). He will fire only when the safety officer indicates safe to fire.

15. Battery Safety Officer.

a. In all Artillery firing, the Battery Safety Officer will have no other duties. He will indicate safe to fire only when:

(1) The Range Officer indicates the range is clear.

(2) The Range visible to him is clear.

(3) The pieces are so laid as to fire inside the safety limits both for direction and for range as determined by the quadrant elevation corresponding to the maximum range designated in the Firing Memorandum.

PART II

SMALL ARMS RANGE

16. General Information:

a. The duties of the assistant Post Range Officer (SA) on the Leesburg Rifle Range, will be as follows:

(1) Maintain all ranges to insure proper operation.

(2) To furnish all target material the Table of Allowance provides.

(3) To turn over all camp property to Organization Range Officer, or Supply Officer.

(4) To see that the ranges are not abused and that all the Government property is taken care of and used properly.

(5) To ascertain that no changes are made in safety angles for any range.

(6) To allow no changes to be made by using troops in any of the ranges.

(7) To permit no unauthorized use of ranges, such as firing weapons and ammunition not authorized for use on that particular range.

(8) Maintain and supervise the use of the camp and range utilities.

Authority NND 947630
By MD NARA Date 3/18/04

17. Duties of Organization (SA) Range Officer.

a. To take over the assigned ranges and Camping Facilities, including all the property and return same at end of firing period to the Assistant Range Officer (SA) in good serviceable condition.

b. To assign all targets, quarters and facilities to the using troops.

c. To furnish guards and transportation for posting the necessary guard to keep the danger area clear of personnel during the hours of firing.

d. To act as representative for the using troops in which case all requests made by using troops will be made to him only.

e. Report to Post Range Officer any facilities assigned and not being used

18. SMALL ARMS RANGES:

a. Known Distance Ranges are designated as follows from the most westerly range (A) through east to the most northerly range (Y).

(A) 100 Machine Targets, 30 Caliber only.

(B) 30 Pistol Targets, 45 Caliber.

(C) 1 AA Range, 22 Caliber.

(D) 1 AA Range, 22 Caliber.

(E) 100 Pistol Targets, 45 Caliber.

(FG) 100 Rifle 200 yards, 30 Caliber

(HI) 100 Rifle 100-200 yards, and 300 yards, 30 Caliber.

(JK) 100 Rifle 100-200 yards, and 300 yards, 30 Caliber.

(LM) 100 Rifle 200 yard, 30 Caliber.

(N) 4 sets Anti-Tank, 30 Caliber only.

(P) 50 Rifle 100-200-300-500 yards, 30 Caliber.

(R) 100 Target plain 1000", 30 Caliber.

(S) 1 set AA Targets, 22 Caliber only.

(T) 1 set AA Targets, 22 Caliber only.

(U) 8 sets of Landscape, 30 caliber only.

(V) 25 Pistol Targets, 45 Caliber.

(W) 100 Machine Gun, 30 & 50 Caliber.

(X) 25 Pistol Targets, 45 Caliber.

(Y) 4 sets Anti-Tank, 22 Caliber.

b. Each range is distinctly marked by a large conspicious, designating letter. Also the type of ammunition to be used.

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19. Control and Safety Regulations:

a. Guards will be posted under the supervision of the Organization Range Officer, so as to provide safety during the hours of firing, unless otherwise requested.

b. When all guards are posted, red streamers will be raised on poles in rear of Ranges C-H and R. No firing will be started until these streamers are raised. All firing will cease when streamers are lowered. A change in these streamers will be preceded by a long blast on the siren located at the water tank connected to tower. With no streamer raised, the blast will indicate that the streamer is to be flown. A series of blast on the siren, after firing has begun will indicate that all ranges will cease firing immediately.

c. Each range will be operated under the senior officer in charge. Where pits are provided, the pits will be under the supervision of an officer. Range procedure will be followed as specified in training manuals, for the arm being fired.

d. Prior to firing, the officer in charge of a range will notify the pit officer who will order the streamer on the target line to be raised when the pit is clear. Thereafter, no person will be allowed to stray from the pits, or leave the pits except by the authorized tunnels. Pit details will be instructed to operate and travel under the shelter.

e. An overlay will be furnished by Post Range Officer from time to time as to the location of the range guards. As the situation warrants, the location of these guards will change.

f. It will be the duty of the using troops to furnish one (1) non-commissioned officer and the guard for the range, and the duty of the organization (SA) Range Officer to ascertain that they are properly posted and instructed.

g. Ranges have been constructed to conform to Army Regulations for safety. Ranges will be used only for the purpose for which they were constructed (see paragraph 1). Special problems may be fired by arrangement with the Post Range Officer.

h. On all Combat Ranges and other Ranges beyond hearing distance of the siren at the water tank, the officer in charge of firing will communicate with the Leesburg Range Office to determine whether the Range Guards are posted and whether the range is clear. At most of the Ranges telephone communication is established with the Range Detachment. The officer in charge of firing will notify the Leesburg Range Detachment Officer when firing is concluded each day.

i. The Officer in charge of firing will be responsible that the Range he uses is properly policed, targets are properly posted or replaced for the next day, and any repairs that cannot be made on the "spot" will be reported to the Range Detachment at the conclusion of the day's firing.

j. Combat Ranges 1-2-3-4-5-6 are designed for firing Infantry Squad and Platoon Problems with Caliber .30, ball ammunition. The safety limits are marked and the Officer in Charge of Firing will see that all firing is within the Safety Limits.

These ranges will not be used for Training Areas or "Dry Run Exercises" except by permission of the Post Range Officer.

No changes in the Range Installations will be made by troops using the ranges. No other than caliber .30 ammunition will be fired on Combat Ranges except by permission of the Post Range Officer.

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k. Woods Combat Course: The Officer in Charge of Firing will see that all possible precautions are taken to avoid accidents. Before giving the order to Commence Firing he will:

(1) Ascertain that the range guard is posted.

(2) That a Red Streamer is flying in the vicinity of the firing point.

(3) That only M-2 ammunition, or ammunition with a maximum range of 400 yards is used.

(4) That all personnel operating the targets are in the pits and understanding the safety precautions.

(5) That all explosive charges placed to represent enemy fire and all "Booby Traps" are prepared and exploded under the supervision of an officer.

(6) That all troops are instructed in the safety angles of fire. The safety angle of fire is 35 degrees to the right and left of the long axis of the course.

(7) The right and left sides and the finishing end of the course are marked by a single strand of barb-wire.
The officer in charge of firing will see that all problems are conducted within this enclosure and that all troops who have completed an exercise have been moved to the Safety Zone before the beginning of an exercise.

(8) That all targets are repaired and that the Range is in operating condition at close of firing.

(9) That all personnel taking part in the exercise and all pit details wear the regulation steel helmet.

l. Infiltration Courses: The Officer in Charge of Firing will see that all possible precautions are taken to avoid accidents. Before giving the order to Commence Firing he will:

(1) Ascertain that the range guard is posted.

(2) That a Red Streamer is flying in the vicinity of the firing point.

(3) That Machine Guns have been properly laid and that the elevating and traversing stops are in their proper place to keep the fire at a minimum of 36 inches above the ground and within the bounds of the range.

(4) That only M-2 ammunition or ammunition with a maximum range of 4000 yards is used.

(5) That each gunner thoroughly understands the functions of the traversing and elevating safety stops.

(6) That an officer is on the control tower at all times during firing and that he has proper means for immediately communicating with the gunner.

(7) That all explosive charges placed to represent enemy fire, or "Booby Traps" be prepared and exploded under the supervision of an officer.

(8) That all personnel taking part in the exercise and all pit detail wear the regulation steel helmet.

m. Mock Village Course: The Officer in Charge of Firing will see that all possible precautions are taken to avoid accidents. Before giving the order to Commence Firing he will:

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(1) Ascertain that the range guard is posted.

(2) That a Red Streamer is flying in the vicinity of the firing point.

(3) That only M-2 ammunition, or ammunition with a maximum range of 4000 yards is used.

(4) That all personnel operating the targets are in the pits and understand the safety precautions.

(5) That an officer is on the control tower at all times during firing and that he has proper means of communication with all the pits for which targets are operated.

(6) That all explosive charges placed to represent enemy fire and all "Booby Traps" are prepared and exploded under the supervision of an officer.

(7) That all troops are instructed in the safety angles of fire. The safety angle of fire is 90 degrees to the right and left of the center line of the street.

(8) That all targets are repaired and that the Range is in operating condition at close of firing.

(9) That all personnel taking part in the exercise and all pit details wear the regulation steel helmet.

n. Live Grenade Courts. The Officer in charge of Firing will:

(1) Take all possible precautions to insure the greatest amount of safety to personnel.

(2) See that all personnel not in trenches or behind masks are at least 250 yards from the impact area.

(3) That all personnel in the trenches and behind the mask wear the issue Steel Helmet.

(4) That a guard is posted to prevent anyone from approaching within 250 yards of the impact area.

(5) Designate an officer or Non-Commissioned Officer with the necessary assistants to check for "Duds."

(6) Upon completion of firing police the range and if any "Duds" are not exploded they will be marked and a guard posted over them until arrangements are completed for their destruction. (See par. 10)

(7) Before firing a Red Streamer will be displayed from a pole erected for that purpose in rear of the center mask. This streamer can be drawn from the [illegible] Officer. [illegible]

REFERENCES:
FM 23-30 - AR 750-10 - TM 9-1900- SNL-S-3.

o. Thompson Sub-Machine Gun Ranges, Dismounted: The officer in charge of firing will:

(1) Take all possible precautions to insure the greatest amount of safety to personnel.

(2) See that all personnel not participating in the firing remain in the area immediately in rear of the firing positions.

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(3) That only the marked routes of approach to ranges are used in getting into ranges.
(These ranges are close by other ranges and if other than marked roads are used men may wander into the danger area.)

(4) These ranges have three firing points on each range. If adjacent firing points are being used they will be used simultaneously. Men will advance from positions "A" to position "B" at a signal from the officer in charge of firing.

No scoring will be permitted when there is a man firing on an adjacent firing point.

(5) At the close of firing for the day targets and target material will be removed and placed in desiginated target house, the range will be thoroughly policed, any repairs that cannot be made will be reported to Assistant Range Officer - (Telephone Tie Line 12.)

o. Thompson Sub-Machine Gun Range, Mounted: The Officer in charge of firing will:

(1) Take all possible precautions to insure the greatest amount of safety to personnel.

(2) See that all personnel not participating in the firing remain in the area immediately in rear of the firing positions.

(3) That only the marked routes of approach to ranges are used in getting into ranges.
(These ranges are close by other ranges and if other than marked roads are used men may wander into danger area.)

(4) Vehicles will drive in the direction indicated by markers when firing.

(5) No one will be permitted on the course after firing begins until the vehicle doing the firing has completed the course and all weapons have been unloaded.

(6) At the close of firing for the day, targets and target materials will be removed and placed in dosignated target house, the range will be thoroughly policed, any repairs that cannot be made will be reported to Assistant Range Officer - (Telephone Tie Line 12.)

q. Anti-Tank Range: Request will be made to Post Range Officer in same manner as for Artillery Range.

(1) For the present time, only the following will be fired.

75mm send loaded and armour piercing.
37mm armour piercing, sand loaded, and sub-cal.
50 caliber Machine Gun.

(2) The motor car and target car will be operated by personnel of the Range Detachment and under no circumstances by units firing. The Car Operator will set the car in motion and then report to officer in charge of firing that the range is clear and ready to be fired on.

(3) A flag pole is available on the firing line. A red streamer will be flown when the Range is being fired

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on. No firing will be permitted unless the streamer is being flown. It will be the duty of the officer in charge of firing to cause the streamer to be hoisted and lowered. Before the car operator goes forward, the order cease firing and lower the flag will be given. Upon return from target car the operator will report to officer in charge that range is clear and ready to be fired on. The officer in charge will order the flag to be hoisted and command begin firing.

(4) The officer in charge of firing will furnish transportation for car operator to go to and from the target car to eliminate so much time when adjustments are to be made on car and target.

(5) There is a white post at each end of the firing line. Pieces that are to be fired will take up positions between these points.

(6) Pieces that are merely for tracking purposes may be placed on an extension of the firing line.

(7) There are two white poles 800 yards out with pieces of target cloth attached to the top which are to be used as right and left safety limits markers respectively.

(8) The car is able to operate at two speeds, slow speed which is 5-15 miles per hour. Fast speed is from 5-25 miles per hour. The car operator will set the car at either speed the officer in charge of firing so desires. No other speed will be used except the above listed, without permission of the Post Range Officer.

20. Range Supplies and Property:

a. Ranges will be released to units when their authorized representatives have taken over the range property. This property will be maintained in good operating condition by the using unit. (Exception - broken targets, frames, etc., will be turned into the Post Range House for replacement.)

21. Communication:

a. Phones for ranges will be turned over with the range. Phones may be exchanged for repair at Post Range House.

22. Administration: - Camp Area:

a. Requests for use of the Camp Area on the Small Arms Range will be submitted to the Post Range Officer.

b. When the Camp Area is assigned to an organization, the Commanding Officer of that organization or an officer designated by him will contact the Assistant Range Officer at Leesburg and will sign for all property on Memo Receipt. Obtain from the Assistant Range Officer a proposed administrative order to the using troops covering the interior economy of the camp.

c. Assignments in camp area, will be made by Commanding Officer of using troops, and administrative arrangement for the camp area. Senior officer will command for coordination of installations.

d. Before departure, organization will:

(1) Fasten down sides of tents and loosen ropes.

(2) Stack all cots in mess halls for check.

(3) Scrub kitchen and mess halls.

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(4) Clean i_ b_ and leave op

(5) Skim grease trap.

(6) Remove all garbage.

(7) Scrub Bath house.

(8) Scrub latrines, sprinkle lime in pits, and leave covers closed.

(9) Burn out and clean all latrines.

(10) Police area.

(11) Clean incinerator and haul rubbish to dump.

(12) Return property to Assistant Range Officer and get Memo Receipt.

e. When the Post Exchange is in operation in the Camping Area the Senior Officer will issue orders regulating the hours and arranging for police and sanitary conditions. Post Exchange Officer should be informed of important changes or requests.

23. Facilities:

a. Each unit commander will notify the Organization Range Officer when he has facilities that are assigned to him and which he does not need.

b. All requests for additional facilities should be made to the Organization Range Officer.

c. Available targets and ranges will be assigned by the Organization Range Officer.

d. The following equipment and facilities for each company or similar unit are available:

(1) Mess hall and kitchen.
(2) Pyramidal tents.
(3) Cots, canvas, folding.
(4) One (1) bath house to three (3) mess buildings.
(5) One (1) latrine, pit type.
(6) Screens or pyramidal tents, for latrines and bath houses.
(7) Ice Box.

e. The following equipment must be furnished by using troops.

(1) Field range.
(2) Cooking utensils.
(3) Mess Kits, Complete
(4) Bedding.
(5) Light Bulbs.

f. Water facilities are very limited. Arrangements must be made within organizations to conserve all that is possible and alternate the use of it between the kitchen and bath houses when necessary. No water will be used for sprinkling streets.

24. Sanitation: The Commanding Officer of troops is responsible for sanitation and will appoint the senior medical officer as medical inspector for the camp and range.

25. Range Fires:

a. The control of fires resulting from firing on the range is the responsibility of the Officer in Charge of Firing.

When a fire on the range is observed the Officer in charge of firing on that range will immediately contact the Post Range Officer or his assistant to determine the danger area.

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If the fire is located inside a danger area the Range Officer or the Assistant Range Officer will stop all firing in that area. The Officer in Charge of Firing will then proceed to extinguish the fire.

b. Unit Commanders in the vicinity of the fire will give assistance when called upon to do so.

c. There are tools available for fighting range fires at the Leesburg Range Headquarters Detachment.

d. During extremely dry weather when the danger of Range Fires is imminent Officers in Charge of Firing will inspect the impact areas of their ranges for fires at the conclusion of each day firing.

By command of Brig. Gen. BEEBE:

A. T. MURPHEY
Col, FA
Adj

DISTRIBUTION "A".

Authority NND 947030
By MD NARA Date 3/18/09

March 16, 1944

Extract

A COPY OF THIS GENERAL ORDER WILL BE INSERTED IN THE POST REGULATIONS AS APPENDIX "K".

ARMY SERVICE FORCES
Fourth Service Command
Fort Jackson, South Carolina

GENERAL ORDER)
NUMBER 18)

PART I

16 March 1944

POST RANGE REGULATIONS

1. General Order #25, this headquarters, dated 8 July 1943 and General Order #26, dated 20 July 1943, are rescinded.

2. GENERAL INFORMATION:

a. The purpose of these regulations is to govern the use of ranges and to prescribe safety precautions to be observed in service firing.

b. All firing on the reservation will be EAST OF TELEPHONE ROAD as follows:

(1) SMALL ARMS FIRING will be conducted on the Known Distance Ranges at Leesburg and other ranges especially constructed or designated for Small Arms Firing.

The following weapons will be classified as Small Arms:

Pistol	Cal 50 Machine Guns
Carbine	37mm Guns
Rifle	60 & 81mm Mortars
Cal 30 Machine Gun	

(2) ARTILLERY FIRING will be conducted in the area EAST OF TELEPHONE ROAD exclusive of the Small Arms Ranges.

(3) HAND GRENADES: Live hand grenades will be discharged on courts especially constructed for that purpose in the training areas.

(4) LARGE SIZE CANNON: By arrangements with the Post Range Officer, 8 inch Cannon, or larger, may be fired from positions West of Telephone Road, but the Impact Area must be to the East of Telephone Road.

c. When firing is in progress, signals will be displayed as follows:

(1) LEESBURG RANGE: Red streamers on poles in rear of firing lines on Ranges C-H-R.

(2) ARTILLERY AREA: Red streamer on Tower Wiehrs Hill (13.4-13.7) when firing on the southern part of artillery range.
Red streamers on North Tower (15.7-21.2) when firing on northern part of artillery range.

(3) ALL OTHER RANGES: Red streamer in vicinity of the firing points.

d. Persons entering the reservation EAST OF TELEPHONE ROAD will inform themselves as to the firing scheduled or in progress. The current days firing will be posted on maps located as follows:

(1) Artillery Range House. (C.R. Ancrum Ferry and Telephone Roads.)

(2) Leesburg Range Detachment.

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RG 337, Hq. Army Ground Forces
E. 108 (U.D.) AGF - AFF Instrs.
Box 51

(3) Office of the Post Range Officer.

(4) See paragraph 12.

3. RANGE CONTROL:

a. The Post Range Officer will control the range and will coordinate all firing on the Fort Jackson reservation.

(1) SMALL ARMS RANGES:

(a) The Assistant Post Range Officer at Leesburg will represent the Post Range Officer, with direct charge of all firing on Small Arms Ranges in the Leesburg area. An organization firing on the Small Arms Ranges will appoint a Range Officer to arrange for targets and other materials, also for posting Range Guards.

(2) ARTILLERY RANGE:

(a) The Battalion or similar units will detail one officer as Assistant Range Officer for the period when the battalion is firing on the artillery range. This officer will function as Assistant Post Range Officer with respect to artillery firing of his battalion. He will report to the Post Range Officer for instructions twenty-four (24) hours before each days firing.

4. RANGE DETACHMENT:

a. A permanent detachment will operate under the orders of the Post Range Officer. The Range Detachment will operate the Post Range Communications System. It will establish signs and road blocks as directed by the Range Officer and will keep range maps posted.

5. GOVERNING REGULATIONS:

a. The provisions of AR 750-10 will govern all firing. The provisions of appropriate Field Manuals will govern the firing of the particular weapons.

6. RANGE TELEPHONE SYSTEM:

a. Traffic diagram of the Range Telephone System is in the office of the Post Range Officer.

b. Tapping of circuits on the Range Telephone System at other than installed terminal strips, or cutting or rearranging of any installed circuit, is forbidden.

c. Requests for special circuits will be submitted to Post Range Officer one (1) day in advance.

d. Damage to telephone cables or metallic circuits on artillery range will be reported to Artillery Range Central immediately; damage to installations on Leesburg Range to Leesburg Range Office.

e. Permanent pole lines of the Range Telephone System will not be used by troops.

f. All field wire will be disconnected at the conclusion of each day firing.

7. ASSIGNMENT OF RANGES:

a. The general assignment of the Small Arms Ranges and the artillery ranges will be announced by Post Headquarters.

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(1) SMALL ARMS RANGES:

(a) Requests for ranges will be submitted to the Post Range Officer.

(b) The organization assigned a small arms range will inform the Assistant Range Officer, Leesburg, of the calibers and ranges on which firing is to be conducted twenty-four (24) hours before firing is to begin.

(c) If small arms ranges are to be used for any other purpose than that for which they were constructed, requests will show the type of firing to be conducted.

(2) ARTILLERY AREA:

(a) The Post Range Officer will assign firing areas, will prescribe the limitations on firing therein, the safety limits, and any other restrictions necessary for safety.

(b) Requests for artillery range will be submitted to the Post Range Officer and accompanied by an overlay giving the following information:

Organization
Date and day of week
Hours of firing
Caliber
Ammunition
Gun Position
Impact area
Safety limits
Observation posts.

(c) Units, other than those normally assigned the Artillery Area, desiring to fire special problems will submit requests for firing areas to the Post Range Officer ten (10) days in advance of the proposed firing.

(d) Sentinels for enclosing the danger area will be furnished by units conducting fire and will be posted by the unit Range Officer under the direction of the Post Range Officer.

8. PUBLICATION OF FIRING SCHEDULE:

A WEEKLY FIRING SCHEDULE IS ISSUED BY POST HEADQUARTERS EACH TUESDAY MORNING AT 0800 COVERING ALL FIRING FOR THE SUCCEEDING WEEK. ALL REQUESTS FOR FIRING MUST REACH THIS HEADQUARTERS BEFORE 0800 TUESDAY.

9. DUTIES OF THE POST RANGE OFFICER:

a. The Post Range Officer is responsible for the coordination of activities on the range and for the safety of the entire range.

b. When requests for firing positions are submitted, the Range Officer will adjust any conflicts as to areas, check safety provisions, and will issue a firing memorandum prescribing the safety limits for each position.

c. When request for an area is submitted, the firing memorandum will define the area assigned. The officer supervising the exercise will prescribe safety provisions for each position in compliance with AR 750-10.

d. When required, in addition to the usual warning issued to personnel of the Post, announcement will be made in the daily papers, and Daily Bulletin.

e. The Post Range Officer is responsible for the posting of permanent signs on the reservation.

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10. DUDS:

a. The Post Ordnance Officer is charged with the destruction of "duds" on the range.

b. "Duds" discovered on the range will be marked by stakes and reported to the Post Range Officer. Reports will show type of caliber of each "dud" location by coordinates, and the name, organization, and telephone number of any person familiar with its location. Artillery units conducting fire will report location of any suspected"duds" during the days firing.

c. Officers in charge of Mortar Firing will police range for "duds" at the completion of firing and report the locaion of all "duds" to the Post Range Officer. Officer in charge will sign certificate of clearance at Range Detachment Office regardless of whether there were any duds.

11. PERMANENT INSTALLATIONS:

a. Artillery firing will not be placed within 500 yards of permanent installations except dugouts.

b. All dugouts, except #5, are constructed against caliber 105-mm and less. Dugout #5 offers protection against 37mm and less.

c. Permanent roads, bridges, mockups, dams, and cemeteries, may be included in firing areas, but no adjustment will be made on such installations. Every precaution will be taken to prevent direct hits on such installations. Precautions will be taken to insure that firing will not endanger permanent telephone lines.

12. DANGER AREAS:

a. The size of the reservation and the nature of the terrain prevents the posting of guards to cover all approaches to danger areas. The danger areas will be marked by signs at points where sentinels are not posted. These signs will not be passed by personnel, except in the following cases:

(1) Personnel going to and from service firing on safe routes designated by the unit commander in charge of the firing.

(2) Officers, and parties accompanied by an officer, checking through the Range House and signing the range book. In this case, the officer accepts responsibility for a complete knowledge of the danger areas and of all firing in progress.

13. UNIT COMMANDER:

a. The Unit Commander is responsible that:

(1) Safety precautions prescribed in AR 750-10, regarding handling of ammunition and service of the piece are complied with.

(2) A red flag is displayed in a conspicious place in the vicinity of the battery position during firing.

(3) That all personnel of the battery are properly instructed as to safety precautions in general, and in particular as to the location of adjacent gun positions and sector of fire.

(4) When the shell is fired other than with bore safe fuses, or fuses considered in the category of bore safe, all personnel within the danger limits are protected as prescribed in paragraph 10, AR 750-10.

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(5) The Range Central is promptly notified on completion of firing.

(6) The area used will be policed at the end of practice and all excavations will be refilled.

(7) He will not fire until he has been informed by the Assistant Range Officer from his unit that the range is clear, and will cease firing when directed by the proper authority.

PART II

SMALL ARMS RANGE

14. GENERAL INFORMATION:

a. The duties of the assistant Post Range Officer (SA) on the Leesburg Rifle Range, will be as follows:

(1) Maintain all ranges to insure proper operation.

(2) To furnish all target material the Table of Allowance prescribes.

(3) To turn over camp property to Organization Range Officer or Supply Officer on memo receipt.

(4) To see that the ranges are not abused and that all Government property is taken care of and used properly.

(5) To ascertain that no changes are made in safety angles for any range.

(6) To allow no changes to be made by using troops in any of the ranges.

(7) To permit no unauthorized use of ranges, such as firing weapons and ammunition not authorized for use on that particular range.

(8) Maintain and supervise the use of the camp and range utilities.

15. DUTIES OF ORGANIZATION (SA) RANGE OFFICER:

a. To take over the assigned ranges and camp facilities, including all the property and return same at end of firing period to the Assistant Range Officer (SA) in good serviceable condition.

b. To assign all targets, quarters and facilities to the using troops.

c. To furnish guards and transportation for posting the necessary guard to keep the danger area clear of personnel during the hours of firing.

d. To act as representative for the using troops in which case all requests made by using troops will be made to him only.

e. Report to Post Range Officer any facilities assigned and not being used.

16. SMALL ARMS RANGES:

a. Known Distance Ranges are designated as follows from the most westerly range (A) through east to the most northerly range (Y).

(A) 100 Machine Targets, 30 Caliber only.

(B) 30 Pistol Targets, 45 Caliber.

(C) 1 AA Range, 22 Caliber.

(D) 1 AA Range, 22 Caliber.

(E) 100 Pistol Targets, 45 Caliber.

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(FG) 100 Rifle, 200 yards, 30 Caliber.

(HI) 100 Rifle, 100-200 and 300 yards, 30 Caliber.

(JK) 100 Rifle, 100-200 and 300 yards, 30 Caliber.

(LM) 100 Rifle, 200 yard, 30 Caliber.

(N) 4 sets Anti-Tank, 30 Caliber only.

(P) 50 Rifle, 100-200-300-500 yards, 30 Caliber.

(Q) Mortar 60 & 81mm.

(R) 100 Targets plain 1000", 30 Caliber.

(S) 1 set AA Targets, 200 Caliber only.

(T) 1 set AA Targets, 22 Caliber only.

(U) 8 sets of Landscape, 22 & 30 Caliber only.

(V) 25 Pistol Targets, 45 Caliber.

(W) 100 Machine Gun, 30 & 50 Caliber.

(X) 25 Pistol Targets, 45 Caliber.

(Y) 4 sets Anti-Tank, 22 Caliber.

b. Each range is distinctly marked by a large conspicious, designating letter. Also the type of ammunition to be used.

17. CONTROL AND SAFETY REGULATIONS:

a. Guards will be posted under the supervision of the Organization Range Officer, so as to provide safety during the hours of firing, unless otherwise requested.

b. When all guards are posted, red streamers will be raised on poles in rear of Ranges C-H and R. No firing will begin until these streamers are raised. All firing will cease when streamers are lowered. A change in these streamers will be preceded by a long blast on the siren located at the water tank connected to tower. With no streamer raised, the blast will indicate that the streamer is to be flown. A series of blast on the siren, after firing has begun will indicate that all ranges will cease firing immediately.

c. Each range will be operated under the senior officer in charge. Where pits are provided, the pits will be under the supervision of an officer. Range procedure will be followed as specified in training manuals, for the arm being fired.

d. Prior to firing, the officer in charge of a range will notify the pit officer who will order the streamer in pit to be raised when the pit is clear. Thereafter, no person will be allowed to stray from the pits, or leave the pits except by the authorized tunnels. Pit details will be instructed to operate and travel under the shelter.

e. An overlay will be furnished by Post Range Officer from time to time as to the location of the range guards. As the situation warrants, the location of these guards will change.

f. It will be the duty of the using troops to furnish one (1) non-commissioned officer and the guard for the range, and the duty of the organization (SA) Range Officer to ascertain that they are properly posted and instructed.

g. Ranges have been constructed to conform to Army Regulations for safety. Ranges will be used only for the purpose for which they were constructed (see paragraph 1). Special problems may be fired by arrangement with the Post Range Officer.

Authority NND 947030 By MD NARA Date 3/15/04

h. On all Combat Ranges and other Ranges beyond hearing distance of the siren at the water tank, the officer in charge of firing will communicate with the Leesburg Range Office to determine whether the Range Guards are posted and whether the Range is clear. At most of the Ranges, telephone communication is established with the Range Detachment. The officer in charge of firing will notify the Leesburg Range Detachment Office when firing is concluded each day.

i. The officer in charge of firing will be responsible that the range he uses is properly policed, targets are properly posted and replaced for the next day, and any repairs that cannot be made on the "spot" will be reported to the Range Detachment at the conclusion of the day's firing.

j. Combat Ranges 1-2-3-4-5-6 are designed for firing Infantry Squad and Platoon Problems with Caliber .30, ball ammunition. The safety limits are marked and the officer in charge of firing will see that all firing is within the safety limits.

k. These ranges will not be used for training areas or "dry run exercises" except by permission of the Post Range Officer.

l. No changes in the range installations will be made by troops using the ranges. No other than caliber 30 ammunition will be fired on combat ranges except by permission of the Post Range Officer.

m. The officer in charge of firing will inspect all pits before firing begins and if any are found to be unsafe he will have the necessary corrections made.

18. CARBINE TRANSITION FIRING will be conducted on Combat Ranges 2 and 5. Before the firing begins the officer in charge of firing will inspect all pits and if any are found to be unsafe he will have the necessary corrections made.

19. WOODS COMBAT COURSE: The officer in charge of firing will see that all possible precautions are taken to avoid accidents. Before giving the order to commence firing he will:

a. Ascertain that the range guard is posted.

b. That a red streamer is flying in the vicinity of the firing point.

c. That only M-2 ammunition or ammunition with a maximum range of 4000 yards is used.

d. That all personnel operating the targets are in the pits and understand the safety precautions.

e. That all explosive charges placed to represent enemy fire and all "Booby Traps" are prepared and exploded under the supervision of an officer.

f. That all troops are instructed in the safety angles of fire. The safety angle of fire is 35 degrees to the right and left of the long axis of the course.

g. The right and left sides and the finishing end of the course are marked by a single strand of barb-wire.

The officer in charge of firing will see that all problems are conducted within this enclosure and that all troops who have completed an exercise have been moved to the safety zone before the beginning of an exercise.

h. That all targets are repaired and that the range is in operating condition at close of firing.

i. That all personnel taking part in the exercise and all pit details wear the regulation steel helmet.

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j. The officer in charge of firing will inspect all pits before firing begins and if any are found to be unsafe he will have the necessary corrections made.

20. INFILTRATION COURSES: The officer in charge of firing will see that all possible precautions are taken to avoid accidents. Before giving the order to commence firing he will:

a. Ascertain that the range guard is posted.

b. That a red streamer is flying in the vicinity of the firing point.

c. That machine guns have been properly laid and that the elevating and traversing stops are in their proper place to keep the fire at a minimum of 36 inches above the ground and within the bounds of the range.

d. That only M-2 ball ammunition or ammunition with a maximum range of 4000 yards is used. See par. 45d, AR 775-10, for regulations governing tracer ammunition.

e. That each gunner thoroughly understands the functions of the traversing and elevating safety stops.

f. That an officer is on the control tower at all times during firing and that he has proper means for immediately communicating with the gunner.

g. That all explosive charges placed to represent enemy fire, or "Booby Traps" be prepared and exploded under the supervision of an officer.

h. That all personnel taking part in the exercise and all pit detail wear the regulation steel helmet.

21. MOCK VILLAGE COURSE: The officer in charge of firing will see that all possible precautions are taken to avoid accidents. Before giving the order to commence firing he will:

a. Ascertain that the range guard is posted.

b. That a red streamer is flying in the vicinity of the firing point.

c. That only M-2 ammunition or ammunition with a maximum range of 4000 yards is used.

d. That all personnel operating the targets are in the pits and understand the safety precautions.

e. That an officer is on the control tower at all times during firing and that he has proper means of communication with all the pits from which targets are operated.

f. That all explosive charges placed to represent enemy fire and all "Booby Traps" are prepared and exploded under the supervision of an officer.

g. That all troops are instructed in the safety angles of fire. The safety angle of fire is 90 degrees to the right and left of the center line of the street.

h. That all targets are repaired and that the range is in operating condition at close of firing.

i. That all personnel taking part in the exercise and all pit details wear the regulation steel helmet.

j. That all pits be inspected before firing begins and if any are found to be unsafe he will have the necessary corrections made.

[redacted]
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22. LIVE GRENADE COURTS: The Officer in charge of firing will:

a. Take all possible precautions to insure the greatest amount of safety to personnel.

b. See that all personnel not in trenches or behind masks are at least 250 yards from the impact area.

c. That all personnel in the trenches or behind masks wear the issue steel helmet.

d. That a guard is posted to prevent anyone from approaching within 250 yards of the impact area.

e. Designate an officer or non-commissioned officer with the necessary assistants to check for "duds".

f. Upon completion of firing, police the range and if any "duds" are not exploded they will be marked and a guard posted over them until arrangements are completed for their destruction. (See par. 10).

g. Before firing, a red streamer will be displayed from a pole erected for that purpose in rear of the center mask. This streamer can be drawn from the Post Range Officer on memo receipt.

REFERENCES:
FM 23-30 - AR 750-10 - TM 9-1900 - SNL-S-3.

23. SUB-MACHINE GUN RANGES, DISMOUNTED: The officer in charge of firing will:

a. Take all possible precautions to insure the greatest amount of safety to personnel.

b. See that all personnel not participating in the firing remain in the area immediately in rear of the firing positions.

c. That only the marked routes of approach to ranges are used in getting into ranges. (These ranges are close by other ranges and if other than marked roads are used men may wander into the danger area.)

d. These ranges have three firing points on each range. If adjacent firing points are being used, they will be used simultaneously. Men will advance from positions "A" to position "B" at a signal from the officer in charge of firing.

No scoring will be permitted when there is a man firing on an adjacent firing point.

e. At the close of firing for the day, targets and target material will be removed and stored in designated target house, the range will be thoroughly policed and any repairs that cannot be made will be reported to Assistant Range Officer - (Telephone Tie Line 12.).

24. SUB-MACHINE GUN RANGE, MOVING VEHICLE: The officer in charge of firing will:

a. Take all possible precautions to insure the greatest amount of safety to personnel.

b. See that all personnel not participating in the firing remain in the area immediately in rear of the firing positions.

c. That only the marked routes of approach to ranges are used in getting into ranges. (These ranges are close by other ranges and if other than marked roads are used men may wander into danger area.)

d. Vehicles will drive in the direction indicated by markers when firing.

e. No one will be permitted on the course after firing begins until the vehicle carrying the firing has completed the course and all weapons have been unloaded.

Authority NND 947030
By MD NARA Date 3/15/04

At the close of firing for the day targets and target materials will be removed and placed in designated target house, the range will be thoroughly policed, any repairs that cannot be made will be reported to Assistant Range Officer - (Telephone Tie Line 12.).

25. ANTI-TANK RANGE: Request will be made to Post Range Officer in same manner as for artillery range.

a. For the present time, only the following will be fired.

75mm sand loaded and armour piercing.
37mm armour piercing, (without windshields), sand loaded, and sub cal.
50 caliber machine gun.

b. The motor car and target car will be operated by personnel of the Range Detachment and under no circumstances by units firing. The car operator will set the car in motion and then report to officer in charge of firing that the range is clear and ready to be fired on.

c. A flag pole is available on the firing line. A red streamer will be flown when the range is being fired on. No firing will be permitted unless the red streamer is being flown. It will be the duty of the officer in charge of firing to cause the streamer to be hoisted and lowered. Before the car operator goes forward, the order cease firing and lower the flag will be given. Upon return from target car, the operator will report to officer in charge that range is clear and ready to be fired on. The officer in charge will order the flag to be hoisted and command begin firing.

d. The officer in charge of firing will furnish transportation for car operator to go to and from the target when adjustments are to be made on car and target.

e. There is a white post at each end of the firing line. Pieces that are to be fired will take up positions between these points.

f. Pieces that are merely for tracking purposes may be placed on an extension of the firing line.

g. There are two white poles 800 yards out with pieces of target cloth attached to the top which are to be used as right and left safety limits markers respectively.

h. The car is able to operate at two speeds, slow speed which is 5-15 miles per hour. Fast speed is from 5-25 miles per hour. The car operator will set the car at either speed the officer in charge of firing so desires. No other speed will be used except the above listed, without permission of the Post Range Officer.

26. TRANSITION RANGES: Before commencing to fire, the officer in charge of firing will inspect all pits and if any are found to be unsafe he will have the necessary corrections made.

27. RANGE SUPPLIES AND PROPERTY:

Ranges will be released to units when their authorized representatives have taken over the range property. This property will be maintained in good operating condition by the using unit. (Exception - broken targets, frames, etc., will be turned into the Range House for replacement.)

28. COMMUNICATION:

Phones for ranges will be drawn from the Assistant Range Officer. Phones may be exchanged for repair at Range Detachment.

29. CAMP AREA:

a. Requests for use of the Camp Area on the Small Arms Ranges will be submitted to the Post Range Officer.

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b. When the Camp Area is assigned to an organization, the Commanding Officer of that organization or an officer designated by him will contact the Assistant Range Officer at Leesburg and will sign for all property on memo receipt. Obtain from the Assistant Range Officer a proposed administrative order to the using troops covering the interior economy of the camp.

c. Assignments in camp area will be made by Commanding Officer of using troops, and administrative arrangement for the camp area. Senior officer will command for coordination of installations.

d. Before departure, organization will:

(1) Roll sides of tents and loosen ropes.

(2) Stack all cots in mess halls for check.

(3) Scrub kitchen and mess halls.

(4) Clean ice box and leave open.

(5) Clean electric refrigerator; leave closed and connected.

(6) Skim grease trap.

(7) Remove all garbage.

(8) Scrub bathhouse.

(9) Scrub latrines, sprinkle lime in pits, and leave covers closed.

(10) Police area.

(11) Clean incinerator and haul rubbish to dump.

(12) Return property to Assistant Range Officer and get memo receipt.

e. When the Post Exchange is in operation in the camping area, the senior officer will issue orders regulating the hours and arranging for police and sanitary conditions. Post Exchange Officer should be informed of important changes or requests.

30. FACILITIES:

a. The following equipment and facilities for each company or similar unit is available:

(1) Mess hall and kitchen.
(2) Pyramidal tents.
(3) Cots, canvas, folding.
(4) One (1) bathhouse to three (3) mess buildings.
(5) One (1) latrine, pit type.
(6) Ice box and electric refrigerator.

b. The following equipment must be furnished by using troops:

(1) Field range.
(2) Cooking utensils.
(3) Mess kits, complete.
(4) Bedding.
(5) O. D. Blankets.

c. Water facilities are very limited. Arrangements must be made within organizations to conserve all that is possible and alternate the use of it between the kitchen and bathhouses when necessary. No water will be used for sprinkling streets.

d. During freezing weather the commanding officer of troops occupying the camp area will take all precautions to protect exposed water pipes.

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By MD NARA Date 3/15/04

31. SANITATION: The commanding officer of troops is responsible for sanitation and will appoint the senior medical officer as medical inspector for the camp and range.

32. RANGE FIRES:

a. The control of fires resulting from firing on the range is the responsibility of the officer in charge of firing.

When a fire on the range is observed, the officer in charge of firing on that range will immediately contact the Post Range Officer or his Assistant to determine the danger area.

If the fire is located inside a danger area, the Range Officer or the Assistant Range Officer will stop all firing in that area. The officer in charge of firing will then proceed to extinguish the fire.

b. Unit commanders in the vicinity of the fire will give assistance when called upon to do so.

c. During extremely dry weather when the danger of range fires is imminent, officers in charge of firing will inspect the impact areas of their ranges at the conclusion of each days firing.

By command of Brigadier General RICHART:

JOSEPH P. O'HARA
Major, AUS
Adjutant

DISTRIBUTION "A"

Authority NND 947030
By MD NARA Date 3/18/04

WAR DEPARTMENT
OFFICE OF THE CHIEF OF ENGINEERS

FORT JACKSON, SOUTH CAROLINA

RESTRICTED

POST WAR UTILIZATION STUDIES

SEPT
1945

DECLASSIFIED
Authority NND 803038
By CAARA Date 3-5-04

ANALYSIS OF FORT JACKSON, SOUTH CAROLINA

GENERAL DESCRIPTION AND USE

Fort Jackson is located in the central part of South Carolina, 5 miles east of the city of Columbia (population 62,396). The reservation comprises an area of 60,217 acres of which 51,344 acres are Government-owned. From June 1940 to October 1944, a total of 8 Infantry Divisions received training for primary missions at this post. During the year 1942 the training of four Infantry Divisions was prosecuted at one time. Besides acting as a training post for infantry divisions, Fort Jackson has also been used for the training of miscellaneous tactical groups and service battalions.

REGIONAL FACTORS

Other nearby centers of population are: Sumter, 45 miles distant, (population 15,874), and Orangeburg, 50 miles distant (population 10,521). The proximity of Fort Jackson to the city of Columbia is very advantageous from the viewpoint of social outlets. The climate is moderate. The health of the troops is protected from mosquitoes by adequate drainage within the housing area, principal recreation areas, and for a one-mile strip surrounding these areas. Beyond the limits of the controlled area, mosquito breeding grounds are extensive and require the application of standard measures of malaria control. The area surrounding Fort Jackson is primarily an agricultural community.

POST DEVELOPMENT

In the cantonment area, based upon 80 square feet per man, there is available space for 19,714 men in mobilization type barracks. There have been housed 43,690 men in hutments and 2,198 in theater of operations type barracks. There are no permanent quarters. It would be desirable in the postwar period to convert the present hand fired space heaters and hot water heaters to automatic firing. Present housing conditions with respect to fire prevention are satisfactory.

The water supply system is constructed of permanent materials and is considered satisfactory for postwar use. The supply is from a dam on Gill Creek, treated in a water filtration plant, and is adequate and dependable.

The sewage disposal facilities are constructed of permanent materials and are considered very satisfactory and suitable for postwar use. Complete treatment is provided and therefore no nuisance is created.

Cold Storage facilities are adequate for postwar use.

The electric power is furnished by the South Carolina Gas and Electric Company. Service is excellent and supply adequate. No standby supply is provided. The last monthly billing of energy use was .7719 cents per KWH.

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By CB NARA Date 3-4-04

Fort Jackson, South Carolina

Rail service is furnished by the Atlantic Coast Lines, the Southern Railway and the Seaboard Air Lines over jointly operated tracks. Switching operations within the warehouse area are increased due to the fact that ten to twelve warehouses must be served by a single track. Three general supply depots are within 150 miles of the camp.

Highway access adequately serves Fort Jackson. The roads and drainage within the post are satisfactory for postwar use.

The total cost of Fort Jackson to the Government since July 1, 1940, including land and construction, has been approximately $31,078,000.

TRAINING FACILITIES

The general soil characteristic of the reservation is sand and sandy loam. Water is absorbed quickly and troops can drill a few minutes after a normal rainfall.

All training aids, except small arms ranges, are located within a maximum of thirty minutes' marching time of the housing area.

Small arms ranges are located sixteen miles from the housing area. A tent camp sufficient to accommodate 6,000 troops is located within an average marching time of thirty minutes of all small arms ranges. Troops using these ranges train progressively and usually remain at the tent camp until all small arms training is completed. No loss in training time is incurred by the location of the ranges.

The artillery ranges afford excellent ground observation of impact area in open ground. Maximum range is 18,000 yards.

The maneuver areas include well proportioned open and wooded areas and are very suitable for training. The wooded areas are accessible to all types of motor and tracked equipment.

Sufficient drill fields are located near small units and allow 60% of the troop strength to use the areas at any one time. A division review field is also available.

There are two air strips located on the reservation for the operation of L-2 (Artillery Liaison) Planes. Land is available for expansion of these strips. There are two Army airports in the vicinity. One is the Columbia Army Air Base, approximately 18 miles from the post having 3 - 5,000' runways evaluated for 30,000 pounds capacity operation, 40,000 pounds limited operation. The second airport is Congaree, approximately 10 miles from Fort Jackson, having 3 - 4,500' runways, evaluated for 40,000 pounds capacity operation, 74,000 pounds limited operation.

Engineering training is available for floating and fixed bridges.

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By CB NARA Date 8-24-04

Fort Jackson, South Carolina

Tank deployment training facilities are satisfactory.

CONCLUSION

From an engineering standpoint, Fort Jackson may be considered satisfactory for postwar retention except in the matter of housing. There is a discrepancy of 13,136 between the available space in mobilization type barracks and the proposed strength of 32,850. Based upon the assumptions given in the attached appendix, the cost of providing permanent quarters for the officer complement, quarters for the first three grades of W.C.S.'s, additional barracks, and remodeling the existing mobilization type barracks for postwar use would be in the neighborhood of $55,000,000.

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By CB NARA Date 8-4-04

APPENDIX A

Assumptions on Basis of Which Estimated Costs Were Made

In the absence of determined policy as to types of construction to be used, ace allocation for different kinds of structures, method of housing married ficers and top-grade non-commissioned officers, etc., the following assumptions ve been used in preparing the housing costs given in the preceding conclusion:

(1) That Theater of Operations construction, hutments, and tents would be disposed of, that only permanent or mobilization-type construction would be retained, and that mobilization-type construction would be improved to supply facilities suitable for permanent occupancy.

(2) That all new construction with the exception of extensions or additions to existing mobilization-type construction would be of permanent construction.

(3) That station hospitals, being normally of mobilization-type construction or better, would not usually require more than nominal expenditure for conversion to permanent use. (Estimates do not include this conversion cost.)

(4) That officer strength at a given post is roughly 5% of the total complement assigned to the post.

(5) That all officers at regular army stations and all regular army cadre officers serving as trainers at other types of posts would be provided family housing.(This applies to married officers only.)

(6) That all trainee officers will be provided bachelors' officers quarters. (National Guard and Reserve Camps would have no family quarters.)

(7) That top three grades of non-commissioned officers to be housed in family quarters comprise 2.2% of the total complement assigned to the post.

(Above percentages are based roughly on the Table of Organization for an Infantry Division and check fairly closely with the actual conditions of housing at seven pre-war permanent posts.)

(8) That existing housing given in "War Department Owned, Sponsored, and Leased Facilities" would accommodate only 75% of rated capacity, since capacities given in this publication (30 June 1945) are based on 60 square feet per man, while allocation approved for planning is 80 square feet per enlisted man. (Costs of new permanent family housing takes into account existing permanent family housing as given in Historical Records.)

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By CB KARA Date 3-4-04

Based on the above assumptions and on the best available information, the following rough approximations of unit costs of housing were used:

(1) For remodeling mobilization type barracks and other related buildings, including necessary minimum improvements of roads, utilities, etc. . . . . $. 300.00 per S.M.

(2) For new permanent housing, replacing Theater of Operations structures, tents, and hutments, and including a proportional share of other facilities (buildings, utilities, etc.). . . . $ 2,000.00 per S.M.

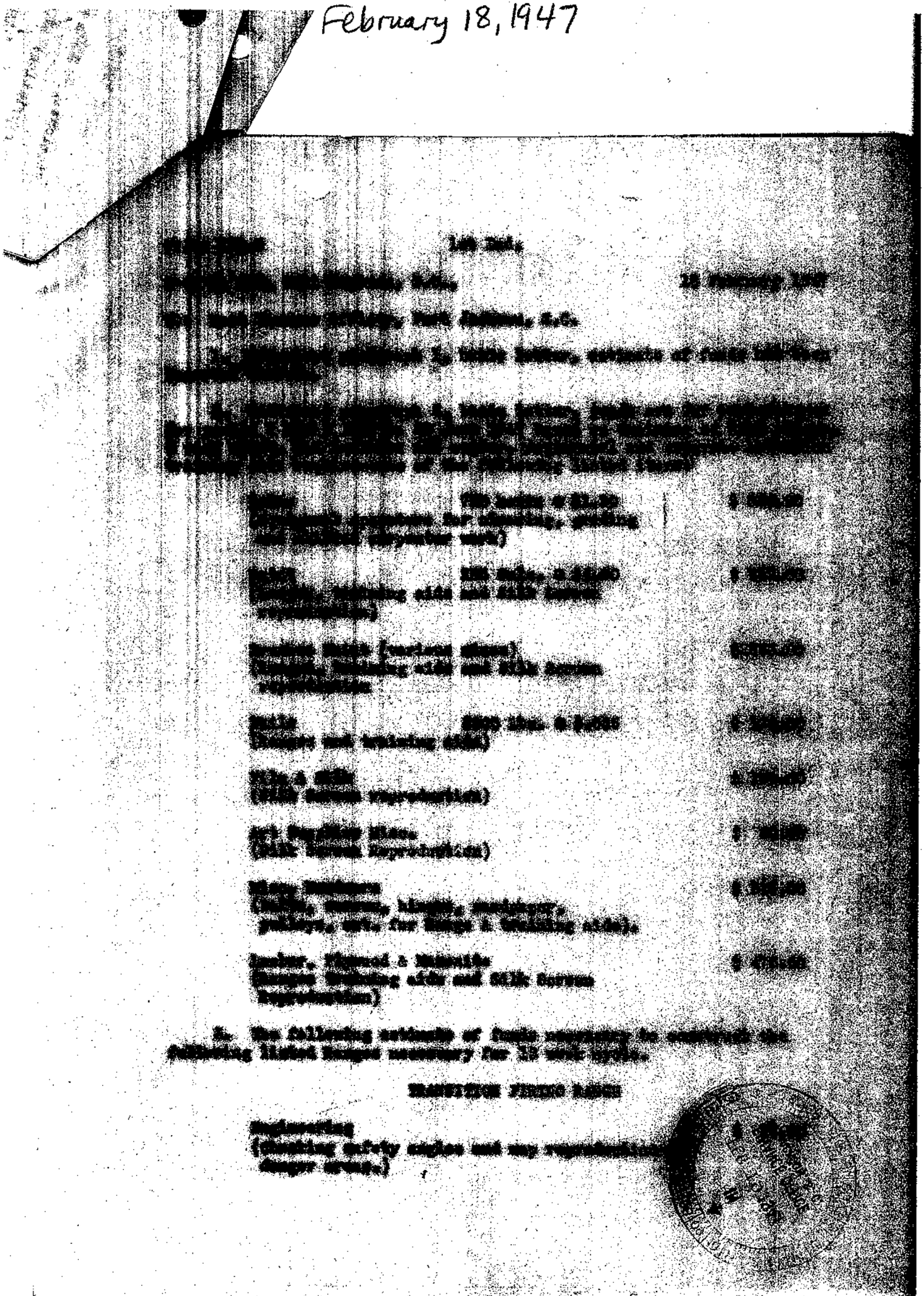
(3) For new permanent officers' family housing (field and company grades averaged), including roads, utilities and other necessary miscellaneous community facilities, such as schools, club, etc. . . . . $10,320.00 per Officer

(4) For new permanent apartment quarters for bachelor officers, including same as above . . . . . $ 3,000.00 per Officer

(5) For new permanent family quarters for Warrant officers and top-grade N.C.O.'s, including roads, utilities and other miscellaneous community facilities such as schools, club, etc.. . $14,770.00 per man

Authority NND 803038
By CORA Date 8-24-04

February 18, 1947



RG 337, Hq. Army Ground Forces
E. 51-A, Subject File, 1941-50
Box 23

Labor (Heavy equipment operators for clearing and grading.)	600 hours @ $1.20	$ 720.00
Lumber (Target frames, foxhole reveting and various Range fixtures.)		$ 420.00
Nails & Misc Hardware (Springs, pulleys, wire, Cable, pipe and ect. for 90 disappearing targets.)		$ 260.00
Concrete (Safety pits for target operators.)	100 Cubic yds.	$ 850.00
GRAND TOTAL		$5,538.00

FOR THE S-4:

LYNDEN R. ANDERSON
Major, Ord Dept
Asst S-4

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HEADQUARTERS
RANGE & TRAINING AIDS DIVISION
Fort Jackson, South Carolina

25 April 1947

SUBJECT: Construction of Ranges.

TO : Post Engineer, Fort Jackson, S.C.

1. Request the construction and rehabilitation of the following Ranges, to meet the training requirements set forth in the Military Training Program of Hq. Army Ground Forces, annex # 3 Sec. 2 Dated 1 Feb. 47, as follows.

2. Transition Range as in plan number OCE # 1600-200. This range is to consist of 6 #6 lanes, 4 #7 lanes, 1 #8 lane. The firing line is to be located at coordinates, 1008.40-1212.00, Map Ft. Jackson and Vicinity 1:25,000 compiled form reservation map Ft. Jackson, dated, 3 May 43.

3. Techinque of Fire Range, to be constructed in accordance with OCE plan # 1600-110, consisting of 4 panels, 5 targets per panel. The firing line to be located at coordinates, 1009.30-1214.60, Map Ft. Jackson and Vicinity S.C., 1:25,000 , Compiled from reservation map Ft. Jackson, dated, 3 May 43.

4. Field firing Range, to be constructed in accordance with OCE plan # 1600-140. Firing line to be located at coordinates 1009.35-1214.30. Map Fort Jackson and Vicinity S.C., 1:25,000, compiled from reservation map Ft. Jackson, dated 3 May 43.

5. Rehabilitation of existing hand grenade court located at coordinates 1008.35-1217.00. Map Fort Jackson and Vicinity S.C.,1:25,000, compiled from reservation map Fort Jackson, dated 3 May 43. Rehabilitation consists of replaceing sand bags, duck boards and other minor repairs.

6. Rifle Grenade Range, to be constructed in accordance with diagram, Figure 44, page 114, FM-23-30. To be located at coordinates, 1007.50-1216.50 Map Fort Jackson and Vicinity SC., 1:25,000, compiled from reservation map Ft. Jackson, dated, 3 May 43. Rocket Launcher Range can be combined in with the Rifle Grenade Range, with very little additional expense and materials.

7. It is necessary that the construction of these ranges be given top prority, as the 13 week Training cycle starts 5 May 47 and all ranges are used from the 5th. to the 8th. week of the Training cycle. Ranges must be completed prior to 23 June 47.

8. This request is based on the Training of approximately 10,000 troops.

JOHN R LUCAS
Captain, Infantry
Range Officer

RG 337 Hq. Army Ground Forces
E. 55, Box 1, Corr., 1942-48
E DX 1123

Authority NNDS 923194
By MW NARA Date

June 17, 1949

HEADQUARTERS
Fort Jackson, South Carolina

GNJDC 314.7

17 June 1949

SUBJECT: Historical Report

TO: Commanding General
Third Army
Fort McPherson, Georgia

In compliance with letter, Headquarters, Third Army, Subject and file as above, dated 28 April 1949, the attached historical report of Fort Jackson is submitted.

G. H. DECKER
Major General U. S. A.
Commanding

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Authority NND 997000
By CO NARA Date 3-22-04

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RG 337, Hq. Army Ground Forces
Entry 108 (UD)
AGF + AFF Installations
Box 34

HEADQUARTERS
Fort Jackson, South Carolina

GNJDT 300.8 24 May 1949

SUBJECT: Range Regulations

TO: See Distribution

RANGE REGULATIONS FORT JACKSON

1. These regulations will be considered to be organizational property of the unit concerned and will be turned over to successors as such. Individual sections of this publication will not be extracted for use in the field. This will not be interpreted to mean that the entire book may not be taken to the field for reference material.

2. In case of revision, each newly revised page will indicate, at the top, the page that it rescinds. Such changes will be posted and the old copies removed from the files.

3. All officers will read all pertinent sections of this publication prior to conducting range firing on any range.

4. Unit commanders are responsible that all range firing is conducted in compliance with the instructions set forth herein.

BY COMMAND OF MAJOR GENERAL DECKER:

M. BAILEY
Major AGD
Asst. Adjutant

Distribution:

6 ea. Co.	1 Ordnance Officer
3 ea. Bn.	1 QM Officer
10 ea. Rogt.	1 Medical Supply Officer
1 CG	1 TI&E Officer
1 Asst. CG	1 Bivouac Equip. Pool
1 Exec Officer	1 Weapons Pool
1 C of S	1 Chemical Officer
1 G-1	1 Chaplain
1 G-2	2 Safety Director
50 G-3	5 S.C. Military District
10 G-4	5 S.C. National Guard
4 AG	
1 Hq Comdt	
1 Ldrs Course	
1 Motor Officer	
1 Staff Surgeon	
1 Ord. Ammo. Officer	
1 Post Engineer	
1 Provost Marshal	
1 IG	
1 Engr Troop Supply	

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Authority NND 947000
By CO NARA Date 3-22-04

RANGE REGULATIONS

Reference Copy

FORT JACKSON
SOUTH CAROLINA

JAN 16 1950

DECLASSIFIED
Authority NND 947020
By CO NARA Date 3-22-04

HEADQUARTERS
Fort Jackson, South Carolina

11 April 1949

FORT JACKSON RANGE REGULATIONS

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(1) The range is in proper mechanical condition for firing.

(2) The ambulance and qualified aid men are present.

(3) Range guards have been oriented and posted properly.

(4) The range has been scheduled and notice of firing placed in the Daily Bulletin.

(5) No situations have arisen that would make firing contrary to safety precautions.

7. During Use of Range by Using Units:

a. Range Supplies and Equipment: The Post Range Officer will furnish all requisite range supplies for specific ranges upon request for range supplies from the using unit.

b. On-the-spot Maintenance: The Post Range Officer will be responsible for continuous maintenance, during firing, of target frames, target devices and communication lines.

8. After Use of Range by Using Units:

a. Final Clearance: The Post Range Officer will be responsible for issuance of a written clearance of the range upon request by the using unit. Prior to the issuance of this clearance, he will personally, or by a commissioned officer or non-commissioned officer representative, ascertain that:

(1) The range proper is in an acceptable state of police.

(2) The condition of range facilities is the same as when accepted by the using unit.

(3) All non-expendable range supplies and equipment are turned in by the using unit and that expendable range supplies in excess of those used by the using unit are also turned in.

(4) The using unit has checked for range fires and duds.

b. Necessary Repair: The Post Range Officer will be responsible for making all necessary repairs. He will also be responsible for proper notification of the Post Engineer or Post Signal Officer for repairs of such nature as to require their aid.

Section III
Responsibilities of Officer in Charge of Firing

9. Before Using Range:

a. The Officer in Charge of Firing will be responsible for having personal knowledge of, and having the operation of ranges in compliance with, pertinent provisions of:

AR 750-10

Pertinent Technical Manuals and Field Manuals.

Chapter III below.

He will also be responsible for the dissemination of, and compliance with, the information contained in the pertinent provisions of the above references for all supervisory personnel.

b. The Officer in charge of firing will be responsible for notifying the Post Range Officer in the event firing is cancelled for any reason.

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(2) On The Firing Line:

(a) The organization of personnel on the firing line will be so arranged as to adapt the using unit to the course to be fired.

(b) The organization of personnel on the firing line will be so arranged as to make the most efficient use of the time allotted.

(c) An officer will be present on the firing line at all times.

(d) Safety precautions will be followed at all times, including the following:

1. Weapons will be pointed "down range".

2. Weapons will be cleared and placed in the "safe" firing position when not in operation.

3. "Cease firing" will be given at any time when a condition arises which in anyway precludes the continuation of safe firing.,

4. Firing, limited to designated firing lines or areas and between designated limiting points, will be observed at all times.

5. No one will move from the firing line in the direction of the impact area until all weapons have been cleared and placed in the "safe" firing position.

6. No firing will be conducted when the scarlet streamer is not displayed on the range pole.

7. In case of an accident, such as the bursting of a barrel, or permanent damage to the weapon, the weapon will be left in the position in which the accident occured and the Ordnance Officer, Ft Jackson, notified.

8. If any serious malfunction of Ordnance equipment occurs on the range, such equipment will be turned over promptly to the Ordnance Officer without effort to repair it.

(3) Pits (where applicable):

(a) Organization:

1. Scheduling personnel as target operators in pits should be so arranged as to not interfere, or to cause an unnecessary break in firing.

2. Personnel should be rotated as frequently as is consistent with the efficient operation of the range in the performance of duties as target operators in the pits.

(b) Safety:

1. Each pit will have a red flag, which flag is to be waved during firing, only when for some necessitous reason or emergency (except on the KD range), a target operator must have the firing line "cease fire" in order to emerge from pit.

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2. No target operator (s) will emerge from a pit or expose himself to fire until specific orders have been issued on the firing line to "cease fire" and "clear all weapons" and specific approval given to the target operator (s) to expose themselves.

3. The red flag will be exhibited from a prominent position in a pit during the entire time a target operator is exposed.

(4) Impact Area: Firing will be halted in the event:

(a) A range fire is detected on the range at any time. In which event the following procedure will be used:

1. Notify the Range Officer to obtain clearance to enter the impact area.

2. If the range fire is limited and clearance has been received extinguish fire with personnel and facilities available.

3. If the fire is large and clearance has been obtained or if possibility of its becoming large exists:

a. Use personnel and facilities available in attempt to prevent spread of fire, and if possible, extinguish it entirely.

b. Notify Post Range Officer that assistance will be required.

(5) Miscellaneous: All immediate repairs necessary will be reported to the Range Officer for action.

11. After Use of Range: The Officer-charge-of-firing will be responsible, upon completion of firing to:

a. Check for all range fires detected on the range, using the same procedure as in par 10 a (4) above, in the event one is discovered.

b. Check for, and report duds (where applicable) as follows:

(1) Appoint a limited number of responsible, experienced, non-commissioned officers to conduct a search for duds.

(2) Leave the suspected dud undisturbed.

(3) Mark the location by a dud marker (Note: Dud markers, 10" red discs with DUD marked in white letters, placed on 6 foot pole, are located in all target houses).

(4) Report the exact location by coordinates to the Post Ammunition Officer (tel 24). If Post Ammunition Officer indicates that he will investigate immediately, leave someone nearby to guide him to the exact location.

c. Police the entire range site for trash.

d. Conduct a search of all personnel for live ammunition.

e. Turn in all supplies, drawn specifically for range firing, to same agencies drawn from (See par 9 c, above).

f. Execute the following certificate (issued with all Ammunition) for all HE ammunition expended:

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C E R T I F I C A T E

(Battery_____, _____, Field Artillery Bn.)

(Company_____, _____, Infantry)

_____
(Date)

I certify that the following information, concerning quantities of ammunition listed below is true and correct to the best of my knowledge and belief:

TYPE	ISSUED	EXPENDED	TURNED IN	DUDS	LOCATION OF DUDS

_____
(Signature)

_____
(Name Typed)

_____
(Rank and Organization)

g. Obtain a final clearance, in writing, from the Post Range Officer. This clearance will be maintained on file for a period of 2 months from the date of issuance.

h. Report to Post Range Officer all repairs needed.

i. Report the individual scores attained. The following extract from C1 to MR 775-10, dtd 23 Sept. 48 is quoted:

" 16. Records and Reports:

* * * * * *

c. Upon completion of the record practice or examination, score cards or a report from examining boards will be transferred to the Headquarters of the unit, where the order of classification will be published----------".

CHAPTER - III
Detailed Information and Responsibilities for Specific Ranges

SECTION I

Machine Gun Range #1

12. Description:

a. Location: (1007.7 - 1214.9) See Annex #1.

b. Telephone Numbers: Tie Line 14 Ring 1.

c. Number of Firing Points: 60

d. Type Weapon Fired: Machine Gun Cal..30, Light (M1919A4)
Machine Gun Cal..30, Heavy (M1917A1)

e. Course to be fired on range: A or B (modified to 500" range).

f. Distance from gun position to target: 500 inches.

g. Safety Limits: See Annex #1.

h. Danger Area: See Annex #1.

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i. Range Guard Positions: None necessary.

j. Available Range Facilities:

(1) Control Tower

(2) Covered Latrine

(3) Dry Firing Line with 60 Targets

(4) Mess Hall

(5) Scoring and Critique Tables

(6) Supply House

(7) Target House

k. Type Target: 500 inch Machine Gun.

13. Responsibilities of Post Range Officer:

a. Continuous responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in par 12 j, above.

b. Before Use of Range by Using Unit: The Post Range Officer is responsible for supplying using units with 500 inch Machine Gun targets and target frames.

14. Responsibilities of Officer-in-charge-of-firing:

a. Before Use of Range: The Officer-in-charge-of-firing will be responsible that:

(1) Both he and his supervisory personnel are thoroughly familiar with pars 110-122, FM 23-55, and AR 750-10.

(2) All firers have completed, as a minimum requirement, all mechanical training, gun drill and marksmanship, required by SOP 27 Hq 5th Inf Div. Requests for waiver of this prerequisite instruction will be submitted to this Headquarters ATTN: GNJDT, one week prior to actual firing.

(3) Prior to Firing:

(a) An officer will check headspace of each gun and make the proper adjustment.

(b) A cleaning rod and dry patch is run through the bore of each gun.

b. During Use of The Range:

(1) Operation of The Range:

(a) Behind the firing line (Opposite side of firing line from impact area): The Officer-in-charge-of-firing will be responsible that before removing a machine gun from its firing position, or from the firing line, each gun will be inspected, by an officer to see that it is unloaded. As part of this inspection, a cleaning rod will be passed completely through the barrel of each gun.

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(b) On The Firing Line:

1. The most efficient organization, for this range consists of a breakdown into 5 equal sized orders as outlined below:

1 Order	Gunner	Wet Line
1 Order	Asst Gunner	Wet Line
1 Order	Observer	Wet Line
1 Order	Gunner	Dry Line
1 Order	Asst Gunner	Dry Line

2. Safety Precautions: The Officer-in-charge-of-firing will be responsible for the accomplishment of the following safety precautions: Note: The "Safe firing position" referred to in par 10 a (2) (d) 2 "Safety Precautions" will be considered to have been attained for the machine gun when:

a. A cleaning rod has been passed completely through the barrel.

b. A clearing block has been placed in the receiver of the gun.

(c) A clearing block should be inserted in the receiver of each gun during the time it is not being used to fire an exercise.

(d) All decisions as to actions to be taken on stoppages will be made by an officer.

c. After Use of Range: The Officer-in-charge-of-firing will be responsible that all trash accumulated in the trash bin is burned in the metal receptacles provided for that purpose.

SECTION II

ROCKET LAUNCHER RANGE

15. Description:

a. Location: (1007.7 - 1216.4).

b. Telephone Number: Tie Line 15, Ring 3.

c. Number of Firing Points: 24

12 Practice Ammunition
12 Service Ammunition

d. Type of Weapon Fired: Rocket Launcher, 2.36 inch M9 and M9A1.

e. Distance from Gun Position to Target: 100 Yards.

f. Safety Limits: See Annex #1.

g. Danger Area: See Annex #1.

h. Range Gaurd Positions: None Necessary.

i. Available Range Facilities:

(1) Range House.

(2) Dry Firing Line with 12 Targets.

(3) Control Tower.

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f. After use of the range: The officer-in-charge-of-firing will be responsible that all trash has been policed.

SECTION IV

TRANSITION RANGE

21. Description:

a. Location (1008.7-1212.3)

b. Telephone Number - Tie Line 11.

c. Number of firing lanes: 15.

6 Lanes (1 through 6) - Table VI.
4 Lanes (7 through 10) - Table VII.
1 Lane (11) - Table VIII.
4 Lanes (12 through 15) - Table IX.

d. Course to be fired:

Table VI and VII - Par 69d FM 23-5
Table VIII - Par 69d FM 23-5, C2
Table IX - as follows:

PHASE LINES	TARGETS SINGLE	DOUBLE	TRIPLE	RANGE (YARDS)	SHOTS	TARGET	POSITION	SLING
2 - 3	2	1	0	5-70	4	E	Off Hand	None
3 - 4	0	1	2	5-70	8	E	Hip	None
4 - Final	2	3	0	5-70	8	E	Off Hand	None

(1) A single silhouette represents an enemy rifleman. A double silhouette represents an enemy automatic rifle team. A triple silhouette represents a machine gun.

(2) Targets will be exposed in sequence upon signal from the coach. Time of exposure of targets is as follows: (a) Single silhouettes, 3 Seconds. (b) Double silhouettes, 4 seconds. (c) Triple silhouettes, 5 seconds.

(3) Phase lines are placed after the 4th, 12th and 20th targets to assist in the enforcement of safety precautions.

e. Scoring and satisfactory scores:

TABLE	SCORING PROCEDURE	SATISFACTORY SCORES
Table VI & VII	Par 69e, (1) & (2), FM 23-5.	VII - 8
Table VIII	Par 69e (3), FM 23-5, C2	4
Table IX	1 for each target hit	8

f. Type of weapon fired: Rifle Cal .30, M1.

g. Distance from firing position to target:

Table VI - 200, 300, and 500 yards.

Table VII - 250, 300, 350, 400, 450 & 500 yards.

Table VIII - 100 yards.

Table IX - 5-70 yards.

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h. Safety Limits: See Annex #1

i. Danger Areas: See Annex #1

j. Range Guard Positions:

POSITION	DUTIES
1008.6-1211.2	- Block all traffic moving into transition range danger area.
1009.1-1213.4	- Block all traffic moving Southeast on Hartsville Guards Road and all other traffic seen moving into transition range danger area.
1009.6-1211.3	- Block all traffic moving North into the transition range danger area.
1013.3-1210.1	- Block all traffic moving North along Telephone Road.
1014.5-1217.6	- Block all traffic moving South along Telephone Road.

k. Available range facilities:

(1) 6 Control towers

(2) Latrines

(3) 3 Bleachers (Capacity 50 each).

(4) Target House

(5) Work Tables

(6) Communication Arrangement (See Annex #2).

22. Responsibilities of Post Range Officer:

a. Continuous responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in K above.

b. Before use of range by using unit: The Post Range Officer is responsible for supplying using units with a sufficient number of [illegible] silhouettes, including those colored Red [illegible] yard firing, and also a sufficient number of target staves for the entire period of firing.

23. Responsibilities of Post Signal Officer:

a. Before use of range by using unit: The Post Signal Officer (Tel 10) will be responsible, upon requests by Regimental S-3's to advise the units as to use of cable facilities and to restore inoperative cable facilities.

b. During use of range by using unit: The Post Signal Officer will be responsible, upon request of Regimental S-3's, for repairing broken wire communication facilities.

c. After use of range by using unit: The Post Signal Officer will be responsible, upon request by the Post Range Officer, to make any necessary repairs.

24. Responsibilities of Officer in Charge of Firing:

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a. Before Use of Range: The Officer in Charge of firing will be responsible that:

(1) Both he and supervisory personnel are thoroughly familiar with pars 34, 69d, e, f, g, 189-191b FM 23-5, C1 and 2, and AR 750-10, and SOP 24A.

(2) All firers have fired the rifle qualification Course "B" and also have received instruction in range estimation, assuming firing position and assault fire, required per SOP 24A, Hq 5th Inf Div. Requests for waiver of this prerequisite instruction will be submitted to this Hq, ATTN: GNJDT, one week prior to actual firing.

(3) Range Guards are posted in positions listed in 21 j above.

(4) When pits are filled with water they are bailed out prior to firing and that every third pit has a bucket available for any subsequent seepage into the pits.

(5) The first pit detail is familiarized with its duties and have at least one "dry run" prior to actual firing.

b. During use of Range: The Officer in charge of firing will be responsible for the overall operation of the range to include:

(1) Behind the firing line (opposite side of firing line from impact area).

(a) Only weapons that have been unloaded, locked, and have had a cleaning rod run through the bore, will be permitted to be removed from any firing point or firing line.

(b) Movement in rear of firing points by personnel undergoing this course, will be at a walk with rifles held at "Port Arms".

(2) On the firing line:

(a) Procedure for firing: As outlined in SOP 24A.

(b) Organization of firing line: As outlined in SOP 24A.

(d) Safety:

1. The safe firing position referred to in par 10 a (2) (d) 2, "Safety precautions" will be considered to have been attained when:

a. Rifle is locked.

b. Ammunition completely removed from rifle.

c. Bolt to rear.

d. A cleaning rod has been run through the bore of the rifle.

2. Safety Precautions: For Table IX.

The firer will be instructed prior to firing that targets are not more than 3 feet in size, targets will be on same level as ground, targets to front, right or left front only.

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The Coach Cadre [illegible] will:

Stay immediately in rear of firer.
Regulate speed of movement of firer.
Keep target operator well in rear of firer.
Determine that firer has unloaded his weapon before moving back to starting point.

(d) Communication: The firing point on each firing lane will maintain contact with the pits in its own lane by the use of field telephones.

(3) Pits:

(a) Organization: Pit details subsequent to the 1st order will be thoroughly instructed in their duties and also in safety precautions to be observed before being assigned to pits.

(b) Communication: Each lane within each of the 4 tables, will have its own integral communication net by which control will be exercised, as follows:

TABLE VI: The center pit at each of the three ranges (200, 300, 500 yds) will have a terminal for telephone communication to the firing point.

Communication between any of the three pits located at one of the three ranges may be established by use of whistles signals. Suggested signals are as follows:

"Attention" 4 short blasts

"Targets Up" 1 long blast

"Targets Down" 2 long blasts

"All Clear" 2 short blasts

TABLE VII: Each pit at each of the six different ranges (200, 250, 300, 350, 400, &450 yds) will have a terminal for telephone communications to the firing point.

TABLE VIII: The pit will have a terminal for telephone communication to the firing point.

(c) Scoring: Scoring will be accomplished by pit detail as follows:

TABLE VI: Flutter and lower target when hit then score.

TABLE VII: Same as above.

TABLE VIII: Score after command "Targets Down" is given.

TABLE IX: Not applicable (See par 21d & e, for scoring).

(d) Safety: See par 10 (2) (d) 2 "Safety".

c. After use of Range: The Officer in charge of firing will be responsible:

(1) That all trash accumulated in trash bins is burned.

(2) That new targets are fastened on all staves and then stored in target house for the use of the next unit.

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5. See that there are no burs on the rings of the grenade launcher, and that the rings are free from grit.

6. Inspect frequently the wing nut on the clamp of the launchers M1, M2, and M8 to insure that it is tight.

7. Never place a grenade on the launcher unless it is intended to fire it immediately. Never fire service ammunition or standard blank ammunition when grenade is on the launcher.

8. If the hand grenade with the grenade projection adapter should accidently become armed after the removal of the safety pin, unlock the weapon and fire immediately as the grenade will explode in 4 to 5 seconds. Care should be taken not to strike the lever after the safety pin is removed as such action may cause the lever to spring from the grenade and allow the fuze to function.

9. Do not drop a grenade after the safety pin has been removed.

10. In the event the rifle grenade cartridge M3 or carbine grenade cartridge M6 does not fire and there are no additional M3 or M6 cartridges available., lock the weapon, replace the grenade safety pin, and remove the grenade.

11. Do not recover or tamper with live grenades, once fired, that fail to fire.

c. After use of the Range:

(1) Execute a certificate for all HE ammunition expended (see par 11f for example of certificate).

(2) Police all trash

SECTION VIII

PISTOL RANGE

34 Description:

a. Location (1008.8-1214.9)

b. Telephone Number Tie Line 14 Ring 4

c. Number of Firing Points: 10

d. Type weapon fired: Automatic pistol, Cal..45 M1911 or M1911A1 Colt Revolver, cal..45 M1917.

e. Courses to be fired as prescribed in pars 87-90 FM 23-35

f. Distance from firing line to targets: 15 and 25 yards.

g. Safety Limits: See Annex #1.

h. Danger Area: See Annex #1.

i. Range guard positions: None.

j. Available Range facilities.

Target House
Latrine (to be used in conjunction with latrine on MG Range #2).
Pistol Butts

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35. Responsibilities of Post Range Officer:

a. Continuous responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in 34 j above.

b. Before use of range by using unit: The Post Range Officer is responsible for supplying using units with sufficient numbers of E&L type targets.

36. Responsibilities of officer in charge of firing:

a. Before use of range: The Officer in charge of firing will be responsible that:

(1) Both he and his supervisory personnel are throughly familiar with pars 13, 24, 25, 91, 96 FM 23-35 and AR 750-10.

(2) All firers have completed as a minimum requirement, all mechanical training and marksmanship training listed in FM 23-35. Requests for waiver of this instruction will be submitted to this headquarters ATTN: GNJDT one week prior to actual firing.

(3) All pistols have had safety devices tested per par 25.

All revolvers have had safety devices tested per par 64.

b. During use of range:

(1) Behind the firing line (opposite side of firing line from impact areas).

(a). Only weapons that have been unloaded, locked and have had a cleaning rod run through the bore will be permitted to be removed from the firing line.

(b). All weapons will be carried at the "Raise Pistol" position.

(2) On the firing line:

(a). Procedure for firing: As outlined in pars 94e FM 23-35.

(b). Organization: As outlined in par 94a and d FM 23-35.

(c). Safety: For pistol cal .45 M1911 or 1911A1.

1. When units carrying the pistol are first formed the officer or noncommissioned officer in charge causes the men to execute "Inspection Pistol".

2. The safe firing position referred to in par 10a (2) (d) 2. "Safety precautions" will be considered to have been attained when the weapon is unloaded, the magazine has been removed and the slide has been locked in the rearmost position with the slide stop.

3. Execute unload every time the pistol is picked up for any purpose. Never trust memory. Consider every pistol as loaded until it has been proven otherwise.

4. Always unload the pistol if it is to be left where someone else may handle it.

5. Always point the pistol up when snapping it after examination. Keep the hammer fully down when the pistol is not loaded.

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6. Never place the finger within the trigger guard until it is intended to fire or to snap for practice.

7. Never point the pistol at anyone.

8. Before loading the pistol, draw back the slide and look through the bore to see that it is free from obstruction.

9. On the range, do not insert a loaded magazine until the time for firing.

10. Never turn around at the firing point.

11. On the range, do not load the pistol with a cartridge in the chamber until immediate use is anticipated. If there is any delay, lock the pistol and only unlock it while extending the arm to fire. Do not lower the hammer on a loaded cartridge; the pistol is much safer cocked and locked.

12. In reducing a jam first remove the magazine.

13. To remove a cartridge not fired first remove the magazine and then extract the cartridge from the chamber by drawing back the slide.

For Revolver Cal..45:

14. The safe firing position referred to in par 10 a (2) (d) 2 "Safety precautions" will be considered to have been attained when the weapon is unloaded, the cylinder is opened and the safety has been placed in a safe position.

15. Execute unload every time the revolver is picked up for any purpose. Consider every revolver as loaded until proven otherwise.

16. Always unload the revolver if it is to be left where someone else may handle it.

17. Always point the revolver up when snapping it after examination. Keep the hammer fully down when the revolver is not loaded.

18. Never place the finger within the trigger guard until it is intended to fire or to snap for practice.

19. Never point the revolver at anyone. On the range do not snap for practice while standing back of the firing line.

20. Before loading, open the cylinder and look through the bore to see that it is free from obstruction.

21. Never turn around at the firing point.

23. On the range do not cock the revolver until immediate use is anticipated. If there is any delay, lower the hammer and recock it only when ready to fire.

24. If the revolver fails to fire, open the cylinder and unload if the hammer is down. If the hammer is cocked or partly cocked, a breakage has occurred. In this case hold the revolver at raise pistol and announce the fact to the officer in charge.

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25. To remove a cartridge not fired, open the cylinder and eject, first lowering the hammer if cocked.

(d) After Use of Range: The Officer in Charge of Firing will be responsible that all trash has been policed.

SECTION IX

ARTILLERY RANGE

37. Description:

a. Location: Gun Position (Center of Gun Position):

"A" - (1014.0-1211.3)
"B" - (1015.3-1214.8)
"C" - (1011.2-1210.4)

Impact Area (Center): (1019 - 1214)

b. Telephone Number: (Weir Tower) Tie Line 10.

c. Type Weapon Fired: 105mm and 155m Howitzer.

d. Safety Limits: See Annex #8.

e. Danger Area: See Annex #8.

f. Range Guard Positions: (See Annex #8)

For Impact Area: All road guards on the numbered road guard positions will prevent entry into the impact area.

When firing from gun position "A" the following additional guards will be posted in addition to impact area road guards: RG-A (1013.0-1210.0) allow only authorized traffic to proceed North along Telephone Road.

When firing from gun position "C" the following additional guard will be posted in addition to impact area road guards: RG-C (1011.2-1209.5) allow only authorized traffic to proceed North along Telephone Road.

When firing from gun position "B": Only impact area road guards will be posted.

38. Responsibilities of Officer in Charge of Firing:

a. Before Use of The Range: The Officer in Charge of Firing will be responsible that:

(1) Both he and his supervisory personnel are thoroughly familiar with Section I, Appendix I, FM 6-40 and FM 6-140, FM 6-75 (105mm Howitzer) FM 6-81 (155mm Howitzer) and AR 750-10.

(2) The following minimum number of personnel are designated:

1 Officer - Commanding Officer of Unit Firing.
1 Safety Officer at each Battery Position.
EM Range Guards as needed (See a.6. above).
1 EM Telephone Orderly.
2 EM First Aid Men.

(3) One (1) ambulance will be available during firing.

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(4) All firing personnel have completed training as outlined in FM 6-75 (for 105mm Howitzer) or FM 6-81 (for 155mm Howitzer).

(5) Post Range Guards (See Annex #8) at least thirty (30) minutes prior to scheduled firing time. Numbered range guards will be posted during all firing. Lettered range guards will be posted when corresponding lettered firing positions are being used.

(6) Instruct range guards as to their duties, i.e., allow no one to enter the impact area or gun position area without permission of the Range Officer or the Commanding Officer of unit firing.

(7) Raise the Red Flag, See Annex #8 , when range is clear for firing.

(8) Notify the Commanding Officer of unit firing when range is clear for firing.

(9) Entry into firing positions for the following gun positions will be as listed below;

"A" - From the South along Telephone Road.
"B" - From either of the following:

(a) From the North on the trail from Old Camden Road at coordinates (1015.4-1217.5).

(b) From the South on the Washington Light Infantry Road.

"C" - From the South along Hartsville Guards Road.

b. During Use of Range;

(1) The Officer in Charge of Firing will be in constant communication with the Observation Post (CO of Unit firing) and as near as practicable to his Range Guards.

(2) The Officer in Charge of Firing will be responsible that all safety requirements and precautions outlined in par 38 a (1) are complied with.

c. After Use of Range; The Officer in Charge of Firing will be responsible that;

(1) Range Guards are relieved.

(2) All trash has been policed.

(3) A certificate has been executed on all HE ammunition expended.

SECTION X

PISTOL RANGE "E"

39. Description;

a. Location; (1027.4-1212.5).

b. Telephone Number; Tie Line 14.

c. Number of Firing Points; 60.

d. Type Weapon Fired; Automatic Pistol Cal..45, M1911 or M1911A1, Colt Revolver, Cal..45, M1917.

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e. Courses to Be Fired: As prescribed in pars 87-90, FM 23-35.

f. Distances from Firing Points to Targets: 15 & 25 yards.

g. Safety Limits: See Annex #1.

h. Danger Area: See Annex #1.

i. Range Guard Positions: None.

j. Available Range Facilities:

Target House
Latrine
120 Pistol Rests

40. Responsibilities of Post Range Officer:

Same as outlined in par 35.

41. Responsibilities of Officer in Charge of Firing:

Same as outlined in par 36.

SECTION XI

MACHINE GUN RANGE #2

42. Description:

a. Location: (1009.1-1214.7).

b. Telephone Number: Tie Line 14, Ring 2.

c. Number of Firing Points: 60.

d. Type Weapon Fired: MG Cal..30, Light, M1919A4; MG Cal..30, Heavy, M1917A1.

e. Courses to be Fired: A or B (Modified to 500 inch Range).

f. Distance from Firing Point to Targets: 500 inches.

g. Safety Limits: (See Annex #1).

h. Danger Area: (See Annex #1).

i. Range Guard Positions: None.

j. Available Range Facilities:

(1) Control Tower.
(2) Covered Latrine.
(3) Dry Firing Line with 10 Targets.
(4) Mess Hall.
(5) Scoring and Critique Tables.
(6) Supply House.
(7) Target House.

k. Type Target: 500 inch Machine Gun.

43. Responsibilities of Post Range Officer: As outlined in par 13.

44. Responsibilities of Officer in Charge of Firing: As outlined in par 14.

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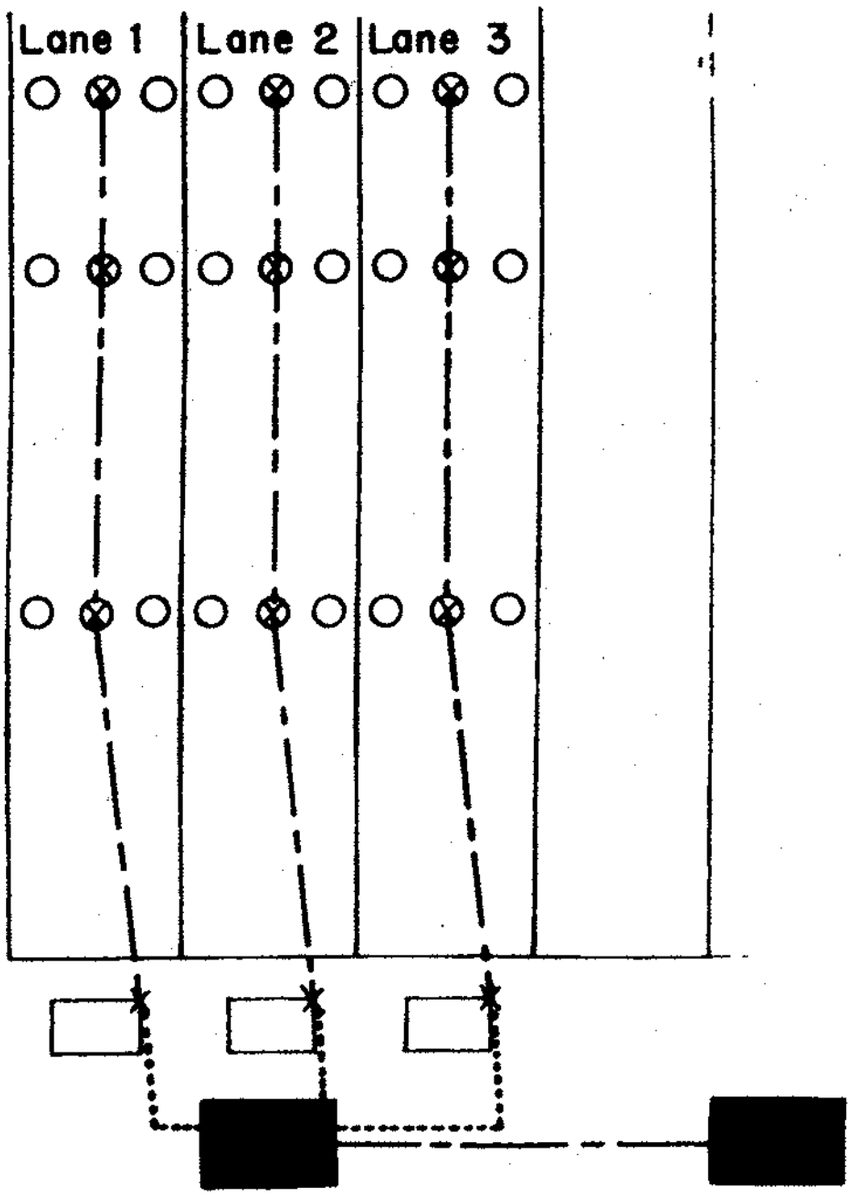

Schematic diagram of communication system for transition range.

-Legend-

X Terminals

—·— Cables

..... Field phone lines

O Pits

□ Firing points

■ Control towers

Annex 2

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ANNEX NO 5

US RIFLE CAL .30, M-1

INSTRUCTION PRACTICE

TABLE I - Slow Fire

Range (Yards)	TIME	SHOTS	TARGET	POSITION	SLING
200	No Limit	4	A	Prone (Sandbag Optional)	Loop
200	do	12	A	Prone	do
300	do	4	A	Prone (Sandbag Optional)	do
300	do	16	A	Prone	do
500	do	5	B	Prone (Sandbag Optional)	do

TABLE II - Slow Fire

Range (Yards)	TIME	SHOTS	TARGET	POSITION	SLING
200	No Limit	8	A	Sitting	Loop
200	do	8	A	Kneeling	do
200	do	8	A	Standing	Hasty
300	do	8	A	Sitting	Loop
300	do	8	A	Kneeling	do

TABLE III - Sustained Fire

Range (Yards)	TIME (Seconds)	SHOTS	TARGET	POSITION	SLING
200*	27	3#	D	Kneeling or sitting from standing	Loop
200	51	9@	D	Kneeling or Sitting from standing	do
300*	27	3#	D	Prone from standing	do
300	51	9@	D	Prone from standing	do

*Fire Twice

#The rifle is to be loaded with one round initially and reloaded with a full clip, only two rounds of which are to be fired.

@The rifle is to be loaded with one round initially and reloaded with a full clip.

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RECORD PRACTICE

TABLE IV - Slow Fire

Range (Yards)	Time	Shots	Target	Position	Sling
200	No Limit	6	A	Kneeling	Loop
200	do	6	A	Standing	Hasty
300	do	6	A	Prone	Loop
300	do	6	A	Sitting or squatting	do

TABLE V - Sustained Fire

Range (Yards)	Time (Seconds)	Shots	Target	Position	Sling
200	51	9*	D	Kneeling or Sitting from standing	Loop
300	51	9*	D	Prone from standing	do

*The rifle is to be loaded with one round initially and reloaded with a full clip.

Minimum Scores for Classification

Expert Rifleman - - - - - - - - - - - - - - 180
Sharpshooter - - - - - - - - - - - - - - - 165
Marksman - - - - - - - - - - - - - - - - - 140

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1950

Maj. O'Herrill
Ord. Adv.

File
Ar

FORT JACKSON 1950

RANGE REGULATIONS

FORT JACKSON
SOUTH CAROLINA

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By CB NARA Date 3-22-04

RG 337, Hq. Army Ground Forces
Entry 108 (U.D.)
AGF + AFF Installations
Box 34

HEADQUARTERS
Fort Jackson, South Carolina

GNJDT 300.8 15 April 1950

SUBJECT: Range Regulations

TO: See Distribution

RANGE REGULATIONS FORT JACKSON

1. These regulations will be treated as Memorandum Receipt property and will be turned in to Post Range Officer prior to the units departure from this Post. The Post Range Officer is designated as accountable officer for these regulations and is charged with distribution to units using the range facilities at this Post. Individual sections will not be removed from these regulations; the book will be maintained as bound.

2. In case of revision, each newly revised page will indicate, at the top, the page that it rescinds. Such changes will be posted and the old copies removed from the files.

3. All officers will familiarize themselves with all pertinent sections of these regulations prior to conducting range firing on any range.

4. Unit commanders are responsible that all range firing is conducted in compliance with the instructions set forth herein.

BY ORDER OF COLONEL REES:

F. J. REESE
Lt Col, AGD
Adjutant

Distribution:
1 Hq Third Army
6 Post Hq, Ft Jackson, SC
10 S-3, Fort Jackson, SC
100 Range Hq, Ft Jackson, SC
1 Post Engineer, Ft Jackson, SC
1 Post Signal Officer, Ft Jackson, SC
1 Post Property Officer, Ft Jackson, SC
1 S. C. Military District
5 51st N. G. Inf Div
5 48th N.G. Inf Div
5 30th N.G. Inf Div
2 S.C. Air N.G., Congaree Air Base, S. C.
2 Shaw Field, S.C.

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HEADQUARTERS
Fort Jackson, South Carolina

15 April 1950

FORT JACKSON RANGE REGULATIONS

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a. All personnel of the company are notified of the Fire Alert status of the company.

b. All personnel (less not more than 15%) are immediately available to the company area at all times during the Fire Alert tour.

c. Not less than one (1) officer and four (4) non-commissioned officers are available on thirty (30) minutes notice for supervision in case of fire.

8. Instructions in case of fire:

a. In the event of a fire on the Fort Jackson reservation the Fire Alert Company will be alerted by the Fire Marshal. At the time of alerting, the Fire Marshal will furnish information to the Fire Alert Company as to the transportation being furnished to the Company.

b. The First Sergeant, (or the Charge of Quarters if after duty hours) will notify, by the most expeditious means, the Alert Officer and Non-commissioned Officers of the Alert, and will then proceed to form the company in readiness to move to the fire.

c. The Alert Officer, upon arrival in the company area will assume command of the company, and will hold the company in readiness pending instructions from the Fire Marshal. Troops will be issued any fire fighting equipment available in the company area such as picks, shovels, etc. Personnel will again be cautioned on the dangers of handling duds.

d. Once alerted and until released from alert, by the Fire Marshal, the Fire Alert Company will be under direct control of the Post Fire Marshal. The Post Fire Marshal will be responsible for the movement, and employment of this company in combating the fire.

e. At all times during the actual fighting of the fire, the Alert Officer and Non-commissioned Officers will be in the immediate vicinity of the men fighting the fire, and will exercise close supervision to prevent touching of duds by personnel.

SECTION III

AMMUNITION, EXPLOSIVES AND DUDS

9. Members of any command quartered in company or detachment areas will not have ammunition, grenades, shells, fuses, or any other explosive, live or otherwise, of any type, in their possession or secreted on the reservation. Such items may be in the possession of military personnel only when required in the performance of military duty. Unit Commanders will make frequent searches to insure compliance with the preceding regulation and will cause a search to be made of all EM after any use of ammunition or explosives.

10. Any enlisted man at this station who discovers the unauthorized presence of explosives referred to above will immediately report such to the unit commander. No one will molest, touch, or in any manner handle such explosives whenever found except as follows:

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a. When required in performance of military duty.

b. When small arms ammunition (caliber .22, .30, .45, and .50) is discovered, the finder will collect and carry same openly to unit commander for disposition.

11. No one will procure, secure or retain in their possession any explosive, dud of any type or any part thereof as a souvenir of for their own personal use, unless specifically authorized in writing by a commissioned officer to have such items.

12. Duds:

a. It is the responsibility of all unit commanders to orient their troops in the danger of handling duds. Specifically:

(1) Teach men the importance of leaving DUDS ALONE.

(2) "Policing the Area" does NOT mean picking up duds.

(3) HE impact areas are OFF LIMITS except as outlined in (4) and (5) below.

(4) The Officer-in-charge of firing will be responsible for appointing experienced non-commissioned officers from within his own unit to check the impact area for all duds upon completion of firing. The non-commissioned officers so appointed will be the sole persons from the firing unit authorized to enter the impact area from the time the firing unit has fired its first live round until it has been cleared by Range Headquarters.

(5) For Weapons Demonstration Range: The only authorized personnel to enter the impact area are demonstrators and non-commissioned officers appointed by Officer-in-charge of firing as in (4) above.

b. In the event a dud is found, the site will be marked and the Range Officer, Fort Jackson will be notified as follows:

(1) Location of Dud (coordinates if possible)

(2) Type of Dud

(3) Number of Duds

(4) Person making report (Name, rank and organization)

c. All ranges and impact areas will be "Off Limits" to all unauthorized personnel, ie., any personnel not firing on the range or not a member of the permanent Range Detachment.

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b. On-the-spot Maintenance: The Post Range Officer will be responsible for continuous maintenance, during firing, of target frames, target devices and communication lines.

17. After Use of Range by Using Units:

a. Final Clearance: The Post Range Officer will be responsible for issuance of a written clearance of the range upon request by the using unit. Prior to the issuance of this clearance, he will determine by inspection that:

(1) The range proper is in an acceptable state of police.

(2) The condition of range facilities is the same as when accepted by the using unit.

(3) All expendable and non-expendable range supplies and equipment are turned in by the using unit.

(4) The using unit has extinguished all range fires and has disposed of any known duds.

b. Necessary Repair: The Post Range Officer will be responsible for making all necessary repairs. He will be responsible for making the necessary work order requests to the Post Engineer or Post Signal Officer for repairs of such a nature as to require their aid.

SECTION III

Responsibilities of Officer-in-Charge of Firing

18. Before Using Range:

a. The Officer-in-Charge of firing will be responsible for the operation of ranges in compliance with pertinent provisions of:

SR 385-310-1
Pertinent Technical Manuals and Field Manuals
Chapter III below

He will also be responsible for the dissemination of the information contained in the pertinent provisions of the above references for all supervisory personnel.

b. The Officer-in-charge of firing will be responsible for notifying the Post Range Officer if, for any reason, firing is cancelled.

c. Safety Precautions: The Officer-in-charge of firing will be responsible that all personnel on the range have received a course of instruction in the weapon(s) to be fired and that they are familiar with:

(1) The safety features of the weapon(s) to be fired.

(2) The danger areas and safety limits.

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(2) On the Firing Line:

(a) The organization of personnel on the firing line will be so arranged as to adapt the using unit to the course to be fired.

(b) The organization of personnel on the firing line will be so arranged as to make the most efficient use of the time allotted.

(c) An officer will be present on the firing line at all times.

(d) Safety precautions will be followed at all times, including the following:

1. Weapons will be pointed "down range".

2. Weapons will be cleared and placed in the "safe" firing position when not in operation.

3. "Cease firing" will be given at any time when a condition arises which in anyway precludes the continuation of safe firing.

4. Firing, limited to designated firing lines or areas and between designated limiting points, will be observed at all times.

5. No one will move from the firing line in the direction of the impact area until all weapons have been cleared and placed in the "safe" firing position and then not until order to do so has been given by the Officer-in-charge of the firing line.

6. No firing will be conducted when the scarlet streamer is not displayed on the range pole.

7. In case of an accident, such as the bursting of a barrel, or permanent damage to the weapon, the weapon will be left in the position in which the accident occurred and the Ordnance Officer, Fort Jackson, notified.

8. If any serious malfunction of Ordnance equipment occurs on the range, such equipment will be turned over promptly to the Ordnance Officer without effort to repair it.

(3) Pits (where applicable):

(a) Organization:

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(5) Miscellaneous: All immediate repairs necessary will be reported to the Range Officer for action.

20. After Use of Range: The Officer-in-charge of firing will be responsible, upon completion of firing to:

a. Check for all range fires detected on the range, using the same procedure as in par 8 and 19 a (4) above, in the event one is discovered.

b. Check for, and report duds (where applicable) as follows:

(1) Appoint a limited number of responsible, experienced, non-commissioned officers to conduct a search for duds.

(2) Leave the suspected dud undisturbed.

(3) Mark the location by a dud marker (Note: Dud markers, 10" red discs with DUD marked in white letters, placed on 8 foot pole, are located in all target houses).

(4) Report the exact location by coordinates to the Post Range Officer. If Post Range Officer indicates that he will investigate immediately, leave someone nearby to guide him to the exact location.

c. Police the entire range site for trash and brass.

d. Conduct a search of all personnel for live ammunition.

e. Turn in all supplies, drawn specifically for range firing, to same agencies drawn from (See par 9 c, above).

f. Execute the following certificate (issued with all ammunition) for all HE ammunition expended:

C E R T I F I C A T E

(Battery_____, _____, Field Artillery Bn)

(Company_____, _____, Infantry)

_____
(Date)

I certify that the following information, concerning quantities of ammunition listed below, is true and correct to the best of my knowledge and belief:

TYPE	ISSUED	EXPENDED	TURNED IN	DUDS	LOCATION OF DUDS

_____
(Signature)

_____
(Name Typed)

_____
(Rank and Organization)

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10. Sand bag walls at least 20 inches thick or equivalent protection are provided for coaches, officer-in-charge of throwing, assistant instructors, or nonparticipants in instruction.

11. Practice hand grenades are practically free from hazard when properly used but they require the same degree of care in handling and operation as the standard live grenades.

12. The practice grenade may be thrown a safe distance by the average thrower, but personnel should take cover for the purpose of training. The steel helmet should be worn. Although there is practically no danger involved, personnel should remain at a safe distance.

13. Practice grenades that fail to function (duds) will not be recovered until at least 10 minutes have elapsed, and should be handled by experienced personnel.

c. After Use of the Range:

(1) Execute certificate for all HE Ammunition expended (See par 20 f) for example of certificate.

(2) Police all trash, dummy grenades, and all component parts of practice grenades.

d. Dummy Grenade Court: Dummy grenade court will be used to familiarize men with the throwing positions.

e. Rear Area Training Area: Rear Area training area is to be used for instruction in nomenclature and characteristics of grenades only. No demonstrations in throwing practice or live grenades will be conducted in this rear training area.

SECTION II

PISTOL RANGE # 1 AND PISTOL RANGE "E"

24. Description:

a. Location:

Pistol Range # 1 - (1008.8 - 1214.9)
Pistol Range "E" - (1027.4 - 1212.5)

b. Telephone Number:

Pistol Range # 1 - Tie Line 14, Ring 3
Pistol Range "E" - None

c. Number of Firing Points:

Pistol Range # 1 - 20. See Annex # 7
Pistol Range "E" - 60. See Annex # 8

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d. Type Weapon Fired: Automatic pistol, Cal. .45 M1911 or M1911A1
Colt Revolver, Cal. .45 M1917

e. Courses to be Fired: As prescribed in pars 87-90, FM 23-25

f. Distance from firing line to targets:

Pistol Range # 1 - 15, 25 & 50 yards
Pistol Range "E" - 15 & 25 yards

g. Safety Limits: See Annex # 1

h. Danger Area: See Annex # 1

i. Range guard positions: None

j. Available Range facilities:

Pistol Range # 1 - Target House
Latrine (to be used in conjunction with latrine on MG Range # 2).
Pistol Rests

Pistol Range "E" - Target House
Latrine
120 Pistol Rests

25. Responsibilities of Post Range Officer:

a. Continuous responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in 24j above.

b. Before use of range by using unit: The Post Range Officer is responsible for supplying using units with sufficient number of E&L type targets.

26. Responsibilities of Officer-in-charge of firing:

a. Before use of range: The Officer-in-charge of firing will be responsible that:

(1) Both he and his supervisory personnel are thoroughly familiar with pars 13, 24, 25, 91, 96 FM 23-35, SR 385-310-1, and par 1-20 of these range regulations.

(2) All firers have completed as a minimum requirement all mechanical training and marksmanship training listed in FM 23-35.

(3) All pistols have had safety devices tested per par 25 FM 23-35.

(4) All revolvers have had safety devices tested per par 64 FM 23-35.

b. During use of range:

(1) Behind the firing line (opposite side of firing line from impact areas).

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(a) Only weapons that have been unloaded, locked and cleared by the officer-in-charge of firing, will be permitted to be removed from the firing line.

(b) All weapons will be carried at the "Raise Pistol" position.

(2) On the firing line:

(a) Procedure for firing: As outlined par 94 e, FM 23-35.

(b) Organization: As outlined in par 94 a and d, FM 23-35.

(c) Safety: For pistol and revolver.

1. Execute unload every time the pistol or revolver is picked up for any purpose. Consider every revolver as loaded until proven otherwise.

2. Always unload the pistol or revolver if it is to be left where someone else may handle it.

3. Always point the pistol or revolver up when snapping it after examination. Keep the hammer fully down when the weapon is not loaded.

4. Never place the finger within the trigger guard until it is intended to fire or to snap for practice.

5. Never turn around at the firing point while you hold a pistol or revolver in your hand.

6. Never point the revolver or pistol at anyone. On the range do not snap for practice while standing back of the firing line.

For Pistol Cal. .45 M1911 or 1911A1 only

7. When units carrying the pistol are first formed, the officer or non-commissioned officer-in-charge causes the men to execute "Inspection Pistol".

8. The safe firing position referred to in par 19 a (2) (d) 2 "Safety precautions" will be considered to have been attained when the weapon is unloaded, the magazine has been removed and the slide has been locked in the [illegible] position with the slide stop.

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9. Before loading the pistol, draw back the slide and look through the bore to see that it is free from obstruction.

10. On the range do not insert a loaded magazine until the time for firing.

11. On the range do not load the pistol with a cartridge in the chamber until immediate use is anticipated. If there is any delay, lock the pistol and unlock it only while extending the arm to fire. Do not lower the hammer on a loaded cartridge; the pistol is much safer cocked and locked.

12. In reducing a jam, first remove the magazine.

13. To remove a cartridge not fired, first remove the magazine and then extract the cartridge from the chamber by drawing back the slide.

For Revolver Cal. .45

14. The safe firing position referred to in par 19 a (2) (d) 2 "Safety precautions" will be considered to have been attained when the weapon is unloaded, the cylinder is opened and the safety has been placed in a safe position.

15. Before loading, open the cylinder and look through the bore to see that it is free from obstruction.

16. On the range do not cock the revolver until immediate use is anticipated. If there is any delay, lower the hammer and recock it only when ready to fire.

17. If the revolver fails to fire, open the cylinder and unload if the hammer is down. If the hammer is cocked or partly cocked, a breakage has occurred. In this case hold the revolver at "Raise Pistol" and announce the fact to the officer-in-charge.

18. To remove a cartridge not fired, open the cylinder and eject, first lowering the hammer if cocked.

(d) After Use of Range: The Officer-in-charge of firing will be responsible that all trash has been policed and burned and that all brass has been collected and disposed of in accordance with par 108, AR 775-10.

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SECTION III

DISMOUNTED SUB-MACHINE GUN RANGE # 1

27. Description:

a. Location: (1017.4 - 1212.2) See Annex # 1.

b. Telephone Numbers: Tie Line 10 Ring 2.

c. Number of Firing Points: 3 (See Annex # 19).

d. Type Weapon Fired: Sub-Machine Gun M3A1 Cal. .45, Thompson Sub-Machine Gun Cal. .45 M1928A1

e. Course to be fired on range: See par 53-57 FM 23-40 and FM 23-41.

f. Safety Limits: See Annex # 1.

g. Danger Area: See Annex # 1.

h. Range Guard Positions:

(1) Position: Guard at junction of Timmonsville Guard Road and Range Road. Coordinates (1018.2 - 1211.4).

Instructions: Allow no travel to proceed North on Timmonsville Guard Road into impact area.

(2) Position: Guard at Weston Pond Road and Hwy # 262. Coordinates (1015.7 - 1210.4).

Instructions: To allow no traffic to proceed North on Weston Pond Road from Hwy # 262.

(3) Position: Guard at junction of Washington Light Infantry Road and Hwy # 262. Coordinates (1015.3 - 1210.4).

Instructions: To allow no traffic to proceed North on Washington Light Infantry Road from Hwy # 262.

i. Available Range Facilities:

(1) Covered Latrine

(2) 3 Target Houses

(3) Target frames, target assemblies and levers.

j. Type Target: E, F and Trapezoid.

28. Responsibilities of Post Range Officer:

a. Continuous responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in par 27 i, above.

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b. Before Use of Range by Using Unit: The Post Range Officer is responsible for supplying using units with targets listed in paragraph 27 j above, target frames and paste.

29. Responsibilities of Officer-in-charge of firing:

a. Before Use of Range: The Officer-in-charge of firing will be responsible that:

(1) Both he and his supervisory personnel are thoroughly familiar with par 53-57, FM 23-40, FM 23-41, SR 385-310-1 and par 1-20 of these range regulations.

(2) All firers have completed, as a minimum requirement, all mechanical training, gun drill and marksmanship required by FM 23-40 and FM 23-41.

(3) Prior to Firing:

(a) An officer will check each gun and make sure that each weapon is functioning properly.

(b) A cleaning rod and dry patch is run through the bore of each gun.

b. During Use of the Range:

(1) Operation of the Range:

(a) Behind the firing line (Opposite side of firing line from impact area): The Officer-in-charge of firing will be responsible that before removing a sub-machine gun from the firing points, or from the firing line, each gun will be inspected, by an officer to see that it is unloaded. As part of this inspection, a cleaning rod will be passed through the bore of each gun.

(b) On the Firing line:

1. Safety Precautions: The Officer-in-charge of firing will be responsible for the accomplishment of the following safety precautions: Note: The "Safe firing position" referred to in par 19 (2) (d) 2 "Safety Precautions" will be considered to have been attained for the sub-machine gun when:

a. The bolt has been opened.

b. A cleaning rod has been passed through the barrel.

(c) All decisions as to actions to be taken on stoppages will be made by an officer.

c. After Use of Range: The Officer-in-charge of firing will be responsible that all trash accumulated in the trash bin is burned in the metal receptacles provided for that purpose, that proper disposition has been made of all brass and that the targets have been prepared for use by the next unit.

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SECTION IV

Machine Gun Range # 1 and # 2

30. Description:

a. Location:

Range # 1 - (1008.1 - 1215.1). See Annex # 1
Range # 2 - (1009.1 - 1214.7).

b. Telephone Number:

Range # 1 - Tie Line 14, Ring 1.
Range # 2 - Tie Line 14, Ring 2.

c. Number of Firing Points:

Range # 1 - 60. See Annex # 5.
Range # 2 - 60. See Annex # 6.

d. Type Weapon Fired: Machine Gun Cal. .30, Light (M1919A4)
Machine Gun Cal. .30, Heavy (1917A1)

e. Course to be Fired: A or B.

f. Distance from gun position to target: 500 and 1000 inches.

g. Safety Limits: See Annex # 1.

h. Danger Area: See Annex # 1.

i. Range Guard Positions: None necessary.

j. Available Range Facilities:

(1) Control Tower
(2) Covered Latrine
(3) Dry Firing Line with 60 Targets
(4) Mess Hall
(5) Scoring and Critique Tables
(6) Supply House
(7) Target House

k. Type Target: 500 or 1000 inch Machine Gun.

31. Responsibilities of Post Range Officer:

a. Continuous Responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in par 30 j, above.

b. Before Use of Range by Using Unit: The Post Range Officer is responsible for supplying using units with 500 and 1000 inch Machine Gun targets and target frames.

32. Responsibilities of Officer-in-charge of firing:

a. Before Use of Range: The Officer-in-charge of firing will be responsible that:

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(1) Both he and his supervisory personnel are thoroughly familiar with pars 110-122, FM 23-55, SR 385-310-1 and par 1-20 of these range regulations.

(2) All firers have completed, as a minimum requirement, all mechanical training, gun drill and marksmanship required by FM 23-55.

(3) Prior to Firing:

(a) An officer will check headspace of each gun and make the proper adjustment.

(b) A cleaning rod and dry patch is run through the bore of each gun.

b. During Use of the Range:

(1) Operation of the Range:

(a) Behind the firing line (Opposite side of firing line from impact area): The Officer-in-charge of firing will be responsible that before removing a machine gun from its firing position, or from the firing line, each gun will be inspected, by an officer to see that it is unloaded. As part of this inspection, a cleaning rod will be passed through the bore of each gun.

(b) On the Firing Line:

1. The most efficient organization, for this range consists of a breakdown into 5 equal sized orders as outline below.

1 Order Gunner	Wet Line
1 Order Asst Gunner	Wet Line
1 Order Observer	Wet Line
1 Order Gunner	Dry Line
1 Order Asst Gunner	Dry Line

2. Safety Precautions: The Officer-in-charge of firing will be responsible for the accomplishment of the following safety precautions: Note: The "Safe firing position" referred to in par 19 a (2) (d) 2 "Safety Precautions" will be considered to have been attained for the machine gun when:

a. A cleaning rod has been passed through the bore.

b. A clearing block has been placed in the receiver of the gun.

(c) A clearing block should be inserted in the receiver of each gun during the time it is not being used to fire.

(d) All decisions as to actions to be taken on stoppages will be made by an officer.

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c. After Use of Range: The Officer-in-charge of firing will be responsible that all trash accumulated in the trash bin is burned in the metal receptacles provided for that purpose and that all brass has been collected and disposed of in accordance with par 108, AR 775-10.

SECTION V

.50 CAL. MACHINE GUN 1000" RANGE

33. Description:

a. Location: Center of Firing Line (1029.7 - 1216.3)

b. Telephone Number: TL 18 R 3

c. Number of Firing Points: 12

d. Type of Weapon: .50 Cal. Machine Gun, ground or vehicle mount

e. Safety Limits: See Annex # 1

f. Danger Areas: See Annex # 1

g. Range Guard Position:

(1) Position: Guard at junction of Pilgrim Church Road and Range Road. Coordinates (1029.7 - 1216.4)

(2) Instructions: To allow no traffic to proceed West on Pilgrim Church Road from Range Road

h. Available Range Facilities:

Target frames

34. Responsibilities of Post Range Officer:

a. Continuous Responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in par 33 h, above.

b. Before use of Range by Using Unit: The Post Range Officer is responsible for supplying using units with targets, target frames, and paste.

35. Responsibilities of Officer-in-charge of firing:

a. Before Use of Range: The Officer-in-charge of firing will be responsible that:

(1) Both he and his supervisory personnel are thoroughly familiar with safety regulations for weapon being fired, SR 385-310-1 and par 1-20 of these range regulations.

(2) All firers have completed, as a minimum requirement, all mechanical training, gun drill and marksmanship, required by FM 23-65.

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(2) On the firing line:

(a) Procedure for firing:

Rifle - as outlined in FM 23-5.
Carbine - as outlined in FM 23-7.
BAR - as outlined in FM 23-15.

(b) Organization of the firing line:

Rifle - as outlined in FM 23-5.
Carbine - as outlined in FM 23-7.
BAR - as outlined in FM 23-15.

(c) Safety:

1. The "Safe Firing Position" referred to in par 19 a (2) (d) 2 "Safety Precautions" will be considered to have been attained when:

Weapon is locked.
Ammunition is completely removed from the weapon.
Bolt is open.
A cleaning rod has been run through the bore of the weapon.

2. Weapons will be checked daily by an officer prior to firing to determine that chambers and bores are free from obstruction.

(d) Communication: Control of the pits will be maintained by telephone communication from the firing line.

All request for marking and disking targets will be transmitted via telephone.

(3) Pits:

(a) Personnel in the pit details will stay on the concrete walk between the target frames and the revetment at all times when firing is in progress.

c. After Use of the Range:

(1) Brass will be policed daily after the use of the range.

(2) All trash accumulated will be policed daily.

SECTION VII

RIFLE TRANSITION RANGE # 1

39. Description:

a. Location (1008.7 - 1212.3)

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b. Telephone Number - Tie Line 11.

c. Number of firing lanes: 15.

6 lanes (1 through 6) - Table VI.
4 lanes (7 through 10) - Table VII.
1 lane (11) - Table VIII.
4 lanes (12 through 15) - Table IX.

d. Course to be fired:

Table VI and VII - Par 69d FM 23-5
Table VIII - Par 69d FM 23-5, C2
Table IX - as follows:

PHASE LINES	TARGETS SINGLE	DOUBLE	TRIPLE	RANGE YARDS	SHOTS	TARGET	POSITION	SLING
2 - 3	2	1	0	5-70	4	E	Off Hand	None
3 - 4	0	1	2	5-70	8	E	Hip	None
4 - Final	2	3	0	5-70	8	E	Off Hand	None

(1) A single silhouette represents an enemy rifleman. A double silhouette represents an enemy automatic rifle team.
A triple silhouette represents a machine gun.

(2) Targets will be exposed in sequence upon signal from the coach. Time of exposure of targets is as follows: (a) Single silhouettes, 3 seconds. (b) Double silhouettes, 4 seconds. (c) Triple silhouettes, 5 seconds.

(3) Phase lines are placed after the 4th, 12th and 20th targets to assist in the enforcement of safety precautions.

e. Scoring and satisfactory scores:

TABLE	SCORING PROCEDURE	SATISFACTORY SCORES
Table VI & VII	Par 69e, (1) & (2), FM 23-5	VI not applicable VII - 8
Table VIII	Par 69e (3), FM 23-5 C2	1 - 4
Table IX	For each target hit - 1 Pt	8

f. Type of weapon fired: Rifle Cal. .30, M1.

g. Distance from firing position to target:

Table VI - 200, 300, and 500 yards.
Table VII - 250, 300, 350, 400, 450 and 500 yards.
Table VIII - 100 yards.

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h. Safety Limits: See Annex # 1

i. Danger Areas: See Annex # 1

j. Range Guard Positions:

(1) # 1 - Junction Ancrum Ferry Road and Hartsville Guard Road (1009.1 - 1213.4)

(a) Instructions:

1. Allow no one to enter Hartsville Guard Road.

2. Instruct all personnel travelling on Ancrum Ferry Road not to turn South between Range Road and Telephone Road.

(2) # 2 - Junction Ancrum Ferry Road and Telephone Road (1013.1 - 1214.3)

(a) Instructions:

1. Instruct personnel travelling on Telephone Road not to turn West between Ancrum Ferry Road and Hwy 262.

2. Instruct all personnel travelling on Ancrum Ferry Road not to turn South between Range Road and Telephone Road.

(3) # 3 - Junction Telephone Road and Hwy 262 (1013.3 - 1210.1)

(a) Instructions:

1. Instruct personnel travelling on Telephone Road not to turn West between Hwy 262 and Ancrum Ferry Road.

(4) # 4 - Junction Catawba Rifles and Range Road (1008.6 - 1211.7)

(a) Instructions:

1. Instruct personnel travelling on Range Road not to turn East between Catawba Rifles Road and Ancrum Ferry Road.

2. Allow no one to enter Catawba Rifles Road.

(5) # 5 - Junction Ancrum Ferry Road and Range Road (1008.3 - 1213.2)

(a) Instructions:

1. Instruct personnel travelling on Range Road not to turn East between Ancrum Ferry and Semmes Roads.

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(6) # 6 - Junction Semmes Road and Range Road (1008.6 - 1211.2)

(a) Instructions:

1. Instruct personnel travelling on Semmes Road not to turn North between Range Road and Telephone Road.

2. Instruct personnel travelling on Range Road not to turn East between Semmes Road and Anerum Ferry Road.

(7) # 7 - Junction Semmes Road and Hartsville Guard Road (1011.2 - 1209.3)

(a) Instructions:

1. Instruct personnel travelling on Semmes Road and Hwy 262 not to turn North between Range Road and Telephone Road, except that personnel may travel on Hartsville Guard Road not further than 1500 yards North of Hwy 262.

k. Available range facilities:

(1) 7 Control Towers
(2) 1 Latrine
(3) 1 Set of Bleachers
(4) 2 Target Houses
(5) Work Tables
(6) Mess Area
(7) Communication Arrangement (See Annex # 21).
(8) Table Model of Range

40. Responsibilities of Post Range Officer:

a. Continuous Responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in k (above).

b. Before Use of Range by Using Unit: The Post Range Officer is responsible for supplying using units with a sufficient number of type "E" Silhouettes, including those colored Red for 500 yard firing, and a sufficient number of target staves for the entire period of firing.

41. Responsibilities of Post Signal Officer:

a. Before Use of Range by Using Unit: The Post Range Officer will be responsible for instructing the Unit Range Officer in the use of permanent type telephone system. On request from the Post Range Officer, the Post Signal Officer will make the necessary repairs to these facilities.

42. Responsibilities of Officer-in-Charge of Firing:

a. Before Use of Range: The Officer-in-Charge of firing will be responsible that:

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(1) Both he and supervisory personnel are thoroughly familiar with pars 34, 69d, e, f, g, 189-191b FM 23-5, C1 and 2, and SR 385-310-1 and Annex # 24 as well as par 1-20 of these range regulations.

(2) All firers have fired the rifle qualification Course "B" and have received instruction in range estimation, assuming firing position and assault fire required by Annex 24.

(3) One day prior to firing the Unit Range Officer makes a check of the range facilities, supplies and communications to insure that the range is in proper condition for firing. Any deficiencies will be reported to the Post Range Officer promptly so that repairs can be made prior to firing.

(4) Range Guards are posted in psoitions listed in 39 j above.

(5) When pits are filled with water, they are bailed out prior to firing and that every third pit has a bucket available for any subsequent seepage into the pits.

(6) The pit details are familiarized with their duties and have at least one "dry run" prior to actual firing.

b. During Use of Range: The Officer-in-charge of firing will be responsible for the overall operation of the range to include:

(1) Behind the firing Line (Opposite side of firing line from impact area).

(a) Only weapons that have been unloaded, locked, and cleared by an officer will be permitted to be removed from any firing point or firing line.

(b) Movement in rear of firing points by personnel undergoing this course will be at a walk with rifles held at "Port Arms".

(c) Any minor repairs on table model targets and table 9 will be done by using unit.

(2) On the Firing Line:

(a) Procedure for firing: As outlined in Annex 24.

(b) Organization of firing line: As outlined in Annex 24.

(c) Safety:

1. The safe firing position referred to in par 19 a (2) (d) 2, "Safety precautions" will be considered to have been attained when:

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a. Rifle is locked.

b. Ammunition completely removed from rifle.

c. Bolt is open.

d. A cleaning rod has been run through the bore of the rifle.

2. Safety Precautions: For Table IX.
The firer will be instructed prior to firing that targets are not more than 3 feet in size, targets will be on same level as ground, targets to front, right or left front only.
The Coach Cadreman will;
Stay immediately in rear of firer.
Regulate speed of movement of firer.
Keep target operation well in rear of firer.
Determine that firer's weapon is unloaded and bolt is open before moving back to starting point.

(d) Communication: The firing point on each firing lane will maintain contact with the pits in its own lane by the use of field telephones.

(3) Pits:

(a) Organization: Pit details subsequent to the first order will be thoroughly instructed in their duties and in safety precautions to be observed while operating the pits.

(b) Communication: Each lane within each of the 4 tables will have its own integral communication met by which control will be exercised. as follows;

TABLE VI: The centerpit at each of the three ranges (200,300,500 yds) will have a terminal for telephone communication to the firing point.
Communication between any of the three pits located at one of the three ranges may be established by use of whistles signals.
Suggested signals are as follows:
"Attention" 4 short blasts
"Targets Up" 1 long blast
"Targets Down" 2 long blasts
"All Clear" 2 short blasts

TABLE VII: Each pit at each of the six different ranges (200,250, 300, 350, 400 & 450 yds) will have a terminal for telephone communications to the firing point.

TABLE VIII: The pit will have a terminal for telephone communication to the firing point.

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(c) Red silhouette targets used at 500 yds will be scored and pasted on the backside so as to not deface the red front.

(d) Scoring: Scoring will be accomplished by pit detail as follows.

TABLE VI: Flutter and lower target when hit, then score.
TABLE VII: Same as above.
TABLE VIII: Score after command "Targets Down" is given.
TABLE IX: Not applicable (see par 39 d & e, for scoring).

(e) Safety: See par 19 (2) (d) 2 "Safety".

c. After Use of Range: The Officer-in-Charge of firing will be responsible:

(1) That all trash accumulated in trash bins is burned.

(2) That new targets are fastened on all staves and then stored in target house for the use of the next unit.

SECTION VIII

RIFLE AND CARBINE TRANSITION RANGE # 1 AND # 2

43. Description:

a. Location:

(1) Range # 1 (1029.8 - 1216.6)
(2) Range # 2 (1028.2 - 1218.8)

b. Telephone Numbers:

(1) Range # 1 - TI 21 R1
(2) Range # 2 - TI 21 R2

c. Number of firing lanes:

(1) Range # 1: 10

6 lanes (1 thru 6) Table 6 - M-1
Table 4 - Carbine
4 lanes (7 thru 10) Table 7 - M-1
Table 5 - Carbine

(2) Range # 2: 6

4 lanes (1 thru 4) Table 6 - M-1
Table 4 - Carbine
2 lanes (5 thru 6) Table 7 - M-1
Table 4 - Carbine

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(5) Red flag is taken down upon completion of firing.

(6) All trash around gun position is policed upon completion of firing.

SECTION XIII

4.2 MORTAR RANGE # 1 AND # 2

57. Description:

a. Location:

(1) Range # 1 - Firing line coordinates (1009.4 - 1214.1) to (1009.3 - 1214.3)

(2) Range # 2 - Firing line coordinates (1022.45 - 1218.45) to (1022.20 - 1218.75)

(3) Impact Area - (See Annex # 1)

b. Telephone Number:

(1) Range # 1 - Tie line 14, Ring 4

(2) Range # 2 - None

c. Type of Weapon: 4.2" Chemical Mortar. (See FM 23-92 and TC 3 DA 28 Feb 50)

d. Maximum Range:

(1) Range # 1 - No weapon will be fired at a range greater than 1800 yards.

(2) Range # 2 - No weapon will be fired at a range greater than 2000 yards.

e. Targets: Natural terrain features. Drums and 6' x 6' target frames may be put out.

f. Observation Position:

(1) 4.2" Mortar Range # 1 - Control tower above firine line.

(2) 4.2" Mortar Range # 2 - Bunker # 17, coordinates (1022.4 - 1218.9).

g. Available facilities for 4.2" Mortar Range # 1:

Control tower
Stands capable of seating approx 1200
Latrine
Two target houses

h. Safety Limits: (See Annex # 1)

i. Danger Areas: (See Annex # 1)

j. Range Guard Positions:

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(1) 4.2" Mortar Range # 1: -

(a) # 1 - Junction Ancrum Ferry Road and Range Road (1009.1 - 1213.3).

1. Instructions:

a. Instruct personnel travelling on Ancrum Ferry Road not to turn North between Range Road and Telephone Road.

b. Instruct personnel travelling on Range Road not to turn East between Ancrum Ferry and Camden Roads.

(b) # 2 - Junction Ancrum Ferry and Telephone Roads (1013.1 - 1214.3).

1. Instructions:

a. Instruct personnel travelling on Ancrum Ferry Road not to turn North between Telephone Road and Range Road.

b. Instruct personnel travelling on Telephone Road not to turn West between Ancrum Ferry and Old Camden Roads.

(c) # 3 - Junction Old Camden Road and Telephone Road (1014.5 - 1217.5).

1. Instructions:

a. Instruct personnel travelling on Telephone Road not to turn West between Old Camden Road and Ancrum Ferry Road.

b. Instruct personnel travelling on Old Camden Road not to turn South between Telephone Road and Range Road.

(d) # 4 - Junction Old Camden Road and Range Road (1007.6 - 1215.1).

1. Instructions:

a. Instruct personnel travelling on Old Camden Road not to turn South between Range Road and Telephone Road.

b. Instruct personnel travelling on Range Road not to turn East between Old Camden Road and Ancrum Ferry Road except that personnel firing on ranges may enter those Ranges.

(2) 4.2" Mortar Range # 2: Five Range Guards will be posted at points indicated in Annex # 1 at 30 minutes prior to scheduled firing time.

(a) # 1 Guard will prevent any travel from going Northeast on Division Road.

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(b) # 2 Guard will prevent travel from going South on Colonel Creek Road into the impact area.

(c) # 3 Guard will prevent any travel from going on Messers Pond Road from turning South on the road into the impact area.

(d) # 4 Guard will prevent any traffic from going West on Division Road into the impact area.

(e) # 5 Guard will prevent any traffic on Chavers PondRoad from going West into the impact area.

The officer-in-charge of firing will make sure the temporary road block is in position at junction of highway # 262 and Colonel Creek Road, coordinates (1025.9 - 1211.8). The officer-in-charge of firing will be responsible that any additional range guards necessary to insure that safety measures are observed are posted on approaches into the danger area.

k. Safety: The provisions of SR 385-310-1 and FM 23-92 will govern all firing. In case of conflict, SR 385-310-1 will govern all firing.

58. Responsibilities of Officer-in-Charge of Firing:

a. In addition to his responsibility for the posting of necessary range guards, the officer-in-charge of firing will be responsible that:

(1) Range guards are instructed as to their duties, i.e., allow no one to enter the impact area or gun position area without permission of the range officer or the commanding officer of the unit firing.

(2) Both he and his supervisory personnel are thoroughly familiar with the provisions of SR 385-310-1, and par 1-20 of the Fort Jackson Range Regulations.

(3) Red flag is predominantly displayed in the vicinity of the gun positions when range is cleared for firing.

(4) The Commanding Officer of the unit firing is notified when range is cleared for firing.

(5) Range guards are relieved and red flag is taken down upon completion of firing.

(6) All trash around gun position is policed upon completion of firing.

b. The officer-in-charge of firing will be responsible for the control of fires and the protection of personnel against duds on the Mortar Range in accordance with par 8 Sec II and Sec III of Chapter I of these regulations.

(1) The officer-in-charge of firing will warn all personnel of the danger of "duds" in the area.

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(a) Duds discovered on the range will be plainly marked so they can be seen for a distance of 100 yards. These duds will not be moved or tampered with except by authorized personnel.

(b) The location of any duds will be reported to the Post Range Officer. Reports will show type, location and map coordinates and the name, rank, organization and telphone number of any person familiar with dud locations.

(2) The control of fires resulting from firing on the Mortar Range is the responsibility of the officer-in-charge of firing.

(a) When a fire on the Mortar Range is observed, the officer-in-charge of firing will immediately stop the firing and extinguish the fire.

(b) If the fire is located inside a danger area other than that of the Mortar Range, the officer-in-charge of firing will contact the Post Range Officer and report its location. The Post Range Officer will stop all firing in that area until the fire is extinguished.

(c) If a fire gets out of control of the using unit, the Post Range Officer and Post Engineer will be notified of that fact immediately.

(d) The officer-in-charge of firing will inspect the target area at the conclusion of each day's firing and extinguish all fires.

SECTION XIV

ROCKET LAUNCHER RANGE

59. Description:

a. Location: (1007.7 - 1216.4).

b. Telephone Number: Tie Line 15, Ring 3.

c. Number of Firing Points: 24

12 Practice Ammunition
12 Service Ammunition

d. Type of Weapon Fired: Rocket Launcher, 2.36 inch M9 and M9A1.

e. Distance from Gun Position to Target: 100 Yards.

f. Safety Limits: See Annex # 1.

g. Danger Area: See Annex # 1.

h. Rocket Launcher Range Guard Positions:

(1) # 1 - Boyden Arbor Road at (1007.0 - 1216.2)

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(2) Danger Area: See Annex 11

(3) Safety Limits: See Annex 11

f. Range Guards: Range guards will be posted at points indicated in Annex 11 at least 30 minutes prior to scheduled firing time. The Officer-in-charge of firing will be responsible that any additional range guards necessary to insure that safety measures are observed are posted on approaches into the danger area. If the Artillery Range is in use at the same time that the Tank Range is being used, guard positions # 1, 2 and 3 of the Tank Range are not necessary. Temporary road blocks will be picked up at the KD Range Detachment and placed into position as indicated on Annex 11.

g. Safety: The provisions of SR 385-310-1 and the provisions of the appropriate Field Manuals will govern all firing. In case of conflict, SR 385-310-1 will govern.

69. Responsibilities of the Officer-in-Charge of Firing:

a. In addition to his responsibility for the posting of necessary range guards, the Officer-in-charge of firing will be responsible that:

(1) Range guards are instructed as to their duties, i. e., allow no one to enter the impact area or gun position area without permission of the range officer or the commanding officer of the unit firing.

(2) Both he and his supervisory personnel are thoroughly familiar with the provisions of SR 385-310-1 and par 1-20 of the Fort Jackson Range Regulations.

(3) Red flag is predominantly displayed in the vicinity of the gun positions and Weir Tower when range is cleared for firing.

(4) The Commanding Officer of the unit firing is notified when range is cleared for firing.

(5) Temporary road blocks have been placed in position and that same are returned to the KD Range Detachment upon completion of firing.

(6) Range guards are relieved and red flag is taken down upon completion of firing.

(7) All trash around gun position is policed upon completion of firing.

SECTION XVIII

ARTILLERY RANGE

70. Description:

a. Location: Gun Position Area - See Annex 12
Impact Area - See Annex 12

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b. Telephone Number: (Weir Tower) Tie Line 10

c. Type Weapon Fired: 105mm and 155mm Howitzer and Rifles

d. Safety Limits: See Annex 12

e. Danger Area: See Annex 12

f. Range Guard Positions: See Annex 12

For Impact Area: All road guards on the numbered road guard positions will prevent entry into the impact area.

For Telephone Road: Two guards will be posted in addition to impact area road guards. RG-#2 (1013.0 - 1210.0) will allow only authorized traffic to proceed North along Telephone Road. RG-#11 (1011.2 - 1209.5) will allow only authorized traffic to proceed North along Telephone Road.

71. Responsibilities of Officer-in-charge of Firing:

a. Before Use of the Range: The Officer-in-charge of firing will be responsible that:

(1) Both he and his supervisory personnel are thoroughly familiar with Section 1, Appendix 1 FM 6-40 and FM 6-140, FM 6-75 (105mm Howitzer); FM 6-81 (155mm Howitzer); FM 6-90 plus C1 (155mm Gun); SR 385-310-1 and par 1-20 of these regulations.

(2) The following minimum number of personnel are designated:

1 Officer - Commanding Officer of Unit Firing.
1 Safety Officer at each Battery Position
EM Range Guards as needed (See par 68f above).
1 EM Telephone Orderly.
2 EM First Aid Men.

(3) One (1) ambulance will be available during firing.
(4) All firing personnel have completed training as outlined in FM 6-75 (for 105mm Howitzer) or FM 6-81 (for 155mm Howitzer) and FM 6-90 (for 155mm Gun).

(5) Three days prior to day of firing an overlay of the firing plan to include gun positions, proposed targets and type and number of weapons to be used will be sent to the Post Range Officer.

(6) Range Guards have been posted (See Annex 12).

(a) At least thirty (30) minutes prior to scheduled firing time. Numbered range guards will remain posted during all firing.

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(b) Instruct range guards as to their duties, i. e., allow no one to enter the impact area or gun position area without permission of the Range Officer or the Commanding Officer of unit firing.

(7) Temporary road blocks have been received from the KD Range Detachment Area and have been placed in position prior to firing as indicated on Annex 12.

(8) Raise the red flag on Weir Tower. (See Annex 12), when range is clear for firing.

(9) Notify the Commanding Officer of unit firing when range is clear for firing.

(10) Entry into firing positions area will be as listed below:

(a) From Hwy 262 North on Telephone Road.

(b) From Old Camden Road South on Telephone Road.

(c) East to West on Ancrum Ferry Road.

(11) Before moving personnel into impact area for setting up targets or before moving personnel up to observation posts, clearance will be made with Post Range Officer in order that firing on Tank Range can be halted until impact area of this range has been cleared of personnel.

b. During Use of Range:

(1) The Officer-in-charge of firing will be in constant communication with the Observation Post (CO of unit firing) and as near as practicable to his Range Guards.

(2) The Officer-in-charge of firing will be responsible that all safety requirements and precautions outlined in par 38 a (1) are complied with.

c. After Use of Range: The Officer-in-charge of firing will be responsible that:

(1) Range Guards are relieved and that temporary blocks have been returned.

(2) All trash has been policed.

(3) A certificate has been executed on all HE ammunition expended.

SECTION XIX

AIR-TO-GROUND RANGE REGULATIONS

72. The purpose of these regulations is to govern the use of the Air-to-Ground Range and to prescribe safety precautions to be observed in its use.

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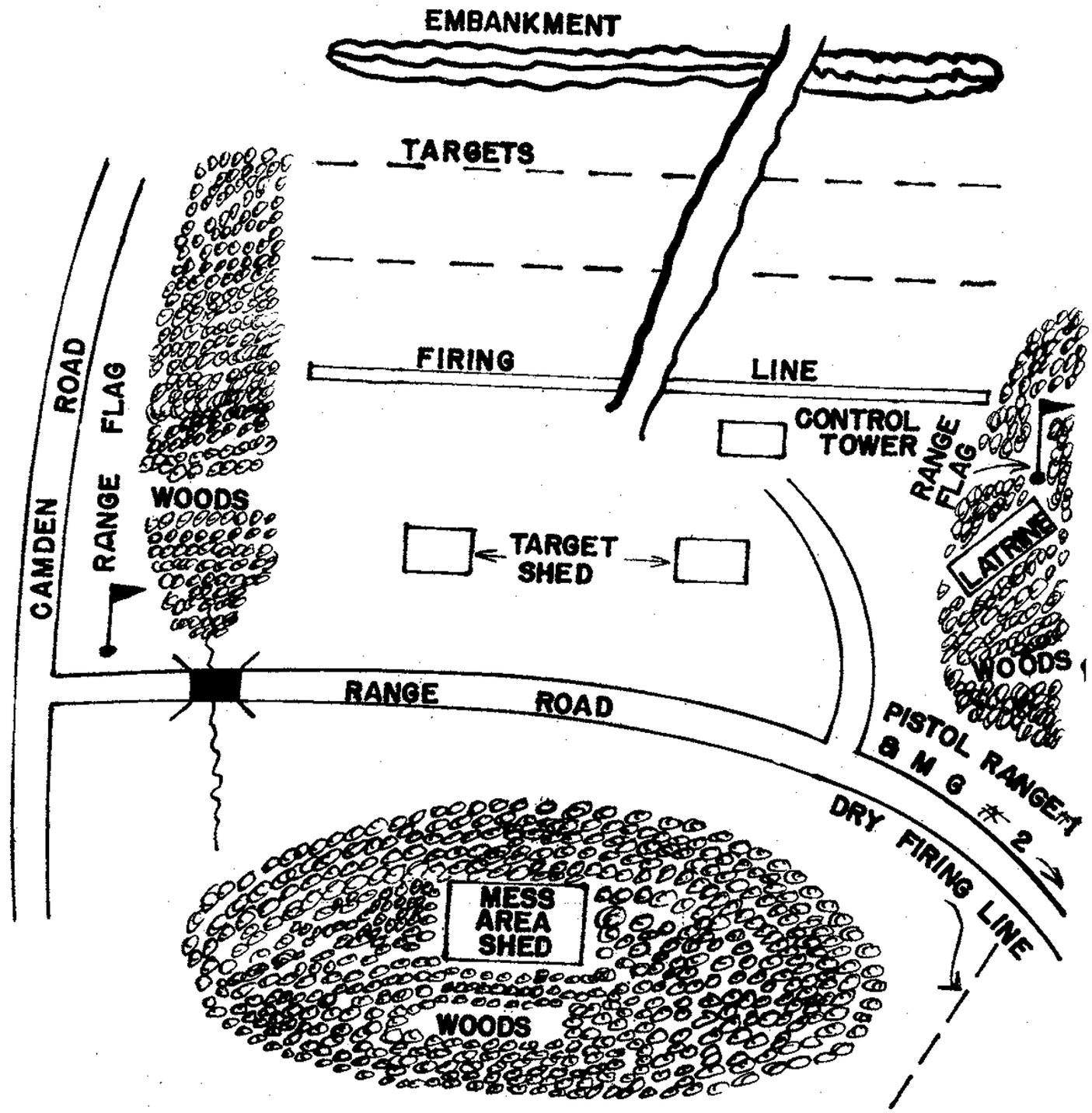

ANNEX # 5

SCHEMATIC DIAGRAM of MACHINE GUN RANGE # 1

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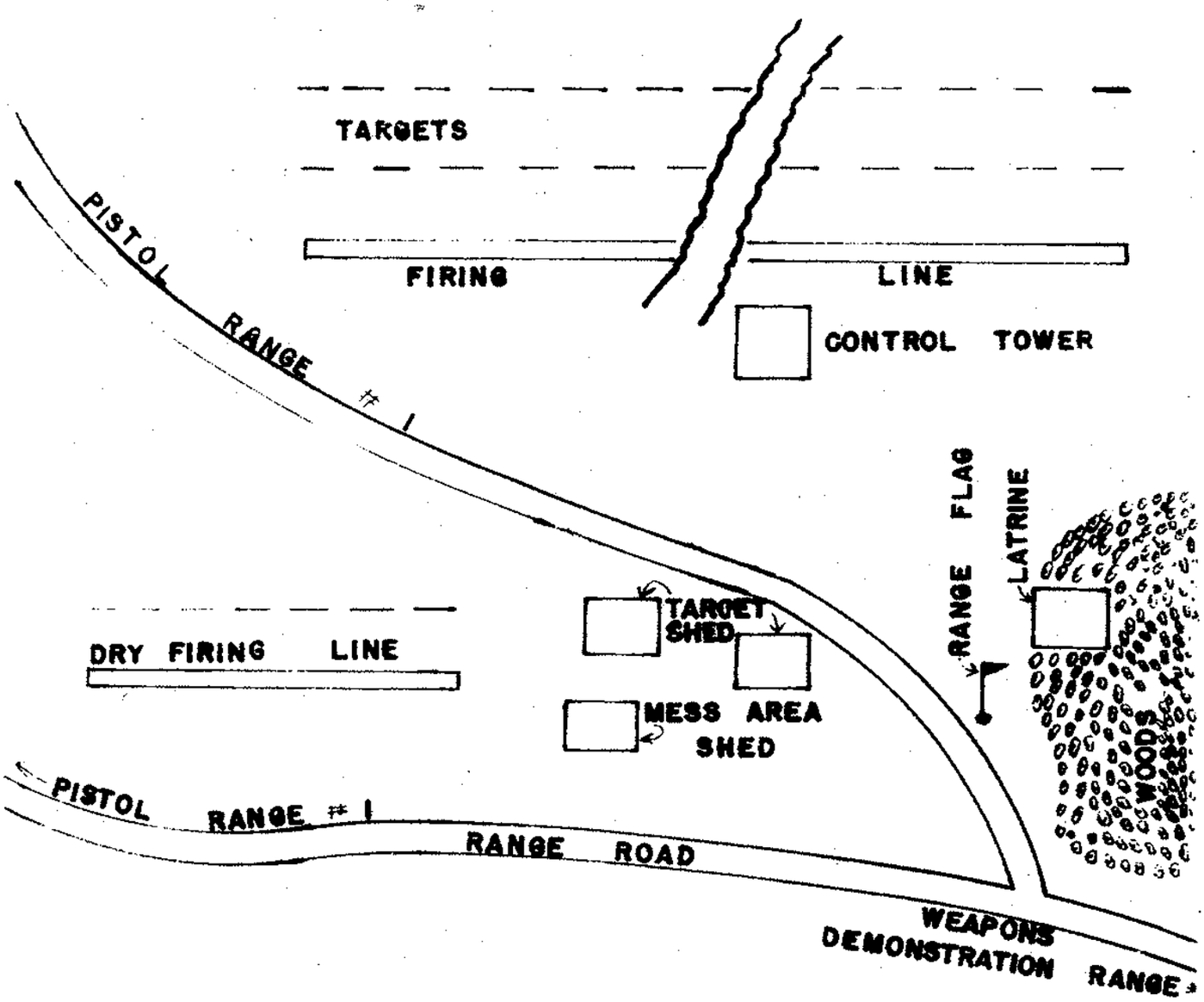
By CO NARA Date 3-22-04



ANNEX # 6

SCHEMATIC DIAGRAM of MACHINE GUN RANGE # 2

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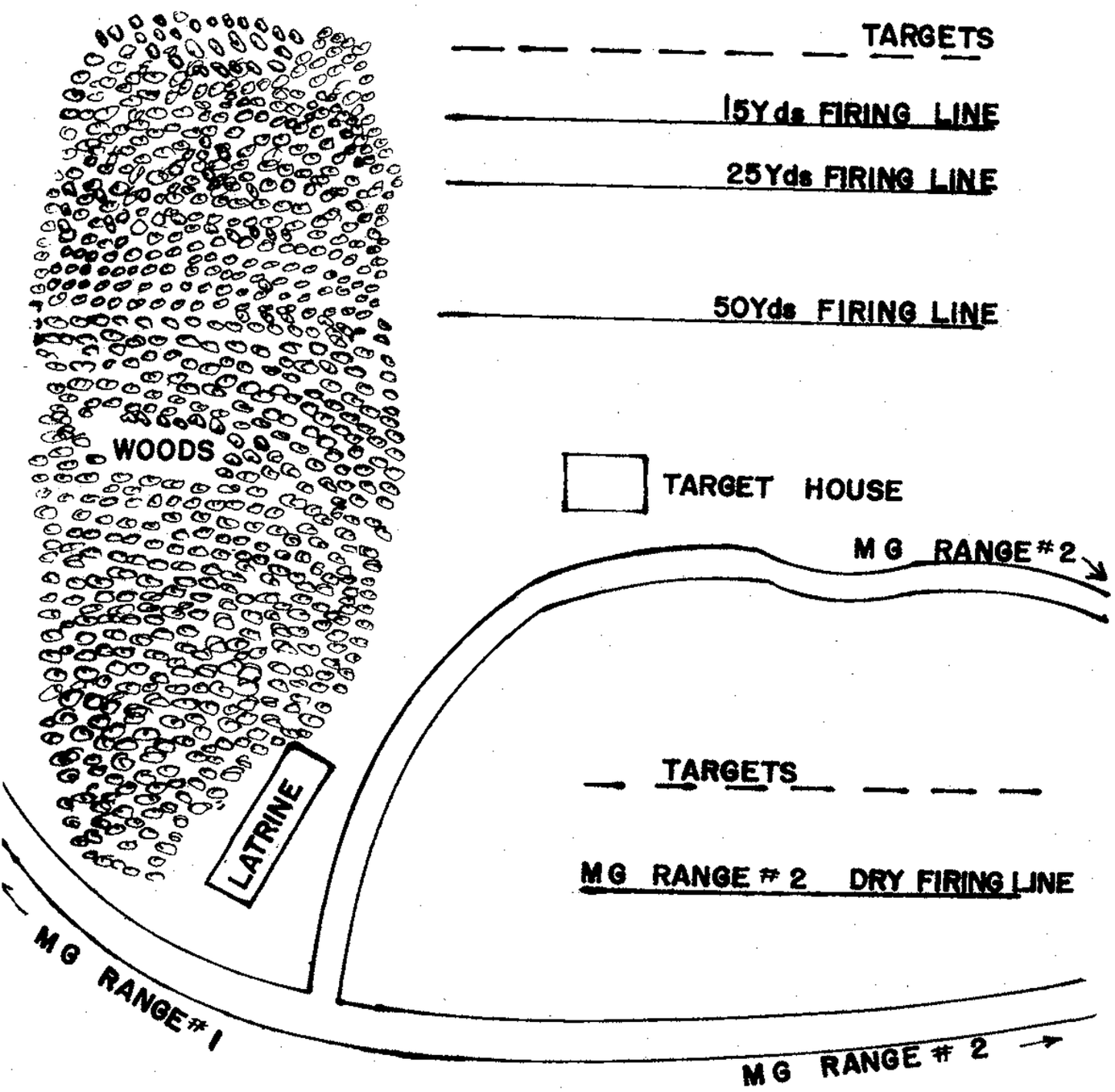

ANNEX # 7

SCHEMATIC DIAGRAM of PISTOL RANGE # 1

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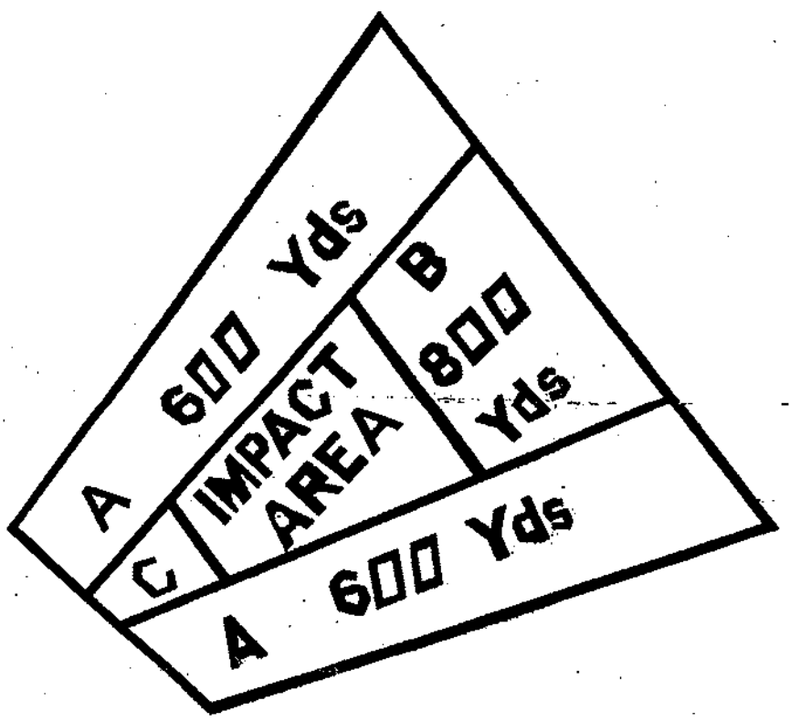
OVERLAY SHOWING 4.2 MORTAR RANGE NO
MAP: FT. JACKSON & VICINITY
SCALE: 1/25,000



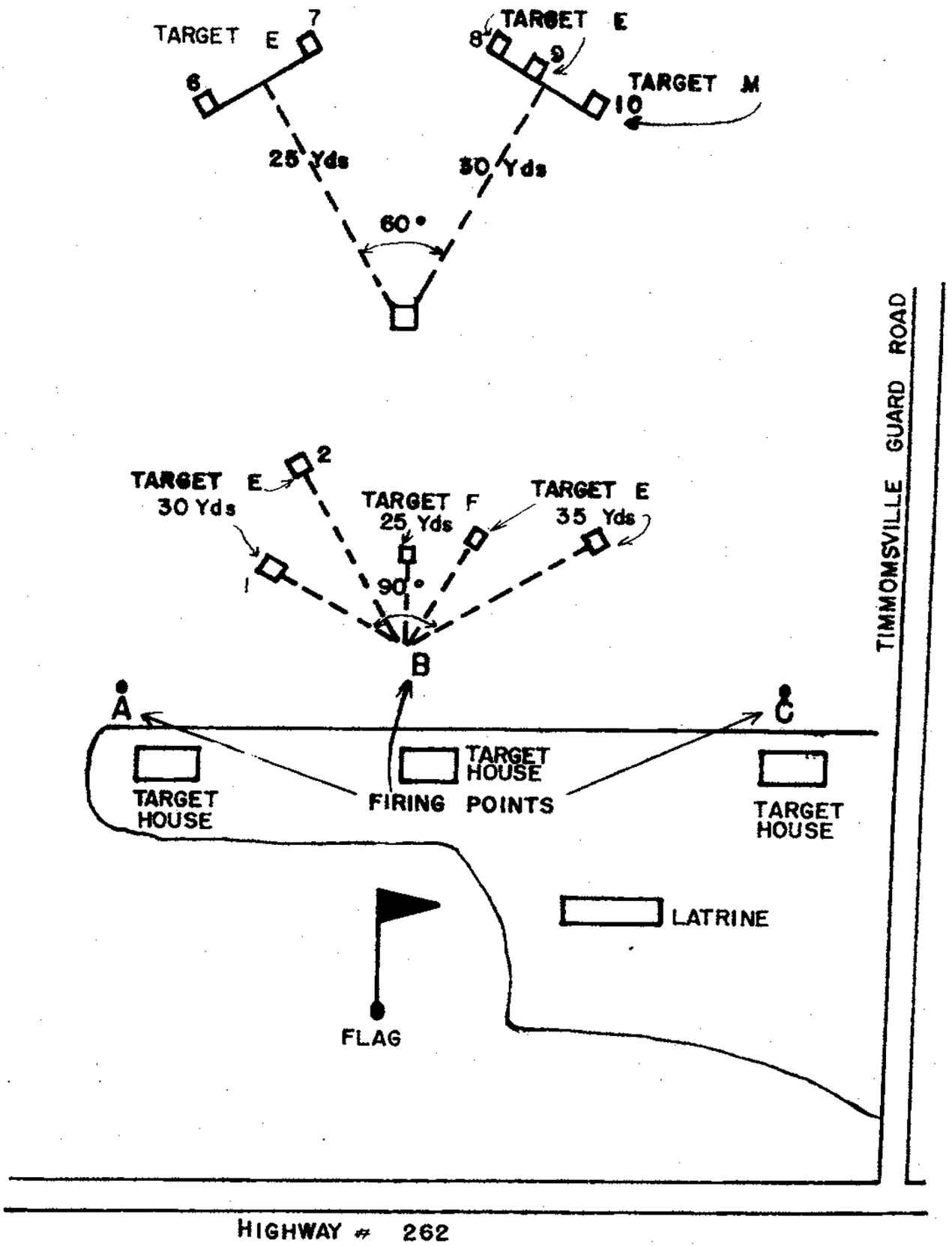
X4

X3

1013

1212

ANNEX # 10



ANNEX # 19

SCHEMATIC DIAGRAM of SUB MACHINE GUN # I

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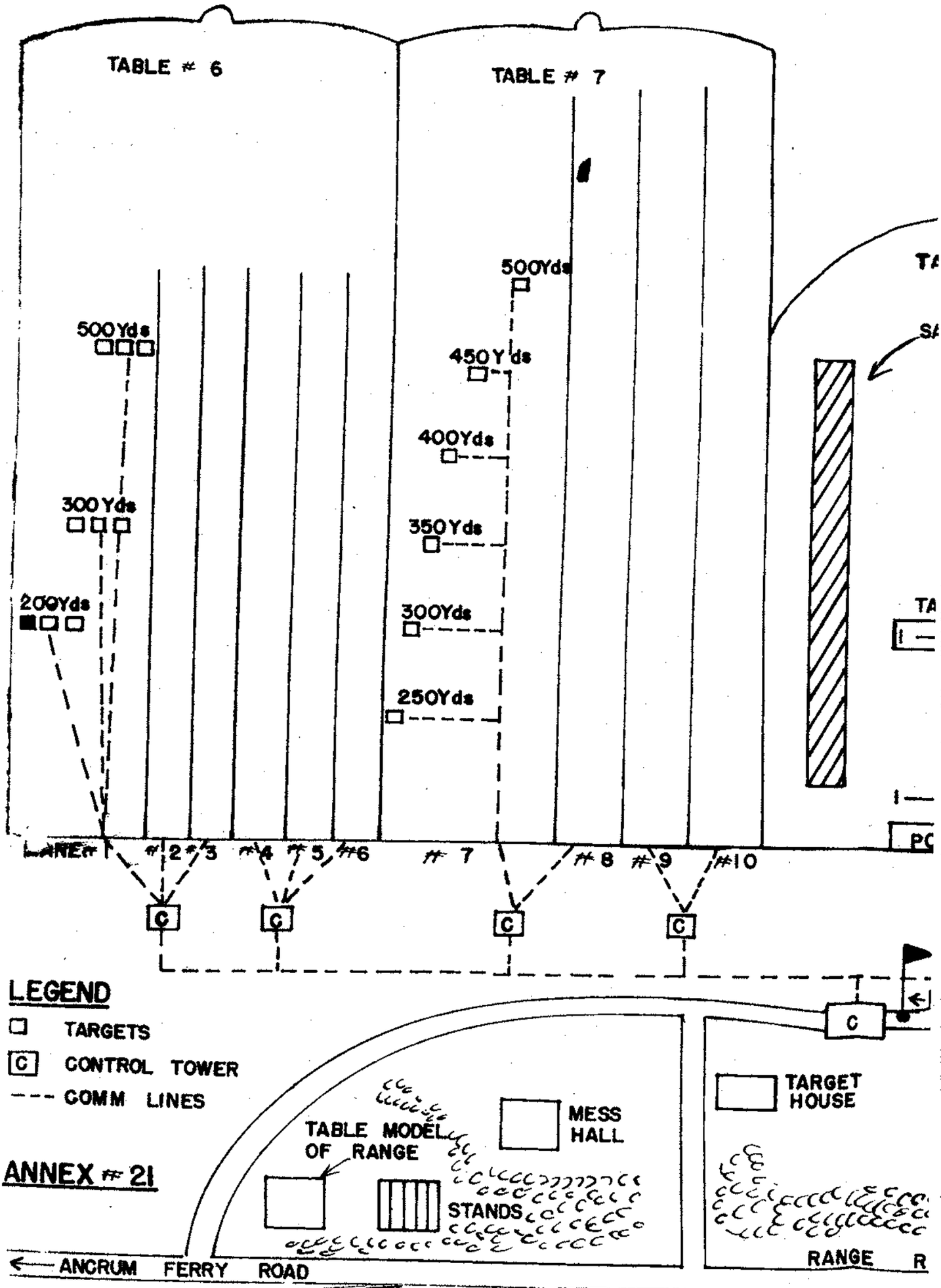

ANNEX # 21

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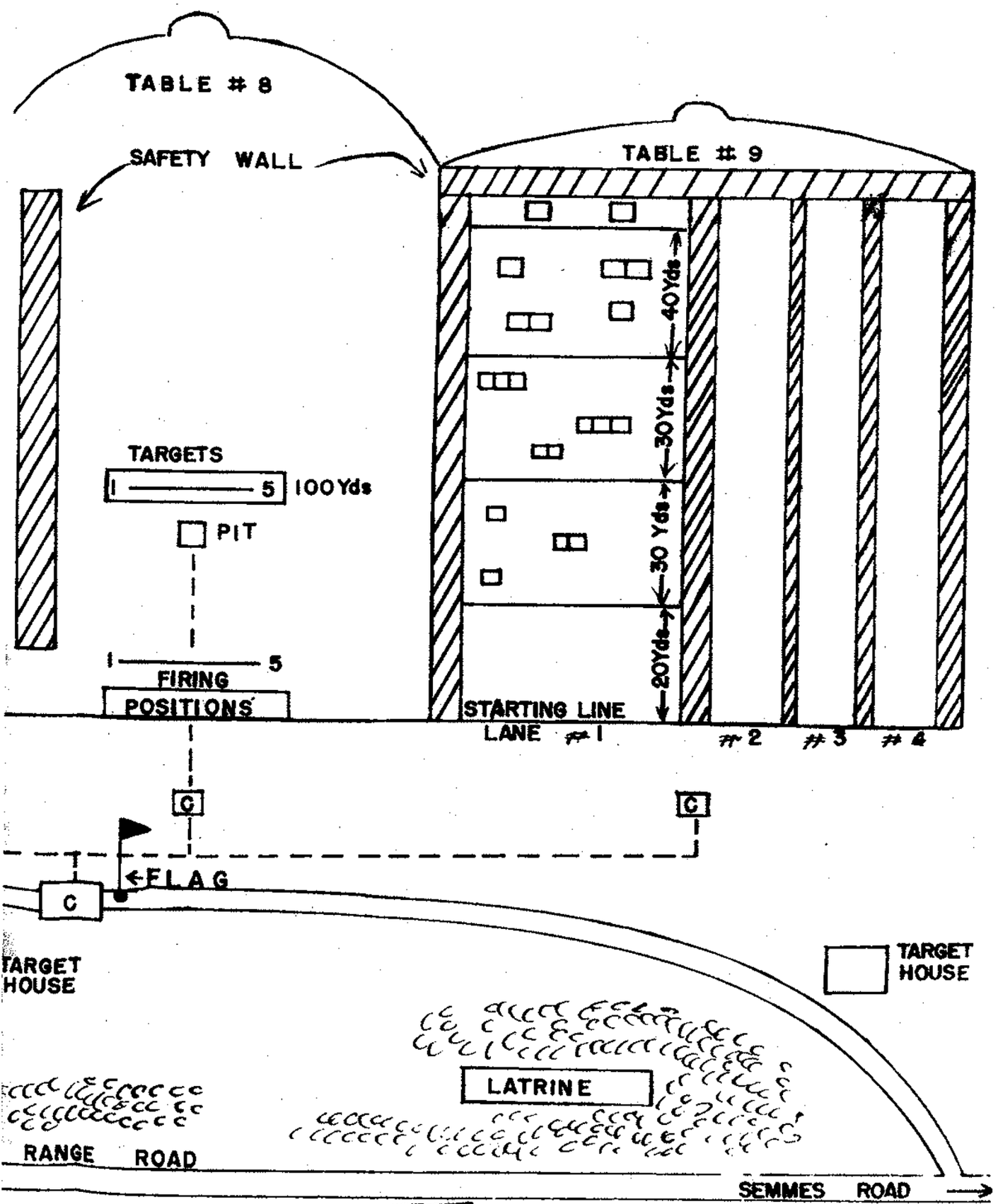
EMATIC DIAGRAM of RIFLE



RIFLE TR ANGE # 1

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By CO NARA Date 3.22.04

INSTRUCTIONS ON THE PROCEDURE

IN THE USE OF

RIFLE TRANSITION RANGE # 1 (12 Hrs)

1. OBJECTIVE:

a. To give the individual soldier practice in searching for targets, in estimating ranges, in setting his sights rapidly, and in firing an accurate shot quickly.

b. To emphasize the necessity for the continued application of the principles of rifle marksmanship in firing at field targets.

c. To give the individual soldier practice in assault firing.

2. TEXT REFERENCES:

FM 23-5, C1, 2 & 3
FM 23-7, C4
SR 385-310-1
ATP 21-1
Range Regulations, Fort Jackson

3. PROCEDURE:

a. Period 1 (2 Hours):

(1) Subject: Range Estimation.
(2) Text References: FM 23-5, pars 120-124.
(3) Equipment: Blackboard; Range Chart; Paper and pencil for each trainee; Chart - Factors effecting estimation by eye.
(4) Area: Range Estimation Course.
(5) Procedure: Explain the importance of estimating range accurately. Explain each of the methods employed in estimating ranges (Use of tracers, observation of fire, estimation by eye). Conduct the practical work exercises described in FM 23-5, par 124.

b. Period 2 (1 Hour):

(1) Subject: Setting Sights Rapidly; Stoppages; Immediate action.
(2) Text Reference: FM 23-5, pars 35-38, 66.
(3) Area: Out-of-doors.
(4) Procedure: Review sight setting and changes. Explain the importance of setting sights rapidly. Conduct practical exercises in setting sights rapidly. Review stoppages and immediate action.

c. Period 3 (1 Hour):

(1) Subject: Assuming Positions Rapidly; Assault Fire.
(2) Text References: FM 23-5, pars 65c, 138.
(3) Equipment: Type "E" and "F" silhouette targets. 2 EE8 telephones; Blackboard; whistles.
(4) Area: Out of Doors.
(5) Procedure: Review firing positions; Conduct explanation, demonstration and practical work in assuming positions rapidly. Conduct practical exercises requiring soldiers to estimate ranges, set sights, assume a firing position, and simulate firing at silhouette targets which are exposed for brief intervals. Explain, demonstrate, and conduct practical work in assault fire position procedure.

ANNEX #24

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d. Period 4 (8 Hours):

(1) Subject: Transition Firing.
(2) Text References: FM 23-5, C1 and 2, pars 69d-g, 189, 191e.
(3) Personnel: Officer personnel requirements in sub par below are for ideal conditions. Minimum number for firing this range are:

Table VI and VII - 1 Officer
Table VIII - 1 Officer
Table IX - 1 Officer

(a) Table VI:
Officers: Two (2) Range Officers
Cadremen: Six (6) Asst Range Officers(Scorers)
Trainees: Fifty-four (54) Target Operators; two (2) ammunition bearers; one (1) Latrine Orderly; Six (6) Coaches

(b) Table VII:
Officers: Two (2) Range Officers
Cadremen: Four (4) Asst Range Officers
Trainees: Two (2) Target Operators; One (1) ammunition bearer; Four (4) Coaches

(c) Table VIII:
Officers: One (1) Range Officer
Cadremen: Four (4) Asst Range Officers
Trainees: Two (2) target operators; One (1) ammunition bearer; Four (4) Coaches

(d) Table IX:
Officers: One (1) Range Officer
Cadremen: Four (4) Asst Range Officers(Coaches)
Trainees: Four (4) target operators, One (1) ammunition bearer.

(e) Stations 1, 1A, 2 3, 4, 5, and 6:

One Orientation and Critique Non-commissioned officer for each station. Use table model of range.

(4) Equipment:

(a) Table VI; 72 targets
26 EE8 telephones
54 red flags
18 whistles
18 buckets suitable for bailing water.

(b) Table VII; 32 targets
27 telephones
2 whistles
24 red flags
8 buckets suitable for bailing water.

(c) Table VIII; 4 targets
2 telephones
1 red flag
1 bucket suitable for bailing water.

(d) Table IX; 1 red flag
16 clips adapted to hold 4 rounds.

(e) Station # 1 - Sight Blackening Equipment (Unit responsibility).
2 - Blackboards
3 - Blackboards
4 - Blackboards
5 - Blackboards and cleaning materials (Unit Responsibility)
1A - Clips of dummy ammunition.

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(5) Area: Transition Range.

(6) Procedure: (See Annex # 3).

For Firing Line and Stations in Rear of Firing Line:

(a) Pit detail and coaches will precede firing personnel to the range by 40 minutes.

(b) Equipment Area: Direct troops to remove and align packs and excess equipment. Direct firing personnel to Station # 1.

(c) Station # 1: Review Safety Regulations in general and those peculiar to the Transition Range (FM 23-5, par 191). Orient soldiers on the course to be fired. Direct twelve (12) trainees to Table VI (6 wet firing and six (6) dry firing).

(d) Table VI: Conduct firing of Table VI as prescribed in Annex # 1. Require the dry firers to follow the course simultaneously with the actual firers. Direct personnel to Station # 2. Present score sheets to Critique Officer.

(e) Station # 2: Critique Firing. Direct personnel who display noted deficiencies to Station # 1A for additional instructions. Orient personnel on Table VII. Direct personnel to Table VII. Present scorers with score sheets.

(f) Table VII: Conduct firihg of Table VII as prescribed in Annex # 1. Require dry dirers to fire the course simultaneously with the actual firers. Direct personnel to Station #3. Present score sheets to Critique Officer.

(g) Station #3: Critique Firing. Direct personnel who failed to qualify to Station # 1A for further instruction. Orient personnel on Table VIII. Direct personnel to Table VIII. Present scorers with score sheets.

(h) Table VIII: Conduct firing of Table VIII as prescribed in Annex # 1. Require firer to "stand fast" between shots. No dry firing will be done. Direct personnel to Station # 4. Present score sheets to Critique Officer.

(i) Station # 4: Critique firing. Direct personnel who failed to qualify to Station # 1A. Orient personnel on Table IX. Direct personnel to Table IX. Present scorer (coach) with score sheets.

(j) Table IX: Conduct firing of Table IX as prescribed in Annex #1, (also see Annex # 4). No dry firing will be done. Direct personnel to Station #5. Present score sheets to Critique Officer.

(k) Station # 5: Critique firing. Direct personnel who failed to qualify to Station # 1A. Inspect rifles and search men for live ammunition. Require men to clean rifles. Inspect rifles for cleanliness. Direct men to Station # 6.

(l) Station # 6: Orient men on duties of target operators or coaches. Relieve target operators or coaches of a complete lane when sufficient personnel arrives.

(m) Station # 1A: (This Station may be incorporated with Station # 1 if desired)
Concurrent instruction will be presented on: Rapid setting of sights. Assuming firing position quickly. Rapid loading. Immediate action. Firing from sitting and kneeling positions. Firing

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from "off-hand" and "hip-firing" positions. Officer in charge of training will replace men in flow when he believes them able to qualify.

For Pits:

(n) Tables VI, VII and VIII:
The officer in charge of the control tower for each table will:

Supervise instruction of pit detail.
Supervise drawing of targets and red flags.
Demonstrate the operation of a pit to include target operation and communication.
Supervise the installation of the pit detail in their respective pits.
Conduct sufficient number of dry runs to insure both efficient and safe operation.

(o) Table IX - The range officer in charge of this Table will orient and supervise the operation of this detail. Upon completion of firing this exercise, and upon signal by the coach, the target operator will assist in scoring and pasting the hits with the coach.

4. MISCELLANEOUS:

a. Targets are fastened to staves and are operated by men protected in individual pits.

b. At firing points for Tables VI and VII, the following men are the only authorized personnel at each point.

1 Firer (Dry Run) 1 Firer (wet) 1 Telephone Operator
1 Coach (dry run) 1 Coach (wet) 1 Asst Range Officer

c. Coaches:

(1) The coaches in Tables VI and VII will set-off the sights of all men under their control sufficiently to require an adjustment. This adjustment will be accomplished by the firer after he has taken his firing position.
(2) The coach will enforce safety regulations.
(3) The coach will observe firing technique.
(4) The coach will note errors on the score sheet.
(5) The coach will observe dry firers (where applicable) and make any necessary corrections.

d. During Table VIII and IX, "Battle Sights" will be set and left there during the entire course.

e. Pits: Pits will not be used as latrines.
Pits will be policed at the completion of each day's firing.

f. Scores: Score sheets (See Annex #2) will be reproduced by units concerned.

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ANNEX # 1

TO

INSTRUCTION ON THE PROCEDURE IN
THE USE OF RIFLE TRANSITION RANGE # 1

1. Courses:

Table VI:

RANGE (YARDS)	TIME	SHOTS 1	TARGET 2	POSITION	SLING
200	60 Secs	5	3E	Kneeling or Sitting From Standing	Loop
300	60 Secs	5	3E	Prone from Standing	Loop
500	60 Secs	5	3E	Prone from Standing	Loop

1. The rifle is to be loaded with a partial clip containing five rounds.
2. Targets should be approximately five yards apart and as near the prescribed range as terrain permits.

Table VII:

RANGE 1 (YARDS)	TIME SECONDS	SHOTS 2	TARGET	POSITION	SLING
	120	10	6E	Prone from Standing	Loop

1. Two targets between ranges of 200 and 300 yards, two targets between 300 and 400 yards, and two between 400 and 500 yards. Each pair of targets will be staggered and separated in depth from 25 to 50 yards.
2. The rifle is to be loaded initially with a partial clip of two rounds and reloaded with a full clip.

TABLE VIII:

RANGE (Yards)	Time 1 Seconds	Shots 2	TARGET	POSITION	SLING
100	3 Secs per Round	5	E	Standing	None

1. Target will be exposed for 3 second period during which rifle will be brought to the shoulder and round fired.
2. Rifle is locked and loaded before start of exercise.
3. Rifle is held at the ready and brought to the shoulder for firing each round.

TABLE IX:

PHASE LINES	TARGETS SINGLE	DOUBLE	TRIPLE	RANGE (YARDS)	SHOTS	TARGET	POSITION	SLING
2-3	2	1	0	5-70	4	E	Off-hand	None
3-4	0	1	2	5-70	8	E	Hip	None
4-Final	2	3	0	5-70	8	E	Off-hand	None

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Annex 1 to Instruction on the Procedure in the Use of Rifle Transition Range # 1 (contd)

a. A single silhouette represents an enemy rifleman.
A double silhouette represents an enemy automatic rifle team.
A triple silhouette represents an enemy machine gun.

b. Targets will be exposed in sequence upon signal from the coach.
Time of exposure of targets is as follows: (a) Single silhouettes, 3 seconds. (b) Double silhouettes, 4 seconds. (c) Triple silhouettes, 5 seconds.

c. Phase lines are placed after the 4th, 12th, and 20th targets to assist in the enforcement of safety precautions. (See Annex # 1.)

d. Firer starts from the prone position, with rifle locked, 4 rounds in the rifle, and two, 8 round clips in his belt.

e. On signal from the range officer, the firer rises and moves down the lane on the alert. As targets are exposed the firer fires one round at each silhouette between phase lines two and three from the "Off Hand" position. He then reloads and fires from the "Hip" firing position at each silhouette between phase lines three and four. He reloads again and fires from the "Off Hand" position at each silhouette between the fourth and final base lines.

f. A coach accompanies each firer, to insure control, to assist the range officer and to critique the firer at the end of his firing.

g. Safety Precautions:
The firer will be instructed prior to firing that targets are not more than 3 feet high, targets will be on same level as ground, targets to front, right or left front only.

2. Scoring:

a. Table VI:
For each target hit . . . . . 1 Point
For each unexpended round if all targets are hit. . . . 1 Point

b. Table VII: For each target hit
Between 200 and 300 Yards . . . . . 1 Point
Between 300 and 400 Yards . . . . . 2 Points
Between 400 and 500 Yards . . . . . 3 Points
For each unexpended round if all targets are hit. . . 3 Points

c. Table VIII:
For each target hit . . . . . 1 Point

d. Table IX:
For each target hit . . . . . 1 Point
For each unexpended round if all targets are hit. . . . 1 Point

e. Satisfactory Scores:

Table	Satisfactory Score
VI	Not applicable
VII	8
VIII	4
IX	8

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Annex #2 to Instruction on the Procedure in the Use of Rifle Transition Range #1

SCORE SHEET

TRANSITION FIRING M-1

Name_____ Plat_____ Co_____ Bn_____ Regt_____

Date:_____

	TABLE VI	TABLE VII	TABLE VIII	TABLE IX
500 yds	1 1 1 (3)	3 3 (6)		
300 yds	1 1 1 (3)	2 2 (4)		
200 yds	1 1 1 (3)	1 1 (2)		
100 yds		1 1 1 1 1 (5)	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 (20	
	Add 1 point for each un-expended round if all targets are hit.	Add 1 point for each un-expended round if all targets are hit.	Add 1 point for each un-expended round if all targets are hit.	

COACH: CHECK ERRORS MADE

	TABLE VI	TABLE VII	TABLE VIII	TABLE IX
Sling				
Loading				
Positions				
Sight Aiming				
Trigger Squeeze				
Flinching				
Jerking				

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Annex # 2 to Instruction on the Procedure in the Use of Rifle Transition Range # 1 (contd)

	TABLE VI	TABLE VII	TABLE VIII	TABLE IX
Breathing	_____	_____	_____	_____
Rate of Fire	_____	_____	_____	_____

COACH _____

Asst Range Officer _____
(Initial)

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Annex # 3 to Instruction on the Procedure in the use of Rifle Transition Range # 1.

Annex # 3.

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Annex # 4 to Instruction on the Procedure in the use of Rifle Transition Range # 1.

NOTES:

1. As many lanes as local conditions permit may be used- average time per firer is 5 minutes.

2. Firer must be required to engage targets immediately after crossing each phase line.

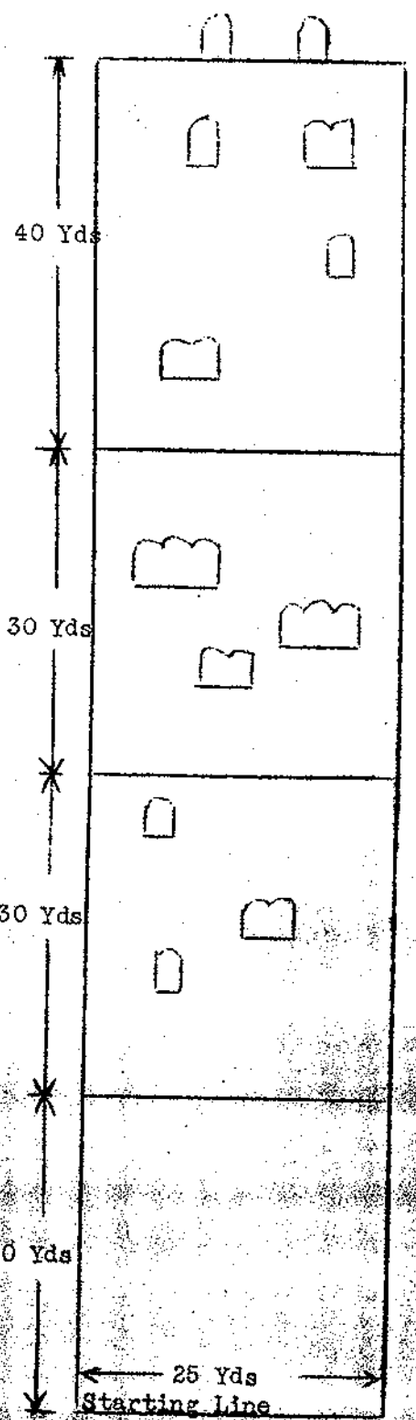

DIAGRAM FOR TABLE IX

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By CO NARA Date 3-22-04

April 10, 1951

HEADQUARTERS 31ST INFANTRY DIVISION
Office of The AC of S, G-2
Fort Jackson, S. C.

DDACB 10 April 1951

1. INTELLIGENCE TRAINING:

a. Twenty-One (21) officers and one hundred eight (108) enlisted men, division intelligence personnel, are currently attending Intelligence Courses at The Army General School, Fort Riley, Kansas and other service schools. Quotas have been approved for three (3) officers and fifty (50) enlisted men to attend intelligence courses at The Army General School commencing 25 April 1951.

b. All Division personnel are currently receiving Intelligence Training in accordance with appropriate ATP's.

c. A Division Intelligence School will be conducted during Unit Training Cycle, 11 June to 20 August 1951 inclusive.

2. AGGRESSOR:

a. Uniforms: There are approximately four hundred (400) AGGRESSOR Uniforms, complete with all accessories currently available for issue. Requisition for eleven hundred (1100) additional uniforms has been approved. 31st Division Quartermaster will coordinate issue of all AGGRESSOR Uniforms through the AC of S, G-2.

b. Simulation Equipment and Ammunition: Simulation Equipment and Ammunition have been requisitioned for use in AGGRESSOR Training.

c. AGGRESSOR Training:

(1) All AGGRESSOR training will be supervised and coordinated by AC of S, G-2.

(2) The AGGRESSOR Team from AGGRESSOR Headquarters, Fort Riley, Kansas, will present a demonstration for 31st Infantry Division 29 April - 5 May 1951 inclusive.

3. CLEARANCES:

Immediate Access clearances for access to TOP SECRET matter have been processed for the General Staff. Interim clearances for access to Secret matter have been processed for two hundred (200) officers and enlisted men of this division. Seven hundred eighty-five (785) Personal History Forms of division personnel have been processed to date. Cryptologic Clearance Requests have been processed for twenty-five (25) officers and enlisted men.

RG 337, Hq. Army Ground Force, Entry 1, Insp. Repts, 1951
BOX 37

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10 April 1951

4. MAPS:

a. A sufficient number of Topographic maps has been received and distributed.

b. Requisitions for Photo maps have been made. Third Army reports expected delivery date 15 April 1951.

Lother B. Sibert

LOTHER B. SIBERT
Lt. Col., GSC
AC of S, G-2

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By G9 NARA Date 2/23/07

CONDENSED TRAINING REPORT

1. Pre-cycle (cadre) training was completed on March 3rd and on March 5th this division started basic training with a strength of approximately 21,000; all fillers having been received in time to start on schedule. Training progressed according to Master Training Program for National Guard Divisions, dated October 1950, until 23 March, when we were directed to complete PCR qualifications in 14 weeks. A revised schedule was issued and all units are now in the 6th week of basic training.

2. FACTORS AFFECTING TRAINING:

a. SHORTAGE OF TRAINED PERSONNEL:

(1) As of 10 April 1951 this division had 416 officers and 660 enlisted men in attendance at service schools off the post. 385 enlisted men are attending schools on the post. It is believed the handicap created by this situation will be more than repaid when these school trained personnel return to the division.

b. INSUFFICIENT TRAINING AREAS:

(1) While much has been said about securing additional maneuver area the fact remains that we are reaching that stage of training where more maneuver area is required than is now available. The leasing of the proposed strip South of the reservation will remedy this situation.

c. FACILITIES:

(1) A definite shortage exists in transition ranges, close combat ranges and combat in cities courses. The division has initiated action to construct two additional close combat ranges with its own forces and thus solve one problem. By firing Saturdays and Sundays we can complete transition firing. But we cannot complete combat in cities fighting in the required time unless given priority on the course.

(2) There is a shortage of class room space, ordnance shop facilities and storage space.

(3) The original Field Artillery range was inadequate. Current negotiations with post may correct this situation.

(4) There is no range available for AAA firing, nor 90MM tank firing.

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HEADQUARTERS 31ST INFANTRY DIVISION
Office of AC of S, G-4
Fort Jackson, South Carolina

10 April 1951

SUBJECT: Supply Status, 31st Infantry Division

TO : Chief of Staff

1. One of the major problems is lack of Tactical Vehicles, especially for the 31st Division Artillery, in connection with Service Practice RSOP's being conducted. A letter has been written to the Commanding General, Ft. Jackson, South Carolina, in reference to this subject.

2. Division Artillery is authorized 100% TO&E on 155 and 105 Howitzers, which are on requisition, but is only authorized 30% on Prime Movers for said weapons. A letter was written to Commanding General, Ft. Jackson, requesting 100% TO&E for Tractors, high speed, 13 Ton M5A3, Prime Movers, also. Post has submitted requisitions on above basis.

3. Bayonets are issued on basis of one (1) per Rifle M-1 up to full TO&E strength, and one (1) per ten (10) men for balance of fillers. It is recommended that Bayonets be issued on the basis of one (1) per Rifle M-1 authorized. Knives, Bayonet M-4 are authorized on basis of one (1) per ten (10) Carbines. It is recommended that knives be issued on a basis of one (1) per Carbine.

4. Suspenders and Combat Packs are in short supply. General Sullivan called Army Field Forces to ascertain status of these items, during his visit with the 31st Division last week. General Sullivan indicated that these items would be available at an early date.

5. There has been a critical shortage of Combat Boots, but it is believed that each individual within the Division has at least one (1) pair of issue footwear. Said supply is improving gradually.

6. Steel Helmets were in short supply, but POst received 6,000 yesterday, which should practically complete requirements of the 31st Division.

7. The 31st Division is vitally in need of class room facilities. A letter has been written to Commanding General, Ft. Jackson, requesting ten (10) assembly tents be issued this Division for said purpose.

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8. As mentioned in Par 1, lack of vehicles within the Division is one of the shortages that affect training, but this Division has received copies of Shipping Documents, covering 132, 2½ Ton, 6x6, M-34 Trucks, and a copy of a telephone conversation which indicates an additional allotment of 238 Trucks.

9. With exception of aforementioned items, the supply status of the Division as a whole is satisfactory.

Clifford P. Morrison

CLIFFORD P MORRISON
Lt. Col. GSC
AC of S G-4

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Authority 947030
By CPKARA Date 2/23/07

REDUCED TABLE OF ORGANIZATION

The 31st Division is organized under the reduced strength Table of Organization for an Infantry Division. This Division has approximately 50% overstrength in enlisted men. There are 416 officers away at Army Field Forces' Schools. It was determined that it would be far better to have the Division weak in the beginning and strong in the end as a policy, and therefore a determined effort was made to fill every available quota. Naturally with a reduced T/O strength in officers, further reduced by officers attending school, the problem of training has placed a tremendous burden on those officers remaining. They have accepted this challenge willingly.

It is recommended that an Infantry Division be allowed the full T/O strength in officers. The following list contains the minimum number of officers which should be restored to the T/O in the event the full T/O is not allowed:

Division Headquarters - 3 Capt. Assistants for the G-2 and G-3 Sections, 1 Lt. Postal Officer.

QM Co - 1 Lt. Platoon Leader.

Signal Co - 1 Lt.,Message Center.

Div. Arty. Hq. - 1 Capt. Liaison

AAA AW Bn Hq. - 1 Capt. Adjutant

AAA AW Btrys - 2 Lts. each

Engineer Bn. Hq. - 1 Capt. and 3 Lts. (Adjutant, Assistant S-2, Assistant S-4 Liaison Officer).

Engineer Co. - 1 Platoon Leader

155 MM FA Firing Btrys - 1 Lt. each.

105 MM FA Btrys - 1 Lt. each Firing Btry.

Infantry Bn. Hq. - 1 Capt. Adjutant and 1 Lt. Motor Officer.

Infantry Tank Co. - 2 Lts. Platoon Leaders.

Tank Bn. Hq. - 1 Capt. Adjutant

Tank Bn. Companies - 2 Platoon Leaders each.

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Appendix C: Interview Records

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	16 June 2004
Interview By:	Susan Burtnett/Leigh Blake
Person Interviewed:	Mark Dutton, Natural Resource Specialist Fort Jackson Wildlife Office

Discussion:

Mark Dutton provided information regarding cultural resources at Fort Jackson. He provided GIS maps showing archeological/cultural resource sites (both eligible and ineligible sites).

The maps showed cemeteries located at the installation. Other than a cemetery located north of the Hand Grenade Court No. 2 and the Rifle Grenade Range NR2 in the Weston Lake Area (on the east side of Washington Light Infantry Road), no cultural resources were identified in the other that operational areas evaluated as part of the HRR.

Duded areas were also shown on the maps. These areas are noted so the natural resource staff were aware of the areas at the installation where they are not allowed to enter due to the potential to encounter UXO.

In the Cantonment Area, the area adjacent to Chestnut Road was not surveyed because it was determined to be too disturbed to do a routine cultural resources survey. The forested areas in the Cantonment Area (i.e., the areas where the 600-Yard, 1000-Yard and Machine Gun Ranges and Live Hand Grenade Court 2 are located) have been surveyed. Mark noted that everything east of Chestnut Road has been surveyed, except for areas were structures have been constructed and an irregular shaped area south/southeast of Hilton Field that was shown as duded on an archeological inventory map dated 1990. (Note: this area is not shown as duded on any other maps reviewed.)

The majority of the area near and including Fort Jackson Flight Club (FJFC) was surveyed, with the exception of the duded area adjacent to and east of the FJFC. No potentially eligible or eligible sites were found (surveyed).

The Weston Lake Area, including the areas where the CTT sites (the Mortar Range, Submachine Gun Area, and Hand Grenade Court No 2) are located, has been surveyed. The only cultural resource site identified was the Brazelle cemetery located north of the Rifle Grenade Range NR2. The Rifle Grenade Range NR2 was not surveyed because it is shown as duded on installation maps. The installation maps actually show 3 separate duded areas identified as Rifle Grenade/Hand Grenade/Rifle Grenade in this area.

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	16 June 2004
Interview Made By:	Susan Burtnett/Leigh Blake
Person Interviewed:	Lahiri Estaba, IRP Manager Fort Jackson Environmental Department

Discussion:

Lahiri Estaba provided information regarding Fort Jackson's Installation Restoration Program (IRP) and the sites located near the MMRP ranges/sites where environmental investigations (soil/groundwater sampling) have been conducted. He also provided copies of relevant IRP documents for the team's use.

SWMU 1 (Sanitary Landfill No. 3) and SWMU 34 (Building 2183, Vehicle Wash Pad and Oil Water Separator) are located east/northeast of the Cantonment Area MMRP sites/ranges. In addition, background soil (surface and near-surface) samples were collected near this area. B-6 was obtained approximately ½ mile north of the 1000-Yard Range along Chestnut Road and B-5 was obtained approximately ½ mile south of the 1000-Yard Range.

There are no IRP sites near the FJFC (nothing within at least 5 miles).

SWMU 17 (Inchon OB/OD) is located approximately 5 miles east of the Mortar Range and Submachine Gun Area. Two phases of RFI have been completed and conditional approval has been received from the State. Mr. Estaba noted that the reports have good general soils and groundwater information.

SWMU 21 (Inactive Range 17 Landfill) is also located approximately 5 miles east of the Mortar Range and Submachine Gun Area. Groundwater monitoring has been conducted at this site.

There are no IRP sites west of Weston Lake (i.e., nothing near the Hand Grenade Court No. 2 and Rifle Grenade Range NR2).

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	June 16, 2004
Interview Made By:	Susan Burtnett/Leigh Blake
Person Interviewed:	John Maitland, Lead Forester Fort Jackson Forestry Office

Discussion:

Mr. Maitland was familiar with the areas where the MMRP sites/ranges are located, especially the sites west of the Weston Lake Area. He provided historical aerial photographs of the different sections of the installation where the MMRP sites/ranges are located (from the Forestry Office aerial photograph collection). During a follow-up site visit in July, relevant portions of the aerial photographs were copied and they served as a primary source of site-specific information for the HRR.

The area east/southeast of the Cantonment Area sites/ranges has been logged and replanted with pines at least once in the past.

Recently, slash pines have been planted at and east/southeast of the FJFC.

The sites/ranges located west of Weston Lake (the Hand Grenade Court No. 2 and Rifle Grenade Range NR2) have been surface cleared. Recently, the Rifle Grenade Range NR2 was logged (the area south of the cemetery was logged).

Mr. Maitland noted that there were inconsistencies in how the hand grenade and rifle grenade ranges are shown on the installation maps over the years. The team talked with him about the different ways the ranges are shown. The CTT Inventory identified one range (Rifle Grenade Range NR2), but the previous installation maps show three separate ranges in this area.

The CTT Inventory map shows the Hand Grenade Court No. 2 by Fire Break 12. Mr. Maitland did not remember anything in that area. He noted that is has been logged twice. Slash pine has been planted (Slash pine plantation in the 1970s) and the soil has been significantly disturbed down to at least one foot. This is also the case at the Rifle Grenade Range NR2 where logging has taken place.

Based on review of the aerials, it doesn't look like there was any range activity north of Fire Break 9. The area north of Fire Break 9 has been planted with slash pine, as well.

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	17 June 2004
Interview Made By:	Susan Burtnett/Leigh Blake
Person Interviewed:	SSGT Mark Wood Fort Jackson Range Control

Discussion:

SSGT Wood escorted the data collection team during a limited visual survey of several of the ranges. These included:

- Fort Jackson Flight Club (FJFC)
- Hand Grenade Court No. 2
- Rifle Grenade Range NR2

SSGT Wood provided general descriptions of current uses in the vicinity of these ranges. He noted that the FJFC is used by a club for flying remote controlled model airplanes. The area near the Rifle Grenade Range NR2 has Red Cockaded Woodpecker habitat. He did not have knowledge of historical range use since he has been at Fort Jackson for only the last 3 years.

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	18 June 2004
Interview By:	Susan Burtnett/Leigh Blake
Person Interviewed:	Jim McCracken, NEPA Coordinator Fort Jackson Environmental Department

Discussion:

Jim McCracken provided information regarding the past use of other than operational ranges in the Cantonment Area, the Fort Jackson Flight Club, and the Weston Lake Area.

Cantonment Area
The ranges used during the time period when the installation was Camp Jackson were discussed. These included the 1000-Yard, 600-Yard, 300-Yard, and Machine Gun Ranges. Mr. McCracken noted that the Baseball Field and Soccer Field were constructed in the area where these ranges were located in approximately 1980. The elementary school was constructed later.

Fort Jackson Flight Club (FJFC)
There were several ranges that existed in the area of the FJFC. In addition to the machine gun range, there was a 40mm range north of the area currently used by the FJFC.

Weston Lake Area
The Mortar Range, Submachine Gun Area, Rifle Grenade Range NR2, and Hand Grenade Court No. 2 were discussed. The team noted that the Rifle Grenade Range NR2 is shown differently depending on the map reviewed.

Mr. McCracken noted that there was a long wall located behind the commissary, behind the officer housing area, that he had been told may have been used as a range. Note: the team walked this area on a return site visit in July. The team walked along the wall and noted no bullet holes in the concrete or other visual signs of use as a range. The team did note that the area east of the wall was planted with bamboo at some time in the past. The bamboo plants were well established.

Mr. McCracken provided the data collection team with a map showing the Cantonment Area (Cantonment Area, Fort Jackson, SC, Sheet 1 of 3, September 1945, Army Map SVC, War Department). He also noted that an area located south of Hilton Field was shown on a 1990 map, but this area was not identified on any other maps.

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	18 June 2004
Interview By:	Susan Burtnett/Leigh Blake
Person Interviewed:	Jim Wyatt, Range Control Officer Fort Jackson Range Control

Discussion:

Mr. Wyatt provided maps and other documents (including range sketches) regarding the MMRP ranges/sites. The team discussed the historical range uses and range locations in the following areas:

Cantonment Area:
Mr. Wyatt noted that the area where the Live Hand Grenade Court 2 is located was used for Field Fortification training in the 1970s and 1980s. As such, the area has been significantly disturbed since its use as a hand grenade court.

The team discussed the 300-Yard Range that was identified on archival documents obtained as part of the HRR. Mr. Wyatt agreed that this appears to be an additional range used in the Cantonment Area in the early 1900s.

FJFC:
Mr. Wyatt provided information regarding use of this area as the Saint Lo Range and Salerno Range. The Saint Lo Range was used in 1965 as a combat indoctrination (C/I) range, not as a machine gun range. Later it was converted to the machine gun range. The Salerno Demonstration Range was depicted on a range sketch provided by Mr. Wyatt.

Weston Lake Area:
Mr. Wyatt agreed with the team that the Hand Grenade Court No. 2 and Rifle Grenade Range NR2 are inconsistently shown on installation maps. Review of historical maps and aerial photographs with Mr. Wyatt indicated that hand and rifle grenade use occurred east of Washington Light Infantry Road in the areas where these sites are located.

Historical photographs were reviewed by Mr. Wyatt. Mr. Wyatt noted that he was at Fort Jackson from 1956 – 1966.

He noted that in 1958 training at the installation was moved north so it was centrally located. Everything to the east was closed and the direction of fire was directed that way.

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	28 July 2004
Call Made By:	Leigh Blake
Person Called:	Jim Murphy (803) 751-5614 Fort Jackson Engineering Office

Discussion:

During a telephone conversation, Leigh Blake spoke to Jim Murphy about the 1957 Basic Information for Master Plan, Range, and Training Areas Map (June 1, 1957) that he provided to the team during the Phase 3 CTT Inventory data collection site visit. The map legend on the copy of the map that the data collection team had obtained is faded in several areas. We needed clarification on the missing information for the HRR. Mr. Murphy stated that he would look for the map to see if he could find a better copy.

Note: Ms. Blake followed up with a call to the Fort Jackson Museum (Ms. Bessie Williams and Mr. Fred DeMag) where she was able to obtain the missing information by telephone as museum personnel looked at the copy of the map and helped interpret/convey the missing information. Ms. Williams and Mr. DeMag were also helpful during the site visit in providing historical documents and maps for review while the team was at the Fort Jackson Museum.

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	30 July 2004
Call Made By:	Leigh Blake
Person Called:	Tom Peel (803) 751-7261 Fort Jackson Real Property Office

Discussion:

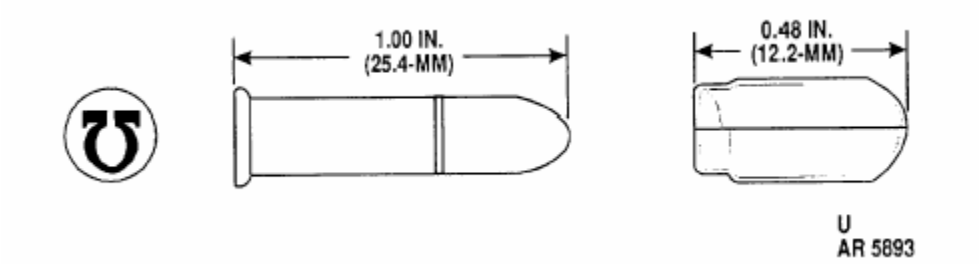
During a telephone conversation, Leigh Blake spoke to Tom Peel about Real Property records for range use and range closure dates. Mr. Peel stated that Leigh would need to speak with Jim Wyatt at Range Control for that information. He stated that he did not have information on ranges.

Mr. Peel noted that there have been no property boundary changes associated with the team's area of interest.

Appendix D: Munitions Technical Data Sheets

Ordnance Technical Data Sheet

.22 Caliber Small Arms



Nomenclature: .22 Caliber Small Arms Ammunition
Ordnance Family: Small Arms
DODIC: A086
Filler: None
Filler weight: None
Item weight: 416 g (416 grain)
Diameter: 5.58 mm (.22 in)
Length: 25.40 mm (1 in)

Usage: Sub-caliber Rifle M2A1; Caliber .22 Rifle; Remington Models 40X and M513T; Steven's Model 416-2; Winchester Models 52 and 75; Machine Gun Trainers M3 and M4; pistols for gallery practice and training purposes. The cartridge is intended for use against small game for survival purposes.

Description: BALL Cartridge. The cartridge is identified by a plain bullet tip.

Reference: Army Technical Manual, TM 43-0001-27

Ordnance Technical Data Sheet

U.S. Carbine Cartridge, .30 Caliber, Ball

Nomenclature: U.S. Carbine Cartridge, .30 Caliber, Ball
Ordnance Family: Small Arms
DODIC: Not Provided
Filler: None
Filler weight: None
Item Weight: Not Provided
Diameter: 7.62 mm (.30 in)
Length: 42.67 mm (1.68 in)

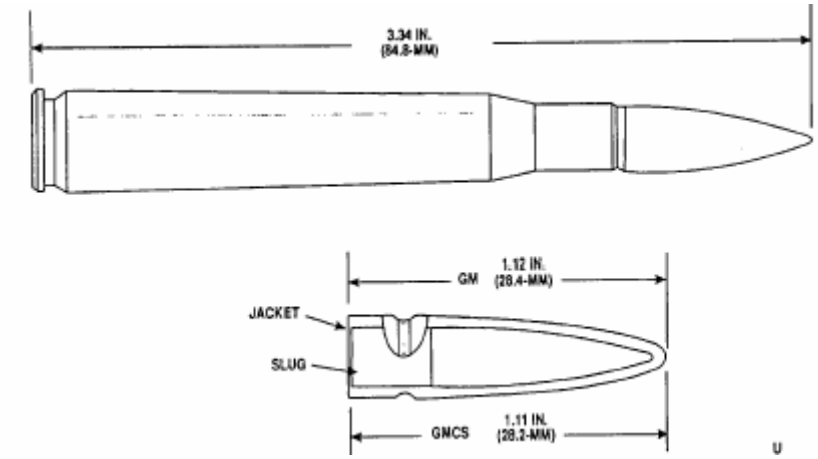
Usage: Standard general purpose small arms ammunition for the M-1 and M1A1 Carbine. The maximum range is 2,012 meters or 2,200 yards.

Description: BALL Cartridge. Ball ammunition is unpainted; tracer ammunition has the tip painted either orange or red.

Reference: Army Technical Manual, TM-9-1300-200.

Ordnance Technical Data Sheet

.30 Caliber Small Arms



Nomenclature:	.30 Caliber Small Arms Ammunition
Ordnance Family:	Small Arms
DODIC:	A212
Filler:	None
Filler weight:	None
Item weight:	26.96 g (416 grains)
Diameter:	7.62 mm (.30 in)
Length:	84.80 mm (3.34 in)

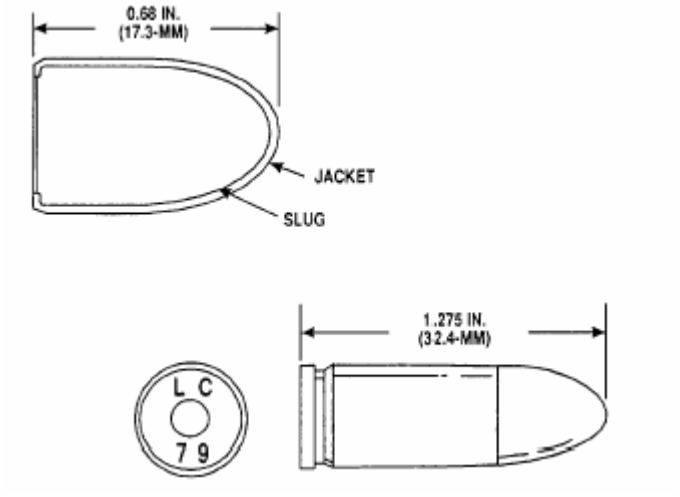
Usage: Machine Guns, Caliber .30, M37, M1919A4 and M1919A6; Rifle, Caliber .30, M1. The cartridge is intended for use against personnel or unarmored targets.

Description: BALL Cartridge. The cartridge is identified by a plain bullet tip.

Reference: Army Technical Manual, TM 43-0001-27

Ordnance Technical Data Sheet

Cartridge Ball .45 Caliber M1911



Nomenclature:	Cartridge Ball .45 Caliber M1911
Ordnance Family:	Small Arms
DODIC:	Not Provided
Filler:	None
Filler weight:	None
Item weight:	332 gr (11.32 oz)
Diameter:	11.43 mm (.45 in)
Length:	32.4 mm (1.275 in)

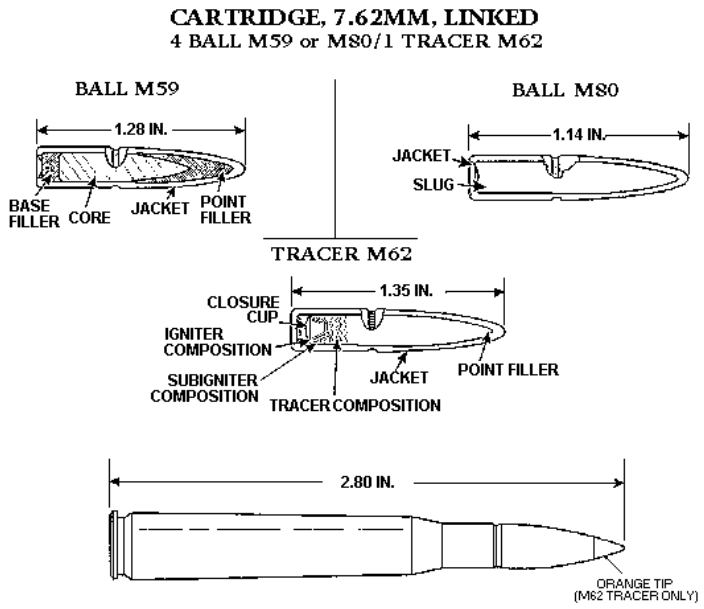
Usage: Submachine Gun, Caliber .45 M3A1; Pistol Caliber .45, M1911A1. The cartridge is intended for use against personnel.

Description: BALL Cartridge. The cartridge is identified by a plain bullet tip.

Reference: Army Technical Manual, TM-0001-27

Ordnance Technical Data Sheet

7.62MM Small Arms



Nomenclature:	7.62MM Small Arms Ammunition
Ordnance Family:	Small Arms
DODIC:	A138
Filler:	None
Filler weight:	None
Item weight:	376.5 g (13.2 oz)
Diameter:	7.62 mm (.3085 in)
Length:	71.12 mm (2.80in)

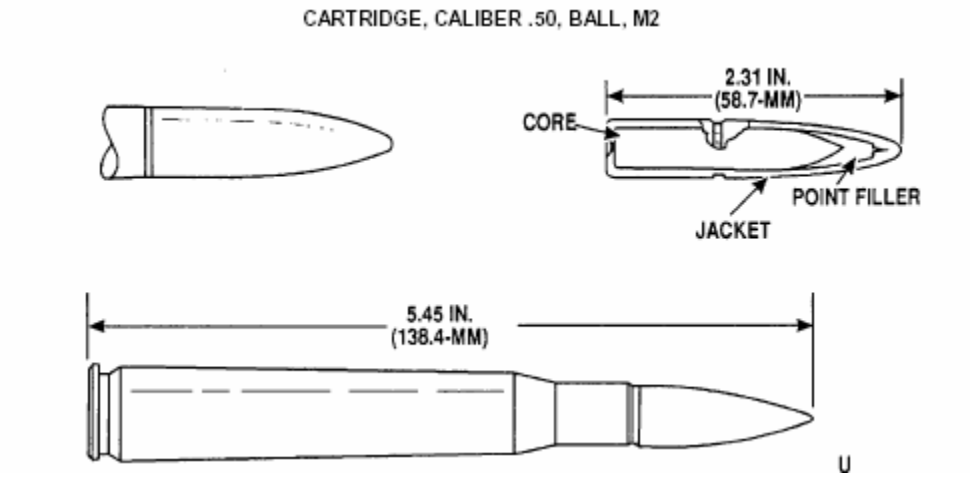
Usage: This cartridge is intended for use against personnel and unarmored targets.

Description: Full metal jacketed bullet and brass cartridge case. Center fired NATO standard small arms.

Reference: ORDATA Online; MIDAS; Army Technical Manual, TM-9-1306-200

Ordnance Technical Data Sheet

.50 Caliber Small Arms



Nomenclature:	.50 Caliber Small Arms Ammunition
Ordnance Family:	Small Arms
DODIC:	A552
Filler:	None
Filler weight:	None
Item weight:	117.50 g (.25 lb)
Diameter:	12.70 mm (.50 in)
Length:	138.40 mm (5.45 in)

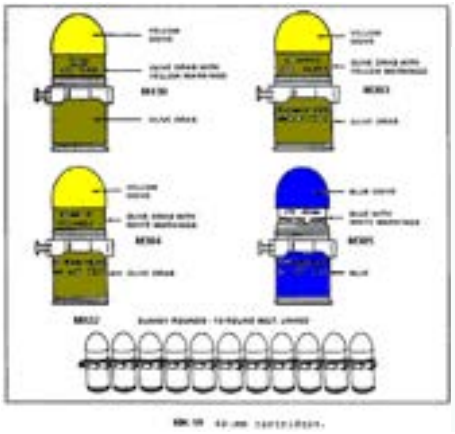
Usage: Machine Guns, Caliber .50, M2 and M85. The cartridge is intended for use against personnel or unarmored targets.

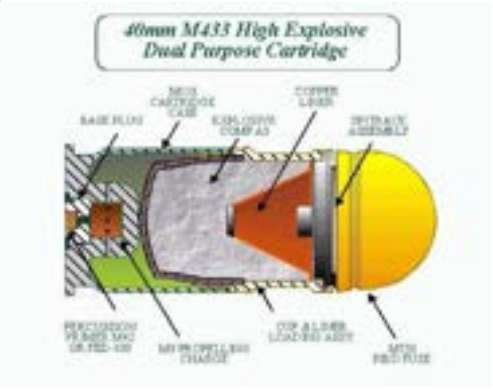
Description: BALL Cartridge. The cartridge is identified by a plain bullet tip.

Reference: Army Technical Manual, TM 43-0001-27

Ordnance Technical Data Sheet

40MM Grenade





Nomenclature: 40MM Grenade
Ordnance Family: Projectile
DODIC: B564
Filler: Explosive Composition A5
Filler weight: ± 57.00 g (2.011 oz)
Item weight: 340 g (11.99 oz)
Diameter: 40 mm (1.57 in)
Length: 79 mm (3.11 in)
Maximum Range: 400 m (437 yds)
Fuze: M550 (Impact Fuze)

Usage: Light Support Weapon. Providing capability for anti-personnel, anti-vehicle, anti-material, and training depending on type of round selected.

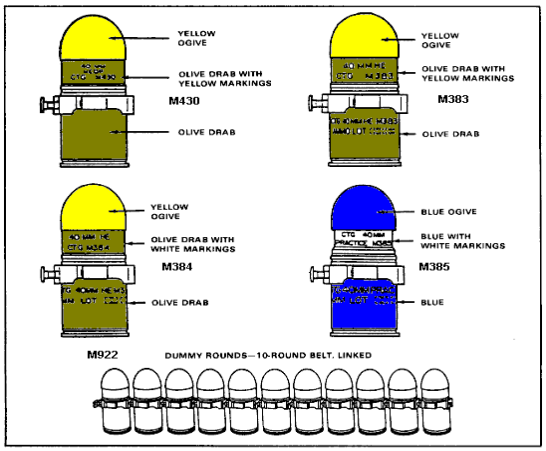
Description: The projectiles are olive drab with anodized gold ogives. The M383 has white markings; the M384 and M677 have yellow markings.

Filler Description: Composition A is a wax coated, granular explosive consisting of TDX and plasticizer wax. It is normally used as a bursting charge.

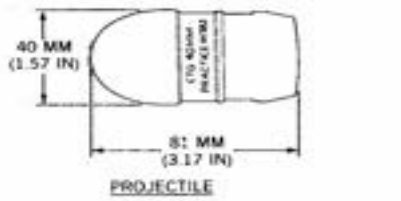
Reference: ORDATA Online

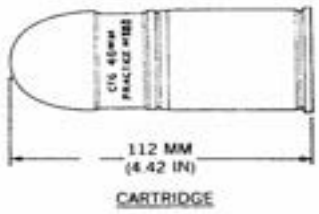
Ordnance Technical Data Sheet

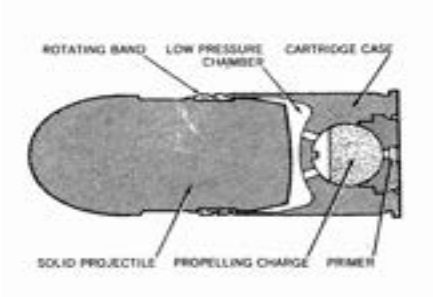
40MM Grenade Practice



MK-19 40-mm cartridges.







Nomenclature:	40MM Grenade Practice
Ordnance Family:	Projectile
DODIC:	B564
Filler:	None
Filler weight:	None
Item weight:	340 g (11.99 oz)
Diameter:	40 mm (1.57 in)
Length:	79 mm (3.11 in)
Range:	50 – 400 m (164 – 1312 ft)
Maximum Range:	400 m (437 yds)
Fuze:	None

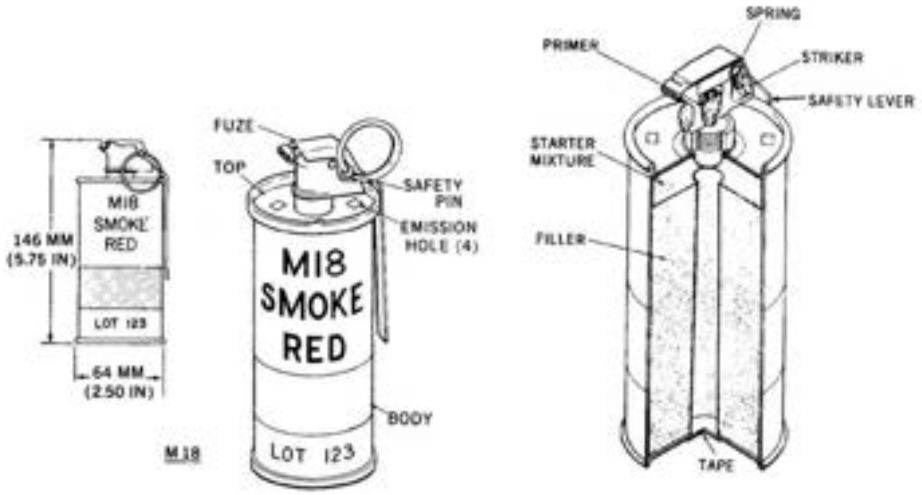
Usage: Light Support Weapon; In-service Training/Familiarization.

Description: The projectile is anodized blue with black markings.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Hand, Smoke, M18



Nomenclature:	U.S. Grenade, Hand, Smoke, M18
Ordnance Family:	Grenades
DODIC:	G955
Filler:	Smoke Mix, Colored
Filler weight:	326.03 g (11.5 oz)
Item weight:	539.00 g (19.01 oz)
Diameter:	64.00 mm (2.52 in)
Length:	146.00 mm (5.748 in)
Maximum Range:	Not Provided
Fuze:	Pyrotechnic, delay-igniting fuze (2 second delay)

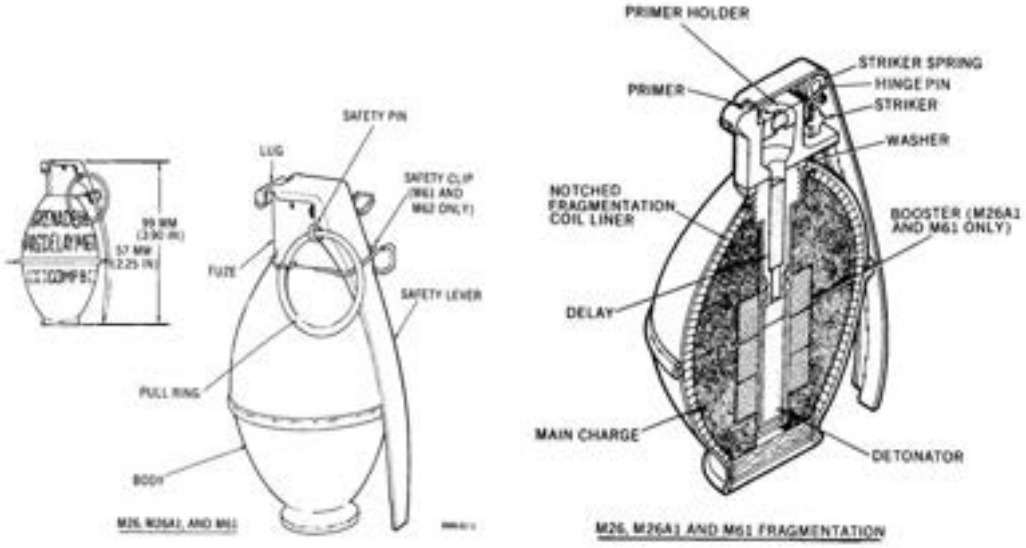
Usage: The M18 is a hand-thrown smoke grenade that emits red, yellow, or violet smoke for 50 to 90 seconds. The M18 may also emit green smoke. These grenades use a pyrotechnic, delay-igniting fuze that provides an approximate 2 second delay.

Description: The M18 grenade may be olive drab with a light green band around the lower body and nomenclature and smoke color stenciled in light green, or light green and stenciled with the color of the smoke. The top of the grenade is painted the color of the smoke.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Hand, Frag, M26, M26A1, M61



Nomenclature:	Hand Grenade, Frag, M26, M26A1, and M61
Ordnance Family:	Grenades
DODIC:	G890
Filler:	Composition B
Filler weight:	164.43 g (5.8 oz)
Item weight:	453.60 g (15.98 oz)
Diameter:	57.00 mm (2.52 in)
Length:	99.00 mm (3.187 in)
Maximum Range:	40.00 m (43.7 yds)
Fuze:	Powder train time delay

Usage: The M26, M26A1, and M61 are fragmentation (frag), antipersonnel, delay-detonating hand grenades that have a notched fragmentation coil liner.

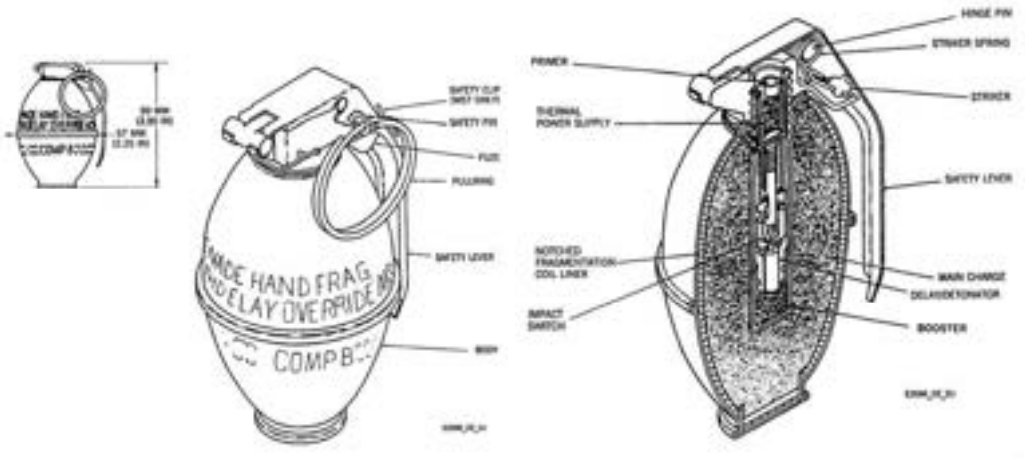
Description: The M26, M26A1, and M61 grenades are painted olive drab, with yellow markings stenciled on the body.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (trinitrotoluene) and RDX (cyclotrimethylenetrinitramine, cyclonite, and hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Hand, Frag, M26A2, M57



Nomenclature:	U.S. Grenade, Hand, Frag, M26A2 and M57
Ordnance Family:	Grenades
DODIC:	Not Provided
Filler:	Composition B
Filler weight:	155.93 g (5.5 oz)
Item weight:	454.00 g (16.01 oz)
Diameter:	57.00 mm (2.244 in)
Length:	99.00 mm (3.898 in)
Maximum Range:	40.00 mm (43.7 yds)
Fuze:	Powder Train Time-delay

Usage: These are fragmentation (frag), antipersonnel, delay-detonating, impact-actuated hand grenades that have a notched fragmentation coil liner.

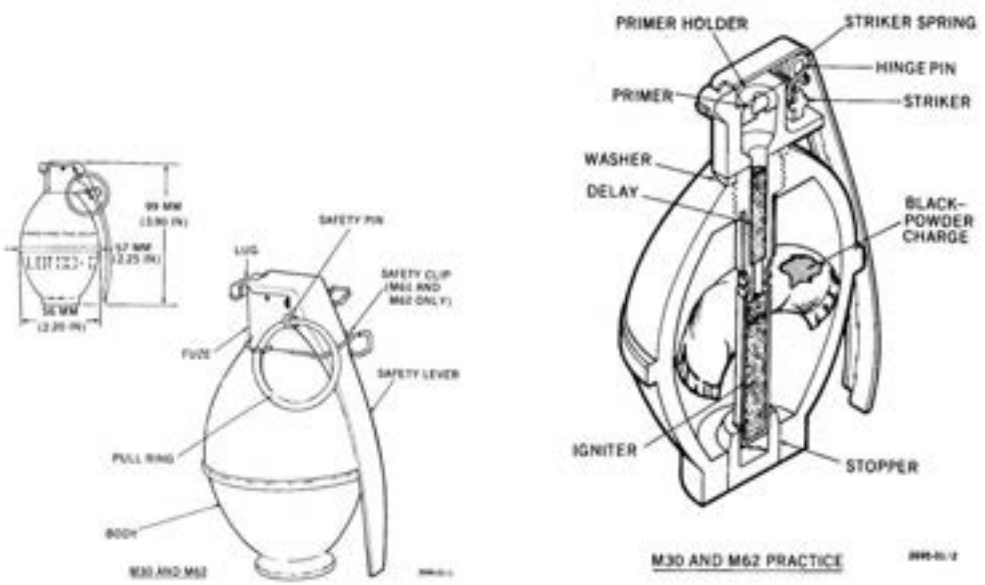
Description: The grenade is olive drab with markings stenciled in yellow. The safety lever is red. The word "IMPACT" is embossed on newer models and may or may not be stenciled in black on older models.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (trinitrotoluene) and RDX (cyclotrimethylenetrinitramine, cyclonite, and hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Practice, M30 and M62



Nomenclature:	U.S. Grenade, Practice, M30 and M62
Ordnance Family:	Grenades
DODIC:	G810
Filler:	Black Powder (Witness Charge Only)
Filler weight:	1.00 g (.03527 oz)
Item weight:	454.00 g (16.01 oz)
Diameter:	57.00 mm (2.244 in)
Length:	99.00 mm (3.898 in)
Maximum Range:	40.00 mm (43.7 yds)
Fuze:	Powder Train Time-delay

Usage: The M30 and M62 are standard, practice, delay-detonating hand grenades. The M30 is the practice version of the M26 and M26A1 grenades; the M62 is the practice version of the M61 grenade.

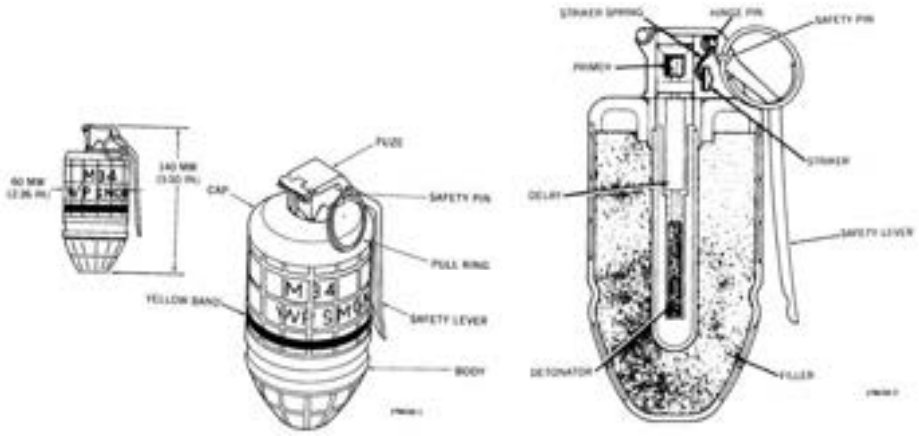
Description: The M30 and M62 grenades are blue, with a brown band around the body or neck. Markings, if any, are stenciled in white.

Filler (Witness Charge) Description: Black powder is a low explosive composed of potassium nitrate or sodium nitrate, charcoal, and sulfur. It is very sensitive to heat, friction, or spark. It was used in safety fuses and practice munitions. It is no longer used as a propellant or bursting charge.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Hand, Smoke, WP, M34



Nomenclature:	U.S. Grenade, Hand, Smoke, WP, M34
Ordnance Family:	Grenades
DODIC:	G937
Filler:	Smoke Mix (White Phosphorus)
Filler weight:	425.25 g (15 oz)
Item weight:	680.00 g (23.99 oz)
Diameter:	60.00 mm (2.362 in)
Length:	140.00 mm (5.512 in)
Maximum Range:	Not Provided
Fuze:	Powder Train Time-delay

Usage: This is a hand-thrown, bursting, smoke-producing grenade. It may also be launched by ground or by airborne grenade launchers.

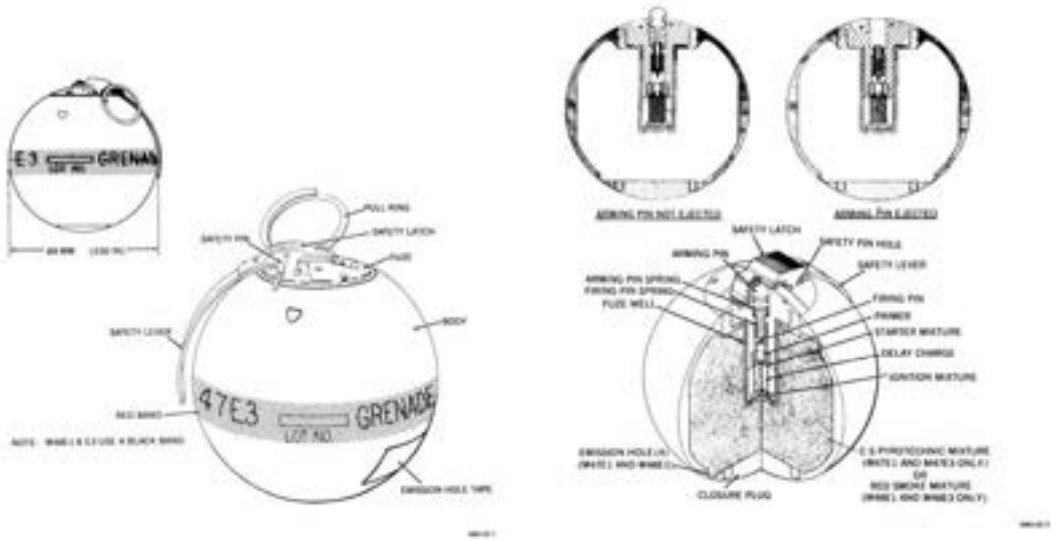
Description: The grenade is painted light green or gray, with one yellow band around the circumference. Nomenclature is stenciled in light red or yellow. The fuze is olive drab with black markings.

Filler Description: White phosphorus (WP) is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Hand, Red Smoke, M48E1 (Obsolete) and M48E3



Nomenclature:	U.S. Grenade, Hand, Red Smoke, M48E1 and M48E3
Ordnance Family:	Grenades
DODIC:	G932
Filler:	Smoke, Red/Pyrotechnic Mix
Filler weight:	142.00 g (5.009 oz)
Item weight:	390.00 g (13.76 oz)
Diameter:	89.00 mm (3.504 in)
Length:	Not provided
Maximum Range:	Not provided
Fuze:	Powder Train Time-delay

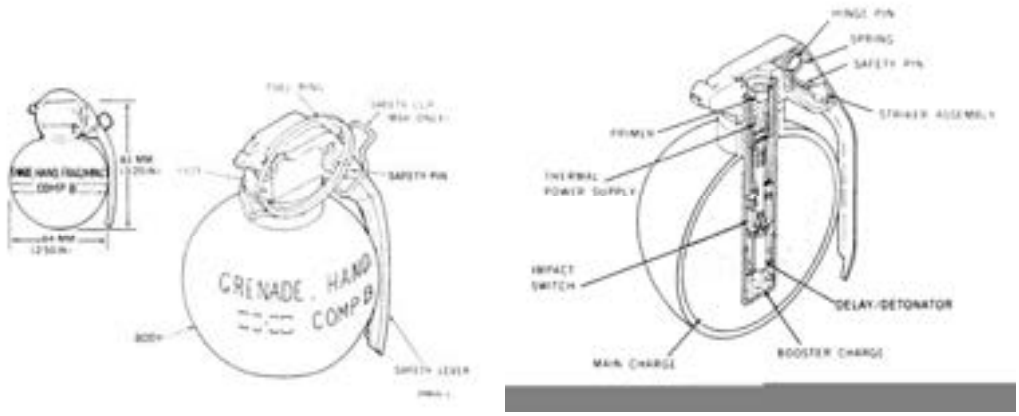
Usage: The M48E1 and M48E3 produce a red-smoke cloud used for training. These are the training grenades for the M47E1 and M47E3.

Description: The M48E1 and M48E3 are painted light green, with a black band and markings stenciled in black.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Hand, Frag, M59 and M68



Nomenclature:	U.S. Grenade, Hand, Frag, M59 and M68
Ordnance Family:	Grenades
DODIC:	G882
Filler:	Composition B
Filler weight:	198.45 g (7 oz)
Item weight:	397.00 g (14 oz)
Diameter:	64.00 mm (2.52 in)
Length:	81.00 mm (3.198 in)
Maximum Range:	Not Provided
Fuze:	Powder Train Time-delay

Usage: These are fragmentation (frag), antipersonnel, impact-activated hand grenades. They use the M217 fuze with a self-destruct delay-detonating feature.

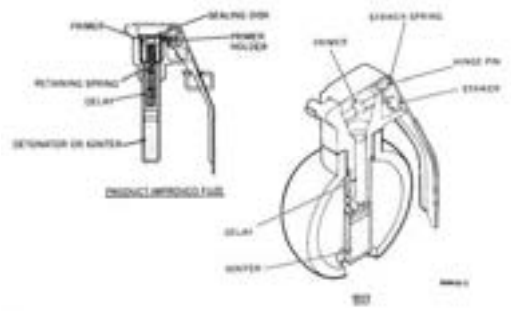
Description: The grenades are olive drab, with markings stenciled in yellow. The fuzes are olive drab with black stenciling.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (trinitrotoluene) and RDX (cyclotrimethylenetrinitramine, cyclonite, and hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenades, Hand, Practice, M69



Nomenclature: U.S. Grenades, Hand, Practice, M69
Ordnance Family: Grenades
DODIC: G918
Filler: None
Filler weight: None
Item weight: 397.00 g (13.37 oz)
Diameter: 64.00 mm (2.52 in)
Length: 90.00 mm (3.543 in)
Maximum Range: Not Provided
Fuze: Powder Train Time-delay

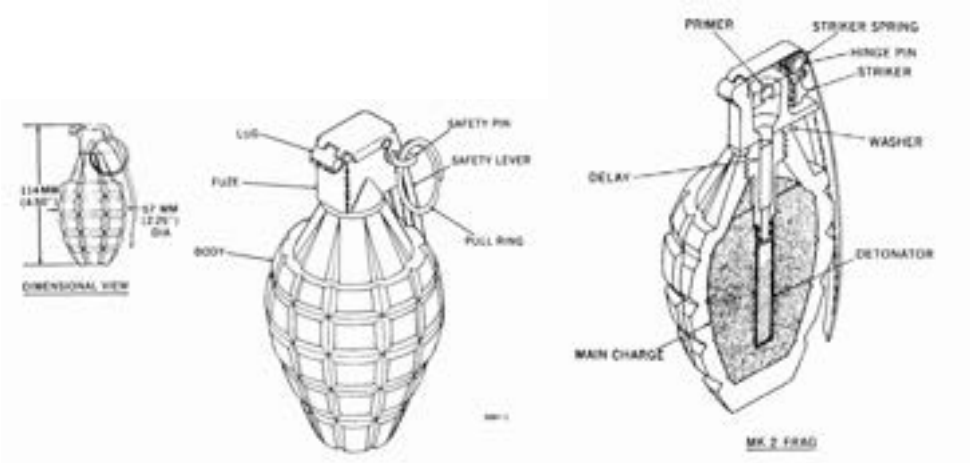
Usage: The M69 is a standard-delay practice version of the M33 and M67 grenades. The M33 and M67 are fragmentation (frag), antipersonnel (apers), delay-detonating hand grenades.

Description: The M69 is blue with a brown band around the body or neck.

Reference: ORDATA Online

Ordnance Technical Data Sheet

MK 2 Grenade, Hand, Antipersonnel



Nomenclature:	MK 2 Grenade, Hand, Antipersonnel
Ordnance Family:	Grenade
DODIC:	G890
Filler:	Flaked TNT
Filler weight:	± 56.70 g (2 oz)
Item weight:	589.68 g (1.3 lbs)
Diameter:	57.00 mm (2.244 in)
Length:	114.00 mm (4.88 in)
Maximum Range:	10.00 m (10.44 yds)
Fuze:	Not Provided

Usage: Fragmentation (frag), antipersonnel, delay-detonating hand grenade.

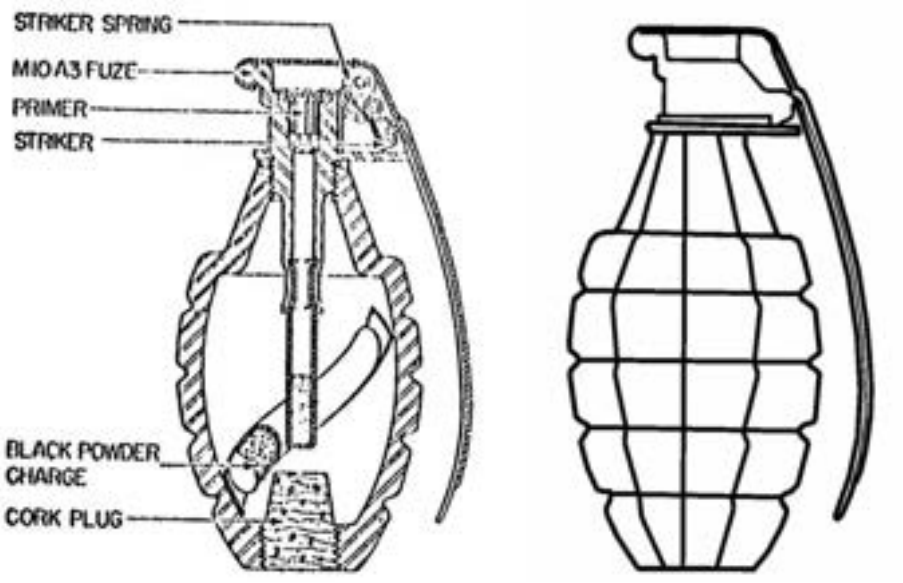
Description: The MK 2 grenade is painted olive drab, with a yellow band around the top of the fuze well. The grenade is referred to as the "Pineapple" because its shape and external serrations resemble a pineapple.

Filler Description: TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. In a refined form, it is one of the most stable high explosives. It is also used as a constituent of other explosives, including Amatol, Pentolite, Tetrytol, Tritonal, Picratol, and Composition B.

Reference: ORDATA Online, Army Field Manual FM 3-23.30

Ordnance Technical Data Sheet

U.S. Grenade, Practice, MK II (2)



Nomenclature:	U.S. Grenade, Practice, MK II (2)
Ordnance Family:	Grenades
DODIC:	G915
Filler:	Black Powder (Witness Charge Only)
Filler weight:	28.35 g (1 oz)
Item weight:	580.61 g (20.48 oz)
Diameter:	57.17 mm (2.25 in)
Length:	114.30 mm (4.5 in)
Maximum Range:	Not Provided
Fuze:	Powder Train Time-delay

Usage: This grenade consists of a fragmentation body with a filing hole in the base, an Igniting Fuze M206, a small charge of black powder, and a cork plug that is placed in the filling hole. Extra fuzes, charges, and plugs are supplied separately, so that the grenade body can be reused.

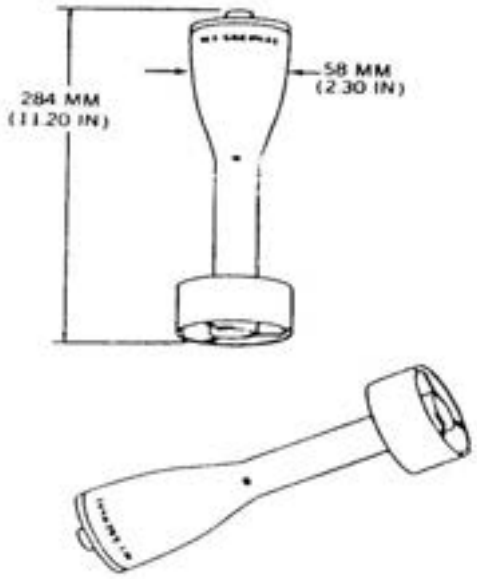
Description: The body is light blue.

Filler (Witness Charge) Description: Black powder is a low explosive composed of potassium nitrate or sodium nitrate, charcoal, and sulfur. It is very sensitive to heat, friction, or spark. It was used in safety fuses and practice munitions. It is no longer used as a propellant or bursting charge.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Rifle, M9



Nomenclature:	U.S. Grenade, Rifle, M9
Ordnance Family:	Grenades
DODIC:	Obsolete
Filler:	TNT
Filler weight:	113.40 g (4 oz)
Item weight:	557.00 g (19.68 oz)
Diameter:	58.00 mm (2.283 in)
Length:	284.00 mm (11.18 in)
Maximum Range:	Not Provided
Fuze:	Point-detonating Fuze

Usage: The M9 is an earlier model of the M9A1. It has the same tail assembly, but the head is acorn-shaped and equipped with a point-detonating fuze. The shrouded fin assembly aids in stabilization. It is slightly less sensitive than the M9A1. The safety pin of the M9 is located in the base of the grenade body instead of in the stabilizer tube. The pull ring is secured to the body with adhesive tape.

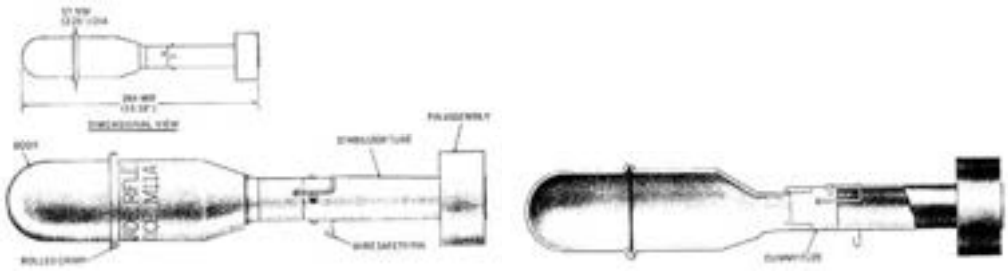
Description: The grenade is painted olive drab.

Filler (Main Charge) Description: TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. In a refined form, it is one of the most stable high explosives. It is also used as a constituent of other explosives, including Amatol, Pentolite, Tetrytol, Tritonal, Picratol, and Composition B.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Practice, Inert, M11 Series



Nomenclature: U.S. Grenade, Practice, Inert, M11 Series
Ordnance Family: Grenades
DODIC: G980
Filler: None
Filler weight: None
Item weight: 558.00 g (19.68 oz)
Diameter: 57.00 mm (2.244 in)
Length: 284.00 mm (11.18 in)
Maximum Range: Not Provided
Fuze: N/A

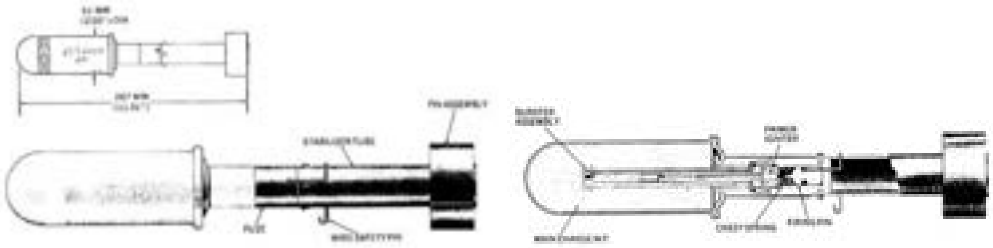
Usage: Rifle-projected grenades, except for the M11 Series, contain a simple impact inertia, base detonating fuze. The M11 Series practice grenade contains a dummy fuze that only has a safety pin hole.

Description: The grenades are painted blue or black, with white markings.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Rifle, Smoke, HC, M20



Nomenclature: U.S. Grenade, Rifle, Smoke, HC, M20
Ordnance Family: Grenades
DODIC: Not Provided (obsolete)
Filler: Smoke Mix, HC
Filler weight: 306.00 g (10.79 oz)
Item weight: 712.00 g (25.12 oz)
Diameter: 51.00 mm (2.008 in)
Length: 287.00 mm (4.3 in)
Maximum Range: Not Provided
Fuze: Impact Inertia, Base Detonating Fuze

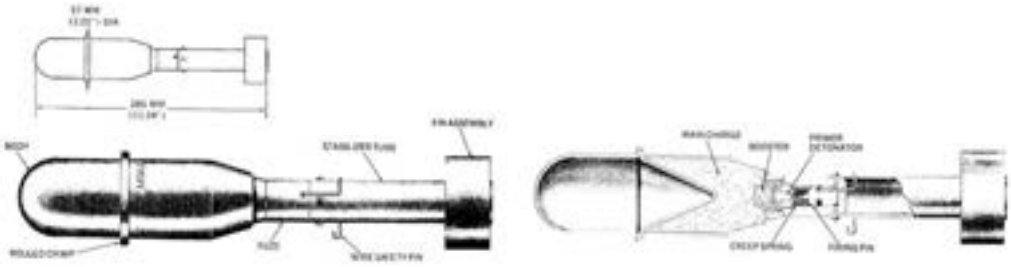
Usage: These are rifle-projected grenades that, except for the M11 series, contain a simple impact inertia, base detonating fuze.

Description: The painting and markings for each grenade are either light gray or light green with yellow markings.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Rifle, HEAT, M9A1 and M9A2



Nomenclature:	U.S. Grenade, Rifle, HEAT, M9A1 and M9A2
Ordnance Family:	Grenades
DODIC:	Not Provided (Obsolete)
Filler:	Pentolite
Filler weight:	113.40 g (4 oz)
Item weight:	558.00 g (1.23 lbs)
Diameter:	57.00 mm (2.244 in)
Length:	285.00 mm (11.22 in)
Maximum Range:	Not Provided
Fuze:	Impact Inertia, Base Detonating Fuze

Usage: These are rifle-projected High Explosive Anti-Tank (HEAT) rifle grenades that contain a simple impact inertia, base detonating fuze.

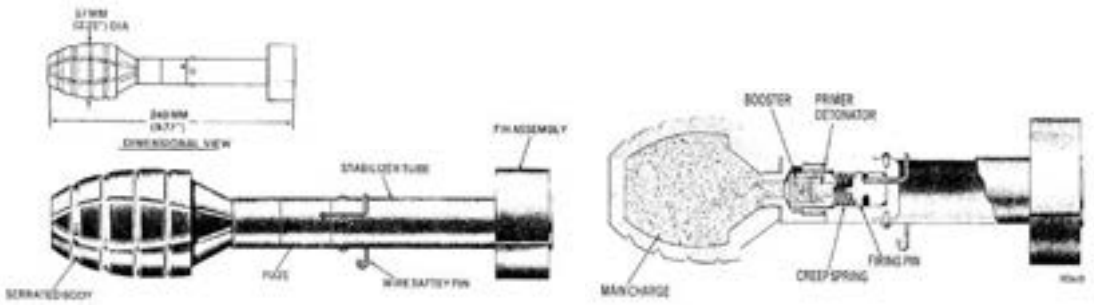
Description: The grenades are olive drab or black with yellow markings.

Filler (Main Charge) Description: Pentolite is composed of explosives, including TNT.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Rifle, Fragmentation, M17



Nomenclature:	U.S. Grenade, Rifle, Fragmentation, M17
Ordnance Family:	Grenades
DODIC:	Obsolete
Filler:	Flaked TNT
Filler weight:	22.00 g (.776 oz)
Item weight:	667.00 g (23.53 oz)
Diameter:	57.00 mm (2.244 in)
Length:	248.00 mm (9.764 in)
Maximum Range:	120 m (131 yds)
Fuze:	Impact Inertia, Base Detonating Fuze

Usage: These are rifle-projected grenades that contain a simple impact inertia, base detonating fuze.

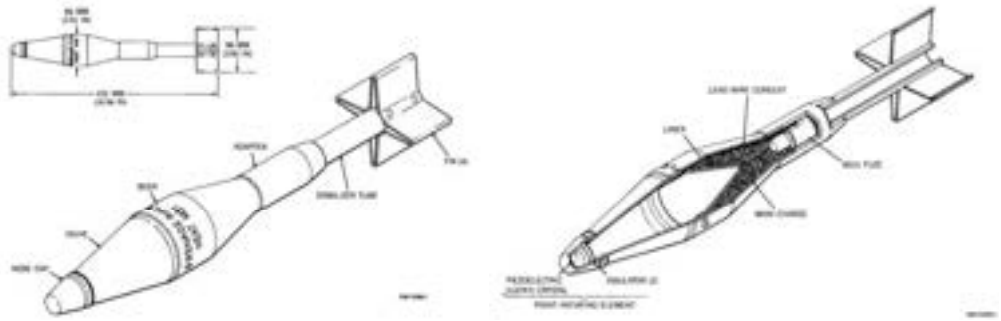
Description: The painting and markings for each grenade are olive drab, with yellow markings.

Filler (Main Charge) Description: TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. In a refined form, it is one of the most stable high explosives. It is also used as a constituent of other explosives, including Amatol, Pentolite, Tetrytol, Tritonal, Picratol, and Composition B.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Rifle, HEAT, M31



Nomenclature:	U.S. Grenade, Rifle, HEAT, M31
Ordnance Family:	Grenades
DODIC:	G970
Filler:	Composition B
Filler weight:	280.67 g (9.9 oz)
Item weight:	708.00 g (24.97 oz)
Diameter:	66.00 mm (2.598 in)
Length:	431.00 mm (16.97 in)
Maximum Range:	200 m (218.7 yds)
Fuze:	Point-initiating Base-detonating Fuze, M211

Usage: This is a fin-stabilized high-explosive antitank rifle grenade that has an integral setback-armed, point-initiating base-detonating fuze (M211) that contains a piezoelectric crystal and an electric detonator.

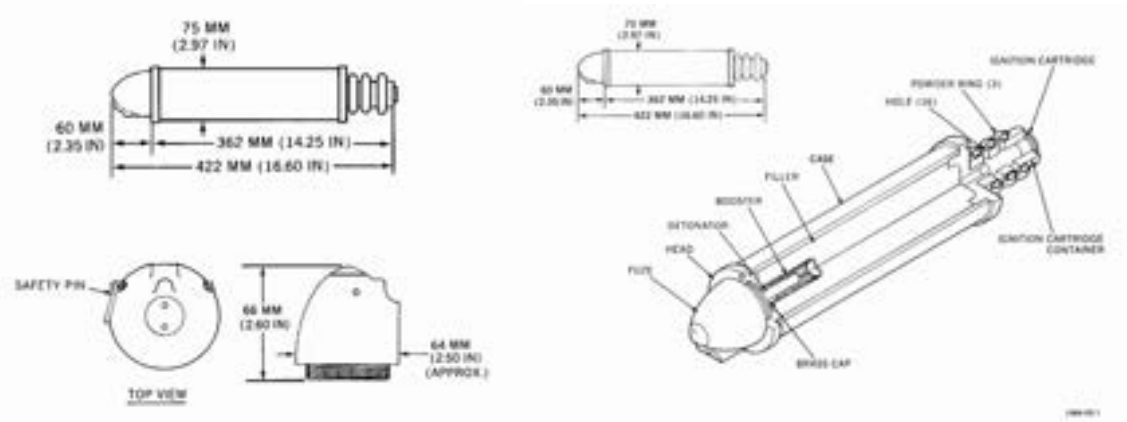
Description: The grenade is painted olive drab and the markings are in yellow. The practice version is painted blue with white markings.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (trinitrotoluene) and RDX (cyclotrimethylenetrinitramine, cyclonite, and hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

3-Inch Stokes Mortar



Nomenclature:	Mortar, 3-inch Stokes, WP, MK 1 and Practice MK 1
Ordnance Family:	Projectile
DODIC:	Not Provided (obsolete)
Filler:	White Phosphorus (plasticized)
Filler weight:	1.10 kg (2.425 lbs)
Item weight:	5.70 kg (12.57 lbs)
Diameter:	75 mm (2.953 in)
Length:	362 mm (14.25 in)
Maximum Range:	731 m (800 yds)
Fuze:	MK VI Setback-armed, Impact-inertia Fired, All-ways Acting

Usage: The Stokes is a mortar-fired, white phosphorus (WP), or practice cartridge. The WP cartridge is used for screening and against personnel.

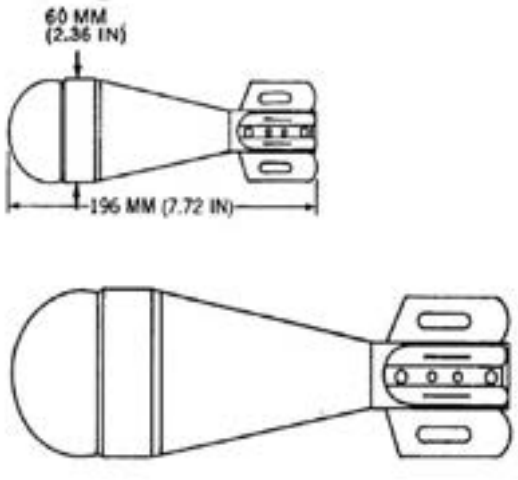
Description: The WP case is painted blue-gray with yellow stenciling; the practice case is painted dark blue with white stenciling. The heads of the cases are stamped with the name and mark number of the case, lot number of unfilled cases, inspector's stamp, and initials or symbol of the manufacturer of the metal parts. The cases are stenciled to show the caliber and type, mark number, filler, lot number, and the date and place loaded.

Filler Description: WP is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 60MM, Mortar, Drill, M69



Nomenclature: U.S. Projectile, 60MM, Mortar, Drill, M69
Ordnance Family: Projectile
DODIC: Not Provided
Filler: None
Filler weight: None
Item weight: 2.1 kg (4.63 lbs)
Diameter: 60.00 mm (2.36 in)
Length: 196.00 mm (7.27 in)
Maximum Range: 301.00 m (330 yds)
Fuze: None

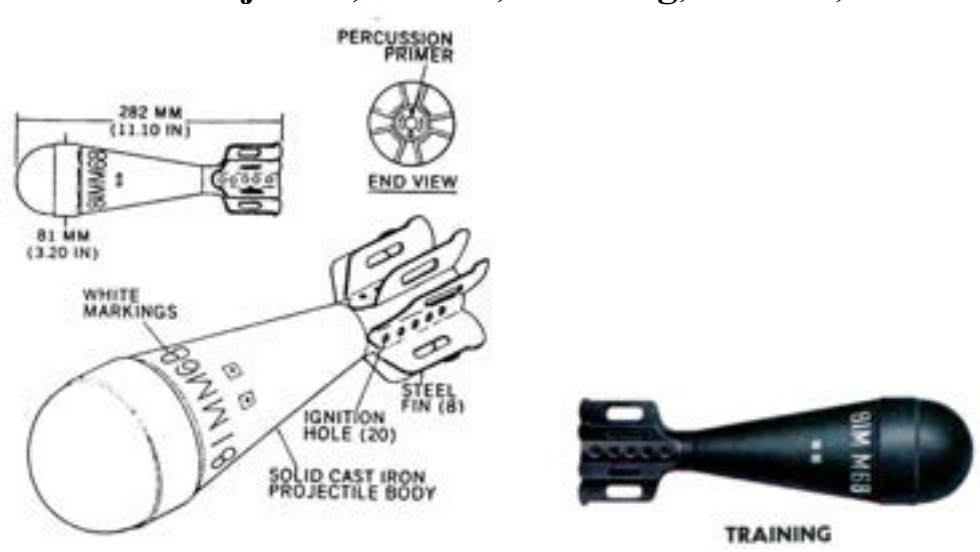
Usage: These projectiles are completely inert and simulate service projectiles for use in training, handling, loading, display, and instruction.

Description: Current projectiles are painted blue, earlier manufactured projectiles are painted black.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 81MM, Training, Mortar, M68



Nomenclature:	U.S. Projectile, 81MM, Training, Mortar, M68
Ordnance Family:	Projectiles
DODIC:	C228
Filler:	None
Filler weight:	None
Item weight:	4.89 kg (10.78 lbs)
Diameter:	81.00 mm (3.189 in)
Length:	282.00 mm (11.1 in)
Maximum Range:	301.00 m (330 yds)
Fuze:	None

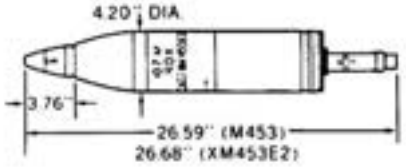
Usage: This is an Army, fin-stabilized, mortar-fired projectile used for training on the loading and firing of the mortar weapon system.

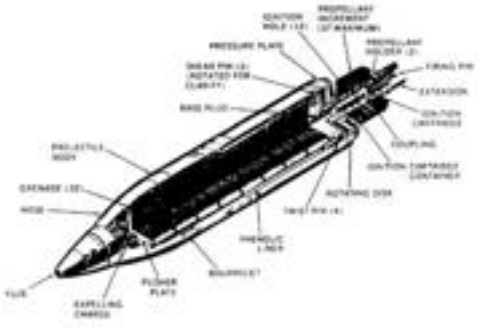
Description: Currently manufactured projectiles are painted blue, earlier manufactured projectiles are painted black.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 4.2-IN (107MM), HE, XM453E2 and M453





Nomenclature: 4.2 Inch (107MM), HE, XM453E2 and M453
Ordnance Family: Projectiles
DODIC: Not Provided
Filler: RDX
Filler weight: 680.40 g (1.5 lbs)
Item weight: 14.06 kg (31 lbs)
Diameter: 107.00 mm (4.2 in)
Length: 675.00 mm (26.57 in)
Maximum Range: Not Provided
Fuze: Mission Dependent

Usage: The general appearance, dimensions, and arrangement of the XM453E2 and M453 4.2-inch (107mm) HE cartridges are shown in the figure above. When the XM453E2 cartridge was type classified, it was designated M453.

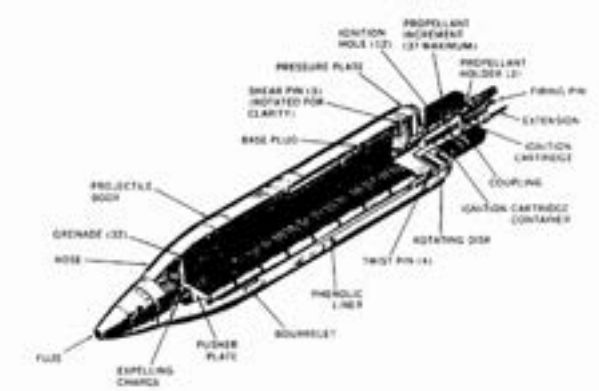
Description: The projectile is painted olive drab with markings stenciled in yellow. The identifying features of the cartridges are shown in the figure.

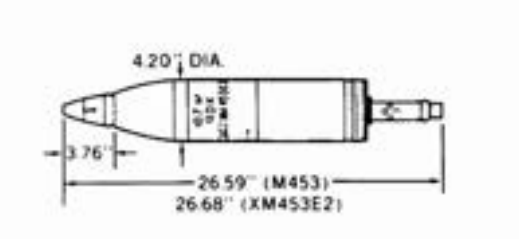
Filler Description: RDX is composed of Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen. It is very stable and is considered the most powerful and brisant of the military high explosives. Although rarely used alone, it is often used in/with other explosives. RDX forms the base for Composition A, B, and C; HBX; H-6; and Cyclotol.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 4.2-IN (107MM)





Nomenclature:	U.S. Cartridge, 4.2 Inch (107MM)
Ordnance Family:	Projectiles
DODIC:	Not Provided
Filler:	RDX
Filler weight:	680.40 g (1.5 lbs)
Item weight:	14.06 kg (31 lbs)
Diameter:	107.00 mm (4.2 in)
Length:	675.00 mm (26.57 in)
Maximum Range:	3,658 m (4,000 yds)
Fuze:	Mission Dependent

Usage: These are Army, spin-stabilized, mortar-fired, high explosive projectiles.

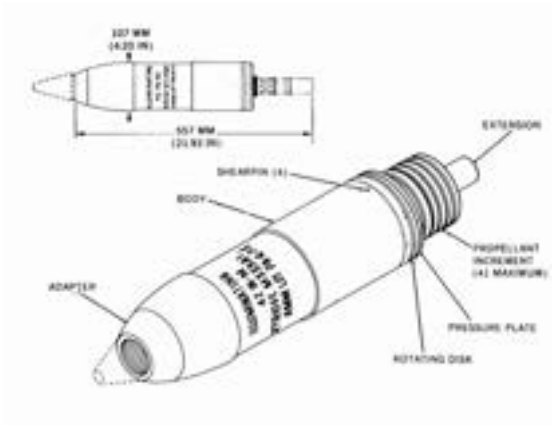
Description: The complete round consists of a projectile body, fuze, and tail assembly. The projectile body is painted olive drab with yellow markings.

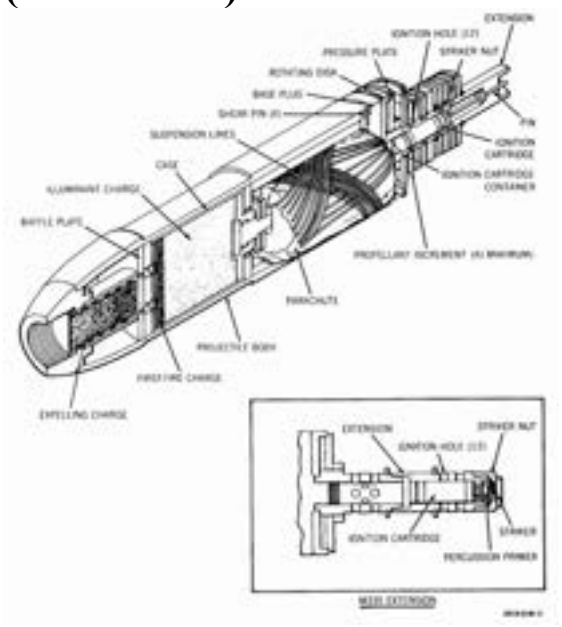
Filler Description: RDX is composed of Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen. It is very stable and is considered the most powerful and brisant of the military high explosives. Although rarely used alone, it is often used in/with other explosives. RDX forms the base for Composition A, B, and C; HBX; H-6; and Cyclotol.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 4.2-IN (107MM), Illuminating, M335, M335A1, and M335A2 (M335A1E1)





Nomenclature:	Stokes 4.2 inch (107mm) Mortar, Illuminating, M335
Ordnance Family:	Projectile
DODIC:	C706
Filler:	Illuminant Mix
Filler weight:	1.60 kg (3.527 lbs)
Item weight:	11.80 kg (26.01 lbs)
Diameter:	107.00 mm (4.213 in)
Length:	577.00 mm (21.93 in)
Maximum Range:	Not provided
Fuze:	Not provided

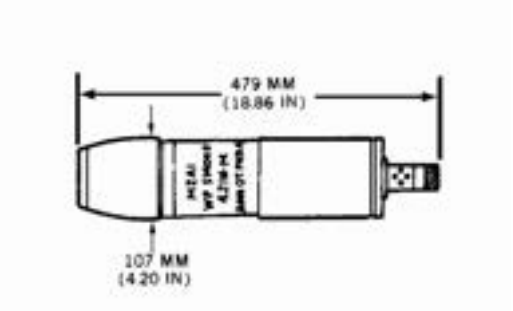
Usage: These are Army, spin-stabilized projectiles containing a base-ejected, parachute suspended illuminant charge. They are fired from mortars when illumination is required.

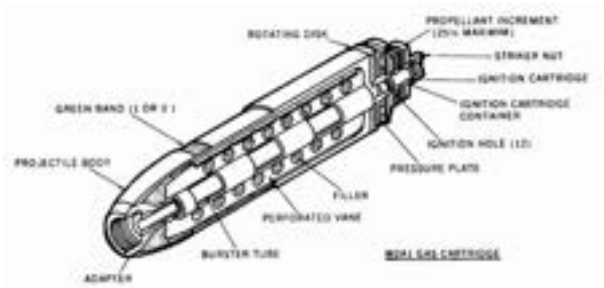
Description: Cartridges have either white projectile bodies with black identification markings or are painted gray with one white band and white identification markings.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 4.2-Inch (107MM), Smoke, WP, M2, M2A1





Nomenclature: Stokes 4.2-inch Mortar, Smoke (WP)
Ordnance Family: Projectile
DODIC: C708
Filler: Smoke Mix (White Phosphorus)
Filler weight: 3.40 kg (7.496 lbs)
Item weight: 11.30 kg (24.91 lbs)
Diameter: 107.00 mm (4.2 in)
Length: 479.00 mm (18.86 in)
Fuze: Not Provided

Usage: These are Army spin-stabilized projectiles fired from mortars to produce screening or spotting smoke and incendiary effects. The projectiles are filled with white phosphorus (WP), some obsolete M2-series smoke cartridges have a substitute filler of titanium tetrachloride (FM) or sulfur trioxide-chlorsulfonic acid (FS).

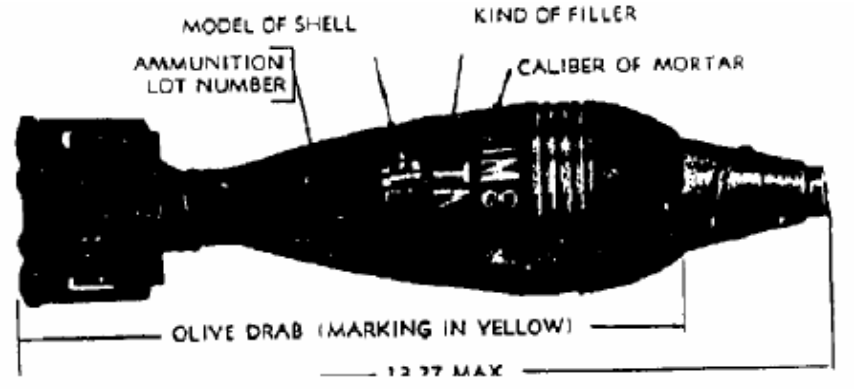
Description: Currently manufactured projectiles have light green projectile bodies with one yellow band and light red identification markings. Earlier manufactured projectiles have gray bodies with one yellow band and yellow markings.

Filler Description: WP is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 81MM, HE, M43A1



Nomenclature:	81MM, HE, Mortar
Ordnance Family:	Projectile
DODIC:	C225
Filler:	TNT
Filler weight:	553.39 kg (1.22 lbs)
Item weight:	3.20 kg (7.055 lbs)
Diameter:	81 mm (3.189 in)
Length:	337.06 mm (13.27 in)
Maximum Range:	2,400 m (2,625 yards)
Fragmentation Distance:	612.3 m (2,009 ft)
Fuze:	Various

Usage: The shell was originally adapted as the light shell for the 81mm mortar. It is designed for use against light targets, such as machine gun nests, barbed wire entanglements, and personnel in the open.

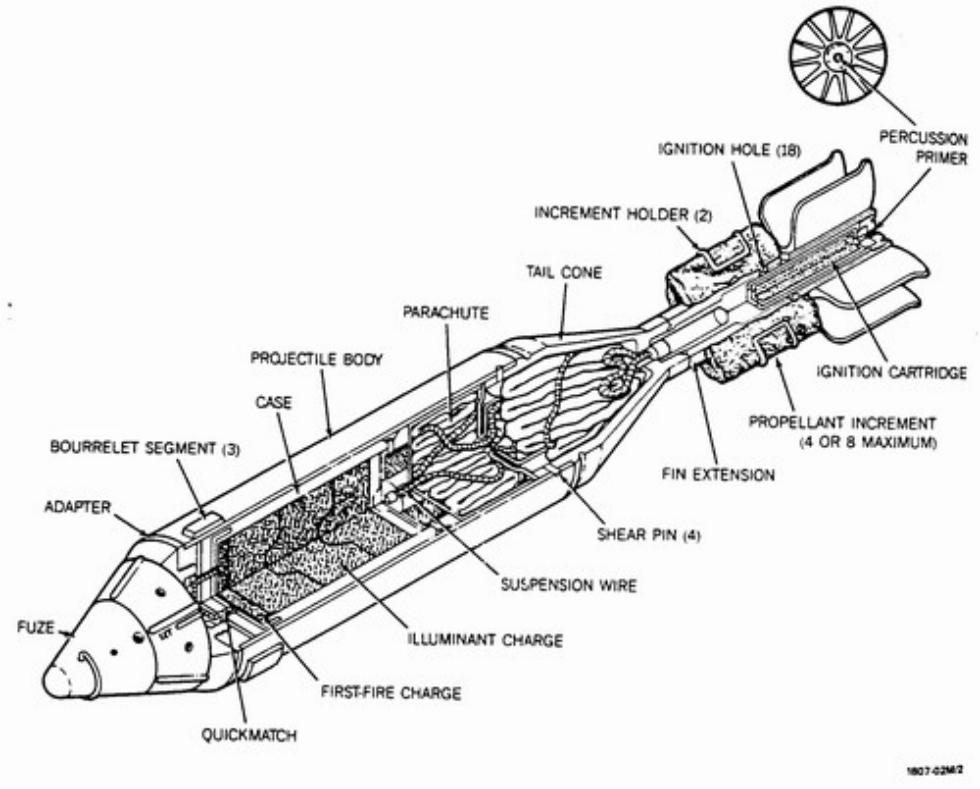
Description: The body is olive drab with yellow markings. The body, filler, adapter, and bakelite fuze well cup are exactly the same as in the M43. The fuze used is the Point-detonating Fuze M52, which has a super quick action. Due to the light weight and blunt nose of this shell, very little penetration can be obtained. This shell is designed to produce fragments as its primary function against personnel in the open and against barbed wire entanglements. Fragments to be effective must be above ground. A super quick fuze is used to burst the shell above ground. The body of the shell is constructed of forged steel.

Filler Description: TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. In a refined form, it is one of the most stable high explosives. It is also used as a constituent of other explosives, including Amatol, Pentolite, Tetrytol, Tritonal, Picratol, and Composition B.

Reference: ORDATA Online

Ordnance Technical Data Sheet

81MM Mortar



Nomenclature:	81MM (3.18in) Mortar
Ordnance Family:	Projectile
DODIC:	C225
Filler:	Round Dependent (Illuminant Charge)
Filler weight:	± 645.00 g
Item weight:	3.4 kg (7.5 lbs)
Diameter:	81 mm (3.189 in)
Length:	571.00 mm (23.20 in)
Maximum Range:	2,400 m (2,625 yds)
Fuze:	M935 Point Detonating Fuze or M734/734A1 Multi-Option Fuze

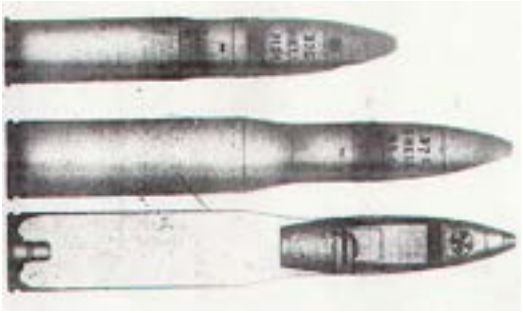
Usage: A Light Support Weapon that provides capability for high explosive, screening smoke, and illumination rounds delivered out to a maximum range of 2,400 m.

Description: The projectiles are painted white with stenciled black identification markings on the projectile bodies. Projectiles also may be gray with a white band and white markings.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 37MM, Gun, HE, M54A1



Nomenclature:	37MM Projectile, High Explosive
Ordnance Family:	Projectile
Filler:	Tetryl
Filler weight:	45.36 g (1.6 oz)
Item weight:	1.188 kg (2.62 lbs)
Diameter:	37.00 mm (1.457 in)
Length:	325.4 mm (12.81 in)
Maximum Range:	11,750 m (12,850 yds)
Fuze:	M56 Fuze

Usage: This general purpose projectile is used for blast and fragmentation effect against personnel, unarmored material targets, and aircraft. It has a substantial high explosive (HE) main charge. The projectile has a relatively thin to medium body-wall thickness. The fragmentation effect results from fracture of the body wall on detonation of the main charge.

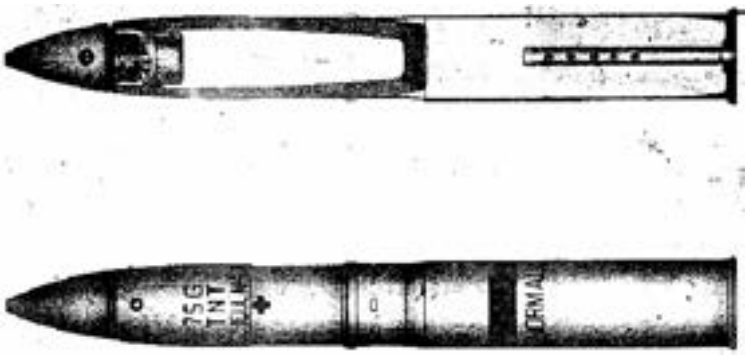
Description: The projectile may be fitted with a variety of fuzes for effective use in engaging different types of targets. The presence of the M56 Fuze identifies the round as an HE M54. The complete M54 round (HE shell) can be identified for the M1A2 Antiaircraft Gun by the extracting groove in the cartridge case.

Filler Description: Tetryl is composed of 2,4,6-Trinitrophenylmethylnitramine, N-methyl-N, 2,4,6-Tetranitroaniline, Tetralite, Tetrylite, and Pyronite. It is used extensively as a booster and main charge for small caliber projectiles. It is also used as the base charge in compound detonators. Tetryl is a finely divided crystalline powder that is colorless when freshly prepared and highly purified, rapidly acquires a yellow color when exposed to light, and turns gray when graphite is added as a lubricant during loading. Sensitivity is intermediate between TNT and PETN; it is more sensitive than Picric acid and can be detonated easier than TNT or Ammonium picrate. Tetryl is considered as sensitive as Mercury fulminate when finely divided and it will usually detonate when subjected to bullet impact. Tetryl is slightly hygroscopic, but not adversely affected by moisture.

Reference: ORDATA Online, MIDAS

Ordnance Technical Data Sheet

U.S. Projectile, 75MM, Gun, HE, M48



Nomenclature:	75MM Projectile, High Explosive		
Ordnance Family:	Projectile		
Filler:	TNT or Amatol		
Filler weight:	675.9 g (23.84 oz)		
Item weight:	8.274 kg (18.24 lbs)		
Diameter:	75.00 mm (2.953 in)		
Length:	596.4 mm (23.48 in)		
Maximum Range:	7,224 m (7,900 yds)		
Fragmentation Distance:	612.3 m (2,009 ft)	**Fuze:**	Varies

Usage: This is an Army gun-fired projectile that is nose fuzed only. It is painted green.

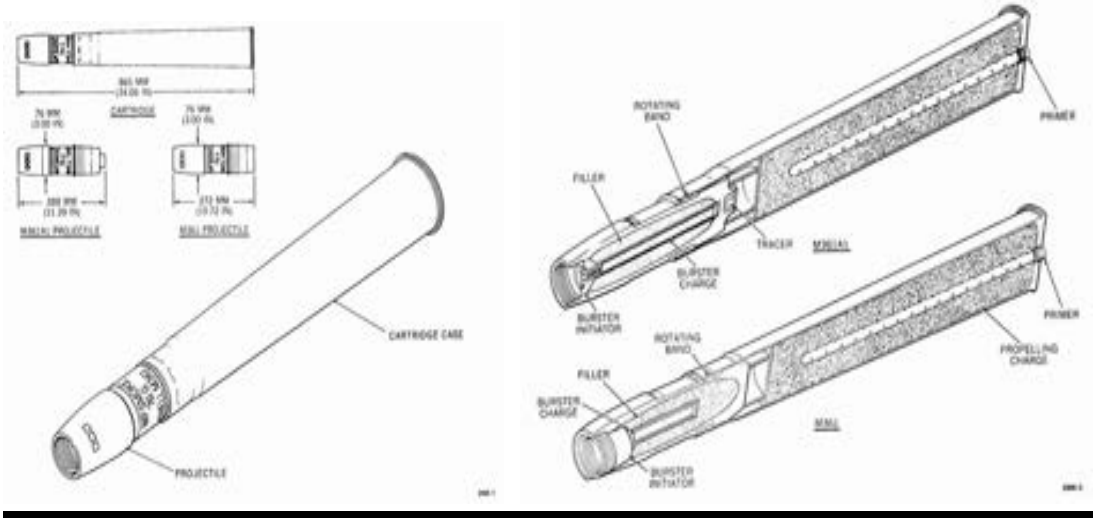
Description: Army HE projectiles are issued either with a nose fuze in place or with a removable lifting plug or closing plug that is replaced with a nose fuze before firing. Fuze types include ET, MT, MTSQ, PD, and PDSD. These projectiles do not have base fuzes.

Filler (Main Charge) Description: TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. In a refined form, it is one of the most stable high explosives. It is also used as a constituent of other explosives, including Amatol, Pentolite, Tetrytol, Tritonal, Picratol, and Composition B. Amatol is a main charge explosive employed by practically all foreign countries. It is used in the U.S. as a substitute explosive in 3-inch, 155mm, and larger shells. It is a mixture of Ammonium nitrate and TNT, with the percentage by weight of ammonium nitrate varying from 40 to 80 percent. It has a color of yellow to dark brown depending on the composition and purity of components. Amatol is less sensitive to detonation than TNT, but is readily detonated by mercury fulminate and other high explosives. It is very hygroscopic and, therefore, is usually protected by a sealing pour of TNT.

Reference: ORDATA Online, MIDAS

Ordnance Technical Data Sheet

U.S. Cartridge, 76MM, Smoke, WP, M361 (T140E2) and M361A1



Nomenclature:	76MM, Smoke (WP), M361
Ordnance Family:	Projectile
DODIC:	C128
Filler:	Smoke Mix (White Phosphorus)
Filler weight:	612.00 g (1.349 lbs)
Item weight:	6.00 kg (13.23 lbs)
Diameter:	76.00 mm (2.992 in)
Length:	272.00 mm (10.71 in)
Maximum Range:	Not Provided
Fuze:	Impact Fired

Usage: These are Army smoke projectiles used for spotting targets or screening; the projectiles also have a slight incendiary effect.

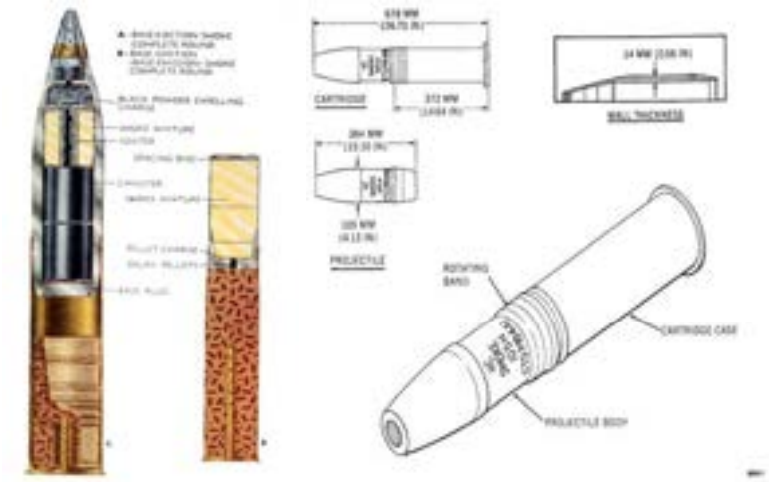
Description: Older projectiles are gray with a yellow band and yellow markings; newer projectiles are light green with a yellow band and red markings.

Filler Description: White phosphorus (WP) is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 105MM, HC and Colored Smoke, BE, M84 and M84A1



Nomenclature:	105MM, HC and Colored Smoke, BE, M84 and M84A1
Ordnance Family:	Projectile
DODIC:	C452
Filler:	Smoke Mix
Filler weight:	5.90 kg (13.01 lbs)
Item weight:	19.00 kg (41.89 lbs)
Diameter:	105.00 mm (4.123 in)
Length:	384.00 mm (15.12 in)
Maximum Range:	2,003 m (2,190 yds)
Fuze:	Mechanical Time Fuze

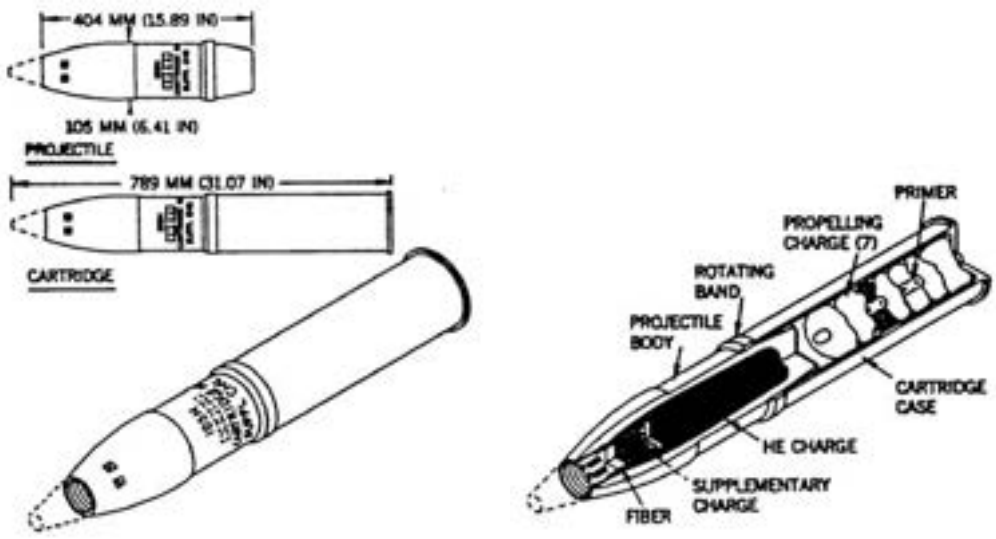
Usage: These are percussion-primed, semi-fixed Howitzer-fired cartridges with spin-stabilized, base-ejection smoke projectiles. They contain smoke canisters that emit either white, red, yellow, green, or violet smoke upon ejection. They are used for screening, spotting, or signaling purposes. The figure shows the appearance and dimensions of the M84A1 cartridge. The M84 and M84B1 cartridges are similar.

Description: Earlier manufactured projectiles are painted gray, with one yellow band and yellow-stenciled identification and manufacturing markings. Newer projectiles are painted light green, with black-stenciled identification and manufacturing markings. Older projectiles are marked with a row of squares whose color corresponds to the color of the smoke produced. Newer projectiles have either the letters HC, indicating that white smoke is produced, or a row of three letter C's in the color of the smoke produced. Brass cartridge cases are not painted. Steel cartridge cases are lacquered dark green or dark brown. White-stenciled identification and manufacturing markings are found on the base and on the lower portion of the cartridge case.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 105MM, HE, M1



Nomenclature:	U.S. Projectile, 105MM, HE, M1
Ordnance Family:	Projectiles
DODIC:	C430
Filler:	Composition B
Filler weight:	2.30 kg (5.071 lbs)
Item weight:	18.11 kg (39.9 lbs)
Diameter:	105.00 mm (4.134 in)
Length:	404.00 mm (15.91 in)
Maximum Range:	7,585 m (8,295 yds)
Fuze:	Not Provided

Usage: This is an Army, spin-stabilized, Howitzer-fired, high explosive projectile.

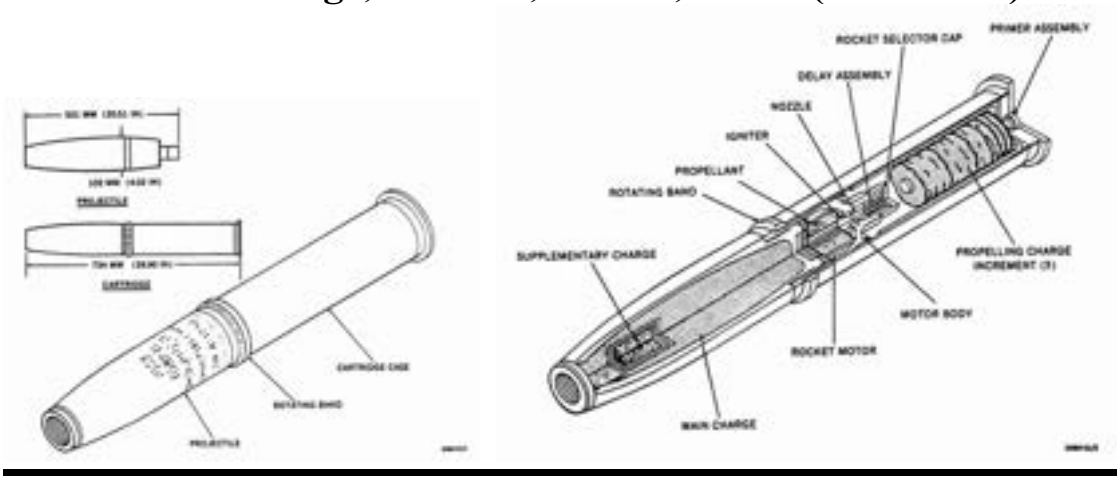
Description: The projectile is olive drab with yellow markings.

Filler (HE Charge) Description: Composition B consists of a mixture of TNT (Trinitrotoluene) and RDX (Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 105MM, HERA, M548 (XM548E1)



Nomenclature: 105MM, HERA, M548 (XM548E1)
Ordnance Family: Projectile
DODIC: C468
Filler: Composition B
Filler weight: 3.00 kg (6.614 lbs)
Item weight: 13.00 kg (28.66 lbs)
Diameter: 102.00 mm (4.16 in)
Length: 521.00 mm (20.51 in)
Maximum Range: 7,585 m (8,295 yds)
Fuze: Not Provided

Usage: This is a spin-stabilized, high-explosive rocket-assisted (HERA) semi-fixed cartridge with an extended-range capability. It is used against personnel and material.

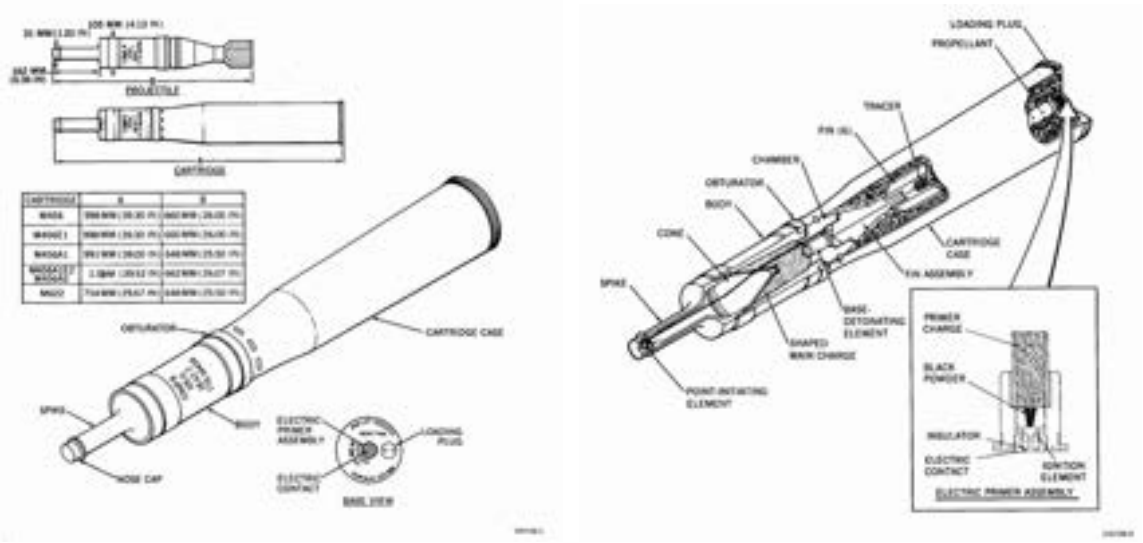
Description: The projectile is painted olive drab with markings stenciled in yellow. The cartridge case is unpainted with yellow markings.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (Trinitrotoluene) and RDX (Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 105MM, HEAT-T, M622 and M456A1



Nomenclature: 105MM, HEAT-T, M622 and M456A1
Ordnance Family: Projectile
DODIC: C508
Filler: Composition B
Filler weight: 1.00 kg (2.205)
Item weight: 10.00 kg (22.50)
Diameter: 105.00 mm (4.134 in)
Length: 648.00 mm (25.51 in)
Maximum Range: Not Provided
Fuze: M509 Series Impact Fuze

Usage: This is a fixed cartridge with a fin-stabilized high-explosive antitank with tracer (HEAT-T) projectile. The projectile incorporates a setback-armed, point-initiating base-detonating (PIBD) fuze containing a piezoelectric (Lucky) crystal and an electric detonator. The M509-series fuzes are impact fired.

Description: The projectiles are painted black or olive drab. The M622 markings are white. The M456A1 markings are yellow and white, with yellow bands on the spike.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (Trinitrotoluene) and RDX (Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 155MM (Howitzer), HE, M107

Nomenclature:	U.S. Projectile, 155MM (Howitzer), HE, M107
Ordnance Family:	Projectiles
DODIC:	D544
Filler:	TNT or Composition B
Filler weight:	6.99 kg (15.41 lbs)
Item weight:	42.91 kg (94.6 lbs)
Diameter:	155.00 mm (6.102 in)
Length:	605.00 mm (23.82 in)
Maximum Range:	18,100 m (19,795 yds)
Fuze:	Not Provided

Usage: This is an Army, spin-stabilized, Howitzer-fired, high explosive (HE) projectile.

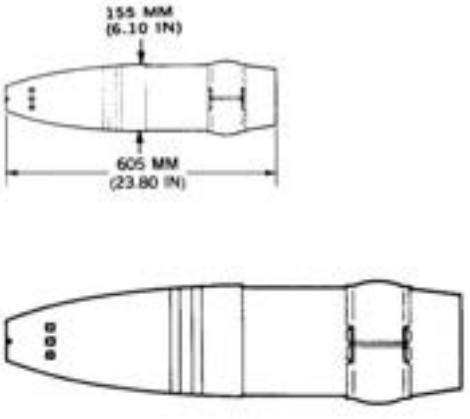
Description: The projectile is olive drab with yellow markings.

Filler Description: TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. In a refined form, it is one of the most stable high explosives. It is also used as a constituent of other explosives, including Amatol, Pentolite, Tetrytol, Tritonal, Picratol, and Composition B. Composition B consists of a mixture of TNT (Trinitrotoluene) and RDX (Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen). It is used as a buster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 155MM (Gun), Smoke, WP, M104



Nomenclature:	U.S. Projectile, 155MM (Gun), Smoke, WP, M104
Ordnance Family:	Projectiles
DODIC:	D487
Filler:	Smoke Mix (White Phosphorous)
Filler weight:	7.10 kg (15.65 lbs)
Item weight:	44.00 kg (97 lbs)
Diameter:	155.00 mm (6.102 in)
Length:	605.00 mm (23.82 in)
Maximum Range:	24,000 m (26,685 yds)
Fuze:	Not Provided

Usage: This is an Army, spin-stabilized, separate-loaded, Howitzer-fired bursting smoke projectile used to screen or mark targets.

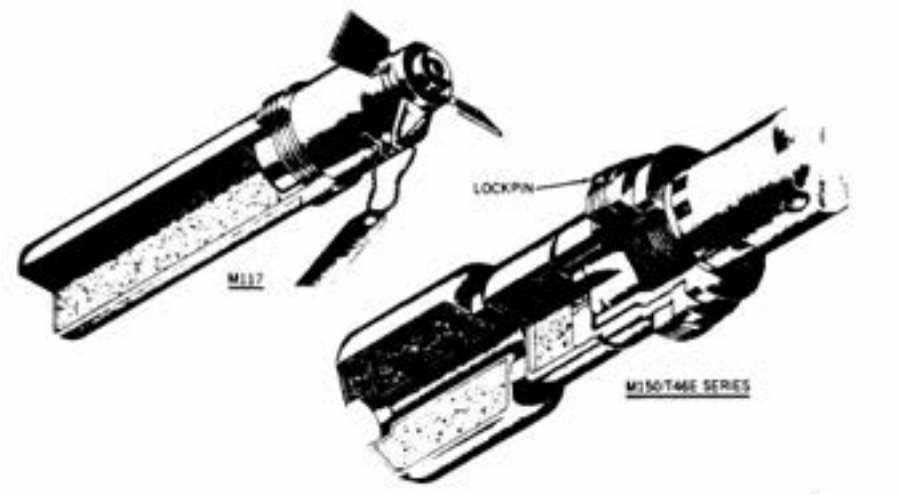
Description: The projectile is painted blue-gray with yellow stenciled markings and one 0.5-inch yellow band.

Filler Description: WP is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

Adapter Booster



Nomenclature: Adapter Booster
Ordnance Family: Misc.
DODIC: Not Provided
Filler: Tetryl
Filler weight: 196 g (6.9 oz)
Item weight: Not Available
Diameter: Varies
Length: 173 mm (6.8 in)

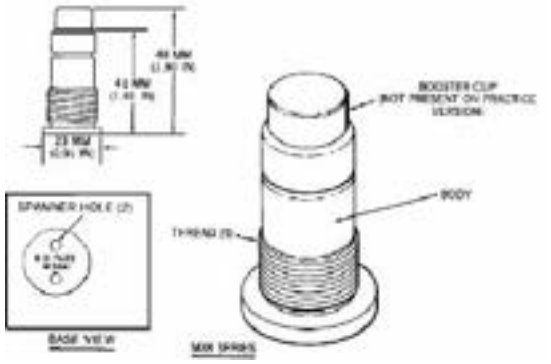
Usage: The adapter booster is a device fitted into the fuze well of a bomb that allows a fuze of smaller diameter to be used. Adapter boosters contain an explosive that transmits the firing train output of the fuze to the main explosive charge of the bomb. These devices can be used in projectiles, bombs, and rocket warheads.

Filler Description: Tetryl is composed of 2,4,6-Trinitrophenylmethylnitramine, N-methyl-N, 2,4,6-Tetranitroaniline, Tetralite, Tetrylite, and Pyronite. It is used extensively as a booster and main charge for small caliber projectiles. It is also used as the base charge in compound detonators. Tetryl is a finely divided crystalline powder that is colorless when freshly prepared and highly purified, rapidly acquires a yellow color when exposed to light, and turns gray when graphite is added as a lubricant during loading. Sensitivity is intermediate between TNT and PETN; it is more sensitive than Picric acid and can be detonated easier than TNT or Ammonium picrate. Tetryl is considered as sensitive as Mercury fulminate when finely divided and it will usually detonate when subjected to bullet impact. Tetryl is slightly hygroscopic, but not adversely affected by moisture.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Fuze, Projectile, BD, M38 and M38A1



Nomenclature:	Projectile Fuze
Ordnance Family:	Fuze
DODIC:	Not Provided
Filler:	Tetryl
Filler weight:	Less than 2 grams
Item weight:	Not Available
Diameter:	23 mm (0.91 in)
Length:	48 mm (1.90 in)
Fuze:	Various

Usage: These are setback-armed, impact-inertia-fired, non-delay, base-detonating fuzes. The fuzes are not painted and are marked on their bases with their nomenclatures. The bodies of the M38 series fuzes are brass.

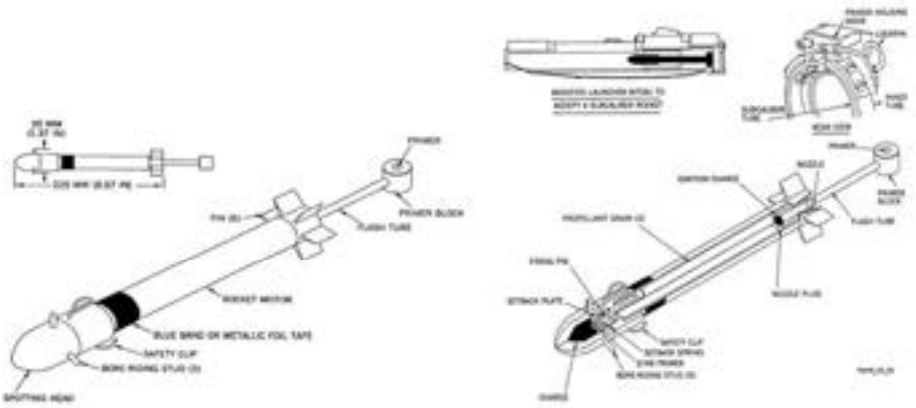
Description: On projectile firing, the setback drives the setback sleeve rearward, which forces the resistance ring rearward over the shoulder and into the groove around the base of the firing pin. The resistance ring locks the setback sleeve and firing pin together, with the tip of the firing pin protruding from the front of the sleeve. On projectile impact, inertia drives the firing pin and sleeve forward against the creep spring. The firing pin stabs the detonator, initiating the explosive train.

Filler Description: Tetryl is composed of 2,4,6-Trinitrophenylmethylnitramine, N-methyl-N, 2,4,6-Tetranitroaniline, Tetralite, Tetrylite, and Pyronite. It is used extensively as a booster and main charge for small caliber projectiles. It is also used as the base charge in compound detonators. Tetryl is a finely divided crystalline powder that is colorless when freshly prepared and highly purified, rapidly acquires a yellow color when exposed to light, and turns gray when graphite is added as a lubricant during loading. Sensitivity is intermediate between TNT and PETN; it is more sensitive than Picric acid and can be detonated easier than TNT or Ammonium picrate. Tetryl is considered as sensitive as Mercury fulminate when finely divided and it will usually detonate when subjected to bullet impact. Tetryl is slightly hygroscopic, but not adversely affected by moisture.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Rocket, 35MM, Sub-caliber, Practice, M73



Nomenclature: U.S. Rocket, 35MM, Sub-caliber, Practice, M73
Ordnance Family: Rocket
DODIC: H708
Filler: Smoke Mix (Witness Charge Only)
Filler weight: 10.00 g (.3527 oz)
Item weight: 145.00 g (5.115 oz)
Diameter: 35.00 mm (1.3878 in)
Length: 225.00 mm (8.858 in)
Maximum Range: 220 m (240.6 yds)
Fuze: Impact-inertia Fuze

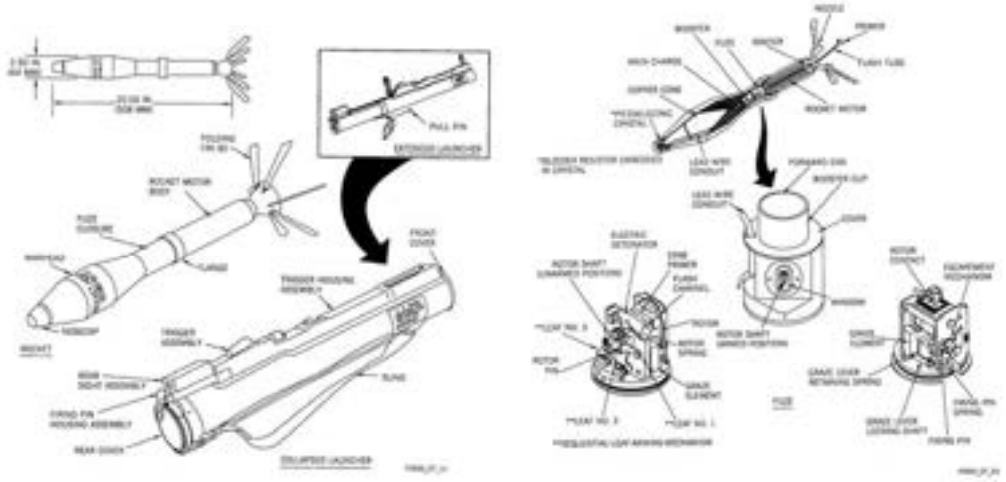
Usage: This is a sub-caliber practice rocket incorporating an integral, impact-inertia fuze. It is used for training and simulates the rocket for the light antitank weapon (LAW) system. The rocket is fired from a practice M190 launcher (a modified M72A1 LAW launcher). The figure shows the appearance and dimensions of the M73 practice rocket and M190 launcher.

Description: The spotting head and fins are painted black; the remainder of the rocket is olive drab. A blue band appears on the forward end of the rocket motor. On later production rockets, the spotting head is painted blue and the fins are painted brown. The rocket motor section is olive drab with white markings. A metallic foil covered tape is attached around the forward end of the rocket motor for weight adjustment.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Rocket, 66MM, Law, M72, M72A1, M72A2, and M72A3



Nomenclature:	66MM, Law, M72, M72A1, M72A2, and M72A3
Ordnance Family:	Rockets
DODIC:	B642
Filler:	Octol
Filler weight:	454.00 g (16.01 oz)
Item weight:	2.18 kg (4.806 lbs)
Diameter:	64.00 mm (2.52 in)
Length:	508.00 mm (20 in)
Maximum Range:	1,000 meters (3,300 feet)
Fuze:	M412 PIBD or M412A1

Usage: These are shoulder-fired, fin-stabilized, high-explosive light antitank weapons used primarily to penetrate armored targets. The rockets use an M54 rocket motor. The M72 uses an M18 warhead and an M412 point-initiating base-detonating (PIBD) fuze.

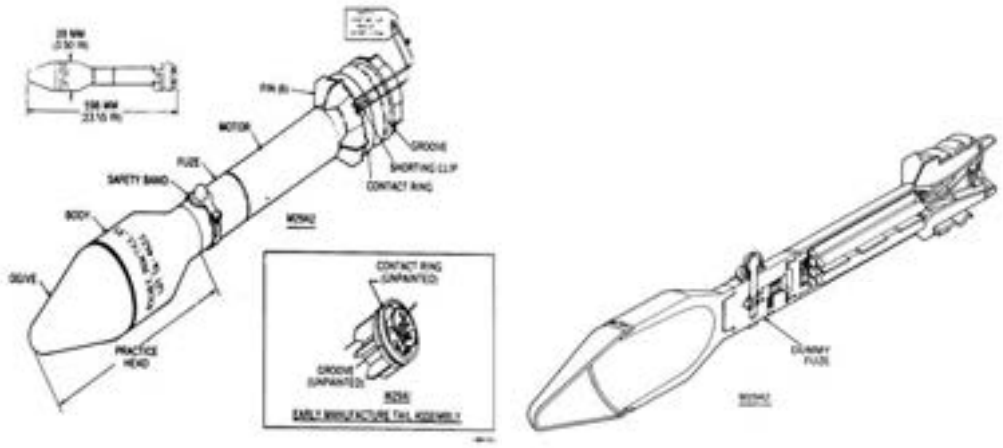
Description: The rocket launcher is painted olive drab with instruction labels on olive drab backgrounds with white printing. The manufacturing information is also printed in white. Launchers with limited light sights have a decal stating such and front sights coated with a yellow- or white-colored radioactive material at the 100- and 150-meter range markings and the remaining markings in red. Front sights not coated for night use will have all range markings in red. The rocket motor is brown and the warhead is black with yellow markings.

Filler (Main Charge) Description: Octol is a mixture of HMX (75%) and TNT (25%). HMX is a high melting explosive composed of Octogen and Cyclotetramethylene-tetranitramine. It is sensitive to high temperatures and is typically mixed with TNT in high blast explosives. TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. It is one of the most stable high explosives in refined form.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Rocket, 3.5-Inch, Practice, M29, M29A1, and M29A2



Nomenclature:	3.5-Inch, Practice, M29, M29A1, and M29A2
Ordnance Family:	Rockets
DODIC:	H601
Filler:	None
Filler weight:	None
Item weight:	3.90 kg (137.6 oz)
Diameter:	89.00 mm (3.5 in)
Length:	598.00 mm (23.54 in)
Fuze:	None

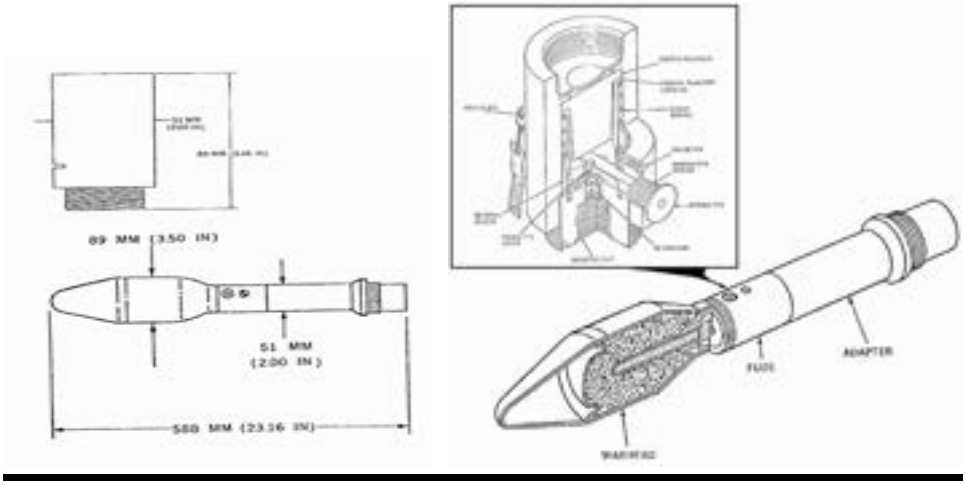
Usage: The M29-series rockets are inert and are used for training. The M29A2 rocket is modified for use in the M69 practice landmine system.

Description: The fuzes are painted olive drab or black and have the designation and loading information stamped on the body. The M29 warhead and rocket motor are blue. The M29A1 and M29A2 warheads are blue and the rocket motors are brown or olive drab with brown bands. The M29-series practice heads have white markings. The contact ring and groove, or notch, on the rockets are not painted.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Rocket Warhead, 3.5-Inch



Nomenclature: U.S. Rocket Warhead, 3.5-Inch Smoke, WP, Aircraft
Ordnance Family: Rockets
DODIC: Obsolete
Filler: Smoke Mix (White Phosphorus)
Filler weight: 1.00 kg (2.2 lbs)
Item weight: 4.90 kg (10.8 lbs)
Diameter: 89.00 mm (3.5 in)
Length: 588.00 mm (23.15 in)
Maximum Range: Not Provided
Fuze: M404A1 Base Detonating (BD)

Usage: This is a 3.5-inch white phosphorus (WP) filled rocket warhead. It uses the M404A1 (modified) fuze, which is a direct-arming, base-detonating (BD), non-delay fuze. The warhead and fuze are coupled to a 2.75-inch rocket motor by an adapter and are used against aircraft.

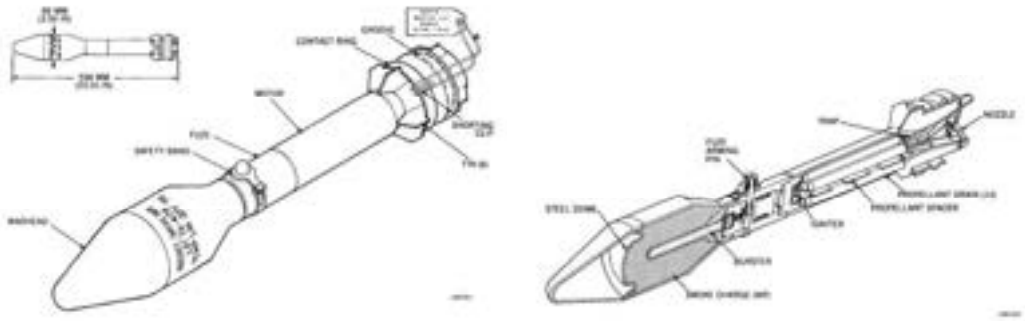
Description: The fuze is painted olive drab or black and has the designation and loading information stamped on the body. Older warheads are painted gray with yellow markings.

Filler Description: WP is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Rocket, 3.5-Inch, Smoke (WP), M30 (T127E3) and T127E2



Nomenclature: 3.5-Inch, Smoke (WP), M30 (T127E3) and T127E2
Ordnance Family: Rockets
DODIC: Not Provided
Filler: Smoke Mix (White Phosphorus)
Filler weight: 1.10 kg (2.425 lbs)
Item weight: 4.10 kg (9.039 lbs)
Diameter: 98.00 mm (3.5 in)
Length: 589.00 mm (23.54 in)
Maximum Range: Not Provided
Fuze: Impact, Base Detonating Fuze

Usage: These are 3.5-inch, ground-fired, fixed-fin, smoke (white phosphorus) rockets.

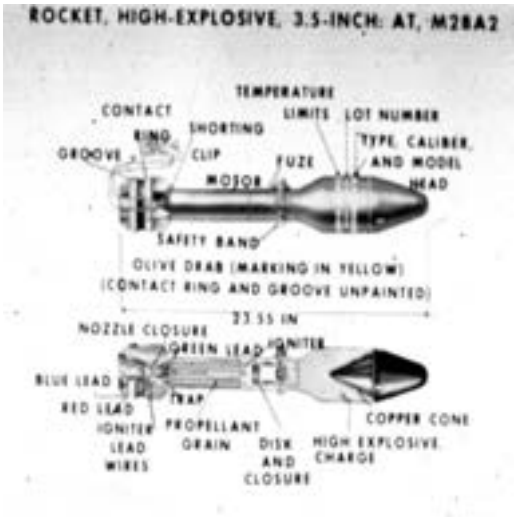
Description: The warheads are light green with light red markings and a light red band. Older warheads are painted gray with yellow markings. The rocket motor is brown or olive drab. The fuzes are painted olive drab or black and have the designation and loading information stamped on the body.

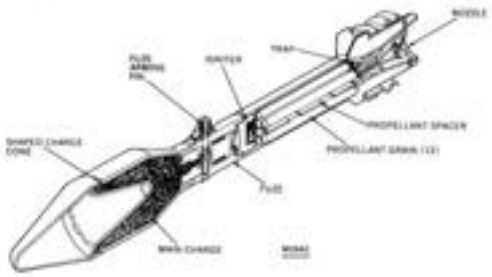
Filler (Smoke Charge) Description: White phosphorus (WP) is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Rocket, 3.5-Inch, HEAT, M28 and M28A2





Nomenclature:	U.S. Rocket, 3.5-Inch, HEAT, M28 and M28A2
Ordnance Family:	Rockets
DODIC:	H600
Filler:	Composition B
Filler weight:	853.00 g (30.09 oz)
Item weight:	4.10 kg (9.039 lbs)
Diameter:	89.00 mm (3.5 in)
Length:	598.00 mm (23.54 in)
Maximum Range:	Not Provided
Fuze:	Setback-armed, Base-detonating (BD)

Usage: These are ground-fired, fixed-fin rockets that use setback-armed, base-detonating (BD), non-delay, impact-inertia-fired fuzes and a high-explosive antitank (HEAT) shaped-charge warhead. The fuzes are painted olive drab or black and have the designation and loading information stamped on the body.

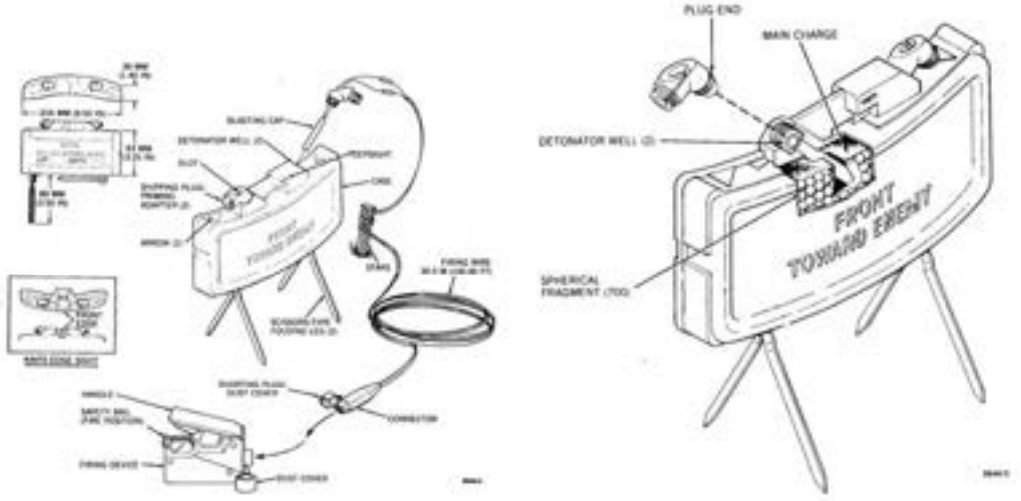
Description: The M28 warhead is olive drab with yellow markings; the M28A2 may have an olive drab or black warhead with yellow markings. Some M28A2 warheads with fuzes may be inert and painted blue. The rocket motor may be brown or olive drab with a brown band.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (Trinitrotoluene) and RDX (Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Landmine, Apers, HE, M18A1 Claymore and Practice, M68



Nomenclature:	APERS, HE, M18A1 Claymore and Practice, M68
Ordnance Family:	Landmines
DODIC:	K143
Filler:	Composition C-4 (M18A1 only)
Filler weight:	680.00 g (23.99 oz)
Item weight:	1.60 kg (3.52 lbs)
Diameter:	216.00 mm (8.50 in)
Length:	83.00 mm (3.26 in)
Maximum Range:	Not Provided
Fuze:	Electric/non-electric command detonation

Usage: The M68 practice mine is similar to the M18A1 mine, except that the inert loaded M33 mine body replaces the high explosive loaded M18A1 mine body and the empty practice blasting cap M10 replaces the loaded blasting cap. The M18A1 is a directional, fragmentation, high explosive (HE), antipersonnel (apers) landmine that may be electrically or non-electrically initiated. It may be used as a controlled-fired mine in offensive or defensive situations.

Description: The M18A1 mine is olive drab.

Filler (Main Charge) Description: C-4 is a plastic demolition explosive consisting of RDX, other explosives, and plasticizers. C-4 can be molded by hand for demolition work and packed by hand into shape charge devices.

Reference: ORDATA Online

subEM	subMAG	surfHits	mppeh	fe	nonFe	uxo	dmm	md	rrd	cd	pntType	desc1	desc1CNT	desc2	desc2CNT	desc3	desc3CNT	desc4	desc4CNT	desc5	desc5CNT	desc6	desc6CNT	desc7	desc7CNT	desc8	desc8CNT	notes	POINT_X	POINT_Y
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0	start	514821.95	3764975.02
2	0	2	0	1	1	0	0	1	0	1	Recon Point	Medium Frag	1		0		0		0		0		0		0		0		514832.70	3764927.13
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514840.49	3764873.91
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514842.47	3764821.46
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514859.94	3764770.69
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514877.25	3764719.47
0	0	1	0	0	0	0	0	0	0	1	Recon Point		0		0		0		0		0		0		0		0		514872.55	3764676.21
6	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514875.94	3764625.56
12	0	1	0	0	0	0	0	1	0	0	Recon Point	Small Arm Projectile	1		0		0		0		0		0		0		0		514894.21	3764572.49
10	0	1	0	0	0	0	0	1	0	0	Recon Point	Small Arm Projectile	1		0		0		0		0		0		0		0		514839.32	3764547.13
7	0	2	0	0	0	0	0	1	1	0	Recon Point	Small Arm Projectile	1		0		0		0		0		0		0		0		514794.23	3764515.89
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514781.34	3764571.45
4	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514771.79	3764624.08
3	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514772.93	3764670.87
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514765.40	3764718.35
0	0	2	0	0	0	0	0	0	0	2	Recon Point		0		0		0		0		0		0		0		0		514756.44	3764767.76
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514752.78	3764816.26
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2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514736.13	3764919.75
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514722.18	3764965.17
3	0	2	0	0	0	0	0	2	0	0	Recon Point	81mm MOR Illum	1	105mm TP	1		0		0		0		0		0		0	pot uxo only fin showing	514710.48	3765014.15
5	0	4	0	0	0	0	0	4	0	0	Recon Point	Medium Frag	3	Small Arm F	1		0		0		0		0		0		0		514707.84	3765066.35
0	0	3	0	0	0	0	0	0	3	0	Target		0		0		0		0		0		0		0		0		514725.58	3765093.76
16	0	203	0	0	0	0	0	3	200	0	Recon Point	Target	3	25mm TP	1		0		0		0		0		0		0	120mm mortar	514700.38	3765112.87
14	0	12	0	0	0	0	0	12	0	0	Recon Point	105mm TP HEAT	5	Medium Fra	1	Small Arm F	5	25mm TP	1		0		0		0		0		514690.81	3765160.02
7	0	15	0	0	0	0	0	15	0	0	Recon Point	40mm GR TP	1	25mm TP	1	Medium Fra	2	Small Arm F	10	TP HEAT D	1		0		0		0		514675.63	3765209.84
40	0	102	0	0	0	0	0	102	0	0	Recon Point	Berm	1	Target	1	Small Arm F	100	Medium Fra	1	81mm MOR	1		0		0		0		514695.64	3765268.85
23	0	54	0	0	0	0	0	54	0	0	Recon Point	81mm MOR Illum	2	Small Arm F	50	40mm GR T	2		0		0		0		0		0		514665.50	3765307.11
20	0	101	0	0	0	0	0	101	0	0	Recon Point	Small Arm Projectile	100	Medium Fra	1		0		0		0		0		0		0		514664.21	3765358.88
23	0	102	0	0	0	0	0	102	0	0	Recon Point	Small Arm Projectile	100	81mm MOR	1	25mm TP	1		0		0		0		0		0		514651.80	3765409.30
25	0	102	0	0	0	0	0	102	0	0	Recon Point	Small Arm Projectile	100	81mm MOR	1	Medium Fra	1		0		0		0		0		0		514646.48	3765449.27
25	0	107	0	0	0	0	0	107	0	0	Recon Point	Light Frag	2	40mm GR T	1	81mm MOR	4	Small Arm F	100	81mm MOR	1		0		0		0	WP	514592.80	3765449.31
25	0	106	0	0	0	0	0	106	0	0	Recon Point	Light Frag	5	Small Arm F	100	TP HEAT D	1		0		0		0		0		0		514547.44	3765427.36
25	0	103	0	0	0	0	0	103	0	0	Recon Point	Small Arm Projectile	100	25mm TP	1	Medium Fra	2		0		0		0		0		0		514556.22	3765386.11
25	0	105	0	0	0	0	0	105	0	0	Recon Point	Small Arm Projectile	100	81mm MOR	5		0		0		0		0		0		0		514563.25	3765338.03
18	0	82	6	0	0	0	0	76	0	0	Recon Point	Small Arm Projectile	75	81mm MOR	1		0		0		0		0		0		0		514574.50	3765290.72
25	0	79	0	0	0	0	0	79	0	0	Recon Point	Small Arm Projectile	75	81mm MOR	1	Medium Fra	1	25mm TP	1	Light Frag	1		0		0		0		514569.45	3765243.86
12	0	79	0	0	0	0	0	79	0	0	Recon Point	Small Arm Projectile	75	81mm MOR	3	120mm TP	1		0		0		0		0		0		514589.74	3765194.51
7	0	55	0	0	0	0	0	55	0	0	Recon Point	Small Arm Projectile	50	Light Frag	1	TP HEAT D	3	25mm TP	1		0		0		0		0		514584.69	3765139.83
6	0	28	0	0	0	0	0	28	0	0	Recon Point	Small Arm Projectile	25	TP HEAT D	2	81mm MOR	1		0		0		0		0		0		514585.97	3765085.26
3	0	26	0	0	0	0	0	26	0	0	Recon Point	Small Arm Projectile	25	155mm TP	1		0		0		0		0		0		0		514606.53	3765046.94
0	0	0	0	0	0	0	0	0	0	0	UXO Item	75mm HE	1		0		0		0		0		0		0		0		514605.31	3765043.46
3	0	23	0	0	0	1	0	22	0	0	Recon Point	75mm HE	1	Heavy Frag	1	TP HEAT D	1	Small Arm F	20		0		0		0		0		514621.44	3764995.44
2	0	1	0	0	0	0	0	1	0	0	Recon Point	TP HEAT Debris	1		0		0		0		0		0		0		0		514626.43	3764937.51
1	0	2	0	0	0	0	0	2	0	0	Recon Point	Light Frag	1	Flare	1		0		0		0		0		0		0		514642.35	3764896.38
1	0	1	0	0	0	0	0	1	0	0	Recon Point	40mm GR TP	1		0		0		0		0		0		0		0		514639.12	3764844.37
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514642.12	3764799.38
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514657.86	3764749.96
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514662.09	3764691.13
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514675.29	3764650.50
4	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514682.95	3764603.02
7	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514691.98	3764552.44
3	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514700.02	3764505.20
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514643.04	3764483.39
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514599.02	3764496.05
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514587.58	3764536.51
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514573.95	3764585.62
1	0	1	0	0	0	0	0	0	0	1	Recon Point		0		0		0		0		0		0		0		0		514571.91	3764636.28
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514562.77	3764695.74
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514557.62	3764735.59
5	0	1	0	0	0	0	0	1	0	0	Recon Point	Heavy Frag	1		0		0		0		0		0		0		0		514545.79	3764788.04
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514526.10	3764837.35
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514535.78	3764887.62
2	0	1	0	0	0	0	0	1	0	0	Recon Point	TP HEAT Debris	1		0		0		0		0		0		0		0		514527.27	3764937.39
4	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514517.77	3764977.70
9	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514509.19	3765032.86
3	0	3	0	0	0	0	0	3	0	0	Recon Point	Light Frag	1	TP HEAT D	2		0		0		0		0		0		0		514499.64	3765091.23
3	0	55	0	0	0	0	0	54	0	1	Recon Point	105mm TP HEAT	1	Small Arm F	50	40mm GR T	3		0		0		0		0		0		514497.39	3765132.61
9	0	67	0	0	0	0	0	67	0	0	Recon Point	Small Arm Projectile	50	40mm GR T	9	Penetrator D	1	Medium Fra	2	TP HEAT D	5		0		0		0		514483.39	3765180.21
18	0	57	0	0	0	0	0	57	0	0	Recon Point	Small Arm Projectile	50	40mm GR T	4	81mm MOR	2	152mm TP	1		0		0		0		0		514485.02	3765225.34
30	0	62	0	0	0	0	0	62	0	0	Recon Point	40mm GR TP	2	25mm TP	2	Small Arm F	50	81mm MOR	2	Medium Fra	5	TP HEAT D	1		0		0		514469.21	3765276.16
30	0	112	0	0	0	0	0	112	0	0	Recon Point	Small Arm Projectile	100	81mm MOR	5	Medium Fra	5	25mm TP	2		0		0		0		0		514462.65	3765325.31
20	0	79	0	0	0	0	0	79	0	0	Recon Point	Small Arm Projectile	75	81mm MOR	2	40mm GR T	1	25mm TP	1		0		0		0		0		514408.98	3765310.73
15	0	107	0	0	0	0	0	107	0	0	Recon Point	Small Arm Projectile	100	Light Frag	5	40mm GR T	1	81mm MOR	1		0		0		0		0		514362.79	3765314.84
7	0	56	0	0	0	0	0	56	0	0	Recon Point	Small Arm Projectile	50	Light Frag	2	40mm GR T	3	81mm MOR	1		0		0		0		0		514373.67	3765253.77
10	0	52	0	0	0	0	0	52	0	0	Recon Point	TP HEAT Debris	1	Small Arm F	50	81mm MOR	1		0		0		0		0		0		514377.51	3765204.74
15	0	57	0	0	0	0	0	56	1	0	Recon Point	Small Arm Projectile	50	Medium Fra	5	40mm GR T	1		0		0		0		0		0		514386.95	3765159.21
9	0	58	0	0	0	0	0	58	0	0	Recon Point	Small Arm Projectile	50	40mm GR T	5	81mm MOR	1	25mm TP	1	Medium Fra	1		0		0		0		514396.55	3765111.86
7	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514400.36	3765066.28
4	0	1	0	0	0	0	0	0	0	1	Recon Point		0		0		0		0		0		0		0		0		514415.38	3765007.04
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514424.29	3764965.23
2	0	1	0	0	0	0	0	1	0	0	Recon Point	TP HEAT Debris	1		0		0		0		0		0		0		0		514424.57	3764912.60
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514438.51	3764861.73

subEM	subMAG	surfHits	mppeh	fe	nonFe	uxo	dmm	md	rrd	cd	pntType	desc1	desc1CNT	desc2	desc2CNT	desc3	desc3CNT	desc4	desc4CNT	desc5	desc5CNT	desc6	desc6CNT	desc7	desc7CNT	desc8	desc8CNT	notes	POINT_X	POINT_Y
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514456.89	3764804.08
1	0	1	0	0	0	0	0	1	0	0	Recon Point	Flare	1		0		0		0		0		0		0		0		514447.30	3764760.36
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514453.61	3764711.74
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514459.93	3764662.03
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514478.65	3764618.65
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514478.24	3764572.31
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514489.79	3764517.31
0	0	1	0	0	0	0	0	1	0	0	Recon Point	Heavy Frag	1		0		0		0		0		0		0		0		514499.07	3764468.40
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514449.54	3764467.73
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514400.35	3764462.97
1	0	1	0	0	0	0	0	1	0	0	Recon Point	Small Arm Projectile	1		0		0		0		0		0		0		0		514389.93	3764509.62
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514377.98	3764558.06
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514373.38	3764606.87
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514365.19	3764655.10
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514357.68	3764703.02
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514355.52	3764746.66
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514341.12	3764799.90
3	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514337.17	3764853.03
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514321.34	3764893.84
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514319.36	3764952.65
4	0	2	0	0	0	0	0	2	0	0	Recon Point	25mm TP	1	TP HEAT D	1		0		0		0		0		0		0		514310.00	3764994.61
0	0	0	0	0	0	0	0	0	0	0	Target		0		0		0		0		0		0		0		0		514317.21	3765009.09
11	0	60	0	0	0	0	0	60	0	0	Recon Point	40mm GR TP	3	Light Frag	5	81mm MOR	1	Target	1	Small Arm F	50		0		0		0		514305.06	3765047.75
0	0	0	0	0	0	0	0	0	0	0	Target		0		0		0		0		0		0		0		0		514304.87	3765087.51
20	0	276	0	0	0	0	0	76	200	0	Recon Point	Medium Frag	10	40mm GR T	10	Fuze	1	Small Arm F	50	25mm TP	2	Target	2	Mover	1		0		514291.19	3765106.35
23	0	63	0	0	0	0	0	63	0	0	Recon Point	155mm TP	1	165mm TP	1	25mm TP	1	40mm GR T	10	Small Arm F	50		0		0		0		514286.10	3765144.76
14	0	79	0	0	0	0	0	79	0	0	Recon Point	Small Arm Projectile	75	81mm MOR	1	40mm GR T	3		0		0		0		0		0		514282.22	3765196.58
30	0	116	0	0	0	0	0	116	0	0	Recon Point	Small Arm Projectile	100	37mm TP	1	40mm GR T	5	Medium Fra	10		0		0		0		0		514237.30	3765185.94
21	0	119	0	0	0	0	0	119	0	0	Recon Point	57mm PRJ TP	2	40mm GR T	10	Small Arm F	100	25mm TP	2	Medium Fra	5	Fuze	0		0		0	M396A1, 51 series fuzeW	514186.82	3765169.02
14	0	111	0	0	0	0	0	111	0	0	Recon Point	Small Arm Projectile	100	Medium Fra	5	Fuze	1	40mm GR T	5		0		0		0		0		514192.12	3765125.46
22	0	116	0	0	0	0	0	116	0	0	Recon Point	Small Arm Projectile	100	TP HEAT D	3	40mm GR T	8	25mm TP	1	Light Frag	4		0		0		0		514202.25	3765073.26
16	0	63	0	0	0	0	0	63	0	0	Recon Point	Missile Debris	1	TP HEAT D	4	40mm GR T	3	25mm TP	2	Small Arm F	50	Light Frag	3		0		0	Dragon	514202.26	3765032.18
12	0	29	0	0	0	0	0	29	0	0	Recon Point	75mm Schrapnel	1	105mm TP	1	105mm TP	1	105mm BAS	1	Small Arm F	25		0		0		0		514221.34	3764983.71
6	0	12	0	0	0	0	0	12	0	0	Recon Point	81mm MOR Illum	2	Small Arm F	10		0		0		0		0		0		0		514217.44	3764924.87
3	0	1	0	0	0	0	0	1	0	0	Recon Point	105mm BASE EJC	1		0		0		0		0		0		0		0		514229.26	3764880.14
4	0	2	0	0	0	0	0	2	0	0	Recon Point	TP HEAT Debris	2		0		0		0		0		0		0		0		514243.26	3764834.05
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514241.98	3764795.93
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514253.77	3764734.83
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514274.75	3764685.13
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514269.33	3764629.67
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514270.93	3764584.43
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514276.98	3764528.27
1	0	1	0	0	0	0	0	0	0	1	Recon Point		0		0		0		0		0		0		0		0		514288.24	3764477.18
1	0	1	0	0	0	0	0	1	0	0	Recon Point	Fuze Component	1		0		0		0		0		0		0		0		514286.12	3764453.09
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514238.80	3764460.09
0	0	2	0	1	1	0	0	1	0	1	Recon Point	Wire	1		0		0		0		0		0		0		0		514191.24	3764453.44
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514184.78	3764526.01
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514182.15	3764572.40
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514167.78	3764626.67
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514157.90	3764675.90
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514147.29	3764720.83
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514144.49	3764781.15
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514138.00	3764818.09
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514125.15	3764873.22
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514116.14	3764921.21
6	0	1	0	0	0	0	0	1	0	0	Recon Point	TP HEAT Debris	1		0		0		0		0		0		0		0		514114.12	3764970.25
4	0	1	0	0	0	0	0	1	0	0	Recon Point	Berm	1	81mm MOR	1		0		0		0		0		0		0		514109.31	3765017.17
8	0	31	0	0	0	0	0	31	0	0	Recon Point	40mm GR TP	9	25mm TP	2	TP HEAT D	2	Small Arm F	20		0		0		0		0		514097.04	3765077.23
9	0	37	0	0	0	0	0	37	0	0	Recon Point	40mm GR TP	7	Small Arm F	30		0		0		0		0		0		0		514095.72	3765116.56
7	0	44	0	0	0	0	0	44	0	0	Recon Point	40mm GR TP	7	Small Arm F	30	Medium Fra	2	TP HEAT D	5		0		0		0		0		514078.47	3765159.95
20	0	110	0	0	0	0	0	110	0	0	Recon Point	Small Arm Projectile	100	TP HEAT D	5	40mm GR T	5		0		0		0		0		0		514030.71	3765155.41
11	0	62	0	0	0	0	0	62	0	0	Recon Point	Medium Frag	3	TP HEAT D	3	Small Arm F	50	40mm GR T	5	106mm HE	1		0		0		0		513986.04	3765145.44
12	0	52	0	0	0	0	0	52	0	0	Recon Point	40mm GR TP	12	Small Arm F	30	TP HEAT D	10		0		0		0		0		0		514001.29	3765088.22
7	0	52	0	0	0	0	0	52	0	0	Recon Point	40mm GR TP	25	Small Arm F	20	Discarded S	2	TP HEAT D	5		0		0		0		0		514009.56	3765039.60
0	0	0	0	0	0	0	0	0	0	0	Target		0		0		0		0		0		0		0		0	2 poles, tract trailer frame	514029.54	3765014.20
5	0	17	0	0	0	0	0	16	1	0	Recon Point	40mm GR TP	10	105mm TP	1	Small Arm F	5	Target	1		0		0		0		0		514008.70	3764993.16
6	0	5	0	0	0	0	0	5	0	0	Recon Point	40mm GR TP	5		0		0		0		0		0		0		0		514011.31	3764945.48
3	0	2	0	0	0	0	0	2	0	0	Recon Point	40mm GR TP	2		0		0		0		0		0		0		0		514020.39	3764897.99
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514042.93	3764850.74
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514038.89	3764791.57
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514044.91	3764748.13
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514057.62	3764696.18
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514074.23	3764649.94
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514058.72	3764602.93
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514079.96	3764553.14
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514080.15	3764503.73
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514085.68	3764452.38
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514043.45	3764451.72
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513996.00	3764447.46
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513988.00	3764498.33
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513974.18	3764548.52
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513971.84	3764597.71
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513964.91	3764644.16

subEM	subMAG	surfHits	mppeh	fe	nonFe	uxo	dmm	md	rrd	cd	pntType	desc1	desc1CNT	desc2	desc2CNT	desc3	desc3CNT	desc4	desc4CNT	desc5	desc5CNT	desc6	desc6CNT	desc7	desc7CNT	desc8	desc8CNT	notes	POINT_X	POINT_Y
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513955.60	3764695.12
2	0	2	0	0	0	0	0	1	0	1	Recon Point	Discarded Sabot	1		0		0		0		0		0		0		0		513948.93	3764739.62
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513942.31	3764790.59
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513933.15	3764840.19
1	0	4	0	0	0	0	0	2	0	2	Recon Point	40mm GR TP	2		0		0		0		0		0		0		0		513919.97	3764887.31
11	0	3	0	0	0	0	0	3	0	0	Recon Point	Discarded Sabot	2	TP HEAT D	1		0		0		0		0		0		0		513915.64	3764940.23
26	0	18	0	0	0	0	0	18	0	0	Recon Point	40mm GR TP	5	Discarded S	1	Flare	2	Small Arm F	10		0		0		0		0		513903.12	3764989.11
23	0	50	0	0	0	0	0	50	0	0	Recon Point	40mm GR TP	20	Small Arm F	20	25mm TP	2	Discarded S	3	TP HEAT D	5		0		0		0		513908.02	3765038.49
14	0	137	0	0	0	0	0	137	0	0	Recon Point	Target	1	40mm GR T	31	Small Arm F	100	TP HEAT D	5		0		0		0		0		513894.35	3765083.41
15	0	135	0	0	0	0	0	135	0	0	Recon Point	Small Arm Projectile	100	40mm GR T	20	TP HEAT D	5	Medium Fra	10	Target	1		0		0		0		513842.36	3765081.32
15	0	55	0	0	0	0	0	55	0	0	Recon Point	Small Arm Projectile	25	40mm GR T	15	TP HEAT D	10	Medium Fra	5		0		0		0		0		513789.67	3765074.53
0	0	0	0	0	0	0	0	0	0	0	Target	Mover	1	Berm	1		0		0		0		0		0		0	old, saturated w ordnance	513759.65	3765029.88
36	0	250	0	0	0	0	0	200	50	0	Recon Point	40mm GR TP	100	Small Arm F	100	60mm MOR	1	Missile Debr	1	Medium Fra	10		0		0		0		513797.62	3765005.83
12	0	42	0	0	0	0	0	42	0	0	Recon Point	40mm GR TP	12	Small Arm F	20	TP HEAT D	5	Medium Fra	5		0		0		0		0		513807.63	3764964.02
4	0	8	0	0	0	0	0	8	0	0	Recon Point	40mm GR TP	3	Small Arm F	5		0		0		0		0		0		0		513825.41	3764915.21
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513827.92	3764865.42
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513839.58	3764821.15
0	0	1	0	0	0	0	0	1	0	0	Recon Point	TP HEAT Debris	1		0		0		0		0		0		0		0		513850.00	3764764.34
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513851.60	3764719.60
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513860.72	3764670.88
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513867.16	3764619.63
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513873.78	3764570.75
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513884.05	3764523.00
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513884.93	3764472.53
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513896.56	3764442.77
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513848.82	3764455.30
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513789.65	3764479.67
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513762.43	3764561.94
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513771.08	3764611.42
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513750.39	3764658.85
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513756.19	3764714.18
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513747.93	3764763.26
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513737.58	3764810.42
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513728.31	3764857.62
1	0	2	0	0	0	1	0	1	0	0	Recon Point	90mm HE	1	81mm MOR	1		0		0		0		0		0		0	M371A1, HEAT UXO AT Pt	513708.15	3764903.50
3	0	9	0	0	0	0	0	9	0	0	Recon Point	81mm MOR Illum	3	40mm GR T	3	TP HEAT D	3		0		0		0		0		0		513701.29	3764948.97
5	0	38	0	0	0	0	0	38	0	0	Recon Point	40mm GR TP	3	81mm MOR	1	Light Frag	4	Small Arm F	30		0		0		0		0		513657.79	3764935.83
6	0	32	0	0	0	0	0	32	0	0	Recon Point	40mm GR TP	8	Small Arm F	20	Medium Fra	3	Discarded S	1		0		0		0		0		513612.58	3764926.43
3	0	24	0	0	0	0	0	24	0	0	Recon Point	40mm GR TP	1	Small Arm F	20	Light Frag	2	Sub Calibre	1		0		0		0		0	35mm	513623.54	3764876.22
7	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513640.62	3764828.89
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513633.89	3764791.11
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513649.19	3764724.07
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513653.78	3764685.28
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513665.58	3764638.86
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513669.60	3764582.36
1	0	2	0	0	0	0	0	1	0	1	Recon Point	Flare	1		0		0		0		0		0		0		0		513674.05	3764537.54
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513680.67	3764486.46
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513679.38	3764438.88
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513635.74	3764441.28
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513586.75	3764448.07
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513539.49	3764438.05
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513493.10	3764439.68
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513435.49	3764436.93
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513390.37	3764434.61
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513329.83	3764476.25
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513284.91	3764537.02
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513254.77	3764574.38
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513259.62	3764632.30
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513256.16	3764675.32
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513239.63	3764728.49
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513290.83	3764740.62
3	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513348.20	3764738.06
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513347.16	3764687.63
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513362.24	3764638.89
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513364.50	3764589.85
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513376.78	3764543.80
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513433.80	3764532.23
1	0	1	0	0	0	0	0	0	0	1	Recon Point		0		0		0		0		0		0		0		0		513478.09	3764500.40
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513463.72	3764550.31
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513475.26	3764607.46
0	0	0	0	0	0	0	0	0	0	0	Other Item	Berm	0		0		0		0		0		0		0		0		513460.65	3764631.05
4	0	0	0	0	0	0	0	0	0	0	Recon Point	Berm	1		0		0		0		0		0		0		0		513465.16	3764668.61
4	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513440.56	3764707.50
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513459.16	3764755.64
3	0	3	0	0	0	0	0	3	0	0	Recon Point	Light Frag	3		0		0		0		0		0		0		0		513438.98	3764808.83
18	0	6	0	0	0	0	0	6	0	0	Recon Point	Medium Frag	5	Flare	1		0		0		0		0		0		0		513493.73	3764831.76
13	0	3	0	0	0	0	0	3	0	0	Recon Point	Discarded Sabot	1	Medium Fra	2		0		0		0		0		0		0		513530.48	3764817.30
7	0	1	0	0	0	0	0	1	0	0	Recon Point	Medium Frag	1		0		0		0		0		0		0		0		513537.13	3764775.05
6	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513537.63	3764723.80
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513562.49	3764673.59
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513563.20	3764626.17
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513579.42	3764577.27
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513625.08	3764574.26

subEM	subMAG	surfHits	mppeh	fe	nonFe	uxo	dmm	md	rrd	cd	pntType	desc1	desc1CNT	desc2	desc2CNT	desc3	desc3CNT	desc4	desc4CNT	desc5	desc5CNT	desc6	desc6CNT	desc7	desc7CNT	desc8	desc8CNT	notes	POINT_X	POINT_Y
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513619.18	3764623.20
0	0	1	0	0	0	0	0	0	0	1	Recon Point		0		0		0		0		0		0		0		0		513608.95	3764679.83
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513606.51	3764732.04
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513594.82	3764778.32

90mm HEAT Projectile - UXO

Target Berm

81mm Mortar Probable Illumination – Probable MD

81mm Mortar TP - MD

Old HE Hard Target - RRD

Old HE Hard Target - RRD

Small Arms Debris – Abundant on North Side of Site - MD

105mm TP Projectile Debris - MD

75mm HE Projectile - UXO

105mm TP Projectile Debris - MD

Old HE Hard Target - RRD

Old Target Debris - RRD

Old Berm/Target

155mm TP Projectile - MD

165mm TP Projectile - MD

51 Series Fuze - MD

51 Series Fuze - MD

25mm TP Projectile - MD

Unknown Munitions Debris

Mortar Illumination – Probable MD

Target Stand

Old Mover Rails

Old Mover Car

60mm TP Mortar - MD

Appendix D

QC Log

Note Taker: Jason Burcham

11/11/12

0730 – Swept an area offsite and determined it free of subsurface anomalies. Placed a MEC simulant on the surface and swept the item with a Schiebel MIMID on high setting. The instrument produced an audible signal indicating a positive detect and proper function. Survey commenced

1700 – Re-swept test strip. The instrument produced an audible signal indicating a positive detect and proper function. Departed site.

11/12/12

0730 - Re-swept test strip. The instrument produced an audible signal indicating a positive detect and proper function. Survey commenced.

1430 - Re-swept test strip. The instrument produced an audible signal indicating a positive detect and proper function. Survey Complete.

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
INSTALLATIONS AND ENVIRONMENT
110 ARMY PENTAGON
WASHINGTON, DC 20310-0110

APR 2 1 2005

MEMORANDUM FOR THE ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT

SUBJECT: Munitions Response Terminology

1. This memorandum replaces my October 28, 2003 memorandum, subject: Definitions Related to Munitions Response Terms, and requests your office ensure that the enclosed terms and their definitions (Enclosure 1) are used, when appropriate, in correspondence (e.g., policies, guidance) and briefings concerning the Army's implementations of its Military Munitions Response Program (MMRP), Sustainable Range Management Program (SRMP) and, as appropriate, in other munitions-related matters.

2. In the past three years, the Department of Defense (DoD) has developed policies and guidance to implement its MMRP and SRMP. It has also worked to close a policy gap related to the management of material that may pose explosives hazards to DoD personnel and/or the public. During this period, DoD has been actively engaged, through the Munitions Response Committee (MRC), with the U.S. Environmental Protection Agency, Federal Land Managers, states, and with American Indians and Alaska Natives, to address issues related to the cleanup of munitions response sites.

3. To provide clarity and consistency in these efforts and in internal and external discussions, DoD has been working to establish and use common terms and definitions. The consistent use of accurate, descriptive terms, the definitions of which are commonly understood, is important to our dialogue with environmental regulators and safety officials, stakeholders, and the public.

4. Many of the terms that DoD has adopted for use in addressing munitions-related issues are now codified in Federal statute. On December 14, 2004, the Department of Defense Explosives Safety Board approved revisions to DoD 6055.9-STD, Ammunition and Explosives Safety Standards, using the enclosed terms.

5. The U.S. Army Technical Center for Explosives Safety, in coordination with other agencies, developed the enclosed matrix (Enclosure 2) to help the communities (e.g., operational, explosives safety, logistical, and cleanup) involved in addressing munitions-related operations to better understand how some of the new terms apply to actions they conduct.

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6. Use of this terminology does not imply any specific funding authority, nor does it alter the DERP Management Guidance's program eligibility criteria.

7. My staff point of contact is J. C. King at (703) 697-5564 or jc.king@us.army.mil.

Raymond J. Fatz
Deputy Assistant Secretary of the Army
(Environment, Safety and Occupational Health)
OASA(I&E)

Enclosures

cf:
G-3
G-4
DAIM-BD
SFIM-OP
SAGC
OTJAG-ELD
NGB
CEMP-R
USACE
AEC

Enclosure 1: Military Munitions-Related Terms and Definitions

Consolidated Definitions
Anomaly Avoidance. Techniques employed on property known or suspected to contain UXO, other munitions that may have experienced abnormal environments (e.g., DMM), munitions constituents in high enough concentrations to pose an explosive hazard, or CA, regardless of configuration, to avoid contact with potential surface or subsurface explosive or CA hazards, to allow entry to the area for the performance of required operations.
Chain of Custody. The activities and procedures taken throughout the inspection, re-inspection and documentation process to maintain positive control of MPPEH to ensure the veracity of the process used to determine the status of material as to its explosive hazard. This includes all such activities from the time of collection through final disposition.
Chemical Agent (CA). A chemical compound (to include experimental compounds) that, through its chemical properties produces lethal or other damaging effects on human beings, is intended for use in military operations to kill, seriously injure, or incapacitate persons through its physiological effects. Excluded are research, development, testing and evaluation (RDTE) solutions; riot control agents; chemical defoliants and herbicides; smoke and other obscuration materials; flame and incendiary materials; and industrial chemicals.
Chemical Agent (CA) Hazard. A condition where danger exists because CA is present in a concentration high enough to present potential unacceptable effects (e.g., death, injury, damage) to people, operational capability, or the environment.
Chemical Agent (CA) Safety. A condition where operational capability and readiness, people, property, and the environment are protected from the unacceptable effects or risks of a mishap involving chemical warfare material (CWM) and CA in other than munitions configurations.
Chemical Warfare Material (CWM). Items generally configured as a munition containing a chemical compound that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. CWM includes V- and G-series nerve agents or H-series (mustard) and L-series (lewisite) blister agents in other-than-munition configurations; and certain industrial chemicals (e.g., hydrogen cyanide (AC), cyanogen chloride (CK), or carbonyl dichloride (called phosgene or CG)) configured as a military munition. Due to their hazards, prevalence, and military-unique application, chemical agent identification sets (CAIS) are also considered CWM. CWM does not include: riot control devices; chemical defoliants and herbicides; industrial chemicals (e.g., AC, CK, or CG) not configured as a munition; smoke and other obscuration producing items; flame and incendiary producing items; or soil, water, debris or other media contaminated with low concentrations of chemical agents where no CA hazards exist.
Chemical Warfare Material (CWM) Response. Munitions responses and other responses to address the chemical safety; explosives safety, when applicable; human health; or environmental risks presented by CA-filled munitions and CA in other than munitions configurations. (See munitions response.)
Construction Support. Assistance provided by DoD EOD or UXO-qualified personnel and/or by personnel trained and qualified for operations involving CA, regardless of configuration, during intrusive construction activities on property known or suspected to contain UXO, other munitions that may have experienced abnormal environments (e.g., DMM), munitions constituents in high enough concentrations to pose an explosive hazard, or CA, regardless of configuration, to ensure the safety of personnel or resources from any potential explosive or CA hazards.
Cultural Debris. Debris found on operational ranges or munitions response sites, which may be removed to facilitate a range clearance or munitions response, that is not related to munitions or range operations. Such debris includes, but is not limited to: rebar, household items (refrigerators, washing machines, etc.), automobile parts and automobiles that were not associated with range targets, fence posts, and fence wire.
Defense Sites. Locations that are or were owned by, leased to, or otherwise possessed or used by the Department of Defense. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions. (10 U.S.C. 2710(e)(1))
Discarded Military Munitions (DMM). Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of, consistent with applicable environmental laws and regulations. (10 U.S.C. 2710(e)(2))
Disposal. End of life tasks or actions for residual materials resulting from demilitarization or disposition operations.
Disposition. The process of reusing, recycling, converting, redistributing, transferring, donating, selling, demilitarizing, treating, destroying, or fulfilling other life-cycle guidance, for DoD property.

Documentation of the Explosives Safety Status of Material. Documentation attesting that material: (1) does not present an explosive hazard and is consequently safe for unrestricted transfer within or release from DoD control, or (2) is MPPEH, with the known or suspected explosive hazards stated, that is only transferable or releasable to a qualified receiver. This documentation must be signed by a technically qualified individual with direct knowledge of: (1) the results of both the material's 100 percent inspection and 100 percent re-inspection or of the approved process used and the appropriate level of re-inspection, and (2) the veracity of the chain-of-custody for the material. This signature is followed by the signature of another technically qualified individual who inspects the material on a sampling basis (sampling procedures are determined by DoD entity that is inspecting the material).
Environmental Regulators and Safety Officials. Include, but may not be limited to environmental regulators, environmental coordinators or hazardous material coordinators, law enforcement officers, and safety personnel of the U.S. Environmental Protection Agency (USEPA), American Indians and Alaska Natives, other Federal Land Managers, and/or the States. When appropriate, public health officials of various agencies may also be involved.
Explosive Hazard. A condition where danger exists because explosives are present that may react (e.g., detonate, deflagrate) in a mishap with potential unacceptable effects (e.g., death, injury, damage) to people, property, operational capability, or the environment.
Explosive Ordnance Disposal (EOD). The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded ordnance and of other munitions that have become an imposing danger, for example, by damage or deterioration.
Explosive Ordnance Disposal (EOD) Personnel. Military personnel who have graduated from the Naval School, Explosive Ordnance Disposal; are assigned to a military unit with a Service-defined EOD mission; and meet Service and assigned unit requirements to perform EOD duties. EOD personnel have received specialized training to address explosive and certain CA hazards during both peacetime and wartime. EOD personnel are trained and equipped to perform Render Safe Procedures (RSP) on nuclear, biological, chemical, and conventional munitions, and on improvised explosive devices.
Explosive Ordnance Disposal (EOD) Unit. A military organization constituted by proper authority; manned with EOD personnel; outfitted with equipment required to perform EOD functions; and assigned an EOD mission.
Explosives or Munitions Emergency Response. All immediate response activities by an explosives and munitions emergency response specialist to control, mitigate, or eliminate the actual or potential threat encountered during an explosives or munitions emergency. An explosives or munitions emergency response may include in-place render-safe procedures, treatment or destruction of the explosives or munitions, and/or transporting those items to another location to be rendered safe, treated, or destroyed. Any reasonable delay in the completion of an explosives or munitions emergency response caused by a necessary, unforeseen, or uncontrollable circumstance will not terminate the explosives or munitions emergency. Explosives and munitions emergency responses can occur on either public or private lands and are not limited to responses at RCRA facilities. (Military Munitions Rule, 40 CFR 260.10)
Explosives Safety. A condition where operational capability and readiness, people, property, and the environment are protected from the unacceptable effects or risks of potential mishaps involving military munitions.
Interim Holding Facility (IHF). A temporary storage facility designed to hold recovered chemical warfare material (RCWM).
Land Use Controls (LUC). LUC are physical, legal, or administrative mechanisms that restrict the use of, or limit access to, real property, to manage risks to human health and the environment. Physical mechanisms encompass a variety of engineered remedies to contain or reduce contamination and/or physical barriers to limit access to real property, such as fences or signs.
Long-Term Management (LTMgt). The period of site management (including maintenance, monitoring, record keeping, 5-year reviews, etc.) initiated after response (removal or remedial) objectives have been met (i.e., after Response Complete).
Material Potentially Presenting an Explosive Hazard (MPPEH). Material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris); or material potentially containing a high enough concentration of explosives such that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization or disposal operations). Excluded from MPPEH are munitions within DoD's established munitions management system and other hazardous items that may present explosion hazards (e.g., gasoline cans, compressed gas cylinders) that are not munitions and are not intended for use as munitions.

Enclosure 1: Military Munitions-Related Terms and Definitions

Military Munitions. Military munitions means all ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the Department of Defense, the Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives, and chemical warfare agents; chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges; and devices and components thereof. The term does not include wholly inert items; improvised explosive devices; and nuclear weapons, nuclear devices, and nuclear components, other than nonnuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) have been completed. (10 U.S.C. 101(e)(4)(A) through (C))
Military Munitions Burial Site. A site, regardless of location, where military munitions or CA, regardless of configuration, were intentionally buried, with the intent to abandon or discard. This term includes burial sites used to dispose of military munitions or CA, regardless of configuration, in a manner consistent with applicable environmental laws and regulations or the national practice at the time of burial. It does not include sites where munitions were intentionally covered with earth during authorized destruction by detonation, or where in-situ capping is implemented as an engineered remedy under an authorized response action.
Minimum Separation Distance (MSD). MSD is the distance at which personnel in the open must be from an intentional or unintentional detonation.
Munition with the Greatest Fragmentation Distance (MGFD). The munition with the greatest fragment distance that is reasonably expected (based on research or characterization) to be encountered in any particular area.
Munitions and Explosives of Concern (MEC). This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) Unexploded ordnance (UXO), as defined in 10 U.S.C. 101(e)(5); (B) Discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2); or (C) Munitions constituents (e.g., TNT, RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.
Munitions Constituents (MC). Any materials originating from unexploded ordnance (UXO), discarded military munitions (DMM), or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. 2710(e)(3)).
Munitions Debris. Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.
Munitions Response. Response actions, including investigation, removal actions and remedial actions to address the explosives safety, human health, or environmental risks presented by unexploded ordnance (UXO), discarded military munitions (DMM), or munitions constituents (MC), or to support a determination that no removal or remedial action is required.
Munitions Response Area (MRA). Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. A munitions response area is comprised of one or more munitions response sites.
Munitions Response Site (MRS). A discrete location within an MRA that is known to require a munitions response.
Mutual Agreement. A meeting of the minds on a specific subject, and a manifestation of intent of the parties to do or refrain from doing some specific act or acts. Inherent in any mutual agreement or collaborative process are the acknowledgement of each member's role in the process and their differing views of their authorities. The mutual agreement process will provide a means of resolving differences without denying the parties an opportunity to exercise their respective authorities should mutual agreement fail to be achieved.
One Percent Lethality Distance. A distance calculated from a given CA Maximum Credible Event (MCE) and meteorological conditions (temperature, wind speed, Pasquill stability factor) and established as the distance at which dosage from that MCE agent release would be 150 mg-min/m^3 for H and HD agents, 75 mg-min/m^3 for HT agent, 150 mg-min/m^3 for Lewisite, 10 mg-min/m^3 for GB agent, 4.3 mg-min/m^3 for VX vapor, and 0.1 mg-min/m^3 for inhalation and deposition of liquid VX.

On-call Construction Support. Construction support provided, on an as needed basis, where the probability of encountering UXO, other munitions that may have experienced abnormal environments (e.g., DMM), munitions constituents in high enough concentrations to pose an explosive hazard, or CA, regardless of configuration, has been determined to be low. This support can respond from off-site when called, or be on-site and available to provide required construction support.
On-site Construction Support. Dedicated construction support, where the probability of encountering UXO, other munitions that may have experienced abnormal environments (e.g., DMM), munitions constituents in high enough concentrations to pose an explosive hazard, or CA, regardless of configuration, has been determined to be moderate to high.
On-the-Surface. A situation in which UXO, DMM or CA, regardless of configuration, are: (A) entirely or partially exposed above the ground surface (i.e., the top of the soil layer); or (B) entirely or partially exposed above the surface of a water body (e.g., because of tidal activity).
Open Burn (OB). An open-air combustion process by which excess, unserviceable, or obsolete munitions are destroyed to eliminate their inherent explosive hazards.
Open Detonation (OD). An open-air process used for the treatment of excess, unserviceable or obsolete munitions whereby an explosive donor charge initiates the munitions being treated.
Operational Range. A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities; or although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities. (10 U.S.C. 101(e)(3)(A) and (B)). Also includes "military range," "active range," and "inactive range" as those terms are defined in 40 CFR §266.201.
Primary Explosives. Primary explosives are highly sensitive compounds that are typically used in detonators and primers. A reaction is easily triggered by heat, spark, impact or friction. Examples of primary explosives are lead azide and mercury fulminate.
Public Access Exclusion Distance (PAED). The PAED is defined as longest distance of the hazardous fragment distance, inhabited building distance (IBD) for overpressure, or the One Percent Lethality Distance. For siting purposes, the PAED is analogous to the IBD for explosives; therefore, personnel not directly associated with the chemical operations are not to be allowed within the PAED.
Qualified Receiver. Entities that have personnel who are, or individuals who are, trained and experienced in the identification and safe handling of used and unused military munitions, and any known or potential explosive hazards that may be associated with the MPPEH they receive; and are licensed and permitted or otherwise qualified to receive, manage, and process MPPEH.
Range. A designated land or water area that is set aside, managed, and used for range activities of the Department of Defense. The term includes firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration. (10 U.S.C. 101(e)(1)(A) and (B))
Range activities. Research, development, testing, and evaluation of military munitions, other ordnance, and weapons systems; and the training of members of the armed forces in the use and handling of military munitions, other ordnance, and weapons systems. (10 U.S.C. 101(e)(2)(A) and (B))
Range Clearance. The destruction, or removal and proper disposition of used military munitions (e.g., unexploded ordnance (UXO) and munitions debris) and other range-related debris (e.g., target debris, military munitions packaging and crating material) to maintain or enhance operational range safety or prevent the accumulation of such material from impairing or preventing operational range use. "Range clearance" does not include removal, treatment, or remediation of chemical residues or munitions constituents from environmental media, nor actions to address discarded military munitions (e.g., burial pits) on operational ranges.
Range-Related Debris. Debris, other than munitions debris, collected from operational ranges or from former ranges (e.g., target debris, military munitions packaging and crating material).
Recovered Chemical Warfare Material (RCWM). CWM used for its intended purpose or previously disposed of as waste, which has been discovered during a CWM response or by chance (e.g., accidental discovery by a member of the public), that DoD has either secured in place or placed under DoD control, normally in a DDESB-approved storage location or interim holding facility, pending final disposition.

Render Safe Procedures (RSP). The portion of EOD procedures that involves the application of special disposal methods or tools to interrupt the functioning or otherwise defeat the firing train of UXO from triggering an unacceptable detonation.
Secondary Explosives. Secondary explosives are generally less sensitive to initiation than primary explosives and are typically used in booster and main charge applications. A severe shock is usually required to trigger a reaction. Examples are TNT, cyclo-1,3,5-trimethylene-2,4,6-trinitramine (RDX or cyclonite), HMX, and tetryl.
Small Arms Ammunition. Ammunition, without projectiles that contain explosives (other than tracers), that is .50 caliber or smaller, or for shotguns.
Team Separation Distance (TSD). The distance that munitions response teams must be separated from each other during munitions response activities involving intrusive operations.
Technical Escort Unit (TEU). A DoD organization manned with specially trained personnel that provide verification, sampling, detection, mitigation, render safe, decontamination, packaging, escort and remediation of chemical, biological and industrial devices or hazardous material.
Technology-aided Surface Removal. A removal of UXO, DMM or CWM on the surface (i.e., the top of the soil layer) only, in which the detection process is primarily performed visually, but is augmented by technology aids (e.g., hand-held magnetometers or metal detectors) because vegetation, the weathering of UXO, DMM or CWM, or other factors make visual detection difficult.
Time Critical Removal Action (TCRA). Removal actions where, based on the site evaluation, a determination is made that a removal is appropriate, and that less than 6 months exists before on-site removal activity must begin. (40 CFR 300.5)
Unexploded Ordnance (UXO). Military munitions that (A) have been primed, fuzed, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (C) remain unexploded whether by malfunction, design, or any other cause. (10 U.S.C. 101(e)(5)(A) through (C)))
UXO Technicians. Personnel who are qualified for and filling Department of Labor, Service Contract Act, Directory of Occupations, contractor positions of UXO Technician I, UXO Technician II, and UXO Technician III.
UXO-Qualified Personnel. Personnel who have performed successfully in military EOD positions, or are qualified to perform in the following Department of Labor, Service Contract Act, Directory of Occupations, contractor positions: UXO Technician II, UXO Technician III, UXO Safety Officer, UXO Quality Control Specialist, or Senior UXO Supervisor.
Venting. Exposing any internal cavities of MPPEH, to include training or practice munitions (e.g., concrete bombs), using DDESB- or DoD Component-approved procedures, to confirm that an explosive hazard is not present.

Military Munitions-Related Terms (1)
How do they apply to specific types of material?

Type of Material (These are only examples.)	What is it **BEFORE** it is inspected for explosives hazards? (2) What is it **BEFORE** it is inspected? (16)		What is it **AFTER** it is inspected for explosive hazards?					
			If it presents an explosive hazards?			If it does not present an explosive hazards?		
	MPPEH	Other	MEC			MC (5)	Munitions Debris	Other
			UXO	DMM (3)	MC (4)			
Used military munition, on a range, fired	X		X				X	
Unused military munition, on a range, apparently discarded	X			X			X	
Used military munition, in a burial pit, on an operational range or on former ranges	X		X (6)				X	
Unused military munition, in a burial pit on an operational range or on former ranges	X			X (6)			X	
Explosives in the soil	X				X (7)	X		
Refrigerator, nails, soft drink cans, old fence wire, etc.		(8)	NA	NA	NA			(8)
Used cartridge cases, from a range, with live unused munitions possibly mixed in	X			X			(9)	
Target from a range (other than small arms range)	X		(10)	(10)	(10)			(11)
Remnants of munitions from an operational range or former range	X		X (12)	X (12)	X (12)		X (13)	
Kicked out military munition from a former open burn or open detonation ground	X			X (14)			X	
Residual MC in a melt kettle of a former (closed) explosive cast loading building	X		(15)	(15)	X (15)	X		X (16)
Residual MC in a floor drain pipe from an explosives-laden wash water drain of a former (closed) explosives cast loading facility.	X		(15)	(15)	X (15)			X (16)
Residual MC in cracks in floor slab (and in soil underneath floor cracks) in a former explosives manufacturing building	X		(15)	(15)	X (15)	X		X (16)
Small arms bullets or lead particulates n the soil from small arms use at a former small arms range used only for firing small arms ammunition		X (17)	Not Applicable (17)			X		

Note: The examples in this table are not all inclusive. The numbers in the table refer to footnotes that are found on the next page. It is important to read the footnotes, as they provide additional information of importance to understanding.

Enclosure 2

Endnotes:

(1) DoD has been working to standardize terms related to military munitions.

(2) Before material that is considered MPPEH can be either transferred within or released from DoD, its explosives safety status must be determined (see definition--Documentation of the Explosives Safety Status of Material). The type material involved determines the type of inspection (e.g., visual examination, chemical analysis, X-ray) required. Personnel qualified to determine the status of the particular material being examined must perform required inspections. For example, EOD and UXO-qualified personnel may inspect UXO and DMM during a munitions response or during range clearance activities. A QASAS or certified Wage Grade ammunition operator may inspect steamed-out projectiles at a depot's steam-out operation. A laboratory technician may perform a chemical analysis of soil to determine the percent explosives in the soil.

(3) Munitions generally considered as DMM include: buried munitions; un-recovered kick outs from open detonations; munitions left behind or discarded accidentally during munitions-related activities; munitions intentionally disposed of without authorization during munitions-related activities. Munitions removed from storage for the purpose of disposal that are awaiting disposal are not DMM.

(4) This is MC that is both (a) an explosive; and (b) present in sufficient concentrations to present explosive hazards.

(5) This is MC that is either (a) not an explosive (e.g., lead, beryllium, and cadmium); or (b) an explosive not present in sufficient concentrations to present explosive hazards.

(6) Although military munitions in a burial pit will normally be DMM, some may be UXO. For explosives safety reasons, munitions in a burial pit should be approached as UXO until assessed by technically qualified personnel (e.g., EOD personnel, UXO-qualified personnel) and determined that they are not UXO or that they do not present explosive hazards similar to UXO.

(7) Explosive soil is typically found in sumps and settling lagoons for explosives-laden wastewater, and in and around drainage ditches and pipes that carry the wastewater to such sumps and lagoons.

(8) These items are cultural debris.

(9) After determination of their explosives safety status, used cartridge cases documented as safe would, after any demilitarization required to remove their military characteristics, be available for release from DoD. In addition to these DoD requirements, other regulatory criteria may apply.

(10) A target is a type of range-related debris. Although a target is not MEC, it may contain UXO, DMM, or MC. Prior to its release from DoD control, its explosives safety status must be documented.

(11) A target's explosives safety status must be documented and any demilitarization required to remove its military characteristics must be performed prior to its release from DoD control.
(12) UXO, DMM, or MC may be found on operationalranges and on former ranges (previously referred to as closed, transferring or transferred ranges). An inspection of the material will determine into which category this material falls. For example, if a projectile breaks apart on impact, one could find (a) a sheared-off fuze, which would be UXO or (b) explosive filler, which would be MC, that broke away from the projectile's open body. If during an open detonation of an unserviceable munition that is conducted on an operational range, the donor charge detonates, but the munition being destroyed breaks up, but does not detonate, the remnants of the munition would be DMM or, if explosive residue (e.g., clumps of TNT), MC.
(13) After determination of its explosives safety status, scrap metal from used munitions on a range that is documented as safe would, after any demilitarization required to remove its military characteristics, be available for release from DoD control. In additions to these DoD requirements, other regulatory criteria may apply.
(14) Prudent safety practice is to consider kick outs, which have experienced an unknown environment, to be equally dangerous and managed like UXO until technically qualified personnel assess and determine that they are not UXO or do not present explosive hazards similar to UXO.
(15) Of itself, such material (e.g., mettle kettle, drainpipes, floor slabs) do not present an explosive hazard and would not be classified as UXO, DMM or MC. However, residual MC (e.g., TNT, RDX, HMX) could remain in such material in high enough concentrations to present an explosive hazard.
(16) After determination of its explosives safety status, such material (e.g., mettle kettle, drainpipes, floor slabs) when documented as safe would be available for release from DoD control. In addition to this DoD requirement, other regulatory criteria may apply.
(17) At operational ranges or former ranges used exclusively for live fire of small arms ammunition, some unfired small arms ammunition may be found. Although this ammunition is considered DMM and would be MPPEH, it is not considered to present a significant explosive hazard.

Pre-Construction Site Assessment

Range Development Plan

SCARNG McCrady Training Center

Eastover, SC 29044

ERC Project No. 515

MILCON P/N: 450377, 450462, 450464, 450386

Environmental Resources Center

South Carolina Army National Guard

01 February 2013

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Pre-Construction Site Assessment (PCA)

Range Development Plan

McCrady Training Center, Eastover, SC 29044

01 February 2013

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Appendices

Appendix A: Site Maps

Appendix B: Site Photos

Appendix C: Environmental Risk Assessment (EDR)

- The EDR Aerial Photo Decade Package
- EDR Historical Topographic Map Report
- The EDR Radius Map w/GeoCheckEDR NEPA Check
- The EDR City Directory Abstract
- Certified Sanborn Map Report

Appendix D: Interview Contact List

Appendix E: Orphan Sites

Appendix F: Biological Assessment

1.0 Executive Summary

The South Carolina Army National Guard has prepared this Pre-Construction Site Assessment (PCA) Report for the Range Development Plan EA, hereafter referred to as the "target property." The Site is located at 5401 Leesburg Rd, Columbia, SC 29044. This PCA was prepared in anticipation of range construction in at McCrady Training Center.

This PCA Report was conducted in conformance with Army guidance, *Army Regulation (AR) 200-1, Environmental Protection and Enhancement (*Feb 1997), *ARNG Environmental Condition of Property SOP (*Mar *2007), Army National Guard Environmental Condition of Property Handbook (June 2001) and the Standard Practice for Conducting Pre-Construction Site Assessments, Phase I Environmental Site Assessment Process,* American Society for Testing & Materials (ASTM) E 1527-05 as secondary guidance when it was not inconsistent with the primary guidance.

This PCA Report details the history of the property, including the SCARNG and any prior tenant uses of the Site and the resulting environmental condition of the property.

The entire property is on approximately 15,000 acres and contains 217 permanent structures.

Based on a review of interviews and aerial photographs and U.S. Geological Survey topographical maps dating back to 1937, the target property was originally rural area located east of the city of Columbia. The property has been used as a military training facility since 1917, except for a brief break from 1921-1925.

Areas of potential environmental concern were reviewed and no significant concerns relating to environmental condition of the target property were found. In accordance with Department of Defense (DoD) policy defining the classifications, the target property has been overall classified as Category I with UXO areas classified as Category III.

2.0 Introduction

2.1 Location & Property Identification

The proposed site is located in the central portion of South Carolina (see Appendix A - Maps). The Multi Purpose Machine Gun (MPMG), Modified Record Fire (MRF), and 10/25m zero range target properties are located at 34 Degrees 0' 24.48" North LAT and 80 Degrees 49' 9.48" West LONG. See Appendix A for the Map showing exact target property locations. The EDR report was based off of the midpoint of the MPMG, MRF, and 10/25m zero ranges. The close proximity of the ranges allowed one report to accurately address all three within one search radius. The Live Fire Shoothouse is to be located at 34 Degrees 1' 45.84" North LAT and 80 Degrees 42' 22.68" West LONG. The target property address is: 5411 Leesburg Rd, Columbia, SC 29223.

2.2 References

1.1.1 *Standard Practices for Environmental Site Assessment: Phase I Environmental Site Assessment Process,* American Society for Testing & Materials ASTM E 1527-05

1.1.2 *Army Regulation (AR) 200-1, Environmental Protection and Enhancement,* Dec 2007

1.1.3 *ARNG Environmental Condition of Property SOP, dated 3/14/2007*

1.1.4 Environmental Data Resources Inc. (EDR) Report for the subject property

1.1.5 *The Army National Guard Environmental Condition of Property Handbook , The ARNG's ECOP Process Handbook, 1 June 2011*

2.3 Methodology

The ESA was conducted in three phases. The first phase was to compile background information. This was accomplished though document reviews, gathering of aerial photos and background interviews (see Appendix D for interview contact list). The second phase was a site reconnaissance. Three members of the SCARNG ERC Team inspected the site on 1/30/12. The final phase was to compile all the information to create the PCA to be used for making the final environmental determination for construction of proposed ranges.

3.0 Property Description & Environmental Setting

3.1 Property Description

The property is currently licensed to the SC Army National Guard for use as a military training facility. The target sites are licensed to the SC Army National Guard for use as live fire shooting ranges. The entire property is on approximately 15,000 acres licensed to the Army National Guard and contains 0 permanent structures in the actual target site footprints. There are, however, several sheds and other shooting-related open air structures in the area surrounding the 10/25m zero range. These structures receive water from a local well and use septic systems. No heat is provided to these structures. The MPMG range site is located in proximity to a weather station structure that uses no water or septic system. No heat is provided to this station. The MRF range site is not located in the proximity of any permanent structures. The Live Fire Shoothouse is not located in close proximity to any existing permanent structures.

3.2 Surrounding Land Use

The target property is located in Richland County, South Carolina. The surrounding areas appear to be rural and residential.

3.3 Surface Water

There was no permanent surface water areas present at the target locations. In addition, there were no temporary standing water areas at the target locations. This information is based on aerial photography and site maps as well as visual inspection during the site visits on January 30, 2012.

3.4 Topography

The general topography of the property and surrounding areas appears to be slightly sloped towards the South. The site elevation is 340 feet above sea level for the MPMG, MRF, and 10/25m zero ranges. The site elevation is 232ft above sea level for the Live Fire Shoothouse. The general topography appears to be slightly sloped towards the South for the Live Fire Shoothouse as well. See Appendix C (Environmental Risk Assessment / Geocheck – Physical Setting Source Summary) for more information.

3.5 Geology

The geology of the target MPMG, MRF and 10/25m zero range sites and surrounding area is of the following composition: Rock Stratigraphic Unit is of the Mesozoic Era, the Cretaceous System, the Woodbine and Tuscaloosa Groups Series and UK1 Code and a Stratified Sequence Category. There are 5 dominant soil compositions in the general area of the target property.

- The first dominant soil composition is Lakeland component, sand surface texture and of the Class A Hydrologic Group. The Soils Drainage Class is of the "Excessively drained" category and does not meet the requirements for a hydric soil. Depth to water table is greater than zero (0) inches.
- The second dominant soil composition is Blanton component, sand surface texture and of the Class A Hydrologic Group. The Soils Drainage Class is of the "moderately well drained" category and does not meet the requirements for a hydric soil. Depth to water table is greater than 122 inches.
- The third dominant soil composition is Ailey component, loamy sand surface texture and of the Class B Hydrologic Group. The Soils Drainage Class is of the "well drained" category and does not meet the requirements for a hydric soil. Depth to water table is greater than 0 inches.
- The fourth dominant soil composition is Johnston component, loam surface texture and of the Class D Hydrologic Group. The Soils Drainage Class is of the "very poorly drained" category and meets the requirements for an all hydric soil. Depth to water table is greater than 0 inches.
- The fifth dominant soil composition is Lakeland component, sand surface texture and of the Class A Hydrologic Group. The Soils Drainage Class is of the "excessively drained" category and does not meet the requirements for a hydric soil. Depth to water table is greater than 0 inches.

More information on soils types can be found in Appendix C – "Geocheck – Physical Setting Source Summary."

The Geology of the target Live Fire Shoothouse and surrounding area is of the following composition: Rock Stratigraphic Unit is of the Mesozoic Era, the Cretaceous System, the Woodbine and Tuscaloosa Groups Series and UK1 Code and a Stratified Sequence Category. There are 5 dominant soil compositions in the general area of the target property.

- The first dominant soil composition is Vaucluse component, loamy sand surface texture and of the Class C Hydrologic Group. The Soils Drainage Class is of the "well drained" category and does not meet the requirements for a hydric soil. Depth to water table is greater than zero (0) inches.
- The second dominant soil composition is Johnston component, loam surface texture and of the Class D Hydrologic Group. The Soils Drainage

Class is of the "very poorly drained" category and meets the requirements for an all hydric soil. Depth to water table is greater than zero (0) inches.

- The third dominant soil composition is Pelion component, loamy sand surface texture and of the Class B/D Hydrologic Group. The Soils Drainage Class is of the "moderately well drained" category and meets the requirements for a partially hydric soil. Depth to water table is greater than 30 inches.
- The fourth dominant soil composition is Ailey component, loamy sand surface texture and of the Class B Hydrologic Group. The Soils Drainage Class is of the "well drained" category and does not meet the requirements for a hydric soil. Depth to water table is greater than 0 inches.
- The fifth dominant soil composition is Lakeland component, sand surface texture and of the Class A Hydrologic Group. The Soils Drainage Class is of the "excessively drained" category and does not meet the requirements for a hydric soil. Depth to water table is greater than 0 inches.

More information on soils types can be found in Appendix C – "Geocheck – Physical Setting Source Summary."

3.6 Hydrological

The EDR report indicates the FEMA Flood Zone and the National Wetland Inventory Data for this site. The subject MPMG, MRF, 10/25m zero range and Live Fire Shoothouse properties are not shown to be in a flood plain. The Overview Map (Map 3248581.2s - page 9 of 60 in the radius report), contained in Appendix C, does show that there are seven (7) national wetlands inventory zones within 1 mile of the MPMG, 10/25m zero, and MRF range target properties in all directions of the target properties. The Overview Map (Map 3248581.9s – page 9 of 52 in the radius report), contained in Appendix C, does show that there are eight (8) national wetlands inventory zones within 1 mile of the Live Fire Shoothouse target property in all directions of the target properties. See maps located in Appendix A and Appendix C for more information.

3.7 Sensitive Environmental & Natural/Cultural Resources

Per the EDR data, there are no listed Designated Wilderness Areas, Designated Wildlife Preserve Areas or Critical Habitat within 1 mile of target property.

The MPMG, MRF, and 10/25m Zero Ranges are proposed in an area that has the potential to impact the federally listed red cockaded woodpecker habitat. An extensive biological assessment of the potential impacts is being completed in coordination with the US Fish and Wildlife Service to better define the impacts. There is also potential habitat for two endangered plant species on McCrady Training Center; however the proposed location of these ranges and Shoothouse is not expected to impact these species. See Appendix F: "Biological Assessment", for further details.

Evaluations pursuant to Section 106 of the National Historic Preservation Act were conducted on all possible target site areas. Past Cultural Resource Surveys, GIS data and on site investigations were used to determine the potential impacts to Cultural and Historic resources. The historical Inchon Range (located within the proposed footprint of the MFR Range) has been deemed "Eligible for Listing" for the National Register and the SCARNG is currently working with the SHPO to create mitigation measures for this property.

4.0 Past & Current Operations

4.1 Land Use History

This property is currently used as a military training facility. The property was originally established as a military training facility in 1917 by the state of South Carolina. It was transferred to the Federal Government in 1939, and is licensed to the state of South Carolina for use as a military training facility currently. For more information see "Final Site Inspection Report" in Appendix G: Works Cited.

4.2 Regulatory Records Analysis

Federal, State, and EDR records have been reviewed to prepare this PCA.

4.3 Analysis of Aerial Photography

Aerial photography of the site was analyzed after the site visit. The aerial photographs analyzed are included in Appendix C – Environmental Risk Assessment of this PCA. The Historical Aerial Photo Decade Maps obtained for the MPMG, MRF, and 10/25m zero ranges are for years 1961, 1971, 1978, 1983, 1994, 2005, and 2006. Below are summaries of the aerial photographs:

1961

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded with no signs of development.

1971

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded with no signs of residents.

1978

Target Property area appears to be rural and wooded, with the addition of Weston Lake. The surrounding areas are also rural and wooded with minimal residential development.

1983

Target Property area appears to be rural and wooded with slightly increasing military development compared to previous images. The surrounding areas are also rural and wooded.

1994

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded.

2005

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded.

2006

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded.

The Historical Aerial Photo Decade Maps obtained for the Live Fire Shoothouse are for years 1961, 1976, 1983, 1989, 1994, 1999, 2005, and 2006. Below are summaries of the aerial photographs:

1961

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded, with very minimal residential area mixed in.

1976

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded, with very minimal residential area mixed in.

1983

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded, with very minimal residential area mixed in.

1989

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded, with very minimal residential area mixed in.

1994

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded, with very minimal residential area mixed in.

1999

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded, with very minimal residential area mixed in.

2005

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded, with very minimal residential area mixed in.

2006

Target Property area appears to be rural and wooded. The surrounding areas are also rural and wooded, with very minimal residential area mixed in.

4.4 Historical Records

Historical Topographic Maps were obtained for the target property area. Appendix C contains the "EDR Historical Topographic Map Report" which was also reviewed by SCARNG. The results of these topographic maps review is summarized below for the MPMG, MRF, and 10/25m zero range locations:

1937:
Target Property area appears to rural. The surrounding areas appear to be rural and military training areas.

1953:

Target Property area appears to rural. The surrounding areas appear to be rural and military training areas.

1972:

Target Property area appears to rural. The surrounding areas appear to be rural and military training areas.

1986:

Target Property area appears to rural. The surrounding areas appear to be rural and military training areas.

The adjacent areas were also reviewed and the results are as follows:

1943:

Target Property area appears to rural. The surrounding areas appear to be rural and military training areas.

1953:

Target Property area appears to rural. The surrounding areas appear to be rural and military training areas.

1972:

Target Property area appears to rural. The surrounding areas appear to be rural and military training areas.

1982:

Target Property area appears to rural. The surrounding areas appear to be rural and military training areas.

1987:

Target Property area appears to rural. The surrounding areas appear to be rural and military training areas.

The topographic maps for the Live Fire Shoothouse were also reviewed and the results are as follows:

1938:

Target Property area appears to rural. The surrounding areas appear to be rural and military training areas.

1953:

Target Property area appears to rural. The surrounding areas appear to be rural and military training areas.

1986:

Target Property area appears to rural. The surrounding areas appear to be rural and military training areas.

4.5 Hazardous Materials Use, Handling and Storage

The chemicals used and stored on site are primarily associated with UXO and other military training related munitions. Any hazardous materials and wastes are properly managed and stored per State and Federal Laws and regulations and as such there is no reason to believe said chemicals and wastes pose a significant risk to the project.

4.6 Hazardous Waste Generation, Handling and Storage

Any hazardous materials and wastes are properly managed and stored per State and Federal Laws and regulations and as such there is no reason to believe said chemicals and wastes pose a significant risk to the project.

4.7 Petroleum Products Use, Handling and Storage

There are currently no underground or above ground storage tanks in the immediate vicinity of the proposed range sites. This is confirmed by the EDR report, as well as an interview with Linda A. Johnson, Environmental Compliance Manager, SCARNG. See Appendix D: "Interviews" for more information. There are storage tanks in the McCrady Training Center Cantonment area; however these are more than one mile from the target sites and are not deemed to be of concern.

4.8 Other Environmental Contamination

Several of the range locations have UXO (Unexploded Ordnance) within the range limits. These areas will be surveyed by an outside agency and cleared by UXO removal prior to construction. These UXO areas can be seen in ECOP maps located in Appendix A: "Site Maps". UXO presence is indicated by a MILCON level III category and will be color coded yellow. Per industry standards, UXO at the target site are not deemed to be a hazardous substance because it is within the realm of range operations and was used for its intended purpose.

There is no evidence to suggest any other environmental contamination in the areas proposed for the construction of any of the ranges. This is determined from the data provided in the EDR report, as well as information obtained through interviews. For any site specific contamination found, see section entitled 5.0 Site Reconnaissance.

5.0 Site Reconnaissance

Three members of the SCARNG ERC staff, Mark Mohr, Deputy Conservation Manager, Brittanie Young, Environmental Review Manager, and Joe Adams, SCARNG Intern, visited the proposed target site locations on January 30, 2012. The investigation included a walkthrough of the site and taking representative photos of the area.

At the proposed 10/25m zero range site, a leaking 55 gallon drum was discovered approximately 75 yards from the proposed range. There was a plastic-like substance spread around one end of the drum; however it did not appear to have leached into the soil. On February 23, 2012, a sample of the previously mentioned spill was taken for further investigation. After further investigation, the substance found at the previously mentioned drum was determined to be a plastic portion of the drum itself which was melted during a prescribed fire, conducted for forestry management. Living vegetation was observed in close proximity to the spill, and given that the substance was deemed to be melted plastic, there is no reason to believe that a significant threat is posed to the target site or its future construction activities. This spill is deemed a de minimis finding. A suspicious mound of dirt was also discovered at the site, approximately 50-75 yards from the proposed range. On February 23, 2012 the mound of dirt was probed and deemed to be the result of a nearby roadbed. This mound poses no significant risk to the construction of this range.

The proposed MPMG range site was also visited. A walkthrough of the area was conducted and pictures were taken. No evidence of spills or contamination was found at this site. There was no evidence found that would indicate any hazards or concerns with proceeding with this range. On March 27, 2012, the MPMG site was revisited to complete a Biological Assessment. During this walkthrough, a small area of debris was discovered which appears to be the remains of past human activities in the area. The exact source of the debris could not be determined; however the debris appears to contain a burn barrel, and other small pieces of metal. There is no evidence of chemical presence or other environmental hazards, and this is deemed as a de minimis finding.

The proposed MRF range site was also visited. A walkthrough of the area was conducted and pictures were taken. There was no evidence of spills or

contamination at this site, or any other indications of hazards that could interfere with the construction of this range.

The proposed Live Fire Shoothouse site was visited on February 22, 2012 by the aforementioned group. A walkthrough of the area was conducted and pictures were taken. No evidence of spills or contamination was found at this site. Three concrete structures were discovered in close proximity to the target site, which appear to be the remains of past military training activities. No evidence was discovered to suggest any threats or hazards to proceeding with construction.

Photographs can be found in Appendix B: "Site Photos".

6.0 Response Action

There currently no current or closed response actions regarding the target property. This is confirmed by review of the EDR report and interviews with SCARNG environmental compliance personnel.

7.0 Findings on Adjacent Properties

7.1 Federal & State Records Search

The target property address of 2563 Essayons Way, Columbia, SC 29223 for the MPMG, 10/25m zero, and MRF ranges does not show the ranges to be listed on any databases per the EDR Report. This address is the location of Fort Jackson and was used to ensure the reporting of any incidents assigned to that address that may impact this proposed project. The target property address of 5411 Leesburg Rd for the Live Fire Shoothouse does not show the range to be listed on any databases per the EDR Report.

A review of EDR records shows zero (0) Resource Conservation and Recovery Act (RCRA) Small Quantity Generator (SQG) within 0.25 miles of the target properties.

The National Priority List (NPL) has revealed that there are zero (0) NPL Sites within approximately 1 mile of the target properties.

A review of the State Hazardous Waste Sites (SHWS) records which are an equivalent to the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) list, has revealed that there are zero (0) SHWS sites within approximately 1 mile of the target properties.

The State Groundwater Contamination Inventory Cases (GWCI) List has revealed that there are zero (0) GWCI sites within approximately 0.5 miles of the target properties.

The Leaking Underground Storage Tank (LUST) database showed records of zero (0) LUST sites within approximately 0.5 miles of the target properties.

The Underground Storage Tank (UST) database has revealed that there are zero (0) UST sites within approximately 0.25 miles of the target properties.

The Aboveground Storage Tank (AST) database has revealed that there are zero (0) AST sites within approximately 0.25 miles of the target properties.

The environmental database search yielded thirteen (13) unmapped orphan sites for the MPMG, 10/25m zero, and MRF ranges. The environmental database search yielded seventeen (17) unmapped orphan sites for the Live Fire Shoothouse. Unmapped sites are those with address information sufficient only to identify as within the zip code of the Target Site. These sites were identified and/or estimated the location of each site as well as their potential environmental risk to the target property. After consideration, none of the unmapped sites were deemed to be on significant environmental risk. See Appendix C – Environmental Risk Assessment and Appendix E – Orphan Sites for details on findings in the adjacent properties.

7.2 Historical Activities & Current Use

Historically, the activities on this land have been military training based activities. The 10/25m zero range has evidence of fence posts and barbed wire which marked the boundaries for other ranges previously located in this area. The Live Fire Shoothouse location has three concrete structures in the immediate vicinity that were previously used in training activities for the base. The Modified Record Fire range has evidence of previous anti-tank training activities in the form of trenches that housed a conveyor system for a tank-like target. See "Historical Survey and Evaluation of the Inchon 1000-Inch Miniature Anti-Tank Range, Fort Jackson, SC" located in Appendix G: "Works Cited" for more information. Prior to this use, the area was undeveloped wooded area.

There was no evidence of historic or current uses of the adjacent property that would negatively impact the property that SCARNG proposes to construct the proposed ranges on. The only concern for the target properties is the presence of UXO in some proposed range areas. These areas will be cleared prior to construction. For more information, see Appendix A: "Site Maps."

8.0 Conclusions

8.1 Environmental Condition of the Property

The property is in good environmental condition and is well suited for additions and alterations. The Environmental Condition of Property (ECOP) has been overall classified as Category I (there is no reason to expect contamination will be encountered during the construction) with UXO areas classified as Category III (site is known to be contaminated or there is strong suspicion contamination will be encountered during construction). Because of the nature of the proposed ranges and the construction involved, effects from contaminated sites within 0.125 to 1.0 mile radius of the target property should not pose any adverse environmental impacts. It is the determination of the SCARNG ERC that this property is environmentally suitable for additions and alterations.

8.2 Known or Suspected Issues with Transfer Restrictions

N/A

8.3 Recommendation

The property is in good environmental condition and is well suited to meet the requirements of the SCARNG. Environmental considerations should not prevent the alterations of this property.

9.0 Certification

The Environmental Resources Center (ERC) of the South Carolina Army National Guard conducted the Environmental Baseline Study and prepared this document. The principles in the document creation are listed below.

Lead Investigator: Mark Mohr, SCARNG Deputy Conservation Manager

Brittanie Young, SCARNG Environmental Review Manager

Joe Adams, SCARNG Environmental Intern

Contributing Investigators: N/A

The ERC staff has reviewed all appropriate records made available and conducted a visual inspection of the site following an analysis of the information from the records search. The information contained within this report is based on records made available, and to the best of the investigators knowledge, is current and accurate as of 17 April, 2012.

Certified by: Bryan Hall _____ Date: 6 Nov 2012

Conservation Manager

Approved by: MAJ William Matheny Wm. A. Matheny, Jr Date: _____

Environmental Program Manager

Works Cited

"Historical Survey and Evaluation of the Inchon 1000-Inch Miniature Anti-Tank Range, Fort Jackson, South Carolina". Plaag, Eric W., PhD. Applied Research Division, South Carolina Institute of Archaeology and Anthropology. University of South Carolina, 1321 Pendleton St. Columbia, South Carolina 29208. Steven D. Smith, SCIAA, Principal Investigator. Feb 2011.

"Final Site Inspection Report, (Confirmatory Sampling Report) Fort Jackson, Columbia, South Carolina". Malcolm Pirnie, Inc. 1300 East 8th Avenue, Tampa, Florida 33605. June 2006.

APPENDICES

Appendix A: Site Maps

Appendix B: Site Photos

Appendix C: Environmental Risk Assessment (EDR)

- The EDR Aerial Photo Decade Package
- EDR Historical Topographic Map Report
- The EDR Radius Map w/GeoCheckEDR NEPA Check
- The EDR City Directory Abstract
- Certified Sanborn Map Report
-

Appendix D: Interviews

Appendix E: Orphan Sites

Appendix F: Biological Assessment

Appendix G: Works Cited

Appendix A

Site Maps

0 1.25 2.5 5 7.5 Miles

0 1,100 2,200 4,400 6,600 Feet

515 Range Construction EA

Site Location

Proposed Range Area

Installation Area

Created by: **Sheet No:** **Date: Tuesday, April 17, 2012**

Path: \\MTC-ENVSRVR6\EnviroReviews\Reviews\515 Range Development Plan EA\Maps\ECOP Maps\515_Site_Location1.mxd

0 1.25 2.5 5 7.5 Miles

0 280 560 1,120 1,680 Feet

515 Range Construction EA

Site Location

Proposed Range Area
Installation Area
Location Point

Created by: **Sheet No:** **Date: Tuesday, April 17, 2012**

Path: \\MTC-ENVSRVR6\EnviroReviews\Reviews\515 Range Development Plan EA\Maps\ECOP Maps\515_Site_Location_LFSH.mxd

MRF
515 Development Plan EA

Site Layout

Wetland Area
Land Restriction Area
Proposed Range Limits
Proposed Range Area
Proposed Project Limits

0 115 230 460 690 Feet

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Sheet No:

Date: Tuesday, April 17, 2012

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Shoothouse
515 Development Plan EA

Site Layout

Wetland Area
Land Restriction Area
Proposed Range Area

0 55 110 220 330
Feet

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Sheet No:

Date: Tuesday, April 17, 2012

Path: \\MTC-ENVSRVR6\EnviroReviews\Reviews\515 Range Development Plan EA\Maps\ECOP Maps\Site_Layout_Shoothouse.r

Zero Range

515 Development Plan EA

Site Layout

- Wetland Area
- Land Restriction Area
- Proposed Range Area
- Barricade Area
- Firing Line
- Future Development
- Training Tower
- Firing Lane Area
- Pedestrian Sidewalk Area
- Vehicle Parking Area
- Proposed Project Limits

0 50 100 200 300 Feet

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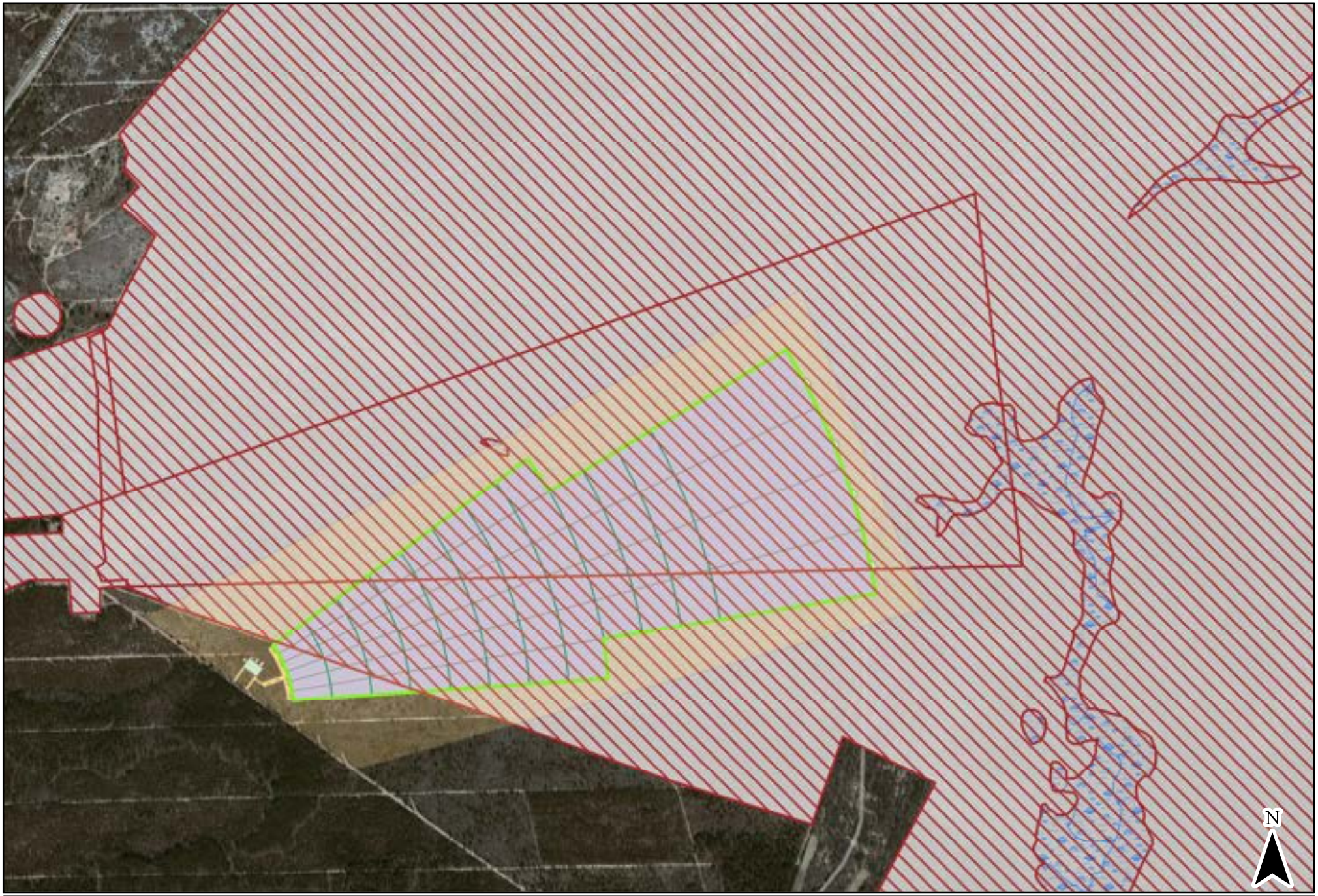
Sheet No:

Date: Tuesday, April 17, 2012

Path: \\MTC-ENVSRVR6\EnviroReviews\Reviews\515 Range Development Plan EA\Maps\ECOP Maps\Site_Layout_ZeroRange.mxd



MPMG
515 Development Plan EA

Site Layout

- Proposed_Project_Limits
- Land Restriction Area
- Wetland Area
- Proposed Range Area
- Military Target Line
- Firing Area
- Vehicle Parking Area
- Tower
- Future Structure
- Road
- Pedestrian Sidewalk
- Firing Lane
- Military Target Area

0 265 530 1,060 1,590 Feet

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Sheet No:

Date: Tuesday, April 17, 2012

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Range Development Plan

MRF Range

Installation Area

Roads

Primary

Fire Breaks

MILCON Categories

I

II

III

0 80 160 320 480 Feet

Created by:

Sheet No:

Date: Wednesday, April 11, 2012

Path: \\MTC-ENVSRVR6\EnviroReviews\Reviews\515 Range Development Plan EA\Maps\ECOP Maps\515 MRF Range ECOP Map1.mxd

Range Development Plan

ZERO Range

Installation Area
Roads
Fire Breaks

MILCON Categories
I
II
III

0 65 130 260 390 Feet

Created by:

Sheet No:

Date: Wednesday, April 11, 2012

Path: \\MTC-ENVSRVR6\EnviroReviews\Reviews\515 Range Development Plan EA\Maps\ECOP Maps\515 Zero Range ECOP Map1.mxd

Range Development Plan

Shoothouse

Installation Area

Roads

PRIMARY

MILCON Categories

I

II

III

0 30 60 120 180 Feet

Created by:

Sheet No:

Date: Wednesday, April 11, 2012

Path: \\MTC-ENVSRVR6\EnviroReviews\Reviews\515 Range Development Plan EA\Maps\ECOP Maps\515 Shoothouse ECOP Map1.mxd

Range Development Plan

MPMG Range

Roads
- Fire Breaks
- Military Target Area
- Installation Area

MILCON Categories
- I
- II
- III

0 212.5 425 850 1,275 Feet

Created by:

Sheet No:

Date: Wednesday, April 11, 2012

Path: \\MTC-ENVSRVR6\EnviroReviews\Reviews\515 Range Development Plan EA\Maps\ECOP Maps\515 MPMG ECOP Map1.mxd

Appendix B

Site Photos

South Carolina Army National Guard

Photographic Log

Project Number:	Project Name:	Project Location:
515	515 Range Development Plan...	MPMG · McCrady Training Center

Photo No.	Photo Description:
1 **Date:** 1/30/2012 **Direction of Photo:** NE **Sketch/Notes:**	Road in wooded area proposed for MPMG range site.

Photo No.	Photo Description:
2 **Date:** 1/30/2012 Direction of Photo: SE **Sketch/Notes:**	Wooded area of proposed MPMG site.

South Carolina Army National Guard

Photographic Log

Project Number:	Project Name:	Project Location:
515	515 Range Development Plan...	MPMG - McCrady Training Center

Photo No.	Photo Description:
3 Date: 1/30/2012 Direction of Photo: S	Wooded area of proposed MPMG site.
Sketch/Notes:	

Photo No.	Photo Description:
4 Date: 1/30/2012 Direction of Photo: W	Wooded area of proposed MPMG site.
Sketch/Notes:	

South Carolina Army National Guard

Photographic Log

Project Number:	Project Name:	Project Location:
515	515 Range Development Plan...	MPMG - McCrady Training Center

Photo No.
5

Date:
1/30/2012

Direction of Photo:
W

Sketch/Notes:

Photo Description:
Turkeys observed in a wooded area adjacent to the proposed MPMG range.

Photo No.
6

Date:
1/1/2012

Direction of Photo:
E

Sketch/Notes:

Photo Description:
View of Main Tank Range adjacent to proposed MPMG range.

South Carolina Army National Guard

Photographic Log

Project Number:	Project Name:	Project Location:
515	515 Range Development Plan...	MRF - McCrady Training Center

Photo No.	Photo Description:
1 Date: 1/30/2012 Direction of Photo: NW	Remains of Inchon training range tank rail system.
Sketch/Notes:	

Photo No.	Photo Description:
2 Date: 1/30/2012 Direction of Photo: NE	Remains of Inchon training range tank rail system.
Sketch/Notes:	

South Carolina Army National Guard

Photographic Log

Project Number:	Project Name:	Project Location:
515	515 Range Development Plan...	MRF - McCrady Training Center

Photo No.	Photo Description:
3 Date: 1/30/2012 Direction of Photo: S	Debris from past training activities at the Inchon site.
Sketch/Notes:	

Photo No.	Photo Description:
4 Date: 1/30/2012 Direction of Photo: E	Open area near the proposed MRF range site.
Sketch/Notes:	

South Carolina Army National Guard

Photographic Log

Project Number:	Project Name:	Project Location:
515	515 Range Development Plan...	Zero Range - McCrady Training Center

Photo No.
1

Date:
1/30/2012

Direction of Photo:
W

Sketch/Notes:

Photo Description:
Wooded area of proposed Zero range site.

Photo No.
2

Date:
1/30/2012

Direction of Photo:
NE

Sketch/Notes:

Photo Description:
Wooded area of proposed Zero range site.

South Carolina Army National Guard

Photographic Log

Project Number:	Project Name:	Project Location:
515	515 Range Development Plan...	Zero Range - McCrady Training Center

Photo No.	Photo Description:
3 Date: 1/30/2012 Direction of Photo: N	Debris found in a wooded area adjacent to the proposed Zero range site.
Sketch/Notes:	

Photo No.	Photo Description:
4 Date: 1/30/2012 Direction of Photo: N	Dirt mound found in wooded area adjacent to proposed Zero range site.
Sketch/Notes:	

South Carolina Army National Guard		Photographic Log
Project Number: 515	*Project Name:* 515 Range Development Plan...	*Project Location:* Zero Range = McCrady Training Center

Photo No. 5	Photo Description:
Date: 2/23/2012 Direction of Photo: NW	55 gallon drum discovered at the proposed Zero range site with suspicious substance surrounding it. The soil was probed and a sample of the substance was taken. The substance was later determined to be an integral plastic piece of the barrel that was melted during routine burning of the landscape.
Sketch/Notes:	

Photo No. 6	Photo Description:
Date: 2/23/2012 Direction of Photo: W	Fencepost remains that believed to be the border of previous ranges on the site.
Sketch/Notes:	

South Carolina Army National Guard		Photographic Log
Project Number: 515	*Project Name:* 515 Range Development Plan...	*Project Location:* Zero Range - McCrady Training Center

Photo No. 7	**Photo Description:** Existing range-related structures adjacent to the proposed Zero range site.
Date: 2/23/2012	
Direction of Photo: Select...	
Sketch/Notes:	

Photo No. 8	**Photo Description:** Spill surrounding 55 gallon drum found at proposed Zero range site. Later determined to be an integral plastic piece of the barrel that was melted during routine burning of the landscape.
Date: 2/23/2012	
Direction of Photo: W	
Sketch/Notes:	

South Carolina Army National Guard		Photographic Log
Project Number: 515	*Project Name:* 515 Range Development Plan...	*Project Location:* Live Fire Shoothouse - McCrady Training Center

Photo No. 1 **Date:** 2/22/2012 **Direction of Photo:** SE **Sketch/Notes:**	**Photo Description:** Cement structure found at the proposed Live Fire Shoothouse site, believed to have been used in past training activities at the McCrady Training Center.

Photo No. 2 **Date:** 2/22/2012 Direction of Photo: W **Sketch/Notes:**	**Photo Description:** Wooded area of proposed Live Fire Shoothouse site.

South Carolina Army National Guard		Photographic Log
Project Number: 515	*Project Name:* 515 Range Development Plan...	*Project Location:* Live Fire Shoothouse - McCrady Training Center

Photo No. 3	**Photo Description:** Wooded area of proposed Live Fire Shoothouse site, leading towards wetlands area.
Date: 2/22/2012	
Direction of Photo: NW	
Sketch/Notes:	

Photo No. 4	**Photo Description:** Low lying area adjacent to proposed Live Fire Shoothouse site, entering wetlands area.
Date: 2/22/2012	
Direction of Photo: W	
Sketch/Notes:	

Appendix C

EDR Report

Shoothouse
5411 LEESBURG ROAD
Columbia, SC 29223

Inquiry Number: 3248581.10
January 30, 2012

Certified Sanborn® Map Report

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

Certified Sanborn® Map Report

1/30/12

Site Name:
Shoothouse
5411 LEESBURG ROAD
Columbia, SC 29223

Client Name:
The Military Dept., State of SC
5411 Leesburg Road
Eastover, SC 29044

EDR Inquiry # 3248581.10

Contact: Brittanie Young

The complete Sanborn Library collection has been searched by EDR, and fire insurance maps covering the target property location provided by The Military Dept., State of SC were identified for the years listed below. The certified Sanborn Library search results in this report can be authenticated by visiting www.edrnet.com/sanborn and entering the certification number. Only Environmental Data Resources Inc. (EDR) is authorized to grant rights for commercial reproduction of maps by Sanborn Library LLC, the copyright holder for the collection.

Certified Sanborn Results:

Site Name: Shoothouse
Address: 5411 LEESBURG ROAD
City, State, Zip: Columbia, SC 29223
Cross Street:
P.O. # NA
Project: Range EA Shoothouse
Certification # 8E0D-40DC-BB88

Sanborn® Library search results
Certification # 8E0D-40DC-BB88

UNMAPPED PROPERTY

This report certifies that the complete holdings of the Sanborn Library, LLC collection have been searched based on client supplied target property information, and fire insurance maps covering the target property were not found.

The Sanborn Library includes more than 1.2 million Sanborn fire insurance maps, which track historical property usage in approximately 12,000 American cities and towns. Collections searched:

- ✔ Library of Congress
- ✔ University Publications of America
- ✔ EDR Private Collection

The Sanborn Library LLC Since 1866™

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Shoothouse
5411 LEESBURG ROAD
Columbia, SC 29223

Inquiry Number: 3248581.9s
January 30, 2012

The EDR Radius Map™ Report with GeoCheck®

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
Toll Free: 800.352.0050
www.edrnet.com

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Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

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EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-05) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

5411 LEESBURG ROAD
COLUMBIA, SC 29223

COORDINATES

Latitude (North):	34.0294000 - 34° 1' 45.84''
Longitude (West):	80.7063000 - 80° 42' 22.68''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	527113.9
UTM Y (Meters):	3765260.2
Elevation:	232 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	34080-A6 LEESBURG, SC
Most Recent Revision:	1953

AERIAL PHOTOGRAPHY IN THIS REPORT

Photo Year:	2009
Source:	USDA

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL---------- National Priority List

EXECUTIVE SUMMARY

Proposed NPL ---------- Proposed National Priority List Sites
NPL LIENS ---------- Federal Superfund Liens

Federal Delisted NPL site list

Delisted NPL ---------- National Priority List Deletions

Federal CERCLIS list

CERCLIS ---------- Comprehensive Environmental Response, Compensation, and Liability Information System
FEDERAL FACILITY ---------- Federal Facility Site Information listing

Federal CERCLIS NFRAP site List

CERC-NFRAP ---------- CERCLIS No Further Remedial Action Planned

Federal RCRA CORRACTS facilities list

CORRACTS ---------- Corrective Action Report

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF ---------- RCRA - Treatment, Storage and Disposal

Federal RCRA generators list

RCRA-LQG ---------- RCRA - Large Quantity Generators
RCRA-SQG ---------- RCRA - Small Quantity Generators
RCRA-CESQG ---------- RCRA - Conditionally Exempt Small Quantity Generator

Federal institutional controls / engineering controls registries

US ENG CONTROLS ---------- Engineering Controls Sites List
US INST CONTROL ---------- Sites with Institutional Controls

Federal ERNS list

ERNS ---------- Emergency Response Notification System

State- and tribal - equivalent CERCLIS

SHWS ---------- Site Assessment Section Project List

State and tribal landfill and/or solid waste disposal site lists

SWF/LF ---------- Permitted Landfills List

State and tribal leaking storage tank lists

LUST ---------- Leaking Underground Storage Tank List
INDIAN LUST ---------- Leaking Underground Storage Tanks on Indian Land

State and tribal registered storage tank lists

UST ---------- Comprehensive Underground Storage Tanks

AST ---------- Aboveground Storage Tank List
INDIAN UST ---------- Underground Storage Tanks on Indian Land
FEMA UST ---------- Underground Storage Tank Listing

State and tribal institutional control / engineering control registries

RCR ---------- Registry of Conditional Remedies

State and tribal voluntary cleanup sites

VCP ---------- Voluntary Cleanup Sites
INDIAN VCP ---------- Voluntary Cleanup Priority Listing

State and tribal Brownfields sites

BROWNFIELDS ---------- Brownfields Sites Listing

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS ---------- A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

ODI ---------- Open Dump Inventory
DEBRIS REGION 9 ---------- Torres Martinez Reservation Illegal Dump Site Locations
SWRCY ---------- Solid Waste Recycling Facilities
INDIAN ODI ---------- Report on the Status of Open Dumps on Indian Lands

Local Lists of Hazardous waste / Contaminated Sites

US CDL ---------- Clandestine Drug Labs
ALLSITES ---------- Site Assessment & Remediation Public Record Database
CDL ---------- Clandestine Drug Lab Sites
US HIST CDL ---------- National Clandestine Laboratory Register

Local Land Records

LIENS 2 ---------- CERCLA Lien Information
LUCIS ---------- Land Use Control Information System

Records of Emergency Release Reports

HMIRS ---------- Hazardous Materials Information Reporting System
SPILLS ---------- Spills Database List

Other Ascertainable Records

RCRA-NonGen ---------- RCRA - Non Generators
DOT OPS ---------- Incident and Accident Data
FUDS ---------- Formerly Used Defense Sites
CONSENT ---------- Superfund (CERCLA) Consent Decrees
ROD ---------- Records Of Decision

UMTRA	Uranium Mill Tailings Sites
MINES	Mines Master Index File
TRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing
SSTS	Section 7 Tracking Systems
ICIS	Integrated Compliance Information System
PADS	PCB Activity Database System
MLTS	Material Licensing Tracking System
RADINFO	Radiation Information Database
FINDS	Facility Index System/Facility Registry System
RAATS	RCRA Administrative Action Tracking System
GWCI	Groundwater Contamination Inventory
UIC	Underground Injection Wells Listing
DRYCLEANERS	Drycleaner Database
NPDES	Waste Water Treatment Facilities Listing
AIRS	Permitted Airs Facility Listing
INDIAN RESERV	Indian Reservations
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing
COAL ASH EPA	Coal Combustion Residues Surface Impoundments List
PCB TRANSFORMER	PCB Transformer Registration Database
COAL ASH	Coal Ash Disposal Sites
FINANCIAL ASSURANCE	Financial Assurance Information Listing
COAL ASH DOE	Sleam-Electric Plan Operation Data

EDR PROPRIETARY RECORDS

EDR Proprietary Records

Manufactured Gas Plants	EDR Proprietary Manufactured Gas Plants

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified in the following databases.

Elevations have been determined from the USGS Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property.
Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

ADDITIONAL ENVIRONMENTAL RECORDS

Other Ascertainable Records

DOD: Consists of federally owned or administered lands, administered by the Department of

Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

A review of the DOD list, as provided by EDR, and dated 12/31/2005 has revealed that there is 1 DOD site within approximately 1 mile of the target property.

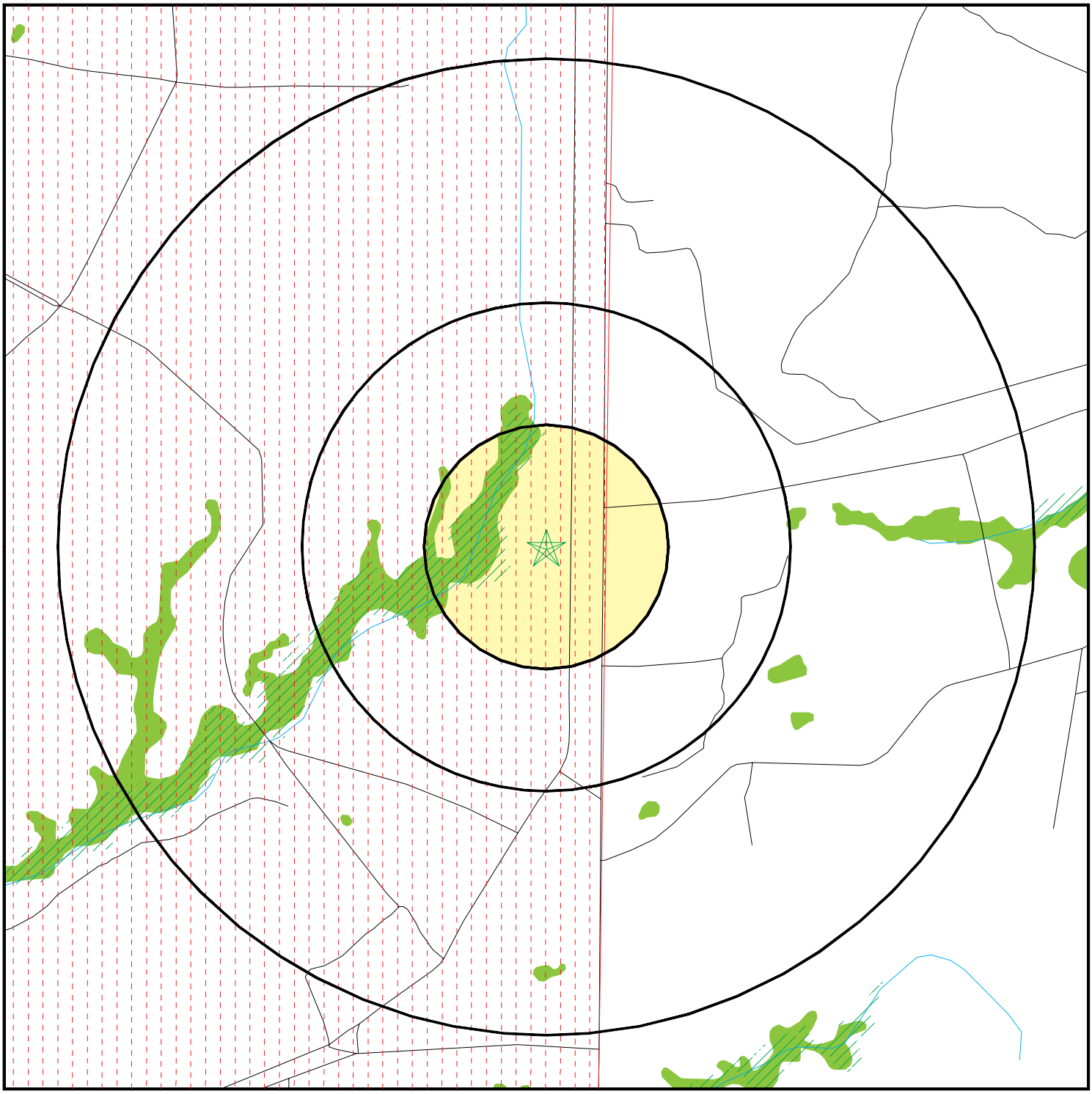
Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
FORT JACKSON		0 - 1/8 (0.000 mi.)	0	7

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped. Count: 17 records.

Site Name	Database(s)
UNDEVELOPED PROPERTY ADJACENT TO A	SHWS, BROWNFIELDS
NEWELL RUBBERMAID	CERC-NFRAP, RCRA-NonGen, FINDS, SHWS
DIAMONT BOART AMERICA	SHWS
OLD EASTOVER DUMP	SHWS
PONTIAC PRECISION BOMBING RANGE (A	CERCLIS, FINDS
VCC-GLOBE	CERCLIS
WEEKS LIQUID FERTILIZER INC.	CERC-NFRAP, GWCI
GASLO 745	GWCI, LUST, UST
YOUNGS 24	GWCI, LUST, UST
GULF SERVICE STATION 24225	GWCI, LUST, UST
NEW CHINA RESTAURANT	GWCI, LUST, UST
JACKSONS	UST
SC SCHOOL BUS DEPOT	UST
SC DHEC MAINTENANCE	UST
MIDWAY GROCERY	UST
MCI LLC-EASTSC	UST
COOPER TOOLS	VCP

OVERVIEW MAP - 3248581.9s



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines from USGS
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Shoothouse	CLIENT: The Military Dept., State of SC
ADDRESS: 5411 LEESBURG ROAD Columbia SC 29223	CONTACT: Brittanie Young
LAT/LONG: 34.0294 / 80.7063	INQUIRY #: 3248581.9s DATE: January 30, 2012 12:51 pm

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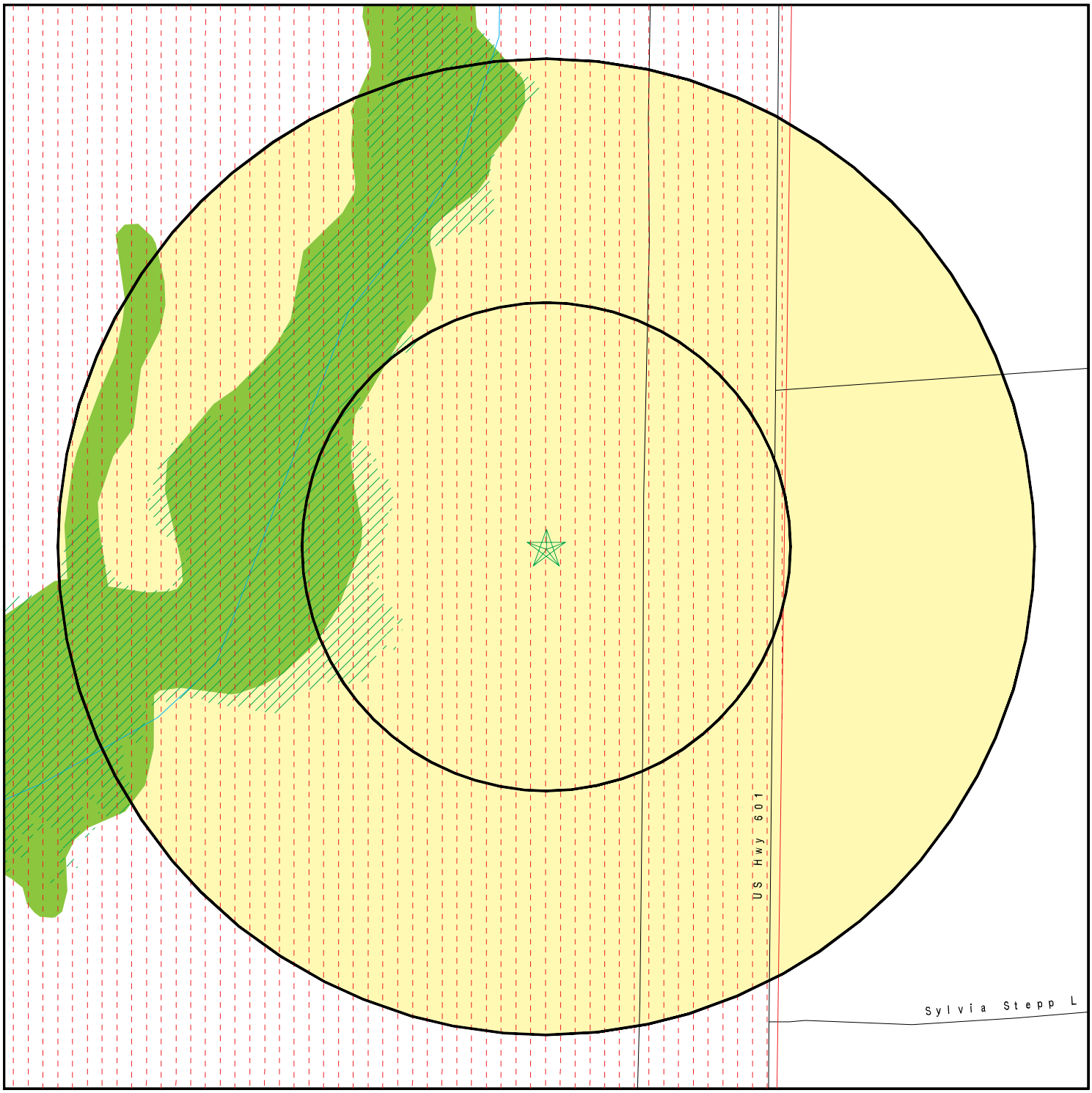
DETAIL MAP - 3248581.9s



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines from USGS
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Shoothouse	CLIENT: The Military Dept., State of SC
ADDRESS: 5411 LEESBURG ROAD Columbia SC 29223	CONTACT: Brittanie Young
LAT/LONG: 34.0294 / 80.7063	INQUIRY #: 3248581.9s DATE: January 30, 2012 12:52 pm

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MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
Federal NPL site list								
NPL		1.000	0	0	0	0	NR	0
Proposed NPL		1.000	0	0	0	0	NR	0
NPL LIENS		TP	NR	NR	NR	NR	NR	0
Federal Delisted NPL site list								
Delisted NPL		1.000	0	0	0	0	NR	0
Federal CERCLIS list								
CERCLIS		0.500	0	0	0	NR	NR	0
FEDERAL FACILITY		1.000	0	0	0	0	NR	0
Federal CERCLIS NFRAP site List								
CERC-NFRAP		0.500	0	0	0	NR	NR	0
Federal RCRA CORRACTS facilities list								
CORRACTS		1.000	0	0	0	0	NR	0
Federal RCRA non-CORRACTS TSD facilities list								
RCRA-TSDF		0.500	0	0	0	NR	NR	0
Federal RCRA generators list								
RCRA-LQG		0.250	0	0	NR	NR	NR	0
RCRA-SQG		0.250	0	0	NR	NR	NR	0
RCRA-CESQG		0.250	0	0	NR	NR	NR	0
Federal institutional controls / engineering controls registries								
US ENG CONTROLS		0.500	0	0	0	NR	NR	0
US INST CONTROL		0.500	0	0	0	NR	NR	0
Federal ERNS list								
ERNS		TP	NR	NR	NR	NR	NR	0
State- and tribal - equivalent CERCLIS								
SHWS		1.000	0	0	0	0	NR	0
State and tribal landfill and/or solid waste disposal site lists								
SWF/LF		0.500	0	0	0	NR	NR	0
State and tribal leaking storage tank lists								
LUST		0.500	0	0	0	NR	NR	0
INDIAN LUST		0.500	0	0	0	NR	NR	0
State and tribal registered storage tank lists								
UST		0.250	0	0	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
AST		0.250	0	0	NR	NR	NR	0
INDIAN UST		0.250	0	0	NR	NR	NR	0
FEMA UST		0.250	0	0	NR	NR	NR	0
State and tribal institutional control / engineering control registries								
RCR		0.500	0	0	0	NR	NR	0
State and tribal voluntary cleanup sites								
VCP		0.500	0	0	0	NR	NR	0
INDIAN VCP		0.500	0	0	0	NR	NR	0
State and tribal Brownfields sites								
BROWNFIELDS		0.500	0	0	0	NR	NR	0
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS		0.500	0	0	0	NR	NR	0
Local Lists of Landfill / Solid Waste Disposal Sites								
ODI		0.500	0	0	0	NR	NR	0
DEBRIS REGION 9		0.500	0	0	0	NR	NR	0
SWRCY		0.500	0	0	0	NR	NR	0
INDIAN ODI		0.500	0	0	0	NR	NR	0
Local Lists of Hazardous waste / Contaminated Sites								
US CDL		TP	NR	NR	NR	NR	NR	0
ALLSITES		0.500	0	0	0	NR	NR	0
CDL		TP	NR	NR	NR	NR	NR	0
US HIST CDL		TP	NR	NR	NR	NR	NR	0
Local Land Records								
LIENS 2		TP	NR	NR	NR	NR	NR	0
LUCIS		0.500	0	0	0	NR	NR	0
Records of Emergency Release Reports								
HMIRS		TP	NR	NR	NR	NR	NR	0
SPILLS		TP	NR	NR	NR	NR	NR	0
Other Ascertainable Records								
RCRA-NonGen		0.250	0	0	NR	NR	NR	0
DOT OPS		TP	NR	NR	NR	NR	NR	0
DOD		1.000	1	0	0	0	NR	1
FUDS		1.000	0	0	0	0	NR	0
CONSENT		1.000	0	0	0	0	NR	0
ROD		1.000	0	0	0	0	NR	0
UMTRA		0.500	0	0	0	NR	NR	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
MINES		0.250	0	0	NR	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0
TSCA		TP	NR	NR	NR	NR	NR	0
FTTS		TP	NR	NR	NR	NR	NR	0
HIST FTTS		TP	NR	NR	NR	NR	NR	0
SSTS		TP	NR	NR	NR	NR	NR	0
ICIS		TP	NR	NR	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
RADINFO		TP	NR	NR	NR	NR	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
GWCI		0.500	0	0	0	NR	NR	0
UIC		TP	NR	NR	NR	NR	NR	0
DRYCLEANERS		0.250	0	0	NR	NR	NR	0
NPDES		TP	NR	NR	NR	NR	NR	0
AIRS		TP	NR	NR	NR	NR	NR	0
INDIAN RESERV		1.000	0	0	0	0	NR	0
SCRD DRYCLEANERS		0.500	0	0	0	NR	NR	0
COAL ASH EPA		0.500	0	0	0	NR	NR	0
PCB TRANSFORMER		TP	NR	NR	NR	NR	NR	0
COAL ASH		0.500	0	0	0	NR	NR	0
FINANCIAL ASSURANCE		TP	NR	NR	NR	NR	NR	0
COAL ASH DOE		TP	NR	NR	NR	NR	NR	0
EDR PROPRIETARY RECORDS								
EDR Proprietary Records								
Manufactured Gas Plants		1.000	0	0	0	0	NR	0

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

DOD **FORT JACKSON** **DOD** **CUSA143184**
Region **N/A**

FORT JACKSON (County), SC

< 1/8
1 ft.

DOD:
Feature 1: Army DOD
Feature 2: Not reported
Feature 3: Not reported
URL: Not reported
Name 1: Fort Jackson
Name 2: Not reported
Name 3: Not reported
State: SC
DOD Site: Yes
Tile name: SCRICHLAND

Count: 17 records. ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
COLUMBIA	U003522673	JACKSONS	RT 1		UST
COLUMBIA	U003525028	SC SCHOOL BUS DEPOT	RT 5 N		UST
COLUMBIA	1006426222	PONTIAC PRECISION BOMBING RANGE (A	COLUMBIA ARMY AIR BASE		CERCLIS, FINDS
COLUMBIA	1011961451	VCC-GLOBE	NE CORNER OF CATAWBA & GADSDEN		CERCLIS
COLUMBIA	U001539668	GASLO 745	2500 4 DECKER RD		GWCI, LUST, UST
COLUMBIA	1000156169	NEWELL RUBBERMAID	10700 FARROW RD		CERC-NFRAP, RCRA-NonGen, FINDS SHWS
COLUMBIA	S108953995	UNDEVELOPED PROPERTY ADJACENT TO A	INT OF LEANING TREE RD	29223	SHWS, BROWNFIELDS
COLUMBIA	S108953990	DIAMONT BOART AMERICA	2 NOTCH RD	29223	SHWS
COLUMBIA	U000483446	YOUNGS 24	PINESTRAW LN		GWCI, LUST, UST
COLUMBIA	U003970326	GULF SERVICE STATION 24225	PINEY GROVE RD & I 26		GWCI, LUST, UST
COLUMBIA	U004017557	NEW CHINA RESTAURANT	3530 RIVER DR AT SUNSET BLVD		GWCI, LUST, UST
COLUMBIA	U003524893	SC DHEC MAINTENANCE	STATE PARK		UST
COLUMBIA	S105528032	COOPER TOOLS	USHY 1 NEARINTERSECTIONOF & S		VCP
CONGAREE	1003869437	WEEKS LIQUID FERTILIZER INC.	CORD 769	29044	CERC-NFRAP, GWCI
EASTOVER	U003523607	MIDWAY GROCERY	HWY 6	29044	UST
EASTOVER	S105736165	OLD EASTOVER DUMP	JOE CHAMPEY RD	29044	SHWS
EASTOVER	U003523515	MCI LLC-EASTSC	2960 OLD EASTOVER DR	29044	UST

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Number of Days to Update: Provides confirmation that EDR is reporting records that have been updated within 90 days from the date the government agency made the information available to the public.

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL: National Priority List

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 06/30/2011
Date Data Arrived at EDR: 07/12/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 79

Source: EPA
Telephone: N/A
Last EDR Contact: 01/11/2012
Next Scheduled EDR Contact: 04/23/2012
Data Release Frequency: Quarterly

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 6
Telephone: 214-655-6659

EPA Region 3
Telephone 215-814-5418

EPA Region 7
Telephone: 913-551-7247

EPA Region 4
Telephone 404-562-8033

EPA Region 8
Telephone: 303-312-6774

EPA Region 5
Telephone 312-886-6686

EPA Region 9
Telephone: 415-947-4246

EPA Region 10
Telephone 206-553-8665

Proposed NPL: Proposed National Priority List Sites

A site that has been proposed for listing on the National Priorities List through the issuance of a proposed rule in the Federal Register. EPA then accepts public comments on the site, responds to the comments, and places on the NPL those sites that continue to meet the requirements for listing.

Date of Government Version: 06/30/2011
Date Data Arrived at EDR: 07/12/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 79

Source: EPA
Telephone: N/A
Last EDR Contact: 01/11/2012
Next Scheduled EDR Contact: 04/23/2012
Data Release Frequency: Quarterly

NPL LIENS: Federal Superfund Liens

Federal Superfund Liens. Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/1991
Date Data Arrived at EDR: 02/02/1994
Date Made Active in Reports: 03/30/1994
Number of Days to Update: 56

Source: EPA
Telephone: 202-564-4267
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: No Update Planned

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Federal Delisted NPL site list

DELISTED NPL: National Priority List Deletions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 06/30/2011
Date Data Arrived at EDR: 07/12/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 79

Source: EPA
Telephone: N/A
Last EDR Contact: 01/10/2012
Next Scheduled EDR Contact: 04/23/2012
Data Release Frequency: Quarterly

Federal CERCLIS list

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System

CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 02/25/2011
Date Data Arrived at EDR: 03/01/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 62

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 11/29/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Quarterly

FEDERAL FACILITY: Federal Facility Site Information listing

A listing of National Priority List (NPL) and Base Realignment and Closure (BRAC) sites found in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Database where EPA Federal Facilities Restoration and Reuse Office is involved in cleanup activities.

Date of Government Version: 12/10/2010
Date Data Arrived at EDR: 01/11/2011
Date Made Active in Reports: 02/16/2011
Number of Days to Update: 36

Source: Environmental Protection Agency
Telephone: 703-603-8704
Last EDR Contact: 01/13/2012
Next Scheduled EDR Contact: 04/23/2012
Data Release Frequency: Varies

Federal CERCLIS NFRAP site List

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned

Archived sites are sites that have been removed and archived from the inventory of CERCLIS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list this site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. This decision does not necessarily mean that there is no hazard associated with a given site; it only means that, based upon available information, the location is not judged to be a potential NPL site.

Date of Government Version: 02/25/2011
Date Data Arrived at EDR: 03/01/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 62

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 11/29/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Quarterly

Federal RCRA CORRACTS facilities list

CORRACTS: Corrective Action Report

CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 08/19/2011
Date Data Arrived at EDR: 08/31/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 132

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 11/14/2011
Next Scheduled EDR Contact: 02/27/2012
Data Release Frequency: Quarterly

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF: RCRA - Treatment, Storage and Disposal

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Transporters are individuals or entities that move hazardous waste from the generator offsite to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (404) 562-8651
Last EDR Contact: 01/05/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Quarterly

Federal RCRA generators list

RCRA-LQG: RCRA - Large Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (404) 562-8651
Last EDR Contact: 01/05/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Quarterly

RCRA-SQG: RCRA - Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (404) 562-8651
Last EDR Contact: 01/05/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Quarterly

RCRA-CESQG: RCRA - Conditionally Exempt Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (404) 562-8651
Last EDR Contact: 01/05/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Varies

Federal institutional controls / engineering controls registries

US ENG CONTROLS: Engineering Controls Sites List

A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 12/30/2011
Date Data Arrived at EDR: 12/30/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 11

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 12/09/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Varies

US INST CONTROL: Sites with Institutional Controls

A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 12/30/2011
Date Data Arrived at EDR: 12/30/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 11

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 12/09/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Varies

Federal ERNS list

ERNS: Emergency Response Notification System

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 10/03/2011
Date Data Arrived at EDR: 10/04/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 38

Source: National Response Center, United States Coast Guard
Telephone: 202-267-2180
Last EDR Contact: 01/18/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Annually

State- and tribal - equivalent CERCLIS

SHWS: Site Assessment Section Project List

State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

Date of Government Version: 10/06/2011
Date Data Arrived at EDR: 10/11/2011
Date Made Active in Reports: 10/31/2011
Number of Days to Update: 20

Source: Department of Health and Environmental Control
Telephone: 803-734-5376
Last EDR Contact: 12/19/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Annually

State and tribal landfill and/or solid waste disposal site lists

SWF/LF: Permitted Landfills List

Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 10/06/2011
Date Data Arrived at EDR: 10/06/2011
Date Made Active in Reports: 10/31/2011
Number of Days to Update: 25

Source: Department of Health and Environmental Control
Telephone: 803-734-5165
Source: Department of Health and Environmental Control, GIS Section
Telephone: 803-896-4084
Last EDR Contact: 12/19/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Varies

State and tribal leaking storage tank lists

LUST: Leaking Underground Storage Tank List

Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 08/31/2011
Date Data Arrived at EDR: 08/31/2011
Date Made Active in Reports: 10/07/2011
Number of Days to Update: 37

Source: Department of Health and Environmental Control
Telephone: 803-898-4350
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

INDIAN LUST R8: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.

Date of Government Version: 08/18/2011
Date Data Arrived at EDR: 08/19/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 25

Source: EPA Region 8
Telephone: 303-312-6271
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

INDIAN LUST R7: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Iowa, Kansas, and Nebraska

Date of Government Version: 11/01/2011
Date Data Arrived at EDR: 11/21/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 50

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 10/31/2011
Next Scheduled EDR Contact: 02/13/2012
Data Release Frequency: Varies

INDIAN LUST R6: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in New Mexico and Oklahoma.

Date of Government Version: 09/12/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 59

Source: EPA Region 6
Telephone: 214-665-6597
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Varies

INDIAN LUST R1: Leaking Underground Storage Tanks on Indian Land

A listing of leaking underground storage tank locations on Indian Land.

Date of Government Version: 10/01/2011
Date Data Arrived at EDR: 11/01/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 10

Source: EPA Region 1
Telephone: 617-918-1313
Last EDR Contact: 11/01/2011
Next Scheduled EDR Contact: 02/13/2012
Data Release Frequency: Varies

INDIAN LUST R10: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 11/02/2011
Date Data Arrived at EDR: 11/04/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 7
Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

INDIAN LUST R4: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Florida, Mississippi and North Carolina.

Date of Government Version: 12/14/2011
Date Data Arrived at EDR: 12/15/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 26
Source: EPA Region 4
Telephone: 404-562-8677
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Semi-Annually

INDIAN LUST R9: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 12/05/2011
Date Data Arrived at EDR: 12/07/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 34
Source: Environmental Protection Agency
Telephone: 415-972-3372
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

State and tribal registered storage tank lists

UST: Comprehensive Underground Storage Tanks
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 08/31/2011
Date Data Arrived at EDR: 08/31/2011
Date Made Active in Reports: 10/06/2011
Number of Days to Update: 36
Source: Department of Health and Environmental Control
Telephone: 803-896-7957
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

AST: Aboveground Storage Tank List
Registered Aboveground Storage Tanks.

Date of Government Version: 03/25/2004
Date Data Arrived at EDR: 08/04/2004
Date Made Active in Reports: 09/23/2004
Number of Days to Update: 50
Source: Department of Health and Environmental Control
Telephone: 803-898-4350
Last EDR Contact: 12/05/2011
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Varies

INDIAN UST R8: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming and 27 Tribal Nations).

Date of Government Version: 08/18/2011
Date Data Arrived at EDR: 08/19/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 25
Source: EPA Region 8
Telephone: 303-312-6137
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

INDIAN UST R7: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 7 (Iowa, Kansas, Missouri, Nebraska, and 9 Tribal Nations).

Date of Government Version: 11/01/2011
Date Data Arrived at EDR: 11/21/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 50

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 10/31/2011
Next Scheduled EDR Contact: 02/13/2012
Data Release Frequency: Varies

INDIAN UST R5: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 5 (Michigan, Minnesota and Wisconsin and Tribal Nations).

Date of Government Version: 07/01/2011
Date Data Arrived at EDR: 08/26/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 18

Source: EPA Region 5
Telephone: 312-886-6136
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Varies

INDIAN UST R6: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 6 (Louisiana, Arkansas, Oklahoma, New Mexico, Texas and 65 Tribes).

Date of Government Version: 05/10/2011
Date Data Arrived at EDR: 05/11/2011
Date Made Active in Reports: 06/14/2011
Number of Days to Update: 34

Source: EPA Region 6
Telephone: 214-665-7591
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Semi-Annually

INDIAN UST R4: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Tribal Nations)

Date of Government Version: 12/14/2011
Date Data Arrived at EDR: 12/15/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 26

Source: EPA Region 4
Telephone: 404-562-9424
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Semi-Annually

INDIAN UST R10: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 10 (Alaska, Idaho, Oregon, Washington, and Tribal Nations).

Date of Government Version: 11/02/2011
Date Data Arrived at EDR: 11/04/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 7

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

INDIAN UST R9: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 9 (Arizona, California, Hawaii, Nevada, the Pacific Islands, and Tribal Nations).

Date of Government Version: 11/28/2011
Date Data Arrived at EDR: 11/29/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 42

Source: EPA Region 9
Telephone: 415-972-3368
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

INDIAN UST R1: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and ten Tribal Nations).

Date of Government Version: 10/01/2011
Date Data Arrived at EDR: 11/01/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 10

Source: EPA, Region 1
Telephone: 617-918-1313
Last EDR Contact: 10/31/2011
Next Scheduled EDR Contact: 02/13/2012
Data Release Frequency: Varies

FEMA UST: Underground Storage Tank Listing
A listing of all FEMA owned underground storage tanks.

Date of Government Version: 01/01/2010
Date Data Arrived at EDR: 02/16/2010
Date Made Active in Reports: 04/12/2010
Number of Days to Update: 55

Source: FEMA
Telephone: 202-646-5797
Last EDR Contact: 01/16/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: Varies

State and tribal institutional control / engineering control registries

RCR: Registry of Conditional Remedies
The Bureau of Land and Waste Management established this Registry to help monitor and maintain sites that have conditional remedies. A Conditional Remedy is an environmental remedy that includes certain qualifications. These qualifications are divided into two major categories: Remedies requiring Land Use Controls and Conditional No Further Actions.

Date of Government Version: 12/20/2011
Date Data Arrived at EDR: 12/21/2011
Date Made Active in Reports: 01/30/2012
Number of Days to Update: 40

Source: Department of Health & Environmental Control
Telephone: 803-896-4000
Last EDR Contact: 12/21/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Varies

State and tribal voluntary cleanup sites

VCP: Voluntary Cleanup Sites
Sites participating in the Voluntary Cleanup Program. Once staff and a non-responsible party have agreed upon an approved scope of work for a site investigation and/or remediation, the party enters into a voluntary cleanup contract. Staff oversees the cleanup efforts to ensure that activities are performed to our satisfaction. Upon completion of the negotiated work in the voluntary cleanup contract, the non-responsible party receives State Superfund liability protection.

Date of Government Version: 12/20/2011
Date Data Arrived at EDR: 12/21/2011
Date Made Active in Reports: 01/30/2012
Number of Days to Update: 40

Source: Department of Health and Environmental Control
Telephone: 803-896-4049
Last EDR Contact: 12/21/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Varies

INDIAN VCP R7: Voluntary Cleanup Priority Lisitng
A listing of voluntary cleanup priority sites located on Indian Land located in Region 7.

Date of Government Version: 03/20/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27

Source: EPA, Region 7
Telephone: 913-551-7365
Last EDR Contact: 04/20/2009
Next Scheduled EDR Contact: 07/20/2009
Data Release Frequency: Varies

INDIAN VCP R1: Voluntary Cleanup Priority Listing
A listing of voluntary cleanup priority sites located on Indian Land located in Region 1.

Date of Government Version: 08/04/2011
Date Data Arrived at EDR: 10/04/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 38

Source: EPA, Region 1
Telephone: 617-918-1102
Last EDR Contact: 01/06/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Varies

State and tribal Brownfields sites

BROWNFIELDS: Brownfields Sites Listing
The Brownfields component of the Voluntary Cleanup Program allows a non-responsible party to acquire a contaminated property with State Superfund liability protection for existing contamination by agreeing to perform an environmental assessment and/or remediation.

Date of Government Version: 10/24/2011
Date Data Arrived at EDR: 10/26/2011
Date Made Active in Reports: 10/31/2011
Number of Days to Update: 5
Source: Department of Health & Environmental Control
Telephone: 803-896-4069
Last EDR Contact: 01/03/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Varies

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS: A Listing of Brownfields Sites
Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. Assessment, Cleanup and Redevelopment Exchange System (ACRES) stores information reported by EPA Brownfields grant recipients on brownfields properties assessed or cleaned up with grant funding as well as information on Targeted Brownfields Assessments performed by EPA Regions. A listing of ACRES Brownfield sites is obtained from Cleanups in My Community. Cleanups in My Community provides information on Brownfields properties for which information is reported back to EPA, as well as areas served by Brownfields grant programs.

Date of Government Version: 06/27/2011
Date Data Arrived at EDR: 06/27/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 78
Source: Environmental Protection Agency
Telephone: 202-566-2777
Last EDR Contact: 12/27/2011
Next Scheduled EDR Contact: 04/09/2012
Data Release Frequency: Semi-Annually

Local Lists of Landfill / Solid Waste Disposal Sites

ODI: Open Dump Inventory
An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/1985
Date Data Arrived at EDR: 08/09/2004
Date Made Active in Reports: 09/17/2004
Number of Days to Update: 39
Source: Environmental Protection Agency
Telephone: 800-424-9346
Last EDR Contact: 06/09/2004
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

DEBRIS REGION 9: Torres Martinez Reservation Illegal Dump Site Locations
A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California.

Date of Government Version: 01/12/2009
Date Data Arrived at EDR: 05/07/2009
Date Made Active in Reports: 09/21/2009
Number of Days to Update: 137
Source: EPA, Region 9
Telephone: 415-947-4219
Last EDR Contact: 12/21/2011
Next Scheduled EDR Contact: 04/09/2012
Data Release Frequency: No Update Planned

SWRCY: Solid Waste Recycling Facilities
A listing of recycling center locations.

Date of Government Version: 11/16/2009
Date Data Arrived at EDR: 12/23/2009
Date Made Active in Reports: 01/27/2010
Number of Days to Update: 35
Source: Department of Health & Enviornmental Control
Telephone: 803-896-8985
Last EDR Contact: 12/07/2011
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Varies

INDIAN ODI: Report on the Status of Open Dumps on Indian Lands
Location of open dumps on Indian land.

Date of Government Version: 12/31/1998
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 01/24/2008
Number of Days to Update: 52
Source: Environmental Protection Agency
Telephone: 703-308-8245
Last EDR Contact: 11/07/2011
Next Scheduled EDR Contact: 02/20/2012
Data Release Frequency: Varies

Local Lists of Hazardous waste / Contaminated Sites

US CDL: Clandestine Drug Labs
A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 10/07/2011
Date Data Arrived at EDR: 12/09/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 32
Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 12/05/2011
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Quarterly

ALLSITES: Site Assessment & Remediation Public Record Database
The South Carolina Department of Health and Environmental Control is pleased to have the Public Record for your review. The purpose of this database is two-fold. First, it will provide to communities another form of notice of cleanup activity, allowing them to have more information about assessment and cleanup activities in their area and in the State. Second, it can assist those seeking to redevelop brownfield properties within South Carolina.

Date of Government Version: 11/16/2011
Date Data Arrived at EDR: 11/17/2011
Date Made Active in Reports: 12/21/2011
Number of Days to Update: 34
Source: Department of Health & Environmental Control
Telephone: 803-896-4000
Last EDR Contact: 12/27/2011
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Quarterly

CDL: Clandestine Drug Lab Sites
A listing of clandestine drug lab site locations.

Date of Government Version: 11/21/2011
Date Data Arrived at EDR: 01/03/2012
Date Made Active in Reports: 01/09/2012
Number of Days to Update: 6
Source: Department of Health & Environmental Control
Telephone: 803-896-4288
Last EDR Contact: 01/23/2012
Next Scheduled EDR Contact: 05/07/2012
Data Release Frequency: Varies

US HIST CDL: National Clandestine Laboratory Register
A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 09/01/2007
Date Data Arrived at EDR: 11/19/2008
Date Made Active in Reports: 03/30/2009
Number of Days to Update: 131
Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 03/23/2009
Next Scheduled EDR Contact: 06/22/2009
Data Release Frequency: No Update Planned

Local Land Records

LIENS 2: CERCLA Lien Information

A Federal CERCLA ('Superfund') lien can exist by operation of law at any site or property at which EPA has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties.

Date of Government Version: 09/09/2011
Date Data Arrived at EDR: 09/16/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 13

Source: Environmental Protection Agency
Telephone: 202-564-6023
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Varies

LUCIS: Land Use Control Information System

LUCIS contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.

Date of Government Version: 12/09/2005
Date Data Arrived at EDR: 12/11/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 31

Source: Department of the Navy
Telephone: 843-820-7326
Last EDR Contact: 11/22/2011
Next Scheduled EDR Contact: 03/05/2012
Data Release Frequency: Varies

Records of Emergency Release Reports

HMIRS: Hazardous Materials Information Reporting System

Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 10/04/2011
Date Data Arrived at EDR: 10/04/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 38

Source: U.S. Department of Transportation
Telephone: 202-366-4555
Last EDR Contact: 01/03/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Annually

SPILLS: Spill List

Spills and releases of petroleum and hazardous chemicals reported to the Oil & Chemical Emergency Response division.

Date of Government Version: 09/27/2011
Date Data Arrived at EDR: 09/28/2011
Date Made Active in Reports: 10/07/2011
Number of Days to Update: 9

Source: Department of Health and Environmental Control
Telephone: 803-898-4111
Last EDR Contact: 12/05/2011
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Varies

Other Ascertainable Records

RCRA-NonGen: RCRA - Non Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (404) 562-8651
Last EDR Contact: 01/05/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Varies

DOT OPS: Incident and Accident Data

Department of Transporation, Office of Pipeline Safety Incident and Accident data.

Date of Government Version: 07/29/2011
Date Data Arrived at EDR: 08/09/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 94

Source: Department of Transporation, Office of Pipeline Safety
Telephone: 202-366-4595
Last EDR Contact: 11/08/2011
Next Scheduled EDR Contact: 02/20/2012
Data Release Frequency: Varies

DOD: Department of Defense Sites

This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 11/10/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 62

Source: USGS
Telephone: 888-275-8747
Last EDR Contact: 01/20/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: Semi-Annually

FUDS: Formerly Used Defense Sites

The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 08/12/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 112

Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
Last EDR Contact: 12/09/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Varies

CONSENT: Superfund (CERCLA) Consent Decrees

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 09/01/2011
Date Data Arrived at EDR: 11/18/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 53

Source: Department of Justice, Consent Decree Library
Telephone: Varies
Last EDR Contact: 12/27/2011
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Varies

ROD: Records Of Decision

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 09/28/2011
Date Data Arrived at EDR: 12/14/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 27

Source: EPA
Telephone: 703-416-0223
Last EDR Contact: 12/14/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Annually

UMTRA: Uranium Mill Tailings Sites

Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.

Date of Government Version: 09/14/2010
Date Data Arrived at EDR: 10/21/2010
Date Made Active in Reports: 01/28/2011
Number of Days to Update: 99

Source: Department of Energy
Telephone: 505-845-0011
Last EDR Contact: 11/29/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Varies

MINES: Mines Master Index File

Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 08/18/2011
Date Data Arrived at EDR: 09/08/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 21

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Last EDR Contact: 12/07/2011
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Semi-Annually

TRIS: Toxic Chemical Release Inventory System

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 09/01/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 131

Source: EPA
Telephone: 202-566-0250
Last EDR Contact: 12/02/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Annually

TSCA: Toxic Substances Control Act

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/2006
Date Data Arrived at EDR: 09/29/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 64

Source: EPA
Telephone: 202-260-5521
Last EDR Contact: 12/27/2011
Next Scheduled EDR Contact: 04/09/2012
Data Release Frequency: Every 4 Years

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
Last EDR Contact: 11/28/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Quarterly

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

A listing of FIFRA/TSCA Tracking System (FTTS) inspections and enforcements.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA
Telephone: 202-566-1667
Last EDR Contact: 11/28/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Quarterly

HIST FTTS: FIFRA/TSCA Tracking System Administrative Case Listing

A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2007
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

HIST FTTS INSP: FIFRA/TSCA Tracking System Inspection & Enforcement Case Listing

A complete inspection and enforcement case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40
Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2008
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

SSTS: Section 7 Tracking Systems

Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 12/10/2010
Date Made Active in Reports: 02/25/2011
Number of Days to Update: 77
Source: EPA
Telephone: 202-564-4203
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Annually

ICIS: Integrated Compliance Information System

The Integrated Compliance Information System (ICIS) supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.

Date of Government Version: 07/20/2011
Date Data Arrived at EDR: 11/10/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 61
Source: Environmental Protection Agency
Telephone: 202-564-5088
Last EDR Contact: 12/21/2011
Next Scheduled EDR Contact: 04/09/2012
Data Release Frequency: Quarterly

PADS: PCB Activity Database System

PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 11/01/2010
Date Data Arrived at EDR: 11/10/2010
Date Made Active in Reports: 02/16/2011
Number of Days to Update: 98
Source: EPA
Telephone: 202-566-0500
Last EDR Contact: 01/20/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: Annually

MLTS: Material Licensing Tracking System

MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 06/21/2011
Date Data Arrived at EDR: 07/15/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 60
Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
Last EDR Contact: 12/12/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Quarterly

RADINFO: Radiation Information Database

The Radiation Information Database (RADINFO) contains information about facilities that are regulated by U.S. Environmental Protection Agency (EPA) regulations for radiation and radioactivity.

Date of Government Version: 01/11/2011
Date Data Arrived at EDR: 01/13/2011
Date Made Active in Reports: 02/16/2011
Number of Days to Update: 34

Source: Environmental Protection Agency
Telephone: 202-343-9775
Last EDR Contact: 01/12/2012
Next Scheduled EDR Contact: 04/23/2012
Data Release Frequency: Quarterly

FINDS: Facility Index System/Facility Registry System

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 08/02/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 119

Source: EPA
Telephone: (404) 562-9900
Last EDR Contact: 12/13/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Quarterly

RAATS: RCRA Administrative Action Tracking System

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/1995
Date Data Arrived at EDR: 07/03/1995
Date Made Active in Reports: 08/07/1995
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4104
Last EDR Contact: 06/02/2008
Next Scheduled EDR Contact: 09/01/2008
Data Release Frequency: No Update Planned

BRS: Biennial Reporting System

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 03/01/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 62

Source: EPA/NTIS
Telephone: 800-424-9346
Last EDR Contact: 11/30/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Biennially

GWCI: Groundwater Contamination Inventory

An inventory of all groundwater contamination cases in the state.

Date of Government Version: 07/01/2008
Date Data Arrived at EDR: 11/06/2008
Date Made Active in Reports: 11/19/2008
Number of Days to Update: 13

Source: Department of Health and Environmental Control
Telephone: 803-898-3798
Last EDR Contact: 01/03/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Annually

UIC: Underground Injection Wells Listing

A listing of underground injection wells locations.

Date of Government Version: 11/29/2011
Date Data Arrived at EDR: 11/30/2011
Date Made Active in Reports: 12/21/2011
Number of Days to Update: 21

Source: Department of Health & Environmental Control
Telephone: 803-898-3799
Last EDR Contact: 11/28/2011
Next Scheduled EDR Contact: 02/27/2012
Data Release Frequency: Varies

DRYCLEANERS: Drycleaner Database

The Drycleaning Facility Restoration Trust Fund database is used to access, prioritze and cleanup contaminated registered drycleaning sites.

Date of Government Version: 12/01/2010
Date Data Arrived at EDR: 02/11/2011
Date Made Active in Reports: 03/15/2011
Number of Days to Update: 32

Source: Department of Health & Environmental Control
Telephone: 803-898-3882
Last EDR Contact: 11/11/2011
Next Scheduled EDR Contact: 02/20/2012
Data Release Frequency: Varies

NPDES: Waste Water Treatment Facilities Listing

A listing of waste water treatment facility locations.

Date of Government Version: 01/03/2012
Date Data Arrived at EDR: 01/05/2012
Date Made Active in Reports: 01/30/2012
Number of Days to Update: 25

Source: Department of Health & Environmental Control
Telephone: 803-898-4300
Last EDR Contact: 12/23/2011
Next Scheduled EDR Contact: 04/09/2012
Data Release Frequency: Varies

AIRS: Permiited Airs Facility Listing

A listing of permitted airs facilities.

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 04/15/2011
Date Made Active in Reports: 05/26/2011
Number of Days to Update: 41

Source: Department of Health & Environmental Control
Telephone: 803-898-4279
Last EDR Contact: 12/05/2011
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Varies

INDIAN RESERV: Indian Reservations

This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 12/08/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 34

Source: USGS
Telephone: 202-208-3710
Last EDR Contact: 01/20/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: Semi-Annually

SCRD DRYCLEANERS: State Coalition for Remediation of Drycleaners Listing

The State Coalition for Remediation of Drycleaners was established in 1998, with support from the U.S. EPA Office of Superfund Remediation and Technology Innovation. It is comprised of representatives of states with established drycleaner remediation programs. Currently the member states are Alabama, Connecticut, Florida, Illinois, Kansas, Minnesota, Missouri, North Carolina, Oregon, South Carolina, Tennessee, Texas, and Wisconsin.

Date of Government Version: 03/07/2011
Date Data Arrived at EDR: 03/09/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 54

Source: Environmental Protection Agency
Telephone: 615-532-8599
Last EDR Contact: 01/23/2012
Next Scheduled EDR Contact: 05/07/2012
Data Release Frequency: Varies

COAL ASH: Coal Ash Disposal Sites

A listing of sites with coal ash ponds.

Date of Government Version: 07/31/2009
Date Data Arrived at EDR: 08/07/2009
Date Made Active in Reports: 08/17/2009
Number of Days to Update: 10

Source: Department of Health & Environmental Control
Telephone: 803-898-3964
Last EDR Contact: 12/23/2011
Next Scheduled EDR Contact: 04/09/2012
Data Release Frequency: Varies

FINANCIAL ASSURANCE 3: Financial Assurance Information Listing
UST financial assurance information.

Date of Government Version: 05/25/2011
Date Data Arrived at EDR: 05/27/2011
Date Made Active in Reports: 06/30/2011
Number of Days to Update: 34
Source: Department of Health & Environmental Control
Telephone: 803-898-3880
Last EDR Contact: 01/26/2012
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Varies

FINANCIAL ASSURANCE 2: Financial Assurance Information Listing
Hazardous waste financial assurance information.

Date of Government Version: 09/01/2011
Date Data Arrived at EDR: 09/01/2011
Date Made Active in Reports: 10/07/2011
Number of Days to Update: 36
Source: Department of Health & Environmental Control
Telephone: 803-898-3880
Last EDR Contact: 12/19/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Varies

FEDLAND: Federal and Indian Lands
Federally and Indian administrated lands of the United States. Lands included are administrated by: Army Corps of Engineers, Bureau of Reclamation, National Wild and Scenic River, National Wildlife Refuge, Public Domain Land, Wilderness, Wilderness Study Area, Wildlife Management Area, Bureau of Indian Affairs, Bureau of Land Management, Department of Justice, Forest Service, Fish and Wildlife Service, National Park Service.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 02/06/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 339
Source: U.S. Geological Survey
Telephone: 888-275-8747
Last EDR Contact: 01/20/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: N/A

COAL ASH DOE: Sleam-Electric Plan Operation Data
A listing of power plants that store ash in surface ponds.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 08/07/2009
Date Made Active in Reports: 10/22/2009
Number of Days to Update: 76
Source: Department of Energy
Telephone: 202-586-8719
Last EDR Contact: 01/18/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: Varies

PCB TRANSFORMER: PCB Transformer Registration Database
The database of PCB transformer registrations that includes all PCB registration submittals.

Date of Government Version: 02/01/2011
Date Data Arrived at EDR: 10/19/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 83
Source: Environmental Protection Agency
Telephone: 202-566-0517
Last EDR Contact: 11/04/2011
Next Scheduled EDR Contact: 02/13/2012
Data Release Frequency: Varies

COAL ASH EPA: Coal Combustion Residues Surface Impoundments List
A listing of coal combustion residues surface impoundments with high hazard potential ratings.

Date of Government Version: 08/17/2010
Date Data Arrived at EDR: 01/03/2011
Date Made Active in Reports: 03/21/2011
Number of Days to Update: 77
Source: Environmental Protection Agency
Telephone: N/A
Last EDR Contact: 12/08/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Varies

FINANCIAL ASSURANCE: Financial Assurance Information Listing
Financial assurance information for aolid waste facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

Date of Government Version: 09/21/2011
Date Data Arrived at EDR: 09/22/2011
Date Made Active in Reports: 10/07/2011
Number of Days to Update: 15

Source: Department of Health & Environmental Control
Telephone: 803-896-4067
Last EDR Contact: 12/19/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Quarterly

EDR PROPRIETARY RECORDS

EDR Proprietary Records

Manufactured Gas Plants: EDR Proprietary Manufactured Gas Plants

The EDR Proprietary Manufactured Gas Plant Database includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the United States from the 1800's to 1950's to produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

CT MANIFEST: Hazardous Waste Manifest Data

Facility and manifest data. Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a tsd facility.

Date of Government Version: 11/21/2011
Date Data Arrived at EDR: 11/22/2011
Date Made Active in Reports: 12/22/2011
Number of Days to Update: 30

Source: Department of Environmental Protection
Telephone: 860-424-3375
Last EDR Contact: 11/22/2011
Next Scheduled EDR Contact: 03/05/2012
Data Release Frequency: Annually

NJ MANIFEST: Manifest Information

Hazardous waste manifest information.

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 07/20/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 22

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 01/20/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: Annually

NY MANIFEST: Facility and Manifest Data

Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a TSD facility.

Date of Government Version: 11/01/2011
Date Data Arrived at EDR: 11/08/2011
Date Made Active in Reports: 12/22/2011
Number of Days to Update: 44

Source: Department of Environmental Conservation
Telephone: 518-402-8651
Last EDR Contact: 11/08/2011
Next Scheduled EDR Contact: 02/20/2012
Data Release Frequency: Annually

PA MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2008
Date Data Arrived at EDR: 12/01/2009
Date Made Active in Reports: 12/14/2009
Number of Days to Update: 13

Source: Department of Environmental Protection
Telephone: 717-783-8990
Last EDR Contact: 01/23/2012
Next Scheduled EDR Contact: 05/07/2012
Data Release Frequency: Annually

RI MANIFEST: Manifest information
Hazardous waste manifest information

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 06/24/2011
Date Made Active in Reports: 06/30/2011
Number of Days to Update: 6

Source: Department of Environmental Management
Telephone: 401-222-2797
Last EDR Contact: 11/28/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Annually

WI MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 08/19/2011
Date Made Active in Reports: 09/15/2011
Number of Days to Update: 27

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 12/19/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Annually

Oil/Gas Pipelines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines.

Electric Power Transmission Line Data
Source: Rextag Strategies Corp.
Telephone: (281) 769-2247
U.S. Electric Transmission and Power Plants Systems Digital GIS Data

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Child Day Care List
Source: Department of Social Services
Telephone: 803-898-7345

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 2003 & 2011 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 and 2005 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Wetlands Inventory
Source: Department of Natural Resources
Telephone: 803-734-9494

Scanned Digital USGS 7.5' Topographic Map (DRG)
Source: United States Geologic Survey
A digital raster graphic (DRG) is a scanned image of a U.S. Geological Survey topographic map. The map images are made by scanning published paper maps on high-resolution scanners. The raster image is georeferenced and fit to the Universal Transverse Mercator (UTM) projection.

STREET AND ADDRESS INFORMATION

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GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

SHOOTHOUSE
5411 LEESBURG ROAD
COLUMBIA, SC 29223

TARGET PROPERTY COORDINATES

Latitude (North):	34.0294 - 34° 1' 45.84''
Longitude (West):	80.7063 - 80° 42' 22.68''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	527113.9
UTM Y (Meters):	3765260.2
Elevation:	232 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property Map:	34080-A6 LEESBURG, SC
Most Recent Revision:	1953

EDR's GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principal investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

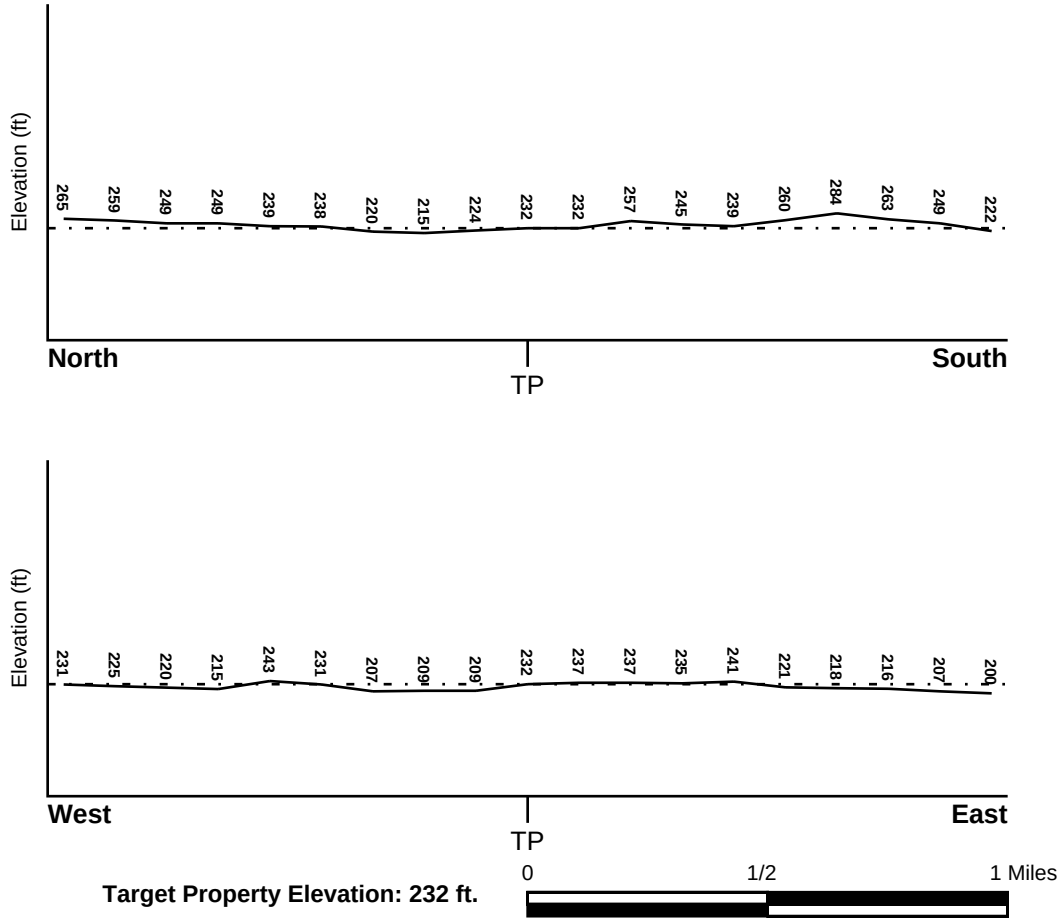
TOPOGRAPHIC INFORMATION

Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General NW

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES



Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Target Property County	FEMA Flood Electronic Data
RICHLAND, SC	YES - refer to the Overview Map and Detail Map

Flood Plain Panel at Target Property: 45079C - FEMA DFIRM Flood data

Additional Panels in search area: Not Reported

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
LEESBURG	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

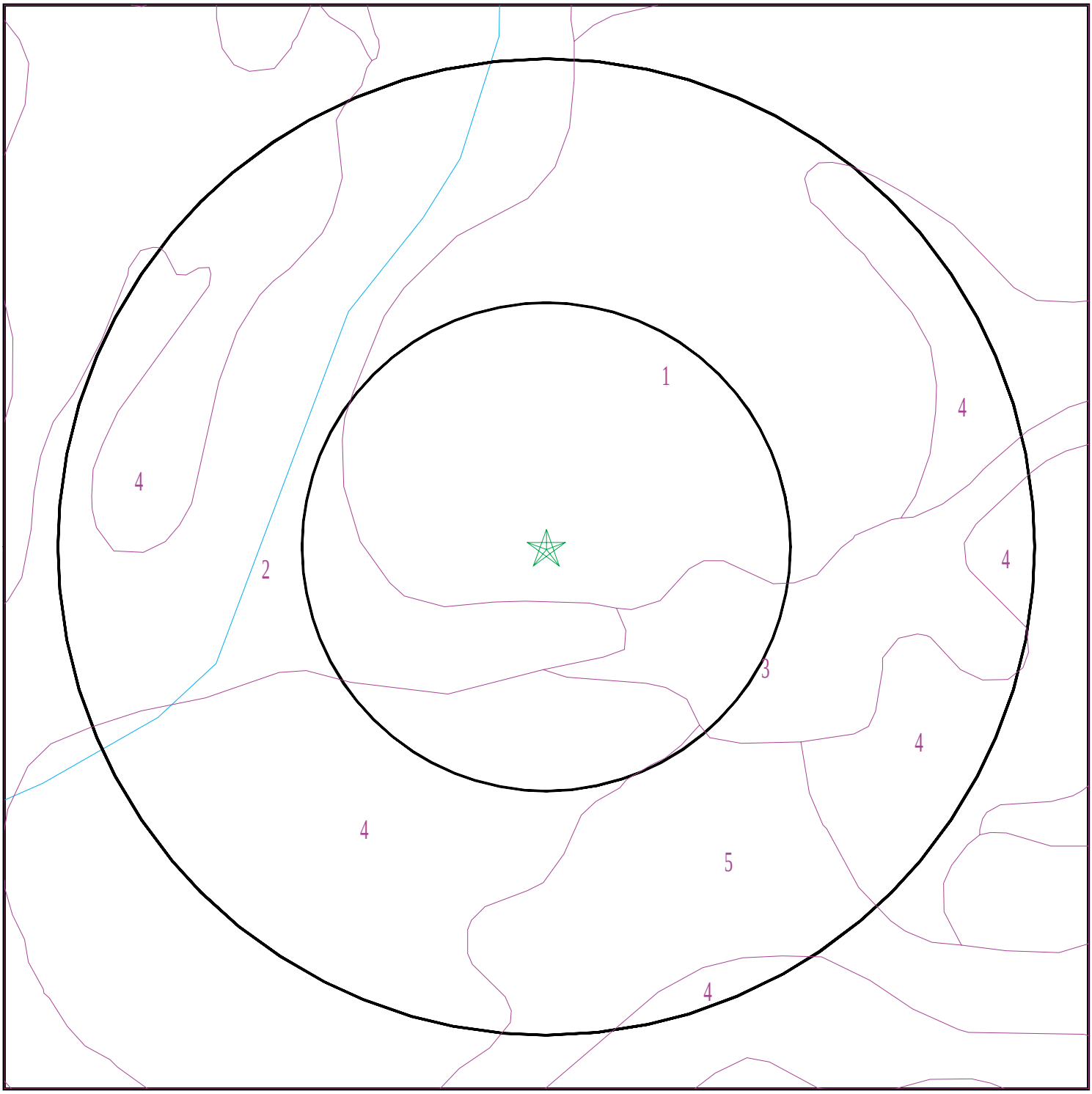
Era:	Mesozoic
System:	Cretaceous
Series:	Woodbine and Tuscaloosa Groups
Code:	uK1 *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Stratified Sequence

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

SSURGO SOIL MAP - 3248581.9s



Target Property
SSURGO Soil
Water

0 1/16 1/8 1/4 Miles

N

SITE NAME:	Shoothouse	CLIENT:	The Military Dept., State of SC
ADDRESS:	5411 LEESBURG ROAD Columbia SC 29223	CONTACT:	Brittanie Young
LAT/LONG:	34.0294 / 80.7063	INQUIRY #:	3248581.9s
		DATE:	January 30, 2012 12:52 pm

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GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. The following information is based on Soil Conservation Service SSURGO data.

Soil Map ID: 1

Soil Component Name: Vaucluse

Soil Surface Texture: loamy sand

Hydrologic Group: Class C - Slow infiltration rates. Soils with layers impeding downward movement of water, or soils with moderately fine or fine textures.

Soil Drainage Class: Well drained

Hydric Status: Not hydric

Corrosion Potential - Uncoated Steel: Low

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 0 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	5 inches	loamy sand	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 42 Min: 14	Max: 5.5 Min: 3.6
2	5 inches	14 inches	loamy sand	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 42 Min: 14	Max: 5.5 Min: 3.6
3	14 inches	29 inches	sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 42 Min: 14	Max: 5.5 Min: 3.6

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
4	29 inches	57 inches	sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 42 Min: 14	Max: 5.5 Min: 3.6
5	57 inches	72 inches	sandy loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 42 Min: 14	Max: 5.5 Min: 3.6

Soil Map ID: 2

Soil Component Name: Johnston

Soil Surface Texture: loam

Hydrologic Group: Class D - Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.

Soil Drainage Class: Very poorly drained

Hydric Status: All hydric

Corrosion Potential - Uncoated Steel: High

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 0 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	9 inches	loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), silt.	Max: 42 Min: 14	Max: 5.5 Min: 4.5

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
2	37 inches	66 inches	stratified sandy loam to fine sandy loam to sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), silt.	Max: 42 Min: 14	Max: 5.5 Min: 4.5
3	9 inches	37 inches	mucky loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), silt.	Max: 42 Min: 14	Max: 5.5 Min: 4.5

Soil Map ID: 3

Soil Component Name: Pelion

Soil Surface Texture: loamy sand

Hydrologic Group: Class B/D - Drained/undrained hydrology class of soils that can be drained and are classified.

Soil Drainage Class: Moderately well drained

Hydric Status: Partially hydric

Corrosion Potential - Uncoated Steel: High

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 30 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	5 inches	loamy sand	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 141 Min: 42	Max: 6 Min: 3.6

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
2	5 inches	7 inches	loamy sand	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 141 Min: 42	Max: 6 Min: 3.6
3	7 inches	25 inches	sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 141 Min: 42	Max: 6 Min: 3.6
4	25 inches	57 inches	sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 141 Min: 42	Max: 6 Min: 3.6
5	57 inches	57 inches	sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 141 Min: 42	Max: 6 Min: 3.6
6	57 inches	74 inches	loamy sand	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 141 Min: 42	Max: 6 Min: 3.6

Soil Map ID: 4

Soil Component Name: Ailey

Soil Surface Texture: loamy sand

Hydrologic Group: Class B - Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils with moderately coarse textures.

Soil Drainage Class: Well drained

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Hydric Status: Not hydric

Corrosion Potential - Uncoated Steel: Moderate

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 0 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	5 inches	loamy sand	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 1.4 Min: 0.42	Max: 5.5 Min: 4.5
2	29 inches	37 inches	sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 1.4 Min: 0.42	Max: 5.5 Min: 4.5
3	5 inches	29 inches	loamy sand	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 1.4 Min: 0.42	Max: 5.5 Min: 4.5
4	37 inches	68 inches	sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 1.4 Min: 0.42	Max: 5.5 Min: 4.5
5	68 inches	81 inches	sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 1.4 Min: 0.42	Max: 5.5 Min: 4.5

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Map ID: 5

Soil Component Name: Lakeland

Soil Surface Texture: sand

Hydrologic Group: Class A - High infiltration rates. Soils are deep, well drained to excessively drained sands and gravels.

Soil Drainage Class: Excessively drained

Hydric Status: Not hydric

Corrosion Potential - Uncoated Steel: Low

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 0 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	29 inches	sand	Not reported	Not reported	Max: 141 Min: 42	Max: 6 Min: 4.5
2	29 inches	98 inches	sand	Not reported	Not reported	Max: 141 Min: 42	Max: 6 Min: 4.5

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile
State Database	1.000

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

MAP ID	WELL ID	LOCATION FROM TP

No PWS System Found

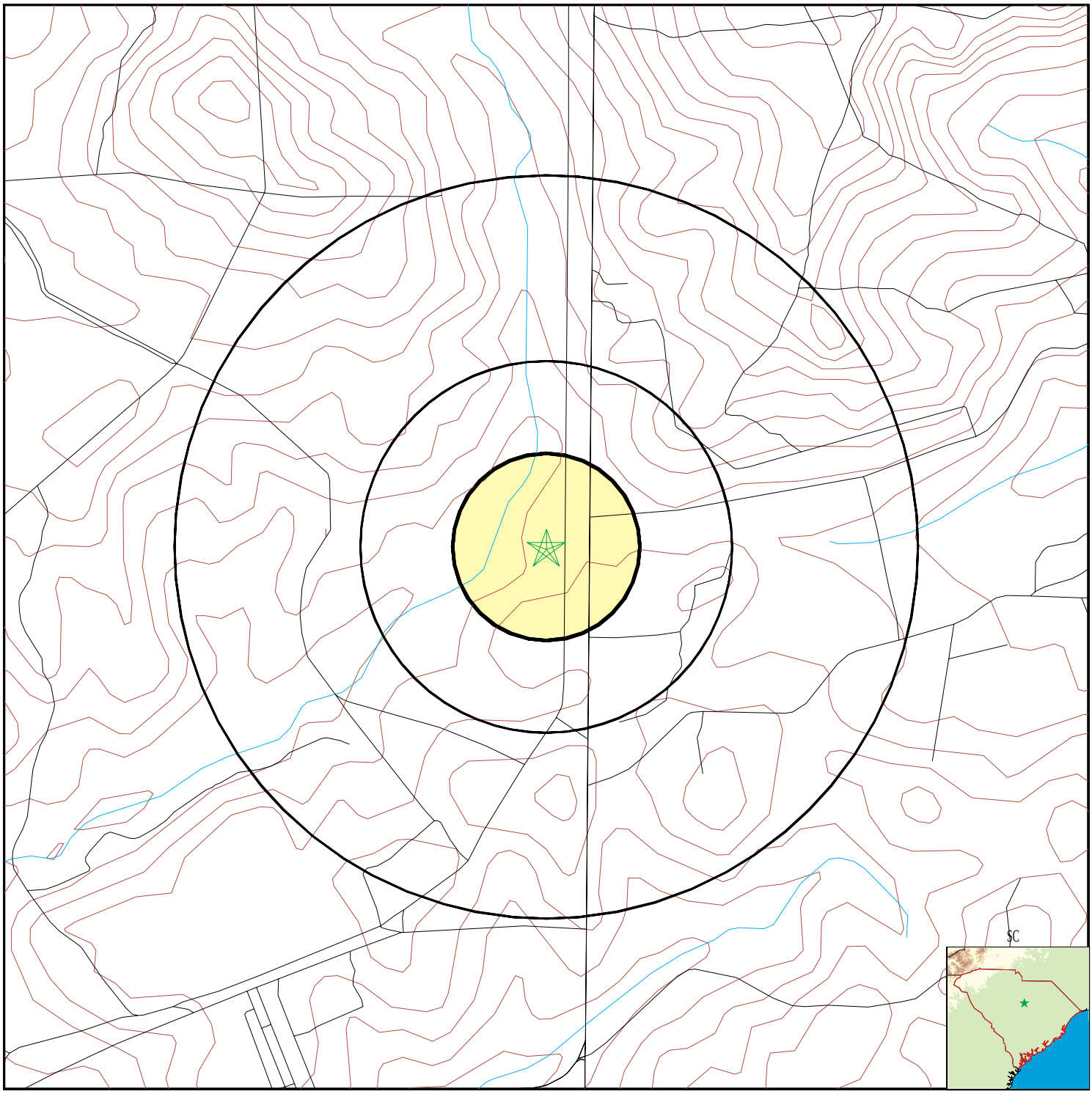
Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP

No Wells Found

PHYSICAL SETTING SOURCE MAP - 3248581.9s



- County Boundary
- Major Roads
- Contour Lines
- Earthquake epicenter, Richter 5 or greater
- Water Wells
- Public Water Supply Wells
- Cluster of Multiple Icons
- Groundwater Flow Direction
- GI Indeterminate Groundwater Flow at Location
- GV Groundwater Flow Varies at Location

SITE NAME:	Shoothouse	CLIENT:	The Military Dept., State of SC
ADDRESS:	5411 LEESBURG ROAD Columbia SC 29223	CONTACT:	Brittanie Young
		INQUIRY #:	3248581.9s
LAT/LONG:	34.0294 / 80.7063	DATE:	January 30, 2012 12:52 pm

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GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

State Database: SC Radon

Radon Test Results

Zipcode	Average	Num Tests	Minimum	Maximum	% > 4 pCi/L
29223	0.8	117	0.3	3.5	0.0

Federal EPA Radon Zone for RICHLAND County: 3

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for Zip Code: 29223

Number of sites tested: 9

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	0.389 pCi/L	100%	0%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	1.650 pCi/L	100%	0%	0%

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

Scanned Digital USGS 7.5' Topographic Map (DRG)
Source: United States Geologic Survey
A digital raster graphic (DRG) is a scanned image of a U.S. Geological Survey topographic map. The map images are made by scanning published paper maps on high-resolution scanners. The raster image is georeferenced and fit to the Universal Transverse Mercator (UTM) projection.

HYDROLOGIC INFORMATION

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 2003 & 2011 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 and 2005 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Wetlands Inventory
Source: Department of Natural Resources
Telephone: 803-734-9494

HYDROGEOLOGIC INFORMATION

AQUIFLOW^{R} Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services (NRCS)
Telephone: 800-672-5559
SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Services, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

STATE RECORDS

Water Well Database
Source: Department of Natural Resources
Telephone: 803-734-6440
Water wells in the Coastal Plain counties of South Carolina

Water Well Database
Source: Department of Natural Resources
Telephone: 864-654-1671
A listing of water wells in the Piedmont (upstate) counties.

OTHER STATE DATABASE INFORMATION

RADON

State Database: SC Radon
Source: Department of Health & Environmental Control
Telephone: 864-241-1090
Radon Test Results by Zip Code

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STREET AND ADDRESS INFORMATION

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Shoothouse
5411 LEESBURG ROAD
Columbia, SC 29223

Inquiry Number: 3248581.13
February 01, 2012

The EDR-City Directory Abstract

Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

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EXECUTIVE SUMMARY

DESCRIPTION

Environmental Data Resources, Inc.'s (EDR) City Directory Abstract is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's City Directory Abstract includes a search and abstract of available city directory data. For each address, the directory lists the name of the corresponding occupant at five year intervals.

RESEARCH SUMMARY

The following research sources were consulted in the preparation of this report. An "X" indicates where information was identified in the source and provided in this report.

Year	Source	TP	Adjoining	Text Abstract	Source Image
2011	Polk City Directories	X	X	X	-
2006	Polk City Directories	X	X	X	-
2001	Polk City Directories	X	X	X	-
1996	Polk City Directories	-	-	-	-
1991	Polk City Directories	-	-	-	-
1986	Polk City Directories	-	-	-	-
1981	Hill's City Directory	-	-	-	-
1976	Hill's City Directory	-	-	-	-
1971	Hill's City Directory	-	-	-	-
1964	Hill's City Directory	-	-	-	-
1952	Hill's City Directory	-	-	-	-

FINDINGS

TARGET PROPERTY INFORMATION

ADDRESS

5411 LEESBURG ROAD
Columbia, SC 29223

FINDINGS DETAIL

Target Property research detail.

Year	*Uses*	*Source*
2011	Adjutant General SC (state govt)	Polk City Directories
	Allsouth Federal Credit Union	Polk City Directories
	Fort Jackson (non-classified estab)	Polk City Directories
2006	Allsouth Federal Credit Union	Polk City Directories
	Fort Jackson (non-classified estab)	Polk City Directories
	Pulau Electronics (ele equip/suppl)	Polk City Directories
2001	218th Regiment Dining Facility	Polk City Directories
	Mc Grady Arng Training Ctr - Billeting Ofc	Polk City Directories
	Pulau Electronics (ele equip/suppl)	Polk City Directories

FINDINGS

ADJOINING PROPERTY DETAIL

The following Adjoining Property addresses were researched for this report. Detailed findings are provided for each address.

LEESBURG ROAD

5396 LEESBURG ROAD

Year	Uses	Source
2011	Residential	Polk City Directories
2006	Residential	Polk City Directories
2001	Residential	Polk City Directories

5405 LEESBURG ROAD

Year	Uses	Source
2011	US Marine Corps (fed govt)	Polk City Directories

5408 LEESBURG ROAD

Year	Uses	Source
2011	Residential	Polk City Directories
2006	Residential	Polk City Directories
2001	Residential	Polk City Directories

5424 LEESBURG ROAD

Year	Uses	Source
2011	No Return	Polk City Directories
2006	Residential	Polk City Directories
2001	Residential	Polk City Directories

5428 LEESBURG ROAD

Year	Uses	Source
2011	Residential	Polk City Directories

5432 LEESBURG ROAD

Year	Uses	Source
2011	Residential	Polk City Directories
2006	Residential	Polk City Directories
2001	Residential	Polk City Directories

FINDINGS

STREET NOT IDENTIFIED IN RESEARCH SOURCE

The following Streets were researched for this report, and the Streets were not identified in the research source.

Street Researched	Street Not Identified in Research Source
LEESBURG ROAD	1996, 1991, 1986, 1981, 1976, 1971, 1964, 1952

ADJOINING PROPERTY: ADDRESSES NOT IDENTIFIED IN RESEARCH SOURCE

The following Adjoining Property addresses were researched for this report, and the addresses were not identified in research source.

Address Researched	Address Not Identified in Research Source
5396 LEESBURG ROAD	No Years Found
5405 LEESBURG ROAD	2006, 2001
5408 LEESBURG ROAD	No Years Found
5424 LEESBURG ROAD	No Years Found
5428 LEESBURG ROAD	2006, 2001
5432 LEESBURG ROAD	No Years Found

Shoothouse
5411 LEESBURG ROAD
Columbia, SC 29223

Inquiry Number: 3248581.12
January 31, 2012

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EDR® Environmental Data Resources Inc

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Milford, CT 06461
800.352.0050
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Date EDR Searched Historical Sources:

Aerial Photography January 31, 2012

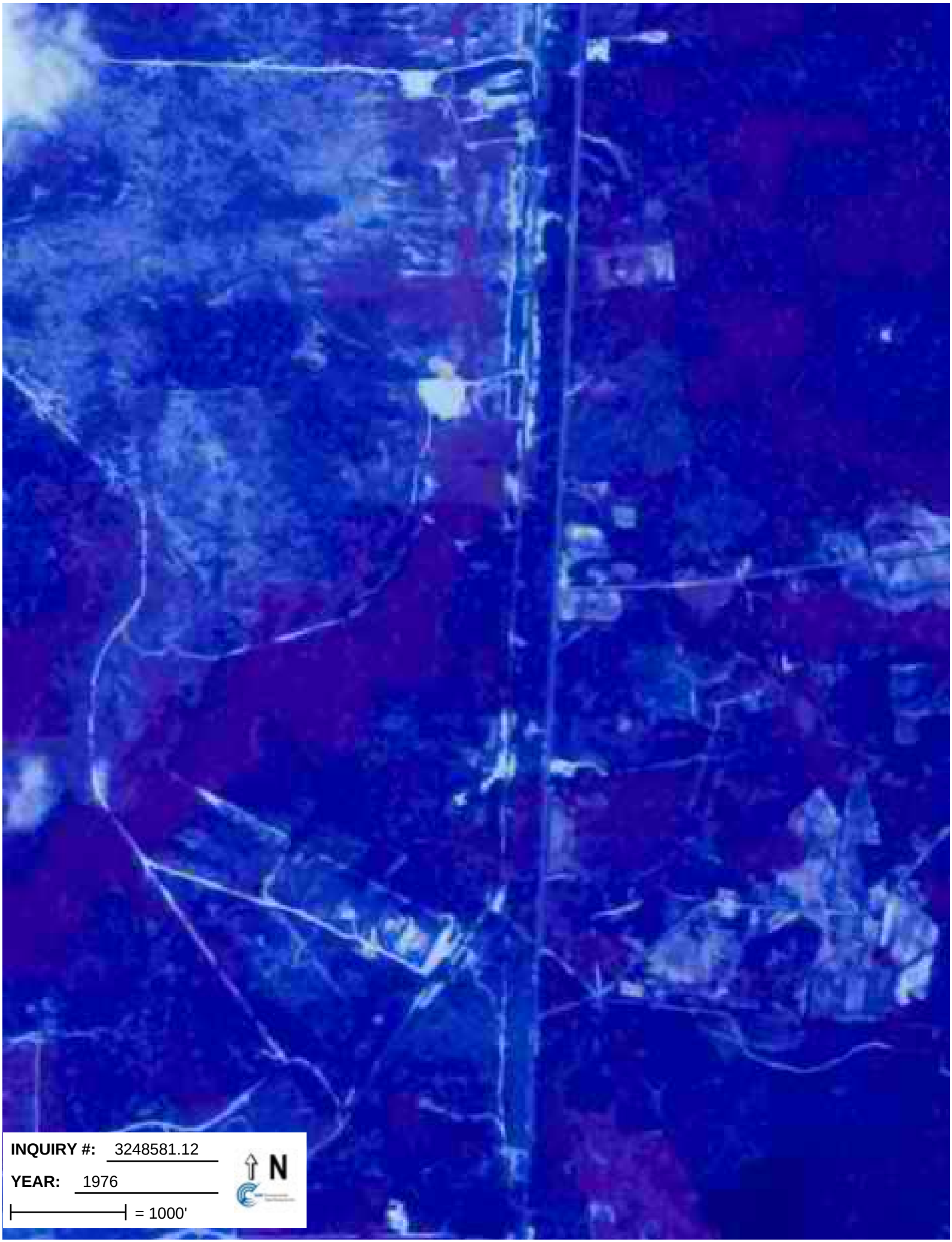
Target Property:

5411 LEESBURG ROAD

Columbia, SC 29223

Year	***Scale***	***Details***	***Source***
1961	Aerial Photograph. Scale: 1"=1000'	Panel #: 34080-A6, Leesburg, SC;/Flight Date: June 23, 1961	EDR
1976	Aerial Photograph. Scale: 1"=1000'	Panel #: 34080-A6, Leesburg, SC;/Flight Date: July 21, 1976	EDR
1983	Aerial Photograph. Scale: 1"=1000'	Panel #: 34080-A6, Leesburg, SC;/Flight Date: March 03, 1983	EDR
1989	Aerial Photograph. Scale: 1"=750'	Panel #: 34080-A6, Leesburg, SC;/Flight Date: March 19, 1989	EDR
1994	Aerial Photograph. Scale: 1"=500'	Panel #: 34080-A6, Leesburg, SC;/Composite DOQQ - acquisition dates: January 22, 1994	EDR
1999	Aerial Photograph. Scale: 1"=750'	Panel #: 34080-A6, Leesburg, SC;/Flight Date: February 15, 1999	EDR
2005	Aerial Photograph. Scale: 1"=500'	Panel #: 34080-A6, Leesburg, SC;/Flight Year: 2005	EDR
2006	Aerial Photograph. Scale: 1"=500'	Panel #: 34080-A6, Leesburg, SC;/Flight Year: 2006	EDR

INQUIRY #: 3248581.12
YEAR: 1961
= 1000'
N


INQUIRY #: 3248581.12
YEAR: 1976
= 1000'
N

INQUIRY #: 3248581.12
YEAR: 1983
= 1000'
N

INQUIRY #: 3248581.12
YEAR: 1989
= 750'
N

INQUIRY #: 3248581.12
YEAR: 1994
= 500'
N

INQUIRY #: 3248581.12
YEAR: 1999
= 750'
N

INQUIRY #: 3248581.12
YEAR: 2005
= 500'
N

INQUIRY #: 3248581.12
YEAR: 2006
= 500'
N

Shoothouse
5411 LEESBURG ROAD
Columbia, SC 29223

Inquiry Number: 3248581.11
January 30, 2012

EDR Historical Topographic Map Report

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EDR Historical Topographic Map Report

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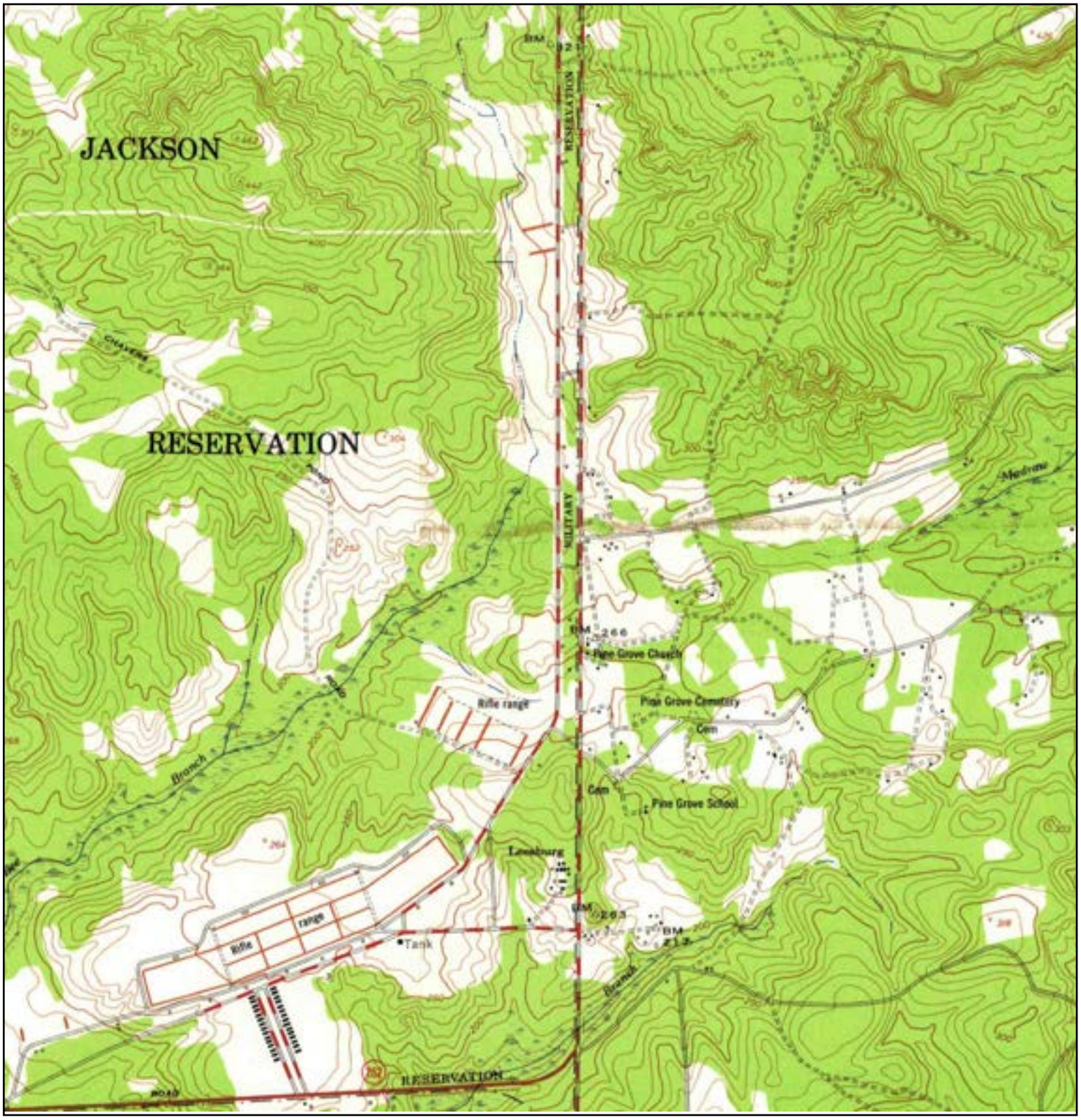
Historical Topographic Map

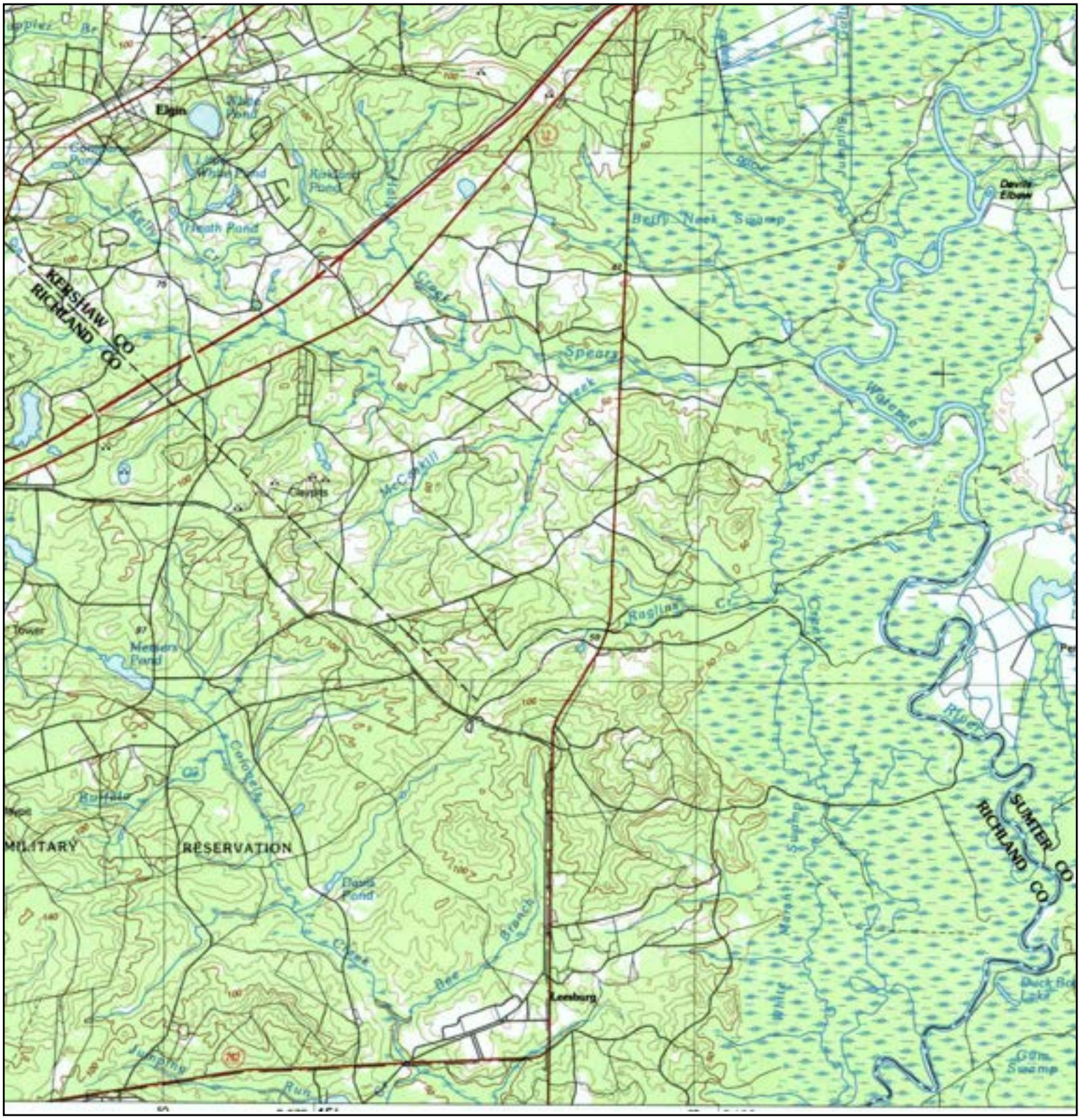
N	TARGET QUAD NAME: HAGOOD MAP YEAR: 1938 SERIES: 15 SCALE: 1:62500	SITE NAME: Shoothouse ADDRESS: 5411 LEESBURG ROAD Columbia, SC 29223 LAT/LONG: 34.0294 / -80.7063	CLIENT: The Military Dept., State of SC CONTACT: Brittanie Young INQUIRY#: 3248581.11 RESEARCH DATE: 01/30/2012

Historical Topographic Map



N	TARGET QUAD NAME: LEESBURG MAP YEAR: 1953 SERIES: 7.5 SCALE: 1:24000	SITE NAME: Shoothouse ADDRESS: 5411 LEESBURG ROAD Columbia, SC 29223 LAT/LONG: 34.0294 / -80.7063	CLIENT: The Military Dept., State of SC CONTACT: Brittanie Young INQUIRY#: 3248581.11 RESEARCH DATE: 01/30/2012

Historical Topographic Map



N	TARGET QUAD NAME: CAMDEN MAP YEAR: 1986 SERIES: 30 SCALE: 1:100000	SITE NAME: Shoothouse ADDRESS: 5411 LEESBURG ROAD Columbia, SC 29223 LAT/LONG: 34.0294 / -80.7063	CLIENT: The Military Dept., State of SC CONTACT: Brittanie Young INQUIRY#: 3248581.11 RESEARCH DATE: 01/30/2012

Range Complex
2563 ESSAYONS WAY
Columbia, SC 29223

Inquiry Number: 3248581.6
February 01, 2012

The EDR-City Directory Abstract

Environmental Data Resources Inc

440 Wheelers Farms Road
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RESEARCH SUMMARY

The following research sources were consulted in the preparation of this report. An "X" indicates where information was identified in the source and provided in this report.

Year	Source	TP	Adjoining	Text Abstract	Source Image
2011	Polk City Directories	-	X	X	-
2006	Polk City Directories	-	X	X	-
2001	Polk City Directories	-	-	-	-
1996	Polk City Directories	-	-	-	-
1991	Polk City Directories	-	-	-	-
1986	Polk City Directories	-	-	-	-
1981	Hill's City Directory	-	-	-	-
1971	Hill's City Directory	-	-	-	-
1964	Hill's City Directory	-	-	-	-
1952	Hill's City Directory	-	-	-	-

FINDINGS

TARGET PROPERTY INFORMATION

ADDRESS

2563 ESSAYONS WAY
Columbia, SC 29223

FINDINGS DETAIL

Target Property research detail.

No Addresses Found

FINDINGS

ADJOINING PROPERTY DETAIL

The following Adjoining Property addresses were researched for this report. Detailed findings are provided for each address.

ESSAYONS WAY

ESSAYONS WAY

Year	Uses	Source
2011	No other listings on street	Polk City Directories
2006	No other listings on street	Polk City Directories

2522 ESSAYONS WAY

Year	Uses	Source
2011	Lions Club Industries Inc (mfr)	Polk City Directories
2006	Lions Club Industries Inc (mfr)	Polk City Directories

2576 ESSAYONS WAY

Year	Uses	Source
2011	Palmetto State Utility Svc (water/sewage co)	Polk City Directories

FINDINGS

STREET NOT IDENTIFIED IN RESEARCH SOURCE

The following Streets were researched for this report, and the Streets were not identified in the research source.

Street Researched	Street Not Identified in Research Source
ESSAYONS WAY	2001, 1996, 1991, 1986, 1981, 1976, 1971, 1964, 1952

TARGET PROPERTY: ADDRESS NOT IDENTIFIED IN RESEARCH SOURCE

The following Target Property addresses were researched for this report, and the addresses were not identified in the research source.

Address Researched	Address Not Identified in Research Source
2563 ESSAYONS WAY	2011, 2006

ADJOINING PROPERTY: ADDRESSES NOT IDENTIFIED IN RESEARCH SOURCE

The following Adjoining Property addresses were researched for this report, and the addresses were not identified in research source.

Address Researched	Address Not Identified in Research Source
ESSAYONS WAY	No Years Found
2522 ESSAYONS WAY	No Years Found
2576 ESSAYONS WAY	2006

INQUIRY #: 3248581.5
YEAR: 2006
= 500'
N

Range Complex
2563 ESSAYONS WAY
Columbia, SC 29223

Inquiry Number: 3248581.5
February 01, 2012

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Date EDR Searched Historical Sources:

Aerial Photography February 01, 2012

Target Property:

2563 ESSAYONS WAY

Columbia, SC 29223

Year	***Scale***	***Details***	***Source***
1961	Aerial Photograph. Scale: 1"=1000'	Panel #: 34080-A7, Messers Pond, SC;/Flight Date: June 23, 1961	EDR
1971	Aerial Photograph. Scale: 1"=500'	Panel #: 34080-A7, Messers Pond, SC;/Flight Date: March 30, 1971	EDR
1978	Aerial Photograph. Scale: 1"=1000'	Panel #: 34080-A7, Messers Pond, SC;/Flight Date: February 28, 1978	EDR
1983	Aerial Photograph. Scale: 1"=1000'	Panel #: 34080-A7, Messers Pond, SC;/Flight Date: March 03, 1983	EDR
1994	Aerial Photograph. Scale: 1"=500'	Panel #: 34080-A7, Messers Pond, SC;/Composite DOQQ - acquisition dates: January 22, 1994	EDR
2005	Aerial Photograph. Scale: 1"=500'	Panel #: 34080-A7, Messers Pond, SC;/Flight Year: 2005	EDR
2006	Aerial Photograph. Scale: 1"=500'	Panel #: 34080-A7, Messers Pond, SC;/Flight Year: 2006	EDR

INQUIRY #: 3248581.5
YEAR: 1961
= 1000'
N

INQUIRY #: 3248581.5
YEAR: 1971
= 500'
N

INQUIRY #: 3248581.5
YEAR: 1978
= 1000'
N

INQUIRY #: 3248581.5

YEAR: 1983

= 1000'

N

INQUIRY #: 3248581.5
YEAR: 1994
= 500'
N

INQUIRY #: 3248581.5
YEAR: 2005
= 500'
N

Range Complex
2563 ESSAYONS WAY
Columbia, SC 29223

Inquiry Number: 3248581.4
January 30, 2012

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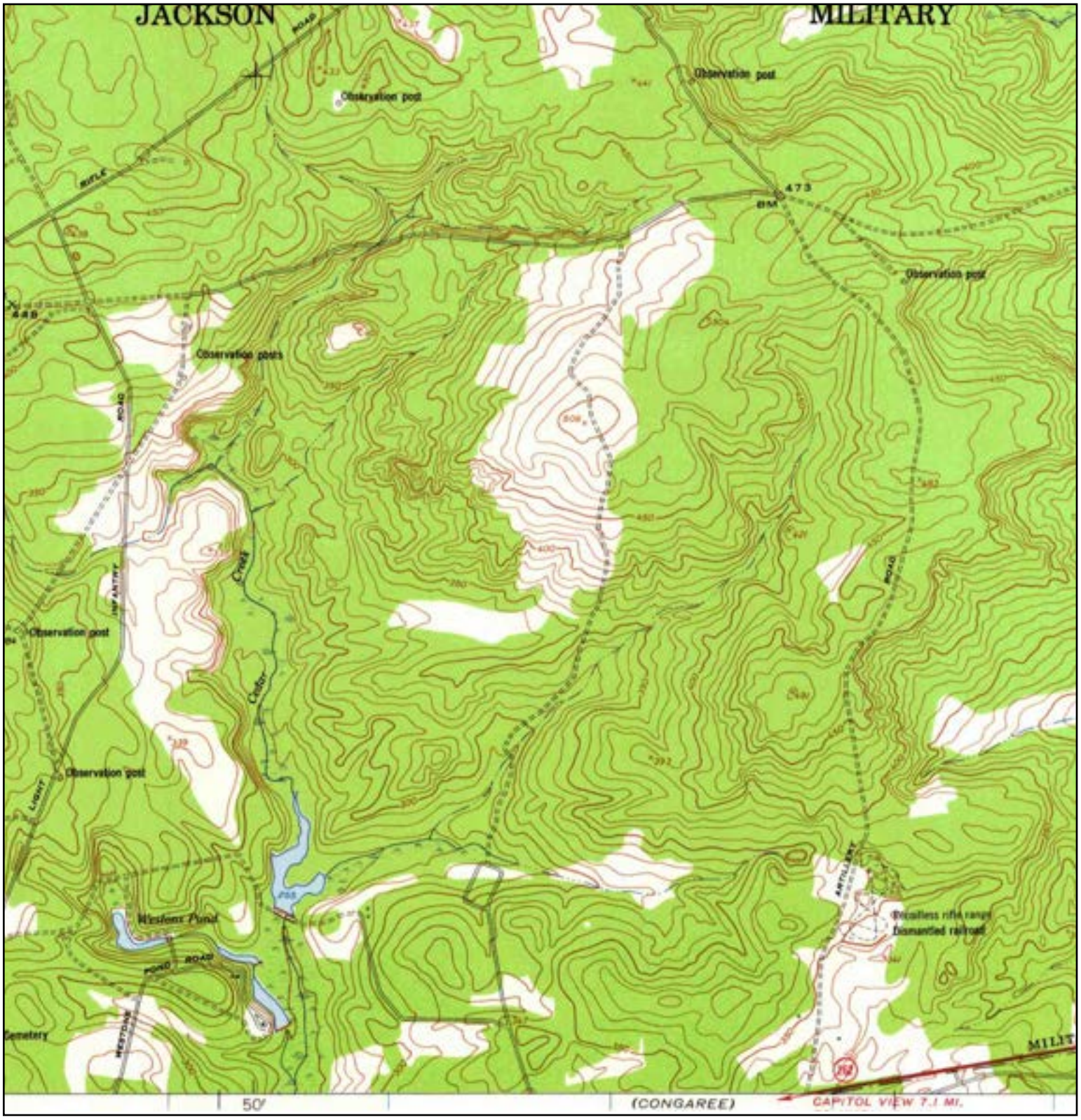
Historical Topographic Map

N	TARGET QUAD			
	NAME:	KILLIAN	SITE NAME:	Range Complex
	MAP YEAR:	1937	ADDRESS:	2563 ESSAYONS WAY
				Columbia, SC 29223
	SERIES:	15	LAT/LONG:	34.0068 / -80.8193
	SCALE:	1:62500		

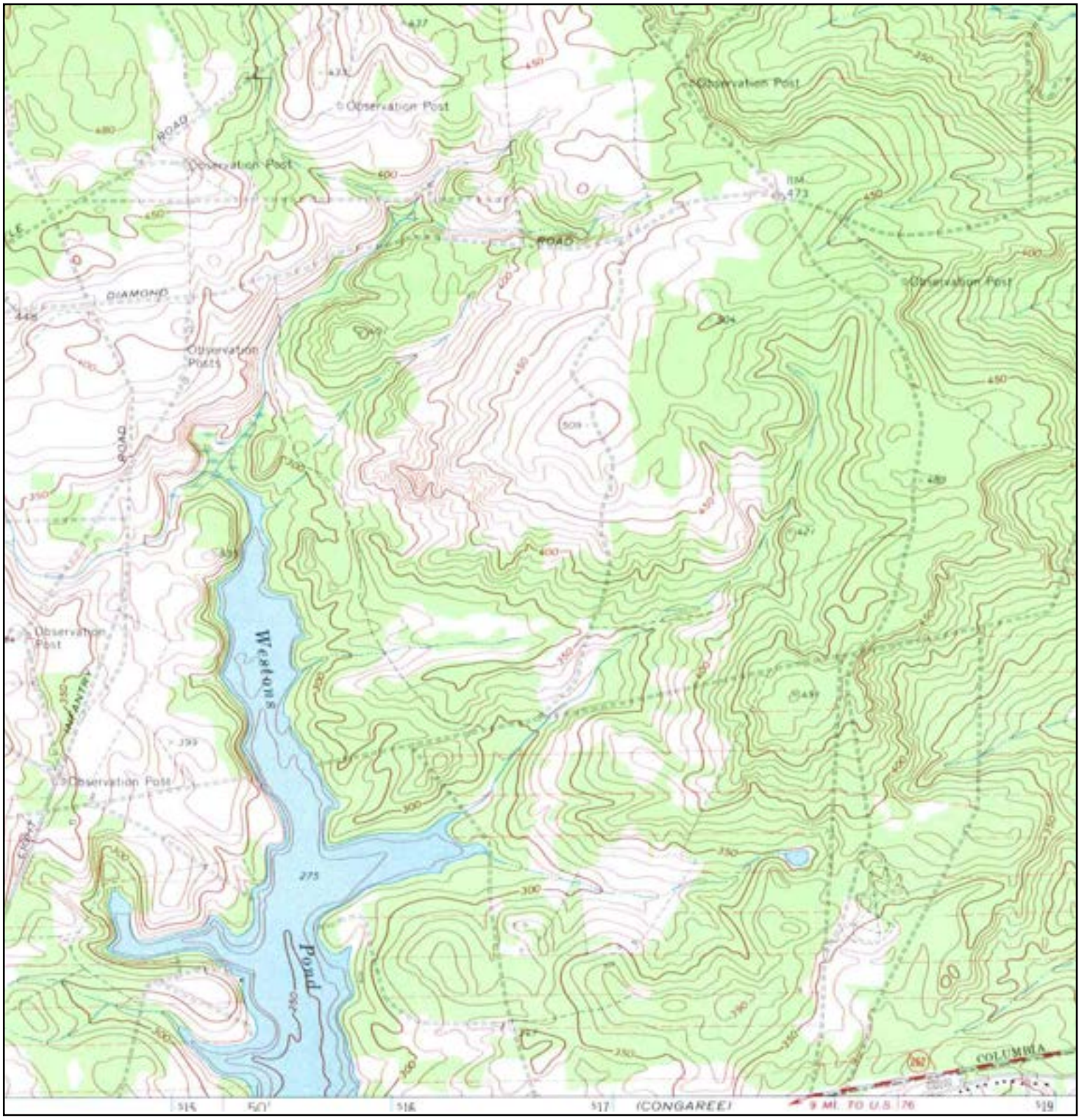
CLIENT: The Military Dept., State of SC
CONTACT: Brittanie Young
INQUIRY#: 3248581.4
RESEARCH DATE: 01/30/2012

Historical Topographic Map



N	TARGET QUAD NAME: MESSERS POND MAP YEAR: 1953 SERIES: 7.5 SCALE: 1:24000	SITE NAME: Range Complex ADDRESS: 2563 ESSAYONS WAY Columbia, SC 29223 LAT/LONG: 34.0068 / -80.8193	CLIENT: The Military Dept., State of SC CONTACT: Brittanie Young INQUIRY#: 3248581.4 RESEARCH DATE: 01/30/2012

Historical Topographic Map



N	TARGET QUAD NAME: MESSERS POND MAP YEAR: 1972 SERIES: 7.5 SCALE: 1:24000	SITE NAME: Range Complex ADDRESS: 2563 ESSAYONS WAY Columbia, SC 29223 LAT/LONG: 34.0068 / -80.8193	CLIENT: The Military Dept., State of SC CONTACT: Brittanie Young INQUIRY#: 3248581.4 RESEARCH DATE: 01/30/2012

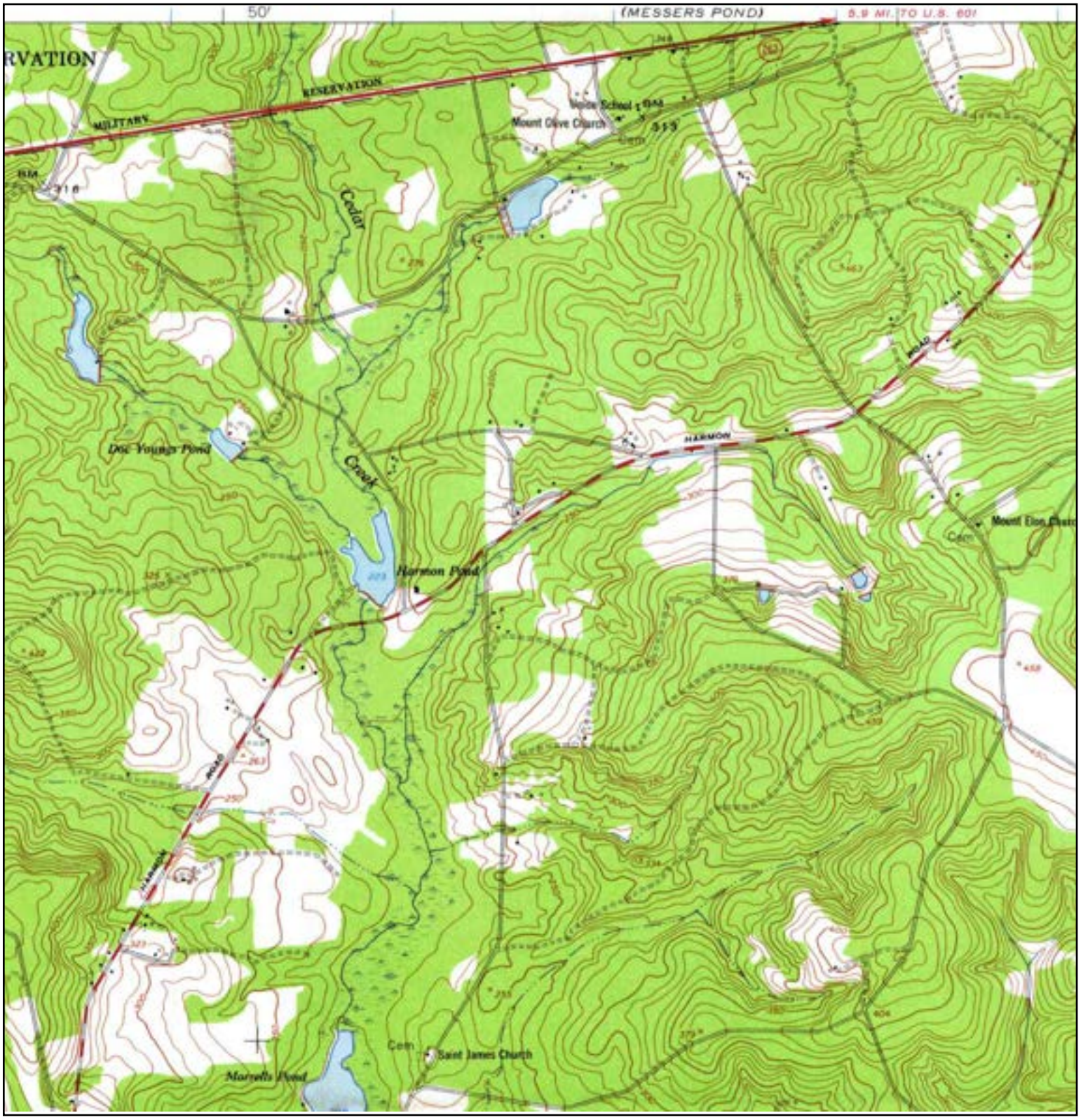
Historical Topographic Map

N	TARGET QUAD NAME: CAMDEN MAP YEAR: 1986 SERIES: 30 SCALE: 1:100000	SITE NAME: Range Complex ADDRESS: 2563 ESSAYONS WAY Columbia, SC 29223 LAT/LONG: 34.0068 / -80.8193	CLIENT: The Military Dept., State of SC CONTACT: Brittanie Young INQUIRY#: 3248581.4 RESEARCH DATE: 01/30/2012

Historical Topographic Map

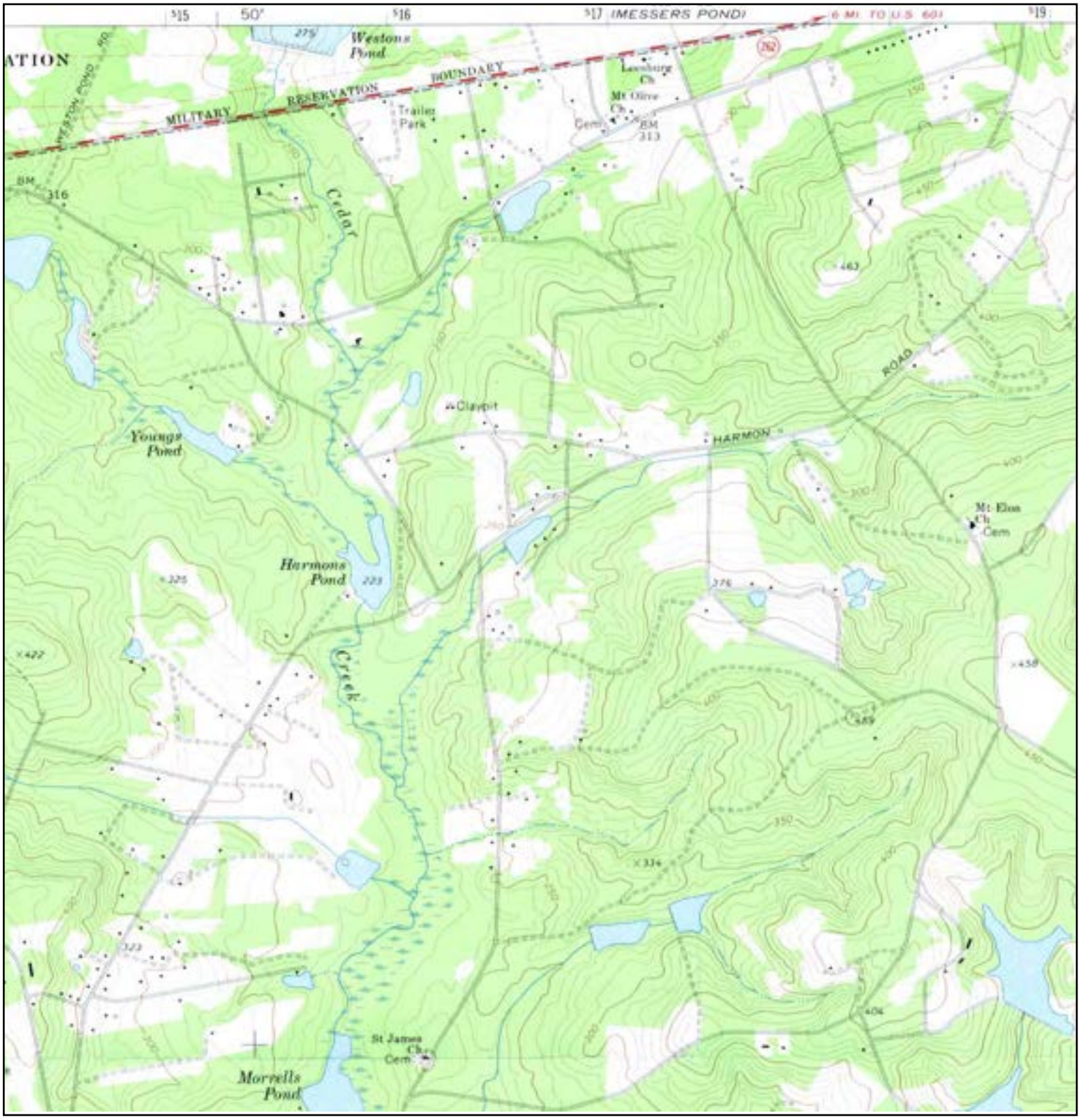
N	ADJOINING QUAD				
	NAME:	HOPKINS	SITE NAME:	Range Complex	CLIENT: The Military Dept., State of SC
	MAP YEAR:	1943	ADDRESS:	2563 ESSAYONS WAY Columbia, SC 29223	CONTACT: Brittanie Young INQUIRY#: 3248581.4
	SERIES:	15	LAT/LONG:	34.0068 / -80.8193	RESEARCH DATE: 01/30/2012
	SCALE:	1:62500			

Historical Topographic Map



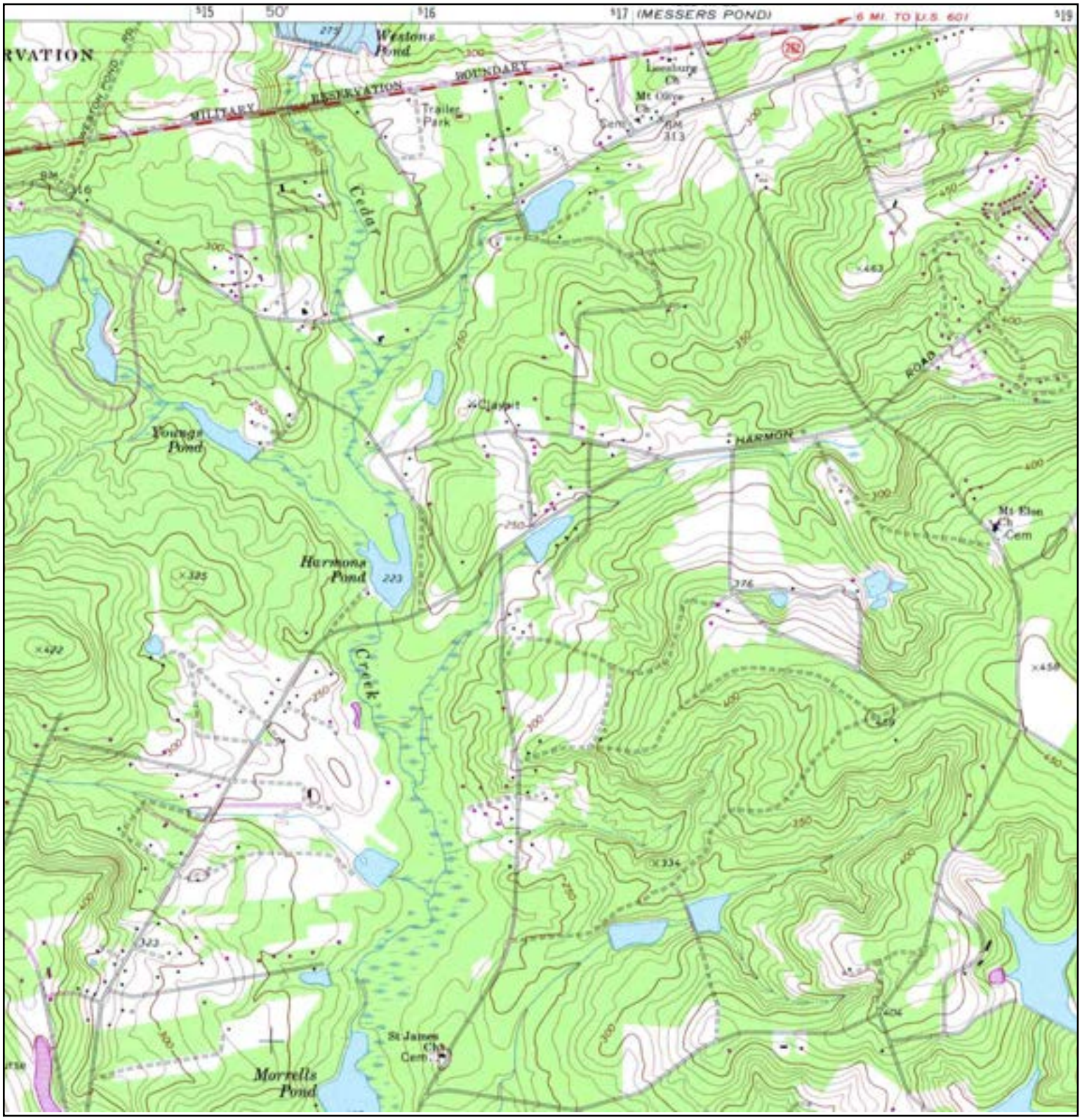
N	ADJOINING QUAD NAME: CONGAREE MAP YEAR: 1953 SERIES: 7.5 SCALE: 1:24000	SITE NAME: Range Complex ADDRESS: 2563 ESSAYONS WAY Columbia, SC 29223 LAT/LONG: 34.0068 / -80.8193	CLIENT: The Military Dept., State of SC CONTACT: Brittanie Young INQUIRY#: 3248581.4 RESEARCH DATE: 01/30/2012

Historical Topographic Map



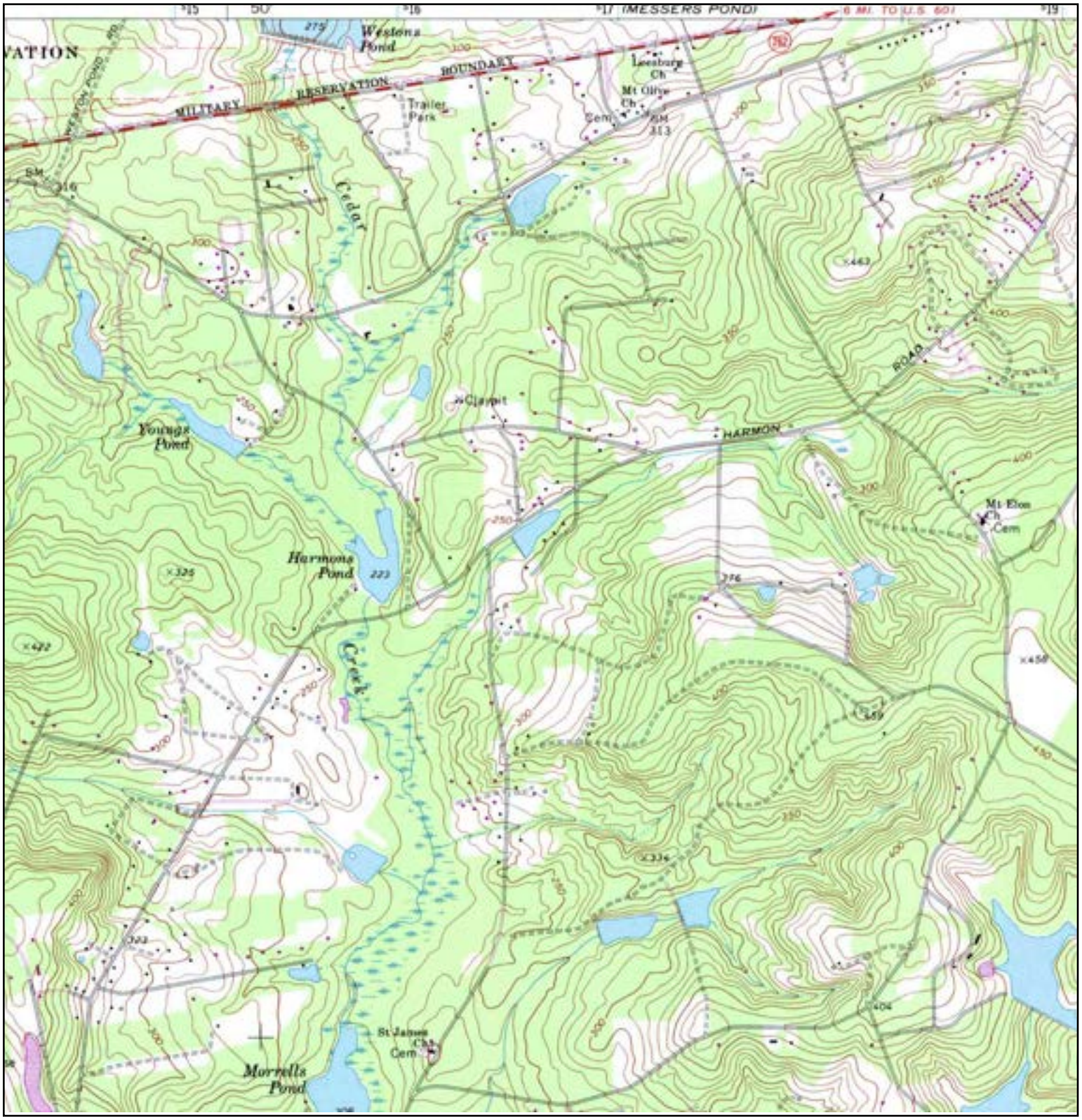
N	ADJOINING QUAD NAME: CONGAREE MAP YEAR: 1972 SERIES: 7.5 SCALE: 1:24000	SITE NAME: Range Complex ADDRESS: 2563 ESSAYONS WAY Columbia, SC 29223 LAT/LONG: 34.0068 / -80.8193	CLIENT: The Military Dept., State of SC CONTACT: Brittanie Young INQUIRY#: 3248581.4 RESEARCH DATE: 01/30/2012

Historical Topographic Map



N	ADJOINING QUAD NAME: CONGAREE MAP YEAR: 1982 PHOTOREVISED FROM :1972 SERIES: 7.5 SCALE: 1:24000	SITE NAME: Range Complex ADDRESS: 2563 ESSAYONS WAY Columbia, SC 29223 LAT/LONG: 34.0068 / -80.8193	CLIENT: The Military Dept., State of SC CONTACT: Brittanie Young INQUIRY#: 3248581.4 RESEARCH DATE: 01/30/2012

Historical Topographic Map



N	ADJOINING QUAD NAME: CONGAREE MAP YEAR: 1987 PHOTOINSPECTED FROM : 1972 SERIES: 7.5 SCALE: 1:24000	SITE NAME: Range Complex ADDRESS: 2563 ESSAYONS WAY Columbia, SC 29223 LAT/LONG: 34.0068 / -80.8193	CLIENT: The Military Dept., State of SC CONTACT: Brittanie Young INQUIRY#: 3248581.4 RESEARCH DATE: 01/30/2012

Range Complex
2563 ESSAYONS WAY
Columbia, SC 29223

Inquiry Number: 3248581.3
January 30, 2012

Certified Sanborn® Map Report

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

Certified Sanborn® Map Report

1/30/12

Site Name:
Range Complex
2563 ESSAYONS WAY
Columbia, SC 29223

Client Name:
The Military Dept., State of SC
5411 Leesburg Road
Eastover, SC 29044

EDR Inquiry # 3248581.3

Contact: Brittanie Young

The complete Sanborn Library collection has been searched by EDR, and fire insurance maps covering the target property location provided by The Military Dept., State of SC were identified for the years listed below. The certified Sanborn Library search results in this report can be authenticated by visiting www.edrnet.com/sanborn and entering the certification number. Only Environmental Data Resources Inc. (EDR) is authorized to grant rights for commercial reproduction of maps by Sanborn Library LLC, the copyright holder for the collection.

Certified Sanborn Results:

Site Name: Range Complex
Address: 2563 ESSAYONS WAY
City, State, Zip: Columbia, SC 29223
Cross Street:
P.O. # NA
Project: Range Complex EA
Certification # BAEE-4D76-BD2F

Sanborn® Library search results
Certification # BAEE-4D76-BD2F

UNMAPPED PROPERTY

This report certifies that the complete holdings of the Sanborn Library, LLC collection have been searched based on client supplied target property information, and fire insurance maps covering the target property were not found.

The Sanborn Library includes more than 1.2 million Sanborn fire insurance maps, which track historical property usage in approximately 12,000 American cities and towns. Collections searched:

- ✔ Library of Congress
- ✔ University Publications of America
- ✔ EDR Private Collection

The Sanborn Library LLC Since 1866™

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Range Complex
2563 ESSAYONS WAY
Columbia, SC 29223

Inquiry Number: 3248581.2s
January 30, 2012

The EDR Radius Map™ Report with GeoCheck®

Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
Toll Free: 800.352.0050
www.edrnet.com

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EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-05) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

2563 ESSAYONS WAY
COLUMBIA, SC 29223

COORDINATES

Latitude (North):	34.0068000 - 34° 0' 24.48''
Longitude (West):	80.8193000 - 80° 49' 9.48''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	516686.3
UTM Y (Meters):	3762730.2
Elevation:	340 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	34080-A7 MESSERS POND, SC
Most Recent Revision:	1972
South Map:	33080-H7 CONGAREE, SC
Most Recent Revision:	1987

AERIAL PHOTOGRAPHY IN THIS REPORT

Photo Year:	2009
Source:	USDA

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL---------- National Priority List

EXECUTIVE SUMMARY

Proposed NPL ---------- Proposed National Priority List Sites
NPL LIENS ---------- Federal Superfund Liens

Federal Delisted NPL site list

Delisted NPL ---------- National Priority List Deletions

Federal CERCLIS list

CERCLIS ---------- Comprehensive Environmental Response, Compensation, and Liability Information System
FEDERAL FACILITY ---------- Federal Facility Site Information listing

Federal CERCLIS NFRAP site List

CERC-NFRAP ---------- CERCLIS No Further Remedial Action Planned

Federal RCRA CORRACTS facilities list

CORRACTS ---------- Corrective Action Report

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF ---------- RCRA - Treatment, Storage and Disposal

Federal RCRA generators list

RCRA-LQG ---------- RCRA - Large Quantity Generators
RCRA-SQG ---------- RCRA - Small Quantity Generators
RCRA-CESQG ---------- RCRA - Conditionally Exempt Small Quantity Generator

Federal institutional controls / engineering controls registries

US ENG CONTROLS ---------- Engineering Controls Sites List
US INST CONTROL ---------- Sites with Institutional Controls

Federal ERNS list

ERNS ---------- Emergency Response Notification System

State- and tribal - equivalent CERCLIS

SHWS ---------- Site Assessment Section Project List

State and tribal landfill and/or solid waste disposal site lists

SWF/LF ---------- Permitted Landfills List

State and tribal leaking storage tank lists

LUST ---------- Leaking Underground Storage Tank List
INDIAN LUST ---------- Leaking Underground Storage Tanks on Indian Land

State and tribal registered storage tank lists

UST ---------- Comprehensive Underground Storage Tanks

EXECUTIVE SUMMARY

AST ---------- Aboveground Storage Tank List
INDIAN UST ---------- Underground Storage Tanks on Indian Land
FEMA UST ---------- Underground Storage Tank Listing

State and tribal institutional control / engineering control registries

RCR ---------- Registry of Conditional Remedies

State and tribal voluntary cleanup sites

VCP ---------- Voluntary Cleanup Sites
INDIAN VCP ---------- Voluntary Cleanup Priority Listing

State and tribal Brownfields sites

BROWNFIELDS ---------- Brownfields Sites Listing

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS ---------- A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

ODI ---------- Open Dump Inventory
DEBRIS REGION 9 ---------- Torres Martinez Reservation Illegal Dump Site Locations
SWRCY ---------- Solid Waste Recycling Facilities
INDIAN ODI ---------- Report on the Status of Open Dumps on Indian Lands

Local Lists of Hazardous waste / Contaminated Sites

US CDL ---------- Clandestine Drug Labs
ALLSITES ---------- Site Assessment & Remediation Public Record Database
CDL ---------- Clandestine Drug Lab Sites
US HIST CDL ---------- National Clandestine Laboratory Register

Local Land Records

LIENS 2 ---------- CERCLA Lien Information
LUCIS ---------- Land Use Control Information System

Records of Emergency Release Reports

HMIRS ---------- Hazardous Materials Information Reporting System
SPILLS ---------- Spills Database List

Other Ascertainable Records

RCRA-NonGen ---------- RCRA - Non Generators
DOT OPS ---------- Incident and Accident Data
FUDS ---------- Formerly Used Defense Sites
CONSENT ---------- Superfund (CERCLA) Consent Decrees
ROD ---------- Records Of Decision

UMTRA	Uranium Mill Tailings Sites
MINES	Mines Master Index File
TRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing
SSTS	Section 7 Tracking Systems
ICIS	Integrated Compliance Information System
PADS	PCB Activity Database System
MLTS	Material Licensing Tracking System
RADINFO	Radiation Information Database
FINDS	Facility Index System/Facility Registry System
RAATS	RCRA Administrative Action Tracking System
GWCI	Groundwater Contamination Inventory
UIC	Underground Injection Wells Listing
DRYCLEANERS	Drycleaner Database
NPDES	Waste Water Treatment Facilities Listing
AIRS	Permitted Airs Facility Listing
INDIAN RESERV	Indian Reservations
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing
COAL ASH EPA	Coal Combustion Residues Surface Impoundments List
PCB TRANSFORMER	PCB Transformer Registration Database
COAL ASH	Coal Ash Disposal Sites
FINANCIAL ASSURANCE	Financial Assurance Information Listing
COAL ASH DOE	Sleam-Electric Plan Operation Data

EDR PROPRIETARY RECORDS

EDR Proprietary Records

Manufactured Gas Plants	EDR Proprietary Manufactured Gas Plants

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified in the following databases.

Elevations have been determined from the USGS Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property.
Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

ADDITIONAL ENVIRONMENTAL RECORDS

Other Ascertainable Records

DOD: Consists of federally owned or administered lands, administered by the Department of

Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

A review of the DOD list, as provided by EDR, and dated 12/31/2005 has revealed that there is 1 DOD site within approximately 1 mile of the target property.

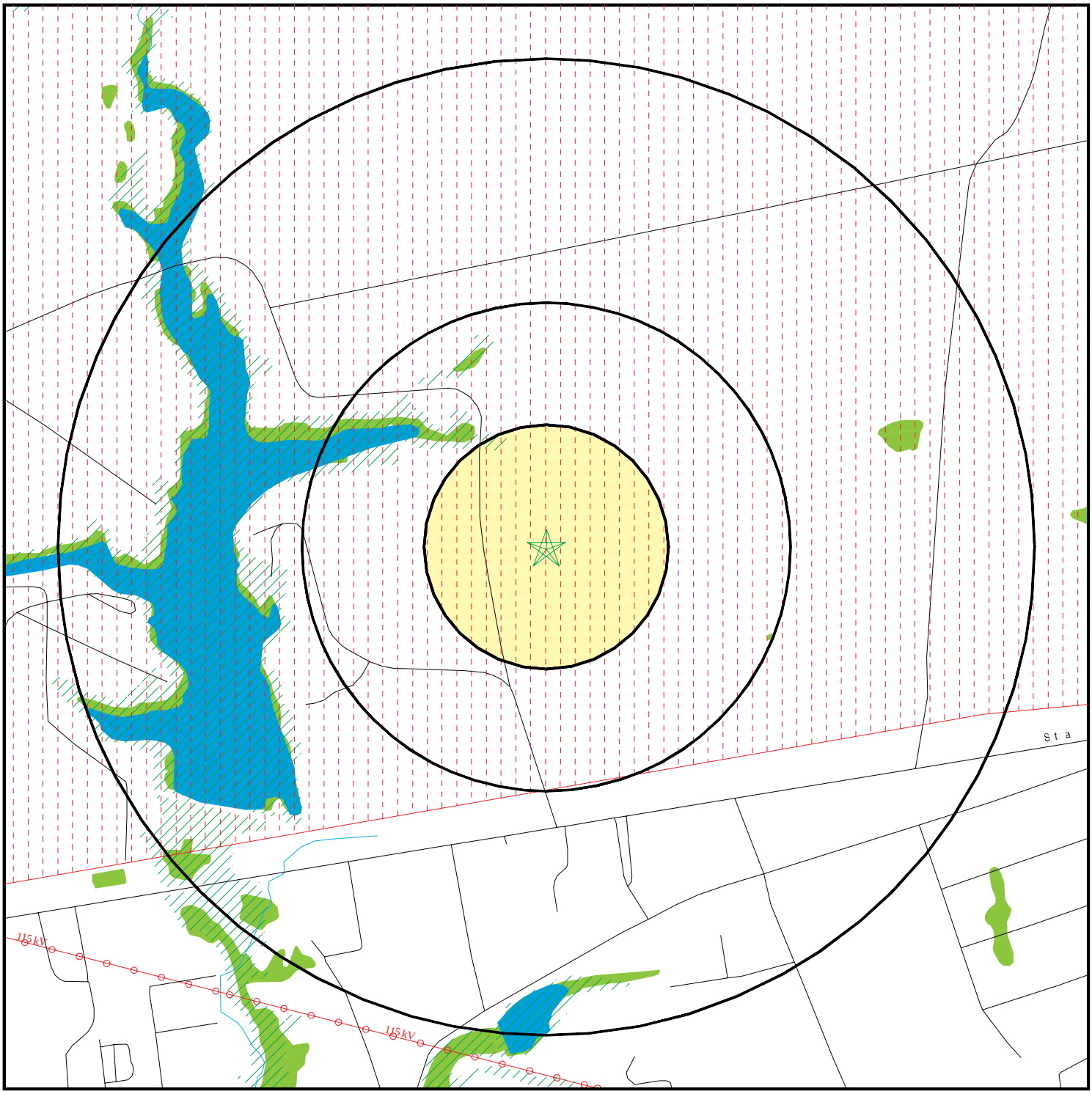
Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
FORT JACKSON		0 - 1/8 (0.000 mi.)	0	7

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped. Count: 13 records.

Site Name	Database(s)
UNDEVELOPED PROPERTY ADJACENT TO A	SHWS, BROWNFIELDS
NEWELL RUBBERMAID	CERC-NFRAP, RCRA-NonGen, FINDS, SHWS
DIAMONT BOART AMERICA	SHWS
PONTIAC PRECISION BOMBING RANGE (A	CERCLIS, FINDS
VCC-GLOBE	CERCLIS
GASLO 745	GWCI, LUST, UST
YOUNGS 24	GWCI, LUST, UST
GULF SERVICE STATION 24225	GWCI, LUST, UST
NEW CHINA RESTAURANT	GWCI, LUST, UST
JACKSONS	UST
SC SCHOOL BUS DEPOT	UST
SC DHEC MAINTENANCE	UST
COOPER TOOLS	VCP

OVERVIEW MAP - 3248581.2s



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Power transmission lines
- Oil & Gas pipelines from USGS
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Range Complex	CLIENT: The Military Dept., State of SC
ADDRESS: 2563 ESSAYONS WAY Columbia SC 29223	CONTACT: Brittanie Young
LAT/LONG: 34.0068 / 80.8193	INQUIRY #: 3248581.2s DATE: January 30, 2012 12:51 pm

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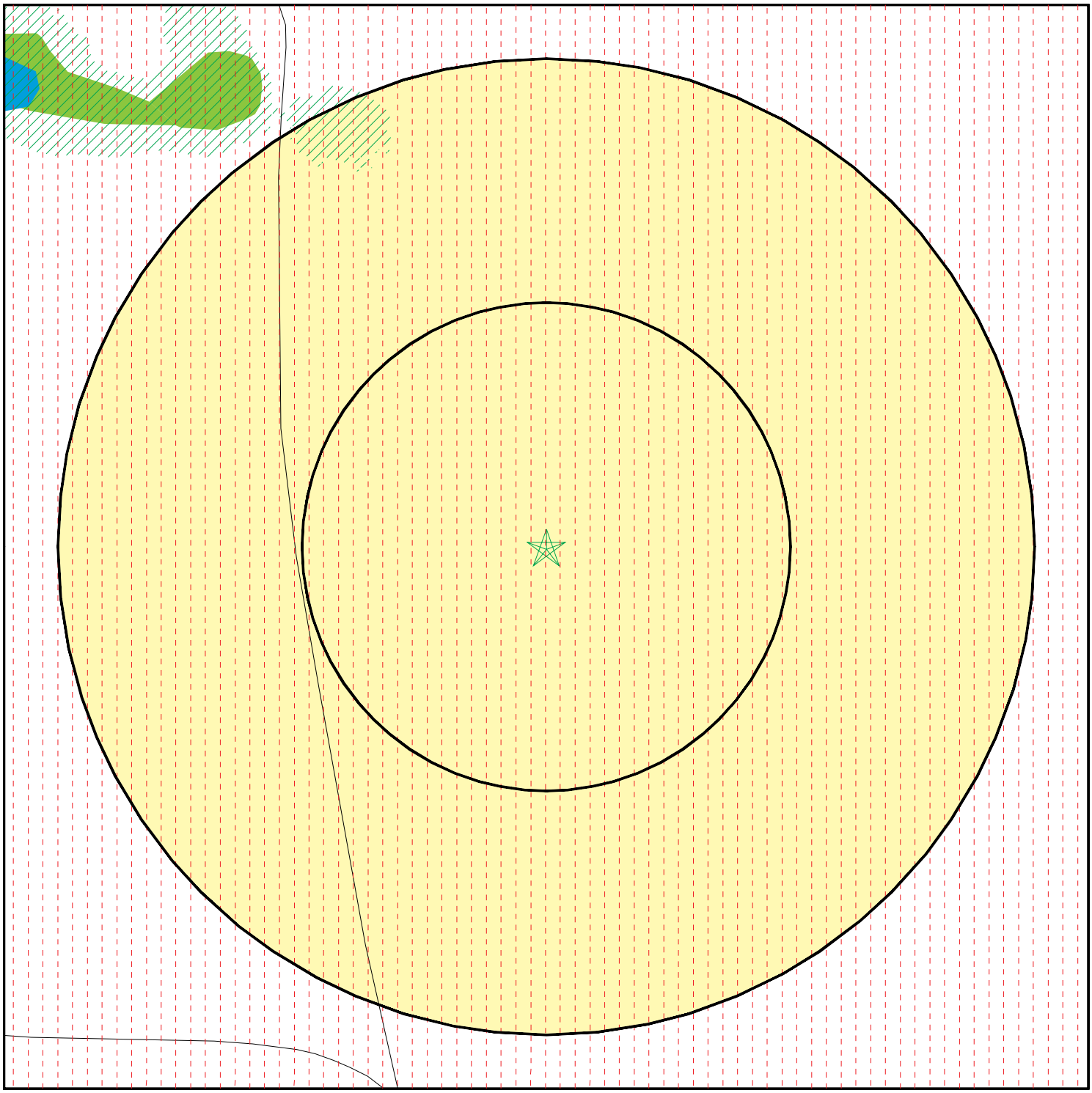
DETAIL MAP - 3248581.2s



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines from USGS
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands

0 1/16 1/8 1/4 Miles

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Range Complex	CLIENT: The Military Dept., State of SC
ADDRESS: 2563 ESSAYONS WAY Columbia SC 29223	CONTACT: Brittanie Young
LAT/LONG: 34.0068 / 80.8193	INQUIRY #: 3248581.2s DATE: January 30, 2012 12:52 pm

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MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
Federal NPL site list								
NPL		1.000	0	0	0	0	NR	0
Proposed NPL		1.000	0	0	0	0	NR	0
NPL LIENS		TP	NR	NR	NR	NR	NR	0
Federal Delisted NPL site list								
Delisted NPL		1.000	0	0	0	0	NR	0
Federal CERCLIS list								
CERCLIS		0.500	0	0	0	NR	NR	0
FEDERAL FACILITY		1.000	0	0	0	0	NR	0
Federal CERCLIS NFRAP site List								
CERC-NFRAP		0.500	0	0	0	NR	NR	0
Federal RCRA CORRACTS facilities list								
CORRACTS		1.000	0	0	0	0	NR	0
Federal RCRA non-CORRACTS TSD facilities list								
RCRA-TSDF		0.500	0	0	0	NR	NR	0
Federal RCRA generators list								
RCRA-LQG		0.250	0	0	NR	NR	NR	0
RCRA-SQG		0.250	0	0	NR	NR	NR	0
RCRA-CESQG		0.250	0	0	NR	NR	NR	0
Federal institutional controls / engineering controls registries								
US ENG CONTROLS		0.500	0	0	0	NR	NR	0
US INST CONTROL		0.500	0	0	0	NR	NR	0
Federal ERNS list								
ERNS		TP	NR	NR	NR	NR	NR	0
State- and tribal - equivalent CERCLIS								
SHWS		1.000	0	0	0	0	NR	0
State and tribal landfill and/or solid waste disposal site lists								
SWF/LF		0.500	0	0	0	NR	NR	0
State and tribal leaking storage tank lists								
LUST		0.500	0	0	0	NR	NR	0
INDIAN LUST		0.500	0	0	0	NR	NR	0
State and tribal registered storage tank lists								
UST		0.250	0	0	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
AST		0.250	0	0	NR	NR	NR	0
INDIAN UST		0.250	0	0	NR	NR	NR	0
FEMA UST		0.250	0	0	NR	NR	NR	0
State and tribal institutional control / engineering control registries								
RCR		0.500	0	0	0	NR	NR	0
State and tribal voluntary cleanup sites								
VCP		0.500	0	0	0	NR	NR	0
INDIAN VCP		0.500	0	0	0	NR	NR	0
State and tribal Brownfields sites								
BROWNFIELDS		0.500	0	0	0	NR	NR	0
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS		0.500	0	0	0	NR	NR	0
Local Lists of Landfill / Solid Waste Disposal Sites								
ODI		0.500	0	0	0	NR	NR	0
DEBRIS REGION 9		0.500	0	0	0	NR	NR	0
SWRCY		0.500	0	0	0	NR	NR	0
INDIAN ODI		0.500	0	0	0	NR	NR	0
Local Lists of Hazardous waste / Contaminated Sites								
US CDL		TP	NR	NR	NR	NR	NR	0
ALLSITES		0.500	0	0	0	NR	NR	0
CDL		TP	NR	NR	NR	NR	NR	0
US HIST CDL		TP	NR	NR	NR	NR	NR	0
Local Land Records								
LIENS 2		TP	NR	NR	NR	NR	NR	0
LUCIS		0.500	0	0	0	NR	NR	0
Records of Emergency Release Reports								
HMIRS		TP	NR	NR	NR	NR	NR	0
SPILLS		TP	NR	NR	NR	NR	NR	0
Other Ascertainable Records								
RCRA-NonGen		0.250	0	0	NR	NR	NR	0
DOT OPS		TP	NR	NR	NR	NR	NR	0
DOD		1.000	1	0	0	0	NR	1
FUDS		1.000	0	0	0	0	NR	0
CONSENT		1.000	0	0	0	0	NR	0
ROD		1.000	0	0	0	0	NR	0
UMTRA		0.500	0	0	0	NR	NR	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
MINES		0.250	0	0	NR	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0
TSCA		TP	NR	NR	NR	NR	NR	0
FTTS		TP	NR	NR	NR	NR	NR	0
HIST FTTS		TP	NR	NR	NR	NR	NR	0
SSTS		TP	NR	NR	NR	NR	NR	0
ICIS		TP	NR	NR	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
RADINFO		TP	NR	NR	NR	NR	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
GWCI		0.500	0	0	0	NR	NR	0
UIC		TP	NR	NR	NR	NR	NR	0
DRYCLEANERS		0.250	0	0	NR	NR	NR	0
NPDES		TP	NR	NR	NR	NR	NR	0
AIRS		TP	NR	NR	NR	NR	NR	0
INDIAN RESERV		1.000	0	0	0	0	NR	0
SCRD DRYCLEANERS		0.500	0	0	0	NR	NR	0
COAL ASH EPA		0.500	0	0	0	NR	NR	0
PCB TRANSFORMER		TP	NR	NR	NR	NR	NR	0
COAL ASH		0.500	0	0	0	NR	NR	0
FINANCIAL ASSURANCE		TP	NR	NR	NR	NR	NR	0
COAL ASH DOE		TP	NR	NR	NR	NR	NR	0
EDR PROPRIETARY RECORDS								
EDR Proprietary Records								
Manufactured Gas Plants		1.000	0	0	0	0	NR	0

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

DOD **FORT JACKSON** **DOD** **CUSA143184**
Region **N/A**

FORT JACKSON (County), SC

< 1/8
1 ft.

DOD:
Feature 1: Army DOD
Feature 2: Not reported
Feature 3: Not reported
URL: Not reported
Name 1: Fort Jackson
Name 2: Not reported
Name 3: Not reported
State: SC
DOD Site: Yes
Tile name: SCRICHLAND

Count: 13 records. ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
COLUMBIA	U003522673	JACKSONS	RT 1		UST
COLUMBIA	U003525028	SC SCHOOL BUS DEPOT	RT 5 N		UST
COLUMBIA	1006426222	PONTIAC PRECISION BOMBING RANGE (A	COLUMBIA ARMY AIR BASE		CERCLIS, FINDS
COLUMBIA	1011961451	VCC-GLOBE	NE CORNER OF CATAWBA & GADSDEN		CERCLIS
COLUMBIA	U001539668	GASLO 745	2500 4 DECKER RD		GWCI, LUST, UST
COLUMBIA	1000156169	NEWELL RUBBERMAID	10700 FARROW RD		CERC-NFRAP, RCRA-NonGen, FINDS SHWS
COLUMBIA	S108953995	UNDEVELOPED PROPERTY ADJACENT TO A	INT OF LEANING TREE RD	29223	SHWS, BROWNFIELDS
COLUMBIA	S108953990	DIAMONT BOART AMERICA	2 NOTCH RD	29223	SHWS
COLUMBIA	U000483446	YOUNGS 24	PINESTRAW LN		GWCI, LUST, UST
COLUMBIA	U003970326	GULF SERVICE STATION 24225	PINEY GROVE RD & I 26		GWCI, LUST, UST
COLUMBIA	U004017557	NEW CHINA RESTAURANT	3530 RIVER DR AT SUNSET BLVD		GWCI, LUST, UST
COLUMBIA	U003524893	SC DHEC MAINTENANCE	STATE PARK		UST
COLUMBIA	S105528032	COOPER TOOLS	USHY 1 NEARINTERSECTIONOF & S		VCP

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Number of Days to Update: Provides confirmation that EDR is reporting records that have been updated within 90 days from the date the government agency made the information available to the public.

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL: National Priority List

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 06/30/2011
Date Data Arrived at EDR: 07/12/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 79

Source: EPA
Telephone: N/A
Last EDR Contact: 01/11/2012
Next Scheduled EDR Contact: 04/23/2012
Data Release Frequency: Quarterly

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 6
Telephone: 214-655-6659

EPA Region 3
Telephone 215-814-5418

EPA Region 7
Telephone: 913-551-7247

EPA Region 4
Telephone 404-562-8033

EPA Region 8
Telephone: 303-312-6774

EPA Region 5
Telephone 312-886-6686

EPA Region 9
Telephone: 415-947-4246

EPA Region 10
Telephone 206-553-8665

Proposed NPL: Proposed National Priority List Sites

A site that has been proposed for listing on the National Priorities List through the issuance of a proposed rule in the Federal Register. EPA then accepts public comments on the site, responds to the comments, and places on the NPL those sites that continue to meet the requirements for listing.

Date of Government Version: 06/30/2011
Date Data Arrived at EDR: 07/12/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 79

Source: EPA
Telephone: N/A
Last EDR Contact: 01/11/2012
Next Scheduled EDR Contact: 04/23/2012
Data Release Frequency: Quarterly

NPL LIENS: Federal Superfund Liens

Federal Superfund Liens. Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/1991
Date Data Arrived at EDR: 02/02/1994
Date Made Active in Reports: 03/30/1994
Number of Days to Update: 56

Source: EPA
Telephone: 202-564-4267
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: No Update Planned

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Federal Delisted NPL site list

DELISTED NPL: National Priority List Deletions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 06/30/2011
Date Data Arrived at EDR: 07/12/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 79

Source: EPA
Telephone: N/A
Last EDR Contact: 01/10/2012
Next Scheduled EDR Contact: 04/23/2012
Data Release Frequency: Quarterly

Federal CERCLIS list

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System

CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 02/25/2011
Date Data Arrived at EDR: 03/01/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 62

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 11/29/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Quarterly

FEDERAL FACILITY: Federal Facility Site Information listing

A listing of National Priority List (NPL) and Base Realignment and Closure (BRAC) sites found in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Database where EPA Federal Facilities Restoration and Reuse Office is involved in cleanup activities.

Date of Government Version: 12/10/2010
Date Data Arrived at EDR: 01/11/2011
Date Made Active in Reports: 02/16/2011
Number of Days to Update: 36

Source: Environmental Protection Agency
Telephone: 703-603-8704
Last EDR Contact: 01/13/2012
Next Scheduled EDR Contact: 04/23/2012
Data Release Frequency: Varies

Federal CERCLIS NFRAP site List

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned

Archived sites are sites that have been removed and archived from the inventory of CERCLIS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list this site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. This decision does not necessarily mean that there is no hazard associated with a given site; it only means that, based upon available information, the location is not judged to be a potential NPL site.

Date of Government Version: 02/25/2011
Date Data Arrived at EDR: 03/01/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 62

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 11/29/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Quarterly

Federal RCRA CORRACTS facilities list

CORRACTS: Corrective Action Report

CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 08/19/2011
Date Data Arrived at EDR: 08/31/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 132

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 11/14/2011
Next Scheduled EDR Contact: 02/27/2012
Data Release Frequency: Quarterly

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF: RCRA - Treatment, Storage and Disposal

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Transporters are individuals or entities that move hazardous waste from the generator offsite to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (404) 562-8651
Last EDR Contact: 01/05/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Quarterly

Federal RCRA generators list

RCRA-LQG: RCRA - Large Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (404) 562-8651
Last EDR Contact: 01/05/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Quarterly

RCRA-SQG: RCRA - Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (404) 562-8651
Last EDR Contact: 01/05/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Quarterly

RCRA-CESQG: RCRA - Conditionally Exempt Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (404) 562-8651
Last EDR Contact: 01/05/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Varies

Federal institutional controls / engineering controls registries

US ENG CONTROLS: Engineering Controls Sites List

A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 12/30/2011
Date Data Arrived at EDR: 12/30/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 11

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 12/09/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Varies

US INST CONTROL: Sites with Institutional Controls

A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 12/30/2011
Date Data Arrived at EDR: 12/30/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 11

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 12/09/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Varies

Federal ERNS list

ERNS: Emergency Response Notification System

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 10/03/2011
Date Data Arrived at EDR: 10/04/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 38

Source: National Response Center, United States Coast Guard
Telephone: 202-267-2180
Last EDR Contact: 01/18/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Annually

State- and tribal - equivalent CERCLIS

SHWS: Site Assessment Section Project List

State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

Date of Government Version: 10/06/2011
Date Data Arrived at EDR: 10/11/2011
Date Made Active in Reports: 10/31/2011
Number of Days to Update: 20

Source: Department of Health and Environmental Control
Telephone: 803-734-5376
Last EDR Contact: 12/19/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Annually

State and tribal landfill and/or solid waste disposal site lists

SWF/LF: Permitted Landfills List

Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 10/06/2011
Date Data Arrived at EDR: 10/06/2011
Date Made Active in Reports: 10/31/2011
Number of Days to Update: 25

Source: Department of Health and Environmental Control
Telephone: 803-734-5165
Source: Department of Health and Environmental Control, GIS Section
Telephone: 803-896-4084
Last EDR Contact: 12/19/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Varies

State and tribal leaking storage tank lists

LUST: Leaking Underground Storage Tank List

Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 08/31/2011
Date Data Arrived at EDR: 08/31/2011
Date Made Active in Reports: 10/07/2011
Number of Days to Update: 37

Source: Department of Health and Environmental Control
Telephone: 803-898-4350
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

INDIAN LUST R8: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.

Date of Government Version: 08/18/2011
Date Data Arrived at EDR: 08/19/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 25

Source: EPA Region 8
Telephone: 303-312-6271
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

INDIAN LUST R7: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Iowa, Kansas, and Nebraska

Date of Government Version: 11/01/2011
Date Data Arrived at EDR: 11/21/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 50

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 10/31/2011
Next Scheduled EDR Contact: 02/13/2012
Data Release Frequency: Varies

INDIAN LUST R6: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in New Mexico and Oklahoma.

Date of Government Version: 09/12/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 59

Source: EPA Region 6
Telephone: 214-665-6597
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Varies

INDIAN LUST R1: Leaking Underground Storage Tanks on Indian Land

A listing of leaking underground storage tank locations on Indian Land.

Date of Government Version: 10/01/2011
Date Data Arrived at EDR: 11/01/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 10

Source: EPA Region 1
Telephone: 617-918-1313
Last EDR Contact: 11/01/2011
Next Scheduled EDR Contact: 02/13/2012
Data Release Frequency: Varies

INDIAN LUST R10: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 11/02/2011
Date Data Arrived at EDR: 11/04/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 7
Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

INDIAN LUST R4: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Florida, Mississippi and North Carolina.

Date of Government Version: 12/14/2011
Date Data Arrived at EDR: 12/15/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 26
Source: EPA Region 4
Telephone: 404-562-8677
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Semi-Annually

INDIAN LUST R9: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 12/05/2011
Date Data Arrived at EDR: 12/07/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 34
Source: Environmental Protection Agency
Telephone: 415-972-3372
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

State and tribal registered storage tank lists

UST: Comprehensive Underground Storage Tanks
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 08/31/2011
Date Data Arrived at EDR: 08/31/2011
Date Made Active in Reports: 10/06/2011
Number of Days to Update: 36
Source: Department of Health and Environmental Control
Telephone: 803-896-7957
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

AST: Aboveground Storage Tank List
Registered Aboveground Storage Tanks.

Date of Government Version: 03/25/2004
Date Data Arrived at EDR: 08/04/2004
Date Made Active in Reports: 09/23/2004
Number of Days to Update: 50
Source: Department of Health and Environmental Control
Telephone: 803-898-4350
Last EDR Contact: 12/05/2011
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Varies

INDIAN UST R8: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming and 27 Tribal Nations).

Date of Government Version: 08/18/2011
Date Data Arrived at EDR: 08/19/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 25
Source: EPA Region 8
Telephone: 303-312-6137
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

INDIAN UST R7: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 7 (Iowa, Kansas, Missouri, Nebraska, and 9 Tribal Nations).

Date of Government Version: 11/01/2011
Date Data Arrived at EDR: 11/21/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 50

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 10/31/2011
Next Scheduled EDR Contact: 02/13/2012
Data Release Frequency: Varies

INDIAN UST R5: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 5 (Michigan, Minnesota and Wisconsin and Tribal Nations).

Date of Government Version: 07/01/2011
Date Data Arrived at EDR: 08/26/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 18

Source: EPA Region 5
Telephone: 312-886-6136
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Varies

INDIAN UST R6: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 6 (Louisiana, Arkansas, Oklahoma, New Mexico, Texas and 65 Tribes).

Date of Government Version: 05/10/2011
Date Data Arrived at EDR: 05/11/2011
Date Made Active in Reports: 06/14/2011
Number of Days to Update: 34

Source: EPA Region 6
Telephone: 214-665-7591
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Semi-Annually

INDIAN UST R4: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Tribal Nations)

Date of Government Version: 12/14/2011
Date Data Arrived at EDR: 12/15/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 26

Source: EPA Region 4
Telephone: 404-562-9424
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Semi-Annually

INDIAN UST R10: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 10 (Alaska, Idaho, Oregon, Washington, and Tribal Nations).

Date of Government Version: 11/02/2011
Date Data Arrived at EDR: 11/04/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 7

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

INDIAN UST R9: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 9 (Arizona, California, Hawaii, Nevada, the Pacific Islands, and Tribal Nations).

Date of Government Version: 11/28/2011
Date Data Arrived at EDR: 11/29/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 42

Source: EPA Region 9
Telephone: 415-972-3368
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Quarterly

INDIAN UST R1: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and ten Tribal Nations).

Date of Government Version: 10/01/2011
Date Data Arrived at EDR: 11/01/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 10

Source: EPA, Region 1
Telephone: 617-918-1313
Last EDR Contact: 10/31/2011
Next Scheduled EDR Contact: 02/13/2012
Data Release Frequency: Varies

FEMA UST: Underground Storage Tank Listing
A listing of all FEMA owned underground storage tanks.

Date of Government Version: 01/01/2010
Date Data Arrived at EDR: 02/16/2010
Date Made Active in Reports: 04/12/2010
Number of Days to Update: 55

Source: FEMA
Telephone: 202-646-5797
Last EDR Contact: 01/16/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: Varies

State and tribal institutional control / engineering control registries

RCR: Registry of Conditional Remedies
The Bureau of Land and Waste Management established this Registry to help monitor and maintain sites that have conditional remedies. A Conditional Remedy is an environmental remedy that includes certain qualifications. These qualifications are divided into two major categories: Remedies requiring Land Use Controls and Conditional No Further Actions.

Date of Government Version: 12/20/2011
Date Data Arrived at EDR: 12/21/2011
Date Made Active in Reports: 01/30/2012
Number of Days to Update: 40

Source: Department of Health & Environmental Control
Telephone: 803-896-4000
Last EDR Contact: 12/21/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Varies

State and tribal voluntary cleanup sites

VCP: Voluntary Cleanup Sites
Sites participating in the Voluntary Cleanup Program. Once staff and a non-responsible party have agreed upon an approved scope of work for a site investigation and/or remediation, the party enters into a voluntary cleanup contract. Staff oversees the cleanup efforts to ensure that activities are performed to our satisfaction. Upon completion of the negotiated work in the voluntary cleanup contract, the non-responsible party receives State Superfund liability protection.

Date of Government Version: 12/20/2011
Date Data Arrived at EDR: 12/21/2011
Date Made Active in Reports: 01/30/2012
Number of Days to Update: 40

Source: Department of Health and Environmental Control
Telephone: 803-896-4049
Last EDR Contact: 12/21/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Varies

INDIAN VCP R7: Voluntary Cleanup Priority Lisitng
A listing of voluntary cleanup priority sites located on Indian Land located in Region 7.

Date of Government Version: 03/20/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27

Source: EPA, Region 7
Telephone: 913-551-7365
Last EDR Contact: 04/20/2009
Next Scheduled EDR Contact: 07/20/2009
Data Release Frequency: Varies

INDIAN VCP R1: Voluntary Cleanup Priority Listing
A listing of voluntary cleanup priority sites located on Indian Land located in Region 1.

Date of Government Version: 08/04/2011
Date Data Arrived at EDR: 10/04/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 38

Source: EPA, Region 1
Telephone: 617-918-1102
Last EDR Contact: 01/06/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Varies

State and tribal Brownfields sites

BROWNFIELDS: Brownfields Sites Listing
The Brownfields component of the Voluntary Cleanup Program allows a non-responsible party to acquire a contaminated property with State Superfund liability protection for existing contamination by agreeing to perform an environmental assessment and/or remediation.

Date of Government Version: 10/24/2011
Date Data Arrived at EDR: 10/26/2011
Date Made Active in Reports: 10/31/2011
Number of Days to Update: 5
Source: Department of Health & Environmental Control
Telephone: 803-896-4069
Last EDR Contact: 01/03/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Varies

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS: A Listing of Brownfields Sites
Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. Assessment, Cleanup and Redevelopment Exchange System (ACRES) stores information reported by EPA Brownfields grant recipients on brownfields properties assessed or cleaned up with grant funding as well as information on Targeted Brownfields Assessments performed by EPA Regions. A listing of ACRES Brownfield sites is obtained from Cleanups in My Community. Cleanups in My Community provides information on Brownfields properties for which information is reported back to EPA, as well as areas served by Brownfields grant programs.

Date of Government Version: 06/27/2011
Date Data Arrived at EDR: 06/27/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 78
Source: Environmental Protection Agency
Telephone: 202-566-2777
Last EDR Contact: 12/27/2011
Next Scheduled EDR Contact: 04/09/2012
Data Release Frequency: Semi-Annually

Local Lists of Landfill / Solid Waste Disposal Sites

ODI: Open Dump Inventory
An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/1985
Date Data Arrived at EDR: 08/09/2004
Date Made Active in Reports: 09/17/2004
Number of Days to Update: 39
Source: Environmental Protection Agency
Telephone: 800-424-9346
Last EDR Contact: 06/09/2004
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

DEBRIS REGION 9: Torres Martinez Reservation Illegal Dump Site Locations
A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California.

Date of Government Version: 01/12/2009
Date Data Arrived at EDR: 05/07/2009
Date Made Active in Reports: 09/21/2009
Number of Days to Update: 137
Source: EPA, Region 9
Telephone: 415-947-4219
Last EDR Contact: 12/21/2011
Next Scheduled EDR Contact: 04/09/2012
Data Release Frequency: No Update Planned

SWRCY: Solid Waste Recycling Facilities
A listing of recycling center locations.

Date of Government Version: 11/16/2009
Date Data Arrived at EDR: 12/23/2009
Date Made Active in Reports: 01/27/2010
Number of Days to Update: 35
Source: Department of Health & Enviornmental Control
Telephone: 803-896-8985
Last EDR Contact: 12/07/2011
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Varies

INDIAN ODI: Report on the Status of Open Dumps on Indian Lands
Location of open dumps on Indian land.

Date of Government Version: 12/31/1998
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 01/24/2008
Number of Days to Update: 52
Source: Environmental Protection Agency
Telephone: 703-308-8245
Last EDR Contact: 11/07/2011
Next Scheduled EDR Contact: 02/20/2012
Data Release Frequency: Varies

Local Lists of Hazardous waste / Contaminated Sites

US CDL: Clandestine Drug Labs
A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 10/07/2011
Date Data Arrived at EDR: 12/09/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 32
Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 12/05/2011
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Quarterly

ALLSITES: Site Assessment & Remediation Public Record Database
The South Carolina Department of Health and Environmental Control is pleased to have the Public Record for your review. The purpose of this database is two-fold. First, it will provide to communities another form of notice of cleanup activity, allowing them to have more information about assessment and cleanup activities in their area and in the State. Second, it can assist those seeking to redevelop brownfield properties within South Carolina.

Date of Government Version: 11/16/2011
Date Data Arrived at EDR: 11/17/2011
Date Made Active in Reports: 12/21/2011
Number of Days to Update: 34
Source: Department of Health & Environmental Control
Telephone: 803-896-4000
Last EDR Contact: 12/27/2011
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Quarterly

CDL: Clandestine Drug Lab Sites
A listing of clandestine drug lab site locations.

Date of Government Version: 11/21/2011
Date Data Arrived at EDR: 01/03/2012
Date Made Active in Reports: 01/09/2012
Number of Days to Update: 6
Source: Department of Health & Environmental Control
Telephone: 803-896-4288
Last EDR Contact: 01/23/2012
Next Scheduled EDR Contact: 05/07/2012
Data Release Frequency: Varies

US HIST CDL: National Clandestine Laboratory Register
A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 09/01/2007
Date Data Arrived at EDR: 11/19/2008
Date Made Active in Reports: 03/30/2009
Number of Days to Update: 131
Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 03/23/2009
Next Scheduled EDR Contact: 06/22/2009
Data Release Frequency: No Update Planned

Local Land Records

LIENS 2: CERCLA Lien Information

A Federal CERCLA ('Superfund') lien can exist by operation of law at any site or property at which EPA has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties.

Date of Government Version: 09/09/2011
Date Data Arrived at EDR: 09/16/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 13

Source: Environmental Protection Agency
Telephone: 202-564-6023
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Varies

LUCIS: Land Use Control Information System

LUCIS contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.

Date of Government Version: 12/09/2005
Date Data Arrived at EDR: 12/11/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 31

Source: Department of the Navy
Telephone: 843-820-7326
Last EDR Contact: 11/22/2011
Next Scheduled EDR Contact: 03/05/2012
Data Release Frequency: Varies

Records of Emergency Release Reports

HMIRS: Hazardous Materials Information Reporting System

Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 10/04/2011
Date Data Arrived at EDR: 10/04/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 38

Source: U.S. Department of Transportation
Telephone: 202-366-4555
Last EDR Contact: 01/03/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Annually

SPILLS: Spill List

Spills and releases of petroleum and hazardous chemicals reported to the Oil & Chemical Emergency Response division.

Date of Government Version: 09/27/2011
Date Data Arrived at EDR: 09/28/2011
Date Made Active in Reports: 10/07/2011
Number of Days to Update: 9

Source: Department of Health and Environmental Control
Telephone: 803-898-4111
Last EDR Contact: 12/05/2011
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Varies

Other Ascertainable Records

RCRA-NonGen: RCRA - Non Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (404) 562-8651
Last EDR Contact: 01/05/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Varies

DOT OPS: Incident and Accident Data

Department of Transporation, Office of Pipeline Safety Incident and Accident data.

Date of Government Version: 07/29/2011
Date Data Arrived at EDR: 08/09/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 94

Source: Department of Transporation, Office of Pipeline Safety
Telephone: 202-366-4595
Last EDR Contact: 11/08/2011
Next Scheduled EDR Contact: 02/20/2012
Data Release Frequency: Varies

DOD: Department of Defense Sites

This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 11/10/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 62

Source: USGS
Telephone: 888-275-8747
Last EDR Contact: 01/20/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: Semi-Annually

FUDS: Formerly Used Defense Sites

The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 08/12/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 112

Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
Last EDR Contact: 12/09/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Varies

CONSENT: Superfund (CERCLA) Consent Decrees

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 09/01/2011
Date Data Arrived at EDR: 11/18/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 53

Source: Department of Justice, Consent Decree Library
Telephone: Varies
Last EDR Contact: 12/27/2011
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Varies

ROD: Records Of Decision

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 09/28/2011
Date Data Arrived at EDR: 12/14/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 27

Source: EPA
Telephone: 703-416-0223
Last EDR Contact: 12/14/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Annually

UMTRA: Uranium Mill Tailings Sites

Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.

Date of Government Version: 09/14/2010
Date Data Arrived at EDR: 10/21/2010
Date Made Active in Reports: 01/28/2011
Number of Days to Update: 99

Source: Department of Energy
Telephone: 505-845-0011
Last EDR Contact: 11/29/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Varies

MINES: Mines Master Index File

Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 08/18/2011
Date Data Arrived at EDR: 09/08/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 21

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Last EDR Contact: 12/07/2011
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Semi-Annually

TRIS: Toxic Chemical Release Inventory System

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 09/01/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 131

Source: EPA
Telephone: 202-566-0250
Last EDR Contact: 12/02/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Annually

TSCA: Toxic Substances Control Act

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/2006
Date Data Arrived at EDR: 09/29/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 64

Source: EPA
Telephone: 202-260-5521
Last EDR Contact: 12/27/2011
Next Scheduled EDR Contact: 04/09/2012
Data Release Frequency: Every 4 Years

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
Last EDR Contact: 11/28/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Quarterly

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

A listing of FIFRA/TSCA Tracking System (FTTS) inspections and enforcements.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA
Telephone: 202-566-1667
Last EDR Contact: 11/28/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Quarterly

HIST FTTS: FIFRA/TSCA Tracking System Administrative Case Listing

A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2007
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

HIST FTTS INSP: FIFRA/TSCA Tracking System Inspection & Enforcement Case Listing

A complete inspection and enforcement case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40
Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2008
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

SSTS: Section 7 Tracking Systems

Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 12/10/2010
Date Made Active in Reports: 02/25/2011
Number of Days to Update: 77
Source: EPA
Telephone: 202-564-4203
Last EDR Contact: 01/30/2012
Next Scheduled EDR Contact: 05/14/2012
Data Release Frequency: Annually

ICIS: Integrated Compliance Information System

The Integrated Compliance Information System (ICIS) supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.

Date of Government Version: 07/20/2011
Date Data Arrived at EDR: 11/10/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 61
Source: Environmental Protection Agency
Telephone: 202-564-5088
Last EDR Contact: 12/21/2011
Next Scheduled EDR Contact: 04/09/2012
Data Release Frequency: Quarterly

PADS: PCB Activity Database System

PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 11/01/2010
Date Data Arrived at EDR: 11/10/2010
Date Made Active in Reports: 02/16/2011
Number of Days to Update: 98
Source: EPA
Telephone: 202-566-0500
Last EDR Contact: 01/20/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: Annually

MLTS: Material Licensing Tracking System

MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 06/21/2011
Date Data Arrived at EDR: 07/15/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 60
Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
Last EDR Contact: 12/12/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Quarterly

RADINFO: Radiation Information Database

The Radiation Information Database (RADINFO) contains information about facilities that are regulated by U.S. Environmental Protection Agency (EPA) regulations for radiation and radioactivity.

Date of Government Version: 01/11/2011
Date Data Arrived at EDR: 01/13/2011
Date Made Active in Reports: 02/16/2011
Number of Days to Update: 34

Source: Environmental Protection Agency
Telephone: 202-343-9775
Last EDR Contact: 01/12/2012
Next Scheduled EDR Contact: 04/23/2012
Data Release Frequency: Quarterly

FINDS: Facility Index System/Facility Registry System

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 08/02/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 119

Source: EPA
Telephone: (404) 562-9900
Last EDR Contact: 12/13/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Quarterly

RAATS: RCRA Administrative Action Tracking System

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/1995
Date Data Arrived at EDR: 07/03/1995
Date Made Active in Reports: 08/07/1995
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4104
Last EDR Contact: 06/02/2008
Next Scheduled EDR Contact: 09/01/2008
Data Release Frequency: No Update Planned

BRS: Biennial Reporting System

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 03/01/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 62

Source: EPA/NTIS
Telephone: 800-424-9346
Last EDR Contact: 11/30/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Biennially

GWCI: Groundwater Contamination Inventory

An inventory of all groundwater contamination cases in the state.

Date of Government Version: 07/01/2008
Date Data Arrived at EDR: 11/06/2008
Date Made Active in Reports: 11/19/2008
Number of Days to Update: 13

Source: Department of Health and Environmental Control
Telephone: 803-898-3798
Last EDR Contact: 01/03/2012
Next Scheduled EDR Contact: 04/16/2012
Data Release Frequency: Annually

UIC: Underground Injection Wells Listing

A listing of underground injection wells locations.

Date of Government Version: 11/29/2011
Date Data Arrived at EDR: 11/30/2011
Date Made Active in Reports: 12/21/2011
Number of Days to Update: 21

Source: Department of Health & Environmental Control
Telephone: 803-898-3799
Last EDR Contact: 11/28/2011
Next Scheduled EDR Contact: 02/27/2012
Data Release Frequency: Varies

DRYCLEANERS: Drycleaner Database

The Drycleaning Facility Restoration Trust Fund database is used to access, prioritze and cleanup contaminated registered drycleaning sites.

Date of Government Version: 12/01/2010
Date Data Arrived at EDR: 02/11/2011
Date Made Active in Reports: 03/15/2011
Number of Days to Update: 32

Source: Department of Health & Environmental Control
Telephone: 803-898-3882
Last EDR Contact: 11/11/2011
Next Scheduled EDR Contact: 02/20/2012
Data Release Frequency: Varies

NPDES: Waste Water Treatment Facilities Listing

A listing of waste water treatment facility locations.

Date of Government Version: 01/03/2012
Date Data Arrived at EDR: 01/05/2012
Date Made Active in Reports: 01/30/2012
Number of Days to Update: 25

Source: Department of Health & Environmental Control
Telephone: 803-898-4300
Last EDR Contact: 12/23/2011
Next Scheduled EDR Contact: 04/09/2012
Data Release Frequency: Varies

AIRS: Permiited Airs Facility Listing

A listing of permitted airs facilities.

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 04/15/2011
Date Made Active in Reports: 05/26/2011
Number of Days to Update: 41

Source: Department of Health & Environmental Control
Telephone: 803-898-4279
Last EDR Contact: 12/05/2011
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Varies

INDIAN RESERV: Indian Reservations

This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 12/08/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 34

Source: USGS
Telephone: 202-208-3710
Last EDR Contact: 01/20/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: Semi-Annually

SCRD DRYCLEANERS: State Coalition for Remediation of Drycleaners Listing

The State Coalition for Remediation of Drycleaners was established in 1998, with support from the U.S. EPA Office of Superfund Remediation and Technology Innovation. It is comprised of representatives of states with established drycleaner remediation programs. Currently the member states are Alabama, Connecticut, Florida, Illinois, Kansas, Minnesota, Missouri, North Carolina, Oregon, South Carolina, Tennessee, Texas, and Wisconsin.

Date of Government Version: 03/07/2011
Date Data Arrived at EDR: 03/09/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 54

Source: Environmental Protection Agency
Telephone: 615-532-8599
Last EDR Contact: 01/23/2012
Next Scheduled EDR Contact: 05/07/2012
Data Release Frequency: Varies

COAL ASH: Coal Ash Disposal Sites

A listing of sites with coal ash ponds.

Date of Government Version: 07/31/2009
Date Data Arrived at EDR: 08/07/2009
Date Made Active in Reports: 08/17/2009
Number of Days to Update: 10

Source: Department of Health & Environmental Control
Telephone: 803-898-3964
Last EDR Contact: 12/23/2011
Next Scheduled EDR Contact: 04/09/2012
Data Release Frequency: Varies

FINANCIAL ASSURANCE 3: Financial Assurance Information Listing
UST financial assurance information.

Date of Government Version: 05/25/2011
Date Data Arrived at EDR: 05/27/2011
Date Made Active in Reports: 06/30/2011
Number of Days to Update: 34
Source: Department of Health & Environmental Control
Telephone: 803-898-3880
Last EDR Contact: 01/26/2012
Next Scheduled EDR Contact: 03/19/2012
Data Release Frequency: Varies

FINANCIAL ASSURANCE 2: Financial Assurance Information Listing
Hazardous waste financial assurance information.

Date of Government Version: 09/01/2011
Date Data Arrived at EDR: 09/01/2011
Date Made Active in Reports: 10/07/2011
Number of Days to Update: 36
Source: Department of Health & Environmental Control
Telephone: 803-898-3880
Last EDR Contact: 12/19/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Varies

FEDLAND: Federal and Indian Lands
Federally and Indian administrated lands of the United States. Lands included are administrated by: Army Corps of Engineers, Bureau of Reclamation, National Wild and Scenic River, National Wildlife Refuge, Public Domain Land, Wilderness, Wilderness Study Area, Wildlife Management Area, Bureau of Indian Affairs, Bureau of Land Management, Department of Justice, Forest Service, Fish and Wildlife Service, National Park Service.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 02/06/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 339
Source: U.S. Geological Survey
Telephone: 888-275-8747
Last EDR Contact: 01/20/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: N/A

COAL ASH DOE: Sleam-Electric Plan Operation Data
A listing of power plants that store ash in surface ponds.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 08/07/2009
Date Made Active in Reports: 10/22/2009
Number of Days to Update: 76
Source: Department of Energy
Telephone: 202-586-8719
Last EDR Contact: 01/18/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: Varies

PCB TRANSFORMER: PCB Transformer Registration Database
The database of PCB transformer registrations that includes all PCB registration submittals.

Date of Government Version: 02/01/2011
Date Data Arrived at EDR: 10/19/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 83
Source: Environmental Protection Agency
Telephone: 202-566-0517
Last EDR Contact: 11/04/2011
Next Scheduled EDR Contact: 02/13/2012
Data Release Frequency: Varies

COAL ASH EPA: Coal Combustion Residues Surface Impoundments List
A listing of coal combustion residues surface impoundments with high hazard potential ratings.

Date of Government Version: 08/17/2010
Date Data Arrived at EDR: 01/03/2011
Date Made Active in Reports: 03/21/2011
Number of Days to Update: 77
Source: Environmental Protection Agency
Telephone: N/A
Last EDR Contact: 12/08/2011
Next Scheduled EDR Contact: 03/26/2012
Data Release Frequency: Varies

FINANCIAL ASSURANCE: Financial Assurance Information Listing
Financial assurance information for aolid waste facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

Date of Government Version: 09/21/2011
Date Data Arrived at EDR: 09/22/2011
Date Made Active in Reports: 10/07/2011
Number of Days to Update: 15

Source: Department of Health & Environmental Control
Telephone: 803-896-4067
Last EDR Contact: 12/19/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Quarterly

EDR PROPRIETARY RECORDS

EDR Proprietary Records

Manufactured Gas Plants: EDR Proprietary Manufactured Gas Plants

The EDR Proprietary Manufactured Gas Plant Database includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the United States from the 1800's to 1950's to produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

CT MANIFEST: Hazardous Waste Manifest Data

Facility and manifest data. Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a tsd facility.

Date of Government Version: 11/21/2011
Date Data Arrived at EDR: 11/22/2011
Date Made Active in Reports: 12/22/2011
Number of Days to Update: 30

Source: Department of Environmental Protection
Telephone: 860-424-3375
Last EDR Contact: 11/22/2011
Next Scheduled EDR Contact: 03/05/2012
Data Release Frequency: Annually

NJ MANIFEST: Manifest Information

Hazardous waste manifest information.

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 07/20/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 22

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 01/20/2012
Next Scheduled EDR Contact: 04/30/2012
Data Release Frequency: Annually

NY MANIFEST: Facility and Manifest Data

Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a TSD facility.

Date of Government Version: 11/01/2011
Date Data Arrived at EDR: 11/08/2011
Date Made Active in Reports: 12/22/2011
Number of Days to Update: 44

Source: Department of Environmental Conservation
Telephone: 518-402-8651
Last EDR Contact: 11/08/2011
Next Scheduled EDR Contact: 02/20/2012
Data Release Frequency: Annually

PA MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2008
Date Data Arrived at EDR: 12/01/2009
Date Made Active in Reports: 12/14/2009
Number of Days to Update: 13

Source: Department of Environmental Protection
Telephone: 717-783-8990
Last EDR Contact: 01/23/2012
Next Scheduled EDR Contact: 05/07/2012
Data Release Frequency: Annually

RI MANIFEST: Manifest information
Hazardous waste manifest information

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 06/24/2011
Date Made Active in Reports: 06/30/2011
Number of Days to Update: 6

Source: Department of Environmental Management
Telephone: 401-222-2797
Last EDR Contact: 11/28/2011
Next Scheduled EDR Contact: 03/12/2012
Data Release Frequency: Annually

WI MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 08/19/2011
Date Made Active in Reports: 09/15/2011
Number of Days to Update: 27

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 12/19/2011
Next Scheduled EDR Contact: 04/02/2012
Data Release Frequency: Annually

Oil/Gas Pipelines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines.

Electric Power Transmission Line Data
Source: Rextag Strategies Corp.
Telephone: (281) 769-2247
U.S. Electric Transmission and Power Plants Systems Digital GIS Data

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Child Day Care List
Source: Department of Social Services
Telephone: 803-898-7345

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 2003 & 2011 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 and 2005 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Wetlands Inventory
Source: Department of Natural Resources
Telephone: 803-734-9494

Scanned Digital USGS 7.5' Topographic Map (DRG)
Source: United States Geologic Survey
A digital raster graphic (DRG) is a scanned image of a U.S. Geological Survey topographic map. The map images are made by scanning published paper maps on high-resolution scanners. The raster image is georeferenced and fit to the Universal Transverse Mercator (UTM) projection.

STREET AND ADDRESS INFORMATION

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GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

RANGE COMPLEX
2563 ESSAYONS WAY
COLUMBIA, SC 29223

TARGET PROPERTY COORDINATES

Latitude (North):	34.0068 - 34° 0' 24.48''
Longitude (West):	80.8193 - 80° 49' 9.48''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	516686.3
UTM Y (Meters):	3762730.2
Elevation:	340 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property Map:	34080-A7 MESSERS POND, SC
Most Recent Revision:	1972
South Map:	33080-H7 CONGAREE, SC
Most Recent Revision:	1987

EDR's GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principal investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

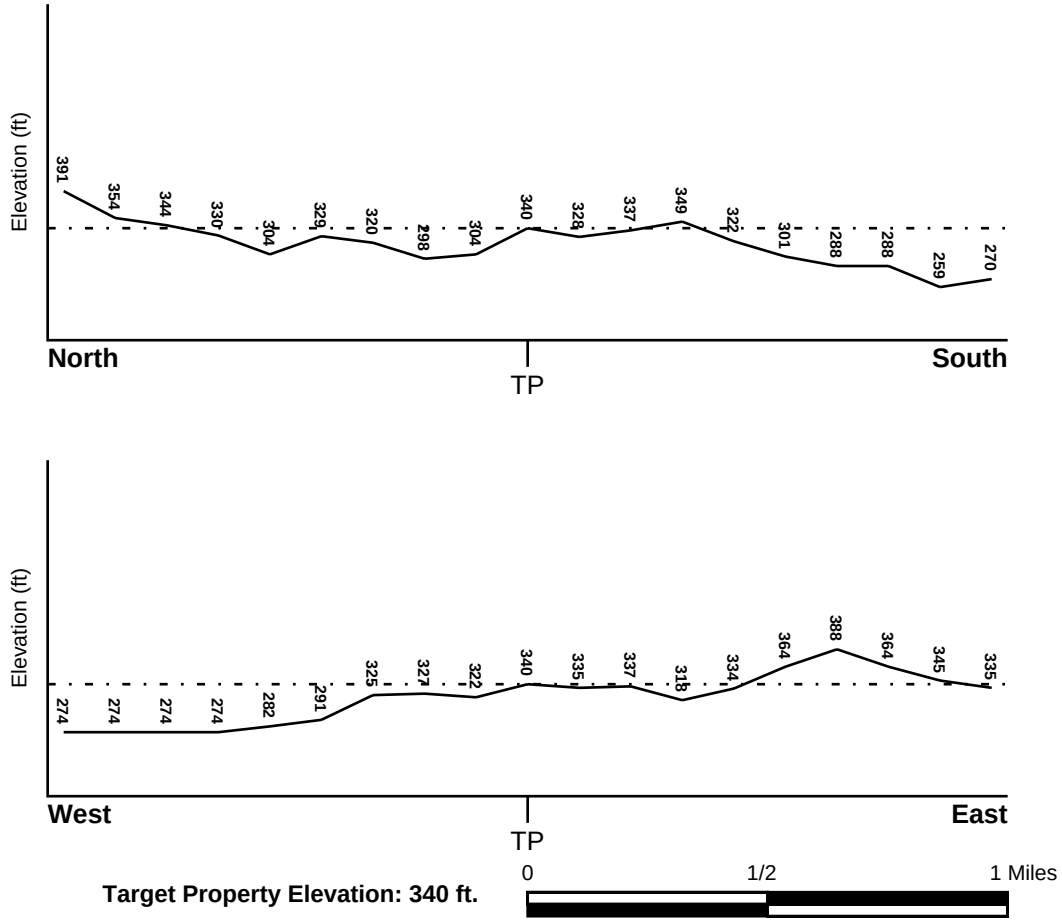
TOPOGRAPHIC INFORMATION

Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General North

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES



Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Target Property County	FEMA Flood Electronic Data
RICHLAND, SC	YES - refer to the Overview Map and Detail Map

Flood Plain Panel at Target Property: 45079C - FEMA DFIRM Flood data

Additional Panels in search area: Not Reported

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
MESSERS POND	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

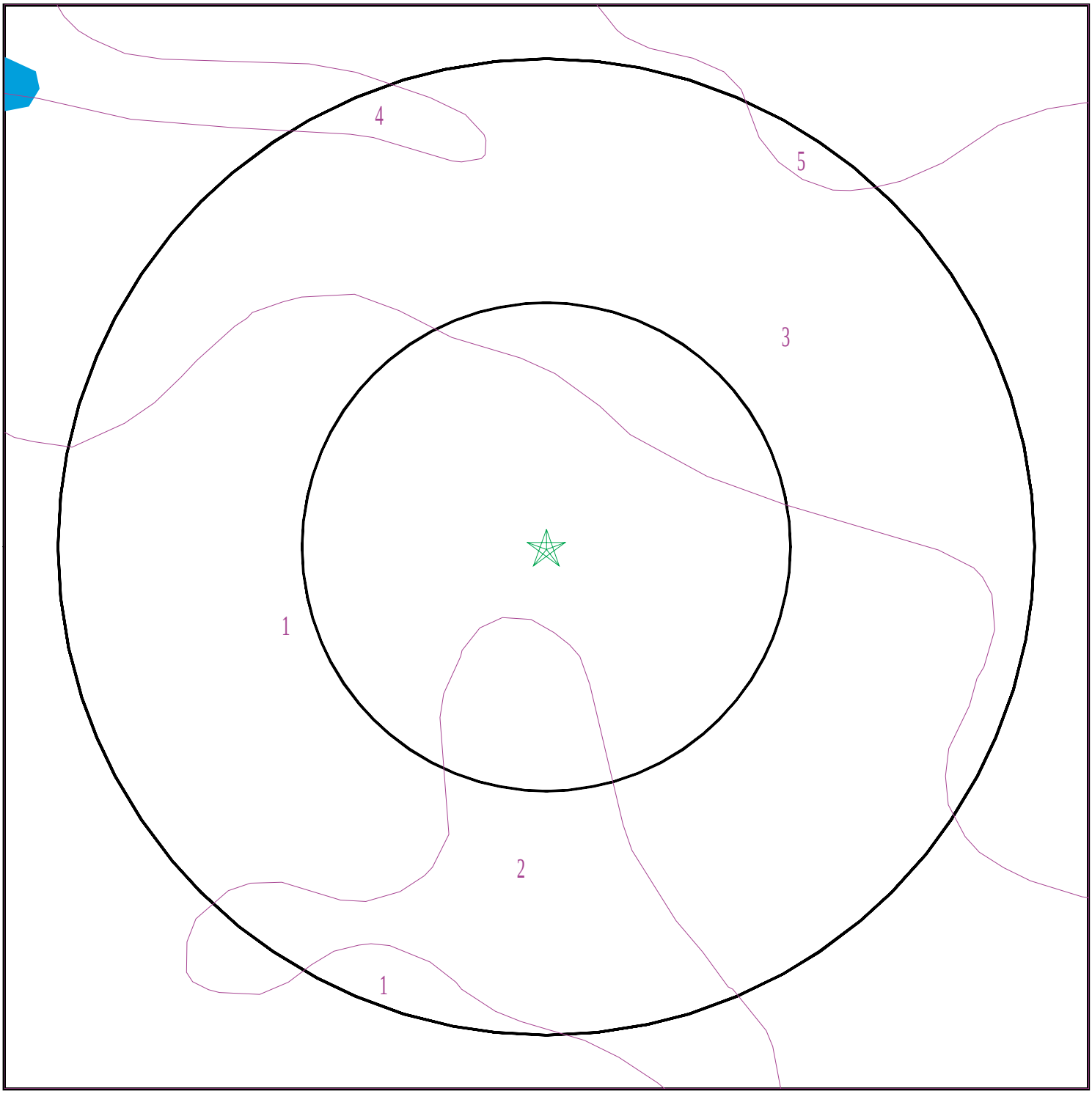
Era:	Mesozoic
System:	Cretaceous
Series:	Woodbine and Tuscaloosa Groups
Code:	uK1 *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Stratified Sequence

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

SSURGO SOIL MAP - 3248581.2s



Target Property
SSURGO Soil
Water

0 1/16 1/8 1/4 Miles

N

SITE NAME:	Range Complex	CLIENT:	The Military Dept., State of SC
ADDRESS:	2563 ESSAYONS WAY Columbia SC 29223	CONTACT:	Brittanie Young
LAT/LONG:	34.0068 / 80.8193	INQUIRY #:	3248581.2s
		DATE:	January 30, 2012 12:52 pm

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GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. The following information is based on Soil Conservation Service SSURGO data.

Soil Map ID: 1

Soil Component Name: Lakeland

Soil Surface Texture: sand

Hydrologic Group: Class A - High infiltration rates. Soils are deep, well drained to excessively drained sands and gravels.

Soil Drainage Class: Excessively drained

Hydric Status: Not hydric

Corrosion Potential - Uncoated Steel: Low

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 0 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	29 inches	sand	Not reported	Not reported	Max: 141 Min: 42	Max: 6 Min: 4.5
2	29 inches	98 inches	sand	Not reported	Not reported	Max: 141 Min: 42	Max: 6 Min: 4.5

Soil Map ID: 2

Soil Component Name: Blanton

Soil Surface Texture: sand

Hydrologic Group: Class A - High infiltration rates. Soils are deep, well drained to excessively drained sands and gravels.

Soil Drainage Class: Moderately well drained

Hydric Status: Not hydric

Corrosion Potential - Uncoated Steel: High

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 122 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	9 inches	sand	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 14 Min: 4	Max: 5.5 Min: 4.5
2	9 inches	50 inches	sand	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 14 Min: 4	Max: 5.5 Min: 4.5
3	50 inches	96 inches	sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 14 Min: 4	Max: 5.5 Min: 4.5

Soil Map ID: 3

Soil Component Name: Ailey

Soil Surface Texture: loamy sand

Hydrologic Group: Class B - Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils with moderately coarse textures.

Soil Drainage Class: Well drained

Hydric Status: Not hydric

Corrosion Potential - Uncoated Steel: Moderate

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 0 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	5 inches	loamy sand	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 1.4 Min: 0.42	Max: 5.5 Min: 4.5
2	29 inches	37 inches	sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 1.4 Min: 0.42	Max: 5.5 Min: 4.5
3	5 inches	29 inches	loamy sand	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 1.4 Min: 0.42	Max: 5.5 Min: 4.5
4	37 inches	68 inches	sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 1.4 Min: 0.42	Max: 5.5 Min: 4.5
5	68 inches	81 inches	sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Clayey sand.	Max: 1.4 Min: 0.42	Max: 5.5 Min: 4.5

Soil Map ID: 4

Soil Component Name: Johnston

Soil Surface Texture: loam

Hydrologic Group: Class D - Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.

Soil Drainage Class: Very poorly drained

Hydric Status: All hydric

Corrosion Potential - Uncoated Steel: High

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 0 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	9 inches	loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), silt.	Max: 42 Min: 14	Max: 5.5 Min: 4.5
2	37 inches	66 inches	stratified sandy loam to fine sandy loam to sandy clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), silt.	Max: 42 Min: 14	Max: 5.5 Min: 4.5
3	9 inches	37 inches	mucky loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), silt.	Max: 42 Min: 14	Max: 5.5 Min: 4.5

Soil Map ID: 5

Soil Component Name: Lakeland

Soil Surface Texture: sand

Hydrologic Group: Class A - High infiltration rates. Soils are deep, well drained to excessively drained sands and gravels.

Soil Drainage Class: Excessively drained

Hydric Status: Not hydric

Corrosion Potential - Uncoated Steel: Low

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 0 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	29 inches	sand	Not reported	Not reported	Max: 141 Min: 42	Max: 6 Min: 4.5
2	29 inches	98 inches	sand	Not reported	Not reported	Max: 141 Min: 42	Max: 6 Min: 4.5

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile
State Database	1.000

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
5	SC4060001	1/2 - 1 Mile SSE

Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

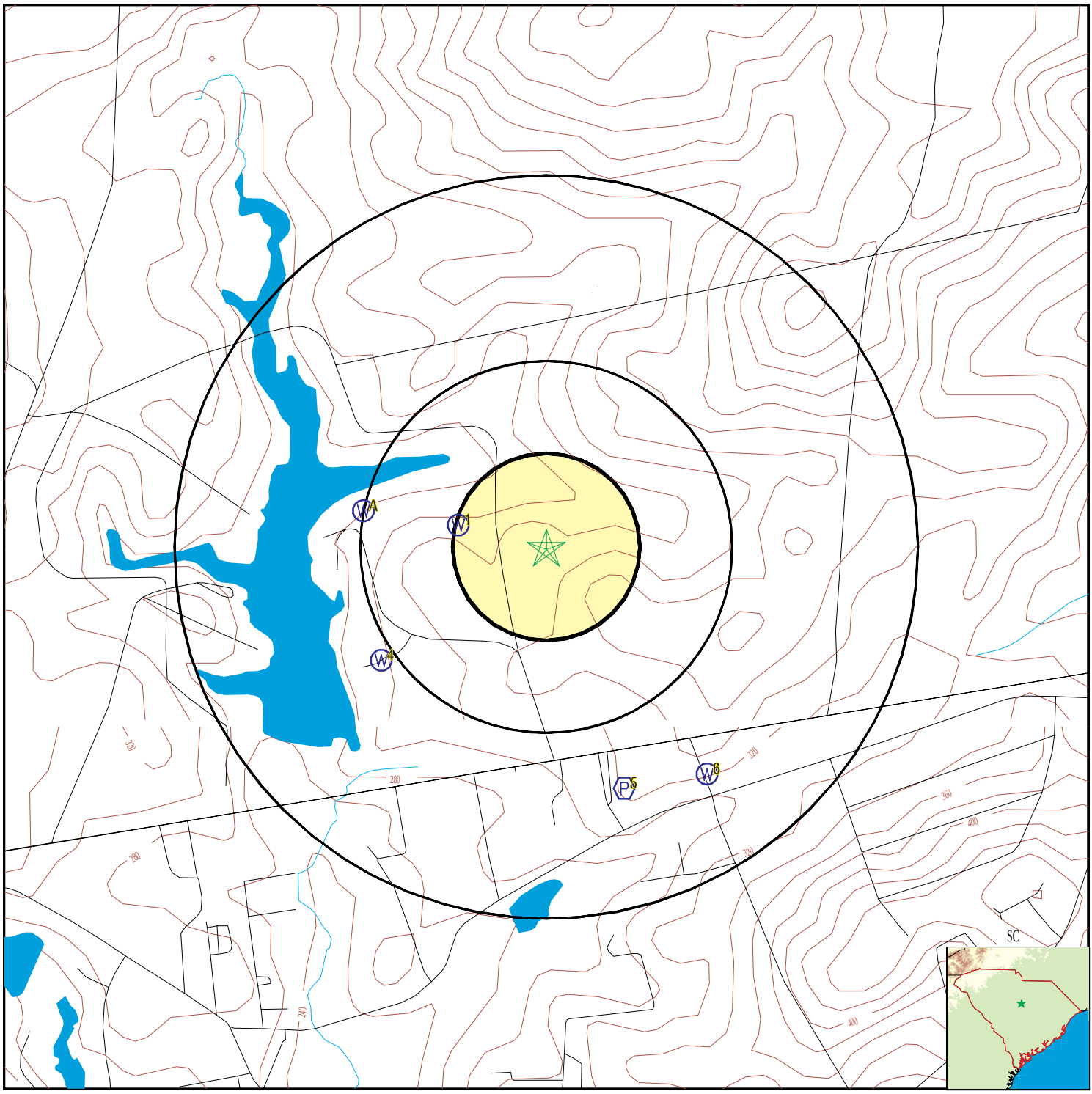
MAP ID	WELL ID	LOCATION FROM TP
1	SCWC30000010540	1/8 - 1/4 Mile WNW
A2	SCWC30000010552	1/4 - 1/2 Mile WNW
A3	SCWC30000010541	1/2 - 1 Mile West

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

STATE DATABASE WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
4	SCWC30000010488	1/2 - 1 Mile SW
6	SCWC30000010430	1/2 - 1 Mile SE

PHYSICAL SETTING SOURCE MAP - 3248581.2s



- County Boundary
- Major Roads
- Contour Lines
- Earthquake epicenter, Richter 5 or greater
- Water Wells
- Public Water Supply Wells
- Cluster of Multiple Icons
- Groundwater Flow Direction
- GI Indeterminate Groundwater Flow at Location
- GV Groundwater Flow Varies at Location

SITE NAME:	Range Complex	CLIENT:	The Military Dept., State of SC
ADDRESS:	2563 ESSAYONS WAY Columbia SC 29223	CONTACT:	Brittanie Young
		INQUIRY #:	3248581.2s
LAT/LONG:	34.0068 / 80.8193	DATE:	January 30, 2012 12:52 pm

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GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

Map ID
Direction
Distance
Elevation

	Database	EDR ID Number
1 **WNW** **1/8 - 1/4 Mile** **Lower**	**SC WELLS**	**SCWC30000010540**

Conum:	RIC-417	Scgrid:	28O-y3
Latn:	340027		
Longn:	804925		
Utm e:	516288		
Utm n:	3762807		
Topo:	Messers Pond		
Elev:	305		
Owner:	U. S. Army	Owner well:	Weston Lake, well 3
Location:	Fort Jackson	Use:	Public Supply
Depth d:	175		
Depth c:	172		
Diam 1:	8		
Diam 2:	Not Reported	Oh cas:	Not Reported
Screen t:	160		
Screen b:	172		
Drill yr:	1962	Drill mo:	7
Yield:	100		
Yield yr:	Not Reported	G logs:	Not Reported
D logs:	1		
P test:	0		
Chem:	C	Wl:	100
Wl yr:	1962	Driller:	Heater Well Co.
Site id:	SCWC30000010540		

	Database	EDR ID Number
A2 **WNW** **1/4 - 1/2 Mile** **Lower**	**SC WELLS**	**SCWC30000010552**

Conum:	RIC-305	Scgrid:	28O-y2
Latn:	340030		
Longn:	804939		
Utm e:	515929		
Utm n:	3762899		
Topo:	Messers Pond		
Elev:	300		
Owner:	U. S. Army	Owner well:	Well 2 (Boathouse)
Location:	Fort Jackson, Weston Lake	Use:	Public Supply
Depth d:	0		
Depth c:	310		
Diam 1:	6		
Diam 2:	Not Reported	Oh cas:	Not Reported
Screen t:	296		
Screen b:	306		
Drill yr:	1972	Drill mo:	2
Yield:	40		
Yield yr:	1972	G logs:	Not Reported
D logs:	1		
P test:	0		

Chem:	C	Wl:	34
Wl yr:	1983	Driller:	Not Reported
Remarks:	Bedrock at 306 feet. USGS NAWQA well.		
Site id:	SCWC30000010552		

A3
West
1/2 - 1 Mile
Lower

SC WELLS **SCWC30000010541**

Conum:	RIC-523	Scgrid:	28O-y4
Latn:	340028		
Longn:	804943		
Utm e:	515826		
Utm n:	3762837		
Topo:	Messers Pond		
Elev:	280		
Owner:	U. S. Army	Owner well:	Not Reported
Location:	Fort Jackson, Weston Lake	Use:	Public Supply
Depth d:	308		
Depth c:	300		
Diam 1:	12		
Diam 2:	6	Oh cas:	Not Reported
Screen t:	265		
Screen b:	295		
Drill yr:	1988	Drill mo:	1
Yield:	40		
Yield yr:	1988	G logs:	E, G, C
D logs:	1		
P test:	0		
Chem:	Not Reported	Wl:	58
Wl yr:	1988	Driller:	McNeill
Site id:	SCWC30000010541		

4
SW
1/2 - 1 Mile
Lower

SC WELLS **SCWC30000010488**

Conum:	RIC-304	Scgrid:	28O-y1
Latn:	340008		
Longn:	804938		
Utm e:	515956		
Utm n:	3762221		
Topo:	Messers Pond		
Elev:	300		
Owner:	U. S. Army	Owner well:	Well 1 (Bathhouse)
Location:	Fort Jackson, Weston Lake	Use:	Public Supply
Depth d:	0		
Depth c:	345		
Diam 1:	6		
Diam 2:	Not Reported	Oh cas:	294
Screen t:	0		
Screen b:	0		
Drill yr:	1972	Drill mo:	3
Yield:	20		
Yield yr:	1972	G logs:	G
D logs:	0		
P test:	0		

Chem:	Not Reported	Wl:	64
Wl yr:	1983	Driller:	Heater Well Co.
Site id:	SCWC30000010488		

5
SSE **FRDS PWS** **SC4060001**
1/2 - 1 Mile
Lower

PWS ID:	SC4060001		
Date Initiated:	Not Reported	Date Deactivated:	Not Reported
PWS Name:	CRESTHAVEN MHP STEVEN NIXON 590 MAIN STREET WEST COLUMBIA, SC 29170		
Addressee / Facility:	Distribution Facility DOBBINS BROWN C/O MANAGER 590 MAIN STREET WEST COLUMBIA, SC 29170		
Facility Latitude:	33 59 50.0000	Facility Longitude:	80 48 57.0000
City Served:	Not Reported		
Treatment Class:	Untreated	Population:	58

PWS currently has or had major violation(s) or enforcement: YES

VIOLATIONS INFORMATION:

Violation ID:	9425997	Source ID:	Not Reported	PWS Phone:	Not Reported
Vio. beginning Date:	07/01/93	Vio. end Date:	12/31/93	Vio. Period:	006 Months
Num required Samples:	Not Reported	Number of Samples Taken:		Not Reported	
Analysis Result:	Not Reported	Maximum Contaminant Level:		Not Reported	
Analysis Method:	Not Reported				
Violation Type:	Initial Tap Sampling for Pb and Cu				
Contaminant:	LEAD & COPPER RULE				
Vio. Awareness Date:	Not Reported				

ENFORCEMENT INFORMATION:

Truedate:	03/31/2009	Pwsid:	SC4060001
Pwsname:	CRESTHAVEN MHP (4060001)		
Retpopsrvd:	37	Pwstypecod:	C
Vioid:	3881400	Contaminant:	COLIFORM (TCR)
Viol. Type:	Monitoring, Repeat Minor (TCR)		
Complperbe:	1/1/2000 0:00:00		
Complperen:	1/31/2000 0:00:00	Enfdate:	3/16/2000 0:00:00
Enf action:	State Public Notif Received		
Violmeasur:	Not Reported		

Truedate:	03/31/2009	Pwsid:	SC4060001
Pwsname:	CRESTHAVEN MHP (4060001)		
Retpopsrvd:	37	Pwstypecod:	C
Vioid:	3881400	Contaminant:	COLIFORM (TCR)
Viol. Type:	Monitoring, Repeat Minor (TCR)		
Complperbe:	1/1/2000 0:00:00		
Complperen:	1/31/2000 0:00:00	Enfdate:	2/28/2000 0:00:00
Enf action:	State Violation/Reminder Notice		
Violmeasur:	Not Reported		

Truedate:	03/31/2009	Pwsid:	SC4060001
Pwsname:	CRESTHAVEN MHP (4060001)		
Retpopsrvd:	37	Pwstypecod:	C
Vioid:	4845103	Contaminant:	COLIFORM (TCR)
Viol. Type:	Monitoring, Routine Major (TCR)		
Complperbe:	5/1/2003 0:00:00		
Complperen:	5/31/2003 0:00:00	Enfdate:	7/18/2003 0:00:00
Enf action:	State Public Notif Received		
Violmeasur:	Not Reported		

Truedate:	03/31/2009	Pwsid:	SC4060001
Pwsname:	CRESTHAVEN MHP (4060001)		
Retpopsrvd:	37	Pwstypecod:	C
Vioid:	4845103	Contaminant:	COLIFORM (TCR)
Viol. Type:	Monitoring, Routine Major (TCR)		
Complperbe:	5/1/2003 0:00:00		
Complperen:	5/31/2003 0:00:00	Enfdate:	11/1/2003 0:00:00
Enf action:	State Compliance Achieved		
Violmeasur:	Not Reported		

Truedate:	03/31/2009	Pwsid:	SC4060001
Pwsname:	CRESTHAVEN MHP (4060001)		
Retpopsrvd:	37	Pwstypecod:	C
Vioid:	4845103	Contaminant:	COLIFORM (TCR)
Viol. Type:	Monitoring, Routine Major (TCR)		
Complperbe:	5/1/2003 0:00:00		
Complperen:	5/31/2003 0:00:00	Enfdate:	7/9/2003 0:00:00
Enf action:	State Violation/Reminder Notice		
Violmeasur:	Not Reported		

Truedate:	03/31/2009	Pwsid:	SC4060001
Pwsname:	CRESTHAVEN MHP (4060001)		
Retpopsrvd:	37	Pwstypecod:	C
Vioid:	4845205	Contaminant:	COLIFORM (TCR)
Viol. Type:	Monitoring, Routine Major (TCR)		
Complperbe:	6/1/2005 0:00:00		
Complperen:	6/30/2005 0:00:00	Enfdate:	7/21/2005 0:00:00
Enf action:	State Violation/Reminder Notice		
Violmeasur:	Not Reported		

Truedate:	03/31/2009	Pwsid:	SC4060001
Pwsname:	CRESTHAVEN MHP (4060001)		
Retpopsrvd:	37	Pwstypecod:	C
Vioid:	4845205	Contaminant:	COLIFORM (TCR)
Viol. Type:	Monitoring, Routine Major (TCR)		
Complperbe:	6/1/2005 0:00:00		
Complperen:	6/30/2005 0:00:00	Enfdate:	7/21/2005 0:00:00
Enf action:	State Public Notif Requested		
Violmeasur:	Not Reported		

Truedate:	03/31/2009	Pwsid:	SC4060001
Pwsname:	CRESTHAVEN MHP (4060001)		
Retpopsrvd:	37	Pwstypecod:	C
Vioid:	4845205	Contaminant:	COLIFORM (TCR)
Viol. Type:	Monitoring, Routine Major (TCR)		
Complperbe:	6/1/2005 0:00:00		
Complperen:	6/30/2005 0:00:00	Enfdate:	7/23/2007 0:00:00
Enf action:	State Compliance Achieved		
Violmeasur:	Not Reported		

Truedate:	03/31/2009	Pwsid:	SC4060001
Pwsname:	CRESTHAVEN MHP (4060001)		
Retpopsrvd:	37	Pwstypecod:	C
Vioid:	4845205	Contaminant:	COLIFORM (TCR)
Viol. Type:	Monitoring, Routine Major (TCR)		
Complperbe:	6/1/2005 0:00:00		
Complperen:	6/30/2005 0:00:00	Enfdate:	8/3/2005 0:00:00
Enf action:	State Compliance Achieved		
Violmeasur:	Not Reported		

System Name:	CRESTHAVEN MHP		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1999-11-01 - 1999-11-30		
Violation ID:	0038597		
Enforcement Date:	2000-01-19	Enf. Action:	State Public Notif Received

System Name:	CRESTHAVEN MHP		
Violation Type:	Initial Tap Sampling for Pb and Cu		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1994-01-01 - 2015-12-31		
Violation ID:	0038597		
Enforcement Date:	1994-08-26	Enf. Action:	State Violation/Reminder Notice

System Name:	CRESTHAVEN MHP		
Violation Type:	Follow-up and Routine Tap Sampling		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1998-01-01 - 2015-12-31		
Violation ID:	0348451		
Enforcement Date:	1999-06-02	Enf. Action:	State Public Notif Received

System Name:	CRESTHAVEN MHP		
Violation Type:	Follow-up and Routine Tap Sampling		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1/1/1998 0:00:00 - 12/31/2025 0:00:00		
Violation ID:	3758499		
Enforcement Date:	5/7/1999 0:00:00	Enf. Action:	State Violation/Reminder Notice

System Name:	CRESTHAVEN MHP		
Violation Type:	Follow-up and Routine Tap Sampling		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1/1/1998 0:00:00 - 12/31/2025 0:00:00		
Violation ID:	3758499		
Enforcement Date:	6/2/1999 0:00:00	Enf. Action:	State Public Notif Received

System Name:	CRESTHAVEN MHP		
Violation Type:	Monitoring, Repeat Minor (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1/1/2000 0:00:00 - 1/31/2000 0:00:00		
Violation ID:	3881400		
Enforcement Date:	2/28/2000 0:00:00	Enf. Action:	State Violation/Reminder Notice

System Name:	CRESTHAVEN MHP (4060001)		
Violation Type:	Monitoring, Repeat Minor (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1/1/2000 0:00:00 - 1/31/2000 0:00:00		
Violation ID:	3881400		
Enforcement Date:	3/16/2000 0:00:00	Enf. Action:	State Public Notif Received

ENFORCEMENT INFORMATION:

System Name:	CRESTHAVEN MHP (4060001)		
Violation Type:	Monitoring, Repeat Minor (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1/1/2000 0:00:00 - 1/31/2000 0:00:00		
Violation ID:	3881400		
Enforcement Date:	2/28/2000 0:00:00	Enf. Action:	State Violation/Reminder Notice
System Name:	CRESTHAVEN MHP		
Violation Type:	Monitoring, Repeat Minor (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1/1/2000 0:00:00 - 1/31/2000 0:00:00		
Violation ID:	3881400		
Enforcement Date:	3/16/2000 0:00:00	Enf. Action:	State Public Notif Received
System Name:	CRESTHAVEN MHP		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	5/1/2003 0:00:00 - 5/31/2003 0:00:00		
Violation ID:	4845103		
Enforcement Date:	11/1/2003 0:00:00	Enf. Action:	State Compliance Achieved
System Name:	CRESTHAVEN MHP (4060001)		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	5/1/2003 0:00:00 - 5/31/2003 0:00:00		
Violation ID:	4845103		
Enforcement Date:	11/1/2003 0:00:00	Enf. Action:	State Compliance Achieved
System Name:	CRESTHAVEN MHP (4060001)		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	5/1/2003 0:00:00 - 5/31/2003 0:00:00		
Violation ID:	4845103		
Enforcement Date:	7/18/2003 0:00:00	Enf. Action:	State Public Notif Received
System Name:	CRESTHAVEN MHP (4060001)		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	5/1/2003 0:00:00 - 5/31/2003 0:00:00		
Violation ID:	4845103		
Enforcement Date:	7/9/2003 0:00:00	Enf. Action:	State Violation/Reminder Notice
System Name:	CRESTHAVEN MHP		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	5/1/2003 0:00:00 - 5/31/2003 0:00:00		
Violation ID:	4845103		
Enforcement Date:	7/9/2003 0:00:00	Enf. Action:	State Violation/Reminder Notice
System Name:	CRESTHAVEN MHP		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	5/1/2003 0:00:00 - 5/31/2003 0:00:00		
Violation ID:	4845103		
Enforcement Date:	7/18/2003 0:00:00	Enf. Action:	State Public Notif Received
System Name:	CRESTHAVEN MHP (4060001)		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	6/1/2005 0:00:00 - 6/30/2005 0:00:00		
Violation ID:	4845205		
Enforcement Date:	8/3/2005 0:00:00	Enf. Action:	State Compliance Achieved

ENFORCEMENT INFORMATION:

System Name:	CRESTHAVEN MHP (4060001)		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	6/1/2005 0:00:00 - 6/30/2005 0:00:00		
Violation ID:	4845205		
Enforcement Date:	7/21/2005 0:00:00	Enf. Action:	State Public Notif Requested
System Name:	CRESTHAVEN MHP		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	6/1/2005 0:00:00 - 6/30/2005 0:00:00		
Violation ID:	4845205		
Enforcement Date:	8/3/2005 0:00:00	Enf. Action:	State Compliance Achieved
System Name:	CRESTHAVEN MHP		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	6/1/2005 0:00:00 - 6/30/2005 0:00:00		
Violation ID:	4845205		
Enforcement Date:	7/21/2005 0:00:00	Enf. Action:	State Public Notif Requested
System Name:	CRESTHAVEN MHP		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	6/1/2005 0:00:00 - 6/30/2005 0:00:00		
Violation ID:	4845205		
Enforcement Date:	7/21/2005 0:00:00	Enf. Action:	State Violation/Reminder Notice
System Name:	CRESTHAVEN MHP (4060001)		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	6/1/2005 0:00:00 - 6/30/2005 0:00:00		
Violation ID:	4845205		
Enforcement Date:	7/21/2005 0:00:00	Enf. Action:	State Violation/Reminder Notice
System Name:	CRESTHAVEN MHP		
Violation Type:	Initial Tap Sampling for Pb and Cu		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1994-01-01 - 2015-12-31		
Violation ID:	9427961		
Enforcement Date:	1994-08-26	Enf. Action:	State Violation/Reminder Notice
System Name:	CRESTHAVEN MHP		
Violation Type:	Initial Tap Sampling for Pb and Cu		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1994-01-01 - 2015-12-31		
Violation ID:	9427961		
Enforcement Date:	1994-08-26	Enf. Action:	State Violation/Reminder Notice
System Name:	CRESTHAVEN MHP		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1999-11-01 - 1999-11-30		
Violation ID:	9427961		
Enforcement Date:	1999-12-22	Enf. Action:	State Violation/Reminder Notice
System Name:	CRESTHAVEN MHP		
Violation Type:	Initial Tap Sampling for Pb and Cu		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1994-01-01 - 1994-06-30		
Violation ID:	9427961		
Enforcement Date:	1994-08-26	Enf. Action:	State Violation/Reminder Notice

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

ENFORCEMENT INFORMATION:

System Name:	CRESTHAVEN MHP		
Violation Type:	Initial Tap Sampling for Pb and Cu		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1994-01-01 - 2015-12-31		
Violation ID:	9427961		
Enforcement Date:	1994-08-26	Enf. Action:	State Violation/Reminder Notice
System Name:	CRESTHAVEN MHP		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1998-11-01 - 1998-11-30		
Violation ID:	99037379		
Enforcement Date:	1998-12-30	Enf. Action:	State Violation/Reminder Notice
System Name:	CRESTHAVEN MHP		
Violation Type:	Follow-up and Routine Tap Sampling		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1998-01-01 - 2015-12-31		
Violation ID:	9937584		
Enforcement Date:	1999-05-07	Enf. Action:	State Violation/Reminder Notice
System Name:	CRESTHAVEN MHP		
Violation Type:	Follow-up and Routine Tap Sampling		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1998-01-01 - 2015-12-31		
Violation ID:	9937584		
Enforcement Date:	1999-05-07	Enf. Action:	State Violation/Reminder Notice
System Name:	CRESTHAVEN MHP		
Violation Type:	Follow-up and Routine Tap Sampling		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1998-01-01 - 2015-12-31		
Violation ID:	9937584		
Enforcement Date:	1999-06-02	Enf. Action:	State Public Notif Received
System Name:	CRESTHAVEN MHP		
Violation Type:	Follow-up and Routine Tap Sampling		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1998-01-01 - 2015-12-31		
Violation ID:	9937584		
Enforcement Date:	1999-06-02	Enf. Action:	State Public Notif Received
System Name:	CRESTHAVEN MHP		
Violation Type:	Follow-up and Routine Tap Sampling		
Contaminant:	LEAD & COPPER RULE		
Compliance Period:	1998-01-01 - 2015-12-31		
Violation ID:	9937584		
Enforcement Date:	1999-06-02	Enf. Action:	State Public Notif Received

CONTACT INFORMATION:

Name:	CRESTHAVEN MHP (4060001)	Population:	37
Contact:	BOWERS, DONNY	Phone:	Not Reported
Address:	1101 APRICOT RD		
Address 2:	HOPKINS		
	SC, 29 803-7		

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

Map ID
Direction
Distance
Elevation

	Database	EDR ID Number
6 **SE** **1/2 - 1 Mile** **Lower**	**SC WELLS**	**SCWC30000010430**

Conum:	RIC-665	Scgrid:	28P-d2
Latn:	335952		
Longn:	804843		
Utm e:	517367		
Utm n:	3761731		
Topo:	Congaree		
Elev:	350		
Owner:	Christal Gallman	Owner well:	Not Reported
Location:	Elon Ct., Hopkins	Use:	Domestic
Depth d:	117		
Depth c:	117		
Diam 1:	4		
Diam 2:	Not Reported	Oh cas:	Not Reported
Screen t:	97		
Screen b:	117		
Drill yr:	2002	Drill mo:	10
Yield:	12		
Yield yr:	2002	G logs:	Not Reported
D logs:	1		
P test:	0		
Chem:	Not Reported	Wl:	57
Wl yr:	2002	Driller:	Mills
Site id:	SCWC30000010430		

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

State Database: SC Radon

Radon Test Results

Zipcode	Average	Num Tests	Minimum	Maximum	% > 4 pCi/L
29223	0.8	117	0.3	3.5	0.0

Federal EPA Radon Zone for RICHLAND County: 3

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for Zip Code: 29223

Number of sites tested: 9

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	0.389 pCi/L	100%	0%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	1.650 pCi/L	100%	0%	0%

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

Scanned Digital USGS 7.5' Topographic Map (DRG)
Source: United States Geologic Survey
A digital raster graphic (DRG) is a scanned image of a U.S. Geological Survey topographic map. The map images are made by scanning published paper maps on high-resolution scanners. The raster image is georeferenced and fit to the Universal Transverse Mercator (UTM) projection.

HYDROLOGIC INFORMATION

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 2003 & 2011 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 and 2005 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Wetlands Inventory
Source: Department of Natural Resources
Telephone: 803-734-9494

HYDROGEOLOGIC INFORMATION

AQUIFLOW^{R} Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services (NRCS)
Telephone: 800-672-5559
SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Services, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

STATE RECORDS

Water Well Database
Source: Department of Natural Resources
Telephone: 803-734-6440
Water wells in the Coastal Plain counties of South Carolina

Water Well Database
Source: Department of Natural Resources
Telephone: 864-654-1671
A listing of water wells in the Piedmont (upstate) counties.

OTHER STATE DATABASE INFORMATION

RADON

State Database: SC Radon
Source: Department of Health & Environmental Control
Telephone: 864-241-1090
Radon Test Results by Zip Code

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STREET AND ADDRESS INFORMATION

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Appendix D

Interviews

Appendix D

Name: Lahiri Estaba, P.G.	
Title: Environmental Restoration Program (IRP) Manager	**Employer:** Engineering & Environment, Inc. Contractor for the US Army at Fort Jackson
Date: 2/29/12	**Method of Contact:** Personal Interview
Reason for Contact: Questions regarding contamination, past use, and UXO for project 515 Range Development Plan ECOP.	

- Mr. Estaba was asked about contamination in the areas of the proposed ranges, as well as past use and any other potential environmental concerns.
- He indicated the potential presence of UXO in all proposed locations and suggested contacting a range safety officer for more information.
- He was not aware of any contamination in the immediate area of the target locations, only SMU sites located at distances too far away to be of concern

Appendix D

Name: Linda A. Johnson	
Title: Environmental Compliance Tech	**Employer:** SCARNG
Date: 3/1/2012	**Method of Contact:** Personal Interview
Reason for Contact: Questions regarding hazardous materials, petroleum products, and other contamination for project 515 Range Development Plan ECOP.	

- Ms. Johnson was asked about known contamination, response actions, petroleum products, storage tanks, and any other potential contamination in the areas of the proposed ranges.
- She was unaware of any of the previously mentioned concerns, except for the SMUs also mentioned by Mr. Estaba, again too far to cause concern.

Appendix D

Name: Patrick Metts	
Title: NEPA Specialist	**Employer:** Engineering and Environment, Inc. Contractor for the US Army at Fort Jackson
Date: 2/29/2012	**Method of Contact:** Personal Interview
Reason for Contact: Questions concerning project 515 Range Development Plan ECOP.	

- Mr. Metts was asked for any previously completed ECOP documents for existing ranges in the area. He was not aware of any such documents.

Appendix E

Orphan Sites

Appendix E

MPMG, MRF, and 10/25m Zero Range Orphan Sites

Jacksons - RT 1 PO Box 241 A Columbia, SC 29203

This site's exact location could not be found. There are 3 underground storage tanks at this facility. None of which are reported to be leaking, so this site is deemed not to pose a significant threat.

SC School Bus Depot - RT 5 PO Box 13 Hwy 21 N

This site's exact location could not be found, however Hwy 21 is approximately 15 miles from the target site at its closest point. Although there is one underground storage tank on the property, its distance from the target site prevents it from posing a threat.

Pontiac Precision Bombing Range, Columbia Army Air Base

This site is listed as a hazardous waste site due to its past use as a bombing range and the potential for UXOs. A housing development has since been created on this property which is known as Summit Subdivision. It is located in the Sand Hills area, approximately 15 miles from the target site and therefore poses no significant threat.

VCC-GLOBE - NE corner of Catawba & Gadsden

This site is located approximately 15 miles from the target site. It is listed as a hazardous waste site, but its distance from the target site prevents it from posing a significant threat.

GASLO 745 - 2500 4 Decker RD

This site is located on Decker Rd, approximately 13 miles from the target site. There are 3 underground storage tanks on the property, and there have been leaks reported. Due to distance from the target site, this facility is not deemed a significant threat.

Newell Rubbermaid - 10700 Farrow Rd

This site is located on Farrow Rd. approximately 14 miles away from the target site. It is recognized as a hazardous waste site, and has received notices of violations. This facility's distance from the target site prevents it from being a significant threat to the target properties.

Undeveloped Property Adjacent to Intersection of Leaning Tree Rd and Olde Still Rd

This property is located approximately 8 miles from the target site, and is listed as a state hazardous waste site. Its distance from the target site prevents it from posing a significant threat.

Diamont Boart America - Two Notch Rd

This site is located approximately 10 miles from the target site and is listed as a state hazardous waste site. Its distance from the target site prevents it from being a threat.

Youngs 24 – Pinestraw Lane

This site's exact location could not be determined; however Pinestraw Lane is located approximately 25 miles from the target site. There are 2 underground storage tanks at the facility, and leaks have been reported. The site's distance from the target site prevents it from posing a threat to the target properties.

Gulf Service Station 24225 – Piney Grove Rd @ I26

This site is located approximately 20 miles from the target site. The site has 5 underground storage tanks and has reported leaks, but its distance from the target properties prevents it from posing a threat.

New China Restaurant – 3530 River Drive at Sunset Blvd

This site is located approximately 20 miles from the target site. There are 4 underground storage tanks on site and leaks have been reported, but its distance from the target site prevents it from posing a significant threat to the target properties.

SC DHEC Maintenance – PO Box 123 State Park

The exact location of this site could not be determined, but it is approximated at 15 miles from the target site. There is one underground storage tank indicated at this location, but it is not deemed to pose a significant threat to the target properties due to its distance from them.

Cooper Tools – Near Intersection of US 1 and Sparkleberry

This site is located approximately 20 miles from the target site. It is listed in a local unique database. Distance from target properties prevents this site from posing a threat.

Shoothouse Orphan Sites

Jacksons - RT 1 PO Box 241 A Columbia, SC 29203

This site's exact location could not be found. There are 3 underground storage tanks at this facility. None of which are reported to be leaking, so this site is deemed not to pose a significant threat.

SC School Bus Depot - RT 5 PO Box 13 Hwy 21 N

This site's exact location could not be found, however Hwy 21 is approximately 15 miles from the target site at its closest point. Although there is one underground storage tank on the property, its distance from the target site prevents it from posing a threat.

Pontiac Precision Bombing Range, Columbia Army Air Base

This site is listed as a hazardous waste site due to its past use as a bombing range and the potential for UXOs. A housing development has since been created on this property which is

known as Summit Subdivision. It is located in the Sand Hills area, approximately 15 miles from the target site and therefore poses no significant threat.

VCC-GLOBE - NE corner of Catawba & Gadsden

This site is located approximately 15 miles from the target site. It is listed as a hazardous waste site, but its distance from the target site prevents it from posing a significant threat.

GASLO 745 - 2500 4 Decker RD

This site is located on Decker Rd, approximately 13 miles from the target site. There are 3 underground storage tanks on the property, and there have been leaks reported. Due to distance from the target site, this facility is not deemed a significant threat.

Newell Rubbermaid - 10700 Farrow Rd

This site is located on Farrow Rd. approximately 14 miles away from the target site. It is recognized as a hazardous waste site, and has received notices of violations. This facility's distance from the target site prevents it from being a significant threat to the target properties.

Undeveloped Property Adjacent to Intersection of Leaning Tree Rd and Olde Still Rd

This property is located approximately 8 miles from the target site, and is listed as a state hazardous waste site. Its distance from the target site prevents it from posing a significant threat.

Diamont Boart America - Two Notch Rd

This site is located approximately 10 miles from the target site and is listed as a state hazardous waste site. Its distance from the target site prevents it from being a threat.

Youngs 24 – Pinestraw Lane

This site's exact location could not be determined; however Pinestraw Lane is located approximately 25 miles from the target site. There are 2 underground storage tanks at the facility, and leaks have been reported. The site's distance from the target site prevents it from posing a threat to the target properties.

Gulf Service Station 24225 – Piney Grove Rd @ I26

This site is located approximately 20 miles from the target site. The site has 5 underground storage tanks and has reported leaks, but its distance from the target properties prevents it from posing a threat.

New China Restaurant – 3530 River Drive at Sunset Blvd

This site is located approximately 20 miles from the target site. There are 4 underground storage tanks on site and leaks have been reported, but its distance from the target site prevents it from posing a significant threat to the target properties.

SC DHEC Maintenance – PO Box 123 State Park

The exact location of this site could not be determined, but it is approximated at 15 miles from the target site. There is one underground storage tank indicated at this location, but it is not deemed to pose a significant threat to the target properties due to its distance from them.

Cooper Tools – Near Intersection of US 1 and Sparkleberry

This site is located approximately 20 miles from the target site. It is listed in a local unique database. Distance from target properties prevents this site from posing a threat.

Weeks Liquid Fertilizer Inc. – County Road #769

This site is located approximately 5 miles from the target property. It is listed as a hazardous waste site, but distance prevents it from posing a threat to the target property.

Midway Grocery – Hwy 6

This site is located approximately10 miles from the target property. It is listed as having underground storage tanks on site, but will not pose a threat to the target property due to distance.

Old Eastover Dump – Joe Champey Rd

This site is located approximately 14 miles from the target property. It is listed as a state hazardous waste site, however its distance from the target property prevents it from posing a threat.

MCI LLC-EASTSC – 2960 Old Eastover Dr.

This site is located approximately 15 miles from the target property. There are 2 underground storage tanks reported on the property, however there have been no leaks reported. Distance from the target property prevents this property from posing a threat.

Appendix F

T&E Survey

SOUTH CAROLINA MILITARY DEPARTMENT
Office of the Adjutant General
Environmental
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Building 3924
Eastover, SC 29044
Mark Mohr
Voice: (803) 299-1898
Fax: (803) 299-1896
Mobile: (803)428-7890

13 November 2012

MEMORANDUM FOR RECORD:

SUBJECT: Endangered Species Act (ESA) Section 7 Consultation

ENV P/N: 515

The SCARNG is currently coordinating with Fort Jackson to complete and submit a Biological Assessment to the Fish and Wildlife Service. The complete consultation information will be included in the Final Environmental Assessment to be submitted to National Guard Bureau at a later date.

EA Engineering, Science, and Technology, Inc., PBC

225 Schilling Circle, Suite 400
Hunt Valley, MD 21031
Telephone: 410-584-7000
Fax: 410-771-1625
www.eaest.com

16 May 2023

Mr. Chong Perry
Range Operations Manager
Fort Jackson, South Carolina

Mr. James Cook
Sustainable Range Program Manager
McCrady Training Center, South Carolina

Re: United States (U.S.) Army Fiscal Year (FY) 18-22 Operational Range Assessment (ORA) Cycle Advanced Assessment Report–Fort Jackson / McCrady Training Center, South Carolina

Dear Mr. Perry and Mr. Cook,

EA Engineering, Science, and Technology, Inc., PBC is pleased to provide this *Draft Operational Range Assessment Advanced Assessment Report* for Fort Jackson / McCrady Training Center, South Carolina. This document is also being provided to the United States Army Environmental Command (USAEC) and the Army Public Health Center (APHC) for their review and comment.

Please provide your comments on this document to me by 23 May 2023 so that we can prepare a response to comments package and incorporate those changes into a subsequent Final Report.

If you have any questions concerning the Draft Advanced Assessment, please do not hesitate to contact me using the information provided below.

Regards,

Kevin Sharpe, Assessment Team Leader

Telephone: 410-329-5145
Email: ksharpe@eaest.com

Enclosure (Draft Advanced Assessment Report)

cc: Headquarters, Department of the Army (Samuel Pierre)
USAEC PM (Paul Smith)
USAEC PgM (Roger Walton)
USAEC ESM (Carl Rabon)
DCPH-A PgM (Kevin Russell)
EA PgM (Vince Williams)
EA PM (David Mercadante)

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Draft
Advanced Assessment Report for FY18–22 Operational Range Assessments Fort Jackson/McCrady Training Center, South Carolina

Prepared for

United States Army Environmental Command
2455 Reynolds Road Joint Base San Antonio
Fort Sam Houston, Texas 78234-7588
Contract No. W91ZLK-13-D-0004-0016

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
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May 2023

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Advanced Assessment Report
for FY 18–22 Operational Range Assessments
Fort Jackson/McCrady Training Center, South Carolina

Prepared for

United States Army Environmental Command
2455 Reynolds Road Joint Base San Antonio
Fort Sam Houston, Texas 78234-7588

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David Mercadante, P.E., PMP — 16 May 2023
Project Manager

James Costello, P.G. — 16 May 2023
Program Manager

May 2023
Version: Draft
EA Project No. 62686.16

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DRAFT

FY18–22 OPERATIONAL RANGE ASSESSMENTS
ADVANCED ASSESSMENT REPORT
FORT JACKSON/MCCRADY TRAINING CENTER

DoD Contract Number: W91ZLK-13-D-0004-0016

Reviewed and Approved by:

_____

Kevin Sharpe
Team Leader
EA Engineering, Science, and Technology, Inc., PBC

_____

David P. Mercadante, P.E., PMP
Project Manager
EA Engineering, Science, and Technology, Inc., PBC

EA Engineering, Science, and Technology, Inc., PBC prepared this report at the direction of the United States Army Environmental Command (USAEC). This document should be used only with the approval of the USAEC or another authorized Department of the Army official organization. This report is based, in part, on information provided in other documents and is subject to the limitations and qualifications presented in the referenced documents.

MAY 2023

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299 **Abbreviations/Acronyms**
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µg/L	Microgram(s) per liter
µmol/g_{oc}	Micromole(s) per gram of organic carbon
AOC	Area of Concern
AVS	Acid volatile sulfide
BLM	Biotic Ligand Model
CCV	Continuing calibration verification
CSM	Conceptual Site Model
DNT	Dinitrotoluene
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DQO	Data quality objective
EA	EA Engineering, Science, and Technology, Inc., PBC
f_{oc}	Fraction of organic carbon
FY18–22	Fiscal Year 2018–2022
FY23–27	Fiscal Year 2023–2027
HMX	Cyclotetramethylenetetranitramine
IRP	Installation Restoration Program
MC	Munitions constituents
MCOC	Munitions constituents of concern
mg/kg	Milligram(s) per kilogram
MS	Matrix spike
MSD	Matrix spike duplicate
NFA	No Further Action
ORA	Operational Range Assessment
ORAP	Operational Range Assessment Program
PAL	Project action limit
QA	Quality assurance
QC	Quality control
RDX	Cyclotrimethylenetrinitramine
SCARNG	South Carolina Army National Guard
SEM	Simultaneously extracted metals
SLERA	Screening Level Ecological Risk Assessment
SSQAPP	Site-Specific Quality Assurance Project Plan
SWMU	Solid Waste Management Unit
U.S.	United States
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
UXO	Unexploded ordnance

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Executive Summary

The Army Operational Range Assessment (ORA) effort was developed to address Department of Defense (DoD) requirements detailed in DoD Directive 4715.11 (10 May 2004) and DoD Instruction (DoDI) 4715.14 (15 November 2018). These documents require all Services to identify operational ranges, identify munitions constituents (MC) contained in military munitions used or being used on operational ranges, and assess whether MC from military munitions used on operational ranges are migrating to off-range areas at levels posing an unacceptable risk to off-range human health and/or the environment. The overall objective of the ORA is to assess operational ranges/range complexes at Fort Jackson/McCrady Training Center to determine if an off-range MC release or substantial threat of an off-range MC release exists; if an off-range MC release exists, does it exceed an applicable regulatory reporting standard; and if an MC release or substantial threat of a release exists, determine whether it creates a potentially unacceptable risk to off-range human health or the environment. The Army conducted an ORA Advanced Assessment at Fort Jackson/McCrady Training Center to achieve this objective and comply with the DoDI requirement to regularly reassess the determination of previous assessments.

The protocols for the execution of the ORA Advanced Assessments for the United States (U.S.) Army are detailed in the Operational Range Assessment Program Phase II Protocol (U.S. Army Center for Health Promotion and Preventive Medicine 2009). The overall strategy for conducting ORA Advanced Assessments is based on the application of the U.S. Environmental Protection Agency's (USEPA) systematic planning or data quality objective (DQO) process. The application of the DQO process is required by DoDI 4715.14, "Operational Range Assessments" (15 November 2018). The DQO process provides a sequence of logical steps to address the sampling rationale, decision criteria, and approaches in selecting a sampling design. The DQO planning process is an iterative process that assists in determining the appropriate type, quantity, and quality of environmental data necessary for making decisions that are technically sound and defensible.

As identified during the DQO process for the ORA Advanced Assessments, the project goal is to determine whether concentrations of MC of concern (MCOC) in surface water systems and/or groundwater are migrating from the operational range and if those concentrations present an unacceptable risk to human health and/or the environment off-range. The Advanced Assessment can address the study goal through an update of the Conceptual Site Model (CSM) from previous assessments by collection of additional data, modeling of MC concentrations, or the analysis and screening of surface water, sediment, benthic macroinvertebrate, and/or groundwater samples collected. The first step in addressing the study goal is to review the CSMs developed during the previous investigations.

The 2008 Phase I studies evaluated Fort Jackson and McCrady Training Center under two separate investigations. At McCrady Training Center, the 2008 Phase I ORA evaluated 62 operational ranges, including 2 firing ranges, 3 small arms ranges, and 57 training areas, totaling approximately 14,895 acres. The ORA concluded that 14 ranges were categorized as Unlikely that a source/receptor interaction could occur because no potential source/pathway receptor interactions were identified. The other 48 ranges at McCrady Training Center were categorized as Inconclusive, including firing ranges, small arms ranges, and training areas.

The 2008 Phase I ORA for Fort Jackson evaluated 104 operational range areas, including 8 firing ranges, 19 small arms ranges, 75 training areas, and 2 impact areas, totaling 29,716.58 acres. The ORA concluded that 53 ranges at Fort Jackson were categorized as Unlikely that a source/receptor interaction could occur because no potential source/pathway receptor interactions were identified. The ORA concluded that 51 ranges, including impact areas, medium and large caliber firing ranges, small arms ranges, and training

areas that either contain artillery or mortar firing points or known or suspected dudded areas or have received heavy historical munitions usage, were categorized as Inconclusive.

The 2014 Phase II ORA evaluated both Fort Jackson and McCrady Training Center in a combined quantitative assessment, as they are adjoining installations occupying a total of 51,961 acres and totaling 163 operational range areas between both installations. The Phase II multi-season sampling event was conducted from 2009 to 2013. The investigation included surface water and sediment samples from five downstream and three reference locations within Colonels Creek Watershed, Cedar Creek Watershed, and Gills Creek Watershed. Surface water was analyzed for metals, propellants, and explosives and sediment was analyzed for metals and explosives. Additionally, benthic macroinvertebrate surveys were conducted to characterize overall stream health. Surface water, sediment, and benthic macroinvertebrate sampling data indicated MCOC were not migrating off-range via Colonels Creek or Cedar Creek. Because Cedar Creek surface water and sediment sampling data were considered conservatively representative of Mill Creek conditions, these data also indicate MCOC were not likely migrating off-range via Mill Creek. Surface water and sediment sampling data from the Gills Creek watershed included lead and copper concentrations exceeding project action limits (PALs). Based on these results, a Screening Level Ecological Risk Assessment (SLERA) was performed to better assess the conditions. The SLERA performed on the results from Gills Creek indicated that the potential for adverse ecological health effects from exposure to sediment in Gills Creek at the operational range boundary is likely low. However, based on the low pH in surface water and low total organic carbon in sediment, these metals may become mobile and bioavailable.

Groundwater sample results showed that concentrations of cyclotrimethylenetrinitramine (RDX) were present in groundwater and had migrated to Cedar Creek monitoring wells near the operational range and installation boundary, upgradient of off-range wells used for drinking water. It could not be determined if RDX had migrated off the operational range area. A separate subsequent investigation outside of ORA was launched under an environmental program and this study showed off-post migration.

The 2023 Advanced Assessment for Fort Jackson/McCrady Training Center refined the CSM through the collection of updated source, pathway, and receptor data and included a review of existing analytical results from previous investigations. Based on recent geographic information system data, Fort Jackson/McCrady Training Center are composed of 148 operational ranges covering 51,322.78 acres, which include 55 maneuver/training areas, 56 firing ranges, 4 dudded impact areas, 15 non-dudded impact areas, and 18 historic impact areas. Additionally, there are approximately 7,591 acres of non-operational cantonment area. A decrease in acreage from the Phase II Assessment to the Advanced assessment results from the exclusion of the area including the Fort Jackson National Cemetery, located north of the installation boundary.

Surface water and sediment samples were collected under the Advanced Assessment to address data gaps identified in the updated CSM. Surface water was analyzed for dissolved metals, explosives, perchlorate, and Biotic Ligand Model parameters. Sediment was analyzed for metals, explosives, and simultaneously extracted metals/acid volatile sulfide. As groundwater in Cedar Creek is being addressed under the Feasibility Study, additional sampling of groundwater was not conducted and existing data was reviewed.

Sampling of surface water and sediment consisted of a single grab sample at the six downstream locations in the Fort Jackson Mill Creek Watershed (SWMC1, SWMC2, SWMC3), the Colonels Creek Watershed (SWCC3, SWCC4) which runs through both Fort Jackson and McCrady Training Center, and Jumping Run Creek Watershed (SWJC1) in McCrady Training Center and one reference location upstream in Fort Jackson from Colonels Creek (SWCC2). Colonels Creek was used as a worst-case indicator to represent Cedar Creek and Gills Creek. Due to a combination of higher detection limits associated with the analytical

method (USEPA SW6020A), low water hardness, and laboratory blank metals contamination, the majority of surface water metals results were qualified as non-detect. Therefore, the potential migration of metals MCOC via surface water within the Upper Colonels Creek, and Lower Colonels Creek (including Jumping Run Creek) was determined to be Inconclusive. The surface water metals results that did not qualify as non-detect included lead detections that exceeded the state specific freshwater ecological regulatory level at SWMC2 and SWMC3; therefore, the Mill Creek watershed was determined to be Referred. There were no detections of explosives or perchlorate in surface water. Sediment results indicated there is no migration of metals from source areas at Fort Jackson/McCrady Training Center and no detections exceeded screening values. No explosives were detected in sediment.

The worst-case scenario for groundwater was explosives along the south-central boundary, and that assessment, originally part of the last ORA study, is now being handled under another environmental program. With the site being characterized, the attention has turned to a Feasibility Study of a residual subsurface soil source of RDX. The Proposed Plan for remedial actions at the site is being finalized.

Based on the Inconclusive results of the surface water samples for metals MCOC, this Advanced Assessment recommends that future ORA assessments analyze surface water at Fort Jackson/McCrady Training Center using USEPA 1638 (trace metals analysis) to accommodate for low water hardness and follow a multi-seasonal sampling approach to provide a more robust dataset that benefits from a statistical analysis of the data results. Therefore, the source area ranges, consisting of 53 firing ranges, 4 dudded impact areas, 14 non-dudded impact areas, 39 maneuver and training areas, and 16 historic impact areas, totaling 46,950.56 acres, should be re-categorized as Inconclusive. The remaining ranges, including the entirety or a portion of 3 firing ranges, 1 non-dudded impact area, 2 historical impact areas, and 16 maneuver and training areas within the Mill Creek Watershed, totaling 4,372.22 acres, should be re-categorized as Referred due to the potential migration of lead MC off-range in surface water at concentrations exceeding screening levels that may potentially pose an unacceptable risk to off-range ecological and human receptors.

All of Fort Jackson/McCrady Training Center's operational ranges should be included in the FY23–27 cycle of ORAs to meet DoDI requirements. **Table ES-3** and **Figure ES-1** summarize the Advanced Assessment findings.

431 **Table ES-1: Advanced Assessment Surface Water Results Summary**

Analyte	Comparison to Screening Value			Comparison to Reference Value		
	PAL (µg/L)[a]	Sample Result (µg/L)	Exceeds Screening Value (Y/N)	Sample Result (µg/L)	Reference Value (µg/L)	Exceeds Reference Value (Y/N)
SWCC3						
Antimony	30	< 0.5 U	N	< 0.5 U	< 0.5 U	N
Copper [b]	0.28	< 2.0 U	N	< 2.0 U	< 2.0 U	N
Lead [b]	0.02	**0.34 J**	**Y**	0.34 J	0.853 J	N
Zinc [b]	3.7	< 8.0 U	N	< 8.0 U	< 8.0 U	N
Perchlorate [c]	15	0.019 J	N	0.019 J	< 0.10 U	N
SWCC4						
Antimony	30	< 0.5 U	N	< 0.5 U	< 0.5 U	N
Copper [b]	0.28	< 2.0 U	N	< 2.0 U	< 2.0 U	N
Lead [b]	0.02	**0.26 J**	**Y**	0.26 J	0.853 J	N
Zinc [b]	3.7	< 8.0 U	N	< 8.0 U	< 8.0 U	N
Perchlorate [c]	15	0.015 J	N	0.015 J	< 0.10 U	N
SWMC1						
Antimony	30	< 0.5 U	N	< 0.5 U	< 0.5 U	N
Copper [b]	0.36	< 2.0 U	N	< 2.0 U	< 2.0 U	N
Lead [b]	0.03	< 0.5 U	N	< 0.5 U	0.853 J	N
Zinc [b]	4.8	< 8.0 U	N	< 8.0 U	< 8.0 U	N
Perchlorate [c]	15	< 0.10 U	N	< 0.10 U	< 0.10 U	N
SWMC2						
Antimony	30	< 0.5 U	N	< 0.5 U	< 0.5 U	N
Copper [b]	1	< 2.0 U	N	< 2.0 U	< 2.0 U	N
Lead [b]	0.12	**3.25**	**Y**	**3.25**	0.853 J	**Y**
Zinc [b]	13.6	< 8.0 U	N	< 8.0 U	< 8.0 U	N
Perchlorate [c]	15	0.023 J	N	0.023 J	< 0.10 U	N
SWMC3						
Antimony	30	< 0.5 U	N	< 0.5 U	< 0.5 U	N
Copper [b]	0.84	< 2.0 U	N	< 2.0 U	< 2.0 U	N
Lead [b]	0.1	**2.18**	**Y**	**2.18**	0.853 J	**Y**
Zinc [b]	11.4	< 8.0 U	N	< 8.0 U	< 8.0 U	N
Perchlorate [c]	15	0.028 J	N	0.028 J	< 0.10 U	N
SWJC1						
Antimony	30	< 0.5 U	N	< 0.5 U	< 0.5 U	N
Copper [b]	0.28	< 2.0 U	N	< 2.0 U	< 2.0 U	N
Lead [b]	0.02	< 0.5 U	N	< 0.5 U	0.853 J	N
Zinc [b]	3.7	< 8.0 U	N	< 8.0 U	< 8.0 U	N
Perchlorate [c]	15	< 0.10 U	N	< 0.10 U	< 0.10 U	N

Notes:
(a) PALs refer to South Carolina Water Classifications & Standards Regulations (R.61-68) Freshwater Criterion (2020). The PAL for Antimony refers to USEPA National Recommended Water Quality Criteria.
(b) Screening level provided based on hardness value found at each location.
µg/L = Microgram(s) per liter
Bold indicates that the sample result exceeds the associated USEPA freshwater ecological regulatory level PAL.

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433 **Table ES-2: Advanced Assessment Sediment Results Summary**

Analyte[a]	Comparison to Screening Value			Comparison to Reference Value		
	PAL (mg/kg)[a]	Sample Result (mg/kg)	Exceeds Screening Value (Y/N)	Sample Result (mg/kg)	Reference Value (µg/L)	Exceeds Reference Value (Y/N)
SWCC3						
Antimony	2.0	0.025 J	N	0.025 J	0.15 J	N
Copper	31.6	< 0.18 U	N	< 0.18 U	21.6	N
Lead	35.8	1.78	N	1.78	33.3	N
Zinc	121	< 0.71 U	N	< 0.71 U	8.5	N
SWCC4						
Antimony	2.0	0.02 J	N	0.02 J	0.15 J	N
Copper	31.6	1.42	N	1.42	21.6	N
Lead	35.8	0.815	N	0.815	33.3	N
Zinc	121	1.5	N	1.5	8.5	N
SWMC1						
Antimony	2.0	0.14 J	N	0.14 J	0.15 J	N
Copper	31.6	4.81	N	4.81	21.6	N
Lead	35.8	7.01	N	7.01	33.3	N
Zinc	121	4.66	N	4.66	8.5	N
SWMC2						
Antimony	2.0	0.025 J	N	0.025 J	0.15 J	N
Copper	31.6	0.32	N	0.32	21.6	N
Lead	35.8	1.48	N	1.48	33.3	N
Zinc	121	< 0.85 U	N	< 0.85 U	8.5	N
SWMC3						
Antimony	2.0	0.08 J	N	0.08 J	0.15 J	N
Copper	31.6	1.18	N	1.18	21.6	N
Lead	35.8	7.84	N	7.84	33.3	N
Zinc	121	4.11	N	4.11	8.5	N
SWJC1						
Antimony	2.0	0.023 J	N	0.08 J	0.15 J	N
Copper	31.6	0.4	N	1.18	21.6	N
Lead	35.8	0.747	N	7.84	33.3	N
Zinc	121	< 0.88 U	N	4.11	8.5	N

Notes:
(a) PALs refer to the lower of the USEPA Region 4 Freshwater Sediment Screening Values (2018) and the USEPA Region 3 Freshwater Sediment Screening Benchmarks (BTAG) (August 2006)
mg/kg = Milligram(s) per kilogram.
Bold indicates that the sample result exceeds the associated USEPA freshwater ecological regulatory level PAL.

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435 **Table ES-3: Advanced Assessment Conclusions Summary**

Category	Total Number of Ranges and Acreage	Source(s)	Pathway(s)	Human Receptors	Ecological Receptors	Conclusions and Rationale
Inconclusive; 46,950.56 acres	53 firing ranges, 4 dudded impact areas, 14 non-dudded impact areas, 39 maneuver and training areas, and 16 historic impact areas	Maneuver training areas, live-fire ranges, impact areas	Surface water-Colonels Creek, Cedar Creek, and Gills Creek Groundwater-Middendorf Aquifer	Recreation users of Weston Lake and users of the recreational facilities at Weston Lake.	Threatened and endangered species and sensitive environments downstream of operational areas.	Undetermined potential of metals in surface water. All Inconclusive ranges should be included in the FY23–27 cycle of ORAs, to meet DoDI requirements.
Referred; 4,372.22 acres	3 firing ranges, 1 non-dudded impact area, 2 historical impact areas, and 16 maneuver and training areas	Maneuver training areas, live-fire ranges, impact areas	Mill Creek Watershed	Recreational users of Old Heises Pond.		MC (lead) associated with the southern portion of the Mill Creek Watershed and are potentially migrating off-range via surface water at levels that pose an unacceptable risk to off-range human and/or ecological receptors. For sediment no MC were determined to be migrating at levels that pose an unacceptable risk to off-range human and/or ecological receptors. The Army and Fort Jackson will determine appropriate further analysis to better characterize the risk posed by these ranges and monitor MC migration off-range.

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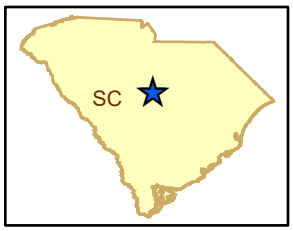
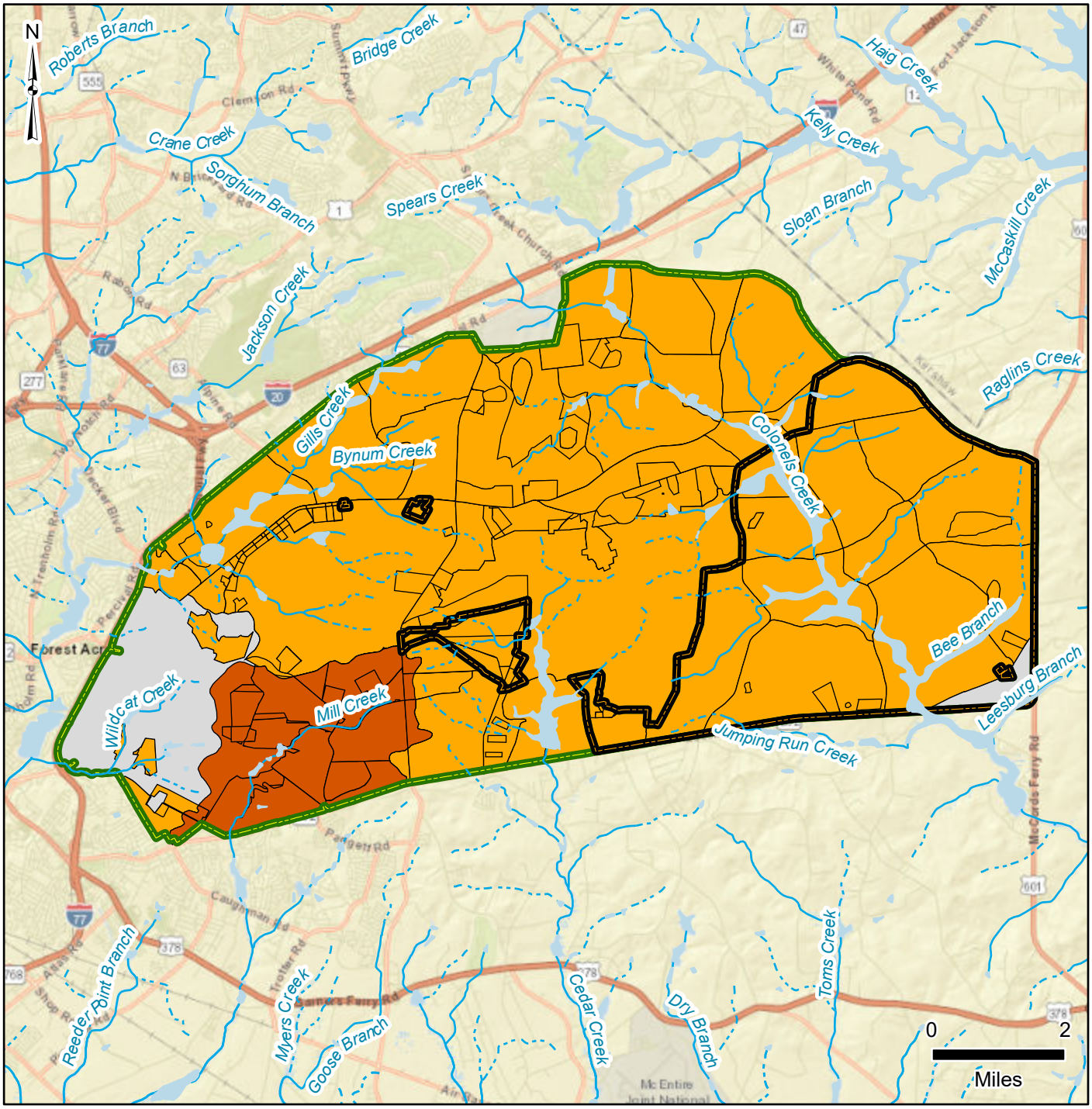
Figure ES-1
Advanced Assessment Conclusions





Installation Data
- Fort Jackson Installation Boundary
- McCrady Training Center Boundary
- Non-Operational Area

Range Conclusions
- Referred
- Inconclusive

Hydrology
- Perennial Stream/Creek
- Intermittent Stream/Creek
- Waterbody

Data Sources:
ESRI 2023
EA 2023

Date:.....May 2023
Prepared By:.....EA
Prepared For:....USAEC

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1.0 Introduction

Under contract to the United States (U.S.) Army Environmental Command (USAEC) (Contract No. W91ZLK-13-D-0004-0016), EA Engineering, Science, and Technology, Inc., PBC (EA) conducted the Operational Range Assessment (ORA) Advanced Assessment at Fort Jackson/McCrady Training Center, South Carolina, in 2023.

1.1 Project Purpose and Overview

The Army ORA effort was developed to address Department of Defense (DoD) requirements detailed in DoD Directive (DoDD) 4715.11 (10 May 2004) and DoD Instruction (DoDI) 4715.14 (15 November 2018). These documents require all Services to identify operational ranges, identify munitions constituents (MC) contained in military munitions used or being used on operational ranges, and assess whether MC from military munitions used on operational ranges are migrating to off-range areas at levels posing an unacceptable risk to off-range human health and/or the environment. The overall objective of the ORA is to assess operational ranges/range complexes at Fort Jackson/McCrady Training Center to determine if an off-range MC release or substantial threat of an off-range MC release exists; if an off-range MC release exists, does it exceed an applicable regulatory reporting standard; and if an MC release or substantial threat of a release exists, determine whether it creates a potentially unacceptable risk to off-range human health or the environment.

The protocols for the execution of the ORA Advanced Assessments for the U.S. Army are detailed in the Operational Range Assessment Program (ORAP) Phase II Protocol (U.S. Army Center for Health Promotion and Preventive Medicine [USACHPPM] 2009). The overall strategy for conducting ORA Advanced Assessments is based on the application of the U.S. Environmental Protection Agency's (USEPA's) systematic planning or data quality objective (DQO) process. The application of the DQO process is required by DoDI 4715.14, "Operational Range Assessments" (15 November 2018). The DQO process provides a sequence of logical steps to address the sampling rationale, decision criteria, and approaches in selecting a sampling design. The DQO planning process is an iterative process that assists in determining the appropriate type, quantity, and quality of environmental data necessary for making decisions that are technically sound and defensible.

As identified during the DQO process for the ORA Advanced Assessments, the project goal is to determine whether concentrations of MC of concern (MCOC) in surface water systems and/or groundwater are migrating from the operational range and if those concentrations present an unacceptable risk to human health and/or the environment off-range.

This Advanced Assessment addressed the study goal through the collection of updated source, pathway, and receptor data. The data were used to update the Conceptual Site Model (CSM) through the analysis and screening of surface water and sediment samples collected at Fort Jackson/McCrady Training Center.

This report summarizes the findings from the previous ORAs, describes the Advanced Assessment data collection activities from March 2023, presents the Advanced Assessment data interpretation and CSM refinements, and provides conclusions and recommendations for Fort Jackson/McCrady Training Center.

1.2 Operational Range Assessment Program Scope and Drivers

The ORA is being implemented to fulfill requirements contained implicitly and explicitly in the following documents:

- DoDD 4715.11, Environmental and Explosives Safety Management on Operational Ranges Within the United States (10 May 2004)

- DoDI 4715.14, *Operational Range Assessments* (15 November 2018). Reissues and cancels DoDI 4715.14 (30 November 2005).

The DoDD and DoDI require the U.S. Army maintain an operational range inventory and evaluate the potential for off-range migration of MC. The DoDI identifies MC to be evaluated and lays out a scientifically sound process for assessing and presorting potential off-range environmental impacts of munitions used on operational ranges. In particular, the DoDI requires the DoD components to respond to a release or substantial threat of release of MCOC from an operational range area to an off-range area, when such a release poses an unacceptable risk to human health or the environment.

This current cycle of ORAs is being conducted as either a Basic or an Advanced Assessment to meet the DoD requirement for installations to be re-assessed on a recurring basis. Both types of assessments involve the compilation and evaluation of readily available information to construct a CSM of each range or range complex; an Advanced Assessment differs from a Basic Assessment in that media samples are collected to close data gaps in the CSM related to potential MC migration and risk.

1.3 Work Authority

The Deputy Assistant Secretary of the Army (Environment, Safety, and Occupational Health) is the U.S. Army proponent for the ORAs. The Deputy Chief of Staff, G-9, Installations (formerly Assistant Chief of Staff for Installation Management) has designated USAEC to serve as program manager for the Active Army and Army Reserve components assessment execution. USAEC is supported by the U.S. Army Public Health Center to provide programmatic technical oversight.

1.4 Previous Operational Range Assessments

Active Army and Army Reserve Installations underwent initial Qualitative (Phase I) Assessments between 2005 and 2009. As a result of the Phase I Assessments, installations either received a Quantitative (Phase II) Assessment, which included sampling, or a "Periodic Review" between 2010 and 2017. The Periodic Reviews meet the DoD requirements for installations to be re-assessed on a recurring basis and resulted in Addendums to the ORAP Phase I Reports.

Based upon the review of readily available information evaluated during the previous ORA process, the ranges were placed into either the Unlikely or Referred category based on whether unacceptable risk to human health or the environment was identified:

Unlikely—Operational range areas categorized as "Unlikely" are those where there is sufficient evidence to show that there are no known releases or source-receptor interactions that could present an unacceptable risk to human health or the environment, based on a review of the information available. No further action needs to be taken at this time and the site has been placed into an ORA periodic review cycle.

Referred—Operational range areas categorized as "Referred" are those with compelling evidence (e.g., sampling data) to indicate the presence of an off-range release that potentially poses an unacceptable risk to human health or the environment.

1.5 Report Organization

This Advanced Assessment Report has been developed in accordance with the USACHPPM Army ORAP Phase II Assessment Protocol (USACHPPM 2009) and includes the following sections:

- *Section 1.0: Introduction* provides an introduction to ORA and discusses the purpose, project reference, work authority, and report organization.
- *Section 2.0: Installation Overview* summarizes the site description, site history, physical features, and previous ORA investigations and CSM.
- *Section 3.0: Advanced Assessment* details the Advanced Assessment and CSM.
- *Section 4.0: Methodology* describes the methodologies employed for sampling and analysis of the surface water system.
- *Section 5.0: Advanced Assessment Results and Discussion* presents the results for the surface water system.
- *Section 6.0: Summary and Conclusions* includes a summary of the investigation's findings and the conclusions drawn from the findings.
- *Section 7.0: References* includes a list of all references used in preparing the ORA Advanced Assessment Report.
- A*ppendix A:* Contains the previous ORA Reports.
- *Appendix B:* Contains the various field forms from the Advanced Assessment including the field book, chain-of custody forms, and quality assurance (QA)/quality control (QC) forms.
- *Appendix C:* Contains the photographic log of field events.
- *Appendix D:* Contains the laboratory reports for surface water and sediment.
- *Appendix E:* Contains the data validation summaries for surface water and sediment data.
- *Appendix F:* Contains the analytical data tables for surface water and sediment.

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2.0 Installation Overview

This section summarizes the installation layout and history and describes the previous ORAs. Additional information regarding munitions use and physical characteristics can be found in (*Draft Final Operational Range Assessment Program Phase I Qualitative Assessment Report, Fort Jackson, South Carolina* (Malcolm Pirnie 2008a), *Draft Final Operational Range Assessment Program Phase I Qualitative Assessment Report, McCrady Training Center, South Carolina* (Malcolm Pirnie 2008b), and *Final Report Operational Range Phase II Assessment, U.S. Army Garrison Fort Jackson and McCrady Training Center, South Carolina* (PIKA-Pirnie Joint Venture, LLC 2014) (**Appendix A**).

2.1 Installation Background

Fort Jackson and McCrady Training Center are adjoining installations, together occupying approximately 51,322.78 acres in Richland County, South Carolina (**Figure 2-1**). The South Carolina Army National Guard (SCARNG) holds a nonexclusive license for training operations on approximately 15,267 acres of the eastern portion of Fort Jackson, known as McCrady Training Center. For purposes of the ORA, both installations will be assessed together. Fort Jackson (as well as the portion now leased by SCARNG) has served as a military training facility since 1917. During World War II, Fort Jackson became a permanent military installation used primarily for infantry training. The current and primary mission of Fort Jackson is to train initial entry recruits for duty as soldiers for Army units. To support this mission, Fort Jackson currently houses Army training brigades and serves as a reception station that processes newly inducted and prior service personnel forwarded to the installation from recruiting and induction stations. Fort Jackson is the largest and most active initial entry center in the U.S. Army, providing training to approximately 25 percent of the men and women who enter the service each year. The installation instructs approximately 55,000 to 65,000 soldiers each year, including participants in Basic Combat Training, Advanced Individual Training, and many professional schools. McCrady Training Center is the SCARNG's largest and most utilized training area, serving as the central point for state missions, while also supporting federal missions.

Fort Jackson and McCrady Training Center utilize 148 operational ranges covering 51,322.78 acres, which includes 55 maneuver/training areas, 56 firing ranges, 4 dudded impact areas, 15 non-dudded impact areas, and 18 historic impact areas (**Figure 2-2)**. The remaining 7,591 acres consist of the non-operational cantonment area. These ranges include live-fire weapons training, heavy and light maneuver exercises, dudded and non-dudded impact areas, and specialty training courses such as night-infiltration and military operations in urban terrain. There are two "wagon-wheel" configurations for the impact areas (that cover 9,645 acres), with the non-dudded impact areas largely surrounded by live-fire ranges to the north and south, and the dudded impact area receiving live-fire from ranges to the north and to the east on McCrady Training Center.

2.2 Physical Description

Gentle to moderately rolling, moderately dissected high plains occupy most of Fort Jackson/McCrady Training Center. These high plains are interrupted by the nearly flat alluvial plains of Gills, Cedar, and Colonels creeks and their tributaries and an irregularly distributed, gently sloping, low relief area in the central portion of the installation near the headwaters of Cedar Creek. The lowest elevation located in the high plains is adjacent to the alluvial plain of Colonels Creek in the eastern portion of the installation, and the highest elevation is in the west-central portion of the installation. The high sand content of the soils at Fort Jackson/McCrady Training Center promotes leaching of minerals, reduced water retention, and increases susceptibility to soil erosion.

Fort Jackson encompasses five watersheds or subwatersheds, that are drained by Colonels, Gills, Wildcat (or Lower Gills), Mill, and Cedar creeks. Additionally, there are 26 lakes, ponds, and impoundments on Fort Jackson/ McCrady Training Center. All creeks and streams leaving Fort Jackson/McCrady Training Center eventually flow into either the Wateree River or the Congaree River. These rivers meet about 16 miles southeast of Fort Jackson/McCrady Training Center, where they form the Santee River, the principal stream of the region. The Santee River continues in a southeasterly direction, eventually emptying into the Atlantic Ocean south of Georgetown, South Carolina.

The Middendorf Aquifer constitutes the primary aquifer used as a groundwater supply in the area including, and surrounding, Fort Jackson/McCrady Training Center. Within this region, the Middendorf Formation is entirely coincident with the Middendorf Aquifer. Half the wells occurring within the Middendorf Aquifer in Richland County are less than 100 feet deep. In the area directly to the south of Fort Jackson/McCrady Training Center the overwhelming majority of wells screened within the Middendorf Aquifer are screened above elevations of 175 feet above mean sea level. Wells located several miles north of the installation extract groundwater from bedrock aquifers, but very few wells on the installation or directly south of the installation extract groundwater from the bedrock aquifers due to the great depths (and therefore well installation expense) to bedrock.

Depths to water on-installation and immediately downgradient (to the south) generally range from two to 20 feet below ground surface within the cantonment area and directly adjacent to streams, up to a maximum depth of over 100 feet on highlands in interstream areas near the central part of the combined installations. The aquifer system in the region is described as stratified, consisting of shallow, intermediate, and deep groundwater flow systems. Fort Jackson/McCrady Training Center represent an important local and regional recharge area for the Middendorf Aquifer system. The majority of groundwater recharging the aquifer is expected to remain within the shallow and intermediate flow system and follow topography, ultimately discharging to local streams and rivers. A smaller proportion of recharge enters the deep groundwater flow system and discharges to regional discharge points. The Congaree and Wateree rivers to the south and east of the installation, respectively, have been identified as regional discharge points for the deep component of the groundwater system in Richland County.

2.3 Previous Investigations

Phase I

Fort Jackson and McCrady Center were evaluated under two separate Phase I ORAs.

At McCrady Training Center, the 2008 Phase I ORA evaluated 62 operational ranges, including 2 firing ranges, 3 small arms ranges, and 57 training areas, totaling approximately 14,895 acres. The ORA concluded that 14 ranges were categorized as Unlikely that a source/receptor interaction could occur because no potential source/pathway receptor interactions were identified. The other 48 ranges at McCrady Training Center were categorized as Inconclusive, including firing ranges, small arms ranges, and training areas.

The Phase I ORA for McCrady Training Center determined that training conducted at the Inconclusive ranges included the use of small, medium, and large caliber munitions, pyrotechnics/obscurants, and other munitions which constituted a source of MCOC that included metals, explosives, and perchlorate. The potential surface water system migration pathways from the inconclusive ranges originated from three primary watersheds: Colonels Creek Watershed, Gills Creek Watershed, and Cedar Creek Watershed. The potential groundwater migration pathways underlying the Inconclusive ranges included the Middendorf Aquifer, which was widely used for drinking water.

The 2008 Phase I ORA evaluated 104 operational range areas at Fort Jackson, including 8 firing ranges, 19 small arms ranges, 75 training areas, and 2 impact areas, totaling 29,716.58 acres. The ORA concluded that 53 ranges at Fort Jackson were categorized as Unlikely that a source/receptor interaction could occur because no potential source/pathway receptor interactions were identified. The ORA concluded that 51 ranges, including impact areas, medium and large caliber firing ranges, small arms ranges, and training areas that either contain artillery or mortar firing points or known or suspected dudded areas or have received heavy historical munitions usage, were categorized as Inconclusive.

The Phase I ORA for Fort Jackson determined that training conducted at the Inconclusive ranges included the use of small, medium, and large caliber munitions, pyrotechnics/obscurants, and other munitions which constituted a source of MCOC that included metals, explosives, and perchlorate. The potential surface water system migration pathways from the Inconclusive ranges originated from five primary watersheds: Colonels Creek Watershed, Gills Creek Watershed, Wildcat Creek Watershed, Mill Creek Watershed, and Cedar Creek Watershed. The potential groundwater migration pathways from the Inconclusive ranges included groundwater in the shallow, perched aquifer.

Phase II

The 2014 Phase II ORA evaluated both Fort Jackson and McCrady Training Center, as they are adjoining installations occupying a total of 51,961 acres. EA/Arcadis conducted the Phase II multi-season sampling event in 2009. Based on analytical data from those sampling events, an additional groundwater investigation was performed for groundwater in 2012–2013 and the report was issued the following year, in 2014. The investigations included surface water and sediment samples from five downstream and three reference locations within Colonels Creek Watershed, Cedar Creek Watershed, and Gills Creek Watershed. Surface water was analyzed for metals, propellants, and explosives and sediment was analyzed for metals and explosives (**Figure 2-3)**. Additionally, benthic macroinvertebrate surveys were conducted to characterize overall stream health.

The 2014 Phase II ORA was used to check the environmental impacts of operational range areas within the base boundaries. The assessment also studied the tendency of range-generated contaminants to migrate via surface pathways and groundwater transport. The findings of the assessment suggested that contaminants (explosives) generated from the operational ranges on-post had leached to groundwater and may be migrating off-post in the direction of private residences and privately-owned groundwater wells to the south. To the northwest, MC including copper and lead were found to be migrating in Gills Creek at unacceptable concentrations to the non-operational area and possibly to ecological receptors off-site past Boyden Arbor Pond.

A follow-on Phase II investigation for explosives in groundwater along the southern boundary included the installation of 16 pairs of shallow/deep monitoring wells and samples were collected from these well pairs along the southern installation boundary. Sample analyses from seven of the monitoring wells resulted in the detection of cyclotrimethylenetrinitramine (RDX), cyclotetramethylenete-tranitramine (HMX), 4,6-dinitrotoluene (DNT), 2,6-DNT, m-nitrotoluene, and o-nitrotoluene. A line of screen point borings was installed just north of the monitoring well pairs (excluding the East Impact 150 Area Operational Range) to assess vertical stratification of the explosives in groundwater. The 50 discrete groundwater samples resulted in the detection of HMX, RDX, and 2,6-DNT. Only 2,6-DNT was detected over the Tapwater Regional Screening Level value. The results indicated that MCOC were being transported from areas north of MW-8 through MW-11.

Based on the data collected for the initial 2009 sampling for surface water and groundwater and the 2012–2013 groundwater sampling, the following Phase II conclusions (**Figure 2-4)** were reached:

- Surface water, sediment, and benthic macroinvertebrate sampling data indicated MCOC were not migrating off-range via Colonels Creek or Cedar Creek. Because Cedar Creek surface water and sediment sampling data are considered conservatively representative of Mill Creek conditions, these data also indicated MCOC are not likely migrating off-range via Mill Creek.

- Surface water and sediment sampling data from the Gills Creek watershed included lead and copper concentrations exceeding project action limits (PALs). The Screening Level Ecological Risk Assessment (SLERA) performed on those results indicated that the potential for adverse ecological health effects from exposure to sediment in Gills Creek at the operational range boundary is likely low. However, based on the low pH in surface water and low total organic carbon in sediment, these metals may become mobile and bioavailable.

- Groundwater sample results showed that concentrations of RDX were present in groundwater and had migrated to monitoring wells near the operational range and installation boundary, upgradient of off-range wells used for drinking water. It was uncertain whether RDX had migrated off the operational range area.

Following the ORA Phase II study, there has been off-post sampling by the Army to assess explosives concentrations in off-post supply wells including many domestic well locations. As of November 2019, these activities have resulted in the Army collecting water samples from 194 wells near Fort Jackson, and installed drinking water treatment systems at 10 properties. A Feasibility Study was developed to assess long-term solutions and this focuses on screening technologies and evaluating alternatives to address RDX in groundwater above the Regional Screening Level. A Proposed Plan has been issued to clean up RDX using Alternative 4: Dynamic Groundwater Recirculation with Operation of Point of Use Treatment Systems and Monitoring. The public comment period for this document is currently underway.

Additionally, Fort Jackson recently completed additional sampling at Boyden Arbor Pond up on Gills Creek; however, during the Advanced Assessment investigation results were confirmed to be pending by environmental personnel.

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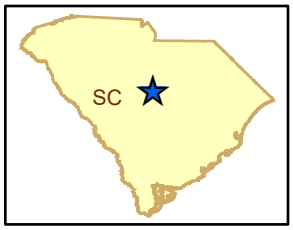
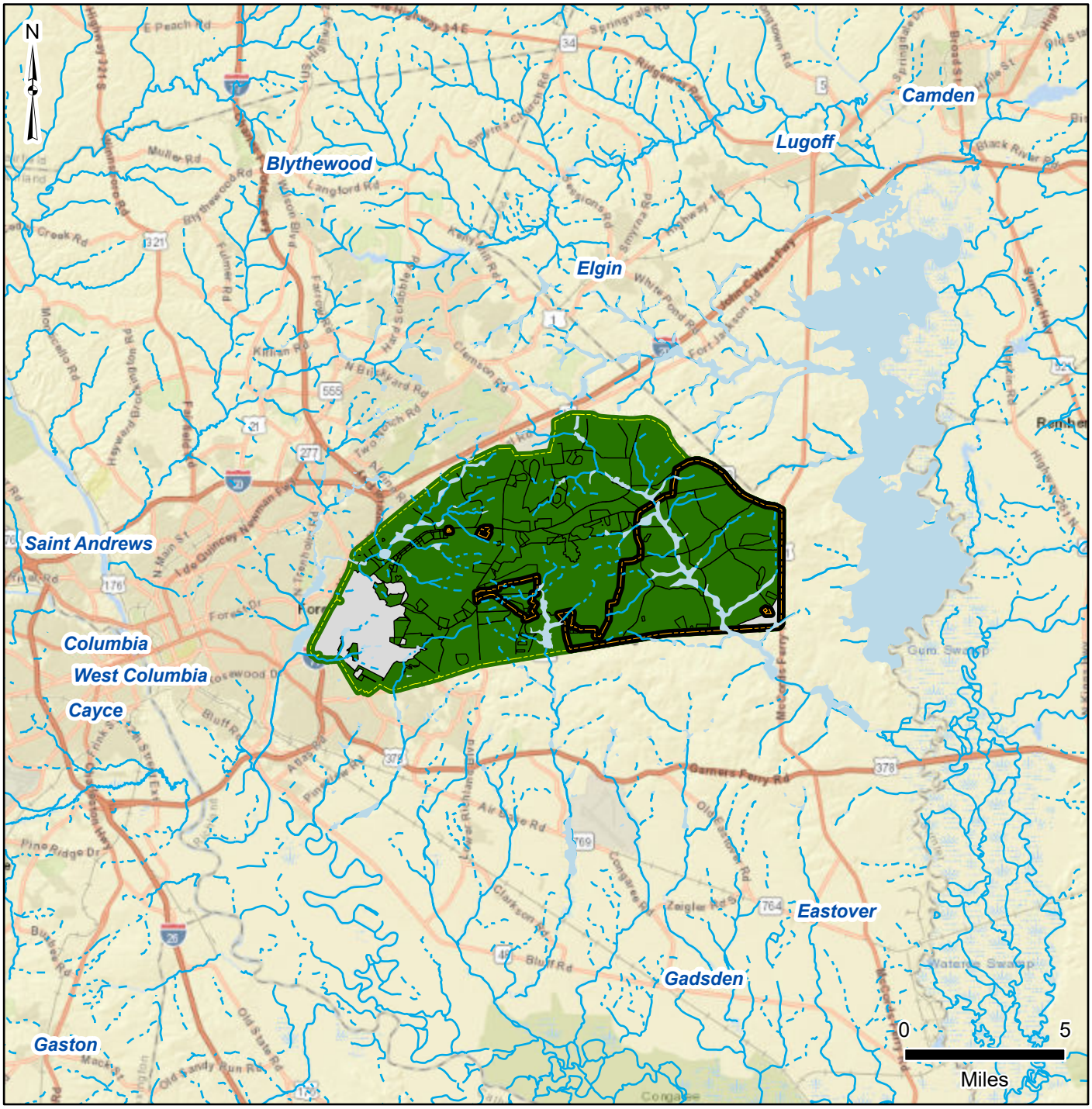
Figure 2-1
General Location of
Fort Jackson and McCrady Training Center





Installation Data

- Installation Boundary
- McCrady Training Center Boundary
- Operational Area
- Non-Operational Area

Hydrology

- Perennial Stream/Creek
- Intermittent Stream/Creek
- Waterbody

Data Sources:
ESRI 2023
EA 2023

Date:.....May 2023
Prepared By:.....EA
Prepared For:....USAEC

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U.S Army FY18-22 ORA Cycle
Advanced Assessment Report
Fort Jackson / McCrady Training Center, South Carolina

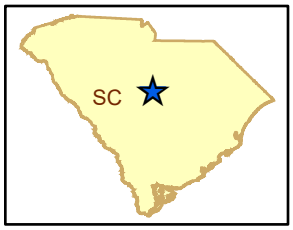
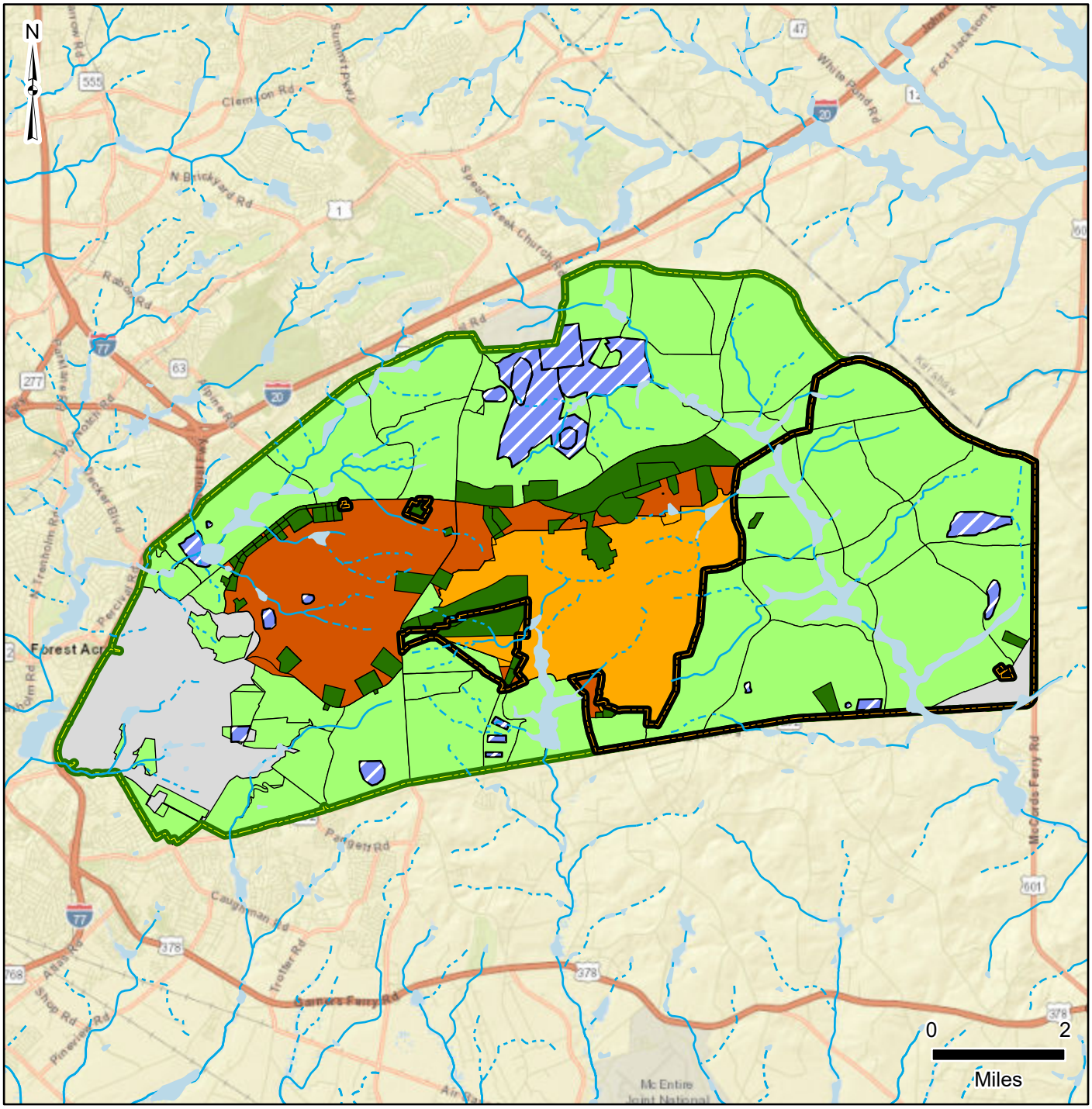


Figure 2-2
Current Operational Range Layout



Installation Data
- Fort Jackson Installation Boundary
- McCrady Training Center Boundary
- Non-Operational Area

Range Type
- Firing Range
- Dudded Impact Area
- Non-Dudded Impact Area
- Historic Impact Area
- Maneuver and Training Area

Hydrology
- Perennial Stream/Creek
- Intermittent Stream/Creek
- Waterbody

Data Sources:
ESRI 2023
EA 2023

Date:.....May 2023
Prepared By:.....EA
Prepared For:....USAEC

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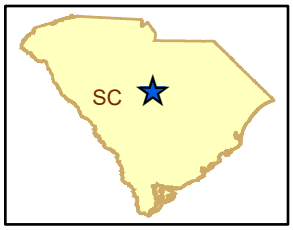
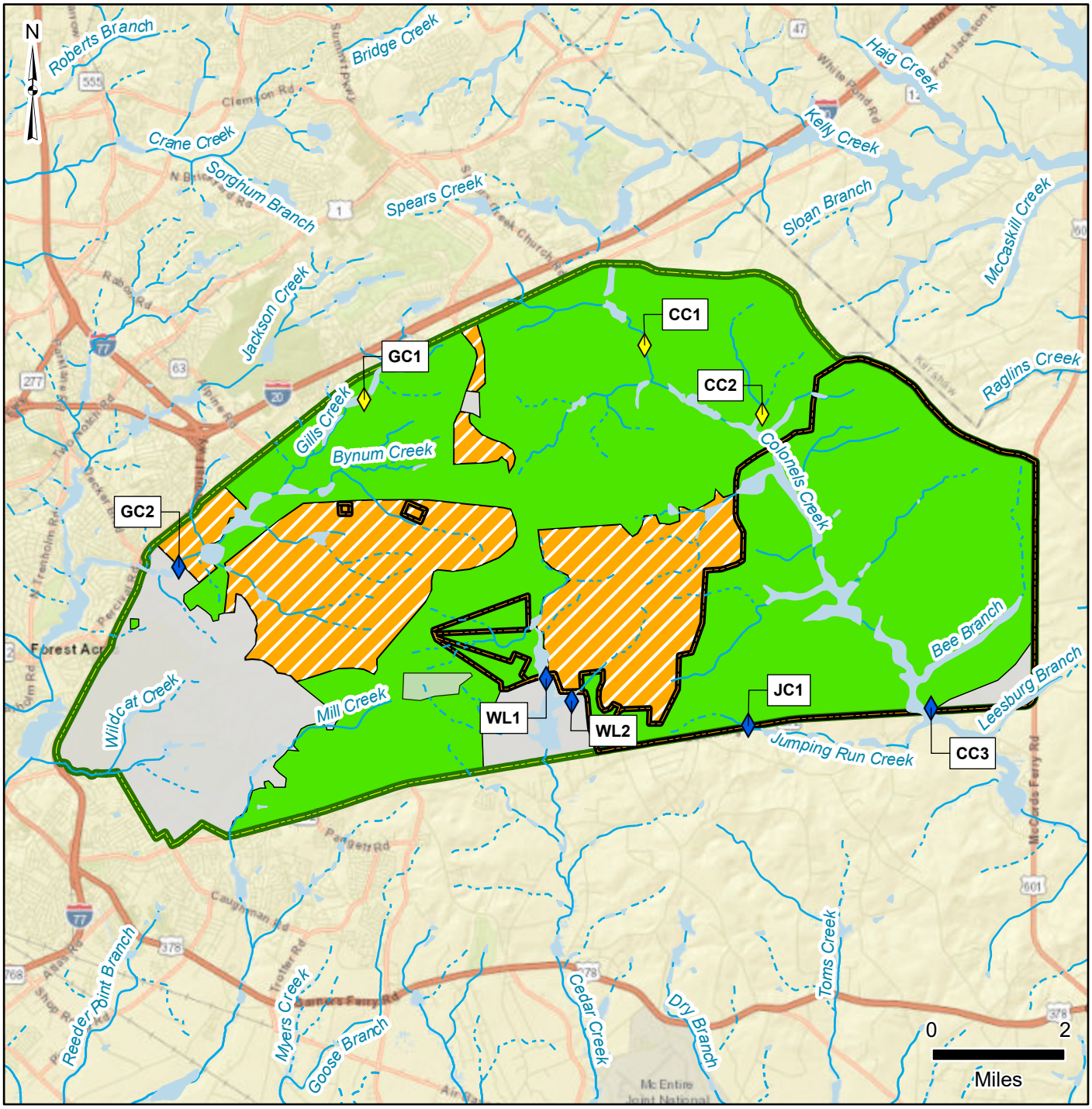
South Carolina

Figure 2-3
Previous Assessment Sampling Locations





Installation Data
- Fort Jackson Installation Boundary
- McCrady Training Center Boundary

Phase II Range Conclusions
- Potential MCOC Source Area
- Unlikely
- Non-Operational Area

Phase II Sampling Locations
- Downstream Surface Water
- Reference Surface Water

Hydrology
- Perennial Stream/Creek
- Intermittent Stream/Creek
- Waterbody

Data Sources:
ESRI 2023
EA 2023
Pike-Pirnie JV, LLC 2014

Date:.....May 2023
Prepared By:.....EA
Prepared For:....USAEC

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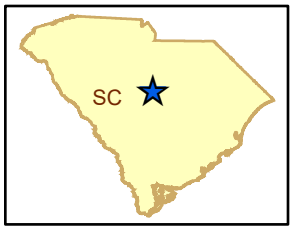
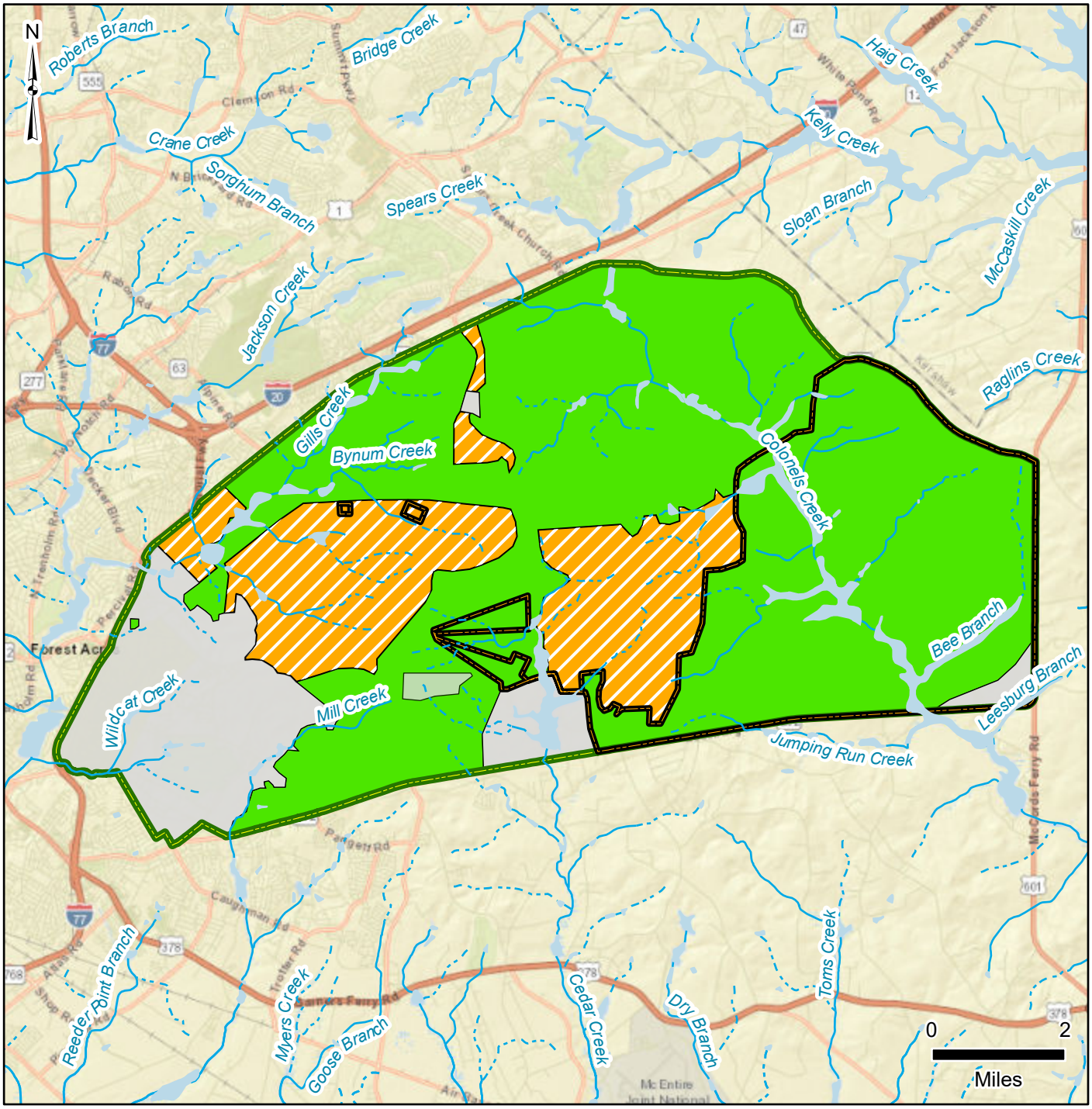
Figure 2-4
Previous Assessment Conclusions





Installation Data
- Fort Jackson Installation Boundary
- McCrady Training Center Boundary
- Non-Operational Area

Phase II Range Conclusions
- Potential MCOC Source Area
- Unlikely

Hydrology
- Perennial Stream/Creek
- Intermittent Stream/Creek
- Waterbody

Data Sources:
ESRI 2023
EA 2023
Pike-Pirnie JV, LLC 2014

Date:.....May 2023
Prepared By:.....EA
Prepared For:....USAEC

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3.0 Advanced Assessment

A CSM is developed to identify and describe the relationships between potential on-range sources of MC, possible off-range migration routes, and suspected off-range receptors. The CSM integrates and interprets information from a variety of resources to assess the potential existence of complete pathways and evaluate source-receptor interactions. CSM development is an iterative process and requires continual refinement. As knowledge and understanding of the site changes based on additional data collected, the CSM is revised to accurately represent current conditions (U.S. Army Corps of Engineers 2003).

As part of the Advanced Assessment, each component of the previous CSM (developed during the Phase II Investigation) was re-evaluated to determine if any changes to associated sources, pathways, or receptors have occurred. The updated CSM was then used to help determine whether potential MC was migrating off-range.

An Advanced Assessment was performed at Fort Jackson/McCrady Training Center to verify and update the installation's operational range inventory; ascertain the overall conditions of the operational range footprint; determine existing and potential best management practices; and determine if potential exists for MCOC to migrate to off-range areas and if such off-range migration poses an unacceptable risk to human health or the environment.

To accomplish the ORA objectives identified in Section 1.0, the following activities were conducted: a re-evaluation of previous investigations, data collection and document review (pertaining to each CSM component), interviews, a site reconnaissance, and the collection of confirmatory surface water and sediment samples. The initial site reconnaissance was conducted at Fort Jackson on 21–23 August 2018. An additional site reconnaissance was conducted on 9 March 2023 at McCrady Training Center, following the sampling event, which was conducted on 8 March 2023.

All information collected during the Advanced Assessment was used to develop an updated CSM **(Figure 3-1)**, which is described in more detail below.

3.1 Conceptual Site Model

Based on current geographic information system data, Fort Jackson/McCrady Training Center encompass 148 operational ranges covering 51,322.78 acres. The ranges within the combined installation areas include 55 maneuver/training areas, 56 firing ranges, 4 dudded impact areas, 15 non-dudded impact areas, and 18 historic impact areas. The remaining 7,591 acres (approximately) consist of the non-operational cantonment area.

Source

Munitions used at Fort Jackson/McCrady Training Center's operational ranges include small, medium, and large caliber; pyrotechnics and obscurants; and other weapon systems. Based on the types of munitions used and results of the Phase II ORA sampling efforts, metals (lead, antimony, copper, and zinc), explosives (HMX, RDX, trinitrotoluene, 2,4-DNT, 2,6-DNT, and pentaerythritol tetranitrate), perchlorate, and white phosphorus area identified as potential MCOC. The annual munitions usage at Fort Jackson and McCrady Training Center has fluctuated since the Phase II ORA data collection. Since 2014, the average annual munitions expenditures have increased at Fort Jackson, and on average, there has been a decrease in munition expenditures at McCrady Training Center. Consistent with Phase II, the majority of munitions expenditures are small arms at Fort Jackson/McCrady Training Center. The annual average of small arms munitions has increased, with approximately 28,428,085 live-fire small arms rounds expended annually at

Fort Jackson, and approximately 1,151,191 live-fire small arms rounds expended annually at McCrady Training Center. The southeast section of McCrady Training Center consists of a historical source area, due to the live-fire training range complex utilized in the 1950s–1960s, that was active until the 1960s. Within this southeast section, the orientation of shooting originated from the perimeter to the middle of the installation, from southeast to northwest, south to north, and north to south. Source areas at Fort Jackson include firing ranges, impact areas, non-dudded impact areas, maneuver and training areas, and historic impact areas. Notable ranges include Range 19, Range 18, and Range 17, which are located within the Mill Creek Watershed. Based on recent Range Facility Management Support System data, these ranges are used for large quantities of small caliber munition expenditures. **Table 3-1** summarizes munitions expenditures based on munitions category at Fort Jackson from 2002–2006 (data provided from the Phase II ORA), and from the previous assessment to the present (2014–2023). **Table 3-2** summarizes munitions expenditures based on caliber at McCrady Training Center from 2002–2006, and from the previous assessment to the present.

Table 3-1: Fort Jackson Total Munition Expenditure Summary

Munition Category	Phase II (2002-2006)	Advanced Assessment (2006-2023)[a]
Large Caliber	218	8,039
Large Caliber Practice	0	11,427
Medium Caliber	40,000	97,547
Medium Caliber Practice	80,000	1,493,541
Small Caliber	14,241,400	454,849,352
Small Caliber Practice	569,000	20,223,546
Pyrotechnic/Obscurant	6,731	102,160
Other	42,050	1,205,652
Other Practice	96,080	4,435,450
Non-lethal Round	0	1,357,445
Total	15,357,000[b]	483,784,176

Notes:
(a) The previous assessment evaluated data from 2002–2006. The munitions data evaluated for the Advanced ORA Assessment includes data from 2006- March 2023.
(b) The previous report munitions total also accounts for unknown munition expenditures.

Table 3-2: McCrady Training Center Total Munition Expenditure Summary

Munition Category	Phase II (2002-2006)	Advanced Assessment (2006-2023)[a]
Large Caliber	1,677	4,560
Large Caliber Practice	0	62
Medium Caliber	65,000	15,202
Medium Caliber Practice	2,400	233,509
Small Caliber	1,896,000	18,419,061
Small Caliber Practice	4,430	97,485
Pyrotechnic/Obscurant	95	13,599
Other	3,830	168,352
Other Practice	0	183
Non-lethal Round	0	2,260
Total	17,335,000[b]	18,954,273

Notes:
(a) The previous assessment evaluated data from 2002–2006. The munitions data evaluated for the Advanced ORA Assessment includes data from 2006- March 2023.
(b) The previous report munitions total also accounts for unknown munition expenditures.

Pathway

Fort Jackson and McCrady Training Center are drained by three major surface water drainage basins including Colonels Creek, Cedar Creek, and Gills Creek. Colonels Creek includes Jumping Run Creek and drains the eastern portion of the combined installation boundary, with flow entering through the eastern corner of Fort Jackson and leaving through the eastern corner of McCrady Training Center. Cedar Creek includes Weston Lake at the south-central installation boundary. Gills Creek watershed drains most of the western portion of Fort Jackson with the exception of Mill Creek on the southwest side. In the cantonment area, Wildcat Creek contributes to the lower part of Gills Creek.

During the ORA Phase II, eight locations were sampled from three watersheds, including two locations in Colonels Creek (including Jumping Run Creek), two locations in Cedar Creek (which includes Weston Lake), and four locations in Gills Creek. Samples were analyzed and comparisons were then made to screening criteria that indicated that there were no issues associated with surface water and sediment concentrations in the Cedar or Colonels Creek watersheds. Gills Creek had surface water and sediment concentrations above screening criteria and additional consideration was given to these concentrations in a SLERA.

Due to similar source, pathway, and receptor characteristics, the Cedar Creek watershed was chosen as the primary proxy for the Mill Creek surface water system in the Phase II Assessment.

Based on the results of a SLERA for Gills Creek, there was a concern about lead and copper in the surface water and sediment. A potential for adverse health effects in aquatic life in surface water was recommended to be assessed farther downstream of Boyden Arbor Pond at the installation boundary. The extent to which sediment may be altered during migration downstream of Boyden Arbor Pond is unknown (based on a possible change in acceptable concentrations due to low pH in surface water and low TOC in sediment) and it was recommended that further assessment may be warranted for those reasons.

With plans for sampling in Gills Creek to be done under another environmental program, other sampling sites were considered for the ORAP sampling with the ultimate selection of: 1) Mill Creek for surface water and sediment since this water body was not previously sampled and, 2) Colonels Creek and Jumping Run to assess surface water and sediment concentrations leaving the installation along with allowing for definition of contributions from Fort Jackson and McCrady Training Center, respectively.

Groundwater below the combined installation boundary occurs within unconsolidated sediments and the underlying bedrock. Precipitation falling on ranges at Fort Jackson and McCrady Training Center may infiltrate through the vadose zone and enter the groundwater system. Most groundwater recharging the Middendorf Aquifer is expected to remain within the shallow and intermediate flow system and ultimately discharge to local streams and rivers. Within the Gills Creek Watershed this means that water will likely be discharged to Gills Creek before leaving the installation. This is similarly true for much of the operational range area lying within the Cedar Creek and Colonels Creek watersheds. However, the topography within the central and western portions of the combined installation is much more variable with topographically higher hills dissected by streams creating deeper valleys. Precipitation that infiltrates these higher areas farther from adjoining streams is more likely to enter the intermediate or deeper flow system and bypass lower order streams, especially during the dry season. The intermediate and deeper flow system ultimately discharges to larger order streams to the south and southwest of the installation.

The area south of the southern installation boundary is generally considered to be hydraulically downgradient of most of the operational range area. For the area located west of Weston Lake, groundwater is unlikely to be utilized for drinking water purposes because the area is connected to a municipal supply

system. Well logs obtained from Fort Jackson and the South Carolina Department of Natural Resources indicate that the aquifers to the south and southeast of the installations are utilized for drinking water. Numerous groundwater supply wells are utilized to supply recreational facilities at Weston Lake. Additionally, numerous residential drinking water wells and larger supply wells were identified in the area south of the operational range area and to the east of Weston Lake. The overwhelming majority of wells screened within the Middendorf Aquifer are screened above elevations of 175 feet above mean sea level. This is particularly true for wells located within one to two miles of the installation boundary.

During the ORA Phase II, groundwater was sampled downgradient of a "Groundwater Assessment Area" that was meant to represent a worst-case scenario for MCOC presence. In 2009, there were groundwater samples collected and analyzed from intervals in 5 soil borings and also from 2 piezometers, and the Weston Lake supply well (all sampled once). In 2012-2013, there were samples collected and analyzed from 6 shallow/deep wells pairs (sampled 3 times over a year). Sample results indicated evidence of explosive concentrations.

Since the ORA Phase II, 194 groundwater samples have been collected from off-post residential wells along the southern installation boundary; RDX was detected in samples from 31 wells. As a result, the Army has treated the water or provided bottled water to residents. This additional on-and off-post sampling has led to the delineation of an explosives plume in groundwater.

Explosives in south-central groundwater are considered the worst-case scenario for the groundwater system in the Advanced Assessment. Since the recent sampling (and all of the off-post sampling) has been handled outside the ORA program, no groundwater sampling was planned for this Advanced Assessment.

Receptors

Receptors that are potentially affected by potential MCOC migrating off-range via surface water and/or groundwater pathways include human and ecological receptors. Aquifers to the south and southeast of the installations are utilized for drinking water and numerous groundwater supply wells are utilized to supply recreational facilities at Weston Lake. Additionally, numerous residential drinking water wells and larger supply wells were identified in the area south of the combined installations and to the east of Weston Lake. Additionally, the Fort Jackson Family and Morale, Welfare and Recreation division maintains recreational facilities on Weston Lake for military personnel and guests (U.S. Army Morale, Welfare and Recreation 2022). Other recreational users could be using the Old Heises Pond area in the Mill Creek Watershed. Twin Lakes is also in the Mill Creek Watershed but has been lower or emptied since historic flooding in 2015.

Potential ecological receptors affected via surface water include the sensitive wetland habitats downstream of operational areas and threatened and endangered species. There are approximately 5,250 acres of wetlands on Fort Jackson (U.S. Army Garrison Fort Jackson 2021). Fort Jackson provides habitat for one resident federally listed endangered animal species, the Red-cockaded Woodpecker (*Dryobates borealis*) (U.S. Army Garrison Fort Jackson 2021).

3.2 Advanced Assessment – Problem Definition

The Site-Specific Quality Assurance Project Plan (SSQAPP) contains detailed plans for execution of the Advanced Assessment at Fort Jackson/McCrady Training Center. The strategy for conducting the Advanced Assessment is based on the application of the USEPA systematic planning or DQO process. The DQO process provides an iterative sequence of seven logical steps to create a detailed technical approach. The following sections describe the major outputs of the site-specific application of the DQO process,

including the updated CSM and the detailed technical approach (i.e., Advanced Assessment) as documented in the Final SSQAPP for Fort Jackson/McCrady Training Center.

This Advanced Assessment was conducted to determine if there is a release or substantial threat of a release of MC from an operational range to an off-range area; if a release exists, determine whether the release of MC from an operational range to an off-range area exceeds an applicable regulatory reporting standard; and also determine whether the release or substantial threat of a release of MC from an operational range to an off-range area creates a potential unacceptable risk to human health or the environment. The Advanced Assessment was designed to answer the following questions:

- Is there a presence of MC in off-range media of concern (surface water or sediment)?
- Is there sufficient evidence present to show an off-range MC release or potential threat of off-range MC release exists?
- Does any release exceed an applicable regulatory reporting standard?
- Does any release create a potential unacceptable risk to human health or the environment?

If the answer to all these questions is "no" for a given range or study area, then the previous ORA finding remains accurate and the ranges are categorized as Unlikely. If the answer to any of the above questions is "yes" for a range or study area, then the MC release conditions may have changed to the point that the ranges/range complexes being re-evaluated should be recategorized as Inconclusive or Referred.

3.3 Surface Water System Investigation

3.3.1 Surface Water System Sampling Approach

Sampling locations for surface water and sediment were selected based on the updated CSM, which included a review of previous ORA Phase II sampling results, changes in range use and/or configuration, surface water hydrology, drainage area, and location of downstream human and/or ecological receptors. The sampling locations included are shown on **Figure 3-2**:

- **SWCC3** – Located at the off-range discharge point of the perennial Colonels Creek and draining all of Colonels Creek on Fort Jackson/ McCrady Training Center. Represents concentrations leaving the installation (combined flow from Fort Jackson/McCrady Training Center).
- **SWCC4** – Located at the off-range discharge point at the Fort Jackson/McCrady Training Center property boundary on perennial Colonels Creek. Represents upgradient concentrations for McCrady Training Center.
- **SWMC1** – Located in the upper reach of perennial Mill Creek receiving drainage from several live-fire ranges to the north. Represents concentrations leaving the source area to non-operational area prior to downstream ponds.
- **SWMC2** – Located in the central portion of perennial Mill Creek downstream of the ponded area within nonoperational area. Receives flow from the upper reach and discharge into the ponded area.

Represents concentrations leaving the ponded area, and upstream of possible baseflow from local landfills.

- **SWMC3** – Located in the lower portion of perennial Mill Creek at the installation boundary within nonoperational area. Receives flow from upgradient source areas and possibly baseflow from groundwater from local landfill sites. Represents concentrations leaving the installation.

- **SWJC1** – Located at the off-range discharge point at the McCrady Training Center property boundary for a 2-mile-long section of perennial Jumping Run Creek that flows along the southern boundary and associated Inconclusive range area. Represents concentrations leaving the installation.

- **SWCC2** – Located in a perennial tributary to Colonels Creek on the northeast side of the watershed that drains Unlikely range area. Represents background MCOC concentrations. The location will be used for Colonels Creek and for Mill Creek (which does not have a reference channel in its own watershed).

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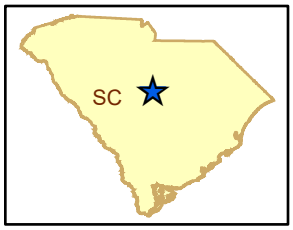
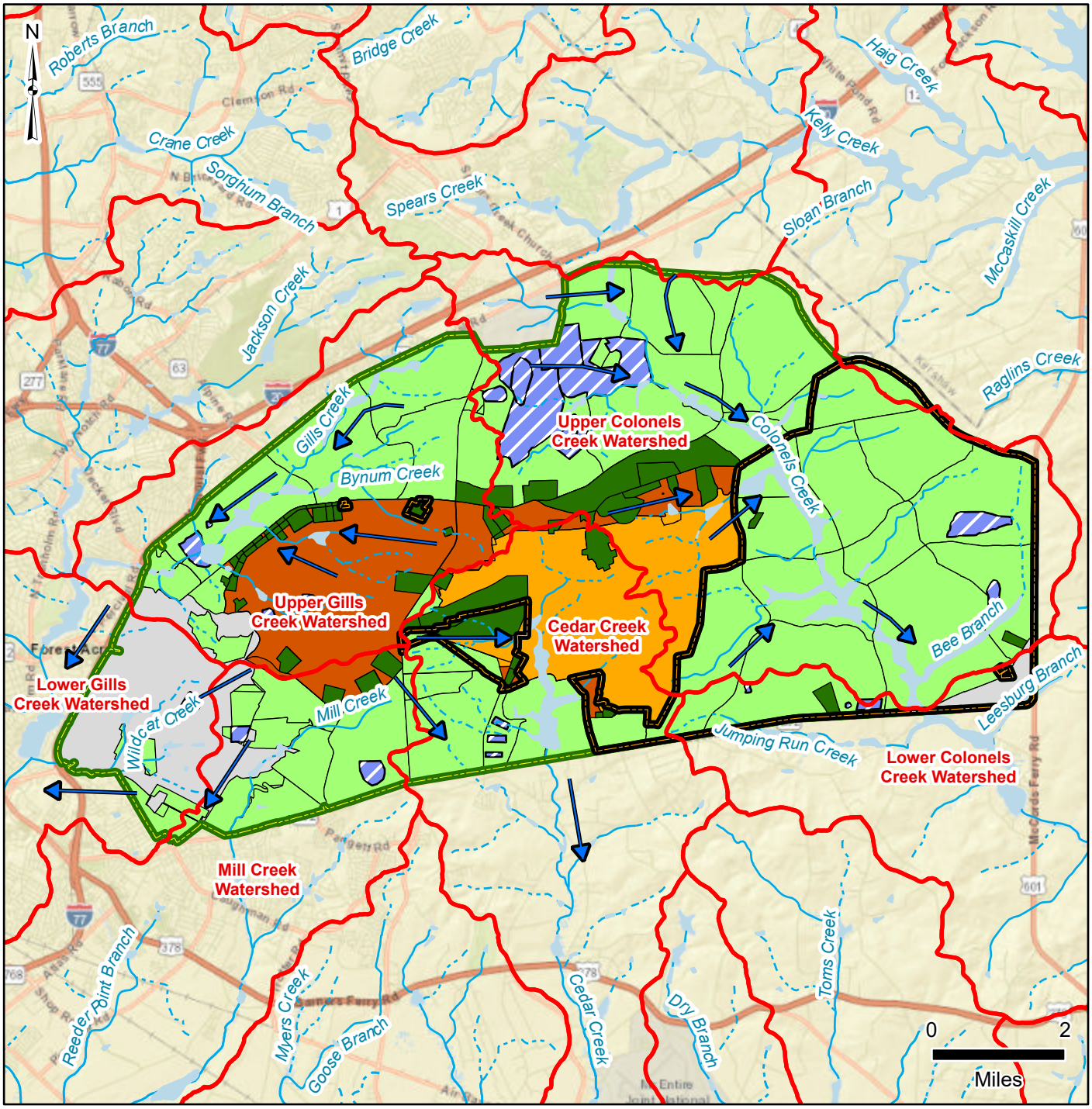
South Carolina

Figure 3-1
Surface Water Conceptual Site Model





Installation Data
- Fort Jackson Installation Boundary
- McCrady Training Center Boundary
- Non-Operational Area

Range Type
- Firing Range
- Dudded Impact Area
- Non-Dudded Impact Area
- Historic Impact Area
- Maneuver and Training Area

Hydrology
- Surface Water Flow Direction
- Perennial Creek/Stream
- Intermittent Creek/Stream
- Waterbody
- Watershed Boundary

Data Sources:
ESRI 2023
EA 2023
Pike-Pirnie JV, LLC 2014

Date:.....May 2023
Prepared By:.....EA
Prepared For:....USAEC

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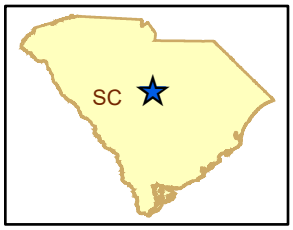
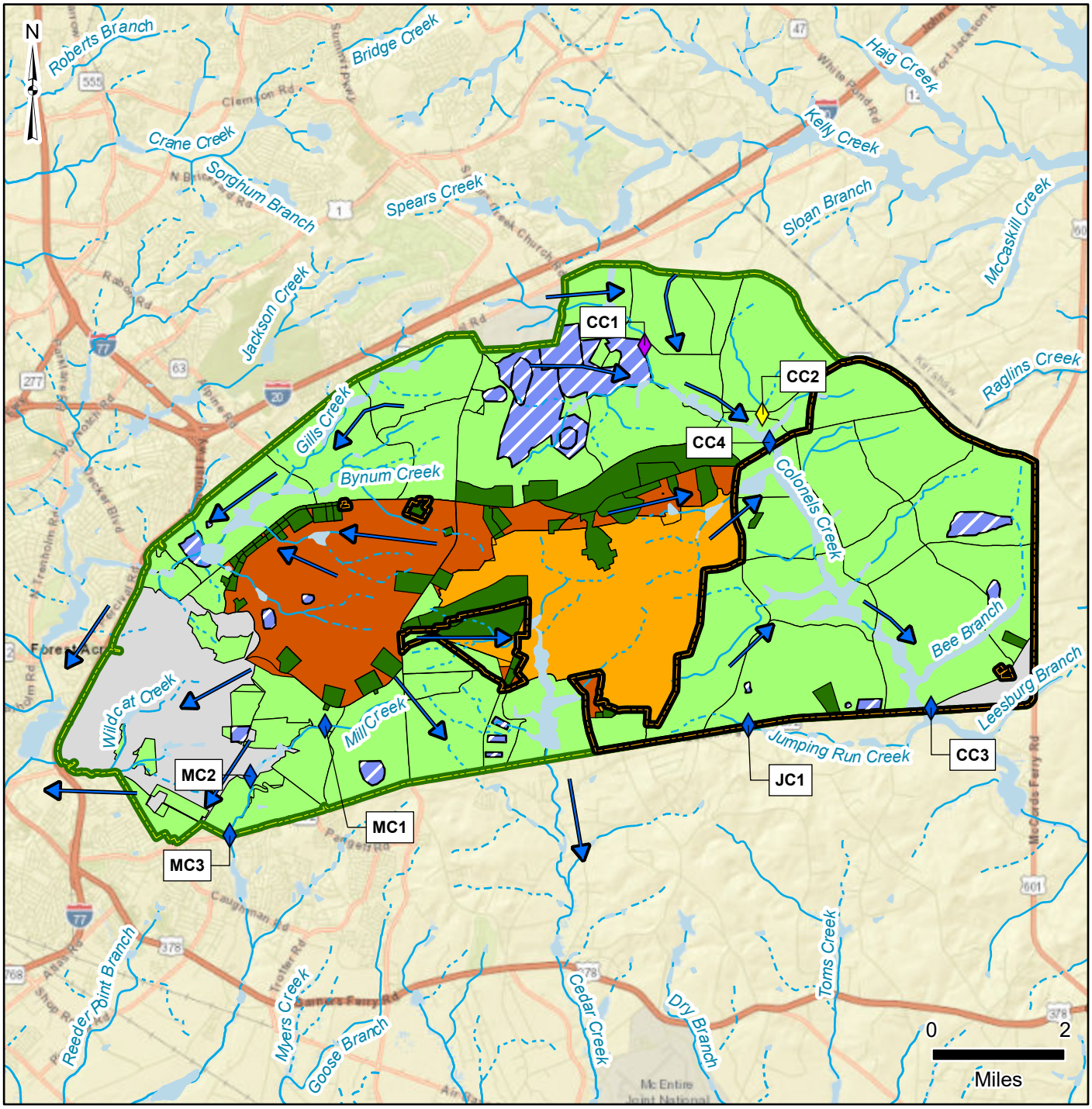
South Carolina

Figure 3-2
Advanced Assessment Sample Locations





Installation Data
- Fort Jackson Installation Boundary
- McCrady Training Center Boundary
- Firing Range
- Dudded Impact Area
- Non-Dudded Impact Area
- Historic Impact Area
- Maneuver and Training Area
- Non-Operational Area

Sample Locations
- Downstream
- Reference
- Alternate Reference

Hydrology
- Surface Water Flow Direction
- Perennial Creek/Stream
- Intermittent Creek/Stream
- Waterbody

Data Sources:
ESRI 2023
EA 2023
Pike-Pirnie JV, LLC 2014

Date:.....May 2023
Prepared By:.....EA
Prepared For:....USAEC

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4.0 Methodology

Field activities were conducted in accordance with the Advanced Assessment SSQAPP (EA 2023). The SSQAPP was based on procedures in the U.S. Army ORAP Phase II Investigation Protocol (USACHPPM 2009); the structure of the USACHPPM Protocol and Work Plan follow the *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA 2006). Details on the sampling and analytical procedures are included in the SSQAPP along with the Accident Prevention Plan, which is included as an appendix to the SSQAPP. Additionally, all applicable sampling Standard Operating Procedures were followed for all sampling activities.

Samples collected during the Advanced Assessment were submitted to Katahdin Analytical Laboratories, DoD Environmental Laboratory Accreditation Program certified laboratories, under strict chain-of-custody procedures. Sample chain-of-custody forms are presented in **Appendix B**.

Safety procedures and unexploded ordnance (UXO) avoidance procedures were employed during all sampling activities in accordance with the Accident Prevention Plan. UXO avoidance procedures began prior to field activities with close coordination between EA and the installation Point of Contact. For ORA Advanced Assessment activities occurring on the installation, a UXO technician accompanied EA personnel and ensured that proper UXO avoidance procedures were followed for sampling events.

A photographic log of the field activities is presented in **Appendix C**.

4.1 Surface Water and Sediment Sampling Investigation

4.1.1 Sampling Events

During the Advanced Assessment, one round of surface water and one round of sediment sampling were conducted at six downstream locations and one reference location. Sediment samples were co-located with surface water samples. A summary of the samples collected is presented in **Table 4-1.**

Table 4-1: Surface Water System Sampling Summary

Media Sampled	Dry Season (March 2023) Clear Weather
Surface Water	One grab sample
Sediment	One composite sample

4.1.2 Surface Water Sample Collection Methods

All sampling events were carried out in accordance with the SSQAPP. The sampling approach followed a modified approach for perennial surface water systems based on the USACHPPM Protocol, without seasonal and storm sampling requirements. One grab surface water sample was collected during clear weather in one mobilization for a total of one surface water sample. One composite sediment sample was collected concurrently with the surface water sample. Samples were collected from seven locations, six downstream off-range discharge locations and one upstream reference location.

Surface water samples were collected using a peristaltic pump, peristaltic tubing, and a sample bottle. Because these grab samples were manually collected, the suction line was not secured on the stream bank or bottom. Instead, it was secured to a PVC pipe and lowered into the water (approximately two-thirds of

the stream depth). Once lowered to the desired depth, approximately 2 liters of water were transferred into laboratory-supplied containers. In addition to the native sample, the team collected the QA/QC samples associated with the specific location.

Field measurements of pH, temperature, dissolved oxygen, turbidity, specific conductivity, and oxidation-reduction potential were made during the sampling event.

4.1.3 Sediment Sample Collection Methods

Sediment samples consisted of 10 subsamples taken from various areas of the wetted perimeter of the stream. Sediment samples were collected in shallow surface water locations using a new disposable plastic scoop and bowl liner.

The sediment sampling procedure was as follows:

- The individual performing the sampling donned sterile latex gloves, obtained a clean liner/plastic bag, and obtained a new disposable plastic scoop.
- Starting downstream of the area to be sampled and moving upstream, at least 10 subsamples of the loose upper sediment deposits, not to exceed 3 centimeters in depth, were slowly scooped from an area where recently deposited sediment had collected.
- The scoops of sediment were carefully placed in the plastic bag, ensuring that fines were not lost during the scooping process. When sufficient volume was obtained, the scoop was used to remove large twigs, leaves, and other debris. Using a clean disposable pipette, the excess water from the sediment was decanted, and care was taken not to remove any fines. Allowing the sample to settle assisted in this effort.
- The bag was massaged to thoroughly mix the sample.
- The scoop was then used to fill sampling containers completely with sediment.

4.1.4 Surface Water and Sediment Analysis

Surface water was analyzed for:

- Munitions-related dissolved metals (antimony, copper, lead, and zinc) via USEPA 6020A
- Explosives via USEPA 8330B
- Hardness via USEPA SM2340B
- Perchlorate via USEPA 6860
- Biotic Ligand Model (BLM) parameters: temperature, pH (E150.1), dissolved organic carbon (USEPA 9060A), humic acid (USEPA 9060A), major cations (USEPA 6010B) and major anions (USEPA 300.0), and alkalinity (E310.1). The in-situ pH value was supplied from a calibrated probe at the time of sample collection.

- Field parameters: pH, conductivity, temperature, oxidation reduction potential, dissolved oxygen, and turbidity.

Sediment was analyzed for:

- Explosives via USEPA 8330B
- Munitions-related total metals (antimony, copper, lead, and zinc) via USEPA Method 6020A
- Simultaneously extracted metals (SEM)/acid volatile sulfide (AVS) via USEPA 821/R-91-100/EPA 6010
- Total organic carbon via Lloyd Kahn procedure.

4.2 Field Quality Assurance/Quality Control

QA/QC samples were collected to evaluate the surface water and sediment field collection methods and the laboratory analytical techniques. The QA/QC samples consisted of duplicate samples, matrix spike (MS)/matrix spike duplicate (MSD) samples, equipment blanks, and container blanks.

4.2.1 Field Duplicates

Duplicate samples were collected at a rate of one per 10 samples for surface water. All sample setup and collection procedures will be the same for surface water samples and field duplicates. All duplicate samples were submitted to the laboratory as indistinguishable samples and were labeled accordingly.

4.2.2 Matrix Spike/Matrix Spike Duplicates

MS/MSD samples were collected at a rate of one per 20 samples for surface water and sediment. Standard MS/MSD samples (triplicate volume: one for the native sample, one for the MS sample, and one for MSD sample) were collected for all analytes at the MS/MSD location. MS/MSDs were noted on sample labels and chains-of-custody. Chains-of-custody are included in **Appendix B**.

4.2.3 Equipment Blanks

Equipment blanks were collected at a minimum rate of one per 20 samples for surface water in accordance with the SSQAPP. For surface water, sample collection consisted of pumping laboratory-provided deionized water through all the tubing and filters. No sediment equipment blanks were required because dedicated and disposable equipment was used for sample collection.

4.2.4 Container Blanks

Container blanks were collected at a minimum rate of one per 20 samples for surface water. No sediment container blanks were collected per the USACHPPM Protocol. Container blanks were collected in accordance with the SSQAPP and consisted of pouring laboratory-provided deionized water directly into sample containers.

4.3 Data Validation and Completeness

An independent third-party reviewer, Environmental Data Services, LTD. performed Stage 2B validation on 90 percent of the laboratory data and stage 4 on 10 percent of the laboratory data. Validation was completed in accordance with the QAPP, the DoD Quality Systems Manual Revision 5.3, the USEPA National Functional Guidelines, and the DoD validation guidance as follows:

- USEPA National Functional Guideline for Inorganic Data Review, January 2017a
- USEPA National Functional Guidance for Organic Data Review, January 2017b
- DoD General Data Validation Guidelines, November 2019.

A Tier IV Data Validation Report was prepared for each Sample Delivery Group as assigned by the laboratory. Data validation reports are included as **Appendix E**.

There were no major issues identified for any of the data during validation. All the data were sufficiently precise and accurate for use. However, there were some minor issues that resulted in qualification of the data. The data validation qualifiers include:

- J = The analyte was positively identified; however, the result is estimated because of discrepancies in meeting certain analyte specific quality control criteria.

- U = The analyte was analyzed for, but not detected or is qualified as non-detected because of blank contamination.

- UJ = The analyte was not detected; however, the result is estimated because of discrepancies in meeting certain analyte-specific QC criteria.

The minor issues associated with blank contamination are as follows:

- The equipment blank associated with surface water samples had positive detections of antimony, calcium, copper, magnesium, water hardness, and zinc. All positive surface water results associated with this equipment blank were evaluated and qualified per validation guidance.

- The method blank associated with sediment samples had positive detections of SEM cadmium, SEM zinc, copper, lead, and zinc. Additionally, the calibration blank had positive detections of SEM cadmium and SEM zinc. Positive sediment results associated with these blanks were evaluated and qualified per validation guidance.

- The method blank associated with the surface water samples had positive detections of antimony, calcium, copper, magnesium, potassium, and zinc. Positive surface water results associated with this method blank were evaluated and qualified per validation guidance.

The minor issues associated with calibrations are as follows:

- The continuing calibration verification (CCV) for total organic carbon recovered below the QC limits. All the total organic carbon results were “J” qualified.

- The CCV for magnesium in samples JACKSON-CB-01 and JACKSON-EB-01 had a recovery above QC limits. The magnesium results in samples JACKSON-CB-01 and JACKSON-EB-01 were "J+" qualified.

The minor issues associated with MS/MSDs are as follows:

- The MS/MSD of sample JACKSON-SDMC3-DC-01 had a recovery outside QC limits for antimony. Antimony was qualified as "J" in sample JACKSON-SDMC3-DC-01.

- The MS/MSD of sample SDDUP had a recovery below QC limits for AVS. AVS was qualified "UJ" in sample SDDUP.

The minor issues associated with laboratory control samples are as follows:

- The laboratory control sample associated with all sediment samples had a recovery outside QC limits for total organic carbon. All total organic carbon results were qualified as "J" in sediment samples.

The minor issues associated with percent difference are as follows:

- The CCV had a percent difference outside QC limits for tetryl associated with sediment samples. All sediment tetryl results were qualified "UJ."

The minor issues associated with surrogates are as follows:

- The surrogate recoveries for explosives associated with the sediment sample JACKSON-SDMC1-DC-01 were below QC limits. Results for explosives were qualified "UJ" in sample JACKSON-SDMC1-DC-01.

- The surrogate recoveries for explosives associated with the surface water sample JACKSON-SWJC1-DC-01 were below QC limits. Results for explosives were qualified "UJ" in sample JACKSON-SWJC1-DC-01.

The minor issues associated with holding time exceedances are as follows:

- Sample JACKSON-SWCC2-DC-01 was analyzed 2 days outside of the 14-day holding time for alkalinity. The alkalinity result in sample JACKSON-SWCC2-DC-01 was "UJ" qualified.

The usability of the qualified data for risk assessment and decision-making was not impaired. The narratives from the data validation package are presented in **Appendix E**.

4.4 Screening Values/Criteria

Validated analytical results were compared to a prioritized list of regulatory standards and screening values (hereinafter referred to as "comparison values") as detailed in the Draft Operational Range Assessment Comparison Values Guidance (Draft Operational Range Assessment Comparison Values Guidance, December 2017). The DoD Components will use the following hierarchy for comparing sampling and modeling data:

- Applicable state-specific regulatory values
- Federal regulatory values
- State-specific screening values
- Federal screening values

Where there are multiple values for the same MC from the same source, the DoD Component will use the most conservative value (Draft Operational Range Assessment Comparison Values Guidance, December 2017).

Ecological screening levels for copper, lead, and zinc in surface water are dependent upon site-specific water hardness. The final ecological screening values were adjusted based on a site-specific minimum hardness of 25 milligrams per liter as specified in South Carolina regulations. Additionally, the BLM was used to further assess the potential impact of site-specific water chemistry on metals toxicity. The BLM data were used to calculate sample-specific criteria for comparison to copper detections from surface water results. BLM-adjusted screening levels can be more representative of site-specific water quality conditions than hardness-adjusted screening levels in waters with higher dissolved organic carbon and low hardness. Therefore, if a copper detection exceeded the hardness-derived screening level, then it was compared to the BLM-adjusted screening level. BLM values are specific to the conditions in which the parameters were collected; therefore, values cannot be used for statistical comparison.

Sediment samples were analyzed for SEM/AVS and total organic carbon. As part of the weight-of-evidence evaluation, the ΣSEM/AVS ratio and the fraction of organic carbon (f_{oc}) were used to determine the bioavailability of metals to benthic organisms and assist in determining if the detected concentrations of divalent cations may, or may not, cause toxicity to benthic organisms.

4.5 Data Analysis

4.5.1 Data Validation

The first step in the process of screening MCOC was the evaluation of analytical data on the basis of qualifiers and the frequency of detection in each medium of concern. Inclusion or exclusion of data on the basis of analytical qualifiers was performed in accordance with the 2017 USEPA National Functional Guidelines:

- Analytical results bearing the U qualifier (indicating that the analyte was not detected at the given detection limit) or UJ qualifier (indicating that the analyte was not detected and the quantitation limit may be inaccurate or imprecise) were retained in the data set and considered non-detects. Where warranted for statistical purposes, each non-detect MCOC was assigned a numerical value of its full limit of detection.

- Analytical results bearing the J qualifier indicating that the reported value was estimated because the analyte was detected at a concentration between the detection limit and the limit of quantitation or because there were quality control criteria outside acceptable limits were retained at the measured concentration.

4.5.2 Surface Water and Sediment Data Analysis

Due to the contractual modification of the USACHPPM Protocol, which consisted of a single grab sample at each location, a statistical analysis was not performed on surface water or sediment sampling results. Instead, a direct comparison to the associated screening levels was used in a discussion of the sampling results.

4.6 Data Uncertainty

As specified in the USACHPPM Protocol, uncertainty of the data obtained should be considered. For the surface water system at Fort Jackson/McCrady Training Center, data uncertainty was related to temporal and hydrologic variability when collecting a single grab sample. Relying on a single sample to provide a complete assessment of the data removes the possibility for a statistical analysis and allows for anomalous results from that single point in time in which the sample was taken. Additionally, a single grab sample does not represent a chronic condition. In order to limit data uncertainty, it is recommended that composite surface water samples are collected over a specified period of time (24-hour period for clear weather sampling events and 2-hour period for storm sampling events) during the wet and dry seasons to capture the temporal and hydrologic variability and reduce data uncertainty. While the calculation of statistical parameters to establish a representative measure of site conditions is limited when collecting a smaller data set, the collection of composite surface water samples aids in reducing data uncertainty. Additionally, selecting the worst-case scenario for MC migration aids in answering the study question of whether sufficient evidence to show off-range MC migration or release.

For surface water analysis, the sample analysis method identified in the 2023 Fort Jackson/McCrady Training Center SSQAPP was USEPA SW6020A, which analyzes dissolved metals (antimony, copper, lead, and zinc) at low concentration levels. Due to the detection limits provided in this analytical method and the low water hardness found at Fort Jackson/McCrady Training Center there is a greater likelihood of data uncertainty, and this is due to ecological screening levels of metals being below reported detection limits.

4.7 Deviations from the Site-Specific Quality Assurance Project Plan

A deviation from the SSQAPP occurred during sample collection at Fort Jackson/McCrady Training Center. Samples for explosives were not collected from the reference location, CC2, as sampling for background concentrations of these compounds was not considered necessary based on a review of current and historic range use and given no detections in previous samples.

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5.0 Advanced Assessment Results and Discussion

Analytical data tables presenting the individual surface water and sediment sampling results are provided in **Appendix F**. Results for metals MCOC are summarized in **Table 5-1** and **Table 5-2**. **Figure 5-1** and **Figure 5-3** show the comparison between the sample results and the screening levels for metals MCOC in surface water and sediment, respectively. **Figure 5-2** and **Figure 5-4** show the comparison between the downstream concentrations and the reference concentrations at each sample location for metals MCOC in surface water and sediment, respectively.

5.1 Surface Water and Sediment Sampling Results

For surface water, results are initially compared to the state regulatory standards (ecological) based on the hierarchy described in Section 4.4. In cases where the result exceeds its state ecological regulatory standard, the result also exceeds the federal ecological standard due to the more conservative calculation of the federal screening level based on site-specific hardness as opposed to a floor value of 25 milligram per kilogram (mg/kg) of calcium carbonate used for state screening level calculations.

5.1.1 SWCC3 – Colonels Creek

For surface water, lead (0.34 microgram per liter [µg/L]) did not exceed the value of lead at the reference location; however, the value exceeded the state specific freshwater ecological regulatory level of 0.02 µg/L. No detected concentrations of antimony, copper, or zinc exceeded their respective reference values and did not exceed the freshwater ecological regulatory levels. Additionally, no explosives were detected in surface water. The perchlorate value did not exceed the reference value and did not exceed the screening value.

For sediment, no downstream concentrations of metals MC were found to be greater than their respective reference concentrations. Additionally, no concentrations of metals MC exceeded their respective ecological sediment screening levels. The ΣSEM/AVS ratios were less than 1 and the normalized ΣSEM-AVS/f_{oc} ratios were less than 130 micromoles per gram of organic carbon (µmol/g_{oc}). No explosives were detected in sediment.

5.1.2 SWCC4 – Colonels Creek

For surface water, lead (0.26 µg/L) did not exceed the value of lead at the reference location; however, the value exceeded the state specific freshwater ecological regulatory level of 0.02 µg/L. No detected concentrations of antimony, copper, or zinc exceeded their respective reference values and did not exceed the ecological regulatory levels. Additionally, no explosives were detected in surface water. The perchlorate value did not exceed the reference and did not exceed the screening value.

For sediment, no downstream concentrations of metals MC were found to be greater than the reference concentrations. Additionally, no concentrations of metals MC exceeded the ecological sediment screening levels. The ΣSEM/AVS ratios were less than 1 and the normalized ΣSEM-AVS/f_{oc} ratios were less than 130 µmol/g_{oc}. No explosives were detected in sediment.

5.1.3 SWMC1 – Mill Creek

For surface water, no detected concentrations of antimony, copper, lead, or zinc exceeded their respective reference values and did not exceed the ecological regulatory levels. Additionally, no explosives or perchlorate were detected in surface water.

For sediment, no downstream concentrations of metals MC were found to be greater than the reference concentrations. Additionally, no concentrations of metals MC exceeded the ecological sediment screening levels. The ΣSEM/AVS ratios were less than 1 and the normalized ΣSEM-AVS/f_{oc} ratios were less than 130 µmol/g_{oc}. No explosives were detected in sediment.

5.1.4 SWMC2 – Mill Creek

For surface water, lead (3.25 µg/L) exceeded the reference value of 0.853 J µg/L. Additionally, lead exceeded the state specific freshwater ecological regulatory level of 0.12 µg/L. No detected concentrations of antimony, copper, or zinc exceeded their respective reference values and did not exceed the ecological regulatory levels. No explosives were detected in surface water. The perchlorate value did not exceed the reference value and did not exceed the screening level value.

For sediment, no downstream concentrations of metals MC were found to be greater than the reference concentrations. Additionally, no concentrations of metals MC exceeded the ecological sediment screening levels. The ΣSEM/AVS ratios were less than 1 and the normalized ΣSEM-AVS/f_{oc} ratios were less than 130 µmol/g_{oc}. No explosives were detected in sediment.

5.1.5 SWMC3 – Mill Creek

For surface water, lead exceeded the reference value of 0.853 J µg/L. Additionally, lead (2.18 µg/L) exceeded the state specific freshwater ecological regulatory level of 0.1 µg/L. No detected concentrations of antimony, copper, or zinc exceeded their respective reference values and did not exceed the ecological regulatory levels. No explosives were detected in surface water. The perchlorate value did not exceed the reference value and did not exceed the screening level value.

For sediment, no downstream concentrations of metals MC were found to be greater than the reference concentrations. Additionally, no concentrations of metals MC exceeded the ecological sediment screening levels. The ΣSEM/AVS ratios were less than 1 and the normalized ΣSEM-AVS/f_{oc} ratios were less than 130 µmol/g_{oc}. No explosives were detected in sediment.

5.1.6 SWJC1 – Jumping Run Creek

For surface water, no detected concentrations of antimony, copper, lead, or zinc exceeded their respective reference values and did not exceed the ecological regulatory levels. Additionally, no explosives or perchlorate were detected in surface water.

For sediment, no downstream concentrations of metals MC were found to be greater than the reference concentrations. Additionally, no concentrations of metals MC exceeded the ecological sediment screening levels. The ΣSEM/AVS ratios were less than 1 and the normalized ΣSEM-AVS/f_{oc} ratios were less than 130 µmol/g_{oc}. No explosives were detected in sediment.

1585 **Table 5-1: Surface Water Result Summary**

Analyte	Comparison to Screening Value			Comparison to Reference Value		
	PAL (µg/L)[a]	Sample Result (µg/L)	Exceeds Screening Value (Y/N)	Sample Result (µg/L)	Reference Value (µg/L)	Exceeds Reference Value (Y/N)
SWCC3						
Antimony	30	< 0.5 U	N	< 0.5 U	< 0.5 U	N
Copper [b]	0.28	< 2.0 U	N	< 2.0 U	< 2.0 U	N
Lead [b]	0.02	**0.34 J**	**Y**	0.34 J	0.853 J	N
Zinc [b]	3.7	< 8.0 U	N	< 8.0 U	< 8.0 U	N
Perchlorate [c]	15	0.019 J	N	0.019 J	< 0.10 U	N
SWCC4						
Antimony	30	< 0.5 U	N	< 0.5 U	< 0.5 U	N
Copper [b]	0.28	< 2.0 U	N	< 2.0 U	< 2.0 U	N
Lead [b]	0.02	**0.26 J**	**Y**	0.26 J	0.853 J	N
Zinc [b]	3.7	< 8.0 U	N	< 8.0 U	< 8.0 U	N
Perchlorate [c]	15	0.015 J	N	0.015 J	< 0.10 U	N
SWMC1						
Antimony	30	< 0.5 U	N	< 0.5 U	< 0.5 U	N
Copper [b]	0.36	< 2.0 U	N	< 2.0 U	< 2.0 U	N
Lead [b]	0.03	< 0.5 U	N	< 0.5 U	0.853 J	N
Zinc [b]	4.8	< 8.0 U	N	< 8.0 U	< 8.0 U	N
Perchlorate [c]	15	< 0.10 U	N	< 0.10 U	< 0.10 U	N
SWMC2						
Antimony	30	< 0.5 U	N	< 0.5 U	< 0.5 U	N
Copper [b]	1	< 2.0 U	N	< 2.0 U	< 2.0 U	N
Lead [b]	0.12	**3.25**	**Y**	**3.25**	0.853 J	**Y**
Zinc [b]	13.6	< 8.0 U	N	< 8.0 U	< 8.0 U	N
Perchlorate [c]	15	0.023 J	N	0.023 J	< 0.10 U	N
SWMC3						
Antimony	30	< 0.5 U	N	< 0.5 U	< 0.5 U	N
Copper [b]	0.84	< 2.0 U	N	< 2.0 U	< 2.0 U	N
Lead [b]	0.1	**2.18**	**Y**	**2.18**	0.853 J	**Y**
Zinc [b]	11.4	< 8.0 U	N	< 8.0 U	< 8.0 U	N
Perchlorate [c]	15	0.028 J	N	0.028 J	< 0.10 U	N
SWJC1						
Antimony	30	< 0.5 U	N	< 0.5 U	< 0.5 U	N
Copper [b]	0.28	< 2.0 U	N	< 2.0 U	< 2.0 U	N
Lead [b]	0.02	< 0.5 U	N	< 0.5 U	0.853 J	N
Zinc [b]	3.7	< 8.0 U	N	< 8.0 U	< 8.0 U	N
Perchlorate [c]	15	< 0.10 U	N	< 0.10 U	< 0.10 U	N

Notes:
(a) PALs refer to South Carolina Water Classifications & Standards Regulations (R.61-68) Freshwater Criterion (2020). The PAL for Antimony refers to USEPA National Recommended Water Quality Criteria.
(b) Screening level provided based on hardness value found at each location.
(c) PAL for perchlorate refer to US EPA National Primary Drinking Water Regulations, Maximum Contaminant Levels (MCL).
µg/L = Microgram(s) per liter
Bold indicates that the sample result exceeds the associated ecological regulatory level PAL.

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1588 **Table 5-2: Sediment Result Summary**

Analyte	Comparison to Screening Value			Comparison to Reference Value		
	PAL (mg/kg)[a]	Sample Result (mg/kg)	Exceeds Screening Value (Y/N)	Sample Result (mg/kg)	Reference Value (µg/L)	Exceeds Reference Value (Y/N)
SWCC3						
Antimony	2.0	0.025 J	N	0.025 J	0.15 J	N
Copper	31.6	< 0.18 U	N	< 0.18 U	21.6	N
Lead	35.8	1.78	N	1.78	33.3	N
Zinc	121	< 0.71 U	N	< 0.71 U	8.5	N
SWCC4						
Antimony	2.0	0.02 J	N	0.02 J	0.15 J	N
Copper	31.6	1.42	N	1.42	21.6	N
Lead	35.8	0.815	N	0.815	33.3	N
Zinc	121	1.5	N	1.5	8.5	N
SWMC1						
Antimony	2.0	0.14 J	N	0.14 J	0.15 J	N
Copper	31.6	4.81	N	4.81	21.6	N
Lead	35.8	7.01	N	7.01	33.3	N
Zinc	121	4.66	N	4.66	8.5	N
SWMC2						
Antimony	2.0	0.025 J	N	0.025 J	0.15 J	N
Copper	31.6	0.32	N	0.32	21.6	N
Lead	35.8	1.48	N	1.48	33.3	N
Zinc	121	< 0.85 U	N	< 0.85 U	8.5	N
SWMC3						
Antimony	2.0	0.08 J	N	0.08 J	0.15 J	N
Copper	31.6	1.18	N	1.18	21.6	N
Lead	35.8	7.84	N	7.84	33.3	N
Zinc	121	4.11	N	4.11	8.5	N
SWJC1						
Antimony	2.0	0.023 J	N	0.08 J	0.15 J	N
Copper	31.6	0.4	N	1.18	21.6	N
Lead	35.8	0.747	N	7.84	33.3	N
Zinc	121	< 0.88 U	N	4.11	8.5	N

Notes:
(a) PALs refer to the lower of the USEPA Region 4 Freshwater Sediment Screening Values (2018) and the USEPA Region 3 Freshwater Sediment Screening Benchmarks (BTAG) (August 2006)
Bold indicates that the sample result exceeds the associated USEPA freshwater ecological regulatory level PAL.

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5.2 Surface Water and Sediment Discussion

For surface water metals results, the sample analysis method identified in the 2023 Fort Jackson/McCrady Training Center SSQAPP is USEPA SW6020A. This method was followed for dissolved metals (antimony, copper, lead, and zinc) analysis at low concentration levels. However, because of higher detection limits associated with this analytical method, greater data uncertainty is likely if presented with laboratory method blank contamination, as was observed during the analysis of the Fort Jackson/McCrady Training Center surface water metals samples. Additionally, based on the surface water, state ecological screening values that were calculated from site-specific water hardness, SW6020A analytical method detection limits for metals were not sensitive enough when comparing to the ecological screening values in streams with low water hardness. Specifically for Fort Jackson/McCrady Training Center, water hardness values ranged from 2 mg/L to 8 mg/L of CaCO3 during the March sampling event, which resulted in low ecological screening values. It should be noted that water hardness is impacted by seasonal variations and the low hardness observed during the Advanced Assessment sampling effort does not necessarily represent hardness in other seasons.

Because of these higher detection limits, which were exacerbated by laboratory method blank contamination and the low water hardness, no determination can be made to evaluate if metals concentrations, including antimony, copper, and zinc, in surface water exceed the hardness-calculated ecological screening values. Based on these factors, it is recommended that future ORA assessments analyze surface water at Fort Jackson/McCrady Training Center using USEPA 1638 and follow a multi-seasonal sampling approach to provide a more robust dataset that benefits from a statistical analysis of the data results. USEPA 1638 utilizes lower detection limits and employs more stringent laboratory techniques that minimize potential cross-contamination during the analysis process. Therefore, USEPA 1638 is the preferred analytical method for sites with low water hardness.

5.2.1 Colonels Creek

Surface water sampling results indicate that there is no migration of metals, explosives, or perchlorate at SWCC3 or SWCC4, since no downstream concentrations exceeded reference concentrations. Therefore, there is no range-related risk to downstream receptors. Although the downstream concentration of lead at both SWCC3 and SWCC4 exceeded the screening criteria, concentrations did not exceed reference and the risk is not attributable to range activities.

For sediment at Colonels Creek, no metals exceeded their respective reference concentrations or exceeded their respective ecological screening levels. Therefore, there is no migration from the operational range area and sediment does not pose a potential risk to downstream ecological receptors. As no explosives were detected, there is no migration from the operational range area and no risk to off-range receptors. Additionally, the ΣSEM/AVS ratios less than 1 and the normalized ΣSEM-AVS/f_{oc} ratios less than 130 μmol/g_{oc}, indicate that divalent metals should not cause direct toxicity to benthic organisms.

During the 2014 ORA Phase II, antimony, copper, lead, and zinc were detected in surface water at values above the reference values in individual sampling events conducted at SWCC3. Antimony exceeded the reference values from two wet sampling events. Copper exceeded the reference values from one dry sampling event, one storm sampling event, and two wet sampling events. Lead exceeded the reference values from one dry sampling event, one storm sampling event, and two wet sampling events. Zinc exceeded the reference value from one dry sampling event. Based on these reference value exceedances, there is evidence of potential range-related MC migration in surface water. In sediment, antimony, copper, lead, and zinc were detected at values above the reference values in individual sampling events. Antimony

exceeded the reference values from one wet sampling event. Copper exceeded the reference values from two dry sampling events and one wet sampling event. Lead exceeded the reference values from two dry sampling events and one wet sampling event. Zinc exceeded the reference values from two dry sampling events and one wet sampling event. Therefore, there is evidence of potential range-related MC migration in sediment. No MC were detected above the PALs in surface water or sediment at the downstream location in Colonels Creek; therefore, there was no risk identified to potential receptors. SWCC4 was not sampled during the 2014 ORA Phase II, so there are no prior data to compare to the Advanced Assessment sampling results.

It was noted that analyte values for all metals were found to be higher in the Colonels Creek reference location sediment samples than in all downstream location sediment samples during the 2023 sampling event. This is consistent to the 2014 ORA Phase II, where notably high analyte values were collected at the same reference location. In particular, the 2014 data showed that lead exceeded the PAL during one dry sampling event. The consistently high analyte values found in the reference location may influence where migration is determined. An additional reference location sampled in 2014, showed lower analyte values, and this location could be considered for future monitoring.

5.2.2 Mill Creek

Surface water sampling results at SWMC1 indicate that there is no migration of metals, explosives, or perchlorate at SWMC1, since none of these analytes exceeded their respective reference comparison values or ecological screening levels. Therefore, there is no migration from the operational range area and no risk to downstream receptors. For sediment at SWMC1, no metals or explosives exceeded their reference comparison values or respective ecological screening. Therefore, there is no migration from the operational range area and sediment does not pose a potential risk to downstream ecological receptors. Additionally, the ΣSEM/AVS ratios less than 1 and the normalized ΣSEM-AVS/f_{oc} ratios less than 130 μmol/g_{oc}, indicate that divalent metals should not cause direct toxicity to benthic organisms.

Surface water sampling results at SWMC2 and SWMC3 indicate that lead is migrating off-range due to the lead value exceeding the reference value, via Mill Creek, downstream of the ponded area within nonoperational area and from upgradient source areas. Additionally, the lead value exceeded the ecological screening level, indicating there is a potential risk to downstream receptors. For sediment at SWMC2 and SWMC3, no metals or explosives exceeded their respective ecological screening levels or reference comparison values. Therefore, there is no migration from the operational range area and sediment does not pose a potential risk to downstream ecological receptors. Additionally, the ΣSEM/AVS ratios less than 1 and the normalized ΣSEM-AVS/f_{oc} ratios less than 130 μmol/g_{oc}, indicate that divalent metals should not cause direct toxicity to benthic organisms.

No location in Mill Creek was sampled during the 2014 ORA Phase II, so there are no prior data to compare to the Advanced Assessment sampling results.

Sampling locations, SWSC2 and SWMC3, were suspected to potentially receive baseflow from groundwater from an adjacent landfill site. Due to the elevated lead concentrations found at SWMC2 and SWMC3, local landfill data was assessed. Fort Jackson personnel confirmed two Installation Restoration Program (IRP) sites are located upstream of SWMC2 and SWMC3: Solid Waste Management Unit (SWMU) 21 (Construction Debris Landfill- Range 17) and Area of Concern (AOC) K (Soils Evaluation Adjacent to SWMU 21). AOC K was granted a No Further Action (NFA) status per the Hazardous Waste Permit SC3 210 020 449 that was issued in 2010 (U.S. Army Garrison Fort Jackson 2020). Based on this classification, it is unlikely the Advanced Assessment ORA sampling exceedances were influenced by AOC

K. Sampling results from 2022, provided by installation personnel, indicate that lead has been reported at a maximum value of 5.6 µg/L in one of three monitoring wells for SWMU21, and values of 0.33 µg/L and 0.36 µg/L were detected in the two additional monitoring wells. These values exceed the state specific freshwater ecological regulatory level used under the ORA investigation (0.12 µg/L for MC2 and 0.1 µg/L for MC3). The location of SWMU 21 is upstream of all three sampling locations at Mill Creek, but it is possible that there is underflow SWMC1 and that dissolved lead from the landfill enters the stream as baseflow farther downgradient. It cannot be confirmed whether SWMU 21 is partially contributing to the lead exceedances at SWMC2 and SWMC3 or if the operational range area of Fort Jackson contributed to the exceedances, as Range 19, Range 18, and Range 17, or if another source exists in the watershed.

5.2.3 Jumping Run Creek

Surface water sampling results indicate that there is no migration from metals, explosives, or perchlorate at SWJC1, since none of these analytes exceeded their respective reference comparison values; therefore, there is no migration from the operational range area. Additionally, metals, explosives, or perchlorate did not exceed the ecological screening levels, so there is no risk to downstream receptors.

For sediment, no metals or explosives exceeded their respective reference comparison values or ecological screening levels. Therefore, there is no migration from the operational range area and sediment does not pose a potential risk to downstream ecological receptors. Additionally, the ΣSEM/AVS ratios less than 1 and the normalized ΣSEM-AVS/f_{oc} ratios less than 130 µmol/g_{oc} indicate that divalent metals should not cause direct toxicity to benthic organisms.

During the 2014 ORA Phase II, antimony, copper and lead were detected in surface water at values above the reference values in individual sampling events. Antimony exceeded the reference value from one dry sampling event, copper exceeded the reference value from one wet sampling event, and lead exceeded the reference value from one dry sampling event. Based on these reference value exceedances, there is evidence of potential range-related MC migration in surface water. In sediment, copper, lead, and zinc were detected at values above the reference values in individual sampling events. Copper exceeded the reference values from two dry sampling events and one wet sampling event. Lead exceeded the reference values from two dry sampling events and one wet sampling event. Zinc exceeded the reference values from two dry sampling events and one wet sampling event. Therefore, there is evidence of potential range-related MC migration in sediment. No MC were detected above the PALs in surface water or sediment at the downstream location in Jumping Run Creek; therefore, there was no risk identified to potential receptors.

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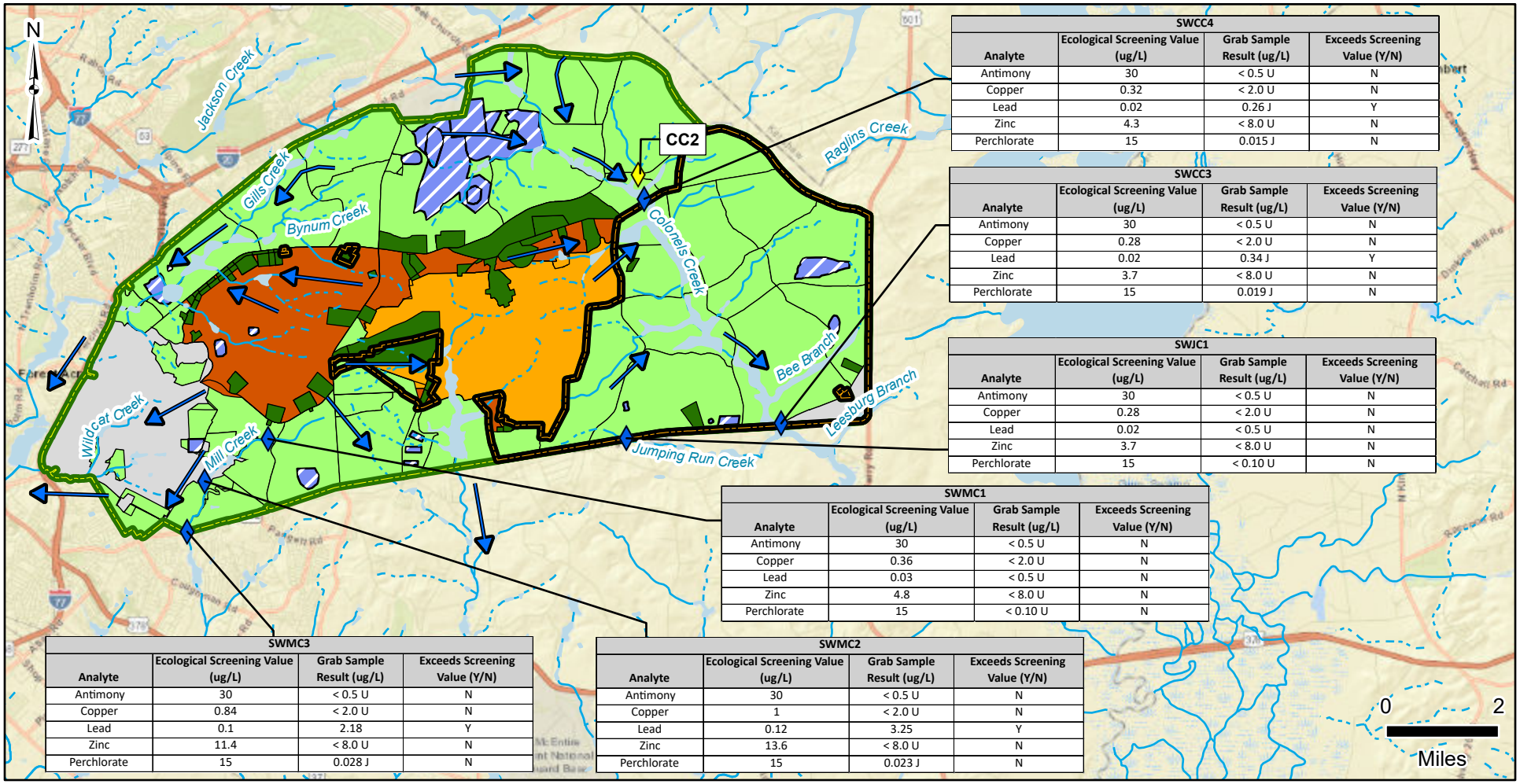
Figure 5-1
Surface Water Sampling Results Comparison to Screening Level



SWCC4			
Analyte	Ecological Screening Value (ug/L)	Grab Sample Result (ug/L)	Exceeds Screening Value (Y/N)
Antimony	30	< 0.5 U	N
Copper	0.32	< 2.0 U	N
Lead	0.02	0.26 J	Y
Zinc	4.3	< 8.0 U	N
Perchlorate	15	0.015 J	N

SWCC3			
Analyte	Ecological Screening Value (ug/L)	Grab Sample Result (ug/L)	Exceeds Screening Value (Y/N)
Antimony	30	< 0.5 U	N
Copper	0.28	< 2.0 U	N
Lead	0.02	0.34 J	Y
Zinc	3.7	< 8.0 U	N
Perchlorate	15	0.019 J	N

SWJC1			
Analyte	Ecological Screening Value (ug/L)	Grab Sample Result (ug/L)	Exceeds Screening Value (Y/N)
Antimony	30	< 0.5 U	N
Copper	0.28	< 2.0 U	N
Lead	0.02	< 0.5 U	N
Zinc	3.7	< 8.0 U	N
Perchlorate	15	< 0.10 U	N

SWMC1			
Analyte	Ecological Screening Value (ug/L)	Grab Sample Result (ug/L)	Exceeds Screening Value (Y/N)
Antimony	30	< 0.5 U	N
Copper	0.36	< 2.0 U	N
Lead	0.03	< 0.5 U	N
Zinc	4.8	< 8.0 U	N
Perchlorate	15	< 0.10 U	N

SWMC3			
Analyte	Ecological Screening Value (ug/L)	Grab Sample Result (ug/L)	Exceeds Screening Value (Y/N)
Antimony	30	< 0.5 U	N
Copper	0.84	< 2.0 U	N
Lead	0.1	2.18	Y
Zinc	11.4	< 8.0 U	N
Perchlorate	15	0.028 J	N

SWMC2			
Analyte	Ecological Screening Value (ug/L)	Grab Sample Result (ug/L)	Exceeds Screening Value (Y/N)
Antimony	30	< 0.5 U	N
Copper	1	< 2.0 U	N
Lead	0.12	3.25	Y
Zinc	13.6	< 8.0 U	N
Perchlorate	15	0.023 J	N

Installation Data
- Fort Jackson Installation Boundary
- McCrady Training Center Boundary
- Firing Range
- Dudded Impact Area
- Non-Dudded Impact Area
- Historic Impact Area
- Maneuver and Training Area
- Non-Operational Area

Sample Locations
- Downstream
- Reference

Hydrology
- Surface Water Flow Direction
- Perennial Creek/Stream
- Intermittent Creek/Stream
- Waterbody

Data Sources:
ESRI 2023
EA 2023
Pike-Pirnie
JV, LLC 2014

Date:.....May 2023
Prepared By:.....EA
Prepared For:....USAEC

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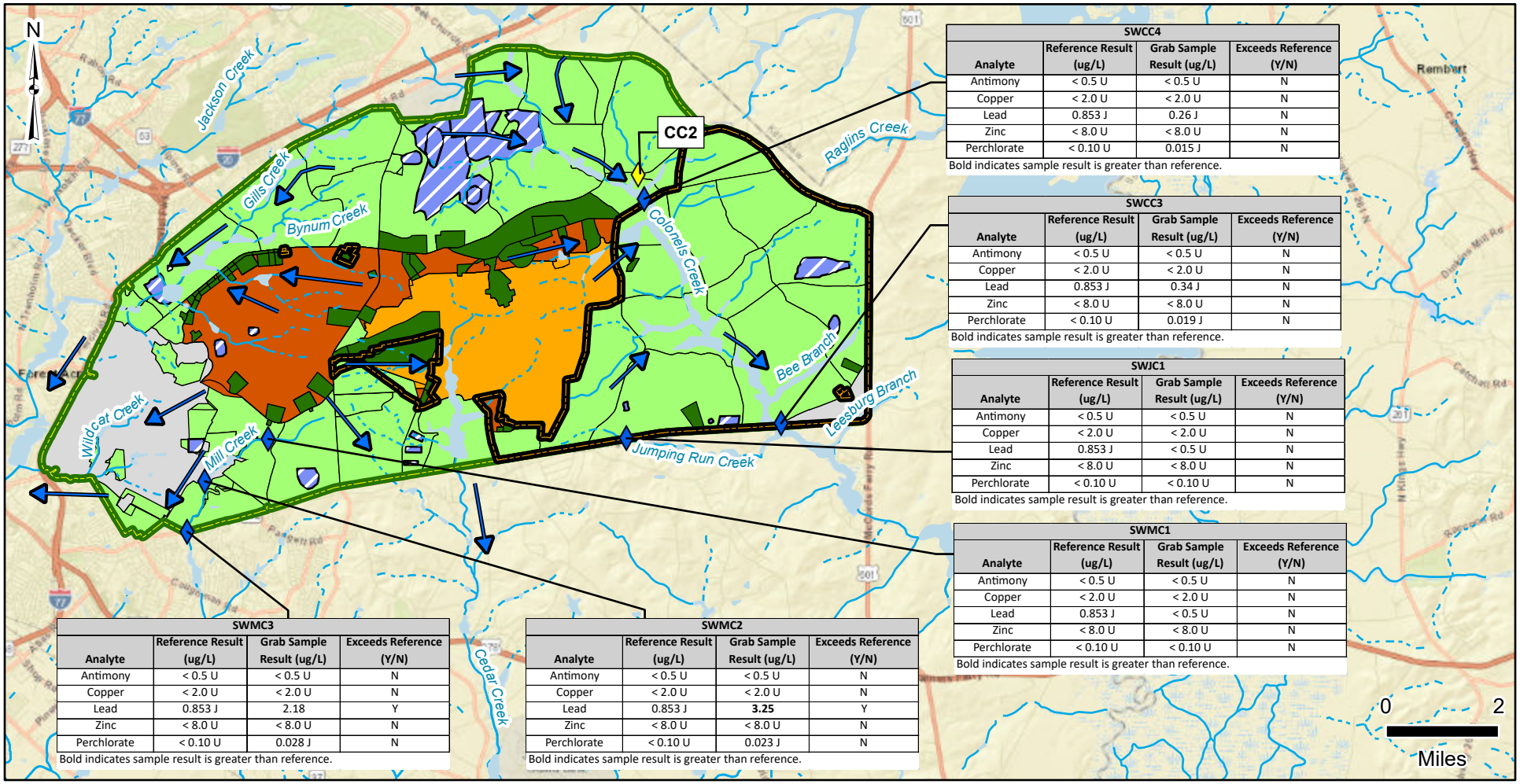
U.S. Army FY18-22 ORA Cycle
Advanced Assessment Report
Fort Jackson / McCrady Training Center,
South Carolina

Figure 5-2
Surface Water Sampling Results Comparison to Reference



SWCC4			
Analyte	Reference Result (ug/L)	Grab Sample Result (ug/L)	Exceeds Reference (Y/N)
Antimony	< 0.5 U	< 0.5 U	N
Copper	< 2.0 U	< 2.0 U	N
Lead	0.853 J	0.26 J	N
Zinc	< 8.0 U	< 8.0 U	N
Perchlorate	< 0.10 U	0.015 J	N

Bold indicates sample result is greater than reference.

SWCC3			
Analyte	Reference Result (ug/L)	Grab Sample Result (ug/L)	Exceeds Reference (Y/N)
Antimony	< 0.5 U	< 0.5 U	N
Copper	< 2.0 U	< 2.0 U	N
Lead	0.853 J	0.34 J	N
Zinc	< 8.0 U	< 8.0 U	N
Perchlorate	< 0.10 U	0.019 J	N

Bold indicates sample result is greater than reference.

SWJC1			
Analyte	Reference Result (ug/L)	Grab Sample Result (ug/L)	Exceeds Reference (Y/N)
Antimony	< 0.5 U	< 0.5 U	N
Copper	< 2.0 U	< 2.0 U	N
Lead	0.853 J	< 0.5 U	N
Zinc	< 8.0 U	< 8.0 U	N
Perchlorate	< 0.10 U	< 0.10 U	N

Bold indicates sample result is greater than reference.

SWMC1			
Analyte	Reference Result (ug/L)	Grab Sample Result (ug/L)	Exceeds Reference (Y/N)
Antimony	< 0.5 U	< 0.5 U	N
Copper	< 2.0 U	< 2.0 U	N
Lead	0.853 J	< 0.5 U	N
Zinc	< 8.0 U	< 8.0 U	N
Perchlorate	< 0.10 U	< 0.10 U	N

Bold indicates sample result is greater than reference.

SWMC3			
Analyte	Reference Result (ug/L)	Grab Sample Result (ug/L)	Exceeds Reference (Y/N)
Antimony	< 0.5 U	< 0.5 U	N
Copper	< 2.0 U	< 2.0 U	N
Lead	0.853 J	2.18	Y
Zinc	< 8.0 U	< 8.0 U	N
Perchlorate	< 0.10 U	0.028 J	N

Bold indicates sample result is greater than reference.

SWMC2			
Analyte	Reference Result (ug/L)	Grab Sample Result (ug/L)	Exceeds Reference (Y/N)
Antimony	< 0.5 U	< 0.5 U	N
Copper	< 2.0 U	< 2.0 U	N
Lead	0.853 J	**3.25**	Y
Zinc	< 8.0 U	< 8.0 U	N
Perchlorate	< 0.10 U	0.023 J	N

Bold indicates sample result is greater than reference.

Installation Data
- Fort Jackson Installation Boundary
- McCrady Training Center Boundary
- Firing Range
- Dudded Impact Area
- Non-Dudded Impact Area
- Historic Impact Area
- Maneuver and Training Area
- Non-Operational Area

Sample Locations
- Downstream
- Reference

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- Surface Water Flow Direction
- Perennial Creek/Stream
- Intermittent Creek/Stream
- Waterbody

Data Sources:
ESRI 2023
EA 2023
Pike-Pirnie
JV, LLC 2014

Date:.....May 2023
Prepared By:.....EA
Prepared For:....USAEC

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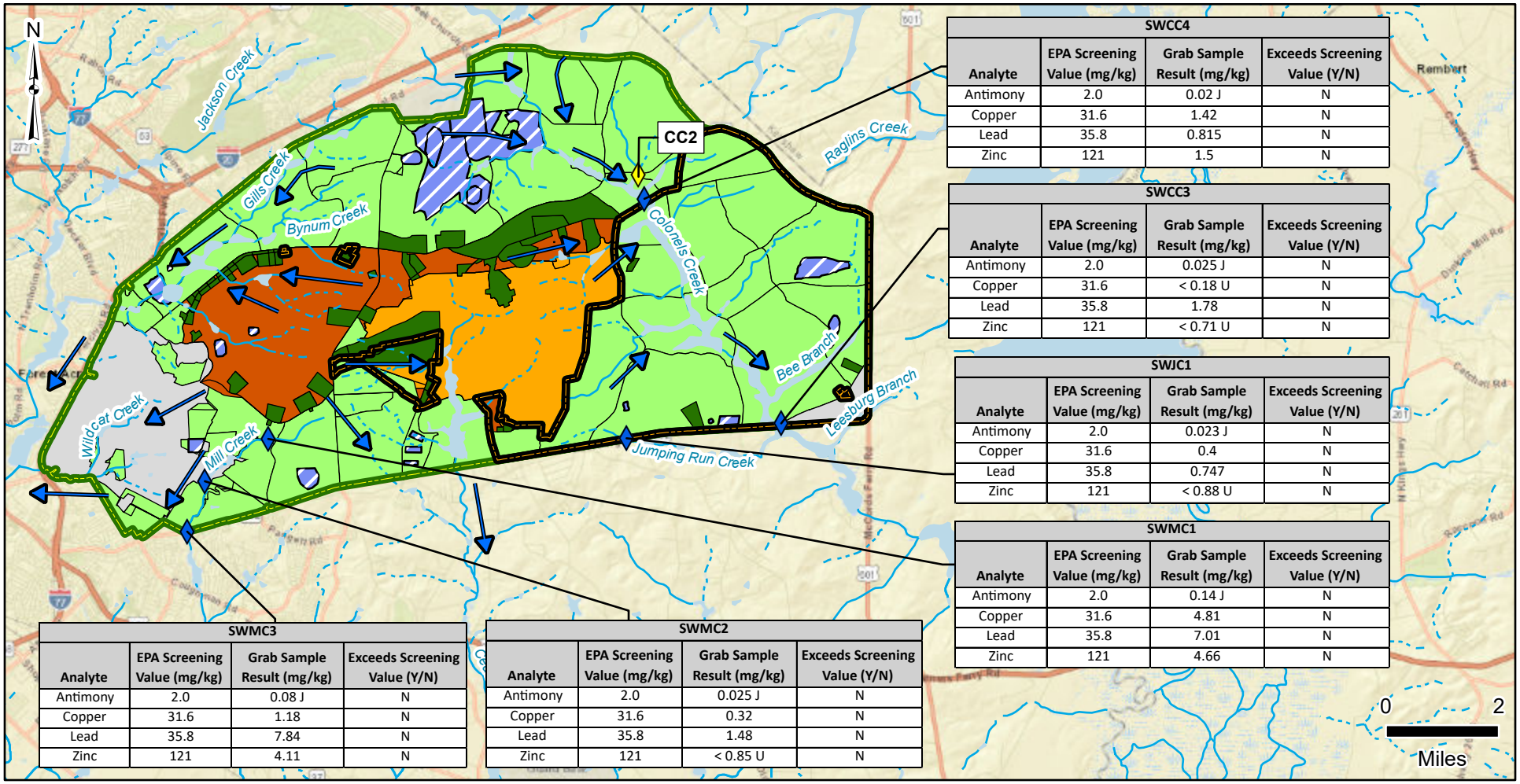
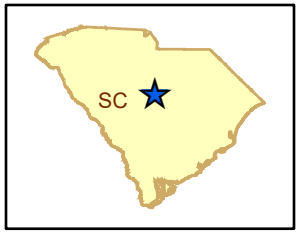
Advanced Assessment Report
Fort Jackson / McCrady Training Center,
South Carolina

Figure 5-3
Sediment Sampling Results Comparison to Screening Level





SWCC4

Analyte	EPA Screening Value (mg/kg)	Grab Sample Result (mg/kg)	Exceeds Screening Value (Y/N)
Antimony	2.0	0.02 J	N
Copper	31.6	1.42	N
Lead	35.8	0.815	N
Zinc	121	1.5	N

SWCC3

Analyte	EPA Screening Value (mg/kg)	Grab Sample Result (mg/kg)	Exceeds Screening Value (Y/N)
Antimony	2.0	0.025 J	N
Copper	31.6	< 0.18 U	N
Lead	35.8	1.78	N
Zinc	121	< 0.71 U	N

SWJC1

Analyte	EPA Screening Value (mg/kg)	Grab Sample Result (mg/kg)	Exceeds Screening Value (Y/N)
Antimony	2.0	0.023 J	N
Copper	31.6	0.4	N
Lead	35.8	0.747	N
Zinc	121	< 0.88 U	N

SWMC1

Analyte	EPA Screening Value (mg/kg)	Grab Sample Result (mg/kg)	Exceeds Screening Value (Y/N)
Antimony	2.0	0.14 J	N
Copper	31.6	4.81	N
Lead	35.8	7.01	N
Zinc	121	4.66	N

SWMC3

Analyte	EPA Screening Value (mg/kg)	Grab Sample Result (mg/kg)	Exceeds Screening Value (Y/N)
Antimony	2.0	0.08 J	N
Copper	31.6	1.18	N
Lead	35.8	7.84	N
Zinc	121	4.11	N

SWMC2

Analyte	EPA Screening Value (mg/kg)	Grab Sample Result (mg/kg)	Exceeds Screening Value (Y/N)
Antimony	2.0	0.025 J	N
Copper	31.6	0.32	N
Lead	35.8	1.48	N
Zinc	121	< 0.85 U	N

Installation Data
- Fort Jackson Installation Boundary
- McCrady Training Center Boundary
- Firing Range
- Dudded Impact Area
- Non-Dudded Impact Area
- Historic Impact Area
- Maneuver and Training Area
- Non-Operational Area

Sample Locations
- Downstream
- Reference

Hydrology
- Surface Water Flow Direction
- Perennial Creek/Stream
- Intermittent Creek/Stream
- Waterbody

Data Sources:
ESRI 2023
EA 2023
Pike-Pirnie
JV, LLC 2014

Date:.....May 2023
Prepared By:.....EA
Prepared For:....USAEC

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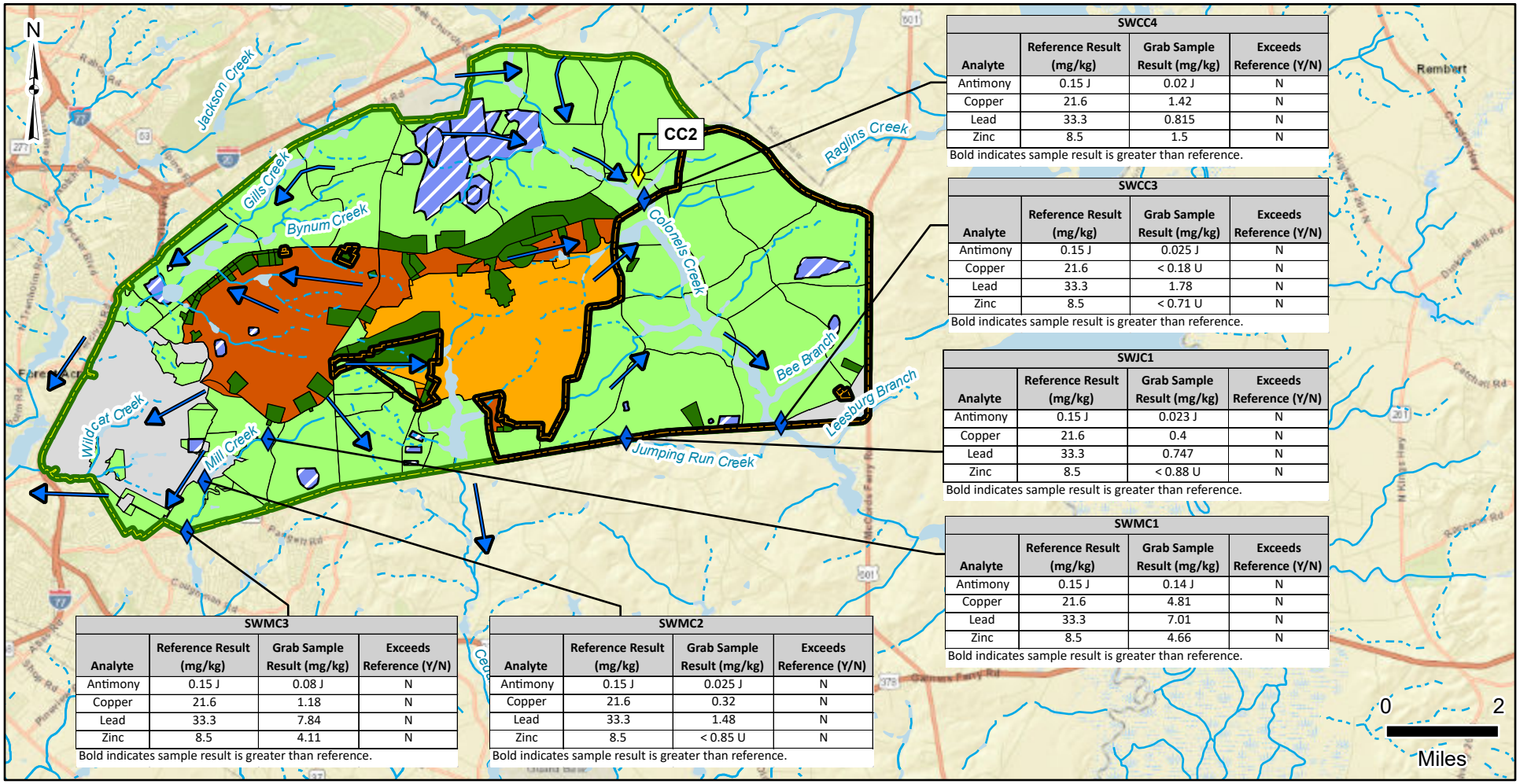
U.S. Army FY18-22 ORA Cycle
Advanced Assessment Report
Fort Jackson / McCrady Training Center, South Carolina

Figure 5-4
Sediment Sampling Results Comparison to Reference



SWCC4

Analyte	Reference Result (mg/kg)	Grab Sample Result (mg/kg)	Exceeds Reference (Y/N)
Antimony	0.15 J	0.02 J	N
Copper	21.6	1.42	N
Lead	33.3	0.815	N
Zinc	8.5	1.5	N

Bold indicates sample result is greater than reference.

SWCC3

Analyte	Reference Result (mg/kg)	Grab Sample Result (mg/kg)	Exceeds Reference (Y/N)
Antimony	0.15 J	0.025 J	N
Copper	21.6	< 0.18 U	N
Lead	33.3	1.78	N
Zinc	8.5	< 0.71 U	N

Bold indicates sample result is greater than reference.

SWJC1

Analyte	Reference Result (mg/kg)	Grab Sample Result (mg/kg)	Exceeds Reference (Y/N)
Antimony	0.15 J	0.023 J	N
Copper	21.6	0.4	N
Lead	33.3	0.747	N
Zinc	8.5	< 0.88 U	N

Bold indicates sample result is greater than reference.

SWMC1

Analyte	Reference Result (mg/kg)	Grab Sample Result (mg/kg)	Exceeds Reference (Y/N)
Antimony	0.15 J	0.14 J	N
Copper	21.6	4.81	N
Lead	33.3	7.01	N
Zinc	8.5	4.66	N

Bold indicates sample result is greater than reference.

SWMC3

Analyte	Reference Result (mg/kg)	Grab Sample Result (mg/kg)	Exceeds Reference (Y/N)
Antimony	0.15 J	0.08 J	N
Copper	21.6	1.18	N
Lead	33.3	7.84	N
Zinc	8.5	4.11	N

Bold indicates sample result is greater than reference.

SWMC2

Analyte	Reference Result (mg/kg)	Grab Sample Result (mg/kg)	Exceeds Reference (Y/N)
Antimony	0.15 J	0.025 J	N
Copper	21.6	0.32	N
Lead	33.3	1.48	N
Zinc	8.5	< 0.85 U	N

Bold indicates sample result is greater than reference.

Installation Data
- Fort Jackson Installation Boundary
- McCrady Training Center Boundary
- Firing Range
- Dudded Impact Area
- Non-Dudded Impact Area
- Historic Impact Area
- Maneuver and Training Area
- Non-Operational Area

Sample Locations
- Downstream
- Reference

Hydrology
- Surface Water Flow Direction
- Perennial Creek/Stream
- Intermittent Creek/Stream
- Waterbody

Data Sources:
ESRI 2023
EA 2023
Pike-Pirnie JV, LLC 2014

Date:.....May 2023
Prepared By:.....EA
Prepared For:....USAEC

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6.0 Summary and Conclusions

The Advanced Assessment at Fort Jackson / McCrady Training Center, South Carolina, evaluated three watersheds, Mill Creek, Upper Colonels Creek, and Lower Colonels Creek, that drain the operational range area of Fort Jackson/McCrady Training Center. These watersheds were designated the worst-case scenario and assessed for surface water system MCOC migration and risk. Additional source areas (Upper Gills Creek including Boyden Arbor Pond) and pathways (groundwater in Cedar Creek) are already being addressed under other environmental programs and were not assessed under this Advanced Assessment. Lower Gills Creek (Wildcat Creek) includes the cantonment area and several maneuver and training areas with a limited source of munitions.

Sampling of surface water and sediment consisted of a single grab sample at the six downstream locations (SWMC1, SWMC2, SWMC3, SWCC3, SWCC4, and SWJC1) and one reference location (SWCC2). Because of higher detection limits associated with the analytical method (USEPA SW6020A), which was utilized for surface water metals analysis, and which were exacerbated by laboratory method blank contamination issues, the majority of surface water metals results were qualified as non-detect. The surface water metals results that did not qualify as non-detect included lead detections that exceeded reference concentrations and state-specific freshwater ecological regulatory levels at SWMC2 and SWMC3; therefore, the Mill Creek Watershed was determined to be Referred. For ranges within Upper Colonels Creek and Lower Colonels Creek, potential migration of metals MCOC via surface water remains Inconclusive. Perchlorate detections in surface water were reported to be less than the reference concentration and regulatory level. There were no detections of explosives in surface water. Sediment results indicated there is no migration of metals from source areas at Fort Jackson/McCrady Training Center and no detections exceeding screening values. No explosives were detected in sediment.

Based on surface water sampling results from the two locations within the Mill Creek Watershed, SWMC2 and SWMC3, both located on perennial Mill Creek, lead was found to be migrating off-range at concentrations that may pose an unacceptable risk to off-range ecological receptors. The range areas draining to these locations include all or portions of live-fire ranges, impact areas, and maneuver training areas, totaling 4,372.22 acres. However, two IRP sites (AOC K and SWMU 21) are located upstream of SWMC2 and SWMC3. It was determined that AOC K does not impact the Advanced Assessment sampling results due to the NFA status. Analytical data from SWMU 21 indicated that lead detections do exceed the PAL used under ORA and SWMU 21 may be a contributing factor to the surface water concentrations detected at SWMC2 and SWMC3. However, it is unclear if lead exceedances are the result of operational range contributions, landfill leachate influence, another source in the watershed, or a combination of factors.

The worst-case scenario for groundwater in the conceptual site model was explosives along the south-central boundary, and that assessment, originally part of the last ORA study, is now being handled under another environmental program. With the site being characterized, activities now include a Feasibility Study for a subsurface soil source of RDX. The Proposed Plan for remedial actions at that site is being finalized.

Based on the findings of this Advanced Assessment, it is recommended that all or portions of the 3 firing ranges, 1 non-dudded impact area, 2 historical impact areas, and 16 maneuver and training areas within the Mill Creek Watershed of Fort Jackson, encompassing 4,372.22 acres, be categorized as Referred due to the migration of lead MC off-range in surface water at concentrations exceeding the state-specific standard and that potentially pose an unacceptable risk to off-range ecological receptors. Additionally, based on the Inconclusive results of the surface water samples for metals MCOC, this Advanced Assessment recommends that future ORA assessments analyze surface water at Fort Jackson/McCrady Training Center using USEPA 1638 (trace metals analysis) to accommodate for the low water hardness and follow a multi-

seasonal sampling approach to provide a more robust dataset that benefits from a statistical analysis of the data results**.** The Army and Fort Jackson/McCrady Training Center will determine appropriate further analysis to better characterize the risk posed by these ranges and monitor MC migration off-range.

All of Fort Jackson/McCrady Training Center's operational ranges should be included in the FY23–27 cycle of ORAs to meet DoDI requirements. Table 6-1 and Figure 6-1 summarize the Advanced Assessment findings.

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1880 **Table 6-1: Summary of Findings and Conclusions for Fort Jackson/McCrady Training Center**

Category	Total Number of Ranges and Acreage	Source(s)	Pathway(s)	Human Receptors	Ecological Receptors	Conclusions and Rationale
Inconclusive; 46,950.56 acres	53 firing ranges, 4 dudded impact areas, 14 non-dudded impact areas, 39 maneuver and training areas, and 16 historic impact areas	Maneuver training areas live-fire ranges, impact areas	Surface water-Colonels Creek, Cedar Creek, and Gills Creek Groundwater-Middendorf Aquifer	Recreation users of Weston Lake and users of the recreational facilities at Weston Lake.	Threatened and endangered species and sensitive environments downstream of operational areas.	Undetermined potential of metals in surface water. All Inconclusive ranges should be included in the FY23–27 cycle of ORAs, to meet DoDI requirements.
Referred; 4,372.22 acres	3 firing ranges, 1 non-dudded impact area, 2 historical impact areas, and 16 maneuver and training areas	Maneuver training areas live-fire ranges, impact areas	Mill Creek watersheds	Recreation users Old Heises Pond.		MC (lead) associated with the southern portion of the Mill Creek Watershed and are potentially migrating off-range via surface water at levels that pose an unacceptable risk to off-range human and/or ecological receptors. For sediment no MC were determined to be migrating at levels that pose an unacceptable risk to off-range human and/or ecological receptors. The Army and Fort Jackson will determine appropriate further analysis to better characterize the risk posed by these ranges and monitor MC migration off-range.

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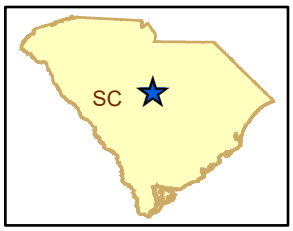
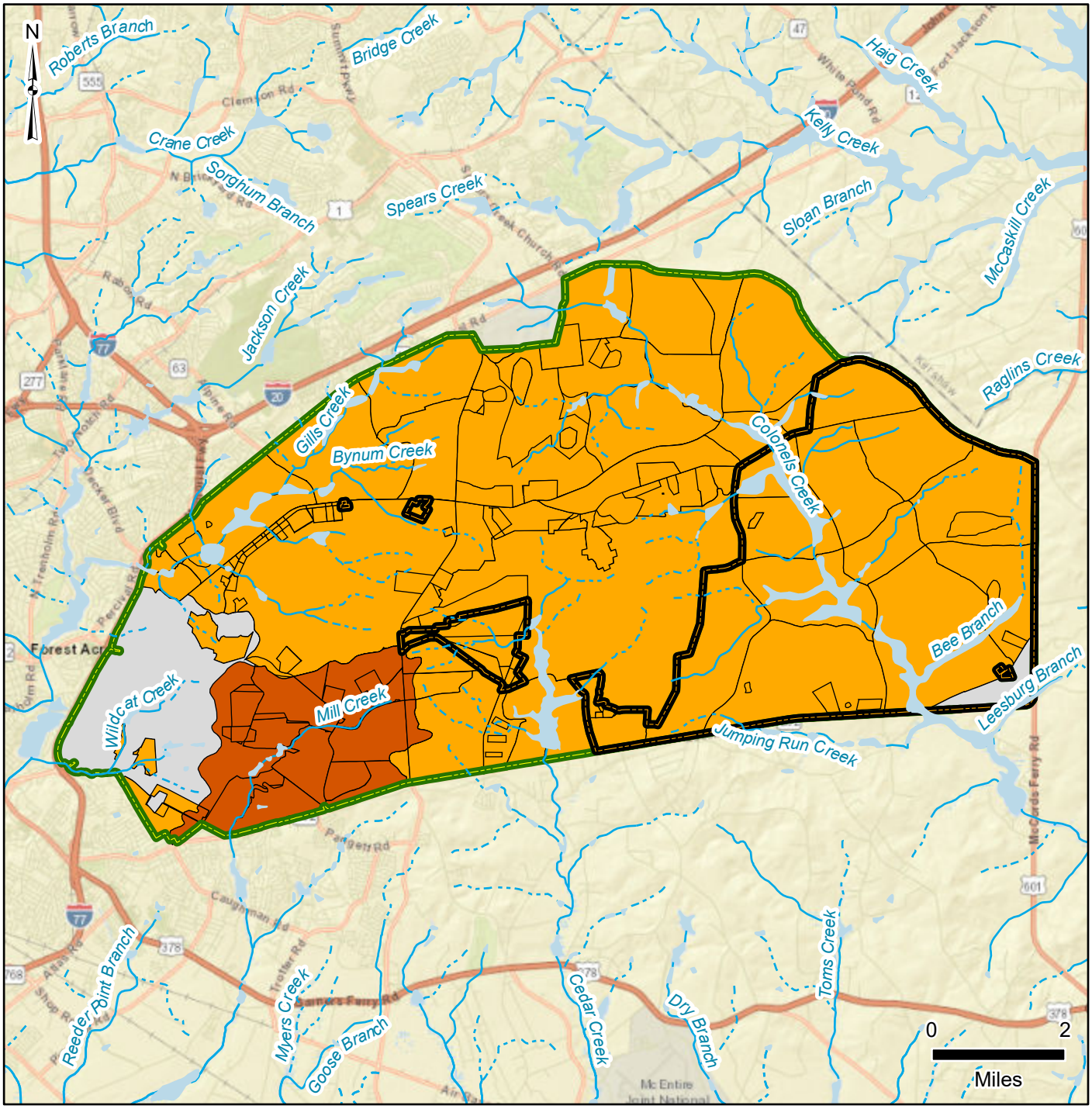
Figure 6-1
Advanced Assessment Conclusions





Installation Data
- Fort Jackson Installation Boundary
- McCrady Training Center Boundary
- Non-Operational Area

Range Conclusions
- Referred
- Inconclusive

Hydrology
- Perennial Stream/Creek
- Intermittent Stream/Creek
- Waterbody

Data Sources:
ESRI 2023
EA 2023

Date:.....May 2023
Prepared By:.....EA
Prepared For:....USAEC

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7.0 References

Department of Defense (DoD). 2004. Department of Defense Directive (DoDD) 4715.11 *Environmental and Explosives Safety Management on Operational Ranges Within the United States*. 10 May.

———. 2018. Department of Defense Instruction (DoDI) 4715.14 *Operational Range Assessments*. 15 November.

Department of Defense (DoD). 2019. *United States Department of Defense General Data Validation Guidelines*. November.

EA Engineering, Science, and Technology, Inc., PBC. 2023. Final Site-Specific Quality Assurance Project Plan, Operational Range Assessments, FY18-22 Army Operational Range Assessment Cycle, Fort Jackson/McCrady Training Center, South Carolina. February.

Malcom Pirnie. 2008a. *Draft Final Operational Range Assessment Program Phase I Qualitative Assessment Report McCrady Training Center, South Carolina.* January.

———.2008b. *Draft Final Operational Range Assessment Program Phase I Qualitative Assessment Report Fort Jackson, South Carolina.* January.

Operational Range Assessment (ORA) Comparison Values Guide. 2017. Draft. December.

PIKA-Pirnie Joint Venture, LLC. 2014 *Final Report Operational Range Phase II Assessment, U.S. Army Garrison Fort Jackson and McCrady Training Center, South Carolina.* January.

United States Army Center for Health Promotion and Preventive Medicine (USACHPPM). 2009. *Army ORAP Phase II Investigation Protocol*. 11 June.

U.S. Army Corps of Engineers. 2003. *Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Waste (HTRW) Projects*. EM 110-1-1200. February.

U.S. Army Garrison Fort Jackson. 2021. *Draft Programmatic Environmental Assessment 2020 Real Property Master Plan*. June.

———. 2020. *Hazardous Waste Permit, Permit Number SC3 210 020 449*. October 14.

U.S. Environmental Protection Agency (USEPA). 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G4*. February.

———. 2017a. *National Functional Guidelines for Inorganic Superfund Data Review.* OLEM 9355.0-135, EPA-540-R-2017-0001. Office of Superfund Remediation and Technology Innovation. Washington D.C. January.

———. 2017b. *National Functional Guidelines for Superfund Organic Methods Data Review.* OLEM 9355.0-136, EPA-540-R-2017-002. Office of Superfund Remediation and Technology Innovation, Washington, D.C. January.

U.S. Army Moral, Welfare and Recreation. 2022. *Fort Jackson Weston Lake.* July.

Appendix A: Previous Operational Range Assessments

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MALCOLM PIRNIE

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31 January 2008

Ms. Barbara Williams
Environmental and Natural Resources Division
Directorate of Logistics and Engineering
Fort Jackson
ATTN: ATZJ-DLE-PS
Building 2563
Fort Jackson, SC 29207-5670

Re: **Draft Final Operational Range Assessment Program Phase I Qualitative Assessment Report**
Fort Jackson, South Carolina

Dear Ms. Williams:

1. Enclosed (3 hard copies and 2 electronic copies) is the Draft Final Operational Range Assessment Program Phase I Qualitative Assessment Report for Fort Jackson, South Carolina. In addition to the Report, the electronic copies also include a copy of the Read-Ahead Package, Site Visit Trip Report, and the Response to Comments documents for the Draft version of the Report.

2. The Army Environmental Division of the Army Headquarters has recently directed that Phase I Qualitative Assessment Reports with at least one range characterized as "Inconclusive" will remain in the "Draft Final" status. The reason for remaining in the "Draft Final" status is that "Inconclusive" ranges require further assessment (Phase II) and therefore the assessment process is not complete. Phase II assessments will begin in 2010. The Phase I report will be incorporated into the corresponding Phase II report as an appendix with the Phase I Conceptual Site Model forming the basis of Phase II sampling.

3. The Technical Outreach Guidance (TOG) for the Operational Range Assessment Program and a Department of Defense Memorandum are also enclosed. These documents provide additional information on how to address questions regarding the Phase I Assessment Report. Any new guidance will be provided to you as it is developed.

4. If you have any questions regarding this matter please call John Buck, USAEC, at 410-436-4844 or me at 813-242-7208.

Regards,

MALCOLM PIRNIE, INC.

Daria Navon, Team Leader

Telephone: 813-242-7208
Email: dnavon@pirnie.com

Enclosures

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c: HQ IMCOM (Dave Mays) w/enclosure
c: IMCOM SE (Joan Hutton) w/enclosure
c: USACE PgM/PM (Andrea Graham) w/ enclosure
c: USAEC PgM (John Buck) w/ enclosure
c: USAEC PM (Steve Starbuck)
c: USACHPPM PgM (Barrett Borry) w/ enclosure
c: USACHPPM PM (Brian Hammond)

DRAFT FINAL
OPERATIONAL RANGE ASSESSMENT PROGRAM
PHASE I QUALITATIVE ASSESSMENT REPORT
FORT JACKSON
COLUMBIA, SOUTH CAROLINA

MAY 2007

Prepared for:

UNITED STATES ARMY CORPS OF ENGINEERS, BALTIMORE DISTRICT
P.O. Box 1715
Baltimore, Maryland 21203

and

UNITED STATES ARMY ENVIRONMENTAL COMMAND
Aberdeen Proving Ground, Maryland 21010

Prepared by:

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DRAFT FINAL
OPERATIONAL RANGE ASSESSMENT PROGRAM
PHASE I QUALITATIVE ASSESSMENT REPORT
FORT JACKSON
COLUMBIA, SOUTH CAROLINA

DoD Contract Number: W912DR-05-D-0004

Reviewed and Approved by:

_____

Daria Navon, P.E.
Team Leader
Malcolm Pirnie, Inc.

_____

Rhonda Stone
Program Manager
Malcolm Pirnie, Inc.

Malcolm Pirnie, Inc., prepared this report at the direction of the United States Army Corps of Engineers (USACE). This document should be used only with the approval of the USACE or another authorized Department of the Army official organization. This report is based, in part, on information provided in other documents and is subject to the limitations and qualifications presented in the referenced documents.

MAY 2007

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ABBREVIATIONS/ACRONYMS

ARID-GEO	Army Range Inventory Database-Geodatabase
bgs	Below Ground Surface
CCC	Criterion Continuous Concentration
CMC	Criterion Maximum Concentration
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSM	Conceptual Site Model
DNT	Dinitrotoluene
DoD	Department of Defense
DODI	Department of Defense Instruction
DPTMS	Directorate of Plans, Training, Mobilization, and Security
E	Ecological receptors identified. (This refers to range grouping; pathway designation always precedes E designation.)
ENRD	Environmental and Natural Resources Division
EOD	Explosive Ordnance Disposal
ESV	Ecological Screening Value
GIS	Geographic Information System
GW	Groundwater pathway identified. (This refers to range grouping; M designation always precedes GW designation.)
H	Human receptors identified. (This refers to range grouping; pathway designation always precedes H designation.)
HMX	Cyclotetramethylenetetranitramine
IRP	Installation Restoration Program
ITAM	Integrated Training Area Management
LS	Limited Source
M	Munitions used. (This refers to range grouping; M designation always precedes applicable pathway.)
MCL	Maximum Contaminant Level
MCOC	Munitions Constituents of Concern
mgd	Million Gallons Per Day
mg/kg	Milligram per Kilogram
mg/L	Milligram per Liter
mm	Millimeter
OB	Open burn
OD	Open detonation
ORAP	Operational Range Assessment Program
PETN	Pentaerythritoltetranitrate
ppb	Parts Per Billion
PU	Munitions used. Pathway unlikely or incomplete. (This refers to range grouping; M designation always precedes PU designation.)
RBC	Risk Based Concentration
RCRA	Resource Conservation and Recovery Act
RDX	Cyclotrimethylenetrinitramine
RFMSS	Range Facility Management Support System
SC	South Carolina
SCARNG	South Carolina Army National Guard

SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SW	Surface water pathway identified. (This refers to range grouping; M designation always precedes SW designation.)
SWMU	Solid Waste Management Unit
TNT	Trinitrotoluene
U.S.	United States
USACE	United States Army Corps of Engineers
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
USAEC	United States Army Environmental Command
USATC	United States Army Aberdeen Test Center
USEPA	United States Environmental Protection Agency
UXO	Unexploded Ordnance
WP	White Phosphorus
^{o}F	Degrees Fahrenheit

EXECUTIVE SUMMARY

The United States (U.S.) Army is conducting qualitative assessments at operational ranges to meet the requirements of Department of Defense policy and to support the U.S. Army Sustainable Range Program. The operational range qualitative assessment (hereinafter referred to as Phase I Assessment) is the first phase of the U.S. Army Operational Range Assessment Program (ORAP). This Phase I Assessment evaluates Fort Jackson's operational range area to assess whether further investigation is needed to determine if potential munitions constituents of concern (MCOC) are or could be migrating off-range at levels that may pose an unacceptable risk to human health or the environment. In conducting the Phase I Assessment, MCOC sources, potential off-range migration pathways, and potential off-range human and ecological receptors are evaluated as appropriate.

Fort Jackson occupies approximately 51,961 acres in Richland County, South Carolina (SC). The SC Army National Guard holds a non-exclusive license for training operations over approximately 14,990 acres of Fort Jackson. Therefore, this acreage has not been included in the Fort Jackson ORAP Phase I Assessment, which investigates only the operational ranges operated by the U.S. Army Training Center. The resulting acreage of Fort Jackson for purposes of this assessment is 36,971. The installation has been incorporated into the eastern section of the city of Columbia, SC. The primary mission of Fort Jackson is to train initial entry recruits for duty as soldiers for Army units. To support this mission, Fort Jackson currently houses Army training brigades and serves as a reception station that processes newly inducted and prior service personnel forwarded to the installation from recruiting and induction stations.

As part of the Operational Range Inventory Sustainment, an update to the Army Range Inventory Database-Geodatabase (ARID-GEO) was submitted to the U.S. Army Environmental Command in March 2006 (ARID-GEO [2006]). ARID-GEO (2006) identified 104 operational range areas at Fort Jackson that are operated by the U.S. Army Training Center, encompassing a total of 29,716.58 acres. During data collection for this report, it was determined that several of the ranges overlap one another, resulting in an actual operational acreage of 29,475.19. The operational areas support a variety of activities including live-fire weapons training, heavy and light maneuver exercises, dudded and non-dudded impact areas, and specialty training courses such as night-infiltration and military operations in urban terrain. Many of these ranges currently receive heavy usage by soldiers undergoing basic training.

The 104 operational ranges at Fort Jackson that are operated by the U.S. Army Training Center are categorized as Inconclusive or Unlikely.

Inconclusive – Phase II Quantitative Assessment Required

Fifty-one ranges at Fort Jackson are categorized as Inconclusive, totaling 16,471 acres. These ranges consist of impact areas, medium and large caliber firing ranges, small arms ranges, and training areas that either contain artillery or mortar firing points or known or suspected dudded areas or have received heavy historical munitions usage. Ranges categorized as Inconclusive are those operational ranges where either existing information is insufficient to make a source-receptor interaction determination or the information indicates the potential for such interaction to be occurring. Ranges categorized as Inconclusive will undergo Phase II of the ORAP, consisting of a quantitative assessment with sampling and additional data collection.

Unlikely – Five-Year Review

Fifty-three ranges at Fort Jackson are categorized as Unlikely, totaling 13,004 acres. These ranges consist of training areas. Ranges where, based upon a review of readily available information, there is sufficient evidence to show that there are no known releases or source-receptor interactions that could present an unacceptable risk to human health or the environment are categorized as Unlikely. Ranges categorized as Unlikely are required to be re-evaluated at least every five years. Re-evaluation may occur sooner if significant changes (e.g., change in range operations, site conditions, regulatory changes) occur that affect determinations made during this Phase I Assessment.

Table ES-1 summarizes the Phase I Assessment findings.

Table ES-1: Summary of Findings and Conclusions for Fort Jackson

Category	Total Number of Ranges and Acreage	Source(s)	Pathway(s)	Human Receptors	Ecological Receptors	Conclusions and Rationale
Inconclusive	36 operational ranges; 12,425 acres	Firing points, small arms firing, dudded impact areas, and heavy historical munitions usage	Mill Creek, Sun View Lake, and Lake Rebecca (southwest of Fort Jackson in Mill Creek watershed); Gills Creek and Forest Lake (west and southwest of Fort Jackson in Gills Creek watershed); Weston Lake and Cedar Creek (non-operational area southwest of the eastern impact area in Cedar Creek watershed); surficial groundwater aquifer (south and west of Fort Jackson in Mills Creek, Gills Creek, and Cedar Creek watersheds)	Residents down gradient, local and off-range residents, and recreational users of Weston Lake, Twin Lakes, Sun View Lake, Lake Rebecca, and Forest Lake	Wetlands and threatened and endangered species downstream	Phase II Quantitative Assessment is required. Residents and recreational users are present down gradient and downstream.
	15 operational ranges; 4,046 acres	Firing points, small arms firing, known or suspected dudded areas, and historical artillery impact areas or heavy historical usage	Colonels Creek and Murray Pond (southeast of McCrady Training Center)	Recreational users of Murray Pond	Wetlands and threatened and endangered species downstream	Phase II Quantitative Assessment is required. Recreational users are present downstream.
Unlikely	53 operational ranges; 13,004 acres	No source – limited or no military munitions use	Not evaluated (no source was identified)			Re-evaluate during the five-year review. No source was identified.

1.0 Introduction

The United States (U.S.) Army is conducting qualitative assessments at operational ranges to meet the requirements of Department of Defense (DoD) policy and to support the U.S. Army Sustainable Range Program. The operational range qualitative assessment (hereinafter referred to as Phase I Assessment) is the first phase of the U.S. Army Operational Range Assessment Program (ORAP). The Phase I Assessment will review readily available data to evaluate, verify, validate, document, and report on operational ranges within the United States and its territories. Phase I Assessments are being conducted on Active Army, Army Reserve, and Army National Guard installations (including both federally and state owned).

The conclusions in this report have been based, in part, on information obtained from third parties and may include environmental assessment reports, environmental agency records, historical aerial photographs, and other public records obtained from various sources. Unless noted, Malcolm Pirnie has not independently evaluated or verified the accuracy or completeness of such third party information. Visual observations of the site only represent conditions at the time of the site visit. Malcolm Pirnie makes no warranties that the on-site observations made during the site visit are representative of historical or future conditions at the site.

1.1 Project Scope and Drivers

The Phase I Assessment process evaluates potential source-receptor interaction between off-range[1] receptors and the potential munitions constituents of concern (MCOC) migrating from all operational ranges within the Operational Range Inventory.

The ORAP is being implemented to fulfill requirements identified implicitly or explicitly in:

- DoD Directive 4715.11 *Environmental and Explosives Safety Management on Operational Ranges Within the United States* (2004) and
- DoD Instruction (DODI) 4715.14 *Operational Range Assessments* (2005).

1.2 Purpose

The purpose of this Phase I Assessment is to evaluate Fort Jackson's operational ranges to assess whether further investigation is needed to determine if potential MCOC are or could be migrating off-range at levels that may pose an unacceptable risk to human health or the environment.

Based on the readily available data obtained during the Phase I Assessment process, all operational ranges at Fort Jackson were placed into groups according to military munitions use and the presence or absence of potential MCOC, migration pathways, and receptors. Each operational range group was then placed into one of three possible categories – Referred, Inconclusive, or Unlikely:

[1] Off-range areas include those areas outside of the boundaries of the operational range area, as established by the Army Range Inventory Database-Geodatabase (ARID-GEO). Off-range areas may include both on-installation (e.g., cantonment areas) and off-installation areas or locations.

- **Referred – Refer to Appropriate Cleanup Program**: ranges with compelling evidence (e.g., sampling data) to indicate the presence of an off-range release that potentially poses an unacceptable risk to human health or the environment
- **Inconclusive – Phase II Quantitative Assessment Required**: ranges where existing information either is insufficient to make a source-receptor interaction determination or indicates the potential for such interaction to be occurring
- **Unlikely – Five-Year Review**[2]: ranges where, based upon a review of readily available information, there is sufficient evidence to show that there are no known releases or source-receptor interactions that could present an unacceptable risk to human health or the environment

Appendix A provides a glossary of common terms referred to in the ORAP.

1.3 General Installation Information

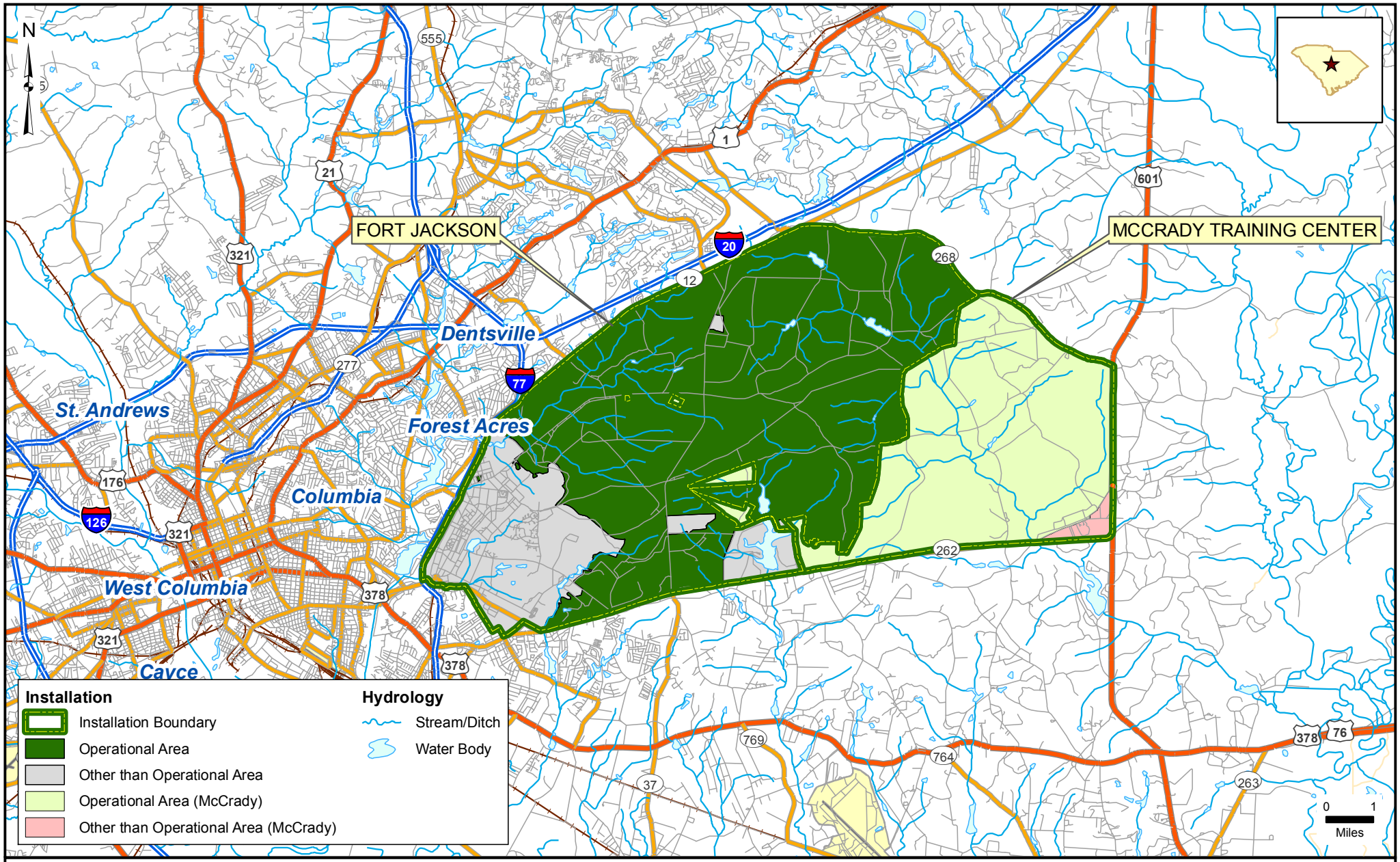
Fort Jackson occupies approximately 51,961 acres in Richland County, South Carolina (SC). The SC Army National Guard (SCARNG) holds a non-exclusive license for training operations over approximately 14,990 acres of the eastern portion of Fort Jackson. Therefore, this acreage has not been included in the Fort Jackson ORAP Phase I Assessment, which investigates only the operational ranges operated by the U.S. Army Training Center. The resulting acreage of Fort Jackson for purposes of this assessment is 36,971. The installation has been incorporated into the eastern section of the city of Columbia, SC. The main gate is located at the intersection of Forest Drive and Interstate 77, which parallels most of the western installation boundary. Interstate 20 is located just north of the installation, and Leesburg Road (Highway 262) forms the southern installation boundary. **Figure 1-1** illustrates the general location of Fort Jackson.

Fort Jackson was originally established in 1917 as an infantry training center (referred to as Camp Jackson). The installation was inactive from 1921 to 1925. In 1925, the War Department decided to use the post again as a training camp for the SCARNG. From 1925 to 1939, it was controlled by the state and used as an encampment and training area for SCARNG troops. During World War II, Fort Jackson became a permanent military installation, used primarily for infantry training. Additional property was acquired on the eastern and northern sides of the installation until the acreage included 52,562 acres. Fort Jackson grew over the years, but most of the buildings were temporary. In 1964, construction began on permanent steel and concrete buildings to replace wooden barracks that had housed the fort's troops since the early 1940s. With the establishment of the modern volunteer Army in 1970 and the need to promote the attractiveness of service life, construction peaked in an effort to modernize facilities and improve services. In June 1973, Fort Jackson was designated as a U.S. Army Training Center. As a result of Base Realignment and Closure actions during the early 1990s, Fort Jackson received additional missions and personnel, including the Soldier Support Institute (consisting of the Adjutant General School, Finance School, and Recruiting and Retention School), Chaplain Center and School, and the DoD Polygraph Institute. The current and primary mission of Fort Jackson is to train initial entry recruits for duty as soldiers for Army units. To support this

[2] All operational ranges must be periodically re-evaluated to determine if there is a release or substantial threat of release of MCOC from an operational range to an off-range area. Range groups categorized as Unlikely are to be re-evaluated at least every five years. Re-evaluation may occur sooner if significant changes (e.g., changes in range operations or site conditions, regulatory changes) occur that affect determinations made during the Phase I Assessment.

mission, Fort Jackson currently houses Army training brigades and serves as a reception station that processes newly inducted and prior service personnel forwarded to the installation from recruiting and induction stations. Fort Jackson is the largest and most active initial entry center in the U.S. Army, providing training to approximately 25 percent of the men and women who enter the service each year. The installation instructs approximately 55,000 to 65,000 soldiers each year, including participants in Basic Combat Training, Advanced Individual Training, and many professional schools (GlobalSecurity.org, 2006).

A draft Operational Range Inventory Sustainment update was submitted to the U.S. Army Environmental Command (USAEC) in March 2006 (ARID-GEO [2006]). The ARID-GEO (2006) identified 104 operational ranges operated by the U.S. Army Training Center, encompassing a total of 29,717 acres. During data collection for this report, it was determined that several of the ranges overlap one another, resulting in an actual operational acreage of 29,475.19. This is explained in further detail in Section 5.4. The operational areas support a variety of activities, including live-fire weapons training, heavy and light maneuver exercises, dudded and non-dudded impact areas, and various specialty training courses such as night infiltration and military operations in urban terrain. Many of the operational ranges currently receive heavy usage by soldiers undergoing basic training. **Figure 1-2** illustrates the operational range areas identified in the ARID-GEO (2006).



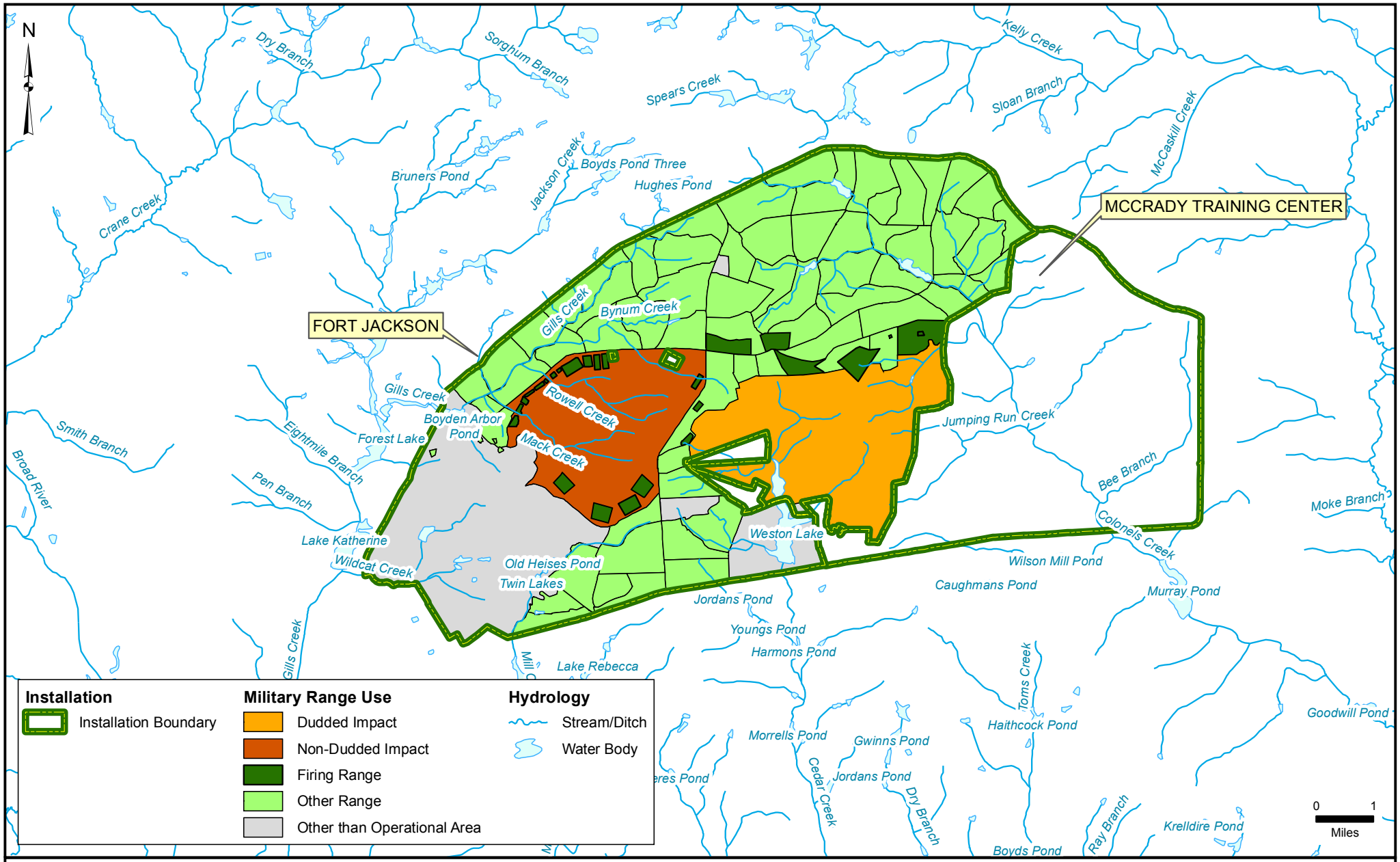
MALCOLM PIRNIE

Operational Range Assessment Program
Phase I Qualitative Assessment
Fort Jackson, SC

Figure 1-1
General Installation Location

Data Sources:
AEC, ARID-GEO, April 2006
ESRI, StreetMap USA, 2005

Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004



Operational Range Assessment Program
Phase I Qualitative Assessment
Fort Jackson, SC

Figure 1-2
General Layout and Operational Range Area

Data Sources:
AEC, ARID-GEO, April 2006
ESRI, StreetMap USA, 2005

Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

2.0 Assumptions, Programmatic Exclusions and Data Collection Efforts

2.1 Assumptions

Statements in this report were made using available supporting documents and data obtained during the centralized data collection efforts and site visit conducted at Fort Jackson from 10 October 2006 through 13 October 2006. The findings and conclusions of the supporting documents and data are assumed to be accurate and scientifically defensible. Conclusions and recommendations are based on the data gathered during the Phase I Assessment.

The Phase I Assessment assumes that the primary pathways for off-range migration are water related (i.e., surface water, sediment, and groundwater). This is to conform to the DODI 4715.14 emphasis on off-range migration (DoD, 2005). Other media may be considered, if warranted based on site-specific conditions.

2.2 Programmatic Considerations and Exclusions

For the purposes of the Phase I Assessment, an unacceptable risk to human health or the environment may occur if there is a source of MCOC, a pathway for MCOC to potentially move off-range, and an off-range receptor that may be impacted by the migrating MCOC. Where all three of these elements are present, further evaluation may be required. The paragraphs below present the potential pathways and receptors considered for the Phase I Assessments. Potential MCOC migration pathways that have been evaluated and programmatically excluded (except in unique situations that compel their inclusion) are also presented.

2.2.1 Exposure to Surface Water

The U.S. Environmental Protection Agency (USEPA) *Guidance for Performing Preliminary Assessments under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* (1991) requires the identification of potential surface water receptors up to 15 miles downstream from the location at which potential MCOC may move beyond the aerial extents of the source area. Only those surface water receptors identified in the surface water pathway segments downstream of the operational range source area are being evaluated and assessed.

Dermal contact and incidental ingestion of MCOC by human receptors within the off-range surface water pathway, for areas other than designated recreational areas (or areas known or suspected of being used frequently for swimming), are programmatically excluded. While surface water may be a viable exposure pathway in some instances, it is not expected to be significant in most cases due to the extremely low levels of MCOC that have been found in surface water during previous quantitative range studies conducted by the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). Therefore, USACHPPM has recommended that this pathway only be evaluated when there is evidence that the surface water body is used regularly for swimming (2005).

2.2.2 Exposure to Groundwater

For human receptors to contact MCOC through the groundwater pathway, there must be an aquifer, a drinking water well, or discharge to a stream or spring that is used as a drinking water source. The USEPA (1991) requires the identification of water wells, both public and private, within four miles down gradient of the potential MCOC source area. For the Phase I Assessments, wells are identified within four miles of the potential MCOC source area boundary.

2.2.3 Surface Soil

The surface soil pathway is not to be evaluated unless potential off-range human or ecological receptors are present within 200 feet of a suspected source of MCOC. This determination is based on USEPA guidance (1991). In general, the results of a variety of range studies indicate that the likelihood of encountering potential source-receptor interactions through the soil pathway is extremely low. Also, while it is generally acknowledged that dermal absorption of substances in surface soil may be occurring in terrestrial ecological receptors, the methodology for quantifying this pathway is not currently available. Therefore, although the surface soil pathway may be complete, it is not evaluated by convention, as indicated in the conceptual site model (CSM) figures in Section 5.

2.2.4 Air Emissions

Air emissions from detonating military munitions have been evaluated under a variety of studies conducted by the DoD, the Army, and the Emergency Planning and Community Right-to-Know Act's Toxic Release Inventory and for Agency for Toxic Substances and Disease Registry purposes. These studies indicate that off-range receptor exposure to MCOC via the air pathway does not pose an unacceptable level of risk. Therefore, the USAEC has decided on a programmatic basis not to evaluate the air emissions migration pathway further during the Phase I Assessment. Should additional information become available that identifies potential problems associated with the air emissions migration pathway, this decision will be re-evaluated.

2.2.5 Potential Receptors

Receptors are organisms (human or ecological) that contact a chemical or physical agent in the environment. For the purposes of the Phase I Assessment, receptors are generally limited to off-range human receptors (workers, residents, and recreational users [including trespassers]) and off-range ecological receptors (threatened and endangered species, wetlands, fisheries, and other ecological receptors of concern or sensitive environments specific to an installation). Ecological receptors should include the identification and location of sensitive terrestrial/avian environments within one-half mile of the potential source areas and fisheries and surface water sensitive environments up to 15 miles downstream of the probable point of entry (USACHPPM, 2005; Malcolm Pirnie, 2005). For the purposes of the Phase I Assessments, sensitive environments are considered surrogates for ecological receptors. Guidance on identifying a sensitive environment was obtained from Exhibit 1-1 of the USEPA guidance (1997).

2.2.5.1 Consumption of Ecological Receptors

Studies conducted by the USACHPPM and other organizations indicate that the uptake and bioaccumulation of select MCOC (e.g., explosives) in terrestrial receptors do not pose a viable health risk to off-range receptors. Therefore, without a viable health risk (source), a potential source-receptor interaction pathway associated with the consumption of terrestrial receptors (e.g., deer) becomes irrelevant and is excluded from the ORAP.

These studies also show that deer and other wildlife species exposed to higher levels of MCOC in soil, including areas around explosive manufacturing areas, do not contain detectable levels of military unique compounds. Based on the data gathered during these studies, and considering the conservatism related to the risk assessment process, the health risk associated with consuming deer and other game harvested off-range is no greater than with harvesting game on-range. Therefore, deer, other wildlife, and even livestock are programmatically excluded.

The inclusion of fish as a potential pathway / exposure point via the food chain is supported by

USACHPPM. This assumption is based on the theory that if MCOC are present in a water body, fish have a more intensive, long-term exposure potential than terrestrial receptors, which may only come into contact with the contamination during incidental, short-term exposures.

2.3 Summary of Data Collection Efforts

Four primary sources of information were researched as part of the data collection effort for the Phase I Assessment:

- DoD data repositories and databases (e.g., ARID-GEO, Technical Information Center, Range Facility Management Support System [RFMSS])
- Off-installation / publicly available data repositories and databases (e.g., South Carolina Department of Health and Environmental Control geographic information system [GIS] database)
- Installation data repositories and databases (e.g., Directorate of Plans, Training, Mobilization, and Security [DPTMS], Environmental and Natural Resources Division [ENRD], Integrated Training Area Management)
- Personnel interviews and windshield tour (e.g., RFMSS Administrator, Installation Restoration Program [IRP] Manager, DPTMS Chief)

Prior to the site visit, information on Fort Jackson and the surrounding area was obtained from centralized databases and assembled into several profiles. Data gaps regarding military munitions usage and off-range receptors were identified during this effort. A site visit to Fort Jackson was conducted from 10 October 2006 to 13 October 2006 to confirm/verify the previously collected information and to fill data gaps. RFMSS data on munitions usage for 1 January 2002 to 12 October 2006 were obtained, along with a wide variety of documents on off-range receptors. Interviews with Fort Jackson personnel, including SCARNG personnel based at the McCrady Training Center, also provided useful information (see **Appendix B**). All of this information was used to construct the CSM profiles and figures presented in Section 3 and Section 5, respectively.

Appendix B provides a complete list of references used throughout the Phase I Assessment.

3.0 Conceptual Site Model Profiles

Section 3 provides a description of the installation and its environment based on information obtained during the Phase I Assessment process. The section includes five profile types:

- Facility Profile: Describes man-made features and potential sources (for example, the current and historical installation area/layout and the munitions type/usage and MCOC associated with the operational range area).
- Physical Profile: Describes physical features/factors that may affect release, transport, and access of potential MCOC (for example, meteorological data, topography, geology, hydrogeology, and surface waters and water resource use) and associated MCOC release mechanisms / pathways.
- Munitions Release / Migration Profile: Describes potential release mechanisms and migration pathways based on the source and type of potential MCOC and their interaction with the physical environment.
- Land Use and Human Receptor Profile: Provides information used to identify and evaluate the applicable exposure scenarios, human receptors, and receptor locations.
- Ecological Profile: Describes natural habitats of the installation and associated ecological receptors.

3.1 Facility Profile

3.1.1 Current and Historical Range Usage and Layout

Fort Jackson occupies approximately 36,971 acres in Richland County, SC, excluding the portion licensed to SCARNG. The installation has been incorporated into the eastern section of the city of Columbia, SC. **Figure 1-1** illustrates the general location of Fort Jackson.

According to ARID-GEO (2006), the U.S. Army Training Center currently operates 104 ranges at Fort Jackson, encompassing 29,717 acres (**Figure 1-2**). Areas not currently associated with operational training activities include the cantonment area (which is situated in the southwest portion of the installation), inactive or closed ranges, and other nontraining land assets. The other than operational land area comprises approximately 7,496 acres (ARID-GEO, 2006). During data collection for this report, it was determined that several of the ranges overlap one another, resulting in an actual 29,475 operational acres. This is explained in further detail in Section 5.4.

Table 3-1 presents the general types of ranges currently utilized at Fort Jackson according to ARID-GEO (2006). The number of ranges and total acreage per range type is also provided.

Table 3-1: Fort Jackson Operational Ranges

Range Type	Number of Ranges	Total Acreage
Mortar range	2	135.85
Tank stationary gun range	1	19.41
Non-live grenade range	1	89.47
Demolition/flame range	2	262.78
Fire and movement range	2	272.31
Squad defense range	2	112.57
Field firing range	1	41.02
Record firing range	5	222.97
Night firing range	2	7.13
Known distance range	2	32.41
Infiltration course	1	1.57
Zero range	5	42.36
Miscellaneous range	4	142.72
Confidence/obstacle course	3	12.44
Bayonet assault course	2	6.65
Light maneuver/training area	5	858.47
Heavy maneuver/training area	1	276.06
Miscellaneous training area	61	17,535.52
Dudded impact area	1	5429.32
Non-dudded impact area	1	4215.55
Total	*104*	*29,716.58*

Source: ARID-GEO (2006)

Many of the operational ranges at Fort Jackson have seen significant historical use. Historical military munitions use at Fort Jackson has been documented through the review of historical range mapping. **Figures 3-1**, **3-2**, **3-3**, and **3-4** illustrate historical munitions usage from the years 1949, 1952, 1956, and 1969, respectively. As shown in **Figure 3-1**, several portions of Fort Jackson along the installation's northeast and southern peripheries that are currently field and maneuver training areas were used for munitions related training in the 1940s. **Figure 3-2** shows a north impact area and a south impact area that were defined in the early 1950s. The historical south impact area is now overlapped by a large dudded impact area. **Figure 3-3** shows range fans from 73 historical ranges utilized in the 1950s (including those on the McCrady Training Center), illustrating that military munitions usage occurred over much of Fort Jackson, with the exception of an area in the northwest portion of the installation. **Figure 3-4**, a 1969 map, shows a layout of training ranges similar to what exists today, including the non-dudded impact area in the western portion of the installation.

The operational ranges at Fort Jackson operated by the U.S. Army Training Center are discussed below according to range type. Historical munitions usage, known or suspected dudded areas, and locations of artillery firing points are also included for areas where limited or no munitions are currently used to determine potential source areas. Range types are shown in **Figure 3-5**.

Firing Ranges
The U.S. Army Training Center operates eight firing ranges at Fort Jackson, totaling approximately 362 acres. These ranges include all medium and large caliber firing ranges identified in ARID-GEO (2006), as well as several additional medium and large caliber firing ranges identified using RFMSS data. Small caliber munitions, pyrotechnics/obscurants, and munitions identified as other or unknown are also utilized at some of these ranges.

Small Arms Ranges
The U.S. Army Training Center operates 19 small arms ranges at Fort Jackson comprising approximately 501 acres. Seventeen of these are located along the perimeter of a 4,216-acre impact area in the western portion of Fort Jackson's operational range area, as shown in **Figure 3-5**. In addition to small caliber munitions, pyrotechnics/obscurants and munitions identified as other or unknown are also utilized at some of these ranges.

Training Areas
Seventy-five training areas covering approximately 18,968 acres are present within the portion of Fort Jackson not licensed to the SCARNG for training. Twenty-five of these, totaling 5,446 acres, are non-live-fire maneuver and training areas or obstacle courses where limited or no current or historical munitions usage has occurred. Historical munitions usage was identified at 33 training areas. Fifteen training areas contain artillery or mortar firing points and/or known or suspected dudded areas, as shown in **Figure 3-5**. The remaining two training areas are entirely overlapped by firing ranges; therefore, their acreages have not been included.

Historical munitions usage has occurred in 33 of the training areas, comprising 9,204 acres, as shown in **Figure 3-5**. These areas have historical overlapping range fans used for small arms, medium caliber, large caliber, and additional unidentified historical military munitions training. Based on information from Fort Jackson's range control office, a surface removal action has been performed over these training areas; therefore, there is a low probability of encountering unexploded ordnance (UXO) items. **Figure 3-5** shows heavy historical munitions usage over five of these training areas that contain historical artillery impact areas or areas that have received heavy and recent historical use.

A total of 12 training areas, totaling 3,324 acres, contain known or suspected dudded areas identified by Fort Jackson range control, as shown in **Figure 3-5**. These areas are the result of historical training activities, primarily mortar and grenade firing ranges. These areas are clearly demarcated on Fort Jackson's Installation Field Map (Fort Jackson ITAM, 2006). Signs are posted to alert personnel to the potential presence of UXO. Five of these training areas, plus three other training areas, contain mortar or artillery firing points.

Impact Areas
Two impact areas are present at Fort Jackson, including a large, dudded area in the eastern portion of Fort Jackson comprising 5,429 acres and a slightly smaller area in the western portion comprising 4,216 acres.

The dudded eastern impact area is the established impact area for mortar and artillery weaponry training. It contains range safety fans for a number of small, medium, and large caliber firing ranges located around the perimeter of the area and includes an Engineer Demolition Site. Roads along the perimeter of this area are routinely patrolled by security vehicles, and access is strictly limited. As shown in **Figure 3-2**, this area historically was known as the south impact area and was used as an

impact zone for a number of large caliber training ranges. No surface clearance activities have been performed at the eastern dudded area.

The 4,216-acre area is mostly non-dudded and is surrounded by 19 permanent small arms ranges (two of which are licensed to the SCARNG for training purposes), as shown in **Figure 3-5**. This impact area contains the safety fans associated with each of the 19 small arms ranges. The safety fans encompass more land than that which is actually impacted because about 90% of the rounds fired are contained by berms constructed 30-320 meters down range from firing lines; however, not all of the ranges are bermed (Fort Jackson DPTMS, 2006). **Table 3-1** shows that this entire impact area is defined as non-dudded impact area in ARID-GEO (2006); however, Fort Jackson's range control personnel have identified known dudded areas to be present in the western portion. This is consistent with historical locations of mortar ranges as shown in **Figure 3-4**. The dudded portion of the western impact area covers 273 acres and is shown in **Figure 3-5**.

3.1.2 Munitions Types and Usage

Munitions Types

Each of the following munitions classes has been historically and/or is currently used at Fort Jackson:

- **Small caliber munitions**: These are used in small arms, which typically have a muzzle diameter of up to .50-caliber or 0.5 inches. Projectiles are typically solid and composed of lead cores with copper alloy jackets. Small caliber practice munitions (commonly referred to as blanks) contain no projectile. Additionally, in an attempt to reduce lead usage, a number of installations have replaced traditional bullets with lead-free tungsten composite rounds. According to RFMSS data, tungsten-nylon small arms round have been used at Fort Jackson, with the period of heaviest use taking place in 2003 and 2004.
- **Medium and large caliber munitions**: These are used in weapons systems that employ projectiles larger than .50-caliber, with sizes ranging from 20 to 60 millimeters (mm) for medium caliber and greater than 60 mm for large caliber. These projectiles are typically comprised of hollow iron alloys that contain a detonator and an explosive charge. These munitions may be live, practice, or inert.
- **Pyrotechnics and obscurants**: These devices give off smoke, light, heat, and/or noise when activated. Common munitions in this category include smoke grenades, artillery simulators, ground burst simulators, hand grenade simulators, and booby trap simulators.
- **Other weapons systems:** Hand grenades, bombs, rockets, missiles, and mines all fall into this category. Generally, these munitions may be found at live-fire ranges or impact areas. Items such as detonation cords and charges may be used in demolition areas. These munitions may be live or practice/inert.

Munitions Usage

Munitions data (e.g., RFMSS) collected during the site visit provide information on the types and number of rounds fired at Fort Jackson since 2002. The estimated number of rounds for each munitions class expended at Fort Jackson from 1 January 2002 to 12 October 2006 is summarized in **Table 3-2**. The munitions expended are presented by range type. This table does not include munitions used in SCARNG training activities in areas licensed to the SCARNG. Approximately 72 million total rounds of military munitions were utilized during this time period. More than 95 percent of these were small arms rounds, including approximately 1.1 million small arms tungsten rounds. Several munitions quantities have been modified to correct RFMSS errors that were confirmed by DPTMS personnel. RFMSS does not show munitions usage for the impact areas because the firing

that was aimed toward these areas took place from the other ranges.

Table 3-2: Fort Jackson Munitions Data Summary

Munitions Type	Live-Fire Rounds	Practice/Blank Rounds	Total Rounds
Firing Ranges			
Small Caliber	12,000,000	580,000	13,000,000
Medium Caliber	190,000	190,000	380,000
Large Caliber	880	0	880
Pyrotechnic/Obscurant	21,000	0	21,000
Other	200,000	330,000	530,000
Unknown[a]	--	--	26,000
Total	**12,000,000**	**1,100,000**	**14,000,000**
Small Arms Ranges			
Small Caliber	56,000,000	1,300,000	57,000,000
Pyrotechnic/Obscurant	13,000	0	13,000
Other	200[b]	130,000	130,000
Unknown[a]	--	--	200,000
Total	**56,000,000**	**1,400,000**	**57,000,000**
Training Areas			
Small Caliber	40,000[b]	840,000[b]	880,000[b]
Medium Caliber	0[b]	0	0[b]
Large Caliber	180	0	180
Pyrotechnic/Obscurant	150	0	150
Other	40	380	420
Unknown[a]	--	--	14,000
Total	**40,000[b]**	**840,000[b]**	**890,000[b]**
All Ranges			
Total	**68,000,000**	**3,300,000**	**72,000,000**

[a]Unknown munitions type indicates an entry of "Not Applicable" in the DoD Identification Code column of the RFMSS data; therefore, the number of rounds cannot be associated with a munitions type (DA, 2000).

[b] Munitions quantity edited to correct RFMSS error identified by Fort Jackson DPTMS personnel.

There are several areas on Fort Jackson where munitions were utilized or disposed that are being addressed under Fort Jackson's Resource Conservation and Recovery Act (RCRA) Part B permit issued by the South Carolina Department of Health and Environmental Control (SCDHEC) in September 1991. Although these areas are potential sources of MCOC, they are not evaluated under the ORAP because they are addressed under the conditions of their permit. Permitted open burn (OB)/open detonation (OD) areas are programmatically excluded from ORAP because the conditions of their permit address potential MCOC migration from these areas. They are briefly described here for informational purposes only.

Inchon Explosive Ordnance Disposal Site

Fort Jackson historically utilized two sites (Wonsan and Inchon) for disposal of explosive ordnance, both by OB and OD. The Wonsan Explosive Ordnance Disposal (EOD) site is located on the portion

of Fort Jackson that is licensed to the SCARNG McCrady Training Center and, thus, is not discussed further in this report. The Inchon EOD site is located on the eastern side of Artillery Road, approximately one mile north of Leesburg Road. The six-acre Inchon EOD site was first used by the 48th EOD Detachment to dispose of unserviceable ammunition in 1973. Use of the site was discontinued in 1981. Disposal consisted of burning small arms ammunition in trenches and detonating larger ordnance in pits. The Inchon EOD site is designated as Solid Waste Management Unit (SWMU) 17 in Fort Jackson's IRP. Field activities to support a RCRA Facility Investigation were conducted in 1991, 1993, 1999, and 2000. Samples were collected from shallow soil, subsurface soil, surface water, sediments, and groundwater and analyzed for a variety of analytes, including explosives and metals. Groundwater concentrations were compared to the National Drinking Water Action Level of 15 parts per billion (ppb) for lead and the 2000 USEPA Region IX Preliminary Remediation Goals for Residential Soil and Tap Water. Soil concentrations were compared to USEPA Ecological Screening Values (ESVs) for surface soil (dated August 1999). Positive detections were noted primarily for metals in soil, including arsenic, barium, cadmium, chromium, and lead. A screening level ecological risk assessment was performed in accordance with USEPA (1997) guidance. This assessment determined that constituents present in the soil and groundwater at the Inchon site do not pose a threat to human health or the environment; however, potential UXO that remains in the soil at the site may pose a safety risk. Additionally, it should be noted that some comparison criteria referenced in this study may be outdated. Fort Jackson is implementing land use controls to prevent access to this site (LAW, 2003; USAEC, 2005).

Old Remagen Impact Range

The Old Remagen Impact Range (SWMU 23) comprises 3.4 acres located in the northern portion of Fort Jackson, north of the cantonment area. This area was used to train troops in the use of hand grenades, including practice and high explosive grenades, until 1979. Several investigations completed at the site included the collection and analysis of surface soil, subsurface soil, groundwater, sediment, and surface water samples. Limited criteria were available for groundwater; however, surface water was compared to the following 1998 criteria: SCDHEC water quality standards for human health and aquatic life and USEPA freshwater surface water screening values for hazardous waste sites. Elevated metals concentrations (i.e., antimony, arsenic, cadmium, chromium, and thallium) were detected in surface soil, subsurface soil, and sediment samples, based on the following comparison criteria: Fort Jackson 2001 background data, May 2001 USEPA Region IX Residential risk based concentrations (RBCs) with a hazard quotient of 0.1, and April 1996 USEPA soil screening levels with dilution factor of one. August 1999 USEPA ESVs were also used as criteria for surface soil only. A screening level ecological risk assessment was performed in accordance with USEPA guidance (1997). This assessment determined that the concentrations of metals present did not pose a risk to site receptors; however, it should be noted that some comparison criteria referenced in this study are outdated. Fort Jackson is planning an interim measure to remove surface debris and soil cover and will implement land use controls as part of a final remedy for the site (Ecology and Environment, 2003; USAEC, 2005).

Old Rocket Launcher and Rifle Grenade Ranges

A historical Rocket Launcher Range and Rifle Grenade Range are located near the northwestern border of the installation and are labeled as Numbers 2 and 3 on a 1956 Training Facilities Map (**Figure 3-3**). A report prepared in 1997 referred to this location as the "Old Rocket Grenade Range (SWMU 24)." The report describes SWMU 24 as a 30-acre area north of Boyden Arbor Road, near the northern border of the installation. Based on this report, the area was used for firing rocket grenades and has been inactive since the 1960s. Review of historical maps indicates that both a Rocket Launcher Range and Rifle Grenade Range were located in this area and that rockets and

grenades were fired. Field activities at SWMU 24 included a UXO clearance and soil sampling. Although several metals were detected in soil, none was present at concentrations exceeding USEPA Region III RBCs for residential soil and no explosives compounds were measured above detection limits. The SCDHEC issued a No Further Action determination for this site in January 1997 (Ecology and Environment, 1997; USAEC, 2005).

3.1.3 Potential MCOC

A majority of Fort Jackson is designated as operational range area, with munitions usage occurring at a number of small, medium, and large caliber live-fire ranges, a non-dudded impact area, and a dudded impact area. Based on a review of the data collected for the Phase I Assessment (e.g., GIS data, RFMSS data, historical range maps, site visit interviews with range and environmental personnel), potential source areas for off-range releases were identified at Fort Jackson. MCOC sampling data for certain portions of the installation were identified during the data collection and reviewed for this Phase I Assessment and are summarized below.

White Phosphorus Wetland Storage Installation Assessment (USACE, 1993)

The U.S. Army Corps of Engineers performed a White Phosphorus Wetland Storage Installation Assessment at Fort Jackson in 1993 to determine whether white phosphorus (WP) was present in areas potentially attractive to wildlife, particularly waterfowl. Sediment samples were collected from 12 locations around Fort Jackson that were deemed most likely to store WP based on historical or current use of WP-containing munitions. Five of the sampling locations were near the eastern dudded impact area, and two locations were near the western impact area (the five other sampling locations were near a recreational area). None of the samples contained WP above the analytical detection limit of 0.00096 milligrams per kilogram (mg/kg) (wet weight). The report concluded that the risk to waterfowl from WP storage in the Fort Jackson wetlands is negligible (USACE, 1993). Additionally, a summary report issued by USACE in 1996 stated that out of 39 samples collected at Fort Jackson, none contained WP levels over 0.00096 mg/kg (USACE, 1996).

Small Arms Ranges Study (Bricka, 2002)

Mississippi State University staff, headed by Dr. R. Mark Bricka, performed a study from 2001 to 2002 to evaluate the potential of off-installation migration of MCOC, particularly metals, from the small arms ranges located around the northern perimeter of the non-dudded impact area in the Gills Creek watershed. This study involved the collection of surface and subsurface soil samples from several ranges, as well as surface water and sediment samples from the creeks that drain the small arms ranges (i.e., Bynum, Rowell, and Mack creeks, which drain into Gills Creek). The data showed that soil containing elevated concentrations of lead is present on the small arms ranges. Also, because the small arms ranges contain sandy soils and are intersected by a network of creeks, the potential for erosive conditions is high, so that lead-contaminated soil was shown to be entering several of the smaller creeks that drain into Gills Creek. The results of the sediment sampling indicated that from Gills Creek, sediment travels into Boyden Arbor Pond, primarily during larger rain events. However, the authors of the study stated that "it is also suspected that little lead is moving off post because of the size of Boyden Arbor Pond and that the sediment lead levels at the discharge end of the pond are quite low." The lead concentration in a sediment sample collected at the discharge end of Boyden Pond was 6.4 mg/kg. Surface water sampling results showed that lead concentrations in all of the filtered water samples (total of 57 samples at 17 stream transect locations) and all but 10 of the unfiltered samples (total of 56 samples at 17 stream transect locations) were below 0.065 milligrams per liter (mg/L), the federal water quality Criterion Maximum Concentration (CMC). The CMC is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect.

To determine whether MCOC are migrating off-range, data must be compared to the Criterion Continuous Concentration (CCC), which is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. The USEPA mandates that the CCC for lead is 0.0025 mg/L using a hardness of 100 mg/L. The appropriate CCC at Fort Jackson would vary throughout the installation, based on hardness values ranging from 10 mg/L to over 100 mg/L (USATC, 2006). According to Dr. Bricka, the detection limit used for lead in this study was approximately 0.010 mg/L, which is above the CCC for lead. Because detection limits do not allow for a comparison to chronic criteria, this study does not rule out off-range migration of metals MCOC from the small arms ranges in the Gills Creek watershed. However, it does show that lead levels downstream from these ranges are substantially lower than in adjacent water bodies.

Small Arms Ranges Study (USATC, 2005)

The U.S. Army Aberdeen Test Center also performed a study to evaluate the potential of off-installation migration of MCOC, particularly metals, from the small arms ranges located around the northern perimeter of the non-dudded impact area in the Gills Creek watershed. This study involved a watershed-based assessment of the small arms ranges. The study included the installation of three shallow groundwater monitoring wells (MW-1, MW-2, and MW-3) at a small arms range to depths of approximately 13.5 to 14.5 feet below ground surface (bgs). Dissolved lead results from MW-1 were as high as 2,900 ppb, while maximum dissolved lead results from MW-2 and MW-3 were 6 ppb and 30 ppb, respectively. The core sections for MW-1 showed a sandy profile, while cores for MW-2 and MW-3 indicated that there is a localized confining condition (i.e., clay lens) that prevents direct communication between the ground surface and groundwater. Groundwater samples were also collected from two potable water supply wells located near the small arms ranges. These wells are screened in the Middendorf Formation at depths of 174 feet bgs and 105 feet bgs. Lead concentrations for groundwater samples from both of the wells were lower than the 15 ppb lead National Drinking Water Action Level.

The study authors noted that there was visual evidence of significant soil erosion and sediment transport from the impact berms on many ranges. Analytical results from three rounds of ambient surface water sampling suggest that the range areas were contributing to low-level lead concentrations in ambient surface waters adjacent to the range areas. Storm water grab sampling suggest that storm water discharge to the creeks is also increasing lead levels in each creek. However, each subwatershed creek flows through marshy areas before discharging into Gills Creek, which is characterized as a heavily vegetated, marshy area. Gills Creek then flows through Boyden Arbor Pond prior to flowing off the installation. These two environments (marsh and pond) act as natural filters to slow down and trap sediments by a decrease in water velocity and a subsequent decrease in the water's ability to carry sediment loads, as well as by the large amount of organic matter in the marshes that may bind or adsorb metals in runoff waters. According to the study authors, "…there are filtering mechanisms in place at Fort Jackson that are mitigating lead and total suspended solids concentrations in storm water runoff flowing from the small arms range area in the Gills Creek watershed." Regarding groundwater impacts, the study concludes that they are limited to the shallow base flow discharging to the creeks.

Table 3-3 summarizes the potential MCOC (if identified) associated with each of the range types described in Section 3.1.1. **Table 3-3** also lists potential MCOC from historical munitions usage at Fort Jackson.

Table 3-3: Potential MCOC (Current and Historical) at Fort Jackson

Range Type	Source Area / Munitions Types	Potential MCOC	Detected MCOC
Firing Ranges	Squad defense ranges, convoy live-fire ranges, hand grenade ranges, tank stationary gun ranges, demolition range, and artillery firing points	Cyclotrimethylenetrinitra-mine (RDX), 2,4-dinitrotolulene (DNT), 2,6-DNT, pentaerythritoltetranitrate (PETN), nitroglycerine, lead, antimony, copper, zinc, and tungsten	No sample results available
Small Arms Ranges	19 small arms ranges	Nitroglycerine, lead, antimony, copper, zinc, and tungsten,	Lead detected in soil, surficial groundwater, sediments, and surface water on ranges in Gills Creek watershed (Bricka, 2002; USATC, 2005)
Training Areas	Artillery firing points and areas currently used for maneuver / field training that fall within historical range fans for small, medium, and large caliber training ranges	RDX, 2,4-DNT, 2,6-DNT, PETN, nitroglycerine, lead, antimony, copper, and zinc	No sample results available
	Known or suspected dudded areas resulting from historical training activities involving primarily mortar and grenade firing	Trinitrotoluene (TNT), RDX, Cyclotetramethylenetetra-nitramine (HMX), 2,4-DNT, 2,6-DNT, PETN, and perchlorate	
	Areas with no historical source and with limited or no current munitions usage	None	
Impact Areas	The eastern dudded impact area, as well as a smaller known dudded area related to historical munitions usage within what is currently used as a non-dudded impact area	TNT, RDX, HMX, 2,4-DNT, 2,6-DNT, PETN, and perchlorate	No sample results available

Explosives MCOC are listed as a concern in dudded impact areas and known or suspected portions of training areas based on the historical use of these areas as artillery impact areas. Since most

explosives are consumed when ordnance properly detonates, the primary source of MCOC in dudded areas is from UXO and low-order detonations. UXO may occur if a fired munitions item fails to detonate. Explosives contamination from intact UXO results from corrosion or deterioration of UXO items over time. Incomplete detonation or breakup of the delivery system without detonation may also occur, leading to the survival of part or all of the explosive (USACE, 1999). These explosives may be scattered over the firing range as free product or partially encased in the remains of the delivery system (USACE, 1999).

A prioritized list of munitions containing perchlorate has been developed by USAEC and USACHPPM (2005). These munitions account for 96 percent of the U.S. Army's annual perchlorate expenditures. A review of available munitions data from RFMSS indicated that these munitions have been used in significant quantities during training activities; therefore, perchlorate has been included in the list of potential MCOC evaluated for Fort Jackson.

3.2 Physical Profile

3.2.1 Meteorology

Fort Jackson has a temperate continental climate with hot, humid summers and mild winters. This southern temperate region can experience temperatures ranging from below freezing to greater than 100 degrees Fahrenheit (ºF); however, there is a relatively narrow annual temperature range, from a mean daily temperature of 81ºF in July to 44ºF in January (Gene Stout & Associates, 2004). Annual precipitation is approximately 46 inches. July and August are the wettest months with approximately 5.5 inches of precipitation each month. Tropical storms producing heavy rainfall occasionally occur during late summer and early autumn. Wind speeds peak at approximately nine miles per hour in spring, and the general wind direction is from the southwest. Snowfall is rare and generally results in little, if any, accumulation (USATHAMA, 1980).

3.2.2 Topography

Gently to moderately rolling, moderately dissected high plains occupy most of Fort Jackson. These high plains are interrupted by the nearly flat alluvial plains of Gills, Cedar, and Colonels creeks and their tributaries and an irregularly distributed, gently sloping, low relief area in the central portion of the installation near the headwaters of Cedar Creek. Local relief in the high plains is largely 165-250 feet. Slopes are predominately three to eight percent; however, along narrow stream valleys, slopes commonly exceed 15 percent. Elevations in the high plains are mostly 295-459 feet above sea level. The lowest elevation in the high plains is about 200 feet, adjacent to the alluvial plain of Colonels Creek in the eastern portion of the installation. The highest elevation, 540 feet, is at Weir Tower in the west-central portion of the installation (Gene Stout & Associates, 2004).

Flat to gently rolling low plains characterize the extreme western portion of the installation, including a major portion of the cantonment area and the alluvial plains occupied by southwesterly flowing Gills and Mill creeks. Local relief around the valley of Gills Creek and its tributaries is generally less than 60 feet. Slopes are predominately between zero and three percent on the alluvial plains, and slopes in the cantonment area are predominately between three and eight percent. Upper valleys of Mill and Cedar creeks occupy low plains along the southern boundary of Fort Jackson. Local relief is generally less than 40 feet, and slopes are usually less than three percent (Gene Stout & Associates, 2004).

3.2.3 Geology

The geology of South Carolina is characterized by two principal physiographic and geologic provinces, the crystalline rocks of the Piedmont physiographic province and the unconsolidated sediments of the Coastal Plain. The boundary between the Piedmont and the Coastal Plain is marked by the Fall Line, which occurs approximately four miles west of Fort Jackson's cantonment area (USATHAMA, 1980; Newcome, 2003). Fort Jackson lies on the northwestern edge of the Coastal Plain province, a region of low to moderate relief and gently rolling plains, known as the Sand Hills. The principle geologic unit in the Sand Hills is the Upper Cretaceous-age Tuscaloosa Formation (also referred to as the Middendorf Formation), which outcrops over most of Fort Jackson and consists of marine deposits of light-colored sands and kaolin clays. Most soils at Fort Jackson are formed from sediment of the Tuscaloosa. A layer of Quaternary sand terrace overlies the Tuscaloosa Formation, which lies unconformably on the peneplained surface of crystalline rocks (Gene Stout & Associates, 2004). The Tuscaloosa complex generally consists of clay strata overlying unconsolidated sands and extends to depths of 90 to 300 feet bgs (USATHAMA, 1980). In the northwestern portions of Fort Jackson, Pleistocene sands and gravel are present at the ground surface (Gene Stout & Associates, 2004).

3.2.4 Hydrogeology

The Tuscaloosa Formation consists of interbedded, generally unconsolidated, fine to coarse sand and clay, causing groundwater to occur under both unconfined and confined (i.e., artesian) conditions. Groundwater occurs under water table conditions in the upper part of the zone of saturation. At a depth of about 99 to 251 feet, permeable sand zones are frequently overlain by less permeable clay zones, and the groundwater exists under artesian conditions (Gene Stout & Associates, 2004). At some places, a perched water table condition exists due to clay and sandy clay layers, which underlie the sands at many places (USATHAMA, 1980). The vertical migration of groundwater may be limited in some areas by the presence of a perched water table. There is extensive communication between surficial groundwater and surface water, as the shallow, perched aquifer discharges as base flow into the network of small creeks that run through much of the operational range area at Fort Jackson. Surficial groundwater flow at Fort Jackson generally follows the surface water flow, as shown in **Figure 3-6**. Static water levels measured on the west side of the installation (i.e., the cantonment area) generally range from two to 20 feet bgs (USATHAMA, 1980). The maximum depth to the water table occurs in the interstream areas near the central part of the installation, where static water levels exceed 100 feet bgs (LAW, 2003).

Aquifers southeast of the Fall Line, discussed in Section 3.2.3, include Upper Cretaceous and Tertiary formations (South Carolina Department of Natural Resources [SCDNR], 2003). The primary groundwater resources for water supply wells in Richland County, SC, are the Cretaceous Middendorf and Black Creek formations (SCDNR, 2003). The deep regional aquifer at Fort Jackson occurs in the basal Middendorf sand formation. Regional groundwater movement arcs in a south to southeasterly direction across Fort Jackson toward two major discharge points, the Congaree River to the south and southwest and the Wateree River to the east (Newcome, 2003). Regional groundwater flow is shown in **Figure 3-7**. Although Fort Jackson is not located within a recharge area for a sole-source aquifer, it is within the recharge area for an aquifer that is widely used for drinking water (Gene Stout & Associates, 2004). According to the SCDNR, approximately 600 groundwater wells were completed in sand beds of the Cretaceous and overlying formations from 2001 to 2002 (SCDNR, 2003). SCDHEC references confirm that South Carolina's major drinking water aquifers are in the subsurface of the Coastal Plain (SCDHEC, 2006).

3.2.5 Soils

Four major soil types are present at Fort Jackson: Lakeland, Vaucluse-Ailey-Pelion, Fuquay-Troup-Vaucluse, and Pelion-Johnson-Vaucluse (USATHAMA, 1980). Lakeland soils are the predominant soil type at Fort Jackson and are found at higher elevations in the central part of Fort Jackson along ridgetops (Gene Stout & Associates, 2004). They consist of deep, gently to strongly sloping, and highly permeable sandy soils. Vaucluse-Ailey-Pelion soils are found along the Colonels Creek watershed in the east and southeastern portions of Fort Jackson. They consist of well-drained to moderately well-drained soils that have a sandy surface layer and a loamy subsoil. Fuquay-Troup-Vaucluse soils are found along Mill Creek and Cedar Creek in two small areas along the southern installation boundary. They consist of well-drained soils with sandy surface and subsurface layers and a loamy subsoil. Pelion-Johnson-Vaucluse soils are found on the western portion of Fort Jackson along the Gills Creek watershed. They consist of moderately well-drained soils that have a sandy surface layer and a loamy subsoil, very poorly drained soils that are loamy throughout, and well-drained soils that have a sandy surface layer and a fragipan in the loamy subsoil (USATHAMA, 1980; Gene Stout & Associates, 2004). The high sand content of soils at Fort Jackson promotes leaching of minerals, reduced water retention, and increases susceptibility to soil erosion (USATC, 2005).

3.2.6 Surface Water

Fort Jackson is located within the Santee River Basin and the Congaree River subbasin. Fort Jackson encompasses five watersheds or subwatersheds, as shown in **Figure 3-8**. These watersheds are drained by Colonels, Gills, Wildcat, Mill, and Cedar creeks described below.

Colonels Creek Watershed
The headwaters of Colonels Creek originate on Fort Jackson. This is a predominately wooded watershed. Colonels Creek drains the eastern portion of the installation, including the area licensed to the SCARNG McCrady Training Center, and flows southeast to the Wateree River, a tributary of the Congaree River.

Gills Creek Watershed
Gills Creek, in the northwest portion of Fort Jackson, drains the small arms ranges and western impact area, as well as non-live-fire training areas. Gills Creek is primarily an urban watershed that has been identified as being very polluted. These pollutants are typical of pollutants found in urban settings: petroleum products, oil and grease, sediments, trash, and sewage. However, a large portion of the Gills Creek watershed on Fort Jackson is relatively pristine when compared to that portion in the more urbanized city of Columbia (Gene Stout & Associates, 2004; SCDHEC, 1997).

Wildcat Creek Watershed
Wildcat Creek drains a small portion of the cantonment area and flows to the west, where it enters Gills Creek just below Lake Katherine. None of the operational range areas are drained by Wildcat Creek.

Mill Creek Watershed
Mill Creek drains an area in the southwest portion of the training areas and flows off-post to the south, where it eventually enters the Congaree River. The Mill Creek watershed encompasses a small area in the southern portion of the non-dudded impact area (including two small arms ranges), wooded training areas, and the Twin Lakes recreational area located on-post.

Cedar Creek Watershed

Cedar Creek drains the majority of a large dudded impact area and flows southward through the Weston Lake Recreation Area, eventually entering the Congaree River.

There are 26 lakes, ponds, and impoundments on Fort Jackson. These water bodies range in size from 0.5 to 173 acres; however, most are less than 35 acres. Five ponds and two lakes are adequate for intensive fisheries management (Old Heises Pond, South Pond, Upper Barstow Pond, Lower Barstow Pond, Odom Pond, Upper Legion Lake, and Big Twin Lake). Remaining lakes and ponds are maintained for waterfowl habitat, recreation, aesthetics, and irrigation water supply for golf courses. The largest lake, Weston Lake, is north of Leesburg Road east of the cantonment area. The lake has a surface area of about 173 acres and accounts for more than one-third of the total impounded surface acreage for the installation. Weston Lake is also the installation's primary waterside recreation lake, with camping facilities, picnic shelters, a community house, a beach pavilion, and a swimming area (Gene Stout & Associates, 2004).

All creeks and streams leaving Fort Jackson eventually flow into either the Wateree River or the Congaree River (**Figure 3-9**). These rivers meet about 16 miles southeast of Fort Jackson, where they form the Santee River, the principal stream of the region. The Santee River continues in a southeasterly direction, eventually emptying into the Atlantic Ocean south of Georgetown, South Carolina (Gene Stout & Associates, 2004).

3.2.7 Vegetation

In general, Fort Jackson can be classified into five primary terrestrial vegetative types: pine, pine/upland hardwood, upland hardwood, bottomland hardwood, and open field. There are no grassland areas on Fort Jackson, except for a small amount in the cantonment area and alongside roads. Vegetation on Fort Jackson is diverse and abundant. Field investigations and surveys have identified over 750 species of flora on the installation. Forest cover is the principal vegetative type and may be grouped into eight major forest types: Natural Pine, Pine Plantation, Pine Scrub Oak, Pine Hardwood, Scrub Oak, Upland Hardwood, Bottomland Hardwood, and Hardwood Pine. Natural Pine is the most important forest type on the installation and includes all natural pine stands, regardless of species, in which less than 20 percent of the basal area of overstory trees is hardwoods or less than 20 percent of the basal area is dominated by scrub oak (Gene Stout & Associates, 2004).

As observed during the site visit, forested areas occupy the majority of the installation, with the exception of the firing ranges and the cantonment area. The dudded and non-dudded impact areas in the center of the installation, as well as the training areas along the outskirts of the installation, are mostly covered with thick vegetation consisting of mature pines and scrub oaks. There are, however, several sandy areas that are not vegetated and that are prone to erosion. These areas have been surveyed by personnel in Fort Jackson's ENRD and are shown in **Figure 3-10**.

3.3 Munitions Release / Migration Profile

Surface water moving off-range provides a possible migration pathway for MCOC. As described in Section 3.2.6, there are five watersheds delineated on Fort Jackson. These watershed drainage areas provide potential avenues for MCOC to migrate off-range via surface water and sediment, as shown in **Figure 3-8**. Receptor interactions are considered up to 15 miles from where these surface water courses exit operational range area, based on guidance developed by the USEPA for the CERCLA Preliminary Assessments (**Figure 3-9**).

At Fort Jackson, groundwater in the shallow, perched aquifer has been identified as a potential pathway for MCOC to migrate off-range. There is an extensive network of creeks and ditches throughout the operational area. Surface water in these creeks provides recharge and receives discharge from surficial groundwater. Surficial groundwater also provides recharge. Localized confining conditions (i.e., clay lenses) may retard communication between the ground surface and groundwater in some areas, limiting the off-range migration of MCOC.

MCOC from source areas, as described in **Table 3-3,** potentially impact source media, including soil (e.g., found in impact berms, firing points, and dudded, as well as non-dudded, impact areas) and surface water / sediment (e.g., via erosional deposition into streams and/or wetlands).

MCOC can be released to groundwater (down gradient), surface water / sediment (downstream), off-range soil, or the food chain via a variety of release mechanisms. Release mechanisms for soil may include leaching from soil to groundwater or erosion and runoff to off-range surface soil or to nearby streams. Once potential MCOC are deposited in surface water / sediment, they have the potential to migrate downstream or be taken up by aquatic plants or animals.

3.4 Land Use and Human Receptor Profile

3.4.1 Current Land Use

The vast majority of land comprising Fort Jackson is used for training activities, including live-fire and non-live-fire ranges and impact areas. There is a cantonment area located in the southwestern portion of the installation. The cantonment area supports a wide variety of land uses (e.g., housing, recreational, commercial, education, healthcare) that comprise the elements necessary for a functional community. The cantonment area is surrounded on the north and east by reserved land and buffer areas, which provide a transitional use to installation range and training areas. The daytime population of Fort Jackson in 2001 was 18,556 persons, consisting of 11,139 students and soldiers in training, 3,575 military personnel, and 3,842 civilians.

The city of Columbia, consisting of highly urbanized developed land, lies to the west and northwest of Fort Jackson. There are a few rural residential and commercial developments immediately south of Fort Jackson adjacent to Leesburg Road. The area surrounding the eastern portion of Fort Jackson is undeveloped and consists of natural woodlands.

3.4.2 Adjoining Areas of Concern

The McCrady Training Center, which covers approximately 15,000 acres of the eastern portion of Fort Jackson, is licensed to the SCARNG for training. The cantonment area of the SCARNG McCrady Training Center is in the southeastern corner on about 517 acres. The remainder of the land is utilized for live-fire and non-live-fire training. Fort Jackson's range control office coordinates training activities for the SCARNG, and all of the medium caliber and large caliber munitions firing from the McCrady Training Center are directed toward the eastern dudded impact area, which is included in the Fort Jackson ORIS.

3.4.3 Current Human Receptors

Potential human receptors include residents (in on-installation housing and in nearby off-installation residential areas), workers (on-installation and in off-installation areas surrounding the installation), and hunters, fishermen and swimmers utilizing on-installation or nearby off-installation areas for recreational purposes. Potential human receptors include the following:

- Residential and commercial/industrial communities within four miles down gradient of current and historical source areas who utilize groundwater from the surficial aquifer. These receptors are primarily located in communities south of Leesburg Road, southeast of Fort Jackson; however, receptors have also been identified to the west and southwest of Fort Jackson.
- Recreational users of Weston Lake and other on-installation recreational ponds and lakes
- Recreational users who utilize surface water from the designated watershed systems within 15 miles downstream of current and historical source areas

3.4.4 Resource Use Location

Fort Jackson purchases most of its drinking water from the City of Columbia water system, which processes 62 million gallons per day (mgd) from the Broad River at Columbia and Lake Murray on the Saluda River just west of the city. Fort Jackson purchases approximately 2.5 mgd of potable water from the City of Columbia (Newcome, 2003). The installation also operates nine wells that provide water to the training ranges, the ammunition depot, and the Weston Lake Recreation Area (**Figure 3-6**). The depths of these wells range from 105 to 263 feet bgs, and they are screened in the Middendorf Formation (LAW, 2003). Water samples from these wells were analyzed for primary and secondary drinking water maximum contaminant levels (MCLs) by the U.S. Army Environmental Hygiene Agency in 1976 and 1978. The results showed that the groundwater is slightly acidic (pH = 5.1 to 6.2), low in dissolved solids (2.0 to 81.3 mg/L), and has a very low alkalinity and hardness (USATHAMA, 1988). Currently, the water from these wells is monitored routinely by the Fort Jackson Preventive Medicine office for total coliform.

Figure 3-6 depicts the water supply lines and groundwater wells in the vicinity of Fort Jackson. The majority of the communities adjacent to Fort Jackson obtain potable water from the City of Columbia; however, the SCDNR database identifies groundwater wells in these areas, indicating that groundwater may also be used as a potable water source. Residences located along Leesburg Road, near the southeastern installation boundary, utilize groundwater as their source of potable water (LAW, 2003). According to the SCDNR database, domestic wells in the vicinity of Fort Jackson draw from both the surficial aquifer and the Middendorf Formation.

Recreational areas on Fort Jackson are primarily hunting areas and fishing ponds and lakes (i.e., Heise Pond, Twin Lakes, and Weston Lake). Weston Lake is the installation's primary waterside recreation lake, with camping facilities, picnic shelters, a community house, a beach pavilion, and a swimming area.

3.5 Ecological Receptor Profile

3.5.1 Sensitive Environments

Wetlands on Fort Jackson consist primarily of bottomland hardwoods in narrow bands adjacent to streams and drainages. There are some wider areas of forested wetlands along the main branch of Colonels Creek and Gills Creek. Approximately 5,250 acres of wetlands have been inventoried on the installation (Gene Stout & Associates, 2004). In addition, the Integrated Natural Resources Management Plan lists the following significant natural areas on Fort Jackson (Gene Stout & Associates, 2004):

Buffalo Creek Bog

Buffalo Creek Bog on Buffalo Creek (**Figure 3-8**), a tributary of Colonels Creek, is a sandhill seepage bog and the most botanically significant site on Fort Jackson. The site is in the dudded impact area and has been exposed to frequent fires. The unique hydrology of the site, in association with these frequent fires, has produced habitat for a number of rare or uncommon plant species, including the federally listed rough-leaved loosestrife (*Lysimachia asperulaefolia*).

Dupre Pond Headwaters

An unusual system of braided streams and rivulets occurs at the northwestern headwaters of Dupre Pond in a training area near the northern installation boundary (**Figure 3-8**). At the base of the dry north-facing slope, a broad expanse of low trees is dominated by grasses, sedges (especially *Rhynchospora spp.* and *Carex spp*.), and various shrubs, providing habitat to numerous invertebrate species, amphibians, and reptiles.

3.5.2 Habitat Types

Approximately 7,000 acres of the 36,971 acres not licensed to SCARNG comprise the Fort Jackson cantonment area. The majority of the remaining area is used for operational ranges and training areas. Much of the operational training area is forested. Natural pine and pine plantation forest types make up the majority of the forest habitat on the installation. There are 26 lakes, ponds, and impoundments on Fort Jackson. Together, these water bodies cover about 427 acres. Approximately 5,250 acres of wetlands have been inventoried on the installation (Gene Stout & Associates, 2004).

The areas to the southeast and northeast of Fort Jackson are largely undeveloped, consisting of natural pine forest habitat as well as creeks and wetlands areas. Areas to the southwest and northwest are characterized by urban development associated with Columbia, the largest city in South Carolina.

3.5.3 Ecological Receptors

Two federally listed endangered plant species, rough-leaved loosestrife and smooth coneflower (*Echinacea laevigata*), occur on Fort Jackson. Rough-leaved loosestrife is found on the eastern edge of the dudded impact area. Smooth coneflower has been documented adjacent to Statue of Liberty Road on land licensed to the SCARNG. **Figure 3-8** indicates the approximate locations of the two endangered plant species populations. Since these plants are located in narrowly defined areas within the operational training ranges, it is not expected that they would be found at off-installation locations.

One federally listed endangered animal, the red-cockaded woodpecker, is a resident of Fort Jackson. Red-cockaded woodpecker distribution on Fort Jackson is depicted in **Figure 3-8**. Due to the wide presence of the red-cockaded woodpecker on Fort Jackson and the presence of similar habitat off-range and off-installation, it is expected that the red-cockaded woodpecker would be present off-range as well. The American Bald Eagle (*Haliaeetus leucocephalus*), which is listed by the SCDNR as a state endangered species (SCDNR, 2006), is a transient visitor to the installation. No American Bald Eagle nests or permanent roost sites are known to occur on the installation, and it is unlikely that the species nest at Fort Jackson due to unsuitable habitat. Although not currently listed as threatened or endangered, Fort Jackson provides habitat for five rare animal species: the Southern hognose snake (Heterodon simus), American Kestrel (Falco sparverius), Rafinesque's big eared bat (*Plecotus rafinesquii*), loggerhead shrike (*Lanius ludovicianus*), and Bachman's sparrow (*Aimphila aestivalis*).

3.6 Relationship of Potential MCOC Sources to Off-Range Human and Ecological Receptors

As summarized in Table 3-3, potential MCOC sources have been identified at the firing ranges, small arms ranges, and impact areas shown in **Figure 3-5**, as well as at some of the training areas. The following discussion describes the relationship between potential MCOC sources present at a given type of range to off-range human and ecological receptors.

Firing Ranges

The U.S. Army Training Center operates eight medium and large caliber firing ranges at Fort Jackson. These ranges are primarily located around the perimeter of the eastern dudded impact area, but a couple of them are located to the north of the impact area. All of these ranges lie within the Gills Creek, Cedar Creek, or Colonels Creek watersheds.

Two firing ranges occur within the Colonels Creek watershed, a hand grenade range in the western portion of the watershed and a small demolition range within a training area. A large erosional area is present over the central portion of the hand grenade range, and the range is up gradient and within 700 feet of two tributaries of Colonels Creek. The demolition range is approximately one-third mile from a tributary of Colonels Creek and is half covered by an identified erosional area. Based on the proximity to surface water and potential for erosion from each site, it is likely that surficial groundwater and/or overland surface flow or soil erosion mechanisms have the potential to transport MCOC off-range. Surface water receptors may be contacted downstream in ponds and impoundments formed by Colonels Creek (e.g., Murray Pond). Groundwater originating at ranges within the Colonels Creek watershed would have a greater than four-mile pathway to reach off-installation groundwater receptors; therefore, it is unlikely that MCOC in groundwater from these ranges would impact off-range groundwater receptors.

Three firing ranges occur within the Gills Creek watershed, which are all within one-half mile of Rose Creek, a tributary of Bynum Creek. A large percentage of each of these ranges is also covered by identified erosional areas. During the site visit, large patches of bare soil were noted at two of these ranges. Based on the potential for sheet erosion at these ranges and an observed lack of adequate vegetative cover, surficial groundwater and/or overland surface flow or soil erosion mechanisms have the potential to transport MCOC from these ranges to nearby surface water. Once potential MCOC are deposited in surface water / sediment, surface water receptors may be contacted downstream in Forest Lake and Lake Katherine. In addition, the shallow depth to groundwater, especially adjacent to the creeks, implies that groundwater in the surficial aquifer discharges to surface water. If transported off-installation via surface water runoff or through infiltration or leaching into the groundwater, MCOC from the firing ranges within the Gills Creek watershed have the potential to reach private domestic wells located to the west and southwest of Fort Jackson, as shown on **Figure 3-6**.

Three firing ranges are present within the Cedar Creek watershed. Surficial groundwater or overland flow that discharges to surface water has the ability to carry potential MCOC from the firing ranges in the Cedar Creek watershed to Weston Lake. If transported off-installation via surface water runoff or through infiltration or leaching into the groundwater, MCOC from the firing ranges within the Cedar Creek watershed have the potential to reach private domestic wells located to the south of Fort Jackson along Leesburg Road within four miles of source areas.

Small Arms Ranges

The U.S. Army Training Center operates 19 small arms ranges at Fort Jackson. Seventeen of these 19 ranges are located in the western operational range area, situated around the perimeter of a largely non-dudded impact area. Fifteen of the ranges located in the western portion of the installation lie within Gills Creek watershed, and two occur within Mill Creek watershed. The remaining two small arms ranges are situated just north of the eastern dudded impact area, within Colonels Creek watershed.

As discussed in Section 3.1.3, two studies have been performed to evaluate the potential of off-installation migration of metals MCOC from the small arms ranges. The conclusions reached in both of the studies are that surface water and surficial groundwater on the small arms ranges are impacted by lead, but concentrations of metals are drastically reduced by the time they reach off-range areas. These conclusions are supported by routine sampling performed by the SCDHEC for the Gills Creek Non-Point Source Watershed Project (SCDHEC, 1997). The results from this sampling effort are shown in **Table 3-4** below. During this period, surface water lead concentration in the Gills Creek samples did not exceed 50.0 ppb; however, higher lead levels were found in storm water samples collected near the ranges in the Mack, Rowell, and Bynum creek tributaries (**Figure 3-8**).

Table 3-4: Small Arms Range Area Storm Water Sampling Results

Date	Total Lead Concentration (ppb)			
	Gills Creek	Mack Creek	Rowell Creek	Bynum Creek
21 Nov 1994	Not sampled	Not sampled	1,100	Not sampled
23 Jan 1995	< 50	Not sampled	70	Not sampled
8 Mar 1995	Not sampled	360	Not sampled	260
24 Apr 1995	< 50	Not sampled	2,200	Not sampled

Source: SCDHEC, 1997

The report author stated that, "Preliminary sampling has determined that no detectable levels of lead are leaving the military reserve." (SCDHEC, 1997). According to SCDHEC personnel, 50.0 ppb was the state MCL for lead at the time the samples were taken (1994 and 1995) but was not reinstituted in 1998. Human health criteria for lead are currently under review, and this 50.0 ppb MCL is no longer used by SCDHEC; therefore, the conclusion of the studies discussed above and the associated sample results cannot conclusively determine that metals MCOC from the small arms ranges located in the Gills Creek watershed do not pose a risk to off-site receptors. Additionally, samples from this area have not been analyzed for explosive and perchlorate MCOC, which may be subject to different fate and transport mechanisms than metals MCOC.

It should be noted that Fort Jackson has implemented engineering controls to mitigate the transport of soil via storm water runoff from its small arms ranges, and lead levels in surface water have most likely decreased since sampling in 2001. According to Fort Jackson Range Control personnel, a new drainage system was just installed at the small arms range adjacent to Rowell Creek, which is the most heavily used range at Fort Jackson. Berm bullet pocket structural enhancements were installed at the small arms range adjacent to Mack Creek as part of a test study on use of storm water management controls at the small arms ranges (USATC, 2006). Sampling data show reduced storm water runoff concentrations (USATC, 2006). However, sampling data downstream of Fort Jackson's operational range area are not available to confirm the effectiveness of these controls on off-range

lead migration. Therefore, both surface water and surficial groundwater pathways exist for these ranges, which are up gradient from groundwater wells identified by the SCDNR database, as shown on **Figure 3-6**.

There are two small arms ranges located in the southern portion of the non-dudded impact area that lie within the Mill Creek watershed. There is a potential surface water pathway for MCOC from these ranges to Mill Creek, which drains to the Twin Lakes, which are used for recreational fishing and swimming. Threatened and endangered species habitat has been identified in this area. There is also a potentially complete groundwater pathway for MCOC, as groundwater wells have been identified down gradient from these ranges, as depicted on **Figure 3-6**.

Colonels Creek watershed contains two small arms ranges: a large range adjacent to the eastern dudded impact area and a small (1.5-acre) night infiltration course located within a training area just north of the eastern impact area. The larger range is intersected by Buffalo Creek, which drains to Colonels Creek; therefore, surface water containing MCOC from this range has the potential to migrate off-site via Colonels Creek to surface water receptors at Murray Pond. The night infiltration course is directly up gradient from Buffalo Creek, at a slope of approximately five percent (GIS Repository, n.d.). Based on the topography and sandy soil present at the range, MCOC also has the potential to migrate off-site from this range via Colonels Creek. Surficial groundwater that may drain along the Colonels Creek watershed would have a transport pathway of farther than four miles prior to reaching the closest groundwater receptor (i.e., domestic wells located to the south of Fort Jackson along Leesburg Road); therefore, no groundwater receptors are identified for either of these two ranges.

Training Areas

Seventy-five training areas are present within the portion of Fort Jackson not licensed to the SCARNG for training. Little or no historical munitions usage has occurred at 25 of these areas, most of which are located within the Gills Creek watershed with two smaller areas located at the installation's southern boundary in the Mill Creek and Cedar Creek watersheds. It is presumed that there is no MCOC source present in these 25 training areas.

Historical munitions usage was identified at 33 of the remaining 50 training areas. Fifteen training areas contain artillery or mortar firing points and/or known or suspected dudded areas, and two training areas are entirely overlapped by firing ranges. Significant MCOC sources may be present in some of these areas and are discussed below.

Training Areas Containing Historical Munitions Usage Areas

Historical munitions usage occurred within 33 training areas, where overlapping historical range fans for small, medium, and large caliber munitions training were identified. These training areas are located primarily in the northeastern portion of the Fort Jackson operational training area, but there are also several in the southwestern portion of the operational training area. Many of the training areas in the northeast portion of Fort Jackson lie within the Colonels Creek watershed. These areas were mostly designated as safety fans for small arms ranges used from the 1940s to the 1960s. Given that these areas have not been used for munitions training since the 1960s and that most of the use was for small arms training, it is likely that only limited MCOC sources remain in these areas and transport of high concentrations of MCOC is unlikely.

This is supported by surface soil MCOC sampling that was conducted at several closed small arms ranges within the cantonment area at Fort Jackson under the Military Munitions Response Program,

as part of a Site Inspection in April/May 2005 (Malcolm Pirnie, 2006). The small arms ranges include a transition range, a pistol range, and overlapping range fans from 1000-inch and landscape target ranges. These ranges, which encompass approximately 475 acres, were used from the 1940s through the 1970s for small arms training. The firing lines and target areas for the ranges account for a much smaller area (approximately 80 acres). Historical information provided general locations of former range features (e.g., firing lines/lanes, target areas); however, these features are no longer discernable at the sites. A combination of technologies was used to field determine biased sampling locations, including visually confirming historical range feature locations (e.g., firing lines, target areas, backstop berms), locating concentrations of bullet fragments/casings using an all-metals detector and X-Ray Fluorescence screening at potential sampling locations to determine areas of higher lead concentrations. Analytical data indicate that total lead concentrations were detected below the USEPA Region 9 Residential Preliminary Remediation Goal of 400 mg/kg for all 51 surface soil samples collected.

The same assumptions are made for the several training areas that are located in either the Cedar Creek or Mill Creek watersheds, provided that historical maps indicate that usage was limited to primarily small arms. Limited MCOC sources were identified in a total of 28 of the 33 training areas with historical munitions usage.

Historical munitions use at the remaining five training areas is characterized as providing potential sources of MCOC, based on type, frequency, and most recent use. Two training areas located in the central portion of the Colonels Creek watershed historically were utilized as artillery impact areas, which may have resulted in the presence of significant UXO. Although a surface removal action has been performed over these training areas, UXO may still exist in the subsurface if a fired munitions item failed to detonate. Incomplete detonation or breakup of the delivery system without detonation may also occur, leading to the survival of part or all of the explosive (USACE, 1999). Intact UXO may corrode or deteriorate over time, leading to explosive MCOC contamination in these areas. These areas are assumed to potentially contain a greater loading of MCOC than the surrounding areas that were range fans for small arms ranges. Surficial groundwater and/or overland surface flow or soil erosion mechanisms have the potential to transport MCOC from these ranges to a surface water course. Potential off-range receptors have been identified in Murray Pond. No groundwater receptors are identified since the distance to the closest domestic wells exceeds four miles.

Likewise, a greater loading of MCOC is assumed at one training area in the Mill Creek watershed historically used as an impact area for a rocket launch range. Mill Creek traverses this range before it empties into the Twin Lakes, which are used as a recreational area. Red-cockaded woodpecker cavity trees are located along Mill Creek just upstream of Twin Lakes, as shown in **Figure 3-8**. Therefore, it is assumed that a potentially complete surface water pathway exists to human and ecological receptors. Down gradient groundwater receptors have also been identified in the Mill Creek watershed, as shown on **Figure 3-6**.

Two training areas with historical munitions use, one located in the Cedar Creek watershed and the other in the Gills Creek watershed, were used through the 1990s as overlapping mortar and firing ranges. Their recent use and the potential for UXO in these areas suggest a greater loading of MCOC than the areas historically used as small arms ranges or range fans. Surface water and groundwater pathways and receptors are identified for both of these ranges.

Training Areas Containing Artillery/Mortar Firing Points and/or Known or Suspected Dudded Areas

Twelve training areas contain known or suspected dudded areas identified by Fort Jackson range control, and five of these training areas, plus three other training areas, contain mortar or artillery firing points.

As shown in **Figure 3-5**, training areas containing known or suspected dudded areas occur primarily in the northeastern portion of the Fort Jackson operational training area (seven of 12 ranges), with two smaller areas occurring in the southern and northwestern portions of the installation. The large area in the northeast lies in the Colonels Creek watershed. Five of the seven training areas with suspected dudded areas in the Colonels Creek watershed also contain one or more artillery firing points. Surface water and surficial groundwater from this area drain to the southeast through the McCrady Training Center (which is mostly comprised of operational training area) and then off-site. MCOC have the potential to reach off-range surface water human receptors at Murray Pond, as well as threatened and endangered species such as the red-cockaded woodpecker. However, groundwater receptors (i.e., residences along Leesburg Road) are located farther than four miles from the source area assuming that surficial groundwater flows along Colonels Creek.

Two training areas that contain a suspected dudded area are located on the southern installation boundary fall within the Mill Creek watershed, which drains southward. There is a creek located approximately one-third of a mile south of this area, south of the installation boundary. Given generally erosive soil conditions on Fort Jackson and the presence of an uncleared dudded area, it is assumed that there is a potential for MCOC to enter the creek and to migrate south to Lake Rebecca, where human and ecological receptors may be present. Since this area is fairly close to the cantonment area, where groundwater depths are shallow, it is presumed that MCOC have the potential to reach the shallow aquifer in this area. The SCDNR database indicates that some off-post residents located south of this area utilize groundwater wells for potable water; therefore, groundwater receptors are identified for these training areas.

Three training areas contain a suspected dudded training area located in the northwest portion of the installation within the Gills Creek watershed. Surface water and surficial groundwater from this area flow to the west and southwest, toward the Fort Jackson cantonment area. Groundwater receptors are identified for this source area, since groundwater wells have been identified west of the installation. There is also a potential for MCOC to enter Gills Creek and migrate to Forest Lake and Lake Katherine, downstream of Fort Jackson, where human and ecological receptors are present.

Three additional training areas contain only artillery or mortar firing points, and do not contain suspected dudded areas. Two of these training areas are located in the Colonels Creek watershed and one is located in Cedar Creek watershed.

Training Areas Overlapped by Firing Ranges

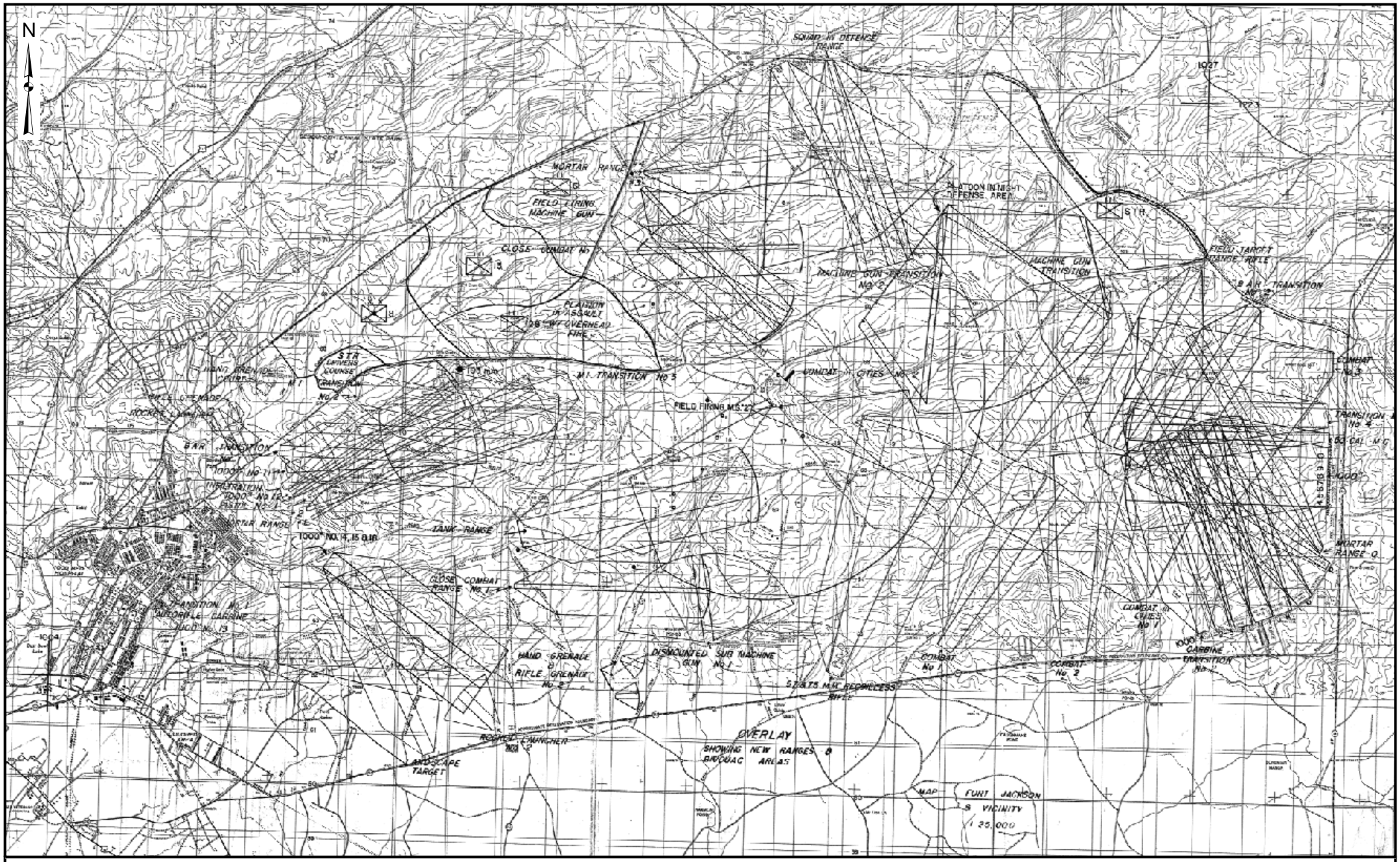
The two training areas overlapped by firing ranges are considered potential MCOC sources due to munitions use associated with the firing ranges. One of these training areas is located within Gills Creek watershed, and one within Cedar Creek watershed.

Impact Areas

The dudded eastern impact area falls almost entirely within the Cedar Creek watershed, which drains southward to Weston Lake, a popular recreational area. Therefore, overland flow and surface water have the ability to carry potential MCOC from this impact area to Weston Lake. The shallow depth

to groundwater, especially adjacent to creeks, implies that groundwater in the surficial aquifer discharges to surface water. If transported off-installation via surface water runoff or through infiltration or leaching into the groundwater, MCOC have the potential to reach private domestic wells located to the south of Fort Jackson along Leesburg Road within four miles of source areas.

The western impact area lies almost entirely within the Gills Creek watershed. Surface water and surficial groundwater from this area flow to the west and southwest toward the Fort Jackson cantonment area and then off-site to Forest Lake and Lake Katherine. As discussed in Section 3.4.4, potable water in the cantonment area is provided by the city of Columbia; however, groundwater wells have been identified west of the installation. Therefore, groundwater receptors are identified for this source area. Likewise, wells have been identified in areas down gradient of the portion of the impact area located within the Mill Creek watershed. Two detailed studies of MCOC migration from the small arms ranges in the Gills Creek watershed have been performed (see Section 3.1.3) and have demonstrated that metals MCOC from this area do enter local creeks. Sampling data do not conclusively show whether concentrations of metals MCOC migrating off-installation pose a potentially complete pathway to human and ecological receptors downstream. Additionally, the MCOC identified for this area include perchlorate and explosive compounds that may be subject to different transport mechanisms than metals; therefore, a surface water pathway and surface water receptors are also potentially present for this area.

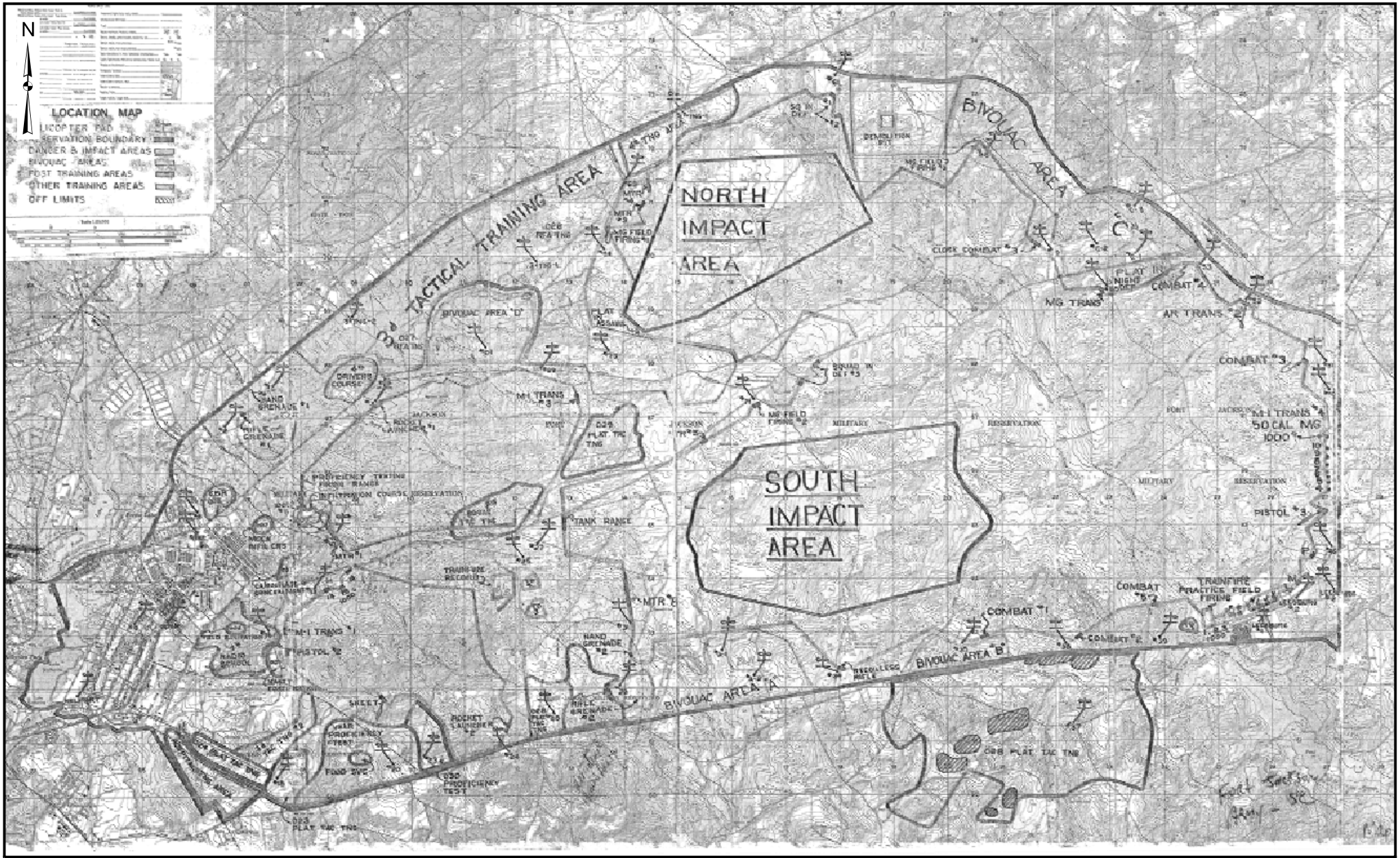


Operational Range Assessment Program
Phase I Qualitative Assessment
Fort Jackson, SC

Figure 3-1
1949 Fort Jackson and Vicinity Map

Data Sources:
1949 Fort Jackson and Vicinity Map

Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

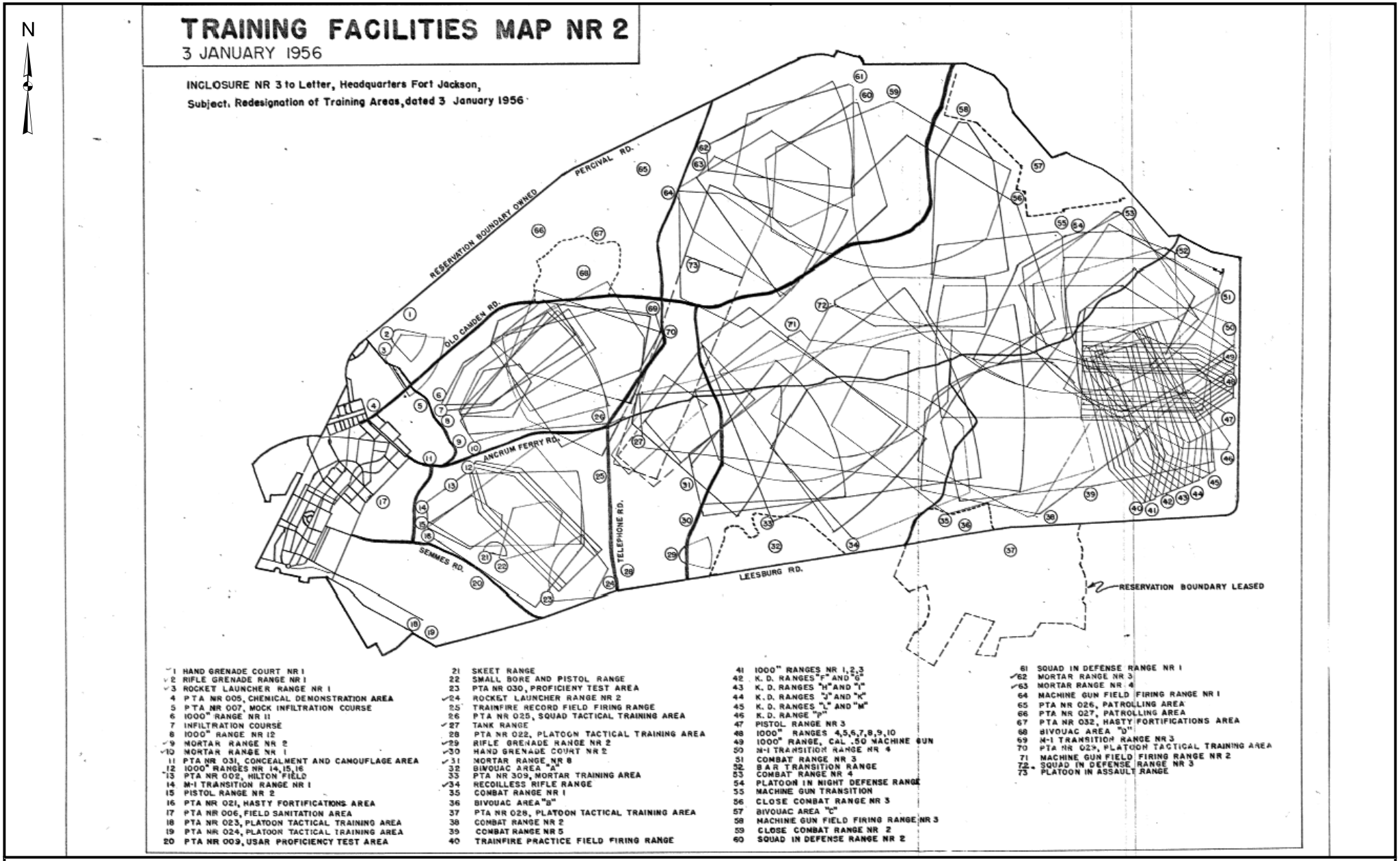


Operational Range Assessment Program
Phase I Qualitative Assessment
Fort Jackson, SC

Figure 3-2
1952 Location Map

Data Sources:
1952 Location Map

Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

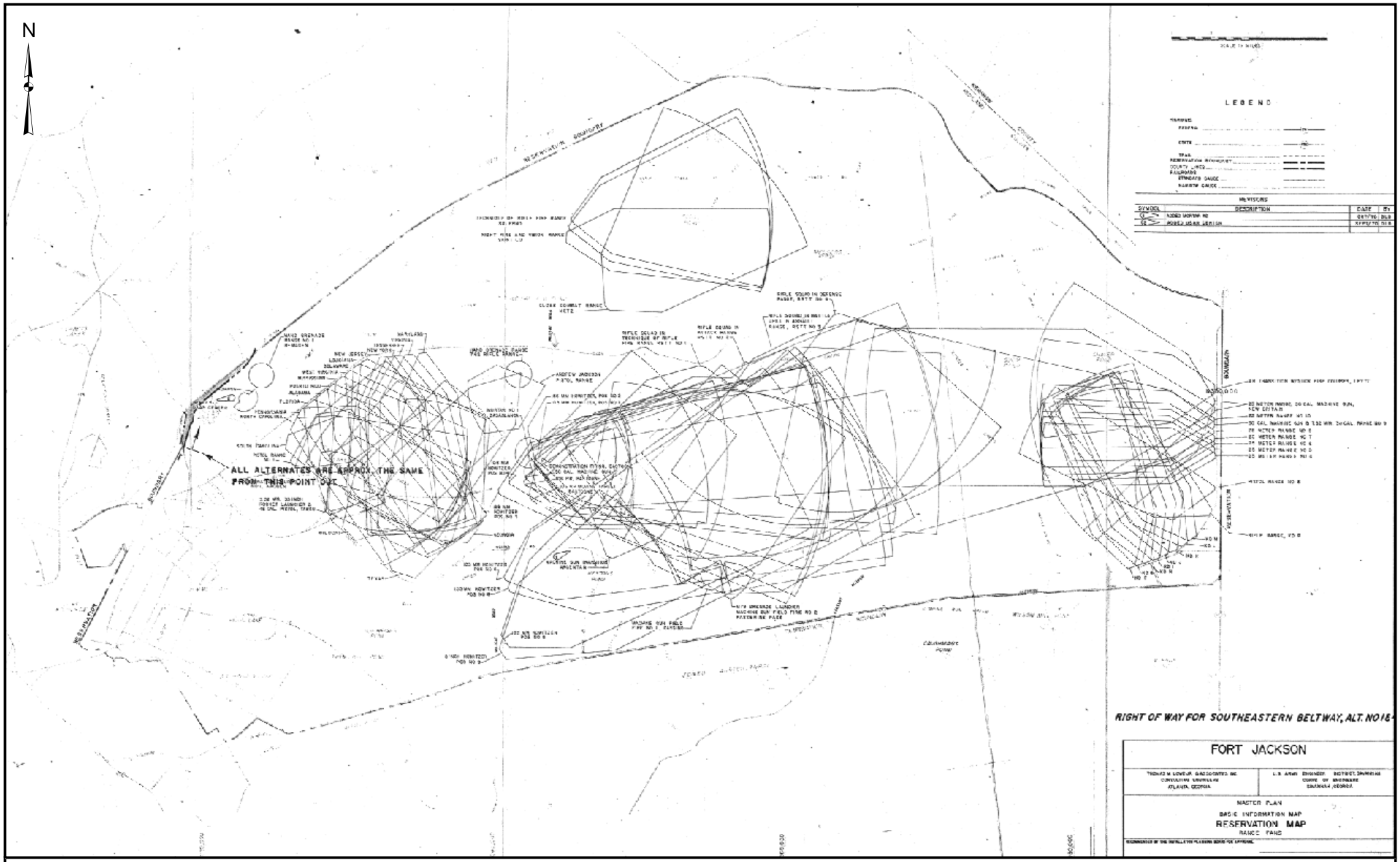


Operational Range Assessment Program
Phase I Qualitative Assessment
Fort Jackson, SC

Figure 3-3
January 1956 Training Facilities Map NR2

Data Sources:
Jan 1956 Tranining Facilities Map NR2

Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

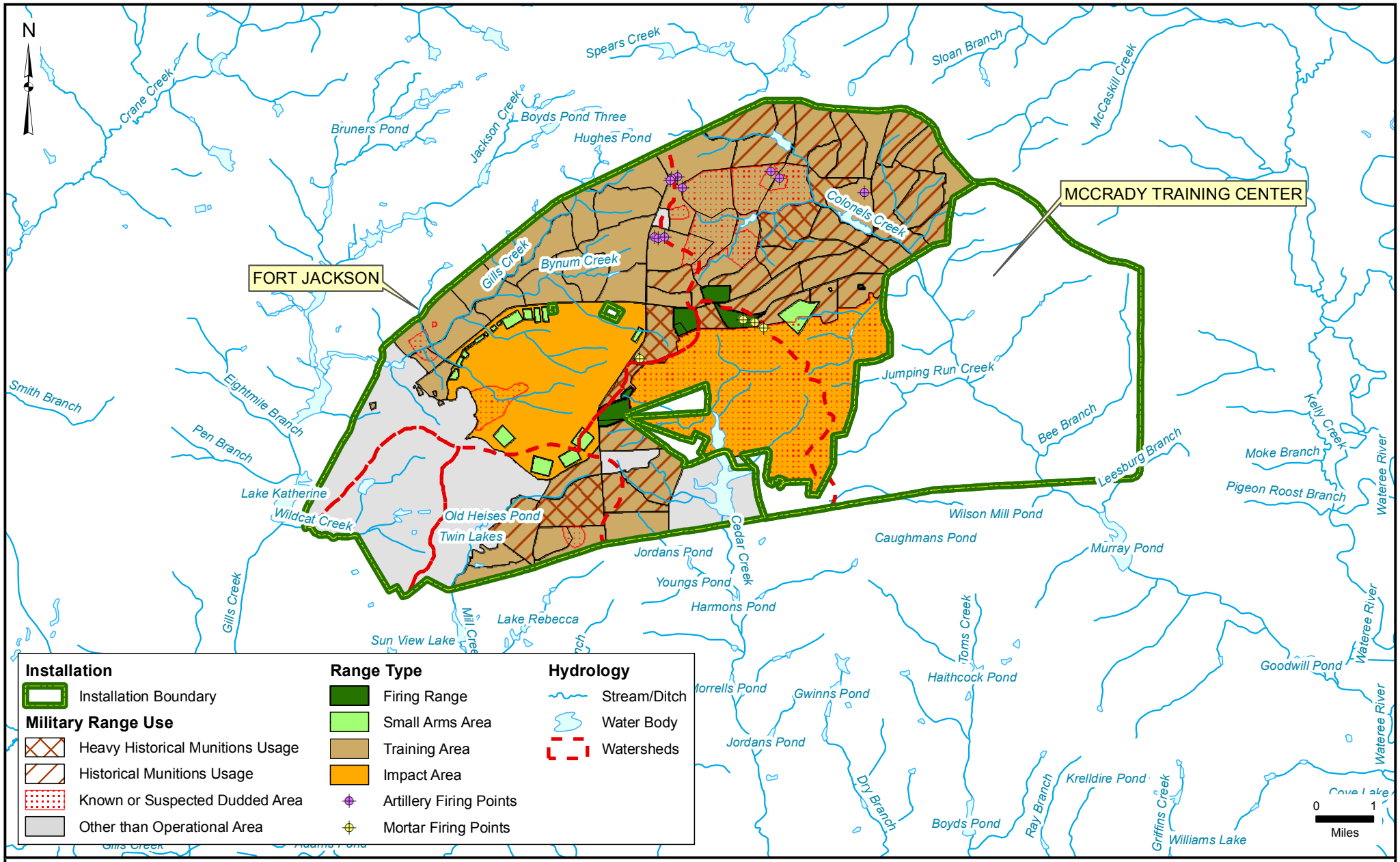


Operational Range Assessment Program
Phase I Qualitative Assessment
Fort Jackson, SC

Figure 3-4
August 1969 Master Plan Reservation Map

Data Sources:
August 1969 Master Plan
Reservation Map

Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004



Operational Range Assessment Program
Phase I Qualitative Assessment
Fort Jackson, SC

Figure 3-5
Range Regions

Data Sources:
AEC, ARID-GEO, April 2006
ESRI, StreetMap USA, 2005
Fort Jackson Installation GIS
Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

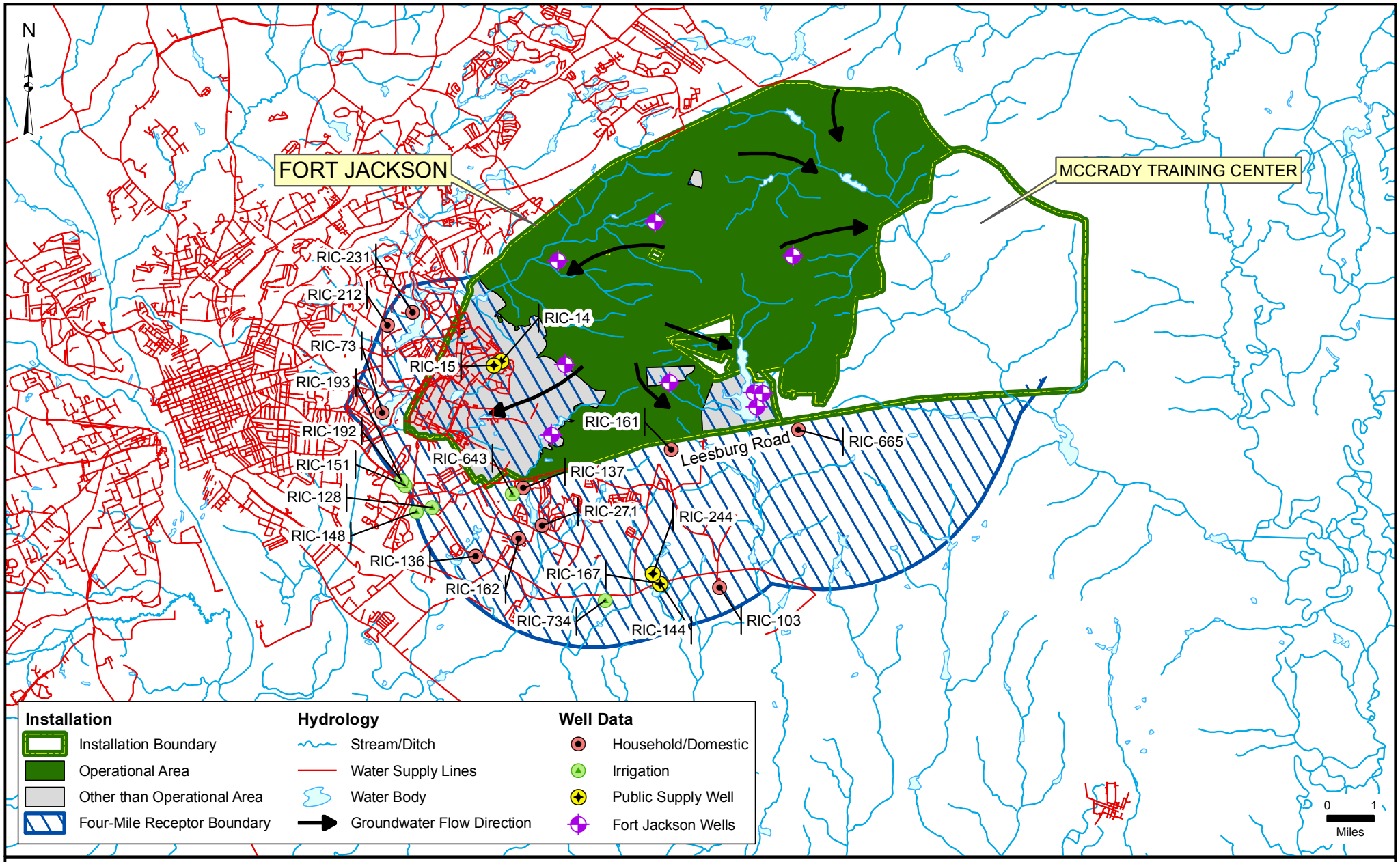


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Figure 3-6
Groundwater Pathways (Surficial Aquifer)

Data Sources:
AEC, ARID-GEO, April 2006
ESRI, StreetMap USA, 2005
Fort Jackson Installation GIS
Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

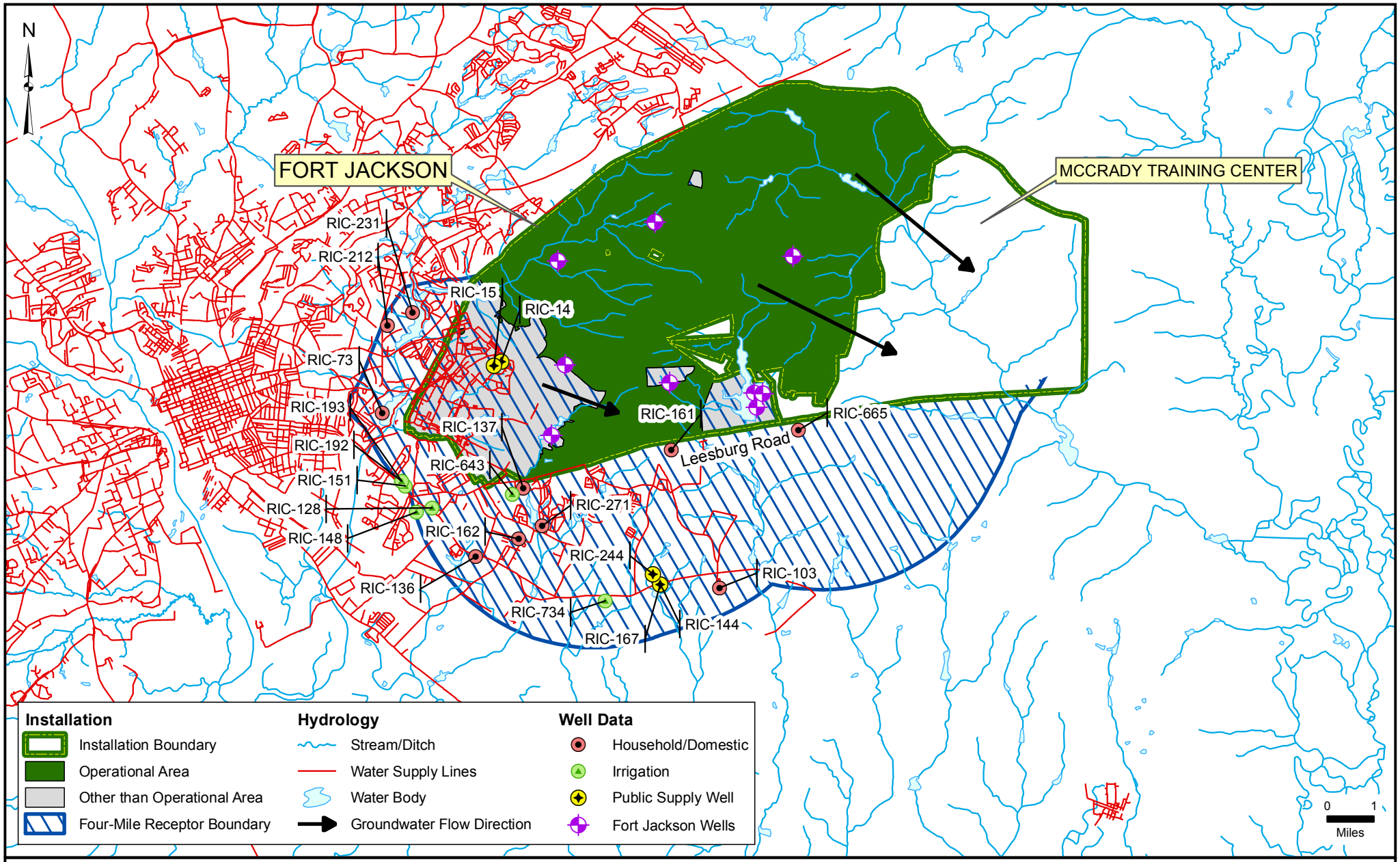

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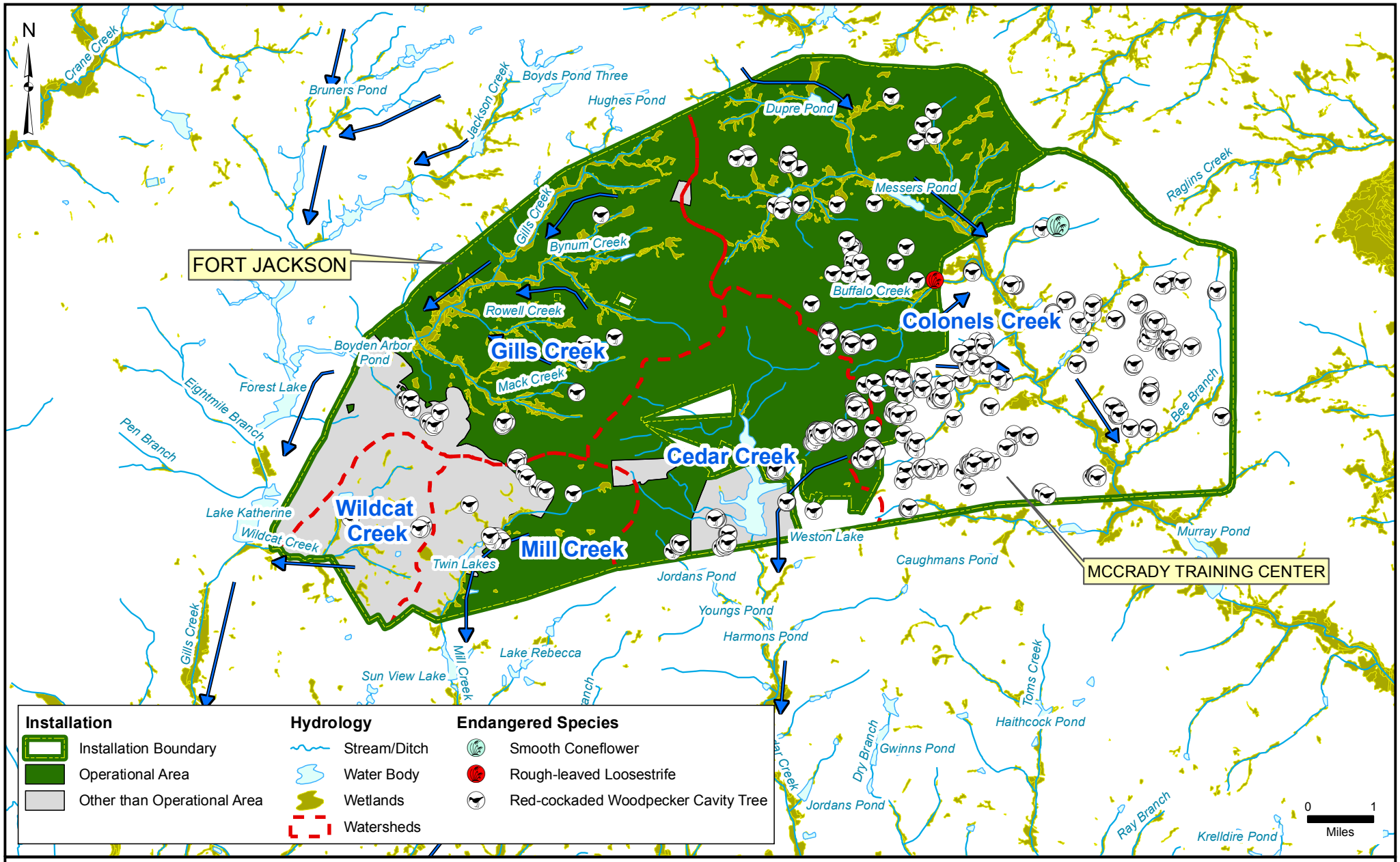
Figure 3-7
Groundwater Pathways (Regional Aquifer)

Data Sources:
AEC, ARID-GEO, April 2006
ESRI, StreetMap USA, 2005
Fort Jackson Installation GIS
Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004



Operational Range Assessment Program
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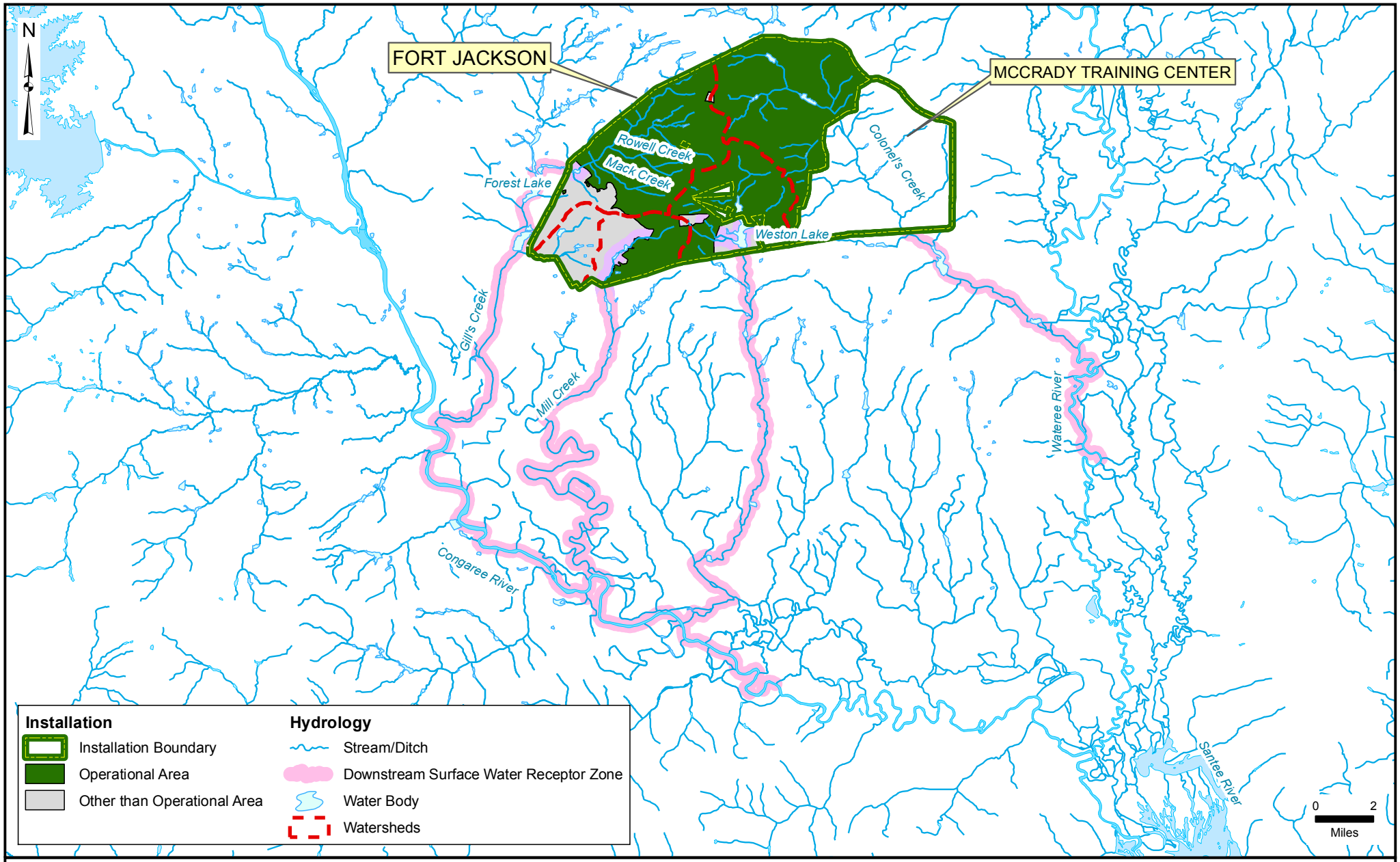
Figure 3-8
Surface Water Pathways

Data Sources:
AEC, ARID-GEO, April 2006
ESRI, StreetMap USA, 2005
Fort Jackson Installation GIS, 2005
Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004



Operational Range Assessment Program
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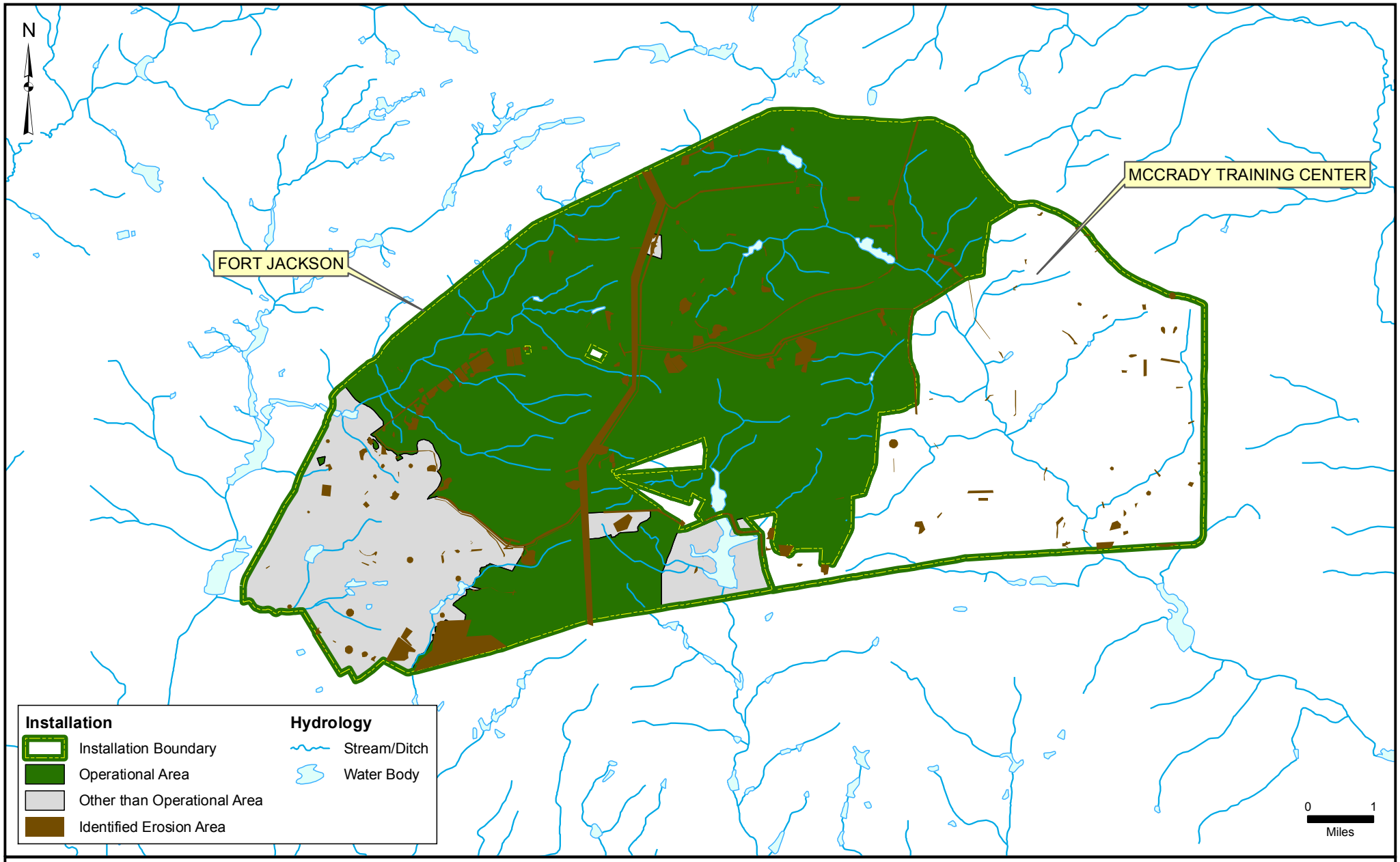
Figure 3-9
Surface Water Pathways 15-Mile Boundary

Data Sources:
AEC, ARID-GEO, April 2006
ESRI, StreetMap USA, 2005
1980 Installation Assessment
Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004



Operational Range Assessment Program
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Figure 3-10
Identified Erosion Areas

Data Sources:
AEC, ARID-GEO, April 2006
ESRI, StreetMap USA, 2005
Fort Jackson Installation GIS, Nov 2004
Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

4.0 Grouping and Categorization Methods

4.1 Grouping Rationale

The ARID-GEO (2006) data identified operational ranges within the installation boundaries. The identified operational ranges may contain live- or non-live-fire ranges, firing points, or other training activities. For the purposes of the Phase I Assessment, operational range areas are divided into various groups. Groups are defined by the presence or absence of the three CSM components: source of MCOC, migration pathway, and receptor. The acronym designations for these components are presented below:

Source of MCOC

- **Limited Source (LS)**: Limited or no munitions have been used on-range. No migration pathway or receptor designation is needed for this group.
- **Munitions (M)**: Munitions have been used on-range. This designation is always followed by the applicable pathway designation.

Migration Pathway

- **Pathways Unlikely (PU)**: Migration pathways are unlikely or incomplete. This designation is always preceded by an M signifying munitions have been used on-range.
- **Groundwater (GW)**: A groundwater migration pathway was identified. This designation is always preceded by an M signifying that munitions have been used on-range.
- **Surface Water (SW)**: A surface water migration pathway was identified. This designation is always preceded by an M signifying that munitions have been used on-range.

Receptor

- **Human (H)**: Source-receptor interaction is complete or potentially complete for human receptors. This designation is always preceded by both the M designation and the applicable pathway designation.
- **Ecological (E)**: Source-receptor interaction is complete or potentially complete for ecological receptors. This designation is always preceded by both the M designation and the applicable pathway designation.

The (H) and (E) designations follow the applicable pathway. For example, if a source has been identified, both surface water and groundwater pathways exist, the source-receptor interaction is complete for human and ecological receptors of surface water, and the source-receptor interaction is complete for human receptors of groundwater, then the group is MSW (H/E) GW (H).

4.2 Categorization Rationale

Each range group can be placed into one of three categories (Referred, Inconclusive, or Unlikely). Category definitions are presented in Section 1.2 and **Appendix A**.

Ranges in groups with at least one CSM component absent (source of MCOC, migration pathway, or receptor) are designated as Unlikely because a source-receptor interaction does not exist.

Ranges in groups with all three CSM components (source of MCOC, migration pathway, and receptor) are categorized based on review of available data using a weight of evidence approach. Examples for placing these range groups into the three categories are provided below.

- **Referred –** If one or more MCOC are present in off-range media (i.e., groundwater, sediment, surface water, or soil) at levels that present an unacceptable risk to human health or the environment as confirmed through acceptable sampling data, the group is categorized as Referred.
- **Inconclusive** – If one or more MCOC are or have the potential to be present in off-range media and source-receptor interactions are complete or potentially complete, but data are unavailable or insufficient to determine whether receptors are at risk or whether potential source-receptor interactions are complete, the group is categorized as Inconclusive.
- **Unlikely** – Ranges where, based upon a review of readily available information, there is sufficient evidence to show that there are no known releases or source-receptor interactions that could present an unacceptable risk to human health or the environment are categorized as Unlikely. In addition, if compelling data (sampling or weight of evidence rationale) indicate that source-receptor interactions are complete, but the levels do not pose unacceptable risk to human health or the environment, the group is categorized as Unlikely.

5.0 Conceptual Site Model Narrative

The operational ranges at Fort Jackson assessed in this Phase I Assessment have been placed into three groups: MSW (H/E) GW (H/E), MSW (H/E) GW, and LS. Rationale for placing ranges into these groups is discussed in the sections below and is based on the source of potential MCOC, exposure pathways, and potential receptors described earlier in this report. This information is used to determine if a potential source-receptor interaction exists for each relevant pathway identified, which is used to determine the appropriate categorization for each group.

Figure 5-1 depicts the range groupings, which are described below. The potential source-receptor interactions based on the CSM components described below are depicted in **Figure 5-2** for Group MSW (H/E) GW (H/E), **Figure 5-3** for Group MSW (H/E) GW, and **Figure 5-4** for Group LS. **Table 5-1** provides site-specific information concerning the CSM components for each group identified within Fort Jackson, including potential sources, source media, release mechanisms, exposure media, exposure routes, and receptors.

5.1 Group MSW (H/E) GW (H/E)

Group MSW (H/E) GW (H/E) includes 36 operational ranges totaling 12,425 acres.

5.1.1 Primary Source and MCOC

Sources of potential MCOC at Group MSW (H/E) GW (H/E) ranges include one large dudded impact area, one mostly non-dudded impact area, eight firing ranges, 17 small arms ranges, and 11 training areas. Training areas have been included in Group MSW (H/E) GW (H/E) if their historical or current use presents a potential MCOC source. Three training areas in Group MSW (H/E) GW (H/E) have received heavy munitions usage in the past, five contain known or suspected dudded areas, and one of the training areas contains two mortar firing points, which present a potential source but have not been used in the last four years according to RFMSS data. The remaining two training areas are entirely overlapped by four of the firing ranges included in this group; therefore, their acreage has not been included in the total acreage of Group MSW (H/E) GW (H/E). Military munitions currently used on Group MSW (H/E) GW (H/E) operational ranges include small to large caliber military munitions, rockets, grenades, and pyrotechnics. It is expected that the dudded impact area contains the greatest concentrations of MCOC since it has been actively used as an impact area since the 1940s and continues to receive heavy usage. MCOC associated with the ranges placed into the MSW (H/E) GW (H/E) group include metals MCOC (lead, antimony, copper, zinc, and tungsten), nitroglycerin, TNT, RDX, HMX, 2,4-DNT, 2,6-DNT, PETN, and perchlorate. WP has not been included as an associated MCOC based on the sampling results discussed in Section 3.1.3, which indicate that the risk of WP contamination at Fort Jackson is negligible (USACE, 1993).

5.1.2 Source Media

Primary source media identified at the ranges in Group MSW (H/E) GW (H/E) include soil, surface water, and sediment. MCOC can deposit in surface water and sediment from munitions landing directly in water. High order detonations, which constitute most munitions detonations, generate undetectable to barely detectable and diffuse surface residuals. Because there is no direct contact of MCOC with groundwater, shallow groundwater is considered a secondary source where potential MCOC can leach/infiltrate into shallow groundwater from soil, sediment, and surface water. Surface water and sediment can also be secondary sources if they receive surface water runoff or erosion from soil source areas or surficial groundwater discharge.

5.1.3 Pathway Analysis

Migration mechanisms for potential MCOC in soil at the ranges in Group MSW (H/E) GW (H/E) include leaching or infiltrating through the soil profile to groundwater and surface erosion and subsequent runoff to sediment and surface water. MCOC in surface water are also subject to plant and animal uptake and subsequent ingestion and/or dermal absorption by humans or off-range ecological receptors. At Fort Jackson, a shallow perched groundwater aquifer produces a high likelihood for surficial groundwater to discharge into down gradient surface water. As a result, MCOC have the potential to migrate from shallow groundwater to surface water. This groundwater pathway exists only for the surficial aquifer and not for the deep regional aquifer, the Middendorf Formation. Sampling data indicate that groundwater wells at Fort Jackson screened in the regional aquifer do not contain elevated levels of MCOC. Therefore, it is not likely that there is a potentially complete pathway for MCOC to the deeper regional aquifer. It is assumed that this is due primarily to the clay layers between the two aquifers, which significantly decrease permeability.

5.1.4 Potential Source-Human Interaction Pathway Analysis

Ranges within Group MSW (H/E) GW (H/E) lie within the Gills Creek, Mill Creek, and Cedar Creek watersheds, which are delineated on **Figure 3-8**. Surface water source-human interaction pathways have been identified for all three watersheds. Potential MCOC sources within the Mill Creek watershed may impact the Twin Lakes recreational area located in the Fort Jackson cantonment area. Potential MCOC sources from the Gill Creek ranges could potentially impact off-installation recreational areas at Forest Lake and Lake Katherine. Surface water and sediment in these recreational areas are potential pathways for human receptors via dermal contact or accidental ingestion. The Weston Lake Recreation Area just downstream of the Cedar Creek watershed ranges is used for fishing, camping, and other recreational activities. Surface water and sediment in the Weston Lake Recreation Area present potential pathways for human receptors via dermal contact or accidental ingestion. **Figure 3-9** displays regional watersheds and down gradient surface water bodies within approximately 15 miles of Fort Jackson. In addition, fish are known to bioaccumulate certain MCOC, including metals. No fish tissue studies were identified for areas in or around Fort Jackson; however, such bioaccumulation from exposure either on-range or off-range is possible. Therefore, consumption of fish is a potential pathway to humans.

Surficial groundwater flow within these watersheds generally follows the direction of surface water flow. The MCOC source areas in the Cedar Creek watershed are up gradient of rural areas that most likely use private groundwater wells as their primary drinking water source. These areas are not serviced by public water supply lines, as shown in **Figure 3-6**. **Figure 3-6** also depicts a four-mile radius of Fort Jackson, where potential groundwater receptors are most likely located. As shown in **Figure 5-1**, much of the area to the south and southeast of Group MSW (H/E) GW (H/E) ranges lies within McCrady Training Center, which is comprised primarily of DoD-owned operational range area. There is a cantonment area in the southeast corner of the McCrady Training Center. Potable water for this cantonment area is supplied by drinking water wells that are screened in the Middendorf Formation and, therefore, are unlikely to contain MCOC based on sampling of wells screened in the regional aquifer. Private groundwater wells located along the southeast portion of Leesburg Road that are screened in the surficial aquifer represent a potential pathway for human receptors via ingestion or dermal contact.

The MCOC source areas in the Gills Creek and Mill Creek watersheds are up gradient of urban areas that receive potable water service from the city of Columbia, as shown by the location of public water supply lines in **Figure 3-6**; however, the SCDNR database has also identified groundwater wells in

these areas. Therefore, source-human interaction groundwater pathways have been identified for MCOC source areas in the Gills Creek and Mill Creek watersheds**.**

5.1.5 Potential Source-Ecological Interaction Pathway Analysis

The migration of potential MCOC off-range from the sources identified at the ranges in Group MSW (H/E) GW (H/E) through surface water and groundwater pathways has the potential to affect sensitive environments (e.g., wetland habitats). **Figure 3-8** shows the locations of red-cockaded woodpecker cavity trees throughout Fort Jackson and the McCrady Training Center. These trees are present in the other than operational land around Twin Lakes, Boyden Arbor Pond, Weston Lake, and additional habitat may exist in the rural land south and southeast of the installation. The migration of MCOC off-range through surface water pathways has the potential to affect these sensitive off-range habitats as well as wetlands throughout the installation. Surficial groundwater potentially containing MCOC may also migrate off-range and discharge to surface water downstream.

5.2 Group MSW (H/E) GW

Group MSW (H/E) GW includes 15 operational ranges totaling 4,046 acres.

5.2.1 Primary Source and MCOC

Group MSW (H/E) GW consists of two firing ranges, two small arms ranges, and 11 training areas. Training areas have been included in Group MSW (H/E) GW if their historical or current use presents a potential MCOC source. Two training areas in Group MSW (H/E) GW have received heavy munitions usage in the past, two contain known or suspected dudded areas, and two contain artillery firing points. An additional five training areas contain both artillery firing points and known or suspected dudded areas. Sources of potential MCOC at Group MSW (H/E) GW ranges consist of areas that are known or suspected to be dudded due to historical munitions use, fixed firing points, and small arms ranges. Military munitions currently used on Group MSW (H/E) GW operational ranges include small, medium, and large caliber military munitions and pyrotechnics. MCOC associated with the ranges placed into the MSW (H/E) GW group include metals MCOC (lead, antimony, copper, zinc, and tungsten), nitroglycerin, TNT, RDX, HMX, 2,4-DNT, 2,6-DNT, PETN, and perchlorate. WP has not been included as an associated MCOC based on the sampling results discussed in Section 3.1.3, which indicate the risk of WP contamination at Fort Jackson is negligible (USACE, 1993).

5.2.2 Source Media

The primary source media identified at the ranges in Group MSW (H/E) GW include soil, surface water, and sediment. MCOC may deposit in surface water and sediment from munitions landing directly in water. High order detonations, which constitute most munitions detonations, generate undetectable to barely detectable and diffuse surface residuals. Because there is no direct contact of MCOC with groundwater, shallow groundwater is considered a secondary source where potential MCOC can leach/infiltrate into shallow groundwater from soil. Surface water and sediment can also be secondary sources if they receive surface water runoff or erosion from soil source areas or surficial groundwater discharge.

5.2.3 Pathway Analysis

Migration mechanisms for potential MCOC in soil at the ranges in Group MSW (H/E) GW include leaching or infiltrating through the soil profile to groundwater and surface erosion and subsequent runoff to sediment and surface water. At Fort Jackson, a shallow perched groundwater aquifer

produces a high likelihood for shallow groundwater to discharge into down gradient surface water. As a result, MCOC have the potential to migrate from shallow groundwater to surface water. This groundwater pathway exists only for the surficial aquifer and not for the deep regional aquifer, the Middendorf Formation. Sampling data indicate that groundwater wells at Fort Jackson screened in the regional aquifer do not contain elevated levels of MCOC. Therefore, it is not likely that there is a potentially complete pathway for MCOC to the deeper regional aquifer. It is assumed that this is due primarily to the clay layers between the two aquifers, which significantly decrease permeability.

5.2.4 Potential Source-Human Interaction Pathway Analysis

All of the ranges within Group MSW (H/E) GW lie within the Colonels Creek watershed. Potential MCOC sources within Colonels Creek watershed may impact Murray Pond, which is located southeast of the installation and utilized for recreational activities. Surface water and sediment in this recreational area is a potential pathway for human receptors via dermal contact or accidental ingestion. **Figure 3-9** displays regional watersheds and down gradient receptor surface water bodies within approximately 15 miles of Fort Jackson. No fish tissue studies were identified for areas in or around Fort Jackson; however, such bioaccumulation from exposure either on-range or off-range is possible. Therefore, consumption of fish is a potential pathway to humans.

Surficial groundwater flow within the Colonels Creek watershed generally follows in the direction of surface water flow. The MCOC source areas in the Colonels Creek watershed are located more than four miles away from residences on Leesburg Road that may use domestic wells and, therefore, are not considered to impact these groundwater receptors.

5.2.5 Potential Source-Ecological Interaction Pathway Analysis

The migration of potential MCOC off-range from the sources identified at the ranges in Group MSW (H/E) GW through down gradient surface water bodies has the potential to affect sensitive environments (e.g., wetland habitats). **Figure 3-8** shows the locations of red-cockaded woodpecker cavity trees throughout Fort Jackson and the McCrady Training Center. Additional habitat may exist in the rural land south and southeast of the installation. The migration of MCOC off-range through surface water pathways has the potential to affect these sensitive off-range habitats as well as wetlands throughout the installation. No fish tissue studies were identified for areas in or around Fort Jackson; however, such bioaccumulation from exposure either on-range or off-range is possible. Therefore, consumption of fish is a potential pathway to humans.

5.3 Group LS

Group LS includes 53 operational ranges totaling 13,004 acres, all of which are training areas.

5.3.1 Primary Source and MCOC

Group LS consists of 28 training areas where historical munitions usage has occurred, which mostly consisted of safety fans for small arms ranges, and 25 training areas that include training and maneuver areas, non-live-fire courses, and obstacle courses. Small caliber blanks are used on these ranges, and there is limited use of pyrotechnics. Small caliber military munitions are also used on one of the Group LS ranges. From 2002 to 2006, approximately 2,500 small caliber rounds were used throughout this 358-acre range. The relatively small amount of MCOC associated with this amount of small caliber rounds, dispersed over several hundred acres, is not considered a potential source. No or limited potential MCOC sources were identified for these 53 ranges.

5.3.2 Source Media

No or limited potential MCOC sources were identified for the operational ranges in Group LS; therefore, source media were not identified.

5.3.3 Pathway Analysis

No or limited potential MCOC sources were identified for the operational ranges in Group LS; therefore, potential pathways were not evaluated.

5.3.4 Potential Source-Human Interaction Pathway Analysis

No or limited potential MCOC sources were identified for the operational ranges in Group LS; therefore, potential source-human receptor interactions were not evaluated.

5.3.5 Potential Source-Ecological Interaction Pathway Analysis

No or limited potential MCOC sources were identified for the operational ranges in Group LS; therefore, potential source-ecological receptor interactions were not evaluated.

5.4 Data Uncertainty

ARID-GEO (2006)

Based on the ORIS data obtained and the interviews conducted during the site visit, the following data uncertainties regarding the ARID-GEO March 2006 data were identified:

- ARID-GEO March 2006 is missing one of the non-live-fire courses present at Fort Jackson, based on interviews with range personnel.

- According to Fort Jackson Range Control, three training areas previously licensed to SCARNG for training have been taken back for Fort Jackson Basic Training mission use, and should be included in the Fort Jackson ORIS. Conversely, one of the firing ranges listed in the Fort Jackson ORIS is licensed for SCARNG use, and should be assessed under the McCrady Training Center ORAP Phase I Assessment.

- According to Fort Jackson's field training map, there are four firing ranges located within two of the training areas at the perimeter of the large dudded impact area (Fort Jackson ITAM, 2006). These training areas are shaded entirely as "Other" ranges on mapping for the March 2006 draft update of ARID-GEO. The overlapping firing ranges are labeled but there is no distinction in use.

- ARID-GEO March 2006 data also shows the western impact area, which is partially dudded, as an entirely non-dudded area, as shown in **Figure 1-2**. During the course of data review for this QAR, it was determined that a 273-acre portion of the West Small Arms Impact Area is known or suspected to be a dudded impact area.

RFMSS

Some RFMSS data for the installation are incorrect, including, for example, the use of small caliber military munitions at known non-live-fire courses. These data conflict with information obtained during the site visit and range tour and from installation documents. Malcolm Pirnie contacted DPTMS personnel, who confirmed that no live ammunition is used on the aforementioned non-live-fire courses and no live grenades are used on one of the small arms ranges. DPTMS also confirmed that no munitions are used at several ranges listed in the RFMSS. Additional facilities were listed in

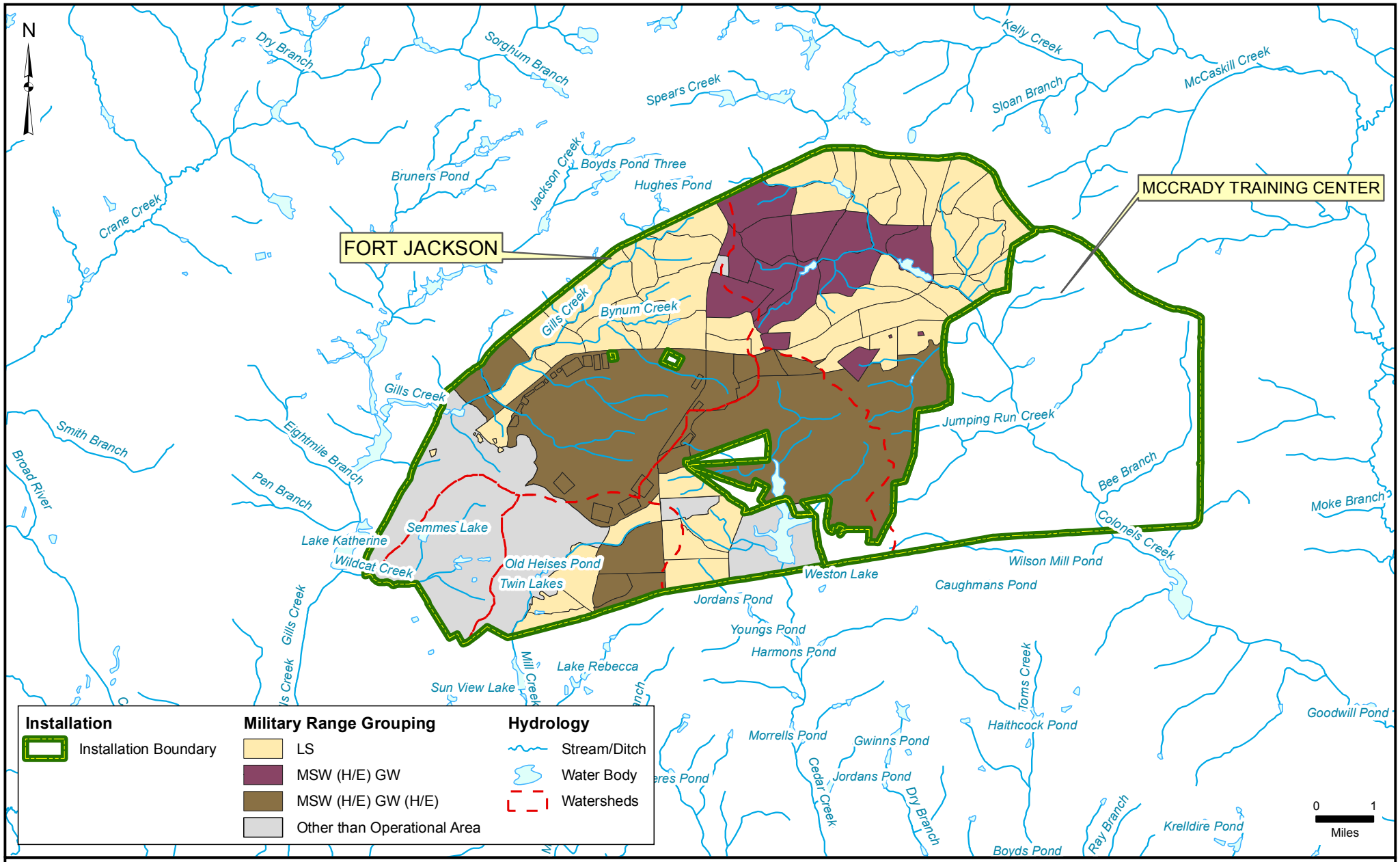
the RFMSS that are not ranges, and DPTMS personnel confirmed that these entries are errors.

Impact of Data Uncertainties

The data uncertainties presented above are included to point out inconsistencies or deficiencies with ARID and RFMSS data. Additional resources (e.g., personnel interviews, documents, previous versions of ARID) have served to close the data gaps opened by these data uncertainties. These data uncertainties are expected to have no significant impact on the conclusions of the report.

Table 5-1: Summary of the Conceptual Site Model Components

Group Identification	Primary Source	Primary MCOC	Source Media	Release Mechanism	Exposure Media	Exposure Routes	Receptors
Group MSW (H/E) GW (H/E)	Firing points, small arms firing, known or suspected dudded areas, impact area, and historical artillery impact areas / heavy usage	TNT, RDX, HMX, 2,4,-DNT, 2,6-DNT, PETN, perchlorate, nitroglycerin, lead, antimony, copper, zinc, and tungsten	Soil, surface water, and sediment	Leaching, infiltration, erosion/runoff, plant and animal uptake, and discharge of groundwater to down gradient surface water	Surface water / sediment, food chain, and groundwater	Ingestion and dermal absorption	Off-range workers and residents, recreational users of surrounding lakes, and off-range threatened and endangered animals
Group MSW (H/E) GW	Firing points, small arms firing, known or suspected dudded areas, dudded impact area, demolition area, and heavy historical munitions usage	TNT, RDX, HMX, 2,4,-DNT, 2,6-DNT, PETN, perchlorate, nitroglycerin, lead, antimony, copper, zinc, and tungsten	Soil, surface water, and sediment	Leaching, infiltration, erosion/runoff, plant and animal uptake, and discharge of groundwater to down gradient surface water	Surface water / sediment, food chain, and groundwater	Ingestion and dermal absorption	Recreational users of surrounding lakes and off-range threatened and endangered animals
Group LS	None or limited	Not evaluated					

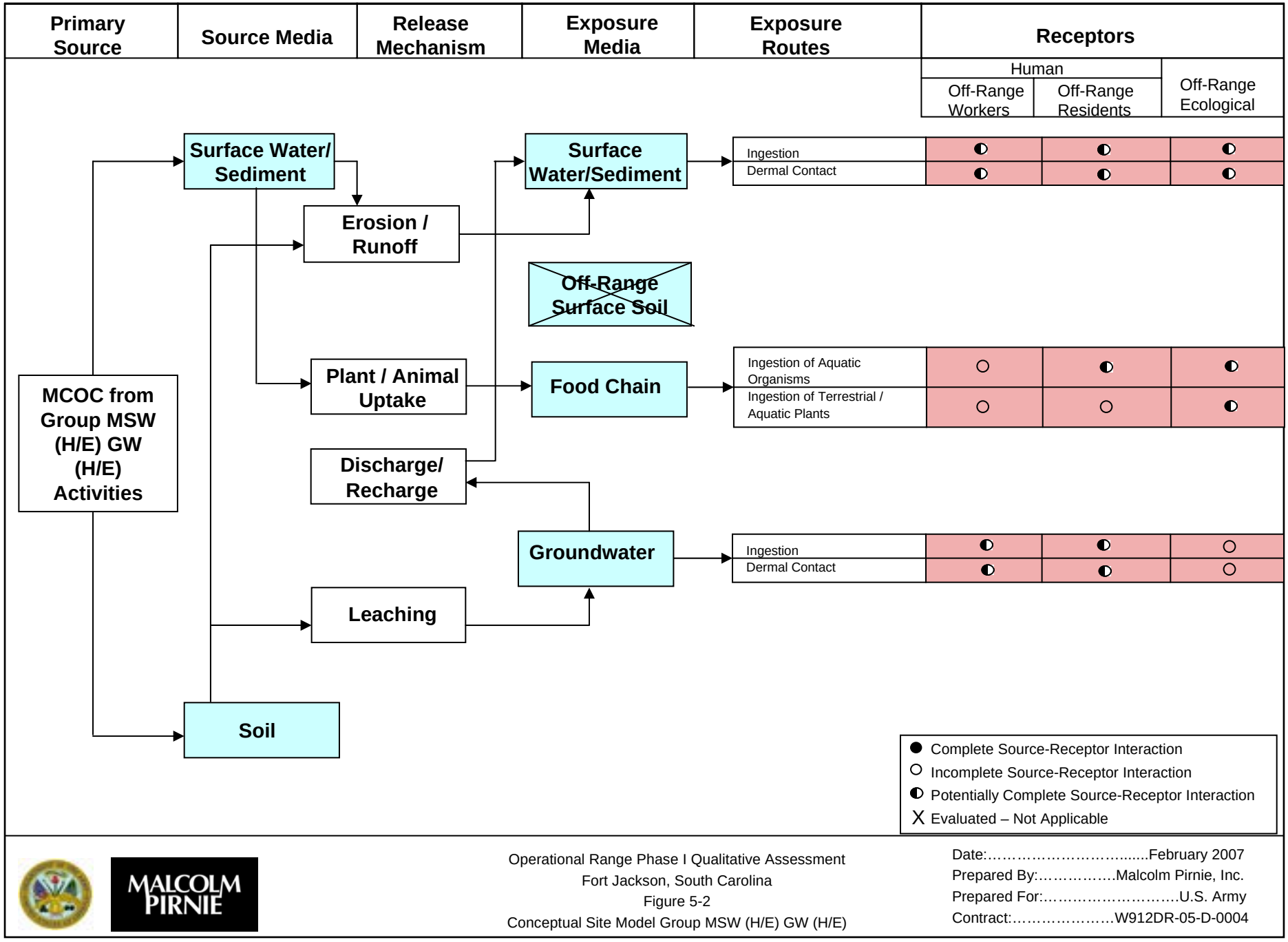


Operational Range Assessment Program
Phase I Qualitative Assessment
Fort Jackson, SC

Figure 5-1
Individual Range Grouping

Data Sources:
AEC, ARID-GEO, April 2006
ESRI, StreetMap USA, 2005

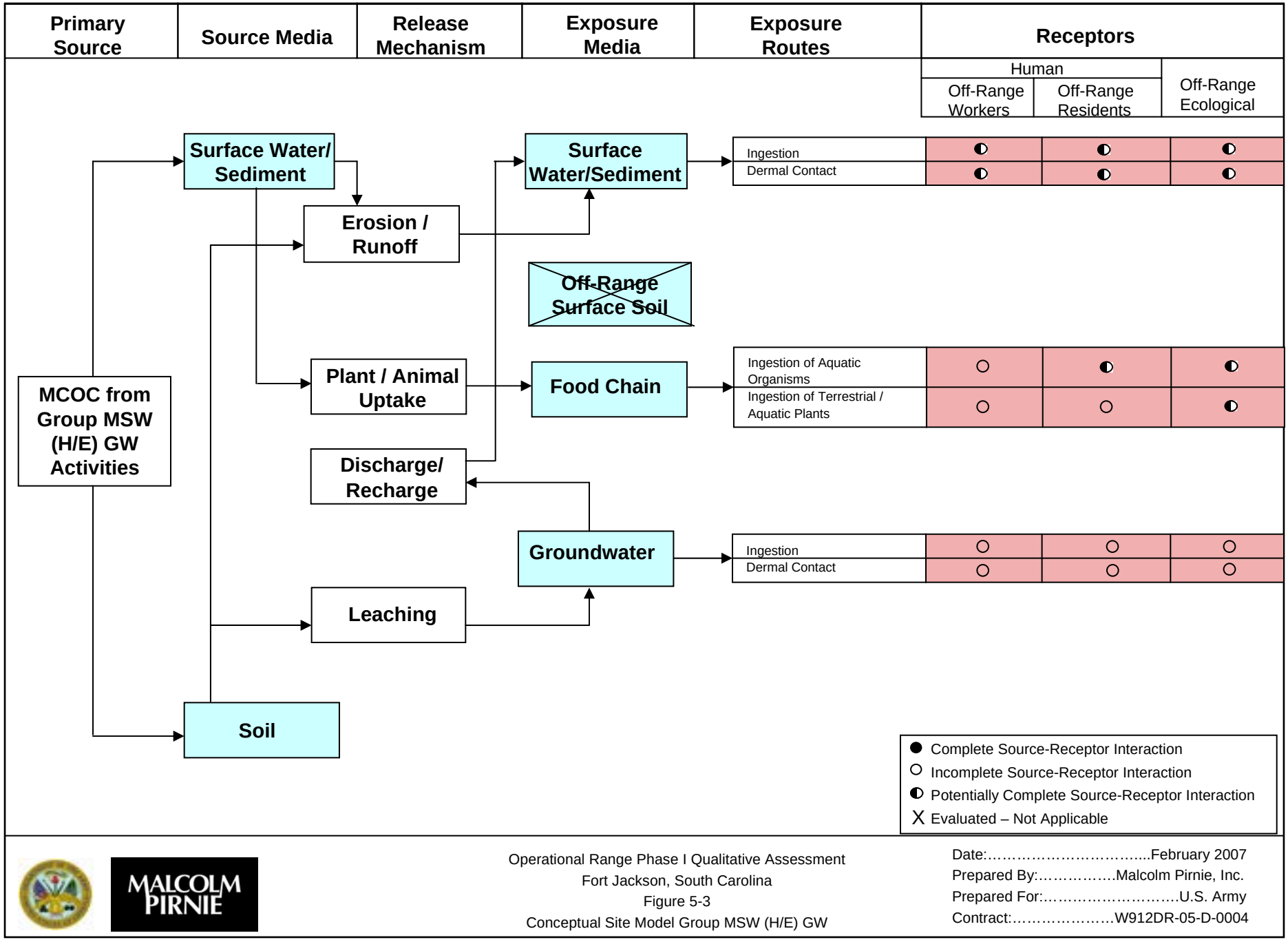
Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004



MALCOLM PIRNIE

Operational Range Phase I Qualitative Assessment
Fort Jackson, South Carolina
Figure 5-2
Conceptual Site Model Group MSW (H/E) GW (H/E)

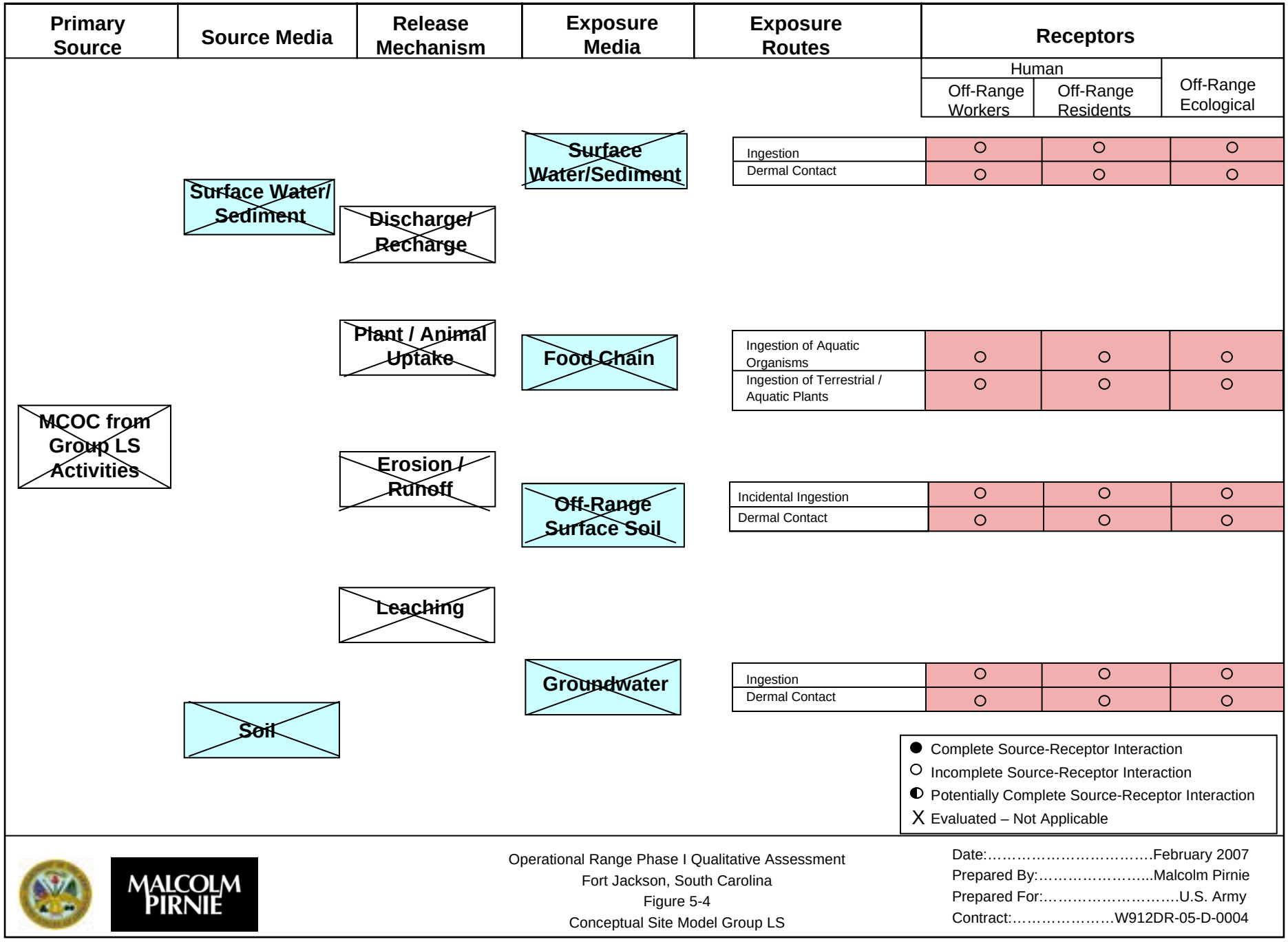
Date:.....February 2007
Prepared By:.....Malcolm Pirnie, Inc.
Prepared For:.....U.S. Army
Contract:.....W912DR-05-D-0004



MALCOLM PIRNIE

Operational Range Phase I Qualitative Assessment
Fort Jackson, South Carolina
Figure 5-3
Conceptual Site Model Group MSW (H/E) GW

Date:.....February 2007
Prepared By:.....Malcolm Pirnie, Inc.
Prepared For:.....U.S. Army
Contract:.....W912DR-05-D-0004



Operational Range Phase I Qualitative Assessment
Fort Jackson, South Carolina
Figure 5-4
Conceptual Site Model Group LS

Date:……February 2007
Prepared By:……..Malcolm Pirnie
Prepared For:……U.S. Army
Contract:…….W912DR-05-D-0004

6.0 Summary of Findings and Conclusions

The operational ranges at Fort Jackson have been categorized as a result of the Phase I Assessment as described below. **Figure 6-1** illustrates the source-receptor interactions identified during the Phase I Assessment. The findings and conclusions for these operational ranges are presented in **Table 6-1.** Conclusions are based on readily available information collected to date.

6.1 Summary of Findings

The 104 ranges at Fort Jackson operated by the U.S. Army Training Center consist of small arms ranges, live-fire ranges, training/maneuver areas, dudded impact areas, and a non-dudded impact area totaling approximately 29,475 acres. According to munitions data collected during the Phase I Assessment, the types of munitions fired include small, medium, and large caliber munitions. Potential MCOC associated with these munitions types include metals (including tungsten), high explosives (e.g., RDX, TNT, HMX), nitroglycerin, and perchlorate.

Based on data collected during the Phase I Assessment regarding current and historical MCOC sources, potential migration pathways from ranges, and potential off-range human and/or ecological receptors, the operational ranges at Fort Jackson operated by the U.S. Army Training Center have been placed into the following range groupings:

Group MSW (H/E) GW (H/E)
The 36 ranges identified in Group MSW (H/E) GW (H/E), covering 12,425 acres of Fort Jackson, have current and historical sources of potential MCOC that were identified during the Phase I Assessment. Sources of potential MCOC at Group MSW (H/E) GW (H/E) ranges include a dudded impact area (5,430 acres), mostly non-dudded impact area, firing ranges, areas that are known or suspected to be dudded due to historical munitions use, and areas historically used for medium and large caliber firing. It is expected that the dudded impact area contains the greatest concentrations of MCOC since it has been actively used as an impact area since the 1940s and continues to receive heavy usage. MCOC from these ranges have the potential to migrate off-range via surface water and/or groundwater pathways to contact either human or ecological receptors.

Group MSW (H/E) GW
The 15 ranges identified in Group MSW (H/E) GW, covering 4,046 acres of Fort Jackson, have current and historical sources of potential MCOC that were identified during the Phase I Assessment. Sources of potential MCOC at Group MSW (H/E) GW ranges consist of areas that are known or suspected to be dudded due to historical munitions use, fixed firing points, and small arms ranges. These sources have potential migration pathways via surface water / sediment and plant and animal uptake that could facilitate potential MCOC migration off-range to contact either human or ecological receptors.

Group LS
The 53 ranges identified in Group LS, covering 13,004 acres of Fort Jackson, were found to have only limited or no known sources of MCOC from current or historical activities.

6.2 Conclusions

Each of the operational range groups described above is placed into one of three possible categories: Referred, Inconclusive, or Unlikely. Conclusions for each category are discussed below.

Referred – Refer to Appropriate Cleanup Program

Based on data reviewed during the Phase I Assessment, no operational ranges at Fort Jackson are categorized as Referred.

Inconclusive – Phase II Quantitative Assessment Required

Operational ranges where a source of potential MCOC source, an exposure pathway, and receptors have been identified are categorized as Inconclusive and comprise Groups MSW (H/E) GW (H/E) and MSW (H/E) GW. Based on current and historical military munitions usage at Fort Jackson and a review of potential migration pathways and potential human and/or ecological receptors, a total of 51 ranges were identified as having the potential for MCOC to migrate off-range and affect human and/or ecological receptors. At the completion of the Phase I Assessment process, installations with ranges in the Inconclusive category will be prioritized for further analysis during Phase II Quantitative Assessments.

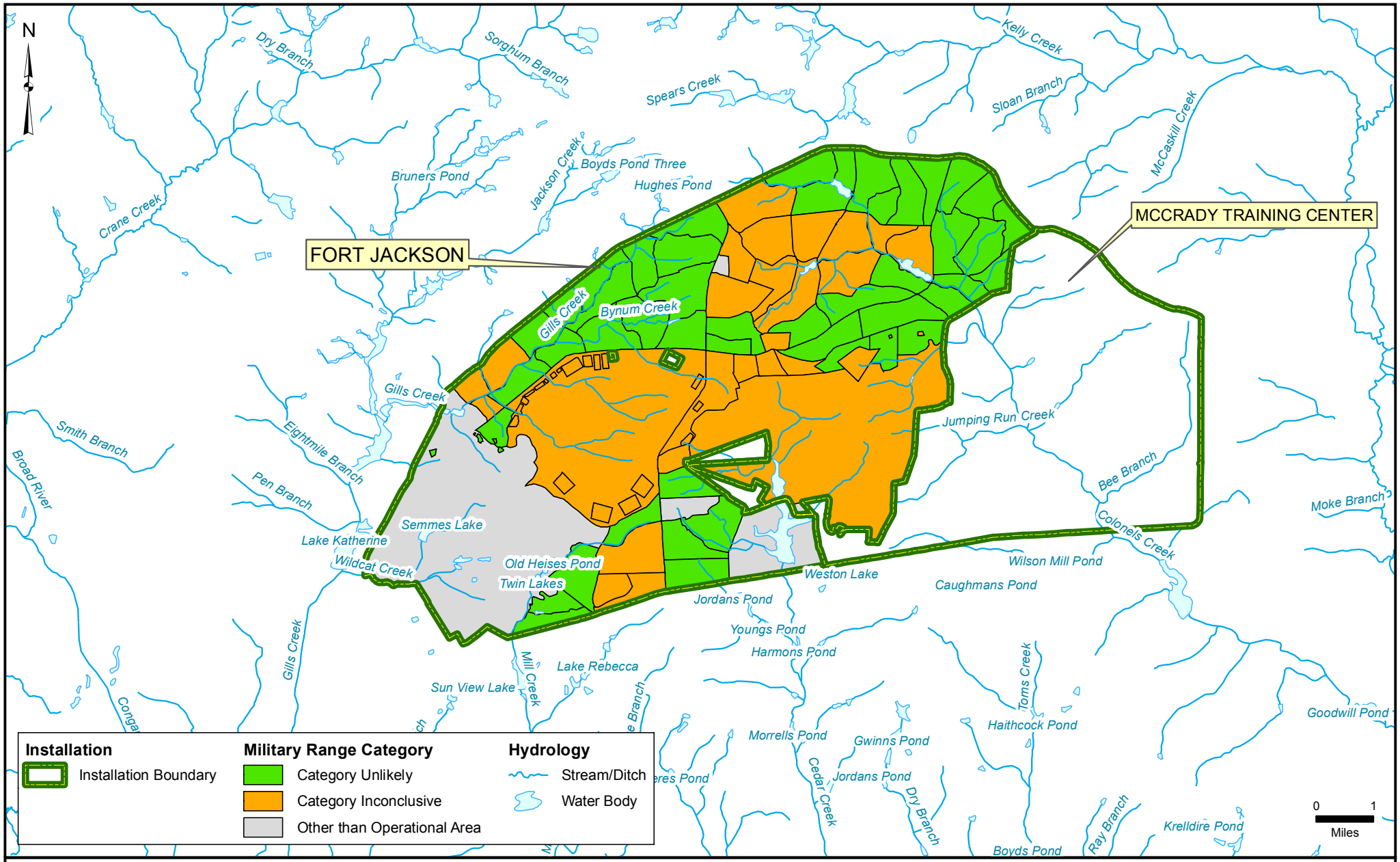
Unlikely – Five-Year Review

Ranges determined to have at least one CSM component (i.e., source of potential MCOC, pathway, or receptor) absent or sampling data indicating that a source-receptor interaction is not present are categorized as Unlikely and comprise Group LS. Based on current and historical military munitions usage at Fort Jackson and a review of potential migration pathways and potential human and/or ecological receptors, a total of 53 ranges were identified as being unlikely to have potential MCOC migrate off-range and affect human or ecological receptors. Ranges categorized as Unlikely will be required to undergo a periodic re-evaluation to determine if conditions affecting this assessment (e.g., range operations, site conditions, applicable regulations) have changed since the original categorization was finalized (DoD, 2005). This re-evaluation will occur at least every five years.

Figure 6-1 presents the Phase I Assessment findings and conclusions for the ranges at Fort Jackson that are operated by the U.S. Army Training Center.

Table 6-1: Summary of Findings and Conclusions for Fort Jackson

Category	Group	Total Number of Ranges and Acreage	Source(s)	Pathway(s)	Human Receptors	Ecological Receptors	Conclusions and Rationale
Inconclusive	Munitions used; surface water and groundwater pathways present; human and ecological receptors identified	36 operational ranges; 12,425 acres	Firing points, small arms firing, impact areas, and historical artillery impact areas or heavy historical usage	Twin Lakes (west of operational range area in cantonment area), Mill Creek, Sun View Lake, and Lake Rebecca (southwest of Fort Jackson in Mill Creek watershed); Gills Creek and Forest Lake (west and southwest of Fort Jackson in Gills Creek watershed); Weston Lake and Cedar Creek (non-operational area southwest of the eastern impact area in Cedar Creek watershed); ; and the surficial groundwater aquifer to the south and west of Fort Jackson	Residents down gradient (south and west of Fort Jackson) and recreational users of Weston Lake, Twin Lakes, Sun View Lake, Lake Rebecca, and Forest Lake	Wetlands and threatened and endangered species downstream	Phase II Quantitative Assessment is required. Residents and recreational users are present down gradient and downstream.
	Munitions used; surface water pathways present; human and ecological receptors identified	15 operational ranges; 4,046 acres	Firing points, small arms firing, known or suspected dudded areas, demolition area, and heavy historical usage areas	Colonels Creek and Murray Pond (southeast of McCrady Training Center)	Recreational users of Murray Pond	Wetlands and threatened and endangered species downstream	Phase II Quantitative Assessment is required. Recreational users are present downstream.
Unlikely	Limited source	53 operational ranges; 13,004 acres	No source – limited or no military munitions use	Not evaluated (no source was identified)			Re-evaluate during the five-year review. Limited sources were identified.



Operational Range Assessment Program
Phase I Qualitative Assessment
Fort Jackson, SC

Figure 6-1
Summary of Conclusions

Data Sources:
AEC, ARID-GEO, April 2006
ESRI, StreetMap USA, 2005

Date: ..... May 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

Appendix A: Glossary of Terms

GLOSSARY OF TERMS

The terms outlined below are those that will be used commonly during the Phase I Assessment process. The relevant reference for each is presented at the end of the definition. If no reference is presented, then the term is not an official Department of Defense (DoD) definition and applies only to the U.S. Army's Operational Range Assessment Program.

Dudded Impact Area – An area having designated boundaries within which all dud-producing ordnance will detonate or impact. Vehicle bodies are sometimes placed in the area to act as targets for direct and indirect artillery fire. The primary function of the impact area is to contain weapons effects as much as possible using earthen berms or natural terrain features. Impact areas containing unexploded ordnance may not be used for maneuver. Each area, typically managed and scheduled by either numeric, lettered, or alphanumeric code through the installation training or range control manager (e.g., Directorate of Plans, Training, Mobilization and Security (DPTMS), DPTMS-equivalent), should be accounted for with a separate facility number and real property record.[1]

Group – A group is a collection of one or more ranges within an operational range area (range complex area) that shares similar characteristics. Similar characteristics can include types of activities, munitions usage, geographic proximity, surface water or groundwater divides, or even common receptors.[2]

Inconclusive – Phase II Quantitative Assessment Required – Ranges where existing information either is insufficient to make a source-receptor interaction determination or indicates the potential for such interaction to be occurring.[3]

Large Caliber – Munitions include projectiles greater than 60 millimeters (mm) (including 75-mm, 76-mm, 81-mm, 90-mm, 105-mm, 155-mm, 14-inch and 16-inch projectiles).[4]

Medium Caliber – Munitions include projectiles sized from 20-mm to 60-mm (including 20-mm, 25-mm, 30-mm, 37-mm, 40-mm and 60-mm projectiles).[5]

Military Munitions – All ammunition products and components produced or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, the United States (U.S.) Coast Guard, the U.S. Department of Energy (DOE), and the Army National Guard. The term military munitions includes: confined gaseous, liquid, and solid propellants; explosives; pyrotechnics; chemical and riot control agents; smoke and incendiaries, including bulk explosives and chemical warfare agents; chemical munitions; rockets; guided and ballistic missiles; bombs; warheads; mortar rounds; artillery ammunition; small arms ammunition; grenades; mines; torpedoes; depth charges; cluster munitions and dispensers; demolition charges; and devices and components thereof. Military munitions do not include wholly inert items; improvised explosive devices; and nuclear weapons, nuclear devices, and nuclear components, other than nonnuclear components of nuclear devices that are managed under the nuclear weapons program of

[2] This definition was based on guidance from the USACHPPM (2005), as well as further input/guidance from the U.S. Army Environmental Command and the U.S. Army Center for Health Promotion and Preventive Medicine.
[3] See note 2.
[4] See note 2.
[5] See note 2.

the DOE after all required sanitization operations under the Atomic Energy Act of 1954 (42 United States Code [U.S.C.] 2011 et seq.) have been completed. (10 U.S.C. 101(e)(4)(A) through (C))

Munitions Constituents (MC) – Any materials that originate from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. 2710(e)(3))

Munitions Constituents of Concern (MCOC) – Those MC that have the potential to migrate from a source area to a receptor (human or ecological) in sufficient quantity to cause an unacceptable risk to human health or the environment. (DoD Instruction [DODI] 4715.14, 30 November 2005) MCOC for high explosives include: trinitrotoluene (TNT); cyclotetramethylenetetranitramine (HMX); pentaerythritoltetranitrate (PETN); cyclotrimethylenetrinitramine (RDX); 2,4-dinitrotoluene (DNT); and 2,6-DNT. MCOC for small arms include lead, antimony, copper, zinc, and tungsten. MCOC for training areas include perchlorate (a propellant) and white phosphorus (an incendiary agent). Additional MCOC may be addressed on an installation-specific basis.[6]

Non-Dudded Impact Area – An area having designated boundaries within which ordnance that does not produce duds will impact. This area is composed mostly of the safety fans for small arms ranges. The primary function of the impact area is to contain weapons effects as much as possible using earthen berms or natural terrain features. Each area, typically managed and scheduled by either numeric, lettered, or alphanumeric code through the installation training or range control manager (e.g., DPTMS, DPTMS-equivalent), should be accounted for with a separate facility number and real property record. These impact areas may be used for maneuver, at the cost of curtailing the use of weapons ranges.[7]

Off-Range Area – For the purpose of the Phase I Assessment, off-range areas include those areas outside of the boundaries of the operational range area as established by the Army Range Inventory Database-Geodatabase. Off-range areas may include both on- (e.g., cantonment areas) and off-installation locations.

Operational Range – A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities or, although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities. (10 U.S.C. 101(e)(3))

Other Munitions – Munitions from aerial fire (rockets and large bombs), hand grenades, light anti-tank weapons, and anti-armor missiles.[8]

Pathway – The environmental medium through which an MCOC is transported from the source to the receptor. (DoD, 2005)

[6] See note 2.
[7] See note 1.
[8] See note 2.

Range – The term range, when used in the geographical sense, means a designated land or water area that is set aside, managed and used for range activities of the DoD. The term includes: (A) firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas and (B) airspace areas designated for military use in accordance with regulations and procedures proscribed by the Administrator of the Federal Aviation Administration. (10 U.S.C. 101(e)(1)(A) and (B))

Range Complex – For the purpose of the Phase I Assessment, range complexes are contiguous operational ranges that may be grouped together and assessed as a single range (also referred to as an operational range area).

Receptor – A human, animal, or plant species that is exposed, or that may be exposed, to MC. (DoD, 2005)

Referred – Ranges with compelling evidence (e.g., sampling data) to indicate the presence of an off-range release that potentially poses an unacceptable risk to human health or the environment.[9]

Sensitive Environments – Terrestrial or aquatic resources, fragile natural settings, or other areas with unique or highly valued environmental features.[10]

Small Arms – Small arms include all shotgun, .22-, .223-, .30-, .32-, .38-, .45-, and .50-caliber, 5.56-mm, 7.62-mm, 9-mm and 10-mm weapons.[11]

Small Caliber – Munitions used in small arms and fired from weapons with muzzle diameter of up to .50-caliber or one-half inch.[12]

Source – An area where MC may have been deposited, disposed, or placed. (DoD, 2005)

Training Area – For the purpose of the Phase I Assessment, training areas refer to the ranges that have non-live-fire troop activities. These areas can have a variety of activities that include bivouac, troop movement, and tactics.

Unknown Munitions – Items that have not been identified or positively identified.[13]

Unlikely – Five-Year Review – Ranges where, based upon a review of readily available information, there is sufficient evidence to show that there are no known releases or source-receptor interactions that could present an unacceptable risk to human health or the environment.[14]

[9] See note 2.
[10] See note 2.
[11] See note 2.
[12] See note 2.
[13] See note 2.
[14] See note 2.

Appendix B: References

B1 – References

B2 – Department of Defense Data Repositories and Databases

B3 – Off-Installation / Publicly Available Data Repositories and Databases

B4 – Installation Data Repositories and Databases

B5 – Personnel Interviews

B1 – References

10 U.S.C. Sec. 101. 2005.

10 U.S.C. Sec. 2710. 2005.

42 U.S.C. Sec. 2011 et seq. 2004.

Army Range Inventory Database-Geodatabase (ARID-GEO). 2006. *U.S. Army Operational Range Inventory Sustainment FY05: Draft Packet for Fort Jackson, South Carolina*.

Bricka, R.M. (Mississippi State University). 2002. *Sampling of the Small Arms Training Areas at Fort Jackson.*

Department of Defense (DoD). 2004. Department of Defense Directive 4715.11 *Environmental and Explosive Safety Management on Operational Ranges Within the United States*.

------. 2005. Department of Defense Instruction (DODI) 4715.14 *Operational Range Assessments*.

Department of the Army (DA). 2000. Department of the Army Pamphlet 415-28 *Guide to Army Real Property Category Codes*.

Ecology and Environment, Inc. 1997. *Confirmatory Sampling Report for Solid Waste Management Units 5, 11, 18, 19, 24, 27, 29, 31, 32, 33, 34, 35, 38, 39, 40 and Area of Concern C, Fort Jackson, South Carolina.* Contract No. DACA21-93-D-0034.

------. 2003. *Phase 2 RCRA Facility Investigation Report for Solid Waste Management Unit 23, Fort Jackson, South Carolina.* Contract No. DACA85-99-D-0003.

Fort Jackson Directorate of Plans, Training, Mobilization, and Security (DPTMS). 2006. *Fort Jackson Regulation 350-14: Training Post Range Regulation.*

Fort Jackson Integrated Training Area Management (ITAM) Office. 2006. *Fort Jackson Installation Field Map, January 2006 – December 2006.*

Gene Stout & Associates. 2004. *Integrated Natural Resources Management Plan and Environmental Assessment, 2004-2008, U.S. Army Training Center and Fort Jackson, South Carolina.*

Geographic Information System (GIS) Repository. n.d. Topography Map.

GlobalSecurity.org. 2006. Fort Jackson. http://www.globalsecurity.org/military/facility/fort-jackson .htm. (Accessed July 2006).

Law Engineering and Environmental Services, Inc. (LAW). 2003. *Revised Final Phase II RCRA Facility Investigation Report for Wonsan (SWMU 12) and Inchon (SWMU 17) Explosive Ordnance Disposal Sites, Fort Jackson, South Carolina.* Contract No. DACA21-97-D0034.

Malcolm Pirnie, Inc. 2005. *Final Work Plan / Management Plan for the Operational Range Assessment Program Qualitative Operational Range Assessments*.

------. 2006. *Final Site Inspection Report for Fort Jackson, SC.*

Newcome, Roy. 2003. *Ground-Water Resources of Richland County, South Carolina.* State of South Carolina Department of Natural Resources. Land, Water and Conservation Division. Water Resources Report 30.

South Carolina Department of Health and Environmental Control (SCDHEC). 1997. *The Gills Creek Watershed Project, An Urban Nonpoint Source Project: Richland County, S.C., February 1994 – September 1996. Final Report.*

------. 2006. *Integrated Report for 2006 Part II: Section 305(b) Assessment and Reporting.* http://www.scdhec.net/eqc/water/pubs/305b.pdf. (Accessed 30 January 2007).

South Carolina Department of Natural Resources. 2003. *Ground-Water Resources of Richland County, South Carolina*. http://www.dnr.sc.gov/lwc/pubs/pdfs/richlandcounty.pdf. (Accessed January 30, 2007).

United States Army Aberdeen Test Center (USATC). 2005. *Small Arms Range Training Area Environmental Screening-Level Assessment at Fort Jackson, South Carolina.*

------. 2006. *Modification of a Small Arms Range for Improved Bullet Pocket and Storm Water Management, Fort Jackson, SC.*

United States Army Center for Health Promotion and Preventive Medicine Army Operational Range Assessment Team (USACHPPM). 2005. *U.S. Army Operational Range Assessment Program Qualitative Assessments Protocol*.

United States Army Corps of Engineers (USACE). 1993. *White Phosphorus Wetland Storage Installation Assessment Report, Fort Jackson*.

------. 1996. *Summary and Evaluation for White Phosphorus Remediation: A Literature Review (Technical Report IRRP-96-7)*. http://el.erdc.usace.army.mil/elpubs/pdf/trirrp96-7.pdf. (Accessed 17 February 2007).

------. 1999. *Technical Report IRRP-99-1: Conceptual Model and Process Descriptor Formulations for Fate and Transport of UXO.* http://el.erdc.usace.army.mil/elpubs/pdf/trirrp-99-1.pdf. (Accessed 8 February 2007).

United States Army Environmental Center (USAEC). 2005. *2005 Fort Jackson Installation Action Plan.*

United States Army Toxic and Hazardous Materials Agency (USATHAMA). 1980. *Installation Assessment of Fort Jackson Report No. 165*.

------. 1988. *Update of the Initial Installation Assessment of Fort Jackson.*

United States Environmental Protection Agency (USEPA). 1991. *Guidance for Performing Preliminary Assessments under CERCLA* (EPA/540/G-91/013): U.S. EPA Soil Exposure Pathway Targets.

------. 1997. *U.S. EPA Interim Final Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.*

B2 – Department of Defense Data Repositories and Databases

Army Knowledge Online

Fort Jackson. 2006. *Fort Jackson Post Guide and Telephone Directory.*

Geographic Information System (GIS) Repository

Range Identification Map, Surface Waterway Map, Topography Map, Soil Survey Geographic Map, Population by Census Block Map

Integrated Training Area Management (ITAM)

United States Army Aberdeen Test Center. 2006. *Modification of a Small Arms Range for Improved Bullet Pocket and Storm Water Management, Fort Jackson, SC.*

United States. Army Aberdeen Test Center, Military Environmental Technology Demonstration Center. 2006. *Range Sustainment Initiatives, Fort Jackson*

Range Facility Management Support System (RFMSS)

Fort Jackson. 2006. Munitions usage data from 1 January 2002 through 12 October 2006.

Technical Information Center

Advanced Sciences, Inc. 1992a. *Preliminary Site Inspection Report for Fort Jackson Military Reservation, South Carolina*.

------. 1992b. *Hazard Ranking System Score (HRS2) Summary Report for Fort Jackson Military Reservation*.

CH2M Hill. 2004a. *Phase II RCRA Facility Investigation Report for SWMU 2, Fort Jackson, South Carolina*.

------. 2004b. *Phase II RCRA Facility Investigation Report for SWMU 1, Fort Jackson, South Carolina*.

Donohue, Inc. 1992. *Facility Investigation Active Ordnance Disposal Site (RST4), Fort Jackson, South Carolina, SEC.*

The Earth Technology Corporation. 1993. *Final Report, Air Pollution Emission Statement, U.S. Army Training Center and Fort Jackson, Fort Jackson, South Carolina*.

Ecology & Environment, Inc. 1995a. *Site Assessment Report for Site No. 1: Q, (GWPD No. 15598), Fort Jackson, South Carolina*

------. 1995b. *Site Assessment Report for Site No. 2: 2079, (GWPD No. 15710), Fort Jackson, South Carolina*.

------. 1995c. *Site Assessment Report for Site No. 3: I, (GWPD No. 15713), Fort Jackson, South Carolina*.

------. 1995d. *Site Assessment Report for Site No. 4: J, (GWPD No. 15351), Fort Jackson, South Carolina*.

------. 1995e. *Site Assessment Report for Site No. 5: T-4501, (GWPD No. 15578), Fort Jackson, South Carolina.*

------. 1995f. *Site Assessment Report for Site No 6: 9431-F, (GWPD No. 15577), Fort Jackson, South Carolina*.

------. 1995g. *Site Assessment Report for Site No. 7: Twin Lakes, (GWPD No. 15716), Fort Jackson, South Carolina*.

------. 1995h. *Site Assessment Report for Site No. 8: 2179, (GWPD No. 16584), Fort Jackson, South Carolina*.

------. 1995i. *Site Assessment Report for Site No. 9: T-3495, (GWPD No. 16584), Fort Jackson, South Carolina*.

------. 1998. *Phase I RCRA Facility Investigation Report for Solid Waste Management Units 6, 20, 21, 23, 30, and 48, Fort Jackson, South Carolina*.

------. 1999a. *Revised Final, RCRA Facility Investigation Report for Solid Waste Management Units 1, 2, and 3, Fort Jackson, South Carolina*.

------. 1999b. *Revised Final, RCRA Facility Investigation Report for SWMU 10, Former Polychlorinated Biphenyls Storage Building 2668, Fort Jackson, South Carolina.*

Environmental Monitoring Systems Laboratory. 1985. *Installation Assessment Relook Program Working Document, Fort Jackson, South Carolina*.

Law Environmental, Inc. 1991a. *Wonsan/Inchon Explosive Ordnance Disposal Sites, Fort Jackson, South Carolina*.

------. 1991b. *Final Report for Remedial Investigation/Feasibility Study Phase 2, Weapons Cleaning Area, Fort Jackson, South Carolina*.

------. 1993. *Second Draft, RCRA Facility Investigation Report for Wonsan/Inchon Explosive Ordnance Disposal Sites, Fort Jackson, South Carolina*.

Parsons Engineering Science, Inc. 1999. *Treatability Study in Support of Remediation by Natural Attenuation at Site 9431-F at Fort Jackson, South Carolina.*

United States Army Aberdeen Test Center. 2005. *Small Arms Range Training Area Environmental Screening-Level Assessment at Fort Jackson, South Carolina*.

------. 2006. *Modification of a Small Arms Range for Improved Bullet Pocket and Storm Water Management, Fort Jackson, SC.*

United States Army Center for Health Promotion and Preventive Medicine. 2002. *Environmental Compliance Assessment System Report for Fort Jackson, South Carolina, 15-26 October 2001*.

United States Army Corps of Engineers. 1993. *White Phosphorus Wetland Storage Installation Assessment Report, Fort Jackson.*

United States Army Environmental Center. 1991. *Final Site Investigation for Abandoned Sewage Treatment Plant at Fort Jackson, South Carolina.*

------. 1996. *Live Site Unexploded Ordnance Advanced Technology Demonstration Program.*

United States Army Environmental Hygiene Agency. 1989. *Evaluation of Solid Waste Management Units, Fort Jackson, South Carolina, 22 August – 2 September 1988, Hazardous Waste Consultation No. 37-26-0215-89.*

------. 1990. *Groundwater Quality Study No. 38-26-8822-90 U.S. Army Training Center and Fort Jackson, Fort Jackson, South Carolina, 28 Nov – 8 Dec 1988 and 4-22 Jan 1989.*

------. 1993. *Groundwater Consultation No. 38-26-KV47-93 U.S. Army Training Center and Fort Jackson, Fort Jackson, South Carolina.*

United States Army Toxic and Hazardous Materials Agency. 1980. *Installation Assessment of Fort Jackson Report No. 165*.

------. 1988. *Update of the Initial Installation Assessment of Fort Jackson.*

United States Army Environmental Command

United States Army Corps of Engineers Norfolk District. 1997a. *Environmental Assessment, 1995 BRAC, Fort Jackson, SC.*

------. 1997b. *Finding of No Significant Impact, 1995 BRAC, Fort Jackson, SC.*

United States Army Corps of Engineers Savannah District. 1992. *Environmental Assessment for BRAC, Fort Jackson, SC.*

United States Army Environmental Center. 1978. *Environmental Assessment, South Carolina Army National Guard Weekend Training Site, Fort Jackson, South Carolina.*

------. 2006. *March 2006 Draft Operational Range Inventory (ORIS).*

B3 – Off-Installation / Publicly Available Data Repositories and Databases

Military Munitions Response Program Documents

Malcolm Pirnie, Inc. 2003. *Final U.S. Army Closed, Transferring and Transferred Range/Site Inventory for Fort Jackson, SC.*

------. 2005a. *Final Historical Records Review for Fort Jackson, SC.*

------. 2005b. *Final Site Inspection Work Plan for Fort Jackson, SC.*

------. 2006. *Final Site Inspection Report for Fort Jackson, SC.*

Internet Search

City-Data.com. n.d. Columbia, South Carolina. http://www.city-data.com/city/Columbia-South-Carolina.html. (Accessed July 2006).

Country Studies. n.d. The Southern Coastlands. http://countrystudies.us/united-states/geography-15.htm. (Accessed July 2006).

Fort Jackson. 2006. http://www.jackson.army.mil/. (Accessed July 2006).

GlobalSecurity.org. 2006. Fort Jackson. http://www.globalsecurity.org/military/facility/fort-jackson.htm. (Accessed July 2006).

Google Earth. n.d. Aerial map of Fort Jackson, South Carolina and surrounding areas. http://earth.google.com. (Accessed July 2006 and November 2006).

South Carolina Department of Health and Environmental Control. 2006. *Integrated Report for 2006 Part II: Section 305(b) Assessment and Reporting*. http://www.scdhec.net/eqc/water/pubs/305b.pdf

South Carolina Department of Natural Resources. 2003. *Ground-Water Resources of Richland County, South Carolina*. http://www.dnr.sc.gov/lwc/pubs/pdfs/richlandcounty.pdf. (Accessed 30 January 2007).

United States Army Corps of Engineers. 1996. *Summary and Evaluation for White Phosphorus Remediation: A Literature Review (Technical Report IRRP-96-7)*. http://el.erdc.usace.army.mil/elpubs/pdf/trirrp96-7.pdf. (Accessed 17 February 2007).

------. 1999. *Technical Report IRRP-99-1: Conceptual Model and Process Descriptor Formulations for Fate and Transport of UXO.* http://el.erdc.usace.army.mil/elpubs/pdf/trirrp-99-1.pdf. (Accessed 8 February 2007).

B4 – Installation Data Repositories and Databases

Fort Jackson Directorate of Plans, Training, Mobilization, and Security (DPTMS)

DPTMS. 2006. *FY07 BCT 5.56-mm Delivery Matrix*.

------. 2006. *RFMSS Data FY 2002 to FY2006*.

------. n.d. *BRM / Live Fire / Non-Live Fire Inventory*.

------. n.d. *Fort Jackson Master Plan: Future Range Prioritization, Utilization, Expansion, and Funding Strategy*.

Fort Jackson Environmental and Natural Resources Division (ENRD)

2c Environmental Services, Inc. 2000. *Fort Jackson Stormwater Sampling Plan and Data.*

Atkins et al. (University of South Carolina). 2000. *Final Report: Water Quality in Mill Creek Basin.*

Nick Audry to unknown party. 27 Mar 1990. Memorandum. Subject: Weston Lake Well.

Bricka, R.M. (Mississippi State University). 2002. *Sampling of the Small Arms Training Areas at Fort Jackson.*

CH2M Hill. 2004. *Integrated Natural Resources Management Plan and Environmental Assessment 2004-2008*.

Ecology and Environment, Inc. 1996. *RCRA Closure Sampling Report, 48th Explosive Ordnance Detachment Demolition Range OB/OD Unit, Fort Jackson, SC.*

------. 1997. *Confirmatory Sampling Report for Solid Waste Management Units 5, 11, 18, 19, 24, 27, 29, 31, 32, 33, 34, 35, 38, 39, 40 and Area of Concern C, Ft. Jackson, South Carolina*.

------. 2001a. *Soil Background Study Report for the Fort Jackson Military Installation, Columbia, South Carolina.*

------. 2001b. *Supplemental Confirmatory Sampling Report for Solid Waste Management Units 5, 11, 29, 33, 34, 38 and Area of Concern C, Fort Jackson, South Carolina.*

------. 2003. *Phase 2 RCRA Facility Investigations Report for Solid Waste Management Unit 23, Fort Jackson, South Carolina.*

Fort Jackson ENRD. 2000. Electronic Data File (Excel). *TRI-DDS Emission Factors.*

------. 2005. Electronic Data File (MS Access Database). *Forestry Data Metals in Trees.*

------. n.d. *Map of Inactive and Active Wells at Fort Jackson, SC.*

Fort Jackson ENRD to South Carolina Department of Health and Environmental Control (SCDHEC) Central Midlands District. 1 Jul 1992. Memorandum. Subject: Permit for Omaha Range Well.

Fort Jackson Installation Geographic Information System (GIS). 2003. Scattered, Known, and Suspected Dudded Areas GIS layers.

------. 2004. Identified Erosional Areas GIS layer.

------. 2005. Threatened and Endangered Species Locations GIS layer.

------. (various dates). General installation informational GIS layers.

Gene Stout and Associates. 2004. *RCRA Facility Investigation SWMU 1, Fort Jackson, Phase II RFI Report.*

Rickard, S. (Fort Jackson ENRD). 2006. *REC Site Inspection Report, Fort Jackson, South Carolina.*

SCDHEC. 1995. *Technical Report No. 006-95: A Water Quality Assessment of Gills Creek Watershed, Richland County, SC.*

SCDHEC and Fort Jackson Directorate of Public Works. April – December 1993. Memorandums. Subject: Permit to Operate No. 1888 for Installation of Waterlines to Ranges #1 thru 9, Fort Jackson, SC.

------. 1993 – 1996. *Sampling for Well at Range #20, Fort Jackson, SC.*

SCDHEC Bureau of Water. 1997. *The Gills Creek Watershed Project, An Urban Nonpoint Source Project: Richland County, SC.*

------. 2004. *Source Water Assessments of Fort Jackson Water Systems: Normandy Site; Twin Lakes; Omaha Beach; Ohio Range 20.*

SCDHEC Bureau of Water to ENRD. 21 Jan 1993. Memorandum. Subject: Replacement Well for Ammo Supply Area, Richland County, SC.

SCDHEC Water Quality Monitoring Section. 17 Jul 1995. Memorandum. Subject: Lead Sampling in Rowell Creek, Fort Jackson, SC.

United States Army Corps of Engineers Savannah District. 2003. *Revised Final Phase II RCRA Facility Investigation Report for Wonsan (SWMU 12) and Inchon (SWMU 17) Explosive Ordnance Disposal Sites, Fort Jackson, South Carolina.*

------. 2004. *2004 Annual Report Post-Closure Care of Fort Jackson Landfill #3*.

------. 2005. *2005 Annual Report Post-Closure Care of Fort Jackson Landfill #3*.

United States Army Environmental Center. 2000 (Revised 2002). *Fort Jackson, South Carolina Integrated Cultural Resources Management Plan (ICRMP).*

United States Department of Agriculture Soil Conservation Service. 1992. *Fort Jackson Resource Inventory.*

United States Geological Survey. 1998. *Fecal-Indicator Bacteria in Surface Waters of the Santee River Basin and Coastal Drainages, North and South Carolina, 1995-1998.*

------. 1999a. *Shallow Groundwater Quality in the Coastal Plain of Columbia, SC, 1996.*

------. 1999b. *Trace Elements in Bed Sediments and Biota from Streams in the Santee River Basin and Coastal Drainages, North and South Carolina, 1995-1997.*

------. 2000. *Water Quality in the Santee River Basin and Coastal Drainages, North and South Carolina, 1995-1998.*

Fort Jackson ITAM

Fort Jackson ITAM. 2006. *Fort Jackson Installation Field Map, January 2006 – December 2006.*

United States Army Aberdeen Test Center. 2006a. *Modification of a Small Arms Range for Improved Bullet Pocket and Storm Water Management, Fort Jackson, SC.*

------. 2006b. *Range Sustainment Initiatives, Fort Jackson.*

Fort Jackson Museum

United States Army Environmental Legacy Program. n.d. *The Cold War in South Carolina, 1945-1991, An Inventory of Department of Defense Cold War Era Cultural and Historical Resources in the State of South Carolina.*

Fort Jackson Preventive Medicine Services

Preventive Medicine and Environmental Health. Fort Jackson. January – August 2006. *Monthly Bacteriological Analysis Sampling Summaries*.

Fort Jackson United States Army Training Center

DPTMS Ammunition Office. 1998. *FY99-FY02 Ammunition Expenditures.*

------. 2000. *FY01 Basic Training Pyrotechnics Package.*

------. 2001. *FY02 Basic Combat Training (BCT) Range Requirements*.

------. 2002. *All DODICs Authorization/Percentage Report (Fiscal Year 2003).*

------. 2002. *FY03 BCT Ammunition Support Package*.

------. 2003. *FY04 Training Area Ammunition Expenditure Report.*

------. 2003. *FY04 Ammunition Report*.

------. 2003. *FY04 BCT Ammunition Support Package*.

------. 2004. *FY05 Ammunition Report*.

------. 2004. *FY05 BCT Ammunition Support Package.*

------. 2004. *FY05 BRM Statistics*.

------. 2005. *FY06 Ammunition Expenditures.*

------. 2005. *FY06 BCT Ammunition Distribution (including Ammunition Support Package).*

------. 2006. *All DODICs Authorization Report (FY 2007)*.

------. 2006. *FY07 BCT Ammunition Distribution*.

------. 2006. *FY07 BCT Ammunition Support Package*.

B5 – Personnel Interviews

Fort Jackson Chief of Environmental Health, Preventive Medicine & Environmental Health
Date of interview: 12 October 2006 by Malcolm Pirnie, Inc.
Provided drinking water quality studies; these are listed in Appendix B4.

Fort Jackson DPTMS GIS Analyst
Date of interview: 12 October 2006 by Malcolm Pirnie, Inc.
No documents obtained.

Fort Jackson DPTMS Range Officer
Date of interview: 10 October 2006 by Malcolm Pirnie, Inc.
Provided the Fort Jackson Range Master Plan listed in Appendix B4.

Fort Jackson DPTMS Scheduler
Date of interview: 12 October 2006 by Malcolm Pirnie, Inc.
Provided RFMSS data for 1 January 2002 through 12 October 2006.

Fort Jackson DPTMS Training Facility Coordinator
Date of interview: 12 October 2006 and 27 November 2006 by Malcolm Pirnie, Inc.
Provided RFMSS data for 1 January 2002 through 12 October 2006.

Fort Jackson ENRD Division Chief
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
No documents obtained.

Fort Jackson ENRD, Environmental Management Branch Chief, Directorate of Logistics and Engineering
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
No documents obtained.

Fort Jackson ENRD Environmental Engineer
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
Provided documents related to landfill ammunition data; these are listed in Appendix B4.

Fort Jackson ENRD Environmental Specialist
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
Provided general environmental documents; these are listed in Appendix B4.

Fort Jackson ENRD Environmental Specialist (Cultural Resources)
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
Provided documents related to the cultural resources of Fort Jackson; these are listed in Appendix B4.

Fort Jackson ENRD Environmental Specialist (Drinking Water)
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
Provided documents related to drinking water studies and well locations; these are listed in Appendix B4.

Fort Jackson ENRD Environmental Specialist (National Environmental Policy Act)
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.

Provided Environmental Data Resources reports and general environmental documents; these are listed in Appendix B4.

Fort Jackson ENRD Forestry Chief
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
Provided the database containing forestry data listed in Appendix B4.

Fort Jackson ENRD GIS Specialist
Date of interview: 11 October 2006 and 4 December 2006 by Malcolm Pirnie, Inc.
Provided GIS layers; these are listed in Appendix B4.

Fort Jackson ENRD Installation Restoration Program (IRP) Manager
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
Provided IRP reports and general environmental documents; these are listed in Appendix B4.

Fort Jackson ENRD Soil Conservationist and Storm Water Manager
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
Provided documents relating to storm water sampling at the small arms ranges, Gills Creek, and Mill Creek; these are listed in Appendix B4.

Fort Jackson ENRD Wildlife Biologist
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
Provided biological assessments and documents related to threatened and endangered species; these are listed in Appendix B4.

Fort Jackson ENRD Wildlife Branch Chief
Date of interview: 12 November 2006 by Malcolm Pirnie, Inc.
Provided biological assessments; these are listed in Appendix B4.

Fort Jackson ITAM Coordinator
Date of interview: 12 October 2006 by Malcolm Pirnie, Inc.
Provided documents related to range sustainment and modification; these are listed in Appendix B4.

McCrady Training Center Environmental/Conservation Manager
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
No documents obtained.

McCrady Training Center Maintenance (Drinking Water)
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
Provided no documents relevant to Fort Jackson.

Mississippi State Professor
Date of interview: 25 January 2007 by Malcolm Pirnie, Inc.
Provided information on small arms ranges study, specifically the lead detection limit used.

U.S. Army Training Center Ammunition Manager
Date of interview: 12 October 2006 and 30 November 2006 by Malcolm Pirnie, Inc.
Provided documents containing data on basic training ammunition packages and use; these are listed in Appendix B4.

MALCOLM PIRNIE

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31 January 2008

LTC Mark Dykes
The Adjutant General of South Carolina
ATTN: FMO-ENV
One National Guard Road
Columbia, SC 29201-4766

Re: **Draft Final Operational Range Assessment Program Phase I Qualitative Assessment Report**
McCrady Training Center, South Carolina

Dear LTC Dykes:

1. Enclosed (3 hard copies and 2 electronic copies) is the Draft Final Operational Range Assessment Program Phase I Qualitative Assessment Report for McCrady Training Center, South Carolina. In addition to the Report, the electronic copies also include a copy of the Read-Ahead Package, Site Visit Trip Report, and the Response to Comments documents for the Draft version of the Report.

2. The Army Environmental Division of the Army Headquarters has recently directed that Phase I Qualitative Assessment Reports with at least one range characterized as "Inconclusive" will remain in the "Draft Final" status. The reason for remaining in the "Draft Final" status is that "Inconclusive" ranges require further assessment (Phase II) and therefore the assessment process is not complete. Phase II assessments will begin in 2010. The Phase I report will be incorporated into the corresponding Phase II report as an appendix with the Phase I Conceptual Site Model forming the basis of Phase II sampling.

3. The Technical Outreach Guidance (TOG) for the Operational Range Assessment Program and a Department of Defense Memorandum were enclosed in the Read-Ahead Package distributed on 16 March 2007. These documents provide additional information on how to address questions regarding the Phase I Assessment Report. Any new guidance will be provided to you as it is developed.

4. If you have any questions regarding this matter please call John Buck, USAEC, at 410-436-4844 or me at 813-242-7208.

Regards,

MALCOLM PIRNIE, INC.

Daria Navon, Team Leader

Telephone: 813-242-7208
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c: ARNG HQ (Major Michael McMullen) w/ enclosure
c: ARNG HQ (Major Chris Tatian)
c: POTO (Colonel Dale Ellenburg)
c: Training Officer (Lieutenant Colonel Gary Fedyschyn)
c: Conservation Manager, McCrady Training Center (Bryan Hall) w/ enclosure
c: USACE PgM/PM (Andrea Graham) w/ enclosure
c: USAEC PgM (John Buck) w/ enclosure
c: USAEC PM (Steve Starbuck)
c: USACHPPM PgM (Barrett Borry) w/ enclosure
c: USACHPPM PM (Brian Hammond)

DRAFT FINAL
OPERATIONAL RANGE ASSESSMENT PROGRAM
PHASE I QUALITATIVE ASSESSMENT REPORT
MCCRADY TRAINING CENTER
COLUMBIA, SOUTH CAROLINA

DECEMBER 2007

Prepared for:

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DRAFT FINAL
OPERATIONAL RANGE ASSESSMENT PROGRAM
PHASE I QUALITATIVE ASSESSMENT REPORT
MCCRADY TRAINING CENTER
COLUMBIA, SOUTH CAROLINA

DoD Contract Number: W912DR-05-D-0004

Reviewed and Approved by:

_____

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Malcolm Pirnie, Inc., prepared this report at the direction of the United States Army Corps of Engineers (USACE). This document should be used only with the approval of the USACE or another authorized Department of the Army official organization. This report is based, in part, on information provided in other documents and is subject to the limitations and qualifications presented in the referenced documents.

DECEMBER 2007

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ABBREVIATIONS/ACRONYMS

ARID-GEO	Army Range Inventory Database-Geodatabase
bgs	Below Ground Surface
CCC	Criterion Continuous Concentration
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMC	Criterion Maximum Concentration
CSM	Conceptual Site Model
DNT	Dinitrotoluene
DoD	Department of Defense
DODI	Department of Defense Instruction
DPTMS	Directorate of Plans, Training, Mobilization, and Security
E	Ecological receptors identified. (This refers to range grouping; pathway designation always precedes E designation.)
ENRD	Environmental and Natural Resources Division
EOD	Explosive Ordnance Disposal
GIS	Geographic Information System
GW	Groundwater pathway identified. (This refers to range grouping; M designation always precedes GW designation.)
H	Human receptors identified. (This refers to range grouping; pathway designation always precedes H designation.)
HE	High Explosives
HMX	Cyclotetramethylenetetranitramine
INRMP	Integrated Natural Resources Master Plan
ITAM	Integrated Training Area Management
LS	Limited Source
M	Munitions used. (This refers to range grouping; M designation always precedes applicable pathway.)
MCOC	Munitions Constituents of Concern
mg/kg	Milligram per Kilogram
mg/L	Milligram per Liter
mm	Millimeter
MMRP	Military Munitions Response Program
MOUT	Military Operations in Urban Terrain
msl	Mean Sea Level
NG	Nitroglycerin
NGB	National Guard Bureau
OB	Open Burn
OD	Open Detonation
ORAP	Operational Range Assessment Program
PETN	Pentaerythritoltetranitrate
ppb	Parts per Billion
PU	Pathway unlikely or incomplete. (This refers to range grouping; M designation always precedes PU designation.)
RCRA	Resource Conservation and Recovery Act
RDX	Cyclotrimethylenetrinitramine
RFMSS	Range Facility Management Support System

SC	South Carolina
SCARNG	South Carolina Army National Guard
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SW	Surface water pathway identified. (This refers to range grouping; M designation always precedes SW designation.)
TNT	Trinitrotoluene
U.S.	United States
USACE	United States Army Corps of Engineers
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
UXO	Unexploded Ordnance
WP	White Phosphorus
WWII	World War II
^{o}F	Degrees Fahrenheit

EXECUTIVE SUMMARY

The United States (U.S.) Army is conducting qualitative assessments at operational ranges to meet the requirements of Department of Defense policy and to support the U.S. Army Sustainable Range Program. The operational range qualitative assessment (hereinafter referred to as Phase I Assessment) is the first phase of the U.S. Army Operational Range Assessment Program (ORAP). This Phase I Assessment evaluates the operational range area at McCrady Training Center to assess whether further investigation is needed to determine if potential munitions constituents of concern (MCOC) are or could be migrating off-range at levels that may pose an unacceptable risk to human health or the environment. In conducting the Phase I Assessment, MCOC sources, potential off-range migration pathways, and potential off-range human and ecological receptors are evaluated as appropriate.

McCrady Training Center is located in Columbia, South Carolina, within Richland County. The Department of the Army owns the entire training center, including the cantonment area, and the South Carolina Army National Guard (SCARNG) has held a nonexclusive license for training operations since 1943. The licensed area comprises 15,267 acres within the boundaries of Fort Jackson. McCrady Training Center is the SCARNG's largest and most utilized training area, serving as the central point for state missions, while also supporting federal missions.

As part of the Operational Range Inventory Sustainment, an update to the Army Range Inventory Database-Geodatabase (ARID-GEO) was submitted to the U.S. Army Environmental Command in October 2006 (ARID-GEO [2006]). ARID-GEO (2006) identified 62 operational range areas encompassing a total of 14,895 acres. The total operational range area was derived from the Operational Use Area (total range area) acreage as reported in ARID-GEO (2006). A total of 416 acres were identified as other than operational acreage. McCrady Training Center serves as a training center for the Army National Guard and the Army Reservists stationed in South Carolina, North Carolina, Georgia, Florida, the Virgin Islands, and Puerto Rico. The operational areas support a variety of activities, including live-fire weapons training, heavy and light maneuver exercises, dudded and non-dudded impact areas, and artillery and mortar firing points.

MCOC sources identified at McCrady Training Center consist of small to large caliber firing ranges, mortar and artillery firing points, demolition areas, training and maneuver areas, suspected dudded areas, and areas that received a heavy historical munitions loading. In general, MCOC from primary source areas potentially impact the following source media: (1) soil (e.g., impact berms, impact areas surrounding targets, burn pits) and (2) surface water / sediment (e.g., direct deposition into streams and wetlands).

MCOC can be released to groundwater (down gradient), surface water / sediment (downstream), off-range soil, or the food chain via a variety of release mechanisms. Release mechanisms for soil may include leaching from soil to groundwater or erosion and runoff to off-range surface soil or to nearby streams. Once potential MCOC are deposited in surface water / sediment, they have the potential to migrate downstream or be taken up by aquatic plants or animals. Release mechanisms for surface water / sediment are natural stream flow and sediment transport. Drainage from the majority of McCrady Training Center is directed toward the Wateree River to the southeast. Two remote small arms ranges drain to the Congaree River to the southwest.

The main human receptors are users of water from off-installation wells and persons utilizing recreational areas downstream of McCrady Training Center. The main ecological receptors are

sensitive environments and threatened and endangered species located off-installation and in other than operational areas on the installation.

The 62 operational ranges at McCrady Training Center are categorized as Inconclusive or Unlikely.

Inconclusive – Phase II Quantitative Assessment Required

Forty-eight ranges at McCrady Training Center are categorized as Inconclusive, totaling 12,243 acres. These ranges consist of firing ranges, small arms ranges, and training areas. Ranges categorized as Inconclusive are those operational ranges where either existing information is insufficient to make a source-receptor interaction determination or the information indicates the potential for such interaction to be occurring. Ranges categorized as Inconclusive will undergo Phase II of the ORAP, consisting of a quantitative assessment with sampling and additional data collection.

Unlikely – Five-Year Review

Fourteen ranges at McCrady Training Center are categorized as Unlikely, totaling 2,652 acres. These ranges consist of training areas. Ranges where, based upon a review of readily available information, there is sufficient evidence to show that there are no known releases or source-receptor interactions off-range that could present an unacceptable risk to human health or the environment are categorized as Unlikely. Ranges categorized as Unlikely are required to be re-evaluated at least every five years. Re-evaluation may occur sooner if significant changes (e.g., change in range operations or site conditions, regulatory changes) occur that affect determinations made during this Phase I Assessment.

Table ES-1 summarizes the Phase I Assessment findings.

Table ES-1: Summary of Findings and Conclusions for McCrady Training Center

Category	Total Number of Ranges and Acreage	Source(s)	Pathway(s)	Human Receptors	Ecological Receptors	Conclusions and Rationale
Inconclusive	46 operational ranges; 12,199 acres	Firing points, small arms firing, demolition areas, suspected dudded areas, and historical artillery impact areas or firing points	Colonels Creek and Murray Pond (to the south and southeast); Weston Lake and Cedar Creek (to the southeast and southwest); surficial groundwater aquifer (to the south, southeast, and southwest)	Residents down gradient, local and off-range residents, and recreational users of Murray Pond and Weston Lake downstream	Wetlands and threatened and endangered species downstream	Phase II Quantitative Assessment is required. Residents and recreational users are present down gradient and downstream.
	2 operational ranges; 44 acres	Small arms firing	Gills Creek and Forest Lake (to the west and southwest)	Recreational users of Forest Lake and Lake Katherine downstream	Wetlands and threatened and endangered species downstream	Phase II Quantitative Assessment is required. Residents and recreational users are present downstream.
Unlikely	14 operational ranges; 2,652 acres	Limited source – limited or no historical military munitions use	Not evaluated (limited source was identified)			Re-evaluate during the five-year review. Limited source was identified.

1.0 Introduction

The United States (U.S.) Army is conducting qualitative assessments at operational ranges to meet the requirements of Department of Defense (DoD) policy and to support the U.S. Army Sustainable Range Program. The operational range qualitative assessment (hereinafter referred to as Phase I Assessment) is the first phase of the U.S. Army Operational Range Assessment Program (ORAP). The Phase I Assessment will review readily available data to evaluate, verify, validate, document, and report on operational ranges within the United States and its territories. Phase I Assessments are being conducted on Active Army, Army Reserve, and Army National Guard Bureau (NGB) installations (including both federally and state owned).

The conclusions in this report have been based, in part, on information obtained from third parties, which may include environmental assessment reports, environmental agency records, historical aerial photographs, and other public records obtained from various sources. Unless noted, Malcolm Pirnie has not independently evaluated or verified the accuracy or completeness of such third party information. Visual observations of the site only represent conditions at the time of the site visit. Malcolm Pirnie makes no warranties that the on-site observations made during the site visit are representative of historical or future conditions at the site.

1.1 Project Scope and Drivers

The Phase I Assessment process evaluates potential source-receptor interaction between off-range[1] receptors and the potential munitions constituents of concern (MCOC) migrating from all operational ranges within the Operational Range Inventory. The process for evaluating potential source-receptor interactions is outlined in the *Final Work Plan / Management Plan for the U.S. Army Operational Range Assessment Program Qualitative Operational Range Assessments* (Malcolm Pirnie, 2005).

The ORAP is being implemented to fulfill requirements identified implicitly or explicitly in:

- DoD Directive 4715.11 *Environmental and Explosives Safety Management on Operational Ranges Within the United States* (2004) and
- DoD Instruction (DODI) 4715.14 *Operational Range Assessments* (2005).

1.2 Purpose

The purpose of this Phase I Assessment is to evaluate the operational ranges at McCrady Training Center to assess whether further investigation is needed to determine if potential MCOC are or could be migrating off-range at levels that may pose an unacceptable risk to human health or the environment.

Based on the readily available data obtained during the Phase I Assessment process, all operational ranges at McCrady Training Center were placed into groups according to military munitions use and the presence or absence of potential MCOC, migration pathways, and receptors. Each operational

[1] Off-range areas include those areas outside of the boundaries of the operational range area, as established by the Army Range Inventory Database-Geodatabase (ARID-GEO). Off-range areas may include both on-installation (e.g., cantonment areas) and off-installation areas or locations.

range group was then placed into one of three possible categories – Referred, Inconclusive, or Unlikely:

- **Referred – Refer to Appropriate Cleanup Program**: ranges with compelling evidence (e.g., sampling data) to indicate the presence of an off-range release that potentially poses an unacceptable risk to human health or the environment
- **Inconclusive – Phase II Quantitative Assessment Required**: ranges where existing information either is insufficient to make a source-receptor interaction determination or indicates the potential for such interaction to be occurring
- **Unlikely – Five-Year Review**[2]: ranges where, based upon a review of readily available information, there is sufficient evidence to show that there are no known releases or source-receptor interactions that could present an unacceptable risk to human health or the environment

Appendix A provides a glossary of common terms referred to in the ORAP.

1.3 General Installation Information

McCrady Training Center is located in Columbia, South Carolina (SC), within Richland County. The Department of the Army owns the entire training center, including the cantonment area, and the South Carolina Army National Guard (SCARNG) has held a nonexclusive license for training operations since 1943. The licensed area comprises 15,267 acres within the boundaries of Fort Jackson. The main gate for McCrady Training Center is located on Leesburg Road (Highway 262), which forms the southern boundary of the training center, just west of the intersection with McCords Ferry Road (Highway 601), which forms the eastern boundary. The training center is bounded by Screaming Eagle Road (Highway 268) to the northeast, and Division Road, within Fort Jackson, to the northwest. **Figure 1-1** illustrates the general location of McCrady Training Center.

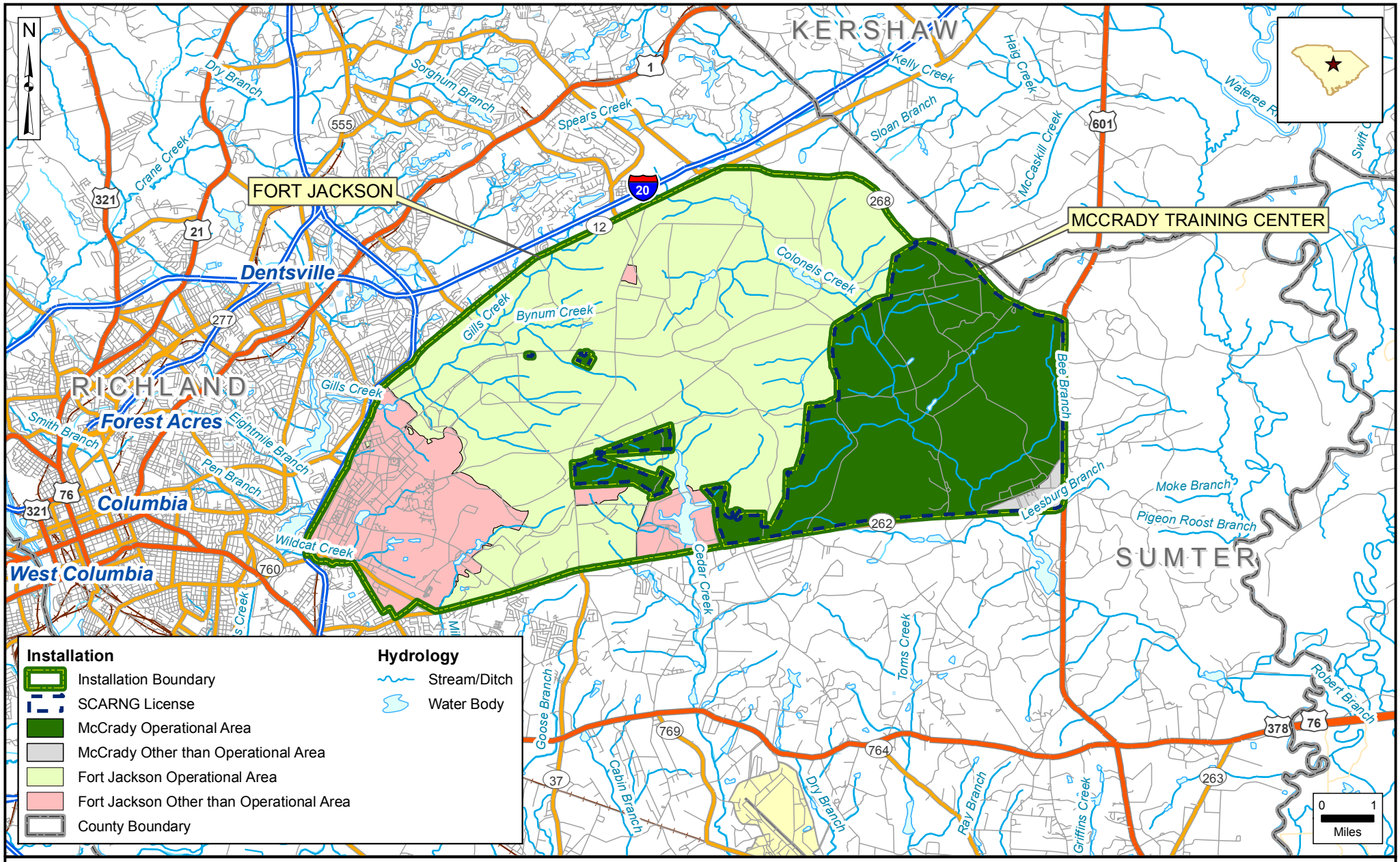
McCrady Training Center's history is intertwined with Fort Jackson's history. Fort Jackson originally was established in 1917 as an infantry training center (referred to as Camp Jackson). The installation was inactive from 1921 to 1925. In 1925, the War Department decided to use the post again as a training camp for the SCARNG. From 1925 to 1939, it was controlled by the state and used as an encampment and training area for SCARNG troops. During World War II (WWII), Fort Jackson became a permanent military installation used primarily for infantry training. Additional property was acquired on the eastern and northern sides of the installation until it included 52,562 acres. In 1943, the land for McCrady Training Center, formerly referred to as Leesburg Training Center, was licensed to the SCARNG by the Department of the Army.

McCrady Training Center is the largest of the SCARNG training centers and is the primary facility for the SCARNG, supporting federal missions and serving as a staging site for state missions. The 218th Regiment (Leadership) Total Army School, located at McCrady Training Center, serves as the schoolhouse for the southeastern region (USAEC and USDA, 2001). McCrady Training Center

[2] All operational ranges must be periodically re-evaluated to determine if there is a release or substantial threat of release of MCOC from an operational range to an off-range area. Range groups categorized as Unlikely are to be re-evaluated at least every five years. Re-evaluation may occur sooner if significant changes (e.g., changes in range operations or site conditions, regulatory changes) occur that affect determinations made during the Phase I Assessment.

provides training ground for a variety of military activities utilizing modern and sophisticated equipment, such as M1A1 tanks, Multiple Launch Rocket Systems, Bradley fighting vehicles, and Apache attack helicopters (USAEC and USDA, 2001).

The final Operational Range Inventory Sustainment update was submitted to the U.S. Army Environmental Command (USAEC) in October 2006 (ARID-GEO [2006]). The ARID-GEO (2006) identified 62 operational ranges licensed to the SCARNG, encompassing a total of 14,895 acres. The total operational range area was derived from the Operational Use Area (total range area) acreage as reported in ARID-GEO (2006). The operational areas support live-fire weapons training and heavy and light maneuver exercises. **Figure 1-2** illustrates the operational range areas identified in the ARID-GEO (2006).

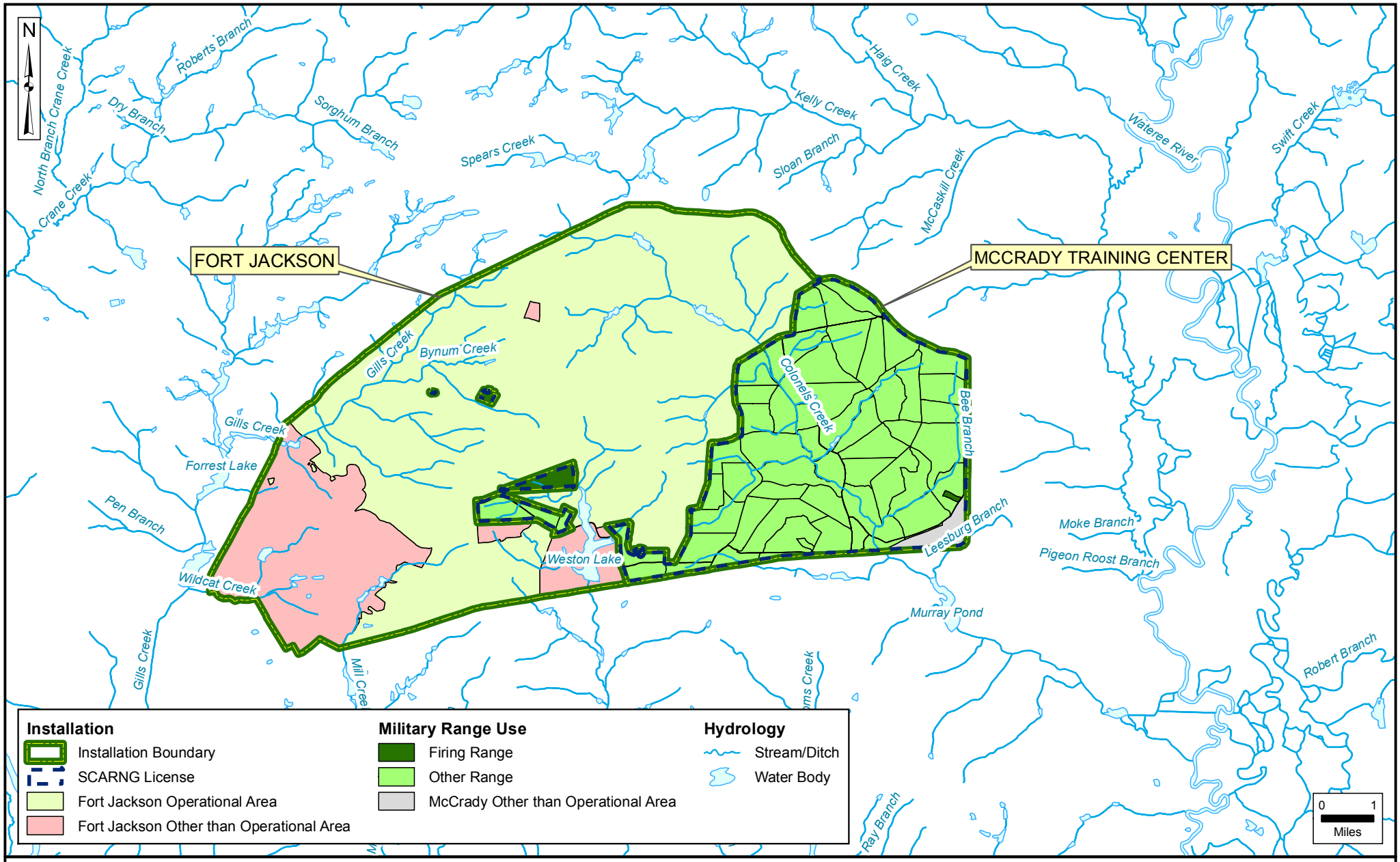


Operational Range Assessment Program
Phase I Qualitative Assessment
McCrady Training Center, SC

Figure 1-1
General Location of McCrady Training Center

Data Sources:
AEC, ARID-GEO, Oct 2006
ESRI, StreetMap USA, 2005

Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004



Operational Range Assessment Program
Phase I Qualitative Assessment
McCrady Training Center, SC

Figure 1-2
Operational Range Area

Data Sources:
AEC, ARID-GEO, Oct 2006
ESRI, StreetMap USA, 2005

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2.0 Assumptions, Programmatic Exclusions, and Data Collection Efforts

2.1 Assumptions

Statements in this report were made using available supporting documents and data obtained during the centralized data collection efforts and site visits conducted at McCrady Training Center in October 2006 and May 2007. An informal briefing and range tour were conducted during the October 2006 site visit in conjunction with the range tour for the Fort Jackson Phase I Assessment. On 23 May 2007, the formal ORAP Phase I Assessment in-brief for McCrady Training Center was held at the SCARNG Joint Forces Headquarters in Columbia, followed by interviews with SCARNG personnel. The findings and conclusions of the supporting documents and data are assumed to be accurate and scientifically defensible. Conclusions and recommendations are based on the data gathered during the Phase I Assessment.

The Phase I Assessment assumes that the primary pathways for off-range migration are water related (i.e., surface water, sediment, and groundwater). This is to conform to the DODI 4715.14 emphasis on off-range migration (DoD, 2005). Other media may be considered, if warranted based on site-specific conditions.

2.2 Programmatic Considerations and Exclusions

For the purposes of the Phase I Assessment, an unacceptable risk to human health or the environment may occur if there is a source of MCOC, a pathway for MCOC to potentially move off-range, and an off-range receptor that may be impacted by the migrating MCOC. Where all three of these elements are present, further evaluation may be required. The paragraphs below present the potential pathways and receptors considered for the Phase I Assessments. Potential MCOC migration pathways that have been evaluated and programmatically excluded (except in unique situations that compel their inclusion) are also presented.

2.2.1 Exposure to Surface Water

The U.S. Environmental Protection Agency (USEPA) *Guidance for Performing Preliminary Assessments under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* (1991) requires the identification of potential surface water receptors up to 15 miles downstream from the location at which potential MCOC may move beyond the aerial extents of the source area. Only those surface water receptors identified in the surface water pathway segments downstream of the operational range source area are being evaluated and assessed.

Dermal contact and incidental ingestion of MCOC by human receptors within the off-range surface water pathway, for areas other than designated recreational areas (or areas known or suspected of being used frequently for swimming), are programmatically excluded. While surface water may be a viable exposure pathway in some instances, it is not expected to be significant in most cases due to the extremely low levels of MCOC that have been found in surface water during previous quantitative range studies conducted by the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). Therefore, USACHPPM (2005) has recommended that this pathway only be evaluated when there is evidence that the surface water body is used regularly for swimming.

2.2.2 Exposure to Groundwater

For human receptors to contact MCOC through the groundwater pathway, there must be an aquifer, a

drinking water well, or discharge to a stream or spring that is used as a drinking water source. The USEPA (1991) requires the identification of water wells, both public and private, within four miles down gradient of the potential MCOC source area. For the Phase I Assessments, wells are identified within four miles of the potential MCOC source area boundary.

2.2.3 Surface Soil

The surface soil pathway is not to be evaluated unless potential off-range human or ecological receptors are present within 200 feet of a suspected source of MCOC. This determination is based on USEPA guidance (1991). In general, the results of a variety of range studies indicate that the likelihood of encountering potential source-receptor interactions through the soil pathway is extremely low. Also, while it is generally acknowledged that dermal absorption of substances in surface soil may be occurring in terrestrial ecological receptors, the methodology for quantifying this pathway is not currently available. Therefore, although the surface soil pathway may be complete, it is not evaluated by convention, as indicated in the conceptual site model (CSM) figures in Section 5.

2.2.4 Air Emissions

Air emissions from detonating military munitions have been evaluated under a variety of studies conducted by the DoD and the Army. These studies indicate that off-range receptor exposure to MCOC via the air pathway does not pose an unacceptable level of risk. Therefore, the USAEC has decided on a programmatic basis not to evaluate the air emissions migration pathway further during the Phase I Assessment. Should additional information become available that identifies potential problems associated with the air emissions migration pathway, this decision will be re-evaluated.

2.2.5 Potential Receptors

Receptors are organisms (human or ecological) that contact a chemical or physical agent in the environment. For the purposes of the Phase I Assessment, receptors are generally limited to off-range human receptors (workers, residents, and recreational users [including trespassers]) and off-range ecological receptors (threatened and endangered species, wetlands, fisheries, and other ecological receptors of concern or sensitive environments specific to an installation). Ecological receptors should include the identification and location of sensitive terrestrial/avian environments within one-half mile of the potential source areas and fisheries and surface water sensitive environments up to 15 miles downstream of the probable point of entry (USACHPPM, 2005; Malcolm Pirnie, 2005). For the purposes of the Phase I Assessments, sensitive environments are considered surrogates for ecological receptors. Guidance on identifying a sensitive environment was obtained from Exhibit 1-1 of the USEPA guidance (1997).

2.2.5.1 Consumption of Ecological Receptors

Studies conducted by the USACHPPM and other organizations indicate that the uptake and bioaccumulation of select MCOC (e.g., explosives) in terrestrial receptors do not pose a viable health risk to off-range receptors. Therefore, without a viable health risk (source), a potential source-receptor interaction pathway associated with the consumption of terrestrial receptors (e.g., deer) becomes irrelevant and is excluded from the ORAP.

These studies also show that deer and other wildlife species exposed to higher levels of MCOC in soil, including areas around explosive manufacturing areas, do not contain detectable levels of military unique compounds. Based on the data gathered during these studies, and considering the conservatism related to the risk assessment process, the health risk associated with consuming deer and other game harvested off-range is no greater than with harvesting game on-range. Therefore,

deer, other wildlife, and even livestock are programmatically excluded.

The inclusion of fish as a potential pathway / exposure point via the food chain is supported by USACHPPM. This assumption is based on the theory that if MCOC are present in a water body, fish have a more intensive, long-term exposure potential than terrestrial receptors, which may only come into contact with the contamination during incidental, short-term exposures.

2.3 Summary of Data Collection Efforts

Four primary sources of information were researched as part of the data collection effort for the Phase I Assessment:

- DoD data repositories and databases (e.g., ARID-GEO, Technical Information Center, Range Facility Management Support System [RFMSS])
- Off-installation / publicly available data repositories and databases (e.g., South Carolina Department of Health and Environmental Control [SCDHEC] and South Carolina Department of Natural Resources [SCDNR] geographic information system [GIS] databases)
- Installation data repositories and databases (e.g., McCrady Environmental and Natural Resources Office; Fort Jackson Directorate of Plans, Training, Mobilization, and Security [DPTMS])
- Personnel interviews and windshield tour (e.g., McCrady Environmental/Conservation Manager, McCrady RFMSS GIS Analyst, Fort Jackson DPTMS Chief)

Prior to the site visit, information on McCrady Training Center and the surrounding area was obtained from centralized databases and assembled into several profiles. Data gaps regarding military munitions usage and off-range receptors were identified during this effort. The site visit objectives were to confirm/verify the previously collected information and to fill data gaps. RFMSS data on munitions usage for 1 January 2004 to 18 May 2007 were obtained, along with data on off-range receptors to the south, southwest, southeast, and west of McCrady Training Center. Interviews with personnel from McCrady Training Center and Fort Jackson also provided useful information (see **Appendix B**). All of this information was used to construct the CSM profiles and figures presented in Section 3 and Section 5, respectively.

Appendix B provides a complete list of references used throughout the Phase I Assessment.

3.0 Conceptual Site Model Profiles

Section 3 provides a description of the installation and its environment based on information obtained during the Phase I Assessment process. The section includes five profile types:

- Facility Profile: Describes man-made features and potential sources (e.g., the current and historical installation area/layout and the munitions type/usage and MCOC associated with the operational range area).
- Physical Profile: Describes physical features/factors that may affect release, transport, and access of potential MCOC (e.g., meteorological data, topography, geology, hydrogeology, and surface waters and water resource use) and associated MCOC release mechanisms / pathways.
- Munitions Release / Migration Profile: Describes potential release mechanisms and migration pathways based on the source and type of potential MCOC and their interaction with the physical environment.
- Land Use and Human Receptor Profile: Provides information used to identify and evaluate the applicable exposure scenarios, human receptors, and receptor locations.
- Ecological Profile: Describes natural habitats of the installation and associated ecological receptors.

3.1 Facility Profile

3.1.1 Current and Historical Range Usage and Layout

McCrady Training Center is located in Columbia, SC, in Richland County. The training center comprises approximately 15,267 acres of the southeastern portion of Fort Jackson. The Department of the Army owns the land, which has been licensed to the SCARNG since 1943. **Figure 1-1** illustrates the general location of McCrady Training Center.

According to ARID-GEO (2006), 62 ranges are located at McCrady Training Center, encompassing 14,895 acres (**Figure 1-2**). The total operational range area was derived from the Operational Use Area (total range area) acreage as reported in ARID-GEO (2006). The cantonment area, which is situated in the southeast portion of the training center, comprises the 416 nonoperational acres of the training center (ARID-GEO, 2006).

Table 3-1 presents the types of ranges currently utilized at McCrady Training Center as defined by ARID-GEO (2006). The number of ranges and total acreage per range type are also provided.

Table 3-1: McCrady Training Center Operational Ranges

Range Type	Number of Ranges	Total Acreage
Tank Scaled Range (1:5-1:60)	1	253.46
Light Anti-Air Weapon Range	1	8.70
Pistol Qualification Range	1	3.35
Record Firing Range	1	40.80
Zero Range	1	3.69

Range Type	Number of Ranges	Total Acreage
Military Operations in Urban Terrain (MOUT) Facilities	1	21.30
Light maneuver/training area	9	2,327.37
Heavy maneuver/training area	32	9,500.30
Miscellaneous training area	14	2,691.33
Training Area Tank Trails, Surface	1	44.79
Total	62	14,895.09

Source: ARID-GEO (2006)
Note: The total operational range area was derived from the Operational Use Area (total range area) acreage as reported in ARID-GEO (2006).

Many of the operational ranges at McCrady Training Center have seen significant historical use. Historical military munitions use at McCrady Training Center was documented through a review of historical range maps. **Figures 3-1**, **3-2**, **3-3**, and **3-4** illustrate historical munitions usage from the years 1946, 1949, 1956, and 1969, respectively. As shown in these figures, the majority of historical firing points at McCrady Training Center were located along the southern and eastern edges of the operational area. Most of the ranges depicted in these figures are small arms ranges. Multiple historical artillery impact areas also overlap portions of McCrady Training Center, as evidenced by the artillery ranges shown on historical maps. **Figure 3-1** depicts a rifle grenade range along the southern installation boundary. **Figure 3-2** shows a mortar range just north of the cantonment area, and a mortar training area is depicted in **Figure 3-3**. **Figure 3-3** also shows range fans from 73 historical ranges utilized at Fort Jackson in the 1950s, including those licensed to the SCARNG. This illustrates that at least some historical military munitions usage occurred over virtually all of McCrady Training Center. As seen in **Figure 3-4**, by the late 1960s, firing points at McCrady Training Center were concentrated along the northern boundary of the cantonment area and the eastern boundary of the installation.

The 62 operational ranges at McCrady Training Center are discussed below according to range type. Areas of heavy historical munitions use, suspected dudded areas, and locations of artillery and mortar firing points and demolition areas were also considered when identifing potential source areas where limited or no munitions are used currently. Range types are shown in **Figure 3-5**.

Firing Ranges

There are two firing ranges at McCrady Training Center, totaling approximately 262 acres. These ranges were identified as firing ranges in ARID-GEO (2006), and use of medium and/or large caliber munitions was verified using RFMSS data. Small caliber munitions are also used at both of the firing ranges, and pyrotechnics/obscurants are used at one range.

Small Arms Ranges

There are three small arms ranges at McCrady Training Center comprising approximately 48 acres. Two of the three are located in the western portion of Fort Jackson's operational range area, as shown in **Figure 3-5**. The third small arms range is a pistol qualification course classified as a firing range in ARID-GEO (2006); however, RFMSS data indicate that small caliber munitions are the only munitions used at this range. In addition to small caliber munitions, fuzes (practice) are used at one of these ranges with the M69 Practice Hand Grenade, and munitions identified as unknown are utilized at each of these ranges.

Training Areas

McCrady Training Center includes 57 training areas covering approximately 14,585 acres. Fourteen of these training areas, totaling 2,652 acres, are non-live-fire maneuver and training areas where limited or no current munitions use occurs and no historical munitions usage has occurred.

Historical and/or current training involving the use of munitions has been identified at the other 43 training areas, totaling 11,933 acres. Eighteen training areas, including 16 training areas with historical munitions usage, are currently used for training activities involving the use of munitions at artillery or mortar firing points and/or suspected dudded areas, as shown in **Figure 3-5**. Two of the training areas that received heavy historical usage also contain demolition areas. According to the McCrady Training Center RFMSS GIS Analyst, one of these demolition areas is temporary. RFMSS data indicate that use of this temporary demolition area began in 2007.

3.1.2 Munitions Types and Usage

Munitions Types

Each of the following munitions classes has been used at McCrady Training Center:

- **Small caliber munitions**: These are used in small arms, which typically have a muzzle diameter of up to .50-caliber or 0.5 inches. Projectiles are typically solid and composed of lead cores with copper alloy jackets. Small caliber practice munitions (commonly referred to as blanks) contain no projectile. Additionally, in an attempt to reduce lead usage, a number of installations have replaced traditional bullets with lead-free tungsten composite rounds. RFMSS data indicate that tungsten rounds have been used at one of McCrady Training Center's small arms ranges and at one of its firing ranges.
- **Medium and large caliber munitions**: These are used in weapons systems that employ projectiles larger than .50-caliber, with sizes ranging from 20 to 60 millimeters (mm) for medium caliber and greater than 60 mm for large caliber. These projectiles are typically comprised of hollow iron alloys that contain a detonator and an explosive charge. These munitions may be live, practice, or inert.
- **Pyrotechnics and obscurants**: These devices give off smoke, light, heat, and/or noise when activated. Common munitions in this category include smoke grenades, artillery simulators, ground burst simulators, hand grenade simulators, and booby trap simulators.
- **Other weapons systems**: Hand grenades, bombs, rockets, missiles, and mines all fall into this category. Generally, these munitions may be found at live-fire ranges or impact areas. Items such as detonation cord and charges may be used in demolition areas. These munitions may be live, practice, or inert.

Munitions Usage

Munitions data (e.g., RFMSS) collected during the site visit provide information on the types and number of rounds fired at McCrady Training Center since 2004. The estimated number of rounds for each munitions class expended at McCrady Training Center from 1 January 2004 to 18 May 2007 is summarized in **Table 3-2**. The munitions expended are presented by range type. Munitions currently used in the training areas include demolition materials used at the demolition areas and large caliber munitions used at artillery firing points. This table does not include munitions that are used in areas of Fort Jackson not licensed to SCARNG. Approximately 6.6 million total rounds of military munitions were utilized during this time period. Over 95 percent of these were small arms rounds, including approximately 18,000 small arms tungsten rounds.

Table 3-2: McCrady Training Center Munitions Data Summary
(rounds in thousands)

Munitions Type	Live-Fire Rounds	Practice/Blank Rounds	Total Rounds
Firing Ranges			
Small Caliber	3,800	1.8	3,800
Medium Caliber	220	8.2	230
Large Caliber	5.3	0	5.3
Pyrotechnic/Obscurant	.32	0	.32
Total	*4,000*	*10*	*4,000*
Small Arms Ranges			
Small Caliber	2,600	13	2,600
Fuze (practice)	0	10	10
Unknown	0	0	26
Total	*2,600*	*23*	*2,600*
Training Areas			
Large Caliber	.26	0	.26
Other	2.8	0	2.8
Total	*3.1*	*0*	*3.1*
All Ranges			
Total	**6,600**	**33**	**6,600**

McCrady Training Center contains a site where munitions were utilized or disposed of that is being addressed under Fort Jackson's Resource Conservation and Recovery Act (RCRA) Part B permit issued by the SCDHEC in September 1991. Although this area is a potential source of MCOC, it is not evaluated under the ORAP because it is addressed under the conditions of the permit. Permitted open burn (OB) / open detonation (OD) areas are programmatically excluded from ORAP because the conditions of their permit address potential MCOC migration from these areas. This site is briefly described here for informational purposes only.

Wonsan Explosive Ordnance Disposal Site

Fort Jackson historically utilized two sites (Wonsan and Inchon) for disposal of explosive ordnance by OB and OD. The Inchon Explosive Ordnance Disposal (EOD) site is located on the portion of Fort Jackson that is not licensed to the SCARNG and, thus, is not discussed further in this report. The Wonsan EOD site is located approximately 600 feet east of Division Road between Colonels Creek to the north and Jumping Run Creek to the south. The site consists of two areas separated by an east-west firebreak: a one-acre area north of the firebreak and a two-acre area south of the firebreak. The Wonsan EOD site was used by the 48th EOD Detachment to dispose of unserviceable ammunition from 1961 to 1978. Disposal consisted of burning small arms ammunition in trenches and detonating larger ordnance in pits. The Wonsan EOD site is designated as Solid Waste Management Unit 12 in Fort Jackson's Installation Restoration Program. Four field events (in 1991, 1993, 1999, and 2000) were conducted to support a RCRA Facility Investigation. Samples were collected from shallow soil, subsurface soil, surface water, and groundwater and analyzed for a variety of analytes, including explosives and metals. Groundwater concentrations were compared to the National Drinking Water Action Level of 15 parts per billion (ppb) for lead and the 2000 USEPA Region 9 Preliminary

Remediation Goals for Residential Soil and Tap Water. Soil concentrations were compared to USEPA Ecological Screening Values for surface soil (1999). The primary constituents of concern for surface soil were determined to be chromium and lead. A screening level ecological risk assessment was performed in accordance with USEPA guidance (1997). This assessment determined that MC present in the soil and groundwater at the Wonsan EOD site do not pose a threat to human health or the environment; however, potential unexploded ordnance (UXO) that remains in the soil at the site may pose a safety risk. Additionally, it should be noted that some comparison criteria referenced in this study may be outdated. Fort Jackson is implementing land use controls to prevent access to this site (LAW, 2003; USAEC, 2005).

3.1.3 Potential MCOC

Based on a review of the data collected for the Phase I Assessment (e.g., GIS data, RFMSS data, historical range maps, site visit interviews with range and environmental personnel), numerous potential current and/or historical source areas for off-range releases were identified at McCrady Training Center. MCOC sampling data for certain portions of the installation were identified during the data collection and reviewed for this Phase I Assessment and are summarized below.

White Phosphorus Wetland Storage Installation Assessment (USACE, 1993)

The U.S. Army Corps of Engineers (USACE) performed a White Phosphorus Wetland Storage Installation Assessment at Fort Jackson in 1993 to determine whether white phosphorus (WP) was present in areas potentially attractive to wildlife, particularly waterfowl. Sediment samples were collected from 12 locations around Fort Jackson that were deemed most likely to store WP based on historical or current use of WP-containing munitions. Although none of these samples were taken on land that is licensed to the SCARNG, three of the sampling locations were located in the northwestern portion of the Weston Lake recreational area. This area is down gradient from three of the SCARNG ranges, as well as Fort Jackson's most heavily used impact area. None of the samples collected from any of the 12 locations contained WP above the analytical detection limit of 0.00096 milligrams per kilogram (mg/kg) (wet weight). The report concluded that the risk to waterfowl from WP storage in the Fort Jackson wetlands is negligible (USACE, 1993). Additionally, a summary report issued by USACE in 1996 stated that out of 39 samples collected at Fort Jackson, none contained WP levels over 0.00096 mg/kg. This report did not specify whether these sampling locations included samples taken from McCrady Training Center; however, Fort Jackson and McCrady Training Center have received similar historical use.

Small Arms Ranges Study (Bricka, 2002)

Mississippi State University staff, headed by Dr. R. Mark Bricka, performed a study from 2001 to 2002 to evaluate the potential of off-installation migration of MCOC, particularly metals, from 14 of the small arms ranges located in the western portion of Fort Jackson's operational range area, within the Gills Creek watershed. This study involved the collection of surface and subsurface soil samples from several ranges, as well as surface water and sediment samples from the creeks that drain the small arms ranges (i.e., Bynum, Rowell, and Mack creeks, which drain into Gills Creek). The data showed that soil containing elevated concentrations of lead is present on the small arms ranges. Also, because the small arms ranges contain sandy soils and are intersected by a network of creeks, the potential for erosive conditions is high, so that lead-contaminated soil was shown to be entering several of the smaller creeks that drain into Gills Creek. The results of the sediment sampling indicated that from Gills Creek sediment travels into Boyden Arbor Pond, primarily during larger rain events. However, the authors of the study stated that "it is also suspected that little lead is moving off post because of the size of Boyden Arbor Pond and that the sediment lead levels at the discharge end of the pond are quite low." The lead concentration in a sediment sample collected at the discharge

end of Boyden Pond was 6.4 mg/kg. Surface water sampling results showed that lead concentrations in all of the filtered water samples (total of 57 samples at 17 stream transect locations) and all but 10 of the unfiltered samples (total of 56 samples at 17 stream transect locations) were below 0.065 milligrams per liter (mg/L), the federal water quality Criterion Maximum Concentration (CMC). The CMC is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect.

To determine whether MCOC are migrating off-range, data must be compared to the Criterion Continuous Concentration (CCC), which is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. The USEPA mandates that the CCC for lead is 0.0025 mg/L using a hardness of 100 mg/L. The appropriate CCC at McCrady Training Center would vary by range, based on hardness values ranging from 10 mg/L to over 100 mg/L (USATC, 2005). According to Dr. Bricka (2002), the detection limit used for lead in this study was approximately 0.010 mg/L, which is above the CCC for lead. Because detection limits do not allow for a comparison to chronic criteria, this study does not rule out off-range migration of metals MCOC from the small arms ranges in the Gills Creek watershed. However, it does show that lead levels downstream from these ranges are substantially lower than in adjacent water bodies.

Small Arms Ranges Study (USATC, 2005)

The U.S. Army Aberdeen Test Center also performed a study to evaluate the potential of off-installation migration of MCOC, particularly metals, from 14 of the small arms ranges located in the western portion of Fort Jackson's operational range area, within the Gills Creek watershed. This study included the westernmost of the two small arms ranges licensed to the SCARNG. The study showed that there was very heavy erosion on the hillside, or natural berm, bordering most of the southern range boundary. This erosion washes into a swale that drains to the west and transports sediment out through the southwest corner of the range where there is an opening in the berm. According to the study authors, a storm water control structure is not in place at this range. Additional runoff from the firing points leaves the range at its northwest corner and drains directly to Bynum Creek, a tributary of Gills Creek. Analytical results from three rounds of ambient surface water sampling suggest that the small arms ranges were contributing to low-level lead concentrations in ambient surface waters adjacent to the range areas. An ambient surface water sample was collected at the point where overland flow from four small arms ranges in the Bynum Creek subwatershed, including the westernmost SCARNG range, discharge into Bynum Creek. This sample contained a total of 8.0 ppb of dissolved lead and 23 ppb of total lead. This location was cited in the report as a potential storm water monitoring location.

Bynum Creek flows through marshy areas before discharging into Gills Creek, which is characterized as a heavily vegetated, marshy area. Gills Creek then flows through Boyden Arbor Pond prior to flowing off the installation. These two environments (marsh and pond) act as natural filters to slow down and trap sediments by a decrease in water velocity and a subsequent decrease in the water's ability to carry sediment loads, as well as by the large amount of organic matter in the marshes that may bind or adsorb metals in runoff waters. According to the study authors, "…there are filtering mechanisms in place at Fort Jackson that are mitigating lead and total suspended solids concentrations in storm water runoff flowing from the small arms range area in the Gills Creek watershed."

The study also included the installation of three shallow groundwater monitoring wells (MW-1, MW-2, and MW-3) at a small arms range approximately two miles southwest of the SCARNG small arms

ranges to depths of approximately 13.5 to 14.5 feet below ground surface (bgs). Dissolved lead concentrations at MW-1 were as high as 2,900 ppb, while maximum dissolved lead results from MW-2 and MW-3 were 6 and 30 ppb, respectively. The core section for MW-1 showed a sandy profile, while cores for MW-2 and MW-3 indicated that there is a localized confining condition (i.e., clay lens) that prevents direct communication between the ground surface and groundwater. Groundwater samples were also collected from two potable water supply wells located near the small arms ranges. These wells are screened in the Middendorf Formation at depths of 174 and 105 feet bgs. Lead concentrations for groundwater samples from both of the wells were lower than the 15 ppb lead National Drinking Water Action Level. The study concluded that groundwater impacts are limited to the shallow base flow discharging to the creeks.

Fort Jackson Site Inspection Report (Malcolm Pirnie, 2006)

Surface soil MCOC sampling was conducted at several closed small arms ranges within the Fort Jackson cantonment area under the Military Munitions Response Program (MMRP), as part of a Site Inspection in April/May 2005. The closed small arms ranges included a transition range, a pistol range, and overlapping range fans from 1000-inch and landscape target ranges. These ranges, which encompass approximately 475 acres, were used from the 1940s through the 1970s for small arms training. The firing lines and target areas for the ranges account for a much smaller area (approximately 80 acres). Historical information provided general locations of former range features (e.g., firing lines/lanes, target areas); however, these features are no longer discernable at the sites. A combination of technologies was used to field determine biased sampling locations, including visually confirming historical range feature locations (e.g., firing lines, target areas, backstop berms), locating concentrations of bullet fragments/casings using an all-metals detector, and X-ray Fluorescence screening at potential sampling locations to determine areas of higher lead concentrations. Analytical data indicated that total lead concentrations were detected below the USEPA Region 9 Residential Preliminary Remediation Goal of 400 mg/kg for all 51 surface soil samples collected.

Table 3-3 summarizes the potential MCOC (if identified) associated with each of the range types described in Section 3.1.1 and whether or not applicable sampling data, discussed earlier in this section, are available for that MCOC. **Table 3-3** also lists potential MCOC from historical munitions usage at McCrady Training Center. Small, medium, and large caliber ordnance, along with pyrotechnics, obscurants, and other types of munitions, have been used at McCrady Training Center. MCOC associated with each munitions class are discussed below.

- **Small caliber munitions**: Lead is the primary potential MCOC. Other metals, including antimony, copper, zinc, and tungsten, can also contribute to impacts to environmental media (soil, surface water, and groundwater) at small arms ranges. Nitroglycerin (NG) is a component of solid propellant for small caliber munitions; therefore, NG is considered a potential MCOC at small arms ranges firing lines with heavy firing, with very well defined pathways to off-range receptors, and for which a source of metals MCOC has also been identified. Small caliber blanks are not considered to be a source of MCOC.
- **Medium and large caliber munitions**: High explosives used in these munitions may result in the release of trinitrotoluene (TNT), cyclotrimethylenetrinitramine (RDX), and cyclotetramethylenetetranitramine (HMX). The propellants for these munitions may contain 2,4-dinitrotolulene (DNT), 2,6-DNT, and NG. NG is a component of solid propellant for medium and large caliber munitions, including shoulder fired anti-armor weapons. Therefore, NG is considered a potential MCOC at anti-armor ranges and artillery firing points.

- **Pyrotechnics and obscurants**: Perchlorate compounds are the primary MCOC associated with pyrotechnics. WP is frequently used as an incendiary and smoke-screening agent in training areas.
- **Other munitions**: Pentaerythritoltetranitrate (PETN) is a component of detonation cord and could be a potential MCOC at ranges where demolition training is performed. Additionally, the explosive components used in some of these munitions may result in the release of TNT, RDX, and HMX.

Table 3-3: Potential MCOC (Current and Historical) at McCrady Training Center

Range Type	Source Area / Munitions Types	Potential MCOC	Detected MCOC
Firing Ranges	Tank scaled range, anti-air weapon range	TNT, HMX, RDX, 2,4-DNT, 2,6-DNT, PETN, perchlorate, NG, lead, antimony, copper, zinc, and tungsten	No sample results available
Small Arms Ranges	Two small arms ranges in Fort Jackson's western operational area	TNT, lead, antimony, copper, zinc, and tungsten	Lead detected in nearby ambient surface water, surficial groundwater, sediments, and surface water downstream in the Gills Creek watershed (Bricka, 2002; ATC, 2005)
	Pistol qualification course	Lead, antimony, copper, and zinc	No sample results available
Training Areas	Artillery/mortar firing points; demolition areas; areas that contain historical artillery impact areas or firing points, including suspected dudded areas resulting from historical use	TNT, HMX, RDX, 2,4-DNT, 2,6-DNT, PETN, perchlorate, and NG	No sample results available
	Areas with no current source and with limited historical munitions usage (i.e., overlapping surface danger zones for small arms ranges)	None	

A prioritized list of munitions containing perchlorate has been developed by USAEC and USACHPPM (2005). These munitions account for 96 percent of the U.S. Army's annual perchlorate expenditures. A review of McCrady Training Center RFMSS data indicates that these munitions have been used in significant quantities during training activities; therefore, perchlorate has been included in the list of potential MCOC evaluated for McCrady Training Center.

3.2 Physical Profile

3.2.1 Meteorology

McCrady Training Center has a temperate continental climate with hot, humid summers and mild winters. This southern temperate region can experience temperatures ranging from below freezing to greater than 100 degrees Fahrenheit (ºF); however, there is a relatively narrow annual temperature range, from a mean daily temperature of 81ºF in July to 44ºF in January (Gene Stout & Associates, 2004). Annual precipitation is approximately 46 inches. July and August are the wettest months, with approximately 5.5 inches of precipitation each month. Tropical storms producing heavy rainfall occasionally occur during late summer and early autumn. Wind speeds peak at approximately nine miles per hour in spring, and the general wind direction is from the southwest. Snowfall is rare and generally results in little, if any, accumulation (USATHAMA, 1980).

3.2.2 Topography

Gently to moderately rolling, moderately dissected high plains occupy most of McCrady Training Center. These high plains are interrupted by the nearly flat alluvial plains of Colonels Creeks and its tributaries. Elevations in the main portion of McCrady Training Center range from 160 feet above mean sea level (msl) at the outlet point of Colonels Creek to 440 feet above msl in the high plains. Elevations at the small arms ranges located in the western portion of Fort Jackson's operational range area are around 300 to 375 feet above msl. The highest point at McCrady Training Center is located at the ranges northwest of Weston Lake, where elevations reach up to 540 feet above msl (Fort Jackson ITAM, 2006). Slopes are predominately three to eight percent; however, along narrow stream valleys, slopes may exceed 15 percent (Gene Stout & Associates, 2004).

3.2.3 Geology

The geology of South Carolina is characterized by two principal physiographic and geologic provinces, the crystalline rocks of the Piedmont physiographic province and the unconsolidated sediments of the Coastal Plain. The boundary between the Piedmont and the Coastal Plain is marked by the fall line, which represents a geologic unconformity and occurs approximately four miles west of the Fort Jackson cantonment area (USATHAMA, 1980; Newcome, 2003; Wikipedia, 2007). Along the fall line, rapids occur on all of the major rivers as they pass from the harder metamorphic rock of the Piedmont (upland region) to the more easily eroded clays and shales of the Coastal Plain (Microsoft, 2007).

McCrady Training Center lies on the northwestern edge of the Coastal Plain province, a region of low to moderate relief and gently rolling plains, known as the Sand Hills. The principle geologic unit in the Sand Hills is the Upper Cretaceous-age Tuscaloosa Formation (also referred to as the Middendorf Formation), which outcrops over most of McCrady Training Center and consists of marine deposits of light-colored sands and kaolin clays. Most soils at McCrady Training Center are formed from sediment of the Tuscaloosa. A layer of Quaternary sand terrace overlies the Tuscaloosa Formation, which lies unconformably on the peneplained surface of crystalline rocks (Gene Stout & Associates, 2004). The Tuscaloosa complex generally consists of clay strata overlying unconsolidated sands and extends to depths of 90 to 300 feet bgs (USATHAMA, 1980).

3.2.4 Hydrogeology

The Tuscaloosa Formation consists of interbedded, generally unconsolidated, fine to coarse sand and clay, causing groundwater to occur under both unconfined and confined (i.e., artesian) conditions. Groundwater occurs under water table conditions in the upper part of the zone of saturation. At a

depth of about 99 to 251 feet, permeable sand zones frequently are overlain by less permeable clay zones, and the groundwater exists under artesian conditions (Gene Stout & Associates, 2004). At some places, a perched water table condition exists due to clay and sandy clay layers, which underlie the sands at many places (USATHAMA, 1980). The vertical migration of groundwater may be limited in some areas by the presence of a perched water table, as is evidenced by sampling results from shallow monitoring wells, discussed in Section 3.1.3. There is extensive communication between surficial groundwater and surface water, as the shallow, perched aquifer discharges as base flow into the network of small creeks that runs through much of McCrady Training Center's operational range area. Groundwater within the surficial aquifer generally flows in similar pathways as surface water, as shown in **Figure 3-6**.

Aquifers southeast of the fall line discussed in Section 3.2.3 include Upper Cretaceous and Tertiary formations (SCDNR, 2003). The primary groundwater resources for water supply wells in Richland County, SC, are the Cretaceous Middendorf and Black Creek formations (SCDNR, 2003). The deep regional aquifer at McCrady Training Center occurs in the basal Middendorf sand formation. Well log data from the state of South Carolina indicate that a confining unit approximately 50 feet thick occurs at a depth of approximately 175 feet over parts of McCrady Training Center (LAW, 2003). Regional groundwater movement arcs in a south to southeasterly direction across the main portion of McCrady Training Center toward the Wateree River to the east (Newcome, 2003). Regional groundwater flow is shown in **Figure 3-7**. Although McCrady Training Center is not located within a recharge area for a sole-source aquifer, it is within the recharge area for the Middendorf aquifer, which is widely used for drinking water (SCDNR, 2003; Gene Stout & Associates, 2004). According to the SCDNR (2003), approximately 600 groundwater wells were completed in sand beds of the Cretaceous and overlying formations from 2001 to 2002. SCDHEC references (2006) confirm that the major drinking water aquifers in South Carolina are in the subsurface of the Coastal Plain.

There are three drinking water wells located at McCrady Training Center, two of which are located in the nonoperational cantonment area. These wells have depths of 324 and 330 feet, with static water levels of 78.5 and 80.3 feet, respectively. A 144-foot-deep drinking water well is also located at the larger of the two firing ranges just east of Weston Lake (Fort Jackson ENRD, 2007). **Figure 3-6** depicts wells located at and down gradient from McCrady Training Center.

3.2.5 Soils

The major soil association at McCrady Training Center is the Vaucluse-Ailey-Pelion association, which is found along most of Colonels Creek. This association consists of well-drained to moderately well-drained soils that have a sandy surface layer and a loamy subsoil. These soils have a low potential for erosion unless disturbed or located on a steep grade subject to plentiful rainfall (USAEC and USDA, 2001). Five other soil series are present to a lesser extent at McCrady Training Center, the majority of which are sand or sand/loam combinations (USAEC and USDA, 2001). The high sand content of soils at McCrady Training Center promotes leaching of minerals, reduces water retention, and increases susceptibility to soil erosion (ATC, 2005). Strong slopes and an abundance of rainfall add to the potential for erosion. The SCARNG is working with the South Carolina Natural Resources Conservation Service to implement erosion control measures at identified erosion sites, which are shown in **Figure 3-8**. Planned erosion control measures include seeding, rock barriers, and construction and installation of drainage waterways, water bars, and sediment basins (SCARNG, 2005).

3.2.6 Surface Water

McCrady Training Center is located within the Santee River Basin and the Congaree River subbasin. The majority of McCrady Training Center is located within the Colonels Creek watershed. The training center's outlying ranges also lie within two additional watersheds, as shown in **Figure 3-9**. These watersheds are drained by Gills and Cedar creeks. Each watershed is described below.

Colonels Creek Watershed
The headwaters of Colonels Creek originate in the northwestern portion of McCrady Training Center. This is a predominately wooded watershed. Colonels Creek drains the majority of the training center, including the cantonment area. Colonels Creek exits McCrady Training Center at the southwestern boundary of the cantonment area and flows southeast to the Wateree River, a tributary of the Congaree River.

Gills Creek Watershed
Gills Creek flows through the northwest portion of Fort Jackson and drains the two SCARNG small arms ranges that are located in this area. Gills Creek flows southwest to Forest Lake and Lake Katherine, eventually draining into the Congaree River. Gills Creek is primarily an urban watershed and has been identified as very polluted. Pollution in this watershed stems from typical pollutants found in urban settings: petroleum products, oil and grease, sediments, trash, and sewage. The portion of the Gills Creek watershed situated on Fort Jackson is relatively pristine when compared to the area located in the more urbanized portion of Columbia (Gene Stout & Associates, 2004; SCDHEC, 1997).

Cedar Creek Watershed
Cedar Creek drains the SCARNG firing ranges and training areas located immediately northwest and east of Weston Lake. Cedar Creek flows southward through the Weston Lake recreation area, which is located on Fort Jackson's nonoperational area, and eventually enters the Congaree River.

There are 26 lakes, ponds, and impoundments on Fort Jackson. These water bodies range in size from 0.5 to 173 acres; however, most are smaller than 35 acres (Gene Stout & Associates, 2004). Five ponds and two lakes are adequate for intensive fisheries management, including Odom Pond, which covers 4.6 acres in the west-central portion of McCrady Training Center and drains to Colonels Creek (Gene Stout & Associates, 2004; USAEC and USDA, 2001). In addition to Odom Pond, other large ponds at McCrady Training Center include Davis Pond (20.4 acres), Varn Lake (6.0 acres), and Chavers Pond (2.2 acres), all of which are located on or in proximity to tributaries of Colonels Creek (USAEC and USDA, 2001). These water bodies and the other remaining lakes and ponds at McCrady Training Center are maintained for waterfowl habitat, recreation, and aesthetics.

All creeks and streams leaving McCrady Training Center eventually flow into either the Wateree River or the Congaree River (**Figure 3-10**). These rivers meet about 16 miles southeast of the installation, where they form the Santee River, the principal regional waterway. The Santee River continues in a southeasterly direction, eventually emptying into the Atlantic Ocean south of Georgetown, SC (Gene Stout & Associates, 2004).

3.2.7 Vegetation

Vegetation at McCrady Training Center consists of mainly longleaf pine (*Pinus palustrus*) and scrub oak (*Quercus laevis*) with other mixed hardwoods and pines. The vegetation at McCrady Training Center is abundant and diverse, due largely to its relative isolation from urban development. As

observed during the site visit, forested areas occupy the majority of the installation, with the exception of the firing ranges and the cantonment area. Other types of cover include permanent streams, saturated wetlands, and urban or barren lands (USAEC and USDA, 2001). Barren sandy areas have been identified as erosional areas and are shown in **Figure 3-8**.

3.3 Munitions Release / Migration Profile

MCOC from source areas, as described in **Table 3-3,** potentially impact source media, including soil (e.g., found in impact berms, firing points, localized impact areas surrounding targets, and suspected dudded areas) and surface water / sediment (e.g., via direct or erosional deposition into streams and/or wetlands).

MCOC can be released to groundwater (down gradient), surface water / sediment (downstream), off-range soil, or the food chain via a variety of release mechanisms. Release mechanisms for soil may include leaching from soil to groundwater or erosion and runoff to off-range surface soil or to nearby streams. Once potential MCOC are deposited in surface water / sediment, they have the potential to migrate downstream, recharge the shallow groundwater, or be taken up by aquatic plants or animals.

Release mechanisms that enable transport of potential MCOC from soil or surface water / sediment source areas toward off-range receptors are present in the operational range areas at McCrady Training Center. Both surface water and surficial groundwater pathways were identified for soil sources at all of the firing ranges and small arms ranges and within some of the training areas at McCrady Training Center.

Potential MCOC may be directly or indirectly deposited into the many wetlands and streams that drain the operational ranges, recharge the surficial and bedrock groundwater aquifers, and serve as plant and animal habitat. As described in Section 3.2.6, McCrady Training Center ranges lie within three watershed drainage areas that provide potential avenues for MCOC to migrate off-range via surface water and sediment, as shown in **Figure 3-9**. Receptor interactions are considered up to 15 miles from where these surface watercourses exit operational range area, based on guidance developed by the USEPA for CERCLA Preliminary Assessments (1991) (**Figure 3-10**).

Potential MCOC that leach from soil may impact surficial groundwater. Surficial groundwater provides recharge for the extensive network of creeks and ditches throughout the operational area. Sampling data suggest that the deep, regional aquifer has not been impacted by MCOC (ATC, 2005). Localized confining conditions (i.e., clay lenses) may retard communication between the ground surface and groundwater in some areas, limiting the off-range migration of MCOC. Receptor interactions are considered up to four miles from where groundwater leaves operational range area, based on USEPA requirements (1991).

3.4 Land Use and Human Receptor Profile

3.4.1 Current Land Use

Land uses on McCrady Training Center include vehicle maneuvers, bivouac areas, landing zones, firing points, buffers, impact areas, timber production, fishing, and cantonment area (USAEC and USDA, 2001). The majority of land at McCrady Training Center is used for light or heavy maneuver training activities. Small, medium, and large caliber munitions firing and demolition operations are limited to a relatively small percent of the McCrady Training Center area. Approximately three percent of the installation acreage comprises the cantonment area, located in the southeastern corner

(USAEC and USDA, 2001). The cantonment area contains two drill pad areas, the 218th Regiment (Leadership) facilities, administrative facilities, the Unit Training and Equipment Site, U.S. Marine Corps Reserve facilities, and a Battle Simulation Center (USAEC and USDA, 2001).

Columbia is the capital of South Carolina and its largest city, making up over one-third of Richland County's population. The U.S. Census Bureau (2007) reported a 2000 population of 116,278 in Columbia, compared to 320,677 for Richland County. Columbia is comprised of highly urbanized developed land with the exception of Fort Jackson (including McCrady Training Center), which has been incorporated into the eastern city limits. The majority of McCrady Training Center is located approximately 15 miles east of Columbia's business district. Most of the area immediately surrounding McCrady Training Center is rural or undeveloped with natural woodlands.

3.4.2 Adjoining Areas of Concern

McCrady Training Center is comprised of approximately 15,267 acres within the eastern portion of Fort Jackson that are licensed to the SCARNG for training. Ranges in the remaining portion of Fort Jackson are operated by the U.S. Army Training Center. Fort Jackson's operational areas support a variety of activities, including live-fire weapons training, heavy and light maneuver exercises, dudded and non-dudded impact areas, and various specialty training courses, such as night infiltration and MOUT. Many of the operational ranges currently receive heavy usage by soldiers undergoing basic training, as Fort Jackson is the largest and most active initial entry center in the U.S. Army (GlobalSecurity.org, 2006). Fort Jackson's northeastern ranges contain the headwaters of Colonels Creek, which flows through the main portion of McCrady Training Center, as shown in **Figure 3-9**. These ranges constitute a potential source of MCOC that may be carried into McCrady Training Center and subsequently off-range. Potential MCOC source areas at both McCrady Training Center and Fort Jackson also drain to Cedar and Gills creeks, making it difficult to distinguish the original source of potential MCOC downstream. The Fort Jackson ranges have been evaluated in a separate ORAP Phase I Assessment (Malcolm Pirnie, year).

3.4.3 Current Human Receptors

Potential human receptors include residents (in nearby off-installation residential areas); workers (on-installation and in off-installation areas surrounding the installation); and fishermen and swimmers utilizing on-installation or nearby off-installation areas for recreational purposes. Potential human receptors include the following:

- Residential and commercial/industrial communities within four miles down gradient of current or historical source areas who utilize groundwater from the surficial aquifer, as shown in **Figure 3-6**, are receptors. These receptors are located primarily in rural communities south of McCrady Training Center.
- Recreational users of Varn Lake, Weston Lake, and other recreational ponds and lakes (that are downstream of potential MCOC source areas) in nonoperational areas of McCrady Training Center or Fort Jackson.
- Recreational users of off-installation designated recreational areas such as Murray Pond and Forest Lake, within 15 miles downstream of potential MCOC source areas, as shown in **Figure 3-10**.

3.4.4 Resource Use Location

Three drinking water supply wells are located at McCrady Training Center, as shown in **Figure 3-6**. Two of these wells comprise System 4070911, which provides the cantonment area with drinking water. These source wells are 330 and 324 feet deep, indicating that they are screened in the Middendorf Formation. Their static water levels measure 80.3 and 78.5 feet bgs. The third water supply well is 144 deep and is located at the larger of the two firing ranges just east of Weston Lake (Fort Jackson ENRD, 2007). This well supplies potable water to soldiers on-range during training activities.

Figure 3-6 depicts groundwater wells in the vicinity of McCrady Training Center. According to the McCrady Training Center Facilities Engineer, a public water system is not available in the area south of the cantonment area for approximately eight miles. Residents located along Leesburg Road, which forms the southern installation boundary, utilize groundwater as their source of potable water (LAW, 2003). The SCDNR database identifies groundwater wells in these areas, as well as in areas less than four miles down gradient from the firing ranges near Weston Lake. According to the SCDNR database (2003), domestic wells in the vicinity of McCrady Training Center draw from both the surficial aquifer and the deep regional aquifer.

Recreational areas at McCrady Training Center include swimming areas and fishing areas. Odom Pond is one of the main fishing areas and is large enough for fisheries management. The primary recreational area is Varn Lake, which is located in the cantonment area and supports 11 cabins and conference facilities (AKO, 2002). Additional recreational areas in the vicinity of McCrady Training Center include Weston Lake, located in Fort Jackson's nonoperational range area, which is a waterside recreation lake used by the surrounding community, with camping facilities, picnic shelters, a community house, a beach pavilion, and a swimming area (Gene Stout & Associates, 2004).

3.5 Ecological Receptor Profile

3.5.1 Sensitive Environments

McCrady Training Center contains 1,642 acres of wetlands (USAEC and USDA, 2001). Wetlands at McCrady Training Center consist primarily of bottomland hardwoods in narrow bands adjacent to streams and drainages. Vehicles and mechanized equipment must traverse wetlands on established roads and trails, and foot traffic through wetlands generally is not allowed during training activities (USAEC and USDA, 2001).

3.5.2 Habitat Type(s)

McCrady Training Center is located in the Sand Hills of the South Carolina Upper Coastal Plain physiographic province. The areas to the north, east, and south of McCrady Training Center are largely undeveloped, consisting of natural pine forest habitat, as well as creeks and wetlands areas. The remaining portion of McCrady Training Center borders Fort Jackson's operational area.

Longleaf pine forests found in the Sand Hills are home to the federally endangered red-cockaded woodpecker. Longleaf pine is prevalent at McCrady Training Center and provides what has become a scarce habitat for this species. McCrady Training Center has taken precautions to protect known locations of red-cockaded woodpecker populations by applying a 200-foot buffer zone and 0.5-mile restrictive foraging area to each cavity tree occupied or formerly occupied by a group of red-cockaded woodpeckers (USAEC and USDA, 2001). Weapons firing is prohibited in these areas, and maneuver training is limited to established roads (USAEC and USDA, 2001).

3.5.3 Ecological Receptors

Two federally listed endangered plant species, rough-leaved loosestrife (*Lysimachia asperulaefolia*) and smooth coneflower (*Echinacea laevigata*), occur at or in the vicinity of McCrady Training Center. Rough-leaved loosestrife is found just west of the installation boundary along Buffalo Creek. Smooth coneflower has been documented adjacent to Statue of Liberty Road in the northern portion of McCrady Training Center. **Figure 3-9** indicates the approximate locations of the two endangered plant species populations. Since these plants are located in narrowly defined areas within the operational training ranges, it is not expected that they would be found at off-installation locations. In addition to the smooth coneflower and the rough-leaved loosestrife, two other unlisted rare species occur at McCrady Training Center: the crested fringed orchid (*Pteroglossaspis ecristata*) and the Indian olive (*Nestronia umbellula*) (USAEC and USDA, 2001). The Nature Conservancy ranks both species as imperiled statewide (USAEC and USDA, 2001).

One federally listed endangered animal, the red-cockaded woodpecker, is a resident of McCrady Training Center. The red-cockaded woodpecker is endemic to the pine forests of the southeastern United States. It is found most commonly in longleaf pine ecosystems. Red-cockaded woodpecker distribution on McCrady Training Center is depicted in **Figure 3-9**. Due to the wide presence of the red-cockaded woodpecker on McCrady Training Center and the presence of similar habitat off-range and off-installation, it is expected that the red-cockaded woodpecker is present off-range as well. Two additional federally endangered species, the shortnose sturgeon (*Acipenser fulvescens*) and Canby's dropwort (*Oxypolis canbyi*), are found in the vicinity of McCrady Training Center but are not known to occur at the installation. The American Bald Eagle (*Haliaeetus leucocephalus*) , which is listed by the SCDNR as a state endangered species (SCDNR, 2006), is a transient visitor to the installation. No American Bald Eagle nests or permanent roost sites are known to occur on the installation.

3.6 Relationship of Potential MCOC Sources to Off-Range Human and Ecological Receptors

As summarized in **Table 3-3**, potential MCOC sources at McCrady Training Center have been identified at all of the installation's firing ranges and small arms ranges, as well as at a number of its training areas. The following discussion describes the relationship between potential MCOC sources present at a given type of range to off-range human and ecological receptors.

Firing Ranges

There are two medium and large caliber firing ranges at McCrady Training Center; both are located in the Cedar Creek watershed and fire into Fort Jackson's eastern dudded impact area. Significant UXO may exist in the dudded impact area, resulting from fired munitions items that failed to detonate. Incomplete detonation or breakup of the delivery system without detonation may also occur, leading to the survival of part or all of the explosive (USACE, 1999). Intact UXO may corrode or deteriorate over time, leading to explosive MCOC contamination in the dudded impact area. Portions of the two firing ranges lie partially within this dudded impact area and are shown as suspected dudded areas in **Figure 3-5**. Surficial groundwater or overland flow that discharges to surface water has the ability to carry potential MCOC from these firing ranges to Weston Lake. Although it is anticipated that much of the surficial groundwater flow from these firing range will discharge to Weston Lake prior to reaching off-installation area, MCOC from the firing ranges within the Cedar Creek watershed also have the potential to reach private domestic wells south of Weston Lake. **Figure 3-6** shows down gradient wells located within four miles of these ranges.

Small Arms Ranges

Three small arms ranges are located at McCrady Training Center. Two of these ranges are located in Fort Jackson's western operational range area, within the Gills Creek watershed. The other small arms range is situated east of Weston Lake in the Cedar Creek watershed.

As discussed in Section 3.1.3, two studies have been performed to evaluate the potential of off-installation migration of metals MCOC from the small arms ranges in the Gills Creek watershed. The conclusions reached in both of the studies are that surface water and surficial groundwater on the small arms ranges are impacted by lead, but that concentrations of metals are greatly reduced by the time they reach off-range areas. Surface water sampling completed for these studies utilized a 50.0 ppb maximum contaminant level, which is no longer used by SCDHEC. Therefore, the comparisons and conclusions presented by these studies cannot conclusively determine whether metals MCOC from the small arms ranges located in the Gills Creek watershed pose a risk to off-site receptors. Additionally, samples from this area have not been analyzed for explosive and perchlorate MCOC, which may be subject to different fate and transport mechanisms than metals MCOC. Therefore, a surface water pathway exists for these ranges, due to the presence of recreational areas downstream at Forest Lake, as shown in **Figure 3-9**. The majority of surficial groundwater from the SCARNG small arms ranges is expected to discharge into Gills Creek or Boyden Arbor Pond, which is located in Fort Jackson's cantonment area approximately three to four miles to the southwest. Surficial groundwater may travel as far as Forest Lake, as shown in **Figure 3-6.** Surficial groundwater is not considered to be a complete pathway for these ranges because no groundwater wells were identified within four miles down gradient.

The Cedar Creek watershed contains one small arms range. Surficial groundwater or overland flow that discharges to surface water has the ability to carry potential MCOC from this range to Weston Lake. If transported off-installation via surface water runoff or through infiltration or leaching into the groundwater, MCOC from the firing ranges within the Cedar Creek watershed have the potential to reach private domestic wells within four miles of source areas. **Figure 3-6** shows down gradient wells located south and southeast of Weston Lake.

Training Areas

Fifty-seven training areas are present at McCrady Training Center. Limited or no historical munitions usage has occurred at 14 of the 57 training areas, most of which were overlapped by safety fans for small caliber munitions ranges. Forty-one of the 57 training areas contain potential historical MCOC sources, based on the presence of historical impact areas or firing points. Eighteen training areas, including 16 of the training areas with potential historical sources, contain current potential MCOC sources consisting of artillery or mortar firing points, demolition areas, and/or suspected dudded areas.

Training Areas Containing Limited or No MCOC Sources

Limited or no historical munitions usage has occurred at 14 of the training areas present at McCrady Training Center, totaling 2,652 acres. Munitions are not used currently in these training areas. Historical munitions use consists primarily of overlapping safety fans for small arms ranges used from the 1940s to the 1970s. Given that these areas have not been used recently for munitions training and that most of the use was for small arms training, it is likely that only limited MCOC sources remain in these areas and transport of high concentrations of MCOC is unlikely.

This is supported by surface soil MCOC sampling that was conducted at several closed small arms ranges within the cantonment area at Fort Jackson under the MMRP, as part of a Site Inspection in

April/May 2005 (Malcolm Pirnie, 2006). Total lead concentrations were detected below the USEPA Region 9 Residential Preliminary Remediation Goal of 400 mg/kg for all surface soil samples collected. This sampling event is discussed in greater detail in Section 3.1.3.

Training Areas Containing Historical Potential MCOC Sources

Historical munitions use at 41 of the training areas is characterized as providing potential sources of MCOC based on the type and frequency of munitions use. Thirty-seven of these training areas are located in the Colonels Creek watershed; four are located within the Cedar Creek watershed. These training areas contain historical firing points for small, medium, and large caliber munitions or were utilized historically as artillery impact areas. This may have resulted in the presence of significant UXO. UXO may still exist in the subsurface if a fired munitions item failed to detonate. Incomplete detonation or breakup of the delivery system without detonation may also occur, leading to the survival of part or all of the explosive (USACE, 1999). Intact UXO may corrode or deteriorate over time, leading to explosive MCOC contamination in these areas. These areas are assumed to potentially contain a greater loading of MCOC than the training areas discussed in the two preceding paragraphs that were range fans for small arms ranges.

Two of the training areas with significant historical munitions use, both located in the Colonels Creek watershed, were used for live-fire training through the mid-1990s. One of these ranges, located near the south-central installation boundary, was used as a WWII machine gun range. According to Fort Jackson Range Control personnel, the dedicated impact area for this range was designated for a different function in 1987 and use of the range was terminated around 1994 or 1995 because it was not designed to current standards. The SCARNG is converting this range into a tank lane range. The other training area is adjacent to the cantonment area and was also used up until 1994, when use of live-fire was terminated because there was no dedicated impact area for the range. This range is still identified in ARID-GEO (2006) as a firing range; however, it is currently a MOUT facility where only small caliber blanks are used. The area is used frequently, although a portion is under construction by the SCARNG engineering battalion.

Surficial groundwater and/or overland surface flow or soil erosion mechanisms have the potential to transport MCOC from the ranges discussed above to a surface watercourse. Potential off-range surface water receptors have been identified in Murray Pond for ranges located in the Colonels Creek watershed and in Weston Lake for ranges within the Cedar Creek watershed. Down gradient groundwater receptors have also been identified in both watersheds, as shown in **Figure 3-6**.

Training Areas Containing Current Potential MCOC Sources

Eighteen training areas, which include 16 of the training areas with potential historical sources, contain current potential MCOC sources: artillery or mortar firing points, demolition areas, and/or suspected dudded areas.

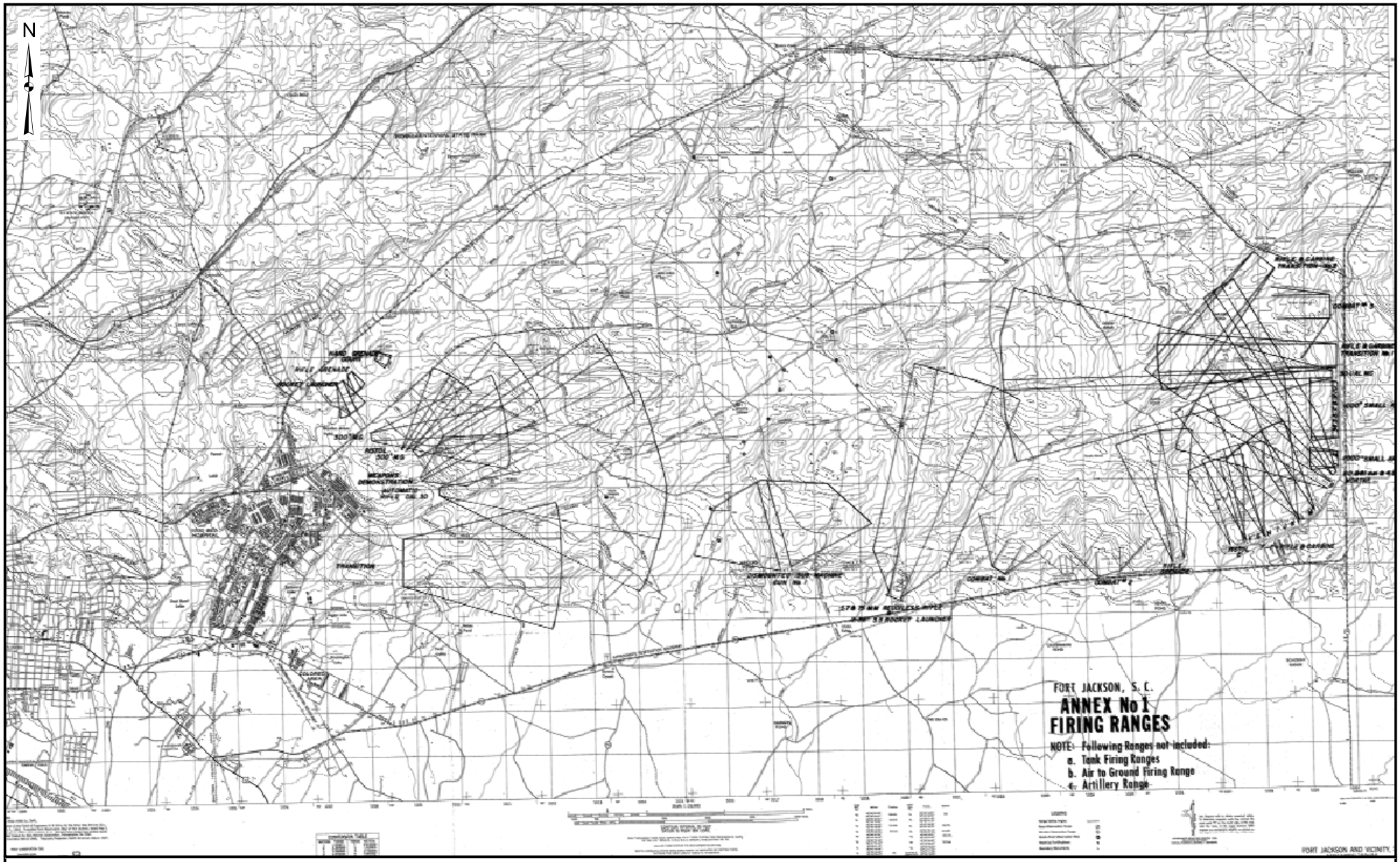
Thirteen training areas, 11 of which contain potential historical MCOC sources, currently contain one or more artillery or mortar firing points. The locations of these firing points are shown in **Figure 3-5**. Three of the training areas containing firing points are located in the Cedar Creek watershed. The remainder of these training areas is located in the Colonels Creek watershed, primarily along the northeastern and southeastern boundaries of the installation. One of these training areas also contains a demolition area, and two of these training areas also contain suspected dudded areas.

Two training areas, both located in the Colonels Creek watershed, contain demolition areas. One demolition area is located in the west-central portion of the installation. According to the McCrady

Training Center GIS RFMSS Analyst, the other demolition area is temporary. It is located in the central portion of the installation, and RFMSS data indicate that use of this temporary demolition area began in 2007.

Six training areas contain suspected dudded areas identified by Fort Jackson range control, all of which are located in the Colonels Creek watershed. Four of these areas are delineated on the Fort Jackson Installation Field Map (Fort Jackson ITAM, 2006) and are shown in **Figure 3-5**. According to Fort Jackson range control, one of the suspected dudded areas along the eastern installation boundary is from a WWII mortar range. **Figures 3-1** and **3-2** confirm the presence of a mortar range in the 1940s that was situated north of the cantonment area and fired to the north-northwest. The dudded area located along the southern boundary of the training center was the impact area for a rifle grenade range in the 1940s based on a 1946 historical map (**Figure 3-1**). Based on interviews with Fort Jackson range control, a suspected dudded area associated with a WWII anti-tank range is located in the central portion of the installation. This area is not shown on the Fort Jackson Installation Field Map.

Historical and/or current MCOC sources may be present at the training areas discussed above. Surface water and surficial groundwater may transport MCOC from these training areas to receptors downstream or down gradient. Potential human surface water receptors have been identified for the Colonels Creek and Cedar Creek watersheds due to the recreational use of Murray Pond and Weston Lake. This pathway also has the potential to affect sensitive environments, such as wetlands. Down gradient groundwater receptors have also been identified in both watersheds, as shown in **Figure 3-6**. Although the majority of surficial groundwater in the Cedar Creek watershed is expected to discharge into Weston Lake, MCOC from these training areas also have the potential to reach private domestic wells south of Weston Lake. Additionally, topographic contours shown in **Figure 3-6** show that surficial groundwater in portions of the training area east of Weston Lake are approximately one-fourth mile up gradient from a domestic well.



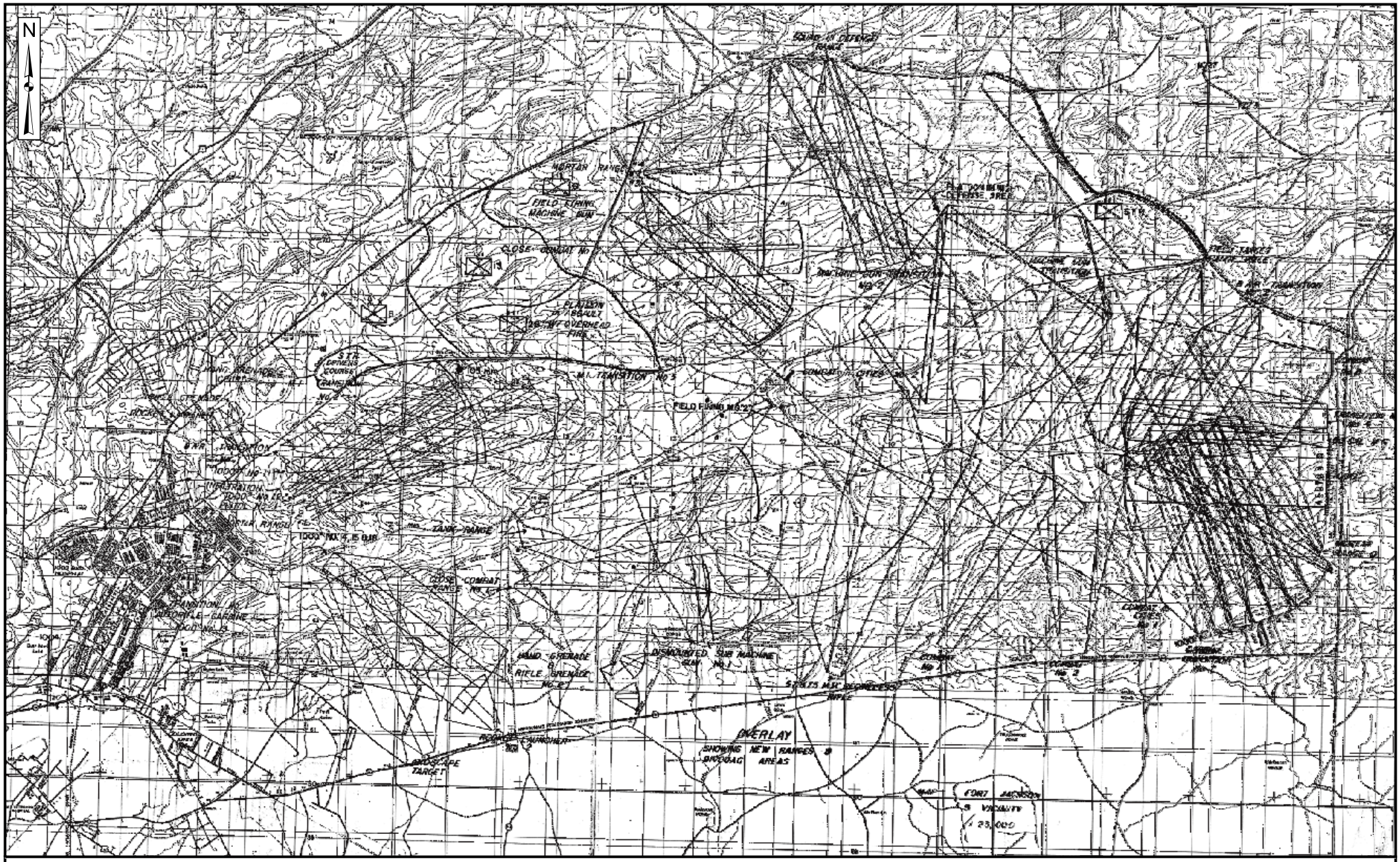
MALCOLM PIRNIE

Operational Range Assessment Program
Phase I Qualitative Assessment
McCrady Training Center, SC

Figure 3-1
1946 Annex No. 1 Firing Ranges

Data Sources:
1946 Annex No. 1 Firing Ranges

Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

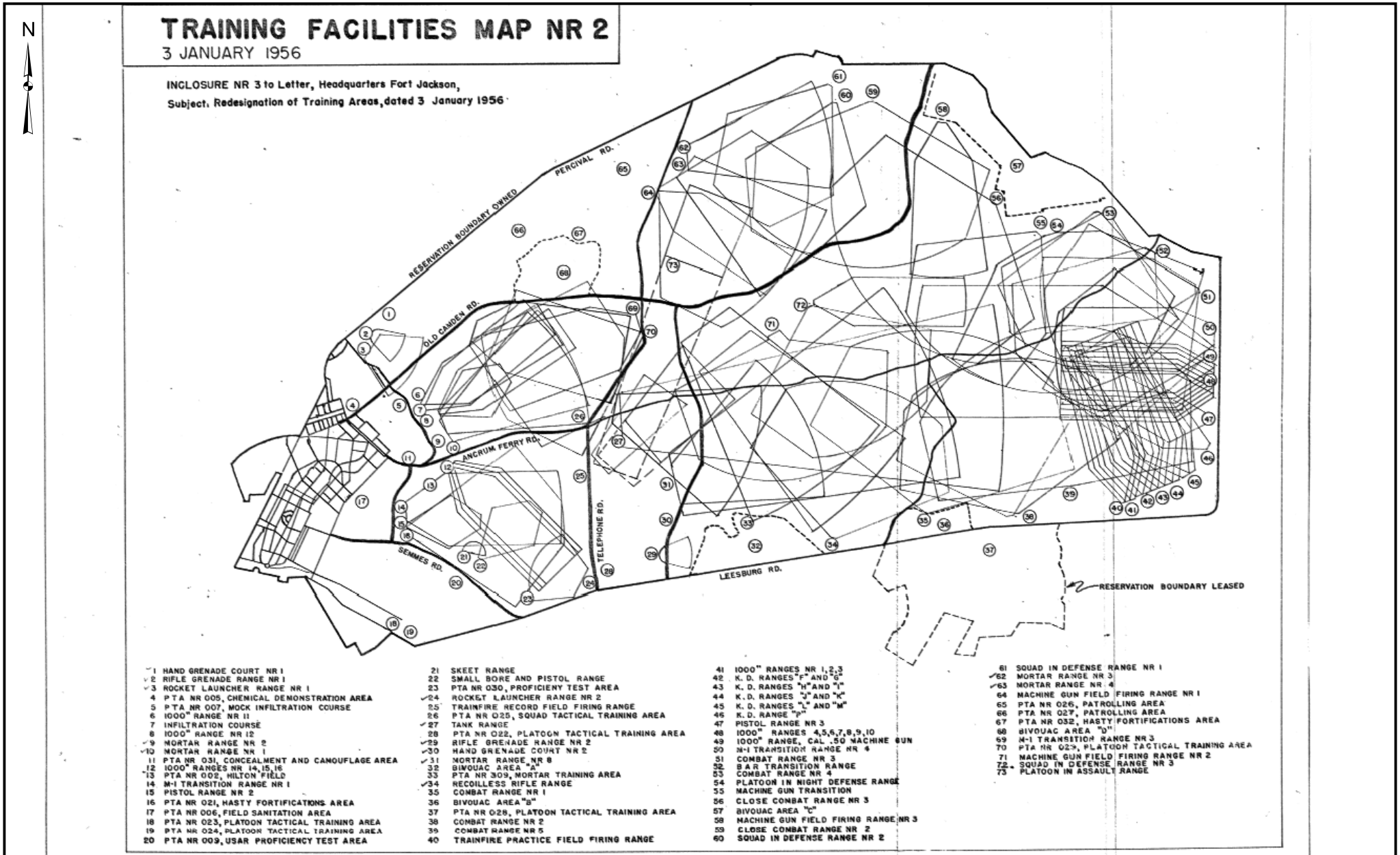


Operational Range Assessment Program
Phase I Qualitative Assessment
McCrady Training Center, SC

Figure 3-2
1949 Fort Jackson and Vicinity Map

Data Sources:
1949 Fort Jackson and Vicinity Map

Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004



Operational Range Assessment Program
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Figure 3-3
January 1956 Training Facilities Map NR2

Data Sources:
Jan 1956 Tranining Facilities Map NR2

Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

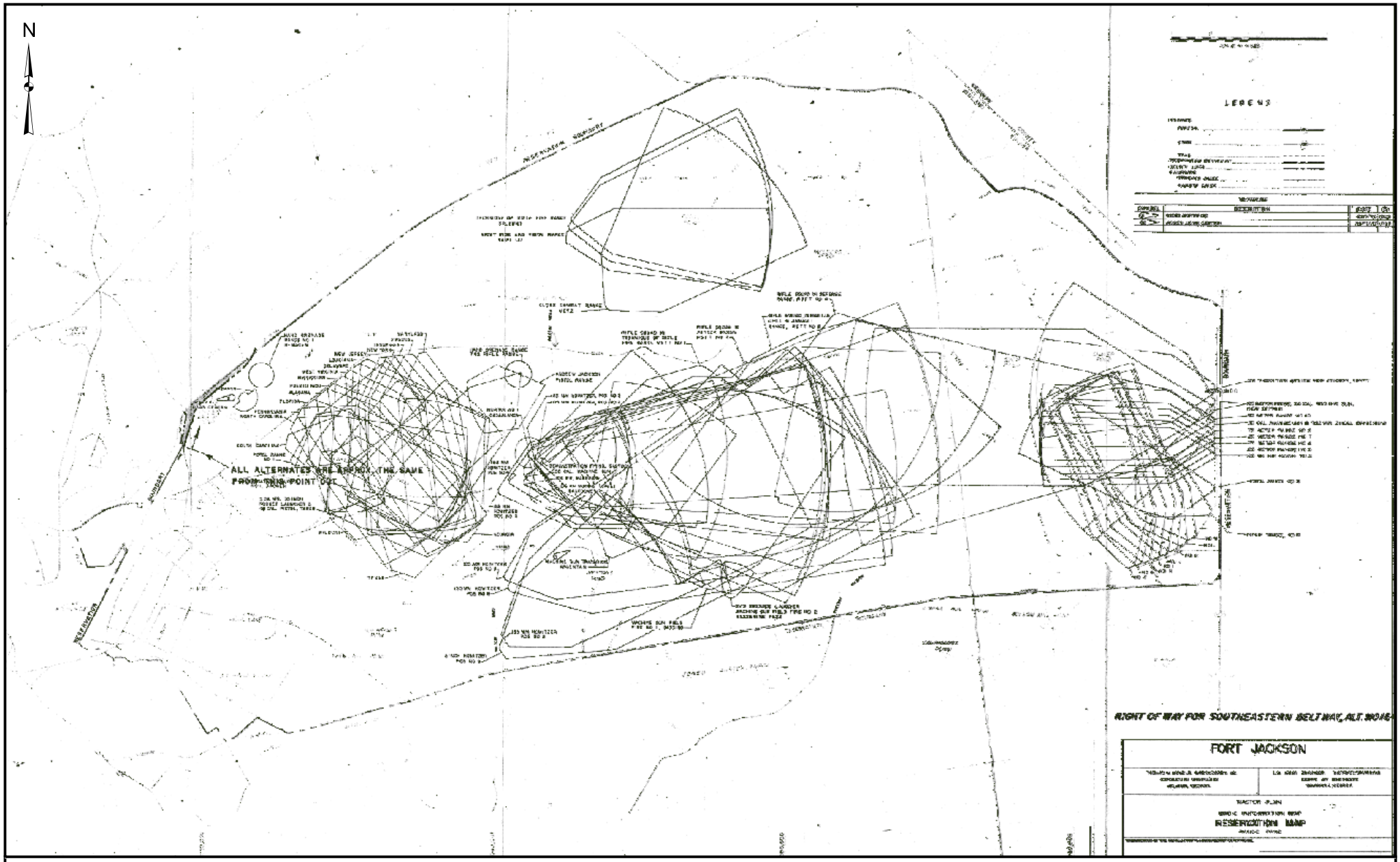

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Figure 3-4
August 1969 Master Plan Reservation Map

Data Sources:
August 1969 Master Plan
Reservation Map

Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

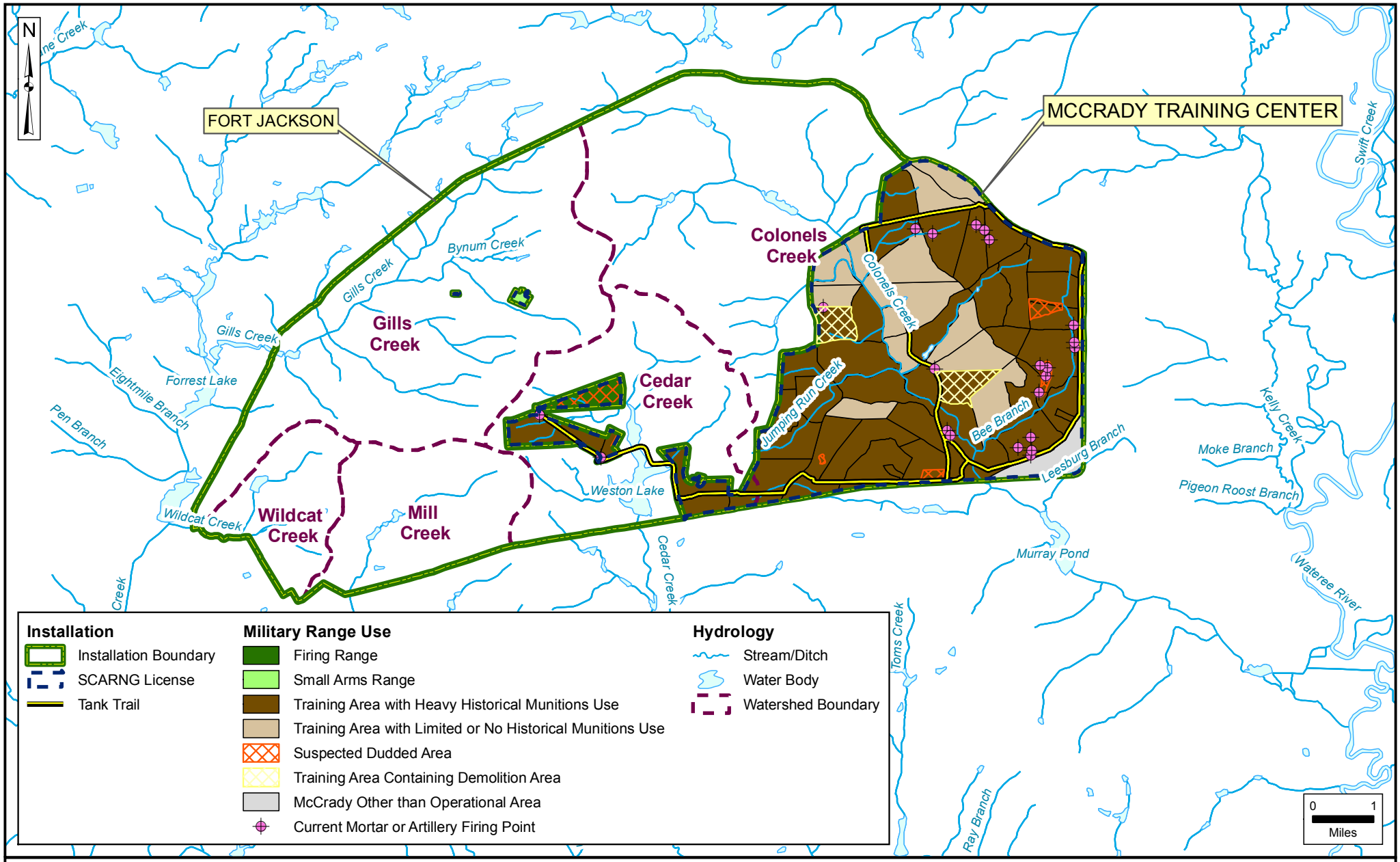

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Figure 3-5
Range Types

Data Sources:
AEC, ARID-GEO, Oct 2006
ESRI, StreetMap USA, 2005
Fort Jackson Installation GIS
Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

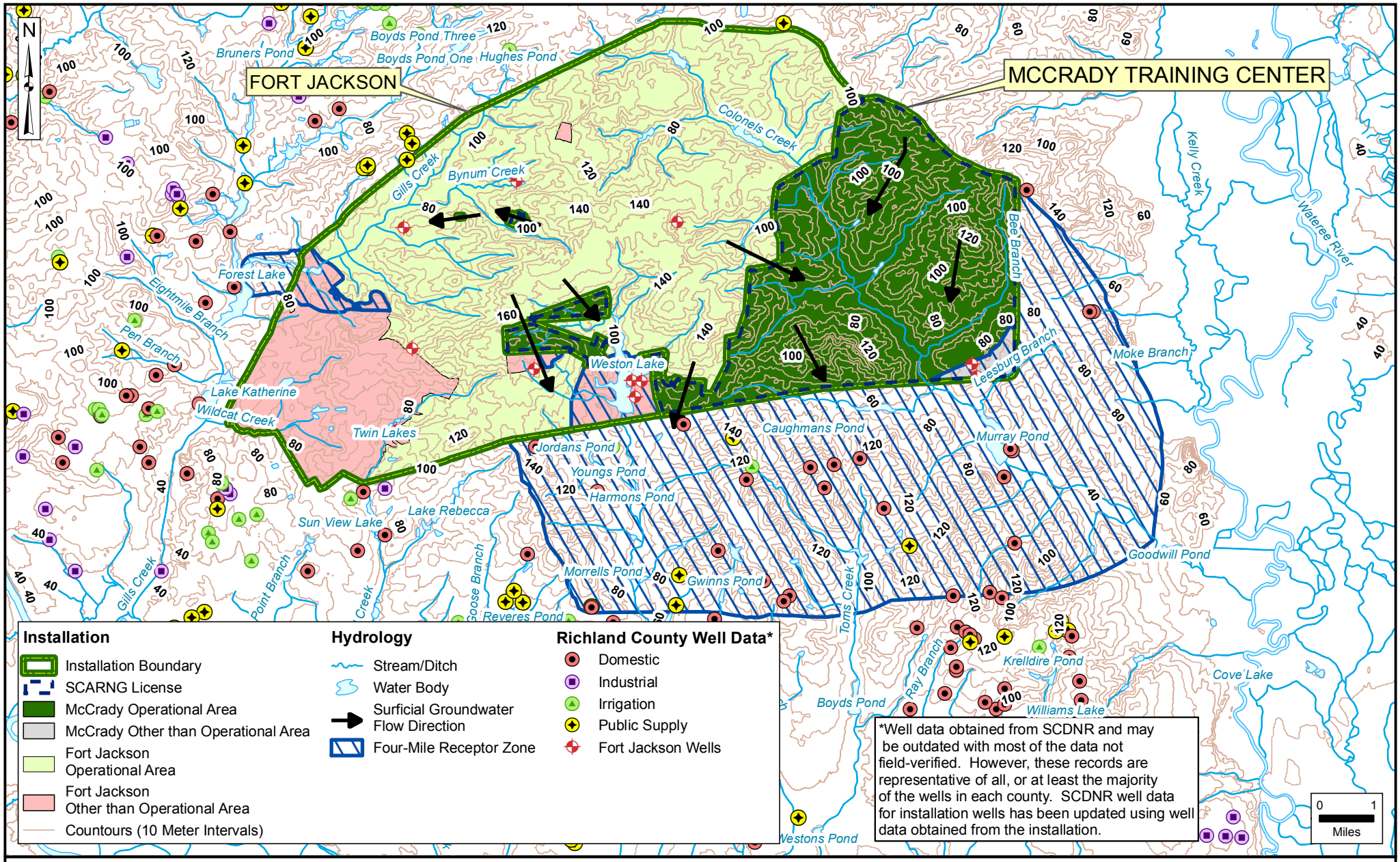

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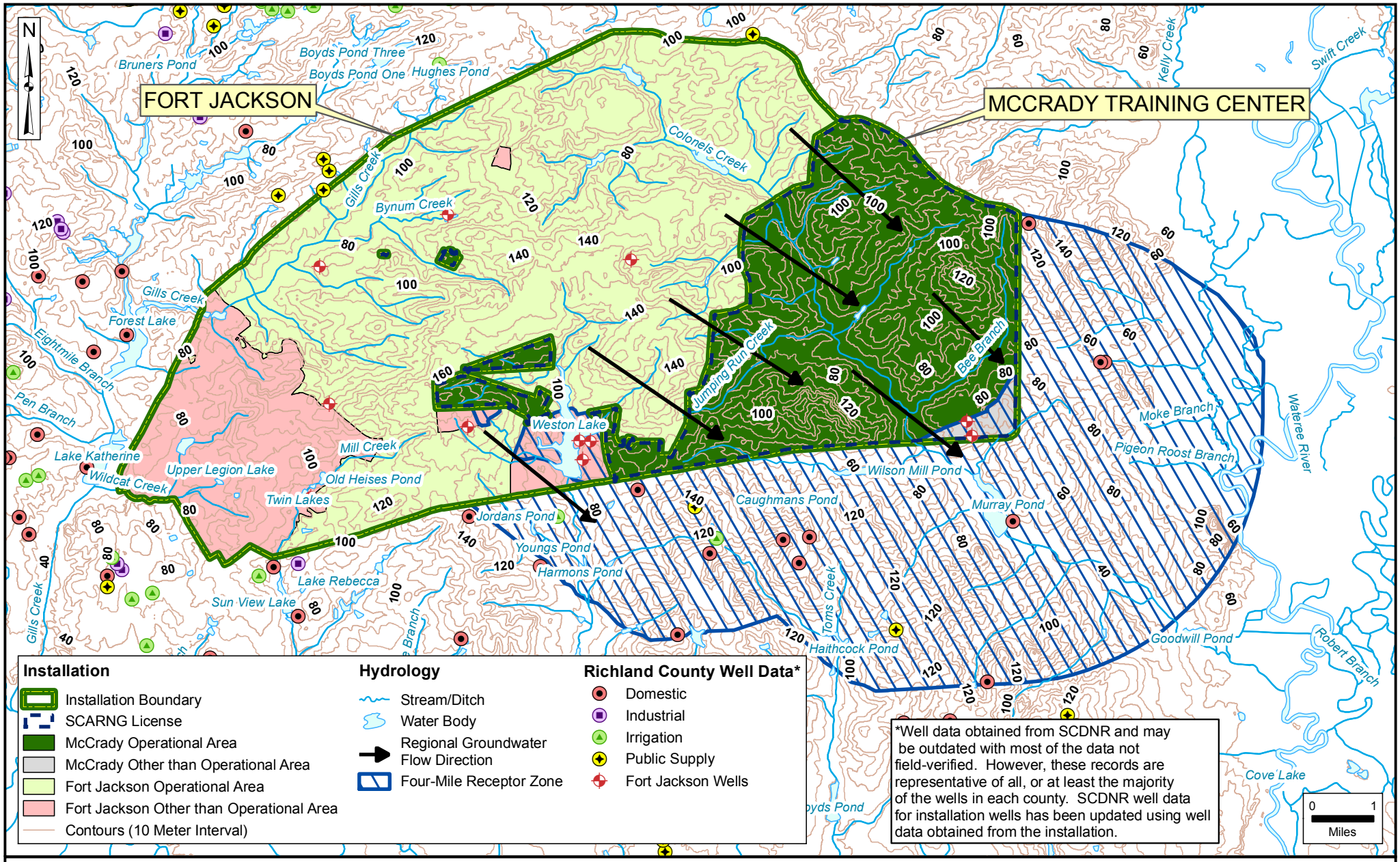
Figure 3-6
Groundwater Pathways (Surficial Aquifer)

Data Sources:
AEC, ARID-GEO, Oct 2006
ESRI, StreetMap USA, 2005
SCDNR, 2007
Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004



Operational Range Assessment Program
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Figure 3-7
Groundwater Pathways (Regional Aquifer)

Data Sources:
AEC, ARID-GEO, Oct 2006
ESRI, StreetMap USA, 2005
SCDNR, 2007
Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

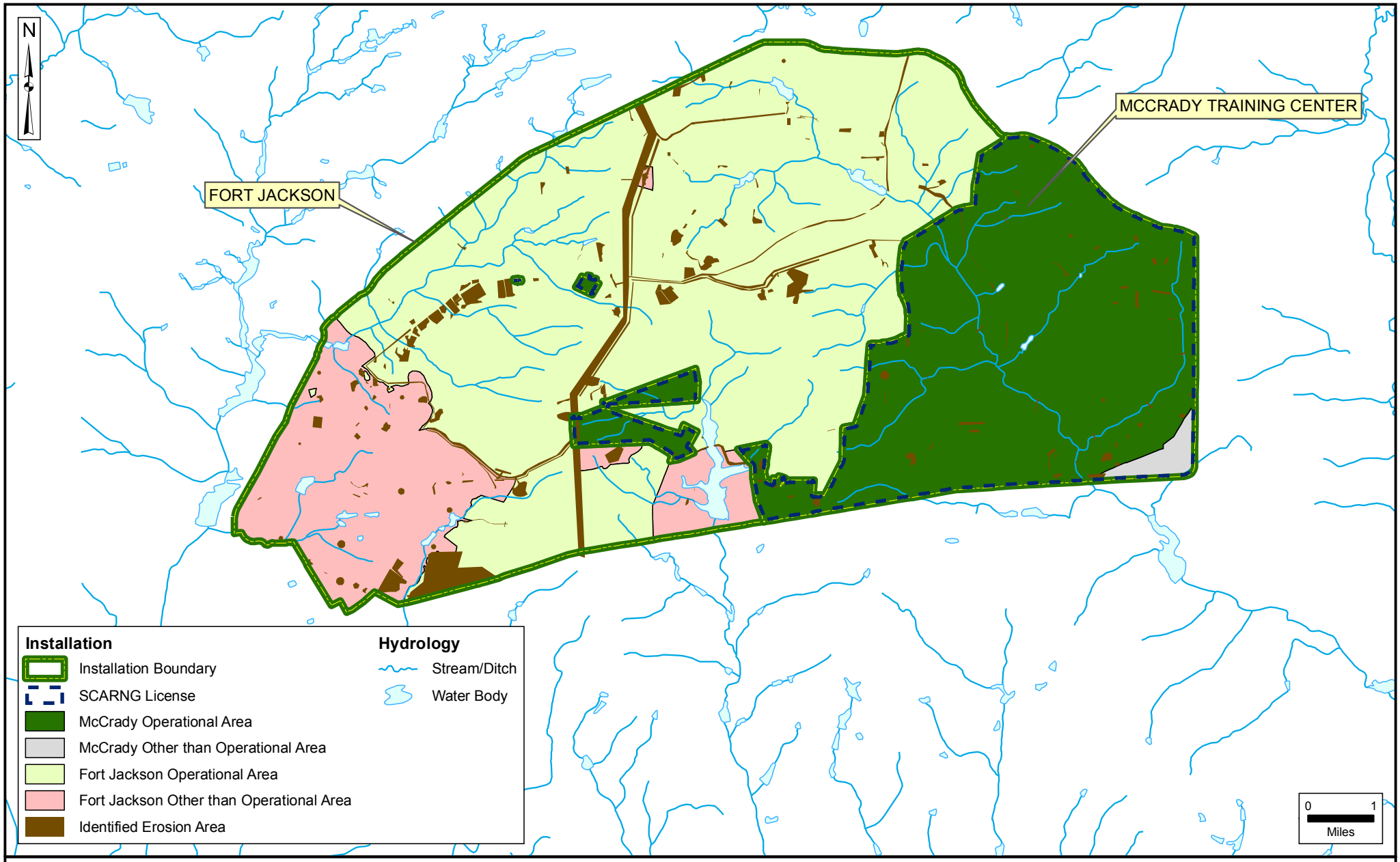

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Figure 3-8
Identified Erosion Areas

Data Sources:
AEC, ARID-GEO, April 2006
ESRI, StreetMap USA, 2005
Fort Jackson Installation GIS, Nov 2004
Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
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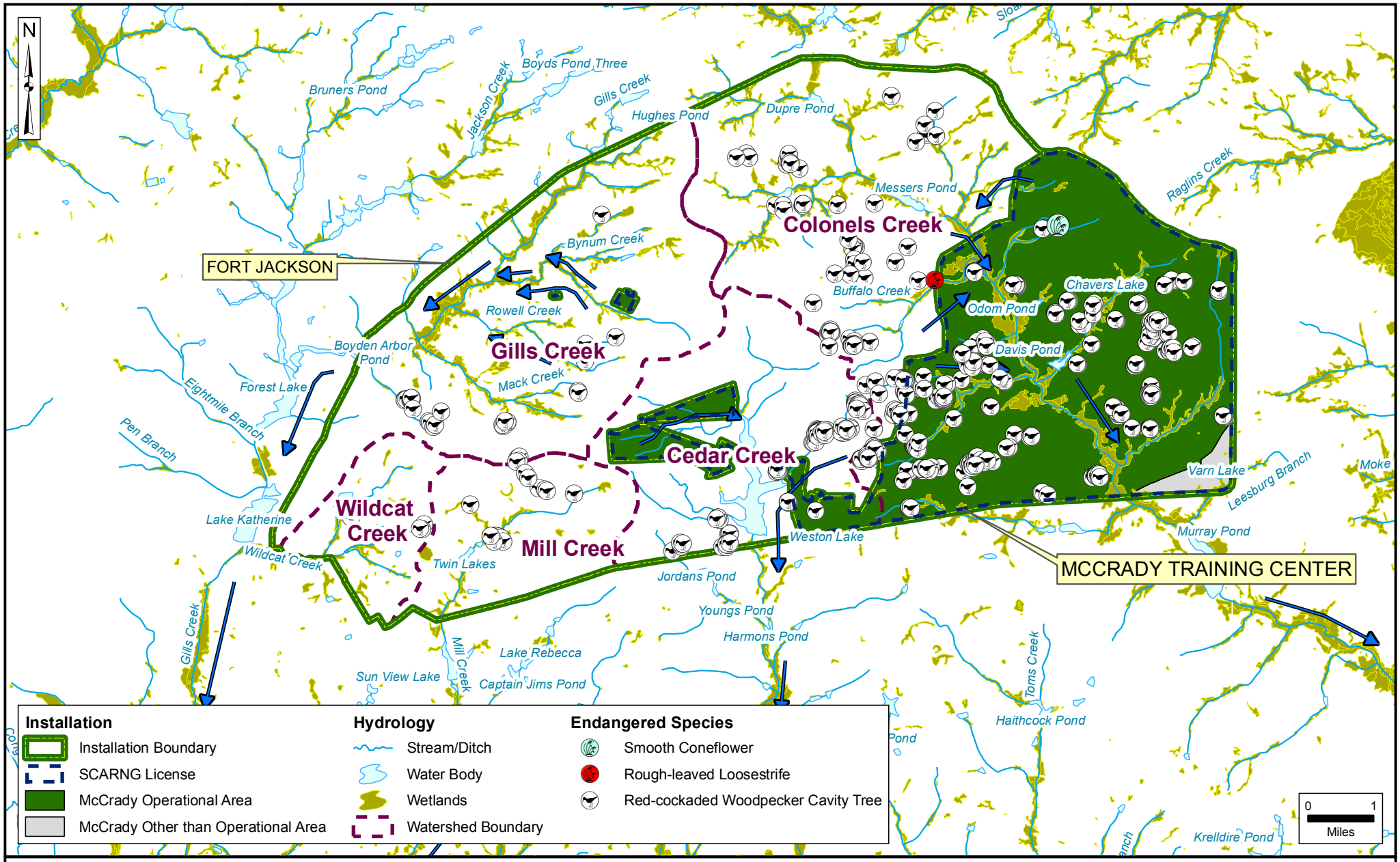

Operational Range Assessment Program
Phase I Qualitative Assessment
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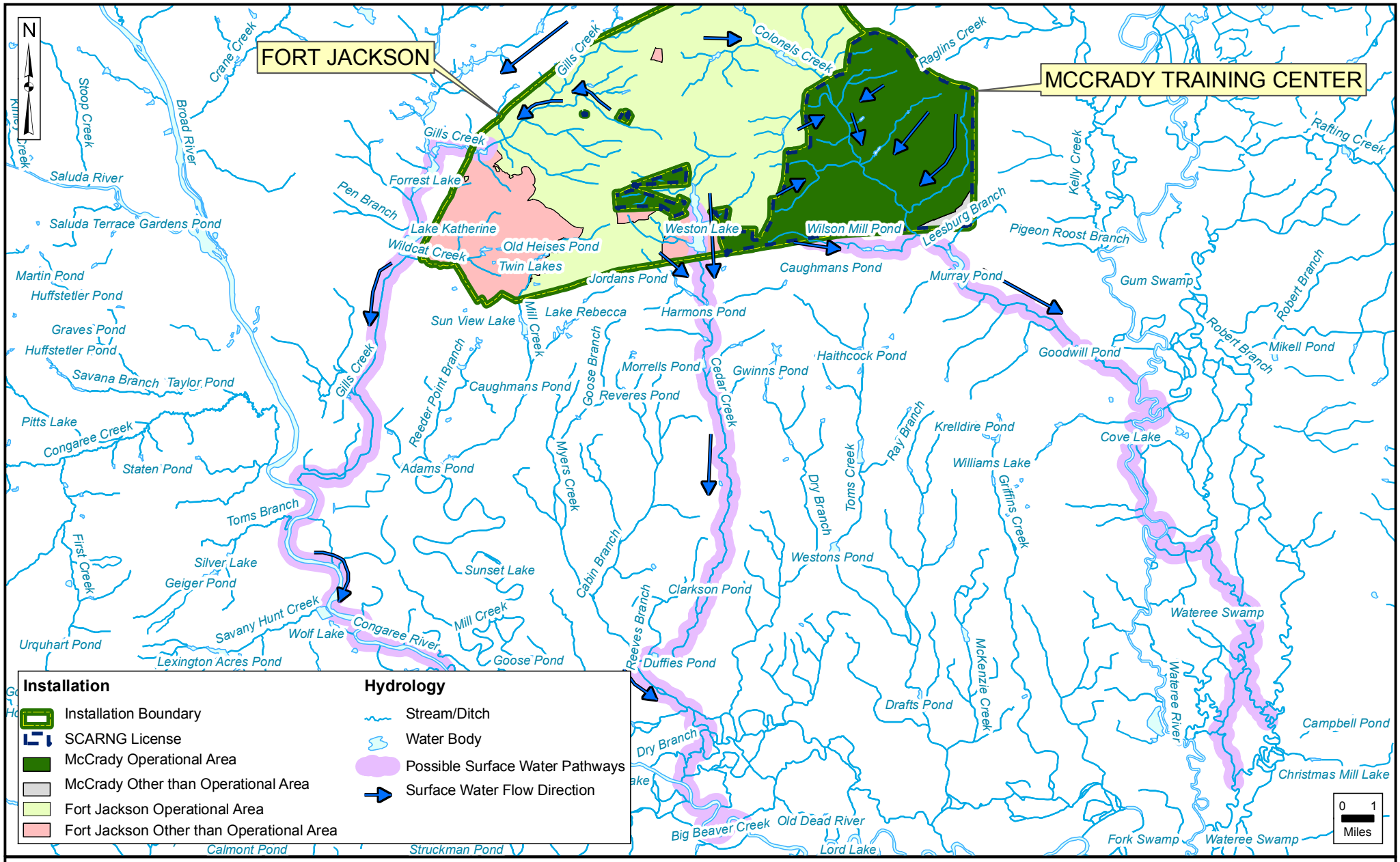
Figure 3-9
Surface Water Pathways

Data Sources:
AEC, ARID-GEO, April 2006
ESRI, StreetMap USA, 2005
Fort Jackson Installation GIS, 2005
Fort Jackson Installation Field Map, 2006
Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004



Operational Range Assessment Program
Phase I Qualitative Assessment
McCrady Training Center, SC

Figure 3-10
Surface Water Pathways 15-Mile Boundary

Data Sources:
AEC, ARID-GEO, Oct 2006
ESRI, StreetMap USA, 2005

Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

4.0 Grouping and Categorization Methods

4.1 Grouping Rationale

The ARID-GEO (2006) data identifies operational ranges within the installation boundaries. The identified operational ranges may contain live- or non-live-fire ranges, firing points, or other training activities. For the purposes of the Phase I Assessment, operational range areas are divided into various groups. Groups are defined by the presence or absence of the three CSM components: source of MCOC, migration pathway, and receptor. The acronym designations for these components are presented below:

Source of MCOC

- **Limited Source (LS)**: Limited or no munitions have been used on-range. No migration pathway or receptor designation is needed for this group.
- **Munitions (M)**: Munitions have been used on-range. This designation is always followed by the applicable pathway designation.

Migration Pathway

- **Pathways Unlikely (PU)**: Migration pathways are unlikely or incomplete. This designation is always preceded by an M signifying that munitions have been used on-range.
- **Groundwater (GW)**: A groundwater migration pathway was identified. This designation is always preceded by an M signifying that munitions have been used on-range.
- **Surface Water (SW)**: A surface water migration pathway was identified. This designation is always preceded by an M signifying that munitions have been used on-range.

Receptor

- **Human (H)**: Source-receptor interaction is complete or potentially complete for human receptors. This designation is always preceded by both the M designation and the applicable pathway designation.
- **Ecological (E)**: Source-receptor interaction is complete or potentially complete for ecological receptors. This designation is always preceded by both the M designation and the applicable pathway designation.

The (H) and (E) designations follow the applicable pathway. For example, if a source has been identified, both surface water and groundwater pathways exist, the source-receptor interaction is complete for human and ecological receptors of surface water, and the source-receptor interaction is complete for human receptors of groundwater, then the group is MSW (H/E) GW (H).

4.2 Categorization Rationale

Each range group can be placed into one of three categories (Referred, Inconclusive, or Unlikely). Category definitions are presented in Section 1.2 and **Appendix A**.

Ranges in groups with at least one CSM component absent (source of MCOC, migration pathway, or receptor) are designated as Unlikely because a source-receptor interaction does not exist.

Ranges in groups with all three CSM components (source of MCOC, migration pathway, and receptor) are categorized based on review of available data using a weight of evidence approach. Examples for placing these range groups into the three categories are provided below:

- **Referred –** If one or more MCOC are present in off-range media (i.e., groundwater, sediment, surface water, or soil) at levels that present an unacceptable risk to human health or the environment as confirmed through acceptable sampling data, the group is categorized as Referred.
- **Inconclusive** – If one or more MCOC are or have the potential to be present in off-range media and source-receptor interactions are complete or potentially complete, but data are unavailable or insufficient to determine whether receptors are at risk or whether potential source-receptor interactions are complete, the group is categorized as Inconclusive.
- **Unlikely** – Ranges where, based upon a review of readily available information, there is sufficient evidence to show that there are no known releases or source-receptor interactions that could present an unacceptable risk to human health or the environment are categorized as Unlikely. In addition, if compelling data (sampling or weight of evidence rationale) indicate that source-receptor interactions are complete, but the levels do not pose unacceptable risk to human health or the environment, the group is categorized as Unlikely.

5.0 Conceptual Site Model Narrative

The operational ranges at McCrady Training Center have been placed into three groups: MSW (H/E) GW (H/E), MSW (H/E) GW, and LS. Rationale for placing ranges into these groups is discussed in the sections below and is based on the source of potential MCOC, exposure pathways, and potential receptors described earlier in this report. This information is used to determine if a potential source-receptor interaction exists for each relevant pathway identified, which is used to determine the appropriate categorization for each group.

Figure 5-1 depicts the range groupings, which are described below. The potential source-receptor interactions based on the CSM components described below are depicted in **Figure 5-2** for Group MSW (H/E) GW (H/E), **Figure 5-3** for Group MSW (H/E) GW, and **Figure 5-4** for Group LS. **Table 5-1** provides site-specific information concerning the CSM components for each group identified within McCrady Training Center, including potential sources, source media, release mechanisms, exposure media, exposure routes, and receptors.

5.1 Group MSW (H/E) GW (H/E)

5.1.1 Primary Source and MCOC

Sources of potential MCOC at Group MSW (H/E) GW (H/E) ranges include two firing ranges, one small arms range, and 43 training areas. Training areas have been included in Group MSW (H/E) GW (H/E) if their current or historical use presents a potential MCOC source. Eighteen of the 43 training areas contain artillery or mortar firing points, demolition areas, or suspected dudded areas, 16 of which also contain potential historical MCOC sources. The remaining 25 training areas also contain potential historical sources of MCOC, which include historical artillery impact areas or firing points. Surface danger zones for numerous historical ranges overlap all of these training areas. Military munitions currently used on Group MSW (H/E) GW (H/E) operational ranges include small to large caliber military munitions, rockets, high explosives (HE), pyrotechnics/obscurants, and demolition materials. MCOC associated with the ranges placed into the MSW (H/E) GW (H/E) group include metals MCOC (lead, antimony, copper, zinc, and tungsten), NG, TNT, RDX, HMX, 2,4-DNT, 2,6-DNT, PETN, and perchlorate. WP has not been included as an associated MCOC based on the sampling results discussed in Section 3.1.3, which indicate that the risk of WP contamination at McCrady Training Center is negligible (USACE, 1993).

5.1.2 Source Media

Primary source media identified at the ranges in Group MSW (H/E) GW (H/E) include soil, surface water, and sediment. MCOC can deposit in surface water and sediment by direct firing. High order detonations, which constitute most munitions detonations, generate undetectable to barely detectable and diffuse surface residuals. Because there is no direct contact of MCOC with groundwater, shallow groundwater is considered a secondary source where potential MCOC can leach/infiltrate into shallow groundwater from soil, sediment, and surface water. Surface water and sediment can also be secondary sources if they receive surface water runoff or erosion from soil source areas or surficial groundwater discharge.

5.1.3 Pathway Analysis

Migration mechanisms for potential MCOC in soil at the ranges in Group MSW (H/E) GW (H/E) include leaching or infiltrating through the soil profile to groundwater and surface erosion and subsequent runoff to sediment and surface water. MCOC in surface water are also subject to plant

and animal uptake and subsequent ingestion and/or dermal absorption by humans or off-range ecological receptors. At Fort Jackson, including the portion licensed to the SCARNG that constitutes McCrady Training Center, a shallow perched groundwater aquifer produces a high likelihood for surficial groundwater to discharge into down gradient surface water. As a result, MCOC have the potential to migrate from shallow groundwater to surface water. This groundwater pathway exists only for the surficial aquifer and not for the deep regional aquifer, the basal Middendorf Formation. Sampling data indicate that groundwater wells at Fort Jackson screened in the regional aquifer do not contain elevated levels of MCOC. It is assumed that this is due primarily to the clay layers between the two aquifers, which significantly decrease permeability. Well logs indicate that installation wells at Fort Jackson, including McCrady Training Center, are all over 100 feet deep, with static water levels ranging from 31 to 169 feet bgs. It is not likely that there is a potentially complete pathway for MCOC to the deeper regional aquifer at McCrady Training Center.

5.1.4 Potential Source-Human Interaction Pathway Analysis

Ranges within Group MSW (H/E) GW (H/E) lie within the Colonels Creek and Cedar Creek watersheds, which are delineated in **Figure 3-9**. Surface water source-human interaction pathways have been identified for each watershed. The two watersheds drain to one or more recreational areas that are located either off-installation or in nonoperational areas of Fort Jackson or McCrady Training Center. Surface water and sediment in these recreational areas are potential pathways for human receptors via dermal contact or accidental ingestion. Potential MCOC sources within the Colonels Creek watershed may impact off-installation recreational areas at Murray Pond, which is located less than one mile south of the McCrady Training Center cantonment area, and recreational areas at Varn Lake, which is located in the cantonment area. The Weston Lake recreation area, which is located in Fort Jackson's nonoperational area, is just downstream of the Cedar Creek watershed ranges and is used for fishing, camping, and other recreational activities. **Figure 3-10** displays down gradient surface water bodies within approximately 15 miles of McCrady Training Center. In addition, fish are known to bioaccumulate certain MCOC, including metals. No fish tissue studies were identified for areas in or around McCrady Training Center; however, such bioaccumulation from exposure either on-range or off-range is possible. Therefore, consumption of fish is a potential pathway to humans.

Surficial groundwater flow within these watersheds generally follows in the direction of surface water flow. The MCOC source areas in the Colonels Creek and Cedar Creek watersheds are up gradient of rural areas serviced by private groundwater wells, as shown in **Figure 3-6**. Private groundwater wells are located to the south, southwest, and southeast of the main portion of McCrady Training Center. These wells may be screened in the surficial aquifer and represent a potential pathway for human receptors via ingestion or dermal contact. McCrady Training Center obtains its potable water from drinking water supply wells that draw from the regional aquifer. As discussed above, these wells are unlikely to be impacted by MCOC.

5.1.5 Potential Source-Ecological Interaction Pathway Analysis

The migration of MCOC off-range from the sources identified at the ranges in Group MSW (H/E) GW (H/E) through surface water and groundwater pathways has the potential to affect sensitive off-range habitats (e.g., wetland habitats), as well as wetlands throughout the installation. Surficial groundwater potentially containing MCOC may also migrate off-range and discharge to surface water downstream.

5.2 Group MSW (H/E) GW

5.2.1 Primary Source and MCOC

Group MSW (H/E) consists of two small arms ranges. Military munitions currently used on Group MSW (H/E) GW operational ranges include small caliber military munitions and pyrotechnics/obscurants. MCOC associated with the ranges placed into the MSW (H/E) GW group include perchlorate, lead, antimony, copper, zinc, and tungsten.

5.2.2 Source Media

Primary source media identified at the ranges in Group MSW (H/E) GW include soil, surface water, and sediment. MCOC can deposit in surface water and sediment by direct firing. Because there is no direct contact of MCOC with groundwater, shallow groundwater is considered a secondary source, where potential MCOC can leach/infiltrate into shallow groundwater from soil, sediment, and surface water. Surface water and sediment can also be secondary sources if they receive surface water runoff or erosion from soil source areas or surficial groundwater discharge.

5.2.3 Pathway Analysis

Migration mechanisms for potential MCOC in soil at the ranges in Group MSW (H/E) GW include leaching or infiltrating through the soil profile to groundwater and surface erosion and subsequent runoff to sediment and surface water. MCOC in surface water are also subject to plant and animal uptake and subsequent ingestion and/or dermal absorption by humans or off-range ecological receptors.

At McCrady Training Center, a shallow perched groundwater aquifer produces a high likelihood for surficial groundwater to discharge into down gradient surface water. Surficial groundwater flow from Group MSW (H/E) GW ranges flows southwest, in the same direction as surface water flow in the Gills Creek watershed. It is anticipated that the majority of this water discharges directly into Gills Creek or into one of its tributaries prior to moving off-installation. Groundwater wells were not identified within four miles down gradient from the Group MSW (H/E) GW ranges. Therefore, a complete pathway is not identified for surficial groundwater. Likewise, a pathway has not been identified for regional groundwater flow at McCrady Training Center. Sampling data indicate that groundwater wells near the SCARNG small arms ranges that are screened in the regional aquifer do not contain elevated levels of MCOC (ATC, 2005). Therefore, it is not likely that there is a potentially complete pathway for MCOC to the deeper regional aquifer. It is assumed that this is due primarily to the presence of clay lenses between the two aquifers, which significantly retard contaminant migration. Additionally, regional groundwater flows to the southeast, and these ranges are located more than four miles up gradient from nonoperational area.

5.2.4 Potential Source-Human Interaction Pathway Analysis

Ranges within Group MSW (H/E) GW lie within the Gills Creek watershed, as shown in **Figure 5-1**. Surface water source-human interaction pathways have been identified for both ranges. Gills Creek drains to Forest Lake, which is used for recreational purposes. Surface water and sediment in this lake are potential pathways for human receptors via dermal contact or accidental ingestion. MCOC sources from the Gills Creek ranges could potentially impact off-installation recreational areas at Forest Lake and Lake Katherine, which are approximately five to 10 miles downstream from the two small arms ranges in Group MSW (H/E) GW. In addition, fish are known to bioaccumulate certain MCOC, including metals. No fish tissue studies were identified for areas in or around McCrady Training Center; however, such bioaccumulation from exposure either on-range or off-range is

possible. Therefore, consumption of fish is a potential pathway to humans.

5.2.5 Potential Source-Ecological Interaction Pathway Analysis

The migration of potential MCOC off-range from the sources identified at the ranges in Group MSW (H/E) GW through surface water pathways has the potential to affect sensitive off-range habitats (e.g., wetland habitats), as well as wetlands throughout the installation.

5.3 Group LS

5.3.1 Primary Source and MCOC

Group LS consists of 14 training areas currently used for training and maneuvering. Currently, no munitions are used in these areas. Limited historical munitions usage, if any, has occurred. Historical munitions use was limited primarily to the presence of one or more safety fans for small arms ranges. No or limited potential MCOC sources were identified for these 14 ranges.

5.3.2 Source Media

No or limited potential MCOC sources were identified for the operational ranges in Group LS; therefore, source media were not identified.

5.3.3 Pathway Analysis

No or limited potential MCOC sources were identified for the operational ranges in Group LS; therefore, potential pathways were not evaluated.

5.3.4 Potential Source-Human Interaction Pathway Analysis

No or limited potential MCOC sources were identified for the operational ranges in Group LS; therefore, potential source-human receptor interactions were not evaluated.

5.3.5 Potential Source-Ecological Interaction Pathway Analysis

No or limited potential MCOC sources were identified for the operational ranges in Group LS; therefore, potential source-ecological receptor interactions were not evaluated.

5.4 Data Uncertainties

ARID-GEO (2006)

One of the ranges included in the McCrady Training Center inventory, issued in October 2006, was also included in the Fort Jackson inventory, issued in March 2006. This training area is located west of Weston Lake and is depicted in **Figure 5-5**. The ARID-GEO (2006) data for McCrady Training Center were not altered based on this data uncertainty, as the McCrady ARID-GEO data are more recent than the Fort Jackson ARID-GEO data. The boundary of Fort Jackson has been altered on the figures included in this document so that it does not encompass this training area.

RFMSS

According to ARID-GEO (2006), the large firing range at McCrady Training Center has the same name as a smaller firing range at Fort Jackson. These firing ranges are both located northwest of Weston Lake, but are in slightly different locations. RFMSS data for the SCARNG firing range are recorded by McCrady Training Center, as well as by Fort Jackson. According to the McCrady Training Center RFMSS GIS Analyst, prior to 2006, RFMSS data for the SCARNG ranges were

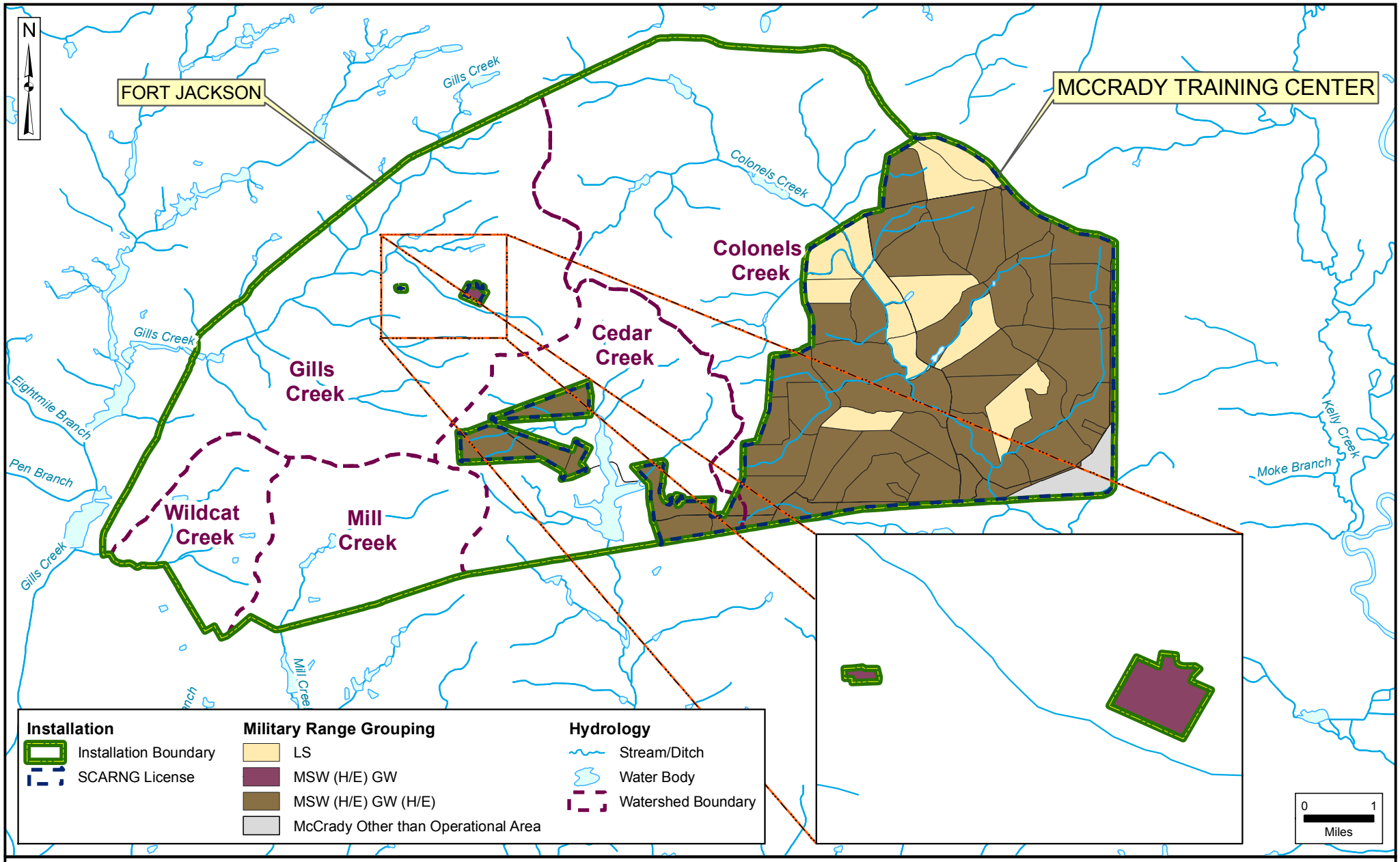
recorded solely by Fort Jackson. Therefore, RFMSS entries for this range from 2004 to 2006 may apply to either the smaller Fort Jackson range or the larger range licensed to the SCARNG. Some of the DoD Identification Codes included in the Fort Jackson 2006 RFMSS data were not included in the SCARNG 2006 RFMSS data for this range, indicating that the munitions use reported in RFMSS may be split between the two ranges. Therefore, 2004 and 2005 munitions data for this range have not been included in this assessment.

Impact of Data Uncertainties

The data uncertainties presented above are included to point out inconsistencies or deficiencies with ARID-GEO and RFMSS data. Due to these data uncertainties, the quantity of munitions reported for the larger SCARNG firing range may be slightly lower than it should be. These data uncertainties are not expected to affect the overall conclusions of this report.

Table 5-1: Summary of the Conceptual Site Model Components

Group Identification	Primary Source	Primary MCOC	Source Media	Release Mechanism	Exposure Media	Exposure Routes	Receptors
Group MSW (H/E) GW (H/E)	Firing points, small arms firing, demolition areas, suspected dudded areas, and historical artillery impact areas or firing points	TNT, PETN, 2,4,-DNT, 2,6-DNT, RDX, HMX, NG, perchlorate, lead, antimony, copper, zinc, and tungsten	Soil, surface water, and sediment	Leaching, infiltration, erosion/runoff, plant and animal uptake, and recharge/discharge of groundwater and surface water	Surface water / sediment, food chain, and groundwater	Ingestion and dermal absorption	Local and off-range residents; residents down gradient; recreational users of water bodies and threatened and endangered species downstream
Group MSW (H/E) GW	Small arms firing	Perchlorate, lead, antimony, copper, zinc, and tungsten			Surface water / sediment and food chain		Recreational users of water bodies and threatened and endangered species downstream
Group LS	Limited source – limited or no historical military munitions use	Not evaluated (limited source was identified)					

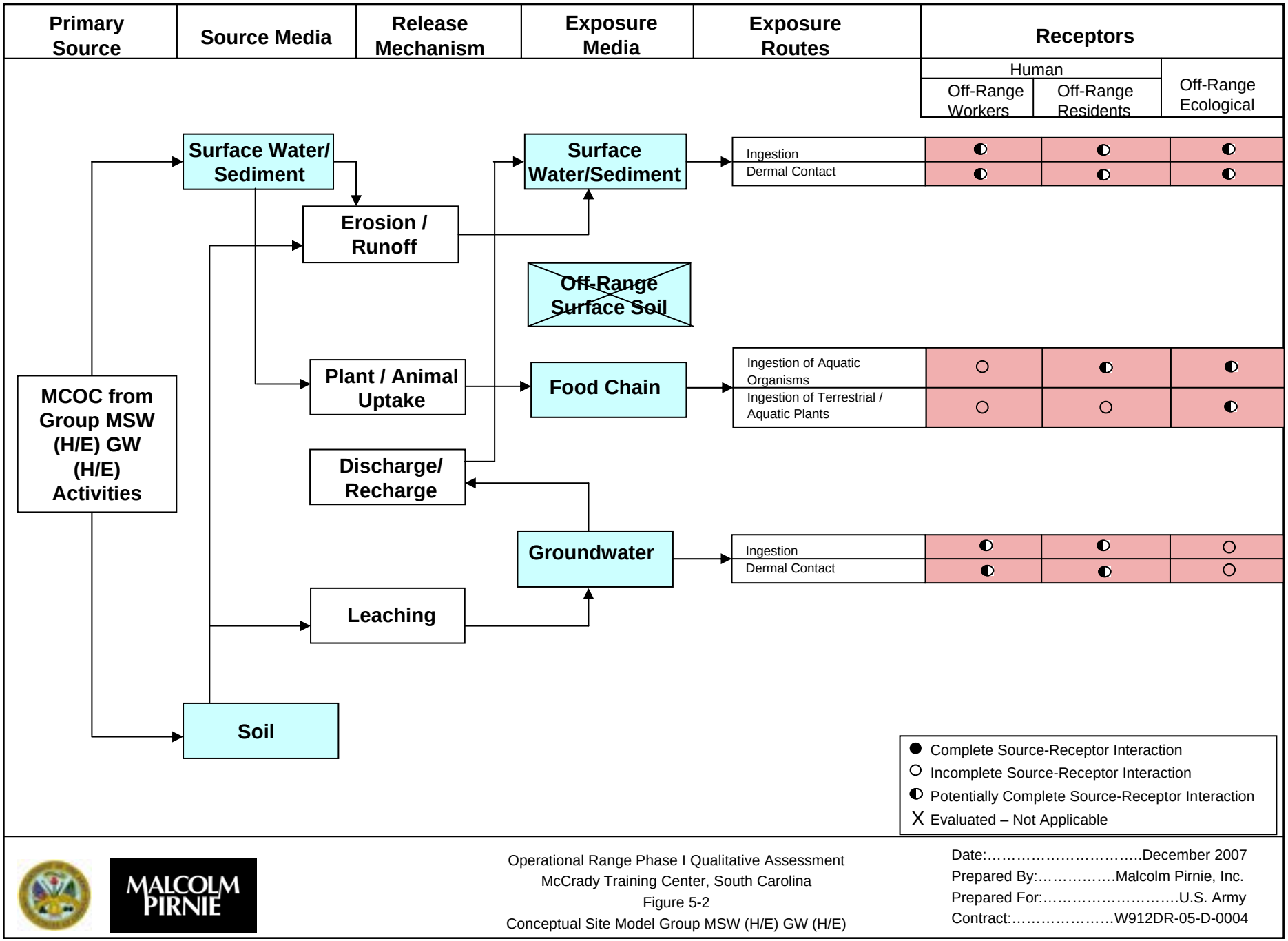


Operational Range Assessment Program
Phase I Qualitative Assessment
McCrady Training Center, SC

Figure 5-1
Military Range Grouping

Data Sources:
AEC, ARID-GEO, Oct 2006
ESRI, StreetMap USA, 2005

Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004



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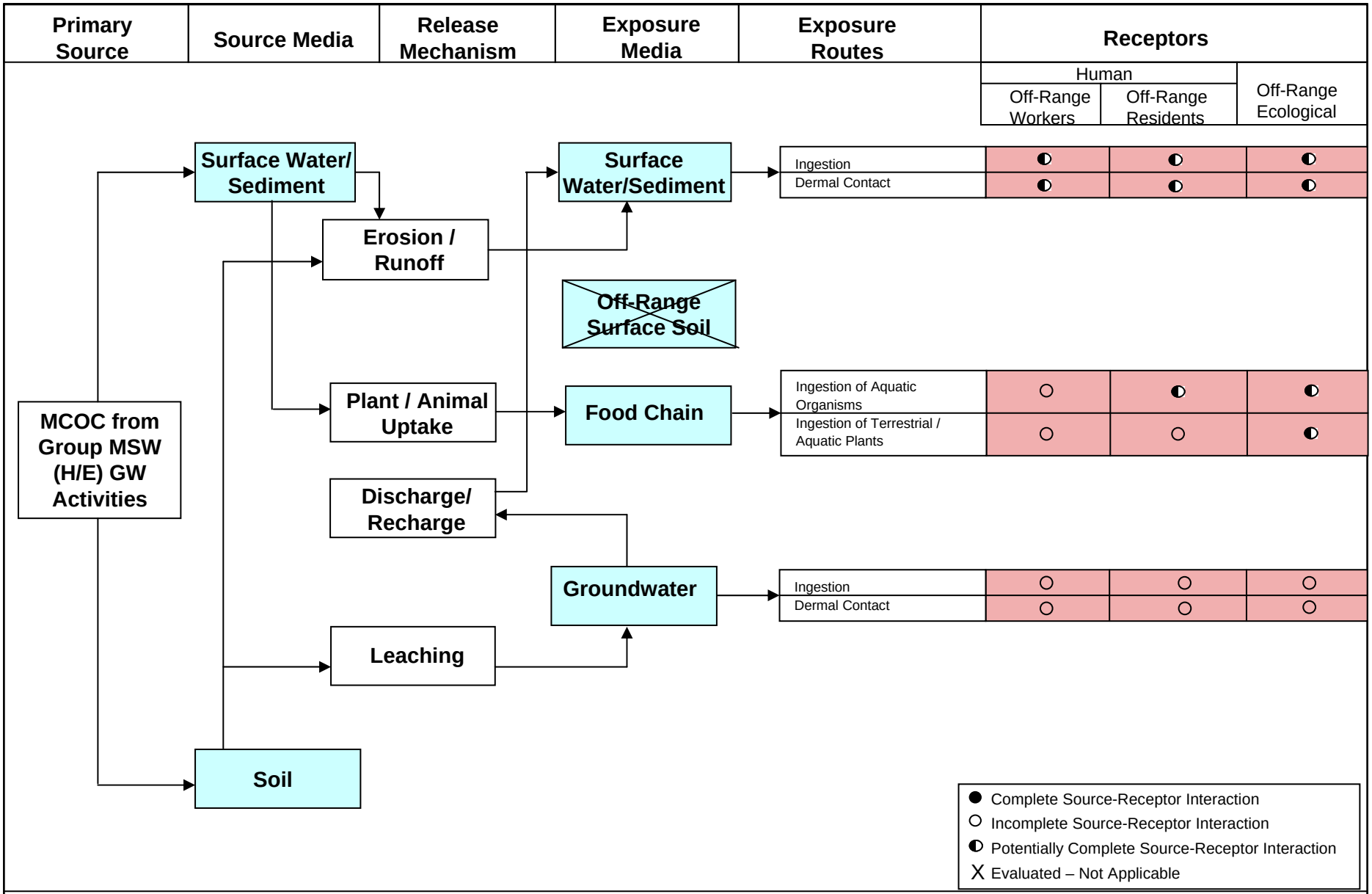
Operational Range Phase I Qualitative Assessment
McCrady Training Center, South Carolina
Figure 5-2
Conceptual Site Model Group MSW (H/E) GW (H/E)

Date:……December 2007
Prepared By:……Malcolm Pirnie, Inc.
Prepared For:……U.S. Army
Contract:……W912DR-05-D-0004



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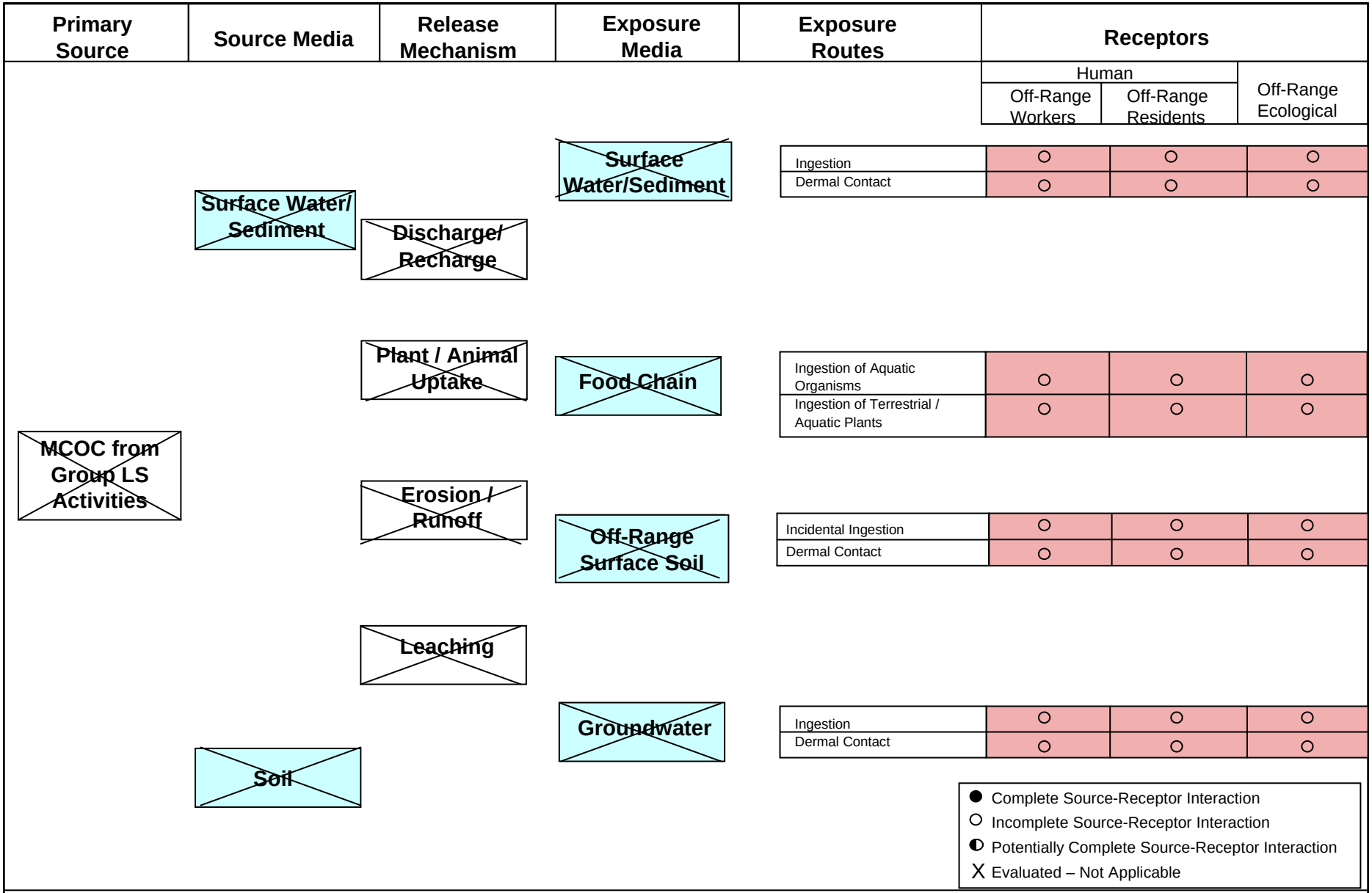
Operational Range Phase I Qualitative Assessment
McCrady Training Center, South Carolina
Figure 5-3
Conceptual Site Model Group MSW (H/E) GW

Date:…… December 2007
Prepared By:……Malcolm Pirnie, Inc.
Prepared For:……U.S. Army
Contract:……W912DR-05-D-0004



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Operational Range Phase I Qualitative Assessment
McCrady Training Center, South Carolina
Figure 5-4
Conceptual Site Model Group LS

Date:…… December 2007
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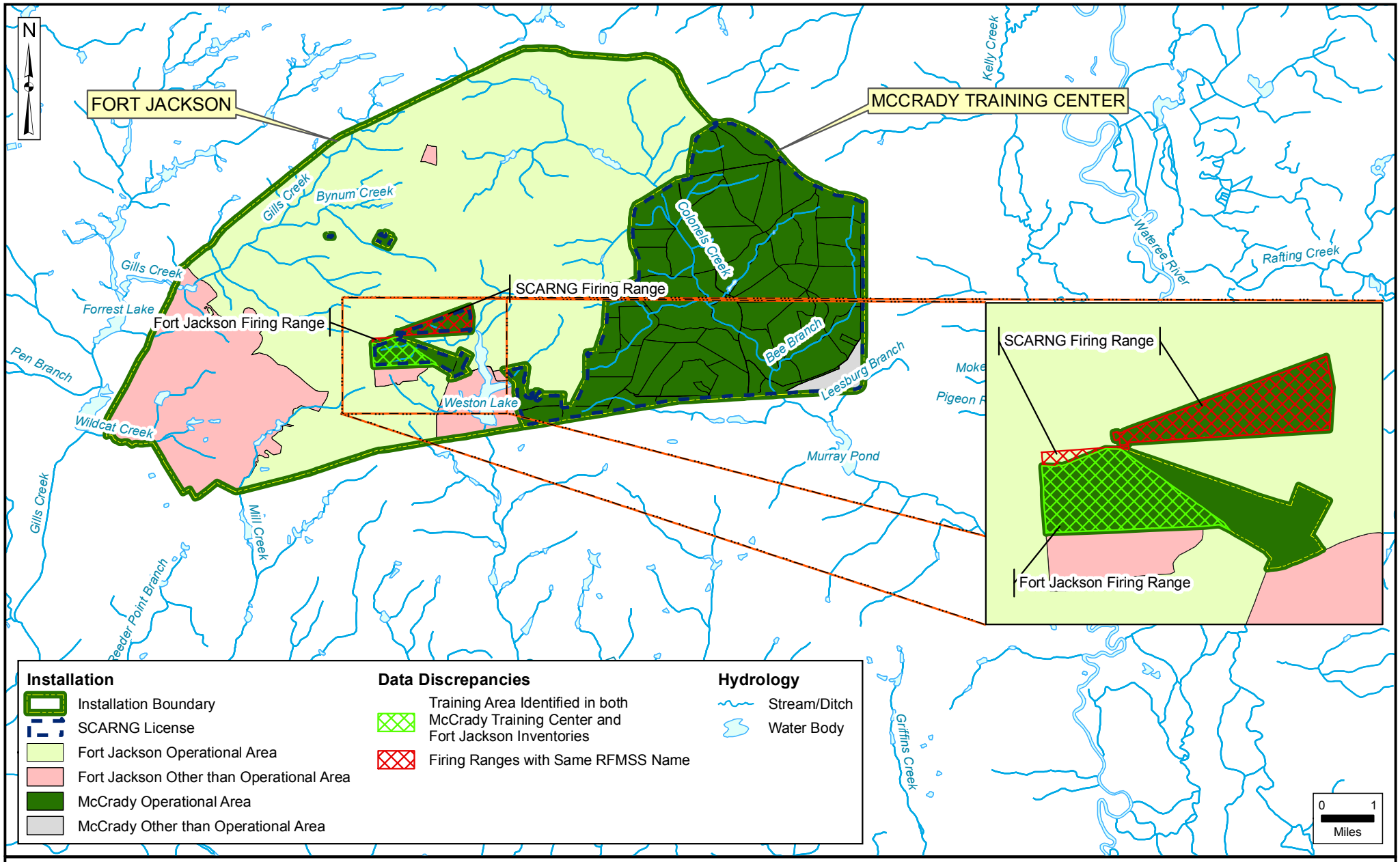
Prepared For:……U.S. Army
Contract:……W912DR-05-D-0004



Operational Range Assessment Program
Phase I Qualitative Assessment
McCrady Training Center, SC

Figure 5-5
Data Discrepancies

Data Sources:
AEC, ARID-GEO, Oct 2006
ESRI, StreetMap USA, 2005

Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

6.0 Summary of Findings and Conclusions

The operational ranges at McCrady Training Center have been categorized as a result of the Phase I Assessment as described below. **Figure 6-1** illustrates the conclusions of this Phase I Assessment. The findings and conclusions for these operational ranges are presented in **Table 6-1.** Conclusions are based on readily available information collected to date.

6.1 Summary of Findings

The 62 ranges at McCrady Training Center consist of firing ranges, small arms ranges, and training areas totaling 14,895 acres[3]. According to munitions data collected during the Phase I Assessment, the types of munitions fired include small, medium, and large caliber munitions, rockets, HE, pyrotechnics/obscurants, and demolition materials. Potential MCOC associated with these munitions types include TNT, HMX, RDX, 2,4-DNT, 2,6-DNT, PETN, perchlorate, NG, lead, antimony, copper, zinc, and tungsten.

Based on data collected during the Phase I Assessment regarding current and historical MCOC sources, potential migration pathways from ranges, and potential off-range human and/or ecological receptors, the operational ranges at McCrady Training Center have been placed into the following range groupings:

Group MSW (H/E) GW (H/E)
The 46 ranges identified in Group MSW (H/E) GW (H/E) have current and/or historical sources of potential MCOC that were identified during the Phase I Assessment. These sources have the potential to migrate off-range via surface water and groundwater pathways. The source-receptor interaction was identified as complete or potentially complete for human and ecological receptors for both the surface water pathway and surficial groundwater pathway.

Group MSW (H/E) GW
The two ranges identified in Group MSW (H/E) GW are currently utilized as small arms ranges and contain current sources of MCOC that were identified during the Phase I Assessment. These sources have the potential to migrate off-range via surface water and groundwater pathways. The source-receptor interaction was identified as complete or potentially complete for human and ecological surface water receptors.

Group LS
The 14 ranges identified in Group LS have only limited or no current and/or historical sources of potential MCOC that were identified during the Phase I Assessment.

6.2 Conclusions

Each of the operational range groups described above is placed into one of three possible categories: Referred, Inconclusive, or Unlikely. Conclusions for each category are discussed below.

Referred – Refer to Appropriate Cleanup Program
Based on data reviewed during the Phase I Assessment, no operational ranges at McCrady Training

[3] The total operational range area was derived from the Operational Use Area (total range area) acreage as reported in ARID-GEO (2006).

Center are categorized as Referred.

Inconclusive – Phase II Quantitative Assessment Required

Operational ranges where a source of potential MCOC source, an exposure pathway, and receptors have been identified are categorized as Inconclusive and comprise Groups MSW (H/E) GW (H/E) and MSW (H/E) GW. Based on current and historical military munitions usage at McCrady Training Center and a review of potential migration pathways and potential human and/or ecological receptors, a total of 48 ranges, covering 12,243 acres[4], were identified as having the potential for MCOC to migrate off-range and affect human and/or ecological receptors. At the completion of the Phase I Assessment process, installations with ranges in the Inconclusive category will be prioritized for further analysis during Phase II Quantitative Assessments.

Unlikely – Five-Year Review

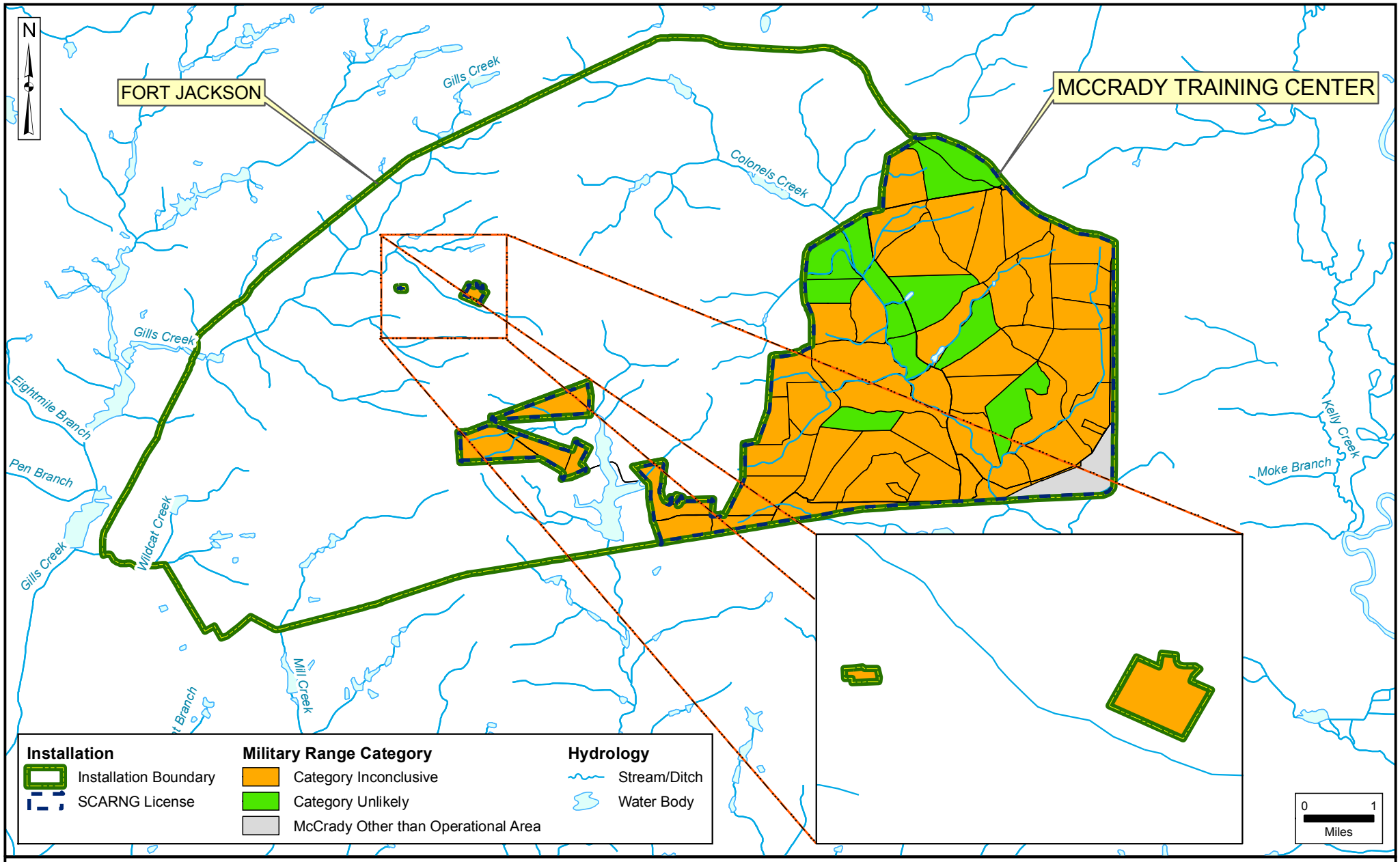
Ranges determined to have at least one CSM component (i.e., source of potential MCOC, pathway, or receptor) absent or sampling data indicating that a source-receptor interaction is not present are categorized as Unlikely and comprise Group LS. Based on current and historical military munitions usage at McCrady Training Center and a review of potential migration pathways and potential human and/or ecological receptors, a total of 14 ranges, covering 2,652 acres[5], were identified as being unlikely to have potential MCOC migrate off-range and affect human or ecological receptors. Ranges categorized as Unlikely will be required to undergo a periodic re-evaluation to determine if conditions affecting this assessment (e.g., range operations, site conditions, applicable regulations) have changed since the original categorization was finalized (DoD, 2005). This re-evaluation will occur at least every five years.

[4] The total acreage for the Inconclusive category was derived by (1) merging individual ranges in the Inconclusive category to eliminate overlap and (2) calculating the total acreage of the merged ranges. Therefore, the Inconclusive category acreage is an estimated value that does not account for overlapping range acreage.

[5] Due to overlapping range boundaries depicted in the ARID-GEO (2006), the total acreage for the Unlikely category was derived by subtracting the Inconclusive category acreage from the Operational Use Area (total range area) acreage as reported in ARID-GEO (2006). Therefore, the Unlikely category acreage is an estimated value.

Table 6-1: Summary of Findings and Conclusions for McCrady Training Center

Category	Total Number of Ranges and Acreage	Group Identification	Source(s)	Pathway(s)	Human Receptors	Ecological Receptors	Conclusions and Rationale
Inconclusive	46 operational ranges; 12,199 acres	MSW (H/E) GW (H/E)	Firing points, small arms firing, demolition areas, suspected dudded areas, and historical artillery impact areas or firing points	Colonels Creek, Varn Lake, and Murray Pond (to the south and southeast); Weston Lake and Cedar Creek (to the southeast and southwest); surficial groundwater aquifer (to the south, southeast, and southwest)	Residents down gradient, local and off-range residents, and recreational users of Murray Pond and Weston Lake downstream	Wetlands and threatened and endangered species downstream	Phase II Quantitative Assessment is required. Residents and recreational users are present down gradient and downstream.
	2 operational ranges; 44 acres	MSW (H/E) GW	Small arms firing	Gills Creek and Forest Lake (to the west and southwest)	Recreational users of Forest Lake and Lake Katherine downstream	Wetlands and threatened and endangered species downstream	Phase II Quantitative Assessment is required. Residents and recreational users are present downstream.
Unlikely	14 operational ranges; 2,652 acres	LS	Limited source – limited or no historical military munitions use	Not evaluated (limited source identified)			Re-evaluate during the five-year review. A limited source was identified.



Operational Range Assessment Program
Phase I Qualitative Assessment
McCrady Training Center, SC

Figure 6-1
Summary of Conclusions

Data Sources:
AEC, ARID-GEO, Oct 2006
ESRI, StreetMap USA, 2005

Date: ..... December 2007
Prepared By: ..... Malcolm Pirnie, Inc.
Prepared For: ..... U.S. Army
Contract: W912DR-05-D-0004

Appendix A: Glossary of Terms

GLOSSARY OF TERMS

The terms outlined below are those that will be used commonly during the Phase I Assessment process. The relevant reference for each is presented at the end of the definition. If no reference is presented, then the term is not an official Department of Defense (DoD) definition and applies only to the U.S. Army's Operational Range Assessment Program.

Dudded Impact Area – An area having designated boundaries within which all dud-producing ordnance will detonate or impact. Vehicle bodies are sometimes placed in the area to act as targets for direct and indirect artillery fire. The primary function of the impact area is to contain weapons effects as much as possible using earthen berms or natural terrain features. Impact areas containing unexploded ordnance may not be used for maneuver. Each area, typically managed and scheduled by either numeric, lettered, or alphanumeric code through the installation training or range control manager (e.g., Directorate of Plans, Training, Mobilization and Security [DPTMS], DPTMS-equivalent), should be accounted for with a separate facility number and real property record.[1]

Group – A group is a collection of one or more ranges within an operational range area (range complex area) that shares similar characteristics. Similar characteristics can include types of activities, munitions usage, geographic proximity, surface water or groundwater divides, or even common receptors.[2]

Inconclusive – Phase II Quantitative Assessment Required – Ranges where existing information either is insufficient to make a source-receptor interaction determination or indicates the potential for such interaction to be occurring.[3]

Large Caliber – Munitions include projectiles greater than 60 millimeters (mm) (including 75-mm, 76-mm, 81-mm, 90-mm, 105-mm, 155-mm, 14-inch and 16-inch projectiles).[4]

Medium Caliber – Munitions include projectiles sized from 20-mm to 60-mm (including 20-mm, 25-mm, 30-mm, 37-mm, 40-mm and 60-mm projectiles).[5]

Military Munitions – All ammunition products and components produced or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, the United States (U.S.) Coast Guard, the U.S. Department of Energy (DOE), and the Army National Guard. The term military munitions includes: confined gaseous, liquid, and solid propellants; explosives; pyrotechnics; chemical and riot control agents; smoke and incendiaries, including bulk explosives and chemical warfare agents; chemical munitions; rockets; guided and ballistic missiles; bombs; warheads; mortar rounds; artillery ammunition; small arms ammunition; grenades; mines; torpedoes; depth charges; cluster munitions and dispensers; demolition charges; and devices and components thereof. Military munitions do not include wholly inert items; improvised explosive devices; and nuclear weapons, nuclear devices, and nuclear components, other than

[1] DA, 2000
[2] This definition was based on guidance from the USACHPPM (2005), as well as further input/guidance from the U.S. Army Environmental Command and the U.S. Army Center for Health Promotion and Preventive Medicine.
[3] See note 2.
[4] See note 2.
[5] See note 2.

nonnuclear components of nuclear devices that are managed under the nuclear weapons program of the DOE after all required sanitization operations under the Atomic Energy Act of 1954 (42 United States Code [U.S.C.] 2011 et seq.) have been completed. (10 U.S.C. 101(e)(4)(A) through (C))

Munitions Constituents (MC) – Any materials that originate from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. 2710(e)(3))

Munitions Constituents of Concern (MCOC) – Those MC that have the potential to migrate from a source area to a receptor (human or ecological) in sufficient quantity to cause an unacceptable risk to human health or the environment. (DoD, 2005) MCOC for high explosives include: trinitrotoluene (TNT); cyclotetramethylenetetranitramine (HMX); pentaerythritoltetranitrate (PETN); cyclotrimethylenetrinitramine (RDX); 2,4-dinitrotoluene (DNT); and 2,6-DNT. MCOC for small arms include lead, antimony, copper, zinc, and tungsten. MCOC for training areas include perchlorate (a propellant) and white phosphorus (an incendiary agent). Additional MCOC may be addressed on an installation-specific basis.[6]

Non-Dudded Impact Area – An area having designated boundaries within which ordnance that does not produce duds will impact. This area is composed mostly of the safety fans for small arms ranges. The primary function of the impact area is to contain weapons effects as much as possible using earthen berms or natural terrain features. Each area, typically managed and scheduled by either numeric, lettered, or alphanumeric code through the installation training or range control manager (e.g., DPTMS, DPTMS-equivalent), should be accounted for with a separate facility number and real property record. These impact areas may be used for maneuver, at the cost of curtailing the use of weapons ranges.[7]

Off-Range Area – For the purpose of the Phase I Assessment, off-range areas include those areas outside of the boundaries of the operational range area as established by the Army Range Inventory Database-Geodatabase. Off-range areas may include both on- (e.g., cantonment areas) and off-installation locations.

Operational Range – A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities or, although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities. (10 U.S.C. 101(e)(3))

Other Munitions – Munitions from aerial fire (rockets and large bombs), hand grenades, light anti-tank weapons, and anti-armor missiles.[8]

Pathway – The environmental medium through which an MCOC is transported from the source to the receptor. (DoD, 2005)

[6] See note 2.
[7] See note 1.
[8] See note 2.

Range – The term range, when used in the geographical sense, means a designated land or water area that is set aside, managed and used for range activities of the DoD. The term includes: (A) firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas and (B) airspace areas designated for military use in accordance with regulations and procedures proscribed by the Administrator of the Federal Aviation Administration. (10 U.S.C. 101(e)(1)(A) and (B))

Range Complex – For the purpose of the Phase I Assessment, range complexes are contiguous operational ranges that may be grouped together and assessed as a single range (also referred to as an operational range area).

Receptor – A human, animal, or plant species that is exposed, or that may be exposed, to MC. (DoD, 2005)

Referred – Ranges with compelling evidence (e.g., sampling data) to indicate the presence of an off-range release that potentially poses an unacceptable risk to human health or the environment.[9]

Sensitive Environments – Terrestrial or aquatic resources, fragile natural settings, or other areas with unique or highly valued environmental features.[10]

Small Arms – Small arms include all shotgun, .22-, .223-, .30-, .32-, .38-, .45-, and .50-caliber, 5.56-mm, 7.62-mm, 9-mm and 10-mm weapons.[11]

Small Caliber – Munitions used in small arms and fired from weapons with muzzle diameter of up to .50-caliber or one-half inch.[12]

Source – An area where MC may have been deposited, disposed, or placed. (DoD, 2005)

Training Area – For the purpose of the Phase I Assessment, training areas refer to the ranges that have non-live-fire troop activities. These areas can have a variety of activities that include bivouac, troop movement, and tactics.

Unknown Munitions – Items that have not been identified or positively identified.[13]

Unlikely – Five-Year Review – Ranges where, based upon a review of readily available information, there is sufficient evidence to show that there are no known releases or source-receptor interactions that could present an unacceptable risk to human health or the environment.[14]

[9] See note 2.
[10] See note 2.
[11] See note 2.
[12] See note 2.
[13] See note 2.
[14] See note 2.

Appendix B: References

B1 – References

B2 – Department of Defense Data Repositories and Databases

B3 – Off-Installation / Publicly Available Data Repositories and Databases

B4 – Installation Data Repositories and Databases

B5 – Personnel Interviews

B1 – References

10 U.S.C. Sec. 101. 2005.

10 U.S.C. Sec. 2710. 2005.

42 U.S.C. Sec. 2011 et seq. 2004.

Army Knowledge Online (AKO). 2002. *McCrady Training Center Presentation.*

Army Range Inventory Database-Geodatabase (ARID-GEO). 2006. *U.S. Army Operational Range Inventory Sustainment FY06: Final Packet for McCrady Training Center, South Carolina*.

ATC. See United States Army Aberdeen Test Center.

Bricka, R.M. 2002. *Sampling of the Small Arms Training Areas at Fort Jackson.* Mississippi State University.

Department of Defense (DoD). 2004. Department of Defense Directive 4715.11 *Environmental and Explosive Safety Management on Operational Ranges Within the United States*.

------. 2005. Department of Defense Instruction (DODI) 4715.14 *Operational Range Assessments*.

Department of the Army (DA). 2000. Department of the Army Pamphlet 415-28 *Guide to Army Real Property Category Codes*.

Fort Jackson Environmental Natural Resources Division (ENRD). 2007. *South Carolina Well Log Data*.

Fort Jackson Integrated Training Area Management (ITAM) Office. 2006. *Fort Jackson Installation Field Map, January 2006 – December 2006.*

Gene Stout & Associates. 2004. *Integrated Natural Resources Management Plan and Environmental Assessment, 2004-2008, U.S. Army Training Center and Fort Jackson, South Carolina.*

GlobalSecurity.org. 2006. Fort Jackson. http://www.globalsecurity.org/military/facility/fort-jackson .htm. (Accessed July 2006).

Law Engineering and Environmental Services, Inc. (LAW). 2003. *Revised Final Phase II RCRA Facility Investigation Report for Wonsan (SWMU 12) and Inchon (SWMU 17) Explosive Ordnance Disposal Sites, Fort Jackson, South Carolina.* Contract No. DACA21-97-D0034.

Malcolm Pirnie, Inc. 2005. *Final Work Plan / Management Plan for the Operational Range Assessment Program Qualitative Operational Range Assessments*.

------. 2006. *Final Site Inspection Report for Fort Jackson, SC.*

Microsoft® Encarta® Online Encyclopedia. 2007. South Carolina. http://encarta.msn.com (Accessed 14 June 2007).

Newcome, Roy. 2003. *Ground-Water Resources of Richland County, South Carolina.* State of South Carolina Department of Natural Resources. Land, Water and Conservation Division. Water Resources Report 30.

South Carolina Army National Guard (SCARNG). 2005. *South Carolina Army National Guard, McCrady Training Center, Erosion Control Plans for Priority Sites*.

South Carolina Department of Health and Environmental Control (SCDHEC). 1997. *The Gills Creek Watershed Project, An Urban Nonpoint Source Project: Richland County, S.C., February 1994 – September 1996. Final Report.*

------. 2006. *Integrated Report for 2006 Part II: Section 305(b) Assessment and Reporting.* http://www.scdhec.net/eqc/water/pubs/305b.pdf. (Accessed 30 January 2007).

South Carolina Department of Natural Resources (SCDNR). 2003. *Ground-Water Resources of Richland County, South Carolina*. http://www.dnr.sc.gov/lwc/pubs/pdfs/richlandcounty.pdf. (Accessed January 30, 2007).

------. 2006. *South Carolina Rare, Threatened, & Endangered Species Inventory: Species Found In Richland County (Last Updated January 17th, 2006)*. https://www.dnr.sc.gov/pls/heritage/county_species.list?pcounty=richland.

United States Army Aberdeen Test Center (ATC). 2005. *Small Arms Range Training Area Environmental Screening-Level Assessment at Fort Jackson, South Carolina.*

United States Army Center for Health Promotion and Preventive Medicine (USACHPPM) Army Operational Range Assessment Team. 2005. *U.S. Army Operational Range Assessment Program Qualitative Assessments Protocol*.

United States Army Corps of Engineers (USACE). 1993. *White Phosphorus Wetland Storage Installation Assessment Report, Fort Jackson*.

------. 1996. *Summary and Evaluation for White Phosphorus Remediation: A Literature Review (Technical Report IRRP-96-7)*. http://el.erdc.usace.army.mil/elpubs/pdf/trirrp96-7.pdf. (Accessed 2 July 2007).

------. 1999. *Technical Report IRRP-99-1: Conceptual Model and Process Descriptor Formulations for Fate and Transport of UXO.* http://el.erdc.usace.army.mil/elpubs/pdf/trirrp-99-1.pdf. (Accessed 8 February 2007).

United States Army Environmental Command and United States Department of Agriculture Forest Service (USAEC and USDA). 2001. *McCrady Training Center Integrated Natural Resources Management Plan (INRMP) Volumes I and II.*

------. 2005. *2005 Fort Jackson Installation Action Plan.*

United States Army Toxic and Hazardous Materials Agency (USATHAMA). 1980. *Installation Assessment of Fort Jackson Report No. 165*.

United States Census Bureau. 2007. 2000 Census. http://quickfacts.census.gov/qfd/states/12/12069.html. (Accessed 22 January 2007).

United States Environmental Protection Agency (USEPA). 1991. *Guidance for Performing Preliminary Assessments under CERCLA* (EPA/540/G-91/013): U.S. EPA Soil Exposure Pathway Targets.

------. 1997. *U.S. EPA Interim Final Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*.

Wikipedia. 2007. Fall Line. http://en.wikipedia.org/wiki/Fall_line. (Accessed 14 June 2007).

B2 – Department of Defense Data Repositories and Databases

Army Knowledge Online

Army Knowledge Online. 2002. *McCrady Training Center Presentation.*

Geographic Information System (GIS) Repository

Range identification map, installation and range boundaries, surface waterway map, topography map, soil survey geographic map

Range Facility Management Support System (RFMSS)

Fort Jackson Directorate of Plans, Training, Mobilization, and Security. 2006. Fort Jackson munitions usage data from 1 January 2002 through 12 October 2006.

South Carolina Army National Guard. 2007. McCrady Training Center munitions usage data from 1 January 2004 through 18 May 2007.

Technical Information Center

Advanced Sciences, Inc. 1992a. *Hazard Ranking System Score (HRS2) Summary Report for Fort Jackson Military Reservation.*

------. 1992b. *Preliminary Site Inspection Report for Fort Jackson Military Reservation, South Carolina*.

Law Engineering and Environmental Services, Inc.. 1991. *Wonsan/Inchon Explosive Ordnance Disposal Sites, Fort Jackson, South Carolina*.

------. 1993. *Second Draft, RCRA Facility Investigation Report for Wonsan/Inchon Explosive Ordnance Disposal Sites, Fort Jackson, South Carolina*.

The Earth Technology Corporation. 1993. *Final Report, Air Pollution Emission Statement, U.S. Army Training Center and Fort Jackson, Fort Jackson, South Carolina*.

United States Army Aberdeen Test Center (ATC). 2005. *Small Arms Range Training Area Environmental Screening-Level Assessment at Fort Jackson, South Carolina*.

United States Army Corps of Engineers. 1993. *White Phosphorus Wetland Storage Installation Assessment Report, Fort Jackson*.

United States Army Environmental Hygiene Agency. 1990. *Groundwater Quality Study No. 38-26-8822-90 U.S. Army Training Center and Fort Jackson, Fort Jackson, South Carolina, 28 Nov – 8 Dec 1988 and 4-22 Jan 1989*.

United States Army Toxic and Hazardous Materials Agency. 1980. *Installation Assessment of Fort Jackson Report No. 165*.

United States Army Environmental Command (USAEC)

United States Army Environmental Center. 1978. *Environmental Assessment, South Carolina Army National Guard Weekend Training Site, Fort Jackson, South Carolina.*

------. 2006. *October 2006 Final Operational Range Inventory (ORIS).*

United States Army Center for Heath Promotion and Preventive Medicine (USACHPPM)

Fort Jackson Directorate of Plans, Training, Mobilization, and Security. 2006. *Fort Jackson Regulation 350-14: Training Post Range Regulation.*

B3 – Off-Installation / Publicly Available Data Repositories and Databases

Military Munitions Response Program Documents

Malcolm Pirnie, Inc. 2003. *Final U.S. Army Closed, Transferring and Transferred Range/Site Inventory for Fort Jackson, SC.*

------. 2005a. *Final Historical Records Review for Fort Jackson, SC.*

------. 2005b. *Final Site Inspection Work Plan for Fort Jackson, SC.*

------. 2006. *Final Site Inspection Report for Fort Jackson, SC.*

South Carolina Department of Natural Resources

South Carolina Department of Natural Resources. 2007. Statewide GIS data, including fall line, general geologic map, generalized geologic provinces/regions, county soil data, and digital elevation maps.

University of South Carolina

University of South Carolina. 2007. GIS data layers showing watersheds and counties.

Internet Search

City-Data.com. n.d. Columbia, South Carolina. http://www.city-data.com/city/Columbia-South - Carolina.html. (Accessed July 2006).

Country Studies. n.d. The Southern Coastlands. http://countrystudies.us/united-states/geography - 15.htm. (Accessed July 2006).

Fort Jackson. 2006. http://www.jackson.army.mil/. (Accessed July 2006).

GlobalSecurity.org. 2006. Fort Jackson. http://www.globalsecurity.org/military/facility/fort - jackson.htm (Accessed July 2006).

Google Earth. n.d. Aerial map of Fort Jackson, South Carolina and surrounding areas. http://earth .google.com . (Accessed July 2006, November 2006, and June 2007).

Microsoft® Encarta® Online Encyclopedia. 2007. South Carolina. http://encarta.msn.com. (Accessed 14 June 2007).

South Carolina Department of Health and Environmental Control. 2001. *A Preliminary Assessment of the Groundwater Conditions in Charleston, Berkeley, and Dorchester Counties, South Carolina*. http://www.scdhec.net/water. (Accessed November 2006 and June 2007).

------. 2006. *Integrated Report for 2006 Part II: Section 305(b) Assessment and Reporting*. http://www.scdhec.net/eqc/water/pubs/ 305b.pdf. (Accessed November 2006 and June 2007).

South Carolina Department of Natural Resources. 2003. *Ground-Water Resources of Richland County, South Carolina*. http://www.dnr.sc.gov/lwc/pubs/pdfs/richlandcounty.pdf. (Accessed 30 January 2007).

------. 2006. *South Carolina Rare, Threatened, & Endangered Species Inventory: Species Found In Richland County (Last Updated January 17th, 2006)*. https://www.dnr.sc.gov/pls/heritage/ county_species.list?pcounty=richland.

United States Army Corps of Engineers. 1996. *Summary and Evaluation for White Phosphorus Remediation: A Literature Review (Technical Report IRRP-96-7).* http://el.erdc.usace .army.mil/elpubs/pdf/trirrp96-7.pdf. (Accessed 17 February 2007).

------. 1999. *Technical Report IRRP-99-1: Conceptual Model and Process Descriptor Formulations for Fate and Transport of UXO.* http://el.erdc.usace.army.mil/elpubs/pdf/trirrp-99-1.pdf. (Accessed 8 February 2007).

Wikipedia. 2007. Fall Line. http://en.wikipedia.org/wiki/Fall_line. (Accessed 14 June 2007).

B4 – Installation Data Repositories and Databases

Fort Jackson Directorate of Plans, Training, Mobilization, and Security (DPTMS)

Fort Jackson Directorate of Plans, Training, Mobilization, and Security. 2006. RFMSS Data FY 2002 to FY 2006 (1 January 2002 through 12 October 2006).

Fort Jackson Environmental and Natural Resources Division (ENRD)

2c Environmental Services, Inc. 2000. *Fort Jackson Stormwater Sampling Plan and Data.*

Nick Audry to unknown party. 27 Mar 1990. Memorandum. Subject: Weston Lake Well.

Bricka, R.M.. 2002. *Sampling of the Small Arms Training Areas at Fort Jackson.* Mississippi State University.

Gene Stout & Associates. 2004. *Integrated Natural Resources Management Plan and Environmental Assessment 2004-2008.*

Ecology and Environment, Inc. 2001. *Soil Background Study Report for the Fort Jackson Military Installation, Columbia, South Carolina.*

Fort Jackson Environmental and Natural Resources Division. n.d. Map of Inactive and Active Wells at Fort Jackson, SC.

Fort Jackson Installation Geographic Information System. 2003. Scattered, Known, and Suspected Dudded Areas GIS layers.

------. 2004. Identified Erosional Areas GIS layer.

------. 2005. Threatened and Endangered Species Locations GIS layer.

------. Various dates. General installation informational GIS layers.

Law Engineering and Environmental Services, Inc. 2003. *Revised Final Phase II RCRA Facility Investigation Report for Wonsan (SWMU 12) and Inchon (SWMU 17) Explosive Ordnance Disposal Sites, Fort Jackson, South Carolina.* Contract No. DACA21-97-D0034.

Rickard, S. 2006. *REC Site Inspection Report, Fort Jackson, South Carolina.*

South Carolina Department of Health and Environmental Control. 1995. *Technical Report No. 006-95: A Water Quality Assessment of Gills Creek Watershed, Richland County, SC.*

South Carolina Department of Health and Environmental Control and Fort Jackson Directorate of Public Works. 1993 – 1996. *Sampling for Well at Range #20, Fort Jackson, SC.*

South Carolina Department of Health and Environmental Control Bureau of Water. 1997. *The Gills Creek Watershed Project, An Urban Nonpoint Source Project: Richland County, SC.*

------. 2004. *Source Water Assessments of Fort Jackson Water Systems: Normandy Site; Twin Lakes; Omaha Beach; Ohio Range 20.*

South Carolina Department of Health and Environmental Control Bureau of Water to ENRD. 21 Jan 1993. Memorandum. Subject: Replacement Well for Ammo Supply Area, Richland County, SC.

South Carolina Department of Health and Environmental Control Water Quality Monitoring Section. 17 Jul 1995. Memorandum. Subject: Lead Sampling in Rowell Creek, Fort Jackson, SC.

United States Army Environmental Center. 2000 (Revised 2002). *Fort Jackson, South Carolina Integrated Cultural Resources Management Plan (ICRMP).*

------. 2005. *2005 Fort Jackson Installation Action Plan.*

United States Department of Agriculture Soil Conservation Service. 1992. *Fort Jackson Resource Inventory*.

United States Geological Survey. 1998. *Fecal-Indicator Bacteria in Surface Waters of the Santee River Basin and Coastal Drainages, North and South Carolina, 1995-1998*.

------. 1999a. *Shallow Groundwater Quality in the Coastal Plain of Columbia, SC, 1996.*

------. 1999b. *Trace Elements in Bed Sediments and Biota from Streams in the Santee River Basin and Coastal Drainages, North and South Carolina, 1995-1997.*

------. 2000. *Water Quality in the Santee River Basin and Coastal Drainages, North and South Carolina, 1995-1998.*

Fort Jackson Integrated Training Area Management (ITAM) Office

Fort Jackson Integrated Training Area Management Office. 2006. *Fort Jackson Installation Field Map, January 2006 – December 2006.*

McCrady Training Center Environmental Department

Flinchum-Bowles, R.Y. 2000. *South Carolina Army National Guard (SCARNG) Land Condition Trend Analysis Data Report, 1992-1997 Survey Results.*

South Carolina Army National Guard. n.d. SCARNG Conservation Program Overview.

------. Various dates. GIS obtained as shapefiles: Richland County Soils, Solid Waste (SWMU) Points, Installation Well Locations, Threatened and Endangered Flora, Threatened and Endangered Fauna, Red-cockaded Woodpecker Cavity Trees, South Carolina Department of Natural Resources Threatened and Endangered Species found in Richland County, U.S. Parks, Golf and Recreational Areas, South Carolina Parks.

------. Various dates. GIS obtained as both shapefiles and TIFFs: Recreational Areas and Facilities on McCrady Training Site, Geology, Engineering Soils, Munitions Dump Zones, Fort Jackson Non-urban Features, McCrady Cantonment and Recreational Areas, McCrady Hydrology, McCrady Firing Points.

South Carolina Department of Health and Environmental Control, Analytical Services Division. 2005. *Request for Analysis, Drinking Water Monitoring Samples.*

South Carolina Department of Natural Resources. 2001. McCrady Training Center: Neotropical Migratory Bird Survey.

South Carolina Institute of Archaeology and Anthropology. 2003. Integrated Cultural Resources Management Plan.

South Carolina Natural Resources Conservation Service. 2005. *South Carolina Army National Guard, McCrady Training Center, Erosion Control Plans for Priority Sites*.

Underwriters Laboratories, Inc. 2005. *Drinking Water Laboratory Report*.

United States Army Center for Health Promotion and Preventive Medicine. 2007. *South Carolina Army National Guard Statewide Operational Noise Management Plan.*

United States Army Environmental Command and United States Department of Agriculture Forest Service. 2001. *McCrady Training Center Integrated Natural Resources Management Plan (INRMP) Volumes I and II.*

McCrady Training Center Integrated Training Area Management (ITAM) Office

South Carolina Army National Guard. 2006. *Training Ammunition Usage by Facilities Report 01 April 2005 to 30 September 2006.*

------. 2007. RFMSS Data FY 2004 to FY 2007 (1 January 2004 through 18 May 2007).

B5 – Personnel Interviews

Fort Jackson DPTMS Range Officer
Date of interview: 10 October 2006 by Malcolm Pirnie, Inc.
No documents relevant to McCrady Training Center obtained.

Fort Jackson DPTMS Training Facility Coordinator
Date of interview: 27 November 2006 by Malcolm Pirnie, Inc.
Provided locations of several firing points at Fort Jackson and McCrady Training Center.

Fort Jackson ENRD GIS Specialist
Dates of interviews: 11 October 2006 and 4 December 2006 by Malcolm Pirnie, Inc.
Provided GIS layers listed in Appendix B4.

McCrady Training Center Environmental/Conservation Manager
Dates of interviews: 11 October 2006 and 23 May 2007 by Malcolm Pirnie, Inc.
Provided numerous environmental documents listed in Appendix B4.

McCrady Training Center Environmental/Intern
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
No documents obtained.

McCrady Training Center Environmental/Natural Resources Coordinator
Date of interview: 23 May 2007 by Malcolm Pirnie, Inc.
Provided numerous environmental documents and GIS layers listed in Appendix B4.

McCrady Training Center Environmental/Natural Resources Coordinator (former)
Date of interview: 11 October 2006 by Malcolm Pirnie, Inc.
Provided INRMP and Erosion Control Study listed in Appendix B4.

McCrady Training Center Facilities Engineer
Dates of interviews: 11 October 2006 and 24 May 2007 by Malcolm Pirnie, Inc.
Provided groundwater supply well data listed in Appendix B4.

McCrady Training Center Facilities Management Specialist
Date of interview: 23 May 2007 by Malcolm Pirnie, Inc.
No documents obtained.

McCrady Training Center Plans, Operations, and Training Officer/ITAM Coordinator
Dates of interviews: 11 October 2006 and 23 May 2007 by Malcolm Pirnie, Inc.
Provided RFMSS data listed in Appendix B4.

McCrady Training Center Range Operations, Soldier Readiness Program Manager
Date of interview: 23 May 2007 by Malcolm Pirnie, Inc.
No documents obtained.

Mississippi State Professor
Date of interview: 25 January 2007 by Malcolm Pirnie, Inc.
Provided information on small arms ranges study, specifically the lead detection limit used.

31 January 2014

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Subject: Final Report Operational Range Phase II Assessment,
U.S. Army Garrison Fort Jackson and McCrady Training Center, South Carolina

Dear Mr. Estaba and Mr. Mohr:

The PIKA-Pirnie JV is pleased to provide this *Final Report Operational Range Phase Assessmentt, U.S. Army Garrison Fort Jackson and McCrady Training Center, South Carolina* for your review. In addition to the report, the Response to Comments document for the Draft Version of the report and various trip reports for field activities completed are also included. Enclosed are one hard copy of the report and two electronic copies (CDs).

In conformance with our program procedures, this report has also been submitted to the following organizations:

- Assistant Chief of Staff for Installation Management – Installation Services Environmental Division (ACSIM-ISE);
- U.S. Army Environmental Command (USAEC)
- Army National Guard (ARNG) Directorate
- U.S. Army Corps of Engineers (USACE) – Baltimore District
- U.S. Army Institute of Public Health (USAIPH)

If you have any questions, please do not hesitate to contact Mr. Joseph Brutsman, USAEC, at 210-466-1688 or me at 813-242-7215.

Sincerely,

Susan Burtnett, P.E., BCEE
Project Manager
PIKA-Pirnie JV, LLC

c: USACE Program Manager (Andrea Graham) – hard copy and CDs (2)
c: USAEC Program Manager (Joseph Brutsman) – hard copy and CDs (2)
c: ARNG Program Manager (Bonnie Packer) – hard copy and CD
c: USAEC Project Manager (Jeff Davis) – letter only
c: USACHPPM Program Manager (Barrett Borry) – CD only
c: ACSIM-ISE (Malcolm Garg) – CD only

Final Report
Operational Range Phase II Assessment
United States Army Garrison Fort Jackson and McCrady Training Center, South Carolina

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Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
µg/L	micrograms per liter
AMSL	above mean sea level
APP	Accident Prevention Plan
ARCADIS	ARCADIS U.S., Inc. (formerly Malcolm Pirnie, Inc.)
ARID-GEO	Army Range Inventory Database – Geodatabase
ARNG	Army National Guard
bgs	below ground surface
$CaCO_3$	calcium carbonate
CAD	Chromatographic Analysis Division
cm/s	centimeters per second
COC	chain of custody
CSM	conceptual site model
Cu	copper
DI	deionized
DNB	dinitrobenzene
DNT	dinitrotoluene
DO	dissolved oxygen
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DPTMS	Directorate of Plans, Training, Mobilization, and Security
DQO	data quality objective
DU	depleted uranium
ENV	Environmental Division (Fort Jackson)
EPT	Ephemeroptera, Plecoptera, and Trichoptera
HHRE	Human Health Risk Evaluation
HMX	cyclotetramethylenetetranitramine
ID	identification

IDW	investigation-derived waste
ILE	Installations, Logistics, and Environment Division
IRP	Installation Restoration Program
LRU	lower range of uncertainty
Malcolm Pirnie	Malcolm Pirnie, Inc. (now ARCADIS U.S., Inc.)
MC	munitions constituent(s)
MCOC	munitions constituent(s) of concern
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
MMRP	Military Munitions Response Program
mS/cm	millisiemens per centimeter
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolt
NA	not applicable
NG	nitroglycerine
ORA	Operational Range Assessment
ORAP	Operational Range Assessment Program
ORP	oxidation-reduction potential
PAL	project action limit
Pb	lead
PETN	pentaerythritoltetra nitrate
Phase I	ORA Phase I Assessment
Phase II	ORA Phase II Assessment
PIKA	PIKA International, Inc.
PIKA-Pirnie JV, LLC	PIKA-Pirnie Joint Venture Limited Liability Corporation
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RDX	cyclotrimethylenetrinitramine
RFMSS	Range Facility Management Support System

RMUS	Range and Munitions Use Subcommittee
RPD	relative percent difference
Sb	antimony
SCARNG	South Carolina Army National Guard
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SDG	Sample delivery group
SLERA	Screening Level Ecologic Risk Assessment
SOP	standard operating procedure
SVOC	semi-volatile organic compound
SWMU	solid waste management unit
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TNT	trinitrotoluene
TOC	total organic carbon
U	uranium
UCLM	upper confidence limit of the mean
U.S.	United States
USACE	United States Army Corps of Engineers
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
USAEC	United States Army Environmental Command
USAIPH	United States Army Institute of Public Health
USAPHC	United States Army Public Health Command
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UXO	unexploded ordnance
VOC	volatile organic compound
W	tungsten
WP	white phosphorous
XRF	X-Ray fluorescence
Zn	zinc

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Executive Summary

To meet Department of Defense (DoD) requirements and support the United States (U.S.) Army's Sustainable Range Program, U.S. Army Environmental Command (USAEC) and the Army National Guard (ARNG) Directorate are conducting assessments to determine whether a release or substantial threat of release of munitions constituents of concern (MCOC) from an operational range to an off-range area creates a potentially unacceptable risk to human health or the environment. The initial Operational Range Assessment Program (ORAP), Phase I, was a qualitative study of whether MCOC sources exist on the operational range footprint, potential migration mechanisms exist, and human or sensitive ecological receptors are present. For the operational range footprints having a potentially complete source-receptor pathway, the Army conducts a Phase II, a quantitative assessment of potentially complete pathways of MCOC to other than operational areas. This ORAP Phase II Report presents evaluation of source-receptor pathways on the combined footprint of Fort Jackson and McCrady Training Center, South Carolina. Combining the Phase II assessments for these two installations was a decision agreed upon by both the USAEC and the ARNG Directorate as a more efficient method to assess the potential source-receptor interactions for two installations immediately adjacent to one another. Thus, this Phase II Report presents the evaluation of source-receptor interaction at both Fort Jackson and McCrady Training Center. Activities completed as part of this Phase II were performed by Malcolm Pirnie, Inc. (now ARCADIS U.S., Inc.) under contract numbers W912DR-05-D-004 and W912DR-09-D-0016 with the U.S. Army Corps of Engineers – Baltimore District, and by the PIKA-Pirnie Joint Venture, LLC under contract number W912DY-10-D0025 with the U.S. Army Engineering and Support Center, Huntsville.

To determine whether MCOC were leaving the operational range by an identified pathway (e.g., groundwater, surface water) and posed a potential risk to off-site receptors, the ORAP team re-evaluated existing information (*e.g.*, prior sampling reports) and collected media samples. All available information was used to update the conceptual site model (CSM) and perform screening-level risk assessments to determine whether there has likely been an MCOC release from the operational range that may pose an unacceptable risk to an off-range receptor.

Fort Jackson and McCrady Training Center are adjoining installations, together occupying approximately 51,961 acres in Richland County, South Carolina (**Figure ES-1**). The South Carolina Army National Guard (SCARNG) holds a nonexclusive license for training operations on approximately 15,267 acres of the eastern portion of Fort Jackson. These 15,267 acres comprise the McCrady Training Center. Fort Jackson (as well as the portion now leased by SCARNG) has served as a military training facility since 1917. During World War II, Fort Jackson became a permanent military installation used primarily for infantry training.

Phase II multi-season sampling occurred between 2009 and 2013. **Figure ES-2** shows important features of the surface water system and a generalized CSM for surface water at the installation. The surface water CSM identifies potential sources of MCOC, watersheds and the specific surface water pathways by which these constituents could migrate (*i.e.*, streams) off the operational range footprint, and off-range human and ecological receptors that may be affected by migrating MCOC. The figure also shows the locations at which samples were collected as part of this assessment. **Figures ES-3** shows important features of the groundwater system at

Fort Jackson and McCrady Training Center and a generalized CSM. The groundwater CSM identifies potential sources of MCOC, inferred and actual groundwater flow directions, areas where potential human receptors utilize groundwater, and locations at which samples were collected as part of this assessment. The ORA team selected sampling locations to answer the study question: could munitions constituents migrate off the operational range footprint at concentrations that may pose a risk to receptors?

The following executive summary sections present the Phase II evaluation of source-receptor interactions.

1 Conceptual Site Model

1.1 Potential Sources

Operational ranges at Fort Jackson consist of training and maneuver areas, live-fire ranges, dudded and non-dudded impact areas, artillery and mortar firing points, and specialty training areas. Operational ranges at McCrady Training Center include: training and maneuver areas, firing points, and live-fire areas. The types of munitions historically and currently fired at Fort Jackson and McCrady Training Center are small caliber, medium caliber, large caliber, pyrotechnics/obscurants, and other munitions. Munitions constituents for this assessment are:

- Metals (primarily from small arms): antimony (Sb), copper (Cu), lead (Pb), tungsten (W) zinc (Zn), and uranium (U)
- Explosives, among which is cyclotrimethylenetrinitramine (RDX)
- Propellants (nitroglycerin [NG] and perchlorate)

1.2 Migration Pathways and Assessment Areas

MCOC (metals, propellants, and explosives) from the range footprint area may migrate via dissolved and particulate runoff into streams, and/or by infiltrating into groundwater. Groundwater may enter streams through seeps or springs either on- or off-installation.

Three major surface water drainage basins are present at Fort Jackson and McCrady Training Center: (1) Colonels Creek (including Jumping Run Creek), (2) Cedar Creek (which includes Weston Lake, and (3) Gills Creek (**Figure ES-2**). These three watersheds drain the overwhelming majority of the installations and operational ranges. Phase II sampling was conducted in each these three basins. Two other smaller surface water basins occur on installation (Mill Creek and Wildcat Creek) but do not drain a significant portion of the operational range area.

Groundwater at Fort Jackson and McCrady Training Center occurs within unconsolidated sediments and the underlying bedrock. Previously completed investigations in the region and data collected as part of this assessment confirm that shallow groundwater generally discharges to nearby streams (including those on installation such as Gills Creek, Cedar Creek, Colonels Creek, and Jumping Run Creek) while deeper groundwater flows to the south and southeast

towards the Congaree and Wateree rivers. Groundwater occurring within bedrock is not generally utilized in the areas downgradient of the installation. The CSM illustrates groundwater flow and where Phase II groundwater sampling was conducted (**Figure ES-3**).

1.3 Potential Receptors

The City of Columbia supplies drinking water to the population to the northwest and west of the installation from a source well outside of the influence of range activities. This supply network also extends to the south end of the installation and covers the area from Fort Jackson's southwest corner to near Weston Lake. Properties located south of the installation and east of Weston Lake use groundwater for drinking water. A review of available well databases showed hundreds of wells located in the area. MCOC migrating in groundwater may affect human receptors south of the installation where groundwater is used as a drinking water source.

The surface water system provides migration pathways and contact opportunities between potential MCOC sources and off-range human and ecological receptors. For each of the watersheds, potential downstream human receptors include the recreational users of the surface water bodies leaving the installations. For Cedar Creek and Gills Creek in particular, the Fort Jackson Family and Morale, Welfare and Recreation division maintain recreational facilities on Weston Lake and Boyden Arbor Pond, respectively, to provide access for use by the public. Recreational activities include fishing. Potential ecological receptors in surface water bodies leaving the installations include the sensitive wetland habitats downstream of operational areas and threatened and endangered species which may use surface water during part of their life-cycle. This assessment uses wetland areas as surrogates for sensitive species.

2 Sampling Program

2.1 Sampling Program Summary

2.1.1 Surface Water System Assessment

Table ES-1 summarizes the watersheds/assessment areas, sampling media, types of MCOC, and the rationale for sample locations.

Gills Creek Watershed: The ORA team collected surface water samples at a downstream location (GC2) and analyzed samples for metals, propellants, and explosives to assess potential impacts to human and ecological receptors in the area. Sediment samples were also collected at this location and analyzed for metals and explosives. Samples of surface water and sediment were also collected from an upstream location (GC1), and were used to represent reference or background concentrations. Samples of the benthic macroinvertebrate community were not collected in the Gills Creek watershed due to a lack of a suitable sampling area at the downstream location.

Cedar Creek Watershed: Cedar Creek originates within the operational range footprint of the combined installation, so there is no upstream/reference sampling location available within the watershed. Upstream sampling locations in Colonels Creek (CC1 and CC2) were utilized to

represent reference or background concentrations in the Cedar Creek watershed. Cedar Creek flows into Weston Lake which is dammed near the installation boundary. The lake discharges through an outflow at the installation boundary, where Cedar Creek resumes. In order to assess the Cedar Creek watershed the ORA team collected samples from two downstream locations in Weston Lake (WL1 and WL2) (**Figure ES-2**). Surface water samples collected from Weston Lake were analyzed for metals MCOC (Pb, Cu, Zn, and Sb), propellants, and explosives. Sediment samples collected from Weston Lake were analyzed for metals (Pb, Cu, Zn, and Sb) and explosives. Samples of the benthic macroinvertebrate community were not collected due to a lack of suitable sampling locations.

Colonels Creek Watershed: The ORA team collected surface water samples at a downstream location on Colonels Creek (CC3) and a downstream location in Jumping Run Creek (JC1), and analyzed samples for metals, propellants, and explosives. Sediment samples were also collected at these locations and analyzed for metals and explosives. Samples of surface water and sediment were collected from two upstream locations on Colonels Creek (CC1 and CC2) and were used to represent reference or background concentrations. Samples of the benthic macroinvertebrate community were also collected from all four sampling locations within the Colonels Creek watershed to assess the health of the aquatic community.

Table ES-1: Surface Water System MCOC Sampling Summary

Location	Sampled Media	Applicable MCOC	Receptors	Purpose
Gills Creek Watershed				
GC2	Surface Water Sediment	Metals Explosives Propellants[1]	Human and ecological	Downstream location within the operational range boundary draining a primarily non-dudded impact area and many of the small arms ranges within the Gills Creek watershed.
GC1			NA	Reference location upstream of potential source areas in the Gills Creek watershed.
Cedar Creek Watershed				
WL1	Surface Water Sediment	Metals Explosives Propellants[1]	Human and ecological	Downstream of firing ranges and dudded impact area. Also within the footprint of an area under investigation as part of the Military Munitions Response Program (MMRP).

Location	Sampled Media	Applicable MCOC	Receptors	Purpose
WL2				Downstream of firing ranges and dudded impact area within the Cedar Creek watershed. Location was shifted approximately 250 feet to the west for the dry season events, because the original locations were not accessible due to lower lake levels. Located within the footprint of an MMRP investigation area.
Colonels Creek Watershed				
CC1	Surface Water Sediment	Metals Explosives Propellants[1]	NA	Reference location upstream of potential source areas within the Colonels Creek watershed. Also used to provide reference information for the Cedar Creek watershed.
CC2				Reference location upstream of potential source areas in the McCrady Training Center in the Colonels Creek watershed. Also used to provide reference information for the Cedar Creek watershed.
CC3			Human and ecological	Downstream location within the operational range boundary draining more than half of the combined operational range area in the Colonels Creek Watershed.
JC1				Downstream location within the operational range boundary draining live-fire ranges and current and historical impact area within the Colonels Creek watershed. Jumping Run Creek also receives groundwater discharge that originates within the impact area.

Notes:
[1] – Sediment samples were analyzed for NG but not perchlorate.
NA – not applicable

2.1.2 Groundwater System Assessment

The groundwater system was assessed through the identification and evaluation of a worst-case scenario. The groundwater assessment area shown on **Figure ES-3** represents one of the most heavily-utilized impact areas within the combined installation footprint. Groundwater system

investigation activities performed in 2009, 2012, and 2013 included installation of piezometers to evaluate groundwater flow, drilling of soil borings and collection of depth-discrete groundwater samples, sampling of existing groundwater wells, and installation and sampling of new groundwater monitoring wells within the installation footprint.

Piezometers were installed in 2009 to collect water level data and to assist in the selection of drilling locations for soil borings for depth-discrete groundwater sampling. These borings were installed and 29 groundwater samples were collected at approximately 20-foot intervals from the water table down to a pre-determined depth at five locations (SB-2 through SB-6) based on the depths at which off-installation receptor wells are screened. On-installation wells were also sampled during 2009. Laboratory analyses of these samples included metals, explosives, and propellants. Metals and propellants were not detected in concentrations exceeding project action limits (PALs) during the 2009 sampling activities. However, the explosive RDX was detected in one of the wells, leading to additional groundwater investigation activities in 2012 and 2013. Six monitoring well pairs (each consisting of a shallow and deep well) were installed downgradient of the potential source area and the previous RDX detection location and upgradient of off-installation residential drinking water wells.

Three independent groundwater sampling events were completed between July 2012 and February 2013, using Hydrasleeves™ to collect representative groundwater samples from each of the newly installed monitoring wells. Before sampling began, guidance received from the Army indicated that munitions containing depleted U had been used at Fort Jackson. Therefore, laboratory analyses of groundwater samples collected from July 2012 to February 2013 included explosives, which were the remaining MCOC following evaluation of the 2009 groundwater sampling results, and U and U-isotopes. A summary of the groundwater sampling program is provided in **Table ES-2**.

Table ES-2: Groundwater Sampling Summary

Location	Sampled Media/ Frequency	Applicable MCOC	Receptors	Purpose
2009 Activities				
SB-2 SB-3 SB-4 SB-5 SB-6	Groundwater/ Once	Metals Explosives Propellants	Human and Ecological	Downgradient of main impact area. Depth-discrete groundwater samples were collected starting at the water table and then at approximately 20 foot intervals to a target elevation of 175 feet above mean sea level.
P1 P2			Ecological	Downgradient of main impact area. Groundwater samples were collected from piezometers to assess potential MCOC concentrations in groundwater adjacent to surface water bodies.

Location	Sampled Media/ Frequency	Applicable MCOC	Receptors	Purpose
Weston Lake Supply Well (WL1)			Human and ecological	Downgradient of main impact area. Groundwater sample was collected to assess potential MCOC concentrations in groundwater utilized as a drinking water source at the Weston Lake recreation area.
2012 – 2013 Activities				
MW-RS-02S MW-RS-02D MW-RS-03S MW-RS-03D MW-RS-04S MW-RS-04D MW-RS-05S MW-RS-05D MW-RS-06S MW-RS-06D MW-RS-07S MW-RS-07D	Groundwater/ Three times in one year	U U Isotopes Explosives	Human	Downgradient of main impact area and SB-3 location where RDX was detected in 2009. Groundwater samples were collected three times over the course of a year to assess whether MCOC were present and identify potential seasonal variations in concentrations.

Notes:

D – Deep Well
MW – Monitoring Well
P - Piezometer
RS – Installed using Rotosonic® Drilling
S – Shallow Well
SB – Soil Boring
U - Uranium
WL – Weston Lake

2.2 Sampling and Analytical Methods

Streams: The ORA team conducted Phase II sampling during both wet and dry seasons, including one storm event. Surface water samples were collected using the 'clean-hands' method (U.S. Environmental Protection Agency [USEPA] Method 1638) as 24-hour or 2-hour composites whenever conditions allowed; grab samples were used when composite samples were unavailable due to safety issues or when automated composite samplers malfunctioned. During a dry season event, the team collected composite sediment samples in triplicate from the same depositional areas as the surface water sampling locations. The benthic macroinvertebrate community was sampled at four of the surface water system sampling locations (CC1, CC2, CC3, and JC1) in the Colonels Creek watershed during the wet and dry season.

Groundwater: In 2009, piezometers (P1 and P2) were installed and sampled using standard low-flow sampling procedures with a peristaltic pump. The supply well at Weston Lake (WL1 on **Figure ES-3**) was sampled from a pre-treatment outlet at the well head. Procedures utilized for

the collection of samples from temporary wells included: drilling to the anticipated sample depth using Rotosonic® technology, choosing a sampling interval based upon review of the retrieved sample core, advancement of a three-foot long pre-cleaned stainless steel well screen attached to a packer to the appropriate depth, sealing off a discrete interval within the aquifer, utilizing a submersible pump to purge water until water quality readings stabilized, and collection of the groundwater sample. The interval over which the aquifer was sampled was chosen based upon the depths of off-installation residential and supply wells.

Well clusters installed in 2012 were constructed as standard 2-inch inside diameter monitoring wells with shallow and deeper wells installed side-by-side in a 10-inch diameter soil boring. The screen depths were chosen to intercept groundwater from similar intervals in which RDX was detected during 2009. Centralizers were utilized to maintain appropriate spacing between the boring wall and, where present, adjacent casing. These wells were sampled three times (July and November 2012, and February 2013) using HydraSleeves™. The sampling procedure consisted of placing the sampling sleeves in the wells and allowing the wells to equilibrate for a sufficient period of time. For the first sampling event (July 2012), the sleeves were placed two weeks prior to sampling. Following the July 2012 event, new sleeves were lowered into the well following sampling. The sleeves, along with a new samples, were retrieved during the November 2012 sampling event. The same procedure was followed for the final February 2013 event.

Laboratory Analytical Methods and Project Action Limits: Surface water, sediment, and groundwater samples were submitted to DoD National Environmental Laboratory Accreditation Program certified laboratories for analysis. The following analytical methods were used for medium-specific analysis.

Surface water was analyzed for:

- Explosives by U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) Standard Operating Procedure (SOP) Chromatographic Analysis Division (CAD) Method 13.3
- Perchlorate by USEPA Method SW6850
- Dissolved metals (Sb, Cu, Pb, Zn, and W) by USEPA Method 1638M
- Hardness metals (calcium and magnesium) by USEPA Method 200.7

Sediment was analyzed for:

- Explosives by USEPA Method SW8330A
- Total metals (Sb, Cu, Pb, Zn, and W) by USEPA Method SW6020
- Total organic carbon (TOC) by USEPA technical report number CE-81-1 (Walkley-Black Method)

Benthic Macroinvertebrates were analyzed for:

- Species diversity (Shannon's diversity index)
- Species richness
- Ephemeroptera, plecoptera, and trichoptera (EPT) richness
- EPT percent contribution

Groundwater was analyzed for:

- Explosives by USACHPPM SOP CAD 13.3 (2009 samples) and by USEPA 8330B (2012/2013 samples)
- Perchlorate by USEPA 6850 (2009 samples)
- Hardness metals (calcium and magnesium) plus sodium by USEPA E200.7 (2009 samples)
- Total and dissolved metals (Sb, Cu, Pb, Zn, and W) by USEPA 200.8 (2009 samples)
- U and U-isotopes by USEPA 6020 (2012/2013 samples)
- Anions (sulfate, chloride, and nitrate) by USEPA 300.0 (2009 samples)
- Alkalinity by USEPA 310.1/SM2320B (2009 samples)
- Total dissolved solids (TDS) by SM2450C (2009 samples)

PALs for surface water, sediment, and groundwater were established for the potential MCOC. For Fort Jackson and McCrady Training Center, PALs are based on the lower of either the DoD Range and Munitions Use Subcommittee (RMUS) 2012 Operational Range Assessment Screening Values Version 6.0, updated 21 May 2012 (DoD, 2012), or the South Carolina Department of Health and Environmental Control (SCDHEC) *R.61-68, Water Classifications & Standards* (22 June 2012).

For metals in surface water, the ORA and SCDHEC ecological criteria are identical. For surface water and sediment, the ORA screening values (both human and ecological) for explosives MCOC are lower and so are selected as the PALs. The ORA screening values for freshwater ecological acute and chronic toxicity of Cu, Pb, and Zn are adjusted by a formula and are inversely proportional to the measured hardness concentration[1]. Therefore, hardness concentrations were measured to calculate screening criteria for those metals with hardness-dependent criteria in surface water. All measured surface water hardness values were below 25 milligrams per liter (mg/L) Calcium Carbonate ($CaCO_3$). The surface water event/assessment area-specific PALs are listed in **Table ES-3**. MCOC concentrations detected in storm event samples were compared to the respective acute screening value. MCOC concentrations detected in all other event samples were compared to the respective chronic screening values. Sediment PALs are presented in **Table ES-3**.

For metals, explosives, and perchlorate in groundwater, PALs are based on the lower of either the ORA human drinking water screening levels (DoD, 2012) or the SCDHEC values for human health. For each MCOC listed, the ORA value was either the same or more restrictive than the SCDHEC value, so ORA values were selected as PALs. Groundwater PALs are included in **Table ES-3**.

[1] A relative increase in hardness will lower the ecological toxicity of Cu, Pb, and Zn in surface water resulting in an increase in the ecological risk screening criteria/PAL. The SCDHEC utilizes the same hardness based formulae as the ORA screening values (DoD, 2012) to calculate the ecological risk screening criteria/PAL.

Table ES-3: PALs

	Medium	SURFACE WATER					SEDIMENT	GROUND-WATER
	Screening Criteria Type	Human Health	Ecological		Selected PAL		Ecological	Human Health
	Event	All	Chronic (Wet and Dry Season)	Acute (Storm)	Chronic	Acute	All	All
Analyte	Units	(µg/L)	(µg/L)	(µg/L)	(µg/L)		(mg/kg)	(µg/L)
MCOC Metals								
Sb		5.6 [b]	30 [a]	30 [a]	5.6 [b]	5.6 [b]	12 [a]	5.6 [b]
Cu		620 [a]	2.7 [a]	3.6 [a]	2.7 [a]	3.6 [a]	34 [a]	620 [a]
Pb		15 [a]	0.54 [a]	14 [a]	0.54 [a]	14 [a]	47 [a]	15 [a]
W		NA	NA	NA	NA	NA	NA	NA
Zn		4,700 [a]	36 [a]	36 [a]	36 [a]	36 [a]	150 [a]	4,700 [a]
U and U Isotopes		Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not Sampled	30 [c]
Perchlorate								
Perchlorate		15 [a]	9,300 [a]		15 [a]		--	15 [a]
Explosives MCOC [d]								
RDX		0.61 [a,e]	190 [a]		0.61 [a,e]		0.013 [f]	0.61 [a,e]
DNB		1.5 [a]	20 [a]		1.5 [a]		0.0067 [f]	1.5 [a]

NOTES:

mg/kg = milligrams per kilogram

mg/L = milligrams per liter

µg/L = micrograms per liter

NA = No applicable screening level is available

(a) Human health and ecological screening criteria for metals and explosives MCOC are based on DoD *Operational Range Assessment Screening Values,* Version 6.0 (DoD, 2012) for freshwater.

(b) South Carolina Water Classifications and Standards. SC Regulation § 61-68. (SC, 2012).

(c) The PAL listed is based upon the USEPA drinking water MCL for uranium of 30mg/L.

(d) RDX and Dinitrobenzene (DNB) were the only explosives MCOC detected in surface water and/or sediment at Fort Jackson and McCrady Training Center. All other explosives PALs can be found in **Appendix B** summary tables.

(e) No promulgated standard is currently available. USEPA IRIS values were used for ORA and apply here.

(f) RDX and DNB sediment screening values shown in table are based on a minimum 1 percent total organic carbon (TOC) concentration. The RDX and DNB screening values for sediments with a higher associated total organic carbon is obtained by multiplying the measured TOC (up to a maximum value of 100 percent) by the sediment PAL value shown to a maximum value of 1.3 mg/kg for RDX and 0.67 mg/kg for DNB.

3 Results and Discussion

3.1 Surface Water Assessment

Of the three watersheds evaluated, only the Gills Creek watershed results indicate that munitions constituents (Cu and Pb) were detected near the range boundary at concentrations above the PAL for ecological receptors. The results for all three watersheds are described below.

Gills Creek Watershed

Explosives and perchlorate were not detected at concentrations exceeding the PAL in any of the surface water or sediment samples collected within the Gills Creek watershed. As shown on **Figure ES-4**, Cu concentrations exceeded the PAL in two of the four surface water samples collected at the downstream location (GC2), and Pb concentrations exceeded the PAL in all four of the downstream surface water samples.

In one of the three sediment samples collected at downstream location GC2, Cu exceeded the ecological PAL and also exceeded the Cu concentrations at reference location GC1 by more than two orders of magnitude. Pb in sediment collected at GC2 exceeded the ecological PAL in two of three samples, and also generally exceeded the concentrations at the reference location GC1 by more than two orders of magnitude.

Due to the Cu and Pb exceedances in surface water and sediment, a Screening Level Ecological Risk Assessment (SLERA) was completed using data collected in Gills Creek. The SLERA found a potential for adverse health effects in aquatic life from exposure to Cu and Pb in surface water at the range boundary (Location GC2). Immediately downstream of location GC2 and the operational range boundary, Gills Creek enters Boyden Arbor Pond, which is located within the installation boundary.

Colonels Creek Watershed:

No MCOC (metals, explosives, and perchlorate) were detected above their respective PALs at the downstream locations CC3 and JC1 in either surface water or sediment. In samples from upstream/reference location CC2, Pb was detected in surface water at concentrations that exceeded the PAL. Pb and dinitrobenzene were detected in sediment at concentrations exceeding PALs. Because the sample location is upstream of operational areas, these exceedances did not originate in operational areas. Given the lack of MCOC exceeding the PALs in any of the downstream samples analyzed, the results of the Colonels Creek watershed sampling indicate that MCOC are not migrating off the operational range footprint via Colonels Creek at concentrations that could pose an unacceptable risk to human or ecological receptors.

The results of the population index evaluation for the benthic macroinvertebrate communities in Colonels Creek indicate no significant difference in metrics between the reference and downstream locations, which is consistent with the surface water and sediment sampling results.

Cedar Creek Watershed:

No explosives or perchlorate were detected at concentrations exceeding the PALs in any sediment or surface water samples collected within the Cedar Creek watershed. Cu and Pb were detected slightly above their respective PALs in one of the three sediment samples collected at WL2 (refer to Figure ES-4 for concentrations). Although concentrations of Cu and Pb in sediment exceeded the PALs at WL2, these exceedances are likely due to sources not associated with operational ranges.

Given that no MCOC were detected above the PALs in any of the samples collected at WL1 and that results from WL2 location are consistent with historical munitions usage of the MMRP site, results of the Cedar Creek watershed sampling indicate that MCOC are unlikely to migrate off

the operational range footprint via Cedar Creek at concentrations that pose an unacceptable risk to human or ecological receptors.

3.2 Groundwater Assessment

2009 Results

In 2009, the total Pb concentration in one of the 29 depth-discrete samples collected from the five borings exceeded the PAL; however, dissolved Pb in that sample was below the PAL. Total and dissolved Zn concentrations exceeded the PAL in one of the 29 samples collected. In each case, Pb and Zn were only detected above the PAL in one sampling interval. In the case of Pb, the sample which exceeded the PAL was collected at the water table. The sample collected immediately below the interval contained total Pb at a concentration well below the PAL (concentration of 3.1 µg/L compared to the PAL of 15 µg/L). For Zn, the samples collected both above and below the interval that contained the exceedances again contained Zn at concentrations well below the PAL. The total Zn concentration in the interval above was 438 µg/L while the concentration in the sample below was 577 µg/L. The PAL for Zn in groundwater is 4,700 µg/L. Because the Pb and Zn exceedances were so limited in extent, it is unlikely that these results are indicative of groundwater impacted by Pb or Zn from munitions. It is also unlikely that either Pb or Zn in groundwater presents a risk to off-range receptors.

Perchlorate was detected in eight depth-discrete samples from three of the five boring locations and in an existing water supply well on the installation near Weston Lake. All of these perchlorate concentrations were two orders of magnitude below the PAL.

RDX was detected in three depth-discrete groundwater samples collected in 2009 over an approximately 60-foot-thick interval at soil boring location SB-3. All samples were collected from the same aquifer depth intervals in which downgradient water supply wells are screened. Although all RDX concentrations were below the PAL, the presence of RDX in groundwater upgradient of, but close to the operational range boundary warranted additional assessment.

2012 – 2013 Results

The 2012 and 2013 sampling activities consisted of collecting groundwater samples from the newly installed monitoring well clusters that were installed near the operational range boundary, downgradient of the SB-3 location. Three rounds of groundwater samples were collected from the 12 new wells from July 2012 to February 2013 (for a total of 36 groundwater samples) and analyzed for explosives, U, and U-isotopes. Results for each of the three sampling events are summarized on **Figure ES-5**. As indicated on the figures, U was detected (as U-238) in one of the 36 samples at a concentration two orders of magnitude below the human health PAL. Also, the isotopic ratios indicated that the U-238 detected is naturally occurring in the groundwater and is, therefore, not related to munitions use. Multiple explosives analytes were detected in groundwater during each of the sampling events. However, only low concentrations of RDX were detected consistently.

The RDX concentrations detected exceeded the groundwater PAL in samples collected from MW-RS-04D and MW-RS-06D, which are near the operational range and installation boundary and directly upgradient of off-range receptors, during all three rounds of sampling. These results

indicate that RDX from operational range sources has reached groundwater. However, uncertainty remains regarding whether RDX is migrating off the operational range footprint.

The PAL for RDX is the USEPA's Integrated Risk Information System screening value of 0.61 µg/L. Screening values tend to be conservative and it is notable that there is no RDX drinking water maximum contaminant level (Federal standard) or state standard available for comparison. The USEPA does list 2.0 µg/L as a lifetime health advisory level for RDX. All measured concentrations in surface water and groundwater during this assessment fall well below this value.

A human health risk evaluation (HHRE) of the RDX detections in groundwater from the wells installed in 2012 near the operational range boundary was performed. The HHRE concluded that potential exposure to RDX concentrations detected in groundwater samples collected from the on-installation wells is unlikely to result in unacceptable health risks.

4 Conclusions

A summary of the CSM and conclusions for each of the watersheds and groundwater assessment area are included in **Table ES-4**. Conclusions are presented below.

Surface water, sediment, and benthic macroinvertebrate sampling data indicate MCOC are not migrating off-range via Colonels Creek or Cedar Creek. Because Cedar Creek surface water and sediment sampling data are considered conservatively representative of Mill Creek conditions, these data also indicate MCOC are not likely migrating off-range via Mill Creek. Surface water and sediment sampling data from the Gills Creek watershed included Pb and Cu concentrations exceeding PALs. The SLERA performed on those results indicates that the potential for adverse ecological health effects from exposure to sediment in Gills Creek at the operational range boundary is likely low. However, based on the low pH in surface water and low TOC in sediment, these metals may become mobile and bioavailable.

Groundwater sampling data indicate that RDX has infiltrated to groundwater. This groundwater containing detectable concentrations of RDX has migrated to groundwater monitoring wells near the operational range and installation boundary, upgradient of off-range wells used for drinking water. Uncertainty remains regarding whether RDX has migrated off the operational range. The implementation of best management practices can serve to limit or slow the migration of MCOC at Fort Jackson and McCrady Training Center.

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Table ES-4: Conceptual Site Model with Conclusions

Study Area	Potential Source Areas	Potential MCOC*	Pathway(s)	Human Receptors	Ecological Receptors	Conclusions and Rationale
Gills Creek	Small arms range, western impact area, and non-live-fire training areas	Metals (Sb, Cu, Pb, W, Zn); Explosives; and Perchlorate	Gills Creek and Forest Lake (west and southwest of Fort Jackson in Gills Creek watershed)	Recreational users of Weston Lake, Twin Lakes, Sun View Lake, Lake Rebecca, and Forest Lake	Wetlands and threatened and endangered species downstream	Results indicate a potential for MCOC to migrate off-range via the surface water pathway.
Colonels Creek	Multipurpose ranges, artillery and mortar firing points and demolition sites Multipurpose ranges, artillery and mortar firing points, western impact area, demolition sites	Metals (Sb, Cu, Pb, W, Zn); Explosives; and Perchlorate	Colonels Creek Groundwater (evaluated through the groundwater assessment area)	Recreational users of Colonels Creek Users of groundwater as a drinking water supply	Wetlands and threatened and endangered species downstream Wetlands and threatened and endangered species downstream	Results indicate MCOC are unlikely to migrate off-range via the surface water pathway at a concentration that poses a risk to human or ecological receptors.
Cedar Creek		Metals (Sb, Cu, Pb, W, Zn); Explosives; and Perchlorate	Weston Lake and Cedar Creek (non-operational area southwest of the eastern impact area in Cedar Creek watershed) Twin Lakes (west of operational range area in cantonment area), Mill Creek, Sun View Lake, and Lake Rebecca (southwest of Fort Jackson in Mill Creek watershed); Groundwater (evaluated through the groundwater assessment area)	Recreational users of Weston Lake Users of groundwater as a drinking water supply		
Groundwater Assessment Area	Multipurpose ranges, artillery and mortar firing points and demolition sites, impact areas	Metals (Sb, Cu, Pb, W, U, and Zn); Explosives; and Perchlorate	Surficial groundwater aquifer to the south and west of Fort Jackson and McCrady Training Center	Residents down gradient (south and west of Fort Jackson and McCrady Training Center)	Wetlands and threatened and endangered species downstream where groundwater discharges to surface water	Results indicate RDX is present in groundwater and has migrated to groundwater monitoring wells near the operational range and installation boundary, upgradient of off-range wells used for drinking water.

* - As identified during Phase I

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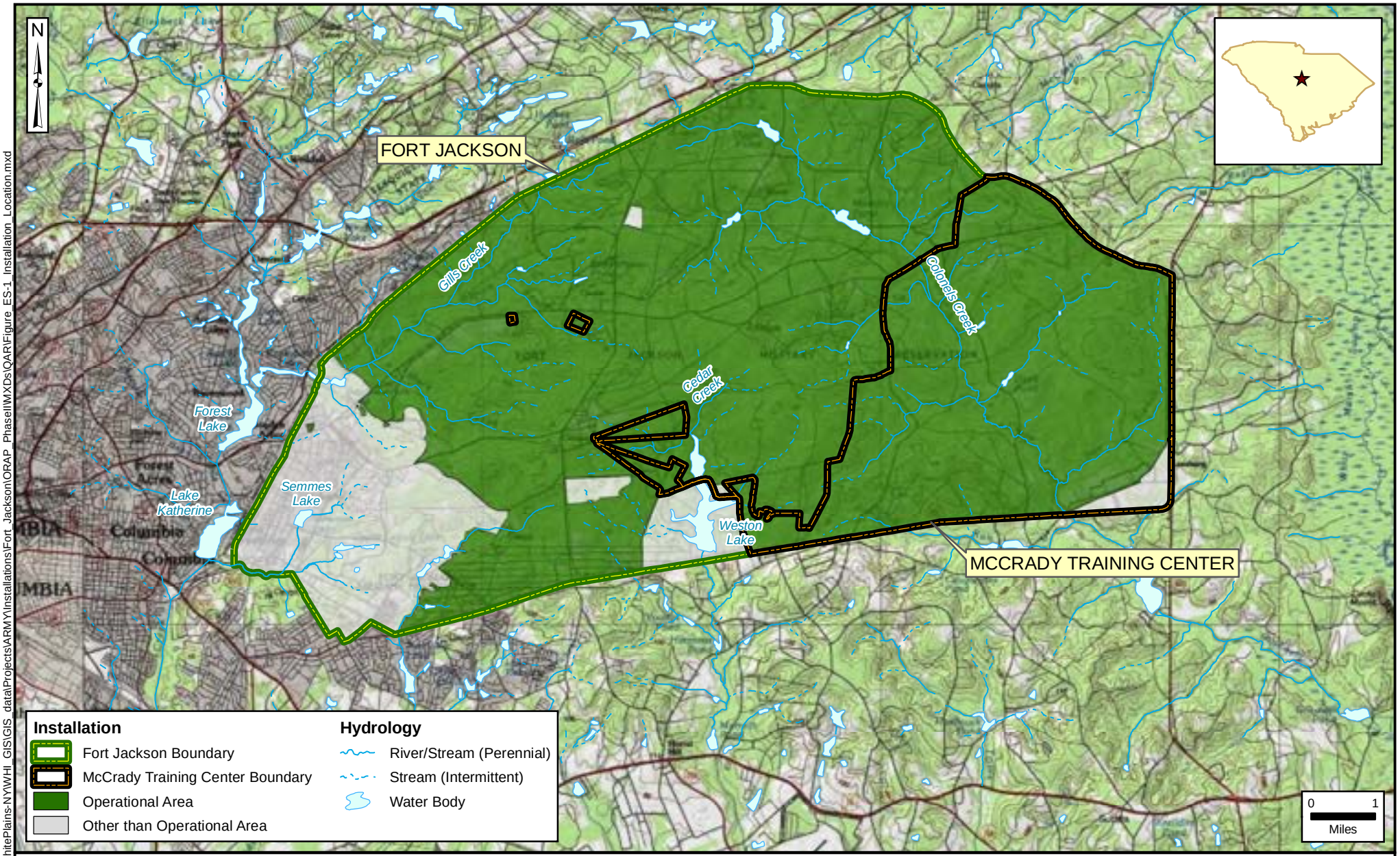

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Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure ES-1
Installation Location Map

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

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Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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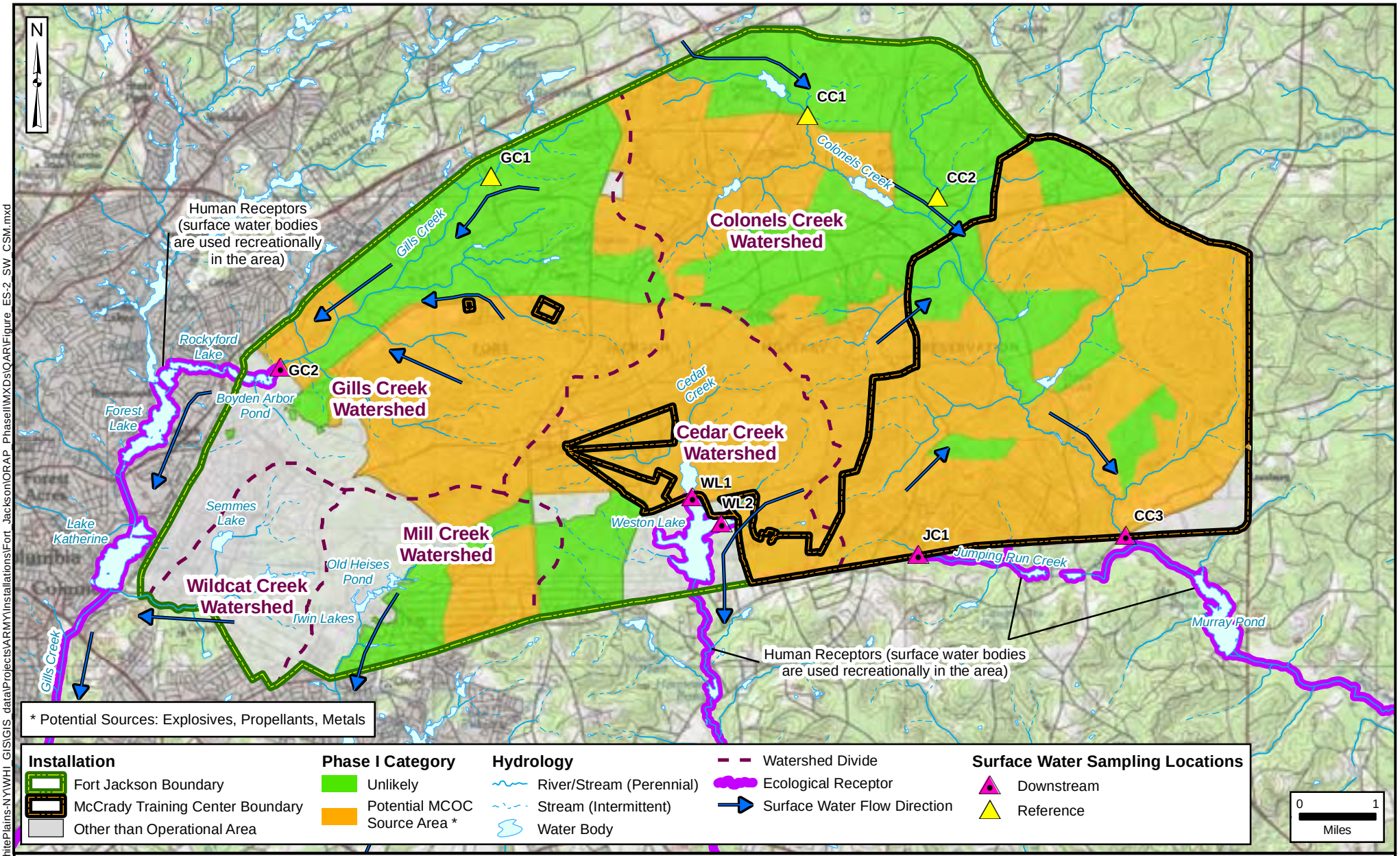

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Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure ES-2
Surface Water CSM

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

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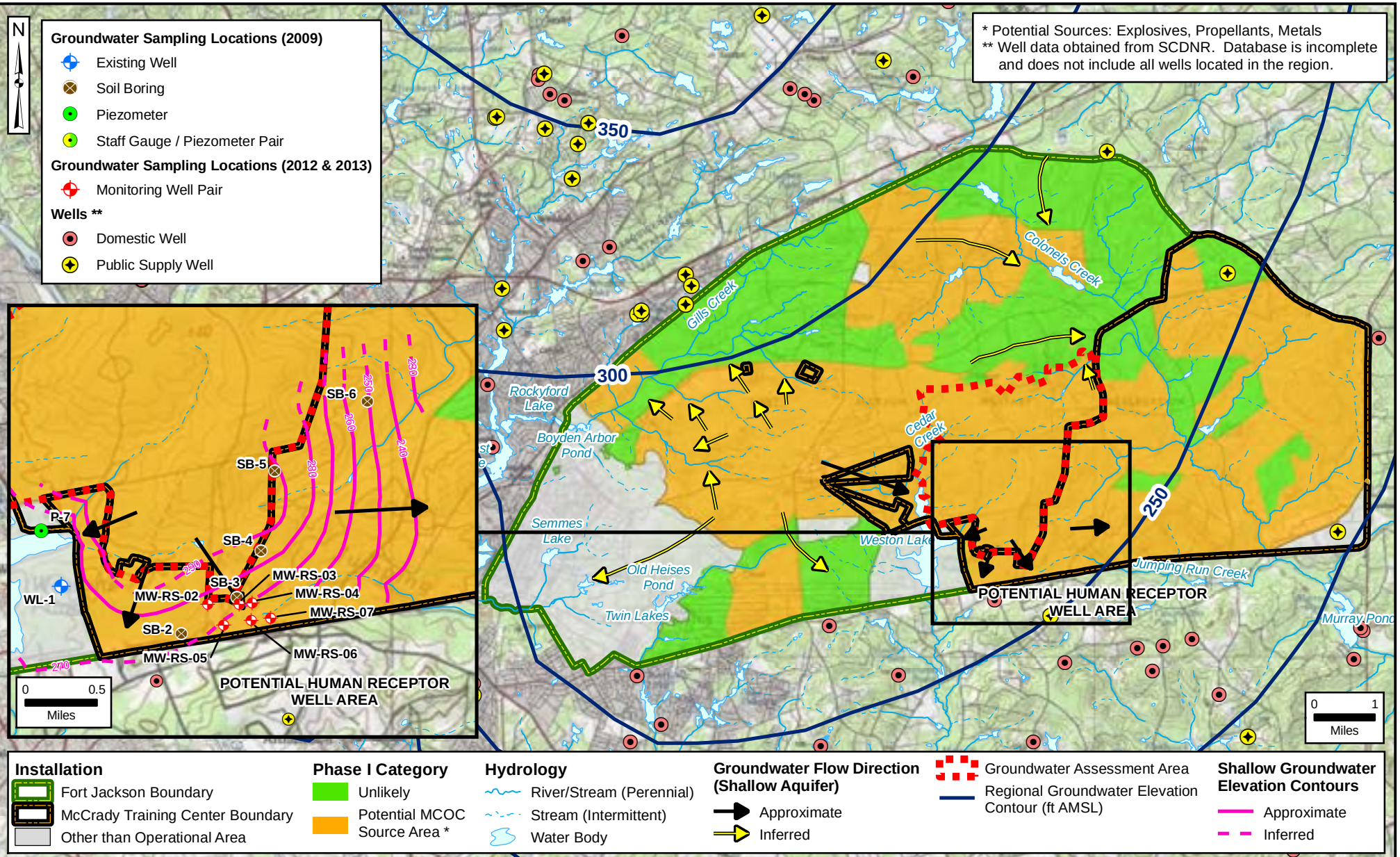

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Fort Jackson and McCrady Training Center, SC

Figure ES-3
Groundwater CSM

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo
SCDNR, Wells, 2007
Date: ..... January 2014
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Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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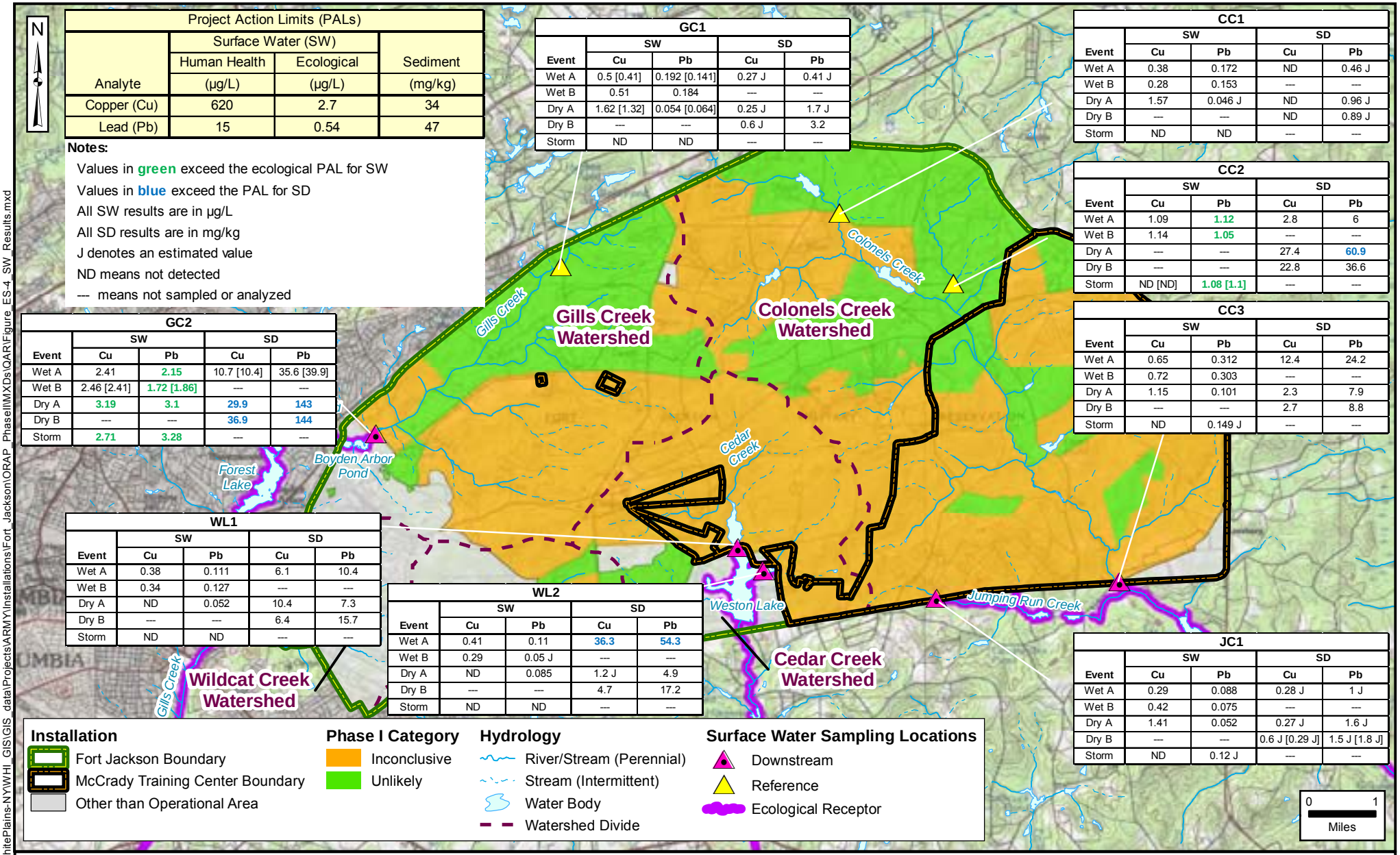

Project Action Limits (PALs)			
	Surface Water (SW)		
	Human Health	Ecological	Sediment
Analyte	(µg/L)	(µg/L)	(mg/kg)
Copper (Cu)	620	2.7	34
Lead (Pb)	15	0.54	47

Notes:

Values in **green** exceed the ecological PAL for SW

Values in **blue** exceed the PAL for SD

All SW results are in µg/L

All SD results are in mg/kg

J denotes an estimated value

ND means not detected

--- means not sampled or analyzed

GC1

	SW		SD	
Event	Cu	Pb	Cu	Pb
Wet A	0.5 [0.41]	0.192 [0.141]	0.27 J	0.41 J
Wet B	0.51	0.184	---	---
Dry A	1.62 [1.32]	0.054 [0.064]	0.25 J	1.7 J
Dry B	---	---	0.6 J	3.2
Storm	ND	ND	---	---

CC1

	SW		SD	
Event	Cu	Pb	Cu	Pb
Wet A	0.38	0.172	ND	0.46 J
Wet B	0.28	0.153	---	---
Dry A	1.57	0.046 J	ND	0.96 J
Dry B	---	---	ND	0.89 J
Storm	ND	ND	---	---

CC2

	SW		SD	
Event	Cu	Pb	Cu	Pb
Wet A	1.09	1.12	2.8	6
Wet B	1.14	1.05	---	---
Dry A	---	---	27.4	60.9
Dry B	---	---	22.8	36.6
Storm	ND [ND]	1.08 [1.1]	---	---

GC2

	SW		SD	
Event	Cu	Pb	Cu	Pb
Wet A	2.41	2.15	10.7 [10.4]	35.6 [39.9]
Wet B	2.46 [2.41]	1.72 [1.86]	---	---
Dry A	3.19	3.1	29.9	143
Dry B	---	---	36.9	144
Storm	2.71	3.28	---	---

CC3

	SW		SD	
Event	Cu	Pb	Cu	Pb
Wet A	0.65	0.312	12.4	24.2
Wet B	0.72	0.303	---	---
Dry A	1.15	0.101	2.3	7.9
Dry B	---	---	2.7	8.8
Storm	ND	0.149 J	---	---

WL1

	SW		SD	
Event	Cu	Pb	Cu	Pb
Wet A	0.38	0.111	6.1	10.4
Wet B	0.34	0.127	---	---
Dry A	ND	0.052	10.4	7.3
Dry B	---	---	6.4	15.7
Storm	ND	ND	---	---

WL2

	SW		SD	
Event	Cu	Pb	Cu	Pb
Wet A	0.41	0.11	36.3	54.3
Wet B	0.29	0.05 J	---	---
Dry A	ND	0.085	1.2 J	4.9
Dry B	---	---	4.7	17.2
Storm	ND	ND	---	---

JC1

	SW		SD	
Event	Cu	Pb	Cu	Pb
Wet A	0.29	0.088	0.28 J	1 J
Wet B	0.42	0.075	---	---
Dry A	1.41	0.052	0.27 J	1.6 J
Dry B	---	---	0.6 J [0.29 J]	1.5 J [1.8 J]
Storm	ND	0.12 J	---	---

Installation
- Fort Jackson Boundary
- McCrady Training Center Boundary
- Other than Operational Area

Phase I Category
- Inconclusive
- Unlikely

Hydrology
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Watershed Divide

Surface Water Sampling Locations
- Downstream
- Reference
- Ecological Receptor

Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure ES-4
Surface Water Results

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

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Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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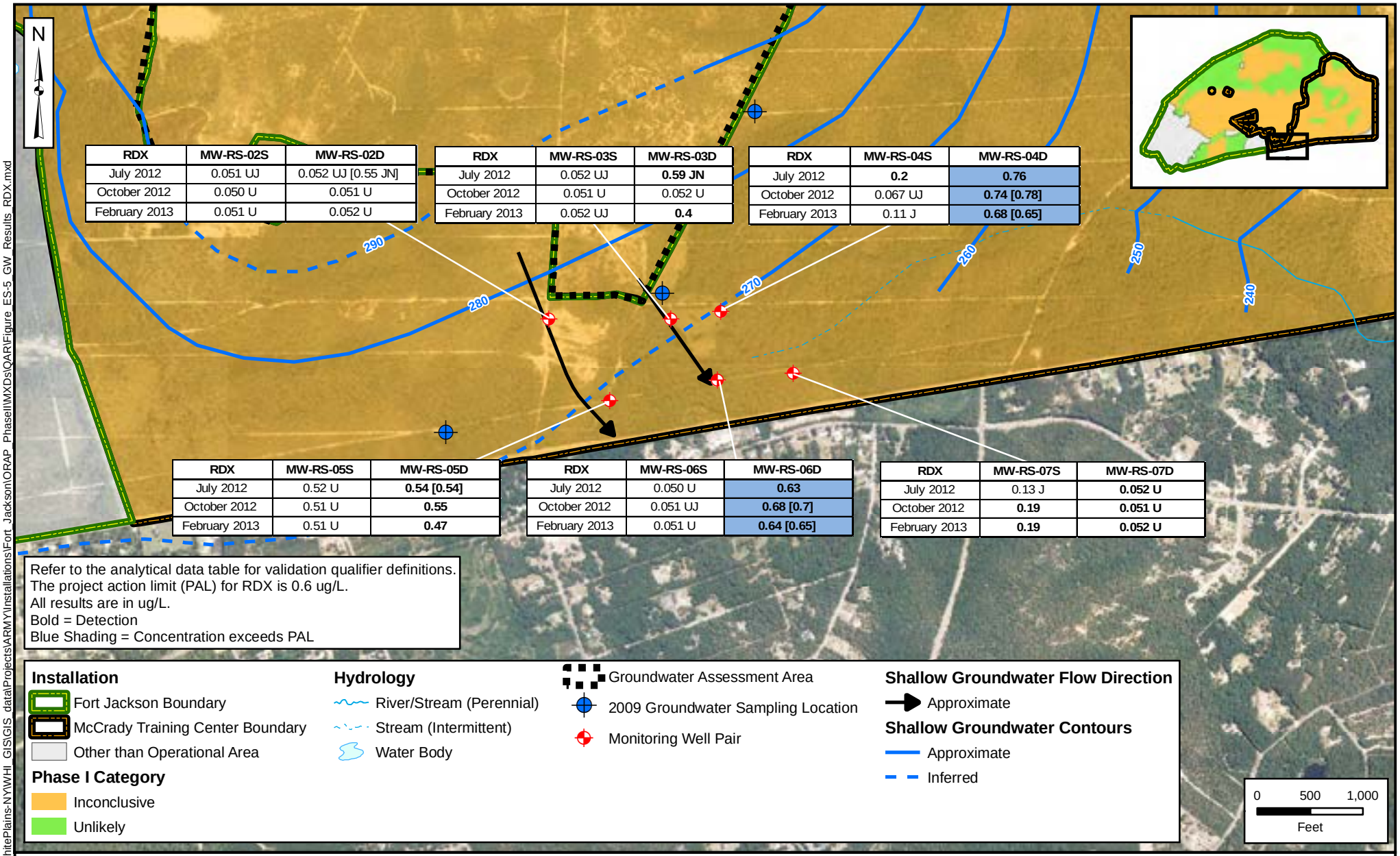

RDX	MW-RS-02S	MW-RS-02D
July 2012	0.051 UJ	0.052 UJ [0.55 JN]
October 2012	0.050 U	0.051 U
February 2013	0.051 U	0.052 U

RDX	MW-RS-03S	MW-RS-03D
July 2012	0.052 UJ	**0.59 JN**
October 2012	0.051 U	0.052 U
February 2013	0.052 UJ	**0.4**

RDX	MW-RS-04S	MW-RS-04D
July 2012	**0.2**	**0.76**
October 2012	0.067 UJ	**0.74 [0.78]**
February 2013	0.11 J	**0.68 [0.65]**

RDX	MW-RS-05S	MW-RS-05D
July 2012	0.52 U	**0.54 [0.54]**
October 2012	0.51 U	**0.55**
February 2013	0.51 U	**0.47**

RDX	MW-RS-06S	MW-RS-06D
July 2012	0.050 U	**0.63**
October 2012	0.051 UJ	**0.68 [0.7]**
February 2013	0.051 U	**0.64 [0.65]**

RDX	MW-RS-07S	MW-RS-07D
July 2012	0.13 J	**0.052 U**
October 2012	**0.19**	**0.051 U**
February 2013	**0.19**	**0.052 U**

Refer to the analytical data table for validation qualifier definitions.
The project action limit (PAL) for RDX is 0.6 ug/L.
All results are in ug/L.
Bold = Detection
Blue Shading = Concentration exceeds PAL

Installation
- Fort Jackson Boundary
- McCrady Training Center Boundary
- Other than Operational Area

Phase I Category
- Inconclusive
- Unlikely

Hydrology
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body

- Groundwater Assessment Area
- 2009 Groundwater Sampling Location
- Monitoring Well Pair

Shallow Groundwater Flow Direction
- Approximate

Shallow Groundwater Contours
- Approximate
- Inferred

0 500 1,000
Feet

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Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure ES-5
Groundwater Results

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
USDA-FSA, Aerial Photo, 2006

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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1 Introduction

1.1 Project Purpose and Overview

ARCADIS U.S., Inc. (ARCADIS) conducted an Operational Range Assessment (ORA) Phase II study at the United States (U.S.) Army Garrison Fort Jackson (referred to as Fort Jackson throughout this report) and McCrady Training Center for the U.S. Army Corps of Engineers (USACE), the U.S. Army Environmental Command (USAEC), and the Army National Guard Directorate Installations, Logistics, and Environment Division (ARNG-ILE). The Operational Range Phase II Assessment (Phase II) was required due to the conclusions of the Phase I Assessments (Phase Is) conducted for Fort Jackson and McCrady Training Center in 2007 (Malcolm Pirnie, 2007a and 2007b) (**Figure 1-1**).

The Phase Is used readily available information to determine whether operational areas had a source of munitions constituents of concern (MCOC), a migration pathway (via surface water or groundwater systems) for MCOC, and potential receptors (human or ecological) along that pathway. The conclusion of the Phase Is at Fort Jackson and McCrady Training Center was that the available information was not sufficient to confirm whether an off-range release of MCOC is occurring at concentrations that present an unacceptable risk to human health and/or sensitive ecological receptors. A Phase II was therefore required at each installation and was designed to collect and evaluate appropriate data to determine whether or not an off-range release has occurred at concentrations above risk-based thresholds.

For operational ranges determined in the Phase Is to have a potentially complete source-receptor pathway, both the USAEC and the ARNG Directorate conduct Phase IIs to assess potentially complete pathways of MCOC to non-operational areas. As part of initiating a program to complete Phase II Assessments at all of the installations with potentially complete source-receptor pathways, USAEC and ARNG Directorate agreed in 2008 to complete a pilot study focused on the combined footprint of the two adjoining installations. This allowed both USAEC and the ARNG Directorate to provide input based on experience with the developing program and also was more efficient by completing one assessment rather than two separate assessments. This Phase II report presents the evaluation of source-receptor pathways at Fort Jackson and McCrady Training Center, South Carolina.

ARCADIS collected the Phase II quantitative assessment field data for Fort Jackson and McCrady Training Center in two phases. The initial phase of the assessment was performed from 30 March 2009 to 28 July 2009 and included the Phase II data collection efforts (collection of readily available information such as reports published since the Phase I reports, geographical information system data, Range Facility Management Scheduling System [RFMSS] data, etc.), the sampling and analysis of surface water systems, and the initial groundwater pathway sampling and analysis. A second phase of the assessment included the collection of supplementary groundwater data from 14 May 2012 to 14 February 2013, completion of a screening level ecological risk assessment (SLERA), and completion of a human health risk evaluation (HHRE). This report includes descriptions of the data collection activities and data evaluation process, data interpretation, Conceptual Site Model (CSM) refinements, and

conclusions and recommendations for the Phase II for Fort Jackson and McCrady Training Center.

1.2 Project Scope and Drivers

The U.S. Army is conducting assessments at operational ranges to meet the requirements of Department of Defense (DoD) policy and to support the U.S. Army Sustainable Range Program. The ORA is being implemented to fulfill requirements identified implicitly or explicitly in:

- DoD Directive (DoDD) 4715.11 Environmental and Explosives Safety Management on Operational Ranges Within the United States (DoD, 2004) and

- DoD Instruction (DoDI) 4715.14 *Operational Range Assessments* (DoD, 2005).

The DoDD and DoDI require that U.S. Army installations maintain an operational range inventory and evaluate the potential for off-range migration of munitions constituents. The DoDI identifies munitions constituents to be evaluated and lays out a scientifically sound process for assessing and presorting potential off-range environmental impacts of military munitions used on operational ranges. In particular, the DoDI requires the DoD components to respond to a release or substantial threat of release of MCOC from an operational range area to off-range areas, when such release poses an unacceptable risk to human health or the environment.

1.3 Work Authority

The Phase II for Fort Jackson and McCrady Training Center was performed under USACE, Baltimore District contract numbers W912DR-05-004 and W912DR-09-D-0016 and U.S. Army Engineering and Support Center, Huntsville contract number W912DY-10-D-0025. The USAEC is the Program Manager for the Phase II quantitative assessments, providing programmatic coordination for the Fort Jackson and McCrady Training Center Phase II, as designated by the Assistant Chief of Staff for Installation Management's Installation Services Environmental Division. The ARNG-ILE has program management responsibilities related to the Phase II assessment conducted concurrently at the McCrady Training Center. The USACE, Baltimore District is the executing organization and is responsible for planning and conducting the assessments. The USACE ORA Program Manager is responsible for management of the contractors' delivery orders. The U.S. Army Institute of Public Health (USAIPH) provides technical oversight for assessments completed at Active Army installations and additionally provides technical assistance to the ARNG-ILE for assessments completed at ARNG installations.

Work performed under contract numbers W912DR-05-D-004 and W912DR-09-D-0016 was completed by Malcolm Pirnie, Inc. (Malcolm Pirnie). In 2009, Malcolm Pirnie merged with ARCADIS. Throughout the remainder of this document, ARCADIS is used to represent this organization except when referencing a document prepared by Malcolm Pirnie. Work under contract number W912DY-10-D-0025 is being performed under a joint venture between Malcolm Pirnie (now ARCADIS) and PIKA International, Inc. (PIKA), collectively known as

the PIKA-Pirnie JV, LLC. Throughout the remainder of this document, this organization will be referred to as the PIKA-Pirnie JV. Activities covered under the PIKA-Pirnie JV contract include the majority of field activities completed as part of the 2012/13 phase of the assessment and preparation of this report.

1.4 ORA Phase I

Phase I qualitative assessments were performed at Fort Jackson and McCrady Training Center in 2007 (Malcolm Pirnie, 2007a and 2007b). These assessments formed the basis for the design of the Phase II assessment and are summarized briefly here.

A total of 166 operational ranges were evaluated under the Phase I assessments (104 ranges at Fort Jackson and 62 ranges at McCrady Training Center) and placed into one of two possible categories – *Unlikely or Inconclusive*. The two categories are defined as follows:

- ***Unlikely* – Periodic Review:**[2] Based on a review of readily available information, the CSM indicates that one or more of the three conditions for a source-receptor interaction is not present (*i.e.*, no source, pathway, or receptor), or where pathways are complete, data are sufficient to indicate no unacceptable risk to human health or the environment. These operational areas are placed into a periodic review cycle to re-evaluate whether a change in conditions has occurred.

- ***Inconclusive* – Phase II Required**: Readily available information is insufficient to ascertain whether MCOC from an operational area is migrating to a potential off-range receptor or the information indicates the potential for such an interaction, but risk levels are uncertain. These sites undergo a Phase II.

The types and aerial extent covered by the 166 operational ranges at Fort Jackson and McCrady Training Center are detailed in **Table 1-1**.

Table 1-1: Range Types and Aerial Extent Covered

Range Type	Fort Jackson		McCrady Training Center	
	Number of Ranges	Acreage	Number of Ranges	Acreage
Firing Ranges	8	362	2	262

[2] All operational ranges must be periodically re-evaluated to determine if there is a release or substantial threat of release of MCOC from an operational range to an off-range area. Range groups categorized as *Unlikely* are to be re- evaluated periodically. Re-evaluation may occur if significant changes (*e.g.*, changes in range operations or site conditions, regulatory changes) occur that affect determinations made during the Phase I Assessment.

Small Arms Ranges	19	501	3	48
Training Areas	75	18,968	57	14,585
Impact Areas	2	5,429	0*	0
Totals	**104**	**25,260**	**62**	**14,895**
* - Firing from McCrady Training Center live fire ranges is directed toward the impact areas at Fort Jackson.				

According to munitions data collected during the Phase I, the types of munitions fired at the installations are small caliber, medium caliber, large caliber, pyrotechnics/obscurants, and other munitions. Potential MCOC associated with these munitions types include the following:

- Explosives: Cyclotetramethylenetetranitramine (HMX), Cyclotrimethylenetrinitramine (RDX), 2,4-Dinitrotoluene (DNT), 2,6-DNT, Nitroglycerine (NG), Pentaerythritoltetranitrate (PETN), Trinitrotoluene (TNT);
- Metals: antimony (Sb), copper (Cu), lead (Pb), zinc (Zn), and tungsten (W);
- Perchlorate; and
- White phosphorus (WP).

In the Phase I, sixty-seven (67) operational ranges (53 ranges at Fort Jackson and 14 ranges at McCrady Training Center) covering 15,656 acres (13,004 acres at Fort Jackson and 2,652 acres at McCrady Training Center) having no current and/or historical sources of potential MCOC were categorized as *Unlikely*.

Ninety-nine (99) operational ranges (51 ranges at Fort Jackson and 48 ranges at McCrady Training Center) covering 28,714 acres (16,471 acres at Fort Jackson and 12,243 acres at McCrady Training Center) were categorized as *Inconclusive*. These ranges have current and/or historical sources of potential MCOC that were identified during the Phase I that have the potential to migrate off-range (**Figure 1-1**).

1.5 ORA Phase II

The strategy for the Phase II was based on the U.S. Environmental Protection Agency's (USEPA) systematic planning or data quality objective (DQO) process. The application of the DQO process is required by DoDI 4715.14. The DQO process provides a sequence of logical steps to address the sampling rationale, decision criteria, and approaches in selecting a sampling design. The DQO process is iterative and assists in determining the appropriate type, quantity, and quality of environmental data necessary for making decisions that are

technically sound and defensible. Guidance on using the DQO process can be found in *Guidance on Systematic Planning Using the Data Quality Objective Process* (USEPA, 2006a).

The structure of the ORA process is based on the DQOs. The Phase I was designed to provide the basis for Step 1 of the DQO process, which leads to the seven-step planning process for the Phase II. The Phase I was the initial gathering of data that enabled construction of a CSM and the identification of pathways that could allow MCOC from an on-range source to interact with off-range receptors at concentrations that would pose a potential risk to human health or the environment.

The Phase II uses a weight-of-evidence approach to determine whether there is an unacceptable risk to off-range human and ecological receptors from on-range MCOC sources. When appropriate, a Phase II includes sampling and analysis of media in the potential pathways for the MCOC identified in the Phase I and refined through the preliminary stages of the Phase II evaluation. The Phase II was guided in part by the U.S. Army Public Health Command (USAPHC, formerly the U.S. Army Center for Health Promotion and Preventive Medicine [USACHPPM]) *Army Operational Range Assessment Phase II Investigation Protocol* (USACHPPM,[3] 2009) and the *ARNG ORA Focus for Technical Sampling* (ARNG, 2011).

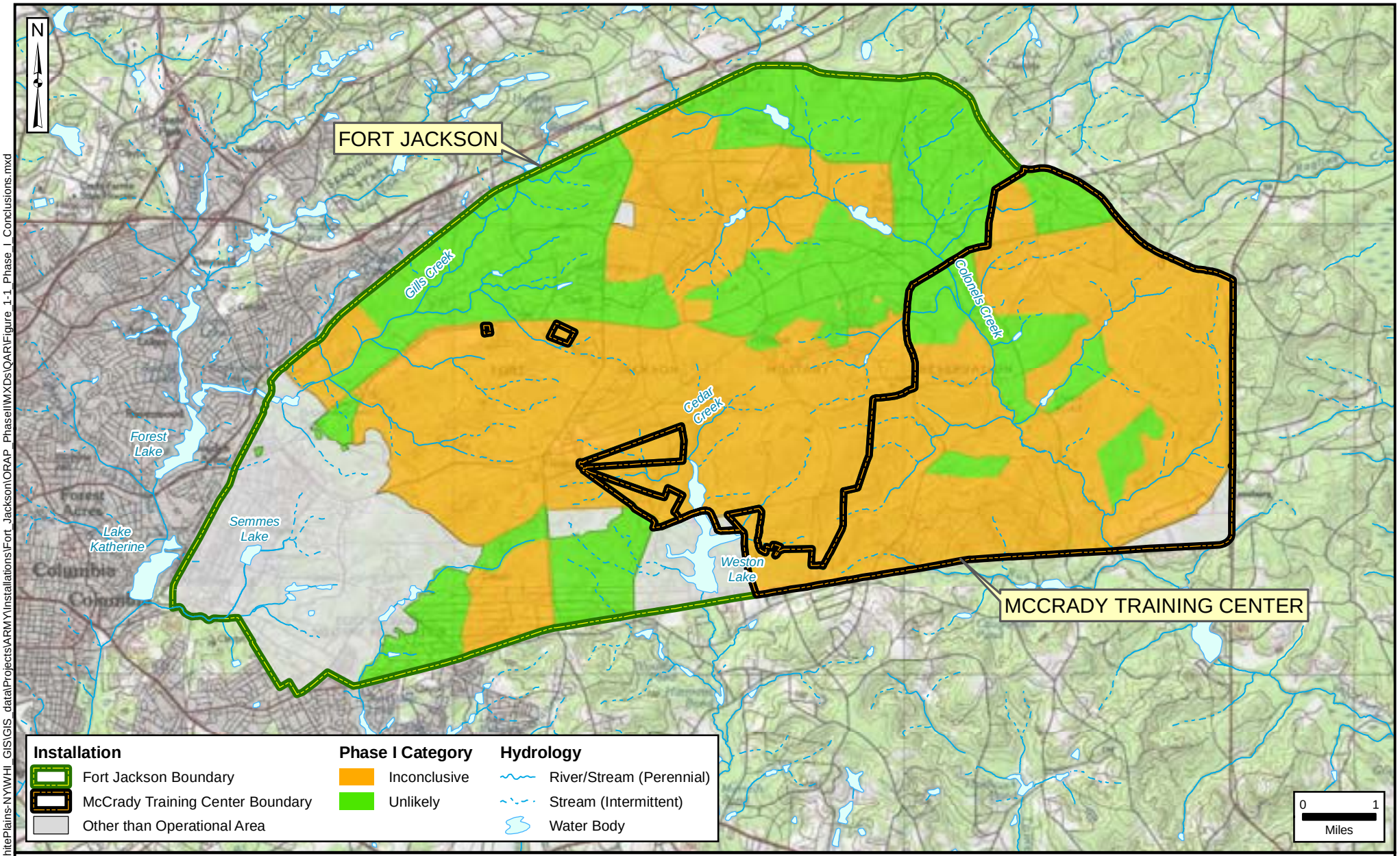
1.6 Organization of the Report

The Phase II methodology, analyses, results, and conclusions are presented in this report. The report consists of nine sections and eleven appendices:

- **Section 1 – Introduction**: Project purpose, background, work authority, and introduction to ORA
- **Section 2 – Fort Jackson and McCrady Training Center Overview**: Installation profiles, physical features, and summary of previous investigations
- **Section 3 – ORA Phase II**: CSM for the surface and groundwater pathways and technical approach for the Phase II
- **Section 4 – Methodology**: Methodologies used in the Phase II
- **Section 5 – Data Analyses**: Overview of laboratory methods and analyses
- **Section 6 – Data Results**: Results of the Phase II and other evidence used to reach conclusions
- **Section 7 – Screening Level Risk Assessments**: Summaries of the SLERA for the surface water pathway and the HHRE for the groundwater pathway.
- **Section 8 – Summary of Findings and Conclusions**: Summary of the findings and the conclusions of the Phase II.

[3] The USAIPH was formerly the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM).

- **Section 9 – References**: List of all documents used in the preparation of the Phase II report
- **Appendix A – Photograph Log**: Photographs taken at the sampling locations
- **Appendix B – Laboratory analytical reports**: Laboratory analytical reports have been compiled and included in this appendix.
- **Appendix C – Trip Reports**: Trip reports documenting decisions and changes to procedures occurring in the field
- **Appendix D – Field Forms**: Documents and notes completed in the field: chain of custody (COC), field safety forms, and surface water, sediment, and groundwater sample collection logs
- **Appendix E – Soil Boring and Well Construction Logs:** Soil boring logs and monitoring well construction logs for all wells including piezometers
- **Appendix F – IDW Sampling Results**: Laboratory results for investigative-derived waste (IDW) samples submitted for analytical testing
- **Appendix G – Data Usability Summary Reports**: Tier III Data Validation Report prepared for each Sample Delivery Group as assigned by the laboratory
- **Appendix H – Statistical Evaluation for Surface Water Assessment**: Includes summaries of the statistical evaluations of surface water, sediment, and benthic macroinvertebrate data.
- **Appendix I – Screening Level Ecological Risk Assessment**: Contains a SLERA which evaluates the potential for adverse health effects in ecological receptors associated with the Fort Jackson and McCrady Training Center Phase II
- **Appendix J – Human Health Risk Evaluation**: Contains an HHRE which evaluates the potential for adverse health effects in human receptors associated with the Fort Jackson and McCrady Training Center Phase II



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Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 1-1
Phase I Assessment Findings

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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2 Fort Jackson and McCrady Training Center Overview

2.1 Installation Background

Fort Jackson and McCrady Training Center are adjoining installations, together occupying approximately 51,961 acres in Richland County, South Carolina (**Figure 2-1**). The South Carolina Army National Guard (SCARNG) holds a nonexclusive license for training operations on approximately 15,267 acres of the eastern portion of Fort Jackson. These 15,267 acres comprise the McCrady Training Center.

Fort Jackson was established in 1917 as an infantry training center (then known as Camp Jackson). The installation was inactive from 1921 to 1925. In 1925, the War Department decided to use the post again as a training camp for the SCARNG. From 1925 to 1939, the state controlled the site and used it as an encampment and training area for SCARNG troops. During World War II, Fort Jackson became a permanent military installation used primarily for infantry training. Additional property was acquired on the eastern and northern sides of the installation until the acreage reached approximately 52,000 acres. In 1943, the land for McCrady Training Center, formerly referred to as Leesburg Training Center, was licensed to the SCARNG by the Department of the Army.

Fort Jackson is the largest and most active initial entry center in the U.S. Army. The installation instructs participants in Basic Combat Training, Advanced Individual Training, and many professional schools. Currently, McCrady Training Center is the largest of the SCARNG training centers and is the primary facility for the SCARNG, supporting federal missions and serving as a staging site for state missions. The 218th Regiment (Leadership) Total Army School, located at McCrady Training Center, serves as the schoolhouse for the southeastern region (USAEC and USDA, 2001).

The Army Range Inventory Database-Geodatabase (ARID-GEO) (2006a) identified 104 operational range areas at Fort Jackson encompassing a total of 29,475 acres. The operational areas support a variety of range uses, including live-fire weapons training, heavy and light maneuver exercises, dudded and non-dudded impact areas, and specialty training courses, such as night-infiltration and military operations in urban terrain. Many of these ranges are heavily used by soldiers undergoing basic training. The ARID-GEO for McCrady Training Center (2006b) identified 62 operational ranges encompassing 14,895 acres. The McCrady Training Center ranges support live-fire weapons training and heavy and light maneuver exercises.

2.1.1 Medium and Large Caliber (Explosive) Live-Fire Ranges

There are eight firing ranges at Fort Jackson covering approximately 362 acres and two additional firing ranges at McCrady Training Center covering approximately 262 acres. These ranges include all medium and large caliber firing ranges identified in ARID-GEO (2006), as well as several additional medium and large caliber firing ranges identified using RFMSS data. Small caliber munitions, pyrotechnics/ obscurants, and munitions identified as other or unknown are also utilized at some of these ranges.

2.1.2 Small Arms Live-Fire Ranges

There are 19 small arms ranges at Fort Jackson covering approximately 501 acres. Seventeen of these are located along the perimeter of a 4,216-acre impact area in the western portion of Fort Jackson's operational range area within the Gills Creek Watershed. McCrady Training Center operates three additional small arms ranges covering approximately 48 acres, with two of the ranges located in the western half of Fort Jackson's operational range area. The third is located in the southeast corner of the installation. In addition to small caliber munitions, pyrotechnics/obscurants and munitions identified as other or unknown are also utilized at some of these ranges.

2.1.3 Training Areas

Seventy-five training areas covering approximately 18,968 acres are present within Fort Jackson. Twenty-five of these, totaling 5,446 acres, are non-live-fire maneuver and training areas or obstacle courses where limited or no current or historical munitions usage has occurred. Historical munitions usage was identified at 33 training areas covering 9,204 acres. Fifteen training areas contain artillery or mortar firing points and/or known or suspected dudded areas. The remaining two training areas are entirely overlapped by firing ranges. These areas have historical overlapping range fans used for small arms, medium caliber, large caliber, and additional unidentified historical military munitions training. Based on information from Fort Jackson's Range Operations (formerly Range Control) office, an unexploded ordnance (UXO) surface removal action has been performed at these training areas; therefore, there is a low probability of encountering UXO items at the ground surface except where erosion has since occurred. A total of 12 training areas, totaling 3,324 acres, contain known or suspected dudded areas identified by Fort Jackson Range Operations. These areas are the result of historical training activities, primarily mortar and grenade firing ranges. These areas are clearly demarcated on Fort Jackson's Installation Field Map (Fort Jackson ITAM, 2006). Signs are posted to alert personnel to the potential presence of UXO. Five of these training areas, plus three other training areas, contain mortar or artillery firing points.

McCrady Training Center includes 57 training areas covering approximately 14,585 acres. Fourteen of these training areas, totaling 2,652 acres, are non-live-fire maneuver and training areas where limited or no current munitions use occurs and no historical munitions usage has occurred. Historical and/or current training involving the use of munitions has been identified at the other 43 training areas, totaling 11,933 acres. Eighteen training areas, including 16 training areas with historical munitions usage, are currently used for training activities involving the use of munitions at artillery or mortar firing points and/or suspected dudded areas. Two of the training areas that received heavy historical usage also reportedly contain demolition areas. RFMSS data collected as part of the Phase I indicate that use of this temporary demolition area began in 2007.

2.1.4 Impact Areas

Two impact areas are present at Fort Jackson, including a large, dudded area in the eastern portion of Fort Jackson comprising 5,429 acres and a slightly smaller mostly non-dudded impact area in the western portion comprising 4,216 acres. No impact areas are present within the limits of McCrady Training Center.

The eastern dudded impact area is the established impact area for mortar and artillery weaponry training. It contains range safety fans for a number of small, medium, and large caliber firing ranges located around the perimeter of the area and includes an Engineer Demolition Site. This area was also historically known as the south impact area and was used as an impact zone for a number of large caliber training ranges. No surface clearance activities have been performed at the eastern dudded area.

The western impact area covers 4,216-acres and is mostly non-dudded. It is surrounded by 19 permanent small arms ranges (two of which are licensed to the SCARNG for training purposes). This impact area contains the safety fans associated with each of the 19 small arms ranges. The safety fans encompass more land than that which is actually impacted because about 90% of the rounds fired are contained by berms constructed 30-320 meters down range from firing lines; however, not all of the ranges are bermed (Fort Jackson Directorate of Plans, Training, and Mobilization, and Security (DPTMS), 2006). This entire impact area is defined as non-dudded impact area in ARID-GEO (2006); however, Fort Jackson's Range Operations personnel have identified known dudded areas to be present in the western portion. This is consistent with historical locations of mortar ranges. The dudded portion of the western impact area covers 273 acres.

2.1.5 Munitions Data

Munitions use data (*i.e.*, RFMSS) collected during the Phase I provided information on the types and numbers of munitions fired at Fort Jackson and McCrady Training Center; these data are summarized in **Table 2-1**. Munitions use data from reflect annual munitions usage averaged over the period of available data (1 January 2002 through 12 October 2006 for Fort Jackson and 1 January 2004 through 18 May 2007 for McCrady Training Center). Approximately 216,000 rounds were recorded without a Department of Defense Identification Code; these rounds are tabulated as having an unknown munitions type. Based on the use of the ranges where these munitions were fired, most of the rounds were likely live-fire, small caliber rounds.

Approximately 17 million rounds of military munitions were utilized per year during the period of available data. More than 95 percent of these were small arms rounds, including a total of approximately 1.1 million small arms tungsten rounds[4]. Several munitions quantities have been modified to correct RFMSS errors that were confirmed by DPTMS personnel. RFMSS does not show munitions usage for the impact areas because the firing that was aimed toward these areas took place from the other ranges.

[4] In an attempt to reduce lead usage at small arms ranges, lead-free tungsten composite rounds were used at several Fort Jackson ranges and at one of McCrady Training Center's small arms ranges and one of its firing ranges. According to RFMSS data, the period of heaviest use for the tungsten-nylon small arms rounds was in 2003 and 2004. Due to potential environmental impacts, usage of tungsten composite rounds was suspended at Army installations by the Department of the Army in spring 2006.

Table 2-1: Munitions Data Summary by Range Type

Range and Munitions Type	Fort Jackson Rounds Expended per Year [d]			McCrady Training Center Rounds Expended per Year [e]			Total Rounds Expended[f]
	Live-Fire	Practice/ Blank	Total[f]	Live-Fire	Practice/ Blank	Total[f]	
Large and Medium Caliber (Explosive) Live-Fire Ranges							
Small Caliber	2,512,000	121,000	2,633,000	1,126,000	530	1,126,000	3,759,000
Medium Caliber	40,000	40,000	80,000	65,000	2,400	68,000	148,000
Large Caliber	180	--	180	1,600	--	1,600	1,780
Pyrotechnic/Obscurant	4,000	--	4,000	95	--	95	4,000
Other	42,000	69,000	111,000	--	--	--	111,000
Unknown[a]	--	--	5,400	--	--	--	5,400
Total[f]	**2,598,000**	**230,000**	**2,834,000**	**1,193,000**	**2,900**	**1,196,000**	**4,030,000**
Small Arms Live-Fire Ranges							
Small Caliber	11,721,000	272,000	11,993,000	770,000	3,900	770,000	12,763,000
Pyrotechnic/Obscurant	2,700	--	13,000	--	--	--	13,000
Other	42 [b]	27,000	130,000	--	3,000 [c]	3,000	133,000
Unknown[a]	--	--	200,000	--	--	7,700	208,000
Total[f]	**11,724,000**	**299,000**	**12,336,000**	**770,000**	**7,000**	**781,000**	**13,117,000**
Training Areas							
Small Caliber	8,400 [b]	176,000 [b]	184,000 [b]	--	--	--	184,000
Medium Caliber	-- [b]	--	-- [b]	--	--	--	0
Large Caliber	38	--	38	77	--	77	120
Pyrotechnic/Obscurant	31	--	31	--	--	--	31
Other	8	80	88	830	--	830	920
Unknown[a]	--	--	2,900	--	--	--	2,900
Total[f]	**8,500**	**176,000**	**187,000**	**910**	**0**	**910**	**188,000**
All Ranges							
Total[f]	**14,330,500**	**705,000**	**15,357,000**	**1,964,000**	**9,900**	**1,978,000**	**17,335,000**

[a] Unknown munitions type indicates an entry of "Not Applicable" in the DoD Identification Code column of the RFMSS data; therefore, the number of rounds cannot be associated with a munitions type (DA, 2000).
[b] Munitions quantity edited to correct RFMSS error identified by Fort Jackson DPTMS personnel.
[c] Practice fuzes
[d] Data based on munitions expended expended at Fort Jackson from 1 January 2002 to 12 October 2006 and normalized to annual usage
[e] Data based on munitions expended at McCrady Training Center from 1 January 2004 to 18 May 2007 and normalized to annual usage
[f] Rounded to the nearest thousand or two significant digits, if less than one thousand

2.2 Physical Description

2.2.1 Climate

The region surrounding Fort Jackson and McCrady Training Center has a temperate continental climate with hot, humid summers and mild winters. This southern temperate region can experience temperatures ranging from below freezing to greater than 100 degrees Fahrenheit (ºF); however, there is a relatively narrow annual temperature range, from a mean daily temperature of 81ºF in July to 44ºF in January (Gene Stout & Associates, 2004). Average annual precipitation is approximately 46 inches. July and August are the wettest months with

approximately 5.5 inches of precipitation each month. Although July is one of the wettest months of the year with respect to precipitation, the net precipitation (i.e. precipitation - evaporation) and streamflow are low at this time of year. The evaporation potential generally exceeds precipitation during the summer months; therefore, net precipitation is highest in the winter months (**Figure 2-2**). Tropical storms producing heavy rainfall occasionally occur during late summer and early autumn. Wind speeds peak at approximately nine miles per hour in spring, and the general wind direction is from the southwest. Snowfall is rare and generally results in little, if any, accumulation (USATHAMA, 1980).

2.2.2 Topography

Gentle to moderately rolling, moderately dissected high plains occupy most of Fort Jackson and McCrady Training Center. These high plains are interrupted by the nearly flat alluvial plains of Gills, Cedar, and Colonels creeks and their tributaries and an irregularly distributed, gently sloping, low relief area in the central portion of the installation near the headwaters of Cedar Creek. Local relief in the high plains is largely 165-250 feet. Slopes are predominantly three to eight percent; however, along narrow stream valleys, slopes commonly exceed 15 percent. Elevations in the high plains are mostly 295-459 feet above mean sea level. The lowest elevation in the high plains is about 200 feet, adjacent to the alluvial plain of Colonels Creek in the eastern portion of the installation. The highest elevation, 540 feet, is at Weir Tower in the west-central portion of the installation (Gene Stout & Associates, 2004).

Flat to gently rolling low plains characterize the extreme western portion of the installation, including a major portion of the cantonment area and the alluvial plains occupied by southwesterly flowing Gills and Mill creeks. Local relief around the valley of Gills Creek and its tributaries is generally less than 60 feet. Slopes are predominantly between zero and three percent on the alluvial plains, and slopes in the cantonment area are predominantly between three and eight percent. Upper valleys of Mill and Cedar creeks occupy low plains along the southern boundary of Fort Jackson. Local relief is generally less than 40 feet, and slopes are usually less than three percent (Gene Stout & Associates, 2004).

2.2.3 Soils

Four major soil types are present at Fort Jackson and McCrady Training Center: Lakeland, Vaucluse-Ailey-Pelion, Fuquay-Troup-Vaucluse, and Pelion-Johnson-Vaucluse (USATHAMA, 1980). Lakeland soils are the predominant soil type at Fort Jackson and McCrady Training Center and are found at higher elevations in the central part of Fort Jackson and McCrady Training Center along ridgetops (Gene Stout & Associates, 2004). They consist of deep, gently to strongly sloping, and highly permeable sandy soils. Vaucluse-Ailey-Pelion soils are found along the Colonels Creek watershed in the east and southeastern portions of Fort Jackson and McCrady Training Center. They consist of well-drained to moderately well-drained soils that have a sandy surface layer and a loamy subsoil. Fuquay-Troup-Vaucluse soils are found along Mill Creek and Cedar Creek in two small areas along the southern installation boundary. They consist of well-drained soils with sandy surface and subsurface layers and a loamy subsoil. Pelion-Johnson-Vaucluse soils are found on the western portion of Fort Jackson along the Gills Creek watershed. They consist of moderately well-drained soils that have a sandy surface layer and a loamy subsoil, very poorly drained soils that are loamy throughout, and well-drained soils that have a sandy surface layer and a fragipan in the loamy subsoil (USATHAMA, 1980; Gene

Stout & Associates, 2004). The high sand content of soils at Fort Jackson and McCrady Training Center promotes leaching of minerals, reduced water retention, and increases susceptibility to soil erosion (USATC, 2005).

2.2.4 Geology

The geology of South Carolina is characterized by two principal physiographic and geologic provinces, the crystalline rocks of the Piedmont physiographic province and the unconsolidated sediments of the Coastal Plain. The boundary between the Piedmont and the Coastal Plain is marked by the Fall Line, which occurs approximately four miles west and north of Fort Jackson's cantonment area (USATHAMA, 1980; Newcome, 2003). Fort Jackson and McCrady Training Center lie on the northwestern edge of the Coastal Plain province, a region of low to moderate relief and gently rolling plains, known as the Sand Hills. The installations sit directly on the unnamed sediments of Tertiary age and the upper Coastal Plain portion of the Cretaceous aged Middendorf Formation (Kite, 1988; USGS, 1994 and 1996). The majority of both installations sits directly on the Middendorf Formation, with Tertiary sediments locally capping uplands on the southern half of each of the installations.

The Middendorf Formation (also referred to as the Tuscaloosa Formation) consists of deltaic deposits of light-colored sands and kaolin clays. Most soils at Fort Jackson and McCrady Training Center are formed from sediment of the Middendorf Formation. The Middendorf Formation thickens considerably to the southeast, sitting on top of crystalline bedrock that dips to the southeast at approximately 25 feet per mile. The thickness of the unconsolidated sediments varies considerably across the installation depending on the distance from the fall line and the local topography, with total thickness of unconsolidated sediments of the Tertiary units and Middendorf Formation varying from approximately 300 feet in the northwestern portion of Fort Jackson to approximately 500 feet in the southwestern corner of McCrady Training Center.

2.2.5 Hydrogeology

The Middendorf Aquifer constitutes the primary aquifer used as a groundwater supply in the area including, and surrounding, Fort Jackson and McCrady Training Center. Within this region, the Middendorf Formation is entirely coincident with the Middendorf Aquifer. Half the wells occurring within the Middendorf Aquifer in Richland County are less than 100 feet deep. In the area directly to the south of Fort Jackson and McCrady Training Center the overwhelming majority of wells screened within the Middendorf Aquifer are screened above elevations of 175 feet above mean sea level. Wells located several miles north of the installation extract groundwater from bedrock aquifers, but very few wells on the installation or directly south of the installation extract groundwater from the bedrock aquifers due to the great depths (and therefore well installation expense) to bedrock.

Depths to water on-installation and immediately downgradient (to the south) generally range from two to 20 feet below ground surface (bgs) within the cantonment area and directly adjacent to streams (USATHAMA, 1980), up to a maximum depth of over 100 feet on highlands in interstream areas near the central part of the combined installations (LAW, 2003). The aquifer system in the region is described as stratified, consisting of shallow, intermediate, and deep groundwater flow systems (USGS, 1996). Fort Jackson and McCrady Training Center represent an important local and regional recharge area for the Middendorf aquifer system. The majority

of groundwater recharging the aquifer is expected to remain within the shallow and intermediate flow system and follow topography, ultimately discharging to local streams and rivers (**Figure 2-3**). A smaller proportion of recharge enters the deep groundwater flow system and discharges to regional discharge points. The Congaree and Wateree rivers to the south and east of the installation, respectively, have been identified as regional discharge points for the deep component of the groundwater system in Richland County (USGS, 1987). Regional groundwater flow directions along with other features of the groundwater system are shown on **Figure 2-4**.

As indicated on **Figure 2-3,** water infiltrating to shallow groundwater on-installation within the southern half of the combined installation generally flows in a southerly direction as does the groundwater flow in the intermediate and deep flow systems. Flow velocities in the shallow and intermediate portion of the aquifer were calculated using hydraulic gradients measured as part of this assessment and hydraulic conductivities measured during a previous investigation by Law Engineering and Environmental Services (2003). Horizontal flow velocities using these data varied from 34 to 368 feet per year. As shown on **Figure 2-3**, the area located south of the southern Fort Jackson installation boundary and west of Weston Lake is serviced by water supply infrastructure servicing Columbia and its suburbs. As such, it is unlikely that groundwater is utilized for drinking water purposes in this portion of the hydraulically downgradient area. This infrastructure does not extend to Weston Lake. Well logs obtained from Fort Jackson and the South Carolina Department of Natural Resources (SCDNR) indicated that the aquifers to the south and southeast of the installations are utilized for drinking water. Numerous groundwater supply wells are utilized to supply recreational facilities at Weston Lake. Additionally, numerous residential drinking water wells and larger supply wells were identified in the area south of the combined installations and to the east of Weston Lake (**Figure 2-3**). During a windshield survey completed in the area, dozens of additional wells not included in the database obtained from the SCDNR were also observed. Although no information is available for these wells, they are likely similarly utilized for residential drinking water as those included in the well database.

2.2.6 Hydrology / Surface Water

There are 26 lakes, ponds, and impoundments on Fort Jackson and McCrady Training Center. These water bodies range in size from 0.5 to 173 acres; however, most are less than 35 acres. Five ponds and two lakes are adequate for intensive fisheries management (Old Heises Pond, South Pond, Upper Barstow Pond, Lower Barstow Pond, Odom Pond, Upper Legion Lake, and Big Twin Lake). Remaining lakes and ponds are maintained for waterfowl habitat, recreation, aesthetics, and irrigation water supply for golf courses. The largest lake, Weston Lake, is north of Leesburg Road east of the cantonment area. The lake has a surface area of about 173 acres and accounts for more than one-third of the total impounded surface acreage for the installation. Weston Lake is also the installation's primary waterside recreation lake, with camping facilities, picnic shelters, a community house, a beach pavilion, and a swimming area (Gene Stout & Associates, 2004).

Fort Jackson and McCrady Training Center is located within the Santee River Basin and the Congaree River subbasin. All creeks and streams leaving Fort Jackson and McCrady Training Center eventually flow into either the Wateree River or the Congaree River. These rivers meet about 16 miles southeast of Fort Jackson and McCrady Training Center, where they form the

Santee River, the principal stream of the region. The Santee River continues in a southeasterly direction, eventually emptying into the Atlantic Ocean south of Georgetown, South Carolina (Gene Stout & Associates, 2004).

Fort Jackson encompasses five watersheds or subwatersheds, as shown on **Figure 2-5**. These watersheds are drained by Colonels, Gills, Wildcat, Mill, and Cedar creeks described below.

Colonels Creek Watershed
The headwaters of Colonels Creek originate on Fort Jackson and McCrady Training Center. This is a predominantly wooded watershed. Colonels Creek drains the eastern portion of the installation, including the area licensed to the SCARNG McCrady Training Center, and flows southeast to the Wateree River, a tributary of the Congaree River.

Gills Creek Watershed
Gills Creek, in the northwest portion of Fort Jackson, drains the small arms ranges and western impact area, as well as non-live-fire training areas, and flows into Boyden Arbor Pond before resuming downstream of the installation. Gills Creek drains a primarily forested watershed on Fort Jackson and a predominantly urban watershed downstream of Fort Jackson. Gills Creek downstream of Fort Jackson is listed as impaired for fecal coliform and dissolved oxygen (DO) on South Carolina's 2012 Clean Water Act Section 303(d) list of water quality limited segments (Gene Stout & Associates, 2004; SCDHEC 2012).

The United States Geological Survey (USGS) maintains a stream gauge on Gills Creek downstream of Fort Jackson within the city of Columbia. **Figure 2-2** shows that evapotranspiration has a strong influence on stream flow rate within Gills Creek and that months with the highest precipitation do not correspond to the months with the highest stream flow rate. This is consistent with conditions common in forested areas of the southeastern United States.

Wildcat Creek Watershed
Wildcat Creek drains a small portion of the cantonment area and flows to the west, where it enters Gills Creek just below Lake Katherine. None of the operational range areas are drained by Wildcat Creek.

Mill Creek Watershed
Mill Creek drains an area in the southwest portion of the training areas and flows off-post to the south, where it eventually enters the Congaree River. The Mill Creek watershed encompasses a small area in the southern portion of the non-dudded impact area (including two small arms ranges), wooded training areas, and the Twin Lakes recreational area located on-post.

Cedar Creek Watershed
Cedar Creek drains the majority of a large dudded impact area and flows southward through the Weston Lake Recreation Area, eventually entering the Congaree River.

2.2.7 Ecological Setting

Two federally listed endangered plant species, rough-leaved yellow loosestrife (*Lysimacia asperulaefolia*) and smooth purple coneflower (*Echniacea laevigata*), occur at or near Fort Jackson and McCrady Training Center. Rough-leaved yellow loosestrife is found just west of the

installation boundary along Buffalo Creek. Smooth purple coneflower has been documented adjacent to Statue of Liberty Road in the northern portion of Fort Jackson. Since these plants are located in narrowly defined areas within the operational training ranges, it is not expected that they would be found at off-installation locations. In addition to the smooth purple coneflower and the rough-leaved yellow loosestrife, two other unlisted rare species occur at McCrady Training Center: the crestless fringed orchid (*Pteroglassaspis ecristata*) and the Indian olive (*Nestromia umbellula*) (USAEC and USDA, 2001). The Nature Conservancy ranks both species as imperiled statewide (USAEC and USDA, 2001). One federally listed endangered animal, the red-cockaded woodpecker (*Picoides borealis*), is a resident of Fort Jackson and McCrady Training Center. The red-cockaded woodpecker is endemic to the pine forests of the southeastern United States. It is found most commonly in the longleaf pine ecosystems. Due to the wide presence of the red-cockaded woodpecker on Fort Jackson and McCrady Training Center and the presence of similar habitat off range and off installation, it is expected that the red-cockaded woodpecker is present off range as well. Two additional federally endangered species, the shortnose sturgeon (*Acipenser brevirostrum*) and Canby's dropwort (*Oxypolis canbyi*), are found in the vicinity of Fort Jackson and McCrady Training Center, but are not known to occur at the installation. The American Bald Eagle (*Haliaeetus leucocephalus*), which is listed by the SCDNR as a state endangered species (SCDNR, 2006), is a transient visitor to the installation as is the state endangered Rafinesque's big-eared bat (*Corynorhinus rafinesquii*). No American bald eagle nests or permanent roost sites are known to occur on this installation.

Fort Jackson and McCrady Training Center can be classified into five primary terrestrial vegetative types: pine, pine/upland hardwood, upland hardwood, bottomland hardwood, and open field. There are no grassland areas on Fort Jackson, except for a small amount in the cantonment area and alongside roads. Vegetation on Fort Jackson and McCrady Training Center is diverse and abundant. Field investigations and surveys have identified over 750 species of flora on the installation. Forest cover is the principal vegetative type and may be grouped into eight major forest types: Natural Pine, Pine Planation, Pine Scrub Oak, Pine Hardwood, Scrub Oak, Upland Hardwood, Bottomland Hardwood, and Hardwood Pine. Natural Pine is the most important forest type on the installation and includes all natural pine stands, regardless of species, in which less than 20 percent of the basal area of overstory trees is hardwoods or less than 20 percent of the basal area is dominated by scrub oak (Gene Stout & Associates, 2004).

Forested areas occupy the majority of the installation, with the exception of the firing ranges and the cantonment area. The dudded and non-dudded impact areas in the center of the installation, as well as the training areas along the outskirts of the installation, are mostly covered with thick vegetation consisting of mature pines and scrub oaks. There are, however, several sandy areas that are not vegetated and that are prone to erosion. These areas have been surveyed by personnel in Fort Jackson's Environmental Division (ENV).

2.3 Summary of Previous Investigations

2.3.1 White Phosphorus Wetland Storage Installation Assessment (USACE, 1993)

The U.S. Army Corps of Engineers performed a White Phosphorus Wetland Storage Installation Assessment at Fort Jackson in 1993 to determine whether white phosphorus (WP) was present in areas potentially attractive to wildlife, particularly waterfowl. Sediment samples were collected

from 12 locations around Fort Jackson that were deemed most likely to store WP based on historical or current use of WP-containing munitions. Five of the sampling locations were near the eastern dudded impact area, and two locations were near the western impact area (the five other sampling locations were near a recreational area). None of the samples contained WP above the analytical detection limit of 0.00096 milligrams per kilogram (mg/kg) (wet weight). The report concluded that the risk to waterfowl from WP storage in the Fort Jackson wetlands is negligible (USACE, 1993). Additionally, a summary report issued by USACE in 1996 stated that out of 39 samples collected at Fort Jackson, none contained WP levels over 0.00096 mg/kg (USACE, 1996).

2.3.2 Small Arms Ranges Study (Bricka, 2002)

Mississippi State University staff, headed by Dr. R. Mark Bricka, performed a study from 2001 to 2002 to evaluate the potential of off-installation migration of MCOC, particularly metals, from the small arms ranges located around the northern perimeter of the non-dudded impact area in the Gills Creek watershed. This study involved the collection of surface and subsurface soil samples from several ranges, as well as surface water and sediment samples from the creeks that drain the small arms ranges (*i.e.*, Bynum, Rowell, and Mack creeks, which drain into Gills Creek). The data showed that soil containing elevated concentrations of Pb is present on the small arms ranges. Also, because the small arms ranges contain sandy soils and are intersected by a network of creeks, the potential for erosive conditions is high, so that Pb-contaminated soil was shown to be entering several of the smaller creeks that drain into Gills Creek. The results of the sediment sampling indicated that from Gills Creek, sediment travels into Boyden Arbor Pond, primarily during larger rain events. The authors of the study stated that "it is also suspected that little Pb is moving off post because of the size of Boyden Arbor Pond and that the sediment Pb levels at the discharge end of the pond are quite low." While information from the study is useful from a general perspective, the data from the Bricka study cannot be used to assess potential off-range migration of Pb from the small arms ranges in the Gills Creek watershed because detection limits in the Bricka study do not meet the Phase II DQOs (*i.e.*, the method detection limits from the Bricka study are higher than the Phase II PALs for lead).

2.3.3 Small Arms Ranges Study (USATC, 2005)

The U.S. Army Aberdeen Test Center also performed a study to evaluate the potential of off-installation migration of MCOC, particularly metals, from the small arms ranges located around the northern perimeter of the non-dudded impact area in the Gills Creek watershed. This study involved a watershed-based assessment of the small arms ranges. The study included the installation of three shallow groundwater monitoring wells (MW-1, MW-2, and MW-3) at a small arms range to depths of approximately 13.5 to 14.5 feet bgs. Dissolved Pb results from MW-1 were as high as 2,900 ppb, while maximum dissolved Pb results from MW-2 and MW-3 were 6 ppb and 30 ppb, respectively. The core sections for MW-1 showed a sandy profile, while cores for MW-2 and MW-3 indicated that there is a localized confining condition (*i.e.*, clay lens) that prevents direct communication between the ground surface and groundwater. Groundwater samples were also collected from two potable water supply wells located near the small arms ranges. These wells are screened in the Middendorf Formation at depths of 174 feet bgs and 105 feet bgs. Pb concentrations for groundwater samples from both of the wells were lower than the 15 ppb Pb National Drinking Water Action Level.

The study authors noted that there was visual evidence of significant soil erosion and sediment transport from the impact berms on many ranges. Analytical results from three rounds of baseflow surface water sample collection suggested that the range areas were contributing to Pb concentrations in surface water immediately downstream of the small arms ranges. Similarly, storm water grab sample analytical data also indicated that runoff was increasing Pb concentrations in each creek. Regarding groundwater impacts, the study concludes that they are limited to the shallow base flow discharging to the creeks. The authors of the study stated that "range use effects on surface water resources are not detectable at the overall training area boundary or installation boundary". However, the data from the USATC study cannot be used to assess potential off-range migration of Pb from the small arms ranges in the Gills Creek watershed, because detection limits in the USATC study do not meet the Phase II DQOs.

2.3.4 Numerous Installation Restoration Program (IRP) Investigations

A number of investigations completed under the IRP evaluated MCOC concentrations in soil and shallow groundwater near the southern combined installation boundary east of Weston Lake. In general, the data collected as part of these investigations did not meet the DQOs being utilized as part of the current assessment. Therefore, the data could not be utilized as part of this assessment. However, as part of these evaluations, slug tests were performed within shallow wells near former open demolition areas. The data are utilized within this report to estimate aquifer properties and travel times in groundwater.

There are several areas on Fort Jackson and McCrady Training Center where munitions were utilized or disposed that are being addressed under Fort Jackson's Resource Conservation and Recovery Act (RCRA) Part B permit issued by the South Carolina Department of Health and Environmental Control (SCDHEC) in September 1991. Although these areas are potential sources of MCOC, they are not evaluated under the ORAP because they are addressed under the conditions of their permit. Permitted open burn (OB)/open detonation (OD) areas are programmatically excluded from ORAP because the conditions of their permit address potential MCOC migration from these areas. They are briefly described here for informational purposes only as they are located within operational range areas characterized as *Inconclusive* during the Phase I. The two sites are the Inchon and Wonsan Ordnance Disposal Sites.

Fort Jackson and McCrady Training Center historically utilized these two sites for disposal of explosive ordnance, both by OB and OD. The Wonsan Explosive Ordnance Disposal (EOD) site is located within McCrady Training Center less than one mile from the southern installation boundary. The Inchon EOD site is located to the east of Weston Lake within Fort Jackson and is also located less than one mile from the southern combined installation boundary. Groundwater in this area flows to the south off-range and off-installation.

Inchon Explosive Ordnance Disposal Site

The six-acre Inchon EOD site was first used by the 48th EOD Detachment to dispose of unserviceable ammunition in 1973. Use of the site was discontinued in 1981. Disposal consisted of burning small arms ammunition in trenches and detonating larger ordnance in pits. The Inchon EOD site is designated as Solid Waste Management Unit (SWMU) 17 in Fort Jackson's IRP. Field activities to support a RCRA Facility Investigation were conducted in 1991, 1993, 1999, and 2000. Samples were collected from shallow soil, subsurface soil, surface water, sediments,

and groundwater and analyzed for a variety of analytes, including explosives and metals. Groundwater concentrations were compared to the National Drinking Water Action Level of 15 parts per billion (ppb) for lead and the 2000 USEPA Region IX Preliminary Remediation Goals for Residential Soil and Tap Water. Soil concentrations were compared to USEPA Ecological Screening Values (ESVs) for surface soil (dated August 1999). Positive detections were noted primarily for metals in soil, including arsenic, barium, cadmium, chromium, and lead. A screening level ecological risk assessment was performed in accordance with USEPA (1997) guidance. This assessment determined that constituents present in the soil and groundwater at the Inchon site do not pose a threat to human health or the environment; however, potential UXO that remains in the soil at the site may pose a safety risk and serve as a potential ongoing source of MCOC as the munitions degrade. Additionally, it should be noted that some comparison criteria referenced in this study are now outdated. Fort Jackson is implementing land use controls to prevent access to this site (LAW, 2003; USAEC, 2005). As part of the investigations completed at the site, slug tests were completed in shallow wells to estimate K-values for the Middendorf Aquifer in the area. The K-values were utilized during development of the technical approach for the current assessment and subsequent analysis of data.

Wonsan Explosive Ordnance Disposal Site

The Wonsan EOD site consists of two areas separated by an east-west firebreak: a one-acre area north of the firebreak and a two-acre area south of the firebreak. The Wonsan EOD site was used by the 48th EOD Detachment to dispose of unserviceable ammunition from 1961 to 1978. Disposal consisted of burning small arms ammunition in trenches and detonating larger ordnance in pits. The Wonsan EOD site is designated as SWMU 12 in McCrady Training Center's IRP. Four field events (in 1991, 1993, 1999, and 2000) were conducted to support a RCRA Facility Investigation. Samples were collected from shallow soil, subsurface soil, surface water, and groundwater and analyzed for a variety of analytes, including explosives and metals. Groundwater concentrations were compared to the National Drinking Water Action Level of 15 parts per billion (ppb) for lead and the 2000 USEPA Region 9 Preliminary Remediation Goals for Residential Soil and Tap Water. Soil concentrations were compared to USEPA Ecological Screening Values for surface soil (1999). The primary constituents of concern for surface soil were determined to be chromium and lead. A screening level ecological risk assessment was performed in accordance with USEPA guidance (1997). This assessment determined that MC present in the soil and groundwater at the Wonsan EOD site do not pose a threat to human health or the environment; however, potential unexploded ordnance (UXO) that remains in the soil at the site may pose a safety risk and serve as a continuing source of MCOC as the munitions present degrade. Additionally, it should be noted that some comparison criteria referenced in this study may be outdated. and McCrady Training Center is implementing land use controls to prevent access to this site (LAW, 2003; USAEC, 2005). As part of the investigations completed at the site, slug tests were completed in shallow wells to estimate K-values for the Middendorf Aquifer in the area. The K-values were utilized during development of the technical approach for the current assessment and subsequent analysis of data.

2.4 Phase I Conceptual Site Model

The Phase I CSM provided the initial basis of the Phase II. The CSM identified pathways that could allow MCOC from an on-range source to interact with off-range receptors at concentrations that could pose potential risk to human health or the environment.

A summary of potential MCOC associated with each range region/type is presented in Table 2-2.

Table 2-2: Potential MCOC (Current and Historical) at Fort Jackson & McCrady Training Center

Range Type	Source Area / Munitions Type	Potential MCOC
Firing Ranges	Squad defense ranges, convoy live-fire ranges, hand grenade ranges, tank stationary gun ranges, demolition range, artillery firing points, tank scaled range, anti-air weapon range	2,4-DNT, 2,6-DNT, HMX, nitroglycerine, PETN, RDX, TNT, perchlorate, Pb, Sb, Cu, Zn, and W
Small Arms Ranges	19 small arms ranges	NG, Pb, Sb, Cu, Zn, and W
Training Areas	Artillery firing points and areas currently used for maneuver / field training that fall within historical range fans for small, medium, and large caliber training ranges	2,4-DNT, 2,6-DNT, PETN, RDX, NG, Pb, Sb, Cu, and Zn
	Known or suspected dudded areas resulting from historical training activities involving primarily mortar and grenade firing	2,4-DNT, 2,6-DNT, HMX, PETN, RDX, TNT, and perchlorate
	Areas with no historical source and with limited or no current munitions usage.	None
Impact Areas	The eastern dudded impact area, as well as a smaller known dudded area related to historical munitions usage within what is currently used as a non-dudded impact area	2,4-DNT, 2,6-DNT, HMX, PETN, RDX, TNT, and perchlorate

The MCOC listed in **Table 2-2** are potentially present in source media, including soil (*e.g.*, impact berms, localized impact areas surrounding targets, burn pits) and surface water/sediment (*e.g.*, via direct deposition into streams and/or wetlands).

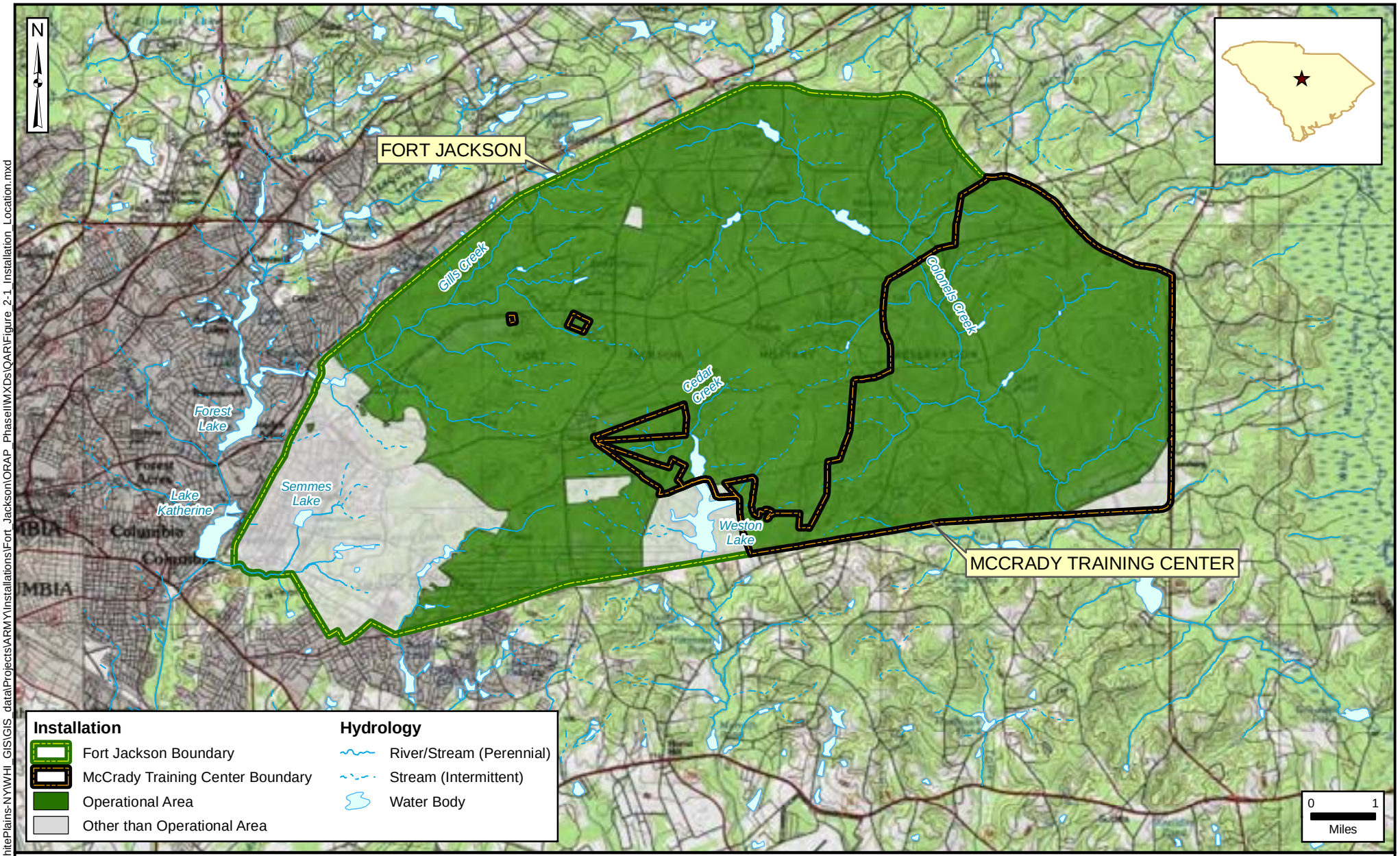
MCOC can be released to groundwater (downgradient), surface water/sediment (downstream), or the food chain via a variety of release mechanisms. Release mechanisms for soil may include leaching from soil to groundwater or erosion and runoff to nearby surface soil or streams. Once potential MCOC are deposited in surface water/sediment, they can migrate downstream or be taken up by aquatic plants or animals.

Release mechanisms that enable transport of potential MCOC from soil or surface water/sediment source areas toward off-range receptors are present in the operational range areas at Fort Jackson and McCrady Training Center. Both surface water and groundwater pathways were identified for soil sources in the live-fire ranges and the impact areas at Fort Jackson and McCrady Training Center.

The surface water system provides migration pathways and contact opportunities between MCOC source areas and off-range human and ecological receptors. Some of the downgradient lakes and streams are within sensitive environments, such as state or local parks or protected rivers. These water bodies are used recreationally by human receptors and as potential habitat for ecological receptors.

Distribution infrastructure for a municipal supply associated with the city of Columbia supplies many of the homes located south of the installation to the west of Weston Lake. South and east of Weston Lake, groundwater is a primary source of drinking water for dozens of residents located to the south and southeast of Fort Jackson and McCrady Training Center. Regional investigations of the Middendorf Aquifer, as well as local topography, indicate that groundwater infiltrating operational range area may flow to the south and southeast towards these residential wells.

The CSM was refined during the initial stages of the Phase II as described in **Section 3**.



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Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 2-1
Installation Location

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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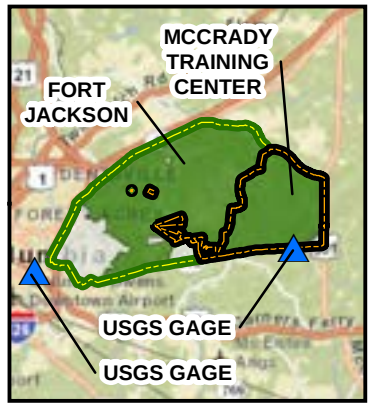

Average Pan Evaporation
Florence SC
(1980-1992)
[adjusted by pan coefficient of 0.75]

Average Total Precipitation
COLUMBIA UNIV OF SC, SOUTH CAROLINA (381944)
1971-2000 Monthly Climate Summary

USGS GAGE 02169570
GILLS CREEK AT COLUMBIA, SC
MONTHLY MEAN FLOW DATA
WATER YEARS 1967 - 2007
[normalized to watershed area]

USGS GAGE 02148300
COLONELS CREEK
MONTHLY MEAN FLOW DATA
WATER YEARS 1966 - 1980, 2005-2007
[normalized to watershed area]

Average Net Precipitation
(Total Precipitation - Evaporation)

Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 2-2
Monthly Stream Discharge, Evaporation, and Precipitation

Data Sources:
USGS/NWIS
SCDNR State Climatology Office
ESRI, ArcGIS Online, StreetMap USA

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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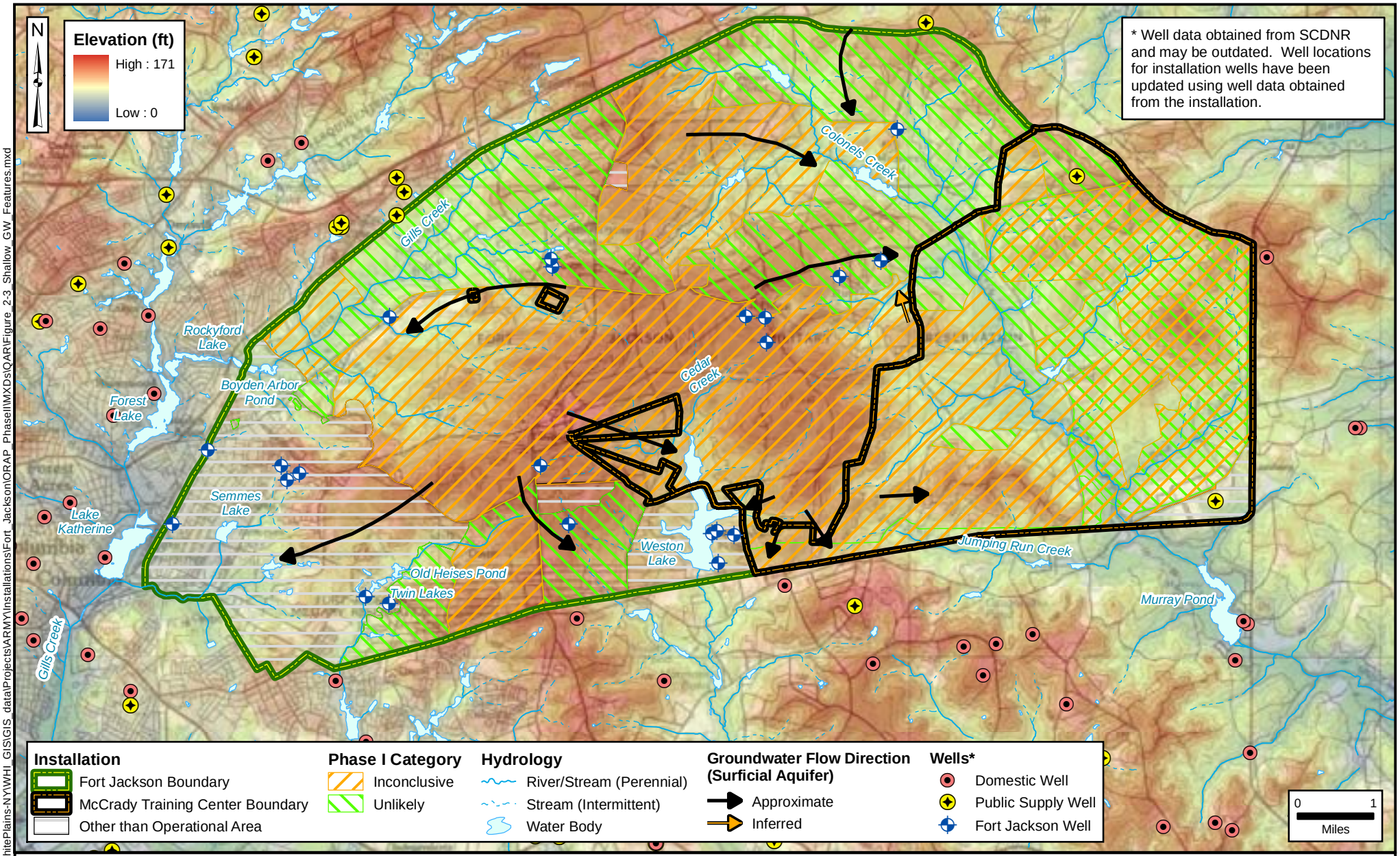

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Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 2-3
Shallow Groundwater Flow System

Data Sources:
AEC, ARID-GEO, 2006
SCDNR, Wells, 2007
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

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Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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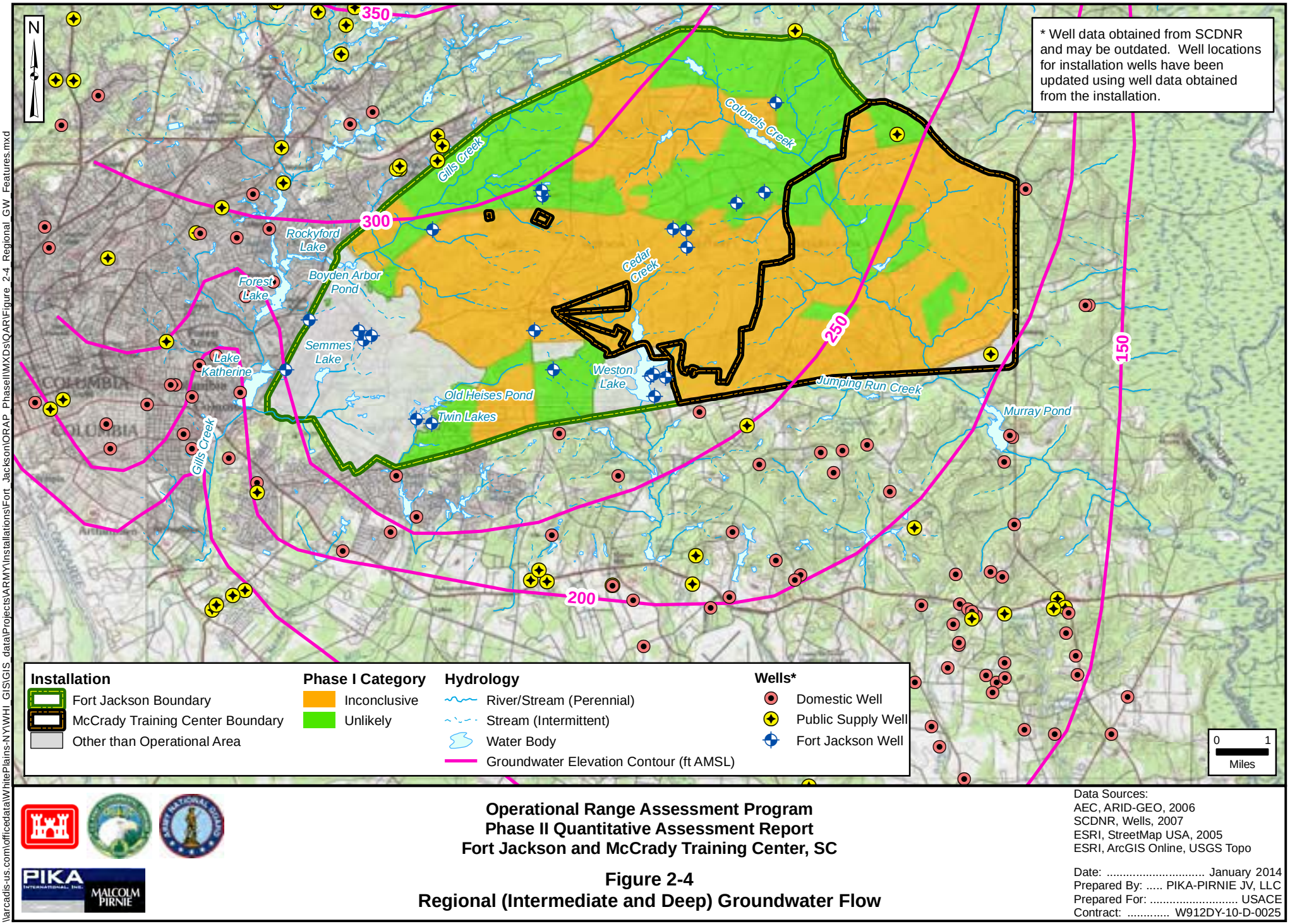

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Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 2-4
Regional (Intermediate and Deep) Groundwater Flow

Data Sources:
AEC, ARID-GEO, 2006
SCDNR, Wells, 2007
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

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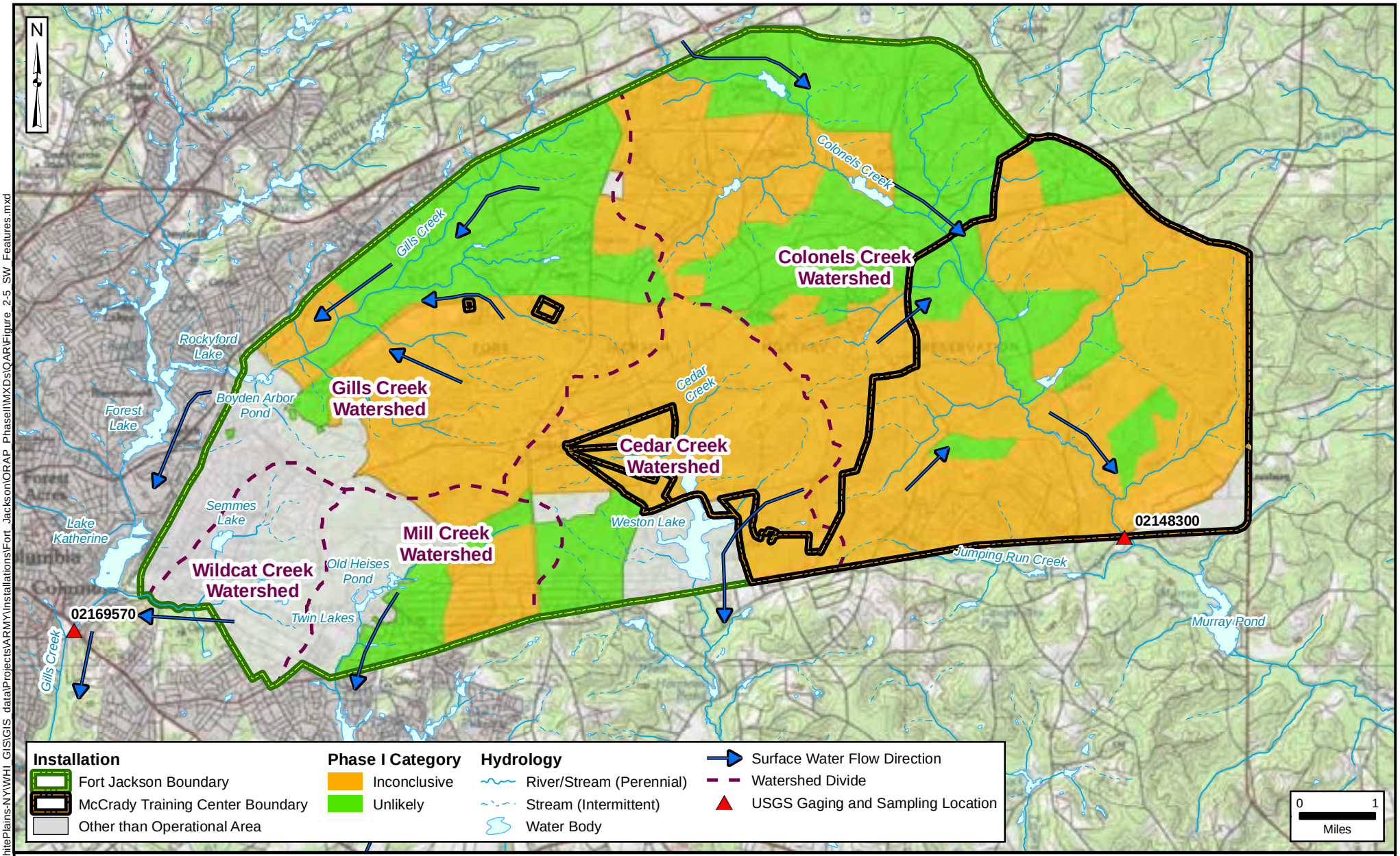

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Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 2-5
Surface Water Features

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

Date: ..... January 2014
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Prepared For: ..... USACE
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3 ORA Phase II

As described in **Section 1**, the strategy for conducting the Phase II was based on the USEPA systematic planning or DQO process. The DQO process provides an iterative sequence of seven logical steps to create a detailed technical approach. The preliminary CSM was developed during the Phase I (Step 1 of the DQO process) and updated during the Phase II planning. The subsequent steps in the DQO process include the following:

- Identifying the goal of the Phase II (the "if-then" statements to determine whether surface water and groundwater pathways are present)
- Identifying information inputs (media to be sampled and analytical methods)
- Defining the study boundaries (which waterways will be sampled depending on the pathways and receptors present)
- Developing the analytical approach (how the data will be analyzed)
- Specifying performance or acceptance criteria (*i.e.*, project action limits [PALs])
- Developing the detailed plan for obtaining data (developing the detailed CSM and technical approach)

The following sections describe the major outputs of the site-specific application of the DQO process, including the updated CSM and the detailed technical approach developed for the Phase II.

3.1 Phase II Site Reconnaissance

3.1.1 Technical Project Planning Meeting and Initial Site Visit (September 2008)

During the Technical Project Planning meeting on 24 September 2008, ARCADIS team members defined the program objectives, programmatic overview, requested support from Fort Jackson and McCrady Training Center, and presented a proposed schedule.

It was during this initial meeting that the idea of completing a combined assessment for both Fort Jackson and McCrady Training Center was first proposed as the installations are adjoining, the property is "owned by" Fort Jackson, they have similar histories of use, and they have similar conceptual site models.

3.1.2 Additional Scoping Meeting & Site Reconnaissance (October 2008)

A meeting took place on 27 October 2008 to coordinate the Phase II Assessment for Fort Jackson and McCrady Training Center. Reconnaissance of proposed surface water and groundwater sampling locations occurred following the meeting on 27 October 2008 and on 28 October 2008. Data collection at both installations also occurred concurrently with the reconnaissance effort.

At the meeting it was decided that the assessments of Fort Jackson and McCrady Training Center would occur together. As such, sampling along the boundary between Fort Jackson and McCrady Training Center was not needed. Based on the reconnaissance observations, some of the proposed upstream and downstream surface water sampling points were relocated. The team agreed that samples collected from Weston Lake would be analyzed only for chemical constituents and no macroinvertebrates. Some of the proposed up gradient and down gradient

groundwater well locations were relocated based on reconnaissance observations. The project team also decided that a piezometer study would be implemented to obtain sufficient groundwater data to develop an understanding of localized groundwater flow. The general consensus among the team was that the piezometer study would be instrumental in subsequently siting groundwater wells.

3.1.3 Final Site Reconnaissance (February 2009)

ARCADIS conducted a pre-investigation site visit at Fort Jackson and McCrady Training Center on 18 through 20 February 2009. During the site visit, the project team gathered previously unavailable data from Fort Jackson and McCrady Training Center, confirmed access to each of the proposed piezometer and surface water sampling locations with Range Operations, met with the drilling subcontractors to confirm drill rig accessibility at each of the proposed piezometer locations, and discussed sampling program logistics. The project team obtained newly collected data associated with recent drilling and surface water sampling activities at the installations. The field team visited the hydrology department at the SCDNR to obtain copies of well logs for wells located on and surrounding the installations.

On 19 February 2009, the field team met with drilling subcontractors and visited proposed piezometer locations to verify accessibility and identify any safety issues associated with the locations. Most of the locations were determined to be accessible by the drillers although three of the piezometer locations (P-11, P-13, and P-15) were determined to require a minimal amount of site work (surface grading) to gain access to the locations.

The team visited proposed surface water sampling locations to confirm accessibility and verify logistics associated with collecting samples. The field team also confirmed Fort Jackson Morale, Welfare, and Recreation would provide a boat for use in sampling activities on Weston Lake.

3.1.4 Post 2009 Assessment Scoping Discussions

Following the completion of Phase II Assessment field activities in 2009 and evaluation of the data generated, numerous discussions were held to discuss the results. Based upon these discussions, the results of the 2009 field activities were deemed to be inconclusive for explosives in groundwater and for metals (primarily copper, lead, tungsten, and zinc) in the Gills Creek watershed. Therefore, the project team decided to prepare a SLERA to further evaluate potential risks associated with the metals MCOC in the Gills Creek watershed, and to perform another phase of field work to obtain additional data to evaluate explosives in groundwater. Additionally, newly available information indicated that depleted uranium (DU) containing munitions were historically utilized at Fort Jackson. As such, uranium (U) and U-isotopes were added to the list of MCOC to evaluate in groundwater. The project team agreed that field activities completed in 2012 would consist of installing well pairs at six locations downgradient of identified potential source areas. The wells would be sampled for explosives, U and U-isotopes.

3.2 Conceptual Site Model

The updated CSMs for the *Inconclusive* areas are summarized in the following sections. Differences in potential MCOC sources, pathways, and receptor locations dictated that Fort Jackson and McCrady Training Center be divided into three separate Phase II assessment areas (Cedar, Colonels, and Gills Creeks) based on watershed divides as shown on **Figure 3-1** and

discussed in the sections below. For the groundwater assessment, a "worst-case" approach was utilized. The groundwater assessment focused on a heavily utilized impact area straddling the Cedar Creek and Colonels Creek watersheds along the combined southern installation boundary.

3.2.1 Primary Sources and MCOC

The potential MCOC considered for analysis in the Phase II are based on the types of munitions used (current and historical) on the *Inconclusive* ranges, as identified in the Phase I. However, potential MCOC identified in the Phase I were revised based on an analysis of more recent information gathered during the site surveys as part of the Phase II. The specific MCOC that were investigated for each potential pathway (surface water system and groundwater system) during the Phase II are outlined below.

3.2.1.1 Surface Water

- Explosives (2,4–DNT, 2,6–DNT, HMX, NG, RDX, and TNT), perchlorate, and metals (Pb, Sb, Cu, Zn, and W) at all sample locations in each watershed.

3.2.1.2 Sediment

- Explosives (2,4–DNT, 2,6–DNT, HMX, NG, RDX, and TNT) and metals (Pb, Sb, Cu, Zn, and W) at all sample locations in each watershed.

3.2.1.3 Groundwater

- Explosives (2,4–DNT, 2,6–DNT, HMX, NG, RDX, and TNT), perchlorate, and metals (Sb, Cu, Pb, W, and Zn) at each sampling point. In 2012, U and U isotopes were added to the list of MCOC.

Based on the findings of the WP study (USACE, 1993), WP was considered unlikely to migrate off-range at concentrations that may pose an unacceptable risk to off-range ecological or human receptors. As such, WP was removed from the list of MCOC to be analyzed for as part of the Phase II assessment.

3.2.2 Pathway Analysis

3.2.2.1 Surface Water Pathways

The surface water system provides migration pathways and contact opportunities between sources and off-range human and ecological receptors. The surface water pathways that receive runoff and/or groundwater discharge from *Inconclusive* ranges include Colonel Creek Watershed, Cedar Creek Watershed, Gills Creek Watershed, and Mill Creek Watershed (**Figure 2-5**).

3.2.2.1.1 **Cedar Creek Watershed**

The surface water source-pathway-receptor CSM for the Cedar Creek watershed is presented on **Figure 3-2**. Potential sources of MCOC in the Gills Creek watershed consist of *Inconclusive* small, medium, and large caliber munitions ranges, and the MCOC include explosives, perchlorate, and MCOC metals. The *Inconclusive* areas are drained by Cedar Creek and its tributaries, which originate on the operational range areas. Potential downstream human receptors include the recreational users of Weston Lake and that portion of Cedar Creek located

south of the outfall of Weston Lake. Potential ecological receptors include the sensitive wetland habitats downstream of operational areas and threatened and endangered species which may use surface water during part of their life-cycle.

3.2.2.1.2 **Colonels Creek Watershed**

The surface water source-pathway-receptor CSM for the Colonels Creek watershed is presented on **Figure 3-3**. Potential sources of MCOC in the Colonels Creek watershed consist of *Inconclusive* small, medium, and large caliber munitions ranges, and the MCOC include explosives, perchlorate, and metals. The *Inconclusive* areas are drained by Colonels Creek and its tributaries, which originate on the operational range areas. Potential downstream human receptors include the recreational users of Colonels Creek. Potential ecological receptors include the sensitive wetland habitats downstream of operational areas and threatened and endangered species which may use surface water during part of their life-cycle.

3.2.2.1.3 **Gills Creek Watershed**

The surface water source-pathway-receptor CSM for the Gills Creek watershed is presented on **Figure 3-4**. Potential sources of MCOC in the Gills Creek watershed consist of *Inconclusive* small, medium, and large caliber munitions ranges, and the MCOC include explosives, perchlorate, and MCOC metals. The *Inconclusive* areas are drained by Gills Creek and its tributaries, which originate on the operational range areas. Potential downstream human receptors include the recreational users of Gills Creek and Boyden Arbor Pond. According to Fort Jackson Family and Morale, Welfare and Recreation division, this recreational use includes fishing. Potential ecological receptors include the sensitive wetland habitats downstream of operational areas and threatened and endangered species which may use surface water during part of their life-cycle.

3.2.2.1.4 **Mill Creek Watershed**

The Mill Creek Watershed drains a small portion of the southwestern corner of the operational range footprint within Fort Jackson along the southern installation boundary. According to RFMSS data and interviews conducted with installation personnel, these ranges have not been utilized for live-fire training since at least the 1960's. Potential historical sources of MCOC were identified at the areas historically utilized as firing points. Because of the small areas covered by the firing points and the likelihood that the sources of MCOC within the watershed are limited, it was determined that the source, pathway, and receptor conditions in the Mill Creek watershed could be adequately characterized by sampling planned for the other three watersheds. Due to similar source, pathway, and receptor characteristics, the Cedar Creek watershed was chosen as the primary proxy for the Mill Creek surface water system in the Phase II Assessment.

3.2.2.2 Groundwater Pathway

Precipitation falling on ranges at Fort Jackson and McCrady Training Center may infiltrate through the vadose zone and enter the groundwater system. The majority of groundwater recharging the Middendorf aquifer is expected to remain within the shallow and intermediate flow system and ultimately discharge to local streams and rivers. Within the Gills Creek watershed this means that water will likely discharge to Gills Creek before leaving the installation. This is similarly true for much of the operational range area lying within the Cedar Creek and Colonels Creek watersheds. However, the topography within the central and western

portions of the combined installation is much more variable with topographically higher hills dissected by streams creating deeper valleys (**Figure 2-3**). Precipitation that infiltrates these higher areas farther from adjoining streams is more likely to enter the intermediate or deeper flow system and bypass lower order streams, especially during the dry season. The intermediate and deeper flow system ultimately discharges to larger order streams to the south and southwest of the installation (**Figure 2-4**).

The area south of the southern installation boundary is generally considered to be hydraulically downgradient of most of the combined installations. For the area located west of Weston Lake, groundwater is unlikely to be utilized for drinking water purposes because the area is connected to a municipal supply system (**Figure 2-3**). Well logs obtained from Fort Jackson and the SCDNR indicate that the aquifers to the south and southeast of the installations are utilized for drinking water. Numerous groundwater supply wells are utilized to supply recreational facilities at Weston Lake. Additionally, numerous residential drinking water wells and larger supply wells were identified in the area south of the combined installations and to the east of Weston Lake (**Figure 2-3**). During a windshield survey completed in the area, dozens of additional wells not included in the database obtained from the SCDNR were also observed. Although no information is available for these wells, they are likely utilized for residential drinking water supply, similar to the wells included in the database. Detailed review of the available wells logs in the area directly to the south of Fort Jackson and McCrady Training Center and east of Weston Lake indicates that the overwhelming majority of wells screened within the Middendorf Aquifer are screened above elevations of 175 feet above mean sea level. This is particularly true for wells located within one to two miles of the installation boundary. A CSM for the groundwater pathway is included as **Figure 3-5**.

Slug tests were completed as part of a previous investigation at two solid waste management unit sites near the installation boundary (Law Engineering and Environmental Services, 2003). The slug tests were used to measure hydraulic conductivities (K values) within the upper portion of the Middendorf Formation. Using these K values, approximate travel times from source areas to the installation boundary could be calculated. Horizontal flow velocities using these K values and hydraulic gradients measured near the installation boundary varied from 34 to 368 feet per year. Although the wells utilized to obtain the hydraulic conductivity data are shallower than many of the residential wells located down gradient, these values are typical for the sediments and conditions found deeper in the aquifer as well (Freeze and Cherry, 1979). As such, the K values and flow rates likely represent reasonable estimates of aquifer properties within the investigation area deeper in the aquifer. Given these flow velocities, water infiltrating heavily utilized ranges near the southern combined installation boundary could reach nearby human receptors in as little as seven years.

3.3 ORA Phase II Technical Approach

As identified during the DQO process and outlined in the *Final Work Plan Operational Range Assessment Program Phase II Quantitative Assessment, United States Army Garrison Fort Jackson and McCrady Training Center, South Carolina* (Malcolm Pirnie, 2009), the appended

Quality Assurance Project Plan (herein referred to as the QAPP)[5], and a subsequent addendum to the QAPP (PIKA-Pirnie JV, 2012), the project goal for the Phase II was to determine whether MCOC potentially present in the groundwater and surface water systems are migrating off-range at concentrations that could pose an unacceptable risk to off-range human and/or ecological receptors. The Phase II was designed to gather data to quantitatively assess the surface water and groundwater pathways to address the goals of the study for the selected assessment areas.

The questions addressed by the Phase II are:

- 1a. Are MCOC migrating from the assessment areas to an off-range area via the surface water system?
- 1b. If so, does the surface water system release pose an unacceptable risk to human or ecological receptors?
- 2a. Are MCOC migrating from the assessment areas to downgradient off-range areas via the groundwater system?
- 2b. If so, does the groundwater system release pose an unacceptable risk to human receptors?

The Phase II used a weight-of-evidence approach to determine whether there is an unacceptable risk to off-range human and/or ecological receptors due to potential on-range MCOC sources. It included assessing the surface water system (surface water, sediment, and benthic macroinvertebrate samples were collected and analyzed) and groundwater system for pertinent MCOC to characterize conditions for three watersheds and one groundwater assessment area.

For the surface water system, sampling locations were selected in upstream and downstream sections of Cedar, Gills, and Colonels Creek watersheds. The upstream sampling locations provided a reference point upstream of the operational range areas identified as *Inconclusive* in the Phase I assessment. The downstream sampling locations were selected to allow evaluation of potential MCOC migration off range via a surface water pathway. Surface water, sediment, and benthic macroinvertebrate sampling was performed on a watershed-by-watershed basis, as explained in the subsections that follow. Surface water system sampling locations are shown on **Figure 3-6**.

Five surface water system sampling events were conducted as part of the initial sampling approach:

- Wet A from 30 March to 6 April 2009; surface water and sediment samples collected
- Wet B from 2 to 7 April 2009; surface water samples collected
- Storm event (dry season) on 18 May 2009; surface water samples collected
- Dry A from 20 to 22 July 2009; surface water and sediment samples collected
- Dry B from 21 to 22 July 2009; sediment samples collected

[5] The QAPP was based in part on the USAIPH *Army Operational Range Assessment Phase II Investigation Protocol* (USACHPPM, 2009). It should be noted that USAIPH was formerly USACHPPM.

For groundwater, a "worst-case" scenario groundwater assessment area was selected. The areas from which samples were collected were biased down gradient from ranges that represent a "worst-case" scenario for MCOC presence and transport to receptors based on historical and current range use and munitions loading, as well as proximity to the installation boundary and groundwater receptors. The potential source area identified as the "worst-case" is shown on **Figure 3-7** and will subsequently be referred to as the groundwater assessment area. These ranges represent a potentially significant source of MCOC (explosives and metals) and are located near enough to the installation boundary that the potential for off-site migration of MCOC via groundwater and/or surface water was identified in the Phase I assessment.

In order to develop an understanding of groundwater flow directions downgradient of the groundwater assessment area, a series of piezometers were initially installed to obtain water table elevations for the unconfined portion of the aquifer (**Figure 3-8**). Using groundwater flow directions interpreted from these elevations, soil borings were advanced to collect groundwater samples from temporary wells installed at intervals separated vertically within the aquifer. These data were collected from May to June 2009. The soil boring locations from which groundwater samples were collected from temporary wells along with other locations sampled in 2009 are shown on **Figure 3-9**.

Based on the results of the 2009 work, a series of six monitoring well clusters (each cluster contains two wells) were installed downgradient of the groundwater assessment area as shown on **Figure 3-10**. These well clusters were sampled three times (July and October 2012 and February 2013) in order to identify any spatial or temporal variations in the concentrations of targeted MCOC.

The analytical data from the surface water and groundwater assessments were used to evaluate potential off-range impacts to human and ecological receptors. Details of the sampling and analysis methodology are presented in **Sections 4** and **5**, respectively. Details of the DQO planning process and the sampling and analysis methods can be found in the *QAPP* and *QAPP Addendum* developed for the Phase II (Malcolm Pirnie, 2009 and PIKA-Pirnie JV, 2012).

The QAPPs are based on procedures outlined in the USAIPH Army Operational Range Assessment Phase II Investigation Protocol (USACHPPM, 2009) and the USEPA Guidance on Systematic Planning Using the Data Quality Objective Process (USEPA, 2006a). QAPP Worksheet #11 contains the planning process statements used to develop the technical approach, while QAPP Worksheet #17 documents the sampling design and rationale.

3.3.1 Surface Water System

3.3.1.1 Surface Water

Surface water samples were collected at eight locations on the installation (**Figure 3-6**) from three separate watersheds. Potential seasonal variations in water quality were evaluated by sampling during both dry and wet seasons. Twenty-four hour composite samples were collected to capture diurnal variations and 2-hour composite samples were collected to characterize potential migration during a storm event in the dry season. Water column composite samples were collected from Weston Lake. All surface water samples were analyzed for explosives MCOC (2,4-DNT, 2,6-DNT HMX, RDX, TNT; plus nine other explosives constituents),

perchlorate, and dissolved MCOC metals (Sb, Cu, Pb, W, and Zn). A more detailed description of sampling activities is provided in **Section 4**. Photographs that detail sampling activities are located in **Appendix A**. Surface water sampling locations within each of the watersheds are described below.

3.3.1.1.1 Cedar Creek Watershed

This watershed includes portions of Cedar Creek and tributaries originating on range and within the main impact area on Fort Jackson. Cedar Creek was dammed to form Weston Lake which the creek now discharges to (**Figure 3-6**). Sampling locations include:

- North branch of Weston Lake (WL1) – lake sampling location located downstream of firing ranges and dudded impact area.
- East branch of Weston Lake (WL2) – lake sampling location located downstream of firing ranges and dudded impact area.

No suitable upstream reference sample locations were available in the Cedar Creek watershed; consequently, the upstream sample locations in the Colonels Creek watershed were used as reference locations for the Cedar Creek downstream locations in Weston Lake.

3.3.1.1.2 Colonels Creek Watershed

This watershed drains almost the entire eastern half of the combined installation and includes live-fire ranges and numerous ranges used historically. Sampling locations include:

- Colonels Creek (CC1) – The location was selected as a reference location upstream of potential source areas.
- Colonels Creek (CC2) – The location was selected as a reference location upstream of potential source areas and upstream of McCrady Training Center.
- Colonels Creek (CC3) – Downstream location within the operational range boundary draining more than half of the combined operational range area.
- Jumping Run Creek (Tributary to Colonels Creek) (JC1) – Downstream location within the operational range boundary draining live-fire ranges and current and historic impact area. Stream also received groundwater discharge from water infiltrating within the impact area.

No suitable upstream reference sample location was available on Jumping Run Creek; consequently, the upstream locations in the Colonels Creek watershed were used as reference locations for the Jumping Run Creek downstream location.

3.3.1.1.3 Gills Creek Watershed

The Gills Creek watershed drains the northwestern portion of the combined installation and includes live-fire ranges, the majority of the small arms ranges on the installations, and a non-dudded impact area, as well as numerous ranges used historically. Sampling locations include:

- Gills Creek (GC1) – The location was selected as a reference location upstream of potential source areas.

- Gills Creek (GC2) – Downstream location draining a primarily non-dudded impact area and many of the small arms ranges located on Fort Jackson, located within the operational range boundary.

3.3.1.2 Sediment

Sediment samples were collected from each of the eight locations from which surface water was sampled as detailed below.

- Two locations in Weston Lake in the Cedar Creek watershed (WL1 and WL2)
- Four locations in the Colonels Creek watershed including:
  - Three locations in Colonels Creek (CC1, CC2, and CC3)
  - One location in Jumping Run Creek (JC1)
- Two locations in Gills Creek within the Gills Creek watershed: GC1 and GC2

Sediment samples were collected during the Wet A event from 30 March to 6 April 2009, the Dry A event from 20 to 22 July 2009, and the Dry B event from 21 to 22 July, 2009. The dates overlap for sampling during the Dry A and Dry B events because on 21 and 22 July, Dry A event samples were being collected in one watershed while Dry B samples were being collected in a different watershed. No sediment samples from Dry A and Dry B were collected on the same day in the same watershed. All sediment samples were analyzed for explosives MCOC (2,4-DNT, 2,6-DNT HMX, RDX, TNT; plus nine other explosives constituents) and MCOC metals (Sb, Cu, Pb, W, and Zn). A more detailed description of sampling activities is provided in **Section 4**. Photographs that detail sampling activities are located in **Appendix A**.

3.3.1.3 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrate samples were collected at four locations in the Colonels Creek watershed: CC1, CC2, CC3, and JC1 in accordance with the QAPP. Benthic macroinvertebrate samples were not collected within the Gills or Cedar Creeks because habitat conditions at the sampling locations selected were deemed unsuitable for benthic macroinvertebrate sampling.

For the Colonels Creek watershed, the benthic macroinvertebrate samples were collected from the four locations during two sampling events: Wet A and Dry A. Three replicate samples were collected at each sampling location during each event for a total of 24 benthic macroinvertebrate samples. A detailed description of benthic macroinvertebrate sample collection procedures is included in **Section 4**. Benthic macroinvertebrate samples were submitted to the Department of Forestry and Natural Resources, Clemson University, Clemson, South Carolina, for population index evaluation as discussed in **Section 5**.

3.3.2 Groundwater System

Due to the size of the combined installations, and in an effort to provide a cost-effective approach, a "worst-case" groundwater assessment area was established to focus the investigation. This area is located in the eastern half of the East Impact Area at Fort Jackson (see **Figure 3-7**) with field activities largely taking place on McCrady Training Center. This impact area has been used heavily for several decades and has received live fire from many munitions

types; thus, it represents a potentially significant source of all of the MCOC identified during the Phase I assessments. Aerial photographs reviewed during preparation of the groundwater approach show that portions of the impact area located near the southern combined installation boundary are heavily cratered and devoid of trees. The areas are also located close enough to the installation boundary and potential human receptors, for transport of MCOC in groundwater to receptor locations to be potentially viable. This area was also selected because it is one of the more accessible areas of the installation. The southern and eastern boundaries of the impact area may be accessed by improved roads without adversely affecting training activities.

The eastern shore of Weston Lake and the east bank of Cedar Creek (**Figure 3-7**), which flows into the northernmost point of the lake, define the western limit of the groundwater assessment area. Together, the stream and Weston Lake provide a boundary to MCOC movement either as a discharge point (the stream and portions of the lake) or as an area where artificially elevated groundwater levels (elevated by the impoundment or losing stretches of stream) may drive groundwater flow locally to the east. The northern, eastern, and southern boundaries of the groundwater assessment area are defined by the limits of the impact area. Much of the groundwater assessment area consists of a north-south trending ridge with the ground surface and likely the groundwater table, sloping from the center of the eastern half of the impact area (and also the groundwater assessment area) to the southwest toward Weston Lake and Cedar Creek and to the south and southeast toward the installation boundary. Additionally, the regional groundwater flow system underlying Fort Jackson and McCrady Training Center flows to the south and southeast (**Figure 2-4**), discharging to the Congaree and Wateree rivers, respectively.

3.3.2.1 Groundwater Assessment Approach

3.3.2.1.1 **2009 Assessment**

The groundwater assessment was initially designed to proceed in two stages to be completed in 2009. During the first stage, piezometers and staff gauge / piezometer pairs were placed to determine the localized groundwater flow direction along the western, southern, and eastern boundaries of the groundwater assessment area. The placement of the piezometers and staff gauge / piezometer pairs was based on interpreted likely shallow groundwater flow directions near the groundwater assessment area, reported regional groundwater flow directions for the greater area, the locations of known human and ecological receptors to the south of the installation, and predominant flow directions estimated based on the existing groundwater CSM. As part of defining groundwater flow directions downgradient of the groundwater assessment area, five staff gauge/shallow piezometer pairs (SG/P-1 and SG/P-3 through SG/P-6) and seven deeper piezometers (P-2, P-7, P-8, and P-10 through P-13) were installed (**Figure 3-8**).

The second stage of the 2009 investigation used the groundwater elevation data and interpreted flow directions obtained from the piezometers to locate groundwater sampling locations down gradient of interpreted potential source areas within the groundwater assessment area. Due to the spatial distribution of potential receptors surrounding the installation (dozens of wells appear to be present downgradient of the installation with the available records indicating that the screened intervals of residential well screens located to the south of the installation generally vary from 315 to 175 feet above mean sea level), depth-discrete groundwater samples from soil borings were needed to meet study objectives. Five soil borings were drilled (locations SB-2 through SB-6 shown on **Figure 3-9**) and depth-discrete water samples were collected at approximately 20

foot intervals starting at the water table and extending to elevations of 150 feet above mean sea level (AMSL), or approximately 25 feet below the deepest residential wells in the area. Appropriately located piezometers and on-installation supply wells were also sampled (**Figure 3-9**). All samples were analyzed for MCOC and other selected parameters.

3.3.2.1.2 **Supplementary Sampling (2012 and 2013)**

As discussed in Section 3.1.4, based upon the results of the depth-discrete groundwater sampling, a third phase of the groundwater assessment was performed in 2012 and 2013. Six well clusters (two wells per cluster) were installed downgradient of the groundwater assessment area to provide additional groundwater sampling data for targeted MCOC (**Figure 3-10**). Samples were collected at approximately four month intervals over the course of a year to identify temporal variations in groundwater chemistry. The spacing of the wells and the installation of a shallow and deep well at each cluster location was designed to identify horizontal and vertical variations in groundwater chemistry near the downgradient range boundary. During development of the technical approach for this phase of assessment, DU-containing munitions were identified as being utilized at Fort Jackson. Therefore, U and U-isotopes were added to the MCOC list.

3.3.3 PALs

PALs for surface water, sediment, and groundwater were established for the potential MCOC. For Fort Jackson and McCrady Training Center, PALs are based on the lower of either the DoD Range and Munitions Use Subcommittee (RMUS) 2012 Operational Range Assessment Screening Values Version 6.0, updated 21 May 2012 (DoD, 2012), or the South Carolina Department of Health and Environmental Control (SCDHEC) *R.61-68, Water Classifications & Standards* (22 June 2012).

For metals in surface water, the ORA and SCDHEC ecological criteria are identical. For surface water and sediment, the ORA screening values (both human and ecological) for explosives MCOC are lower and so are utilized as the PALs.

The ORA screening values for freshwater ecological acute and chronic toxicity of Cu, Pb, and Zn are adjusted by a formula and are inversely proportional to the measured hardness concentration[6]. Therefore, hardness concentrations were measured to calculate screening criteria for those metals with hardness-dependent criteria in surface water. The single lowest hardness value determined in either primary or duplicate samples collected at a given watershed during a given sampling event was conservatively used to calculate event-specific hardness-dependent PALs except where measured hardness values were below 25 milligrams per liter (mg/L) $CaCO_3$ in which case hardness dependent PALs were calculated based on a value of 25 mg/L $CaCO_3$. All measured surface water hardness values were below 25 mg/L $CaCO_3$. The surface water event/assessment area-specific PALs are listed in **Table 3-2**. MCOC concentrations detected in storm event samples were compared to the respective acute screening value. MCOC

[6] A relative increase in hardness will lower the ecological toxicity of Cu, Pb, and Zn in surface water resulting in an increase in the ecological risk screening criteria/PAL. The SCDHEC utilizes the same hardness based formulae as the ORA screening values (DoD, 2012) to calculate the ecological risk screening criteria/PAL.

concentrations detected in all other event samples were compared to the respective chronic screening values. Sediment PALs are presented in **Table 3-2**.

For metals, explosives, and perchlorate in groundwater, PALs are based on the lower of either the ORA human drinking water screening levels (DoD, 2012) or the SCDHEC values for human health. For each MCOC listed, the ORA value was either the same or more restrictive than the SDHEC value. Groundwater PALs are included in **Table 3-3**. In addition, for the purposes of the Phase II assessments, the USACHPPM Protocol established estimates of uncertainty that were applied to the screening values rather than the individual datum. Any value falling within this range of uncertainty is questionable with regard to making the conclusion and subsequent decisions. That is, if the data fall within the range of uncertainty, a definitive conclusion that the screening value has, or has not been exceeded, cannot be reached, and further study is recommended. **Table 3-3** lists the Lower Range of Uncertainty (LRU) for the MCOC of interest.

1 **Table 3-1: Watershed and Groundwater CSMs**

2

Watersheds	Potential Source Areas	Potential MCOC*	Surface Water Pathways	Surface Water Receptors	Groundwater Pathways	Groundwater Receptors
Cedar Creek (Weston Lake)	Multipurpose ranges, artillery and mortar firing points, western impact area, demolition sites	Explosives, perchlorate, & MCOC metals	Cedar Creek and tributaries originating on-range and flowing south into Weston Lake	Species of special concern and sensitive environments. Recreational users of Weston Lake	Leaching and infiltration into the Middendorf Aquifer	Users of groundwater from supply wells at Weston Lake and supply wells and residential drinking water wells south of the installations
Colonels Creek	Multipurpose ranges, artillery and mortar firing points and demolition sites	Explosives, perchlorate, & MCOC metals	Colonels Creek and tributaries originating on-range and flowing south off-installation	Species of special concern and sensitive environments. Recreational users of Colonels Creek and Murray Pond	Leaching and infiltration into the Middendorf Aquifer	Users of groundwater from supply wells and residential drinking water wells south of the installations
Gills Creek	Small arms range, western impact area, and non-live-fire training areas	Explosives, perchlorate, & MCOC Metals	Gills Creek and tributaries originating on range flowing off-range and southwest off-installation	Species of special concern and sensitive environments. Recreational users of Gills Creek, Boyden Arbor Pond, Forest Lake, and Lake Katherine	Leaching and infiltration into the Middendorf Aquifer	Users of groundwater from supply wells located between ranges and Gills Creek

* - As identified during Phase I

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Table 3-2: Surface Water System PALs

Analyte	Surface Water *(values in µg/L)*						Sediment[a] *(values in mg/kg)*
	Human Health		Ecological Surface Water Screening Criteria[a]		Selected Project Action Limits		
	ORA SV[a]	SC SV [b]	Chronic *(Non-Storm)*	Acute *(Storm)*	Chronic *(Non-Storm)*	Acute *(Storm)*	
Hardness (as mg/L $CaCO_3$)							
Hardness[c]	NA	NA	< 25	< 25	< 25	< 25	--
MCOC Metals							
Sb	6	5.6	30	30	5.6	5.6	12
Cu	620	1,300	2.7	3.6	2.7	3.6	34
Pb	15	--	0.54	14	0.54	14	47
W	--	--	--	--	--	--	--
Zn	4,700	7,400	36	36	36	36	150
Perchlorate							
Perchlorate	15	--	9,300		15		--
Explosives MCOC[d]							
RDX	0.61	--	190		0.61		0.013[e]
DNB	1.5		20		1.5		0.0067[e]

NOTES:

mg/kg = milligrams per kilogram

mg/L = milligrams per liter

µg/L = micrograms per liter

NA = No applicable screening level is available

[a] Human health and ecological screening criteria for metals and explosives MCOC are based on DoD *Operational Range Assessment Screening Values*, Version 6.0 (DoD, 2012) for freshwater.

[b] South Carolina Water Classifications and Standards. SC Regulation § 61-68. (SC, 2012).

[c] Hardness values are not subject to applicable risk screening criteria, but presented as the basis for Cu, Pb, and Zn ecological risk screening criteria, as discussed above.

[d] RDX and DNB were the only explosives MCOC detected in surface water and/or sediment at Fort Jackson and McCrady Training Center. All other explosives PALs can be found in **Appendix B** summary tables.

[e] RDX and DNB sediment screening values shown in table are based on a minimum 1 percent total organic carbon (TOC) concentration. The RDX and DNB sediment screening values for sediments with a higher associated total organic carbon is obtained by multiplying the measured TOC (up to a maximum value of 100 percent) by the sediment PAL value shown to a maximum value of 1.3 mg/kg for RDX and 0.67 mg/kg for DNB.

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Table 3-3: Groundwater System PALs

Analyte	Project Action Limit (µg/L)[1]	Lower Limit of Range of Uncertainty (µg/L)[2]
Explosives		
1,3,5-Trinitrobenzene	460	46
1,3-Dinitrobenzene	1.5	0.15
2,4,6-Trinitrotoluene	2.2	0.22
2,4-Dinitrotoluene	0.2	0.02
2,6-Dinitrotoluene	15	1.5
2-Amino-4,6-dinitrotoluene	30	3.0
2-Nitrotoluene	0.27	0.027
3-Nitrotoluene	1.3	0.13
4-Nitrotoluene	3.7	0.37
4-Amino-2,6-Dinitrotoluene	30	3.0
Cyclotetramethylenetetranitramine (HMX)	780	78
Nitrobenzene	0.12	0.012
Nitroglycerin	1.5	0.15
Pentaerythritol Tetranitrate (PETN)	16	1.6
Cyclotrimethylenetrinitramine (RDX)[3]	0.61	0.061
Tetryl	63	6.3
Perchlorate		
Perchlorate	15	9
MCOC Metals		
Antimony (Total & Filtered)	5.6	3.36
Copper (Total & Filtered)	620	310
Lead (Total & Filtered)	15	7.5
Tungsten (Total & Filtered)	--	--
Zinc (Total & Filtered)	4,700	2,820
Uranium	30	3.0
Uranium Isotopes	30	3.0

Notes:

[1] Following the hierarchy for human health drinking water screening values in the Army Operational Range Assessment Phase II Investigation Protocol (ORA Protocol) (USACHPPM, 2009), PALs are the current USEPA Regional Screening Values for tap water (dated November 2012) for all MCOC except perchlorate. The PAL for perchlorate is the value listed in the DoD Range and Munitions Use Subcommittee (RMUS) 2012 Operational Range Assessment Screening Values Version 6.0, Updated 21 May 2012 (DoD 2012).

[2] Following the ORA Protocol, LRUs for metals were set at 50% (copper and lead) or 60% (antimony and zinc) of the PALs and LRUs for explosives were set at 1/10th the PALs. The LRU for RDX was set at the limit of quantitation of 0.1 µg/L.

[3] It is important to note that the PAL for RDX is a United States Environmental Protection Agency (USEPA) Integrated Risk Information System screening value and not an enforceable federal standard. A 2.0 µg/L value is listed by the USEPA as a lifetime health advisory level, which is also not an enforceable standard. All RDX concentrations detected downgradient of the groundwater assessment area and other assessment areas were below this lifetime health advisory level.

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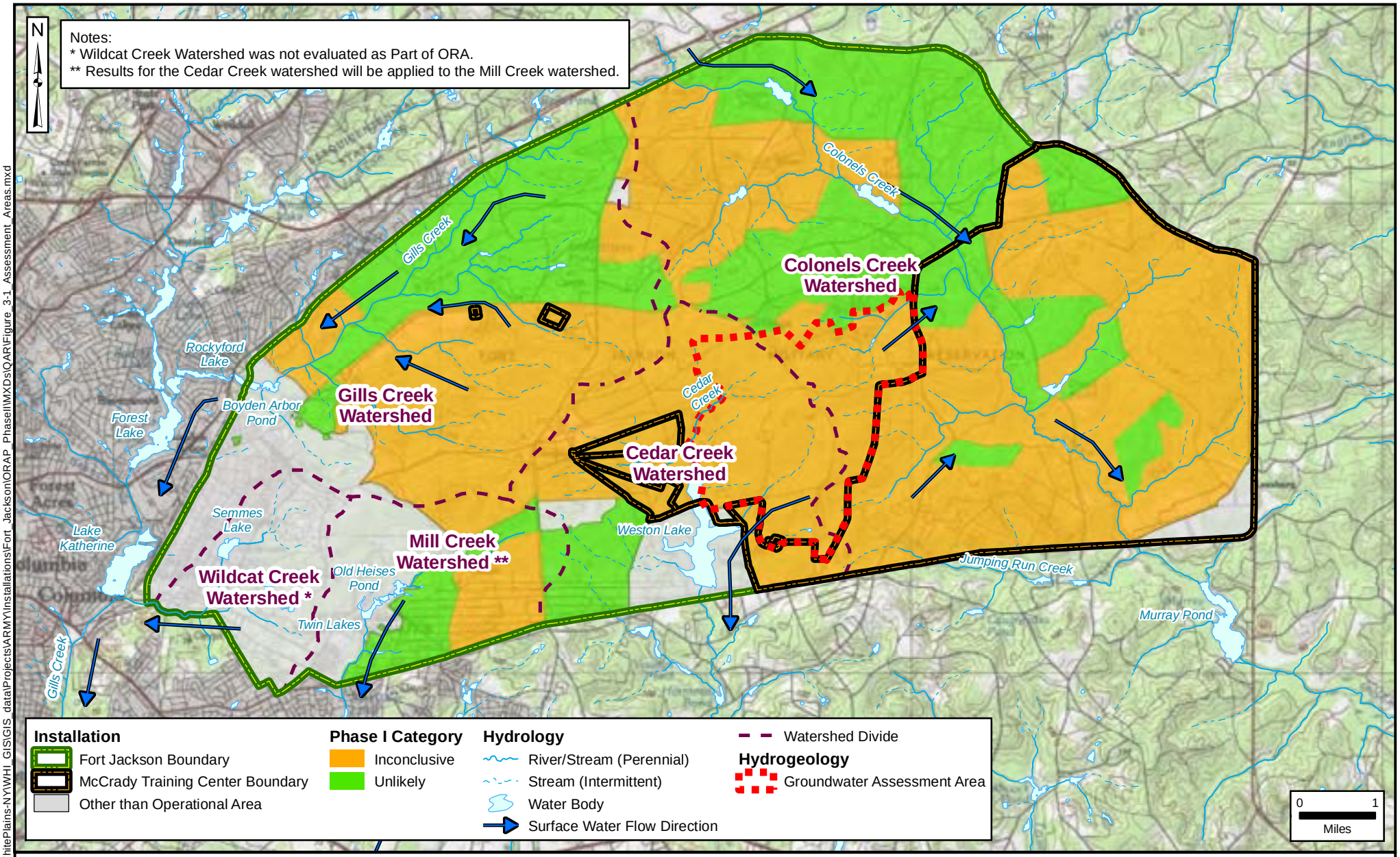

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Figure 3-1
Surface Water and Groundwater Assessment Areas

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

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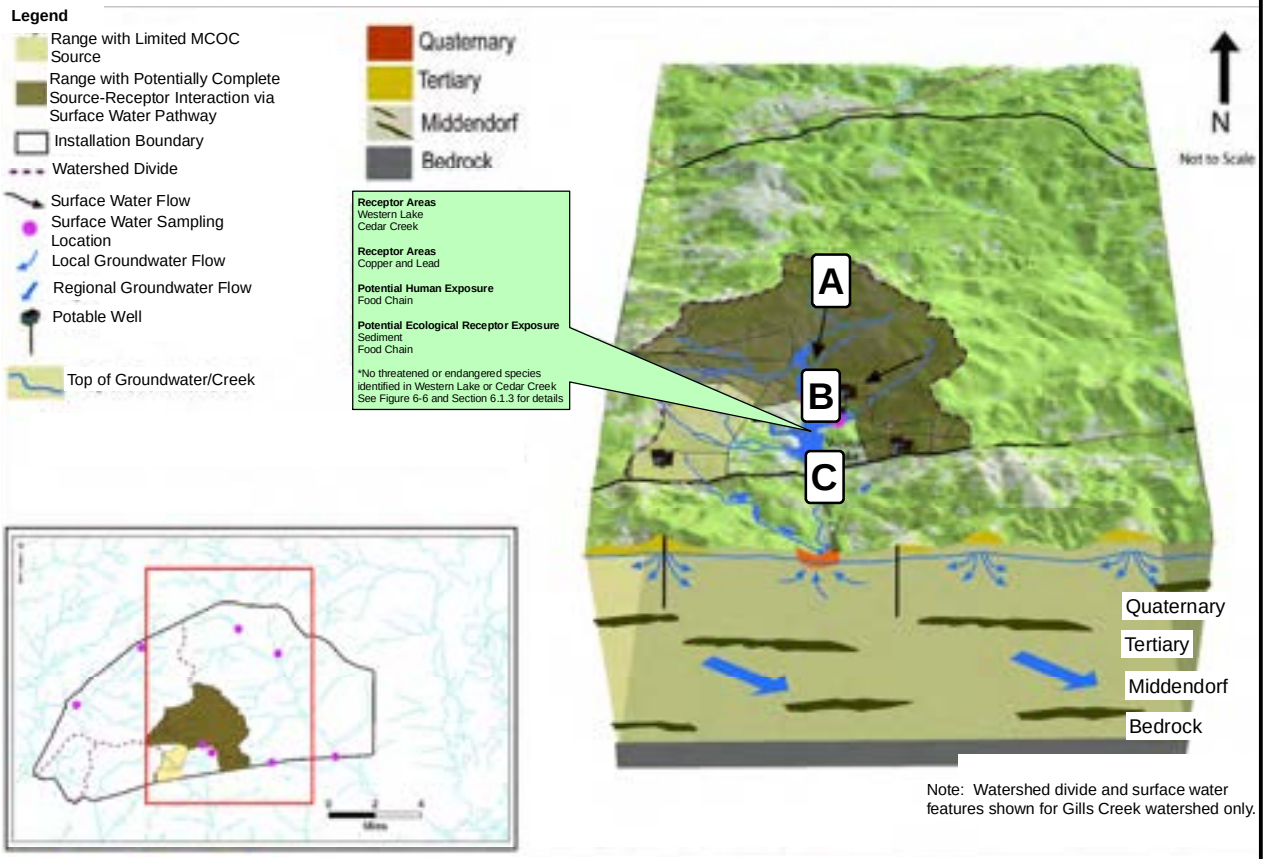
\\arcadis-us.com\officedata\WhitePlains-NY\WHI_GIS\GIS_data\Projects\ARMY\Installations\Fort_Jackson\ORAP_PhaseII\MXDs\QAR\Figure_3-2_Cedar Creek CSM.mxd



Note: Watershed divide and surface water features shown for Gills Creek watershed only.

A

Source: Large Impact Area

B

Pathway: Off-range drain at dam separating the operational portion of Weston Lake from the recreational portion of Weston Lake

C

Ecological Receptors

Human Receptors

Receptors: Sensitive habitats and recreational users of Weston Lake

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Figure 3-2
Surface Water CSM for Cedar Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006

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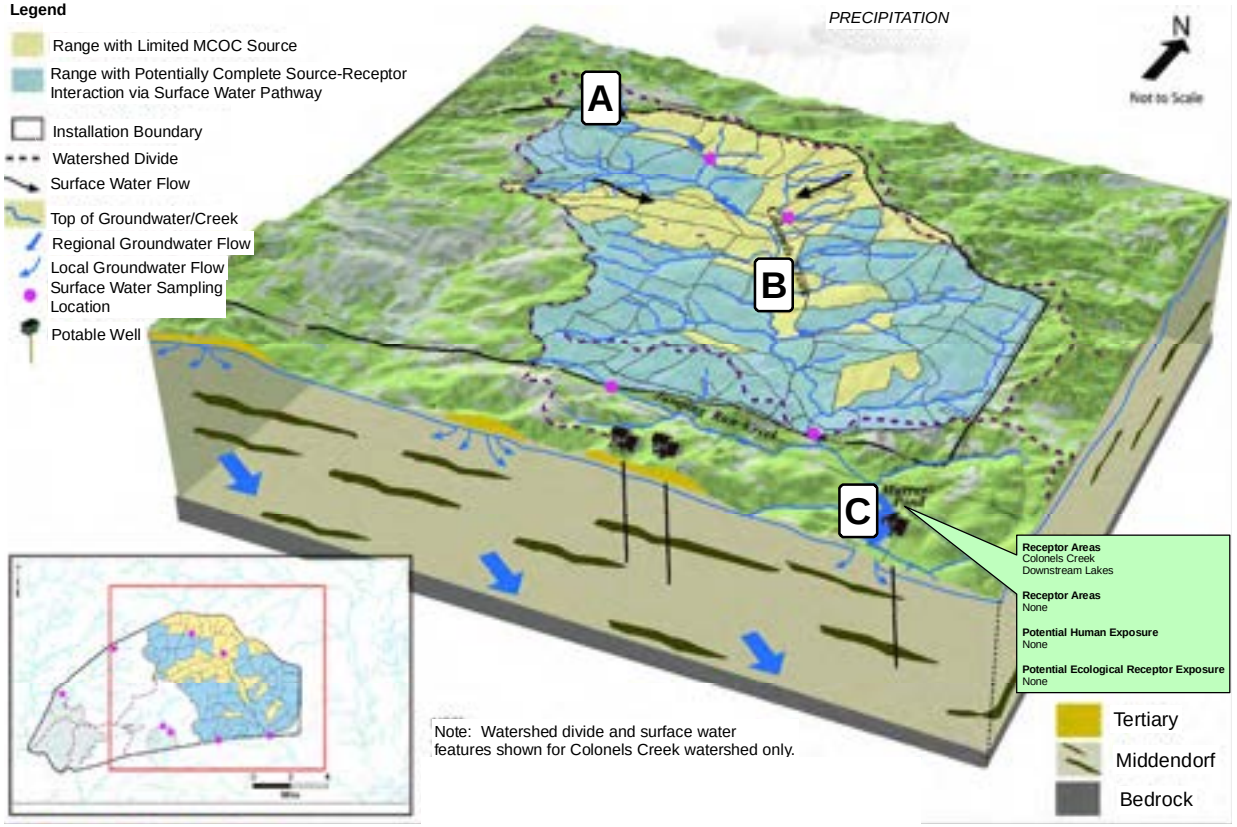

A

Source: Training and Maneuver Areas

B

Pathway: Colonels Creek via runoff and groundwater discharge

C

Human Receptors: Recreational users of Murray Pond and downstream waters
Ecological receptors: Sensitive Habitats and threatened and endangered species

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Figure 3-3
Surface Water CSM for Colonels Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006
ESRI, ArcGIS Online, Aerial Imagery

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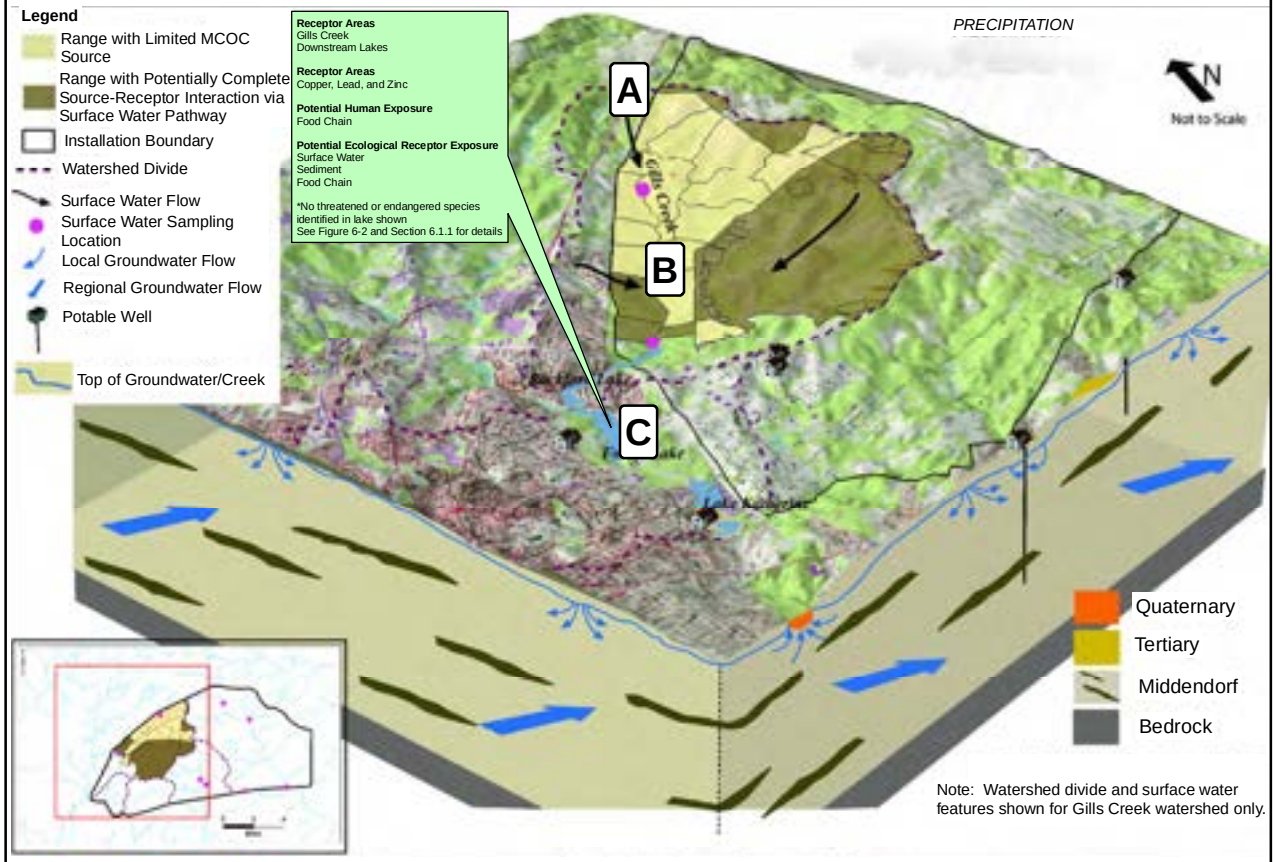

A

Source: Small arms ranges

B

Pathway: Gills Creek via runoff and groundwater discharge

C

Human Receptors: Recreational users of Rockford Lake and downstream waters

Ecological receptors: Sensitive Habitats and threatened and endangered species

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Figure 3-4
Surface Water CSM for Gills Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006

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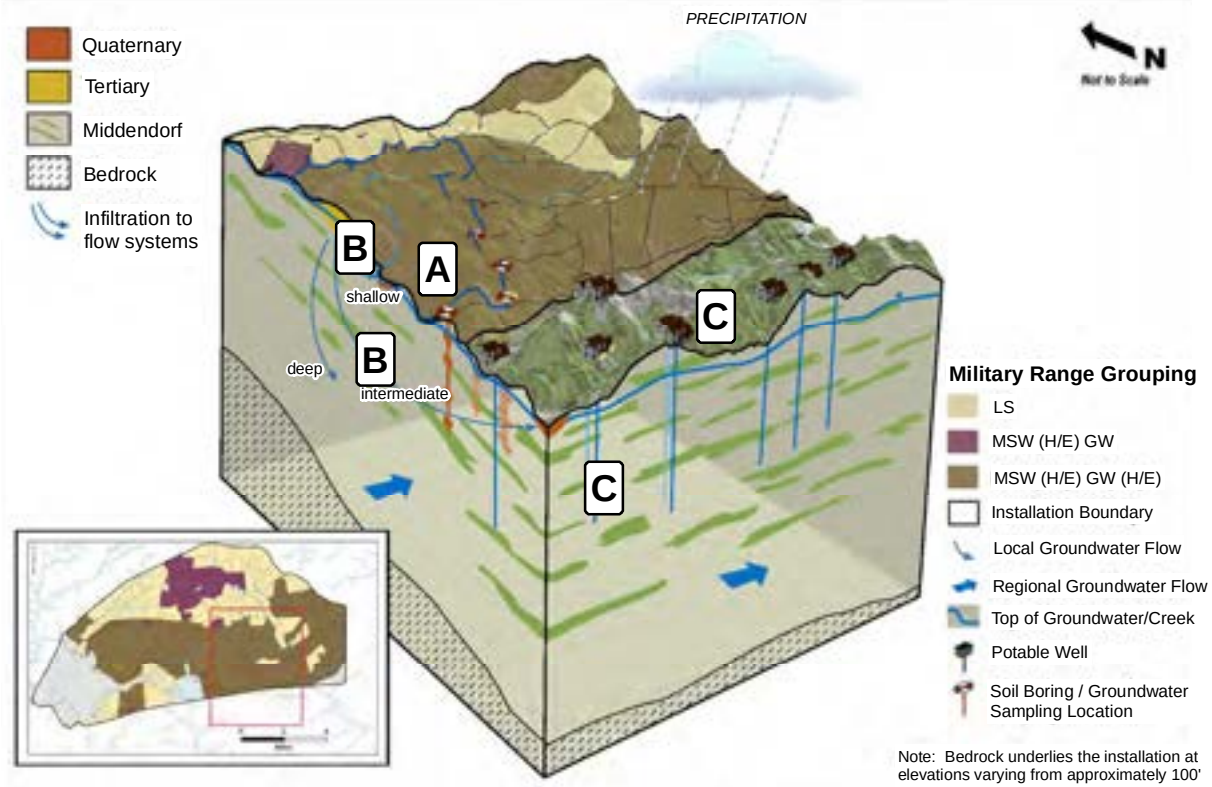
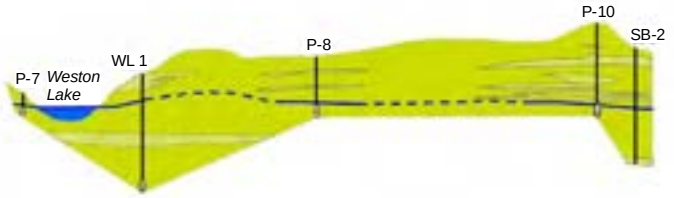


Note: Bedrock underlies the installation at elevations varying from approximately 100' above mean sea level to 100' below mean sea level.

A

Source: Current and Historic Impact Area

B



Pathway: Shallow and Intermediate Groundwater

C

Receptors: Off-installation groundwater users (residential wells)

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Figure 3-5
Groundwater CSM

Data Sources:
AEC, ARID-GEO, 2006

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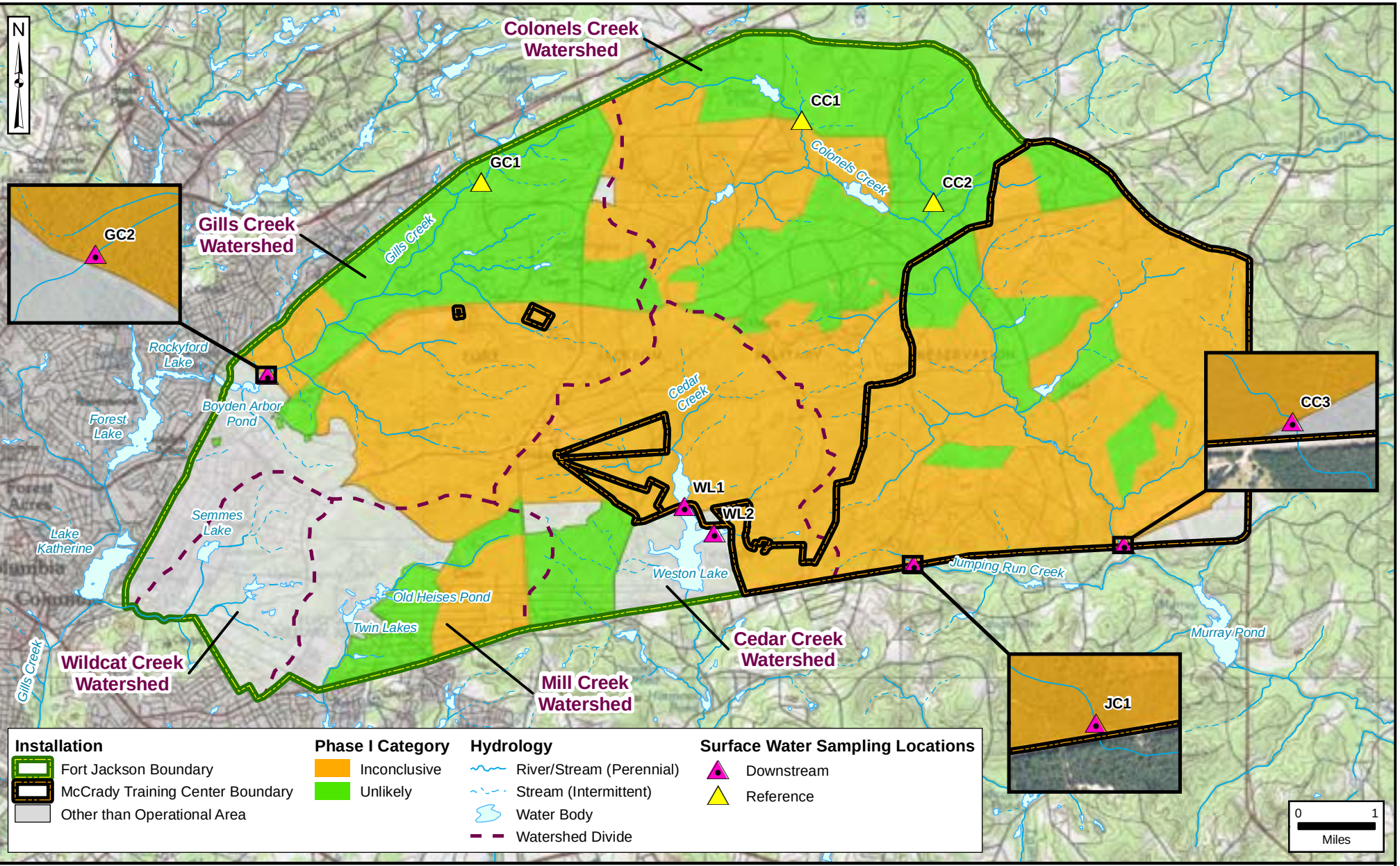

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Figure 3-6
Surface Water Sampling Locations

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

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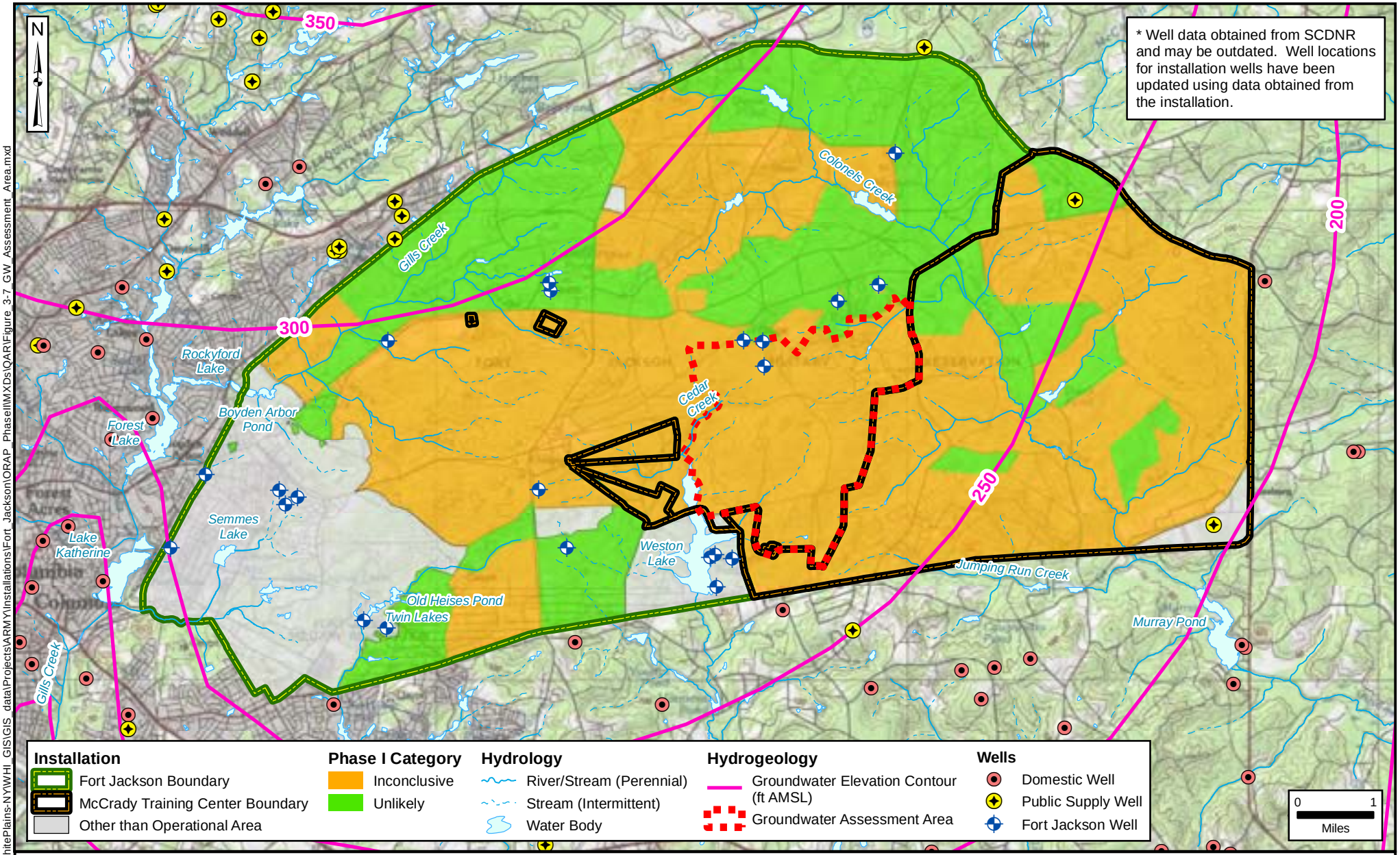

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Figure 3-7
Groundwater Assessment Area

Data Sources:
AEC, ARID-GEO, 2006
SCDNR, Wells, 2007
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo
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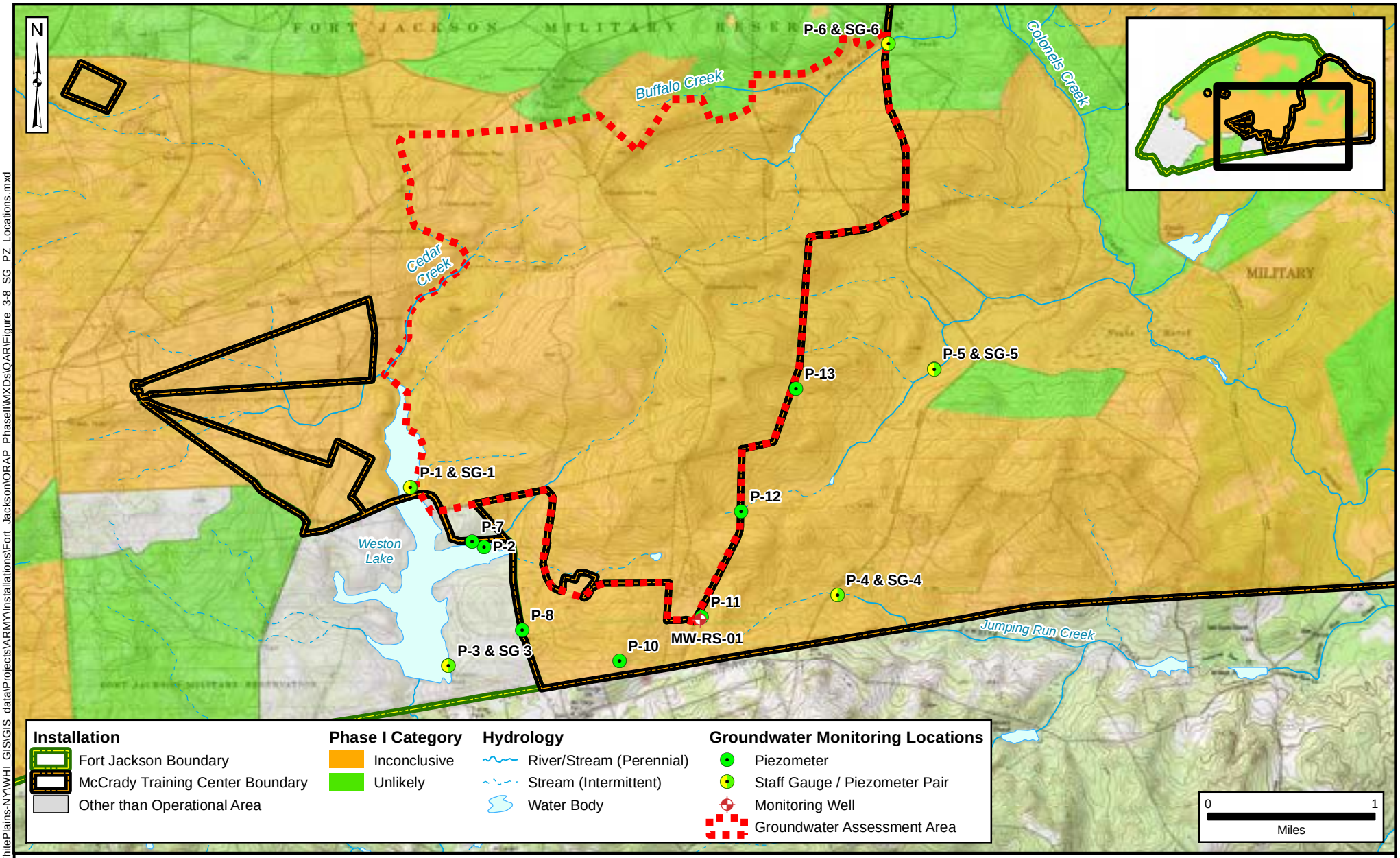

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Figure 3-8
Piezometer and Staff Gauge Locations (2009)

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

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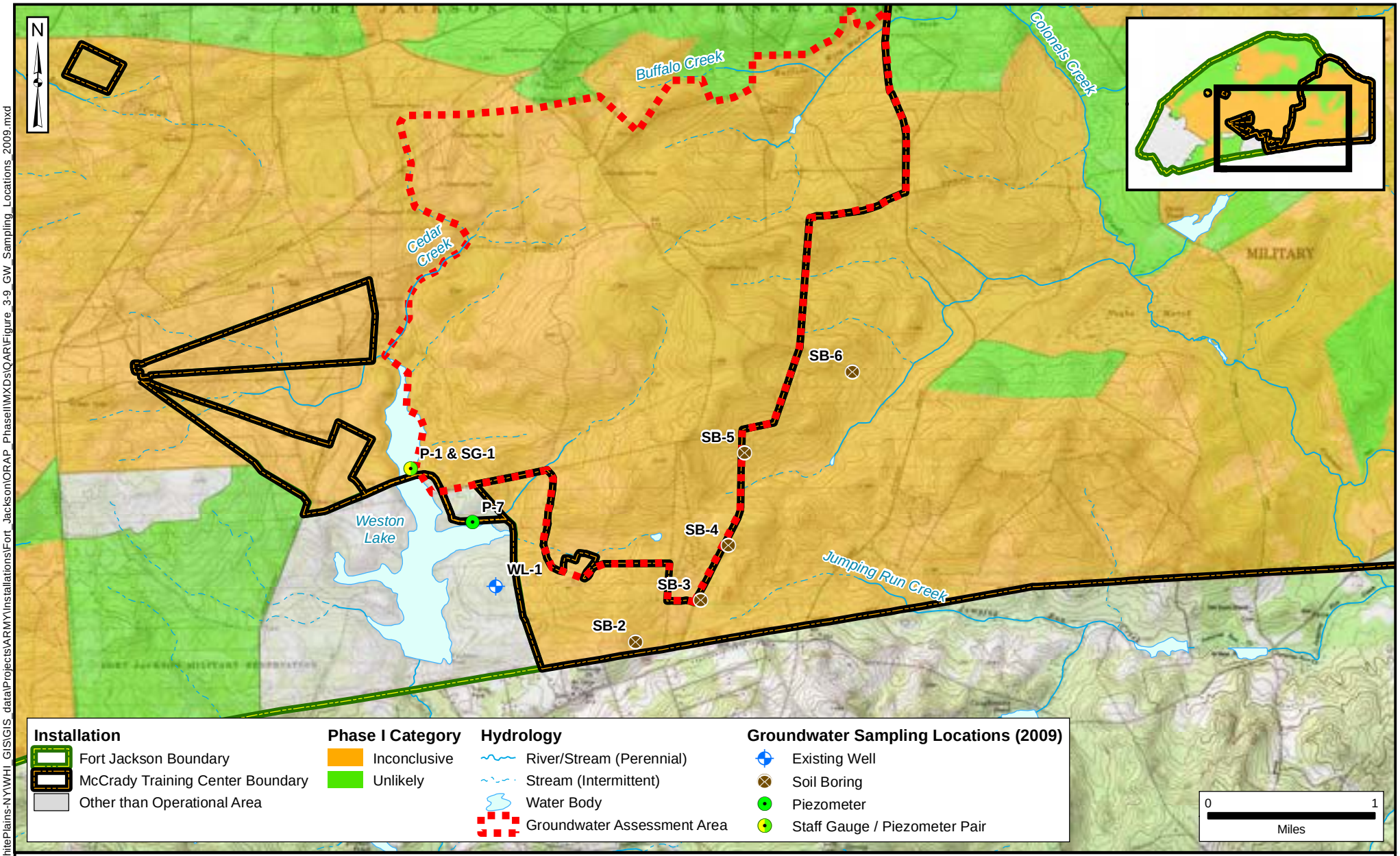

Installation
- Fort Jackson Boundary
- McCrady Training Center Boundary
- Other than Operational Area

Phase I Category
- Inconclusive
- Unlikely

Hydrology
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Groundwater Assessment Area

Groundwater Sampling Locations (2009)
- Existing Well
- Soil Boring
- Piezometer
- Staff Gauge / Piezometer Pair

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Figure 3-9
Groundwater Sampling Locations (2009)

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

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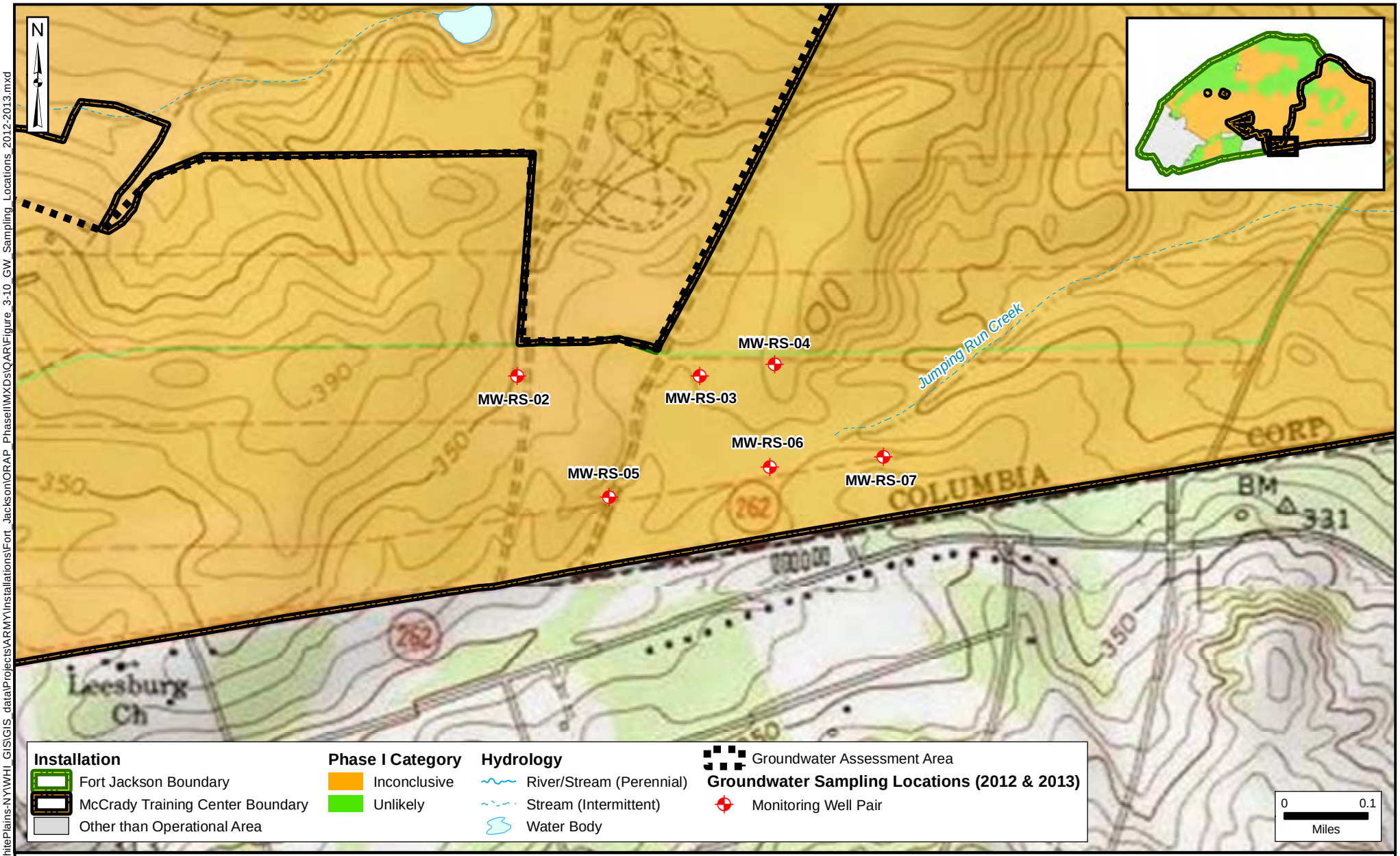

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Figure 3-10
Monitoring Well Pair and Sampling Locations (2012 & 2013)

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

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4 Methodology

Details on the sampling and analytical procedures, along with health and safety plans, are included in the Fort Jackson and McCrady Training Center Work Plan/QAPP (Malcolm Pirnie, 2009a), the appended Accident Prevention Plan (APP), and QAPP Addendum (PIKA-Pirnie JV, 2012). Field activities were conducted in accordance with the QAPP and QAPP Addendum, including the Standard Operating Procedures (SOPs) contained in Appendix B of the QAPP and Attachment 1 of the QAPP Addendum. Safety procedures used during sampling activities were in accordance with the APP.

4.1 Field Methods

The following field method SOPs, detailed in the QAPP and QAPP Addendum, were used for the surface water, sediment, benthic macroinvertebrate, and groundwater sample collection:

- Groundwater Sampling
- Low Stress (Low Flow) Groundwater Sampling
- Standard Operating Procedure for HydraSleeves™
- Monitoring Well Development
- Groundwater Level Measurement
- Field Portable X-Ray Fluorescence (XRF) Spectrometry
- Draft USACHPPM Benthic Macroinvertebrate Sampling SOP
- Excerpt from Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual
- Surface Water Sample Collection Using Autonomous Samplers
- Care, Maintenance, and Storage of YSI 6-Series Probes and Sondes
- Method 1669 Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels

Modifications to field procedures potentially affecting data usability or quality required same-day approval from the Team Leader, the Project Manager, and the Project Quality Assurance (QA) Manager. All such modifications were discussed with the appropriate members of the project team and then documented in trip reports following each of the field events. Modifications to the QAPP or QAPP Addendum requiring approval from USACE and ARNG Directorate were secured by the Project Manager.

4.2 Surface Water System Investigation

Table 4-1, at the end of this section, indicates when each sampling event occurred, which locations were sampled, sample collection method (*i.e.*, grab versus composite), and sample type

(*i.e.*, primary sample, duplicate sample, equipment blank, etc.). **Figure 3-6** shows each sample location.

Surface water sampling activities included dry season, wet season, and storm water sampling to evaluate stream conditions under different seasonal conditions. Wet and dry seasons were defined by readily available annual precipitation data and stream flow conditions.

4.2.1 Surface Water Sampling

Composite samples were collected using ISCO brand 6712 series composite autosamplers, which were programmed to collect 96 discrete samples over a 24-hour period for clear weather samples and 20 samples over a 2-hr period for storm samples. In situ field measurements of pH, temperature, DO, turbidity, and specific conductivity were recorded following each sampling event. The composite samples at all surface water sampling locations were contained in 4-liter laboratory-certified clean carboys. Carboys were kept on ice to maintain a temperature of 4 degrees Celsius (°C), plus or minus 2°C, during sampling and until transfer to laboratory-cleaned sampling containers. The field team filtered and collected the samples from each carboy within 48 hours of the start of sample collection. Each sample container was appropriately labeled using indelible ink and secured. Each sample was logged on the chain-of-custody (COC) form with the required analyses. The COC forms are included in **Appendix C**. The samples were placed in ice-filled coolers and each cooler was sealed with the COC inside; custody seals were signed, dated, and placed on opposite corners of the cooler, and the coolers were shipped overnight to the analytical laboratories. **Appendix A** provides photographs of a typical sampling location. Surface water sampling locations are shown on **Figure 3-6**.

In the Gills Creek watershed, an upstream sample was collected at location GC1 and a downstream sample was collected at location GC2. In the Colonels Creek watershed, upstream samples were collected at locations CC1 and CC2, and downstream samples were collected at locations CC3 and JC1 (located in Jumping Run Creek). In the Cedar Creek watershed, downstream samples were collected at WL1 and WL2 (located in Weston Lake). No upstream locations were available in the Cedar Creek watershed or on Jumping Run Creek; consequently, the upstream locations in the Colonels Creek watershed were used as reference locations for the Jumping Run Creek and the Cedar Creek downstream locations. **Table 4-1a** provides a summary of the surface water samples collected as part of this assessment.

Deviations from the planned sampling approach are summarized below:

- Because the level of water in Weston Lake decreased between the Wet A event in March and the Dry A and Dry B events in July, the sampling location for WL2, which was selected during the Wet A event, was not accessible by boat during the Dry A and Dry B events. USAEC and USAPHC personnel overseeing the sampling activities were consulted, and agreed that the sampling location for WL2 should be shifted to the west by approximately 250 feet for the Dry A and B events. While both sampling locations for WL2 (and also WL1) are within the footprint of a site currently being investigated under the Military Munitions Response Program (MMRP), the Dry A and Dry B event's location was closer, and possibly within, the former target area for a small arms range. The Wet A location for WL2 and the wet/dry location for WL1 are located within the former safety fan associated with the small arms range. The Dry A/Dry B location for WL2 is within or close to the target area for the small arms range.

- Surface water samples were intended to be 24-hour time composited with sample aliquots collected every 15 minutes. Some samples (from location CC2 during Wet A and locations CC1, CC2, CC3, and JC1 during Wet B) were collected over 20 hours rather than 24 hours due to autosampler rechargeable battery failure. This deviation from the Work Plan was discussed with USAPHC personnel who provided on-site technical oversight during the sampling events.
- A surface water sample was not collected at CC2 during the Dry A sampling event, as there was no standing or flowing surface water at the time of sampling. The sediment in the creek bed was wet; therefore, a sediment sample was collected from location CC2 during the Dry A event.

None of the deviations are expected to have adversely affected the overall quality of the collected data set.

4.2.2 Sediment Sampling

During the Wet A sampling event, grab samples of sediment were collected at each stream location. To facilitate selection of the sediment sampling locations, an X-50 mobile portable XRF unit was used to field analyze sediment samples for metals (XRF field forms are included in **Appendix D**). The XRF screening was performed to field test the applicability of this screening approach for future Phase II assessments at U.S. Army and ARNG installations. Two or more grab samples were collected at each location, depending on site conditions. Each grab sample was screened with the XRF for MCOC metals. An additional sediment sample was collected in the location that had the highest overall metal concentrations, according to the XRF readings. This grab sample was submitted to the laboratory for analysis. Because there was little variation in metals concentrations for the specific stream locations screened using the XRF during the Wet A sampling event and because the XRF detection limits for the MCOC were significantly higher than the PALs, the XRF screening was determined not to be applicable for the Fort Jackson and McCrady Training Center sediment sampling.

The sediment sampling approach described in the USACHPPM Phase II protocol (2009) was used for the remaining field events. USEPA's *Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses* (USEPA, 2001) was used as guidance for the selection of the appropriate sampler/sampling technique. During the Dry A and Dry B sampling events, composite samples of sediment were collected at each stream location. Subsamples of sediment were collected across a cross section of the stream, mixed together, and placed in jars for submittal to the analytical laboratory. Disposable scoops and bowl liners were used for each location. Sediment samples collected from Weston Lake were collected using an Ekman bottom grab sampler during all sampling events. The Ekman sampler was scrubbed with an Alconox™ solution and rinsed with distilled water. It was then rinsed with methanol (followed by distilled water) and nitric acid (followed by distilled water). The Ekman sampler was then rinsed with site water (*i.e.*, lake or creek water) prior to use at each sample location. Subsamples were collected from the center of multiple Ekman bottom grab samples and homogenized by mixing until a sufficient quantity was obtained to fill sample jars. **Table 4-1b** provides a summary of the sediment samples collected as part of this assessment.

4.2.3 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrates are considered indicators of ecological system impacts over an extended period of time; consequently, general health of the benthic macroinvertebrate community is only moderately dependent on the time that samples are collected. Benthic macroinvertebrate populations vary with seasonal trends, such as temperature and longer-term rainfall, and according to their natural life cycles. Therefore, grab samples were collected at four of the surface water system sampling locations during the Wet A and Dry A sampling events. The four locations are CC1, CC2, CC3, and JC1 in the Colonels Creek watershed (no sample was collected at location CC2 during the Dry A event because there was no flowing or standing water).

Initially, benthic macroinvertebrate samples also were planned to be collected from the Gills Creek watershed. However, as noted in the Work Plan, after performing a site reconnaissance, habitat conditions at the two surface water locations selected in Gills Creek (GC1 and GC2) were deemed unsuitable for benthic macroinvertebrate sampling. While GC1 (upstream) was representative of a stream habitat with a clearly defined channel and higher flow rates, GC2 is located in an area where Gills Creek widens at the headwaters of Boyden Arbor Pond and the habitat is more typical of wetlands. The difference in habitats was deemed to be substantial enough that a comparison of results could not be used reliably to determine if benthic macroinvertebrate health was degraded between the upstream and downstream locations. No benthic macroinvertebrate samples were collected from the Cedar Creek watershed because the sampling locations are in Weston Lake and, thus, could not be compared to the upstream Colonels Creek sampling locations.

The benthic macroinvertebrate sample collection and analysis activities followed the Benthic Macroinvertebrate Sampling Standard Operating Procedure as outlined in the USACHPPM Phase II protocol (2009). All samples were collected by the same two-person team consisting of an aquatic biologist and an environmental scientist. The team collected samples using D-frame dip nets as outlined in the USACHPPM Phase II protocol (2009). At each location, subsamples were collected from all habitat types present (*e.g.*, sandy bottom), sieved with a U.S. Standard #30 sieve, composited, and field preserved with 80% ethanol. To the extent practical, the team sampled like habitats and used similar sampling practices at each location. The aquatic biologist visually inspected the samples to ensure collection of 100 organisms per replicate sample as recommended in the USACHPPM Phase II protocol (2009). Samples were transported by ARCADIS employees to the Department of Forestry and Natural Resources Laboratory at Clemson University under proper COC procedures. **Table 4-1c** provides a summary of the benthic macroinvertebrate samples collected as part of this assessment.

4.3 Groundwater System Assessment

Site activities completed as part of the groundwater system assessment included installation of staff gauge/piezometer pairs, installation of piezometers, measurement of groundwater elevations, collection of depth-discrete groundwater samples from temporary wells, installation of well clusters (with shallow and deep wells), and collection of groundwater samples from the well clusters. Procedures utilized in the field generally followed those outlined in the QAPP and QAPP addendum (Malcolm Pirnie, 2009 and PIKA-Pirnie JV, 2012) except where changes are discussed below.

4.3.1 Piezometer and Staff Gauge Installation Procedures

Staff gauge and piezometer pairs were installed using hand augers at locations identified on **Figure 3-8**. Each of six staff gauges was installed adjacent to an associated piezometer and consisted of a metal fence post driven into a stream bottom or lake bottom. A 1-inch diameter perforated polyvinyl chloride (PVC) pipe was attached to the fence post to create a fixed, protected measurement point, unaffected by stream flow or wave action. The top of the PVC pipe elevation was surveyed and used as the measurement point for the surface water elevation at that location. The adjacent piezometers (P-1 to P-6) were installed by hand augering to saturated soils to install a water table piezometer. A 1-foot well screen attached to a 1-inch-diameter PVC pipe was installed in the hand augered hole at a depth intended to intercept the water table. The annular space surrounding each well point was backfilled with clean silica sand, 6 inches to 1 foot above the screen. The remaining annular space was backfilled with bentonite chips to the ground surface. **Figure 4-1** illustrates the general staff gauge / piezometer pair construction.

Piezometers P-7 and P-8 were installed using direct-push technology and hollow-stem auger drilling methods. Piezometers P-10 through P-13 were installed using Rotosonic drilling procedures due to the greater depths to groundwater at these locations. Piezometer P-10 was moved slightly at the request of the installation as the initially identified location was located adjacent to a heavily utilized access road. Piezometer P-14 was not installed because, although Range Operations initially indicated that the area was readily accessible, the location was subsequently identified to be in a surface danger zone for a heavily utilized firing range. The on-site project geologist logged the physical characteristics of the soil using visual and manual observations according to the Unified Soil Classification System, depth to groundwater, and other notable conditions on the test boring log for each piezometer. Test boring logs for each of the stand-alone piezometers are included in **Appendix E.**

The seven stand-alone piezometers were completed using standard well installation techniques. All piezometers were constructed of 2-inch inside diameter, flush joint, Schedule 40 PVC, with 0.010-inch slotted screen varying from 5 to 15 feet in length. Screen lengths were chosen based on lithological conditions and depths to groundwater. The intent was to straddle the water table with enough unsaturated screen length to accommodate potential fluctuations in the water table. At the time of the investigation, installation personnel reported that the water table was approximately 7 feet lower than average due to drought conditions occurring in the region. As a result, several piezometers were installed with 15-foot screen lengths to accommodate fluctuations in the water table. A silica sand filter pack was placed to approximately 2 feet above the top of the screened interval. A minimum 2-foot-thick bentonite chip or powdered bentonite seal was placed above the sand pack to prevent the downward infiltration of shallow groundwater or surface water. The remainder of the boring annulus was filled with cement/bentonite grout. The piezometers were completed at the surface with 4-inch square, steel protective casing and a 2-foot-by-2-foot concrete pad at the surface. All piezometers were locked with keyed-alike padlocks on the steel protective casings.

All non-dedicated, down-hole drilling equipment was decontaminated on site at a temporary decontamination pad prior to advancement of each boring per the procedures detailed in Section 4.3.8 and in accordance with the project QAPP.

4.3.2 Piezometer and Monitoring Well Development

The newly installed piezometers were developed to flush the well and sand pack of fine sediments. The development process is intended to create wells that will yield water samples that are representative of the groundwater quality at that location, as well as to provide viable measurement points for groundwater elevations.

The piezometers were developed no sooner than 48 hours after well installation was completed, with the exception of piezometer P-12. P-12 was developed the same day it was completed to assure that training schedules for nearby ranges were not affected by the field activities (*i.e.*, access to P-12 was restricted to only the time periods when the ranges were not actively being used). Development of the piezometers was performed by purging with submersible pumps and/or dedicated disposable bailers. Specific conductivity, temperature, DO, pH/eH, and turbidity were monitored frequently during the development process. Subsequently installed monitoring wells were developed in a similar manner to that described above. Well Development/ Purging Logs are provided in **Appendix E**.

4.3.3 Groundwater Elevation Measurements

Following the installation of the seven piezometers and five staff gauge / piezometer pairs, depth-to-water measurements were determined to the nearest 0.01 foot from the top of the riser using an electronic water level indicator. Following the completion of the site survey, all measured water levels were converted to elevation measurements in units of feet AMSL. Groundwater levels were measured to determine direction of groundwater flow at the piezometers and surface water / groundwater interactions at the staff gauge / piezometer pairs. An equipotential map of the water table was prepared using the calculated groundwater elevations from the measurements recorded on 7 April 2009. These elevations were used to select the boring locations from which depth-discrete groundwater samples would be collected, down gradient of interpreted potential source areas within the groundwater assessment area.

4.3.4 Borehole Drilling and Temporary Well Installation and Sampling Procedures

The second stage of the investigation consisted of collecting depth-discrete groundwater samples at five soil borings (SB-2, SB-3, SB-4, SB-5, and SB-6) as shown on **Figure 3-9**. The five soil borings were advanced to depths ranging from 156 to 214 feet bgs. This corresponds to elevations of approximately 203 to 144 feet AMSL. A total of 26 depth-discrete groundwater samples were collected from the boreholes. Samples were collected starting at the water table and at approximately 20-foot intervals beneath the water table. As indicated in the 2009 QAPP, samples initially were planned to depths roughly equivalent to 150 feet AMSL. However, after collecting stratigraphic data at SB-3, SB-5, and SB-6, which were completed to their approximate targeted depths (148, 147, and 144 feet AMSL, respectively), significant clayey units were interpreted to potentially be laterally persistent near the target boring depths at SB-2 and SB-4. As a result, borings SB-2 and SB-4 were terminated within clay units above the proposed target elevation of 150 feet AMSL (SB-2 and SB-4 were completed at elevations of 202 and 167 feet AMSL, respectively) to avoid penetrating the potential confining unit. The clay units were penetrated near the bottoms of SB-3, SB-5, and SB-6. All of the boreholes, except for SB-3, were abandoned with a cement and bentonite grout mixture tremmied to the bottom of the hole. At SB-3, a monitoring well (MW-RS-1) was installed adjacent to the previously installed

piezometer P-11. This well was set at a depth of 182 feet bgs, and care was taken in choosing the screened interval so that it did not create an avenue for migration between two previously unconnected water bearing units. Measurements from MW-RS-1 and the adjacent piezometer provide information regarding vertical gradients at this location.

The boreholes used for depth-discrete groundwater sampling were advanced using sonic drilling methodology with 6-inch flush-joint threaded casing and 4-inch drill rods (Sonic 4 x 6). The soil cores were collected by advancing a core barrel (approximately 5-inch outer diameter) in 10- or 20-foot continuous runs. Soil cores were collected continuously to the target sample interval. Groundwater samples at each boring location were collected at the water table and at approximately 20-foot intervals beneath the water table, with the actual sample interval selected by the on-site geologist based on lithology and relative permeability. Sample intervals were adjusted to target more productive zones, typically consisting of coarser grained sands, based on visual observations; or to depths just above clay layers or relatively impermeable zones. Some sample intervals were skipped due to the presence of significant thicknesses of clayey soils at the target depth that were significantly less permeable and, therefore, not productive enough to collect a groundwater sample. A groundwater sample was then collected from the next permeable zone encountered. Sampling continued below the less permeable zones as most of the clay units encountered were considered laterally discontinuous. Exceptions to this were the lower clay layers encountered at soil borings SB-2 and SB-4. The more productive zones targeted for sample collection are more likely to transport potential MCOC off range.

Two different methods were used to collect groundwater samples during the 2009 effort: the Pump and Packer method and the Push-Ahead™ Sampler. The Pump and Packer method consists of a 2-inch stainless steel temporary well screen and K-Packer, a rubber gasket at the top of the well screen designed to seal off the inside of the 6-inch drill casing. A 5 to 10 foot long well screen was lowered into the drilling casing to the desired sample interval depth. The casing was then retracted to expose the well screen to the formation. The K-Packer remained inside the casing, sealing off the well screen intake from the water inside the casing, allowing the pump to draw water from the formation. The sampling assembly is shown on **Figure 4-2**.

Since the drilling process required the addition of water to advance the casing, the target sample interval was purged using a submersible pump (Geotech SS Geosub or Mega Monsoon DC pump) prior to collecting the groundwater sample. The quantities of water used during the drilling process to advance the casing to the 20-foot interval above the target sample interval varied from none to as much as 450 gallons. Most intervals required approximately 100 to 250 gallons of water to advance the casing the 20-foot interval. At each depth-discrete sample interval, a submersible pump and new disposable tubing were lowered into the temporary well screen. Purging rates varied from interval to interval and often decreased with depth to less than 1 gallon per minute. At some sample intervals, the purging was supplemented with air-lift methods or a combination of pump and air-lift to increase the purge rate of the selected sample interval. The air-lift method involves injecting compressed air through an air-injection line into the water column. The compressed air forces the water upward through the casing or the air and water discharge tubing consisting of ¾-inch to 1-inch inside diameter black polyethylene tubing. The air-injection line discharge point is set typically 10 to 20 feet above the well screen to prevent any aeration at the well screen or formation. For this investigation, separate air-injection line and discharge tubing were used, where the air-injection line discharge point was fed a

minimum of 2 feet upward into the discharge tubing. The air displaces the water inside the discharge tubing only and does not come into contact with the well screen or surrounding formation, forcing the water out the discharge line. The compressed air was filtered through an activated carbon oil-vapor removal element before injecting into the water column to prevent moisture or oils from the compressor entering the water column. Water quality parameters were measured from the pump discharge line. **Figure 4-2** illustrates the Pump and Packer and air-lift assembly used during this investigation. The air-lift method was considered a viable alternative to assist with purging because the MCOC for this investigation are not particularly sensitive to volatilization and the air-lift system was turned off well before collection of the sample.

The field team also evaluated a Push-Ahead™ sampler to collect groundwater samples as a quicker alternative for collecting groundwater samples. The Push-Ahead™ sampler is driven ahead of the casing into undisturbed soils to the desired sample interval depth. Upon reaching the target depth, a water level indicator is lowered into sampling rods to check for leakage through pipe joints or sampling ports. Once verified as dry, the sampler is opened to allow infiltration of depth-specific formation water into the drilling rods, where the water can be purged with the submersible pump or a bailer. Confirmation of groundwater infiltration was verified with the water level indicator. For this investigation, the Push-Ahead™ sampler was used to collect only one sample at SB-3 and two samples at SB-6. After evaluating the Push-Ahead™ sampler, it was decided that the Pump and Packer method allowed the team to more accurately target permeable intervals for sampling and reduced sample turbidity.

To ensure that the samples collected were representative of the formation at that depth, groundwater was purged from the target sample interval and measured periodically for water quality parameters, including pH, conductivity, temperature, turbidity, and oxidation reduction potential (ORP). During the purging process, water levels inside the 6-inch casing were monitored periodically to verify that the drill casing was sealed off from the temporary well screen intake. These measurements indicated only negligible fluctuations, indicating that the K-packer was functioning properly. Samples were collected after the water quality parameters stabilized as outlined in the project QAPP. The water quality parameters were recorded and are included in **Appendix D.** The quantities of water purged to reach stabilization of water quality parameters often approached, and on occasion exceeded, the quantity of water used to advance the casing the entire 20-foot interval above the target sample depth. This process was considered sufficient since the water introduced to advance the casing was distributed over the length of the 20-foot interval above the target sample depth and not at the target sample depth. All samples were collected directly from the pump and disposable tubing or bailer used for purging once the parameters stabilized. Sample bottles were filled directly from the disposable tubing or bailer. Groundwater samples were collected and submitted to GPL Laboratories in Frederick, Maryland, for the following laboratory analyses:

- Explosives by USACHPPM SOP CAD 13.3
- Perchlorate by USEPA 6850
- Hardness metals (calcium and magnesium) plus sodium by USEPA 200.7
- Total and dissolved metals (Sb, Cu, Pb, Zn, and W) by USEPA 200.8
- Anions (sulfate, chloride, and nitrate) by USEPA 300.0

- Alkalinity by USEPA 310.1/SM2320B
- Total dissolved solids (TDS) by SM2450C.

The samples submitted for dissolved metals and for hardness metals analyses were field filtered using a 0.45-micron high volume cartridge filter. When the field turbidity measurements were less than 10 Nephelometric Turbidity Units (NTUs) prior to sample collection, dissolved metals analysis was not performed. Perchlorate samples, except for the groundwater samples from SB-3, were field filtered using a 0.20-micron high volume cartridge filter as per the DoD perchlorate sampling guidance (2007). The field team inadvertently omitted the perchlorate field filtering when sampling from SB-3. These samples were not filtered at the lab as this process is done to reduce anaerobic microbial degradation during shipping. One of the proposed depth-discrete sampling intervals in SB-6 (106 feet bgs) was not sampled due to the lack of an adequately permeable zone for sample collection. A summary of the depth-discrete samples collected from temporary wells is included in **Table 4-2.**

Groundwater samples were collected from temporary wells at numerous depth-discrete intervals within the aquifer from soil borings SB-2 through SB-6. All groundwater samples were collected during the first sampling event and, therefore, are labeled with the sampling event designation GW1.

All groundwater samples were analyzed for total metals identified as MCOC (Sb, Cu, Pb, W, and Zn), explosives compounds, and perchlorate. For samples where the turbidity measured just prior to sample collection exceeded 10 NTUs, an additional sample was collected and filtered in the field through a 0.45-micron filter with the sample analyzed for dissolved metals. All perchlorate samples were filtered in the field through a 0.20-micron filter except for those collected from SB-3. Analytical data results for groundwater are discussed in **Section 6** of this report.

It is important to note that a monitoring well was installed within the soil boring SB-3. This well, MW-RS-01, was installed in the same manner described above for the piezometers. The well is screened from 177 feet bgs to 182 feet bgs (elevations of 148.1 to 153.1 feet AMSL). The well was developed is a similar manner to that described in Section 4.3.2.

4.3.5 Piezometer and Well Sampling

On 4 June 2009, two of the piezometers (P-1 and P-7) were sampled using USEPA low-flow sampling techniques (1998). Each piezometer was purged and sampled using a peristaltic pump. Attempts were also made to sample piezometers P-2, P-4, and P-5. Each of these locations purged dry almost immediately, with fewer than 500 milliliters of water removed. It was determined in the field that these piezometers would not produce sufficient volume for sample collection, which required approximately 7 liters of water per sample.

The Weston Lake supply well, WL-1, was sampled on 10 June 2009. According to Palmetto State Utility representatives, this well is treated with a chlorination and granular activated carbon system. Samples were filled directly from a hose spigot at the well location, which is located prior to the treatment systems. Depths to water and total depth of the well were also measured and are included on the monitoring well sampling forms in **Appendix D**. A summary of the samples collected from piezometers and the Weston Lake well is included in **Table 4-2**

4.3.6 Monitoring Well Pair Installation

As part of the follow-on work for the Phase II Assessment (see Section 3.1.4), six monitoring well pairs (MW-RS-02 through MW-RS-07) were installed at locations downgradient of potential source zones in the groundwater assessment area (**Figure 3-10**). Well locations were selected based upon the previous detections of RDX in numerous depth-discrete groundwater samples collected from SB-3, groundwater flow directions as interpreted using groundwater elevation data obtained from the previously installed piezometers, and accessibility. The monitoring wells were installed in two rows. The first row of wells (MW-RS-02 through MW-RS-04) was installed to evaluate the groundwater conditions near the suspected source area and the previous location at which RDX was detected. The second row (MW-RS-05 through MW-RS-07) was located downgradient of the first row near the installation boundary along the groundwater flow path. Each location consisted of a set of paired wells (*i.e.*, two screened intervals) installed within one borehole.

The screened intervals for all of the monitoring well pairs were intended to target the elevation range of the previous RDX detections at SB-3 (248 to 195 feet AMSL). The actual elevations of the well screens were chosen based on the initial targeted depth while making accommodation for the lithological conditions encountered. As an example, if a particularly course grained zone likely to have a high hydraulic conductivity was encountered during drilling efforts, that zone was targeted with a well screen placed in that interval. For zones where clay was encountered, the screened interval was set above or below that interval based upon the on-site geologist's interpretation of site conditions. Due to the interbedded nature of the aquifer and the very difficult drilling conditions, sonic-drilling methods were utilized. At each location the soil borings were drilled to the target depth using a 4-inch inside diameter core-barrel which was over-drilled with a 6-inch inside diameter casing to maintain the integrity of the borehole for well construction. Based upon the soil characteristics, the on-site geologist chose a ten-foot interval to set the shallow well screen. The 6-inch casing was then overdrilled to the base of the shallow well screened interval with an 8-inch inside diameter casing. Both the 6-inch and 8-inch casings were then left in place during construction of the wells to maintain the integrity of the borehole. The total depths of the boreholes varied from 119.0 feet bgs to 156.5 feet bgs (elevations varying from 181.7 feet AMSL to 197.5 feet AMSL) using a 4-inch inside diameter core barrel. Soil cores were described on-site by a geologist. Soil borings with soil descriptions and well construction logs are included in **Appendix E**.

After the completion of soil coring efforts at each location, the on-site geologist chose the final intervals in which to construct the monitoring well pairs. **Figure 4-3** shows a typical well construction detail. For each location, both shallow and deep intervals were chosen for construction of a monitoring well. The well pairs were installed within one boring with the bottom well being constructed first in a manner similar to that previously described for the piezometers in **Section 4.3.1**. Because two wells were installed in one boring, centralizers were utilized to maintain a proper distance between the well screens and boring annulus or riser for the other well. Once the sand pack was placed for the lower screened interval, a bentonite seal was installed from the top of the sand pack for the lower screened interval to the bottom of the screened interval for the shallow location. The 6-inch inside diameter casing was removed from the lower section of the borehole during construction of the deep monitoring well. After the bentonite seal was allowed to properly set, construction of the shallow well commenced. The

riser and screened interval was lowered into place with a centralizer being utilized to maintain proper separation between the well screen, boring annulus, and the riser for the deeper well. Once the screen and riser for the lower well were set in place, construction of the well proceeded as previously described. A summary of the drilling efforts and well installation details are included as **Table 4-3**.

The monitoring wells were developed no sooner than 24-hours after installation in order to provide enough time for the seal and grout to set. Well development records are included as **Appendix E**. The ground surface adjacent to each monitoring well location and the top of casing elevations of each of the monitoring wells were surveyed by a Professional Land Surveyor. The ground surface was measure to the nearest 0.1 feet AMSL while the top of casing elevations were measured to the nearest 0.01 feet AMSL. Ground surface and top of casing elevations are included on **Table 4-3**.

4.3.7 Monitoring Well Pair Sampling

Following installation and development of the final well cluster, the wells were allowed to stabilize for at least two weeks prior to collecting groundwater samples. After this period, the field team collected groundwater samples from each of the newly installed wells during three sampling events and analyzed the samples for RDX and total uranium and/or uranium isotopes. The three independent groundwater sampling events were conducted at approximately four-month intervals from July 2012 through February 2013. In order to collect representative samples of the screened interval and significantly reduce the volume of IDW, the groundwater samples were collected using passive sampling techniques. The sampling method chosen involved using two-inch diameter HydraSleeve™ discrete samplers. The samplers consist of non-reactive sampling bags with a check valve at the top that allows the samplers to be lowered into the wells and retrieved at a later date. The samples do not fill with water until retrieved from the well. As such, the samplers can be lowered into the well during one mobilization and then, after the well is allowed to re-equilibrate, the samplers can be retrieved, and a representative groundwater sample can be collected. These samplers provided the ability to collect water from much of the screened interval while providing adequate sample volume and producing almost no waste to be disposed.

For the first sampling event, the HydraSleeves™ were installed in the new wells on 06 June 2013 after all wells had been developed. The samplers were installed in the wells in accordance with procedures outlined in the QAPP Addendum (PIKA-Pirnie JV, 2012) and the appended SOP. Based upon horizontal groundwater flow velocities previously calculated for the site, a minimum equilibration period of two weeks was deemed appropriate between placing and retrieving the samplers. The samplers were retrieved and the first round of groundwater samples was collected between 10 and 12 July 2012. Prior to retrieving the samplers, water level measurements were recorded at the well location being sampled. Samplers were retrieved in accordance with the QAPP Addendum and SOP. After the samplers were removed from a well, a multi-parameter water quality probe was lowered into the well and allowed to stabilize while the sample jars were filled. Turbidity, conductivity, pH, temperature, and DO were measured at each well and recorded in field notes. The sample containers were filled directly from the HydraSleeves™ except for the U samples which were run through a 0.45 micron filter using a peristaltic pump. Once the sample containers were filled, they were labeled and packed in accordance with

procedures outlined in the QAPP. After the groundwater samples were collected, the samplers were discarded. New clean samplers were then installed in each of the wells.

Two additional sampling events were completed following the same procedures described above. The samplers placed in the wells after the previous round of sampling were removed from the wells in order to collect groundwater samples for the subsequent round of sampling. The second round of groundwater samples was collected on 15 and 16 October 2012. The third round of groundwater samples was collected on 12 and 13 February 2013. Samplers were not left in the wells following the third round of sampling. A summary of sampling completed from the well pairs is included in **Table 4-4**.

4.3.8 Decontamination Procedures

Temporary decontamination pads were constructed at a central location for decontaminating the drill rigs and tooling between soil boring, piezometer, and well locations. One pad was constructed for the 2009 drilling effort and disposed of following completion of those activities. Another pad was constructed for the 2012 drilling effort and disposed of following completion of those activities. Each decontamination pad consisted of a 2-inch-by-6-inch wood framed box and two layers of 6 mil plastic sheeting. The plastic sheeting was underlain by one-half-inch-thick polyethylene ground protection mats to prevent puncturing of the plastic sheeting. All sampling equipment (bailers and submersible pumps) with the exception of the disposable HydraSleeves™ were decontaminated prior to sampling at each interval using an Alconox™ wash solution and potable water rinse. The temporary well screen and drill rods utilized during the depth-discrete sampling were decontaminated between sample intervals and soil boring locations using a high pressure steam cleaner. The sampling equipment decontamination fluids were collected and transferred to a holding tank where the temporary decontamination pad was setup. High pressure steam cleaning between soil boring locations occurred at the decontamination pad, with decontamination fluids temporarily stored in a holding tank. All decontamination fluids were handled as IDW, in accordance with the procedures outlined in the project QAPP and in compliance with Fort Jackson's Investigation Derived Waste Management Plan (USACE, 1998). Following the completion of the groundwater assessment tasks, the temporary decontamination pads were dismantled and the expendable materials (wood and plastic sheeting) were disposed of in a 30-cubic-yard roll-off container leased by ARCADIS during the Phase II assessment activities. Waste Management, Inc. disposed of the materials in the roll-off container as municipal solid waste.

4.3.9 Investigative-Derived Waste Sampling

Waste disposal characterization samples were collected from the soil cutting stockpiles. To obtain the waste disposal characterization samples, each soil cutting stockpile first was sampled by obtaining a five-point composite sample. These composite soil samples were collected from each stockpile and then combined into two waste disposal characterization samples, with an effort to equally represent the total volume of each soil stockpile for the corresponding waste disposal characterization composite sample. For example, the soil cutting composite samples from the larger soil stockpiles (*i.e.*, from the deeper borings) had larger volumes of soil added to the waste disposal characterization samples. The two waste disposal characterization composite soil samples were then submitted for full toxicity characteristic leaching procedure (TCLP)

analysis, plus explosives and perchlorate analyses. Specifically, the waste disposal characterization soil samples were analyzed for the following parameters:

- TCLP metals by SW6010B/SW7471A
- TCLP organochlorine pesticides by SW8081A
- TCLP chlorinated herbicides by SW8151A
- TCLP volatile organic compounds (VOCs) by SW8260B
- TCLP semivolatile organic compounds (SVOCs) by SW8270C
- Explosives by USEPA 8330A
- Perchlorate by USEPA 6850
- Percent solids
- Flashpoint by SW1010
- Reactivity, cyanide by SW9014R
- Reactivity, sulfide by SW9034R
- pH by SW9045C

A waste disposal characterization sample was also collected, using a bailer, from the tank containing the decontamination and well development water. The waste disposal characterization water sample was analyzed for the following parameters:

- Organochlorine pesticides by SW8081A
- Chlorinated herbicides by SW8151A
- VOCs by SW8260B
- SVOCs by SW8270C
- Explosives by CAD13.3
- Perchlorate by USEPA 6850
- Flashpoint by SW1010
- Total metals by SW6010B, SW7471A, and USEPA 200.8
- Reactivity, cyanide by SW9014R
- Reactivity, sulfide by SW9034R
- pH by SW9040

The results of the waste characterization sample analyses and a description of the subsequent procedures used to handle the soil cuttings and decontamination/well development water are presented in **Section 6.1**.

4.4 Quality Assurance / Quality Control

Prior to commencing the groundwater investigation tasks, a sample of the source water used in the drilling process and decontamination procedures was collected and analyzed for MCOC. The source water was obtained from a supply well located in the cantonment area of McCrady Training Center and the sample was identified as GW1-MTC1-GW-01.

Additional QA/ quality control (QA/QC) samples were collected to evaluate the field collection methods and the laboratory analytical techniques for surface water samples, sediment samples, and groundwater samples. The QA/QC samples consisted of duplicate samples, matrix spike / matrix spike duplicate (MS/MSD) samples, and equipment blanks. Triplicate samples were collected at each benthic macroinvertebrate location for QC purposes. In addition, 10% of the benthic macroinvertebrate samples were re-identified at the Clemson University laboratory as a method to verify the data. If an error of greater that 5 percent was found, the samples for that sampling event at the location affected by the error were re-identified.

Internal field sampling audits were performed by Susan Burtnett of ARCADIS for surface water, sediment, and benthic macroinvertebrate sampling on 1 and 2 April 2009 and by Larry Jordan of ARCADIS for groundwater sampling on 12 and 13 May 2009. Field QC samples were collected for each medium in accordance with the project QAPP as described below.

4.4.1 Duplicates

Duplicate samples were collected at a rate of at least 1 per 10 samples with at least 1 duplicate per mobilization. Duplicate samples were collected simultaneously from the same source under identical conditions and submitted to the laboratory as indistinguishable samples and labeled accordingly.

Surface water duplicates during the wet season and dry season were considered co-located samples from two side-by-side composite samplers and carboy setups. The sample collection tubes from both samplers were attached to a single polyvinyl chloride stake in the center of the stream channel.

4.4.2 MS/MSD

Additional water volume was not needed for metals and hardness MS/MSD analysis in surface water. Sub-samples were obtained from the parent sample by the analytical laboratory. Separate sample containers for MS/MSD analyses were necessary only for explosives. For sediment samples, sub-samples were obtained from the primary sample for MS/MSD analysis. MS/MSD samples were analyzed at a rate of 5 percent for surface water and sediment.

Additional sample volume was collected for all analytes for groundwater. During each phase of sampling, MS/MSD samples were collected at a rate of 5 percent for groundwater.

4.4.3 Equipment Blanks

Equipment blanks were collected at least once per mobilization and at a minimum rate of 5 percent for surface water and sediment. For surface water, the equipment blank was collected using the entire sampler and carboy sampling train and the entire peristaltic pump sample

collection train. Prior to setting up the composite sampler and placing the tubing into the stream channel, transfer pump, tubes, and filters were set up as if a sample was going to be collected from the carboy. Approximately 4 liters of clean deionized (DI) water was pumped through the system and into the carboy. Approximately 100 milliliters of DI water was then pumped from the carboy to purge the transfer pump tubing and 0.45-micron filter. Once the transfer tubing and filter were purged, the equipment blank was collected. For sediment, the equipment blank was collected by passing analyte-free DI water over a decontaminated sediment sampler into the sampling containers. For groundwater, equipment blanks for explosives were collected by passing analyte-free DI water through a length of clean tubing from the batch used to sample the wells using a peristaltic pump. For perchlorate and metals, the appropriate filter was added to the tubing train and water was collected after passing through the tubing and appropriate filter.

4.5 Sample Identification

Samples collected at Fort Jackson and McCrady Training Center were identified using the procedures detailed in the QAPP. Each sample was labeled with a seven-character identification that consisted of a four-character sampling event identifier, three-character sampling location identifier, two-character matrix code, two-character location code, and two-character identification code. Unique sequential sample numbers began with 01. QC samples (*e.g.*, duplicates and equipment blanks) received unique sequential sample numbers and were not identified as QC samples on the laboratory COC. MS/MSD samples were collected from parent primary samples in the laboratory.

The surface water and sediment samples collected at Fort Jackson and McCrady Training Center used the unique sequential sample numbers shown in **Table 4-1**. The groundwater samples collected at Fort Jackson and McCrady Training Center used the unique sequential sample numbers shown in **Table 4-2** and **Table 4-4**.

Groundwater samples collected during the 2009 sampling event were the first samples collected from each location and, therefore, are labeled with the sampling event designation GW1. The location code varies according to the sample point from which samples were collected. Groundwater samples collected from on-installation wells at Weston Lake contain the location code WL. Groundwater samples collected from piezometers contain the location code PX, where X corresponds to the piezometer location from which the sample was collected. Depth-discrete samples contain the location code SBX+YY, where X represents the number for the soil boring from which they were collected and YY represents the depth below the identified water table in feet. The analytical laboratory erroneously transcribed the sample identifications (IDs) with a minus ("-") following the soil boring ID, instead of a plus ("+"). To maintain consistency between the laboratory reports, the analytical data tables, and the report text, the minus sign has been adopted to identify the depth-discrete sample depth below the water table. For example, a sample collected from soil boring SB-3 at 20 feet below the water table would be identified as GW1-SB3-20-GW-01. It should be noted, however, that the field forms included in **Appendix D** maintain the original sample identification convention, and the depth-discrete sample depths below the water table are identified with a plus sign. Samples collected at the water table are identified as SBX-WT. The final identifiers placed at the end of the unique identifier (GW-01 in the example above) in that that the sample is groundwater (GW) and that it is either a primary sample (01), a duplicate (02), or part of an MS/MSD pair (02 and 03).

Groundwater samples collected during the July 2012 sampling event were the first samples collected from each of the monitoring well locations and, therefore, are labeled with the sampling event designation GW1. The location code for these wells MW for monitoring well. The letters RS were used to denote that the wells were drilled using Rotosonic™ drilling methods. The final three characters (*e.g.* 0XS) are used to designate the well location (0X) and whether the sample was collected from the shallow (S) or deep (D) well.

Table 4-1: Surface Water Investigation Samples
Fort Jackson and McCrady Training Center, SC

(a) Surface Water Samples

Location		Event	Field Sample ID	Collected		Composite	QA/QC
				Date	Time		
Gills Creek	GC1	WETA	WETA-GC1-SW-01	6-Apr-2009	13:45	Y	Primary
			WETA-GC1-SW-02			Y	Duplicate
			WETA-GC1-SW-03			N	Equip. Blank
		WETB	WETB-GC1-SW-01	7-Apr-2009	16:00	Y	Primary
		STRM	STRM-GC1-SW-01	18-May-2009	0:00	Y	Primary
		DRYA	DRYA-GC1-SW-01	22-Jul-2009	8:30	Y	Primary
			DRYA-GC1-SW-02			Y	Duplicate
	GC2	WETA	WETA-GC2-SW-01	6-Apr-2009	15:15	Y	Primary
		WETB	WETB-GC2-SW-01	7-Apr-2009	16:45	Y	Primary
			WETB-GC2-SW-02			Y	Duplicate
			WETB-GC2-SW-03			N	Equip. Blank
		STRM	STRM-GC2-SW-01	18-May-2009	0:00	Y	Primary
		DRYA	DRYA-GC2-SW-01	22-Jul-2009	8:30	Y	Primary
Colonels Creek	CC1	WETA	WETA-CC1-SW-01	1-Apr-2009	14:15	Y	Primary
		WETB	WETB-CC1-SW-01	2-Apr-2009	18:00	Y	Primary
		STRM	STRM-CC1-SW-01	18-May-2009	0:00	Y	Primary
		DRYA	DRYA-CC1-SW-01	22-Jul-2009	7:00	Y	Primary
	CC2	WETA	WETA-CC2-SW-01	1-Apr-2009	13:00	Y	Primary
		WETB	WETB-CC2-SW-01	2-Apr-2009	9:45	Y	Primary
		STRM	STRM-CC2-SW-01	18-May-2009	0:00	Y	Primary
			STRM-CC2-SW-02			Y	Duplicate
		DRYA	*** NOT COLLECTED - STREAM BED WAS DRY *****				
	CC3	WETA	WETA-CC3-SW-01	1-Apr-2009	18:00	Y	Primary
		WETB	WETB-CC3-SW-01	2-Apr-2009	17:34	Y	Primary
		STRM	STRM-CC3-SW-01	18-May-2009	0:00	Y	Primary
		DRYA	DRYA-CC3-SW-01	22-Jul-2009	7:00	Y	Primary
	JC1	WETA	WETA-JC1-SW-01	1-Apr-2009	18:20	Y	Primary
		WETB	WETB-JC1-SW-01	2-Apr-2009	17:50	Y	Primary
		STRM	STRM-JC1-SW-01	18-May-2009	0:00	Y	Primary
		DRYA	DRYA-JC1-SW-01	22-Jul-2009	7:00	Y	Primary
Cedar Creek	WL1	WETA	WETA-WL1-SW-01	1-Apr-2009	16:30	Y	Primary
		WETB	WETB-WL1-SW-01	2-Apr-2009	13:00	Y	Primary
		STRM	STRM-WL1-SW-01	18-May-2009	11:15	Y	Primary
		DRYA	DRYA-WL1-SW-01	21-Jul-2009	10:35	Y	Primary
	WL2	WETA	WETA-WL2-SW-01	1-Apr-2009	17:12	Y	Primary
		WETB	WETB-WL2-SW-01	2-Apr-2009	13:48	Y	Primary
		STRM	STRM-WL2-SW-01	18-May-2009	12:00	Y	Primary
		DRYA	DRYA-WL2-SW-01	21-Jul-2009	12:00	Y	Primary

Table 4-1: Surface Water Investigation Samples
Fort Jackson and McCrady Training Center, SC

(b) Sediment Samples

Location		Event	Field Sample ID	Collected		Composite	QA/QC
				Date	Time		
Gills Creek	GC1	WETA	WETA-GC1-SD-01	1-Apr-2009	7:35	Y	Primary
		DRYA	DRYA-GC1-SD-01	20-Jul-2009	14:20	Y	Primary
		DRYB	DRYB-GC1-SD-01	21-Jul-2009	16:55	Y	Primary
	GC2	WETA	WETA-GC2-SD-01	1-Apr-2009	10:00	Y	Primary
			WETA-GC2-SD-02			Y	Primary
		DRYA	DRYA-GC2-SD-01	20-Jul-2009	15:30	Y	Primary
		DRYB	DRYB-GC2-SD-01	21-Jul-2009	17:30	Y	Primary
Colonels Creek	CC1	WETA	WETA-CC1-SD-01	31-Mar-2009	10:50	Y	Primary
		DRYA	DRYA-CC1-SD-01	20-Jul-2009	13:15	Y	Primary
		DRYB	DRYB-CC1-SD-01	21-Jul-2009	16:30	Y	Primary
	CC2	WETA	WETA-CC2-SD-01	31-Mar-2009	10:00	Y	Primary
		DRYA	DRYA-CC2-SD-01	22-Jul-2009	8:15	Y	Primary
		DRYB	DRYB-CC2-SD-01	21-Jul-2009	16:00	Y	Primary
	CC3	WETA	WETA-CC3-SD-01	31-Mar-2009	17:09	Y	Primary
		DRYA	DRYA-CC3-SD-01	20-Jul-2009	10:20	Y	Primary
		DRYB	DRYB-CC3-SD-01	21-Jul-2009	15:15	Y	Primary
	JC1	WETA	WETA-JC1-SD-01	31-Mar-2009	15:00	Y	Primary
		DRYA	DRYA-JC1-SD-01	20-Jul-2009	8:00	Y	Primary
		DRYB	DRYB-JC1-SD-01	21-Jul-2009	14:45	Y	Primary
			DRYB-JC1-SD-02			Y	Duplicate
Cedar Creek	WL1	WETA	WETA-WL1-SD-01	2-Apr-2009	13:00	Y	Primary
		DRYA	DRYA-WL1-SD-01	21-Jul-2009	11:10	Y	Primary
		DRYB	DRYB-WL1-SD-01	22-Jul-2009	14:10	Y	Primary
	WL2	WETA	WETA-WL2-SD-01	2-Apr-2009	13:48	Y	Primary
			WETA-WL2-SD-02			Y	Duplicate
		DRYA	DRYA-WL2-SD-01	21-Jul-2009	13:00	Y	Primary
		DRYB	DRYB-WL2-SD-01	22-Jul-2009	14:45	Y	Primary

Table 4-1: Surface Water Investigation Samples
Fort Jackson and McCrady Training Center, SC

(c) Benthic Macroinvertebrate Samples

Location		Event	Field Sample ID	Collected Date	QA/QC
Colonels Creek	CC1	WETA	WETA-CC1-BM-01	30-Mar-2009	Primary
			WETA-CC1-BM-02		Duplicate
			WETA-CC1-BM-03		Triplicate
		DRYA	DRYA-CC1-BM-01	20-Jul-2009	Primary
			DRYA-CC1-BM-02		Duplicate
			DRYA-CC1-BM-03		Triplicate
	CC2	WETA	WETA-CC2-BM-01	31-Mar-2009	Primary
			WETA-CC2-BM-02		Duplicate
			WETA-CC2-BM-03		Triplicate
		DRYA	DRYA-CC2-BM-01	*** NOT COLLECTED ** stream bed was dry*	Primary
			DRYA-CC2-BM-02		Duplicate
			DRYA-CC2-BM-03		Triplicate
	CC3	WETA	WETA-CC3-BM-01	31-Mar-2009	Primary
			WETA-CC3-BM-02		Duplicate
			WETA-CC3-BM-03		Triplicate
		DRYA	DRYA-CC3-BM-01	20-Jul-2009	Primary
			DRYA-CC3-BM-02		Duplicate
			DRYA-CC3-BM-03		Triplicate
	JC1	WETA	WETA-JC1-BM-01	31-Mar-2009	Primary
			WETA-JC1-BM-02		Duplicate
			WETA-JC1-BM-03		Triplicate
		DRYA	DRYA-JC1-BM-01	20-Jul-2009	Primary
			DRYA-JC1-BM-02		Duplicate
			DRYA-JC1-BM-03		Triplicate

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Table 4-2: 2009 Groundwater Sampling Summary
Fort Jackson and McCrady Training Center, SC

Soil Boring ID	Ground Elevation (ft ASL)	Water Table Elevation (ft ASL)	Total depth drilled (ft bgs)	Sample Depth (ft bgs)	Sample Elevation (ft ASL)	Sample ID	QA/QC Samples
SB-1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SB-2	338.9	270.9	136	91	247.9	GW1-SB2+23-GW-01	
						GW1-SB2+23-GW-02	MS
						GW1-SB2+23-GW-03	MSD
				108	230.9	GW1-SB2+40-GW-01	
				126	212.9	GW1-SB2+58-GW-01	
				Boring terminated at 136 ft (est elev of 204') due to impermeable clay from 128' to >136'			
SB-3	330.07	268.07	182	62	268.07	GW1-SB3-WT-GW-01	
				82	248.07	GW1-SB3+20-GW-01	
				105	225.07	GW1-SB3+44-GW-01	
				120	210.07	GW1-SB3+58-GW-01	
				135	195.07	GW1-SB3+73-GW-01	
						GW1-SB3+73-GW-02	FD
						GW1-SB3+73-GW-03	MS
						GW1-SB3+73-GW-04	MSD
				159	171.07	GW1-SB3+97-GW-01	
				182	148.07	GW1-SB3+120-GW-01	
SB-4	373.1	255.1	206	98	275.1	Not sampled, purged dry, insufficient volume	
				118	255.1	GW1-SB4-WT-GW-01	
				138	235.1	GW1-SB4+20-GW-01	
				161	212.1	GW1-SB4+43-GW-01	
						GW1-SB4+43-GW-02	FD
				181	192.1	GW1-SB4+63-GW-01	
				195	178.1	GW1-SB4+77-GW-01	
				Boring terminated at 206' (est elev of 154') due to impermeable clay from 198' to 205'			

Footnotes:

ft - feet
ASL - above sea level
bgs - below ground surface
FD - Field Duplicate
GW - Groundwater
SB - Soil boring
N/A - Not applicable
QA/QC - Quality Assurance/Quality Control
MS - Matrix Spike
MSD - Matrix Spike Duplicate

Table 4-2: 2009 Groundwater Sampling Summary
Fort Jackson and McCrady Training Center, SC

Soil Boring ID	Ground Elevation (ft ASL)	Water Table Elevation (ft ASL)	Total depth drilled (ft bgs)	Sample Depth (ft bgs)	Sample Elevation (ft ASL)	Sample ID	QA/QC Samples
SB-5	361.0	325 (Perched)	214	36	325	Perched zone, insufficient volume to collect sample	
		267		94	267	GW1-SB5-WT-GW-01	
				114	247	GW1-SB5+20-GW-01	
				130	231	GW1-SB5+36-GW-01	
				156	205	GW1-SB5+62-GW-01	
				172	189	GW1-SB5+78-GW-01	
				199	162	GW1-SB5+105-GW-01	
				211	150	GW1-SB5+117-GW-01	
SB-6	300.4	257.4 (Perched)	156	43	257.4	Not sampled, purged dry, insufficient volume	
		234.4		66	234.4	GW1-SB6-WT-GW-01	
				86	214.4	GW1-SB6+20-GW-01	
				106	194.4	Not sampled, formation consisted of fine silty sands at this depth, not likely to produce enoough volume for purging and sampling	
				120	180.4	GW1-SB6+54-GW-01	
				144	156.4	GW1-SB6+78-GW-01	
P-1	277.6	277.3	2.1	2.1	275.5	GW1-P1-GW-01	
P-7	288.3	277.6	25	22	266	GW1-P7-GW-01	
WL-1	343	NA	NA	160-172	171-183	GW1-WL1-GW-01	FD

Footnotes:

ft - feet
ASL - above sea level
bgs - below ground surface
FD - Field Duplicate
GW - Groundwater
SB - Soil boring
N/A - Not applicable
QA/QC - Quality Assurance/Quality Control
MS - Matrix Spike
MSD - Matrix Spike Duplicate

Table 4-3: 2012 Monitoring Well Installation Details

Location	Total Depth Drilled (feet bgs)	Ground Surface Elevation (AMSL)	Top of Casing Elevation (AMSL)	Screened Interval Depth (bgs)	Screened Interval Elevation (AMSL)
MW-RS-02S	156.5	350.5	352.89	90.6 - 100.6	249.9 - 259.9
MW-RS-02D				120.5 - 130.5	220.0 - 230.0
MW-RS-03S	138.0	325.7	328.16	78.0 - 88.0	240.2 - 250.2
MW-RS-03D				121.5 - 131.5	196.7 - 206.7
MW-RS-04S	143.5	335.2	337.57	83.0 - 93.0	244.6 - 254.6
MW-RS-04D				129.2 - 139.2	198.4 - 208.4
MW-RS-05S	119.0	316.5	318.94	70.0 - 80.0	238.9 - 248.9
MW-RS-05D				105.4 - 115.4	203.5 - 213.5
MW-RS-06S	129.0	318.7	321.04	75.3 - 85.3	235.7 - 245.7
MW-RS-06D				115.3 - 125.3	195.7 - 205.7
MW-RS-07S	147.0	328.7	331.27	76.0 - 86.0	245.3 - 255.3
MW-RS-07D				109.0 - 119.0	212.3 - 222.3

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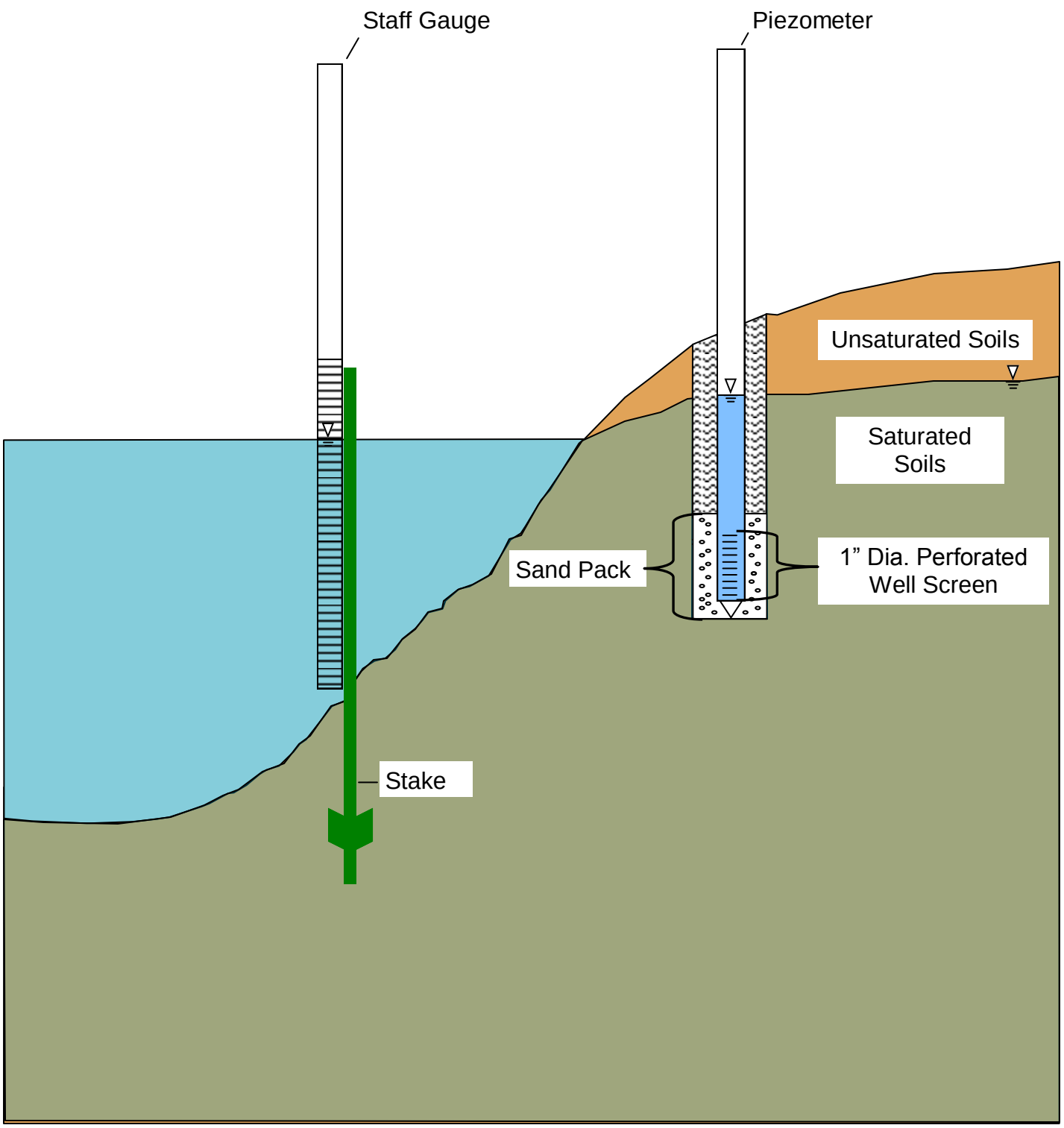
Table 4-4: 2012 & 2013 Monitoring Well Sampling Summary

Well ID	Date Sampled	Time Collected	Sample ID	QA/QC Samples
MW-RS-02S	7/10/2012	1000	GW1-MW-RS-02S	
	10/15/2012	1244	GW2-MW-RS-02S	
	2/12/2013	1035	GW3-MW-RS-02S	
MW-RS-02D	7/10/2012	1130	GW1-MW-RS-02D	Duplicate
	10/15/2012	1350	GW2-MW-RS-02D	
	2/12/2013	1105	GW3-MW-RS-02D	
MW-RS-03S	7/10/2012	1630	GW1-MW-RS-03S	
	10/15/2012	1439	GW2-MW-RS-03S	
	2/12/2013	1145	GW3-MW-RS-03S	
MW-RS-03D	7/11/2012	1030	GW1-MW-RS-03D	
	10/15/2012	1509	GW2-MW-RS-03D	
	2/12/2013	1250	GW3-MW-RS-03D	
MW-RS-04S	7/11/2012	1130	GW1-MW-RS-04S	
	10/15/2012	1546	GW2-MW-RS-04S	
	2/12/2013	1345	GW3-MW-RS-04S	
MW-RS-04D	7/11/2012	1200	GW1-MW-RS-04D	
	10/15/2012	1620	GW2-MW-RS-04D	Duplicate
	2/12/2013	1420	GW3-MW-RS-04D	Duplicate
MW-RS-05S	7/12/2012	930	GW1-MW-RS-05S	
	10/16/2012	1443	GW2-MW-RS-05S	
	2/13/2013	955	GW3-MW-RS-05S	
MW-RS-05D	7/12/2012	1100	GW1-MW-RS-05D	Duplicate
	10/16/2012	1439	GW2-MW-RS-05D	
	2/13/2013	1020	GW3-MW-RS-05D	
MW-RS-06S	7/11/2012	1630	GW1-MW-RS-06S	
	10/16/2012	1210	GW2-MW-RS-06S	
	2/12/2013	1540	GW3-MW-RS-06S	
MW-RS-06D	7/12/2012	800	GW1-MW-RS-06D	
	10/16/2012	1245	GW2-MW-RS-06D	Duplicate
	2/12/2013	1605	GW3-MW-RS-06D	Duplicate
MW-RS-07S	7/11/2012	1430	GW1-MW-RS-07S	

Well ID	Date Sampled	Time Collected	Sample ID	QA/QC Samples
	10/16/2012	935	GW2-MW-RS-07S	
	2/13/2013	830	GW3-MW-RS-07S	
MW-RS-07D	7/11/2012	1515	GW1-MW-RS-07D	
	10/16/2012	52.36	GW2-MW-RS-07D	
	2/13/2013	910	GW3-MW-RS-07D	



Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 4-1
Staff Gauge / Piezometer Pair Construction

Date ..... January 2014
Prepared By: ... PIKA-Pirnie JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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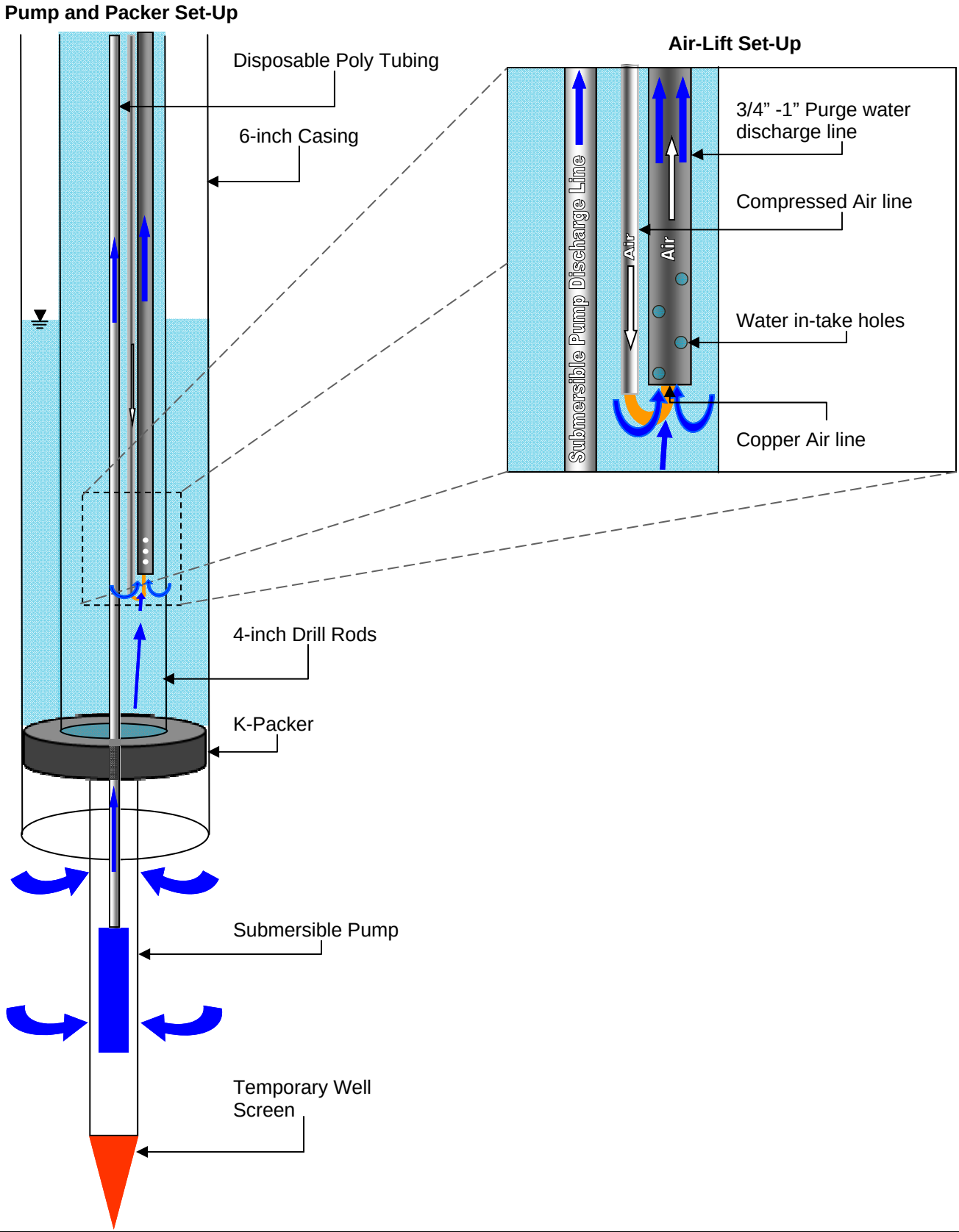

Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 4-2
Depth-Discrete Sampling and Air-Lift Assemblies

Date ……..January 2014
Prepared By: .. .PIKA-Pirnie JV, LLC
Prepared For: …… USACE
Contract: ……W912DY-10-D-0025

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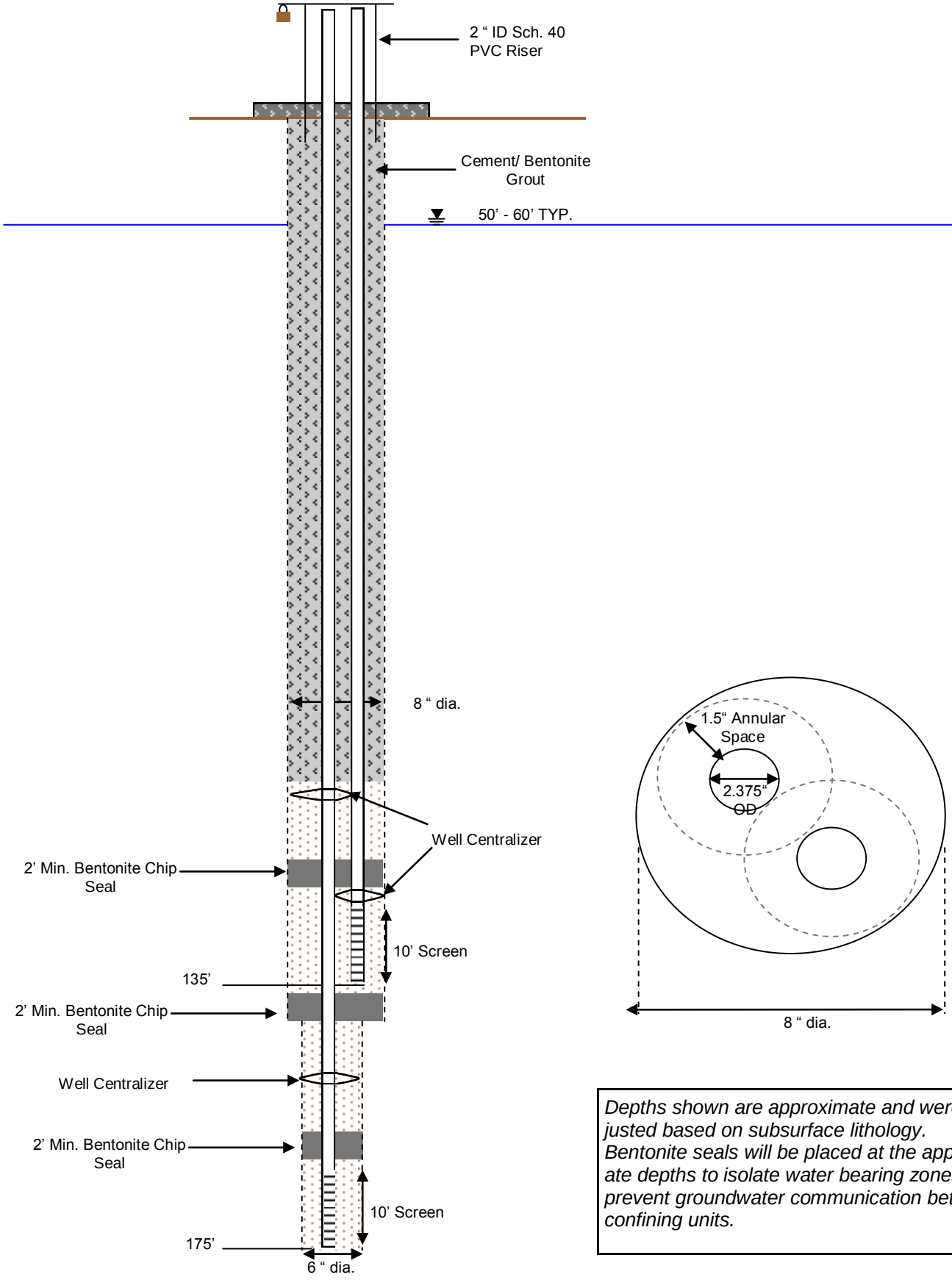

Depths shown are approximate and were adjusted based on subsurface lithology. Bentonite seals will be placed at the appropriate depths to isolate water bearing zones and prevent groundwater communication between confining units.

Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 4-3
Typical Construction for Monitoring Well Pair

Date ……..…. January 2014
Prepared By: ... PIKA-Pirnie JV, LLC
Prepared For: …….…. USACE
Contract: ……W912DY-10-D-0025

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5 Data Analyses

5.1 Laboratory Analytical Methods

Surface water, sediment, and groundwater samples were submitted to DoD Environmental Laboratory Approval Program-certified laboratories (GPL, Test America, and Brooks Rand Laboratories, and the Department of Forestry and Natural Resources at Clemson University, South Carolina for benthic macroinvertebrates) for analysis. The following analytical methods were used for media-specific analysis.

Surface water was analyzed for:

- Explosives by USACHPPM SOP CAD Method 13.3
- Perchlorate by USEPA Method SW6850
- Dissolved metals (Sb, Cu, Pb, Zn, and W) by USEPA Method 1638M
- Hardness metals (calcium and magnesium) by USEPA Method 200.7

Sediment was analyzed for:

- Explosives by USEPA Method SW8330A
- Total metals (Sb, Cu, Pb, Zn, and W) by USEPA Method SW6020
- TOC by USEPA technical report number CE-81-1 (Walkley-Black Method)

Benthic Macroinvertebrates were analyzed for:

- Species diversity (Shannon's diversity index)
- Species richness
- Ephemeroptera, plecoptera, and trichoptera (EPT) richness
- EPT percent contribution

Groundwater was analyzed for:

- Explosives by USACHPPM SOP CAD 13.3 (2009 samples) and by USEPA 8330B (2012/2013 samples)
- Perchlorate by USEPA 6850 (2009 samples)
- Hardness metals (calcium and magnesium) plus sodium by USEPA E200.7 (2009 samples)
- Total and dissolved metals (Sb, Cu, Pb, Zn, and W) by USEPA 200.8 (2009 samples)
- U and U-isotopes by USEPA 6020 (2012/2013 samples)
- Anions (sulfate, chloride, and nitrate) by USEPA 300.0 (2009 samples)
- Alkalinity by USEPA 310.1/SM2320B (2009 samples)
- TDS by SM2450C (2009 samples)

These analytical methods for MCOC achieve the project quantitation limits of at least one-third and in most cases one-tenth the PALs. Therefore, in the evaluation of analytical data in **Section 6**, statements about "non-detect" results mean that a chemical was not detected above the laboratory detection limit. Tabulated results for all analyses appear in **Appendix B**.

5.2 Data Validation

All laboratory results were subjected to third-party data validation. Ninety percent of the data were subjected to USEPA Level 3 data validation. For organic analyses, this included a review of the following:

- Holding times
- Initial calibration
- Continuing calibration
- Blanks
- Surrogate recovery
- MS and MSD recovery
- Laboratory control sample recovery
- Internal standard performance
- Field duplicate sample analysis relative percent difference (RPD)
- Reporting limits
- Overall assessment of data in the sample delivery group (SDG)

For inorganic analyses, this included a review of the following:

- Holding times
- Initial calibration
- Continuing calibration
- Blanks
- MS recovery
- Laboratory duplicate sample RPD
- Laboratory control sample recovery
- Inductively coupled plasma mass spectrometry interference check
- Method of standard additions and serial dilution checks
- Field duplicate sample analysis RPD
- Reporting limits
- Overall assessment of data in the SDG

Ten percent of the data were subjected to USEPA Level 4 data validation. Level 4 data validation includes everything listed for Level 3 data validation, as well as additional reviews. For the Level 4 data validation for organic analyses, this included a review of the following:

- Compound identification
- Compound quantitation and detection limits
- Tentatively identified compound verification (gas chromatography / mass spectrometry)
- System performance

For the Level 4 data validation for inorganic analyses, this included a review of the following:

- Analyte identification
- Analyte quantitation and detection limits
- System performance

The review of nitroaromatics and nitramines data analyzed by USEPA SW 846 Method 8330A (sediments and 2012/2013 groundwater data) and per USACHPPM SOP CAD 13.3, March 2004, GPL SOP Q.23, Nov. 2008, and USEPA SW 846 Method 8095 (surface water and groundwater) followed a modified outline of the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (2008).

The review of perchlorate data analyzed by USEPA SW 846 Method 6850 followed a modified outline of the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (2008), as there are no current guidelines for this method. In the absence of project-specific guidance, data were evaluated against the *Department of Defense Perchlorate Handbook*, Revision 1, Change 1, August 2007 and USEPA SW846 Method 6850.

The review of the data listed below followed a modified outline of the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (2004):

- Metals data by USEPA SW 846 Method 6020 (sediments)
- TOC data by USEPA technical report number CE-81-1 (Walkley-Black Method; sediments)
- Metals data per USEPA 200.7 (surface water)
- Dissolved metals (Sb, Cu, Pb, Zn, and W) by USEPA Method 1638M (surface water)
- U and U-isotope data per USEPA SW 846 Method 6020 (2012/2013 groundwater samples)
- Total and dissolved metals (Sb, Cu, Pb, Zn, and W) by USEPA 200.8 (2009 groundwater samples)
- Alkalinity data by USEPA Method 310.1 (2009 groundwater samples)
- Anions by USEPA Method 300.0 (2009 groundwater samples)
- TDS by USEPA Method 160.1 (2009 groundwater samples)

5.3 Data Analysis

All MCOC detected at downstream locations were evaluated against reference concentrations using direct comparison and statistical tests. All MCOC detected at downstream locations were evaluated against the PALs via direct comparison and calculation of the 95% upper confidence limit of the mean (UCLM). The weight-of-evidence approach used in the assessment helped control decision errors. MCOC concentrations from all sample results, general water quality parameters, and site conditions were taken into account to ensure that additional information did not provide indications that MCOC conclusions may be in error.

5.3.1 Statistical Analysis

The normality of MCOC concentration data was evaluated using the Shapiro-Wilk W test with an alpha value of 0.05. Where the data were normally distributed, statistical comparisons to the PALs were made using a one-tailed two-sample dependent variable t test with an alpha value of 0.05. If the data were identified as not normally distributed by the Shapiro-Wilk W test, then the Wilcoxon signed-rank test, also with an alpha value of 0.05, was used for the PAL comparison. The Wilcoxon signed-rank test generally was required when there was more than one non-detection of an analyte at one of the sites included in the comparison. All statistical tests were performed using STATISTICA, a data analysis software system by StatSoft, Inc. (Version 9.0, 2009).

The small size of the Phase II assessment data sets (four samples per location for surface water and three samples per location for sediment) reduces the ability of statistical hypothesis tests (t-test and Wilcoxon signed-rank test) to reject the null hypothesis of no difference between reference and downstream locations. This is particularly true if the data are not normally distributed or contain a high proportion of censored values (*i.e.*, nondetected values, where the reporting limit was used in the data analysis). To avoid false negatives (*i.e.*, the conclusion of no significant increases in downstream concentrations where such increases do exist), the statistical hypothesis tests were supplemented with a direct comparison of reference and downstream concentrations.

5.3.2 Surface Water Investigation Decision Rules

For the surface water system, the decision rules begin with a statistical comparison of MCOC concentrations at reference locations and downstream sampling sites. The initial question to be answered is: Are MCOC concentrations at the downstream site significantly higher than concentrations at the reference site for each decision unit? For this assessment, each watershed serves as a decision unit. The question is asked independently for MCOC in surface water and sediment. If the concentrations of an MCOC at the downstream site do not exceed the concentrations at the reference site based on a statistical comparison (e.g., t-test, Wilcoxon signed-rank test), then the evaluation of that MCOC is complete and activities at the associated operational range area(s) are not considered to be increasing MCOC concentrations in the surface water pathway (and, therefore, are not causing MCOC to migrate off range), and the operational range area(s) is placed in the Unlikely category for the surface water system. If the concentration of an MCOC is found to be significantly higher at the downstream site than at the reference site, operational range activities are considered to be potentially increasing that MCOC

concentration in the surface water pathway and that MCOC is evaluated further using additional decision rules.

MCOC with concentrations that are determined to be significantly higher at downstream sites than at reference sites are evaluated relative to PALs. For this comparison, the 95% UCLM downstream concentration is calculated for each MCOC. The question to be answered in this step is: Does the 95% UCLM concentration at the downstream site exceed the PAL? If the 95% UCLM concentration does not exceed the PAL, the evaluation of that MCOC ends and activities at the associated operational range area(s) are not considered to be causing off-range migration of MCOC in surface water to levels that could pose an unacceptable risk to human or ecological receptors. An operational range area is placed in the Unlikely category for the surface water system if no downstream surface water or sediment MCOC concentrations that exceed the reference site concentrations are also found to exceed the PAL. If the 95% UCLM of an MCOC concentration is found to exceed its PAL at the downstream location, then a limited risk evaluation for that MCOC is performed.

For ease of analysis, the statistical evaluation was performed in reverse order, comparing the downstream 95% UCLM concentrations to PALs and then performing the statistical comparison between the average reference and downstream concentrations. This was done to minimize the number of calculations, specifically to eliminate comparisons where both means were below the detections limits. Performing the statistical evaluation in reverse order has no effect on the final results and conclusions of the statistical evaluation or of the assessment.

The limited risk evaluation is conducted separately for human and ecological receptors. The question to be answered in the limited risk evaluation step is: Does exceedance of a PAL represent an unacceptable risk to human receptors, ecological receptors, or both? The outcome of the limited risk evaluation is the determination of whether there is an unacceptable risk or whether additional investigation and/or risk assessment is required before a determination can be made on the level of risk. The limited risk evaluation step incorporates review of surface water and sediment studies conducted by others, regulatory screening values established for human and ecological receptors, and studies regarding MCOC effects on these receptors (e.g., bioaccumulation of metal MCOC in the food chain). The limited risk evaluation includes review of the Phase II assessment data and comparison to the study findings and screening criteria. Benthic macroinvertebrate data are used, where available, to check for potential false-positive or false-negative errors and to support the data findings.

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6 Data Results

This section presents the results of field water quality measurements and laboratory analyses of IDW, surface water, sediment, and groundwater samples. The results of the benthic macroinvertebrate sample evaluations are also presented. The MCOC results discussion includes comparison of downstream/downgradient location results to PALs and reference conditions for surface water and sediment and groundwater. As discussed in Section 3.3.3, the PALs are based on the more conservative of applicable human and ecological criteria from the DoD RMUS *Operational Range Assessment Screening Values*, Version 6.0 (DoD, 2012) and South Carolina *Water Classifications and Standards* (SC code §61-68).

6.1 Investigation-Derived Waste

Samples of soil cuttings and purge water were collected and submitted for analytical testing in compliance with the *Fort Jackson Investigation-Derived Waste (IDW) Management Plan* (USACE, 1998).

Two composite soil samples (identified as IDW-Comp-SO-01 for the soil cuttings from SB-2, SB-3, P-7, P-8, P-10, and P-11 and IDW-Comp-SO-02 for the soil cuttings from SB-4, SB-5, SB-6, P-12, and P-13) were submitted for waste characterization. Based on the results of these analyses and in consultation with personnel from Fort Jackson's ENV, it was determined that soil cuttings from drilling activities could be spread safely on the ground surface at each of the locations from which the materials were generated. Analytical results for the waste characterization samples from the soil boring cutting stockpiles are included in **Appendix F**.

All decontamination fluid and discharge water generated during drilling activities, well installation and development, and purging during sampling activities were placed in a temporary storage tank located at a landing zone near piezometer P-11 and stored for the duration of field activities. At the end of the field effort, one grab water sample was collected from the tank and submitted for waste characterization. Based on the results of these analyses and in consultation with personnel from Fort Jackson's ENV, it was determined that water generated during the field investigation could be placed safely on the ground surface at the storage location. Water from the tank was placed on the ground surface near the decontamination area in a location that would not impact installation activities. The flow rate of water from the tank was regulated to prevent surface erosion and allow infiltration into the subsurface. Analytical results for the waste characterization samples from the decontamination fluid and discharge water are included in **Appendix F**.

6.1 Surface Water System Assessment Results

Surface water MCOC results are tabulated by watershed in **Tables 6-1** through **6-3** while field-measured surface water quality parameters are tabulated for all sites in **Table 6-4**. Sediment samples were collocated with surface water sampling locations and were analyzed for specific MCOC. Laboratory analytical results for sediment (less than 2 millimeters in diameter) analysis of MCOC concentrations are presented in **Tables 6-5** through **6-7**. Laboratory reports are provided in **Appendix B** and data usability reports are provided in **Appendix G**. The statistical evaluations discussed below are tabulated in **Appendix H**.

The following section discusses the results with a focus on the MCOC positively detected. The range of detected MCOC concentrations in surface water and sediment at each sample location is depicted in **Figures 6-1** through **6-13**.

6.1.1 Gills Creek Watershed

Surface water and sediment samples collected from location GC1 were upstream of range influence, while surface water and sediment samples collected from location GC2 were downstream of *Inconclusive* areas in the Gills Creek watershed. Samples collected from GC1 were used to characterize reference MCOC concentrations that may be naturally occurring or influenced by non-operational and/or off-installation activities. Samples collected from GC2 were used to evaluate the potential for off-range migration of MCOC to pose an unacceptable risk to downstream off-range ecological and human receptors.

6.1.1.1 Surface Water

Surface water analytical results for samples collected in the Gills Creek watershed are presented in **Table 6-1** and summarized in **Figure 6-1**.

GC1 (reference location)

Metals MCOC

Sb was detected in surface water in all four surface water sampling events; Cu, Pb, and Zn were detected in Wet A, Wet B, and Dry A sampling events; and W was not detected during any of the Phase II sampling events at location GC1. All detected metals concentrations in surface water at GC1 were below their respective PAL.

Explosives MCOC

Explosives were not detected in surface water during any of the Phase II sampling events at location GC1.

Perchlorate

Perchlorate was detected in surface water only during one event (Wet A) at a concentration of 0.08 µg/L, which is significantly below the PAL of 15 µg/L.

GC2 (downstream location)

Metals MCOC

Sb, Cu, Pb, and Zn were detected in surface water samples from all four events and W was detected in samples from the Wet A, Storm, and Dry A sampling events. Pb concentrations detected in surface water were greater than the PAL of 0.54 µg/L in all four sampling events, with concentrations ranging from 1.72 to 3.28 µg/L. The Pb concentration in the Storm event sample (3.28 µg/L) did not exceed the acute PAL of 14 µg/L. Cu concentrations in surface water samples from the Storm and Dry A events were greater than the PAL of 2.7 µg/L, with reported concentrations of 2.71 µg/L and 3.19 µg/L, respectively. The Cu concentration in the Storm event sample (2.71 µg/L) did not exceed the acute PAL of 3.6 µg/L. Detected concentrations of the remaining MCOC metals (Sb, W, and Zn) in surface water were below their respective PAL.

Explosives MCOC

Explosives were not detected in surface water during any of the Phase II sampling events at location GC2.

Perchlorate

Perchlorate was not detected in surface water during any of the Phase II sampling events at location GC2.

6.1.1.2 Sediment

Sediment analytical results for samples collected in the Gills Creek watershed are presented in **Table 6-5** and summarized in **Figure 6-1**.

GC1 (reference location)

Metals MCOC

Cu and Pb were detected in sediment at reference location GC1 during all three sampling events at concentrations below their respective PALs. Zn was detected in sediment only during the Wet A event. W was not detected in sediment during any of the Phase II sampling events at location GC1. All detected metals MCOC concentrations in sediment at GC1 were below their respective PAL.

Explosives MCOC

Explosives were not detected in sediment during any of the Phase II sampling events at location GC1.

GC2 (downstream location)

Metals MCOC

Sb, Cu, Pb, W, and Zn were detected in samples from all events. Pb concentrations in sediment samples from the Dry A and Dry B events were greater than the PAL of 47 mg/kg, with reported concentrations of 143 mg/kg and 144 mg/kg, respectively. The Cu concentration reported in the Dry B event sediment sample was 36.9 mg/kg, which exceeds the PAL of 34 mg/kg. Detected concentrations of the remaining MCOC metals (Sb, W, and Zn) in sediment were below their respective PAL.

Explosives MCOC

Explosives were not detected in sediment during any of the Phase II sampling events at location GC2.

6.1.1.3 Benthic Macroinvertebrates

No benthic macroinvertebrate data were collected at the Gills Creek locations per the rationale provided in the QAPP.

6.1.1.4 Sample Comparison and Statistical Evaluation

At the downstream location on Gills Creek (GC2), Cu and Pb were detected above the PALs in surface water and sediment. Detected Cu concentrations were higher at the downstream location than at the reference location in both surface water (**Figure 6-2**) and sediment (**Figure 6-3**) and downstream concentrations exceeded the PAL in both surface water and sediment at least once. Similarly, detected Pb concentrations are higher at the downstream location than at the reference location in both surface water (**Figure 6-4**) and sediment (**Figure 6-5**) and downstream concentrations exceeded the PAL in both surface water and sediment for multiple sampling events. Sb, W, and Zn were detected in surface water and sediment, but below the PALs.

Table H-1 (in **Appendix H**) provides a comparison of the detected MCOC concentration mean, maximum, and 95% UCLM to the PALs. **Table H-2** provides the results of the statistical comparisons between GC2 and GC1 for detections in surface water and sediment per the ORAP protocol to evaluate whether MCOC concentrations are statistically higher at the downstream sample location (GC2) than at the reference location (GC1). The statistical evaluation is described below.

Statistical Comparison to Surface Water PALs

The 95% UCLM for Sb (0.34 µg/L) in surface water does not exceed the PAL (5.6 µg/L), and none of the individual Sb results exceed the PAL. This provides a reasonable degree of confidence that Sb concentrations in surface water at location GC2 do not exceed the PAL.

The 95% UCLM for Cu (3.11 µg/L) in surface water exceeds the PAL (2.7 µg/L), and Cu was detected in all surface water samples, with two results above the PAL and two results just below the PAL. This provides a reasonable degree of confidence that Cu concentrations in surface water at location GC2 are near or exceed the PAL.

The 95% UCLM for Pb (3.44 µg/L) in surface water exceeds the PAL (0.54 µg/L), and Pb was detected in all samples with all results greater than the PAL. This indicates a high degree of confidence that Pb concentrations in surface water at location GC2 exceed the PAL.

The 95% UCLM for Zn (10.8 µg/L) in surface water does not exceed the PAL (36.5 µg/L), and none of the individual detections of Zn in surface water exceed the PAL. This provides a high degree of confidence that Zn concentrations in surface water at location GC2 do not exceed the PAL.

There is no PAL for W in surface water, as no regulatory limits currently exist. A review of the toxicity of W by USACHPPM (2004) suggests that a reasonable W surface water screening criterion would likely range between 35 and 175 µg/L. While these values cannot be used as a decision point for determining risk to receptors since they are not established regulatory criteria, a comparison shows that W detected in the surface water samples is several orders of magnitude below these values. The 95% UCLM for W (0.02 µg/L) is presented in **Table H-1** without an accompanying PAL. The 95% UCLM for W is several orders of magnitude below the range of toxicity values reviewed by USACHPPM and this provides a reasonable level of confidence that W, while present in the watershed, is not present at concentrations that would likely pose a risk to ecological receptors.

Statistical Comparison to Sediment PALs

The 95% UCLM for Cu (48.7 mg/kg) in sediment exceeds the PAL (34 mg/kg) (**Table H-1**). This provides a reasonable level of confidence that Cu concentrations in sediment at location GC2 exceed the PAL.

The 95% UCLM for Pb in sediment exceeds the PAL and two of three sample concentrations exceed the PAL of 47 mg/kg by one order of magnitude. The 95% UCLM value is relatively high (212.6 mg/kg) based on the maximum observation (144 mg/kg). Given the sample results, there is a high degree of confidence that Pb concentrations in sediment at location GC2 exceed the PAL.

The 95% UCLM for Zn in sediment exceeds the PAL, but none of the individual sample concentrations exceed the PAL. The calculated 95% UCLM is 151.4 mg/kg, and the PAL is 150 mg/kg. This provides a reasonable level of confidence that Zn concentrations in sediment at location GC2 do not exceed the PAL.

Statistical Comparisons to Reference Concentrations

The statistical comparisons of downstream concentrations to reference concentrations have limited utility with a small dataset, such as the one available for this study. However, these comparisons can be used to draw general conclusions about the dataset.

The statistical comparisons show that Sb, Cu, and Pb concentrations in surface water are significantly greater (defined as significantly different using an alpha of 0.05) at GC2 than at the upstream reference location GC1.

Statistical comparisons of Zn and W concentrations in surface water and Sb, Cu, Pb, W, and Zn concentrations in sediment (**Table H-2**) supported the null hypothesis of no significant differences. However, the downstream concentrations of Pb and Cu in sediment at GC2 were several orders of magnitude greater than the concentrations at the reference location GC1 for every sampling event. This is an example of a false negative error because Pb concentrations in sediment at GC2 (mean of 108.0 mg/kg) are obviously higher than Pb concentrations in sediment at GC1 (mean of 1.8 mg/kg). The false negative error is most likely due to the small number of samples collected.

6.1.1.5 Conclusions

The data presented above demonstrate that Cu and Pb are migrating off-range via Gills Creek in surface water and sediment.

MCOC in surface water and sediment were detected at concentrations below human PALs, consequently the source-pathway-receptor interaction for potential human receptors is likely incomplete. Furthermore, the PALs selected for human health are overly conservative for off-range migration in Gills Creek as these values are based upon drinking water criteria, when the only identified likely exposure route through the surface water pathway in the Gills Creek watershed is via ingestion of fish and dermal exposure and these exposure routes are typically less toxic than exposure via drinking water. Therefore, the potential off-range migration of

MCOC in the Gills Creek watershed is unlikely to pose an unacceptable risk to potential human receptors downstream of *Inconclusive* ranges.

MCOC metals (Cu and Pb) in surface water and sediment were detected above ecological PALs, consequently the source-pathway-receptor interaction for ecological receptors may be complete. Per the USACHPPM Phase II protocol (2009), additional evaluation is needed to confirm whether Pb and Cu are migrating off range in surface water at concentrations that may pose an unacceptable risk to the environment. A SLERA was conducted to address this question (see **Appendix I**). The SLERA conclusions are summarized in Section 7.1.

6.1.2 Colonels Creek Watershed

Surface water and sediment samples collected from locations CC1 and CC2 were upstream of range influence on separate tributaries to Colonels Creek, while surface water and sediment samples collected from location CC3 were downstream of *Inconclusive* areas in the Colonels Creek watershed at the operational range/installation boundary. Surface water and sediment samples from location JC1 were collected downstream of *Inconclusive* areas drained by Jumping Run Creek, a tributary to Colonels Creek, at the operational range/installation boundary.

Samples collected from CC1 and CC2 were used to characterize reference MCOC concentrations that may be naturally occurring or influenced by non-operational and/or off-installation activities. Samples collected from CC3 and JC1 were used to evaluate the potential for off-range migration of MCOC to pose an unacceptable risk to downstream off-range ecological and human receptors.

No MCOC (metals, explosives, and perchlorate) were detected above their respective PALs at the downstream locations CC3 and JC1 in the Colonel Creek Watershed. This finding alone demonstrates that MCOC are not likely migrating off-range at unacceptable levels via surface water or sediment in Colonels Creek.

A summary of MCOC detections in the Colonels Creek watershed is included below to support the following discussion and conclusions.

6.1.2.1 Surface Water

Surface water analytical results for samples collected in the Colonels Creek watershed are presented in **Table 6-2** and **Figure 6-6**.

CC1 (reference location)

Metals MCOC

At CC1, Sb, Cu, Pb, and Zn were detected in surface water samples from the Wet A, Wet B, and Dry A events. All detected metals concentrations in surface water at CC1 were below their respective PAL. W was not detected in any surface water samples collected at CC1.

Explosives MCOC

Explosives were not detected in surface water during any of the Phase II sampling events at location CC1.

Perchlorate MCOC

Perchlorate was not detected in surface water during any of the Phase II sampling events at location CC1.

CC2 (reference location)

As discussed above in Section 4.2, the dry season, clear weather event (Dry A) surface water sample was not collected at CC2, as the streambed was dry during the sampling event.

Metals MCOC

At CC2, Pb was detected in surface water samples from the Wet A, Wet B, and Storm sampling events; Sb was detected in samples from the Wet A and Storm sampling events; and Cu and Zn were detected in samples from the Wet A and Wet B sampling events. Pb concentrations were greater than the PAL of 0.54 µg/L in samples from the Wet A, Wet B, and Storm sampling events, with concentrations ranging from 1.05 to 1.12 µg/L (the Storm event Pb concentration of 1.08 µg/L did not exceed the acute Pb PAL of 14 µg/L). W was not detected in surface water during any of the Phase II sampling events at CC2. All detected metals concentrations in surface water at CC2, with the exception of Pb, were below their respective PALs.

Explosives MCOC

Explosives were not detected in surface water during any of the Phase II sampling events at location CC2.

Perchlorate MCOC

Perchlorate was not detected in surface water during any of the Phase II sampling events at location CC2.

CC3 (downstream location)

Metals MCOC

At CC3, Pb was detected in surface water samples from all events; Sb was detected in samples from the Wet A, Storm, and Dry A sampling events; Cu and Zn were detected in samples from the Wet A, Wet B, and Dry A sampling events; and W was detected in the sample from the Wet B sampling event. None of the metals concentrations detected in surface water samples at CC3 were greater than the PALs.

Explosives MCOC

Explosives were not detected in surface water during any of the Phase II sampling events at location CC3.

Perchlorate MCOC

Perchlorate was detected in surface water only during the Wet B event at CC3 at a concentration less than both the PAL of 15 µg/L and the reporting limit of 0.2 µg/L.

JC1 (downstream location)

Metals MCOC

At JC1, Pb was detected in surface water samples from all events; Cu and Zn were detected in samples from the Wet A, Wet B, and Dry A events; and Sb was detected in samples from the

Storm and Wet A sampling events. None of the metals concentrations detected in surface water samples at JC1 were greater than the PALs.

Explosives MCOC

Explosives were not detected in surface water during any of the Phase II sampling events at location JC1.

Perchlorate MCOC

Perchlorate was detected during both Wet A and Wet B sampling events at JC1. The perchlorate detections during the Wet A and Wet B sampling events were less than the PAL of 15 µg/L and the reporting limit of 0.2 µg/L. Perchlorate was also detected in groundwater upgradient of Jumping Run Creek, but at concentrations well below the PAL.

6.1.2.2 Sediment

Sediment analytical results for samples collected in the Colonels Creek watershed are presented in **Table 6-6**.

CC1 (reference location)

Metals MCOC

In sediment, Pb was detected in samples from all sampling events and Zn was detected in the sample from the Wet A event. Sb, Cu, and W were not detected in sediment during any of the Phase II sampling events at CC1. All detected metals concentrations in sediment at CC1 were below their respective PALs.

Explosives MCOC

Explosives were not detected in sediment during any of the Phase II sampling events at location CC1.

CC2 (reference location)

Metals MCOC

In sediment, Cu, Pb, and Zn were detected in samples from all events and W was detected in the sample from the Wet A event. Sb was not detected in sediment during any of the Phase II sampling events at location CC2. Pb was detected at 60.9 mg/kg in the sediment sample from the Dry A event, exceeding the PAL of 47 mg/kg. No other metals MCOC (Sb, Cu, W, and Zn) were detected in sediment at concentrations above respective PALs at location CC2.

Explosives MCOC

DNB was detected in the Wet A sediment sample at a concentration of 0.038 mg/kg, which exceeded the TOC-adjusted sediment PAL of 0.035 mg/kg. No other explosives MCOC were detected in sediment during the Phase II sampling events at location CC2.

CC3 (downstream location)

Metals MCOC

In sediment samples collected at CC3, Cu and Pb were detected in samples from all events and Zn was detected in samples from the Dry B and Wet A events. None of the metals concentrations detected in sediment samples at CC3 were greater than the PALs.

Explosives MCOC

Explosives were not detected in surface water during any of the Phase II sampling events at location CC3.

JC1 (downstream location)

Metals MCOC

In sediment collected at JC1, Cu and Pb were detected in samples from all events and Zn was detected in the sample from the Wet A event. None of the metals concentrations detected in sediment samples at JC1 were greater than the PALs.

Explosives MCOC

Explosives were not detected in sediment during any of the Phase II sampling events at location JC1.

6.1.2.3 Benthic Macroinvertebrate Sampling Data

The results of the benthic macroinvertebrate laboratory evaluations (see Section 4.2.3) are presented in **Table 6-8**. Biodiversity indices, including Shannon's diversity index, species richness, EPT species richness, and percent EPT abundance were assessed for each sample. Shannon's diversity index, which accounts for both species abundance and evenness, commonly is used to represent species diversity in a community. The species richness represents the total number of all the benthic macroinvertebrate species for each sample separated into the lowest taxonomic level (genus/species whenever possible). The EPT richness is the number of species from the taxonomic orders Ephemeroptera, Plecoptera, and Trichoptera found in the sample. The percent EPT is the percentage of the total number of organisms found in the sample that are in the taxonomic orders of Ephemeroptera, Plecoptera, and Trichoptera.

Sample location CC2 exhibited significantly lower diversity and richness values than the other three sample locations (CC1, CC3, and JC1) during the wet season event (Wet A). Species abundance at CC2 was not distributed as evenly as in the samples from other sample locations. The EPT community accounted for approximately 44% of the total number of organisms collected at this site. Ninety-five percent of the EPT species came from two Plecoptera groups (*Leuctra sp*. and *Amphinemoura delosa*). The lack of flowing or standing water at CC2 during the dry season event (Dry A) prevented collection of benthic macroinvertebrate samples at this location. Species richness values were stable at CC1 and CC3 between sample events; however, species richness and EPT richness values at JC1 decreased by 30%. This decrease in richness values coincides with a large increase in plecotperan organisms.

Overall, samples collected during the wet season event (Wet A) had higher diversity index values than the Dry A event samples. During Wet A, Shannon's diversity index values were greater in the downstream samples (CC3 and JC1) compared to the upstream sample CC2, but very similar to the results from upstream sample CC1. During the Dry A event, Shannon's diversity index values were mixed; the value for the sample from CC3 (downstream) was greater than the value for the sample from CC1 (upstream), but the value for the sample from JC1 (downstream) was less than the value for the sample from CC1 (upstream).

6.1.2.4 Sample Comparison and Statistical Evaluation

No MCOC were detected above the PALs in surface water or sediment at the downstream locations in Colonels Creek (CC3 and JC1). Detected Cu concentrations at the downstream locations (CC3 and JC1) appear to be generally less than or comparable to the range of detected concentrations at the reference locations (CC1 and CC2) in both surface water (**Figure 6-7**) and sediment (**Figure 6-8**). Similarly, detected Pb concentrations at the downstream locations appear to be less than or comparable to the range of detected concentrations at the reference locations in both surface water (**Figure 6-9**) and sediment (**Figure 6-10**).

Table H-1 (in **Appendix H**) provides a comparison of the detected MCOC concentration mean, max and 95% UCLM to the PALs, while **Table H-3** provides the results of the statistical comparisons between the downstream locations (CC3 and JC1) and the reference location CC1 for detections in surface water and sediment per the ORAP protocol. CC1 was conservatively used as the reference location for comparison because detected concentrations were lower at CC1 than at CC2. **Table H-4** provides the results of the statistical comparisons between the downstream locations and the reference location (CC1) for benthic macroinvertebrate metrics. Results indicate no significant difference in benthic macroinvertebrate metrics between the reference and downstream locations.

6.1.2.5 Discussion and Conclusions

The data above demonstrate that MCOC are not migrating off-range in the Colonels Creek surface water system at concentrations that pose an unacceptable risk to human and ecological receptors and indicate that source-pathway-receptor interactions for the Colonels Creek watershed are incomplete for human and ecological receptors.

6.1.3 Cedar Creek Watershed

Surface water and sediment samples collected from locations WL1 and WL2 were downstream of *Inconclusive* areas in the Cedar Creek watershed and located on the two upper branches of Weston Lake within the non-operational area. Because Cedar Creek and its tributaries originate within the *Inconclusive* areas, no suitable reference location could be found within the watershed. Therefore, CC1 on Colonels Creek (described above in Section 6.1.2) was used as a proxy reference location for the downstream Cedar Creek sample locations.

Samples collected from WL1 and WL2 were used to evaluate the potential for off-range migration of MCOC to pose an unacceptable risk to downstream off-range ecological and human receptors.

6.1.3.1 Surface Water

Surface water analytical results for samples collected in the Cedar Creek watershed are presented in **Table 6-3** and **Figure 6-11**, while the surface water analytical results for the reference location (CC1) are presented in **Table 6-2** and **Figure 6-6**.

CC1 (reference location)

Metals MCOC

At CC1, Sb, Cu, Pb, and Zn were detected in surface water samples from the Wet A, Wet B, and Dry A events. All detected metals concentrations in surface water at CC1 were below their respective PALs. W was not detected in any surface water samples collected at CC1.

Explosives MCOC

Explosives were not detected in surface water during any of the Phase II sampling events at location CC1.

Perchlorate MCOC

Perchlorate was not detected in surface water during any of the Phase II sampling events at location CC1.

WL1

Metals MCOC

At WL1, Sb was detected in surface water samples from the Wet A, Storm, and Dry A sampling events; Pb was detected in samples from the Wet A, Wet B, and Dry A events; and Cu and Zn were detected in samples from the Wet A and Wet B events. W was not detected in surface water during any of the Phase II sampling events at location WL1. No metals MCOC were detected above PALs in surface water at downstream location WL1.

Explosives MCOC

RDX was detected at concentrations less than its reporting limit and the PAL at the downstream location WL1 in surface water samples collected during the Wet A and Dry A events. No other explosives MCOC were detected in samples collected at WL1.

Perchlorate MCOC

Perchlorate was detected in surface water only during one event (Wet A) at a concentration of 0.098 µg/L, which is significantly below the PAL of 15 µg/L.

WL2

Metals MCOC

At WL2, Zn was detected in surface water samples from all events; Pb was detected in samples from the Wet A, Wet B, and Dry A events; Sb was detected in samples from the Wet A, Storm, and Dry A events; and Cu was detected in samples from the Wet A and Wet B events. W was not detected in surface water during any of the Phase II sampling events at location WL2. No metals MCOC were detected above PALs in surface water at downstream location WL2.

Explosives MCOC

Explosives were not detected in surface water during any of the Phase II sampling events at location WL2.

Perchlorate MCOC

Perchlorate was detected in surface water during only one event (Wet A) at a concentration of 0.1 µg/L, which is significantly below the PAL of 15 µg/L.

6.1.3.2 Sediment

Sediment analytical results for samples collected in the Cedar Creek watershed are presented in **Table 6-7**, while the sediment analytical results for the reference location (CC1) are presented in **Table 6-6**. Results for Cu and Pb in sediment are shown graphically on **Figures 6-12** and **6-13**, respectively.

CC1 (reference location)

Metals MCOC

In sediment, Pb was detected in samples from all sampling events and Zn was detected in the sample from the Wet A event. Sb, Cu, and W were not detected in sediment during any of the Phase II sampling events at CC1. All detected metals concentrations in sediment at CC1 were below their respective PALs.

Explosives MCOC

Explosives were not detected in sediment during any of the Phase II sampling events at location CC1.

WL1

Metals MCOC

In sediment, Cu, Pb, and Zn were detected in samples from all events and Sb was detected in the sample from the Wet A event. W was not detected in surface water during any of the Phase II sampling events at location WL1. All detected metals concentrations in sediment at WL1 were below their respective PALs.

Explosives MCOC

Explosives were not detected in sediment during any of the Phase II sampling events at location WL1.

WL2

Metals MCOC

In sediment, Cu, Pb, and Zn were detected in samples from all sampling events and Sb was detected in the sample from the Wet A sampling event. W was not detected in sediment during any of the Phase II sampling events at location WL1. The detected Pb concentration was greater than the PAL of 47 mg/kg in the sediment sample from the Wet A event, with a reported concentration of 54.3 mg/kg. The detected Cu concentration also was greater than its PAL of 34 mg/kg in the sediment sample from the Wet A event, with a reported concentration of 36.3 mg/kg. All other metal MCOC (Sb, W, and Zn) concentrations in sediment at WL2 were below their respective PALs.

Explosives MCOC

Explosives were not detected in sediment during any of the Phase II sampling events at location WL2.

6.1.3.3 Benthic Macroinvertebrates

No benthic macroinvertebrate data were collected at the Cedar Creek locations because the sampling locations are in Weston Lake, and, thus, could not be compared to the upstream Colonels Creek sampling locations given the significant difference in habitats.

6.1.3.4 Sample Comparison and Statistical Evaluation

At the downstream locations in Cedar Creek (WL1 and WL2), no MCOC were detected above the PALs in surface water. The only MCOC detected above PALs in sediment were Cu and Pb at WL2 during the Dry A event. **Table H-1** provides a comparison of the detected MCOC concentration mean, max and 95% UCLM to the PALs. **Table H-2** provides the results of the statistical comparisons between the downstream locations (WL1 and WL2) and the reference location CC1 for detections in surface water and sediment per the ORAP protocol.

Statistical Comparison to Sediment PALs

The 95% UCLM for Cu (46.7 mg/kg) in sediment at WL2 exceeds the PAL, and one of the individual Cu results exceeds the PAL. The 95% UCLM for Pb (68.8 mg/kg) in sediment at WL2 exceeds the PAL, and one of the individual Pb results exceeds the PAL.

Statistical Comparisons to Reference Concentrations

The statistical comparisons of downstream concentrations to reference concentrations have limited utility with a small dataset such as the one available for this study, particularly for sediment, where only three data points are available. With that caveat, **Table H-5** shows that the statistical tests comparing Cu and Pb at WL2 to the reference concentrations could not reject the null hypothesis of no significant difference between reference and downstream locations.

6.1.3.5 Discussion and Conclusions

Detected concentrations of Cu and Pb in sediment exceeded the PALs at WL2; however, these exceedances may be due to metals sources not covered by the ORAP. As discussed in Section 4.2.1, the location of WL2 was shifted during field activities because the wet season sampling location was not accessible by boat during the dry season since water levels decreased in Weston Lake. The shifted location may have been located within the former target area for a small arms range being addressed under the MMRP. The metals MCOC concentrations reported for the sample obtained from WL2 during the Dry A and Dry B events are greater than those reported for the sample obtained from WL2 during the Wet A event. Additionally, the MCOC detected (metals) are more typical of small arms range use. The possibility exists that MCOC at WL2 may be from sources not associated with the operational range areas evaluated under ORAP. The area of Weston Lake where WL2 is located is within the site boundary of a Military Munitions Response Program site; further evaluation of Pb and Cu at this site will be addressed as part of studies conducted under the MMRP.

6.2 Groundwater System Assessment Results

The assessment of the groundwater system at Fort Jackson and McCrady Training Center was completed in three phases. The first phase, in 2009, consisted of the installation of piezometers to collect water level data to inform the subsequent phases of the investigation. The second phase, also in 2009, consisted of the drilling of soil borings and the collection of groundwater

samples to obtain preliminary information regarding the presence or absence of MCOC in groundwater. Based upon the results of the 2009 assessment, additional data and sample collection was required to answer the assessment questions for groundwater. As previously described, these activities included the installation of monitoring well pairs in 2012 and the completion of three sampling events conducted from July 2012 through February 2013.

As described in previous sections, data gathered during the groundwater system assessment activities included the following:

- Detailed, installation-specific subsurface geologic information
- Shallow groundwater elevations from which groundwater flow directions were interpreted
- Depth-discrete and supply well groundwater sampling results for MCOC
- Monitoring well pair groundwater sampling results for MCOC

The results of the combined assessment are described below.

6.2.1 Geologic Conditions

Fort Jackson and McCrady Training Center overlie predominantly Cretaceous sediments of the Middendorf Formation, which is the primary aquifer in the area. Locally, Tertiary age unconsolidated sediments overlie the Middendorf Formation. These Tertiary sediments are mainly confined to the tops of highlands, but make up a larger proportion of the exposed units in the northern portions of the installation. In the Fort Jackson and McCrady Training Center area, the Middendorf Formation is described as consisting of unconsolidated fine- to coarse-grained sand with varying amounts of interstitial clay (kaolin), interbedded with laterally discontinuous thin silty and clayey beds and occasional thin gravelly lenses. In localized areas, clay (kaolin) lenses are of sufficient thickness, quality, and lateral extent to be of economic significance. These units reportedly have been mined at the ground surface on Fort Jackson north-northwest of the groundwater assessment area (Kite, 1988).

The piezometer installations and soil borings advanced during the assessment provided additional detailed geologic information. The subsurface conditions encountered consisted of predominantly fine- to medium-grained sand, silty sand, clayey sand, and clay. The sands were predominantly poorly graded, subangular, quartz sands with frequent heavily micaceous zones. The clays encountered varied from sandy clay units to very hard, massive, white to gray clay. The test boring logs for the piezometers and soil borings are presented in **Appendix E**. The test boring logs were used to create conceptual cross sections through the test boring and piezometer locations near the installation boundary. Cross sections A-A' and B-B' are shown on **Figure 6-14**. Most of the uppermost clay layers did not readily correlate by elevation or general description from boring to boring and are considered laterally discontinuous clay lenses. A lower and potentially continuous clay unit was encountered at borings SB-2, SB-3, SB-4, SB-5, and SB-6. This unit was a gray to white, massive, hard clay with dark red streaks or clasts. Its thickness ranged from 6 to 10 feet. Elevations of the top of this clay unit ranged from 212 feet AMSL at boring SB-2 to 174 feet AMSL at boring SB-3. The base of this clay ranged from 172 feet AMSL in SB-5 to 165 feet AMSL in SB-3. As described in the QAPP, the target depth for the soil borings and vertical aquifer sampling was approximately 150 feet AMSL. Soil borings

SB-3, SB-5, and SB-6 were advanced to approximately 150 feet AMSL. Soil borings SB-2 and SB-4 were terminated within the lower clay unit, which was shallower than the target depth, to avoid fully penetrating this clay unit. This was done because preliminary analytical results from SB-3 received in the field during drilling at SB-4 (and prior to the start of drilling at SB-2) indicated that MCOC were present in groundwater. Therefore, the project team opted not to penetrate a clay unit that was thought to be laterally continuous, thereby creating an avenue for potential MCOC migration.

Subsurface conditions encountered during drilling efforts in 2012 to install the monitoring well pairs were similar to those encountered previously with fine- to medium-grained sand with varying amounts of silt and clay making up most of the subsurface. These sandy units are interbedded with silty sand, clayey sand, and clay. Even over the smaller area covered by the soil borings drilled to install the well pairs, the clayey units encountered above approximately 225 feet AMSL appear to be laterally discontinuous. Each of these borings ended in a clayey unit that appears to be laterally continuous across the area where the well pairs were installed and as previously indicated across the larger area downgradient of the groundwater assessment area. At the borings for MW-RS-02 through MW-RS-07 the top of this lower clay unit was encountered at elevations varying from 202.5 feet AMSL to 185.9 feet AMSL. Drilling efforts were stopped when this clay was encountered in order to maintain the integrity of the clay as a confining unit. Therefore, the thickness of the clay in this region was not measured.

6.2.2 Groundwater Elevations and Aquifer Properties

As described in Section 4.3, the initial phase of drilling consisted of piezometer installation for the purpose of collecting groundwater elevation data in the areas interpreted to be down gradient of the groundwater assessment area and potential MCOC source areas. The groundwater elevation measurements and interpreted flow directions were used to select the locations for the soil borings used for the temporary well depth-discrete groundwater sampling performed subsequently as part of the groundwater assessment. Following installation and development of the piezometers, groundwater elevations were measured on 7 April, 17 April, 1 June, and 29 July 2009. The groundwater elevation measurements are summarized in **Table 6-9**. The groundwater elevation measurements collected on 7 April 2009 were used to generate the shallow groundwater flow directions near the groundwater assessment area shown on **Figure 6-15.** Based on the 7 April 2009 groundwater elevation measurements and interpreted groundwater elevation contours, shallow groundwater flows from the topographically elevated regions of the groundwater assessment area (just northeast of Weston Lake) to the west-southwest toward Weston Lake, south and southeast toward Leesburg Road and Jumping Run Creek, and east toward Colonels Creek. Groundwater in the northeastern portion of the groundwater assessment area flows north-northwest toward Buffalo Creek and Wise Marsh. Ground surface topography and the presence or absence of flowing water in the surface water bodies were considered during generation of the shallow groundwater contours. Since the subsurface soils are predominantly sand and are highly permeable, it is likely that the groundwater table mimics surface topography, flowing from the elevated regions to the lower elevations in the stream valleys. Field observations, such as the point at which the streams exhibited continual flow, were noted on maps during each sampling event and were also used in generation of the groundwater contours.

The staff gauge and adjacent piezometer measurements indicate that groundwater is discharging to the surface water bodies at the staff gauge / piezometer pair locations at the northern end of Weston Lake (SG/P-1), an unnamed tributary to Colonels Creek (SG/P-5), and Buffalo Creek (SG/P-6) (**Figure 6-15**). The staff gauge / piezometer pair located on Jumping Run Creek (SG/P-4) indicated that at that location, the creek was a losing stream during all but one of the measurement events. However, the area surrounding this staff gauge / piezometer pair had evidence of groundwater discharging to the ground surface in the form of springs discharging to small channels that feed the headwaters of Jumping Run Creek upslope and upstream of SG/P-4. The surrounding area was very wet and swampy with iron staining and lush vegetation indicative of continued wet conditions. Since no soil borings were advanced in this area, it is unclear whether these conditions represent the water table intersecting the ground surface or locally perched conditions. Therefore, the location of this staff gauge / piezometer pair may not accurately represent the surface water / groundwater interaction along this stretch of Jumping Run Creek. Staff gauge / piezometer pair SG/P-3 was located along the eastern shore of Weston Lake near the southern end of the lake. The piezometer was dry during three of the four measurement events, and subsurface soils encountered during the installation of piezometer P-3 were fine grained. Therefore, groundwater data obtained from SB/P-3 may not accurately represent the groundwater potentiometric level in this area. Neither of the data uncertainties described above is significant enough to impact the conclusions of this report.

Groundwater data collected as part of this investigation, coupled with data from previous investigations completed near the groundwater investigation area, indicate that the stratified groundwater system described for the larger area is also present on installation. As previously discussed, groundwater elevation data collected from piezometers as part of this investigation indicate that topography exerts a primary control on groundwater flow directions, with groundwater underlying the investigation area flowing radially to the west toward Weston Lake and Cedar Creek, to the south, and to the east. Additionally, data from piezometer / staff gauge pairs, along with observations made during the investigation, indicate that, locally, shallow groundwater flow discharges to tributaries of Cedar and Colonels Creeks (including Jumping Run Creek). However, groundwater discharge rates to these low-order tributaries vary seasonally. Groundwater flow of intermediate depth likely bypasses these tributaries, moving off installation and potentially discharging to more deeply incised higher order streams. Water level data collected in July 2012, October 2012, and February 2013 from the monitoring well pairs generally confirm the flow directions interpreted from the data collected in 2009. These data are included in **Table 6-9**.

Slug tests were completed as part of a previous investigation at two SWMUs within or near the groundwater assessment area (one SWMU is located approximately 1,500 feet west of SB-5 with another approximately 1,000 feet north of P-4) (Law Engineering and Environmental Services, 2003). The slug tests were used to measure hydraulic conductivities within the upper portion of the Middendorf Formation. K values at the first site (near SB-5) varied from 0.00026 feet/minute (1.10×10^{-4} centimeters/second [cm/s]) to 0.0028 feet/minute (1.19×10^{-4} cm/s). Using hydraulic gradients measured near the site, horizontal flow rates of 34 to 368 feet per year were calculated based on these K values. K values measured near P-4 varied from 0.0036 feet/minute (1.52×10^{-4} cm/s) to 0.0056 feet/minute (2.37×10^{-4} cm/s). Using hydraulic gradients measured near the site, horizontal flow rates of 189 to 294 feet per year were calculated based on these K values. The wells from which the slug tests were measured (as part of a previous

investigation of IRP sites) are shallower than those installed as part of this assessment. However, given that the descriptions from the boring logs are quite similar, the K values and flow rates likely represent reasonable estimates of aquifer properties within the investigation area deeper in the aquifer. The range in values agrees well with those reported for fine to medium grained unconsolidated sand deposits (Freeze and Cherry, 1979) similar to those observed at Fort Jackson and McCrady Training Center. Based upon the flow rates calculated from these data, precipitation that infiltrates through potential source areas within 2,000 feet of the installation and reaches the groundwater table could potentially reach the installation boundary in as little as seven years.

6.2.3 Groundwater Analytical Results

6.2.3.1 2009 Assessment

6.2.3.1.1 **Groundwater Quality Measurements**

As discussed in Section 4, groundwater quality measurements were recorded during well development and sampling activities in order to track water quality changes during purging, identify when water quality parameters had stabilized and groundwater samples could be collected, and measure important groundwater chemistry parameters. The chemical parameters measured included pH, specific conductance, turbidity, DO, and ORP. All measurements were noted on field sheets and/or in field notes and are included in **Appendix D**. The final measurements recorded during the collection of each groundwater sample in 2009 have been compiled and are included as **Table 6-10.**

pH measurements recorded during the 2009 sampling varied from 4.96 to 9.81. However, pH measurements above 7.0 occurred only at two locations. In 22 of the 29 samples, pH varied from 5.16 to 5.99. Specific conductance measurements recorded during the 2009 sampling varied from 0.005 millisiemens per centimeter (mS/cm) to 0.049 mS/cm. DO measurements recorded during the 2009 sampling varied from 0.62 mg/L to 14.33 mg/L. ORP measurements recorded during the 2009 sampling varied from -205 millivolts (mV) to 237 mV.

6.2.3.1.2 **MCOC Metals**

Groundwater samples collected in 2009 were analyzed for MCOC metals including Sb, Cu, Pb, W, and Zn. The results for all MCOC metals analyses for samples collected in 2009 are shown in **Table 6-11** and summarized below.

Results **-** Total Sb was detected in six of the 29 groundwater samples analyzed, with concentrations varying from 0.06 to 0.19 µg/L. Dissolved Sb was detected in three of the 17 groundwater samples analyzed, with concentrations varying from 0.059 to 0.12 µg/L. All detected total and dissolved Sb concentrations were estimated because they were less than the reporting limit of 0.5 µg/L. All detected Sb concentrations were also less than both the LRU of 3.36 µg/L for Sb and the PAL of 5.6 µg/L for Sb in groundwater.

Total Cu was detected in 19 of the 29 groundwater samples analyzed in 2009, with concentrations varying from 0.57 µg/L (estimated) to 30.8 µg/L. Dissolved Cu was detected in 10 of the 17 groundwater samples analyzed, with concentrations varying from 0.56 µg/L

(estimated) to 2.7 µg/L. All detected total and dissolved Cu concentrations were less than both the LRU (310 µg/L) and the PAL (620 µg/L) for Cu in groundwater.

Total Pb was detected in 16 of the 29 groundwater samples analyzed in 2009, with concentrations generally varying from 0.049 µg/L (estimated) to 3.9 µg/L, except for two samples that contained total Pb at concentrations of 11.6 µg/L and 18.3 µg/L. Dissolved Pb was detected in 10 of the 17 groundwater samples analyzed, with concentrations varying from 0.049 µg/L (estimated) to 0.85 µg/L. One groundwater sample (GW1-WL1-GW-01) collected from the Weston Lake supply well contained total Pb at a concentration of 11.6 µg/L, which exceeds the LRU of 7.5 µg/L. Additionally, one groundwater sample (GW1-SB6-WT-GW-01, collected at the water table, an approximate depth of 66 feet bgs or an approximate elevation of 234 feet AMSL) contained total Pb at a concentration of 18.3 µg/L, which exceeds the PAL of 15 µg/L. However, dissolved Pb concentrations for each of these locations (0.64 µg/L for GW1-WL1-GW-01 and below the method detection limit for GW1-SB6-WT-GW-01) and both total and dissolved Pb concentrations in all of the other samples analyzed, were less than both the LRU (7.5 µg/L) and the PAL (15 µg/L) for Pb in groundwater.

Total W was detected in three of the 29 groundwater samples analyzed, with estimated concentrations varying from 0.047 to 0.14 µg/L. Dissolved W was detected in one of the 17 groundwater samples analyzed at an estimated concentration of 0.11 µg/L. No exposure criteria currently exist for W in water; therefore, no LRU or PAL was established for W. All detected total and dissolved W concentrations were less than the reporting limit (1.0 µg/L).

Total Zn was detected in 24 of the 29 groundwater samples analyzed, with concentrations varying from 6.4 to 3,200 µg/L. Dissolved Zn was detected in 16 of the 17 groundwater samples analyzed, with concentrations varying from 22.4 to 3,140 µg/L. Only one interval that was sampled contained Zn above the LRU (2,820 µg/L) for Zn in groundwater. Both total and dissolved Zn exceeded the LRU in samples SB2-40-GW-01 and SB2-40-GW-01-FIL at concentrations of 3,200 µg/L and 3,140 µg/L, respectively. Zn concentrations did not exceed the PAL (4,700 µg/L) for Zn in groundwater at any of the locations sampled.

Discussion – As indicated above, Sb, Cu, and W were present in groundwater samples collected during 2009 but did not exceed either the PAL or LRU in any of the samples collected. Concentrations of total Pb exceeded the LRU in one sample and both the LRU and PAL in another sample. However, for both of these samples, dissolved Pb concentrations were below both the PAL and LRU. Because the exceedances of Pb are rare and localized, and because the accompanying dissolved sample did not exceed either the LRU or PAL, it is unlikely that these results are indicative of groundwater impacted by Pb from munitions. Additionally, research in the region by Landmeyer, et al. (2003) indicates that Pb occurs naturally in the Middendorf aquifer. Because exceedances only occurred when total Pb was measured (which includes suspended sediment), it is likely that these exceedances result from naturally occurring Pb from the formation. For Zn, the exceedances occurred only in one sampled interval from one boring location (in both the total and dissolved samples). Again, because of the very limited extent of these exceedances, it is unlikely that that elevated Zn concentrations within the aquifer result from munitions. Even if the Zn concentrations do result from munitions use, the apparent limited extent of Zn is unlikely to present a risk to receptors.

6.2.3.1.3 **Major Cations and Anions**

Groundwater samples collected in 2009 were analyzed for major cations (calcium, magnesium, and sodium) and major anions (nitrate, chloride, and sulfate) to potentially assist in the identification of groundwater sources. The data did not ultimately prove useful for this purpose. The results of cation and anion analyses are presented in **Table 6-11**. These constituents are not considered MCOC themselves, nor were they analyzed for comparison to regulatory criteria, so PALs were not developed for these constituents.

6.2.3.1.4 **Perchlorate**

The twenty-nine groundwater samples collected in 2009 were submitted for analysis for perchlorate. Analytical results are included as **Table 6-12** and presented in **Figure 6-16.**

Results **-** Perchlorate was detected in samples collected from four intervals at soil boring SB-4, with estimated concentrations varying from 0.14 µg/L in sample GW1-SB4-WT-GW-01 (collected at the first permeable unit below the inferred water table or 118 feet bgs, corresponding to an approximate elevation of 255 feet AMSL) to 0.27 µg/L in sample GW1-SB4-43-GW-02 (collected from an approximate depth of 43 feet below the first permeable interval below the inferred water table or 161 feet bgs, corresponding to an approximate elevation of 212 feet AMSL). Perchlorate was also detected in samples from one depth-discrete sample interval at soil borings SB-2 (GW1-SB2-40-GW-01 collected from an approximate depth of 40 feet below the water table or 108 feet bgs, corresponding to an approximate elevation of 231 feet AMSL) and SB-5 (GW1-SB5-78-GW-01 collected from an approximate depth of 78 feet below the water table or 172 feet bgs, corresponding to an approximate elevation of 189 feet AMSL) at estimated concentrations of 0.12 µg/L and 0.11 µg/L, respectively. As previously discussed in Section 3.1.3.3, the groundwater samples collected from SB-3 and analyzed for perchlorate were not field filtered. Perchlorate was also detected in the sample collected from Weston Lake Well (sample GW1-WL1-GW-01 screened from elevations of 171 to 183 feet AMSL) at a concentration of 0.26 µg/L. Perchlorate concentrations in groundwater samples were all less than both the LRU (9.0 µg/L) and the PAL (15 µg/L) for perchlorate in groundwater.

Discussion **–** Perchlorate was detected in eight of 29 samples from three of the five boring locations and in the supply well at Weston Lake. Although perchlorate was present, the concentrations were very low everywhere it was detected. In every case, the reported concentrations were an order of magnitude below the LRU and two orders of magnitude below the PAL. Although perchlorate is present in groundwater, the concentrations at which it is occurring are unlikely to pose a risk to receptors.

6.2.3.1.5 **Explosives Constituents**

Twenty-nine groundwater samples were collected and submitted for analysis for the full suite of explosives included in method USACHPPM SOP CAD 13.3. Analytical results are presented in **Table 6-12**.

Results **-** RDX was detected in groundwater samples collected in 2009. As indicated in **Table 6-12** and presented in **Figure 6-16**, RDX was detected in groundwater samples from three of the seven sampled intervals at soil boring location SB-3. Estimated RDX concentrations in groundwater samples varied from 0.064 µg/L in sample GW1-SB3-20-GW-01 (collected from an

approximate depth of 20 feet below the identified water table or 82 feet bgs, corresponding to an approximate elevation of 248 feet AMSL) to 0.17 µg/L in sample GW1-SB3-73-GW-02 (collected from an approximate depth of 73 feet below the identified water table or 135 feet bgs, corresponding to an approximate elevation of 195 feet AMSL). RDX concentrations were below the PAL for RDX (0.61 µg/L) but exceeded the LRU for RDX (0.10 µg/L) in groundwater in three samples.

Discussion – As indicated, RDX was detected in groundwater over an approximately 60 feet thick interval within the aquifer that is utilized downgradient for drinking water. Although the concentrations were below the PAL, they were above the LRU. Additionally, the drilling and sampling method utilized to collect the samples may have been prone to diluting MCOC in the aquifer due to the addition of water during the drilling process. Although procedures were utilized to limit the effects of drilling fluids, the RDX concentrations should be considered to represent the minimum concentrations present within the intervals sampled. As previously discussed, these samples were collected from temporary wells that were removed in order to advance the borehole further. As such, these locations were unable to be resampled.

6.2.3.2 2012 & 2013 Assessment

At the end of the 2009 phase of the groundwater assessment, the full suite of groundwater data collected was evaluated. Based upon this assessment and discussions with the larger Army team, the evaluation of metals and perchlorate in groundwater was considered to be complete. The conclusions for these MCOC are presented below.

For explosives in groundwater, the data collected in 2009 was not considered sufficient to draw a conclusion regarding whether RDX in groundwater posed a potential risk to receptors. In order to further evaluate whether RDX posed a potential risk to receptors downgradient of the groundwater assessment area, six monitoring well pairs were installed. Groundwater samples were collected three times over the course of a year (July and October 2012, and February 2013).

Based on guidance received from the Army during preparation of the technical approach for this additional assessment, U and U isotopes were added to the list of potential MCOC in groundwater, and thus were included in the analytical suite for groundwater.

The results of the laboratory analysis of samples collected in 2012 and 2013 are presented and discussed below.

6.2.3.2.1 **Groundwater Quality Measurements**

Groundwater quality measurements were recorded during development of the monitoring well pairs and during sampling activities. For the samples collected as part of the 2012 and 2013 phase of the groundwater assessment, the water quality parameters measured included pH, specific conductance, turbidity, DO, and ORP. All measurements were noted on field sheets and/or in field notes and are included in **Appendix D**. After collection of the samples from the sampler, the stabilized in-situ water quality measurements were recorded as well. These measurements have been compiled and are included as **Table 6-13**.

pH measurements recorded during the 2012 and 2013 sampling events varied from 4.41 to 9.52 with measurements generally more variable than during the 2009 sampling. Measurements from

14 of the 36 samples collected were above 7.0, including all of the measurements from MW-RS-02D, MW-RS-03S and MW-RS-07D, two of the three measurements from MW-RS-02S and MW-RS-05S, and one measurement from MW-RS-05D. Specific conductance measurements recorded during the 2012 and 2013 sampling range from 0.011 mS/cm to 0.169 mS/cm. DO measurements recorded during the 2012 and 2013 sampling ranged from 0.05 mg/L to 9.29 mg/L. ORP measurements recorded during the 2012 and 2013 sampling were similarly variable to those collected in 2009 with values ranging from -310.2 mV to 225.8 mV.

6.2.3.2.2 **MCOC Metals**

As previously indicated, based upon an evaluation of MCOC metals data collected as part of the 2009 sampling, groundwater samples collected in 2012 and 2013 were not analyzed for Sb, Cu, Pb, W, and Zn. Groundwater samples were analyzed for total dissolved U and dissolved isotopic-U. Dissolved U concentrations and the concentrations of U-isotopes were measured in groundwater samples collected from the monitoring well pairs installed in 2012. Results for each of the sampling events completed in July and October 2012, and February 2013 are shown in **Tables 6-14**, **6-15**, and **6-16**; respectively.

Results – Dissolved U was detected only in one sample collected in July 2012 and was not detected in any of the samples collected during the October 2012 or February 2013 sampling events. U was detected at an estimated concentration of 0.46 µg/L in the sample collected from MW-RS-02D in July 2012. Isotopic analysis shows that the U that was detected was present entirely as U-238. The level at which U was detected in groundwater is two orders of magnitude below the PAL of 30.0 µg/L for U in groundwater.

Discussion – In general the evaluation of U data collected as part of ORA Phase II Assessment is a two-step process. First the concentration of U is compared to the PAL. If the U concentration exceeds the PAL, the isotopic-U data is evaluated to determine if the U present is sourced from DU. The uranium enrichment process used to create DU reduces the percentage of U-234 and U-235 relative to U-238 (USEPA, 2006b); therefore, samples containing DU would be expected to have higher concentrations of U-238 (relative to the concentrations of U-234 and U-235) than samples containing naturally occurring uranium.

U was detected only in one groundwater sample at a concentration two orders of magnitude below the PAL. As such, no further evaluation of the data is warranted. Although the concentration of U-238 exceeds the concentrations of the other U-isotopes, the concentration is so low that the source of the U cannot be conclusively indicated.

6.2.3.2.3 **Explosives Constituents**

A total of 12 samples were collected during each of the three sampling events completed in July and October 2012 and February 2013. The laboratory analytical results are included in in **Tables 6-14**, **6-15**, and **6-16**; respectively.

Results – Two or more explosive compounds were detected during each of the three sampling events completed as part of the 2012 and 2013 assessment of the groundwater pathway at Fort Jackson and McCrady Training Center. A summary of these results is included below.

Two explosives analytes were detected in groundwater samples collected from the monitoring wells pairs in July 2012. 1,3,5-Trinitrobenzene was detected in the duplicate sample (but not the primary sample) collected from MW-RS-05D at an estimated concentration of 0.14 µg/L, well below the groundwater PAL of 460 µg/L. RDX was detected in seven of the 12 samples collected in July 2012 (the duplicate at MW-RS-02D and samples MW-RS-03D, MW-RS-04S, MW-RS-04D, MW-RS-05D, MW-RS-06D, and MW-RS-07S). As shown in **Table 6-14** and **Figure 6-17**, RDX concentrations ranged from an estimated concentration of 0.13 µg/L to a concentration of 0.76 µg/L. Concentrations of RDX exceeded the groundwater PAL of 0.61 µg/L at two locations (MW-RS-04D and MW-RS-06D).

Three explosives analytes were detected in groundwater samples collected from the monitoring wells pairs in October 2012. 2,4,6-TNT was present in two samples collected from the MW-RS-03 location in both the shallow and deep wells at concentrations of 0.11 µg/L and 0.064 µg/L (estimated), respectively. Both values are significantly lower than the PAL of 460 µg/L. 4-Nitrotoluene was detected in one sample (MW-RS-03S) at an estimated concentration of 0.15 µg/L. The PAL for 4-nitrotoluene is 3.7 µg/L. RDX was present in four of the samples collected in October 2012 (samples MW-RS-04D, MW-RS-05D, MW-RS-06D, and MW-RS-07S). As shown in **Table 6-15** and**Figure 6-18**, RDX concentrations ranged from 0.19 µg/L to 0.78 µg/L. Concentrations of RDX exceeded the groundwater PAL of 0.61 µg/L at two locations (MW-RS-04D and MW-RS-06D).

Five explosives analytes were detected in groundwater samples collected from the monitoring well pairs in February 2013. 1,3-DNB was detected at a concentration of 0.11 µg/L at location MW-RS-07D, below the groundwater PAL of 1.5 µg/L. 2,4,6-TNT was present in one sample (MW-RS-02D) at an estimated concentration of 0.18 µg/L, below the PAL of 2.2 µg/L. 2-Amino-4,6-DNT was detected in sample MW-RS-03D at an estimated concentration of 0.14 µg/L (PAL is 30 µg/L). HMX was present in one sample (MW-RS-05D) at an estimated concentration of 0.037 µg/L (PAL is 780 µg/L). Finally, RDX was present in six of the samples collected in February 2013 (samples MW-RS-03D, MW-RS-04S, MW-RS-04D, MW-RS-05D, MW-RS-06D, and MW-RS-07S). As shown in **Table 6-16** and **Figure 6-19**, RDX concentrations ranged from 0.11 µg/L (estimated) to 0.68 µg/L. RDX exceeded the PAL in two of the samples analyzed (MW-RS-04D and MW-RS-06D).

It is important to note that the PAL for RDX is a USEPA Integrated Risk Information System screening value and not an enforceable federal standard. A 2.0 µg/L value is listed by the USEPA as a lifetime health advisory level, which is also not an enforceable standard. All RDX concentrations detected downgradient of the groundwater assessment area and other assessment areas were below this lifetime health advisory level.

Discussion – Multiple explosives analytes were detected in groundwater during each of the sampling events. However, only RDX occurred consistently at similar concentrations at the locations and intervals in which it was identified. In particular, RDX concentrations exceeded the groundwater PAL in samples collected from MW-RS-04D and MW-RS-06D during all three rounds of sampling. These results indicate that RDX from operational range sources has reached groundwater. However, uncertainty remains regarding whether RDX is migrating off the range footprint at concentrations of concern to human receptors.

6.3 Uncertainty

6.3.1 Data Validation Results

Data validation results are presented in **Appendix G**. The data qualifiers used to qualify the analytical results associated with QC parameters outside of the established DQOs are defined below:

- J The analyte was positively identified; however, the result should be considered an estimated value.
- UJ The reporting limit is considered an estimated value.
- R QC indicates that the data are not usable.

Results qualified as "J" or "UJ" are of acceptable data quality and may be used quantitatively to fulfill the objectives of the analytical program, per USEPA guidelines. Results that required qualification based on the data validation are summarized in Table G-1, **Appendix G**.

6.3.2 Completeness

Technical completeness was calculated for this project by the following equation:

$$\%\ \text{Technical Completeness} = \left(\frac{\text{Number of usable results}}{\text{Number of reported results}}\right) \times 100$$

As specified in the QAPP, the DQO goal for percent technical completeness is 95% for each combination of matrix and analysis. All data were usable; therefore, the technical completeness was 100% for all matrices and analyses. The results were considered usable for the intended purposes, and the project DQOs have been met.

6.3.3 Analysis

Statistical Comparisons to Reference

The small size of the Phase II assessment data sets (four samples per location for surface water and three samples per location for sediment) reduces the ability of statistical hypothesis tests (t-test and Wilcoxon) to reject the null hypothesis of no difference between reference and downstream locations. The statistical tests' limitations were exacerbated where the data were not normally distributed or where the results for more than one sampling event were nondetections reported at the reporting limit. When 50% or more of the values are nondetections, statistical tests have little power to detect differences in mean values (Helsel and Hirsch, 2002). This statistical limitation produced false negative errors in the initial comparison of downstream and reference MCOC concentrations. The potential for false negative errors was mitigated by the decision to supplement the statistical hypothesis tests with a direct comparison of reference and downstream concentrations, as discussed in Section 5.3.1.

95% UCLM Greater than Maximum Observation

The 95% UCLMs were calculated in accordance with the USEPA guidance documents on computing 95% UCLMs and the USACHPPM Phase II protocol (USACHPPM, 2009; USEPA,

2002a, 2002b, and 2009). The USEPA guidance documents caution against attempting tests with 95% UCLM when a sampling location data set is small (n < 5) or when the number of detected values is zero or small (*e.g.*, one or two). Each of these cases occurs in the data collected for this study. All downstream sample location data sets contain four or fewer samples, and non-detections were common. One of the concerns with small data sets such as those collected for this study is that the 95% UCLM can often be greater than the maximum observed value. This was the case for all 17 of the 95% UCLM values calculated for MCOC in sediment and for five of the 11 95% UCLM values calculated for MCOC in surface water. In the case of Zn in sediment at GC2, the maximum detected concentration of 122 mg/kg was less than the PAL of 150 mg/kg; however, the 95% UCLM calculated for Zn in sediment at GC2 was 151.4 mg/kg, which is greater than the PAL. Use of the 95% UCLM, even where the 95% UCLM is greater than the maximum observation, is an environmentally conservative approach because it decreases the possibility of a false negative error of finding no unacceptable risk to human or ecological receptors when an unacceptable risk actually exists.

Lack of Tungsten PALs

There is no PAL for W in surface water, as no regulatory limits currently exists. As noted in Section 6.1.1.4, a review of the toxicity of W by USACHPPM (2004) suggests that if surface water criteria for W were developed they might be on the order of 35 to 175 µg/L. While these values cannot be used as a decision point for determining risk to receptors since they are not established regulatory criteria, a comparison shows that W detected in the surface water samples is several orders of magnitude below these values. The lack of PALs for W does affect the ability of the Phase II assessment to draw conclusions for W based on established regulatory screening criteria and PALs; however, review of the data indicates that W was detected at concentrations well below the preliminary toxicity values.

6.3.4 Field Modifications

Nonfiltered Perchlorate Samples

Groundwater samples collected from SB-3 were not filtered in the field during collection. Filtering generally is done to prevent microbial degradation of perchlorate during sample shipment. Headspace is also left in the containers to maintain aerobic conditions in the sample. Although the groundwater samples from SB-3 were not filtered, headspace was left in each of the containers submitted for perchlorate analysis. With the headspace, aerobic conditions likely were maintained up to the time of sample analysis, and microbial (anaerobic) degradation of perchlorate would have been slowed in the samples. While the degree of influence of filtering is not known, the effect of leaving headspace in the sample provided conditions that would have limited degradation of the perchlorate. As such, the lack of filtering is not anticipated to have affected the perchlorate data (*i.e.*, bias the perchlorate concentrations lower than if the sample had been filtered). The lack of filtering of perchlorate samples at SB-3 did not impact groundwater recommendations.

Results from Reference Location CC2

At the reference location CC2 in the Colonels Creek watershed, only three surface water samples could be collected and several MCOC were detected at concentrations greater than the PALs. The results at CC2 have changed the understanding of potential sources upstream of that

location. Specifically, all operational ranges upstream of CC2 were grouped as Limited Source in the Phase I assessments for having limited potential MCOC sources. The sampling results indicate that CC2 had some of the highest MCOC concentrations in the Colonels Creek watershed and the only detection of a USEPA Method 8095 analyte (DNB in sediment). Historical maps and range information were reviewed again to determine if any potential sources had been overlooked in the Phase I assessments and Phase II planning process, but no such sources were found. This uncertainty does not affect the conclusions of the Phase II assessment.

20-Hour Composite Samples

As discussed in Section 3, surface water samples for the Wet A, Wet B, and Dry A sampling events were intended to be 24-hour time composites with sample aliquots collected every 15 minutes. Some samples (location CC2 during Wet A and locations CC1, CC2, CC3, and JC1 during Wet B) were collected over 20 hours rather than 24 hours due to autosampler rechargeable battery failure. This minor deviation from the Work Plan was discussed among the ARCADIS surface water team and with USACHPPM, who provided on-site technical oversight during these two events. The samples were determined to be adequate to meet the project objectives since the goal of the wet season sampling was to characterize seasonal conditions and the slightly shorter collection period would not affect data quality or usability. The 20-hour samples do not influence the confidence in findings.

Different Sampling Locations for Wet A versus Dry A and Dry B Events at WL2

The level of water in Weston Lake decreased between the Wet A event in March and the Dry A and Dry B events in July. With the decrease in the lake level, the sampling location for WL2, which was selected during the Wet A event, was not accessible by boat during the Dry A and Dry B events. For these dry season events, the sampling location for WL2 was shifted to the west by approximately 250 feet. While both sampling locations for WL2 (and also WL1) are within the footprint of a site currently being investigated under the MMRP, the dry events location was closer, and possibly within, the former target area for a small arms range. The Wet A location for WL2 and the wet/dry location for WL1 are located within the former safety fan associated with the small arms range. The concentrations reported for the sample obtained from WL2 during the Dry A and Dry B events are greater than those reported for the sample obtained from WL2 during the Wet A event. Additionally, the MCOC detected (metals) are more typical of small arms range use. This uncertainty affects the conclusions of the Phase II assessment by identifying potential additional sources not associated with the operational range areas evaluated under ORA (*i.e.*, non-operational areas evaluated under the MMRP).

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Table 6-1: Surface Water Analytical Results for Gills Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID: Date Sampled: Matrix:	Project Action Limit for SW	MDL[a]	RL[a]	DRYA-GC1-SW-01 7/22/2009 Surface Water		DRYA-GC1-SW-02 7/22/2009 Surface Water		STRM-GC1-SW-01 5/18/2009 Surface Water		WETA-GC1-SW-01 4/6/2009 Surface Water		WETA-GC1-SW-02 4/6/2009 Surface Water	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Explosives (CHPPM CAD13.3)													
TNB	11	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	UJ	0.06	UJ
DNB	3.7	0.049	0.2	0.2	U	0.2	U	0.2	U	0.2	UJ	0.2	UJ
TNT	2.2	0.013	0.06	0.06	UJ	0.06	UJ	0.06	U	0.06	UJ	0.06	UJ
2,4-DNT	0.11	0.01	0.04	0.04	UJ	0.04	UJ	0.04	U	0.04	UJ	0.04	UJ
2,6-DNT	37	0.004	0.02	0.02	U	0.02	U	0.02	U	0.02	UJ	0.02	UJ
2-A-4,6-DNT	20	0.079	0.3	0.3	U	0.3	U	0.3	U	0.3	UJ	0.3	UJ
4-A-2,6-DNT	73	0.057	0.3	0.3	U	0.3	U	0.3	U	0.3	UJ	0.3	UJ
HMX	150	2.6	4.8	4.8	U	4.8	U	4.8	U	4.8	UJ	4.8	UJ
NB	3.4	0.2	0.6	0.6	U	0.6	U	0.6	U	0.6	UJ	0.6	UJ
NG	3.65	0.052	0.2	0.2	UJ	0.2	UJ	0.2	U	0.2	UJ	0.2	UJ
RDX	0.61	0.064	0.24	0.24	U	0.24	U	0.24	UJ	0.24	UJ	0.24	UJ
Tetryl	150	0.049	0.3	0.3	U	0.3	U	0.3	U	0.3	UJ	0.3	UJ
m-NT	122	0.35	2	2	U	2	U	2	UJ	2	UJ	2	UJ
o-NT	370	0.54	2	2	U	2	U	2	U	2	UJ	2	UJ
p-NT	4.2	0.48	2	2	U	2	U	2	U	2	UJ	2	UJ
Perchlorate (EPA 6850)													
Perchlorate	15	0.062	0.2	0.2	U	0.2	U	0.2	U	**0.08**	J	0.2	U
Dissolved Metals (EPA 1638M)													
Antimony	5.6	0.005	0.02	**0.08**	J	**0.022**	J	**0.061**	--	**0.039**	--	**0.035**	--
Copper	2.7	0.04	0.2	**1.62**	--	**1.32**	--	0.72[f]	U	**0.52**	--	**0.41**	--
Lead	0.54	0.015 (0.078)[b]	0.051 (0.233)[b]	**0.054**	--	**0.064**	--	0.233	U	**0.192**	--	**0.141**	--
Tungsten	~	0.004	0.02	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Zinc	36.5	0.05	0.2	**5.1**	J	**1.62**	J	3.89[f]	U	**3.95**	--	**3.53**	--
Hardness Metals (EPA E200.7)													
Calcium	~	41 (33)[d]	500	**1400**	--	**1350**	--	**1870**	--	**1310**	--	**1310**	--
Magnesium	~	6.5	125	**563**	--	**562**	--	**586**	--	**488**	--	**479**	--
Hardness (calculated)[e]	~			**5.81**		**5.68**		**7.08**		**5.28**		**5.24**	

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

ug/L - micrograms per liter

J - estimated

U - not detected

UJ - not-detected; RL is estimated

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

EPA - Environmental Protection Agency

CHPPM CAD - Center for Health Promotion and Preventive Medicine Chromatographic Analysis Division

Footnotes:

a The MDLs and RLs listed apply to all samples except those listed in footnotes b and d

b The MDLs and RLs in parentheses for lead apply to STRM-GC1-SW-01, STRM-GC2-SW-01, STRM-JC1-SW-01

d The MDL in parentheses applies for Calcium to WETA-JC1-SW-01

e Hardness, mg equivalents/L CaCO3 = [(Ca, mg/L / 20.04 mg/meq) + (Mg, mg/L / 12.16 mg/meq)] * 50.05 mg/meq CaCO3

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G).

Table 6-1: Surface Water Analytical Results for Gills Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID: Date Sampled: Matrix:	Project Action Limit for SW	MDL[a]	RL[a]	WETA-GC1-SW-03 4/6/2009 Equipment Blank		WETB-GC1-SW-01 4/7/2009 Surface Water		DRYA-GC2-SW-01 7/22/2009 Surface Water		STRM-GC2-SW-01 5/18/2009 Surface Water		WETA-GC2-SW-01 4/6/2009 Surface Water	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Explosives (CHPPM CAD13.3)													
TNB	11	0.013	0.06	--	--	0.06	UJ	0.06	U	0.06	U	0.06	UJ
DNB	3.7	0.049	0.2	--	--	0.2	UJ	0.2	U	0.2	U	0.2	UJ
TNT	2.2	0.013	0.06	--	--	0.06	UJ	0.06	UJ	0.06	U	0.06	UJ
2,4-DNT	0.11	0.01	0.04	--	--	0.04	UJ	0.04	U	0.04	U	0.04	UJ
2,6-DNT	37	0.004	0.02	--	--	0.02	UJ	0.02	U	0.02	U	0.02	UJ
2-A-4,6-DNT	20	0.079	0.3	--	--	0.3	UJ	0.3	U	0.3	U	0.3	UJ
4-A-2,6-DNT	73	0.057	0.3	0.3	UJ	0.3	UJ	0.3	U	0.3	U	0.3	UJ
HMX	150	2.6	4.8	4.8	UJ	4.8	UJ	4.8	U	4.8	U	4.8	UJ
NB	3.4	0.2	0.6	0.6	UJ	0.6	UJ	0.6	U	0.6	U	0.6	UJ
NG	3.65	0.052	0.2	0.2	UJ	0.2	UJ	0.2	UJ	0.2	U	0.2	UJ
RDX	0.61	0.064	0.24	0.24	UJ	0.24	UJ	0.24	U	0.24	UJ	0.24	UJ
Tetryl	150	0.049	0.3	0.3	UJ	0.3	UJ	0.3	U	0.3	U	0.3	UJ
m-NT	122	0.35	2	2	UJ	2	UJ	2	U	2	UJ	2	UJ
o-NT	370	0.54	2	2	UJ	2	UJ	2	U	2	U	2	UJ
p-NT	4.2	0.48	2	2	UJ	2	UJ	2	U	2	U	2	UJ
Perchlorate (EPA 6850)													
Perchlorate	15	0.062	0.2	--	--	0.2	U	0.2	U	0.2	U	0.2	U
Dissolved Metals (EPA 1638M)													
Antimony	5.6	0.005	0.02	--	--	**0.032**	--	**0.223**	--	**0.266**	--	**0.323**	--
Copper	2.7	0.04	0.2	--	--	**0.51**	--	**3.19**	--	**2.71**	--	**2.41**	--
Lead	0.54	0.015 (0.078)[b]	0.051 (0.233)[b]	--	--	**0.184**	--	**3.1**	--	**3.28**	--	**2.15**	--
Tungsten	--	0.004	0.02	--	--	0.02	U	**0.01**	J	**0.015**	J	**0.006**	J
Zinc	36.5	0.05	0.2	--	--	**4.02**	--	**6.07**	--	**11.5**	--	**7.35**	--
Hardness Metals (EPA E200.7)													
Calcium	--	41 (33)[d]	500	33	UE	**1250**	--	**719**	--	**1900**	--	**1420**	--
Magnesium	--	6.5	125	6.5	UE	**469**	--	**336**	--	**450**	--	**428**	--
Hardness (calculated)[e]	--					**5.05**		**3.18**		**6.60**		**5.31**	

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

ug/L - micrograms per liter

J - estimated

U - not detected

UJ - not-detected; RL is estimated

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

EPA - Environmental Protection Agency

CHPPM CAD - Center for Health Promotion and Preventive Medicine Chromatographic Analysis Division

Footnotes:

a The MDLs and RLs listed apply to all samples except those listed in footnotes b and d

b The MDLs and RLs in parentheses for lead apply to STRM-GC1-SW-01, STRM-GC2-SW-01, STRM-JC1-SW-01

d The MDL in parentheses applies for Calcium to WETA-JC1-SW-01

e Hardness, mg equivalents/L CaCO3 = [(Ca, mg/L / 20.04 mg/meq) + (Mg, mg/L / 12.16 mg/meq)] * 50.05 mg/meq CaCO3

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G).

Table 6-1: Surface Water Analytical Results for Gills Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID: Date Sampled: Matrix:	Project Action Limit for SW	MDL[a]	RL[a]	WETB-GC2-SW-01 4/7/2009 Surface Water		WETB-GC2-SW-02 4/7/2009 Surface Water		WETB-GC2-SW-03 4/7/2009 Equipment Blank	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Explosives (CHPPM CAD13.3)									
TNB	11	0.013	0.06	0.06	UJ	0.06	UJ	--	--
DNB	3.7	0.049	0.2	0.2	UJ	0.2	UJ	--	--
TNT	2.2	0.013	0.06	0.06	UJ	0.06	UJ	--	--
2,4-DNT	0.11	0.01	0.04	0.04	UJ	0.04	UJ	--	--
2,6-DNT	37	0.004	0.02	0.02	UJ	0.02	UJ	--	--
2-A-4,6-DNT	20	0.079	0.3	0.3	UJ	0.3	UJ	--	--
4-A-2,6-DNT	73	0.057	0.3	0.3	UJ	0.3	UJ	--	--
HMX	150	2.6	4.8	4.8	UJ	4.8	UJ	--	--
NB	3.4	0.2	0.6	0.6	UJ	0.6	UJ	--	--
NG	3.65	0.052	0.2	0.2	UJ	0.2	UJ	--	--
RDX	0.61	0.064	0.24	0.24	UJ	0.24	UJ	--	--
Tetryl	150	0.049	0.3	0.3	UJ	0.3	UJ	--	--
m-NT	122	0.35	2	2	UJ	2	UJ	--	--
o-NT	370	0.54	2	2	UJ	2	UJ	--	--
p-NT	4.2	0.48	2	2	UJ	2	UJ	--	--
Perchlorate (EPA 6850)									
Perchlorate	15	0.062	0.2	0.2	U	0.2	U		
Dissolved Metals (EPA 1638M)									
Antimony	5.6	0.005	0.02	**0.317**	--	**0.318**	--	0.02	U
Copper	2.7	0.04	0.2	**2.46**	--	**2.41**	--	0.02	U
Lead	0.54	0.015 (0.078)[b]	0.051 (0.233)[b]	**1.72**	--	**1.86**	--	0.051	U
Tungsten	--	0.004	0.02	0.02	U	0.02	U	--	--
Zinc	36.5	0.05	0.2	**7.04**	--	**6.89**	--	0.31	U
Hardness Metals (EPA E200.7)									
Calcium	--	41 (33)[d]	500	**1310**	--	**1340**	--	--	--
Magnesium	--	6.5	125	**395**	--	**392**	--	--	--
Hardness (calculated)[e]	--			**4.90**		**4.96**			

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

ug/L - micrograms per liter

J - estimated

U - not detected

UJ - not-detected; RL is estimated

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

EPA - Environmental Protection Agency

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Footnotes:

a The MDLs and RLs listed apply to all samples except those listed in footnotes b and d

b The MDLs and RLs in parentheses for lead apply to STRM-GC1-SW-01, STRM-GC2-SW-01, STRM-JC1-SW-01

d The MDL in parentheses applies for Calcium to WETA-JC1-SW-01

e Hardness, mg equivalents/L CaCO3 = [(Ca, mg/L / 20.04 mg/meq) + (Mg, mg/L / 12.16 mg/meq)] * 50.05 mg/meq CaCO3

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G).

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Table 6-2: Surface Water Analytical Results for Colonels Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID: Date Sampled: Matrix:	Project Action Limit for SW	MDL[a]	RL[a]	DRYA-CC1-SW-01 7/22/2009 Surface Water		STRM-CC1-SW-01 5/18/2009 Surface Water		WETA-CC1-SW-01 4/1/2009 Surface Water		WETB-CC1-SW-01 4/2/2009 Surface Water	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Explosives (CHPPM CAD13.3)											
TNB	11	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	U
DNB	3.7	0.049	0.2	0.2	U	0.2	U	0.2	U	0.2	U
TNT	2.2	0.013	0.06	0.06	UJ	0.06	U	0.06	U	0.06	UJ
2,4-DNT	0.11	0.01	0.04	0.04	UJ	0.04	U	0.04	U	0.04	U
2,6-DNT	37	0.004	0.02	0.02	U	0.02	U	0.02	U	0.02	U
2-A-4,6-DNT	20	0.079	0.3	0.3	U	0.3	U	0.3	U	0.3	U
4-A-2,6-DNT	73	0.057	0.3	0.3	U	0.3	U	0.3	U	0.3	U
HMX	150	2.6	4.8	4.8	U	4.8	U	4.8	U	4.8	U
NB	3.4	0.2	0.6	0.6	U	0.6	U	0.6	U	0.6	U
NG	3.65	0.052	0.2	0.2	UJ	0.2	U	0.2	U	0.2	U
RDX	0.61	0.064	0.24	0.24	U	0.24	UJ	0.24	U	0.24	U
Tetryl	150	0.049	0.3	0.3	U	0.3	U	0.3	U	0.3	U
m-NT	122	0.35	2	2	U	2	UJ	2	U	2	U
o-NT	370	0.54	2	2	U	2	U	2	U	2	U
p-NT	4.2	0.48	2	2	U	2	U	2	U	2	U
Perchlorate (EPA 6850)											
Perchlorate	15	0.062	0.2	0.2	U	0.2	U	0.2	U	0.2	U
Dissolved Metals (EPA 1638M)											
Antimony	5.6	0.005	0.02	**0.018**	J	**0.021**	--	**0.028**	--	0.027[f]	U
Copper	2.7	0.04	0.2	**1.57**	--	0.39[f]	U	**0.38**	--	**0.28**	--
Lead	0.54	0.015 (0.078)[b]	0.051 (0.233)[b]	**0.046**	J	0.233	U	**0.172**	--	**0.153**	--
Tungsten	~	0.004	0.02	0.02	U	0.02	U	0.02	U	0.02	U
Zinc	36.5	0.05 (0.1)[c]	0.2 (0.4)[c]	**4.54**	--	3.18[f]	U	**3.12**	--	**2.85**	--
Hardness Metals (EPA E200.7)											
Calcium	~	41 (33)[d]	500	**203**	J	500	U	**350**	J	**246**	J
Magnesium	~	6.5	125	**240**	--	**276**	--	**342**		**292**	
Hardness (calculated)[e]	~			**1.49**		**1.14**		**2.28**		**1.82**	

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

ug/L - micrograms per liter

J - estimated

U - not detected

UJ - not-detected; RL is estimated

EPA - Environmental Protection Agency

CHPPM CAD - Center for Health Promotion and Preventive Medicine Chromatographic Analysis Division

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

Footnotes:

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parentheses for lead apply to STRM-CC1-SW-01, STRM-CC2-SW-01, and STRM-CC2-SW-02, STRM-CC3-SW-01

c The MDL and RL in parentheses for zinc apply to WETB-CC2-SW-01

d The MDL in parentheses apply for Calcium to WETA-CC1-SW-01 and WETB-CC1-SW-01, WETA-CC2-SW-01, WETA-CC3-SW-01

e Hardness, mg equivalents/L CaCO3 = [(Ca, mg/L / 20.04 mg/meq) + (Mg, mg/L / 12.16 mg/meq)] * 50.05 mg/meq CaCO3

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G).

Table 6-2: Surface Water Analytical Results for Colonels Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID: Date Sampled: Matrix:	Project Action Limit for SW	MDL[a]	RL[a]	STRM-CC2-SW-01 5/18/2009 Surface Water		STRM-CC2-SW-02 5/18/2009 Surface Water		WETA-CC2-SW-01 4/1/2009 Surface Water		WETB-CC2-SW-01 4/2/2009 Surface Water	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Explosives (CHPPM CAD13.3)											
TNB	11	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	UJ
DNB	3.7	0.049	0.2	0.2	U	0.2	U	0.2	U	0.2	UJ
TNT	2.2	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	UJ
2,4-DNT	0.11	0.01	0.04	0.04	U	0.04	U	0.04	U	0.04	UJ
2,6-DNT	37	0.004	0.02	0.02	U	0.02	U	0.02	U	0.02	UJ
2-A-4,6-DNT	20	0.079	0.3	0.3	U	0.3	U	0.3	U	0.3	UJ
4-A-2,6-DNT	73	0.057	0.3	0.3	U	0.3	U	0.3	U	0.3	UJ
HMX	150	2.6	4.8	4.8	U	4.8	U	4.8	U	4.8	UJ
NB	3.4	0.2	0.6	0.6	U	0.6	U	0.6	U	0.6	UJ
NG	3.65	0.052	0.2	0.2	U	0.2	U	0.2	U	0.2	UJ
RDX	0.61	0.064	0.24	0.24	UJ	0.24	UJ	0.24	U	0.24	UJ
Tetryl	150	0.049	0.3	0.3	U	0.3	U	0.3	U	0.3	UJ
m-NT	122	0.35	2	2	UJ	2	UJ	2	U	2	UJ
o-NT	370	0.54	2	2	U	2	U	2	U	2	UJ
p-NT	4.2	0.48	2	2	U	2	U	2	U	2	UJ
Perchlorate (EPA 6850)											
Perchlorate	15	0.062	0.2	0.2	U	0.2	U	0.2	U	0.2	U
Dissolved Metals (EPA 1638M)											
Antimony	5.6	0.005	0.02	**0.049**	--	**0.048**	--	**0.053**	--	0.058 [f]	U
Copper	2.7	0.04	0.2	1.32[f]	U	1.59[f]	U	**1.09**	--	**1.14**	--
Lead	0.54	0.015 (0.078)[b]	0.051 (0.233)[b]	**1.08**	--	**1.1**	--	**1.12**	--	**1.05**	--
Tungsten	--	0.004	0.02	0.02	U	0.02	U	0.02	U	0.02	U
Zinc	36.5	0.05 (0.1)[c]	0.2 (0.4)[c]	5.11[f]	U	4.43[f]	U	**3.67**	--	**3.72**	--
Hardness Metals (EPA E200.7)											
Calcium	--	41 (33)[d]	500	500	U	500	U	**272**	J	**352**	J
Magnesium	--	6.5	125	**191**	--	**195**	--	**309**		**333**	
Hardness (calculated)[e]	--			**0.79**		**0.80**		**1.95**		**2.25**	

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

ug/L - micrograms per liter

J - estimated

U - not detected

UJ - not-detected; RL is estimated

EPA - Environmental Protection Agency

CHPPM CAD - Center for Health Promotion and Preventive Medicine Chromatographic Analysis Division

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

Footnotes:

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parentheses for lead apply to STRM-CC1-SW-01, STRM-CC2-SW-01, and STRM-CC2-SW-02, STRM-CC3-SW-01

c The MDL and RL in parentheses for zinc apply to WETB-CC2-SW-01

d The MDL in parentheses apply for Calcium to WETA-CC1-SW-01 and WETB-CC1-SW-01, WETA-CC2-SW-01, WETA-CC3-SW-01

e Hardness, mg equivalents/L CaCO3 = [(Ca, mg/L / 20.04 mg/meq) + (Mg, mg/L / 12.16 mg/meq)] * 50.05 mg/meq CaCO3

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G).

Table 6-2: Surface Water Analytical Results for Colonels Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID: Date Sampled: Matrix:	Project Action Limit for SW	MDL[a]	RL[a]	DRYA-CC3-SW-01 7/22/2009 Surface Water		STRM-CC3-SW-01 5/18/2009 Surface Water		WETA-CC3-SW-01 4/4/2009 Surface Water		WETB-CC3-SW-01 4/2/2009 Surface Water	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Explosives (CHPPM CAD13.3)											
TNB	11	0.013	0.06	0.06	U	0.06	U	0.06	UJ	0.06	UJ
DNB	3.7	0.049	0.2	0.2	U	0.2	U	0.2	UJ	0.2	UJ
TNT	2.2	0.013	0.06	0.06	UJ	0.06	U	0.06	UJ	0.06	UJ
2,4-DNT	0.11	0.01	0.04	0.04	UJ	0.04	U	0.04	UJ	0.04	UJ
2,6-DNT	37	0.004	0.02	0.02	U	0.02	U	0.02	UJ	0.02	UJ
2-A-4,6-DNT	20	0.079	0.3	0.3	U	0.3	U	0.3	UJ	0.3	UJ
4-A-2,6-DNT	73	0.057	0.3	0.3	U	0.3	U	0.3	UJ	0.3	UJ
HMX	150	2.6	4.8	4.8	U	4.8	U	4.8	UJ	4.8	UJ
NB	3.4	0.2	0.6	0.6	U	0.6	U	0.6	UJ	0.6	UJ
NG	3.65	0.052	0.2	0.2	UJ	0.2	U	0.2	UJ	0.2	UJ
RDX	0.61	0.064	0.24	0.24	U	0.24	UJ	0.24	UJ	0.24	UJ
Tetryl	150	0.049	0.3	0.3	U	0.3	U	0.3	UJ	0.3	UJ
m-NT	122	0.35	2	2	U	2	UJ	2	UJ	2	UJ
o-NT	370	0.54	2	2	U	2	U	2	UJ	2	UJ
p-NT	4.2	0.48	2	2	U	2	U	2	UJ	2	UJ
Perchlorate (EPA 6850)											
Perchlorate	15	0.062	0.2	0.2	U	0.2	U	0.2	U	**0.1**	J
Dissolved Metals (EPA 1638M)											
Antimony	5.6	0.005	0.02	**0.04**	--	**0.022**	--	**0.03**	--	0.029[f]	U
Copper	2.7	0.04	0.2	**1.15**	--	0.92[f]	U	**0.68**	--	**0.72**	--
Lead	0.54	0.015 (0.078)[b]	0.051 (0.233)[b]	**0.101**	--	**0.149**	J	**0.312**	--	**0.303**	--
Tungsten	--	0.004	0.02	0.02	U	0.02	U	0.02	U	**0.007**	J
Zinc	36.5	0.05 (0.1)[c]	0.2 (0.4)[c]	**9.06**	--	2.63[f]	U	**2.7**	--	**2.68**	--
Hardness Metals (EPA E200.7)											
Calcium	--	41 (33)[d]	500	**201**	J	500	U	**279**	J	500	U
Magnesium	--	6.5	125	**153**	--	**190**	--	**248**		228[f]	U
Hardness (calculated)[e]	--			**1.13**		**0.78**		**1.72**		**0.00**	

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

ug/L - micrograms per liter

J - estimated

U - not detected

UJ - not-detected; RL is estimated

EPA - Environmental Protection Agency

CHPPM CAD - Center for Health Promotion and Preventive Medicine Chromatographic Analysis Division

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

Footnotes:

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parentheses for lead apply to STRM-CC1-SW-01, STRM-CC2-SW-01, and STRM-CC2-SW-02, STRM-CC3-SW-01

c The MDL and RL in parentheses for zinc apply to WETB-CC2-SW-01

d The MDL in parentheses apply for Calcium to WETA-CC1-SW-01 and WETB-CC1-SW-01, WETA-CC2-SW-01, WETA-CC3-SW-01

e Hardness, mg equivalents/L CaCO3 = [(Ca, mg/L / 20.04 mg/meq) + (Mg, mg/L / 12.16 mg/meq)] * 50.05 mg/meq CaCO3

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G).

Table 6-2: Surface Water Analytical Results for Colonels Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID: Date Sampled: Matrix:	Project Action Limit for SW	MDL[a]	RL[a]	DRYA-JC1-SW-01 7/22/2009 Surface Water		STRM-JC1-SW-01 5/18/2009 Surface Water		WETA-JC1-SW-01 4/1/2009 Surface Water		WETB-JC1-SW-01 4/2/2009 Surface Water	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Explosives (CHPPM CAD13.3)											
TNB	11	0.013	0.06	0.06	U	0.06	UJ	0.06	UJ	0.06	UJ
DNB	3.7	0.049	0.2	0.2	U	0.2	UJ	0.2	UJ	0.2	UJ
TNT	2.2	0.013	0.06	0.06	UJ	0.06	UJ	0.06	UJ	0.06	UJ
2,4-DNT	0.11	0.01	0.04	0.04	UJ	0.04	UJ	0.04	UJ	0.04	UJ
2,6-DNT	37	0.004	0.02	0.02	U	0.02	UJ	0.02	UJ	0.02	UJ
2-A-4,6-DNT	20	0.079	0.3	0.3	U	0.3	UJ	0.3	UJ	0.3	UJ
4-A-2,6-DNT	73	0.057	0.3	0.3	U	0.3	UJ	0.3	UJ	0.3	UJ
HMX	150	2.6	4.8	4.8	U	4.8	UJ	4.8	UJ	4.8	UJ
NB	3.4	0.2	0.6	0.6	U	0.6	UJ	0.6	UJ	0.6	UJ
NG	3.65	0.052	0.2	0.2	UJ	0.2	UJ	0.2	UJ	0.2	UJ
RDX	0.61	0.064	0.24	0.24	U	0.24	UJ	0.24	UJ	0.24	UJ
Tetryl	150	0.049	0.3	0.3	U	0.3	UJ	0.3	UJ	0.3	UJ
m-NT	122	0.35	2	2	U	2	UJ	2	UJ	2	UJ
o-NT	370	0.54	2	2	U	2	UJ	2	UJ	2	UJ
p-NT	4.2	0.48	2	2	U	2	UJ	2	UJ	2	UJ
Perchlorate (EPA 6850)											
Perchlorate	15	0.062	0.2	0.2	U	0.2	U	**0.1**	J	**0.13**	J
Dissolved Metals (EPA 1638M)											
Antimony	5.6	0.005	0.02	0.02	U	**0.008**	J	**0.01**	J	0.02	U
Copper	2.7	0.04	0.2	**1.41**	--	0.39[f]	U	**0.29**	--	**0.42**	--
Lead	0.54	0.015 (0.078)[b]	0.051 (0.233)[b]	**0.052**	--	**0.12**	J	**0.088**	--	**0.075**	--
Tungsten	--	0.004	0.02	0.02	U	0.02	U	0.02	U	0.02	U
Zinc	36.5	0.05 (0.1)[c]	0.2 (0.4)[c]	**2.39**	--	1.45[f]	U	**0.91**	--	**1.38**	--
Hardness Metals (EPA E200.7)											
Calcium	--	41 (33)[d]	500	**198**	J	500	U	**206**	J	500	U
Magnesium	--	6.5	125	**160**	--	**192**	--	196[f]	U	193[f]	U
Hardness (calculated)[e]	--			**1.15**		**0.79**		**0.51**		**0.00**	

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

ug/L - micrograms per liter

J - estimated

U - not detected

UJ - not-detected; RL is estimated

EPA - Environmental Protection Agency

CHPPM CAD - Center for Health Promotion and Preventive Medicine Chromatographic Analysis Division

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

Footnotes:

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parentheses for lead apply to STRM-CC1-SW-01, STRM-CC2-SW-01, and STRM-CC2-SW-02, STRM-CC3-SW-01

c The MDL and RL in parentheses for zinc apply to WETB-CC2-SW-01

d The MDL in parentheses apply for Calcium to WETA-CC1-SW-01 and WETB-CC1-SW-01, WETA-CC2-SW-01, WETA-CC3-SW-01

e Hardness, mg equivalents/L CaCO3 = [(Ca, mg/L / 20.04 mg/meq) + (Mg, mg/L / 12.16 mg/meq)] * 50.05 mg/meq CaCO3

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G).

Table 6-3: Surface Water Analytical Results for Cedar Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID: Date Sampled: Matrix:	Project Action Limit for SW	MDL[a]	RL[a]	DRYA-WL1-SW-01 7/21/2009 Surface Water		STRM-WL1-SW-01 5/18/2009 Surface Water		WETA-WL1-SW-01 4/1/2009 Surface Water		WETB-WL1-SW-01 4/2/2009 Surface Water	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Explosives (CHPPM CAD13.3)											
TNB	11	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	UJ
DNB	3.7	0.049	0.2	0.2	U	0.2	U	0.2	U	0.2	UJ
TNT	2.2	0.013	0.06	0.06	UJ	0.06	U	0.06	U	0.06	UJ
2,4-DNT	0.11	0.01	0.04	0.04	UJ	0.04	U	0.04	U	0.04	UJ
2,6-DNT	37	0.004	0.02	0.02	U	0.02	U	0.02	U	0.02	UJ
2-A-4,6-DNT	20	0.079	0.3	0.3	U	0.3	U	0.3	U	0.3	UJ
4-A-2,6-DNT	73	0.057	0.3	0.3	U	0.3	U	0.3	U	0.3	UJ
HMX	150	2.6	4.8	4.8	U	4.8	U	4.8	U	4.8	UJ
NB	3.4	0.2	0.6	0.6	U	0.6	U	0.6	U	0.6	UJ
NG	3.65	0.052	0.2	0.2	UJ	0.2	U	0.2	U	0.2	UJ
RDX	0.61	0.064	0.24	**0.066**	J	0.24	UJ	**0.1**	J	0.24	UJ
Tetryl	150	0.049	0.3	0.3	U	0.3	U	0.3	U	0.3	UJ
m-NT	122	0.35	2	2	U	2	UJ	2	U	2	UJ
o-NT	370	0.54	2	2	UJ	2	U	2	U	2	UJ
p-NT	4.2	0.48	2	2	U	2	U	2	U	2	UJ
Perchlorate (EPA 6850)											
Perchlorate	15	0.062	0.2	0.2	U	0.2	U	**0.098**	J	0.2	U
Dissolved Metals (EPA 1638M)											
Antimony	5.6	0.005	0.02	**0.032**	--	**0.023**	--	**0.025**	--	0.029[f]	U
Copper	2.7	0.04	0.2	2.16[f]	U	0.81[f]	U	**0.38**	--	**0.34**	--
Lead	0.54	0.015 (0.078)[b]	0.051 (0.233)[b]	**0.052**	--	0.233	U	**0.111**	--	**0.127**	--
Tungsten	~	0.004	0.02	0.02	U	0.02	U	0.02	U	0.02	U
Zinc	36.5	0.05	0.2	1.57[f]	U	3.88[f]	U	**1.4**	--	**1.82**	--
Hardness Metals (EPA E200.7)											
Calcium	~	41 (33)[d]	500	500	U	500	U	**285**	J	**257**	J
Magnesium	~	6.5	125	**158**	--	**164**	--	161[f]	U	166[f]	U
Hardness (calculated)[e]	~			**0.65**		**0.68**		**0.71**		**0.64**	

Notes:
Bold - Detected
Blue - Exceeds Project Action Limit
SW - Surface Water
ug/L - micrograms per liter
J - estimated
U - not detected
UJ - not-detected; RL is estimated

Q - data qualifier
MDL - Method Detection Limit
RL - Method Reporting Limit

EPA - Environmental Protection Agency
CHPPM CAD - Center for Health Promotion and Preventive Medicine Chromatographic Analysis Division

Footnotes:
a The MDLs and RLs listed apply to all samples except those listed in footnotes b and d
b The MDLs and RLs in parentheses for lead apply to STRM-WL1-SW-01, STRM-WL2-SW-01, STRM-WL2-SW-02, WETB-WL2-SW-01
d The MDL in parentheses apply for Calcium to WETA-, WETB-WL2-SW-01
e Hardness, mg equivalents/L CaCO3 = [(Ca, mg/L / 20.04 mg/meq) + (Mg, mg/L / 12.16 mg/meq)] * 50.05 mg/meq CaCO3
f Detection was qualified with 'U' and RL was raised to detection (See Appendix G).

Table 6-3: Surface Water Analytical Results for Cedar Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID: Date Sampled: Matrix:	Project Action Limit for SW	MDL[a]	RL[a]	DRYA-WL2-SW-01 7/21/2009 Surface Water		STRM-WL2-SW-01 5/18/2009 Surface Water		WETA-WL2-SW-01 4/1/2009 Surface Water		WETB-WL2-SW-01 4/2/2009 Surface Water	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Explosives (CHPPM CAD13.3)											
TNB	11	0.013	0.06	0.06	U	0.06	U	0.06	UJ	0.06	UJ
DNB	3.7	0.049	0.2	0.2	U	0.2	U	0.2	UJ	0.2	UJ
TNT	2.2	0.013	0.06	0.06	UJ	0.06	U	0.06	UJ	0.06	UJ
2,4-DNT	0.11	0.01	0.04	0.04	UJ	0.04	U	0.04	UJ	0.04	UJ
2,6-DNT	37	0.004	0.02	0.02	U	0.02	U	0.02	UJ	0.02	UJ
2-A-4,6-DNT	20	0.079	0.3	0.3	U	0.3	U	0.3	UJ	0.3	UJ
4-A-2,6-DNT	73	0.057	0.3	0.3	U	0.3	U	0.3	UJ	0.3	UJ
HMX	150	2.6	4.8	4.8	U	4.8	U	4.8	UJ	4.8	UJ
NB	3.4	0.2	0.6	0.6	U	0.6	U	0.6	UJ	0.6	UJ
NG	3.65	0.052	0.2	0.2	UJ	0.2	U	0.2	UJ	0.2	UJ
RDX	0.61	0.064	0.24	0.24	U	0.24	UJ	0.24	UJ	0.24	UJ
Tetryl	150	0.049	0.3	0.3	U	0.3	U	0.3	UJ	0.3	UJ
m-NT	122	0.35	2	2	U	2	UJ	2	UJ	2	UJ
o-NT	370	0.54	2	2	UJ	2	U	2	UJ	2	UJ
p-NT	4.2	0.48	2	2	U	2	U	2	UJ	2	UJ
Perchlorate (EPA 6850)											
Perchlorate	15	0.062	0.2	0.2	U	0.2	U	**0.1**	J	0.2	U
Dissolved Metals (EPA 1638M)											
Antimony	5.6	0.005	0.02	**0.021**	--	**0.023**	--	**0.032**	--	0.031[f]	U
Copper	2.7	0.04	0.2	0.79[f]	U	0.63[f]	U	**0.41**	--	**0.29**	--
Lead	0.54	0.015 (0.078)[b]	0.051 (0.233)[b]	**0.085**	--	0.233	U	**0.11**	--	**0.05**	J
Tungsten	~	0.004	0.02	0.02	U	0.02	U	0.02	U	0.02	U
Zinc	36.5	0.05	0.2	**5.65**	--	**5.63**		**1.71**	--	**1.79**	--
Hardness Metals (EPA E200.7)											
Calcium	~	41 (33)[d]	500	**273**	J	500	U	**244**	J	**250**	J
Magnesium	~	6.5	125	**171**	--	**162**	--	178[f]	U	172[f]	U
Hardness (calculated)[e]	~			**1.39**		**0.67**		**0.61**		**0.62**	

Notes:
Bold - Detected
Blue - Exceeds Project Action Limit
SW - Surface Water
ug/L - micrograms per liter
J - estimated
U - not detected
UJ - not-detected; RL is estimated

Q - data qualifier
MDL - Method Detection Limit
RL - Method Reporting Limit

EPA - Environmental Protection Agency
CHPPM CAD - Center for Health Promotion and Preventive Medicine Chromatographic Analysis Division

Footnotes:
a The MDLs and RLs listed apply to all samples except those listed in footnotes b and d
b The MDLs and RLs in parentheses for lead apply to STRM-WL1-SW-01, STRM-WL2-SW-01, STRM-WL2-SW-02, WETB-WL2-SW-01
d The MDL in parentheses apply for Calcium to WETA-, WETB-WL2-SW-01
e Hardness, mg equivalents/L CaCO3 = [(Ca, mg/L / 20.04 mg/meq) + (Mg, mg/L / 12.16 mg/meq)] * 50.05 mg/meq CaCO3
f Detection was qualified with 'U' and RL was raised to detection (See Appendix G).

Table 6-4: Summary of Surface Water Quality Field Measurements
Fort Jackson and McCrady Training Center, SC

Location	Event	Sampling Date and Time	Temperature (°C)	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Oxidation-Reduction (mV)
CC1	WetB	04/02/2009 17:50	16.73	3.47	0.026	1.1	10.62	263
	WetA	03/31/2009 10:44	15.9	3.14	0.021	1.1	7.13	305
	STRM	05/18/2009 08:39	18.5	4.15	0.012	**	7.7	278
	DryA	07/20/2009 12:31	24.98	3.34	0.013	2.2	6.31	279
CC2	WetB	04/01/2009 13:25	12.22	3.3	0.041	0.4	7.44	184
	WetA	03/31/2009 10:05	11.48	4.06	0.038	0.5	9.19	205
	STRM	05/18/2009 08:16	15.29	4.12	0.034	**	8.55	259
CC3	WetB	04/01/2009 18:12	15.76	2.82	0.025	2.6	8.36	350
	WetA	03/31/2009 17:37	15.43	2.7	0.021	2.0	9.92	306
	STRM	05/18/2009 07:36	17.32	4.18	0.013	**	7.88	258
	DryA	07/20/2009 10:40	21.3	2.94	0.062	2.9	11.26	188
GC1	WetB	04/07/2009 16:11	14.17	5.03	0.516	5.5	*	204
	WetA	04/02/2009 08:41	15.91	4.53	0.028	13	9.8	201
	STRM	05/18/2009 09:12	17.4	4.93	0.026	**	6.43	243
GC2	WetB	04/07/2009 16:54	12.4	4.87	0.028	2.7	*	225
	WetA	04/02/2009 17:05	16.26	4.75	0.051	0.4	4.8	108
	STRM	05/18/2009 09:39	15.87	5.35	0.028	**	7.37	221
JC1	WetB	04/01/2009 18:32	16.78	3.72	*	2.7	11.63	255
	WetA	03/31/2009 14:27	16.69	4.27	0.246	2.1	8.95	177
	STRM	05/18/2009 07:20	15.58	5.37	0.009	**	6.74	192
	DryA	07/20/2009 11:04	19.56	3.62	0.011	3.2	9.91	266
WL1	WetB	04/02/2009 13:28	17.6	3.19	0.078	2.1	8.26	228
	WetA	04/01/2009 16:40	17.93	2.64	0.146	2.3	6.71	239
	STRM	05/18/2009 11:32	23.41	5.69	0.008	**	5.4	192
	DryA	07/21/2009 11:18	27.24	5.46	0.065	3.4	5.41	224
WL2	WetB	04/02/2009 14:03	17.34	3.24	0.162	2.0	6.87	208
	WetA	04/01/2009 17:14	17.4	3.12	0.011	2.5	6.83	255
	STRM	05/18/2009 12:11	22.55	5.21	0.007	**	8.16	231
	DryA	07/21/2009 12:13	29.05	5.23	0.143	2.5	8.21	78

Footnotes:

* Instrument Error
** No turbidity values for STRM event
WL - Weston Lake
CC - Colonels Creek
GC - Gills Creek
JC - Jumping Run Creek
STRM - Storm
°C - degrees Celcius
mg/L - milligrams per liter
NTU - Nephelometric Turbidity Unit
mS/cm - milliSiemen per centimeter
mV - millivolt

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Table 6-5: Sediment Analytical Results for Gills Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID:		DRYA-GC1-SD-01				DRYB-GC1-SD-01				WETA-GC1-SD-01				Modified	DRYA-GC2-SD-01				Modified	DRYB-GC2-SD-01			
Date Sampled:	Project Action Limit for Sediment	7/20/2009				7/21/2009				4/1/2009				Action Limit [a]	7/20/2009				Action Limit [a]	7/21/2009			
Matrix:		Sediment (Assoc. w/SW)				Sediment (Assoc. w/SW)				Sediment (Assoc. w/SW)					Sediment (Assoc. w/SW)					Sediment (Assoc. w/SW)			
Analyte:	**(mg/kg)**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**(mg/kg)**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**(mg/kg)**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**
Metals (SW6020)																							
Antimony	12	0.062	U	0.062	0.99	0.062	U	0.062	0.99	0.052	U	0.052	0.82		**1**	J	0.11	1.7		**1.6**	J	0.12	1.8
Copper	34	**0.25**	J	0.15	2	**0.6**	J	0.15	2	**0.27**	J	0.12	1.6		**29.9**	--	0.26	3.4		**36.9**	--	0.27	3.7
Lead	47	**1.7**	J	0.078	2	**3.2**	--	0.078	2	**0.41**	J	0.065	1.7		**143**	--	0.13	3.4		**144**	--	0.14	3.7
Tungsten	~	2	U	0.076	2	2	U	0.076	2	0.063	U	0.063	1.6		**1.5**	J	0.13	3.4		**2.3**	J	0.14	3.7
Zinc	150	9.9	U	0.7	9.9	9.9	U	0.7	9.9	**1.1**	J	0.58	8.2		**73.5**	--	1.2	17		**122**	--	1.3	18.3
Explosives (SW8330A)																							
TNB	0.002	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.004	0.08	U	0.01	0.08	0.004	0.08	U	0.01	0.08
DNB	0.007	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.015	0.08	U	0.01	0.08	0.015	0.08	U	0.01	0.08
TNT	0.092	0.04	U	0.006	0.04	0.04	U	0.006	0.04	0.04	U	0.006	0.04	0.202	0.08	U	0.012	0.08	0.202	0.08	U	0.012	0.08
2,4-DNT	0.075	0.04	U	0.007	0.04	0.04	U	0.007	0.04	0.04	U	0.007	0.04		0.08	U	0.015	0.08		0.08	U	0.015	0.08
2,6-DNT	0.021	0.04	U	0.003	0.04	0.04	U	0.003	0.04	0.04	U	0.003	0.04		0.08	U	0.005	0.08		0.08	U	0.005	0.08
2-A-4,6-DNT	~	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04		0.08	U	0.01	0.08		0.08	U	0.01	0.08
4-A-2,6-DNT	~	0.04	U	0.008	0.04	0.04	U	0.008	0.04	0.04	U	0.008	0.04		0.08	U	0.016	0.08		0.08	U	0.016	0.08
HMX	0.005	0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.011	0.16	U	0.028	0.16	0.011	0.16	U	0.028	0.16
NB	0.488	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04		0.08	U	0.01	0.08		0.08	U	0.01	0.08
NG	~	4	U	0.65	4	4	U	0.65	4	4	U	0.65	4		8	U	1.3	8		8	U	1.3	8
RDX	0.013	0.08	U	0.012	0.08	0.08	U	0.012	0.08	0.08	U	0.012	0.08	0.029	0.16	U	0.024	0.16	0.029	0.16	U	0.024	0.16
Tetryl	53.4	0.08	U	0.022	0.08	0.08	U	0.022	0.08	0.08	U	0.022	0.08		0.16	U	0.044	0.16		0.16	U	0.044	0.16
m-NT	~	0.08	U	0.025	0.08	0.08	U	0.025	0.08	0.08	U	0.025	0.08		0.16	U	0.05	0.16		0.16	U	0.05	0.16
o-NT	~	0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.08	U	0.014	0.08		0.16	U	0.028	0.16		0.16	U	0.028	0.16
p-NT	~	0.08	U	0.034	0.08	0.08	U	0.034	0.08	0.08	U	0.034	0.08		0.16	U	0.068	0.16		0.16	U	0.068	0.16
TOC (Walkley Black)		**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**		**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**		**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**
Total Organic Carbon (TOC)	~	**0.17**	--	0.01	0.01	**0.42**	--	0.01	0.01	**0.13**	--	0.12	0.12		**2.2**	--	0.01	0.01		**2.2**	--	0.01	0.01

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

~ no action limit

-- no qualifier

J - estimated

U - not detected

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

Footnotes:

a Modified action limits apply to the sample to the right of the column and were calculated by multiplying action limit times %TOC in cases when TOC was greater than 1%.

% - Percent

mg/kg - milligrams per kilogram

EPA - Environmental Protection Agency

Table 6-5: Sediment Analytical Results for Gills Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID:		DRYB-GC2-SD-01				WETA-GC2-SD-01				WETA-GC2-SD-02			
Date Sampled:	Project Action Limit for Sediment	7/21/2009				4/1/2009				4/1/2009			
Matrix:		Sediment (Assoc. w/SW)				Sediment (Assoc. w/SW)				Sediment (Assoc. w/SW)			
Analyte:	**(mg/kg)**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**
Metals (SW6020)													
Antimony	12	**1.6**	J	0.12	1.8	**0.38**	J	0.096	1.5	**0.19**	J	0.1	1.6
Copper	34	**36.9**	--	0.27	3.7	**10.7**	--	0.23	3	**10.4**	--	0.24	3.3
Lead	47	**144**	--	0.14	3.7	**35.6**	--	0.12	3.1	**39.9**	--	0.13	3.3
Tungsten	~	**2.3**	J	0.14	3.7	**0.16**	J	0.12	3	**0.15**	J	0.13	3.3
Zinc	150	**122**	--	1.3	18.3	**32.8**	--	1.1	15.2	**31.6**	--	1.2	16.3
Explosives (SW8330A)													
TNB	0.002	0.08	U	0.01	0.08	0.04	U	0.005	0.04	0.04	U	0.005	0.04
DNB	0.007	0.08	U	0.01	0.08	0.04	U	0.005	0.04	0.04	U	0.005	0.04
TNT	0.092	0.08	U	0.012	0.08	0.04	U	0.006	0.04	0.04	U	0.006	0.04
2,4-DNT	0.075	0.08	U	0.015	0.08	0.04	U	0.007	0.04	0.04	U	0.007	0.04
2,6-DNT	0.021	0.08	U	0.005	0.08	0.04	U	0.003	0.04	0.04	U	0.003	0.04
2-A-4,6-DNT	~	0.08	U	0.01	0.08	0.04	U	0.005	0.04	0.04	U	0.005	0.04
4-A-2,6-DNT	~	0.08	U	0.016	0.08	0.04	U	0.008	0.04	0.04	U	0.008	0.04
HMX	0.005	0.16	U	0.028	0.16	0.08	U	0.014	0.08	0.08	U	0.014	0.08
NB	0.488	0.08	U	0.01	0.08	0.04	U	0.005	0.04	0.04	U	0.005	0.04
NG	~	8	U	1.3	8	4	U	0.65	4	4	U	0.65	4
RDX	0.013	0.16	U	0.024	0.16	0.08	U	0.012	0.08	0.08	U	0.012	0.08
Tetryl	53.4	0.16	U	0.044	0.16	0.08	U	0.022	0.08	0.08	U	0.022	0.08
m-NT	~	0.16	U	0.05	0.16	0.08	U	0.025	0.08	0.08	U	0.025	0.08
o-NT	~	0.16	U	0.028	0.16	0.08	U	0.014	0.08	0.08	U	0.014	0.08
p-NT	~	0.16	U	0.068	0.16	0.08	U	0.034	0.08	0.08	U	0.034	0.08
TOC (Walkley Black)		**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**
Total Organic Carbon (TOC)	~	**2.2**	--	0.01	0.01	**0.33**	J	0.21	0.21	**0.23**	J	0.23	0.23

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

~ no action limit

-- no qualifier

J - estimated

U - not detected

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

Footnotes:

a Modified action limits apply to the sample to the right of the column and were calculated by multiplying action limit times %TOC in cases when TOC was greater than 1%.

% - Percent

mg/kg - milligrams per kilogram

EPA - Environmental Protection Agency

Table 6-6: Sediment Analytical Results for Colonels Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID:		DRYA-CC1-SD-01				DRYB-CC1-SD-01				WETA-CC1-SD-01			
Date Sampled:	Project Action Limit for Sediment	7/20/2009				7/21/2009				3/31/2009			
Matrix:		Sediment (Assoc. w/SW)				Sediment (Assoc. w/SW)				Sediment (Assoc. w/SW)			
Analyte:	**(mg/kg)**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**
Metals (SW6020)													
Antimony	12	0.062	U	0.062	0.99	0.062	U	0.062	0.99	0.056	U	0.056	0.89
Copper	34	0.15	U	0.15	2	0.15	U	0.15	2	0.13	U	0.13	1.8
Lead	47	**0.96**	J	0.078	2	**0.89**	J	0.078	2	**0.46**	J	0.069	1.8
Tungsten	~	2	U	0.076	2	2	U	0.076	2	0.068	U	0.068	1.8
Zinc	150	0.7	U	0.7	9.9	0.7	U	0.7	9.9	**0.67**	J	0.63	8.9
Explosives (SW8330A)													
TNB	0.002	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04
DNB	0.007	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04
TNT	0.092	0.04	U	0.006	0.04	0.04	U	0.006	0.04	0.04	U	0.006	0.04
2,4-DNT	0.075	0.04	U	0.007	0.04	0.04	U	0.007	0.04	0.04	U	0.007	0.04
2,6-DNT	0.021	0.04	U	0.003	0.04	0.04	U	0.002	0.04	0.04	U	0.003	0.04
2-A-4,6-DNT	~	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04
4-A-2,6-DNT	~	0.04	U	0.008	0.04	0.04	U	0.008	0.04	0.04	U	0.008	0.04
HMX	0.005	0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.08	U	0.014	0.08
NB	0.488	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04
NG	~	4	U	0.65	4	4	U	0.65	4	4	U	0.65	4
RDX	0.013	0.08	U	0.012	0.08	0.08	U	0.012	0.08	0.08	U	0.012	0.08
Tetryl	53.4	0.08	U	0.022	0.08	0.08	U	0.022	0.08	0.08	U	0.022	0.08
m-NT	~	0.08	U	0.025	0.08	0.08	U	0.025	0.08	0.08	U	0.025	0.08
o-NT	~	0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.08	U	0.014	0.08
p-NT	~	0.08	U	0.034	0.08	0.08	U	0.034	0.08	0.08	U	0.034	0.08
TOC (Walkley Black)		**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**
Total Organic Carbon (TOC)	~	**0.059**	--	0.01	0.01	**0.081**	--	0.01	0.01	0.12	U	0.12	0.12

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

~ no action limit

-- no qualifier

J - estimated

U - not detected

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

Footnotes:

a Modified action limits apply to the sample to the right of the column and were calculated by multiplying action limit times %TOC in cases when TOC was greater than 1%.

% - Percent

mg/kg - milligrams per kilogram

EPA - Environmental Protection Agency

Table 6-6: Sediment Analytical Results for Colonels Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID: / Date Sampled: / Matrix:	Project Action Limit for Sediment	Modified Action Limit [a]	DRYA-CC2-SD-01 7/22/2009 Sediment (Assoc. w/SW)				Modified Action Limit [a]	DRYB-CC2-SD-01 7/21/2009 Sediment (Assoc. w/SW)				WETA-CC2-SD-01 3/31/2009 Sediment (Assoc. w/SW)			
Analyte:	**(mg/kg)**	**(mg/kg)**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**(mg/kg)**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**
Metals (SW6020)															
Antimony	12		0.062	U	0.062	0.99		0.063	U	0.063	0.99	0.065	U	0.065	1
Copper	34		**27.4**	--	0.15	2		**22.8**	--	0.15	2	**2.8**	--	0.15	2.1
Lead	47		**60.9**	--	0.078	2		**36.6**	--	0.079	2	**6**	--	0.08	2
Tungsten	~		2	U	0.076	2		2	U	0.077	2	**0.086**	J	0.079	2.1
Zinc	150		**12.9**	--	0.7	9.9		**9**	J	0.71	9.9	**1.2**	J	0.73	10.3
Explosives (SW8330A)															
TNB	0.002	0.012	0.08	U	0.01	0.08	0.000	0.04	U	0.005	0.04	0.04	U	0.005	0.04
DNB	0.007	0.041	0.08	U	0.01	0.08	0.001	0.04	U	0.005	0.04	**0.038**	J	0.005	0.04
TNT	0.092	0.543	0.08	U	0.012	0.08	0.014	0.04	U	0.006	0.04	0.04	U	0.006	0.04
2,4-DNT	0.075		0.08	U	0.015	0.08		0.04	U	0.007	0.04	0.04	U	0.007	0.04
2,6-DNT	0.021		0.08	U	0.005	0.08		0.04	U	0.002	0.04	0.04	U	0.003	0.04
2-A-4,6-DNT	~		0.08	U	0.01	0.08		0.04	U	0.005	0.04	0.04	U	0.005	0.04
4-A-2,6-DNT	~		0.08	U	0.016	0.08		0.04	U	0.008	0.04	0.04	U	0.008	0.04
HMX	0.005	0.030	0.16	U	0.028	0.16	0.001	0.08	U	0.014	0.08	0.08	U	0.014	0.08
NB	0.488		0.08	U	0.01	0.08		0.04	U	0.005	0.04	0.04	U	0.005	0.04
NG	~		8	U	1.3	8		4	U	0.65	4	4	U	0.65	4
RDX	0.013	0.077	0.16	U	0.024	0.16	0.002	0.08	U	0.012	0.08	0.08	U	0.012	0.08
Tetryl	53.4		0.16	U	0.044	0.16		0.08	U	0.022	0.08	0.08	U	0.022	0.08
m-NT	~		0.16	U	0.05	0.16		0.08	U	0.025	0.08	0.08	U	0.025	0.08
o-NT	~		0.16	U	0.028	0.16		0.08	U	0.014	0.08	0.08	U	0.014	0.08
p-NT	~		0.16	U	0.068	0.16		0.08	U	0.034	0.08	0.08	U	0.034	0.08
TOC (Walkley Black)			**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**		**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**
Total Organic Carbon (TOC)	~		**5.9**	--	0.01	0.01		**5.0**	--	0.01	0.01	0.15	U	0.15	0.15

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

~ no action limit

-- no qualifier

J - estimated

U - not detected

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

Footnotes:

a Modified action limits apply to the sample to the right of the column and were calculated by multiplying action limit times %TOC in cases when TOC was greater than 1%.

% - Percent

mg/kg - milligrams per kilogram

EPA - Environmental Protection Agency

Table 6-6: Sediment Analytical Results for Colonels Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID: / Date Sampled: / Matrix:	Project Action Limit for Sediment	Modified Action Limit [a]	DRYA-CC3-SD-01 7/20/2009 Sediment (Assoc. w/SW)				Modified Action Limit [a]	DRYB-CC3-SD-01 7/21/2009 Sediment (Assoc. w/SW)				WETA-CC3-SD-01 3/31/2009 Sediment (Assoc. w/SW)			
Analyte:	(mg/kg)	(mg/kg)	Conc (mg/kg)	Q	MDL	RL	(mg/kg)	Conc (mg/kg)	Q	MDL	RL	Conc (mg/kg)	Q	MDL	RL
Metals (SW6020)															
Antimony	12		0.063	U	0.063	0.99		0.063	U	0.063	0.99	0.25	U	0.25	4
Copper	34		**2.3**	--	0.15	2		**2.7**	--	0.15	2	**12.4**	--	0.6	8
Lead	47		**7.9**	--	0.079	2		**8.8**	--	0.078	2	**24.2**	--	0.29	7.4
Tungsten	~		2	U	0.077	2		2	U	0.076	2	0.31	U	0.31	8
Zinc	150		9.9	U	0.71	9.9		**4.4**	J	0.7	9.9	**25.5**	J	2.8	39.9
Explosives (SW8330A)															
TNB	0.002	0.004	0.04	U	0.005	0.04	0.003	0.04	U	0.005	0.04	0.08	U	0.01	0.08
DNB	0.007	0.013	0.04	U	0.005	0.04	0.011	0.04	U	0.005	0.04	0.08	U	0.01	0.08
TNT	0.092	0.166	0.04	U	0.006	0.04	0.138	0.04	U	0.006	0.04	0.08	U	0.012	0.08
2,4-DNT	0.075		0.04	U	0.007	0.04		0.04	U	0.007	0.04	0.08	U	0.015	0.08
2,6-DNT	0.021		0.04	U	0.003	0.04		0.04	U	0.003	0.04	0.08	U	0.005	0.08
2-A-4,6-DNT	~		0.04	U	0.005	0.04		0.04	U	0.005	0.04	0.08	U	0.01	0.08
4-A-2,6-DNT	~		0.04	U	0.008	0.04		0.04	U	0.008	0.04	0.08	U	0.016	0.08
HMX	0.005	0.009	0.08	U	0.014	0.08	0.008	0.08	U	0.014	0.08	0.16	U	0.028	0.16
NB	0.488		0.04	U	0.005	0.04		0.04	U	0.005	0.04	0.08	U	0.01	0.08
NG	~		4	U	0.65	4		4	U	0.65	4	8	U	1.3	8
RDX	0.013	0.023	0.08	U	0.012	0.08	0.020	0.08	U	0.012	0.08	0.16	U	0.024	0.16
Tetryl	53.4		0.08	U	0.022	0.08		0.08	U	0.022	0.08	0.16	U	0.044	0.16
m-NT	~		0.08	U	0.025	0.08		0.08	U	0.025	0.08	0.16	U	0.05	0.16
o-NT	~		0.08	U	0.014	0.08		0.08	U	0.014	0.08	0.16	U	0.028	0.16
p-NT	~		0.08	U	0.034	0.08		0.08	U	0.034	0.08	0.16	U	0.068	0.16
TOC (Walkley Black)			**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**		**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**
Total Organic Carbon (TOC)	~		**1.8**	--	0.01	0.01		**1.5**	--	0.01	0.01	0.54	U	0.54	0.54

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

~ no action limit

-- no qualifier

J - estimated

U - not detected

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

Footnotes:

a Modified action limits apply to the sample to the right of the column and were calculated by multiplying action limit times %TOC in cases when TOC was greater than 1%.

% - Percent

mg/kg - milligrams per kilogram

EPA - Environmental Protection Agency

Table 6-6: Sediment Analytical Results for Colonels Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID:		DRYA-JC1-SD-01				DRYB-JC1-SD-01				DRYB-JC1-SD-02				WETA-JC1-SD-01			
Date Sampled:	Project Action Limit for Sediment	7/20/2009				7/21/2009				7/21/2009				3/31/2009			
Matrix:		Sediment (Assoc. w/SW)				Sediment (Assoc. w/SW)				Sediment (Assoc. w/SW)				Sediment (Assoc. w/SW)			
Analyte:	**(mg/kg)**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**
Metals (SW6020)																	
Antimony	12	0.063	U	0.063	1	0.063	U	0.063	1	0.062	U	0.062	0.99	0.06	U	0.06	0.95
Copper	34	**0.27**	J	0.15	2	**0.6**	J	0.15	2	**0.29**	J	0.15	2	**0.28**	J	0.14	1.9
Lead	47	**1.6**	J	0.079	2	**1.5**	J	0.079	2	**1.8**	J	0.078	2	**1**	J	0.071	1.8
Tungsten	~	2	U	0.077	2	2	U	0.077	2	2	U	0.076	2	0.073	U	0.073	1.9
Zinc	150	10	U	0.71	10	10	U	0.71	10	0.7	U	0.7	9.9	**1.3**	J	0.67	9.5
Explosives (SW8330A)																	
TNB	0.002	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04
DNB	0.007	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04
TNT	0.092	0.04	U	0.006	0.04	0.04	U	0.006	0.04	0.04	U	0.006	0.04	0.04	U	0.006	0.04
2,4-DNT	0.075	0.04	U	0.007	0.04	0.04	U	0.007	0.04	0.04	U	0.007	0.04	0.04	U	0.007	0.04
2,6-DNT	0.021	0.04	U	0.003	0.04	0.04	U	0.003	0.04	0.04	U	0.003	0.04	0.04	U	0.003	0.04
2-A-4,6-DNT	~	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04
4-A-2,6-DNT	~	0.04	U	0.008	0.04	0.04	U	0.008	0.04	0.04	U	0.008	0.04	0.04	U	0.008	0.04
HMX	0.005	0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.08	U	0.014	0.08
NB	0.488	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04
NG	~	4	U	0.65	4	4	U	0.65	4	4	U	0.65	4	4	U	0.65	4
RDX	0.013	0.08	U	0.012	0.08	0.08	U	0.012	0.08	0.08	U	0.012	0.08	0.08	U	0.012	0.08
Tetryl	53.4	0.08	U	0.022	0.08	0.08	U	0.022	0.08	0.08	U	0.022	0.08	0.08	U	0.022	0.08
m-NT	~	0.08	U	0.025	0.08	0.08	U	0.025	0.08	0.08	U	0.025	0.08	0.08	U	0.025	0.08
o-NT	~	0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.08	U	0.014	0.08
p-NT	~	0.08	U	0.034	0.08	0.08	U	0.034	0.08	0.08	U	0.034	0.08	0.08	U	0.034	0.08
TOC (Walkley Black)		**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**
Total Organic Carbon (TOC)	~	**0.12**	--	0.01	0.01	**0.08**	--	0.01	0.01	**0.1**	--	0.01	0.01	0.13	U	0.13	0.13

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

~ no action limit

-- no qualifier

J - estimated

U - not detected

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

Footnotes:

a Modified action limits apply to the sample to the right of the column and were calculated by multiplying action limit times %TOC in cases when TOC was greater than 1%.

% - Percent

mg/kg - milligrams per kilogram

EPA - Environmental Protection Agency

Table 6-7: Sediment Analytical Results for Cedar Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID:		DRYA-WL1-SD-01					DRYB-WL1-SD-01				WETA-WL1-SD-02				DRYA-WL2-SD-01				DRYB-WL2-SD-01			
Date Sampled:	Project Action Limit for Sediment	7/21/2009				Modified Action Limit [a]	7/22/2009				4/2/2009				7/21/2009				7/22/2009			
Matrix:		Sediment (Assoc. w/SW)					Sediment (Assoc. w/SW)				Sediment (Assoc. w/SW)				Sediment (Assoc. w/SW)				Sediment (Assoc. w/SW)			
Analyte:	**(mg/kg)**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**(mg/kg)**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**
Metals (SW6020)																						
Antimony	12	0.062	U	0.062	0.99		0.063	U	0.063	0.99	**0.32**	J	0.087	1.4	0.062	U	0.062	0.99	0.063	U	0.063	0.99
Copper	34	**10.1**	--	0.15	2		**6.4**	--	0.15	2	**6.1**	--	0.21	2.8	**1.2**	J	0.15	2	**4.7**	--	0.15	2
Lead	47	**7.3**	--	0.078	2		**15.7**	--	0.079	2	**10.4**	--	0.11	2.7	**4.9**	--	0.078	2	**17.2**	--	0.078	2
Tungsten	~	2	U	0.076	2		2	U	0.077	2	0.11	U	0.11	2.8	2	U	0.076	2	2	U	0.076	2
Zinc	150	**92.7**	--	0.7	9.9		**17.7**	--	0.71	9.9	**14.1**	--	0.98	13.8	**3.8**	J	0.7	9.9	**11.4**	--	0.71	9.9
Explosives (SW8330A)																						
TNB	0.002	0.04	U	0.005	0.04	0.002	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04
DNB	0.007	0.04	U	0.005	0.04	0.008	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04
TNT	0.092	0.04	U	0.006	0.04	0.101	0.04	U	0.006	0.04	0.04	U	0.006	0.04	0.04	U	0.006	0.04	0.04	U	0.006	0.04
2,4-DNT	0.075	0.04	U	0.007	0.04		0.04	U	0.007	0.04	0.04	U	0.007	0.04	0.04	U	0.007	0.04	0.04	U	0.007	0.04
2,6-DNT	0.021	0.04	U	0.003	0.04		0.04	U	0.003	0.04	0.04	U	0.003	0.04	0.04	U	0.003	0.04	0.04	U	0.003	0.04
2-A-4,6-DNT	~	0.04	U	0.005	0.04		0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04
4-A-2,6-DNT	~	0.04	U	0.008	0.04		0.04	U	0.008	0.04	0.04	U	0.008	0.04	0.04	U	0.008	0.04	0.04	U	0.008	0.04
HMX	0.005	0.08	U	0.014	0.08	0.006	0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.08	U	0.014	0.08
NB	0.488	0.04	U	0.005	0.04		0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04	0.04	U	0.005	0.04
NG	~	4	U	0.65	4		4	U	0.65	4	4	U	0.65	4	4	U	0.65	4	4	U	0.65	4
RDX	0.013	0.08	U	0.012	0.08	0.014	0.08	U	0.012	0.08	0.08	U	0.012	0.08	0.08	U	0.012	0.08	0.08	U	0.012	0.08
Tetryl	53.4	0.08	U	0.022	0.08		0.08	U	0.022	0.08	0.08	U	0.022	0.08	0.08	U	0.022	0.08	0.08	U	0.022	0.08
m-NT	~	0.08	U	0.025	0.08		0.08	U	0.025	0.08	0.08	U	0.025	0.08	0.08	U	0.025	0.08	0.08	U	0.025	0.08
o-NT	~	0.08	U	0.014	0.08		0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.08	U	0.014	0.08	0.08	U	0.014	0.08
p-NT	~	0.08	U	0.034	0.08		0.08	U	0.034	0.08	0.08	U	0.034	0.08	0.08	U	0.034	0.08	0.08	U	0.034	0.08
TOC (Walkley Black)		**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**		**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**	**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**
Total Organic Carbon (TOC)	~	**0.38**	--	0.01	0.01		**1.1**	--	0.01	0.01	**0.43**	--	0.19	0.19	**0.53**	--	0.01	0.01	**0.67**	--	0.01	0.01

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

~ no action limit

-- no qualifier

J - estimated

U - not detected

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

Footnotes:

a Modified action limits apply to the sample to the right of the column and were calculated by multiplying action limit times %TOC in cases when TOC was greater than 1%.

% - Percent

mg/kg - milligrams per kilogram

EPA - Environmental Protection Agency

Table 6-7: Sediment Analytical Results for Cedar Creek Watershed
Fort Jackson and McCrady Training Center, SC

Sample ID: / Date Sampled: / Matrix:	Project Action Limit for Sediment	Modified Action Limit [a]	WETA-WL2-SD-01 4/2/2009 Sediment (Assoc. w/SW)			
Analyte:	**(mg/kg)**	**(mg/kg)**	**Conc (mg/kg)**	**Q**	**MDL**	**RL**
Metals (SW6020)						
Antimony	12		**1.2**	J	0.66	10.5
Copper	34		**36.3**	--	1.6	21
Lead	47		**54.3**	--	0.82	20.9
Tungsten	~		0.81	U	0.81	21
Zinc	150		**59.1**	J	7.5	105
Explosives (SW8330A)						
TNB	0.002	0.006	0.08	U	0.01	0.08
DNB	0.007	0.020	0.08	U	0.01	0.08
TNT	0.092	0.258	0.08	U	0.012	0.08
2,4-DNT	0.075		0.08	U	0.015	0.08
2,6-DNT	0.021		0.08	U	0.005	0.08
2-A-4,6-DNT	~		0.08	U	0.01	0.08
4-A-2,6-DNT	~		0.08	U	0.016	0.08
HMX	0.005	0.014	0.16	U	0.028	0.16
NB	0.488		0.08	U	0.01	0.08
NG	~		8	U	1.3	8
RDX	0.013	0.036	0.16	U	0.024	0.16
Tetryl	53.4		0.16	U	0.044	0.16
m-NT	~		0.16	U	0.05	0.16
o-NT	~		0.16	U	0.028	0.16
p-NT	~		0.16	U	0.068	0.16
TOC (Walkley Black)			**Conc (%)**	**Q**	**MDL (%)**	**RL (%)**
Total Organic Carbon (TOC)	~		**2.8**	--	1.4	1.4

Notes:

Bold - Detected

Blue - Exceeds Project Action Limit

SW - Surface Water

~ no action limit

-- no qualifier

J - estimated

U - not detected

Q - data qualifier

MDL - Method Detection Limit

RL - Method Reporting Limit

Footnotes:

a Modified action limits apply to the sample to the right of the column and were calculated by multiplying action limit times %TOC in cases when TOC was greater than 1%.

% - Percent

mg/kg - milligrams per kilogram

EPA - Environmental Protection Agency

Table 6-8 Benthic Macroinvertebrate Analytical Data Summary
Fort Jackson and McCrady Training Center, SC

Sample ID: / Date Sampled:	WETA-CC1 -BM-01 03/30/09	WETA-CC1-BM-02 03/30/09	WETA-CC1-BM-03 03/30/09	WETA-CC1 - Combined 03/30/09	DRYA-CC1-BM-01 07/20/09	DRYA-CC1 -BM-02 07/20/09	DRYA-CC1 -BM-03 07/20/09	DRYA-CC1 - Combined 07/20/09
Shannon's diversity index	3.196	3.465	3.483	3.719	2.59	2.29	2.84	2.68
Species Richness	46	55	38	81	45	52	45	72
EPT Richness	9	11	10	18	14	11	10	18
Percent EPT	19	15	31	20	53	64	38	53

Sample ID: / Date Sampled:	WETA-CC2 -BM-01 03/31/09	WETA-CC2 -BM-02 03/31/09	WETA-CC2 -BM-03 03/31/09	WETA-CC2 - Combined 03/31/09	
Shannon's diversity index	2.282	2.31	2.094	2.367	No flowing or standing water present at CC2 during dry season event
Species Richness	17	17	16	26	
EPT Richness	4	3	3	4	
Percent EPT	40	32	57	44	

Sample ID: / Date Sampled:	WETA-CC3 -BM-01 03/31/09	WETA-CC3 -BM-02 03/31/09	WETA-CC3 -BM-03 03/31/09	WETA-CC3 - Combined 03/31/09	DRYA-CC3 -BM-01 07/20/09	DRYA-CC3 -BM-02 07/20/09	DRYA-CC3 -BM-03 07/20/09	DRYA-CC3 - Combined 07/20/09
Shannon's diversity index	3.27	3.536	3.358	3.813	3.29	3.04	2.96	3.27
Species Richness	36	40	44	77	57	55	54	85
EPT Richness	11	9	12	21	18	16	16	25
Percent EPT	22	18	38	28	52	53	53	53

Sample ID: / Date Sampled:	WETA-JC1 -BM-01 03/31/09	WETA-JC1 -BM-02 03/31/09	WETA-JC1 -BM-03 03/31/09	WETA-JC1 - Combined 03/31/09	DRYA-JC1 -BM-01 07/20/09	DRYA-JC1 -BM-02 07/20/09	DRYA-JC1 -BM-03 07/20/09	DRYA-JC1 - Combined 07/20/09
Shannon's diversity index	3.067	3.318	3.348	3.724	2.1	1.42	1.54	1.85
Species Richness	39	33	42	68	31	24	23	45
EPT Richness	10	8	13	16	10	7	7	11
Percent EPT	31	28	37	33	77	82	82	80

Footnotes:

BM - Benthic Macroinvertebrates

EPT - Ephemeroptera, Trichoptera and Plecoptera

WL - Westin Lake CC - Colonels Creek

GC - Gills Creek JC - Jumping Run Creek

Calculations for 'Combined' samples are as follows: Shannon's diversity Index and Percent EPT are the mean of the 3 samples; Species Richness and EPT Richness consist of the count of individual species from the 3 samples minus recurring species (i.e., pool the species list for the 3 samples and count the unique species).

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Table 6-9: Groundwater Elevation Data
Fort Jackson and McCrady Training Center, SC

Location ID	Ground Elevation (ft AMSL)	Riser Elevation (ft AMSL)	DTW (ft BTOR)	Groundwater Elevation (ft AMSL)	DTW (ft BTOR)	Groundwater Elevation (ft AMSL)	DTW (ft BTOR)	Groundwater Elevation (ft AMSL)	DTW (ft BTOR)	Groundwater Elevation (ft AMSL)
			4/7/2009		4/13/2009		6/1/2009		7/29/2009	
P-1	277.59	279.41	2.45	276.96	2.52	276.89	2.05	277.36	2.12	277.29
SG-1	276.36	278.68	1.98	276.7	2	276.68	1.4	277.28	1.49	277.19
P-2	275.99	278.69	3.15	275.54	2.88	275.81	3.13	275.56	3.29	275.4
P-3[1]	274.81	276.48	dry	--	3.53	272.95	dry	--	dry	--
SG-3	273.01	275.69	1.64	274.05	2.13	273.56	1.64	274.05	1.77	273.92
P-4	253.24	255.9	4.32	251.58	3.67	252.23	3.18	252.72	4.7	251.2
SG-4	252.37	256.6	3.85	252.75	3.94	252.66	3.99	252.61	4.2	252.4
P-5	222.9	224.66	2.64	222.02	2.61	222.05	2.53	222.13	2.76	221.9
SG-5	220.71	223.16	NM	--	1.89	221.27	1.89	221.27	1.88	221.28
P-6	220.69	222.71	4.15	218.56	3.9	218.81	NM	--	4.15	218.56
SG-6	216.93	220.48	2.47	218.01	2.6	217.88	NM	--	2.6	217.88
P-7	288.34	290.69	13.82	276.87	13.82	276.87	13.07	277.62	14.12	276.57
P-8	337.63	340.5	66.83	273.67	66.81	273.69	66.78	273.72	66.47	274.03
P-10	368.52	371.11	97.59	273.52	97.43	273.68	97.08	274.03	97	274.11
P-12	329.21	331.91	35.3	296.61	35.47	296.44	37.34	294.57	37.25	294.66
P-13	354.68	356.82	82.63	274.19	82.63	274.19	82.39	274.43	81.96	274.86
P-11[2]	329.89	332.06	56.8	275.26	56.75	275.31	56.3	275.76	56.39	275.67
MW-RS-1[2]	330.07	332.02	NM	--	NM	--	58.76	273.26	58.79	273.23

Footnotes:

AMSL - Above Mean Sea Level
BTOR - Below Top of Riser
MW - Monitoring Well
P - Piezometer
SG - Staff Gage
est - estimated
ft - feet

[1] P-3 dry during 07 April 2009, 01 June 2009, and 29 July 2009 measurements.

[2] Piezometer P-11 and Monitoring Well MW-RS-1 were set as paired measurement points to evaluate vertical gradients at that location.

Table 6-9: Groundwater Elevation Data
Fort Jackson and McCrady Training Center, SC

Location ID	Ground Elevation (ft AMSL)	Riser Elevation (ft AMSL)	DTW (ft BTOR)	Groundwater Elevation (ft AMSL)	DTW (ft BTOR)	Groundwater Elevation (ft AMSL)	DTW (ft BTOR)	Groundwater Elevation (ft AMSL)
			7/10/2012		10/15/2012		2/12/2012	
MW-RS-02S	350.5	352.89	80.39	272.50	80.70	272.19	81.61	271.28
MW-RS-02D		352.92	80.49	272.43	80.68	272.24	81.70	271.22
MW-RS-03S	325.7	328.16	56.79	271.37	57.13	271.03	58.12	270.04
MW-RS-03D		328.17	57.08	271.09	NM	--	58.40	269.77
MW-RS-04S	335.2	337.57	67.33	270.24	NM	--	68.53	269.04
MW-RS-04D		337.56	67.48	270.08	NM	--	NM	--
MW-RS-05S	316.5	318.94	48.22	270.72	48.55	270.39	49.40	269.54
MW-RS-05D		318.94	48.33	270.61	48.67	270.27	49.50	269.44
MW-RS-06S	318.7	321.04	51.84	269.20	52.36	268.68	53.22	267.82
MW-RS-06D		321.03	51.88	269.15	52.39	268.64	53.52	267.51
MW-RS-07S	328.7	331.27	63.81	267.46	64.35	266.92	65.10	266.17
MW-RS-07D		331.26	63.83	267.43	NM	--	65.04	266.22

Footnotes:
AMSL - Above Mean Sea Level
BTOR - Below Top of Riser
MW - Monitoring Well
P - Piezometer
SG - Staff Gage
est - estimated
ft - feet
[1] P-3 dry during 07 April 2009, 01 June 2009, and 29 July 2009 measurements.
[2] Piezometer P-11 and Monitoring Well MW-RS-1 were set as paired measurement points to evaluate vertical gradients at that location.

Table 6-10: Groundwater Quality Measurements – 2009 Groundwater Sampling
Fort Jackson and McCrady Training Center, SC

Sample ID	Date Collected	Time Collected	Temperature (°C)	pH	Spec. Conductance (mS/Cm)	Turbidity (NTU)	DO (mg/L)	ORP (MV)
GWI-SB3-WT-GW-01	5/11/2009	1840	21.6	5.34	0.025	8.0	5.03	83
GWI-SB3+20-GW-01	5/12/2009	1300	20.18	5.99	0.007	2.5	6.59	141
GWI-SB3+44-GW-01	5/12/2009	1550	20.33	5.82	0.005	13.2	6.38	173
GWI-SB3+58-GW-01	5/13/2009	958	20.24	5.99	0.008	3.1	4.59	92
GWI-SB3+73-GW-01	5/13/2009	1420	21.84	6.12	0.012	86.0	3.55	86
GWI-SB3+97-GW-01	5/14/2009	1015	20.41	5.58	0.008	14.5	7.19	157
GWI-SB3+120-GW-01	5/14/2009	1310	21.23	5.95	0.011	>800	3.2	106
GWI-SB6-WT-GW-01	5/16/2009	950	25.28	6.89	0.039	>800	0.62	-205
GWI-SB6+20-GW-01	5/16/2009	1335	25.43	5.92	0.014	>800	3.93	107
GWI-SB6+54GW-01	5/17/2009	945	19.77	5.58	0.009	16.8	10.07	163
GWI-SB6+78-GW-01	5/17/2009	1335	20.57	5.45	0.007	47.2	5.50	237
GWI-SB5-WT-GW-01	5/18/2009	1825	21.28	5.65	0.009	7.9	9.8	152
GWI-SB5-+20-GW-01	5/19/2009	1205	20.13	5.54	0.009	3.8	8.34	173
GWI-SB5+36-GW-01	5/19/2009	1730	20.68	5.75	0.011	7.5	11.7	173
GWI-SB5+62-GW-01	5/20/2009	1115	20.16	5.57	0.009	4.8	10.5	178
GWI-SB5+78-GW-01	5/27/2009	1615	20.72	5.51	0.009	3.2	4.25	114
GWI-SB5+117-GW-01	5/28/2009	1142	19.76	4.96	0.007	0.0	10.28	186
GWI-SB5+105-GW-01	5/28/2009	1515	22.65	6.29	0.019	16.4	2.36	64
GWI-SB4-WT-GW-01	5/30/2009	1345	20.27	5.35	0.006	18.9	9.34	152
GWI-SB4+20-GW-01	5/30/2009	1800	21.12	5.57	0.009	11.5	9.3	90
GWI-SB4+43-GW-01	5/31/2009	1350	22.34	7.07	0.034	61.5	1.9	-107
GWI-SB4+63-GW-01	5/31/2009	1815	21.62	5.52	0.009	4.2	5.30	84
GWI-SB4+77-GW-01	6/1/2009	1605	20.64	5.19	0.006	0.9	7.22	148
GWI-SB2+23-GW-01	6/3/2009	1320	19.18	5.31	0.006	5.8	8.05	150
GWI-SB2+40-GW-01	6/3/2009	1030	27.73	6.36	0.026	113.0	2.36	-176
GWI-SB2+58-GW-01	6/4/2009	900	19.02	5.16	0.006	1.0	10.31	109
GW1-P1-GW-01	6/4/2009	1102	21.38	5.59	0.030	0.0	5.92	-30
GW1-P7-GW-01	6/4/2009	1424	17.34	5.26	0.009	0.0	9.89	205
GW1-WL1-GW-01	6/10/2009	1158	22.36	9.81	0.049	18.5	14.33	32

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Table 6-11: 2009 Groundwater Sampling - Inorganic Analytical Data
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL[a]	RL[a]	GW1-P1-GW-01 1.6-2.1 6/4/2009 Groundwater		GW1-P1-GW-01-FIL 1.6-2.1 6/4/2009 Groundwater		GW1-P7-GW-01 19.5-24.5 6/4/2009 Groundwater		GW1-P7-GW-01-FIL 19.5-24.5 6/4/2009 Groundwater		GW1-SB2-23-GW-01 86-91 6/3/2009 Groundwater		GW1-SB2-23-GW-01-FIL 86-91 6/3/2009 Groundwater		GW1-SB2-40-GW-01 103-108 6/3/2009 Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Total and Dissolved Metals (EPA 200.8)[g]																		
Antimony	5.6	3.36	0.05 (0.25)[b]	0.5 (2.5)[b]	0.5	U	--	--	0.5	U	--	--	0.5	U	--	--	**0.062**	J
Copper	1,300	650	0.3 (1.5)[b]	1 (5)[b]	**0.57**	J	--	--	**2.2**	--	--	--	**1.6**	--	--	--	**1.3**	--
Lead	15	7.5	0.038 (0.19)[b]	1 (5)[b]	1	U	--	--	1	U	--	--	**0.21**	J	--	--	**0.26**	J
Tungsten	~	~	0.04 (0.2)[b]	1 (5)[b]	1	U	--	--	1	U	--	--	1	U	--	--	1	U
Zinc	4,700	2,820	5 (25)[c]	5 (25)[c]	**6.4**	--	--	--	**30.1**	--	--	--	**438**	--	--	--	**3,200**	--
Hardness Metals (EPA E200.7)																		
Calcium	~	~	41 (33)[d]	500	--	--	**274**	J	--	--	**743**	--	**--**	--	**304**	J	--	--
Magnesium	~	~	6.5	125	--	--	**348**	--	--	--	**393**	--	--	--	**149**	--	--	--
Sodium	~	~	75	1250	--	--	**7,670**	--	--	--	**1,110**	J	--	--	**981**	J	--	--
Anions (EPA 300.0)																		
Chloride	~	~	100 (200)[e]	100 (200)[e]	--	--	--	--	**1,800**	--	--	--	**1,300**	--	--	--	**2,100**	--
Nitrate	~	~	100	100	--	--	--	--	**270**	--	--	--	**120**	J	--	--	**130**	--
Sulfate	~	~	100	100	--	--	--	--	**590**	--	--	--	**200**	--	--	--	**2,400**	--
Alkalinity (EPA 310.1)																		
Alkalinity, Total (as $CaCO_3$)	~	~	1,000	1,000	**5,000**	--	--	--	**2,000**	--	--	--	**3,000**	--	--	--	**9,000**	--
Total Dissolved Solids (SM2540C)																		
TDS	~	~	10,000	10,000	**33,000**	--	--	--	**15,000**	--	--	--	**17,000**	--	--	--	**24,000**	--

Footnotes:

Bold - Detected
Blue - Greater than Project Action Limit
Green - Greater than Lower Range of Uncertainty
GW - Groundwater
FIL - field filtered
-- no qualifier
Q - data qualifier
SM - Standard Method
~ no action limit
RL - Reporting Limit
MDL - Method Detection Limit
J - estimated
ug/L - micrograms per liter
U - not detected
$CaCO_3$ - Calcium Carbonate
UJ - not-detected; RL is estimated
EPA - Environmental Protection Agency

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parenthesis for Antimony, Copper, Lead, and Tungsten apply to samples GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01

c The MDL and RLs in parenthesis for Zinc apply to samples GW1-SB2-40-GW-01, GW1-SB2-40-GW-01-FIL, GW1-SB3-WT-GW-01, GW1-SB3-WT-GW-01-FIL, GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01, GW1-WL1-GW-01-FIL

d The MDL in parenthesis apply for Calcium to samples GW1-WL1-GW-01-FIL, GW1-WL1-GW-02-FIL

e The MDLs and RLs in parenthesis apply for chloride to samples GW1-WL1-GW-01, GW1-WL1-GW-02

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G)

g Total metals, except FIL samples are dissolved metals

Table 6-11: 2009 Groundwater Sampling - Inorganic Analytical Data
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL[a]	RL[a]	GW1-SB2-40-GW-01-FIL 103-108 6/3/2009 Groundwater		GW1-SB2-58-GW-01 121-126 6/4/2009 Groundwater		GW1-SB2-58-GW-01-FIL 121-126 6/4/2009 Groundwater		GW1-SB3-WT-GW-01 57-62 5/13/2009 Groundwater		GW1-SB3-WT-GW-01-FIL 57-62 5/11/2009 Groundwater		GW1-SB3-20-GW-01 77-82 5/12/2009 Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Total and Dissolved Metals (EPA 200.8)[g]																
Antimony	5.6	3.36	0.05 (0.25)[b]	0.5 (2.5)[b]	0.5	U	0.5	U	--	--	0.5	U	0.5	U	**0.06**	J
Copper	1,300	650	0.3 (1.5)[b]	1 (5)[b]	**0.85**	J	**0.8**	J	--	--	**0.91**	J	**1.1**	--	**1.7**	--
Lead	15	7.5	0.038 (0.19)[b]	1 (5)[b]	1	U	1	U	--	--	**0.33**	J	**0.092**	J	**0.12**	J
Tungsten	~	~	0.04 (0.2)[b]	1 (5)[b]	1	U	1	U	--	--	1	U	1	U	1	U
Zinc	4,700	2,820	5 (25)[c]	5 (25)[c]	**3,140**	--	**577**	--	--	--	**1,620**	--	**1,560**	--	**330**	--
Hardness Metals (EPA E200.7)																
Calcium	~	~	41 (33)[d]	500	**406**	J	--	--	**324**	J	**591**	--	**564**	--	**332**	J
Magnesium	~	~	6.5	125	125	U	--	--	**160**	--	**616**	--	**531**	--	**170**	--
Sodium	~	~	75	1250	**5,960**	--	--	--	**1,090**	J	**3,310**	--	**3,270**	--	**1,140**	J
Anions (EPA 300.0)																
Chloride	~	~	100 (200)[e]	100 (200)[e]	--	--	**1,400**	--	--	--	**3,800**	--	--	--	**890**	J
Nitrate	~	~	100	100	--	--	**170**	--	--	--	**1,400**	--	--	--	**390**	--
Sulfate	~	~	100	100	--	--	**290**	--	--	--	**820**	J	--	--	**320**	--
Alkalinity (EPA 310.1)																
Alkalinity, Total (as $CaCO_3$)	~	~	1,000	1,000	--	--	**1,000**	J	--	--	**3,000**	--	--	--	**3,000**	--
Total Dissolved Solids (SM2540C)																
TDS	~	~	10,000	10,000	--	--	**10,000**	J	--	--	**36,000**	--	--	--	10,000	U

Footnotes:

Bold - Detected
Blue - Greater than Project Action Limit
Green - Greater than Lower Range of Uncertainty
GW - Groundwater
FIL - field filtered
-- no qualifier
Q - data qualifier
SM - Standard Method
~ no action limit
RL - Reporting Limit
MDL - Method Detection Limit
J - estimated
ug/L - micrograms per liter
U - not detected
$CaCO_3$ - Calcium Carbonate
UJ - not-detected; RL is estimated
EPA - Environmental Protection Agency

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parenthesis for Antimony, Copper, Lead, and Tungsten apply to samples GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01

c The MDL and RLs in parenthesis for Zinc apply to samples GW1-SB2-40-GW-01, GW1-SB2-40-GW-01-FIL, GW1-SB3-WT-GW-01, GW1-SB3-WT-GW-01-FIL, GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01, GW1-WL1-GW-01-FIL

d The MDL in parenthesis apply for Calcium to samples GW1-WL1-GW-01-FIL, GW1-WL1-GW-02-FIL

e The MDLs and RLs in parenthesis apply for chloride to samples GW1-WL1-GW-01, GW1-WL1-GW-02

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G)

g Total metals, except FIL samples are dissolved metals

Table 6-11: 2009 Groundwater Sampling - Inorganic Analytical Data
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL[a]	RL[a]	GW1-SB3-20-GW-01-FIL 77-82 5/12/2009 Groundwater		GW1-SB3-44-GW-01 100-105 5/12/2009 Groundwater		GW1-SB3-44-GW-01-FIL 100-105 5/12/2009 Groundwater		GW1-SB3-58-GW-01 121-126 5/13/2009 Groundwater		GW1-SB3-58-GW-01-FIL 121-126 5/13/2009 Groundwater		GW1-SB3-73-GW-01 130-135 5/13/2009 Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Total and Dissolved Metals (EPA 200.8)[g]																
Antimony	5.6	3.36	0.05 (0.25)[b]	0.5 (2.5)[b]	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Copper	1,300	650	0.3 (1.5)[b]	1 (5)[b]	**2.7**	--	**1.6**	--	**1.1**	--	**0.69**	J	**0.63**	J	**1.5**	J
Lead	15	7.5	0.038 (0.19)[b]	1 (5)[b]	**0.049**	J	**1.2**	--	**0.62**	J	**0.049**	J	**0.32**	J	**0.33**	J
Tungsten	~	~	0.04 (0.2)[b]	1 (5)[b]	1	U	1	U	1	U	1	U	1	U	1	U
Zinc	4,700	2,820	5 (25)[c]	5 (25)[c]	**273**	--	**450**	--	**441**	--	**245**	--	**237**	--	**957**	--
Hardness Metals (EPA E200.7)																
Calcium	~	~	41 (33)[d]	500	**328**	J	**224**	J	**167**	J	**446**	J	**384**	J	**503**	--
Magnesium	~	~	6.5	125	**151**	--	**193**	--	**163**	--	**281**	--	**246**	--	**223**	--
Sodium	~	~	75	1250	**1,220**	J	**609**	J	**690**	J	**1,230**	J	**1,320**	--	**2,710**	--
Anions (EPA 300.0)																
Chloride	~	~	100 (200)[e]	100 (200)[e]	--	--	**900**	--	--	--	**990**	--	--	--	**1,300**	--
Nitrate	~	~	100	100	--	--	**250**	--	--	--	**430**	--	--	--	**330**	--
Sulfate	~	~	100	100	--	--	**160**	--	--	--	**300**	--	--	--	**1,100**	--
Alkalinity (EPA 310.1)																
Alkalinity, Total (as $CaCO_3$)	~	~	1,000	1,000	--	--	**3,000**	--	--	--	**3,000**	--	--	--	**3,000**	--
Total Dissolved Solids (SM2540C)																
TDS	~	~	10,000	10,000	--	--	10,000	U	--	--	**18,000**	--	--	--	**18,000**	--

Footnotes:

Bold - Detected
Blue - Greater than Project Action Limit
Green - Greater than Lower Range of Uncertainty
GW - Groundwater
FIL - field filtered
-- no qualifier
Q - data qualifier
SM - Standard Method
~ no action limit
RL - Reporting Limit
MDL - Method Detection Limit
J - estimated
ug/L - micrograms per liter
U - not detected
$CaCO_3$ - Calcium Carbonate
UJ - not-detected; RL is estimated
EPA - Environmental Protection Agency

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parenthesis for Antimony, Copper, Lead, and Tungsten apply to samples GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01

c The MDL and RLs in parenthesis for Zinc apply to samples GW1-SB2-40-GW-01, GW1-SB2-40-GW-01-FIL, GW1-SB3-WT-GW-01, GW1-SB3-WT-GW-01-FIL, GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01, GW1-WL1-GW-01-FIL

d The MDL in parenthesis apply for Calcium to samples GW1-WL1-GW-01-FIL, GW1-WL1-GW-02-FIL

e The MDLs and RLs in parenthesis apply for chloride to samples GW1-WL1-GW-01, GW1-WL1-GW-02

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G)

g Total metals, except FIL samples are dissolved metals

Table 6-11: 2009 Groundwater Sampling - Inorganic Analytical Data
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL[a]	RL[a]	GW1-SB3-73-GW-01-FIL 130-135 5/13/2009 Groundwater		GW1-SB3-73-GW-02 130-135 5/13/2009 Groundwater		GW1-SB3-73-GW-02-FIL 130-135 5/13/2009 Groundwater		GW1-SB3-97-GW-01 154-159 5/14/2009 Groundwater		GW1-SB3-97-GW-01-FIL 154-159 5/13/2009 Groundwater		GW1-SB3-120-GW-01 181.5-182 5/14/2009 Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Total and Dissolved Metals (EPA 200.8)[g]																
Antimony	5.6	3.36	0.05 (0.25)[b]	0.5 (2.5)[b]	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Copper	1,300	650	0.3 (1.5)[b]	1 (5)[b]	**0.58**	J	**2.2**	J	**0.56**	J	**0.94**	J	**0.77**	J	**10**	--
Lead	15	7.5	0.038 (0.19)[b]	1 (5)[b]	**0.078**	J	**0.54**	J	**0.37**	J	**0.2**	J	**0.074**	J	**3**	--
Tungsten	~	~	0.04 (0.2)[b]	1 (5)[b]	1	U	1	U	1	U	1	U	1	U	1	U
Zinc	4,700	2,820	5 (25)[c]	5 (25)[c]	**934**	--	**1,010**	--	**1,110**	--	**529**	--	**465**	--	**44.1**	--
Hardness Metals (EPA E200.7)																
Calcium	~	~	41 (33)[d]	500	**513**	--	**599**	--	**472**	J	**435**	J	**395**	J	**1,600**	--
Magnesium	~	~	6.5	125	**189**	--	**211**	--	**197**	--	**157**	--	**130**	--	**316**	--
Sodium	~	~	75	1250	**2,950**	--	**2,870**	--	**2,950**	--	**1,600**	--	**1,730**	--	**1,420**	--
Anions (EPA 300.0)																
Chloride	~	~	100 (200)[e]	100 (200)[e]	--	--	**1,300**	--	--	--	**1,200**	J	--	--	**1,200**	J
Nitrate	~	~	100	100	--	--	**350**	--	--	--	**280**	--	--	--	**140**	--
Sulfate	~	~	100	100	--	--	100	U	--	--	**480**	--	--	--	**660**	--
Alkalinity (EPA 310.1)																
Alkalinity, Total (as $CaCO_3$)	~	~	1,000	1,000	--	--	**3,000**	--	--	--	**3,000**	--	--	--	**5,000**	--
Total Dissolved Solids (SM2540C)																
TDS	~	~	10,000	10,000	--	--	**13,000**	--	--	--	10,000	U	--	--	10,000	U

Footnotes:

Bold - Detected
Blue - Greater than Project Action Limit
Green - Greater than Lower Range of Uncertainty
GW - Groundwater
FIL - field filtered
-- no qualifier
Q - data qualifier
SM - Standard Method
~ no action limit
RL - Reporting Limit
MDL - Method Detection Limit
J - estimated
ug/L - micrograms per liter
U - not detected
$CaCO_3$ - Calcium Carbonate
UJ - not-detected; RL is estimated
EPA - Environmental Protection Agency

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parenthesis for Antimony, Copper, Lead, and Tungsten apply to samples GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01

c The MDL and RLs in parenthesis for Zinc apply to samples GW1-SB2-40-GW-01, GW1-SB2-40-GW-01-FIL, GW1-SB3-WT-GW-01, GW1-SB3-WT-GW-01-FIL, GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01, GW1-WL1-GW-01-FIL

d The MDL in parenthesis apply for Calcium to samples GW1-WL1-GW-01-FIL, GW1-WL1-GW-02-FIL

e The MDLs and RLs in parenthesis apply for chloride to samples GW1-WL1-GW-01, GW1-WL1-GW-02

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G)

g Total metals, except FIL samples are dissolved metals

Table 6-11: 2009 Groundwater Sampling - Inorganic Analytical Data
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL[a]	RL[a]	GW1-SB3-120-GW-01-FIL 181.5-182 5/13/2009 Groundwater		GW1-SB4-WT-GW-01 113-118 5/30/2009 Groundwater		GW1-SB4-WT-GW-01-FIL 113-118 5/30/2009 Groundwater		GW1-SB4-20-GW-01 133-138 5/30/2009 Groundwater		GW1-SB4-20-GW-01-FIL 133-138 5/30/2009 Groundwater		GW1-SB4-43-GW-01 151-161 5/31/2009 Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Total and Dissolved Metals (EPA 200.8)[g]																
Antimony	5.6	3.36	0.05 (0.25)[b]	0.5 (2.5)[b]	0.5	U	0.5	U	0.5	U	0.5	U	**0.12**	J	**0.074**	J
Copper	1,300	650	0.3 (1.5)[b]	1 (5)[b]	**0.85**	J	1.2[f]	U	1	U	1.4[f]	U	1	U	3.5[f]	U
Lead	15	7.5	0.038 (0.19)[b]	1 (5)[b]	**0.079**	J	1	U	1	U	1	U	1	U	1	U
Tungsten	~	~	0.04 (0.2)[b]	1 (5)[b]	1	U	1	U	1	U	1	U	1	U	1	U
Zinc	4,700	2,820	5 (25)[c]	5 (25)[c]	**27.2**	--	355[f]	U	**239**	--	**540**	--	**433**	--	**836**	--
Hardness Metals (EPA E200.7)																
Calcium	~	~	41 (33)[d]	500	**850**	--	--	--	500	U	--	--	**261**	J	--	--
Magnesium	~	~	6.5	125	**186**	--	--	--	**96**	J	--	--	**69**	J	--	--
Sodium	~	~	75	1250	**1,490**	--	--	--	**1,560**	--	--	--	**2,600**	--	--	--
Anions (EPA 300.0)																
Chloride	~	~	100 (200)[e]	100 (200)[e]	--	--	**1,200**	--	--	--	**1,400**	--	--	--	**2,000**	--
Nitrate	~	~	100	100	--	--	**140**	J	--	--	**120**	J	--	--	**100**	J
Sulfate	~	~	100	100	--	--	**540**	--	--	--	**650**	--	--	--	**1,200**	--
Alkalinity (EPA 310.1)																
Alkalinity, Total (as $CaCO_3$)	~	~	1,000	1,000	--	--	**2,000**	--	--	--	**2,000**	--	--	--	**20,000**	--
Total Dissolved Solids (SM2540C)																
TDS	~	~	10,000	10,000	--	--	**12,000**	--	--	--	**15,000**	--	--	--	**24,000**	--

Footnotes:

Bold - Detected
Blue - Greater than Project Action Limit
Green - Greater than Lower Range of Uncertainty
GW - Groundwater
FIL - field filtered
-- no qualifier
Q - data qualifier
SM - Standard Method
~ no action limit
RL - Reporting Limit
MDL - Method Detection Limit
J - estimated
ug/L - micrograms per liter
U - not detected
$CaCO_3$ - Calcium Carbonate
UJ - not-detected; RL is estimated
EPA - Environmental Protection Agency

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parenthesis for Antimony, Copper, Lead, and Tungsten apply to samples GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01

c The MDL and RLs in parenthesis for Zinc apply to samples GW1-SB2-40-GW-01, GW1-SB2-40-GW-01-FIL, GW1-SB3-WT-GW-01, GW1-SB3-WT-GW-01-FIL, GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01, GW1-WL1-GW-01-FIL

d The MDL in parenthesis apply for Calcium to samples GW1-WL1-GW-01-FIL, GW1-WL1-GW-02-FIL

e The MDLs and RLs in parenthesis apply for chloride to samples GW1-WL1-GW-01, GW1-WL1-GW-02

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G)

g Total metals, except FIL samples are dissolved metals

Table 6-11: 2009 Groundwater Sampling - Inorganic Analytical Data
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL[a]	RL[a]	GW1-SB4-43-GW-01-FIL 151-161 5/31/2009 Groundwater		GW1-SB4-43-GW-02 151-161 6/1/2009 Groundwater		GW1-SB4-43-GW-02-FIL 151-161 6/1/2009 Groundwater		GW1-SB4-63-GW-01 176-181 5/31/2009 Groundwater		GW1-SB4-63-GW-01-FIL 176-181 5/31/2009 Groundwater		GW1-SB4-77-GW-01 190-195 6/1/2009 Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Total and Dissolved Metals (EPA 200.8)[g]																
Antimony	5.6	3.36	0.05 (0.25)[b]	0.5 (2.5)[b]	**0.059**	J	**0.13**	J	0.5	U	**0.091**	J	--	--	0.5	U
Copper	1,300	650	0.3 (1.5)[b]	1 (5)[b]	1.4[f]	U	3.4[f]	U	1	U	1.4[f]	U	--	--	1.6[f]	U
Lead	15	7.5	0.038 (0.19)[b]	1 (5)[b]	1	U	**1**	--	1	U	1	U	--	--	1	U
Tungsten	~	~	0.04 (0.2)[b]	1 (5)[b]	1	U	1	U	1	U	1	U	--	--	1	U
Zinc	4,700	2,820	5 (25)[c]	5 (25)[c]	**646**	--	**858**	--	**665**	--	**1,080**	--	--	--	**625**	--
Hardness Metals (EPA E200.7)																
Calcium	~	~	41 (33)[d]	500	**2,110**	--	--	--	**2,040**	--	--	--	**483**	J	--	--
Magnesium	~	~	6.5	125	**176**	--	--	--	**181**	--	--	--	**159**	--	--	--
Sodium	~	~	75	1250	**8,100**	--	--	--	**8,030**	--	--	--	**1,800**	--	--	--
Anions (EPA 300.0)																
Chloride	~	~	100 (200)[e]	100 (200)[e]	--	--	**2,000**	--	--	--	**1,400**	--	--	--	**1,200**	--
Nitrate	~	~	100	100	--	--	**100**	--	--	--	**150**	--	--	--	**210**	--
Sulfate	~	~	100	100	--	--	**1,200**	--	--	--	**530**	--	--	--	**310**	--
Alkalinity (EPA 310.1)																
Alkalinity, Total (as $CaCO_3$)	~	~	1,000	1,000	--	--	**20,000**	--	--	--	**2,000**	--	--	--	**2,000**	--
Total Dissolved Solids (SM2540C)																
TDS	~	~	10,000	10,000	--	--	10,000	U	--	--	10,000	U	--	--	10,000	U

Footnotes:

Bold - Detected
Blue - Greater than Project Action Limit
Green - Greater than Lower Range of Uncertainty
GW - Groundwater
FIL - field filtered
-- no qualifier
Q - data qualifier
SM - Standard Method
~ no action limit
RL - Reporting Limit
MDL - Method Detection Limit
J - estimated
ug/L - micrograms per liter
U - not detected
$CaCO_3$ - Calcium Carbonate
UJ - not-detected; RL is estimated
EPA - Environmental Protection Agency

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parenthesis for Antimony, Copper, Lead, and Tungsten apply to samples GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01

c The MDL and RLs in parenthesis for Zinc apply to samples GW1-SB2-40-GW-01, GW1-SB2-40-GW-01-FIL, GW1-SB3-WT-GW-01, GW1-SB3-WT-GW-01-FIL, GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01, GW1-WL1-GW-01-FIL

d The MDL in parenthesis apply for Calcium to samples GW1-WL1-GW-01-FIL, GW1-WL1-GW-02-FIL

e The MDLs and RLs in parenthesis apply for chloride to samples GW1-WL1-GW-01, GW1-WL1-GW-02

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G)

g Total metals, except FIL samples are dissolved metals

Table 6-11: 2009 Groundwater Sampling - Inorganic Analytical Data
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL[a]	RL[a]	GW1-SB4-77-GW-01-FIL 190-195 6/1/2009 Groundwater		GW1-SB5-WT-GW-01 89-94 5/18/2009 Groundwater		GW1-SB5-WT-GW-01-FIL 89-94 5/18/2009 Groundwater		GW1-SB5-20-GW-01 109-114 5/19/2009 Groundwater		GW1-SB5-20-GW-01-FIL 109-114 5/19/2009 Groundwater		GW1-SB5-36-GW-01 125-130 5/19/2009 Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Total and Dissolved Metals (EPA 200.8)[g]																
Antimony	5.6	3.36	0.05 (0.25)[b]	0.5 (2.5)[b]	--	--	0.5	U	--	--	**0.19**	J	--	--	0.5	U
Copper	1,300	650	0.3 (1.5)[b]	1 (5)[b]	--	--	1.4[f]	U	--	--	**1.6**	--	--	--	**1.1**	--
Lead	15	7.5	0.038 (0.19)[b]	1 (5)[b]	--	--	1	U	--	--	**0.3**	J	--	--	1	U
Tungsten	~	~	0.04 (0.2)[b]	1 (5)[b]	--	--	1	UJ	--	--	**0.14**	J	--	--	**0.1**	J
Zinc	4,700	2,820	5 (25)[c]	5 (25)[c]	--	--	600[f]	U	--	--	**609**	--	--	--	**419**	--
Hardness Metals (EPA E200.7)																
Calcium	~	~	41 (33)[d]	500	**440**	J	--	--	500	U	--	--	500	U	--	--
Magnesium	~	~	6.5	125	**164**	--	--	--	**125**	--	--	--	**125**	J	--	--
Sodium	~	~	75	1250	**1,200**	J	--	--	**1,100**	J	--	--	**1,620**	--	--	--
Anions (EPA 300.0)																
Chloride	~	~	100 (200)[e]	100 (200)[e]	--	--	**1,500**	J	--	--	**1,700**	J	--	--	**1,500**	J
Nitrate	~	~	100	100	--	--	**140**	--	--	--	**440**	--	--	--	**170**	--
Sulfate	~	~	100	100	--	--	**580**	--	--	--	**480**	--	--	--	**910**	--
Alkalinity (EPA 310.1)																
Alkalinity, Total (as $CaCO_3$)	~	~	1,000	1,000	--	--	**4,000**	--	--	--	**1,000**	J	--	--	**1,000**	J
Total Dissolved Solids (SM2540C)																
TDS	~	~	10,000	10,000	--	--	**30,000**	--	--	--	**26,000**	--	--	--	**27,000**	--

Footnotes:

Bold - Detected
Blue - Greater than Project Action Limit
Green - Greater than Lower Range of Uncertainty
GW - Groundwater
FIL - field filtered
-- no qualifier
Q - data qualifier
SM - Standard Method
~ no action limit
RL - Reporting Limit
MDL - Method Detection Limit
J - estimated
ug/L - micrograms per liter
U - not detected
$CaCO_3$ - Calcium Carbonate
UJ - not-detected; RL is estimated
EPA - Environmental Protection Agency

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parenthesis for Antimony, Copper, Lead, and Tungsten apply to samples GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01

c The MDL and RLs in parenthesis for Zinc apply to samples GW1-SB2-40-GW-01, GW1-SB2-40-GW-01-FIL, GW1-SB3-WT-GW-01, GW1-SB3-WT-GW-01-FIL, GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01, GW1-WL1-GW-01-FIL

d The MDL in parenthesis apply for Calcium to samples GW1-WL1-GW-01-FIL, GW1-WL1-GW-02-FIL

e The MDLs and RLs in parenthesis apply for chloride to samples GW1-WL1-GW-01, GW1-WL1-GW-02

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G)

g Total metals, except FIL samples are dissolved metals

Table 6-11: 2009 Groundwater Sampling - Inorganic Analytical Data
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL[a]	RL[a]	GW1-SB5-36-GW-01-FIL 125-130 5/19/2009 Groundwater		GW1-SB5-62-GW-01 151-156 5/20/2009 Groundwater		GW1-SB5-62-GW-01-FIL 151-156 5/20/2009 Groundwater		GW1-SB5-78-GW-01 167-172 5/27/2009 Groundwater		GW1-SB5-78-GW-01-FIL 167-172 5/28/2009 Groundwater		GW1-SB5-105-GW-01 194-199 5/28/2009 Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Total and Dissolved Metals (EPA 200.8)[g]																
Antimony	5.6	3.36	0.05 (0.25)[b]	0.5 (2.5)[b]	--	--	2.5	U	--	--	0.5	U	--	--	0.5	U
Copper	1,300	650	0.3 (1.5)[b]	1 (5)[b]	--	--	**4.1**	J	--	--	1	U	--	--	**3.3**	--
Lead	15	7.5	0.038 (0.19)[b]	1 (5)[b]	--	--	5	U	--	--	**0.13**	J	--	--	**0.15**	J
Tungsten	~	~	0.04 (0.2)[b]	1 (5)[b]	--	--	5	U	--	--	1	U	--	--	1	U
Zinc	4,700	2,820	5 (25)[c]	5 (25)[c]	--	--	**624**	J	--	--	**742**	J	--	--	**1,020**	J
Hardness Metals (EPA E200.7)																
Calcium	~	~	41 (33)[d]	500	580[f]	U	--	--	**480**	J	--	--	**653**	--	--	--
Magnesium	~	~	6.5	125	**116**	J	--	--	**173**	--	--	--	**213**	--	--	--
Sodium	~	~	75	1250	**3,070**	--	--	--	**2,140**	--	--	--	**1,570**	--	--	--
Anions (EPA 300.0)																
Chloride	~	~	100 (200)[e]	100 (200)[e]	--	--	**1,400**	--	--	--	**1,400**	--	--	--	**1,400**	--
Nitrate	~	~	100	100	--	--	**210**	--	--	--	**250**	--	--	--	**140**	--
Sulfate	~	~	100	100	--	--	**490**	--	--	--	**250**	--	--	--	**1,400**	--
Alkalinity (EPA 310.1)																
Alkalinity, Total (as $CaCO_3$)	~	~	1,000	1,000	--	--	**1,000**	J	--	--	**2,200**	--	--	--	**9,400**	--
Total Dissolved Solids (SM2540C)																
TDS	~	~	10,000	10,000	--	--	**29,000**	--	--	--	10,000	U	--	--	**20,000**	--

Footnotes:

Bold - Detected
Blue - Greater than Project Action Limit
Green - Greater than Lower Range of Uncertainty
GW - Groundwater
FIL - field filtered
-- no qualifier
Q - data qualifier
SM - Standard Method
~ no action limit
RL - Reporting Limit
MDL - Method Detection Limit
J - estimated
ug/L - micrograms per liter
U - not detected
$CaCO_3$ - Calcium Carbonate
UJ - not-detected; RL is estimated
EPA - Environmental Protection Agency

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parenthesis for Antimony, Copper, Lead, and Tungsten apply to samples GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01

c The MDL and RLs in parenthesis for Zinc apply to samples GW1-SB2-40-GW-01, GW1-SB2-40-GW-01-FIL, GW1-SB3-WT-GW-01, GW1-SB3-WT-GW-01-FIL, GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01, GW1-WL1-GW-01-FIL

d The MDL in parenthesis apply for Calcium to samples GW1-WL1-GW-01-FIL, GW1-WL1-GW-02-FIL

e The MDLs and RLs in parenthesis apply for chloride to samples GW1-WL1-GW-01, GW1-WL1-GW-02

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G)

g Total metals, except FIL samples are dissolved metals

Table 6-11: 2009 Groundwater Sampling - Inorganic Analytical Data
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL[a]	RL[a]	GW1-SB5-105-GW-01-FIL 194-199 5/28/2009 Groundwater		GW1-SB5-117-GW-01 206-211 5/28/2009 Groundwater		GW1-SB5-117-GW-01-FIL 206-211 5/28/2009 Groundwater		GW1-SB6-WT-GW-01 61-66 5/16/2009 Groundwater		GW1-SB6-WT-GW-01-FIL 61-66 5/16/2009 Groundwater		GW1-SB6-20-GW-01 85.5-85 5/16/2009 Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Total and Dissolved Metals (EPA 200.8)[g]																
Antimony	5.6	3.36	0.05 (0.25)[b]	0.5 (2.5)[b]	0.5	U	0.5	U	--	--	2.5	U	0.5	U	0.5	U
Copper	1,300	650	0.3 (1.5)[b]	1 (5)[b]	**1.8**	--	1	U	--	--	**12.9**	--	1.9[f]	U	**6.9**	--
Lead	15	7.5	0.038 (0.19)[b]	1 (5)[b]	**0.052**	J	**0.16**	J	--	--	**18.3**	J	1	U	**3.1**	J
Tungsten	~	~	0.04 (0.2)[b]	1 (5)[b]	1	U	1	U	--	--	5	UJ	1	UJ	1	UJ
Zinc	4,700	2,820	5 (25)[c]	5 (25)[c]	**926**	J	**197**	J	--	--	**1,440**	--	**683**	--	52.6[f]	U
Hardness Metals (EPA E200.7)																
Calcium	~	~	41 (33)[d]	500	**475**	J	--	--	**1,470**	--	--	--	729[f]	U	--	--
Magnesium	~	~	6.5	125	**195**	--	--	--	**273**	--	--	--	**434**	--	--	--
Sodium	~	~	75	1250	**1,340**	--	--	--	**4,030**	--	--	--	**1,140**	J	--	--
Anions (EPA 300.0)																
Chloride	~	~	100 (200)[e]	100 (200)[e]	--	--	**1,300**	--	--	--	**1,600**	J	--	--	**1,400**	J
Nitrate	~	~	100	100	--	--	**170**	--	--	--	**130**	--	--	--	**140**	J
Sulfate	~	~	100	100	--	--	**460**	--	--	--	**1,300**	--	--	--	**310**	--
Alkalinity (EPA 310.1)																
Alkalinity, Total (as $CaCO_3$)	~	~	1,000	1,000	--	--	**1,800**	--	--	--	**10,000**	--	--	--	**4,000**	--
Total Dissolved Solids (SM2540C)																
TDS	~	~	10,000	10,000	--	--	**33,000**	--	--	--	**47,000**	--	--	--	**32,000**	--

Footnotes:

Bold - Detected
Blue - Greater than Project Action Limit
Green - Greater than Lower Range of Uncertainty
GW - Groundwater
FIL - field filtered
-- no qualifier
Q - data qualifier
SM - Standard Method
~ no action limit
RL - Reporting Limit
MDL - Method Detection Limit
J - estimated
ug/L - micrograms per liter
U - not detected
$CaCO_3$ - Calcium Carbonate
UJ - not-detected; RL is estimated
EPA - Environmental Protection Agency

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parenthesis for Antimony, Copper, Lead, and Tungsten apply to samples GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01

c The MDL and RLs in parenthesis for Zinc apply to samples GW1-SB2-40-GW-01, GW1-SB2-40-GW-01-FIL, GW1-SB3-WT-GW-01, GW1-SB3-WT-GW-01-FIL, GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01, GW1-WL1-GW-01-FIL

d The MDL in parenthesis apply for Calcium to samples GW1-WL1-GW-01-FIL, GW1-WL1-GW-02-FIL

e The MDLs and RLs in parenthesis apply for chloride to samples GW1-WL1-GW-01, GW1-WL1-GW-02

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G)

g Total metals, except FIL samples are dissolved metals

Table 6-11: 2009 Groundwater Sampling - Inorganic Analytical Data
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL[a]	RL[a]	GW1-SB6-20-GW-01-FIL 85.5-85 5/16/2009 Groundwater		GW1-SB6--54-GW-01-FIL 115-120 5/17/2009 Groundwater		GW1-SB6-54-GW-01 115-120 5/17/2009 Groundwater		GW1-SB6-78-GW-01 139-144 5/17/2009 Groundwater		GW1-SB6-78-GW-01-FIL 139-144 5/17/2009 Groundwater		GW1-WL1-GW-01 6/10/2009 Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Total and Dissolved Metals (EPA 200.8)[g]																
Antimony	5.6	3.36	0.05 (0.25)[b]	0.5 (2.5)[b]	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	**0.082**	J
Copper	1,300	650	0.3 (1.5)[b]	1 (5)[b]	1	U	1.7[f]	U	2.2[f]	U	4.9[f]	U	1.3[f]	U	**30.8**	J
Lead	15	7.5	0.038 (0.19)[b]	1 (5)[b]	1	U	**0.85**	J	1	U	1	U	1	U	**11.6**	J
Tungsten	~	~	0.04 (0.2)[b]	1 (5)[b]	1	UJ	1	UJ	1	UJ	1	UJ	1	UJ	**0.084**	J
Zinc	4,700	2,820	5 (25)[c]	5 (25)[c]	**22.4**	--	**510**	--	710[f]	U	859[f]	U	**784**	--	**24.8**	
Hardness Metals (EPA E200.7)																
Calcium	~	~	41 (33)[d]	500	500	U	500	U	--	--	--	--	500	U	--	--
Magnesium	~	~	6.5	125	**196**	--	**137**	--	--	--	--	--	**135**	--	--	--
Sodium	~	~	75	1250	**709**	J	**1,550**	--	--	--	--	--	**930**	J	--	--
Anions (EPA 300.0)																
Chloride	~	~	100 (200)[e]	100 (200)[e]	--	--	--	--	**1,400**	J	**1,400**	J	--	--	**2,900**	J
Nitrate	~	~	100	100	--	--	--	--	100	U	**140**	--	--	--	**190**	--
Sulfate	~	~	100	100	--	--	--	--	**680**	--	**720**	--	--	--	**1,600**	--
Alkalinity (EPA 310.1)																
Alkalinity, Total (as $CaCO_3$)	~	~	1,000	1,000	--	--	--	--	**3,000**	--	**4,000**	--	--	--	**22,000**	--
Total Dissolved Solids (SM2540C)																
TDS	~	~	10,000	10,000	--	--	--	--	**38,000**	--	**35,000**	--	--	--	**53,000**	--

Footnotes:

Bold - Detected
Blue - Greater than Project Action Limit
Green - Greater than Lower Range of Uncertainty
GW - Groundwater
FIL - field filtered
-- no qualifier
Q - data qualifier
SM - Standard Method
~ no action limit
RL - Reporting Limit
MDL - Method Detection Limit
J - estimated
ug/L - micrograms per liter
U - not detected
$CaCO_3$ - Calcium Carbonate
UJ - not-detected; RL is estimated
EPA - Environmental Protection Agency

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parenthesis for Antimony, Copper, Lead, and Tungsten apply to samples GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01

c The MDL and RLs in parenthesis for Zinc apply to samples GW1-SB2-40-GW-01, GW1-SB2-40-GW-01-FIL, GW1-SB3-WT-GW-01, GW1-SB3-WT-GW-01-FIL, GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01, GW1-WL1-GW-01-FIL

d The MDL in parenthesis apply for Calcium to samples GW1-WL1-GW-01-FIL, GW1-WL1-GW-02-FIL

e The MDLs and RLs in parenthesis apply for chloride to samples GW1-WL1-GW-01, GW1-WL1-GW-02

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G)

g Total metals, except FIL samples are dissolved metals

Table 6-11: 2009 Groundwater Sampling - Inorganic Analytical Data
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL[a]	RL[a]	GW1-WL1-GW-01-FIL 6/10/2009 Groundwater		GW1-WL1-GW-02 6/10/2009 Groundwater		GW1-WL1-GW-02-FIL 6/10/2009 Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Total and Dissolved Metals (EPA 200.8)[g]										
Antimony	5.6	3.36	0.05 (0.25)[b]	0.5 (2.5)[b]	**0.083**	J	0.5	U	**0.15**	J
Copper	1,300	650	0.3 (1.5)[b]	1 (5)[b]	**2.3**		**12.6**	J	**1.7**	
Lead	15	7.5	0.038 (0.19)[b]	1 (5)[b]	**0.64**	J	**3.9**	J	**0.64**	J
Tungsten	~	~	0.04 (0.2)[b]	1 (5)[b]	**0.11**	J	**0.047**	J	**0.053**	J
Zinc	4,700	2,820	5 (25)[c]	5 (25)[c]	5	U	**20**		**17.8**	--
Hardness Metals (EPA E200.7)										
Calcium	~	~	41 (33)[d]	500	**10,500**	--	--	--	**10,600**	--
Magnesium	~	~	6.5	125	**77**	J	--	--	**76**	J
Sodium	~	~	75	1250	**2,270**	--	--	--	**2,120**	--
Anions (EPA 300.0)										
Chloride	~	~	100 (200)[e]	100 (200)[e]	--	--	**3,200**	J	--	--
Nitrate	~	~	100	100	--	--	**180**	--	--	--
Sulfate	~	~	100	100	--	--	**1,700**	--	--	--
Alkalinity (EPA 310.1)										
Alkalinity, Total (as $CaCO_3$)	~	~	1,000	1,000	--	--	**23,000**	--	--	--
Total Dissolved Solids (SM2540C)										
TDS	~	~	10,000	10,000	--	--	**44,000**	--	--	--

Footnotes:

Bold - Detected
Blue - Greater than Project Action Limit
Green - Greater than Lower Range of Uncertainty
GW - Groundwater
FIL - field filtered
-- no qualifier
Q - data qualifier
SM - Standard Method
~ no action limit
RL - Reporting Limit
MDL - Method Detection Limit
J - estimated
ug/L - micrograms per liter
U - not detected
$CaCO_3$ - Calcium Carbonate
UJ - not-detected; RL is estimated
EPA - Environmental Protection Agency

a The MDLs and RLs listed apply to all samples except those listed in footnotes b, c, and d

b The MDLs and RLs in parenthesis for Antimony, Copper, Lead, and Tungsten apply to samples GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01

c The MDL and RLs in parenthesis for Zinc apply to samples GW1-SB2-40-GW-01, GW1-SB2-40-GW-01-FIL, GW1-SB3-WT-GW-01, GW1-SB3-WT-GW-01-FIL, GW1-SB5-62-GW-01, GW1-SB6-WT-GW-01, GW1-WL1-GW-01-FIL

d The MDL in parenthesis apply for Calcium to samples GW1-WL1-GW-01-FIL, GW1-WL1-GW-02-FIL

e The MDLs and RLs in parenthesis apply for chloride to samples GW1-WL1-GW-01, GW1-WL1-GW-02

f Detection was qualified with 'U' and RL was raised to detection (See Appendix G)

g Total metals, except FIL samples are dissolved metals

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Table 6-12: 2009 Groundwater Sampling - Explosives and Perchlorate Analytical Results
Fort Jackson and McCrady Training Center, SC

Sample ID:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL	RL	GW1-P1-GW-01		GW1-P7-GW-01		GW1-SB2-23-GW-01		GW1-SB2-40-GW-01		GW1-SB2-58-GW-01		GW1-SB3-WT-GW-01	
Sample Depth (ft):					1.6-2.1		19.5-24.5		86-91		103-108		121-126		57-62	
Date Sampled:					6/4/2009		6/4/2009		6/3/2009		6/3/2009		6/4/2009		5/13/2009	
Matrix:					Groundwater		Groundwater		Groundwater		Groundwater		Groundwater		Groundwater	
Analyte:	(ug/L)	(ug/L)	(ug/L)	(ug/L)	Conc (ug/L)	Q	Conc (ug/L)	Q	Conc (ug/L)	Q	Conc (ug/L)	Q	Conc (ug/L)	Q	Conc (ug/L)	Q
Explosives (CHPPM CAD13.3)																
TNB	1,100	110	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
DNB	3.7	0.37	0.049	0.2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	UJ
TNT	2.2	0.22	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
2,4-DNT	0.11	0.011	0.01	0.04	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
2,6-DNT	37	3.7	0.0038	0.02	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
2-A-4,6-DNT	73	7.3	0.079	0.3	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
4-A-2,6-DNT	73	7.3	0.057	0.3	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
HMX	1,800	180	2.6	4.8	4.8	U	4.8	U	4.8	U	4.8	U	4.8	U	4.8	UJ
NB	3.4	0.34	0.2	0.6	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U
NG	3.7	0.37	0.052	0.2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
RDX	0.61	0.061	0.06	0.24	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U	0.24	U
Tetryl	150	15	0.049	0.3	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
m-NT	122	12.2	0.35	2	2	U	2	U	2	U	2	U	2	U	2	UJ
o-NT	370	37	0.54	2	2	U	2	U	2	U	2	U	2	U	2	U
p-NT	4.2	0.42	0.48	2	2	U	2	U	2	U	2	U	2	U	2	U
Perchlorate (EPA 6850)																
Perchlorate	15	9	0.062	0.2	0.2	U	0.2	U	0.2	U	**0.12**	J	0.2	U	0.2	U

Footnotes:

Bold - Detected

Green - Exceeds Lower Range of Uncertainty

Blue - Exceeds Project Action Limit

GW - Groundwater

FIL - filtered

Q - data qualifier

EPA - Environmental Protection Agency

CHPPM CAD - Center for Health Promotion and Preventive Medicine Chromatographic Analysis Division

MDL - Method Detection Limit

RL - Reporting Limit

U - not detected

J - estimated

UJ - not-detected; RL is estimated

ug/L - microgram per liter

ft - feet

Table 6-12: 2009 Groundwater Sampling - Explosives and Perchlorate Analytical Results
Fort Jackson and McCrady Training Center, SC

Sample ID:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL	RL	GW1-SB3-20-GW-01		GW1-SB3-44-GW-01		GW1-SB3-58-GW-01		GW1-SB3-73-GW-01		GW1-SB3-73-GW-02		GW1-SB3-97-GW-01	
Sample Depth (ft):					77-82		100-105		121-126		130-135		130-135		154-159	
Date Sampled:					5/12/2009		5/12/2009		5/13/2009		5/13/2009		5/13/2009		5/14/2009	
Matrix:					Groundwater		Groundwater		Groundwater		Groundwater		Groundwater		Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Explosives (CHPPM CAD13.3)																
TNB	1,100	110	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
DNB	3.7	0.37	0.049	0.2	0.2	UJ	0.2	UJ	0.2	UJ	0.2	UJ	0.2	UJ	0.2	U
TNT	2.2	0.22	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
2,4-DNT	0.11	0.011	0.01	0.04	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
2,6-DNT	37	3.7	0.0038	0.02	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
2-A-4,6-DNT	73	7.3	0.079	0.3	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
4-A-2,6-DNT	73	7.3	0.057	0.3	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
HMX	1,800	180	2.6	4.8	4.8	UJ	4.8	UJ	4.8	UJ	4.8	UJ	4.8	UJ	4.8	U
NB	3.4	0.34	0.2	0.6	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U
NG	3.7	0.37	0.052	0.2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
RDX	0.61	0.061	0.06	0.24	**0.064**	J	0.24	U	**0.14**	J	**0.14**	J	**0.17**	J	0.24	U
Tetryl	150	15	0.049	0.3	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
m-NT	122	12.2	0.35	2	2	UJ	2	UJ	2	UJ	2	UJ	2	UJ	2	UJ
o-NT	370	37	0.54	2	2	U	2	U	2	U	2	U	2	U	2	U
p-NT	4.2	0.42	0.48	2	2	U	2	U	2	U	2	U	2	U	2	U
Perchlorate (EPA 6850)																
Perchlorate	15	9	0.062	0.2	0.2	U	0.2	U	--	--	--	--	--	--	0.2	U

Footnotes:

Bold - Detected

Green - Exceeds Lower Range of Uncertainty

Blue - Exceeds Project Action Limit

GW - Groundwater

FIL - filtered

Q - data qualifier

EPA - Environmental Protection Agency

CHPPM CAD - Center for Health Promotion and Preventive Medicine Chromatographic Analysis Division

MDL - Method Detection Limit

RL - Reporting Limit

U - not detected

J - estimated

UJ - not-detected; RL is estimated

ug/L - microgram per liter

ft - feet

Table 6-12: 2009 Groundwater Sampling - Explosives and Perchlorate Analytical Results
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL	RL	GW1-SB3-120-GW-01 181.5-182 5/14/2009 Groundwater		GW1-SB4-WT-GW-01 113-118 5/30/2009 Groundwater		GW1-SB4-20-GW-01 133-138 5/30/2009 Groundwater		GW1-SB4-43-GW-01 151-161 5/31/2009 Groundwater		GW1-SB4-43-GW-02 151-161 6/1/2009 Groundwater		GW1-SB4-63-GW-01 176-181 5/31/2009 Groundwater	
Analyte:	**(ug/L)**	**(ug/L)**	**(ug/L)**	**(ug/L)**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**	**Conc (ug/L)**	**Q**
Explosives (CHPPM CAD13.3)																
TNB	1,100	110	0.013	0.06	0.06	U	0.06	UJ	0.06	U	0.06	U	0.06	U	0.06	U
DNB	3.7	0.37	0.049	0.2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
TNT	2.2	0.22	0.013	0.06	0.06	U	0.06	UJ	0.06	U	0.06	U	0.06	U	0.06	U
2,4-DNT	0.11	0.011	0.01	0.04	0.04	U	0.04	UJ	0.04	U	0.04	U	0.04	U	0.04	U
2,6-DNT	37	3.7	0.0038	0.02	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
2-A-4,6-DNT	73	7.3	0.079	0.3	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
4-A-2,6-DNT	73	7.3	0.057	0.3	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
HMX	1,800	180	2.6	4.8	4.8	U	4.8	U	4.8	U	4.8	U	4.8	U	4.8	U
NB	3.4	0.34	0.2	0.6	0.6	U	0.6	UJ	0.6	U	0.6	U	0.6	U	0.6	U
NG	3.7	0.37	0.052	0.2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
RDX	0.61	0.061	0.06	0.24	0.24	U	0.24	UJ	0.24	U	0.24	U	0.24	U	0.24	U
Tetryl	150	15	0.049	0.3	0.3	U	0.3	UJ	0.3	U	0.3	U	0.3	U	0.3	U
m-NT	122	12.2	0.35	2	2	UJ	2	UJ	2	UJ	2	UJ	2	UJ	2	UJ
o-NT	370	37	0.54	2	2	U	2	U	2	U	2	U	2	U	2	U
p-NT	4.2	0.42	0.48	2	2	U	2	U	2	U	2	U	2	U	2	U
Perchlorate (EPA 6850)																
Perchlorate	15	9	0.062	0.2	0.2	U	**0.14**	J	**0.15**	J	**0.15**	J	**0.27**	--	0.2	U

Footnotes:

Bold - Detected

Green - Exceeds Lower Range of Uncertainty

Blue - Exceeds Project Action Limit

GW - Groundwater

FIL - filtered

Q - data qualifier

EPA - Environmental Protection Agency

CHPPM CAD - Center for Health Promotion and Preventive Medicine Chromatographic Analysis Division

MDL - Method Detection Limit

RL - Reporting Limit

U - not detected

J - estimated

UJ - not-detected; RL is estimated

ug/L - microgram per liter

ft - feet

Table 6-12: 2009 Groundwater Sampling - Explosives and Perchlorate Analytical Results
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL	RL	GW1-SB4-77-GW-01 190-195 6/1/2009 Groundwater		GW1-SB5-WT-GW-01 89-94 5/18/2009 Groundwater		GW1-SB5-20-GW-01 109-114 5/19/2009 Groundwater		GW1-SB5-36-GW-01 125-130 5/19/2009 Groundwater		GW1-SB5-62-GW-01 151-156 5/20/2009 Groundwater		GW1-SB5-78-GW-01 167-172 5/27/2009 Groundwater	
Analyte:	(ug/L)	(ug/L)	(ug/L)	(ug/L)	Conc (ug/L)	Q	Conc (ug/L)	Q	Conc (ug/L)	Q	Conc (ug/L)	Q	Conc (ug/L)	Q	Conc (ug/L)	Q
Explosives (CHPPM CAD13.3)																
TNB	1,100	110	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
DNB	3.7	0.37	0.049	0.2	0.2	U	0.2	UJ	0.2	UJ	0.2	UJ	0.2	UJ	0.2	U
TNT	2.2	0.22	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
2,4-DNT	0.11	0.011	0.01	0.04	0.04	U	0.04	UJ	0.04	UJ	0.04	UJ	0.04	UJ	0.04	U
2,6-DNT	37	3.7	0.0038	0.02	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
2-A-4,6-DNT	73	7.3	0.079	0.3	0.3	U	0.3	UJ	0.3	UJ	0.3	UJ	0.3	UJ	0.3	U
4-A-2,6-DNT	73	7.3	0.057	0.3	0.3	U	0.3	UJ	0.3	UJ	0.3	UJ	0.3	UJ	0.3	U
HMX	1,800	180	2.6	4.8	4.8	U	4.8	U	4.8	U	4.8	U	4.8	U	4.8	U
NB	3.4	0.34	0.2	0.6	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U
NG	3.7	0.37	0.052	0.2	0.2	U	0.2	UJ	0.2	UJ	0.2	UJ	0.2	UJ	0.2	UJ
RDX	0.61	0.061	0.06	0.24	0.24	U	0.24	UJ	0.24	UJ	0.24	UJ	0.24	UJ	0.24	U
Tetryl	150	15	0.049	0.3	0.3	U	0.3	UJ	0.3	UJ	0.3	UJ	0.3	UJ	0.3	UJ
m-NT	122	12.2	0.35	2	2	U	2	UJ	2	UJ	2	UJ	2	UJ	2	UJ
o-NT	370	37	0.54	2	2	U	2	U	2	U	2	U	2	U	2	U
p-NT	4.2	0.42	0.48	2	2	U	2	U	2	U	2	U	2	U	2	U
Perchlorate (EPA 6850)																
Perchlorate	15	9	0.062	0.2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	**0.11**	J

Footnotes:

Bold - Detected

Green - Exceeds Lower Range of Uncertainty

Blue - Exceeds Project Action Limit

GW - Groundwater

FIL - filtered

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UJ - not-detected; RL is estimated

ug/L - microgram per liter

ft - feet

Table 6-12: 2009 Groundwater Sampling - Explosives and Perchlorate Analytical Results
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL	RL	GW1-SB5-105-GW-01 194-199 5/28/2009 Groundwater		GW1-SB5-117-GW-01 206-211 5/28/2009 Groundwater		GW1-SB6-WT-GW-01 61-66 5/16/2009 Groundwater		GW1-SB6-20-GW-01 85.5-85 5/16/2009 Groundwater		GW1-SB6-54-GW-01 115-120 5/17/2009 Groundwater		GW1-SB6-78-GW-01 139-144 5/17/2009 Groundwater	
Analyte:	(ug/L)	(ug/L)	(ug/L)	(ug/L)	Conc (ug/L)	Q	Conc (ug/L)	Q	Conc (ug/L)	Q	Conc (ug/L)	Q	Conc (ug/L)	Q	Conc (ug/L)	Q
Explosives (CHPPM CAD13.3)																
TNB	1,100	110	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
DNB	3.7	0.37	0.049	0.2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
TNT	2.2	0.22	0.013	0.06	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
2,4-DNT	0.11	0.011	0.01	0.04	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
2,6-DNT	37	3.7	0.0038	0.02	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
2-A-4,6-DNT	73	7.3	0.079	0.3	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
4-A-2,6-DNT	73	7.3	0.057	0.3	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
HMX	1,800	180	2.6	4.8	4.8	U	4.8	U	4.8	U	4.8	U	4.8	U	4.8	U
NB	3.4	0.34	0.2	0.6	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U
NG	3.7	0.37	0.052	0.2	0.2	UJ	0.2	UJ	0.2	U	0.2	U	0.2	U	0.2	U
RDX	0.61	0.061	0.06	0.24	0.24	U	0.24	U	0.24	UJ	0.24	UJ	0.24	UJ	0.24	UJ
Tetryl	150	15	0.049	0.3	0.3	UJ	0.3	UJ	0.3	U	0.3	U	0.3	U	0.3	U
m-NT	122	12.2	0.35	2	2	UJ	2	UJ	2	UJ	2	UJ	2	UJ	2	UJ
o-NT	370	37	0.54	2	2	U	2	U	2	U	2	U	2	U	2	U
p-NT	4.2	0.42	0.48	2	2	U	2	U	2	U	2	U	2	U	2	U
Perchlorate (EPA 6850)																
Perchlorate	15	9	0.062	0.2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U

Footnotes:

Bold - Detected

Green - Exceeds Lower Range of Uncertainty

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GW - Groundwater

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ug/L - microgram per liter

ft - feet

Table 6-12: 2009 Groundwater Sampling - Explosives and Perchlorate Analytical Results
Fort Jackson and McCrady Training Center, SC

Sample ID: Sample Depth (ft): Date Sampled: Matrix:	Project Action Limit for GW	Lower Range of Uncertainty for GW	MDL	RL	GW1-WL1-GW-01 6/10/2009 Groundwater		GW1-WL1-GW-02 6/10/2009 Groundwater	
Analyte:	(ug/L)	(ug/L)	(ug/L)	(ug/L)	Conc (ug/L)	Q	Conc (ug/L)	Q
Explosives (CHPPM CAD13.3)								
TNB	1,100	110	0.013	0.06	0.06	U	0.06	U
DNB	3.7	0.37	0.049	0.2	0.2	U	0.2	U
TNT	2.2	0.22	0.013	0.06	0.06	UJ	0.06	UJ
2,4-DNT	0.11	0.011	0.01	0.04	0.04	U	0.04	U
2,6-DNT	37	3.7	0.0038	0.02	0.02	U	0.02	U
2-A-4,6-DNT	73	7.3	0.079	0.3	0.3	U	0.3	U
4-A-2,6-DNT	73	7.3	0.057	0.3	0.3	U	0.3	U
HMX	1,800	180	2.6	4.8	4.8	U	4.8	U
NB	3.4	0.34	0.2	0.6	0.6	U	0.6	U
NG	3.7	0.37	0.052	0.2	0.2	U	0.2	U
RDX	0.61	0.061	0.06	0.24	0.24	U	0.24	U
Tetryl	150	15	0.049	0.3	0.3	U	0.3	U
m-NT	122	12.2	0.35	2	2	U	2	U
o-NT	370	37	0.54	2	2	U	2	U
p-NT	4.2	0.42	0.48	2	2	U	2	U
Perchlorate (EPA 6850)								
Perchlorate	15	9	0.062	0.2	**0.26**	--	**0.17**	J

Footnotes:

Bold - Detected

Green - Exceeds Lower Range of Uncertainty

Blue - Exceeds Project Action Limit

GW - Groundwater

FIL - filtered

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CHPPM CAD - Center for Health Promotion and Preventive Medicine Chromatographic Analysis Division

MDL - Method Detection Limit

RL - Reporting Limit

U - not detected

J - estimated

UJ - not-detected; RL is estimated

ug/L - microgram per liter

ft - feet

Table 6-13: Groundwater Quality Measurements – 2012 2013 Groundwater Sampling
Fort Jackson and McCrady Training Center, SC

Well ID	Sample ID	Date Collected	Time Collected	Temperature (ºC)	pH	Specific Conductance (mS/cm)	Turbidity	Dissolved Oxygen (mg/L)	Oxidatin Reduction Potential (mV)
MW-RS-02S	GW1-MW-RS-02S	7/10/2012	1000	19.06	6.93	0.146	NR	0.05	-47.90
	GW2-MW-RS-02S	10/15/2012	1244	24.63	7.41	0.136	22.4	2.33	104.90
	GW3-MW-RS-02S	2/12/2013	1035	16.75	7.36	0.095	NR	0.23	222.50
MW-RS-02D	GW1-MW-RS-02D	7/10/2012	1130	18.76	7.38	0.078	NR	0.40	-304.70
	GW2-MW-RS-02D	10/15/2012	1350	22.66	7.52	0.096	136.9	1.57	163.50
	GW3-MW-RS-02D	2/12/2013	1105	16.82	7.70	0.119	NR	0.19	-303.20
MW-RS-03S	GW1-MW-RS-03S	7/10/2012	1630	18.77	9.52	0.169	NR	0.37	-310.20
	GW2-MW-RS-03S	10/15/2012	1439	21.34	8.88	0.135	204	1.55	193.20
	GW3-MW-RS-03S	2/12/2013	1145	16.82	8.51	0.082	NR	0.27	-226.00
MW-RS-03D	GW1-MW-RS-03D	7/11/2012	1030	18.97	4.78	0.022	NR	9.10	193.20
	GW2-MW-RS-03D	10/15/2012	1509	1.24	6.26	0.024	19.9	2.94	16.10
	GW3-MW-RS-03D	2/12/2013	1250	17.13	6.00	0.029	NR	8.93	76.00
MW-RS-04S	GW1-MW-RS-04S	7/11/2012	1130	18.53	4.41	0.016	NR	9.29	211.50
	GW2-MW-RS-04S	10/15/2012	1546	18.31	5.36	0.016	NR	9.09	189.90
	GW3-MW-RS-04S	2/12/2013	1345	16.61	5.33	0.017	NR	8.93	165.10
MW-RS-04D	GW1-MW-RS-04D	7/11/2012	1200	18.75	4.53	0.012	NR	5.71	203.70
	GW2-MW-RS-04D	10/15/2012	1620	18.49	5.32	0.011	NR	7.55	179.30
	GW3-MW-RS-04D	2/12/2013	1420	16.84	5.48	0.014	NR	8.00	99.20
MW-RS-05S	GW1-MW-RS-05S	7/12/2012	930	18.89	7.25	0.057	NR	0.23	-200.80
	GW2-MW-RS-05S	10/16/2012	1443	18.72	7.12	0.062	NR	0.42	83.70
	GW3-MW-RS-05S	2/13/2013	955	16.59	6.58	0.032	NR	1.63	-58.00
MW-RS-05D	GW1-MW-RS-05D	7/12/2012	1100	19.15	4.99	0.018	NR	3.71	30.50
	GW2-MW-RS-05D	10/16/2012	1439	18.72	7.10	0.062	NR	0.43	81.30
	GW3-MW-RS-05D	2/13/2013	1020	17.17	5.96	0.022	NR	5.20	-16.50
MW-RS-06S	GW1-MW-RS-06S	7/11/2012	1630	18.16	4.77	0.021	NR	7.27	197.80
	GW2-MW-RS-06S	10/16/2012	1210	17.86	5.76	0.024	NR	8.33	86.30
	GW3-MW-RS-06S	2/12/2013	1540	16.09	5.50	0.013	NR	9.10	118.50
MW-RS-06D	GW1-MW-RS-06D	7/12/2012	800	18.23	4.41	0.011	NR	7.99	225.80
	GW2-MW-RS-06D	10/16/2012	1245	18.12	5.68	0.013	NR	8.15	107.90
	GW3-MW-RS-06D	2/12/2013	1605	16.09	5.52	0.013	NR	9.10	120.00
MW-RS-07S	GW1-MW-RS-07S	7/11/2012	1430	18.34	6.05	0.065	NR	2.06	120.30
	GW2-MW-RS-07S	10/16/2012	935	16.21	6.05	0.034	85.1	7.44	187.00
	GW3-MW-RS-07S	2/13/2013	830	15.81	5.37	0.017	NR	8.06	184.80
MW-RS-07D	GW1-MW-RS-07D	7/11/2012	1515	18.40	7.30	0.062	NR	0.25	-218.80
	GW2-MW-RS-07D	10/16/2012	52.36	16.57	7.67	0.061	289.1	3.49	88.70
	GW3-MW-RS-07D	2/13/2013	910	16.49	7.00	0.066	NR	0.20	195.70

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Table 6-14: July 2012 Groundwater Sampling - Explosives and Uranium Results
Fort Jackson and McCrady Training Center, SC

Location ID: / Date Collected: / Sample Name:	Ground Water PAL	Units	MW-RS-02D 07/10/12 GW1-MW-RS-02D	MW-RS-02S 07/10/12 GW1-MW-RS-02S	MW-RS-03D 07/11/12 GW1-MW-RS-03D	MW-RS-03S 07/10/12 GW1-MW-RS-03S	MW-RS-04D 07/11/12 GW1-MW-RS-04D	MW-RS-04S 07/11/12 GW1-MW-RS-04S	MW-RS-05D 07/12/12 GW1-MW-RS-05D	MW-RS-05S 07/12/12 GW1-MW-RS-05S
Explosives										
1,3,5-Trinitrobenzene	460	ug/L	0.052 UJ [0.062 UJ]	0.051 UJ	0.062 U	0.052 UJ	0.050 U	0.051 U	0.19 U [**0.14 J**]	0.052 U
1,3-Dinitrobenzene	1.5	ug/L	0.10 UJ [0.12 UJ]	0.10 UJ	0.12 U	0.10 UJ	0.10 U	0.10 U	0.13 U [0.12 U]	0.10 U
2,4,6-Trinitrotoluene	2.2	ug/L	0.10 UJ [0.12 UJ]	0.10 UJ	0.12 U	0.10 UJ	0.10 U	0.10 U	0.13 U [0.12 U]	0.10 U
2,4-Dinitrotoluene	0.2	ug/L	0.10 UJ [0.12 UJ]	0.10 UJ	0.12 U	0.10 UJ	0.10 U	0.10 U	0.13 U [0.12 U]	0.10 U
2,6-Dinitrotoluene	15	ug/L	0.10 UJ [0.12 UJ]	0.10 UJ	0.12 U	0.10 UJ	0.10 U	0.10 U	0.13 U [0.12 U]	0.10 U
2-Amino-4,6-dinitrotoluene	30	ug/L	0.10 UJ [0.12 UJ]	0.10 UJ	0.12 U	0.10 UJ	0.10 U	0.10 U	0.13 U [0.12 U]	0.10 U
2-Nitrotoluene	0.27	ug/L	0.10 UJ [0.12 UJ]	0.10 UJ	0.12 U	0.10 UJ	0.10 U	0.10 U	0.13 U [0.12 U]	0.10 U
3-Nitrotoluene	1.3	ug/L	0.10 UJ [0.12 UJ]	0.10 UJ	0.12 U	0.10 UJ	0.10 U	0.10 U	0.13 U [0.12 U]	0.10 U
4-Amino-2,6-Dinitrotoluene	30	ug/L	0.10 UJ [0.12 UJ]	0.10 UJ	0.12 U	0.10 UJ	0.10 U	0.10 U	0.13 U [0.12 U]	0.10 U
4-Nitrotoluene	3.7	ug/L	0.10 UJ [0.12 UJ]	0.10 UJ	0.12 U	0.10 UJ	0.10 U	0.10 U	0.13 U [0.12 U]	0.10 U
HMX	780	ug/L	0.052 UJ [0.062 UJ]	0.051 UJ	0.062 U	0.052 UJ	0.050 U	0.051 U	0.064 U [0.062 U]	0.052 U
Nitrobenzene	0.12	ug/L	0.10 UJ [0.12 UJ]	0.10 UJ	0.12 U	0.10 UJ	0.10 U	0.10 U	0.13 U [0.12 U]	0.10 U
Nitroglycerin	1.5	ug/L	0.52 UJ [0.62 UJ]	0.51 UJ	0.62 U	0.52 UJ	0.50 U	0.51 U	0.64 U [0.62 U]	0.52 U
Pentaerythritol Tetranitrate	16	ug/L	0.52 UJ [0.62 UJ]	0.51 UJ	0.62 U	0.52 UJ	0.50 U	0.51 U	0.64 U [0.62 U]	0.52 U
RDX	0.61	ug/L	0.052 UJ [**0.55 JN**]	0.051 UJ	**0.59 JN**	0.052 UJ	**0.76**	**0.2**	**0.54 [0.54]**	0.052 U
Tetryl	63	ug/L	0.10 UJ [0.12 UJ]	0.10 UJ	0.12 U	0.10 UJ	0.10 U	0.10 U	0.13 U [0.12 U]	0.10 U
Inorganics										
Uranium	30	ug/L	10.0 UB	**0.46 B**	10.0 U	10.0 UB	10.0 U	10.0 U	10.0 UB	10.0 UB
Uranium-234	30	ug/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Uranium-235	30	ug/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Uranium-238	30	ug/L	0.24 UB	**0.46**	0.05 U	0.13 UB	0.05 U	0.05 U	0.05 UB	0.05 UB

Notes:

Non-detected values are reported at the Limit of Detection (LOD)
Detected results are shown in **bold text**
Data exceeding the GW PAL are shaded
Field duplicate results are shown in brackets [ ]

Qualifier Definitions:

Inorganic	
B	Indicates an estimated value between the instrument detection limit and the reporting limit (RL).
U	The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UB	Analyte considered non-detect at the listed value due to associated blank contamination.
Organic (Explosives)	
J	Indicates an estimated value.
JN	The analysis indicates the presence of a compound for which there is presumptive evidence to make a tentative identification. The associated numerical value is an estimated concentration only.
U	The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

Table 6-14: July 2012 Groundwater Sampling - Explosives and Uranium Results
Fort Jackson and McCrady Training Center, SC

Location ID: / Date Collected: / Sample Name:	Ground Water PAL	Units	MW-RS-06D 07/12/12 GW1-MW-RS-06D	MW-RS-06S 07/11/12 GW1-MW-RS-06S	MW-RS-07D 07/11/12 GW1-MW-RS-07D	MW-RS-07S 07/11/12 GW1-MW-RS-07S
Explosives						
1,3,5-Trinitrobenzene	460	ug/L	0.052 U	0.050 U	0.052 U	0.062 U
1,3-Dinitrobenzene	1.5	ug/L	0.10 U	0.10 U	0.10 U	0.12 U
2,4,6-Trinitrotoluene	2.2	ug/L	0.10 U	0.10 U	0.10 U	0.12 U
2,4-Dinitrotoluene	0.2	ug/L	0.10 U	0.10 U	0.10 U	0.12 U
2,6-Dinitrotoluene	15	ug/L	0.10 U	0.10 U	0.10 U	0.12 U
2-Amino-4,6-dinitrotoluene	30	ug/L	0.10 U	0.10 U	0.10 U	0.12 U
2-Nitrotoluene	0.27	ug/L	0.10 U	0.10 U	0.10 U	0.12 U
3-Nitrotoluene	1.3	ug/L	0.10 U	0.10 U	0.10 U	0.12 U
4-Amino-2,6-Dinitrotoluene	30	ug/L	0.10 U	0.10 U	0.10 U	0.12 U
4-Nitrotoluene	3.7	ug/L	0.10 U	0.10 U	0.10 U	0.12 U
HMX	780	ug/L	0.052 U	0.050 U	0.052 U	0.062 U
Nitrobenzene	0.12	ug/L	0.10 U	0.10 U	0.10 U	0.12 U
Nitroglycerin	1.5	ug/L	0.52 U	0.50 U	0.52 U	0.62 U
Pentaerythritol Tetranitrate	16	ug/L	0.52 U	0.50 U	0.52 U	0.62 U
RDX	0.61	ug/L	**0.63**	0.050 U	0.052 U	**0.13 J**
Tetryl	63	ug/L	0.10 U	0.10 U	0.10 U	0.12 U
Inorganics						
Uranium	30	ug/L	10.0 U [10.0 U]	10.0 U	10.0 UB	10.0 UB
Uranium-234	30	ug/L	0.05 U [0.05 U]	0.05 U	0.05 U	0.05 U
Uranium-235	30	ug/L	0.05 U [0.05 U]	0.05 U	0.05 U	0.05 U
Uranium-238	30	ug/L	0.05 U [0.05 U]	0.05 U	0.11 UB	0.05 UB

Notes:

Non-detected values are reported at the Limit of Detection (LOD)
Detected results are shown in **bold text**
Data exceeding the GW PAL are shaded
Field duplicate results are shown in brackets [ ]

Qualifier Definitions:

Inorganic

B	Indicates an estimated value between the instrument detection limit and the reporting limit (RL).
U	The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UB	Analyte considered non-detect at the listed value due to associated blank contamination.

Organic (Explosives)

J	Indicates an estimated value.
JN	The analysis indicates the presence of a compound for which there is presumptive evidence to make a tentative identification. The associated numerical value is an estimated concentration only.
U	The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

Table 6-15: October 2012 Groundwater Sampling - Explosives and Uranium Results
Fort Jackson and McCrady Training Center, SC

Location ID:	Ground		MW-RS-02D	MW-RS-02S	MW-RS-03D	MW-RS-03S	MW-RS-04D	MW-RS-04S	MW-RS-05D	MW-RS-05S
Date Collected:	Water		10/15/12	10/15/12	10/15/12	10/15/12	10/15/12	10/15/12	10/16/12	10/16/12
Sample Name:	PAL	Units	GW2-MW-RS-02D	GW2-MW-RS-02S	GW2-MW-RS-03D	GW2-MW-RS-03S	GW2-MW-RS-04D	GW2-MW-RS-04S	GW2-MW-RS-05D	GW2-MW-RS-05S
Explosives										
1,3,5-Trinitrobenzene	460	ug/L	0.051 U	0.050 U	0.052 U	0.051 U	0.069 U [0.061 U]	0.067 UJ	0.051 U	0.051 U
1,3-Dinitrobenzene	1.5	ug/L	0.10 U	0.10 U	0.10 U	0.10 U	0.14 U [0.12 U]	0.13 UJ	0.10 U	0.10 U
2,4,6-Trinitrotoluene	2.2	ug/L	0.10 U	0.10 U	**0.064 J**	**0.11**	0.14 U [0.12 U]	0.13 UJ	0.10 U	0.10 U
2,4-Dinitrotoluene	0.2	ug/L	0.10 U	0.10 U	0.10 U	0.10 U	0.14 U [0.12 U]	0.13 UJ	0.10 U	0.10 U
2,6-Dinitrotoluene	15	ug/L	0.10 U	0.10 U	0.10 U	0.10 U	0.14 U [0.12 U]	0.13 UJ	0.10 U	0.10 U
2-Amino-4,6-dinitrotoluene	30	ug/L	0.20 U	0.20 U	0.21 U	0.21 U	0.28 U [0.24 U]	0.27 UJ	0.20 U	0.20 U
2-Nitrotoluene	0.27	ug/L	0.10 U	0.10 U	0.10 U	0.10 U	0.14 U [0.12 U]	0.13 UJ	0.10 U	0.10 U
3-Nitrotoluene	1.3	ug/L	0.10 U	0.10 U	0.10 U	0.10 U	0.14 U [0.12 U]	0.13 UJ	0.10 U	0.10 U
4-Amino-2,6-Dinitrotoluene	30	ug/L	0.10 U	0.10 U	0.10 U	0.10 U	0.14 U [0.12 U]	0.13 UJ	0.10 U	0.10 U
4-Nitrotoluene	3.7	ug/L	0.10 U	0.10 U	0.10 U	**0.15 J**	0.14 U [0.12 U]	0.13 UJ	0.10 U	0.10 U
HMX	780	ug/L	0.051 U	0.050 U	0.052 U	0.051 U	0.069 U [0.061 U]	0.067 UJ	0.051 U	0.051 U
Nitrobenzene	0.12	ug/L	0.10 U	0.10 U	0.10 U	0.10 U	0.14 U [0.12 U]	0.13 UJ	0.10 U	0.10 U
Nitroglycerin	1.5	ug/L	0.51 U	0.50 U	0.52 U	0.51 U	0.69 U [0.61 U]	0.67 UJ	0.51 U	0.51 U
Pentaerythritol Tetranitrate	16	ug/L	0.51 U	0.50 U	0.52 U	0.51 U	0.69 U [0.61 U]	0.67 UJ	0.51 U	0.51 U
RDX	0.61	ug/L	0.051 U	0.050 U	0.052 U	0.051 U	**0.74 [0.78]**	0.067 UJ	**0.55**	0.051 U
Tetryl	63	ug/L	0.10 U	0.10 U	0.10 U	0.10 U	0.14 U [0.12 U]	0.13 UJ	0.10 U	0.10 U
Inorganics										
Uranium	30	ug/L	10.0 UB	10.0 UB	10.0 U	10.0 UB	10.0 U [10 U]	10.0 UB	10.0 UB	10.0 UB
Uranium-234	30	ug/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U [0.05 U]	0.05 U	0.05 U	0.05 U
Uranium-235	30	ug/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U [0.05 U]	0.05 U	0.05 U	0.05 U
Uranium-238	30	ug/L	0.058 UB	0.073 UB	0.05 U	0.071 UB	0.05 U [0.05 U]	0.05 UB	0.05 UB	0.05 UB

Notes:

Non-detected values are reported at the Limit of Detection (LOD)
Detected results are shown in **bold text**
Data exceeding the GW PAL are shaded
Field duplicate results are shown in brackets [ ]

Qualifier Definitions:

Inorganic	
U	The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UB	Analyte considered non-detect at the listed value due to associated blank contamination.
Organic (Explosives)	
J	Indicates an estimated value.
U	The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

Table 6-15: October 2012 Groundwater Sampling - Explosives and Uranium Results
Fort Jackson and McCrady Training Center, SC

Location ID: / Date Collected: / Sample Name:	Ground Water PAL	Units	MW-RS-06D 10/16/12 GW2-MW-RS-06D	MW-RS-06S 10/16/12 GW2-MW-RS-06S	MW-RS-07D 10/16/12 GW2-MW-RS-07D	MW-RS-07S 10/16/12 GW2-MW-RS-07S
Explosives						
1,3,5-Trinitrobenzene	460	ug/L	0.060 U [0.066 U]	0.051 UJ	0.051 U	0.051 U
1,3-Dinitrobenzene	1.5	ug/L	0.12 U [0.13 U]	0.10 UJ	0.10 U	0.10 U
2,4,6-Trinitrotoluene	2.2	ug/L	0.12 U [0.13 U]	0.10 UJ	0.10 U	0.10 U
2,4-Dinitrotoluene	0.2	ug/L	0.12 U [0.13 U]	0.10 UJ	0.10 U	0.10 U
2,6-Dinitrotoluene	15	ug/L	0.12 U [0.13 U]	0.10 UJ	0.10 U	0.10 U
2-Amino-4,6-dinitrotoluene	30	ug/L	0.24 U [0.27 U]	0.20 UJ	0.20 U	0.20 U
2-Nitrotoluene	0.27	ug/L	0.12 U [0.13 U]	0.10 UJ	0.10 U	0.10 U
3-Nitrotoluene	1.3	ug/L	0.12 U [0.13 U]	0.10 UJ	0.10 U	0.10 U
4-Amino-2,6-Dinitrotoluene	30	ug/L	0.12 U [0.13 U]	0.10 UJ	0.10 U	0.10 U
4-Nitrotoluene	3.7	ug/L	0.12 U [0.13 U]	0.10 UJ	0.10 U	0.10 U
HMX	780	ug/L	0.060 U [0.066 U]	0.051 UJ	0.051 U	0.051 U
Nitrobenzene	0.12	ug/L	0.12 U [0.13 U]	0.10 UJ	0.10 U	0.10 U
Nitroglycerin	1.5	ug/L	0.60 U [0.66 U]	0.51 UJ	0.51 U	0.51 U
Pentaerythritol Tetranitrate	16	ug/L	0.60 U [0.66 U]	0.51 UJ	0.51 U	0.51 U
RDX	0.61	ug/L	**0.68 [0.7]**	0.051 UJ	0.051 U	**0.19**
Tetryl	63	ug/L	0.12 U [0.13 U]	0.10 UJ	0.10 U	0.10 U
Inorganics						
Uranium	30	ug/L	10.0 U [10 U]	10.0 U	10.0 UB	10.0 UB
Uranium-234	30	ug/L	0.05 U [0.05 U]	0.05 U	0.05 U	0.05 U
Uranium-235	30	ug/L	0.05 U [0.05 U]	0.05 U	0.05 U	0.05 U
Uranium-238	30	ug/L	0.05 U [0.05 U]	0.05 U	0.05 UB	0.05 UB

Notes:

Non-detected values are reported at the Limit of Detection (LOD)
Detected results are shown in **bold text**
Data exceeding the GW PAL are shaded
Field duplicate results are shown in brackets [ ]

Qualifier Definitions:

Inorganic	
U	The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UB	Analyte considered non-detect at the listed value due to associated blank contamination.
Organic (Explosives)	
J	Indicates an estimated value.
U	The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

Table 6-16: February 2013 Groundwater Sampling - Explosives and Uranium Results
Fort Jackson and McCrady Training Center, SC

Location ID: / Date Collected: / Sample Name:	Ground Water PAL	Units	MW-RS-02D 02/12/13 GW3-MW-RS-02D	MW-RS-02S 02/12/13 GW3-MW-RS-02S	MW-RS-03D 02/12/13 GW3-MW-RS-03D	MW-RS-03S 02/12/13 GW3-MW-RS-03S	MW-RS-04D 02/12/13 GW3-MW-RS-04D	MW-RS-04S 02/12/13 GW3-MW-RS-04S	MW-RS-05D 02/13/13 GW3-MW-RS-05D	MW-RS-05S 02/13/13 GW3-MW-RS-05S
Explosives										
1,3,5-Trinitrobenzene	460	ug/L	0.052 U	0.051 U	0.051 U	0.052 UJ	0.067 U [0.058 U]	0.053 UJ	0.052 U	0.051 U
1,3-Dinitrobenzene	1.5	ug/L	0.10 U	0.10 U	0.10 U	0.10 UJ	0.13 U [0.12 U]	0.11 UJ	0.10 U	0.10 U
2,4,6-Trinitrotoluene	2.2	ug/L	**0.18 J**	0.10 U	0.10 U	0.10 UJ	0.13 U [0.12 U]	0.11 UJ	0.10 U	0.10 U
2,4-Dinitrotoluene	0.2	ug/L	0.10 U	0.10 U	0.10 U	0.10 UJ	0.13 U [0.12 U]	0.11 UJ	0.10 U	0.10 U
2,6-Dinitrotoluene	15	ug/L	0.10 U	0.10 U	0.10 U	0.10 UJ	0.13 U [0.12 U]	0.11 UJ	0.10 U	0.10 U
2-Amino-4,6-dinitrotoluene	30	ug/L	0.10 U	0.10 U	**0.14 J**	0.10 UJ	0.13 U [0.12 U]	0.11 UJ	0.10 U	0.10 U
2-Nitrotoluene	0.27	ug/L	0.10 U	0.10 U	0.10 U	0.10 UJ	0.13 U [0.12 U]	0.11 UJ	0.10 U	0.10 U
3-Nitrotoluene	1.3	ug/L	0.10 U	0.10 U	0.10 U	0.10 UJ	0.13 U [0.12 U]	0.11 UJ	0.10 U	0.10 U
4-Amino-2,6-Dinitrotoluene	30	ug/L	0.10 U	0.10 U	0.10 U	0.10 UJ	0.13 U [0.12 U]	0.11 UJ	0.10 U	0.10 U
4-Nitrotoluene	3.7	ug/L	0.10 U	0.10 U	0.10 U	0.10 UJ	0.13 U [0.12 U]	0.11 UJ	0.10 U	0.10 U
HMX	780	ug/L	0.052 U	0.051 U	0.051 U	0.052 UJ	0.067 U [0.058 U]	0.053 UJ	**0.037 J**	0.051 U
Nitrobenzene	0.12	ug/L	0.10 U	0.10 U	0.10 U	0.10 UJ	0.13 U [0.12 U]	0.11 UJ	0.10 U	0.10 U
Nitroglycerin	1.5	ug/L	0.52 U	0.51 U	0.51 U	0.52 UJ	0.67 U [0.58 U]	0.53 UJ	0.52 U	0.51 U
Pentaerythritol Tetranitrate	16	ug/L	0.52 U	0.51 U	0.51 U	0.52 UJ	0.67 U [0.58 U]	0.53 UJ	0.52 U	0.51 U
RDX	0.61	ug/L	0.052 U	0.051 U	**0.40**	0.052 UJ	**0.68 [0.65]**	**0.11 J**	**0.47**	0.051 U
Tetryl	63	ug/L	0.10 U	0.10 U	0.10 U	0.10 UJ	0.13 U [0.12 U]	0.11 UJ	0.10 U	0.10 U
Inorganics										
Uranium	30	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U [1 U]	1.0 U	1.0 U	1.0 U
Uranium-234	30	ug/L	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U [0.05 U]	0.050 U	0.050 U	0.050 U
Uranium-235	30	ug/L	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U [0.05 U]	0.050 U	0.050 U	0.050 U
Uranium-238	30	ug/L	0.15 B	0.050 UB	0.050 U	0.050 UB	0.050 UB [0.05 UB]	0.050 UB	0.050 UB	0.050 U

Notes:

Non-detected values are reported at the Limit of Detection (LOD)
Detected results are shown in **bold text**
Data exceeding the GW PAL are shaded
Field duplicate results are shown in brackets [ ]

Qualifier Definitions:

Inorganic

U	The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UB	Analyte considered non-detect at the listed value due to associated blank contamination.

Organic (Explosives)

J	Indicates an estimated value.
U	The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

Table 6-16: February 2013 Groundwater Sampling - Explosives and Uranium Results
Fort Jackson and McCrady Training Center, SC

Location ID: / Date Collected: / Sample Name:	Ground Water PAL	Units	MW-RS-06D 02/12/13 GW3-MW-RS-06D	MW-RS-06S 02/12/13 GW3-MW-RS-06S	MW-RS-07D 02/13/13 GW3-MW-RS-07D	MW-RS-07S 02/13/13 GW3-MW-RS-07S
Explosives						
1,3,5-Trinitrobenzene	460	ug/L	0.066 U [0.062 U]	0.051 U	0.052 U	0.053 U
1,3-Dinitrobenzene	1.5	ug/L	0.13 U [0.12 U]	0.10 U	**0.11**	0.11 U
2,4,6-Trinitrotoluene	2.2	ug/L	0.13 U [0.12 U]	0.10 U	0.10 U	0.11 U
2,4-Dinitrotoluene	0.2	ug/L	0.13 U [0.12 U]	0.10 U	0.10 U	0.11 U
2,6-Dinitrotoluene	15	ug/L	0.13 U [0.12 U]	0.10 U	0.10 U	0.11 U
2-Amino-4,6-dinitrotoluene	30	ug/L	0.13 U [0.12 U]	0.10 U	0.10 U	0.11 U
2-Nitrotoluene	0.27	ug/L	0.13 U [0.12 U]	0.10 U	0.10 U	0.11 U
3-Nitrotoluene	1.3	ug/L	0.13 U [0.12 U]	0.10 U	0.10 U	0.11 U
4-Amino-2,6-Dinitrotoluene	30	ug/L	0.13 U [0.12 U]	0.10 U	0.10 U	0.11 U
4-Nitrotoluene	3.7	ug/L	0.13 U [0.12 U]	0.10 U	0.10 U	0.11 U
HMX	780	ug/L	0.066 U [0.062 U]	0.051 U	0.052 U	0.053 U
Nitrobenzene	0.12	ug/L	0.13 U [0.12 U]	0.10 U	0.10 U	0.11 U
Nitroglycerin	1.5	ug/L	0.66 U [0.62 U]	0.51 U	0.52 U	0.53 U
Pentaerythritol Tetranitrate	16	ug/L	0.66 U [0.62 U]	0.51 U	0.52 U	0.53 U
RDX	0.61	ug/L	**0.64 [0.65]**	0.051 U	0.052 U	**0.19**
Tetryl	63	ug/L	0.13 U [0.12 U]	0.10 U	0.10 U	0.11 U
Inorganics						
Uranium	30	ug/L	1.0 U [1 U]	1.0 U	1.0 U	1.0 U
Uranium-234	30	ug/L	0.050 U [0.05 U]	0.050 U	0.050 U	0.050 U
Uranium-235	30	ug/L	0.050 U [0.05 U]	0.050 U	0.050 U	0.050 U
Uranium-238	30	ug/L	0.050 UB [0.05 UB]	0.050 UB	0.050 UB	0.050 UB

Notes:

Non-detected values are reported at the Limit of Detection (LOD)
Detected results are shown in **bold text**
Data exceeding the GW PAL are shaded
Field duplicate results are shown in brackets [ ]

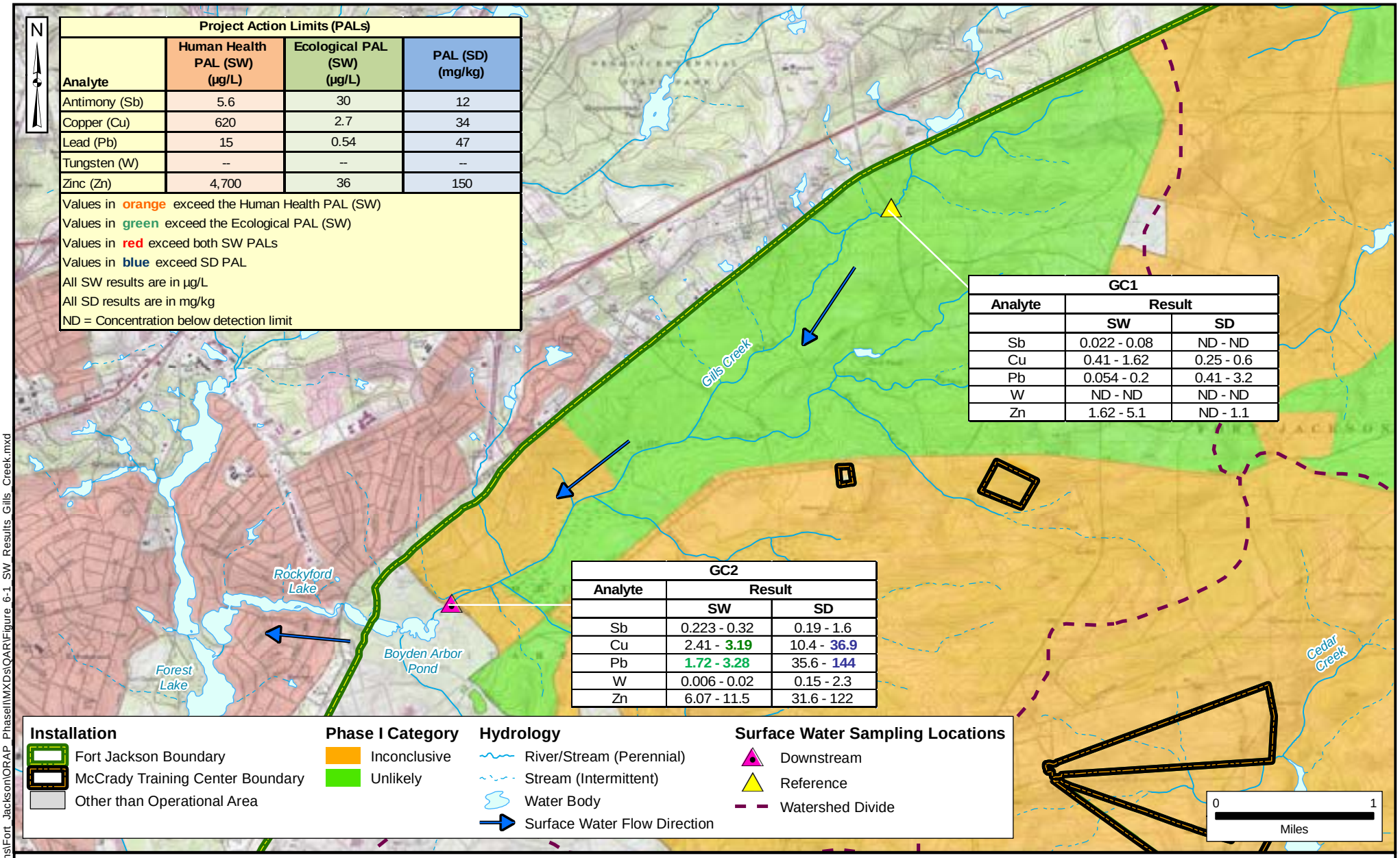
Qualifier Definitions:

Inorganic

U	The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UB	Analyte considered non-detect at the listed value due to associated blank contamination.

Organic (Explosives)

J	Indicates an estimated value.
U	The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.



Project Action Limits (PALs)			
Analyte	Human Health PAL (SW) (µg/L)	Ecological PAL (SW) (µg/L)	PAL (SD) (mg/kg)
Antimony (Sb)	5.6	30	12
Copper (Cu)	620	2.7	34
Lead (Pb)	15	0.54	47
Tungsten (W)	--	--	--
Zinc (Zn)	4,700	36	150

Values in **orange** exceed the Human Health PAL (SW)
Values in **green** exceed the Ecological PAL (SW)
Values in **red** exceed both SW PALs
Values in **blue** exceed SD PAL
All SW results are in µg/L
All SD results are in mg/kg
ND = Concentration below detection limit

GC1		
Analyte	Result	
	SW	SD
Sb	0.022 - 0.08	ND - ND
Cu	0.41 - 1.62	0.25 - 0.6
Pb	0.054 - 0.2	0.41 - 3.2
W	ND - ND	ND - ND
Zn	1.62 - 5.1	ND - 1.1

GC2		
Analyte	Result	
	SW	SD
Sb	0.223 - 0.32	0.19 - 1.6
Cu	2.41 - **3.19**	10.4 - **36.9**
Pb	**1.72 - 3.28**	35.6 - **144**
W	0.006 - 0.02	0.15 - 2.3
Zn	6.07 - 11.5	31.6 - 122

Installation
- Fort Jackson Boundary
- McCrady Training Center Boundary
- Other than Operational Area

Phase I Category
- Inconclusive
- Unlikely

Hydrology
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction

Surface Water Sampling Locations
- Downstream
- Reference
- Watershed Divide

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PIKA INTERNATIONAL INC. MALCOLM PIRNIE

Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 6-1
Surface Water and Sediment Sampling Results - Gills Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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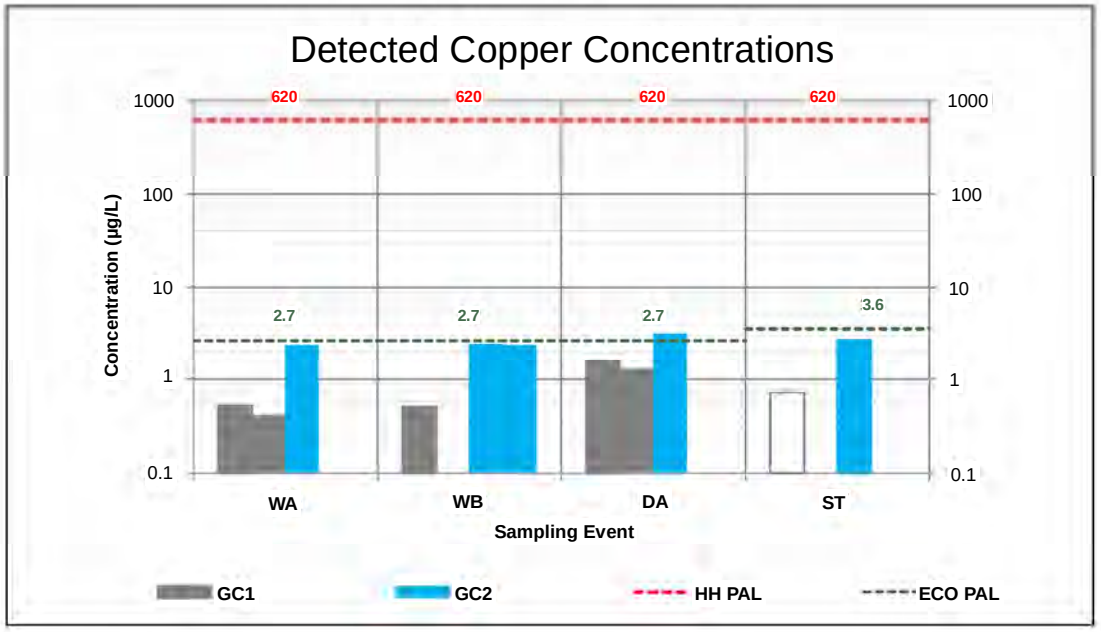
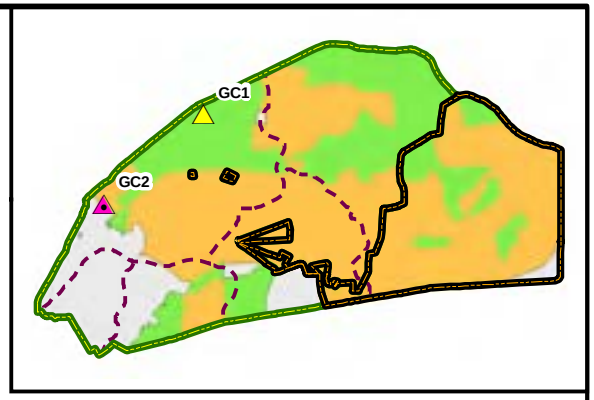
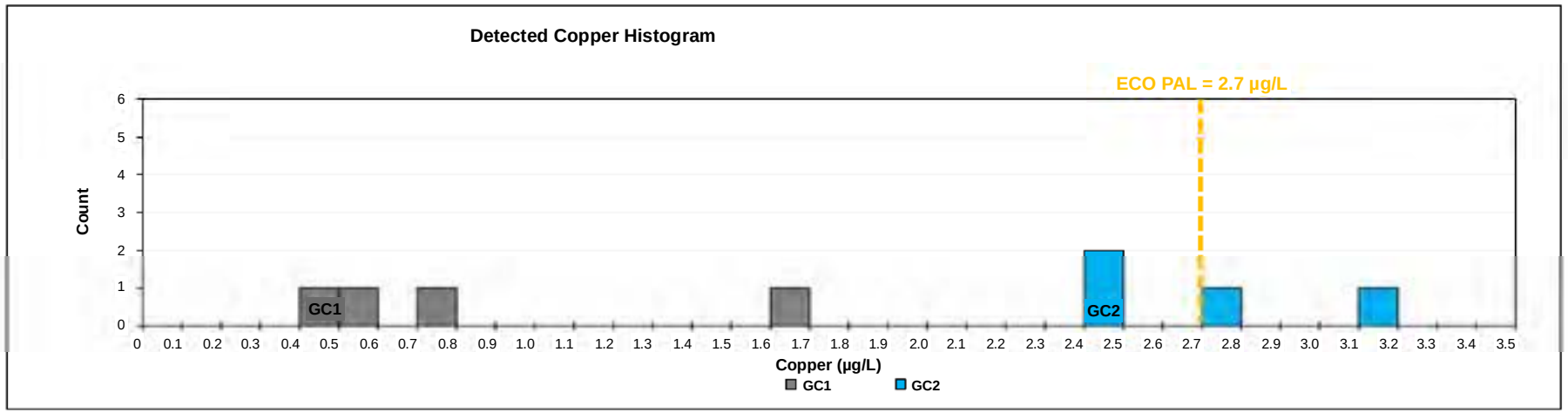




Notes:

- Solid bar chart columns indicate a measured result.
- Empty bar chart columns indicate the detection limit for a non-detect (U-flagged) result.



Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 6-2
Copper Results in Surface Water - Gills Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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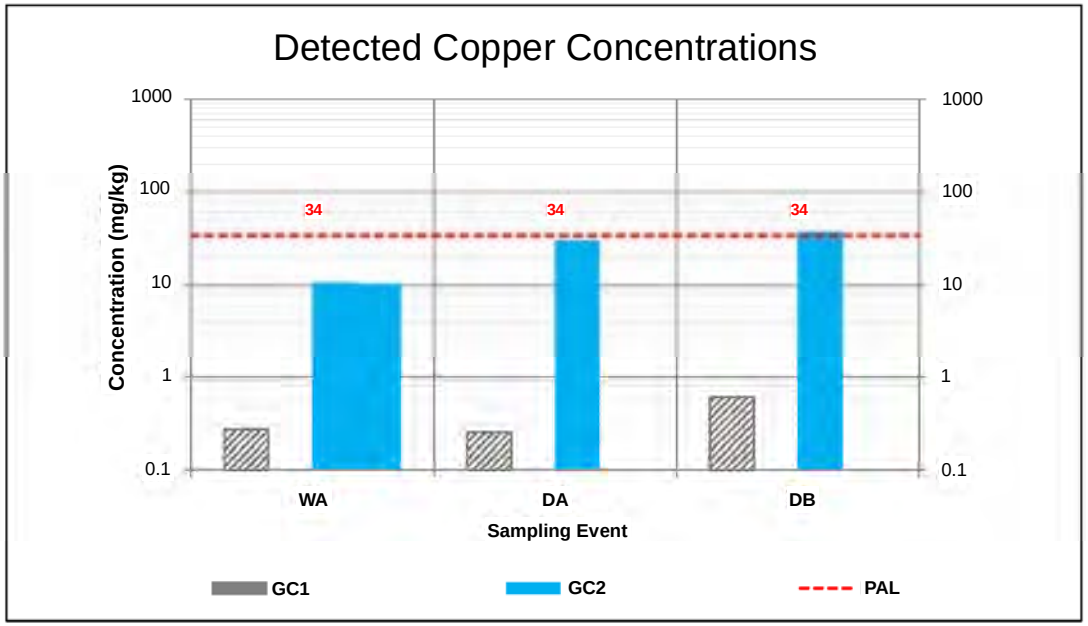
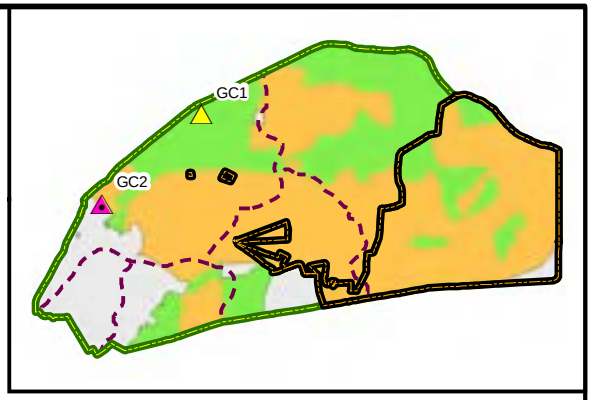
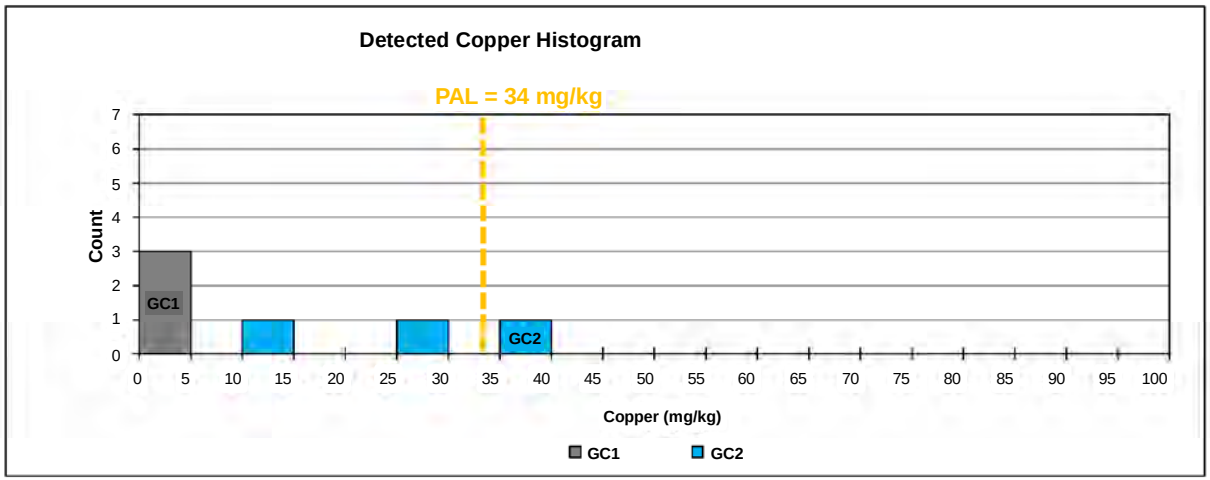




Notes:
- Solid bar chart columns indicate a measured result.

- Hashed bar chart columns indicate an estimated (J-flagged) result.



Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 6-3
Copper Results in Sediment - Gills Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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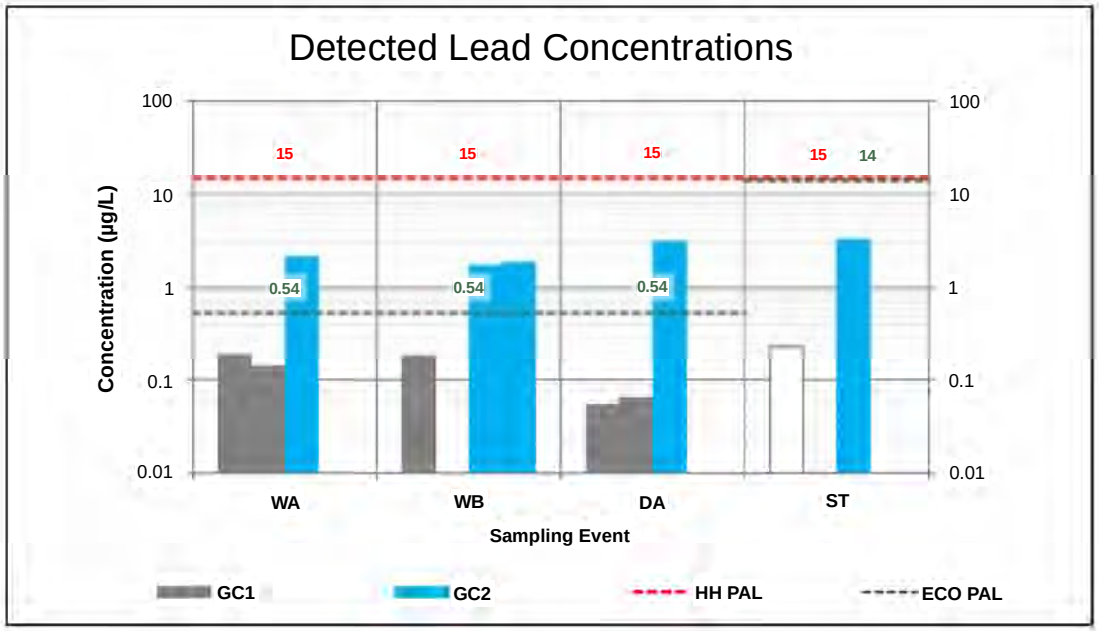
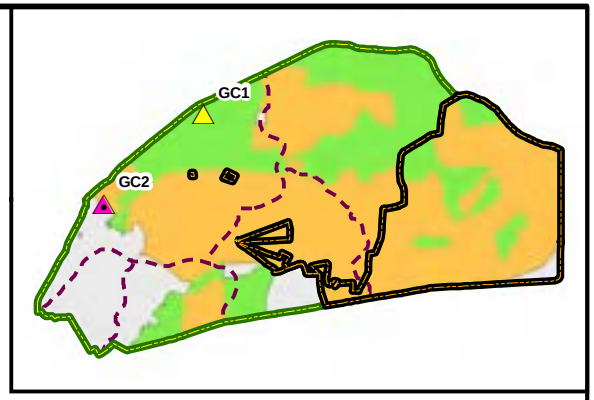
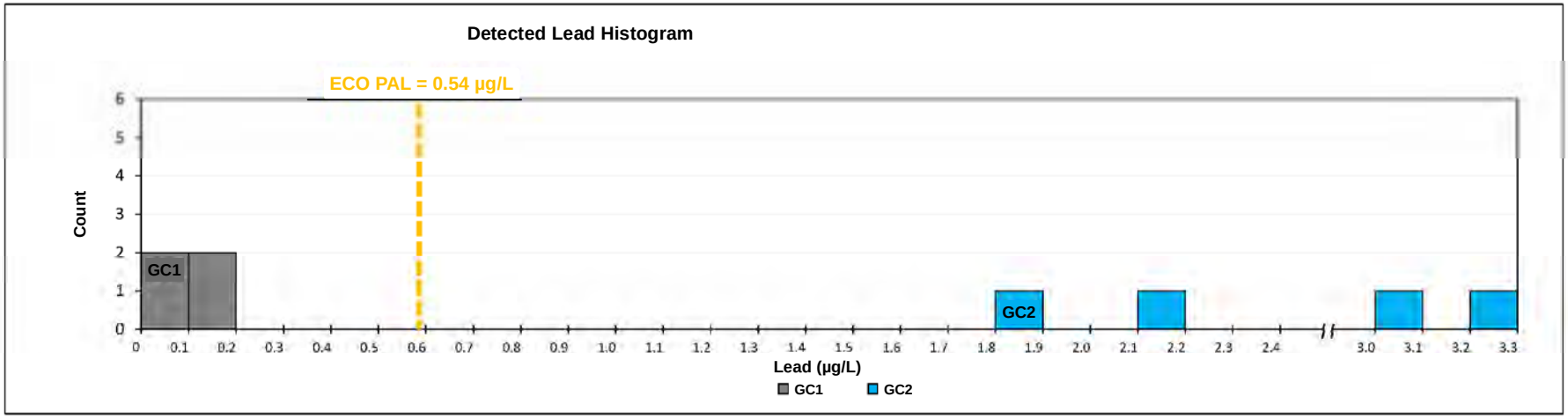




Notes:
- Solid bar chart columns indicate a measured result.
- Empty bar chart columns indicate the detection limit for a non-detect (U-flagged) result.



Operational Range Assessment Program
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Fort Jackson and McCrady Training Center, SC

Figure 6-4
Lead Results in Surface Water - Gills Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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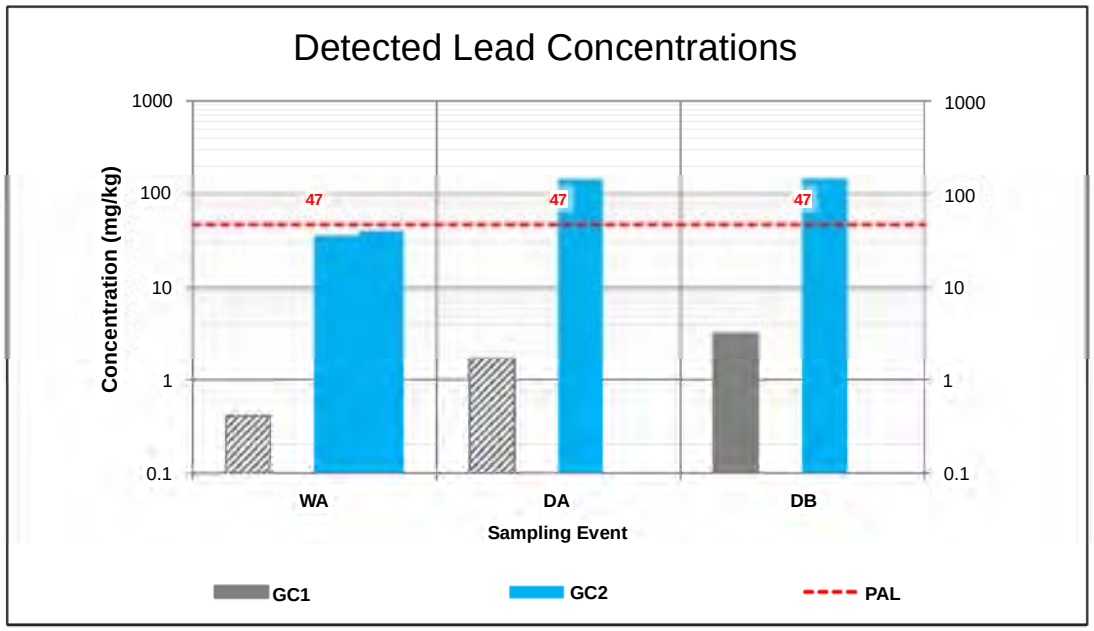
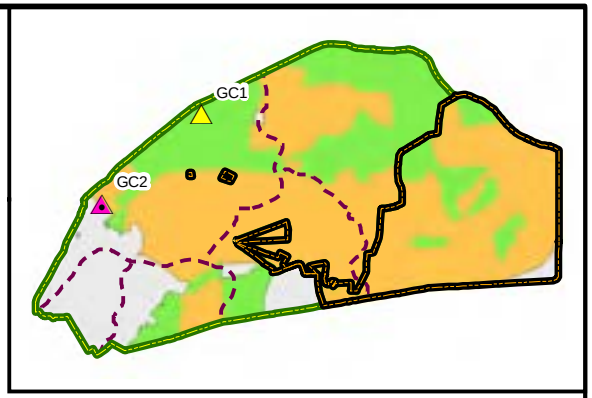
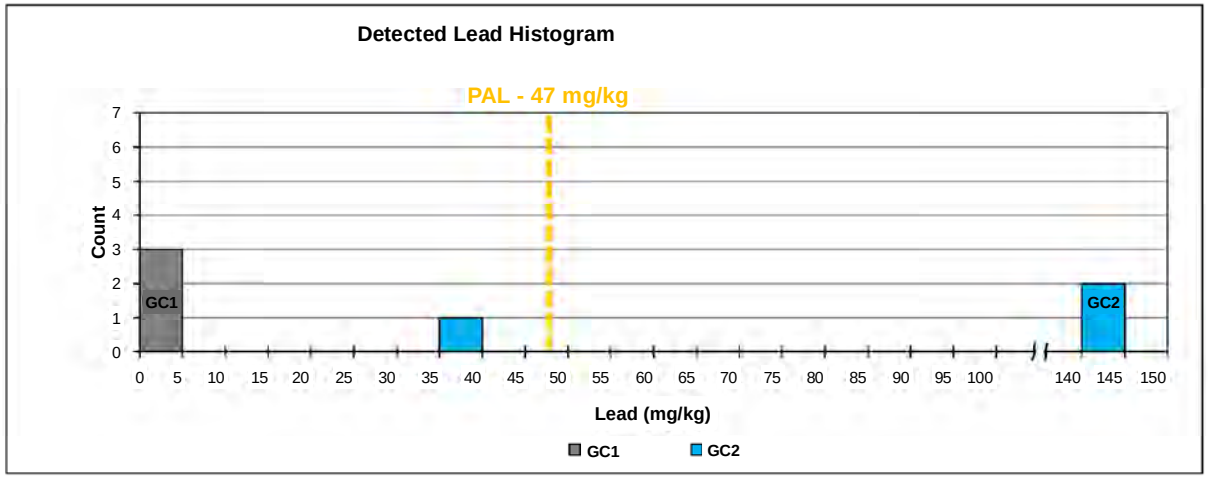




Notes:
- Solid bar chart columns indicate a measured result.

- Hashed bar chart columns indicate an estimated (J-flagged) result.



Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 6-5
Lead Results in Sediment - Gills Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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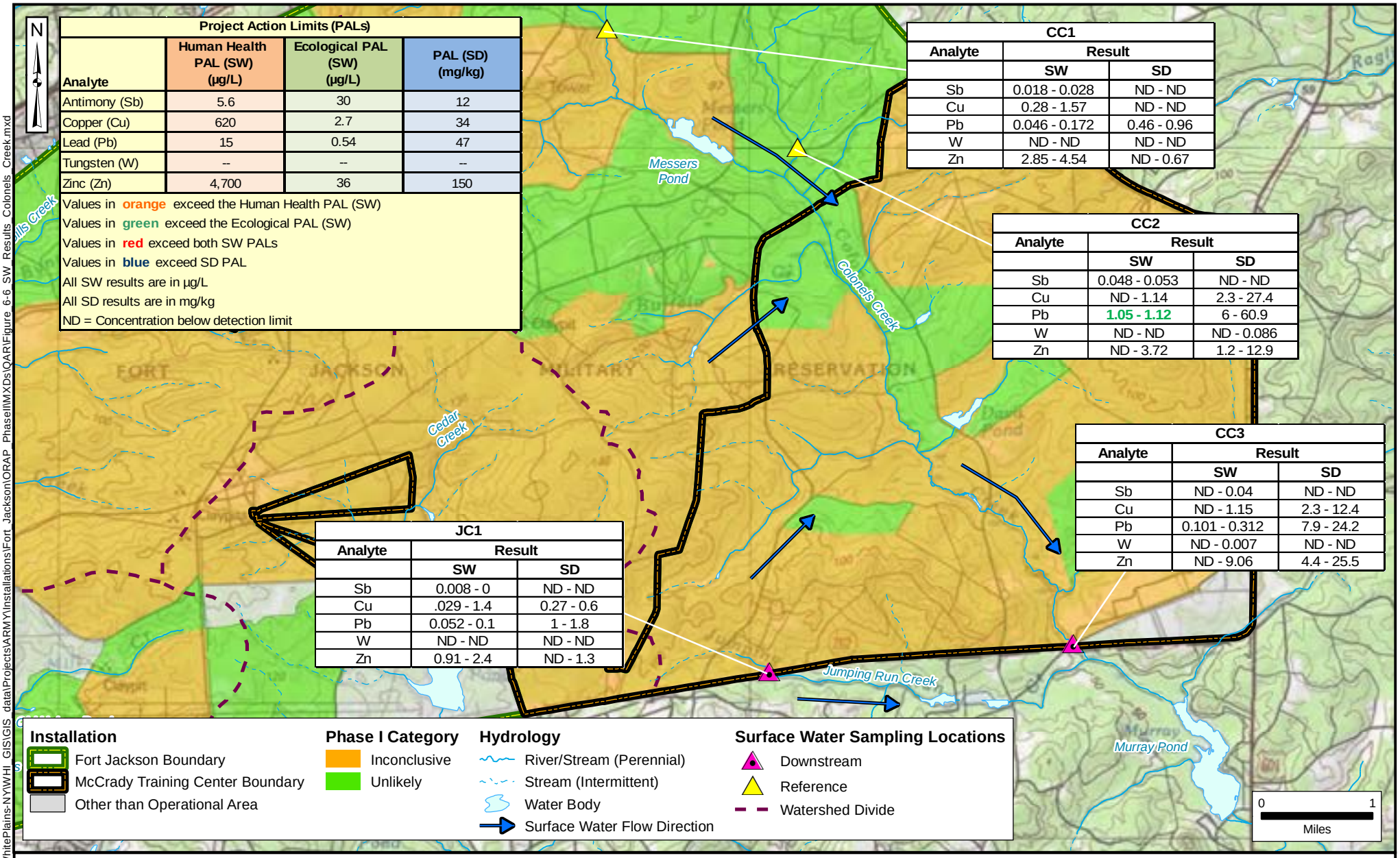

Project Action Limits (PALs)			
Analyte	Human Health PAL (SW) (µg/L)	Ecological PAL (SW) (µg/L)	PAL (SD) (mg/kg)
Antimony (Sb)	5.6	30	12
Copper (Cu)	620	2.7	34
Lead (Pb)	15	0.54	47
Tungsten (W)	--	--	--
Zinc (Zn)	4,700	36	150

Values in **orange** exceed the Human Health PAL (SW)
Values in **green** exceed the Ecological PAL (SW)
Values in **red** exceed both SW PALs
Values in **blue** exceed SD PAL
All SW results are in µg/L
All SD results are in mg/kg
ND = Concentration below detection limit

CC1		
Analyte	Result	
	SW	SD
Sb	0.018 - 0.028	ND - ND
Cu	0.28 - 1.57	ND - ND
Pb	0.046 - 0.172	0.46 - 0.96
W	ND - ND	ND - ND
Zn	2.85 - 4.54	ND - 0.67

CC2		
Analyte	Result	
	SW	SD
Sb	0.048 - 0.053	ND - ND
Cu	ND - 1.14	2.3 - 27.4
Pb	**1.05 - 1.12**	6 - 60.9
W	ND - ND	ND - 0.086
Zn	ND - 3.72	1.2 - 12.9

CC3		
Analyte	Result	
	SW	SD
Sb	ND - 0.04	ND - ND
Cu	ND - 1.15	2.3 - 12.4
Pb	0.101 - 0.312	7.9 - 24.2
W	ND - 0.007	ND - ND
Zn	ND - 9.06	4.4 - 25.5

JC1		
Analyte	Result	
	SW	SD
Sb	0.008 - 0	ND - ND
Cu	.029 - 1.4	0.27 - 0.6
Pb	0.052 - 0.1	1 - 1.8
W	ND - ND	ND - ND
Zn	0.91 - 2.4	ND - 1.3

Installation
- Fort Jackson Boundary
- McCrady Training Center Boundary
- Other than Operational Area

Phase I Category
- Inconclusive
- Unlikely

Hydrology
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction

Surface Water Sampling Locations
- Downstream
- Reference
- Watershed Divide

Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 6-6
Surface Water and Sediment Sampling Results - Colonels Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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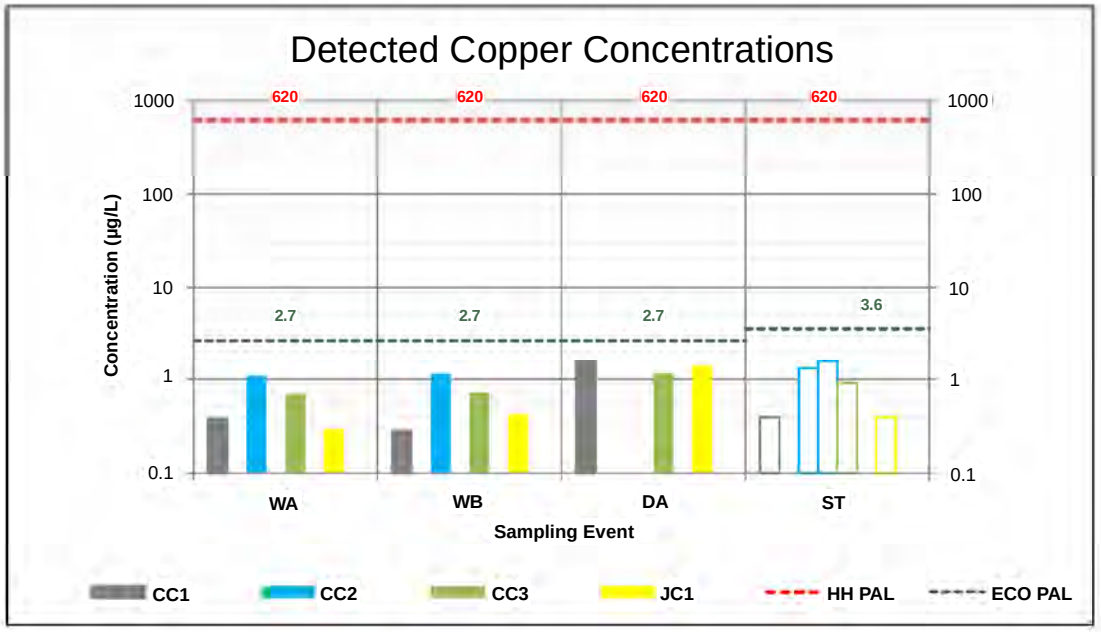
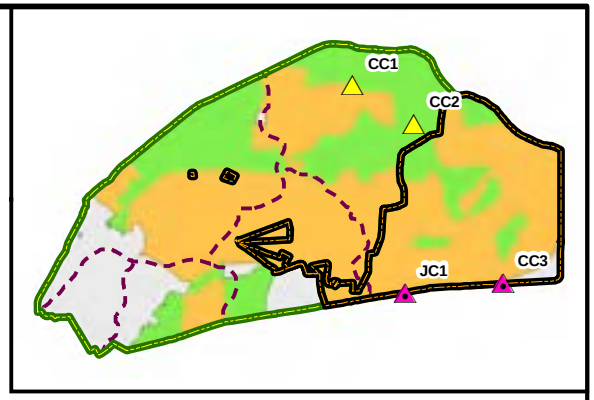
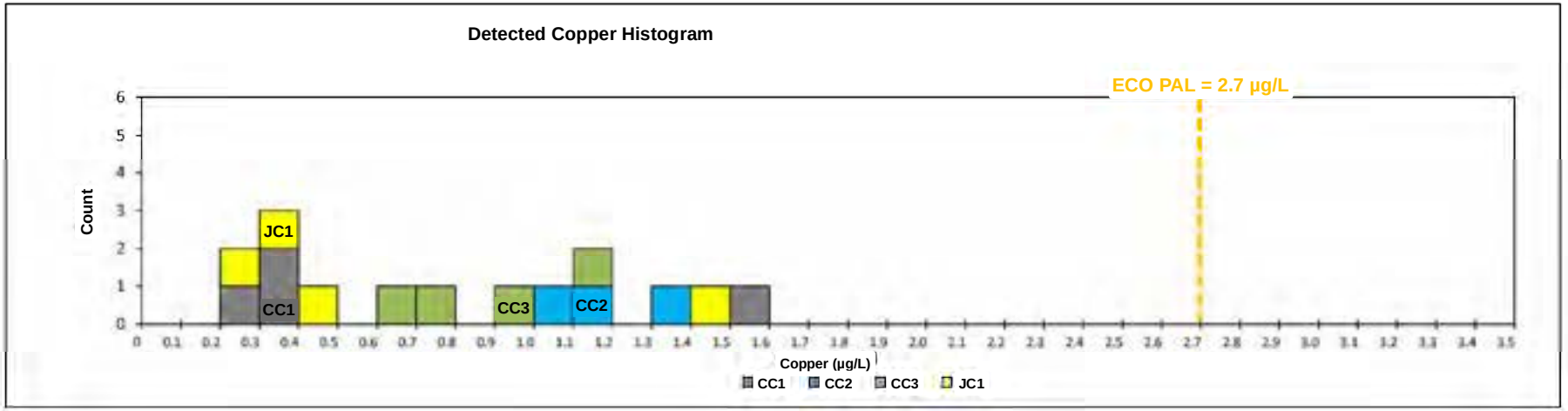




Notes:

- Solid bar chart columns indicate a measured result.
- Empty bar chart columns indicate the detection limit for a non-detect (U-flagged) result.



Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 6-7
Copper Results in Surface Water - Colonels Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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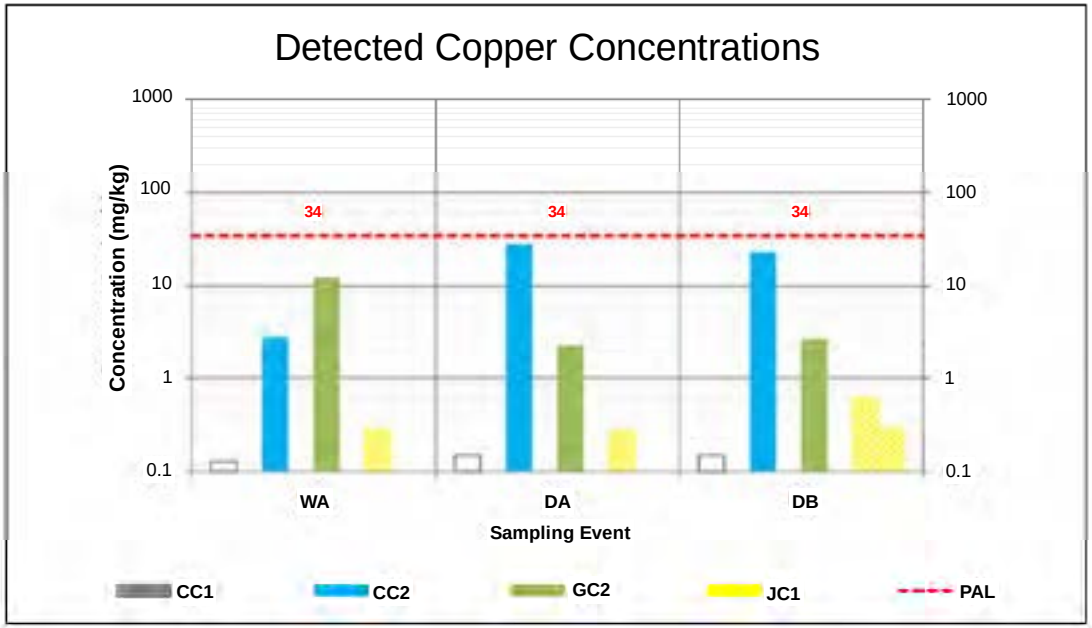

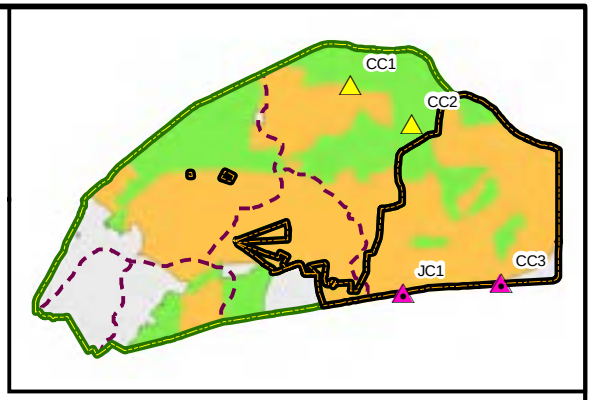

Notes:

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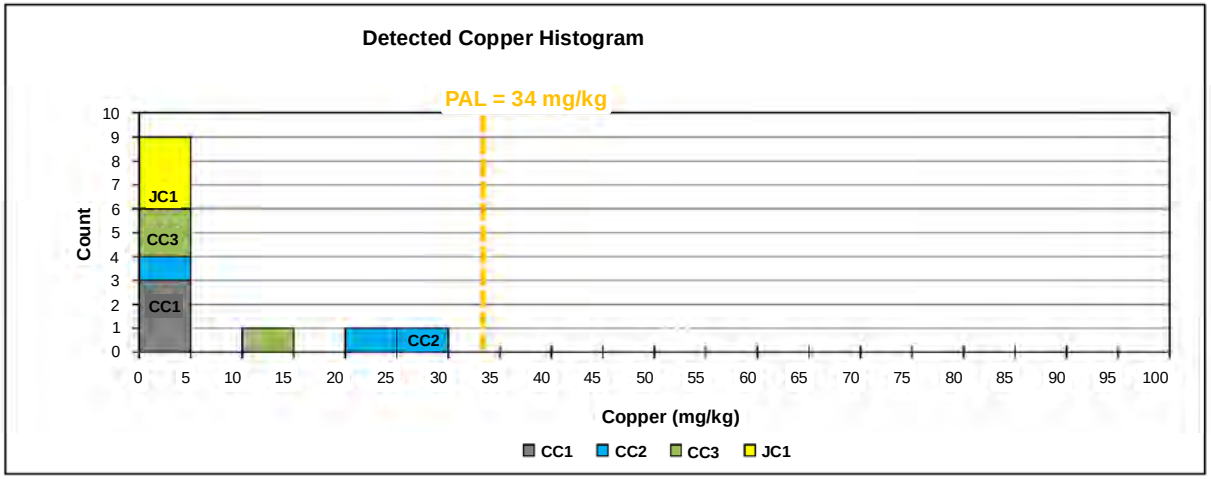
- Empty bar chart columns indicate the detection limit for a non-detect (U-flagged) result.



Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 6-8
Copper Results in Sediment - Colonels Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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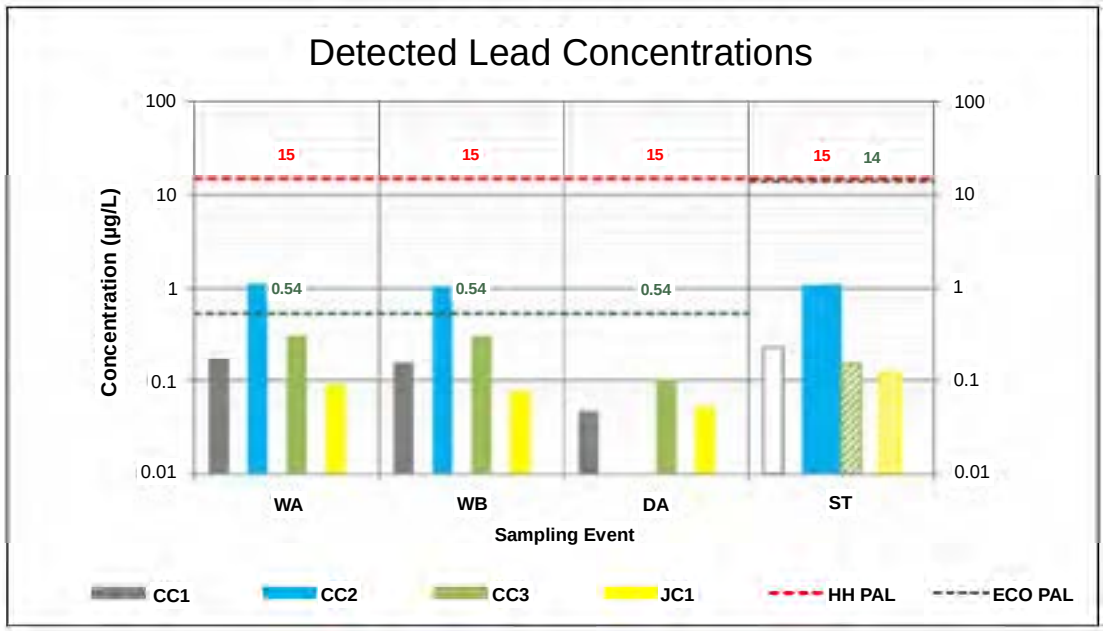

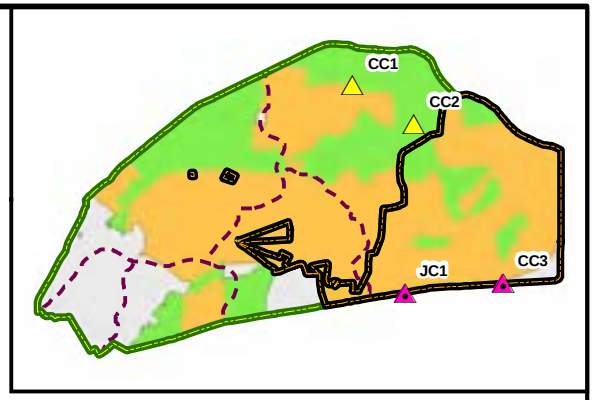

Notes:

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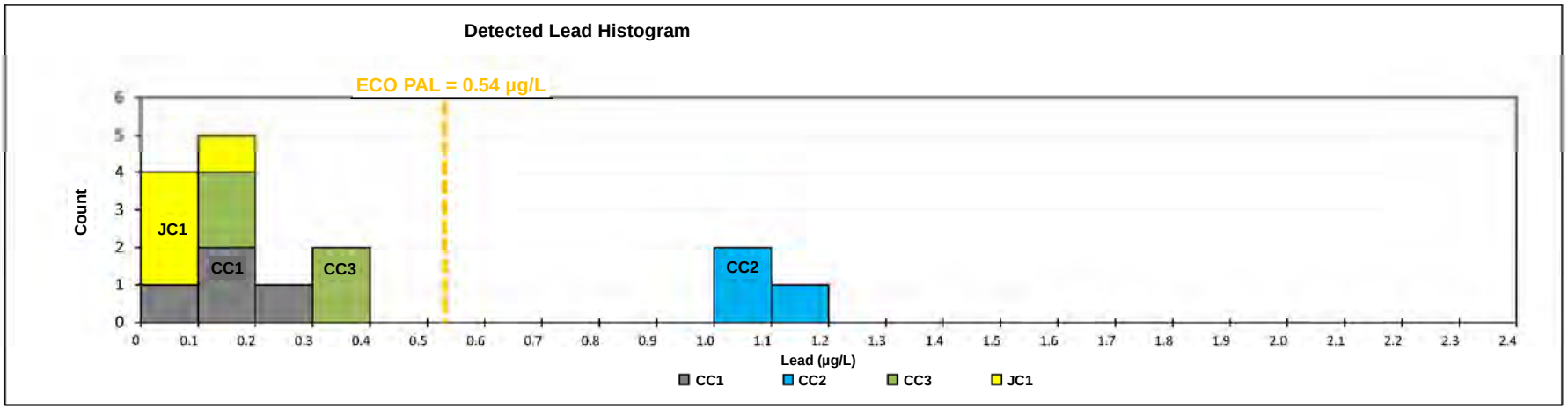
- Empty bar chart columns indicate the detection limit for a non-detect (U-flagged) result.



Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 6-9
Lead Results in Surface Water - Colonels Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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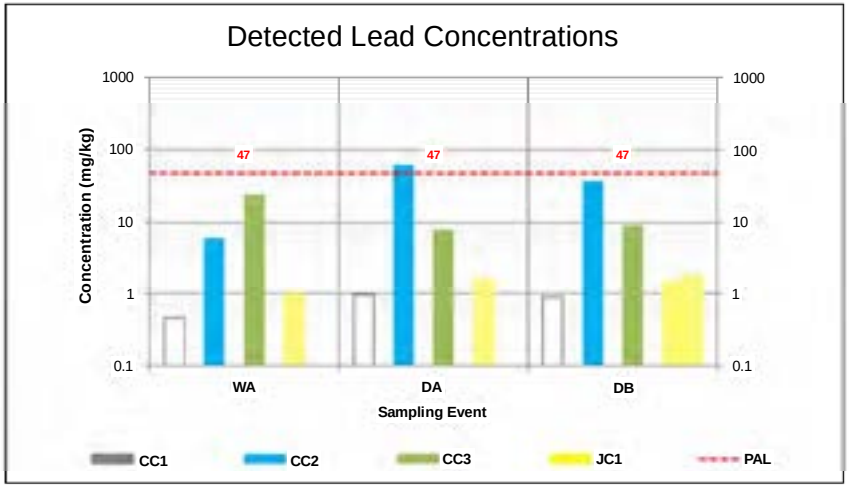

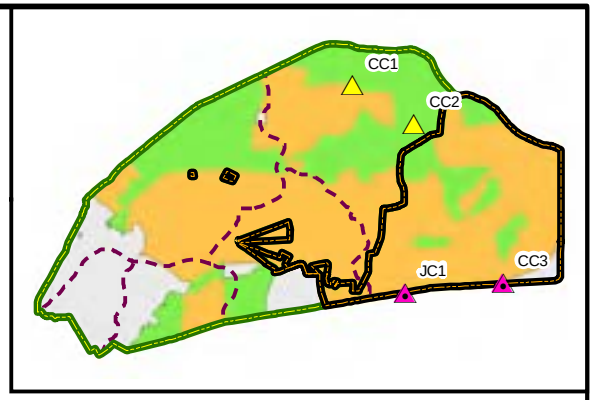

Notes:

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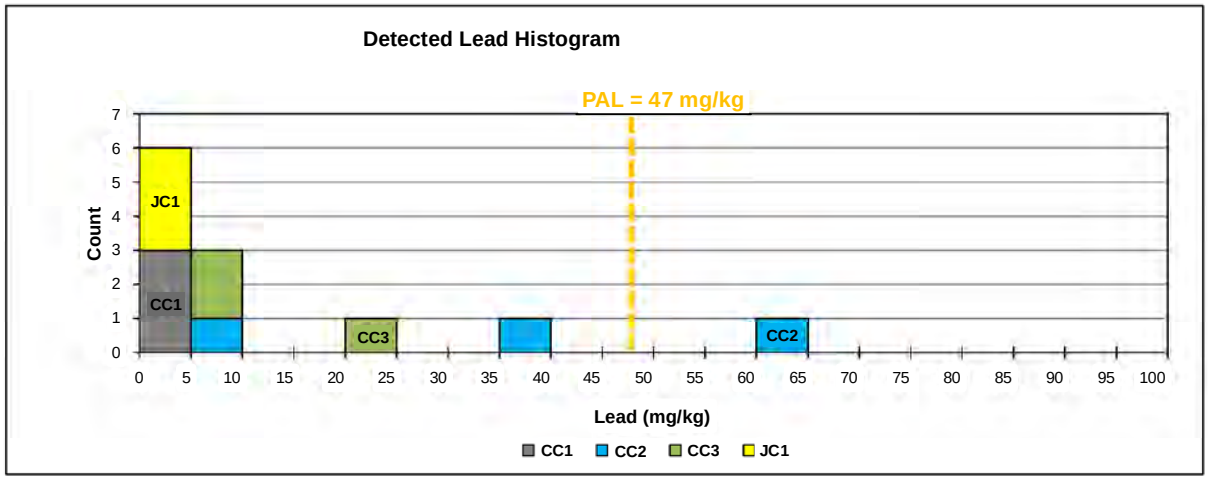
- Empty bar chart columns indicate the detection limit for a non-detect (U-flagged) result.



Operational Range Assessment Program
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Fort Jackson and McCrady Training Center, SC

Figure 6-10
Lead Results in Sediment - Colonels Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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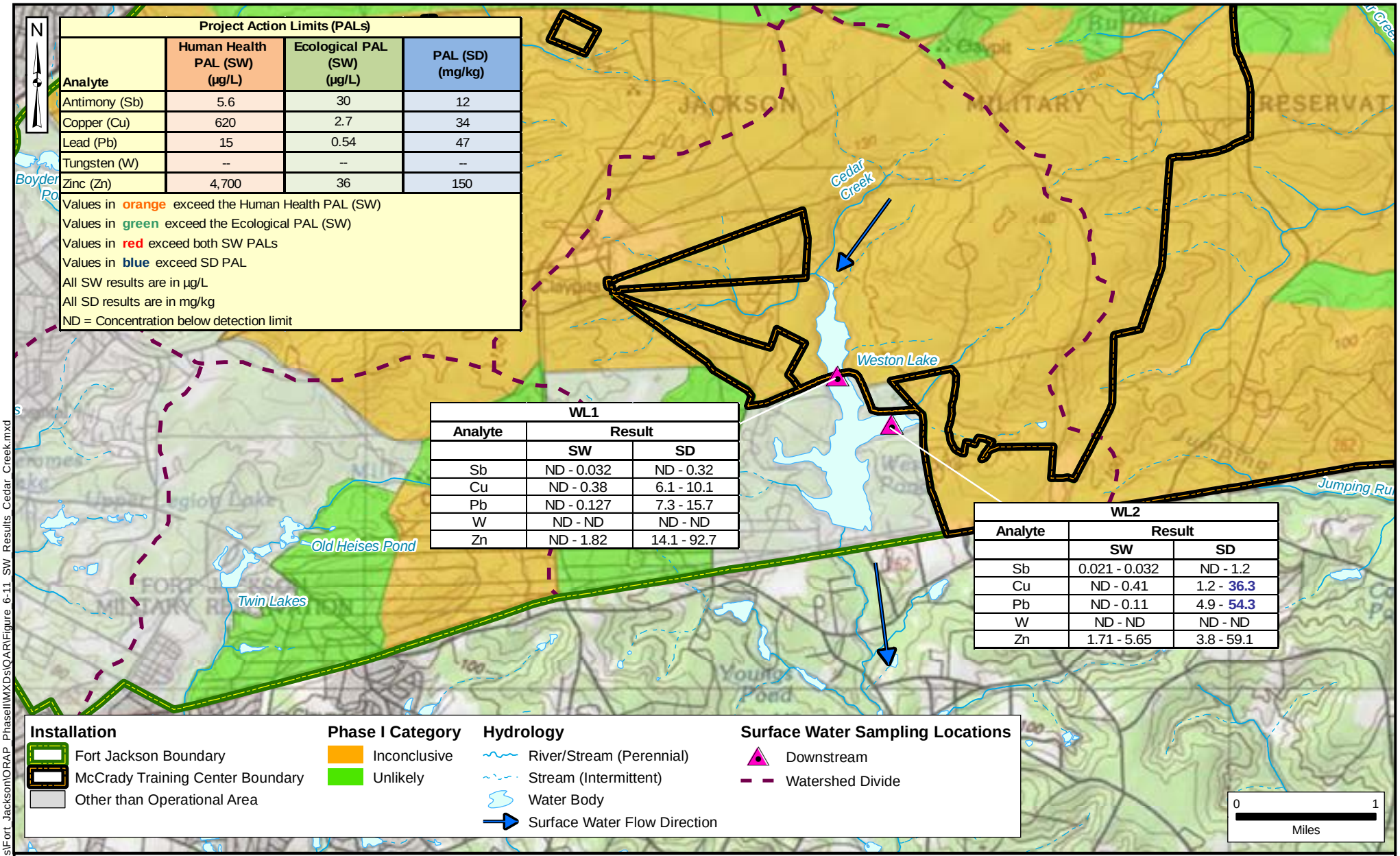

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Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 6-11
Surface Water and Sediment Sampling Results - Cedar Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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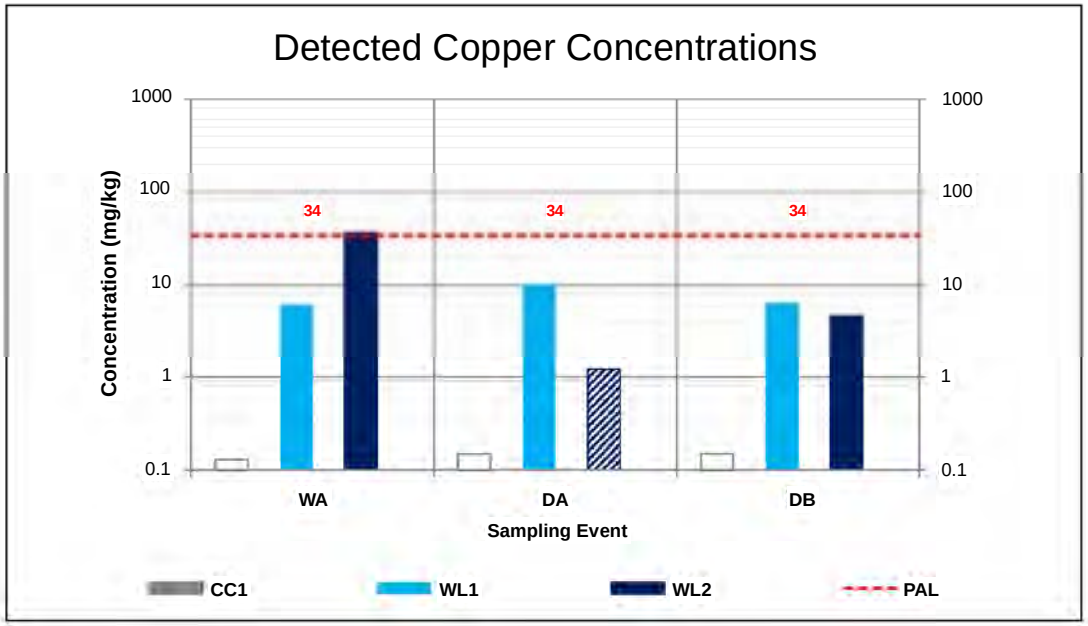

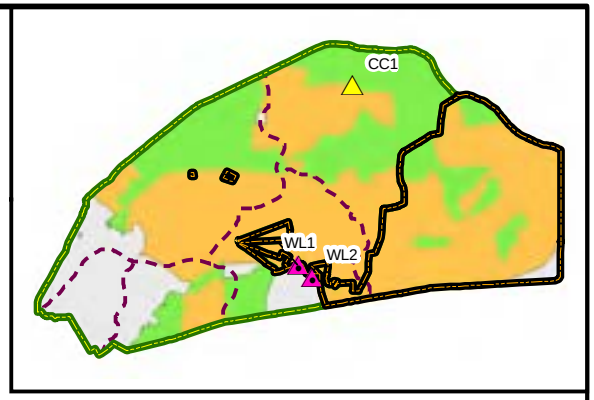

Notes:

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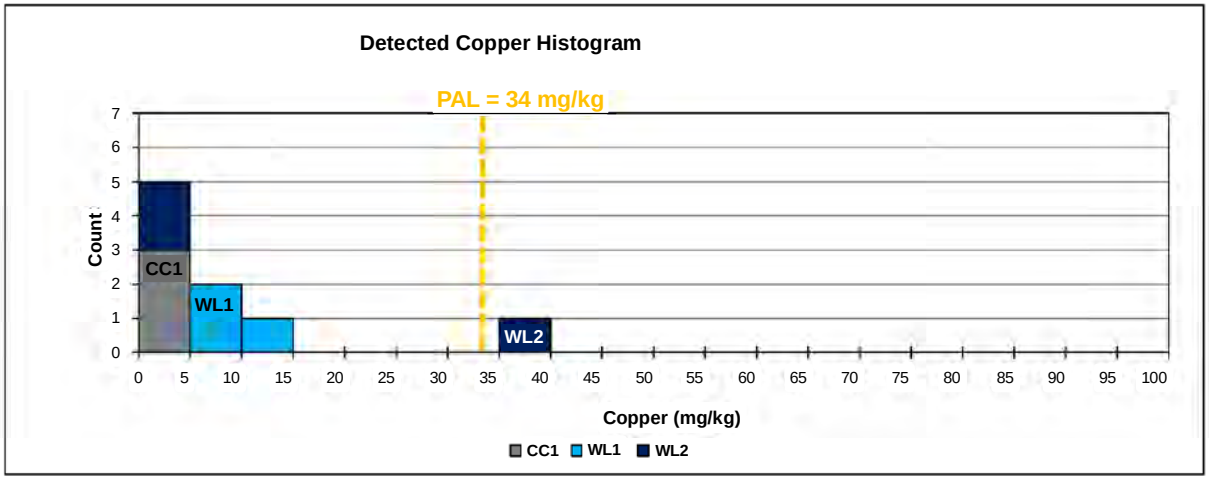
- Empty bar chart columns indicate the detection limit for a non-detect (U-flagged) result.



Operational Range Assessment Program
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Fort Jackson and McCrady Training Center, SC

Figure 6-12
Copper Results in Sediment - Cedar Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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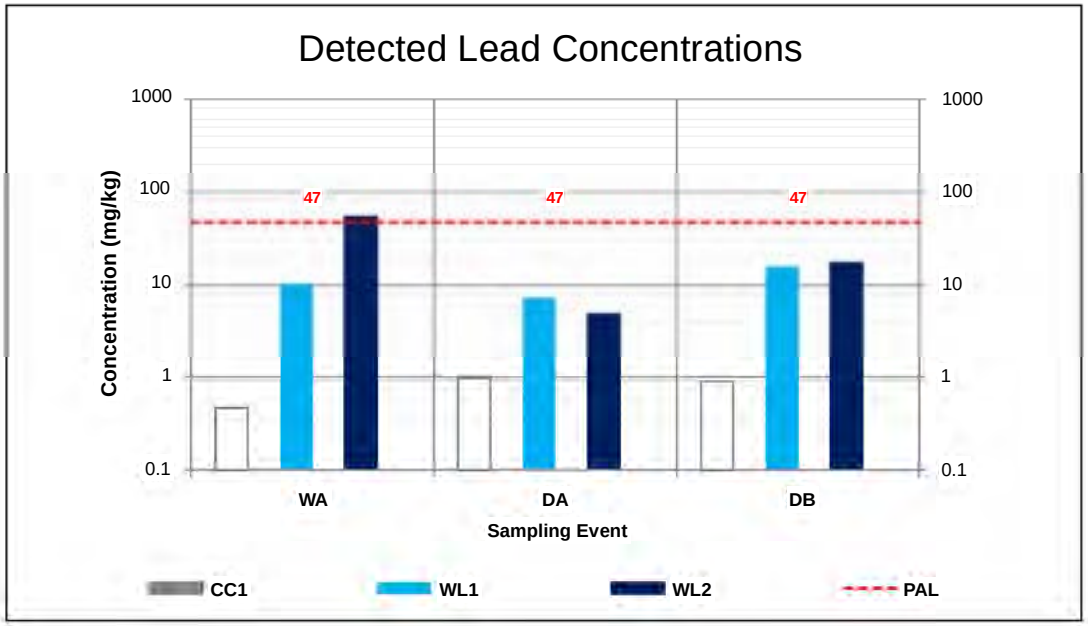

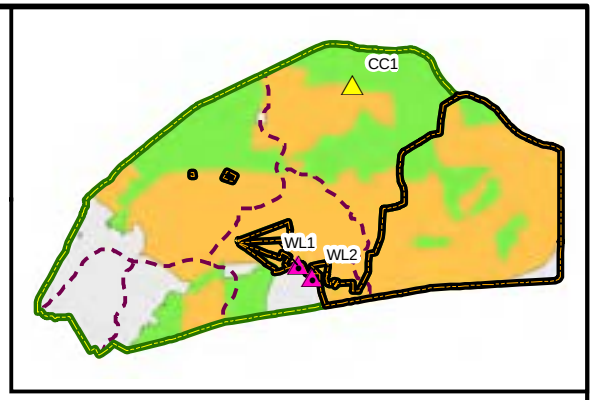

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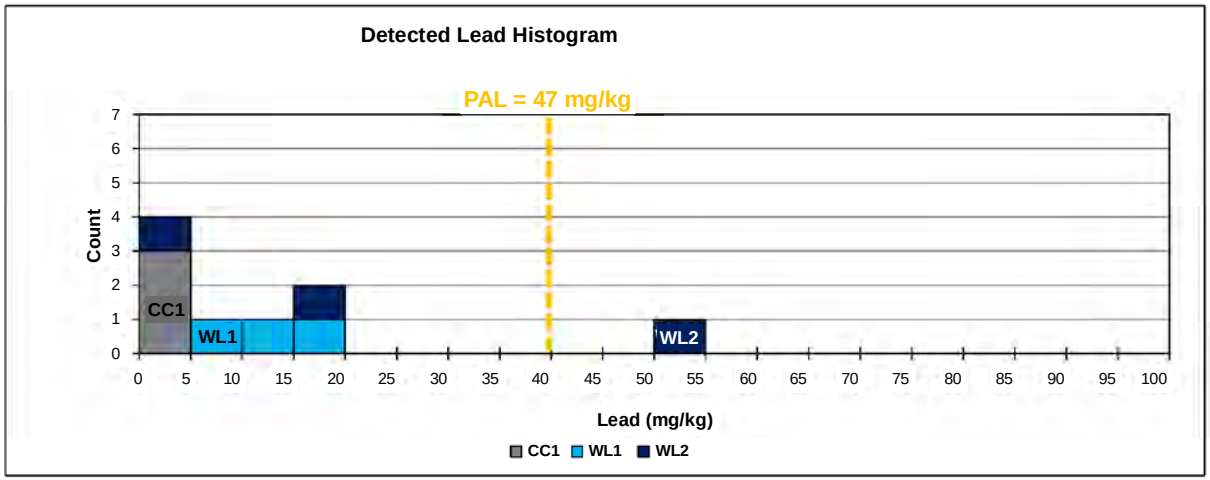
- Empty bar chart columns indicate the detection limit for a non-detect (U-flagged) result.



Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 6-13
Lead Results in Sediment - Cedar Creek Watershed

Data Sources:
AEC, ARID-GEO, 2006

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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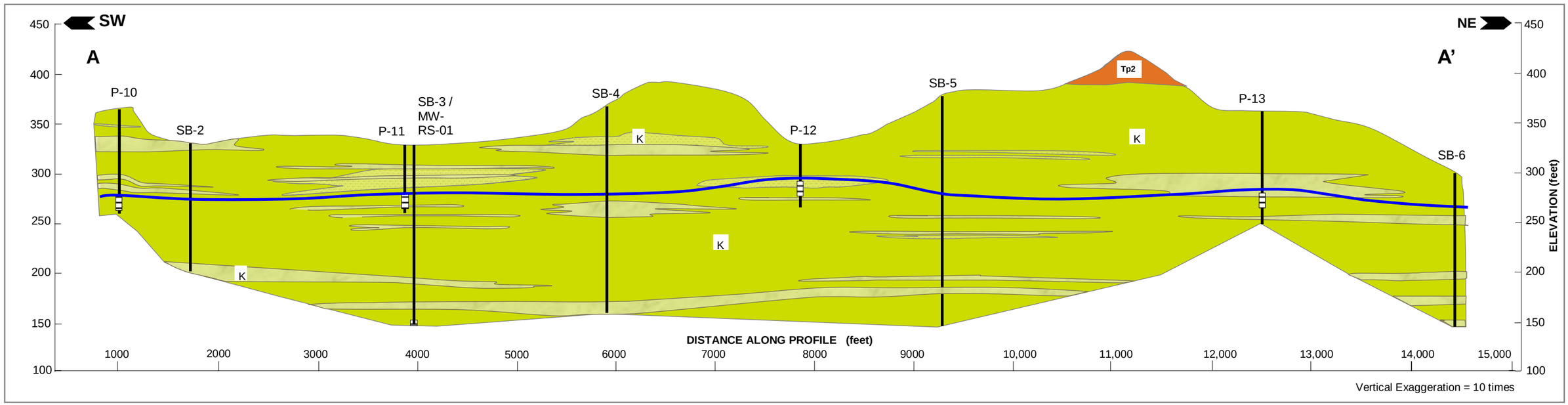

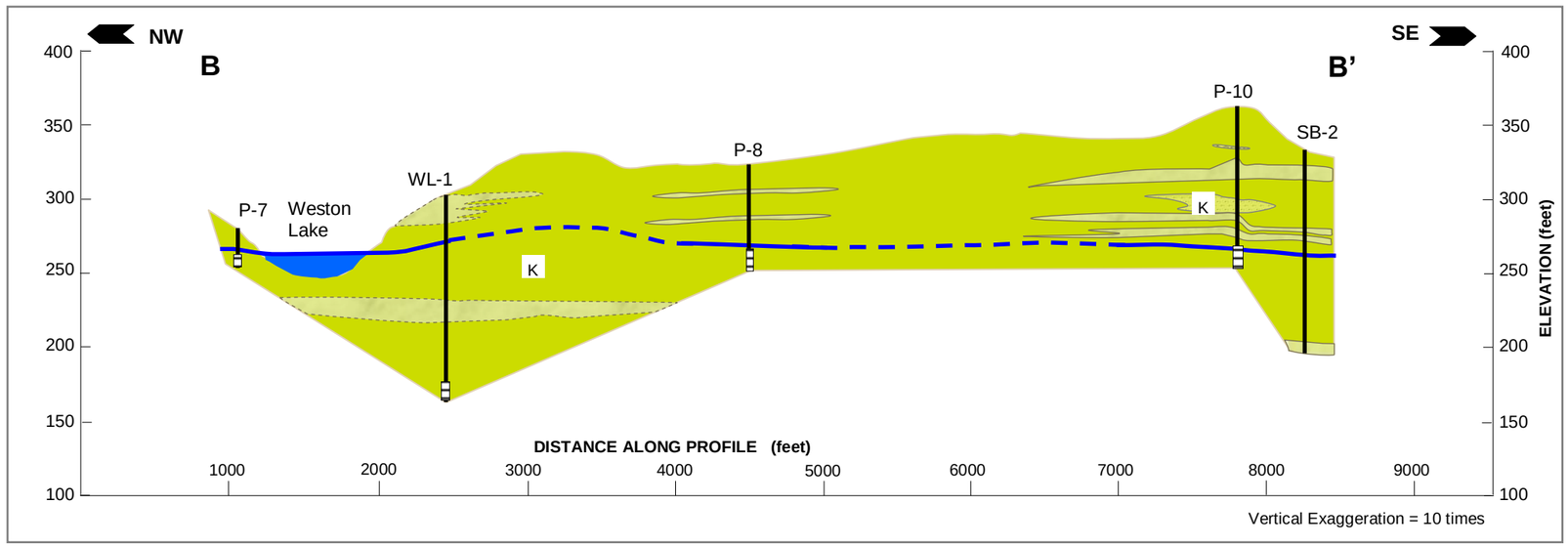

Cross sections represent geologic conditions as interpreted from the soil borings advanced during this investigation, and may not accurately represent actual conditions between the boring locations.
Surface topography as represented on Messers Pond, S.C. USGS 7.5 Minute Series Topographic Quadrangle (USGS, 1972).

Geology

Tertiary

Tp2 — Undifferentiated Units

Cretaceous

Middendorf Formation

K — Clay Beds; Sandy Clay and Clayey Sands; Interbedded Silty Sand, Poorly Graded Sand, and Silt

LEGEND

- Soil Boring Location
- Piezometer/Monitoring Well Screen
- Water Table (dashed where inferred)

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Figure 6-14
Geologic Cross Sections A-A' and B-B'

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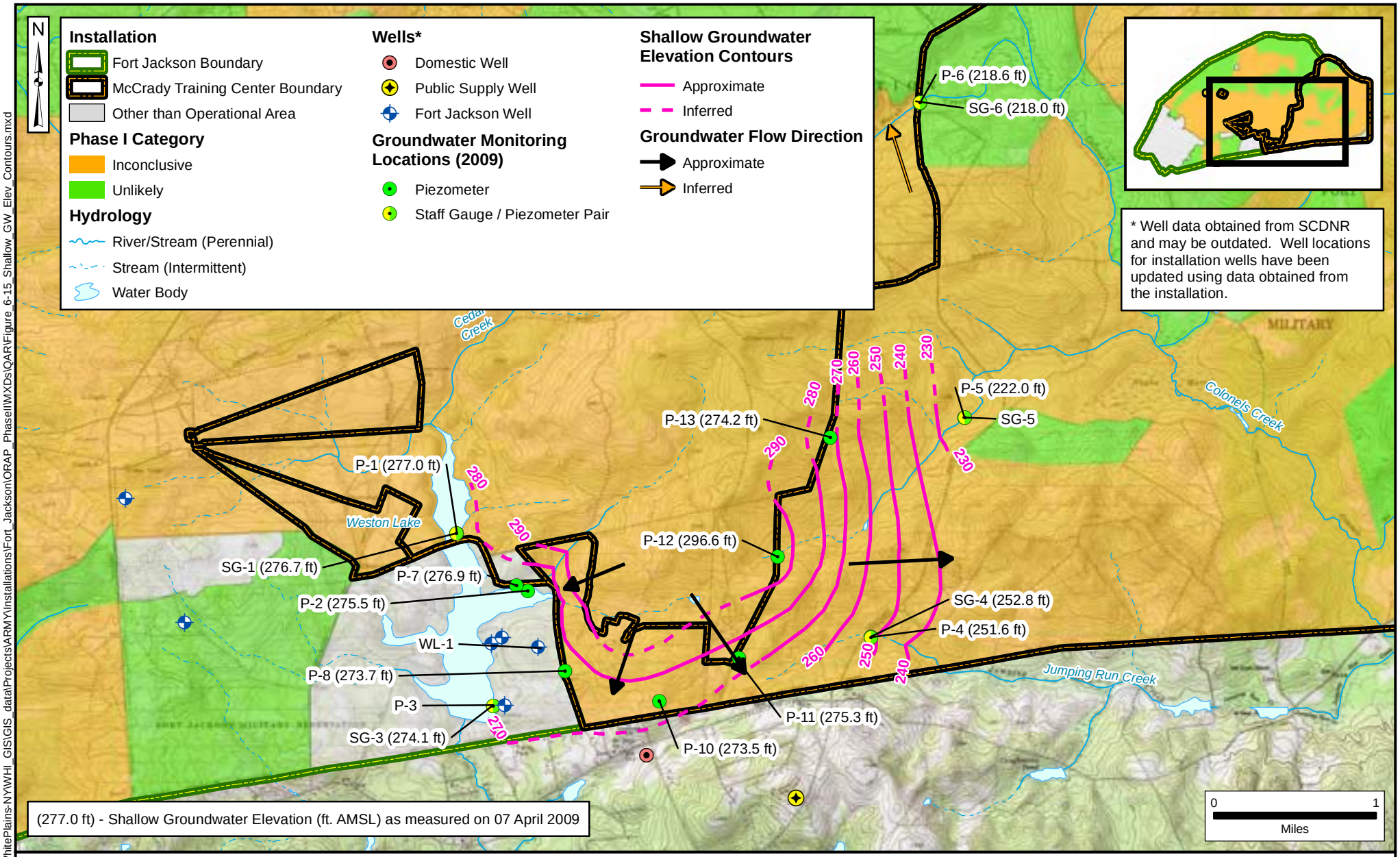

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Figure 6-15
Shallow Groundwater Elevation Contour Map

Data Sources:
AEC, ARID-GEO, 2006
SCDNR, Wells, 2007
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo
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Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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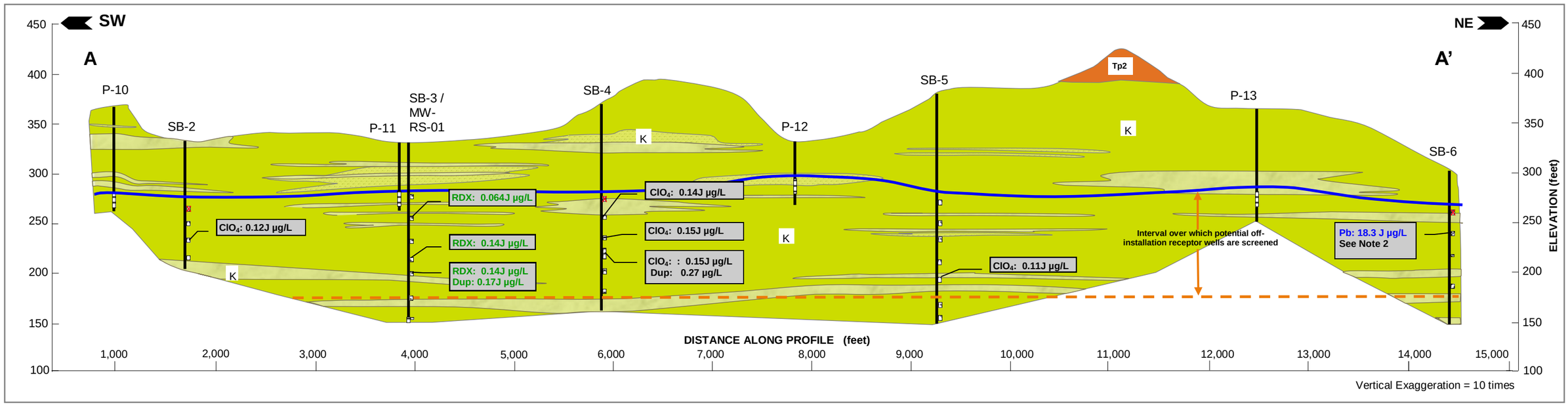

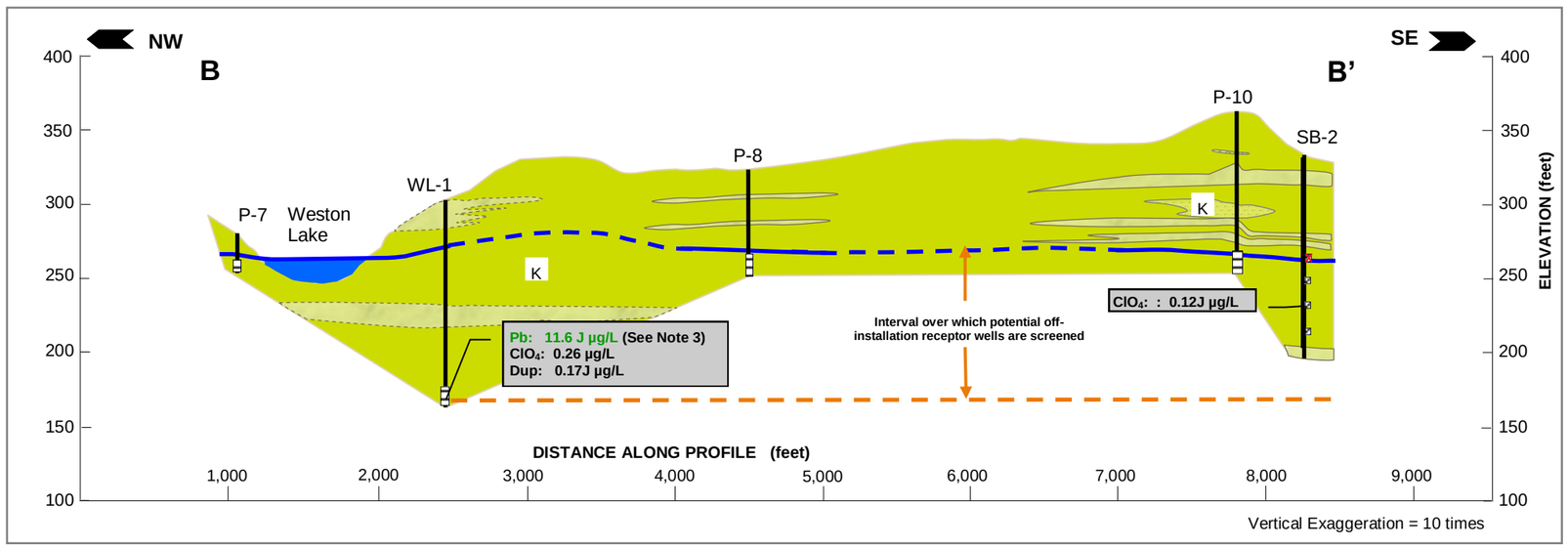

Notes:
1. Analyte detections shown represent all explosive and perchlorate detections, and only dissolved metals that are greater than either the Project Action Limit (PAL) or Lower Range of Uncertainty (LRU). Blue text indicates detections greater than the PAL. Green text indicates detection greater than the LRU.
2. The total lead value of 18.3J µg/L is greater than the PAL of 15 µg/L , however, dissolved lead was not detected at this sample interval.
3. The total lead value of 11.6 J µg/L is greater than the LRU of 7.5 µg/L, however, duplicate samples collected at this interval are less than the LRU for both the total and dissolved lead with results of 3.9J µg/L and 0.64 µg/L, respectively.

ClO_4 = Perchlorate, Dup = Duplicate Sample result, Pb = Lead, RDX = Cyclotrimethylenetrinitramine

Cross sections represent geologic conditions as interpreted from the soil borings advanced during this investigation, and may not accurately represent actual conditions between the boring locations. Surface topography as represented on Messers Pond, S.C. USGS 7.5 Minute Series Topographic Quadrangle (USGS, 1972).

Geology

Tertiary

Tp2 — Undifferentiated Units

Cretaceous

Middendorf Formation

K — Clay Beds; Sandy Clay and Clayey Sands; Interbedded Silty Sand, Poorly Graded Sand, and Silt

LEGEND

- Soil Boring Location
- Depth-Discrete Sample Interval
- Sample Interval not sampled
- Piezometer/Monitoring Well Screen
- Water Table (dashed where inferred)
- Pb 18.3J µg/L — Analyte Detections (See Note 1)

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Figure 6-16
Geologic Cross Sections A-A' and B-B'
Depth-Discrete Groundwater Sample Results (Explosives and Perchlorate)

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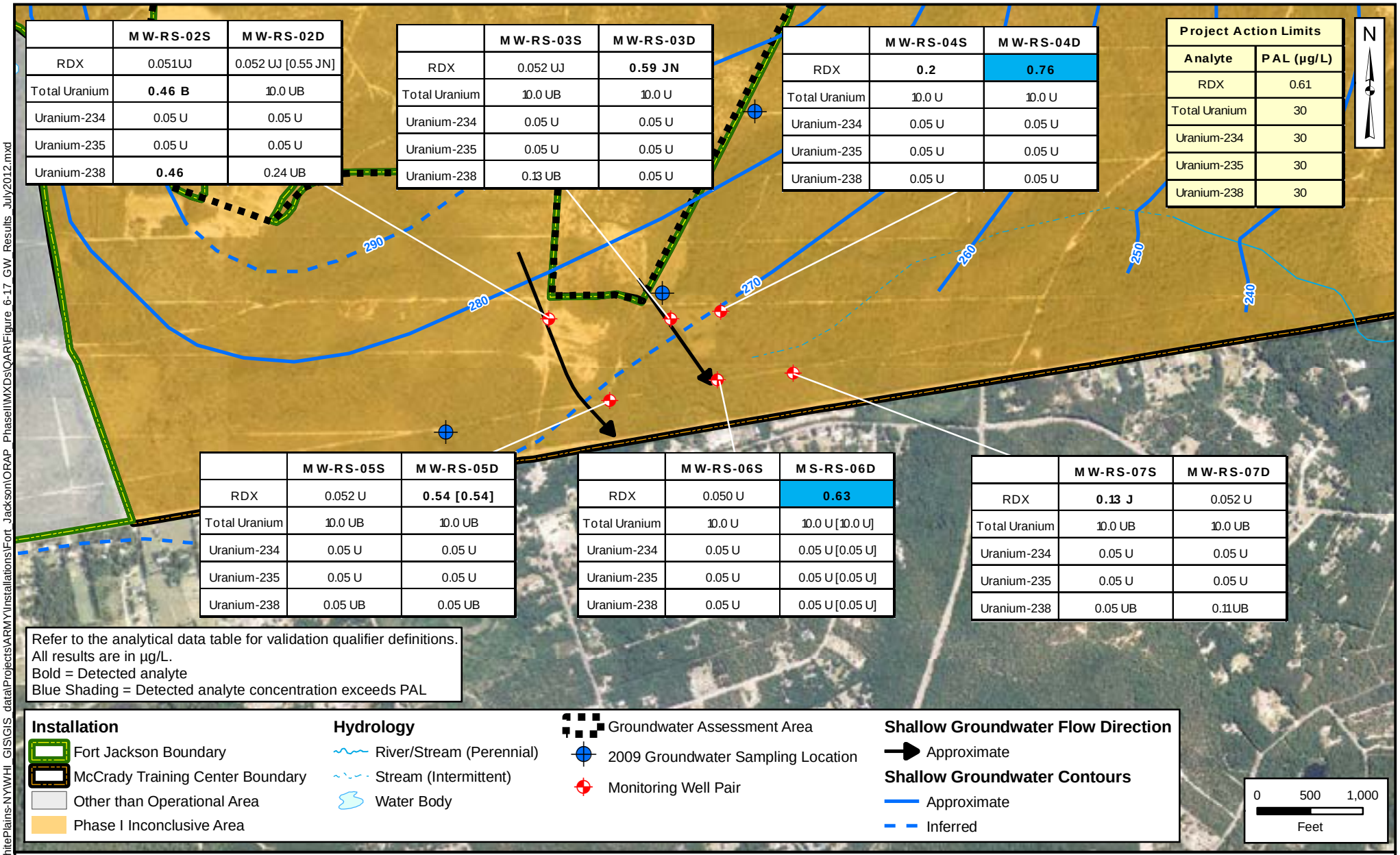

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Figure 6-17
Explosives and Uranium in Groundwater (July 2012)

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
USDA-FSA, Aerial Photo, 2006

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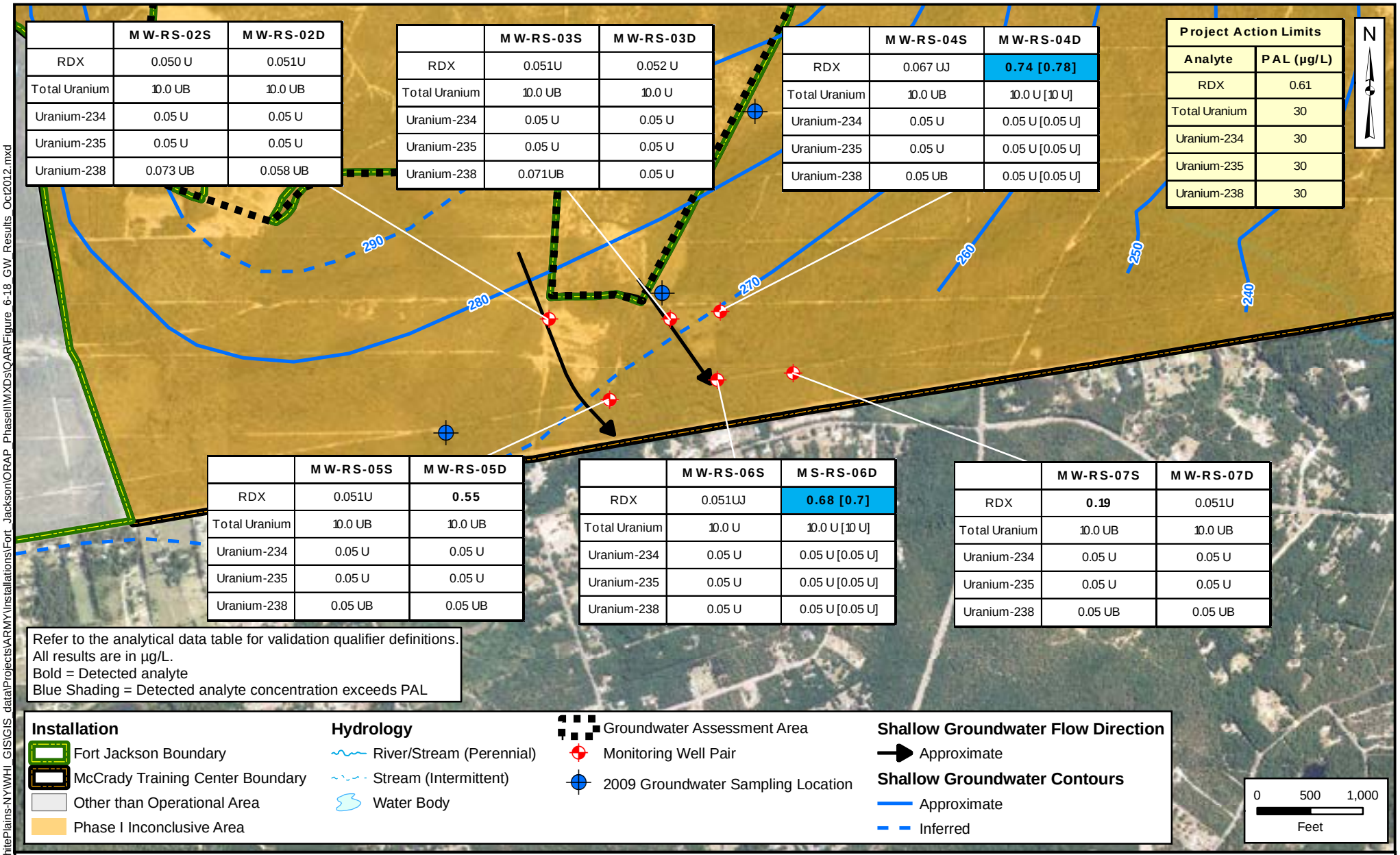

	MW-RS-02S	MW-RS-02D
RDX	0.050 U	0.051U
Total Uranium	10.0 UB	10.0 UB
Uranium-234	0.05 U	0.05 U
Uranium-235	0.05 U	0.05 U
Uranium-238	0.073 UB	0.058 UB

	MW-RS-03S	MW-RS-03D
RDX	0.051U	0.052 U
Total Uranium	10.0 UB	10.0 U
Uranium-234	0.05 U	0.05 U
Uranium-235	0.05 U	0.05 U
Uranium-238	0.071UB	0.05 U

	MW-RS-04S	MW-RS-04D
RDX	0.067 UJ	**0.74 [0.78]**
Total Uranium	10.0 UB	10.0 U [10 U]
Uranium-234	0.05 U	0.05 U [0.05 U]
Uranium-235	0.05 U	0.05 U [0.05 U]
Uranium-238	0.05 UB	0.05 U [0.05 U]

Project Action Limits	
Analyte	PAL (µg/L)
RDX	0.61
Total Uranium	30
Uranium-234	30
Uranium-235	30
Uranium-238	30

	MW-RS-05S	MW-RS-05D
RDX	0.051U	**0.55**
Total Uranium	10.0 UB	10.0 UB
Uranium-234	0.05 U	0.05 U
Uranium-235	0.05 U	0.05 U
Uranium-238	0.05 UB	0.05 UB

	MW-RS-06S	MS-RS-06D
RDX	0.051UJ	**0.68 [0.7]**
Total Uranium	10.0 U	10.0 U [10 U]
Uranium-234	0.05 U	0.05 U [0.05 U]
Uranium-235	0.05 U	0.05 U [0.05 U]
Uranium-238	0.05 U	0.05 U [0.05 U]

	MW-RS-07S	MW-RS-07D
RDX	**0.19**	0.051U
Total Uranium	10.0 UB	10.0 UB
Uranium-234	0.05 U	0.05 U
Uranium-235	0.05 U	0.05 U
Uranium-238	0.05 UB	0.05 UB

Refer to the analytical data table for validation qualifier definitions.
All results are in µg/L.
Bold = Detected analyte
Blue Shading = Detected analyte concentration exceeds PAL

Installation
- Fort Jackson Boundary
- McCrady Training Center Boundary
- Other than Operational Area
- Phase I Inconclusive Area

Hydrology
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body

- Groundwater Assessment Area
- Monitoring Well Pair
- 2009 Groundwater Sampling Location

Shallow Groundwater Flow Direction
- Approximate

Shallow Groundwater Contours
- Approximate
- Inferred

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Figure 6-18
Explosives and Uranium in Groundwater (October 2012)

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
USDA-FSA, Aerial Photo, 2006

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Prepared For: ..... USACE
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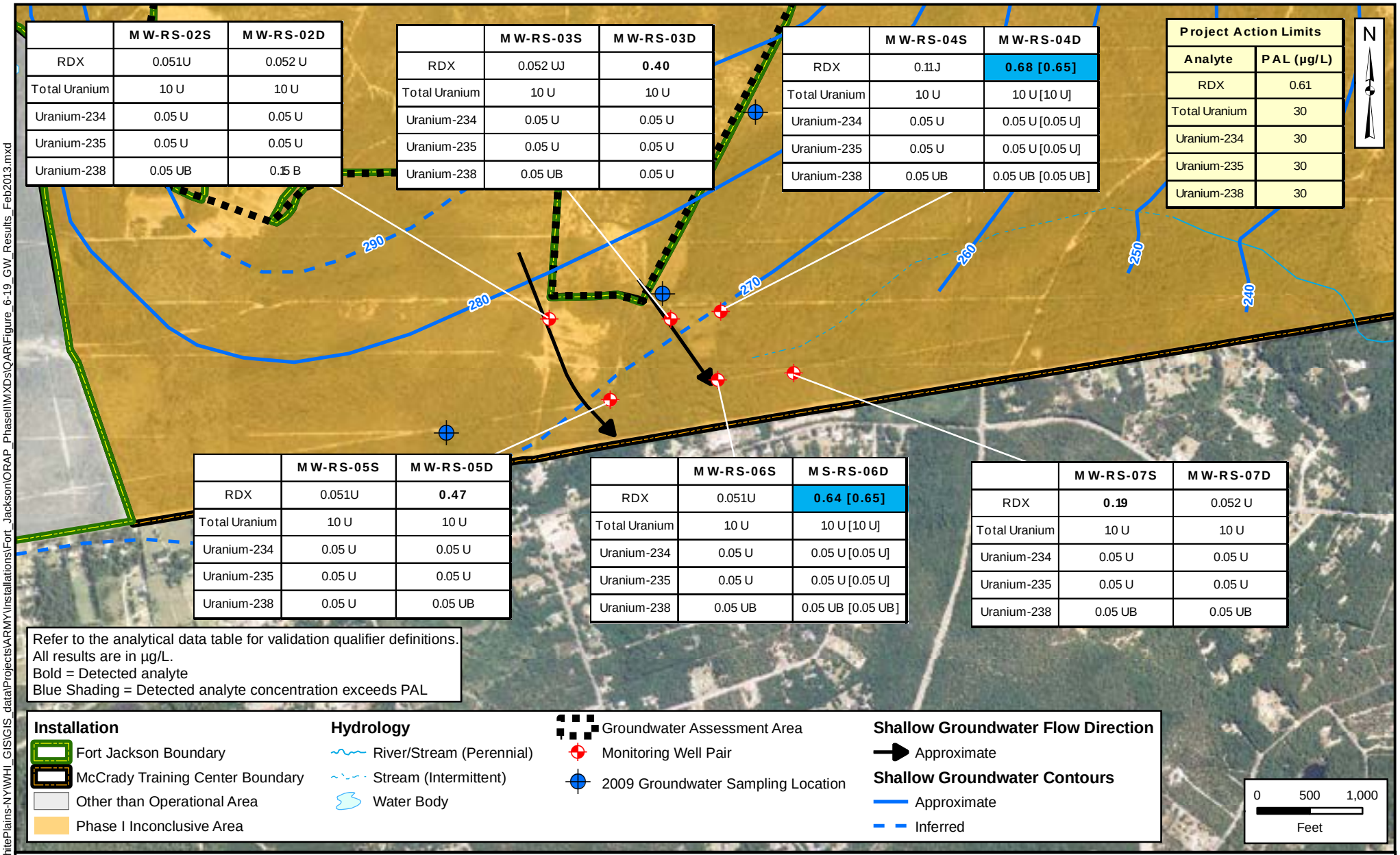

	MW-RS-02S	MW-RS-02D
RDX	0.051U	0.052 U
Total Uranium	10 U	10 U
Uranium-234	0.05 U	0.05 U
Uranium-235	0.05 U	0.05 U
Uranium-238	0.05 UB	0.15 B

	MW-RS-03S	MW-RS-03D
RDX	0.052 UJ	**0.40**
Total Uranium	10 U	10 U
Uranium-234	0.05 U	0.05 U
Uranium-235	0.05 U	0.05 U
Uranium-238	0.05 UB	0.05 U

	MW-RS-04S	MW-RS-04D
RDX	0.11J	**0.68 [0.65]**
Total Uranium	10 U	10 U [10 U]
Uranium-234	0.05 U	0.05 U [0.05 U]
Uranium-235	0.05 U	0.05 U [0.05 U]
Uranium-238	0.05 UB	0.05 UB [0.05 UB]

Project Action Limits	
Analyte	PAL (µg/L)
RDX	0.61
Total Uranium	30
Uranium-234	30
Uranium-235	30
Uranium-238	30

	MW-RS-05S	MW-RS-05D
RDX	0.051U	**0.47**
Total Uranium	10 U	10 U
Uranium-234	0.05 U	0.05 U
Uranium-235	0.05 U	0.05 U
Uranium-238	0.05 U	0.05 UB

	MW-RS-06S	MS-RS-06D
RDX	0.051U	**0.64 [0.65]**
Total Uranium	10 U	10 U [10 U]
Uranium-234	0.05 U	0.05 U [0.05 U]
Uranium-235	0.05 U	0.05 U [0.05 U]
Uranium-238	0.05 UB	0.05 UB [0.05 UB]

	MW-RS-07S	MW-RS-07D
RDX	**0.19**	0.052 U
Total Uranium	10 U	10 U
Uranium-234	0.05 U	0.05 U
Uranium-235	0.05 U	0.05 U
Uranium-238	0.05 UB	0.05 UB

Refer to the analytical data table for validation qualifier definitions.
All results are in µg/L.
Bold = Detected analyte
Blue Shading = Detected analyte concentration exceeds PAL

Installation
- Fort Jackson Boundary
- McCrady Training Center Boundary
- Other than Operational Area
- Phase I Inconclusive Area

Hydrology
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body

- Groundwater Assessment Area
- Monitoring Well Pair
- 2009 Groundwater Sampling Location

Shallow Groundwater Flow Direction
- Approximate

Shallow Groundwater Contours
- Approximate
- Inferred

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Figure 6-19
Explosives and Uranium in Groundwater (February 2013)

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
USDA-FSA, Aerial Photo, 2006

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7 Risk Assessments

As discussed in Section 6, screening level risk assessments were performed to evaluate the likelihood of off-range MCOC migration that could pose an unacceptable risk to potential ecological receptors via surface water and sediment and to potential human receptors via groundwater. The SLERA, which evaluated the potential risk to ecological receptors in in the Gills Creek watershed, is presented in **Appendix I** and discussed below in Section 7.1, while the HHRE, which evaluated the potential risk to human receptors using groundwater as a potable source, is presented in **Appendix J** and discussed below in Section 7.2.

7.1 SLERA

Threatened and Endangered Species and Critical Habitats

Based on information in the Fort Jackson's Integrated Natural Resources Management Plan (Gene Stout & Associates, 2004) and a current SCDNR list of rare, threatened, and endangered species and communities known to occur in Richland County (accessed online at: http://www.dnr.sc.gov/species/), there are several species of state and/or federally listed threatened or endangered species at Fort Jackson and McCrady Training Center. These include: three federally-listed endangered terrestrial plant species [*i.e.*, rough-leaved yellow loosestrife (*Lysimachia asperulaefolia*), Canby's dropwort (*Oxypolis canbyi*), and smooth purple coneflower (*Echinacea laevigata*)], the federally and state endangered red-cockaded woodpecker (*Picoides borealis*), the state endangered Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), and the state threatened bald eagle (*Haliaeetus leucocephalus*).

Of these, the bald eagle is the only species that may potentially be exposed to surface water and sediment in the Gills Creek watershed, feeding mainly on fish. In 2004, there were 190 nesting pairs and 481 individuals counted mid-winter in the state of South Carolina (SCDNR, 2013). However, the bald eagle is only a transient visitor to Fort Jackson and McCrady Training Center and no nests or permanent roost sites are known to occur on the installation (Gene Stout & Associates, 2004). According to the U.S. Fish and Wildlife Service, the federally listed endangered red-cockaded woodpecker rarely comes to the ground surface and even bathes in water-filled depressions on tree limbs (2005). A study of red-cockaded woodpecker foraging behavior in South Carolina found the birds drinking water from water-filled depressions on trees, dew-covered leaves, and puddles on the ground. No observations have been made of the birds drinking from flowing streams or ditches (Hooper and Lennartz, 1981). In addition, the federally-endangered shortnose sturgeon may be found in the vicinity of Fort Jackson and McCrady Training Center, but is not known to occur at the installation.

Exposure Pathways

Potential aquatic or semi-aquatic receptors associated with Gills Creek and any water bodies and associated freshwater forested wetlands off-range include plants, benthic and aquatic invertebrates, reptiles and amphibians, fish, small mammals, wading birds, and piscivorous birds. Benthic and aquatic invertebrates and fish may be exposed to MCOC in sediment or surface

water through direct contact (*e.g.*, absorption or assimilation). Aquatic plants may be exposed to MCOC through the dissolution of chemicals in surface water and subsequent assimilation by plant roots. Small mammals, wading birds, and piscivorous birds may be exposed through the ingestion of MCOC in surface water (either incidentally during feeding or directly). Exposure to MCOC in sediment may also occur through incidental ingestion of sediment suspended in the water column or because of preening activities. Lastly, fish, small mammals, wading birds, and piscivorous birds may be exposed to MCOC in surface water and sediment through the food web; this exposure pathway is of special concern for chemicals that have the potential to bioaccumulate. Direct ingestion of Pb fragments (*e.g.*, grit ingestion by birds) is considered an incomplete pathway, as no bullets, bullet fragments, or casings were found in the stream channels at the ORA Phase II Assessment sampling locations.

SLERA Conclusions

Based on the evaluation presented in the SLERA, a potential for adverse health effects in aquatic life is indicated from exposure to Cu and Pb in surface water in Gills Creek at the operational range boundary (GC2) and a more thorough assessment may be warranted because the metals may settle out and/or be diluted in Boyden Arbor Pond before the water flows off-installation.

For sediment, the maximum detected concentrations of copper and lead at the operational range boundary are within the range of available chronic Toxicity Reference Values (*i.e.*, lower than the highest chronic Toxicity Reference Value for copper and lead in sediment). This indicates that the potential for adverse ecological health effects from exposure to sediment in Gills Creek at the operational range boundary is likely low. However, based on the low pH in surface water and low TOC in sediment, these metals may become mobile and bioavailable. While significant sediment accumulation occurs where Gills Creek enters Boyden Arbor Pond and in the center of Boyden Arbor Pond where another tributary enters, the extent to which sediment transport may occur from the pond downstream of the operational range is unknown. Therefore, there is not adequate information to fully assess ecological risk and further assessment may be warranted.

7.2 HHRE

An initial quantitative data screening was conducted using groundwater analytical data collected as part of this assessment. Analytical data for metals (Sb, Cu, Pb, and Zn), perchlorate, and explosives from samples collected in 2009 were utilized as part of this initial screening. The total cumulative risk factor for groundwater was calculated to be 2, with Pb and Zn being the predominant contributors. However, based upon these 2009 data it was determined it is unlikely that Pb and Zn in groundwater pose a risk to potential down-gradient off-range receptors because:

- Pb concentrations in the dissolved sample from the same location where the PAL exceedance occurred are significantly lower and below the LRU.
- Zn was detected above the LRU in total and dissolved samples from only one location; all other samples had significantly lower Zn concentrations.

- These metals are naturally occurring and concentrations of Pb are comparable with those found elsewhere within the Middendorf formation, as discussed in Section 6.2.3.1.2 .

Therefore, metals were not considered MCOC during additional groundwater investigation. Perchlorate also was not considered a MCOC during additional groundwater investigation because it was detected at concentrations orders of magnitude lower than the PAL.

Additional groundwater assessment was deemed necessary to evaluate RDX concentrations that may have been biased low. Monitoring well clusters were installed in 2012 and sampled in 2012 and 2013 for explosives. Additionally, samples were analyzed for U and U-isotopes due to the concern that DU-containing munitions were used at Fort Jackson and McCrady Training Center. U and U-isotopes were not detected in the additional groundwater samples collected and analyzed in 2012 and 2013. As previously discussed, RDX was identified in these groundwater samples at concentrations that exceeded the PAL. Based upon these results, RDX concentrations were further evaluated as part of the HHRE. This is described in more detail in the following paragraphs.

Potential groundwater receptors down-gradient of Fort Jackson and McCrady Training Center are limited to users (*i.e.*, workers and residents) of potable water supplied from residential or public supply wells. The results of a well search indicate residential and public supply wells down-gradient to the west, south, and east of Fort Jackson and McCrady Training Center. A windshield survey also indicated the likely presence of additional residential wells in the area. The monitoring wells installed during the additional investigation and sampled in 2012 and 2013 are screened generally within intervals where residential wells are also screened, based on review of well construction details for residential wells. RDX was the only MCOC detected in down-gradient monitoring wells (MW-RS-4D and MW-RS-6D on Figure 6-17 through Figure 6-19) at concentrations above PAL.

Excess lifetime cancer risks and noncancer hazards were estimated for resident adults and children, using conservative exposure parameters and maximum detected MCOC concentrations from samples collected in 2012 and 2013 from on-range monitoring wells installed during the additional investigation. The estimated excess lifetime cancer risks (*i.e.*, 1×10^{-6} or 1 in 1,000,000 and 8×10^{-7} or 8 in 10,000,000 for adult and child residents, respectively) were below the upper end of the acceptable risk range established by the National Contingency Plan (*i.e.*, 1×10^{-4}) (USEPA, 1990). The estimated noncancer hazards (*i.e.*, 0.005 and 0.02 for adult and child residents, respectively) were below acceptable hazard index of 1. Therefore, based on existing data obtained from the on-installation wells, potential exposure of down-gradient potable water users to MCOC in groundwater at Fort Jackson is unlikely to result in unacceptable health risks. It is important to note that the data collected to date was not intended to fully characterize subsurface conditions within the operational range or downgradient of the operational range and installation boundary.

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8 Summary of Findings and Conclusions

The Phase II analytical data and supporting observations indicate that MCOC are migrating downstream from Fort Jackson and McCrady Training Center operational range areas via the surface water system in the Gills Creek watershed. However there are no data to confirm whether MCOC are leaving the operational range at concentrations that present an unacceptable risk to off-range human or ecological receptors. Data collected within the Colonels Creek and Cedar Creek watersheds indicate that MCOC are not migrating via the surface water pathway at concentrations that present an unacceptable risk to off-range human or ecological receptors. Groundwater sampling data indicate explosives MCOC (RDX) are present at concentrations that exceed the PAL immediately downgradient from the groundwater assessment area and within the operational range footprint.

Within the Gills Creek watershed:

- Metals MCOC (Cu and Pb) migration is occurring via Gills Creek surface water and sediment at concentrations that may pose an unacceptable risk to ecological receptors downstream of the operational areas. There is a potential for metals MCOC to migrate off-range at levels that may pose an unacceptable risk to ecological receptors downstream of the operational range boundary. However, uncertainty remains regarding the actual concentrations of these metals MCOC in Gills Creek downstream of the operational range area. Metals MCOC are not considered to pose an unacceptable risk to human receptors. Explosives and propellants MCOC are not migrating via surface water or sediment at concentrations that pose an unacceptable risk to ecological or human receptors.

- Groundwater is not considered to be a viable pathway for the transport of metals MCOC. Previous investigations indicated that shallow groundwater may be locally impacted by metals MCOC in areas where clay layers that inhibit MCOC migration to groundwater are absent. However, shallow groundwater likely discharges to adjacent streams before leaving the installation or entering the deeper flow system.

Within the Colonels Creek watershed:

- MCOC are not migrating via surface water or sediment at concentrations that pose an unacceptable risk to ecological or human receptors.

- The potential for MCOC to migrate to groundwater within this watershed was evaluated as part of the investigation of the groundwater assessment area (see below).

Within the Cedar Creek watershed:

- MCOC from operational ranges are not migrating via surface water or sediment at concentrations that pose an unacceptable risk to ecological or human receptors. Although Cu and Pb concentrations in sediment exceeded their respective PALs at location WL2,

the area of Weston Lake where WL2 is located is within the site boundary of a MMRP site; further evaluation of Pb and Cu at this site will be addressed as part of studies conducted under the MMRP.

- The potential for MCOC to migrate to groundwater within this watershed was evaluated as part of the investigation of the groundwater assessment area.

Within the groundwater assessment area where the groundwater wells were installed and sampled:

- One explosive MCOC (RDX) was identified in groundwater downgradient of the groundwater assessment area at concentrations above the human health PAL. The risk to human receptors is not known because the RDX concentrations in groundwater off-installation, where it is utilized as a drinking water source, were not evaluated as part of this study.

The discussion below summarizes the information used to make these determinations for each of the assessment areas (i.e., watersheds and groundwater assessment area). MCOC groups (i.e. metals, explosives, and perchlorate) are discussed separately by assessment area.

8.1 Surface Water System Investigation

As previously discussed, surface water samples were analyzed for metals and explosives MCOC and perchlorate. Sediment samples were analyzed for metals and explosives MCOC. A summary of findings for each watershed and MCOC type are presented below.

8.1.1 Gills Creek Watershed

8.1.1.1 Metals MCOC

The following findings suggest that metals MCOC could potentially migrate off-range via surface water or sediment and pose a potential risk to ecological receptors in the Gills Creek watershed:

- Small arms use is heavily concentrated within this watershed. The ranges within this assessment area are heavily used throughout the year and have a long history of being used for live fire training. The ranges are located in close proximity to streams with low levels of hardness (less than 25 mg/L), which typically increases the ecological toxicity of dissolved MCOC metals. The small arms ranges and non-dudded impact area are dissected by surface water features and, in many cases, are in very close proximity to streams.
- Pb was detected in all of the downstream (GC2) surface water samples at concentrations nearly an order of magnitude or more above the ecological PAL. The lowest Pb concentration measured at GC2 was nearly an order of magnitude greater than the highest Pb concentrations measured at the reference location GC1.

- Pb was detected above the ecological PAL in two of the five sediment samples collected at GC2. Every sample collected from GC2 contained Pb at a concentration that was more than one order of magnitude greater than the highest Pb concentration measured at reference location GC1.
- Cu was detected in two of the five downstream (GC2) surface water samples above the ecological PAL for chronic exposure. Each of the Cu results at GC2 was greater than any of the results from the reference location GC1.
- Cu was detected in one of the five downstream (GC2) sediment samples above the ecological PAL. Each of the Cu results at GC2 was nearly two orders of magnitude greater than any of the results from the reference location GC1.
- The statistical analysis demonstrates that downstream (GC2) Pb and Cu concentrations in surface water and sediment in the Gills Creek watershed are statistically higher than reference levels and, in some cases, the ecological PALs.
- None of the other MCOC metals in surface water and sediment exceeded the ecological or human health PALs in the surface water and sediment samples collected within the Gills Creek watershed.
- Habitat for South Carolina species of concern and sensitive environments has been identified in the areas surrounding Fort Jackson and McCrady Training Center and may be present within the non-operational portions of the installation downstream of the operational ranges associated with the Gills Creek watershed.
- The SLERA concluded that there is a potential for adverse health effects in aquatic life from exposure to Cu and Pb in the surface water of Gills Creek at the downstream sampling location (GC2) 100 feet upstream of the operational range boundary.
- Although the results of previous studies (Bricka, 2002 & USATC, 2005) indicated that metals from the Gills Creek watershed were not leaving the installation at elevated concentrations, the detection limits in those studies were above the PAL and therefore the data cannot be used as part of this assessment.

Given multiple detections of MCOC metals in surface water and sediment at concentrations exceeding PALs at the downstream sampling location (approximately 100 feet upstream of the operational range boundary), there is a potential for MCOC metals to migrate off-range at levels that may pose an unacceptable risk to ecological receptors downstream of the operational range boundary.

For all of the Phase II samples collected from Gills Creek, the concentration of metals MCOC were below the human health screening criteria for surface water. Additionally, surface waters within the Gills Creek watershed have not been identified as a source of drinking water. Therefore, metals MCOC are unlikely to pose an unacceptable risk to off-range human receptors downstream of operational areas in the Gills Creek watershed.

These conclusions for both human and ecological receptors are supported by the repeatability of data demonstrated by the multiple sampling events in different media and seasons, the inherent

conservativeness of the PALs established for this assessment, and by the conclusions of the statistical evaluation and, for ecological receptors, the SLERA. Although previous investigations identified shallow groundwater in this area as being impacted by metals MCOC, available information suggests that shallow groundwater is most likely to discharge to nearby streams and creeks before leaving the operational range areas rather than to migrate downward to deeper groundwater that flows off-range.

8.1.1.2 Explosives MCOC and Perchlorate

Neither explosives nor perchlorate was detected in the surface water and sediment samples collected under various stream conditions. Based up these results, neither explosives MCOC nor perchlorate is migrating off-range at levels that pose an unacceptable risk to human or ecological receptors.

8.1.2 Colonels Creek Watershed

8.1.2.1 Metals MCOC

The following findings indicate that metals MCOC are unlikely to migrate downstream of operational range areas within the Colonels Creek watershed at concentrations that pose an unacceptable risk to off-range human and ecological receptors:

- Small arms are utilized in this area. However, firing into berms or other concentrated source areas is generally limited. Where concentrated firing does occur, the locations are generally separated from streams by significant areas with vegetative cover.
- Although Pb concentrations in surface water and sediment exceeded the ecological PAL at CC2 (reference location), results 60 feet upstream of the operational range and installation boundary (CC3) were all below the ecological PAL and only slightly higher than at the reference location CC1. This indicates that Pb concentrations detected in surface water and sediment at CC2 are attenuated at the range boundary to concentrations that do not present an unacceptable risk to off-range human or ecological receptors.
- At JC1, located on Jumping Creek 100 feet upstream of the operational range and installation boundaries, metals MCOC were detected at concentrations below ecological and human health PALs and were generally consistent with reference levels at reference location CC1 and below reference levels at CC2.
- None of the other MCOC metals in surface water and sediment exceeded the ecological or human health PALs in the surface water and sediment samples collected within the Colonels Creek watershed.
- The benthic macroinvertebrate sampling results indicate that species diversity values were generally similar in the downstream (JC1 and CC3) sampling locations to those in the upstream reference (CC1) sampling location, indicating that stream habitat conditions downstream of the operational ranges have not been degraded.
- Colonels Creek has not been identified as a source of drinking water.

Detected concentrations of MCOC metals exceeded ecological PALs for Pb in sediment and surface water at the reference location CC2; however, all detected concentrations of metals MCOC were below the ecological and human health PALs at the operational range boundary sampling locations (CC3 and JC1). Therefore, concentrations of MCOC metals leaving the operational range are unlikely to pose an unacceptable risk to human or ecological receptors. This conclusion is supported by the repeatability of data demonstrated by the multiple sampling events in different seasons, the inherent conservativeness of the PALs established for this assessment, and the observed site conditions that naturally mitigate MCOC migration.

8.1.2.2 Explosives MCOC and Perchlorate

The following findings indicate that explosives MCOC and perchlorate are unlikely to migrate downstream from operational range areas within the Colonels Creek watershed at concentrations that pose an unacceptable risk to off-range human and ecological receptors:

- The only sediment sample with detectable concentrations of explosives was located more than four stream miles upstream from the combined operational range boundary (location CC2). No explosives were detected in any of the other sediment or surface water samples, including those at the downstream installation boundary, collected within the Colonels Creek watershed.
- Although perchlorate was detected in two of the samples collected from the McCrady Training Center southern installation boundary (at downstream location JC1), the concentrations were two orders of magnitude below the PAL.
- Although training does occur within the limits of the Colonels Creek watershed, most of the firing is directed toward an impact area located within the Cedar Creek watershed.
- Colonels Creek has not been identified as a source of drinking water.

One explosive (DNB) was detected in sediment at the upgradient location CC2 above the PAL within Colonels Creek. However, sediment and surface water samples collected at the downstream location near the operational range and installation boundary (CC3) did not contain detectable concentrations of explosives. Perchlorate was detected at a concentration well below the PAL at the downstream location in Jumping Run Creek (JC1) 100 feet upstream of the operational range and installation boundary. Therefore, within the Colonels Creek surface water system, explosives MCOC and perchlorate are unlikely to pose an unacceptable risk to off-range human or ecological receptors. This conclusion is supported by the repeatability of data demonstrated by the multiple sampling events in different seasons, the inherent conservativeness of the PALs established for this project, and the observed site conditions that naturally mitigate MCOC migration.

8.1.3 Cedar Creek Watershed

8.1.3.1 Metals MCOC

The following findings indicate that metals MCOC are unlikely to migrate downstream of operational range areas at concentrations that pose an unacceptable risk to off-range human and ecological receptors within the Cedar Creek watershed:

- Small arms are utilized in this area. However, firing into berms or other concentrated source areas is generally limited. Where concentrated firing does occur, the locations are generally separated from streams by areas with good vegetative cover.
- No MCOC metals exceeded any of the PALs in surface water samples collected within the watershed.
- Cu and Pb slightly exceeded their respective ecological PALs in one sediment sample (WL2) from Weston Lake. Because of low lake levels during the collection of this sample, the sampling location was moved to an area adjacent to and possibly within the former target area for a small arms range currently being addressed under Fort Jackson's MMRP. The samples collected at other locations in Weston Lake did not contain metals in concentrations that exceeded ecological or human health PALs.
- Cedar Creek and Weston Lake have not been identified as sources of drinking water.

Although the concentrations of Cu and Pb slightly exceeded their respective PALs in one sediment sample, the sample was collected adjacent to (or possibly within the boundary of) an MMRP site. None of the other surface water or sediment samples collected in Weston Lake had detected concentrations of metals MCOC above their respective human health or ecological PALs. The area where the dry season samples for WL2 were collected is being addressed under Fort Jackson's MMRP. Given these results, MCOC metals associated with operational range areas in the Cedar Creek watershed on Fort Jackson and McCrady Training Center are unlikely to pose an unacceptable risk to off-range human or ecological receptors. This conclusion is supported by the repeatability of data demonstrated by the multiple sampling events in different seasons, the inherent conservativeness of the PALs established for this project, and the observed site conditions that naturally mitigate MCOC migration.

8.1.3.2 Explosives MCOC and Perchlorate

The following findings indicate that explosives MCOC and perchlorate are unlikely to migrate downstream of operational range areas within the Colonels Creek watershed at concentrations that pose an unacceptable risk to off-range human and ecological receptors:

- RDX was detected in two of the eight surface water samples collected. Both samples were collected at location WL1. However, concentrations were less than one-sixth of the PAL. No other explosives were detected in surface water.
- No explosives were detected in any of the sediment samples collected within the watershed.
- Perchlorate was detected in two surface water samples collected from Weston Lake (one detection at WL1 and one at WL2). However, concentrations were two orders of magnitude below the applicable PAL.
- Although RDX and perchlorate were present in groundwater within and adjacent to the Cedar Creek watershed (in samples collected from wells as part of the groundwater assessment), some of which likely discharges to Cedar Creek or Weston Lake, measured concentrations in surface water were well below the PAL.

- Cedar Creek and Weston Lake have not been identified as sources of drinking water.

Both RDX and perchlorate were detected in surface water samples at concentrations well below their respective PALs. Also, each was detected in only two of the eight samples collected. Although both RDX and perchlorate were detected in groundwater underlying the Cedar Creek watershed, and in the case of RDX, at concentrations exceeding the human health PAL, surface water results indicate that RDX and perchlorate concentrations in surface water are below their respective PALs. Any RDX and perchlorate in groundwater discharging to Cedar Creek are likely being diluted by the creek to concentrations below PALs. Therefore, within the Cedar Creek surface water system, concentrations of explosives and perchlorate leaving the operational ranges do not pose an unacceptable risk to human or ecological receptors. This conclusion is supported by the repeatability of data demonstrated by the multiple sampling events in different seasons, the inherent conservativeness of the PALs established for this project, and the observed site conditions that naturally mitigate MCOC migration.

8.1.4 Mill Creek Watershed

No surface water system samples were collected from the Mill Creek watershed. As discussed in the project QAPP, this watershed has similar source, pathway, and receptor characteristics as the Cedar Creek watershed, which was used as a worst-case-scenario proxy for the Mill Creek watershed (which has a lower munitions usage rate than Cedar Creek). The results for downstream sample location WL1 in the Cedar Creek watershed were applied as a proxy for a downstream Mill Creek location. None of the MCOC detections at WL1 exceeded the PALs. Therefore, by proxy, neither the surface water nor sediment at the downstream boundary of the operational ranges in the Mill Creek watershed is expected to contain MCOC at concentrations that would pose an unacceptable risk to off-range human or ecological receptors.

8.2 Groundwater System Assessment

The groundwater assessment area was selected to represent a worst-case scenario for explosives and propellant MCOC infiltrating from operational range areas to groundwater and migrating off-range to reach receptors. The intent of selecting a worst-case area to investigate groundwater was to apply the results from the investigation area to the installation as a whole, as appropriate. After a thorough review of site conditions throughout Fort Jackson and McCrady Training Center, conclusions developed as part of this groundwater assessment are considered applicable to source areas on both installations that have been heavily used for training with live rounds containing explosives and perchlorate and where use of small arms is either limited or where their use does not concentrate small arms projectiles in small areas such as berms. These ranges primarily occur within the Colonels Creek, Cedar Creek, and Mill Creek watersheds. Results from the investigation of the groundwater assessment area are unlikely to apply to the potential presence or transport of MCOC metals within the Gills Creek watershed, as aquifer conditions and range use at Gills Creek are very different from conditions within the groundwater assessment area.

8.2.1.1 Metals MCOC

The following findings indicate that metals MCOC are unlikely to migrate via groundwater downgradient of operational range areas at concentrations that pose an unacceptable risk to off-range human receptors:

- Twenty-nine groundwater samples were collected downgradient of potential source areas and analyzed for MCOC metals. The samples were collected from soil borings spaced along a one-mile-long section near the southern combined installation boundary and covered an 80- to 100-foot thick interval of the aquifer, from two shallow piezometers screened across the water table, and from one supply well. Only three samples contained total MCOC metals (total Pb in one sample and total Zn in one sample) above the human health PAL. Of the two, only one sample contained dissolved Zn above the human health PAL.
- In the case of Pb, the sample which exceeded the PAL was collected at the water table. The sample collected immediately below the interval contained total Pb at a concentration well below the PAL (concentration of 3.1 µg/L compared to the PAL of 15 µg/L).
- For Zn, the samples collected both above and below the interval that contained the exceedances again contained Zn at concentrations well below the PAL. The total Zn concentration in the interval above was 438 µg/L while the concentration in the sample below was 577 µg/L. The PAL for Zn in groundwater is 4,700 µg/L .
- As described in Landmeyer et. al (2003), Pb occurs naturally within the sediments that make up the Middendorf Aquifer, present beneath Fort Jackson and the McCrady Training Center. Therefore, the presence of total Pb above the human health PAL in one groundwater sample likely reflects naturally occurring particulate Pb in the formation materials.
- Small arms use within the groundwater assessment area is limited relative to that in other locations on the installations, and ranges with concentrated source areas (such as berms) do not occur within the area.
- U (as U-238) was detected in only one of 36 samples collected from July 2012 to February 2013. No other U isotopes were detected. The concentration of U was two orders of magnitude below the human health PAL.

Pb is naturally occurring within the aquifer, still did not exceed the human health PAL in any of the dissolved samples collected, and was only present above the PAL in one of the 29 samples collected from temporary wells and analyzed for total lead. Similarly, both total and dissolved Zn exceeded the PAL but only in one of the 29 samples collected. Because the Pb and Zn exceedances were so limited in extent, it is unlikely that these results are indicative of groundwater impacted by Pb or Zn from munitions. It is also unlikely that either Pb or Zn in groundwater presents a risk to off-range receptors. U was detected at two orders of magnitude below the human health PAL. Based on the above information, the metals MCOC are unlikely to migrate off-range in groundwater at concentrations that could pose a potential risk to human and ecological receptors. This conclusion is supported by the repeatability of data demonstrated by the multiple sampling events in different seasons, the inherent conservativeness of the PALs

established for this project, and the observed site conditions that naturally mitigate metals MCOC migration. As discussed, this finding may be extrapolated to areas throughout Fort Jackson and McCrady Training Center with similar range use and geologic conditions including the Colonels and Cedar Creek watersheds.

As previously discussed, previous investigations of small arms ranges within Gills Creek have shown that where a clay layers are absent, Pb may impact shallow groundwater. However, within the Gills Creek watershed, shallow groundwater is likely to discharge to directly adjacent surface water bodies before leaving the installation and therefore may contribute Pb concentrations in Gills Creek.

8.2.1.2 Explosives MCOC and Perchlorate

The following findings suggest that explosives MCOC could potentially migrate off-range via groundwater and pose a potential risk to human receptors downgradient of the installation:

- RDX was detected in multiple depth-discrete groundwater samples collected in 2009 in a 60-foot-thick portion of the aquifer at soil boring SB-3. Based upon the presence of RDX in groundwater, additional assessment was determined to be necessary.
- A number of surface water samples collected in 2009 from Weston Lake, which is an identified discharge point for groundwater from the groundwater assessment area, contained both perchlorate and RDX (though at concentrations below their respective surface water PALs).
- Shallow and deep monitoring well pairs installed downgradient of SB-3 and at least 400 feet upgradient of the operational range/installation boundary were sampled three times from July 2012 to February 2013. Two or more explosives were detected during each of the three sampling events with RDX exceeding the PAL at multiple locations during each sampling event.
- RDX was detected consistently at similar concentrations and locations. In particular, RDX concentrations exceeded the groundwater PAL in samples collected from MW-RS-04D and MW-RS-06D during all three rounds of sampling.
- Residential drinking water supply wells were observed downgradient of the monitoring well pairs during windshield surveys of the adjacent off-installation areas, indicating the potential for off-range human receptors. However, only a few well logs were available for review from the SCDNR. The available well logs show that groundwater within the intervals in which explosives were detected is utilized as a drinking water source as close as 600 feet downgradient of the monitoring well in which RDX exceeded the PAL.
- Both Fort Jackson and McCrady Training Center represent important recharge areas for the Middendorf Aquifer. Precipitation exceeds evapotranspiration in the area, increasing the potential for MCOC at the surface to infiltrate to groundwater.
- Estimated groundwater flow velocities indicate that water originating in operational range areas within the last seven to eight years could now be reaching the combined installation boundary. Where coarser zones are present, flow velocities could be greater.

RDX was detected at concentrations that exceeded the human health PAL at the groundwater assessment area. RDX was detected in samples collected downgradient of the groundwater assessment area and upgradient of residential drinking water wells located to the south of the operational range and installation boundary. Given the repeated detections of RDX in groundwater wells located within 350 feet to 1,300 feet of the installation boundary, there is a potential for explosives MCOC in groundwater to migrate downgradient of operational range areas and reach residential wells. However, uncertainty remains regarding the actual risk to potential off-range receptors as no groundwater samples were collected off-installation as part of this assessment.

The following findings indicate that perchlorate is unlikely to migrate downstream of operational range areas at concentrations that pose an unacceptable risk to off-range human receptors:

- Perchlorate was detected in seven of 29 groundwater samples analyzed (six of the detections were from temporary wells and one of the detections was from the Weston Lake supply well WL1). However, concentrations were nearly one order of magnitude below the LRU and two orders of magnitude below the human health PAL.
- The HHRE concluded that the potential for unacceptable health risks to downgradient potable water users is below the upper end of the risk range established by the National Contingency Plan (*i.e.*, 1×10^{-4}), based on the groundwater assessment area data.

8.3 Conclusions

MCOC source-receptor pathways are potentially complete at Fort Jackson and McCrady Training Center for ecological receptors of surface water within the Gills Creek watershed downstream of the range boundary and for human groundwater receptors downgradient of the groundwater assessment area (**Figure 8-1**).

For the conditions evaluated during the 2009 surface water system investigation, there is the potential for MCOC metals concentrations to pose an unacceptable risk to ecological receptors along portions of Gills Creek watershed downstream of the small arms ranges and within the operational range boundary located within the watershed. Boyden Arbor Pond may act as a "sink" for these metals, the evaluation of the risk to receptors within or downgradient of the pond was not completed as part of this assessment.

Given the presence of RDX in groundwater downgradient of the groundwater assessment area during the 2009 and 2012/13 sampling events, there is a potential for RDX to migrate off-range via groundwater. RDX was detected in wells near the operational range and installation boundaries at concentrations that exceed the human health PAL. Given the close proximity of these wells to the installation boundary and the presence of residential wells located within approximately 400 feet downgradient, there is a potential for RDX to migrate off-range and reach human receptors through drinking water. Although the screening-level HHRE concluded that risks to human receptors were minimal due to RDX in groundwater based on the Phase II data, samples were not collected at potential receptor wells located off-installation. Because the assessment of the groundwater system focused on a "worst-case" area these findings apply to

other areas with similar usage and similar subsurface and hydrogeologic conditions to those encountered within and downgradient of the groundwater assessment area.

Additional action may be required to further evaluate or mitigate the potential for metals MCOC to migrate to off-range receptors downgradient of the operational areas within the Gills Creek watershed. Further assessment may similarly be required to evaluate the potential risk, if any, posed by RDX in groundwater to groundwater users located downgradient of the groundwater assessment area.

Based on the present evaluation and current usage patterns, it is unlikely that surface water pathways pose an unacceptable risk to off-range human or ecological receptors associated with operational range areas in the Colonels Creek, Cedar Creek, or Mill Creek watersheds. These operational areas may be placed into a review cycle to periodically evaluate whether future changes in conditions pose unacceptable risk to off-range human or ecological receptors (**Figure 8-1**).

The implementation of best management practices can serve to limit or slow the migration of MCOC.

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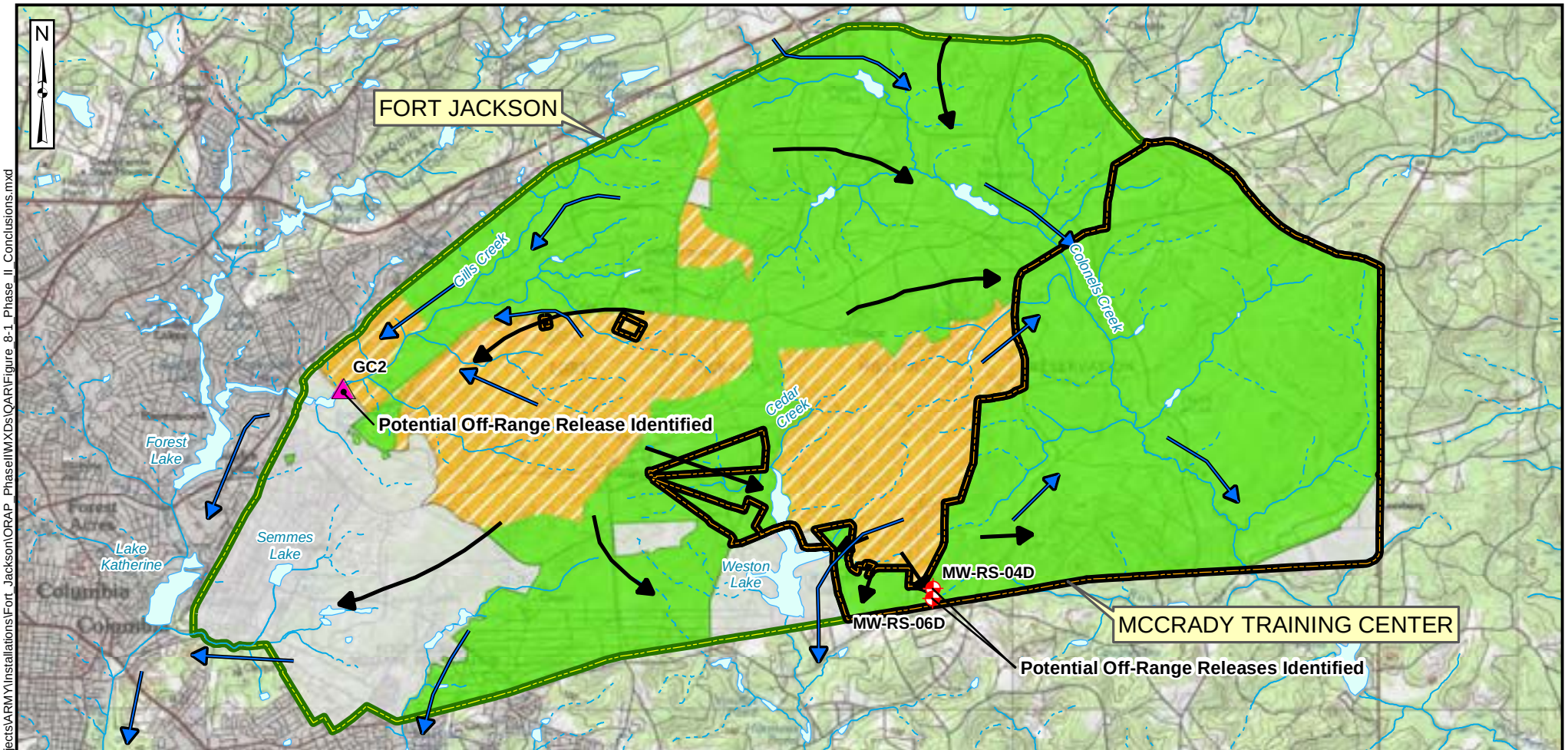

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Operational Range Assessment Program
Phase II Quantitative Assessment Report
Fort Jackson and McCrady Training Center, SC

Figure 8-1
Operational Range Assessment Phase II Conclusions

Data Sources:
AEC, ARID-GEO, 2006
ESRI, StreetMap USA, 2005
ESRI, ArcGIS Online, USGS Topo

Date: ..... January 2014
Prepared By: ..... PIKA-PIRNIE JV, LLC
Prepared For: ..... USACE
Contract: W912DY-10-D-0025

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9 References

Army Range Inventory Database-Geodatabase (ARID-GEO). 2006a. U.S. Army Operational Range Inventory Sustainment FY05: Draft Packet for Fort Jackson, South Carolina.

------. 2006b. U.S. Army Operational Range Inventory Sustainment FY06: Final Packet for McCrady Training Center, South Carolina.

ATC. See United States Army Aberdeen Test Center.

Bricka, R.M. 2002. Sampling of the Small Arms Training Areas at Fort Jackson. Mississippi State University.

Carter, Robin. December 1995. *Birds of Congaree Swamp National Monument. Columbia Audubon Society*. Unpaginated. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.govcongaree.htm (Accessed December 2009)

Department of Defense (DoD). 2004. Department of Defense Directive 4715.11 Environmental and Explosive Safety Management on Operational Ranges Within the United States.

------. 2005. Department of Defense Instruction 4715.14 *Operational Range Assessments*.

------. 2007. Department Of Defense Environmental Data Quality Workgroup. *DoD Perchlorate Handbook.*

Fort Jackson. 2009. http://www.jackson.army.mil/. (Accessed November 2009).

Freeze, R.A. and Cherry, J.A. 1979. *Groundwater*. Prentice-Hall, Inc., Englewood Cliffs, NJ, 604 p.

Gene Stout & Associates. 2004. Integrated Natural Resources Management Plan and Environmental Assessment, 2004-2008, U.S. Army Training Center and Fort Jackson, South Carolina.

Helsel, D.R. and Hirsch, R.M. *Statistical Methods in Water Resources. Techniques of Water-Resources.* Investigations of the United States Geological Survey Book 4, Hydrologic Analysis and Interpretation. September 2002.

Hopper and Lennartz. 1981. Foraging Behavior of the Red-Cockaded Woodpecker in South Carolina. The Auk. 98: 321-334. April 1981.

Kite, L.E. 1988. Geologic Map of the Congaree, Eastover, Leesburg and Messers Pond 7.5-Minute Quadrangles. Open-File Report 62. South Carolina Geological Survey.

Landmeyer, J.E., Bradley, P.M., and Bullen, T.D.. 2003. *Stable Lead Isotopes Reveal a Natural Source of High Lead Concentrations to Gasoline-Contaminated Groundwater:* Environmental Geology, v. 45, no. 1, p. 12-22, doi:10.1007/s00254-003-0863-5.

National Oceanic and Atmospheric Administration (NOAA). 1998. *Final Recovery Plan for the Shortnose Sturgeon*. December 1998.

Malcolm Pirnie, Inc. 2006. Final Site Inspection Report for Fort Jackson, SC.

------. 2007a. Draft Final Operational Range Assessment Program Phase I Qualitative Assessment Report, Fort Jackson, Columbia, South Carolina.

------. 2007b. Draft Final Operational Range Assessment Program Phase I Qualitative Assessment Report, McCrady Training Center, Columbia, South Carolina.

------. 2009. Final Work Plan, Operational Range Assessment Program Phase II Quantitative Assessment, United States Army Garrison Fort Jackson and McCrady Training Center, South Carolina.

Paller, M.H., Specht, W.L., and Dyer, S. A. 2006. Effects of Stream Size on Taxa Richness and other commonly Used Benthic Bioassessment Metrics. Hydrobiologia. 568-1: 309-316

South Carolina Department of Health and Environmental Control (SCDHEC). 1997. The Gills Creek Watershed Project, An Urban Nonpoint Source Project: Richland County, S.C., February 1994 – September 1996. Final Report.

------. 2012 *R.61-68, Water Classifications & Standards* (22 June 2012).

South Carolina Department of Natural Resources (SCDNR). 2001. *General Hydrology of South Carolina*. http://www.dnr.sc.gov/water/hydro/HydroPubs/Map%202 %20letter%20size.pdf. (Accessed August 2009)

South Carolina Department of Natural Resources. 2013. Species Descriptions: Bald Eagle. http://www.dnr.sc.gov/cwcs/species.html#B. (Accessed April 2013)

Smock, L.A. 1985. Macroinvertrebrate Production in a Southeastern United States Blackwater Stream. Ecology. 66:1491-1503.

United States Army Aberdeen Test Center (USATC). 2005. Small Arms Range Training Area Environmental Screening-Level Assessment at Fort Jackson, South Carolina.

United States Army Center for Health Promotion and Preventive Medicine Army Operational Range Assessment Team (USACHPPM). 2004. *Review of the Toxicity of Tungsten Technical Report*.

------. 2005. U.S. Army Operational Range Assessment Program Qualitative Assessments Protocol.

------. 2009. U.S. Army Phase II Operational Range Assessment Protocol.

United States Army Corps of Engineers (USACE), 1998. Fort Jackson Investigation-Derived Waste (IDW) Management Plan.

United States Army Environmental Command (USAEC). 2009. *Procedure for Choosing Screening Values for Operational Range Assessments*, Final Version 5 dated 28 January 2009.

United States Army Environmental Command and United States Department of Agriculture Forest Service (USAEC and USDA). 2001. *McCrady Training Center Integrated Natural Resources Management Plan (INRMP) Volumes I and II.*

U.S. Environmental Protection Agency. 1990. National Oil and Hazardous Substances Pollution Contingency Plan. Final Rule. 40 CFR Part 300. Federal Register. 55(46): 8665-8866. (March 1990)

------. 1996. Ecotox Thresholds. 540/F-95/038. January 1996.

------. 1997. U.S. EPA Interim Final Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.

------. 1998. Groundwater Sampling Procedure, Low Stress (low flow) Purging and Sampling Procedure for the collection of Groundwater Samples from Monitoring Wells.

------. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers. USEPA 841-B-99-002.

------. 2000. Guidance for assessing Chemical Contaminant Data for Use in Fish Advisories. USEPA 823-B-00-007. November 2000.

------. 2001. Lead: Identification of Dangerous Levels of Lead: Final Rule. January 2001.

------. 2002a. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10. December 2002.

------. 2002b. Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites. USEPA 540-R-01-003-OSWER 9285.7-41. September, 2002.

------. 2005. Contaminated Sediment Remediation Guidance for Hazardous Waste Sites. USEPA-540-R-05-012. December 2005.

------. 2006a. Guidance on Systematic Planning Using the Data Quality Objectives Process. USEPA QA/G4. February 2006.

------. 2006b. Depleted Uranium Technical Brief. USEPA-402-R-06-011. December 2006.

------. 2007. *Framework for Metals Risk Assessment.* USEPA 120/R-07/001 | March 2007

------. 2008. Interim Drinking Water Health Advisory For Perchlorate. USEPA 822-R-08-025. December 2008.

------. 2009. *ProUCL Version 4.00.04 Technical Guide (Draft).* USEPA/600/R-07/041. February 2009.

United States Fish and Wildlife Service (USFWS). 2005. *Red-cockaded Woodpecker Picoides borealis.* September 2005.

United States Geological Survey (USGS). 1987. Regional Ground-water Discharge to Large Streams in the Upper Coastal Plain of South Carolina and Parts of North Carolina and Georgia. By W.R. Aucott, R.S. Meadows, and G.G. Patterson. U.S. Geological Survey Water-Resources Investigations Report 86-4332.

------. 1994. Effects of Sediment Depositional Environment and Ground-water Flow on the Quality and Geochemistry of Water in Aquifers in Sediments of Cretaceous Age in the Coastal Plain of South Carolina. By G.K. Speiran andW.R. Aucott. U.S. Geological Survey water-supply paper 2416.

------. 1996. Hydrology of the Southeastern Coastal Plain Aquifer System in South Carolina and Parts of Georgia and North Carolina. By W.R. Aucott. U.S. Geological Survey professional paper 1410-E.

------. 2000. Methods of Analysis by the U.S. Geological Survey National Water Quality Laboratory – Processing, Taxonomy, and Quality Control of Benthic Macroinvertebrate Samples. By S.R. Moulton II, J.L. Carter, S.A. Grotheer, T.F. Cuffney, and T.M. Short. USGS Open-File Report 00-212. Denver, Colorado.

------. 2008. *Water Quality Samples for South Carolina, USGS 02169570 Gills Creek at Columbia, SC.* http://nwis.waterdata.usgs.gov/sc/nwis/qwdata/?site_no=02169570&agency_cd=USGS. (Accessed July 2008).

------. 2009. *Water Quality Samples for South Carolina, USGS 02169570 Gills Creek at Columbia, SC.* http://nwis.waterdata.usgs.gov/sc/nwis/qwdata/?site_no=02169570&agency_cd=USGS. (Accessed December 2009).

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Appendix B: Field Forms, Field Book, Calibration Logs, and Quality Assurance/Quality Control Forms

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March 9, 2023

McCrady Training area

Kevin S, Maddison H, Robin M — meet w/ Mr. Cooke

Kass Pass - Pistol range
Light Rifle
KD range
Maintank range
Common Impact area w/ Fort Jackson
have ranges w/in Jackson
White area is discanced area
1 demo area - training range
MOUT - NOT live-fire since 70s (latest)
CBT - was machine gun range - not used since 80s latest
- Southeast corner of McCrady had old range complex in 50s 60s
Sactive - live fire until 60s, shooting from perimeter in from SE to NW in particular also S to N, N to S
WILDcat road - public road thru installation - was open post - closed at 9/11 & became closed post
Most heavily used
13|4, Pistol, ARGENTAN, demo, tank range
16 pt qual range
On Jackson property
(Combat 2 - Training area, movement to live fire contact, simulation (on McCrady)

on McCrady

- Kass Pass - Not used a ton
- CPac

side by side
Argentine - used for small arms
Light Demo range - sporadically used for classes
- Fort J - Basic training year round

Combat Pistol Range/ Kasserine Pass range

Combat Pistol
15 firing lanes w/ standing positions
5 rows of mounded pop-up tages
- mod vegetated
back berm with tree line behind
enclosed on 3 sides
- gravel firing line
tree line shows thinning from firing
tree line surrounds range on three sides
- used 20-30 X per year

KASS PASS
6 firing lanes toward metal targets, tank targets & covered firing positions
gravel firing line
M203 primarily
tree line surrounding 3 sides
Old spot for Marksmanship range
- inactive
shooting toward downgradient

used ~4X a year
old sand berm shows evidence from old mover

Argentan

17 firing lanes, w/ stand positions
Covered fire line w/ shredded tire
surrounded by tree line on 3 sides
access road on SE side of range
~200 meters
sparse veg over sandy areas down-range
bullet pockets & bullets in back berm
Sandy back berm, sparsely veg
vegetated area behind back berm
drainage would flow east where rift raft is present - no H_2O present but NE-E of berm
- regularly used

TANK RANGE (MAIN TANK)

sits on high topo point, sandy base line
machine gun, tanks
New Machinegun range to be built in a few years
1500 meters
movers, targets w/ berms (unveg)
small arms evidence
drainage toward SE

usually used for machine guns

light DEMO RANGE

partially vegetated w/ shortgrass
dirt path through range, through back tree line - tree line surrounds on 3 sides
~~Firing~~ Range on slope down to tree line
demo area graded
cement bunker w/ glass windows on south (top & upgradient) side of range
low-ceiling shots

prescribed burns yearly

Fort Jackson March 8, 2023
Sampling Event
Kevin Sharpe, Derek Hendricks, Lee Peterson, Maddison H, Terry
Met w/ range control at 0800
Arrive at CC2 (reference) @ 0915
2 Groups
- Maddison, Lee, Derek
- Robin, Kevin, Terry

Collect CC2 @ 1000
Leave site @ 1020

Arrive @ MC1 @ 1135
Collect MC1 @ 1150
Leave @ 1220

Arrive @ MC3 @ 1315
Collect @ MC3 @ 1400
Leave @ 1450 Take Dup 4oz 8oz

Collect EB @ 1530
JACKSON-EB-01
Arrive back to hotel @ 1600 to process sample

Explosives, Metals, TOC

7 x 8oz jars
1 x 8 oz jars

SEM/AVS
7 x 4 oz jars
1 FD 4 oz
1 MS 4 oz
1 MSD 4 oz

MS/MSD

* MC2 - 1130
CC3 - 1415
CC4 - 0940

I have read the Accident Prevention Plan and have been briefed on anticipated site hazards, required accident prevention, and emergency response for work to be performed at this site. I agree to conform to all the requirements of this Plan.

Name	Signature	Affiliation	Date
KEVIN SHARPE		EA	08MAR23
William Peterson		EA	08 Mar 23
Derek Hendricks		EA	08 March 2023
Robin Moloney		EA	08 March 2023
Maddison Hatton		EA	08 March 2023
TONY BERENDS		EA	8 MAR 23

SITE ENTRY AND EXIT LOG
(Daily Tailgate Acceptance)

Date	Name	Representing	Time In	Time Out
08MAR23	KEVIN SHARPE	EA		
3/8/23	Derek Hendricks	EA	0915	
3/8/23	Robin Maloney	EA	0915	
3/8/23	William Peterson	EA	0915	
3/8/23	Maddison Hilton	EA	0915	
3/8/23	TROY BERENDS	EA	0915	

Topics Covered: Expected weather conditions; changes to existing procedures; today's H&S considerations; general site hazards; MEC awareness; environmental conditions; new operations; ingress and egress; exclusion or support zones; biological/physical hazards; PPE required; emergency evacuation procedures; emergency notification and response procedures; AHA review; temperature precautions; buddy system procedures; review of violations/deficiencies from prior day and corrective actions; general hygiene; and other significant events involving health and safety.

EA Engineering, Science, and Technology, Inc., PBC

225 Schilling Circle
Hunt Valley, MD 21031

Safety Meeting Record

Client: Ft. Jackson, SC	**Date:** 8 MAR 23	**Time:** 0730
Project Title: ORAP		
Contract Number: 62686616	**Activities Performed:** ESCORT	
Weather: (Clear) Partly Cloudy Rain Cloudy	**Temperature: High** ~~41~~ 65 **Low** ~~65~~ 41	

Personnel Attending Safety Meeting

Name	Signature	Company
Madilyn Hutton	Madilyn Hutton	EA
Robin Maloney	Robin Maloney	EA
Derek Hendricks		EA
William Peterson		EA
Kevin Sharpe		EA
Robert Voda		Range Operations

Safety Topics covered (Check all that Apply)

✓	Site Work and Description	✓	Emergency Response Plan
✓	Site Control	✓	Directions to Medical Facility
✓	Work, Support and Exclusion Zones	✓	On-Site Emergency Procedures
✓	Physical Hazards	✓	On-Site Injuries/Illness Procedures
✓	Biological Hazards	✓	Evacuation Procedures
	Chemical Hazards	✓	Rally Point(s)
✓	Heat/Cold Stress	✓	Emergency Communications
✓	PPE		Medical Monitoring Program
	Decontamination Procedures		Heavy Equipment
	Air Space Monitoring		Engineering Controls and Equipment
✓	CPR and First Aid		Confined Space
✓	MEC	✓	Lightning
Other Topics as Needed:			

Remarks/Comments:

Terry Berends

EA UXO Supervisor Print Name/Signature

EA Engineering, Science, and Technology, Inc., PBC

225 Schilling Circle, Ste. 400
Hunt Valley, MD 21031

Daily Operational Journal

Client: Ft. Jackson/SC/McCrady Trng Area			**Date:** 9 MAR 23	
Project Title: ORAP				
Contract Number: 6268616		**Task Serviced:** Escort		
EA Site Personnel		**Time on site:** 0730	**Time off site:** 1300	
Name	**Position**	**0% HPD**	**4% HPD**	**8% HPD**
Lee Peterson	UXOTIII	1.5	5	
Terry Berends	UXOTII	1.5	5	

Detector Serial/WHO Number	**Time of Daily Calibration**	**Munitions Debris (MD)**	**Scrap (non-MD)**	**Reportable items (MEC, MPPEH)**
Analog Detector: WLo 379	0750	Ø	Ø	Ø
Down Hole:				
All Metals Detector:				
HAZMATCAD:				

Comments:

Escorted to McCrady Ranges by Mr. Cook for Evaluation.

Terry Berends
EA UXO Supervisor (printed name)

Kevin Shappe
Client Representative (printed name)

9 MAR 23
Signature and Date

03/09/23
Signature and Date

EA Engineering, Science, and Technology, Inc., PBC

225 Schilling Circle, Ste. 400
Hunt Valley, MD 21031

Client: FT. JACKSON, SC	Date: 8 MAR 23
Project Title: ORAP	
Contract Number: 6268616	Activities performed: ESCORT

Area swept/excavated to a depth of: SURFACE

Draw area swept, include GPS points at corners, beginning and ending locations, and MEC located below:

Reportable activities:

SWEPT PATH TO ACCESS WATERWAYS FOR SAMPLING.
TERRY BERENDS ESCORTED ONE GROUP. LEE PETERSON ESCORTED OTHER GROUP.
GEOLOGISTS HAVE LOCATIONS RECORDED ON THEIR PAPERWORK.

Area QC: 100 %

UXO Supervisor
(Print and sign): TERRY BERENDS Date: 8 MAR 23

EA Engineering, Science, and Technology, Inc., PBC

225 Schilling Circle, Ste. 400
Hunt Valley, MD 21031

Safety Meeting Record

Client: Ft. Jackson, SC / McCrady Trng Area	Date: 9 MAR 23	Time: 0730
Project Title: ORAP		
Contract Number: 6268616	Activities Performed: Escort	
Weather: Clear (Partly Cloudy) Rain Cloudy	Temperature: High 63 Low 45	

Personnel Attending Safety Meeting

Name	Signature	Company
William Pettigrew		EA
Maddison Hatton	Maddison Hatton	EA
Robin Moloney		EA
KERN SHARPE		EA

Safety Topics covered (Check all that Apply)

✓	Site Work and Description	✓	Emergency Response Plan
✓	Site Control	✓	Directions to Medical Facility
✓	Work, Support and Exclusion Zones	✓	On-Site Emergency Procedures
✓	Physical Hazards	✓	On-Site Injuries/Illness Procedures
✓	Biological Hazards	✓	Evacuation Procedures
	Chemical Hazards	✓	Rally Point(s)
✓	Heat/Cold Stress	✓	Emergency Communications
✓	PPE		Medical Monitoring Program
	Decontamination Procedures		Heavy Equipment
	Air Space Monitoring		Engineering Controls and Equipment
✓	CPR and First Aid		Confined Space
✓	MEC	✓	Lightning
Other Topics as Needed:			

Remarks/Comments:

TERRY BERENDS

EA UXO Supervisor Print Name/Signature

EA Engineering, Science, and Technology, Inc., PBC

225 Schilling Circle, Ste. 400
Hunt Valley, MD 21031

Daily Operational Journal

Client: Ft. Jackson, SC			**Date:** 8 MAR 23	
Project Title: ORAP				
Contract Number: 6268616	**Task Serviced:** ESCORT			
EA Site Personnel	**Time on site:** 0730		**Time off site:** 1600	
Name	**Position**	**0% HPD**	**4% HPD**	**8% HPD**
LEE PETERSON	UXOTIII	1.5	8	
TERRY BERENDS	UXOTII	1.5	8	

Detector Serial/WHO Number	**Time of Daily Calibration**	**Munitions Debris (MD)**	**Scrap (non-MD)**	**Reportable items (MEC, MPPEH)**
Analog Detector: WHO 379	0730	Ø	Ø	Ø
Down Hole:				
All Metals Detector:				
HAZMATCAD:				

Comments:

CONTACTED RANGE CONTROL FOR GUIDE AND RADIOS, SIGN IN SAFETY BRIEF AT FIRST SAMPLING SITE. BEGAN SAMPLING, TEAM SPLIT TO DO TWO SITES AT ONCE. LEE PETERSON TOOK SECOND TEAM WITH GUIDE.
ARRIVE SECOND SITE. TEAM AGAIN SPLIT. RETURNED TO VEHICLES AND DEPARTED SITE.

TERRY BERENDS
EA UXO Supervisor (printed name)

8 MAR 23
Signature and Date

KEVIN SHAFFE
Client Representative (printed name)

07/08/23
Signature and Date

EA Engineering, Science, and Technology, Inc., PBC

225 Schilling Circle, Ste. 400
Hunt Valley, MD 21031

Client: Ft. Jackson, SC / McCrady Trng Area	Date: 9 MAR 23
Project Title: ORAP	
Contract Number: 6268616	Activities performed: ESCORT

Area swept/excavated to a depth of: SURFACE

Draw area swept, include GPS points at corners, beginning and ending locations, and MEC located below:

Reportable activities:

CHECKED 4 RANGES

Area QC: 100 %

UXO Supervisor
(Print and sign): TERRY BERENDS Date: 9 MAR 23

Kathryn H. Butler, GISP
IRP Manager
kathryn.h.butler3.ctr@army.mil

TEL: 803-751-7332
FAX: 803-751-6821

2363 Essayons Way
USAG Fort Jackson,SC 29207

WHITETAIL
ENVIRONMENTAL, LLC

A Native American Owned Small Business
SBA 8(a) Certified

SITE ENTRY AND EXIT LOG
(Daily Tailgate Acceptance)

Date	Name	Representing	Time In	Time Out
08 MAR 23	KEVIN SHARPE	EA	0915	1600
3/8/23	Derek Hendricks	EA	0915	
3/8/23	Robin Maloney	EA	0915	
3/8/23	William Peterson	EA	0915	
3/8/23	Maddison Hilton	EA	0915	
3/8/23	JERRY BERENDS	EA	0915	

Topics Covered: Expected weather conditions; changes to existing procedures; today's H&S considerations; general site hazards; MEC awareness; environmental conditions; new operations; ingress and egress; exclusion or support zones; biological/physical hazards; PPE required; emergency evacuation procedures; emergency notification and response procedures; AHA review; temperature precautions; buddy system procedures; review of violations/deficiencies from prior day and corrective actions; general hygiene; and other significant events involving health and safety.

BMP Checklist

Installation Fort Jackson Date: 03/09/23

Range Name/#	Range Type	Range Floor Veg %	Back Berm Veg %	Side Berm Veg %	Frag Present	Erosion Potential	Drainage Pathway	Existing BMPs	BMP Details/Comments
Combat Pistol QR.	Pistol	75	80	None Sign	Some	To Left of Firing Lane	None	Berm	15 Lanes. Potential for overshot 0957 hrs. Gravel lane
Kaiserman Pass	Pistol but 7.62 [illegible]		[illegible]	None	Not seen	Stream at [illegible]	Low area left to right	Good Low Grass	w/ abutting pistol range to right
203 [illegible]			w/ trees						New 5.56 to 6.8 mm. Old [illegible]
Agenda - Small Arms	KD	95	20	None	Yes	Low - Med	Left [illegible]	[illegible]	17 Lanes, KD 150-200 m, [illegible]
Main Tank	Targets	5%	Various - [illegible]		-	higher	ahead [illegible]		Left-hand side. Didn't see no [illegible] 1040 hrs.
									1500 M. Bradley, Truck [illegible]
									machine gun. MK 19. [illegible]
Light Demo Range	Demo	0	No berms	None	Graded	Low	To left slightly	Grading and fill	5 lbs + allowed

Notes:

Use Range Specific Evaluation Worksheet if more detail necessary

See Interview Worksheets for specific topics of concern

Location Fort Irwin, CA Date 09/30/21

Project / Client USAEC, APHC

ORA Site Recon

0700 In Las Vegas and to LAS

1000 Flight to BWI

1730 Arrived at BWI. Collected Schonstedt and

1800 headed to home. End of trip. ~1900 hrs.

Location Fort Jackson, SC Date 03/07/23

Project / Client USAEC

ORA Sampling Rm. 224 Scale

1240 - 1330 To BWI

1525 - 1700 Flight to Charleston, SC w/ Robin & Lee

1700 - 1930 Pick up rental trucks and drive w/ Lee to Towne Place Suites in Columbia, SC

1930 - 2045 Derek had sorted equipment, so we loaded equipment into trucks and had a brief meeting inside the hotel. In room afterwards.

03/06/23 Wednesday

0640 - To Walmart w/ Derek for supplies

0730 - To Ft Jackson Contractor's Gate

0815 - At Range Control out by Range 5.

0900 - To CC2 & CC4. Robin Term and I sampled CC2 - swampy area upstream of culvert. Derek, Lee, and Maddison on other team

1100 To Mill Creek #1. We walked from a fire break to the location - a 3-4 ft wide channel filled w/ red algae and precip. Sandy channel. Odor? Derek and others did MC #2 past ponds & dam.

1300 At MC #3 - a long walk down to new Loesburg Rd. 15 ft channel. Sandy, flowing well. Derek and others to JC #1 and CC #3 on S border

Location Fort Jackson, SC Date 03/08/23

Project / Client USAEC

ORA Sampling

1500 - Back at MC#7 Parking Area and sorting and processing samples

1600-1730 At hotel sorting and processing samples in parking lot

1740 - Done for the day

03/09/23 Thursday

0730. Jim Cook 803-667-2572 Bldg 3760.

MTC

Kathryn Butler 803-751-7322 Office

IRP Manager FS 803-571-1356 cell

2067 IFMSS 13, 14 Gabet Pistol M&T area w/ demo area

2563 Bldg Dave for IFMSS Data

1230 Finish at McCrady. Jim Cook - Town of five ranges

0845

1230-1430 Back to Hotel Area for lunch then to packing samples - Robins & Maddison

1430-1500 To Ft Jackson environmental office on Essayons Dr. Bldg 2563. Met Mr. McKnight & met with Kathryn Butler and Barbara Williams. BW issues were wanting a gov inv. at Remington Range and limited timeframe to review the work-plan

1500-1730 - Packing samples, COC at hotel then to Walmart for 7.5-gal bags, ice, and a box

1730-1845 Finish packing then to Fedex and shipped coolers to Katahdin and equipment back to EA. Then to dinner.

Location Fort Jackson, SC Date 03/10/23

Project / Client USAEC

ORA Sampling Scale

03/10/23 Friday

0730 - Depart hotel to CHS airport.

0950 - At airport, then to gate for 1120 flight to BWI.

1120-1330 to BWI then to office - CTS A

3/1/2023

Brief McCrady
gate @ 8:30
in-brief @ 8:40

- pistol Range
- ★ Light demo ★ on post
- KD
- main tank range ↙ armor manuvering
- 13 + 14 ← shared impact area w/ Jackson
  McCrady manages those ranges w/ shared impact area
- 15,000 acres TA liscenced area

★ MOUT site not live fire
not live fire since 70's

★ Machine gun rang ← Convoy 2
No live fire since 80's

active into
50's - 60's
↳ Row of range complex in bottom right corner of McCrady

on McCrady

SAR

- 13, 14 & pistol most heavily used & in jackson

14? 16 point qual. range

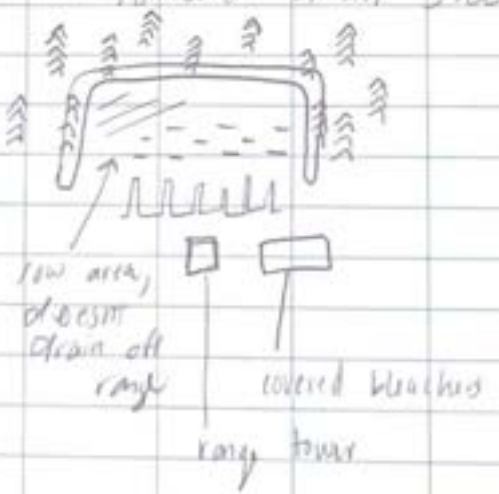
- going to look @ ranges closer to McCrady proper
  > will obtain full RFMSS data from 2007
  - Light Demo ← used in sports
  - Main tank Range
  - CPQQ → only CPQC on Jackson
    → No HE fired now, used to McCrady
    → only TT → lots of use/units
  - (556 762 Argentine ?)

3/9/2023

Left @ 9:30 to 1oxs

CPQC 0950

- 15 firing points / 20/30 times/year
- automated targets
- bare berms (target berms)
- well veg range floors
- slopes towards W/N west
- back berm well vegetated
- some bullet pockets in back berm
- munitions present in target berms
- drainage/erosion behind berms
- side berms
- forested on all sides

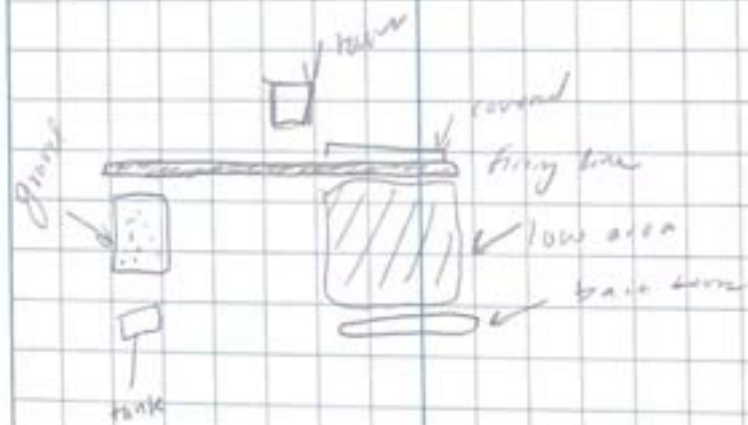


Kasienne pass 1000

- drainage channel behind firing line
- firing point on gravel firing line
- M203, 556, 762

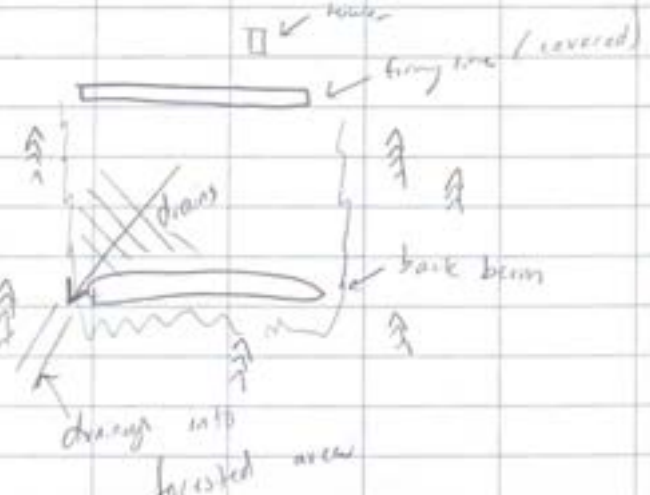
mostly used — used to be fired

- well veg range floor
- bare sandy back berm
- slopes uphill, low area halfway through
- 4x / year



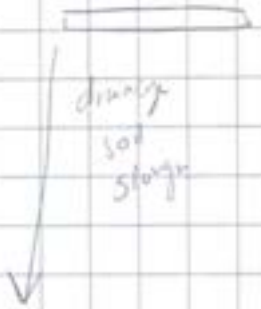
ARGENTAN 1020

- covered firing line
- unveg back berm w/ erosional line
- well veg range floor
- KD range
- frag on ground
- well vegetated drainage (trees in drainage)
- rip-rap in drain
- back berm eroding
- different range groups
- drainage from behind firing line



Main Tank Range 1050

- Training & maneuver area
- tanks fire from baseline
- machine gun fire until machine gun range gets built
- berms mid-distance when targets are
- 1,500 meters out shooting
- unvegetated tank trails
- vegetation most everywhere else
- primarily machine gun use
-



Light Demo 1125

- Well vegetated except where actual demo occurs
- No frag pcs
- Clean up frag
- grade at after use

Back @ 1230

FT Jackson 3/8/2023

Maddison + Derek + Lee

CC4 0940

photo on Derek phone of YSI info

- Sunny
- tannin colored
- water clear + running
- ~56°F

MC2 1130

- Sunny
- water clear + running
- ~60°F

↳ labeled @ tool

JC1 1330

- Sunny
- ~60°

↳ labeled @ tool

CC3 1415

- Sunny
- ~60°

Tuesday 10 AM - 9 PM
Wed 7:00 AM - 5:30 PM
7:30 AM -

Katahdin ANALYTICAL SERVICES

600 Technology Way
Scarborough, ME 04074
Tel: (207) 874-2400
Fax: (207) 775-4029

CHAIN of CUSTODY

PLEASE BEAR DOWN AND PRINT LEGIBLY IN PEN

Client	Contact	Phone #	Fax #
EA Engineering Science, and Technology	Tara Lamond	(410) 584-7000	( )

Address	City	State	Zip Code
225 Schilling Circle	Hunt Valley	MD	21031

Purchase Order #	Proj. Name / No.	Katahdin Quote #
	6268616 . Army ORAP	

Bill (if different than above) 6268616.0005AF.0003 Address

Sampler (Print / Sign)

Copies To:

LAB USE ONLY WORK ORDER #:

KATAHDIN PROJECT NUMBER

REMARKS:

SHIPPING INFO: ☐ FED EX ☐ UPS ☐ CLIENT

AIRBILL NO:

TEMP°C ☐ TEMP BLANK ☐ INTACT ☐ NOT INTACT

*	Sample Description	Date / Time coll'd	Matrix	No. of Cntrs.	ANALYSIS AND CONTAINER TYPE PRESERVATIVES: Filt. Y/N	Metals/explosives/TOC 4oz glass	8oz glass	SEMIVAYS 4oz glass	Metals/explosives/TOC 4oz glass	Filt. Y/N	Filt. Y/N	Filt. Y/N	Filt. Y/N	Filt. Y/N	Filt. Y/N	Filt. Y/N	Filt. Y/N
	JACKSON-SDCC3-DC-01	3/8/23/1415	SED	2		✓		✓									
	JACKSON-SDCC2-DC-01	3/8/23/1000	SED	2		✓		✓									
	JACKSON-SDMC3-DC-01	3/8/23/1400	SED	2		✓		✓									
	JACKSON-SDMC1-DC-01	3/8/23/1150	SED	2		✓		✓									
	JACKSON-SDCC4-DC-01	3/8/23/0940	SED	2		✓		✓									
	JACKSON-SDJC1-DC-01	3/8/23/1330	SED	2		✓		✓									
	JACKSON-SDMC2-DC-01	3/8/23/1130	SED	2		✓		✓									
	SDDUP	3/8/23/—	SED	2		✓		✓									
	JACKSON-SDMC3-DC-01MS	3/8/23/1400	SED	2				✓									
	JACKSON-SDMC3-DC-01MSD	3/8/23/1400	SED	2				✓									
	JACKSON-SDMC3-DC-01MS/MSD	3/8/23/1400	SED	3					✓								
		/															
		/															
		/															
		/															
		/															

COMMENTS

Note 3 4oz glass jars for Metals/explosives/TOC MS/MSD

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)
Robin McKinney	3/9/23 4:20 PM				
Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)

THE TERMS AND CONDITIONS ON THE REVERSE SIDE HEREOF SHALL GOVERN SERVICES, EXCEPT WHEN A SIGNED CONTRACTUAL AGREEMENT EXISTS.

Katahdin ANALYTICAL SERVICES

600 Technology Way
Scarborough, ME 04074
Tel: (207) 874-2400
Fax: (207) 775-4029

CHAIN of CUSTODY

PLEASE BEAR DOWN AND PRINT LEGIBLY IN PEN

Client: EA Engineering, Science, and Technology
Contact: Tara Lamond
Phone #: (410) 584-7000
Fax #: ( )
Address: 225 Schilling Circle
City: Hunt Valley
State: MD
Zip Code: 21031
Purchase Order #:
Proj. Name / No.:
Katahdin Quote #:
Bill (if different than above): 6268616.005AF.0003
Address:
Sampler (Print / Sign):
Copies To:

LAB USE ONLY
WORK ORDER #:
KATAHDIN PROJECT NUMBER:
REMARKS:
SHIPPING INFO: ☐ FED EX ☐ UPS ☐ CLIENT
AIRBILL NO:
TEMP°C: ☐ TEMP BLANK ☐ INTACT ☐ NOT INTACT

ANALYSIS AND CONTAINER TYPE PRESERVATIVES

*	Sample Description	Date / Time coll'd	Matrix	No. of Cntrs.	Explosives / 1 L Amber	Metals/Hardness 250 ml HDPE/H NO3	Perchlorate 250 ml HDPE	DOC 40 ml Vials/H2SO4	Alkalinity, SO4, CL 250 ml HDPE	Ca, Mg, K, Na 250 ml HDPE/H NO3								
	SWDUP	3/8/23/ —	SW	8	✓	✓	✓	✓	✓	✓								
	~~RM SWDUP~~	~~3/8/23/~~	~~SW~~	~~1~~						✓								
	JACKSON-SWMC3-DC-01	3/8/23/1400	SW	8	✓	✓	✓	✓	✓	✓								
	JACKSON-SWMC3-DC-01MS	3/8/23/1400	SW	8	✓	✓	✓	✓	✓	✓								
	JACKSON-SWMC3-DC-01MSD	3/8/23/1400	SW	8	✓	✓	✓	✓	✓	✓								
	Jackson-SWMC2-DC-01	3/8/23/1130	SW	8	✓	✓	✓	✓	✓	✓								
	Jackson-SWJC1-DC-01	3/8/23/1330	SW	8	✓	✓	✓	✓	✓	✓								
	Jackson-SWMC1-DC-01	3/8/23/1150	SW	8	✓	✓	✓	✓	✓	✓								
	JACKSON-SWCC3-DC-01	3/8/23/1415	SW	8	✓	✓	✓	✓	✓	✓								
	JACKSON-SWCC4-DC-01	3/8/23/0940	SW	8	✓	✓	✓	✓	✓	✓								
	JACKSON-SWCC2-DC-01	3/8/23/1000	SW	6		✓	✓	✓	✓	✓								
	JACKSON-EB-01	3/8/23/1530	SW	4	✓	✓	✓											
	JACKSON-CB-01	3/8/23/1600	SW	4	✓	✓	✓											
		/																
		/																
		/																

COMMENTS

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)
[signature]	3/9/23 4:20 PM				
Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)

THE TERMS AND CONDITIONS ON THE REVERSE SIDE HEREOF SHALL GOVERN SERVICES, EXCEPT WHEN A SIGNED CONTRACTUAL AGREEMENT EXISTS.

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Appendix C: Photographic Log

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PHOTOGRAPH LOG
Installation: **Fort Jackson, SC**
Dates: **21-23 August 2018**

<table>
<tr><td> </td><td> </td></tr>
<tr><td>Photo 1: Standard small arms range. Note the vegetated range floor and the non-vegetated sand back berm.</td><td>Photo 2: Non-vegetated range floor and back berm of small arms ranges. Note the flow pathways within the sand range floor.</td></tr>
<tr><td> </td><td> </td></tr>
<tr><td>Photo 3: Standard small arms range back berm and range floor. Note the lack of a side berm at the range as many ranges are separated only by forested swaths.</td><td>Photo 4: Silt sock installed along drainage pathways exiting the western small arms ranges. The socks were emplaced to aid in reducing migration from the small arms ranges towards Gills Creek.</td></tr>
</table>

Photo 5: Tributary exiting the western small arms range complex that discharges to Gills Creek. Note the riprap emplaced in front of the culvert.	**Photo 6:** Recently renovated small arms range. Note the well vegetated range floor and the clay-amended sand target protection berms in the background. The forested buffer separates two adjacent firing ranges.

Photograph Log
Location: Fort Jackson and McCrady Training Center **Dates:** 8-9 March 2023

Photograph 01: View of sample location at MC1

Photograph 02: View MC2, including the blown-out dam along Heises Pond Road.

Photograph 03: View of sample location at MC3.

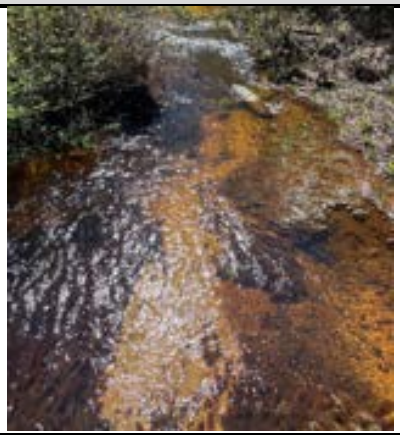
Photograph 04: View of sample location at CC2.

Photograph 05: View of sample location at CC3.

Photograph 06: View of sample location at CC4.

Photograph Log
Location: Fort Jackson and McCrady Training Center **Dates:** 8-9 March 2023

Photograph 07: View of sample location at JC1.



Photograph 08: View of sediment sample location at MC2.

Photograph 09: View of the ponded area of Heises Pond Road where the dam used to be present. Direction of outflow is indicated by the arrow, and the circle indicates the discharge point from the ponded area.

Photograph 10: View of pop-up target berms at Combat Pistol Range located in front of back berm.

Photograph 11: View of the unvegetated protective target berms at Combat Pistol Range.

Photograph 12: View of the covered firing line on the western side of the range at Kasserine Pass.

Photograph Log
Location: Fort Jackson and McCrady Training Center **Dates:** 8-9 March 2023

Photograph 13: View of protective berm for historic mover target at Kasserine Pass.

Photograph 14: View of Kasserine Pass toward the tanks and metal structures are used as targets.

Photograph 15: View of historic Marksmanship Range at Kasserine Pass.

Photograph 16: View of covered firing line with standing firing positions at Argentan.

Photograph 17: View of sparsely vegetated area of the range floor located downrange at Argentan.

Photograph 18: View of unvegetated back berm at Argentan including bullet pockets, soil slough and bullet fragments.

Photograph Log
Location: Fort Jackson and McCrady Training Center **Dates:** 8-9 March 2023

Photograph 19: View of rip-rap located at Argentan, present in the drainage on the northeast portion of the range.

Photograph 20: View of pop-up target located approximately 250 meters from firing line at Main Tank Range.

Photograph 21: View of the unvegetated range floor at Main Tank Range.

Photograph 22: Munitions debris located on the range floor at Main Tank Range.

Photograph 23: View of surface flow evidence toward wooded area south of Main Tank Range.

Photograph 24: View of the demolition area at Light Demo Range that has recently been graded after demolition has occurred.

Photograph Log **Location:** Fort Jackson and McCrady Training Center	**Dates:** 8-9 March 2023
Photograph 25: View of Light Demo Range. Note the surrounding tree line.	

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Appendix D: Laboratory Reports

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EA ENGINEERING, SCIENCE, AND TECHNOLOGY

ORA - MULTIPLE SITES FY 18-22
FORT JACKSON

SQ1188

Ms. Leslie Dimond
207-874-2400

KATAHDIN ANALYTICAL SERVICES
600 TECHNOLOGY WAY
SCARBOROUGH, ME 04074

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SAMPLE DATA PACKAGE

NARRATIVE
KATAHDIN ANALYTICAL SERVICES
EA ENGINEERING, SCIENCE, AND TECHNOLOGY
ORA – MUTIPLE SITES FY18-22- FORT JACKSON
SQ1188

Sample Receipt

The following samples were received on March 10, 2023 and were logged in under Katahdin Analytical Services work order number SQ1188 for a hardcopy due date of March 24, 2023.

KATAHDIN Sample No.	EA ENGINEERING Sample Identification
SQ1188-1	JACKSON-SDCC3-DC-01
SQ1188-2	JACKSON-SDCC3-DC-01
SQ1188-3	JACKSON-SDCC2-DC-01
SQ1188-4	JACKSON-SDCC2-DC-01
SQ1188-5	JACKSON-SDMC3-DC-01
SQ1188-6	JACKSON-SDMC3-DC-01
SQ1188-7	JACKSON-SDMC1-DC-01
SQ1188-8	JACKSON-SDMC1-DC-01
SQ1188-9	JACKSON-SDCC4-DC-01
SQ1188-10	JACKSON-SDCC4-DC-01
SQ1188-11	JACKSON-SDJC1-DC-01
SQ1188-12	JACKSON-SDJC1-DC-01
SQ1188-13	JACKSON-SDMC2-DC-01
SQ1188-14	JACKSON-SDMC2-DC-01
SQ1188-15	SDDUP
SQ1188-16	SDDUP

The samples were logged in for the analyses specified on the chain of custody form. All problems encountered and resolved during sample receipt have been documented on the applicable chain of custody forms.

We certify that the test results provided in this report meet all the requirements of the NELAP standards unless otherwise noted in this narrative or in the Report of Analysis.

We certify that the test results provided in this report are accredited under the laboratory's ISO/IEC 17025:2017 and DoD-ELAP accreditation issued by the ANSI-ASQ National Accreditation Board. Refer to certificate and scope of accreditation L2223.

Analytes which are reported but not listed on our ANAB scope of accreditation will be "^" flagged and the following language will be included in the case narrative for all DoD compliant work: "^" Indicates this analyte is not included on Katahdin Analytical Services DoD-ELAP Scope of Accreditation.

Sample analyses have been performed by the methods as noted herein.

Should you have any questions or comments concerning this Report of Analysis, please do not hesitate to contact your Katahdin Analytical Services Project Manager, **Heather Manz**. This narrative is an integral part of the Report of Analysis.

Organics Analysis

The samples of SQ1188 were analyzed in accordance with Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), V (2015) and VI (2019), and/or for the specific methods listed below or on the Report of Analysis.

Sample SQ1188-5 was used for the Matrix Spike (MS) and Matrix Spike Duplicate (MSD), as requested by the client.

8330B Analysis

Sample SQ1188-7 had a low recovery for the extraction surrogate 1,2-dinitrobenzene which was outside the DoD QSM acceptance limits.

All samples were initially analyzed on the primary Phenomenex column. If a sample has a peak that is within the retention time window of a target analyte and the concentration is above the PQL, the sample is reanalyzed for confirmation on the confirmation Acclaim E2 column. An analyte is considered confirmed if the mentioned criteria are achieved with both columns. The results from the primary column are reported.

The reported percent recovery acceptance limits for the Laboratory Control Samples (LCSs) are based on the DoD QSM acceptance limits for the full list of spiked compounds. The recoveries of the spiked analytes in the LCS, Matrix Spike (MS) and Matrix Spike Duplicate (MSD) are compared to these acceptance limits. Katahdin standard operating procedure is to take corrective action only if the number of spiked analytes in the LCS that are outside of the QC limits is greater than the DoD QSM allowable number of exceedances, which is one. If the associated MS/MSD has greater than the allowable number of exceedances, no corrective action is taken, as long as the LCS is acceptable.

The calibration verification standards (files HQC00151 and HQC00164) had high responses for the target analyte tetryl that resulted in %Ds that were outside of the DoD QSM acceptance limits of 20%.

There were no other protocol deviations or observations noted by the organics laboratory staff.

Metals Analysis

The samples of Katahdin Work Order SQ1188 were prepared and analyzed for metals in accordance with Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III

(1997), IIIA (1999), IIIB (2005), IV (2008), V (2015), and VI (2019). Office of Solid Waste and Emergency Response, U.S. EPA.

Inductively-Coupled Plasma Atomic Emission Spectroscopic Analysis (ICP)

Solid-matrix Katahdin Sample Numbers SQ1188-(2, 4, 6, 8, 10, 12, 14, and 16) were prepared for ICP analysis on 03/21/2023 (QC Batch QC21ICS2) in accordance USEPA Draft Method 821/R-91-100 (Acid Volatile Sulfide / Simultaneously Extractable Metals). Katahdin Sample Number SQ1188-8 was prepared in duplicate and with a matrix-spiked aliquot. The detected concentration of zinc in the preparation blank, PBSQC21ICS2 was above project acceptance criteria. However, there are not undisturbed aliquots of the associated samples available for re-preparation, therefore, results were reported without corrective action.

ICP analyses of Katahdin Work Order SQ1188 sample digestates were performed using a Thermo iCAP 6500 ICP spectrometer in accordance with USEPA Method 6010C. All samples were analyzed within holding times and all analytical run QC criteria were met.

Inductively-Coupled Plasma Mass Spectrometric Analysis (ICP-MS)

Solid-matrix Katahdin Sample Numbers SQ1188-(1, 3, 5, 7, 9, and 15) were digested for ICP-MS analysis on 03/14/2023 (QC Batch QC14IMS2) in accordance with USEPA Method 3050B. Per client request, Katahdin Sample Number SQ1188-5 was prepared with duplicate matrix-spiked aliquots. Duplicate laboratory control samples were prepared in this batch. The measured lead concentration in the preparation blank, PBSQC14IMS2, is above the project acceptance limit. The measured lead concentrations of all samples were greater than ten times that of the preparation blank and were reported with a “B” flag.

Solid-matrix Katahdin Sample Numbers SQ1188-(11 and 13) were digested for ICP-MS analysis on 03/16/2023 (QC Batch QC16IMS1) in accordance with USEPA Method 3050B. The detected concentration of zinc in the preparation blank, PBSQC16IMS1 was above project acceptance criteria. The samples were re-digested on 3/31/2023 (QC Batch QC31IMS1) with similar blank contamination. Results from the original batch are reported.

ICP-MS analyses of Katahdin Work Order SQ1188 sample digestates were performed using an Agilent 7800 ICP-MS spectrometer in accordance with USEPA Method 6020A. Results for all standards and samples are reported using the mean of 3 replicate measurements. All sample digestates were diluted by a factor of 5 during analysis to reduce mass interferences from chlorine, which is present in the digestates from the hydrochloric acid used in digesting the samples. All samples were analyzed within holding times and all analytical run QC criteria were met.

Internal standard recoveries for ICP-MS analyses can be found in the raw data section of the accompanying data package. The following table indicates which analytes are associated with each internal standard element.

Internal Standard Element	Associated Analytes
Lithium	Beryllium, Boron
Scandium	Sodium, Magnesium, Aluminum, Potassium, Calcium
Germanium or Yttrium	Vanadium, Chromium, Manganese, Iron, Cobalt, Nickel, Copper, Zinc, Arsenic, Selenium, Silver, Cadmium, Strontium, Molybdenum
Terbium	Antimony, Barium, Tin, Tungsten
Bismuth	Lead, Thallium, Thorium, Uranium

Instrument tuning information can also be found in the raw data section in the reports labeled "USEPA Method Tune Report". For Method 6020A, the relative standard deviation was determined from 5 replicate measurements and the peak width was measured at 10% of the peak height.

Matrix QC Summary

The measured recoveries in the matrix-spiked aliquots of Katahdin Sample Number SQ1188-5 are outside laboratory acceptance criteria for antimony and lead.

The measured recoveries in the matrix-spiked aliquot of Katahdin Sample Number SQ1188-8 are outside laboratory acceptance criteria for lead and silver.

The duplicate precision of antimony, copper, and zinc in the matrix-spiked duplicate aliquots of Katahdin Sample Number SQ1188-5 were outside of project acceptance criteria.

Reporting of Metals Results

Per client request, analytical results for client samples on Form I and preparation blanks on Form IIIP have been reported using the laboratory's limits of detection (LOD). All results were evaluated down to the laboratory's method detection limits (MDLs). Results that fall between the MDL and the LOQ are flagged with "J" in the C-qualifier column, and the measured concentration appears in the concentration column. Results that are less than the MDL are flagged with "U" in the C-qualifier column, and the LOD is listed in the concentration column. These LOQs, MDLs and LODs have been adjusted for each sample based on the sample amounts used in preparation and analysis.

Analytical results on Forms VA, VD, VII, and IX for client samples, matrix QC samples (duplicates and matrix spikes), and laboratory control samples have been reported down to the laboratory's method detection limits (MDLs). Analytical results that are below the MDLs are flagged with "U" in the C-qualifier column, and the adjusted LOD is listed in the concentration column.

Analytical results for instrument run QC samples (ICVs, ICBs, etc.) have been reported down to the laboratory's instrument detection limits (IDLs).

IDLs, LODs, MDLs, and LOQs are listed on Form 10 of the accompanying data package.

Analytical results for client samples, matrix QC samples (duplicates and matrix spikes), and batch QC samples (preparation blanks and laboratory control samples) for simultaneously extractable metals analysis (SEM) have been reported in units of micromole per gram (umole/g) throughout the accompanying data package.

Wet Chemistry Analysis

The samples of Katahdin sample number SQ1188 were analyzed in accordance with the specific methods listed on the Report of Analysis.

Analyses for acid volatile sulfide (AVS) were performed according to "Draft Analytical Method for Determination of Acid Volatile Sulfide in Sediment", EPA 821/R-91-100, December 1991.

Analyses for total solids were performed according to "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA publication SW-846, Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), V (2015) and VI (2019).

All Wet Chemistry results were evaluated to Katahdin Analytical Services' Method Detection Limits (MDL). Measured concentrations that fall between the MDL and Katahdin's Limit of Quantitation (LOQ) are flagged "J". Measured concentrations that are below the MDL are flagged "U" and reported as "U LOD", where "LOD" is the numerical value of the Limit of Detection.

All analyses were performed within analytical holding times. All quality control criteria were met with the following exception:

The matrix spike performed on SQ1188-8 has a recovery of 42% which outside of the laboratory range (75-125%). No corrective action was taken since all other quality control samples are within the limits.

The client requested a matrix spike (MS) and matrix spike duplicate (MSD) on sample SQ1188-5. Due to analyst error the MS and MSD were not prepared or analyzed. The client was contacted.

Subcontracted Data

Analyses for Total Organic Carbon (TOC) by Method EPA Lloyd Kahn were performed by a subcontract laboratory. Please refer to the section of the data package titled Subcontracted Data.

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Quality Assurance Officer, or their designee, as verified by the following signature.

April, 10th, 2023

for
Leslie Dimond
Quality Assurance Officer

Katahdin Analytical Services, Inc.

Manual Integration Codes For GC/MS, GC, HPLC and/or IC

M1	Peak splitting.
M2	Well defined peaks on the shoulders of the other peaks.
M3	There is additional area due to a coeluting interferant.
M4	There are negative spikes in the baseline.
M5	There are rising or falling baselines.
M6	The software has failed to detect a peak or misidentified a peak.
M7	Excessive peak tailing.
M8	Analysis such as GRO, DRO and TPH require a baseline hold.
M9	Peak was not completely integrated as in GC/MS.
M10	Primary ion was correctly integrated, but secondary or tertiary ion needed manual integration as in GC/MS.
M11	For GC analysis, when a sample is diluted by 1:10 or more, the surrogate is set to undetected and then the area under the surrogate is manually integrated.
M12	Manual integration saved in method due to TurboChrom floating point error.

Katahdin Analytical Services, LLC. — Sample Receipt Condition Report

Client:	EA Engineering	KAS PM:	HHM	Sampled By:	Client
Project:		KIMS Entry By:	MLV	Delivered By:	FedEx
KAS Work Order#:	SQ 1188	KIMS Review By:	HHM	Received By:	GT
		Labeled By:	GT		
SDG #:		Cooler: 1 of 1		Date/Time Rec.:	3/10/23 0940

Receipt Criteria	Y	N	EX*	NA	Comments and/or Resolution
1. Custody seals present / intact?	✓				
2. Chain of Custody present in cooler?	✓				
3. Chain of Custody signed by client?	✓				
4. Chain of Custody matches samples?	✓				
5. Temperature Blanks present? If not, take temperature of any sample w/ IR gun.	✓				Temp (°C): 4.8° — Thermometer ID: IR-1
Samples received at <6 °C w/o freezing?	✓				Note: Not required for metals (except Hg soil) analysis.
Ice packs or ice present?	✓				The lack of ice or ice packs (i.e. no attempt to begin cooling process) or insufficient ice may not meet certain regulatory requirements and may invalidate certain data.
If yes, was there sufficient ice to meet temperature requirements?	✓				
If temp. out, has the cooling process begun (i.e. ice or packs present) and sample collection times <6hrs., but samples are not yet cool?				✓	Note: No cooling process required for metals (except Hg soil) analysis.
6. Volatiles:					
Aqueous: No bubble larger than a pea?				✓	
Soil/Sediment:					
Received in airtight container?				✓	
Received in methanol?				✓	
Methanol covering soil?				✓	
D.I. Water - Received within 48 hour HT?				✓	
7. Trip Blank present in cooler?				✓	
8. Proper sample containers and volume?	✓				
9. Samples within hold time upon receipt?	✓				
10. Aqueous samples properly preserved?					
Metals, COD, NH3, TKN, O/G, phenol, TPO4, N+N, TOC, DRO, TPH – pH <2				✓	
Sulfide - >9				✓	
Cyanide – pH >12				✓	
11. Bottleware Prepped on:					

* Log-In Notes to Exceptions: document any problems with samples or discrepancies or pH adjustments.

Katahdin ANALYTICAL SERVICES

600 Technology Way
Scarborough, ME 04074
Tel: (207) 874-2400
Fax: (207) 775-4029

CHAIN of CUSTODY

PLEASE BEAR DOWN AND PRINT LEGIBLY IN PEN

Client	Contact	Phone #	Fax #
EA Engineering Science and Technology	Tara Lamond	(410) 584-7000	( )

Address	City	State	Zip Code
225 Schilling Circle	Hunt Valley	MD	21031

Purchase Order #	Proj. Name / No.	Katahdin Quote #
	6268616.Army ORAP	

Bill (if different than above) 6268616.0005AF.0003 Address

Sampler (Print / Sign)

Copies To:

LAB USE ONLY

WORK ORDER #: 52 1188

KATAHDIN PROJECT NUMBER

REMARKS:

SHIPPING INFO: ☐ FED EX ☐ UPS ☐ CLIENT

AIRBILL NO:

TEMP°C ☐ TEMP BLANK ☐ INTACT ☐ NOT INTACT

ANALYSIS AND CONTAINER TYPE PRESERVATIVES

*	Sample Description	Date / Time coll'd	Matrix	No. of Cntrs.	Filt. Y☑N☐ Metals/explosives/TOC	Filt. Y☑N☐ 8oz glass	Filt. Y☑N☐ SEM/AVS	Filt. Y☑N☐ 4oz glass	Filt. Y☑N☐ Metals/explosives/TOC	Filt. Y☐N☐ 4oz glass	Filt. Y☐N☐	Filt. Y☐N☐	Filt. Y☐N☐	Filt. Y☐N☐	Filt. Y☐N☐	Filt. Y☐N☐	Filt. Y☐N☐	Filt. Y☐N☐
	JACKSON-SDCC3-DC-01	3/8/23/1415	SED	2	✓		✓											
	JACKSON-SDCC2-DC-01	3/8/23/1000	SED	2	✓		✓											
→	JACKSON-SDMC3-DC-01	3/8/23/1400	SED	2	✓		✓											
	JACKSON-SDMC1-DC-01	3/8/23/1150	SED	2	✓		✓											
	JACKSON-SDCC4-DC-01	3/8/23/0940	SED	2	✓		✓											
	JACKSON-SDJC1-DC-01	3/8/23/1330	SED	2	✓		✓											
	JACKSON-SDMC2-DC-01	3/8/23/1130	SED	2	✓		✓											
	SDDUP	3/8/23/—	SED	2	✓		✓											
	JACKSON-SDMC3-DC-01MS	3/8/23/1400	SED	2			✓											
	JACKSON-SDMC3-DC-01MSD	3/8/23/1400	SED	2			✓											
	JACKSON-SDMC3-DC-01MS/MSD	3/8/23/1400	SED	3					✓									
		/																
		/																
		/																
		/																
		/																

COMMENTS

Note 3 4oz glass jars for Metals/explosives/TOC MS/MSD

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)
Robin Maloney	3/9/23 4:30 PM	3/10/23 0940			
Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)

THE TERMS AND CONDITIONS ON THE REVERSE SIDE HEREOF SHALL GOVERN SERVICES, EXCEPT WHEN A SIGNED CONTRACTUAL AGREEMENT EXISTS.

Login Chain of Custody (ln01)

Mar. 13, 2023
09:24 AM

Login Number: SQ1188

Account: EAENGI002
EA Engineering, Science, and Technolog

Project: EAENG-ORAP-FY18-22

Primary Report Address:

Tara Lamond
EA Engineering, Science, and Technology
225 Schilling Circle

Hunt Valley, MD 21031

tlamond@eaest.com

Primary Invoice Address:

Accounts Payable
EA Engineering, Science, and Technology
225 Schilling Circle

Hunt Valley,MD 21031

midatlancitcap@eaest.com

Report CC Addresses:
Invoice CC Addresses:

Quote/Incoming: EAENG-ORAP-FY18-22

Login Information

ANALYSIS INSTRUCTIONS	:	FDS, DoD QSM 5.1. ND to LOD w/ "J" flags. Client needs final report on time. AVS/SEM = Cd, Cu, Pb, Ni, Ag, Zn. Add TS notes to AVS/SEM samples.
CHECK NO.	:	
CLIENT PO#	:	17796; Proj #6268616
CLIENT PROJECT MANAGE	:	Katherine Wertz
CONTRACT	:	W91ZLK-13-D-0004
COOLER TEMPERATURE	:	4.8
DELIVERY SERVICES	:	FedEx
EDD FORMAT	:	KAS073QC-CSV
ISM INSTRUCTIONS	:	
LOGIN INITIALS	:	MLV
PM	:	HHM
PROJECT NAME	:	ORA - Multiple Sites FY 18-22 Fort Jackson
QC LEVEL	:	IV
REPORT INSTRUCTIONS	:	SDS needs all forms. Email final PDF & EDD to Katherine (KWertz@eaest.com) and Tara (tlamond@eaest.com) no HC. Email invoice to midatlanticap@eaest.com.
SDG ID	:	
SDG STATUS	:	
VERBAL TAT	:	

10:30 am, Mar 13, 2023

Run Reports: Logindetail

Login Number: SQ1188

Account: EAENGI002

EA Engineering, Science, and Technolog

Project: EAENG-ORAP-FY18-22

Quote/Incoming: EAENG-ORAP-FY18-22

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-1	JACKSON-SDCC3-DC-01	08-MAR-23 14:15	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	SW3050MS-PREP	04-SEP-23		
Solid	S	SW6020-ANTIMONY	04-SEP-23		4oz Glass
Solid	S	SW6020-COPPER	04-SEP-23		4oz Glass
Solid	S	SW6020-LEAD	04-SEP-23		4oz Glass
Solid	S	SW6020-ZINC	04-SEP-23		4oz Glass
Solid	S	SW8330-S	22-MAR-23		4oz Glass
Solid	S	TOC-SUB	22-MAR-23		
Solid	S	TS	22-MAR-23		
Service	S	WASTE-DISPOSAL			

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-2	JACKSON-SDCC3-DC-01	08-MAR-23 14:15	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Use TS from SQ1188-1.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	E821-AVS	22-MAR-23		
Solid	P	E821-SEM			4oz Glass
E821-SEM -EXT		SEM-CADMIUM	SEM-COPPER	SEM-LEAD	
SEM-NICKEL		SEM-ZINC			
Solid	S	SEM-SILVER	04-SEP-23		
Solid	S	TS	22-MAR-23		

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-3	JACKSON-SDCC2-DC-01	08-MAR-23 10:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	SW3050MS-PREP	04-SEP-23		
Solid	S	SW6020-ANTIMONY	04-SEP-23		4oz Glass
Solid	S	SW6020-COPPER	04-SEP-23		4oz Glass
Solid	S	SW6020-LEAD	04-SEP-23		4oz Glass
Solid	S	SW6020-ZINC	04-SEP-23		4oz Glass
Solid	S	SW8330-S	22-MAR-23		4oz Glass
Solid	S	TOC-SUB	22-MAR-23		
Solid	S	TS	22-MAR-23		

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-4	JACKSON-SDCC2-DC-01	08-MAR-23 10:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Use TS from SQ1188-3.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	E821-AVS	22-MAR-23		
Solid	P	E821-SEM			4oz Glass
E821-SEM -EXT		SEM-CADMIUM	SEM-COPPER	SEM-LEAD	
SEM-NICKEL		SEM-ZINC			
Solid	S	SEM-SILVER	04-SEP-23		
Solid	S	TS	22-MAR-23		

10:30 am, Mar 13, 2023

Run Reports: Logindetail

Login Number: SQ1188

Account: EAENGI002

EA Engineering, Science, and Technolog

Project: EAENG-ORAP-FY18-22

Quote/Incoming: EAENG-ORAP-FY18-22

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-5	JACKSON-SDMC3-DC-01	08-MAR-23 14:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: MS/MSD.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	SW3050MS-PREP	04-SEP-23		
Solid	S	SW6020-ANTIMONY	04-SEP-23		4oz Glass
Solid	S	SW6020-COPPER	04-SEP-23		4oz Glass
Solid	S	SW6020-LEAD	04-SEP-23		4oz Glass
Solid	S	SW6020-ZINC	04-SEP-23		4oz Glass
Solid	S	SW8330-S	22-MAR-23		4oz Glass
Solid	S	TOC-SUB	22-MAR-23		
Solid	S	TS	22-MAR-23		

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-6	JACKSON-SDMC3-DC-01	08-MAR-23 14:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: MS/MSD. Use TS from SQ1188-5.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	E821-AVS	22-MAR-23		
Solid	P	E821-SEM			4oz Glass
E821-SEM -EXT		SEM-CADMIUM	SEM-COPPER	SEM-LEAD	
SEM-NICKEL		SEM-ZINC			
Solid	S	SEM-SILVER	04-SEP-23		
Solid	S	TS	22-MAR-23		

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-7	JACKSON-SDMC1-DC-01	08-MAR-23 11:50	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	SW3050MS-PREP	04-SEP-23		
Solid	S	SW6020-ANTIMONY	04-SEP-23		4oz Glass
Solid	S	SW6020-COPPER	04-SEP-23		4oz Glass
Solid	S	SW6020-LEAD	04-SEP-23		4oz Glass
Solid	S	SW6020-ZINC	04-SEP-23		4oz Glass
Solid	S	SW8330-S	22-MAR-23		4oz Glass
Solid	S	TOC-SUB	22-MAR-23		
Solid	S	TS	22-MAR-23		

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-8	JACKSON-SDMC1-DC-01	08-MAR-23 11:50	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Use TS from SQ1188-7.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	E821-AVS	22-MAR-23		
Solid	P	E821-SEM			4oz Glass
E821-SEM -EXT		SEM-CADMIUM	SEM-COPPER	SEM-LEAD	
SEM-NICKEL		SEM-ZINC			
Solid	S	SEM-SILVER	04-SEP-23		
Solid	S	TS	22-MAR-23		

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EA Engineering, Science, and Technolog

Project: EAENG-ORAP-FY18-22

Quote/Incoming: EAENG-ORAP-FY18-22

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-9	JACKSON-SDCC4-DC-01	08-MAR-23 09:40	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	SW3050MS-PREP	04-SEP-23		
Solid	S	SW6020-ANTIMONY	04-SEP-23		4oz Glass
Solid	S	SW6020-COPPER	04-SEP-23		4oz Glass
Solid	S	SW6020-LEAD	04-SEP-23		4oz Glass
Solid	S	SW6020-ZINC	04-SEP-23		4oz Glass
Solid	S	SW8330-S	22-MAR-23		4oz Glass
Solid	S	TOC-SUB	22-MAR-23		
Solid	S	TS	22-MAR-23		

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-10	JACKSON-SDCC4-DC-01	08-MAR-23 09:40	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Use TS from SQ1188-9.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	E821-AVS	22-MAR-23		
Solid	P	E821-SEM			4oz Glass
E821-SEM -EXT		SEM-CADMIUM	SEM-COPPER	SEM-LEAD	
SEM-NICKEL		SEM-ZINC			
Solid	S	SEM-SILVER	04-SEP-23		
Solid	S	TS	22-MAR-23		

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-11	JACKSON-SDJC1-DC-01	08-MAR-23 13:30	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	SW3050MS-PREP	04-SEP-23		
Solid	S	SW6020-ANTIMONY	04-SEP-23		4oz Glass
Solid	S	SW6020-COPPER	04-SEP-23		4oz Glass
Solid	S	SW6020-LEAD	04-SEP-23		4oz Glass
Solid	S	SW6020-ZINC	04-SEP-23		4oz Glass
Solid	S	SW8330-S	22-MAR-23		4oz Glass
Solid	S	TOC-SUB	22-MAR-23		
Solid	S	TS	22-MAR-23		

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-12	JACKSON-SDJC1-DC-01	08-MAR-23 13:30	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Use TS from SQ1188-11.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	E821-AVS	22-MAR-23		
Solid	P	E821-SEM			4oz Glass
E821-SEM -EXT		SEM-CADMIUM	SEM-COPPER	SEM-LEAD	
SEM-NICKEL		SEM-ZINC			
Solid	S	SEM-SILVER	04-SEP-23		
Solid	S	TS	22-MAR-23		

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Project: EAENG-ORAP-FY18-22

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Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-13	JACKSON-SDMC2-DC-01	08-MAR-23 11:30	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	SW3050MS-PREP	04-SEP-23		
Solid	S	SW6020-ANTIMONY	04-SEP-23		4oz Glass
Solid	S	SW6020-COPPER	04-SEP-23		4oz Glass
Solid	S	SW6020-LEAD	04-SEP-23		4oz Glass
Solid	S	SW6020-ZINC	04-SEP-23		4oz Glass
Solid	S	SW8330-S	22-MAR-23		4oz Glass
Solid	S	TOC-SUB	22-MAR-23		
Solid	S	TS	22-MAR-23		

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-14	JACKSON-SDMC2-DC-01	08-MAR-23 11:30	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Use TS from SQ1188-13.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	E821-AVS	22-MAR-23		
Solid	P	E821-SEM			4oz Glass
E821-SEM -EXT		SEM-CADMIUM	SEM-COPPER	SEM-LEAD	
SEM-NICKEL		SEM-ZINC			
Solid	S	SEM-SILVER	04-SEP-23		
Solid	S	TS	22-MAR-23		

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-15	SDDUP	08-MAR-23 00:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	SW3050MS-PREP	04-SEP-23		
Solid	S	SW6020-ANTIMONY	04-SEP-23		4oz Glass
Solid	S	SW6020-COPPER	04-SEP-23		4oz Glass
Solid	S	SW6020-LEAD	04-SEP-23		4oz Glass
Solid	S	SW6020-ZINC	04-SEP-23		4oz Glass
Solid	S	SW8330-S	22-MAR-23		4oz Glass
Solid	S	TOC-SUB	22-MAR-23		
Solid	S	TS	22-MAR-23		

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-16	SDDUP	08-MAR-23 00:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Use TS from SQ1188-15.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	S	E821-AVS	22-MAR-23		
Solid	P	E821-SEM			4oz Glass
E821-SEM -EXT		SEM-CADMIUM	SEM-COPPER	SEM-LEAD	
SEM-NICKEL		SEM-ZINC			
Solid	S	SEM-SILVER	04-SEP-23		
Solid	S	TS	22-MAR-23		

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-17	MS CHARGE JACKSON-SDMC3-DC-01	08-MAR-23 14:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Not a sample, MS charge for SQ1188-5/6.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Solid	P	E821-SEM			
Solid	S	SW3050MS-PREP	04-SEP-23		
Solid	S	SW8330-S	22-MAR-23		4oz Glass
Solid	S	TOC-SUB	22-MAR-23		

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Account: EAENGI002

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Project: EAENG-ORAP-FY18-22

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Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1188-18	MSD CHARGE JACKSON-SDMC3-DC-01	08-MAR-23 14:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Not a sample, MSD charge for SQ1188-5/6.

Matrix		*Product*	*Hold Date (shortest)*	*Notes*	*Bottle Type*
Solid	P	E821-SEM			
Solid	S	SW3050MS-PREP	04-SEP-23		
Solid	S	SW8330-S	22-MAR-23		4oz Glass
Solid	S	TOC-SUB	22-MAR-23		

Total Samples: 18 ***Total Analyses: 105***

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SAMPLE DATA SUMMARY PACKAGE

KATAHDIN ANALYTICAL SERVICES - ORGANIC DATA QUALIFIERS

U Indicates the compound was analyzed for but not detected above the specified level. This level may be the Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client.

Note: All results reported as "U" MDL have a 50% rate for false negatives compared to those results reported as "U" PQL, "U" LOQ or "U" LOD, where the rate of false negatives is <1%.

* Compound recovery or percent RPD (relative percent difference) was outside of quality control limits.

D Indicates the result was obtained from analysis of a diluted sample. Surrogate recoveries may not be calculable.

E Estimated value. This flag identifies compounds whose concentrations exceed the upper level of the calibration range of the instrument for that specific analysis.

J Estimated value. The analyte was detected in the sample at a concentration less than the laboratory Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), but above the Method Detection Limit (MDL).

And/or

J Used for Dual Column analytes when there is a greater than 40% difference for detected concentrations between the two GC/HPLC columns.

B Indicates the analyte was detected in the laboratory method blank analyzed concurrently with the sample.

I Indicates that the flagged compound did not meet DoD criteria in the corresponding Initial Calibration (ICAL).

D Indicates that the flagged compound did not meet DoD criteria in the corresponding Initial Calibration Verification (ICV).

C Indicates that the flagged compound did not meet DoD criteria in the corresponding opening Calibration Verification (CV).

V Indicates that the flagged compound did not meet DoD criteria in the corresponding closing Calibration Verification (CV).

L/LL Indicates that the flagged compound did not meet DoD criteria in the corresponding Laboratory Control Sample (LCS) and/or Laboratory Control Sample Duplicate (LCSD) prepared and/or analyzed concurrently with the sample.

M/MM Indicates that the flagged compound did not meet DoD criteria in the Matrix Spike (MS) and/or Matrix Spike Duplicate MSD) prepared and/or analyzed concurrently with the native sample.

H Indicates the flagged compound was detected on the primary column but was not detected on the confirmation column therefore the compound is not reported as a positive detection. (SW846 8330A/B only)

METALS SAMPLE FLAGGING

FLAG	SPECIFIED MEANING
E	The reported value is estimated because of the presence of interference (as indicated by serial dilution).
N	The pre-digestion spiked sample recovery is not within control limits.
*	The duplicate sample analysis relative percent difference (RPD) is not within control limits.
B	Indicates the analyte was detected in the laboratory method blank analyzed concurrently with the sample.
A	The post-digestion spiked sample recovery is not within control limits.
•	Analytical run QC sample (e.g. ICV, CCV, ICB, CCB, ICSA, ICSAB) not within control limits.
U	The analyte was not detected above the specified level. This level may be the Limit of Quantitation (LOQ) (previously called Practical Quantitation Level (PQL)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client. Note: All results reported as "U" MDL have a 50% rate for false negatives compared to those results reported as "U" PQL/LOQ or "U" LOD, where the rate of false negatives is <1%.
J	The analyte was detected in the sample at a concentration less than the laboratory Limit of Quantitation (LOQ) (previously called Practical Quantitation Limit (PQL)), but above the Method Detection Limit (MDL).
Q	One or more quality control criteria failed (e.g., LCS recovery, surrogate spike recovery or CCV).

KATAHDIN ANALYTICAL SERVICES – INORGANIC DATA QUALIFIERS

The sampled date indicated on the attached Report(s) of Analysis (ROA) is the date for which a grab sample was collected or the date for which a composite sample was completed. Beginning and start times for composite samples can be found on the Chain-of-Custody.

U Indicates the compound was analyzed for but not detected above the specified level. This level may be the Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client.

Note: All results reported as "U" MDL have a 50% rate for false negatives compared to those results reported as "U" PQL "U" LOQ or "U" LOD, where the rate of false negatives is <1%.

E Estimated value. This flag identifies compounds whose concentrations exceed the upper level of the calibration range of the instrument for that specific analysis.

J Estimated value. The analyte was detected in the sample at a concentration less than the laboratory Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), but above the Method Detection Limit (MDL).

I-7 The laboratory's Practical Quantitation Level (PQL) or LOQ could not be achieved for this parameter due to sample composition, matrix effects, sample volume, or quantity used for analysis.

A-4 Please refer to cover letter or narrative for further information.

H_ Please note that the regulatory holding time for _____ is "analyze immediately". Ideally, this analysis must be performed in the field at the time of sample collection. _____ for this sample was not performed at the time of sample collection. The analysis was performed as soon as possible after receipt by the laboratory.

H1 - pH H2 - DO H3 - sulfite H4 - residual chlorine

T1 The client did not provide the full volume of at least one liter for analysis of TSS. Therefore, the PQL of 2.5 mg/L could not be achieved.

T2 The client provided the required volume of at least one liter for analysis of TSS, but the laboratory could not filter the full one liter volume due to the sample matrix. Therefore, the PQL of 2.5 mg/L could not be achieved.

M1 The matrix spike and/or matrix spike duplicate recovery performed on this sample was outside of the laboratory acceptance criteria. Sample matrix is suspected. The laboratory criteria was met for the Laboratory Control Sample (LCS) analyzed concurrently with this sample.

M2 The matrix spike and/or matrix spike duplicate recovery was outside of the laboratory acceptance criteria. The native sample concentration is greater than four times the spike added concentration so the spike added could not be distinguished from the native sample concentration.

R1 The relative percent difference (RPD) between the duplicate analyses performed on this sample was outside of the laboratory acceptance criteria (when both values are greater than ten times the PQL).

MCL	Maximum Contaminant Level	NL	No limit
NFL	No Free Liquid Present	FLP	Free Liquid Present
NOD	No Odor Detected	TON	Threshold Odor Number

D-1 As required by Method 5210B, APHA Standard Methods for the Examination of Water and Wastewater (21st edition), the BOD value reported for this sample is 'qualified' because the check standard run concurrently with the sample analysis did not meet the criteria specified in the method (198 +/- 30.5 mg/L). These results may not be reportable for compliance purposes.

D-2 The measured final dissolved oxygen concentrations of all dilutions were less than the method-specified limit of 1 mg/L. The reported BOD result was calculated assuming a final oxygen concentration equal to 1 mg/L. The reported value should be considered a minimum value.

D-3 The dilution water used to prepare this sample did not meet the method and/or regulatory criteria of less than 0.2 or 0.4 mg/L dissolved oxygen (DO) uptake over the five day period of incubation. These results may not be reportable for compliance purposes.

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ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-1
Client ID: JACKSON-SDCC3-DC-01
Matrix: SL
Lab File ID: HQC00154.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 75.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	57	ug/Kgdrywt	1	100	110	9.8	57.
RDX	U	57	ug/Kgdrywt	1	100	110	7.7	57.
1,3,5-Trinitrobenzene	U	57	ug/Kgdrywt	1	100	110	7.6	57.
1,3-Dinitrobenzene	U	57	ug/Kgdrywt	1	100	110	7.1	57.
Tetryl	UL	57	ug/Kgdrywt	1	100	110	6.2	57.
Nitrobenzene	U	57	ug/Kgdrywt	1	100	110	25.	57.
2,4,6-Trinitrotoluene	U	57	ug/Kgdrywt	1	100	110	7.6	57.
2-Am-DNT	U	57	ug/Kgdrywt	1	100	110	24.	57.
4-Am-DNT	U	57	ug/Kgdrywt	1	100	110	19.	57.
2,6-Dinitrotoluene	U	57	ug/Kgdrywt	1	100	110	31.	57.
2,4-Dinitrotoluene	U	57	ug/Kgdrywt	1	100	110	17.	57.
2-Nitrotoluene	U	57	ug/Kgdrywt	1	100	110	14.	57.
3-Nitrotoluene	U	57	ug/Kgdrywt	1	100	110	9.0	57.
4-Nitrotoluene	U	57	ug/Kgdrywt	1	100	110	31.	57.
Nitroglycerin	U	460	ug/Kgdrywt	1	800	910	140	460
1,2-Dinitrobenzene		95.3	%					

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Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-3
Client ID: JACKSON-SDCC2-DC-01
Matrix: SL
Lab File ID: HQC00155.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 23.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	220	ug/Kgdrywt	1	100	440	38.	220
RDX	U	220	ug/Kgdrywt	1	100	440	30.	220
1,3,5-Trinitrobenzene	U	220	ug/Kgdrywt	1	100	440	29.	220
1,3-Dinitrobenzene	U	220	ug/Kgdrywt	1	100	440	27.	220
Tetryl	UL	220	ug/Kgdrywt	1	100	440	24.	220
Nitrobenzene	U	220	ug/Kgdrywt	1	100	440	96.	220
2,4,6-Trinitrotoluene	U	220	ug/Kgdrywt	1	100	440	29.	220
2-Am-DNT	U	220	ug/Kgdrywt	1	100	440	92.	220
4-Am-DNT	U	220	ug/Kgdrywt	1	100	440	74.	220
2,6-Dinitrotoluene	U	220	ug/Kgdrywt	1	100	440	120	220
2,4-Dinitrotoluene	U	220	ug/Kgdrywt	1	100	440	66.	220
2-Nitrotoluene	U	220	ug/Kgdrywt	1	100	440	52.	220
3-Nitrotoluene	U	220	ug/Kgdrywt	1	100	440	34.	220
4-Nitrotoluene	U	220	ug/Kgdrywt	1	100	440	120	220
Nitroglycerin	U	1700	ug/Kgdrywt	1	800	3500	540	1700
1,2-Dinitrobenzene		84.9	%					

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Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-5
Client ID: JACKSON-SDMC3-DC-01
Matrix: SL
Lab File ID: HQC00156.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 74.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	65	ug/Kgdrywt	1	100	130	11.	65.
RDX	U	65	ug/Kgdrywt	1	100	130	8.8	65.
1,3,5-Trinitrobenzene	U	65	ug/Kgdrywt	1	100	130	8.7	65.
1,3-Dinitrobenzene	U	65	ug/Kgdrywt	1	100	130	8.0	65.
Tetryl	UL	65	ug/Kgdrywt	1	100	130	7.0	65.
Nitrobenzene	U	65	ug/Kgdrywt	1	100	130	28.	65.
2,4,6-Trinitrotoluene	U	65	ug/Kgdrywt	1	100	130	8.7	65.
2-Am-DNT	U	65	ug/Kgdrywt	1	100	130	27.	65.
4-Am-DNT	U	65	ug/Kgdrywt	1	100	130	22.	65.
2,6-Dinitrotoluene	U	65	ug/Kgdrywt	1	100	130	35.	65.
2,4-Dinitrotoluene	U	65	ug/Kgdrywt	1	100	130	19.	65.
2-Nitrotoluene	U	65	ug/Kgdrywt	1	100	130	16.	65.
3-Nitrotoluene	U	65	ug/Kgdrywt	1	100	130	10.	65.
4-Nitrotoluene	U	65	ug/Kgdrywt	1	100	130	35.	65.
Nitroglycerin	U	520	ug/Kgdrywt	1	800	1000	160	520
1,2-Dinitrobenzene		93.8	%					

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Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-7
Client ID: JACKSON-SDMC1-DC-01
Matrix: SL
Lab File ID: HQC00159.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 52.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	83	ug/Kgdrywt	1	100	170	14.	83.
RDX	U	83	ug/Kgdrywt	1	100	170	11.	83.
1,3,5-Trinitrobenzene	U	83	ug/Kgdrywt	1	100	170	11.	83.
1,3-Dinitrobenzene	U	83	ug/Kgdrywt	1	100	170	10.	83.
Tetryl	UL	83	ug/Kgdrywt	1	100	170	9.0	83.
Nitrobenzene	U	83	ug/Kgdrywt	1	100	170	37.	83.
2,4,6-Trinitrotoluene	U	83	ug/Kgdrywt	1	100	170	11.	83.
2-Am-DNT	U	83	ug/Kgdrywt	1	100	170	35.	83.
4-Am-DNT	U	83	ug/Kgdrywt	1	100	170	28.	83.
2,6-Dinitrotoluene	U	83	ug/Kgdrywt	1	100	170	45.	83.
2,4-Dinitrotoluene	U	83	ug/Kgdrywt	1	100	170	25.	83.
2-Nitrotoluene	U	83	ug/Kgdrywt	1	100	170	20.	83.
3-Nitrotoluene	U	83	ug/Kgdrywt	1	100	170	13.	83.
4-Nitrotoluene	U	83	ug/Kgdrywt	1	100	170	45.	83.
Nitroglycerin	U	670	ug/Kgdrywt	1	800	1300	210	670
1,2-Dinitrobenzene	*	74.0	%					

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Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-9
Client ID: JACKSON-SDCC4-DC-01
Matrix: SL
Lab File ID: HQC00160.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 80.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	55	ug/Kgdrywt	1	100	110	9.5	55.
RDX	U	55	ug/Kgdrywt	1	100	110	7.5	55.
1,3,5-Trinitrobenzene	U	55	ug/Kgdrywt	1	100	110	7.4	55.
1,3-Dinitrobenzene	U	55	ug/Kgdrywt	1	100	110	6.8	55.
Tetryl	UL	55	ug/Kgdrywt	1	100	110	6.0	55.
Nitrobenzene	U	55	ug/Kgdrywt	1	100	110	24.	55.
2,4,6-Trinitrotoluene	U	55	ug/Kgdrywt	1	100	110	7.4	55.
2-Am-DNT	U	55	ug/Kgdrywt	1	100	110	23.	55.
4-Am-DNT	U	55	ug/Kgdrywt	1	100	110	19.	55.
2,6-Dinitrotoluene	U	55	ug/Kgdrywt	1	100	110	30.	55.
2,4-Dinitrotoluene	U	55	ug/Kgdrywt	1	100	110	16.	55.
2-Nitrotoluene	U	55	ug/Kgdrywt	1	100	110	13.	55.
3-Nitrotoluene	U	55	ug/Kgdrywt	1	100	110	8.7	55.
4-Nitrotoluene	U	55	ug/Kgdrywt	1	100	110	30.	55.
Nitroglycerin	U	440	ug/Kgdrywt	1	800	880	140	440
1,2-Dinitrobenzene		98.9	%					

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Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-11
Client ID: JACKSON-SDJC1-DC-01
Matrix: SL
Lab File ID: HQC00161.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 80.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	57	ug/Kgdrywt	1	100	110	9.8	57.
RDX	U	57	ug/Kgdrywt	1	100	110	7.8	57.
1,3,5-Trinitrobenzene	U	57	ug/Kgdrywt	1	100	110	7.7	57.
1,3-Dinitrobenzene	U	57	ug/Kgdrywt	1	100	110	7.1	57.
Tetryl	UL	57	ug/Kgdrywt	1	100	110	6.2	57.
Nitrobenzene	U	57	ug/Kgdrywt	1	100	110	25.	57.
2,4,6-Trinitrotoluene	U	57	ug/Kgdrywt	1	100	110	7.7	57.
2-Am-DNT	U	57	ug/Kgdrywt	1	100	110	24.	57.
4-Am-DNT	U	57	ug/Kgdrywt	1	100	110	19.	57.
2,6-Dinitrotoluene	U	57	ug/Kgdrywt	1	100	110	31.	57.
2,4-Dinitrotoluene	U	57	ug/Kgdrywt	1	100	110	17.	57.
2-Nitrotoluene	U	57	ug/Kgdrywt	1	100	110	14.	57.
3-Nitrotoluene	U	57	ug/Kgdrywt	1	100	110	9.0	57.
4-Nitrotoluene	U	57	ug/Kgdrywt	1	100	110	31.	57.
Nitroglycerin	U	460	ug/Kgdrywt	1	800	920	140	460
1,2-Dinitrobenzene		107.	%					

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Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-13
Client ID: JACKSON-SDMC2-DC-01
Matrix: SL
Lab File ID: HQC00162.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 84.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	56	ug/Kgdrywt	1	100	110	9.7	56.
RDX	U	56	ug/Kgdrywt	1	100	110	7.7	56.
1,3,5-Trinitrobenzene	U	56	ug/Kgdrywt	1	100	110	7.6	56.
1,3-Dinitrobenzene	U	56	ug/Kgdrywt	1	100	110	7.0	56.
Tetryl	UL	56	ug/Kgdrywt	1	100	110	6.1	56.
Nitrobenzene	U	56	ug/Kgdrywt	1	100	110	25.	56.
2,4,6-Trinitrotoluene	U	56	ug/Kgdrywt	1	100	110	7.6	56.
2-Am-DNT	U	56	ug/Kgdrywt	1	100	110	24.	56.
4-Am-DNT	U	56	ug/Kgdrywt	1	100	110	19.	56.
2,6-Dinitrotoluene	U	56	ug/Kgdrywt	1	100	110	30.	56.
2,4-Dinitrotoluene	U	56	ug/Kgdrywt	1	100	110	17.	56.
2-Nitrotoluene	U	56	ug/Kgdrywt	1	100	110	14.	56.
3-Nitrotoluene	U	56	ug/Kgdrywt	1	100	110	8.9	56.
4-Nitrotoluene	U	56	ug/Kgdrywt	1	100	110	30.	56.
Nitroglycerin	U	450	ug/Kgdrywt	1	800	900	140	450
1,2-Dinitrobenzene		106.	%					

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Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-15
Client ID: SDDUP
Matrix: SL
Lab File ID: HQC00163.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 74.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	65	ug/Kgdrywt	1	100	130	11.	65.
RDX	U	65	ug/Kgdrywt	1	100	130	8.9	65.
1,3,5-Trinitrobenzene	U	65	ug/Kgdrywt	1	100	130	8.7	65.
1,3-Dinitrobenzene	U	65	ug/Kgdrywt	1	100	130	8.1	65.
Tetryl	UL	65	ug/Kgdrywt	1	100	130	7.0	65.
Nitrobenzene	U	65	ug/Kgdrywt	1	100	130	29.	65.
2,4,6-Trinitrotoluene	U	65	ug/Kgdrywt	1	100	130	8.7	65.
2-Am-DNT	U	65	ug/Kgdrywt	1	100	130	27.	65.
4-Am-DNT	U	65	ug/Kgdrywt	1	100	130	22.	65.
2,6-Dinitrotoluene	U	65	ug/Kgdrywt	1	100	130	35.	65.
2,4-Dinitrotoluene	U	65	ug/Kgdrywt	1	100	130	20.	65.
2-Nitrotoluene	U	65	ug/Kgdrywt	1	100	130	16.	65.
3-Nitrotoluene	U	65	ug/Kgdrywt	1	100	130	10.	65.
4-Nitrotoluene	U	65	ug/Kgdrywt	1	100	130	35.	65.
Nitroglycerin	U	520	ug/Kgdrywt	1	800	1000	160	520
1,2-Dinitrobenzene		92.2	%					

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Report of Analytical Results

SDG: SQ1188
Lab ID: WG333925-1
Client ID: Method Blank
Matrix: SL
Lab File ID: HQC00152.D

Sample Date: N/A
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	50	ug/Kgdrywt	1	100	100	8.6	50.
RDX	U	50	ug/Kgdrywt	1	100	100	6.8	50.
1,3,5-Trinitrobenzene	U	50	ug/Kgdrywt	1	100	100	6.7	50.
1,3-Dinitrobenzene	U	50	ug/Kgdrywt	1	100	100	6.2	50.
Tetryl	U	50	ug/Kgdrywt	1	100	100	5.4	50.
Nitrobenzene	U	50	ug/Kgdrywt	1	100	100	22.	50.
2,4,6-Trinitrotoluene	U	50	ug/Kgdrywt	1	100	100	6.7	50.
2-Am-DNT	U	50	ug/Kgdrywt	1	100	100	21.	50.
4-Am-DNT	U	50	ug/Kgdrywt	1	100	100	17.	50.
2,6-Dinitrotoluene	U	50	ug/Kgdrywt	1	100	100	27.	50.
2,4-Dinitrotoluene	U	50	ug/Kgdrywt	1	100	100	15.	50.
2-Nitrotoluene	U	50	ug/Kgdrywt	1	100	100	12.	50.
3-Nitrotoluene	U	50	ug/Kgdrywt	1	100	100	7.9	50.
4-Nitrotoluene	U	50	ug/Kgdrywt	1	100	100	27.	50.
Nitroglycerin	U	400	ug/Kgdrywt	1	800	800	120	400
1,2-Dinitrobenzene		104.	%					

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Form 2
System Monitoring Compound Recovery

Lab Name: Katahdin Analytical Services **SDG:** SQ1188 **Matrix:** SL

Client Sample ID	Lab Sample ID	Col. ID	DNB	#
JACKSON-SDCC3-DC-01	SQ1188-1	P	95.3	
JACKSON-SDCC2-DC-01	SQ1188-3	P	84.9	
JACKSON-SDMC3-DC-01	SQ1188-5	P	93.8	
JACKSON-SDMC1-DC-01	SQ1188-7	P	74.0	*
JACKSON-SDCC4-DC-01	SQ1188-9	P	98.9	
JACKSON-SDJC1-DC-01	SQ1188-11	P	107.	
JACKSON-SDMC2-DC-01	SQ1188-13	P	106.	
SDDUP	SQ1188-15	P	92.2	
Method Blank	WG333925-1	P	104.	
Laboratory Control S	WG333925-2	P	101.	
Matrix Spike	WG333925-3	P	103.	
Matrix Spike Duplica	WG333925-4	P	109.	

Abbr.	Surrogate Compound	QC Limits
DNB	1,2-Dinitrobenzene	78-119

= Column to be used to flag recovery limits.
* = Values outside of contract required QC limits.
D= System Monitoring Compound diluted out.

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LCS Recovery Report

Lab ID: WG333925-2
Client ID: LCS
SDG: SQ1188
LCS File ID: HQC00153.D
Report Date: 27-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
Matrix: SL

Compound	Recovery (%)	Conc Added	Conc Recovered	Conc Units	Limits
HMX	97.6	1000	976.	ug/Kgdrywt	74-124
RDX	94.6	1000	946.	ug/Kgdrywt	67-129
1,3,5-Trinitrobenzene	102.	1000	1020	ug/Kgdrywt	80-116
1,3-Dinitrobenzene	97.7	1000	977.	ug/Kgdrywt	73-119
Tetryl	* 142.	1000	1420	ug/Kgdrywt	68-135
Nitrobenzene	88.1	1000	881.	ug/Kgdrywt	67-129
2,4,6-Trinitrotoluene	114.	1000	1140	ug/Kgdrywt	71-120
2-Am-DNT	96.8	1000	968.	ug/Kgdrywt	71-123
4-Am-DNT	108.	1000	1080	ug/Kgdrywt	64-127
2,6-Dinitrotoluene	101.	1000	1010	ug/Kgdrywt	79-117
2,4-Dinitrotoluene	94.4	1000	944.	ug/Kgdrywt	75-121
2-Nitrotoluene	113.	1000	1130	ug/Kgdrywt	70-124
3-Nitrotoluene	101.	1000	1010	ug/Kgdrywt	67-129
4-Nitrotoluene	99.4	1000	994.	ug/Kgdrywt	71-124
Nitroglycerin	102.	1000	1020	ug/Kgdrywt	73-124
1,2-Dinitrobenzene	101.				78-119

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MS/MSD Recovery Report

MS ID: WG333925-3
MSD ID: WG333925-4
Sample ID: SQ1188-5
Client ID: JACKSON-SDMC3-DC-01
SDG: SQ1188
MS File ID: HQC00157.D

Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925
Report Date: 27-MAR-23
MSD File ID: HQC00158.D

Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
Matrix: SL
% Solids: 74.
Sample File ID: HQC00156.D

Compound	MS Spike	MSD Spike	Conc Units	Samp Conc	MS Conc	MSD Conc	MS Rec (%)	MSD Rec (%)	RPD (%)	RPD Limit	Limits
HMX	1290	1270	ug/Kgdrywt	U65	1300	1300	100.	102.	1	20	74-124
RDX	1290	1270	ug/Kgdrywt	U65	1200	1400	96.7	107.	8	20	67-129
1,3,5-Trinitrobenzene	1290	1270	ug/Kgdrywt	U65	1300	1200	98.2	96.2	4	20	80-116
1,3-Dinitrobenzene	1290	1270	ug/Kgdrywt	U65	1200	1200	95.9	96.9	1	20	73-119
Tetryl	1290	1270	ug/Kgdrywt	UL65	1700	1500	130.	117.	12	20	68-135
Nitrobenzene	1290	1270	ug/Kgdrywt	U65	1100	1100	87.4	89.8	1	20	67-129
2,4,6-Trinitrotoluene	1290	1270	ug/Kgdrywt	U65	1400	1400	111.	110.	3	20	71-120
2-Am-DNT	1290	1270	ug/Kgdrywt	U65	1300	1300	97.4	99.3	0	20	71-123
4-Am-DNT	1290	1270	ug/Kgdrywt	U65	1400	1400	106.	108.	0	20	64-127
2,6-Dinitrotoluene	1290	1270	ug/Kgdrywt	U65	1300	1300	100.	102.	0	20	79-117
2,4-Dinitrotoluene	1290	1270	ug/Kgdrywt	U65	1200	1200	92.8	94.6	0	20	75-121
2-Nitrotoluene	1290	1270	ug/Kgdrywt	U65	1400	1400	111.	114.	1	20	70-124
3-Nitrotoluene	1290	1270	ug/Kgdrywt	U65	1300	1300	99.0	102.	1	20	67-129
4-Nitrotoluene	1290	1270	ug/Kgdrywt	U65	1200	1300	96.7	99.3	1	20	71-124
Nitroglycerin	1290	1270	ug/Kgdrywt	U520	1400	1200	104.	93.8	12	20	73-124
1,2-Dinitrobenzene							103.	109.			78-119

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Method Blank Summary

Lab Name : Katahdin Analytical Services
SDG : SQ1188
Lab File ID : HQC00152.D
Lab Sample ID : WG333925-1
Instrument ID : HPLC02
Date Extracted : 16-MAR-23
Matrix : SL
Date Analyzed : 23-MAR-23
Extraction method : SW846 8330B MOD
Time Analyzed : 08:27

This Method Blank applies to the following samples and QC samples:

Client Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
Laboratory Control S	WG333925-2	HQC00153.D	03/23/23	09:02
JACKSON-SDCC3-DC-01	SQ1188-1	HQC00154.D	03/23/23	09:37
JACKSON-SDCC2-DC-01	SQ1188-3	HQC00155.D	03/23/23	10:11
JACKSON-SDMC3-DC-01	SQ1188-5	HQC00156.D	03/23/23	10:46
Matrix Spike	WG333925-3	HQC00157.D	03/23/23	11:21
Matrix Spike Duplica	WG333925-4	HQC00158.D	03/23/23	11:55
JACKSON-SDMC1-DC-01	SQ1188-7	HQC00159.D	03/23/23	12:30
JACKSON-SDCC4-DC-01	SQ1188-9	HQC00160.D	03/23/23	13:05
JACKSON-SDJC1-DC-01	SQ1188-11	HQC00161.D	03/23/23	13:40
JACKSON-SDMC2-DC-01	SQ1188-13	HQC00162.D	03/23/23	14:14
SDDUP	SQ1188-15	HQC00163.D	03/23/23	14:49

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Form 6
Initial Calibration Summary

Lab Name : Katahdin Analytical Services
SDG: SQ1188
Instrument ID: HPLC02
Calibration Date(s): 15-MAR-23 09:32
15-MAR-23 13:00
Lab File IDs : HQC00038.I,HQC00039.I,HQC00040.I
HQC00041.I,HQC00042.I,HQC00043.I
HQC00044.I

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7		Curve				%RSD or R^2		
	0.0250000	0.0500000	0.1000000	0.2500000	0.5000000	1.0000	2.0000		Type	b	m1	m2	Result	Limit	
NITROGLYCERIN	6230	6420	6913	6952	7130	7000	7155		AVG		6828		5.26	20	O

Legend: O = Acceptable; W = Failed %RSD Value; X = Failed R^2 Value; Y = Failed Minimum RF

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Form 6
Initial Calibration Summary

Lab Name : Katahdin Analytical Services
SDG: SQ1188
Instrument ID: HPLC02
Calibration Date(s): 15-MAR-23 09:32
15-MAR-23 13:00
Lab File IDs : HQC00038.I,HQC00039.I,HQC00040.I
HQC00041.I,HQC00042.I,HQC00043.I
HQC00044.I

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7		Curve				%RSD or R^2		
	0.0250000	0.0500000	0.1000000	0.2500000	0.5000000	1.0000	2.0000		Type	b	m1	m2	Result	Limit	
HMX	7480	7760	7990	8004	8094	7940	8125		AVG		7913		2.842	15	O
RDX	8160	8240	8680	8624	8782	8611	8834		AVG		8562		3.044	15	O
1,3,5-trinitrobenzene	4800	4660	4600	5148	5210	5069	5161		AVG		4950		5.18	15	O
1,3-dinitrobenzene	10480	10720	11420	11344	11552	11296	11631		AVG		11210		3.883	15	O
nitrobenzene	15200	11500	10840	10600	10834	10558	10858		AVG		11480		14.52	15	O
TETRYL	2320	2300	2400	2276	2294	2324	+++++		AVG		2319		1.872	15	O
2,4,6-trinitrotoluene	2760	2920	3190	3164	3162	3128	3125		AVG		3064		5.269	15	O
4-AM-DNT	5760	5840	6140	6212	6326	6207	6372		AVG		6122		3.832	15	O
2-AM-DNT	8160	8200	8810	8800	8964	8778	9062		AVG		8682		4.122	15	O
2,6-dinitrotoluene	4200	3960	3990	4084	4104	4038	4042		AVG		4060		1.956	15	O
2,4-dinitrotoluene	6160	6220	9060	6664	6756	6626	6812		AVG		6900		14.29	15	O
2-nitrotoluene	3920	3800	3930	3932	4008	3912	4016		AVG		3931		1.82	15	O
4-nitrotoluene	3240	3440	3510	3552	3610	3522	3636		AVG		3501		3.779	15	O
3-nitrotoluene	4080	4320	4550	4572	4650	4535	4671		AVG		4483		4.707	15	O
1,2-dinitrobenzene	6280	7780	7390	6236	6330	6427	6304		AVG		6678		9.47	15	

Legend: O = Acceptable; W = Failed %RSD Value; X = Failed R^2 Value; Y = Failed Minimum RF

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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1188
Lab ID: WG334249-1
Analytical Date: 03/23/23 07:45
Lab File ID: HQC00151.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 210 um

Compound	RRF/Amount	RF0.500	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
NITROGLYCERIN	6828	7246	0.010	6.10759	20.00000	Averaged

*** = Compound out of QC criteria**

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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1188
Lab ID: WG334249-1
Analytical Date: 03/23/23 07:45
Lab File ID: HQC00151.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 254 um

Compound	$\overline{RRF}$/Amount	RF0.500	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type	
HMX	7913	8134	0.010	2.78916	20.00000	Averaged	
RDX	8562	8864	0.010	3.53326	20.00000	Averaged	
1,3,5-trinitrobenzene	4950	5418	0.010	9.46244	20.00000	Averaged	
1,3-dinitrobenzene	11206	11936	0.010	6.51369	20.00000	Averaged	
nitrobenzene	11484	11050	0.010	-3.78156	20.00000	Averaged	
TETRYL	2319	2932	0.010	26.43381	20.00000	Averaged	<-
2,4,6-trinitrotoluene	3064	3374	0.010	10.11493	20.00000	Averaged	
4-AM-DNT	6122	6492	0.010	6.03635	20.00000	Averaged	
2-AM-DNT	8682	9220	0.010	6.19673	20.00000	Averaged	
2,6-dinitrotoluene	4060	4386	0.010	8.03906	20.00000	Averaged	
2,4-dinitrotoluene	6900	6994	0.010	1.36757	20.00000	Averaged	
2-nitrotoluene	3931	4188	0.010	6.53584	20.00000	Averaged	
4-nitrotoluene	3501	3724	0.010	6.35659	20.00000	Averaged	
3-nitrotoluene	4483	4794	0.010	6.94925	20.00000	Averaged	
1,2-dinitrobenzene	6678	6380	0.010	-4.46344	20.00000	Averaged	

*** = Compound out of QC criteria**

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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1188
Lab ID: WG334249-2
Analytical Date: 03/23/23 15:24
Lab File ID: HQC00164.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 210 um

Compound	$\overline{\text{RRF}}$/Amount	RF0.250	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
NITROGLYCERIN	6828	7280	0.010	6.61283	20.00000	Averaged

*** = Compound out of QC criteria**

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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1188
Lab ID: WG334249-2
Analytical Date: 03/23/23 15:24
Lab File ID: HQC00164.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 254 um

Compound	$\overline{RRF}$/Amount	RF0.250	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type	
HMX	7913	8284	0.010	4.68471	20.00000	Averaged	
RDX	8562	8956	0.010	4.60784	20.00000	Averaged	
1,3,5-trinitrobenzene	4950	5456	0.010	10.23018	20.00000	Averaged	
1,3-dinitrobenzene	11206	11992	0.010	7.01342	20.00000	Averaged	
nitrobenzene	11484	11032	0.010	-3.93830	20.00000	Averaged	
TETRYL	2319	2856	0.010	23.15653	20.00000	Averaged	<-
2,4,6-trinitrotoluene	3064	3420	0.010	11.61620	20.00000	Averaged	
4-AM-DNT	6122	6556	0.010	7.08169	20.00000	Averaged	
2-AM-DNT	8682	9288	0.010	6.97996	20.00000	Averaged	
2,6-dinitrotoluene	4060	4408	0.010	8.58098	20.00000	Averaged	
2,4-dinitrotoluene	6900	7100	0.010	2.90388	20.00000	Averaged	
2-nitrotoluene	3931	4176	0.010	6.23058	20.00000	Averaged	
4-nitrotoluene	3501	3708	0.010	5.89963	20.00000	Averaged	
3-nitrotoluene	4483	4788	0.010	6.81539	20.00000	Averaged	
1,2-dinitrobenzene	6678	6424	0.010	-3.80456	20.00000	Averaged	

*** = Compound out of QC criteria**

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Form 8
Analytical Sequence

Lab Name: Katahdin Analytical Services **SDG:** SQ1188
Instrument ID: HPLC02 **Wavelength:** 210 um

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed	DNB	
Initial Calibration	WG333590-1	03/15/23	09:32		
Initial Calibration	WG333590-2	03/15/23	10:06		
Initial Calibration	WG333590-3	03/15/23	10:41		
Initial Calibration	WG333590-4	03/15/23	11:16		
Initial Calibration	WG333590-5	03/15/23	11:50		
Initial Calibration	WG333590-6	03/15/23	12:25		
Initial Calibration	WG333590-7	03/15/23	13:00		
Independent Source	WG333590-8	03/15/23	13:35		
Continuing Calibrati	WG334249-1	03/23/23	07:45		
Method Blank	WG333925-1	03/23/23	08:27		
Laboratory Control S	WG333925-2	03/23/23	09:02		
JACKSON-SDCC3-DC-01	SQ1188-1	03/23/23	09:37		
JACKSON-SDCC2-DC-01	SQ1188-3	03/23/23	10:11		
JACKSON-SDMC3-DC-01	SQ1188-5	03/23/23	10:46		
Matrix Spike	WG333925-3	03/23/23	11:21		
Matrix Spike Duplica	WG333925-4	03/23/23	11:55		
JACKSON-SDMC1-DC-01	SQ1188-7	03/23/23	12:30		
JACKSON-SDCC4-DC-01	SQ1188-9	03/23/23	13:05		
JACKSON-SDJC1-DC-01	SQ1188-11	03/23/23	13:40		
JACKSON-SDMC2-DC-01	SQ1188-13	03/23/23	14:14		
SDDUP	SQ1188-15	03/23/23	14:49		
Continuing Calibrati	WG334249-2	03/23/23	15:24		

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Form 8
Analytical Sequence

Lab Name: Katahdin Analytical Services **SDG:** SQ1188
Instrument ID: HPLC02 **Wavelength:** 254 um

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed	DNB	
Initial Calibration	WG333590-1	03/15/23	09:32	8.791	
Initial Calibration	WG333590-2	03/15/23	10:06	8.786	
Initial Calibration	WG333590-3	03/15/23	10:41	8.82	
Initial Calibration	WG333590-4	03/15/23	11:16	8.771	
Initial Calibration	WG333590-5	03/15/23	11:50	8.758	
Initial Calibration	WG333590-6	03/15/23	12:25	8.738	
Initial Calibration	WG333590-7	03/15/23	13:00	8.722	
Independent Source	WG333590-8	03/15/23	13:35		
Continuing Calibrati	WG334249-1	03/23/23	07:45	8.754	
Method Blank	WG333925-1	03/23/23	08:27	8.71	
Laboratory Control S	WG333925-2	03/23/23	09:02	8.701	
JACKSON-SDCC3-DC-01	SQ1188-1	03/23/23	09:37	8.741	
JACKSON-SDCC2-DC-01	SQ1188-3	03/23/23	10:11	8.712	
JACKSON-SDMC3-DC-01	SQ1188-5	03/23/23	10:46	8.747	
Matrix Spike	WG333925-3	03/23/23	11:21	8.755	
Matrix Spike Duplica	WG333925-4	03/23/23	11:55	8.702	
JACKSON-SDMC1-DC-01	SQ1188-7	03/23/23	12:30	8.726	
JACKSON-SDCC4-DC-01	SQ1188-9	03/23/23	13:05	8.785	
JACKSON-SDJC1-DC-01	SQ1188-11	03/23/23	13:40	8.679	
JACKSON-SDMC2-DC-01	SQ1188-13	03/23/23	14:14	8.685	
SDDUP	SQ1188-15	03/23/23	14:49	8.767	
Continuing Calibrati	WG334249-2	03/23/23	15:24	8.665	

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INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDCC3-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 75.0 **Lab Sample ID:** SQ1188-001

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.025	J		MS	5	0.089	0.018	0.044
7440-50-8	COPPER, TOTAL	0.35			MS	5	0.27	0.062	0.18
7439-92-1	LEAD, TOTAL	1.78		B	MS	5	0.089	0.0062	0.044
7440-66-6	ZINC, TOTAL	0.60	J		MS	5	0.89	0.12	0.71

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDCC3-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 75.0 **Lab Sample ID:** SQ1188-002

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-43-9	CADMIUM, SEM	0.000025	J		P	1	0.00098	0.000015	0.00057
7440-50-8	COPPER, SEM	0.00269	J		P	1	0.0083	0.00054	0.0033
7439-92-1	LEAD, SEM	0.00273			P	1	0.00053	0.000087	0.00041
7440-02-0	NICKEL, SEM	0.00028	J		P	1	0.0036	0.00016	0.0014
7440-22-4	SILVER, SEM	0.00079	U		P	1	0.0019	0.000053	0.00079
7440-66-6	ZINC, SEM	0.00478	J	B	P	1	0.0064	0.00055	0.0032

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDCC2-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 22.7 **Lab Sample ID:** SQ1188-003

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-36-0	ANTIMONY, TOTAL	0.15	J		MS	5	0.23	0.046	0.12
7440-50-8	COPPER, TOTAL	21.6			MS	5	0.69	0.16	0.46
7439-92-1	LEAD, TOTAL	33.3		B	MS	5	0.23	0.016	0.12
7440-66-6	ZINC, TOTAL	8.50			MS	5	2.3	0.30	1.8

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDCC2-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 22.7 **Lab Sample ID:** SQ1188-004

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000470	J		P	1	0.0036	0.000058	0.0022
7440-50-8	COPPER, SEM	0.170			P	1	0.031	0.0020	0.013
7439-92-1	LEAD, SEM	0.134			P	1	0.0020	0.00034	0.0016
7440-02-0	NICKEL, SEM	0.00778	J		P	1	0.014	0.00061	0.0056
7440-22-4	SILVER, SEM	0.0030	U		P	1	0.0076	0.00020	0.0030
7440-66-6	ZINC, SEM	0.0587		B	P	1	0.024	0.0021	0.012

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-005

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-36-0	ANTIMONY, TOTAL	0.080	J	N*	MS	5	0.11	0.022	0.055
7440-50-8	COPPER, TOTAL	1.18		*	MS	5	0.33	0.077	0.22
7439-92-1	LEAD, TOTAL	7.84		B	MS	5	0.11	0.0077	0.055
7440-66-6	ZINC, TOTAL	4.11		*	MS	5	1.1	0.14	0.88

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-006

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000178	J		P	1	0.0012	0.000019	0.00070
7440-50-8	COPPER, SEM	0.00595	J		P	1	0.010	0.00066	0.0041
7439-92-1	LEAD, SEM	0.0286			P	1	0.00063	0.00011	0.00048
7440-02-0	NICKEL, SEM	0.00134	J		P	1	0.0044	0.00020	0.0017
7440-22-4	SILVER, SEM	0.00093	U		P	1	0.0024	0.000066	0.00093
7440-66-6	ZINC, SEM	0.0289		B	P	1	0.0081	0.00069	0.0040

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC1-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 52.5 **Lab Sample ID:** SQ1188-007

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.14	J		MS	5	0.18	0.036	0.091
7440-50-8	COPPER, TOTAL	4.81			MS	5	0.54	0.13	0.36
7439-92-1	LEAD, TOTAL	7.01		B	MS	5	0.18	0.013	0.091
7440-66-6	ZINC, TOTAL	4.66			MS	5	1.8	0.24	1.4

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC1-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 52.5 **Lab Sample ID:** SQ1188-008

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000512	J		P	1	0.0016	0.000025	0.00098
7440-50-8	COPPER, SEM	0.0311			P	1	0.014	0.00091	0.0057
7439-92-1	LEAD, SEM	0.0249		N	P	1	0.00087	0.00015	0.00068
7440-02-0	NICKEL, SEM	0.00165	J		P	1	0.0061	0.00027	0.0024
7440-22-4	SILVER, SEM	0.0013	U	N	P	1	0.0033	0.000090	0.0013
7440-66-6	ZINC, SEM	0.0341		B	P	1	0.011	0.00093	0.0055

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDCC4-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 80.3 **Lab Sample ID:** SQ1188-009

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.020	J		MS	5	0.072	0.014	0.036
7440-50-8	COPPER, TOTAL	1.42			MS	5	0.22	0.050	0.14
7439-92-1	LEAD, TOTAL	0.815		B	MS	5	0.072	0.0050	0.036
7440-66-6	ZINC, TOTAL	1.50			MS	5	0.72	0.094	0.58

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDCC4-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 80.3 **Lab Sample ID:** SQ1188-010

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000035	J		P	1	0.0011	0.000017	0.00063
7440-50-8	COPPER, SEM	0.00137	J		P	1	0.0093	0.00060	0.0038
7439-92-1	LEAD, SEM	0.00169			P	1	0.00058	0.00010	0.00046
7440-02-0	NICKEL, SEM	0.00019	J		P	1	0.0041	0.00017	0.0016
7440-22-4	SILVER, SEM	0.00088	U		P	1	0.0022	0.000059	0.00088
7440-66-6	ZINC, SEM	0.00298	J	B	P	1	0.0072	0.00061	0.0037

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDJC1-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 80.1 **Lab Sample ID:** SQ1188-011

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.023	J		MS	5	0.11	0.022	0.055
7440-50-8	COPPER, TOTAL	0.40			MS	5	0.33	0.077	0.22
7439-92-1	LEAD, TOTAL	0.747			MS	5	0.11	0.0077	0.055
7440-66-6	ZINC, TOTAL	2.78		B	MS	5	1.1	0.14	0.88

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDJC1-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 80.1 **Lab Sample ID:** SQ1188-012

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000073	J		P	1	0.0011	0.000018	0.00066
7440-50-8	COPPER, SEM	0.00096	J		P	1	0.0098	0.00063	0.0039
7439-92-1	LEAD, SEM	0.00417			P	1	0.00058	0.00010	0.00048
7440-02-0	NICKEL, SEM	0.00028	J		P	1	0.0042	0.00019	0.0017
7440-22-4	SILVER, SEM	0.00092	U		P	1	0.0023	0.000062	0.00092
7440-66-6	ZINC, SEM	0.00991		B	P	1	0.0075	0.00064	0.0038

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC2-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 83.7 **Lab Sample ID:** SQ1188-013

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.025	J		MS	5	0.11	0.021	0.053
7440-50-8	COPPER, TOTAL	0.32			MS	5	0.32	0.075	0.21
7439-92-1	LEAD, TOTAL	1.48			MS	5	0.11	0.0075	0.053
7440-66-6	ZINC, TOTAL	1.84		B	MS	5	1.1	0.14	0.85

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC2-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 83.7 **Lab Sample ID:** SQ1188-014

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-43-9	CADMIUM, SEM	0.000082	J		P	1	0.00098	0.000016	0.00060
7440-50-8	COPPER, SEM	0.0035	U		P	1	0.0088	0.00057	0.0035
7439-92-1	LEAD, SEM	0.000891			P	1	0.00053	0.000092	0.00043
7440-02-0	NICKEL, SEM	0.00021	J		P	1	0.0037	0.00017	0.0015
7440-22-4	SILVER, SEM	0.00082	U		P	1	0.0020	0.000056	0.00082
7440-66-6	ZINC, SEM	0.00583	J	B	P	1	0.0069	0.00058	0.0034

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** SDDUP

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-015

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.069	J		MS	5	0.13	0.026	0.065
7440-50-8	COPPER, TOTAL	0.79			MS	5	0.39	0.091	0.26
7439-92-1	LEAD, TOTAL	5.69		B	MS	5	0.13	0.0091	0.065
7440-66-6	ZINC, TOTAL	3.19			MS	5	1.3	0.17	1.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** SDDUP

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-016

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000196	J		P	1	0.0012	0.000018	0.00068
7440-50-8	COPPER, SEM	0.00481	J		P	1	0.010	0.00064	0.0041
7439-92-1	LEAD, SEM	0.0244			P	1	0.00063	0.00011	0.00048
7440-02-0	NICKEL, SEM	0.00112	J		P	1	0.0044	0.00019	0.0017
7440-22-4	SILVER, SEM	0.00093	U		P	1	0.0024	0.000064	0.00093
7440-66-6	ZINC, SEM	0.0256		B	P	1	0.0078	0.00067	0.0040

Comments:

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICV

File: IQC24A Mar 24, 2023 15:10

Analyte	True	Found	%R (1)
ALUMINUM	10000.0	10350.00	103.5
CADMIUM	400.0	394.40	98.6
CALCIUM	10000.0	10310.00	103.1
COPPER	400.0	394.60	98.7
IRON	10000.0	10190.00	101.9
LEAD	400.0	403.50	100.9
MAGNESIUM	10000.0	10410.00	104.1
NICKEL	400.0	399.80	100.0
SILVER	400.0	392.70	98.2
ZINC	400.0	393.60	98.4

SAMPLE: CCV

File: IQC24A Mar 24, 2023 15:31

Analyte	True	Found	%R (1)	
ALUMINUM	12500.0	14410.00	115.3	•
CADMIUM	500.0	523.90	104.8	
CALCIUM	12500.0	14300.00	114.4	•
COPPER	500.0	520.30	104.1	
IRON	12500.0	14280.00	114.2	•
LEAD	500.0	529.40	105.9	
MAGNESIUM	12500.0	13120.00	105.0	
NICKEL	500.0	528.70	105.7	
SILVER	500.0	515.40	103.1	
ZINC	500.0	522.00	104.4	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: IQC24A Mar 24, 2023 15:49

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13110.00	104.9
CADMIUM	500.0	523.50	104.7
CALCIUM	12500.0	12930.00	103.4
COPPER	500.0	520.60	104.1
IRON	12500.0	12950.00	103.6
LEAD	500.0	529.40	105.9
MAGNESIUM	12500.0	13460.00	107.7
NICKEL	500.0	529.40	105.9
SILVER	500.0	514.10	102.8
ZINC	500.0	517.40	103.5

SAMPLE: CCV

File: IQC24A Mar 24, 2023 16:39

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12770.00	102.2
CADMIUM	500.0	505.80	101.2
CALCIUM	12500.0	12530.00	100.2
COPPER	500.0	508.90	101.8
IRON	12500.0	12630.00	101.0
LEAD	500.0	512.00	102.4
MAGNESIUM	12500.0	13170.00	105.4
NICKEL	500.0	510.60	102.1
SILVER	500.0	501.30	100.3
ZINC	500.0	498.90	99.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: IQC24A Mar 24, 2023 17:30

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12770.00	102.2
CADMIUM	500.0	510.10	102.0
CALCIUM	12500.0	12650.00	101.2
COPPER	500.0	514.50	102.9
IRON	12500.0	12800.00	102.4
LEAD	500.0	514.60	102.9
MAGNESIUM	12500.0	13270.00	106.2
NICKEL	500.0	513.80	102.8
SILVER	500.0	503.90	100.8
ZINC	500.0	504.10	100.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICV

File: LQC21A Mar 21, 2023 15:17

Analyte	True	Found	%R (1)
ALUMINUM	400.0	407.46	101.9
ANTIMONY	20.0	19.34	96.7
CALCIUM	4000.0	4114.37	102.9
COPPER	20.0	20.60	103.0
IRON	4000.0	4071.60	101.8
LEAD	20.0	19.62	98.1
MAGNESIUM	4000.0	4204.30	105.1
MOLYBDENUM	40.0	39.19	98.0
POTASSIUM	4000.0	4115.22	102.9
SODIUM	4000.0	4169.86	104.2
ZINC	20.0	21.04	105.2

SAMPLE: CCV

File: LQC21A Mar 21, 2023 16:23

Analyte	True	Found	%R (1)
ALUMINUM	500.0	528.13	105.6
ANTIMONY	25.0	23.53	94.1
CALCIUM	5000.0	5018.26	100.4
COPPER	25.0	26.38	105.5
IRON	5000.0	5009.43	100.2
LEAD	25.0	25.22	100.9
MAGNESIUM	5000.0	5458.86	109.2
MOLYBDENUM	25.0	26.34	105.4
POTASSIUM	5000.0	5190.28	103.8
SODIUM	5000.0	5478.25	109.6
ZINC	25.0	26.25	105.0

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC21A Mar 21, 2023 17:32

Analyte	True	Found	%R (1)
ALUMINUM	500.0	526.40	105.3
ANTIMONY	25.0	23.74	95.0
CALCIUM	5000.0	5057.03	101.1
COPPER	25.0	26.30	105.2
IRON	5000.0	4892.41	97.8
LEAD	25.0	24.94	99.8
MAGNESIUM	5000.0	5475.45	109.5
MOLYBDENUM	25.0	25.95	103.8
POTASSIUM	5000.0	5182.05	103.6
SODIUM	5000.0	5437.50	108.7
ZINC	25.0	25.86	103.4

SAMPLE: CCV

File: LQC21A Mar 21, 2023 18:48

Analyte	True	Found	%R (1)
ALUMINUM	500.0	527.12	105.4
ANTIMONY	25.0	24.00	96.0
CALCIUM	5000.0	5140.71	102.8
COPPER	25.0	26.38	105.5
IRON	5000.0	4983.56	99.7
LEAD	25.0	24.89	99.6
MAGNESIUM	5000.0	5470.18	109.4
MOLYBDENUM	25.0	26.18	104.7
POTASSIUM	5000.0	5150.29	103.0
SODIUM	5000.0	5477.25	109.5
ZINC	25.0	26.61	106.4

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC21A Mar 21, 2023 20:01

Analyte	True	Found	%R (1)
ALUMINUM	500.0	515.81	103.2
ANTIMONY	25.0	24.24	97.0
CALCIUM	5000.0	5126.70	102.5
COPPER	25.0	26.53	106.1
IRON	5000.0	5003.09	100.1
LEAD	25.0	25.13	100.5
MAGNESIUM	5000.0	5482.83	109.7
MOLYBDENUM	25.0	26.23	104.9
POTASSIUM	5000.0	5160.08	103.2
SODIUM	5000.0	5460.16	109.2
ZINC	25.0	26.57	106.3

SAMPLE: CCV

File: LQC21A Mar 21, 2023 21:07

Analyte	True	Found	%R (1)
ALUMINUM	500.0	514.90	103.0
ANTIMONY	25.0	23.97	95.9
CALCIUM	5000.0	5138.01	102.8
COPPER	25.0	26.38	105.5
IRON	5000.0	4914.15	98.3
LEAD	25.0	25.33	101.3
MAGNESIUM	5000.0	5452.90	109.1
MOLYBDENUM	25.0	26.10	104.4
POTASSIUM	5000.0	5106.79	102.1
SODIUM	5000.0	5458.77	109.2
ZINC	25.0	26.98	107.9

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC21A Mar 21, 2023 22:17

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	514.98	103.0	
ANTIMONY	25.0	24.15	96.6	
CALCIUM	5000.0	5143.18	102.9	
COPPER	25.0	26.01	104.0	
IRON	5000.0	4973.60	99.5	
LEAD	25.0	24.96	99.8	
MAGNESIUM	5000.0	5534.95	110.7	•
MOLYBDENUM	25.0	26.09	104.4	
POTASSIUM	5000.0	5158.29	103.2	
SODIUM	5000.0	5473.21	109.5	
ZINC	25.0	26.62	106.5	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICV

File: LQC24A Mar 24, 2023 16:38

Analyte	True	Found	%R (1)
ALUMINUM	400.0	398.74	99.7
CALCIUM	4000.0	4087.04	102.2
IRON	4000.0	3966.65	99.2
LEAD	20.0	19.63	98.1
MAGNESIUM	4000.0	4141.96	103.5
MOLYBDENUM	40.0	39.01	97.5
POTASSIUM	4000.0	4104.51	102.6
SODIUM	4000.0	4132.93	103.3

SAMPLE: CCV

File: LQC24A Mar 24, 2023 17:45

Analyte	True	Found	%R (1)
ALUMINUM	500.0	521.81	104.4
CALCIUM	5000.0	5192.91	103.9
IRON	5000.0	5107.87	102.2
LEAD	25.0	26.20	104.8
MAGNESIUM	5000.0	5300.54	106.0
MOLYBDENUM	25.0	24.82	99.3
POTASSIUM	5000.0	5233.65	104.7
SODIUM	5000.0	5315.47	106.3

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC24A Mar 24, 2023 18:21

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	558.41	111.7	•
CALCIUM	5000.0	5217.40	104.3	
IRON	5000.0	5148.44	103.0	
LEAD	25.0	26.12	104.5	
MAGNESIUM	5000.0	5388.17	107.8	
MOLYBDENUM	25.0	27.44	109.8	
POTASSIUM	5000.0	5253.99	105.1	
SODIUM	5000.0	5377.08	107.5	

SAMPLE: CCV

File: LQC24A Mar 24, 2023 19:32

Analyte	True	Found	%R (1)
ALUMINUM	500.0	508.75	101.8
CALCIUM	5000.0	5161.95	103.2
IRON	5000.0	5173.01	103.5
LEAD	25.0	25.77	103.1
MAGNESIUM	5000.0	5430.31	108.6
MOLYBDENUM	25.0	24.48	97.9
POTASSIUM	5000.0	5163.63	103.3
SODIUM	5000.0	5361.48	107.2

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC24A Mar 24, 2023 20:41

Analyte	True	Found	%R (1)
ALUMINUM	500.0	518.23	103.6
CALCIUM	5000.0	5198.22	104.0
IRON	5000.0	5088.11	101.8
LEAD	25.0	25.61	102.4
MAGNESIUM	5000.0	5346.63	106.9
MOLYBDENUM	25.0	24.48	97.9
POTASSIUM	5000.0	5183.10	103.7
SODIUM	5000.0	5318.75	106.4

SAMPLE: CCV

File: LQC24A Mar 24, 2023 21:58

Analyte	True	Found	%R (1)
ALUMINUM	500.0	515.41	103.1
CALCIUM	5000.0	5230.57	104.6
IRON	5000.0	5119.91	102.4
LEAD	25.0	25.45	101.8
MAGNESIUM	5000.0	5328.47	106.6
MOLYBDENUM	25.0	24.59	98.4
POTASSIUM	5000.0	5184.04	103.7
SODIUM	5000.0	5302.15	106.0

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC24A Mar 24, 2023 23:12

Analyte	True	Found	%R (1)
ALUMINUM	500.0	505.88	101.2
CALCIUM	5000.0	5106.43	102.1
IRON	5000.0	5185.49	103.7
LEAD	25.0	25.89	103.6
MAGNESIUM	5000.0	5284.48	105.7
MOLYBDENUM	25.0	24.57	98.3
POTASSIUM	5000.0	5223.49	104.5
SODIUM	5000.0	5301.01	106.0

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICV

File: LQC28E Mar 28, 2023 16:12

Analyte	True	Found	%R (1)
ALUMINUM	400.0	417.03	104.3
CALCIUM	4000.0	4163.20	104.1
IRON	4000.0	3985.48	99.6
MAGNESIUM	4000.0	4215.47	105.4
MOLYBDENUM	40.0	40.47	101.2
POTASSIUM	4000.0	4191.95	104.8
SODIUM	4000.0	4182.33	104.6
ZINC	20.0	21.28	106.4

SAMPLE: CCV

File: LQC28E Mar 28, 2023 17:20

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	551.70	110.3	
CALCIUM	5000.0	5307.23	106.1	
IRON	5000.0	5058.56	101.2	
MAGNESIUM	5000.0	5702.13	114.0	•
MOLYBDENUM	25.0	26.37	105.5	
POTASSIUM	5000.0	5350.41	107.0	
SODIUM	5000.0	5629.73	112.6	•
ZINC	25.0	27.04	108.2	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC28E Mar 28, 2023 18:30

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	591.28	118.3	•
CALCIUM	5000.0	5337.61	106.8	
IRON	5000.0	5144.38	102.9	
MAGNESIUM	5000.0	5638.02	112.8	•
MOLYBDENUM	25.0	25.97	103.9	
POTASSIUM	5000.0	5403.97	108.1	
SODIUM	5000.0	5623.47	112.5	•
ZINC	25.0	26.60	106.4	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: PQL

File: IQC24A Mar 24, 2023 15:18

Analyte	TRUE	FOUND	% R
ALUMINUM	300.0	311.90	104.0
CADMIUM	5.0	4.78	95.6
CALCIUM	100.0	97.07	97.1
COPPER	25.0	24.24	97.0
IRON	100.0	105.80	105.8
LEAD	5.0	5.28	105.6
MAGNESIUM	100.0	108.90	108.9
NICKEL	10.0	9.58	95.8
SILVER	10.0	9.51	95.1
ZINC	20.0	19.42	97.1

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: PQL

File: LQC21A Mar 21, 2023 15:31

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	18.96	94.8
ANTIMONY	0.2	0.23	115.0
CALCIUM	20.0	20.84	104.2
COPPER	0.6	0.70	116.7
IRON	20.0	22.77	113.9
LEAD	0.2	0.19	95.0
MAGNESIUM	20.0	21.63	108.1
MOLYBDENUM	1.0	1.08	108.0
POTASSIUM	200.0	200.53	100.3
SODIUM	200.0	208.44	104.2
ZINC	2.0	2.15	107.5

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: PQL

File: LQC24A Mar 24, 2023 18:06

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	-1.54	-7.7•
CALCIUM	20.0	23.90	119.5
IRON	20.0	21.45	107.3
LEAD	0.2	0.22	110.0
MAGNESIUM	20.0	23.77	118.8
MOLYBDENUM	1.0	1.17	117.0
POTASSIUM	200.0	223.23	111.6
SODIUM	200.0	220.01	110.0

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: PQL

File: LQC28E Mar 28, 2023 16:26

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	20.71	103.6
CALCIUM	20.0	20.36	101.8
IRON	20.0	20.18	100.9
MAGNESIUM	20.0	20.47	102.3
MOLYBDENUM	1.0	1.03	103.0
POTASSIUM	200.0	197.56	98.8
SODIUM	200.0	200.03	100.0
ZINC	2.0	2.24	112.0

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICB

File: IQC24A Mar 24, 2023 15:14

Analyte	Result	C
ALUMINUM	25.170	J
CADMIUM	0.092	U
CALCIUM	11.000	U
COPPER	0.550	U
IRON	8.362	J
LEAD	1.000	U
MAGNESIUM	2.900	U
NICKEL	0.440	U
SILVER	0.530	U
ZINC	0.450	U

SAMPLE: CCB

File: IQC24A Mar 24, 2023 15:35

Analyte	Result	C
ALUMINUM	39.230	J
CADMIUM	0.092	U
CALCIUM	32.660	J
COPPER	0.550	U
IRON	13.760	J
LEAD	1.000	U
MAGNESIUM	7.765	J
NICKEL	0.440	U
SILVER	0.530	U
ZINC	0.450	U

SAMPLE: CCB

File: IQC24A Mar 24, 2023 15:53

Analyte	Result	C
ALUMINUM	12.510	J
CADMIUM	0.144	J
CALCIUM	11.000	U
COPPER	0.550	U
IRON	6.080	J
LEAD	1.000	U
MAGNESIUM	3.012	J
NICKEL	0.440	U
SILVER	0.530	U
ZINC	0.451	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCB

File: IQC24A Mar 24, 2023 16:44

Analyte	Result	C
ALUMINUM	18.980	J
CADMIUM	0.105	J
CALCIUM	11.660	J
COPPER	0.550	U
IRON	7.097	J
LEAD	1.000	U
MAGNESIUM	2.900	U
NICKEL	0.440	U
SILVER	0.530	U
ZINC	0.450	U

SAMPLE: CCB

File: IQC24A Mar 24, 2023 17:35

Analyte	Result	C
ALUMINUM	15.440	J
CADMIUM	0.124	J
CALCIUM	11.000	U
COPPER	0.550	U
IRON	8.215	J
LEAD	1.000	U
MAGNESIUM	2.900	U
NICKEL	0.440	U
SILVER	0.530	U
ZINC	0.551	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICB

File: LQC21A Mar 21, 2023 15:26

Analyte	Result	C
ALUMINUM	0.330	U
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.005	U
MAGNESIUM	3.178	J
MOLYBDENUM	0.170	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC21A Mar 21, 2023 16:33

Analyte	Result	C
ALUMINUM	0.428	J
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.006	J
MAGNESIUM	5.696	J
MOLYBDENUM	0.281	J
POTASSIUM	30.161	J
SODIUM	17.981	J
ZINC	0.220	U

SAMPLE: CCB

File: LQC21A Mar 21, 2023 17:41

Analyte	Result	C
ALUMINUM	0.330	U
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.005	U
MAGNESIUM	3.911	J
MOLYBDENUM	0.141	J
POTASSIUM	27.287	J
SODIUM	10.084	J
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCB
File: LQC21A Mar 21, 2023 18:57

Analyte	Result	C
ALUMINUM	0.330	U
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.005	U
MAGNESIUM	3.709	J
MOLYBDENUM	0.116	J
POTASSIUM	27.751	J
SODIUM	7.937	J
ZINC	0.220	U

SAMPLE: CCB
File: LQC21A Mar 21, 2023 20:11

Analyte	Result	C
ALUMINUM	-0.981	U
ANTIMONY	0.061	U
CALCIUM	9.383	J
COPPER	0.087	U
IRON	6.400	U
LEAD	0.009	J
MAGNESIUM	4.899	J
MOLYBDENUM	0.111	J
POTASSIUM	30.151	J
SODIUM	9.280	J
ZINC	0.220	U

SAMPLE: CCB
File: LQC21A Mar 21, 2023 21:16

Analyte	Result	C
ALUMINUM	-1.459	U
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	-0.005	U
MAGNESIUM	3.954	J
MOLYBDENUM	0.096	J
POTASSIUM	30.361	J
SODIUM	7.758	J
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCB

File: LQC21A Mar 21, 2023 22:27

Analyte	Result	C
ALUMINUM	-1.537	U
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.005	U
MAGNESIUM	3.316	J
MOLYBDENUM	0.066	J
POTASSIUM	29.556	J
SODIUM	6.600	U
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICB

File: LQC24A Mar 24, 2023 16:47

Analyte	Result	C
ALUMINUM	0.871	J
CALCIUM	6.800	U
IRON	6.400	U
LEAD	0.016	J
MAGNESIUM	2.632	J
MOLYBDENUM	0.201	J
POTASSIUM	12.000	U
SODIUM	6.600	U

SAMPLE: CCB

File: LQC24A Mar 24, 2023 17:56

Analyte	Result	C
ALUMINUM	-21.460	B
CALCIUM	6.800	U
IRON	6.400	U
LEAD	0.021	J
MAGNESIUM	6.490	J
MOLYBDENUM	0.334	J
POTASSIUM	24.074	J
SODIUM	14.108	J

SAMPLE: CCB

File: LQC24A Mar 24, 2023 18:30

Analyte	Result	C
ALUMINUM	-13.950	B
CALCIUM	14.188	B
IRON	13.554	B
LEAD	0.015	J
MAGNESIUM	12.790	B
MOLYBDENUM	0.682	B
POTASSIUM	29.969	J
SODIUM	23.010	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCB

File: LQC24A Mar 24, 2023 19:42

Analyte	Result	C
ALUMINUM	-23.769	B
CALCIUM	6.800	U
IRON	6.400	U
LEAD	0.008	J
MAGNESIUM	3.594	J
MOLYBDENUM	0.181	J
POTASSIUM	19.841	J
SODIUM	6.600	U

SAMPLE: CCB

File: LQC24A Mar 24, 2023 20:51

Analyte	Result	C
ALUMINUM	-19.559	B
CALCIUM	7.197	J
IRON	6.909	J
LEAD	0.029	J
MAGNESIUM	5.771	J
MOLYBDENUM	0.173	J
POTASSIUM	24.628	J
SODIUM	6.600	U

SAMPLE: CCB

File: LQC24A Mar 24, 2023 22:07

Analyte	Result	C
ALUMINUM	-21.258	B
CALCIUM	6.800	U
IRON	6.400	U
LEAD	0.018	J
MAGNESIUM	3.995	J
MOLYBDENUM	0.134	J
POTASSIUM	18.102	J
SODIUM	6.600	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCB

File: LQC24A Mar 24, 2023 23:21

Analyte	Result	C
ALUMINUM	-23.510	B
CALCIUM	6.800	U
IRON	6.400	U
LEAD	0.010	J
MAGNESIUM	3.720	J
MOLYBDENUM	0.144	J
POTASSIUM	18.367	J
SODIUM	6.600	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICB

File: LQC28E Mar 28, 2023 16:21

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	2.605	J
MOLYBDENUM	0.207	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC28E Mar 28, 2023 17:28

Analyte	Result	C
ALUMINUM	2.461	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	6.770	J
MOLYBDENUM	0.337	J
POTASSIUM	14.004	J
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC28E Mar 28, 2023 18:39

Analyte	Result	C
ALUMINUM	6.678	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	4.576	J
MOLYBDENUM	0.153	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

3P

PREPARATION BLANKS

Lab Name: Katahdin Analytical Services **Sample ID:** PBSQC14IMS2

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC14IMS2

Concentration Units : mg/Kg drywt

Analyte	RESULT	C
ANTIMONY	0.050	U
COPPER	0.077	J
LEAD	0.066	B
ZINC	0.30	J

3P

PREPARATION BLANKS

Lab Name: Katahdin Analytical Services **Sample ID:** PBSQC16IMS1

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC16IMS1

Concentration Units : mg/Kg drywt

Analyte	RESULT	C
ANTIMONY	0.050	U
COPPER	0.20	U
LEAD	0.016	J
ZINC	0.70	B

3P

PREPARATION BLANKS

Lab Name: Katahdin Analytical Services **Sample ID:** PBSQC21ICS2

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC21ICS2

Concentration Units : umole/g drywt

Analyte	RESULT	C
CADMIUM	0.000017	J
COPPER	0.0031	U
LEAD	0.00039	U
NICKEL	0.0014	U
SILVER	0.00074	U
ZINC	0.0126	B

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICSA

File: IQC24A Mar 24, 2023 15:23

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	527600.00	105.5
CADMIUM	0	0.11	
CALCIUM	500000.00	497700.00	99.5
COPPER	0	-3.44	
IRON	200000.00	203100.00	101.6
LEAD	0	-0.19	
MAGNESIUM	500000.00	429200.00	85.8
NICKEL	0	-0.16	
SILVER	0	0.15	
ZINC	0	1.25	

SAMPLE: ICSAB

File: IQC24A Mar 24, 2023 15:27

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	525200.00	105.0
CADMIUM	1000.00	932.70	93.3
CALCIUM	500000.00	501600.00	100.3
COPPER	500.00	526.90	105.4
IRON	200000.00	202100.00	101.1
LEAD	50.00	44.54	90.0
MAGNESIUM	500000.00	422800.00	84.6
NICKEL	1000.00	922.10	92.2
SILVER	200.00	214.40	107.0
ZINC	1000.00	921.50	92.2

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICSA

File: LQC21A Mar 21, 2023 15:36

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	107781.26	107.8
ANTIMONY	0.05	0.08	
CALCIUM	100000.00	104952.51	105.0
COPPER	0.08	0.10	
IRON	100000.00	101811.97	101.8
LEAD	0.02	0.04	
MAGNESIUM	100000.00	106190.33	106.2
MOLYBDENUM	2000.00	2264.96	113.3
POTASSIUM	100000.00	101679.39	101.7
SODIUM	100000.00	106379.19	106.4
ZINC	1.40	0.94	

SAMPLE: ICSAB

File: LQC21A Mar 21, 2023 15:41

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	105995.40	106.0
ANTIMONY	20.05	19.93	100.0
CALCIUM	100000.00	103377.12	103.4
COPPER	20.08	20.45	100.0
IRON	100000.00	99989.35	100.0
LEAD	20.02	20.37	100.0
MAGNESIUM	100000.00	104319.74	104.3
MOLYBDENUM	2000.00	2240.74	112.1
POTASSIUM	100000.00	100141.96	100.1
SODIUM	100000.00	104424.27	104.4
ZINC	21.40	20.41	95.2

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICSAB

File: LQC24A Mar 24, 2023 17:03

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	107389.78	107.4
CALCIUM	100000.00	104865.54	104.9
IRON	100000.00	99380.44	99.4
LEAD	20.02	20.40	100.0
MAGNESIUM	100000.00	101806.41	101.8
MOLYBDENUM	2000.00	2191.99	109.6
POTASSIUM	100000.00	99718.53	99.7
SODIUM	100000.00	102736.29	102.7

SAMPLE: ICSA

File: LQC24A Mar 24, 2023 18:11

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	108851.54	108.9
CALCIUM	100000.00	104615.12	104.6
IRON	100000.00	99903.75	99.9
LEAD	0.02	0.05	
MAGNESIUM	100000.00	102885.10	102.9
MOLYBDENUM	2000.00	2187.72	109.4
POTASSIUM	100000.00	100549.26	100.5
SODIUM	100000.00	103543.60	103.5

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICSA

File: LQC28E Mar 28, 2023 16:31

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	109818.77	109.8
CALCIUM	100000.00	105452.98	105.5
IRON	100000.00	98193.64	98.2
MAGNESIUM	100000.00	105545.44	105.5
MOLYBDENUM	2000.00	2237.00	111.9
POTASSIUM	100000.00	102270.05	102.3
SODIUM	100000.00	106470.40	106.5
ZINC	1.40	0.98	

SAMPLE: ICSAB

File: LQC28E Mar 28, 2023 16:36

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	109041.59	109.0
CALCIUM	100000.00	105049.96	105.1
IRON	100000.00	99444.93	99.4
MAGNESIUM	100000.00	105567.12	105.6
MOLYBDENUM	2000.00	2300.62	115.1
POTASSIUM	100000.00	102603.93	102.6
SODIUM	100000.00	105691.59	105.7
ZINC	21.40	24.56	119.0

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01P

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-005P

Concentration Units : mg/Kg drywt

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
ANTIMONY, TOTAL	6.45		0.080	J	10.36	61.5	N	72	124	MS
COPPER, TOTAL	27.2		1.18		25.91	100.3		84	119	MS
LEAD, TOTAL	17.4		7.84		10.36	92.6		84	118	MS
ZINC, TOTAL	53.5		4.11		51.82	95.4		82	119	MS

Comments:

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01S

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-005S

Concentration Units : mg/Kg drywt

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
ANTIMONY, TOTAL	4.68		0.080	J	8.18	56.3	N	72	124	MS
COPPER, TOTAL	21.5		1.18		20.45	99.4		84	119	MS
LEAD, TOTAL	15.9		7.84		8.18	98.9		84	118	MS
ZINC, TOTAL	43.5		4.11		40.89	96.4		82	119	MS

Comments:

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC1-DC-01S

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 52.5 **Lab Sample ID:** SQ1188-008S

Concentration Units : umole/g drywt

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
CADMIUM, SEM	0.0803		0.000512	J	0.08256	96.6		82	113	P
COPPER, SEM	0.165		0.0311		0.146	91.7		81	117	P
LEAD, SEM	0.0388		0.0249		0.0179	77.7	N	81	112	P
NICKEL, SEM	0.314		0.00165	J	0.3161	98.8		83	113	P
SILVER, SEM	0.0138		0.0013	U	0.01724	80.0	N	82	112	P
ZINC, SEM	0.299		0.0341		0.2839	93.3		82	113	P

Comments:

5B

POST DIGEST SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01A

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-005A

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
ANTIMONY, TOTAL	2.03		0.15	J	2	93.8		80	120	MS
COPPER, TOTAL	8.85		2.15		6	111.7		80	120	MS
LEAD, TOTAL	16.5		14.3		2	111.3		80	120	MS
ZINC, TOTAL	28.4		7.51		20	104.7		80	120	MS

Comments:

5B

POST DIGEST SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC1-DC-01A

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 52.5 **Lab Sample ID:** SQ1188-008A

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
CADMIUM, SEM	457		1.60	J	500	91.2		80	120	P
COPPER, SEM	517		54.9		500	92.4		80	120	P
LEAD, SEM	606		143		500	92.5		80	120	P
NICKEL, SEM	462		2.7	J	500	92.0		80	120	P
SILVER, SEM	461		0.27	U	500	92.2		80	120	P
ZINC, SEM	512		61.9		500	90.1		80	120	P

Comments:

5D

SPIKE DUPLICATES

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-005

Concentration Units : mg/Kg drywt

Analyte	Control Limits	Spike Result	C	Spike Dup. Result	C	RPD	Q	M
ANTIMONY, TOTAL		4.68		6.45		31.8	*	MS
COPPER, TOTAL		21.5		27.2		23.2	*	MS
LEAD, TOTAL		15.9		17.4		9.0		MS
ZINC, TOTAL		43.5		53.5		20.6	*	MS

Comments:

FORM VD - IN

DUPLICATES

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC1-DC-01D

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 52.5 **Lab Sample ID:** SQ1188-008D

Concentration Units : umole/g drywt

Analyte	Control Limits	Sample Result	C	Duplicate Result	C	RPD	Q	M
CADMIUM, SEM		0.000512	J	0.000480	J	6.5		P
COPPER, SEM		0.0311		0.0299		3.9		P
LEAD, SEM		0.0249		0.0255		2.4		P
NICKEL, SEM		0.00165	J	0.00173	J	4.7		P
SILVER, SEM		0.0013	U	0.0013	U			P
ZINC, SEM		0.0341		0.0338		0.9		P

Comments:

LABORATORY CONTROL SAMPLES

Lab Name: Katahdin Analytical Services **Sample ID:** LC2OQC14IMS2

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC14IMS2

Concentration Units : mg/Kg drywt

Analyte	TRUE	FOUND	% R	LIMITS (%)	
ANTIMONY	10.0	9.23	92.3	72	124
COPPER	25.0	27.1	108.5	84	119
LEAD	10.0	9.78	97.9	84	118
ZINC	50.0	52.0	103.9	82	119

LABORATORY CONTROL SAMPLES

Lab Name: Katahdin Analytical Services **Sample ID:** LCSOQC14IMS2

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC14IMS2

Concentration Units : mg/Kg drywt

Analyte	TRUE	FOUND	% R	LIMITS (%)	
ANTIMONY	10.0	9.08	90.8	72	124
COPPER	25.0	27.2	108.8	84	119
LEAD	10.0	9.84	98.5	84	118
ZINC	50.0	52.5	105.0	82	119

LABORATORY CONTROL SAMPLES

Lab Name: Katahdin Analytical Services **Sample ID:** LCSOQC16IMS1

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC16IMS1

Concentration Units : mg/Kg drywt

Analyte	TRUE	FOUND	% R	LIMITS (%)	
ANTIMONY	10.0	9.12	91.2	72	124
COPPER	25.0	27.0	107.9	84	119
LEAD	10.0	9.85	98.5	84	118
ZINC	50.0	51.3	102.6	82	119

LABORATORY CONTROL SAMPLES

Lab Name: Katahdin Analytical Services **Sample ID:** LCSOQC21ICS2

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC21ICS2

Concentration Units : umole/g drywt

Analyte	TRUE	FOUND	% R	LIMITS (%)	
CADMIUM	0.0445	0.0461	103.6	82	113
COPPER	0.0787	0.0825	104.8	81	117
LEAD	0.00965	0.0103	107.0	81	112
NICKEL	0.170	0.182	106.6	83	113
SILVER	0.00927	0.00961	104.0	82	112
ZINC	0.153	0.163	106.8	82	113

LABORATORY CONTROL SAMPLE DUPLICATES

Lab Name: Katahdin Analytical Services

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC14IMS2 **Lab Sample ID:** LCSOQC14IMS2

Concentration Units: mg/Kg drywt

Analyte	Control Limit (%)	LCS Result	LCS Dup. Result	RPD(%)	Q
ANTIMONY	20.0	9.08	9.23	1.6	
COPPER	20.0	27.2	27.1	0.3	
LEAD	20.0	9.84	9.78	0.6	
ZINC	20.0	52.5	52.0	1.0	

ICP SERIAL DILUTION

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01L

Matrix: SOIL **SDG Name:** SQ1188

Lab Sample ID: SQ1188-005L

Concentration Units: ug/L

Analyte	Sample Result	C	Dilution Result	C	% Difference	Q	M
ANTIMONY, TOTAL	0.15	J	0.20	U	100.0		MS
COPPER, TOTAL	2.15		2.1	J	2.3		MS
LEAD, TOTAL	14.3		15.4		7.7		MS
ZINC, TOTAL	7.51		6.3	J	16.1		MS

ICP SERIAL DILUTION

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC1-DC-01L

Matrix: SOIL **SDG Name:** SQ1188

Lab Sample ID: SQ1188-008L

Concentration Units: ug/L

Analyte	Sample Result	C	Dilution Result	C	% Difference	Q	M
CADMIUM, SEM	1.60	J	1.7	J	6.2		P
COPPER, SEM	54.9		57	J	3.8		P
LEAD, SEM	143		150		4.9		P
NICKEL, SEM	2.7	J	2.2	U	100.0		P
SILVER, SEM	0.27	U	1.4	U			P
ZINC, SEM	61.9		63	J	1.8		P

INSTRUMENT DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 01/23/2019

Concentration Units: ug/L

Analyte	PQL/LOQ	IDL	M
ALUMINUM	300	10	P
CADMIUM	5.0	0.092	P
CALCIUM	100	11	P
COPPER	25	0.55	P
IRON	100	3.6	P
LEAD	5.0	1.0	P
MAGNESIUM	100	2.9	P
MOLYBDENUM	10	0.41	P
NICKEL	10	0.44	P
POTASSIUM	1000	73	P
SILVER	10	0.53	P
SODIUM	1000	12	P
ZINC	20	0.45	P

INSTRUMENT DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 06/11/2018

Concentration Units: ug/L

Analyte	PQL/LOQ	IDL	M
ALUMINUM	20	0.33	MS
ANTIMONY	0.20	0.061	MS
CALCIUM	20	6.8	MS
COPPER	0.60	0.087	MS
IRON	20	6.4	MS
LEAD	0.20	0.0049	MS
MAGNESIUM	20	0.35	MS
MOLYBDENUM	1.0	0.020	MS
POTASSIUM	200	12	MS
SODIUM	200	6.6	MS
ZINC	2.0	0.22	MS

LIMITS of DETECTION

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 06/14/2010

Analyte	LOD	Units	M	EPA Prep./Anal. Method
CADMIUM	0.00053	umole/g	P	821/R-91-100 / SW846 6010C
COPPER	0.0031	umole/g	P	821/R-91-100 / SW846 6010C
LEAD	0.00039	umole/g	P	821/R-91-100 / SW846 6010C
NICKEL	0.0014	umole/g	P	821/R-91-100 / SW846 6010C
SILVER	0.00074	umole/g	P	821/R-91-100 / SW846 6010C
ZINC	0.0030	umole/g	P	821/R-91-100 / SW846 6010C

LIMITS of DETECTION

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 06/13/2010

Analyte	LOD	Units	M	EPA Prep./Anal. Method
ANTIMONY	0.010	mg/kg	MS	SW846 3050B / SW846 6020A
COPPER	0.040	mg/kg	MS	SW846 3050B / SW846 6020A
LEAD	0.010	mg/Kg	MS	SW846 3050B / SW846 6020A
ZINC	0.16	mg/kg	MS	SW846 3050B / SW846 6020A

METHOD DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 01/20/2011

Analyte	MDL	Units	M	EPA Prep./Anal. Method
CADMIUM	0.000014	umole/g	P	821/R-91-100 / SW846 6010C
COPPER	0.00050	umole/g	P	821/R-91-100 / SW846 6010C
LEAD	0.000084	umole/g	P	821/R-91-100 / SW846 6010C
NICKEL	0.00015	umole/g	P	821/R-91-100 / SW846 6010C
SILVER	0.000050	umole/g	P	821/R-91-100 / SW846 6010C
ZINC	0.00052	umole/g	P	821/R-91-100 / SW846 6010C

METHOD DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 01/26/2011

Analyte	MDL	Units	M	EPA Prep./Anal. Method
ANTIMONY	0.0040	mg/kg	MS	SW846 3050B / SW846 6020A
COPPER	0.014	mg/kg	MS	SW846 3050B / SW846 6020A
LEAD	0.0014	mg/kg	MS	SW846 3050B / SW846 6020A
ZINC	0.026	mg/kg	MS	SW846 3050B / SW846 6020A

ICP INTERELEMENT CORRECTION FACTORS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument Name: THERMO ICAP 6500 **Instrument ID:** I **Date:** 03/10/2021

	Wavelength	Interelement Correction Factors for:												
Analyte	**(nm)**	**Al**	**Ca**	**Fe**	**Mg**	**As**	**Cr**	**Co**	**Cu**	**Mn**	**Mo**	**Ni**	**Ti**	**V**
ALUMINUM	396.15	0.0	0.0006250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0293740	0.0	0.0	0.0
ANTIMONY	206.83	0.0000130	0.0	0.0000150	0.0	0.0000731	0.0160080	0.0	0.0	0.0	-0.0046490	-0.0008980	0.0	-0.0005030
ARSENIC	189.04	-0.0000090	0.0	-0.0001780	0.0	0.0	0.0001984	0.0	0.0	0.0	0.0015170	0.0	0.0	0.0
BARIUM	455.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERYLLIUM	313.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0006836	0.0001220
BORON	208.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0501700	0.0	0.0	0.0
CADMIUM	226.50	0.0	0.0	0.0000850	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0001140	0.0000801	0.0
CALCIUM	315.89	0.0	0.0	0.0	0.0	0.0	0.0026700	0.0008487	0.0	0.0	0.0	0.0	0.0	0.0
CHROMIUM	267.72	0.0	0.0	-0.0000010	0.0	0.0	0.0	0.0	0.0	0.0003640	0.0	0.0	0.0	-0.0000100
COBALT	228.62	0.0	0.0	0.0000050	0.0	0.0	0.0001670	0.0	0.0	0.0	0.0	0.0001562	0.0017840	0.0
COPPER	327.40	0.0000079	0.0	-0.0000147	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0006988	0.0004860
GOLD	242.79	0.0	0.0	0.0001110	0.0	0.0	0.0	0.0	0.0	0.0058700	0.0	0.0	0.0	0.0
IRON	259.94	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LEAD	220.35	-0.0001590	0.0	0.0000440	0.0	0.0001480	-0.0000772	-0.0000860	0.0004910	0.0	-0.0010840	0.0003270	-0.0000220	0.0
LITHIUM	670.78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAGNESIUM	202.58	0.0	0.0	0.0000300	0.0	0.0	0.0	0.1395100	0.0	0.0	0.0145280	0.0	0.0003530	0.0
MANGANESE	257.61	-0.0000050	0.0	0.0000100	0.0000391	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOLYBDENUM	202.03	0.0	0.0	0.0	0.0	0.0	0.0000270	0.0	0.0	-0.0000204	0.0	0.0	0.0	-0.0001163
NICKEL	231.60	0.0	0.0	-0.0000490	0.0	0.0	0.0	0.0000390	0.0	0.0	0.0034490	0.0	0.0	0.0
POTASSIUM	766.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SELENIUM	196.09	0.0000090	0.0	0.0000320	0.0	0.0003180	0.0	0.0002310	0.0	0.0006280	0.0	0.0	0.0	0.0003040
SILICON	251.61	0.0	0.0	-0.0000150	0.0	0.0	0.0	0.0	0.0	0.0	0.0132630	0.0	0.0105540	0.0
SILVER	328.07	0.0	0.0	-0.0002820	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0008413	0.0
SODIUM	589.59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STRONTIUM	421.55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THALLIUM	190.86	0.0000030	0.0	0.0000001	0.0	0.0	0.0	0.0023030	-0.0000680	-0.0024730	-0.0000880	0.0	-0.0009840	-0.0078940
TIN	189.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TITANIUM	334.90	0.0	0.0	0.0	0.0	0.0	0.0001510	0.0	0.0	0.0	0.0002130	0.0	0.0	0.0
VANADIUM	292.40	0.0	0.0	0.0000120	0.0	0.0	-0.0053650	0.0	0.0	-0.0001670	-0.0037960	0.0	0.0006990	0.0
ZINC	206.20	0.0	0.0	0.0	0.0	0.0	-0.0010444	0.0	0.0	0.0	0.0	0.0	0.0	0.0

FORM XI - IN

ICP LINEAR RANGES

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 08/11/2022

Concentration Units: ug/L

Analyte	Integration Time (sec)	Linear Range	M
ALUMINUM	5.00	500000	P
ANTIMONY	45.00	20000	P
CADMIUM	45.00	20000	P
CALCIUM	5.00	500000	P
COPPER	10.00	20000	P
IRON	5.00	250000	P
LEAD	45.00	20000	P
MAGNESIUM	45.00	200000	P
MOLYBDENUM	45.00	5000	P
NICKEL	10.00	20000	P
POTASSIUM	5.00	300000	P
SILVER	10.00	2000	P
SODIUM	5.00	200000	P
ZINC	45.00	20000	P

ICP LINEAR RANGES

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 10/06/2022

Concentration Units: ug/L

Analyte	Integration Time (sec)	Linear Range	M
ALUMINUM	0.30	200000	MS
ANTIMONY	0.10	1000	MS
CADMIUM	0.90	1000	MS
CALCIUM	0.30	200000	MS
COPPER	0.30	2000	MS
IRON	0.10	100000	MS
LEAD	0.10	2000	MS
MAGNESIUM	0.15	200000	MS
MOLYBDENUM	0.30	1000	MS
NICKEL	0.30	1000	MS
POTASSIUM	0.20	200000	MS
SILVER	0.30	100	MS
SODIUM	0.10	200000	MS
ZINC	0.30	2000	MS

PREPARATION LOG

Lab Name: Katahdin Analytical Services **QC Batch ID:** QC14IMS2

Matrix: SOIL **SDG Name:** SQ1188

Method: MS **Prep Date:** 03/14/2023

Client ID	Lab Sample ID	Initial (g)	Final (L)	Bottle ID
LC2OQC14IMS2	LC2OQC14IMS2	1	0.1	
LCSOQC14IMS2	LCSOQC14IMS2	1	0.1	
PBSQC14IMS2	PBSQC14IMS2	1	0.1	
JACKSON-SDCC3-DC-01	SQ1188-001	1.5	0.1	A
JACKSON-SDCC2-DC-01	SQ1188-003	1.91	0.1	A
JACKSON-SDMC3-DC-01	SQ1188-005	1.24	0.1	A
JACKSON-SDMC3-DC-01P	SQ1188-005P	1.31	0.1	A
JACKSON-SDMC3-DC-01S	SQ1188-005S	1.66	0.1	A
JACKSON-SDMC1-DC-01	SQ1188-007	1.05	0.1	A
JACKSON-SDCC4-DC-01	SQ1188-009	1.73	0.1	A
SDDUP	SQ1188-015	1.04	0.1	A

FORM XIII - IN

PREPARATION LOG

Lab Name: Katahdin Analytical Services **QC Batch ID:** QC16IMS1

Matrix: SOIL **SDG Name:** SQ1188

Method: MS **Prep Date:** 03/16/2023

Client ID	Lab Sample ID	Initial (g)	Final (L)	Bottle ID
LCSOQC16IMS1	LCSOQC16IMS1	1	0.1	
PBSQC16IMS1	PBSQC16IMS1	1	0.1	
JACKSON-SDJC1-DC-01	SQ1188-011	1.13	0.1	A
JACKSON-SDMC2-DC-01	SQ1188-013	1.12	0.1	A

PREPARATION LOG

Lab Name: Katahdin Analytical Services **QC Batch ID:** QC21ICS2

Matrix: SOIL **SDG Name:** SQ1188

Method: P **Prep Date:** 03/21/2023

Client ID	Lab Sample ID	Initial (g)	Final (L)	Bottle ID
LCSOQC21ICS2	LCSOQC21ICS2	10	0.2	
PBSQC21ICS2	PBSQC21ICS2	10	0.2	
JACKSON-SDCC3-DC-01	SQ1188-002	12.575	0.2	
JACKSON-SDCC2-DC-01	SQ1188-004	10.744	0.2	
JACKSON-SDMC3-DC-01	SQ1188-006	10.314	0.2	
JACKSON-SDMC1-DC-01	SQ1188-008	10.58	0.2	
JACKSON-SDMC1-DC-01D	SQ1188-008D	10.607	0.2	
JACKSON-SDMC1-DC-01S	SQ1188-008S	10.254	0.2	
JACKSON-SDCC4-DC-01	SQ1188-010	10.496	0.2	
JACKSON-SDJC1-DC-01	SQ1188-012	10.104	0.2	
JACKSON-SDMC2-DC-01	SQ1188-014	10.698	0.2	
SDDUP	SQ1188-016	10.61	0.2	

FORM XIII - IN

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: THERMO ICAP 6500 **File Name:** IQC24A

Date: 03/24/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements							
Blank		1	15:01	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
Std 1		1	15:06	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
ICV		1	15:10	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
ICB		1	15:14	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
PQL		1	15:18	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
ICSA		1	15:23	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
ICSAB		1	15:27	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
CCV		1	15:31	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
CCB		1	15:35	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
ZZZZZZ		1	15:40								
ZZZZZZ		1	15:44								
CCV		1	15:49	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
CCB		1	15:53	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
PBSQC21ICS2		1	15:58		CD	CU	PB		NI	AG	ZN
LCSOQC21ICS2		1	16:02		CD	CU	PB		NI	AG	ZN
SQ1188-002	JACKSON-SDCC3-DC-01	1	16:06		CD	CU	PB		NI	AG	ZN
SQ1188-004	JACKSON-SDCC2-DC-01	1	16:10		CD	CU	PB		NI	AG	ZN
SQ1188-006	JACKSON-SDMC3-DC-01	1	16:14		CD	CU	PB		NI	AG	ZN
SQ1188-008	JACKSON-SDMC1-DC-01	1	16:19		CD	CU	PB		NI	AG	ZN
SQ1188-008L	JACKSON-SDMC1-DC-01L	5	16:23		CD	CU	PB		NI	AG	ZN
SQ1188-008A	JACKSON-SDMC1-DC-01A	1	16:27		CD	CU	PB		NI	AG	ZN
SQ1188-008D	JACKSON-SDMC1-DC-01D	1	16:31		CD	CU	PB		NI	AG	ZN
SQ1188-008S	JACKSON-SDMC1-DC-01S	1	16:35		CD	CU	PB		NI	AG	ZN
CCV		1	16:39	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
CCB		1	16:44	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
SQ1188-010	JACKSON-SDCC4-DC-01	1	16:48		CD	CU	PB		NI	AG	ZN
SQ1188-012	JACKSON-SDJC1-DC-01	1	16:52		CD	CU	PB		NI	AG	ZN

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: THERMO ICAP 6500 **File Name:** IQC24A

Date: 03/24/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements							
SQ1188-014	JACKSON-SDMC2-DC-01	1	16:57		CD	CU	PB		NI	AG	ZN
SQ1188-016	SDDUP	1	17:01		CD	CU	PB		NI	AG	ZN
ZZZZZZ		2	17:05								
ZZZZZZ		2	17:09								
ZZZZZZ		2	17:13								
ZZZZZZ		2	17:18								
ZZZZZZ		1	17:22								
ZZZZZZ		1	17:26								
CCV		1	17:30	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
CCB		1	17:35	AL	CD CA	CU	FE PB	MG	NI	AG	ZN

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC21A

Date: 03/21/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements								
CalBlank		1	15:00	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
CalStd		1	15:05	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ICV		1	15:17	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ICB		1	15:26	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
PQL		1	15:31	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ICSA		1	15:36	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ICSAB		1	15:41	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ZZZZZZ		1	15:49											
ZZZZZZ		1	16:01											
ZZZZZZ		1	16:12											
ZZZZZZ		1	16:18											
CCV		1	16:23	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
CCB		1	16:33	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ZZZZZZ		5	16:38											
ZZZZZZ		5	16:43											
ZZZZZZ		10	16:51											
ZZZZZZ		50	16:56											
ZZZZZZ		10	17:01											
ZZZZZZ		10	17:07											
ZZZZZZ		10	17:12											
ZZZZZZ		5	17:17											
ZZZZZZ		5	17:22											
PBSQC14IMS2		5	17:27		Sb		Cu							Zn
CCV		1	17:32	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
CCB		1	17:41	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
LC2OQC14IMS2		5	17:46		Sb		Cu							Zn
LCSOQC14IMS2		5	17:54		Sb		Cu							Zn

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC21A

Date: 03/21/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements										
SQ1188-001	JACKSON-SDCC3-DC-01	5	18:02		Sb			Cu						Zn
SQ1188-003	JACKSON-SDCC2-DC-01	5	18:07		Sb			Cu						Zn
SQ1188-005	JACKSON-SDMC3-DC-01	5	18:12		Sb			Cu						Zn
SQ1188-005L	JACKSON-SDMC3-DC-01L	25	18:17		Sb			Cu						Zn
SQ1188-005A	JACKSON-SDMC3-DC-01A	5	18:22		Sb			Cu						Zn
SQ1188-005P	JACKSON-SDMC3-DC-01P	5	18:27		Sb			Cu						Zn
SQ1188-005S	JACKSON-SDMC3-DC-01S	5	18:35		Sb			Cu						Zn
SQ1188-007	JACKSON-SDMC1-DC-01	5	18:43		Sb			Cu						Zn
CCV		1	18:48	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
CCB		1	18:57	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
SQ1188-009	JACKSON-SDCC4-DC-01	5	19:02		Sb			Cu						Zn
SQ1188-015	SDDUP	5	19:07		Sb			Cu						Zn
ZZZZZZ		5	19:12											
ZZZZZZ		5	19:17											
ZZZZZZ		5	19:25											
ZZZZZZ		5	19:30											
ZZZZZZ		25	19:35											
ZZZZZZ		5	19:40											
ZZZZZZ		5	19:45											
ZZZZZZ		5	19:53											
CCV		1	20:01	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
CCB		1	20:11	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ZZZZZZ		5	20:16											
ZZZZZZ		5	20:21											
ZZZZZZ		5	20:26											
ZZZZZZ		5	20:31											
ZZZZZZ		5	20:37											

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC21A

Date: 03/21/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements
ZZZZZZ		5	20:42	
ZZZZZZ		5	20:47	
ZZZZZZ		5	20:52	
ZZZZZZ		5	20:57	
ZZZZZZ		5	21:02	
CCV		1	21:07	Al Sb Ca Cu Fe Pb Mg Mo K Na Zn
CCB		1	21:16	Al Sb Ca Cu Fe Pb Mg Mo K Na Zn
ZZZZZZ		5	21:21	
ZZZZZZ		5	21:26	
ZZZZZZ		5	21:31	
ZZZZZZ		5	21:37	
PBSQC16IMS1		5	21:42	Sb Cu Pb
LCSOQC16IMS1		5	21:47	Sb Cu Pb
SQ1188-011	JACKSON-SDJC1-DC-01	5	21:54	Sb Cu Pb
SQ1188-013	JACKSON-SDMC2-DC-01	5	21:59	Sb Cu Pb
ZZZZZZ		5	22:05	
ZZZZZZ		5	22:10	
CCV		1	22:17	Al Sb Ca Cu Fe Pb Mg Mo K Na Zn
CCB		1	22:27	Al Sb Ca Cu Fe Pb Mg Mo K Na Zn

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC24A

Date: 03/24/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
CalBlank		1	16:21	Al	Ca	Fe Pb	Mg	Mo	K	Na
CalStd		1	16:27	Al	Ca	Fe Pb	Mg	Mo	K	Na
ICV		1	16:38	Al	Ca	Fe Pb	Mg	Mo	K	Na
ICB		1	16:47	Al	Ca	Fe Pb	Mg	Mo	K	Na
ZZZZZZ		1	16:52							
ZZZZZZ		1	16:58							
ICSAB		1	17:03	Al	Ca	Fe Pb	Mg	Mo	K	Na
ZZZZZZ		1	17:12							
ZZZZZZ		1	17:23							
ZZZZZZ		1	17:35							
ZZZZZZ		1	17:40							
CCV		1	17:45	Al	Ca	Fe Pb	Mg	Mo	K	Na
CCB		1	17:56	Al	Ca	Fe Pb	Mg	Mo	K	Na
ZZZZZZ		1	18:01							
PQL		1	18:06	Al	Ca	Fe Pb	Mg	Mo	K	Na
ICSA		1	18:11	Al	Ca	Fe Pb	Mg	Mo	K	Na
ZZZZZZ		1	18:16							
CCV		1	18:21	Al	Ca	Fe Pb	Mg	Mo	K	Na
CCB		1	18:30	Al	Ca	Fe Pb	Mg	Mo	K	Na
ZZZZZZ		5	18:35							
ZZZZZZ		5	18:41							
ZZZZZZ		5	18:49							
ZZZZZZ		5	18:54							
ZZZZZZ		5	18:59							
ZZZZZZ		5	19:04							
ZZZZZZ		5	19:09							
ZZZZZZ		25	19:14							

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC24A

Date: 03/24/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
ZZZZZZ		5	19:19							
ZZZZZZ		5	19:25							
CCV		1	19:32	Al	Ca	Fe Pb	Mg	Mo	K	Na
CCB		1	19:42	Al	Ca	Fe Pb	Mg	Mo	K	Na
ZZZZZZ		5	19:47							
ZZZZZZ		5	19:55							
ZZZZZZ		5	20:00							
ZZZZZZ		5	20:05							
ZZZZZZ		5	20:10							
ZZZZZZ		5	20:15							
ZZZZZZ		5	20:21							
ZZZZZZ		5	20:26							
ZZZZZZ		5	20:31							
PBSQC14IMS2		5	20:36			Pb				
CCV		1	20:41	Al	Ca	Fe Pb	Mg	Mo	K	Na
CCB		1	20:51	Al	Ca	Fe Pb	Mg	Mo	K	Na
LC2OQC14IMS2		5	20:56			Pb				
LCSOQC14IMS2		5	21:03			Pb				
SQ1188-001	JACKSON-SDCC3-DC-01	5	21:11			Pb				
SQ1188-003	JACKSON-SDCC2-DC-01	5	21:16			Pb				
SQ1188-005	JACKSON-SDMC3-DC-01	5	21:22			Pb				
SQ1188-005L	JACKSON-SDMC3-DC-01L	25	21:27			Pb				
SQ1188-005A	JACKSON-SDMC3-DC-01A	5	21:32			Pb				
SQ1188-005P	JACKSON-SDMC3-DC-01P	5	21:37			Pb				
SQ1188-005S	JACKSON-SDMC3-DC-01S	5	21:45			Pb				
SQ1188-007	JACKSON-SDMC1-DC-01	5	21:53			Pb				
CCV		1	21:58	Al	Ca	Fe Pb	Mg	Mo	K	Na

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC24A

Date: 03/24/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
CCB		1	22:07	Al	Ca	Fe	Pb	Mg	Mo	K	Na
SQ1188-009	JACKSON-SDCC4-DC-01	5	22:12				Pb				
SQ1188-015	SDDUP	5	22:17				Pb				
ZZZZZZ		5	22:22								
ZZZZZZ		5	22:28								
ZZZZZZ		5	22:35								
ZZZZZZ		5	22:41								
ZZZZZZ		5	22:46								
ZZZZZZ		5	22:51								
ZZZZZZ		5	22:59								
ZZZZZZ		5	23:07								
CCV		1	23:12	Al	Ca	Fe	Pb	Mg	Mo	K	Na
CCB		1	23:21	Al	Ca	Fe	Pb	Mg	Mo	K	Na

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC28E

Date: 03/28/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
ZZZZZZ		1	15:39								
ZZZZZZ		1	15:44								
ZZZZZZ		1	15:49								
CalBlank		1	15:55	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CalStd		1	16:00	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICV		1	16:12	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICB		1	16:21	Al	Ca	Fe	Mg	Mo	K	Na	Zn
PQL		1	16:26	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSA		1	16:31	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSAB		1	16:36	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	16:45								
ZZZZZZ		1	16:57								
ZZZZZZ		1	17:04								
ZZZZZZ		1	17:09								
ZZZZZZ		1	17:14								
CCV		1	17:20	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	17:28	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	17:33								
ZZZZZZ		5	17:38								
ZZZZZZ		5	17:43								
PBSQC16IMS1		5	17:48								Zn
LCSOQC16IMS1		5	17:54								Zn
SQ1188-011	JACKSON-SDJC1-DC-01	5	18:01								Zn
SQ1188-013	JACKSON-SDMC2-DC-01	5	18:07								Zn
ZZZZZZ		5	18:12								
ZZZZZZ		5	18:17								
ZZZZZZ		5	18:25								

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC28E

Date: 03/28/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
CCV		1	18:30	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	18:39	Al	Ca	Fe	Mg	Mo	K	Na	Zn

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ANALYTICAL SERVICES

Report of Analytical Results

Lab Sample ID: SQ1188-1
Client ID: JACKSON-SDCC3-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 14:15	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	75. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:08	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-2
Client ID: JACKSON-SDCC3-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 14:15	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.10 umole/g	0.13	0.051	0.10	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	75. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:08	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-3
Client ID: JACKSON-SDCC2-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 10:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	23. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:09	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-4
Client ID: JACKSON-SDCC2-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 10:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.34 umole/g	0.44	0.17	0.34	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	23. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:09	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-5
Client ID: JACKSON-SDMC3-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 14:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	74. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:09	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-6
Client ID: JACKSON-SDMC3-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 14:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.10 umole/g	0.14	0.052	0.10	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	74. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:09	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-7
Client ID: JACKSON-SDMC1-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 11:50	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	52. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:09	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-8
Client ID: JACKSON-SDMC1-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 11:50	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.14 umole/g	0.19	0.072	0.14	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	M1
Total Solids	52. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:09	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-9
Client ID: JACKSON-SDCC4-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 09:40	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	80. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:10	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-10
Client ID: JACKSON-SDCC4-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 09:40	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.095 umole/g	0.12	0.047	0.095	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	80. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:10	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-11
Client ID: JACKSON-SDJC1-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 13:30	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	80. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:10	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-12
Client ID: JACKSON-SDJC1-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 13:30	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.095 umole/g	0.12	0.047	0.095	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	80. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:10	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-13
Client ID: JACKSON-SDMC2-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 11:30	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	84. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:10	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-14
Client ID: JACKSON-SDMC2-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 11:30	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.091 umole/g	0.12	0.045	0.091	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	84. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:10	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-15
Client ID: SDDUP
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 00:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	74. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:11	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-16
Client ID: SDDUP
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 00:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.10 umole/g	0.14	0.052	0.10	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	74. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:11	SW846 3540C	22-MAR-23	

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ANALYTICAL SERVICES

Quality Control Report

Blank Sample Summary Report

Acid Volatile Sulfide

QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	Units	LOQ	MDL	LOD
WG334165	EPA 821	21-MAR-23	21-MAR-23	U0.076	umole/g	0.10	0.038	0.076

Total Solids

QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	Units	LOQ	MDL	LOD
WG334193	SW846 3540C	24-MAR-23	22-MAR-23	100	%	1.0	1.0	1.0

Quality Control Report

Laboratory Control Sample Summary Report

Acid Volatile Sulfide

Laboratory Sample ID	Sample Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amount	Result	Recovery (%)	Acceptance Range	RPD
WG334165-2	LCS	WG334165	21-MAR-23	21-MAR-23	umole/g	17.355	19.	111	50-120	

Total Solids

Laboratory Sample ID	Sample Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amount	Result	Recovery (%)	Acceptance Range	RPD
WG334193-2	LCS	WG334193	24-MAR-23	22-MAR-23	%	90	90.	99	90-110	
WG334193-3	LCSD	WG334193	24-MAR-23	22-MAR-23	%	90	89.	99	90-110	0

Quality Control Report

Duplicate Sample Summary Report

Acid Volatile Sulfide

Duplicate Sample ID	Original Sample ID	QC Batch	Analysis Date	Units	Sample Result	Duplicate Result	RPD	RPD Limit
WG334165-3	SQ1188-8	WG334165	21-MAR-23	umole/g	U 0.14	U 0.14	NC	20

Quality Control Report

Matrix Spike Sample Summary Report

Acid Volatile Sulfide

Matrix Spike Sample ID	Sample Type	Original Sample ID	QC Batch	Analysis Date	Units	Spike Amount	Sample Result	MS Result	Recovery (%)	Acceptance Range	RPD
WG334165-4	MS	SQ1188-8	WG334165	21-MAR-23	umole/g	30.639	U 0.14	13.	42*	75 - 125	

EXPLOSIVES DATA

QC Summary Section

Form 2
System Monitoring Compound Recovery

Lab Name: Katahdin Analytical Services **SDG:** SQ1188 **Matrix:** SL

Client Sample ID	Lab Sample ID	Col. ID	DNB	#
JACKSON-SDCC3-DC-01	SQ1188-1	P	95.3	
JACKSON-SDCC2-DC-01	SQ1188-3	P	84.9	
JACKSON-SDMC3-DC-01	SQ1188-5	P	93.8	
JACKSON-SDMC1-DC-01	SQ1188-7	P	74.0	*
JACKSON-SDCC4-DC-01	SQ1188-9	P	98.9	
JACKSON-SDJC1-DC-01	SQ1188-11	P	107.	
JACKSON-SDMC2-DC-01	SQ1188-13	P	106.	
SDDUP	SQ1188-15	P	92.2	
Method Blank	WG333925-1	P	104.	
Laboratory Control S	WG333925-2	P	101.	
Matrix Spike	WG333925-3	P	103.	
Matrix Spike Duplica	WG333925-4	P	109.	

Abbr.	Surrogate Compound	QC Limits
DNB	1,2-Dinitrobenzene	78-119

= Column to be used to flag recovery limits.
* = Values outside of contract required QC limits.
D= System Monitoring Compound diluted out.

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Method Blank Summary

Lab Name : Katahdin Analytical Services
SDG : SQ1188
Lab File ID : HQC00152.D
Lab Sample ID : WG333925-1
Instrument ID : HPLC02
Date Extracted : 16-MAR-23
Matrix : SL
Date Analyzed : 23-MAR-23
Extraction method : SW846 8330B MOD
Time Analyzed : 08:27

This Method Blank applies to the following samples and QC samples:

Client Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
Laboratory Control S	WG333925-2	HQC00153.D	03/23/23	09:02
JACKSON-SDCC3-DC-01	SQ1188-1	HQC00154.D	03/23/23	09:37
JACKSON-SDCC2-DC-01	SQ1188-3	HQC00155.D	03/23/23	10:11
JACKSON-SDMC3-DC-01	SQ1188-5	HQC00156.D	03/23/23	10:46
Matrix Spike	WG333925-3	HQC00157.D	03/23/23	11:21
Matrix Spike Duplica	WG333925-4	HQC00158.D	03/23/23	11:55
JACKSON-SDMC1-DC-01	SQ1188-7	HQC00159.D	03/23/23	12:30
JACKSON-SDCC4-DC-01	SQ1188-9	HQC00160.D	03/23/23	13:05
JACKSON-SDJC1-DC-01	SQ1188-11	HQC00161.D	03/23/23	13:40
JACKSON-SDMC2-DC-01	SQ1188-13	HQC00162.D	03/23/23	14:14
SDDUP	SQ1188-15	HQC00163.D	03/23/23	14:49

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Form 8
Analytical Sequence

Lab Name: Katahdin Analytical Services **SDG:** SQ1188
Instrument ID: HPLC02 **Wavelength:** 210 um

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed	DNB	
Initial Calibration	WG333590-1	03/15/23	09:32		
Initial Calibration	WG333590-2	03/15/23	10:06		
Initial Calibration	WG333590-3	03/15/23	10:41		
Initial Calibration	WG333590-4	03/15/23	11:16		
Initial Calibration	WG333590-5	03/15/23	11:50		
Initial Calibration	WG333590-6	03/15/23	12:25		
Initial Calibration	WG333590-7	03/15/23	13:00		
Independent Source	WG333590-8	03/15/23	13:35		
Continuing Calibrati	WG334249-1	03/23/23	07:45		
Method Blank	WG333925-1	03/23/23	08:27		
Laboratory Control S	WG333925-2	03/23/23	09:02		
JACKSON-SDCC3-DC-01	SQ1188-1	03/23/23	09:37		
JACKSON-SDCC2-DC-01	SQ1188-3	03/23/23	10:11		
JACKSON-SDMC3-DC-01	SQ1188-5	03/23/23	10:46		
Matrix Spike	WG333925-3	03/23/23	11:21		
Matrix Spike Duplica	WG333925-4	03/23/23	11:55		
JACKSON-SDMC1-DC-01	SQ1188-7	03/23/23	12:30		
JACKSON-SDCC4-DC-01	SQ1188-9	03/23/23	13:05		
JACKSON-SDJC1-DC-01	SQ1188-11	03/23/23	13:40		
JACKSON-SDMC2-DC-01	SQ1188-13	03/23/23	14:14		
SDDUP	SQ1188-15	03/23/23	14:49		
Continuing Calibrati	WG334249-2	03/23/23	15:24		

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Form 8
Analytical Sequence

Lab Name: Katahdin Analytical Services **SDG:** SQ1188
Instrument ID: HPLC02 **Wavelength:** 254 um

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed	DNB	
Initial Calibration	WG333590-1	03/15/23	09:32	8.791	
Initial Calibration	WG333590-2	03/15/23	10:06	8.786	
Initial Calibration	WG333590-3	03/15/23	10:41	8.82	
Initial Calibration	WG333590-4	03/15/23	11:16	8.771	
Initial Calibration	WG333590-5	03/15/23	11:50	8.758	
Initial Calibration	WG333590-6	03/15/23	12:25	8.738	
Initial Calibration	WG333590-7	03/15/23	13:00	8.722	
Independent Source	WG333590-8	03/15/23	13:35		
Continuing Calibrati	WG334249-1	03/23/23	07:45	8.754	
Method Blank	WG333925-1	03/23/23	08:27	8.71	
Laboratory Control S	WG333925-2	03/23/23	09:02	8.701	
JACKSON-SDCC3-DC-01	SQ1188-1	03/23/23	09:37	8.741	
JACKSON-SDCC2-DC-01	SQ1188-3	03/23/23	10:11	8.712	
JACKSON-SDMC3-DC-01	SQ1188-5	03/23/23	10:46	8.747	
Matrix Spike	WG333925-3	03/23/23	11:21	8.755	
Matrix Spike Duplica	WG333925-4	03/23/23	11:55	8.702	
JACKSON-SDMC1-DC-01	SQ1188-7	03/23/23	12:30	8.726	
JACKSON-SDCC4-DC-01	SQ1188-9	03/23/23	13:05	8.785	
JACKSON-SDJC1-DC-01	SQ1188-11	03/23/23	13:40	8.679	
JACKSON-SDMC2-DC-01	SQ1188-13	03/23/23	14:14	8.685	
SDDUP	SQ1188-15	03/23/23	14:49	8.767	
Continuing Calibrati	WG334249-2	03/23/23	15:24	8.665	

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Sample Data Section

KATAHDIN ANALYTICAL SERVICES - ORGANIC DATA QUALIFIERS

U Indicates the compound was analyzed for but not detected above the specified level. This level may be the Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client.

Note: All results reported as "U" MDL have a 50% rate for false negatives compared to those results reported as "U" PQL, "U" LOQ or "U" LOD, where the rate of false negatives is <1%.

* Compound recovery or percent RPD (relative percent difference) was outside of quality control limits.

D Indicates the result was obtained from analysis of a diluted sample. Surrogate recoveries may not be calculable.

E Estimated value. This flag identifies compounds whose concentrations exceed the upper level of the calibration range of the instrument for that specific analysis.

J Estimated value. The analyte was detected in the sample at a concentration less than the laboratory Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), but above the Method Detection Limit (MDL).

And/or

J Used for Dual Column analytes when there is a greater than 40% difference for detected concentrations between the two GC/HPLC columns.

B Indicates the analyte was detected in the laboratory method blank analyzed concurrently with the sample.

I Indicates that the flagged compound did not meet DoD criteria in the corresponding Initial Calibration (ICAL).

D Indicates that the flagged compound did not meet DoD criteria in the corresponding Initial Calibration Verification (ICV).

C Indicates that the flagged compound did not meet DoD criteria in the corresponding opening Calibration Verification (CV).

V Indicates that the flagged compound did not meet DoD criteria in the corresponding closing Calibration Verification (CV).

L/LL Indicates that the flagged compound did not meet DoD criteria in the corresponding Laboratory Control Sample (LCS) and/or Laboratory Control Sample Duplicate (LCSD) prepared and/or analyzed concurrently with the sample.

M/MM Indicates that the flagged compound did not meet DoD criteria in the Matrix Spike (MS) and/or Matrix Spike Duplicate MSD) prepared and/or analyzed concurrently with the native sample.

H Indicates the flagged compound was detected on the primary column but was not detected on the confirmation column therefore the compound is not reported as a positive detection. (SW846 8330A/B only)

Katahdin Analytical Services, Inc.

Manual Integration Codes For GC/MS, GC, HPLC and/or IC

M1	Peak splitting.
M2	Well defined peaks on the shoulders of the other peaks.
M3	There is additional area due to a coeluting interferant.
M4	There are negative spikes in the baseline.
M5	There are rising or falling baselines.
M6	The software has failed to detect a peak or misidentified a peak.
M7	Excessive peak tailing.
M8	Analysis such as GRO, DRO and TPH require a baseline hold.
M9	Peak was not completely integrated as in GC/MS.
M10	Primary ion was correctly integrated, but secondary or tertiary ion needed manual integration as in GC/MS.
M11	For GC analysis, when a sample is diluted by 1:10 or more, the surrogate is set to undetected and then the area under the surrogate is manually integrated.
M12	Manual integration saved in method due to TurboChrom floating point error.

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ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-1
Client ID: JACKSON-SDCC3-DC-01
Matrix: SL
Lab File ID: HQC00154.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 75.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	57	ug/Kgdrywt	1	100	110	9.8	57.
RDX	U	57	ug/Kgdrywt	1	100	110	7.7	57.
1,3,5-Trinitrobenzene	U	57	ug/Kgdrywt	1	100	110	7.6	57.
1,3-Dinitrobenzene	U	57	ug/Kgdrywt	1	100	110	7.1	57.
Tetryl	UL	57	ug/Kgdrywt	1	100	110	6.2	57.
Nitrobenzene	U	57	ug/Kgdrywt	1	100	110	25.	57.
2,4,6-Trinitrotoluene	U	57	ug/Kgdrywt	1	100	110	7.6	57.
2-Am-DNT	U	57	ug/Kgdrywt	1	100	110	24.	57.
4-Am-DNT	U	57	ug/Kgdrywt	1	100	110	19.	57.
2,6-Dinitrotoluene	U	57	ug/Kgdrywt	1	100	110	31.	57.
2,4-Dinitrotoluene	U	57	ug/Kgdrywt	1	100	110	17.	57.
2-Nitrotoluene	U	57	ug/Kgdrywt	1	100	110	14.	57.
3-Nitrotoluene	U	57	ug/Kgdrywt	1	100	110	9.0	57.
4-Nitrotoluene	U	57	ug/Kgdrywt	1	100	110	31.	57.
Nitroglycerin	U	460	ug/Kgdrywt	1	800	910	140	460
1,2-Dinitrobenzene		95.3	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00154.D
Report Date: 27-Mar-2023 11:56

Katahdin Analytical Services

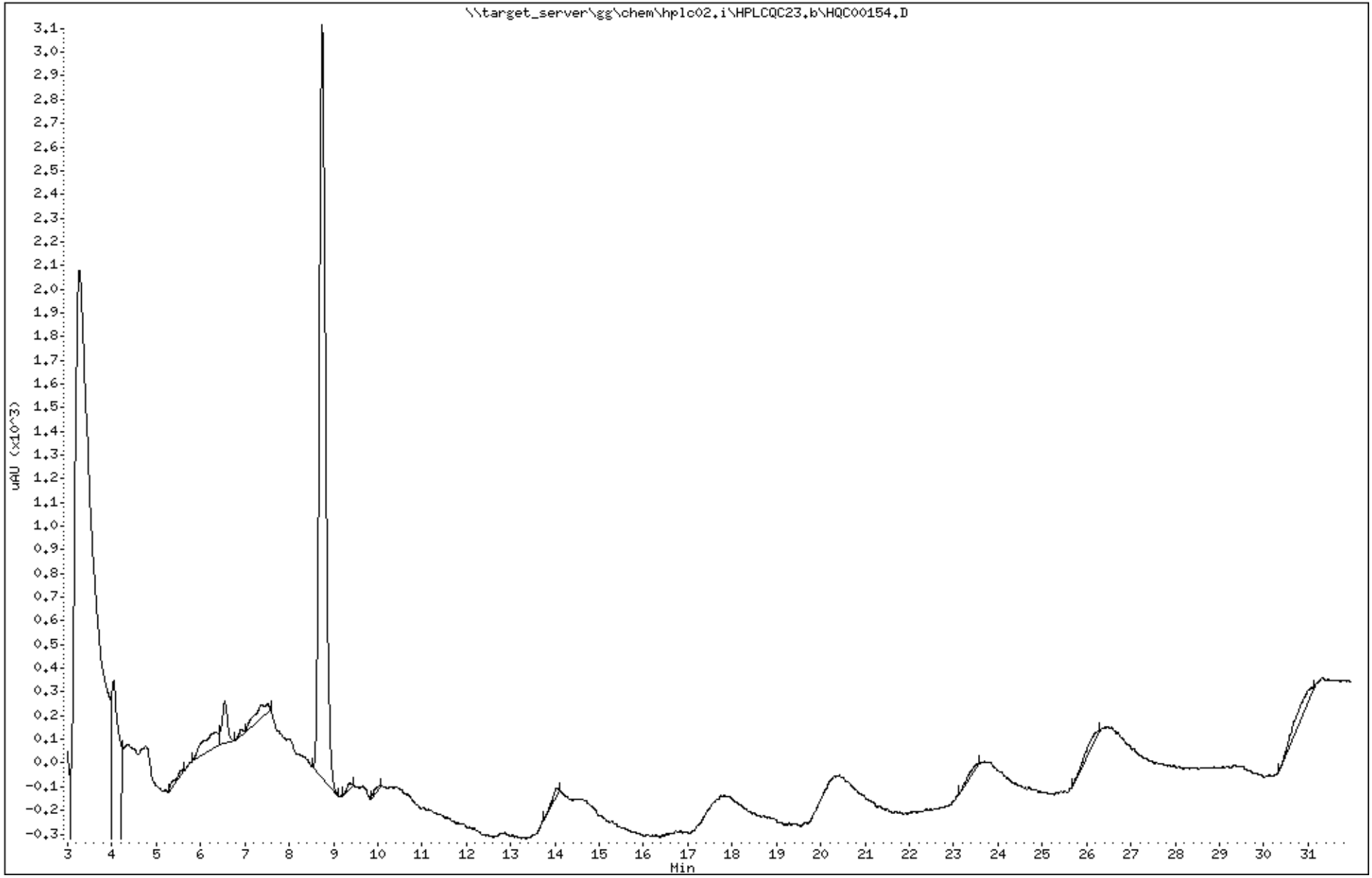
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00154.D
Lab Smp Id: SQ1188-1 Client Smp ID: JACKSON-SDCC3-DC-01
Inj Date : 23-MAR-2023 09:37
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-1
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01170	Weight of Sample (Kg)
M	24.994	% Moisture
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00154.D
Date : 23-MAR-2023 09:37
Client ID: JACKSON-SDCC3-DC-01
Instrument: hplc02.i
Sample Info: SQ1188-1
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1188 Page 158 of 654

Data File: HQC00154.D
Report Date: 27-Mar-2023 11:50

Katahdin Analytical Services

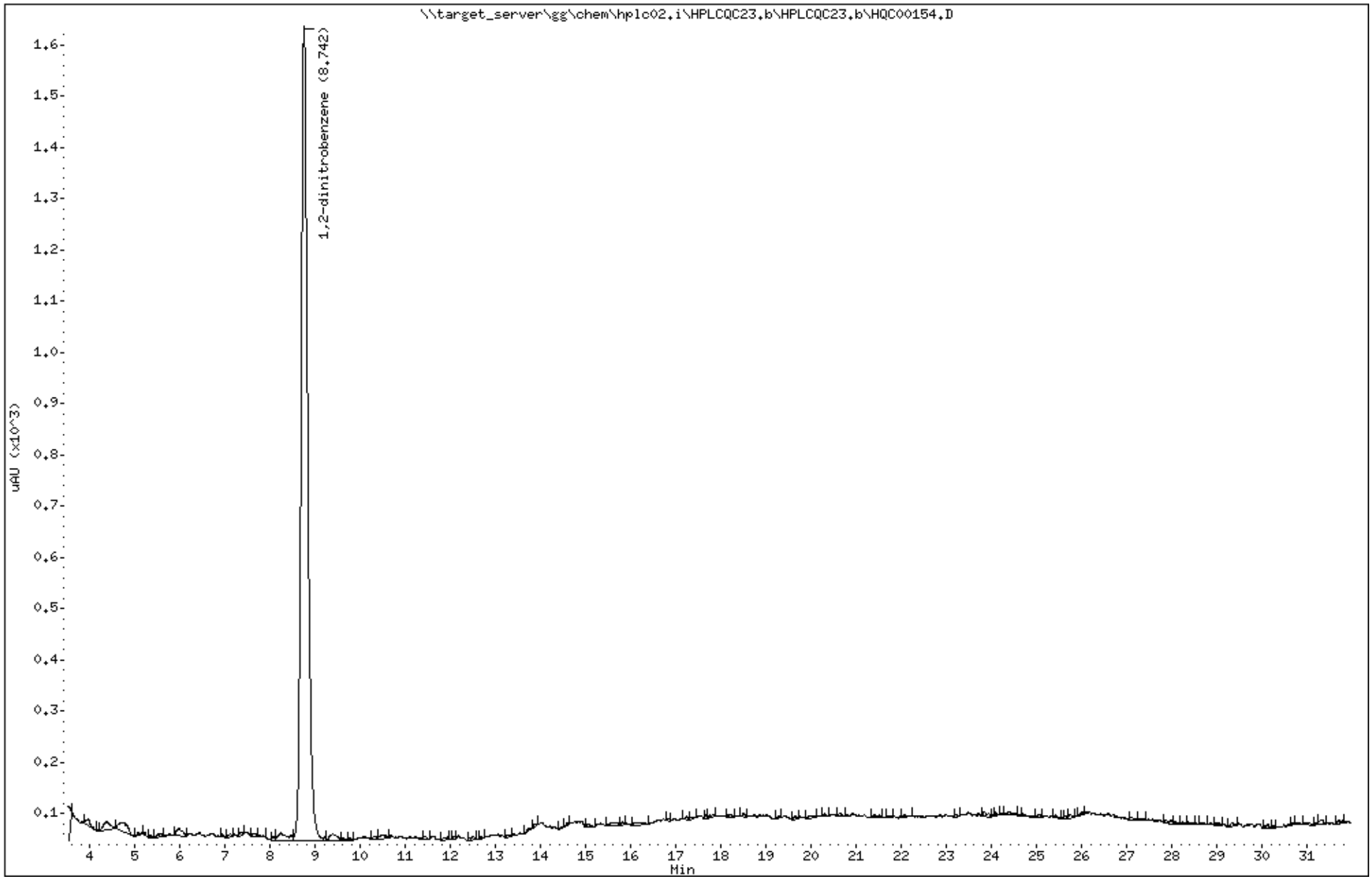
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00154.D
Lab Smp Id: SQ1188-1 Client Smp ID: JACKSON-SDCC3-DC-01
Inj Date : 23-MAR-2023 09:37
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-1
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01170	Weight of Sample (Kg)
M	24.994	% Moisture
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/Kgdrywt)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.741	8.754	-0.013	1590	0.23809	543	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00154.D
Date : 23-MAR-2023 09:37
Client ID: JACKSON-SDCC3-DC-01
Instrument: hplc02.i
Sample Info: SQ1188-1
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-3
Client ID: JACKSON-SDCC2-DC-01
Matrix: SL
Lab File ID: HQC00155.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 23.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	220	ug/Kgdrywt	1	100	440	38.	220
RDX	U	220	ug/Kgdrywt	1	100	440	30.	220
1,3,5-Trinitrobenzene	U	220	ug/Kgdrywt	1	100	440	29.	220
1,3-Dinitrobenzene	U	220	ug/Kgdrywt	1	100	440	27.	220
Tetryl	UL	220	ug/Kgdrywt	1	100	440	24.	220
Nitrobenzene	U	220	ug/Kgdrywt	1	100	440	96.	220
2,4,6-Trinitrotoluene	U	220	ug/Kgdrywt	1	100	440	29.	220
2-Am-DNT	U	220	ug/Kgdrywt	1	100	440	92.	220
4-Am-DNT	U	220	ug/Kgdrywt	1	100	440	74.	220
2,6-Dinitrotoluene	U	220	ug/Kgdrywt	1	100	440	120	220
2,4-Dinitrotoluene	U	220	ug/Kgdrywt	1	100	440	66.	220
2-Nitrotoluene	U	220	ug/Kgdrywt	1	100	440	52.	220
3-Nitrotoluene	U	220	ug/Kgdrywt	1	100	440	34.	220
4-Nitrotoluene	U	220	ug/Kgdrywt	1	100	440	120	220
Nitroglycerin	U	1700	ug/Kgdrywt	1	800	3500	540	1700
1,2-Dinitrobenzene		84.9	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00155.D
Report Date: 27-Mar-2023 11:56

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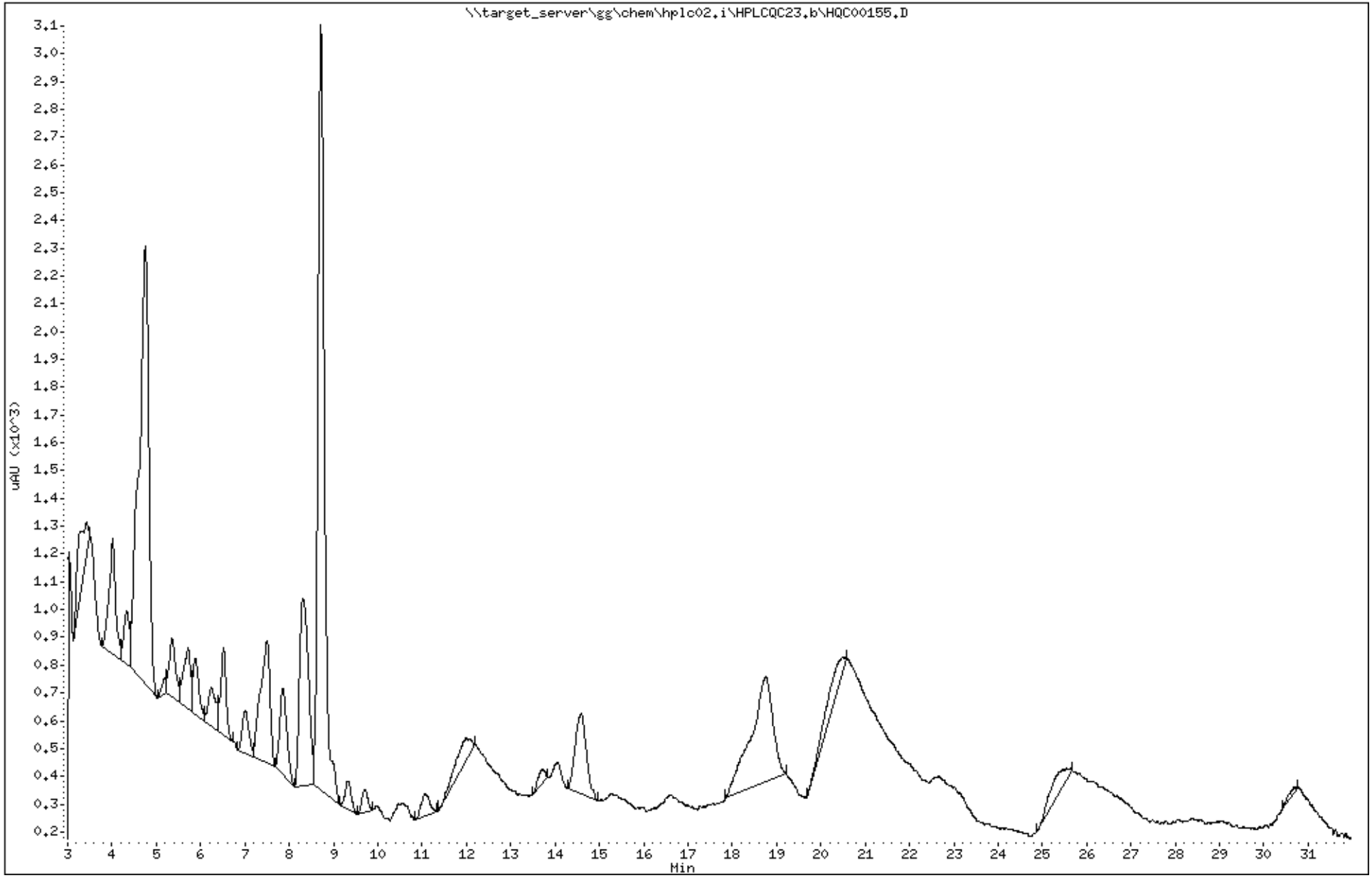
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00155.D
Lab Smp Id: SQ1188-3 Client Smp ID: JACKSON-SDCC2-DC-01
Inj Date : 23-MAR-2023 10:11
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-3
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01010	Weight of Sample (Kg)
M	77.331	% Moisture
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00155.D
Date : 23-MAR-2023 10:11
Client ID: JACKSON-SDCC2-DC-01
Instrument: hplc02.i
Sample Info: SQ1188-3
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1188 Page 163 of 654

Data File: HQC00155.D
Report Date: 27-Mar-2023 11:50

Katahdin Analytical Services

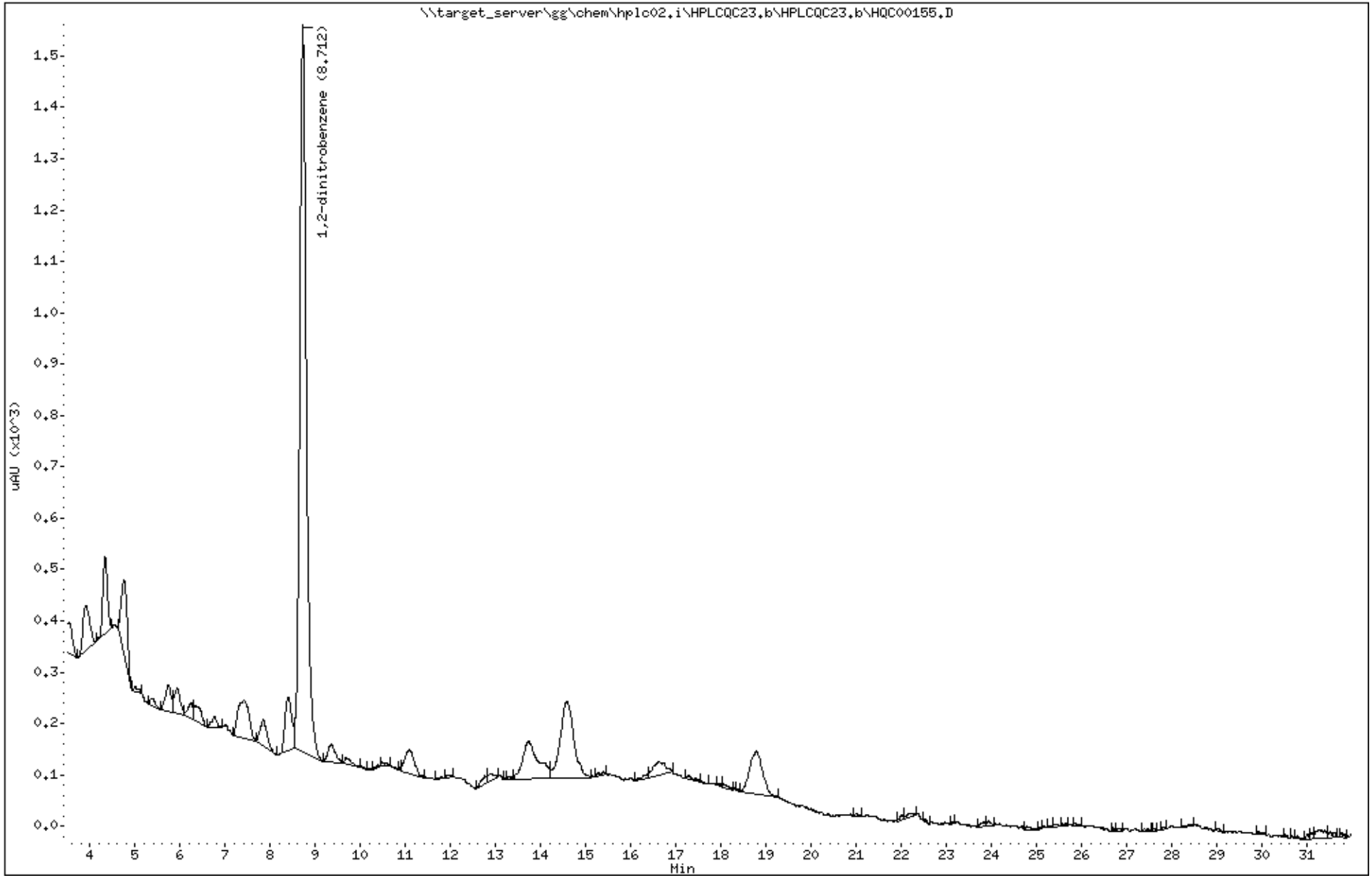
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00155.D
Lab Smp Id: SQ1188-3 Client Smp ID: JACKSON-SDCC2-DC-01
Inj Date : 23-MAR-2023 10:11
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-3
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01010	Weight of Sample (Kg)
M	77.331	% Moisture
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/Kgdrywt)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.712	8.754	-0.042	1416	0.21204	1850	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00155.D
Date : 23-MAR-2023 10:11
Client ID: JACKSON-SDCC2-DC-01
Instrument: hplc02.i
Sample Info: SQ1188-3
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-5
Client ID: JACKSON-SDMC3-DC-01
Matrix: SL
Lab File ID: HQC00156.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 74.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	65	ug/Kgdrywt	1	100	130	11.	65.
RDX	U	65	ug/Kgdrywt	1	100	130	8.8	65.
1,3,5-Trinitrobenzene	U	65	ug/Kgdrywt	1	100	130	8.7	65.
1,3-Dinitrobenzene	U	65	ug/Kgdrywt	1	100	130	8.0	65.
Tetryl	UL	65	ug/Kgdrywt	1	100	130	7.0	65.
Nitrobenzene	U	65	ug/Kgdrywt	1	100	130	28.	65.
2,4,6-Trinitrotoluene	U	65	ug/Kgdrywt	1	100	130	8.7	65.
2-Am-DNT	U	65	ug/Kgdrywt	1	100	130	27.	65.
4-Am-DNT	U	65	ug/Kgdrywt	1	100	130	22.	65.
2,6-Dinitrotoluene	U	65	ug/Kgdrywt	1	100	130	35.	65.
2,4-Dinitrotoluene	U	65	ug/Kgdrywt	1	100	130	19.	65.
2-Nitrotoluene	U	65	ug/Kgdrywt	1	100	130	16.	65.
3-Nitrotoluene	U	65	ug/Kgdrywt	1	100	130	10.	65.
4-Nitrotoluene	U	65	ug/Kgdrywt	1	100	130	35.	65.
Nitroglycerin	U	520	ug/Kgdrywt	1	800	1000	160	520
1,2-Dinitrobenzene		93.8	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00156.D
Report Date: 27-Mar-2023 11:56

Katahdin Analytical Services

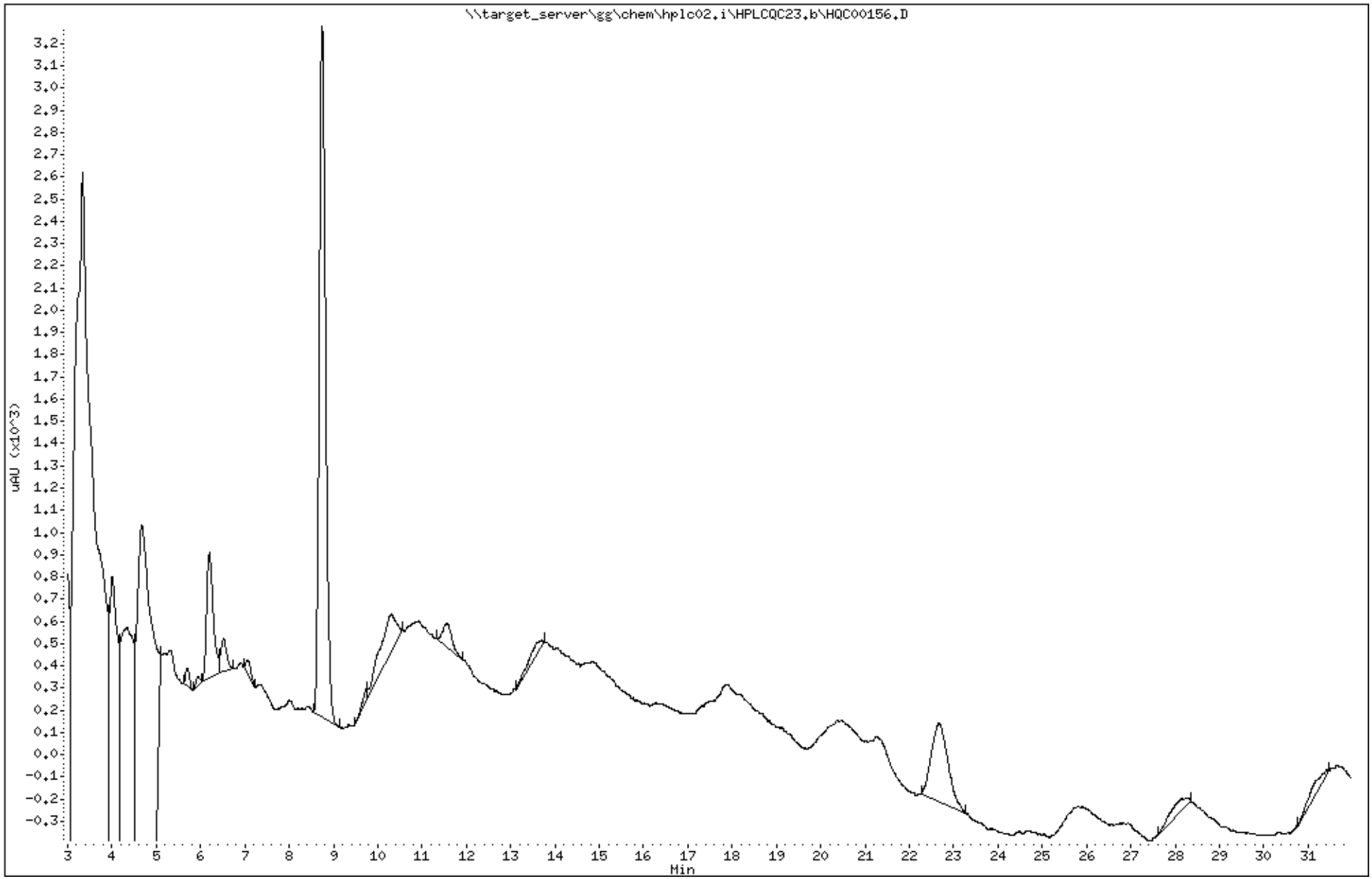
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00156.D
Lab Smp Id: SQ1188-5 Client Smp ID: JACKSON-SDMC3-DC-01
Inj Date : 23-MAR-2023 10:46
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-5
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01050	Weight of Sample (Kg)
M	26.342	% Moisture
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00156.D
Date : 23-MAR-2023 10:46
Client ID: JACKSON-SDMC3-DC-01
Instrument: hplc02.i
Sample Info: SQ1188-5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1188 Page 168 of 654

Data File: HQC00156.D
Report Date: 27-Mar-2023 11:50

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00156.D
Lab Smp Id: SQ1188-5 Client Smp ID: JACKSON-SDMC3-DC-01
Inj Date : 23-MAR-2023 10:46
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-5
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01050	Weight of Sample (Kg)
M	26.342	% Moisture
Cpnd Variable		Local Compound Variable

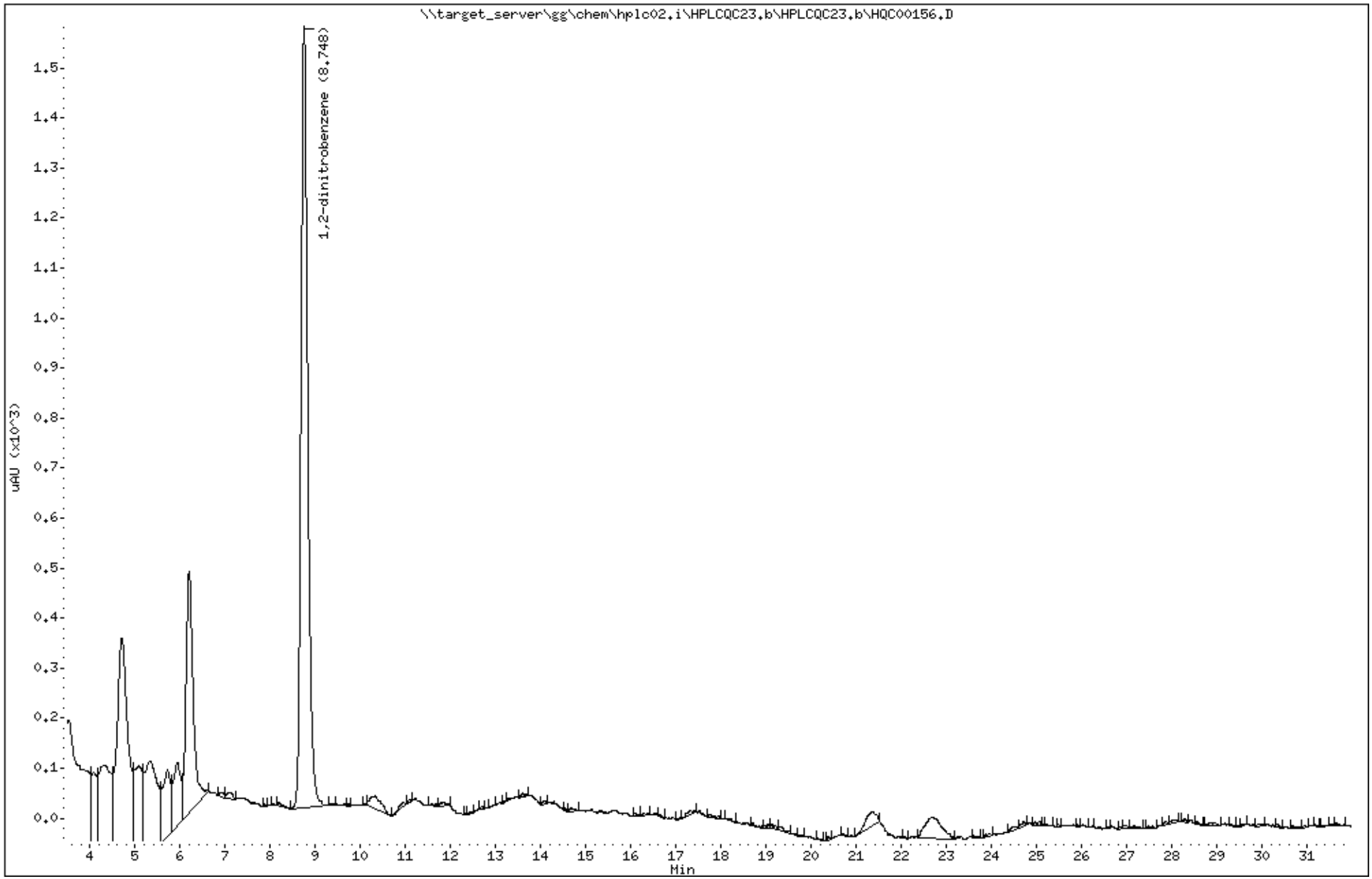
					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/Kgdrywt)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.747	8.754	-0.007	1564	0.23420	606	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00156.D
Date : 23-MAR-2023 10:46
Client ID: JACKSON-SDMC3-DC-01
Sample Info: SQ1188-5

Instrument: hplc02.i

Operator: EP
Column diameter: 4.60

Column phase: Phenomenex Kinetex



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Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-7
Client ID: JACKSON-SDMC1-DC-01
Matrix: SL
Lab File ID: HQC00159.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 52.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	83	ug/Kgdrywt	1	100	170	14.	83.
RDX	U	83	ug/Kgdrywt	1	100	170	11.	83.
1,3,5-Trinitrobenzene	U	83	ug/Kgdrywt	1	100	170	11.	83.
1,3-Dinitrobenzene	U	83	ug/Kgdrywt	1	100	170	10.	83.
Tetryl	UL	83	ug/Kgdrywt	1	100	170	9.0	83.
Nitrobenzene	U	83	ug/Kgdrywt	1	100	170	37.	83.
2,4,6-Trinitrotoluene	U	83	ug/Kgdrywt	1	100	170	11.	83.
2-Am-DNT	U	83	ug/Kgdrywt	1	100	170	35.	83.
4-Am-DNT	U	83	ug/Kgdrywt	1	100	170	28.	83.
2,6-Dinitrotoluene	U	83	ug/Kgdrywt	1	100	170	45.	83.
2,4-Dinitrotoluene	U	83	ug/Kgdrywt	1	100	170	25.	83.
2-Nitrotoluene	U	83	ug/Kgdrywt	1	100	170	20.	83.
3-Nitrotoluene	U	83	ug/Kgdrywt	1	100	170	13.	83.
4-Nitrotoluene	U	83	ug/Kgdrywt	1	100	170	45.	83.
Nitroglycerin	U	670	ug/Kgdrywt	1	800	1300	210	670
1,2-Dinitrobenzene	*	74.0	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00159.D
Report Date: 27-Mar-2023 11:56

Katahdin Analytical Services

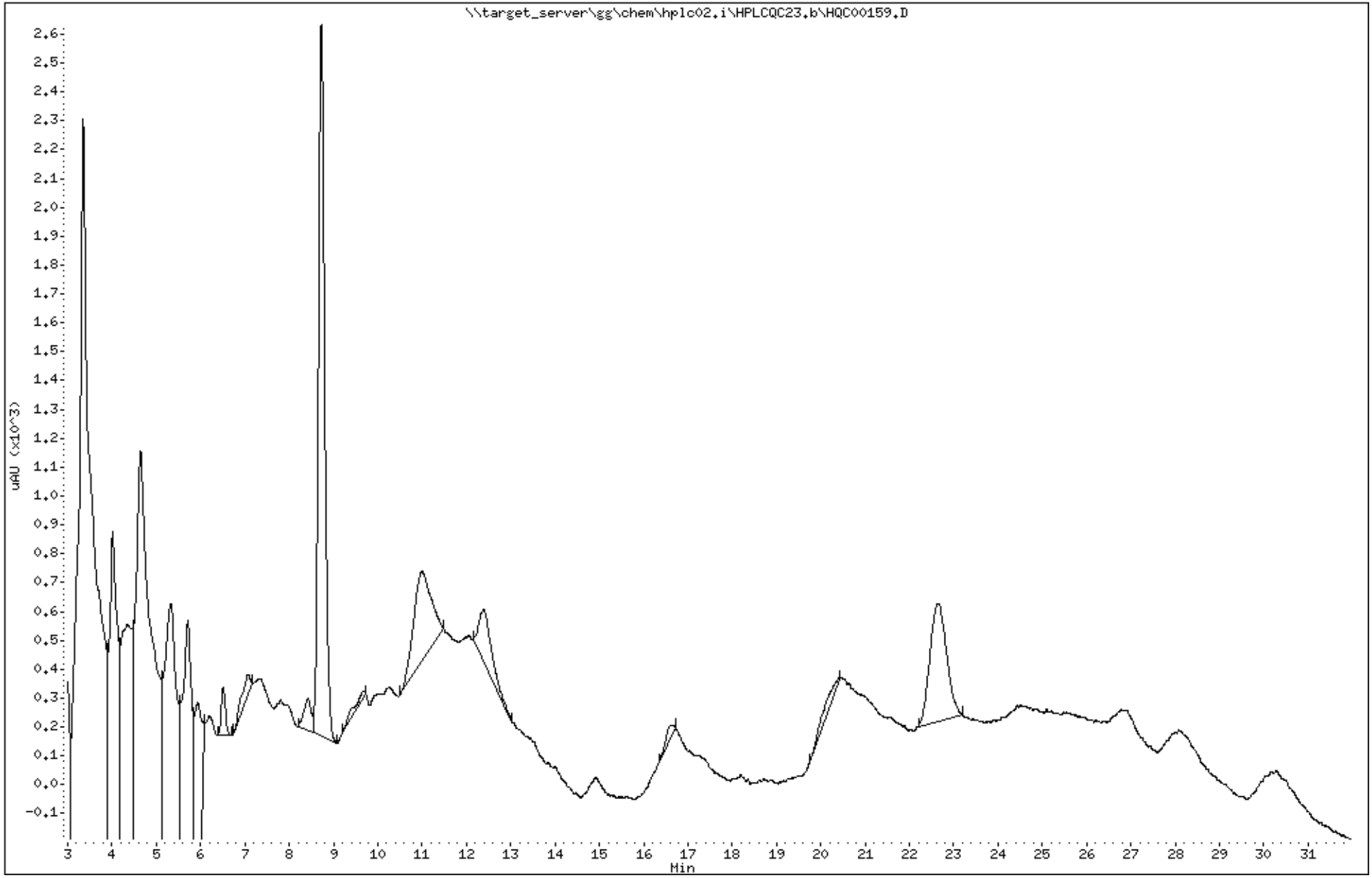
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00159.D
Lab Smp Id: SQ1188-7 Client Smp ID: JACKSON-SDMC1-DC-01
Inj Date : 23-MAR-2023 12:30
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-7
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01140	Weight of Sample (Kg)
M	47.455	% Moisture
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00159.D
Date : 23-MAR-2023 12:30
Client ID: JACKSON-SDMC1-DC-01
Instrument: hplc02.i
Sample Info: SQ1188-7
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Data File: HQC00159.D
Report Date: 27-Mar-2023 11:50

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00159.D
Lab Smp Id: SQ1188-7 Client Smp ID: JACKSON-SDMC1-DC-01
Inj Date : 23-MAR-2023 12:30
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-7
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

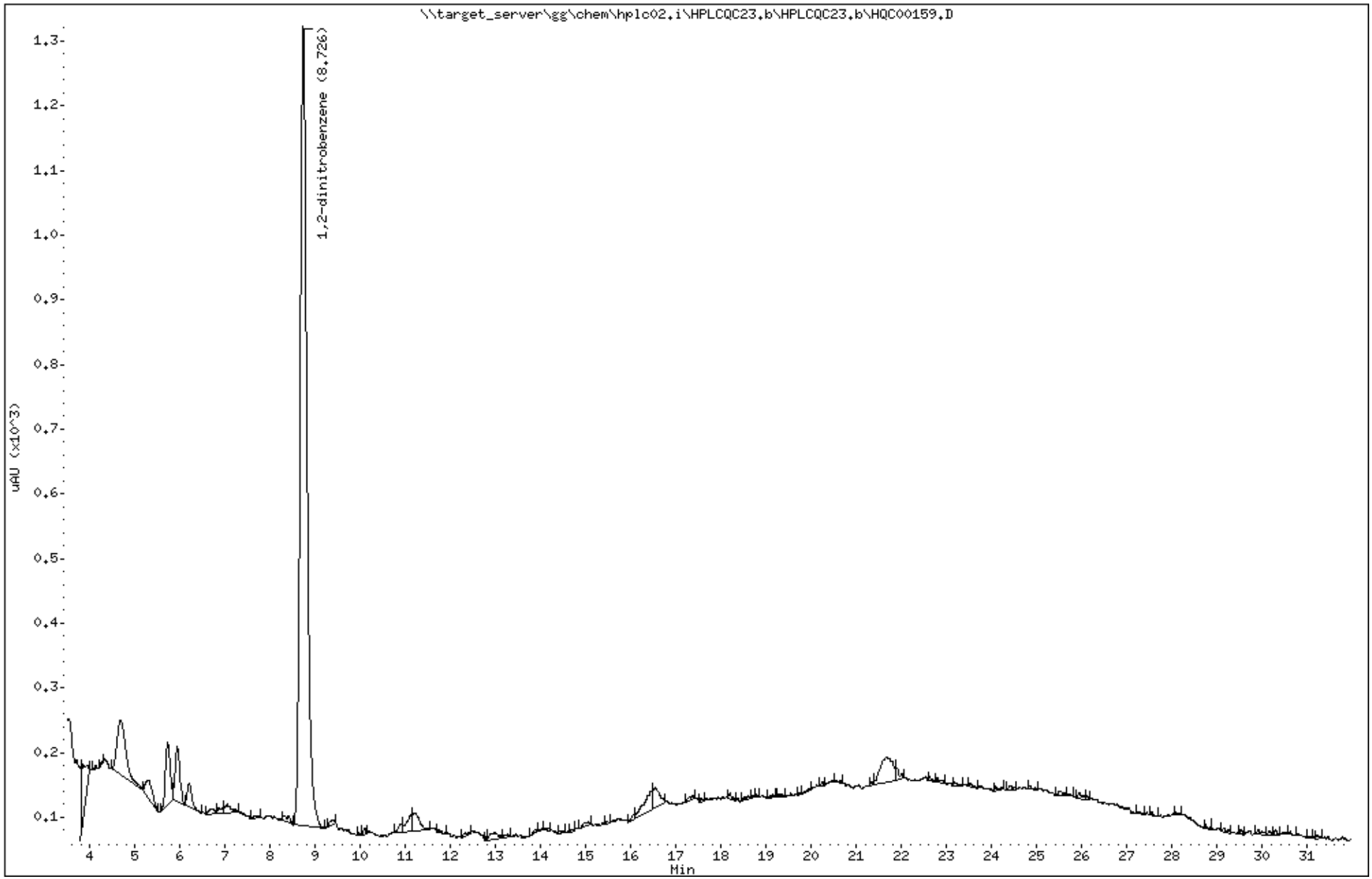
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01140	Weight of Sample (Kg)
M	47.455	% Moisture
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/Kgdrywt)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.726	8.754	-0.028	1236	0.18508	618(R)	

QC Flag Legend

R - Spike/Surrogate failed recovery limits.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00159.D
Date : 23-MAR-2023 12:30
Client ID: JACKSON-SDMC1-DC-01
Instrument: hplc02.i
Sample Info: SQ1188-7
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-9
Client ID: JACKSON-SDCC4-DC-01
Matrix: SL
Lab File ID: HQC00160.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 80.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	55	ug/Kgdrywt	1	100	110	9.5	55.
RDX	U	55	ug/Kgdrywt	1	100	110	7.5	55.
1,3,5-Trinitrobenzene	U	55	ug/Kgdrywt	1	100	110	7.4	55.
1,3-Dinitrobenzene	U	55	ug/Kgdrywt	1	100	110	6.8	55.
Tetryl	UL	55	ug/Kgdrywt	1	100	110	6.0	55.
Nitrobenzene	U	55	ug/Kgdrywt	1	100	110	24.	55.
2,4,6-Trinitrotoluene	U	55	ug/Kgdrywt	1	100	110	7.4	55.
2-Am-DNT	U	55	ug/Kgdrywt	1	100	110	23.	55.
4-Am-DNT	U	55	ug/Kgdrywt	1	100	110	19.	55.
2,6-Dinitrotoluene	U	55	ug/Kgdrywt	1	100	110	30.	55.
2,4-Dinitrotoluene	U	55	ug/Kgdrywt	1	100	110	16.	55.
2-Nitrotoluene	U	55	ug/Kgdrywt	1	100	110	13.	55.
3-Nitrotoluene	U	55	ug/Kgdrywt	1	100	110	8.7	55.
4-Nitrotoluene	U	55	ug/Kgdrywt	1	100	110	30.	55.
Nitroglycerin	U	440	ug/Kgdrywt	1	800	880	140	440
1,2-Dinitrobenzene		98.9	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00160.D
Report Date: 27-Mar-2023 11:56

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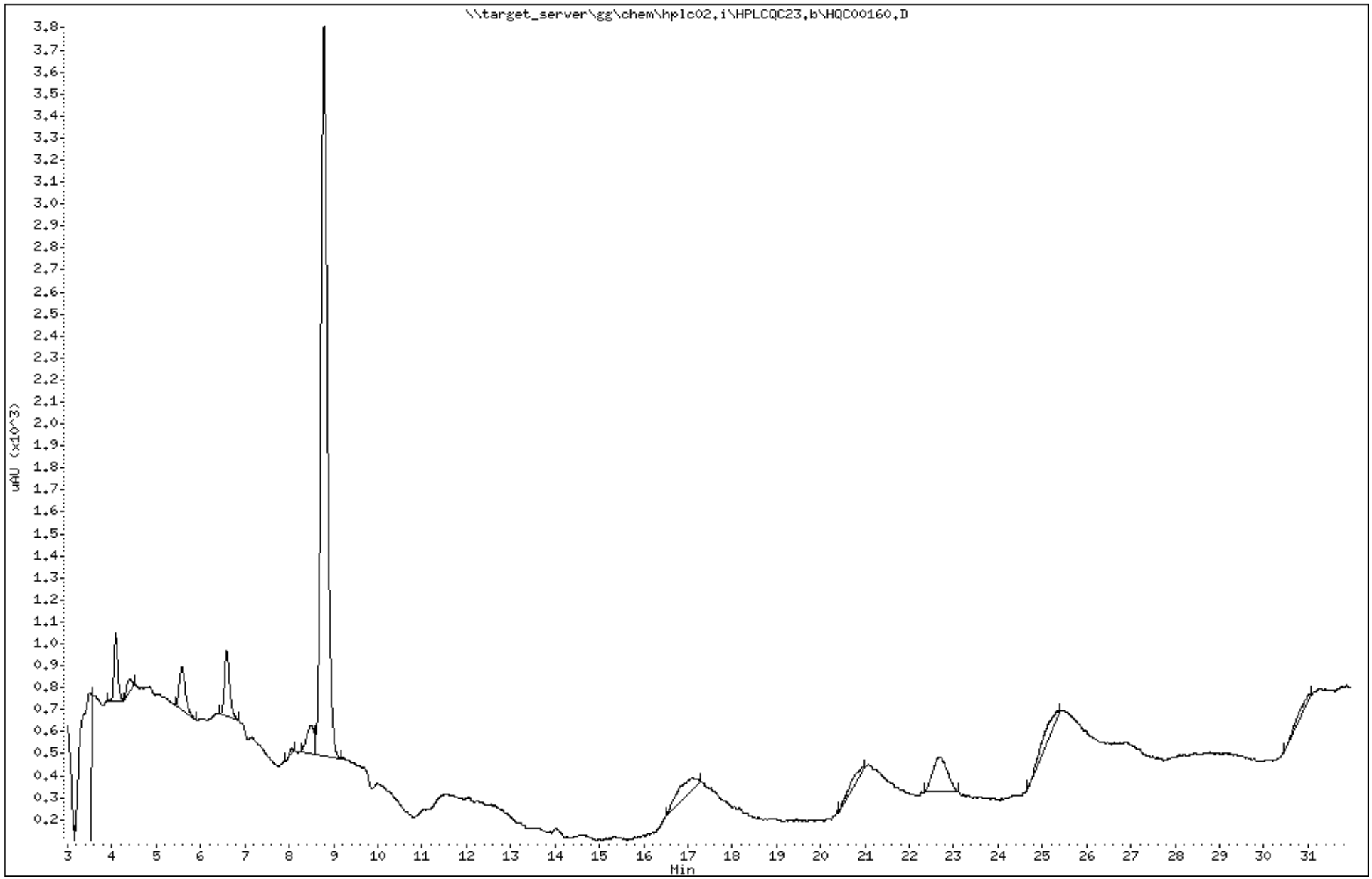
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00160.D
Lab Smp Id: SQ1188-9 Client Smp ID: JACKSON-SDCC4-DC-01
Inj Date : 23-MAR-2023 13:05
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-9
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01130	Weight of Sample (Kg)
M	19.730	% Moisture
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00160.D
Date : 23-MAR-2023 13:05
Client ID: JACKSON-SDCC4-DC-01
Instrument: hplc02.i
Sample Info: SQ1188-9
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Report Date: 27-Mar-2023 11:50

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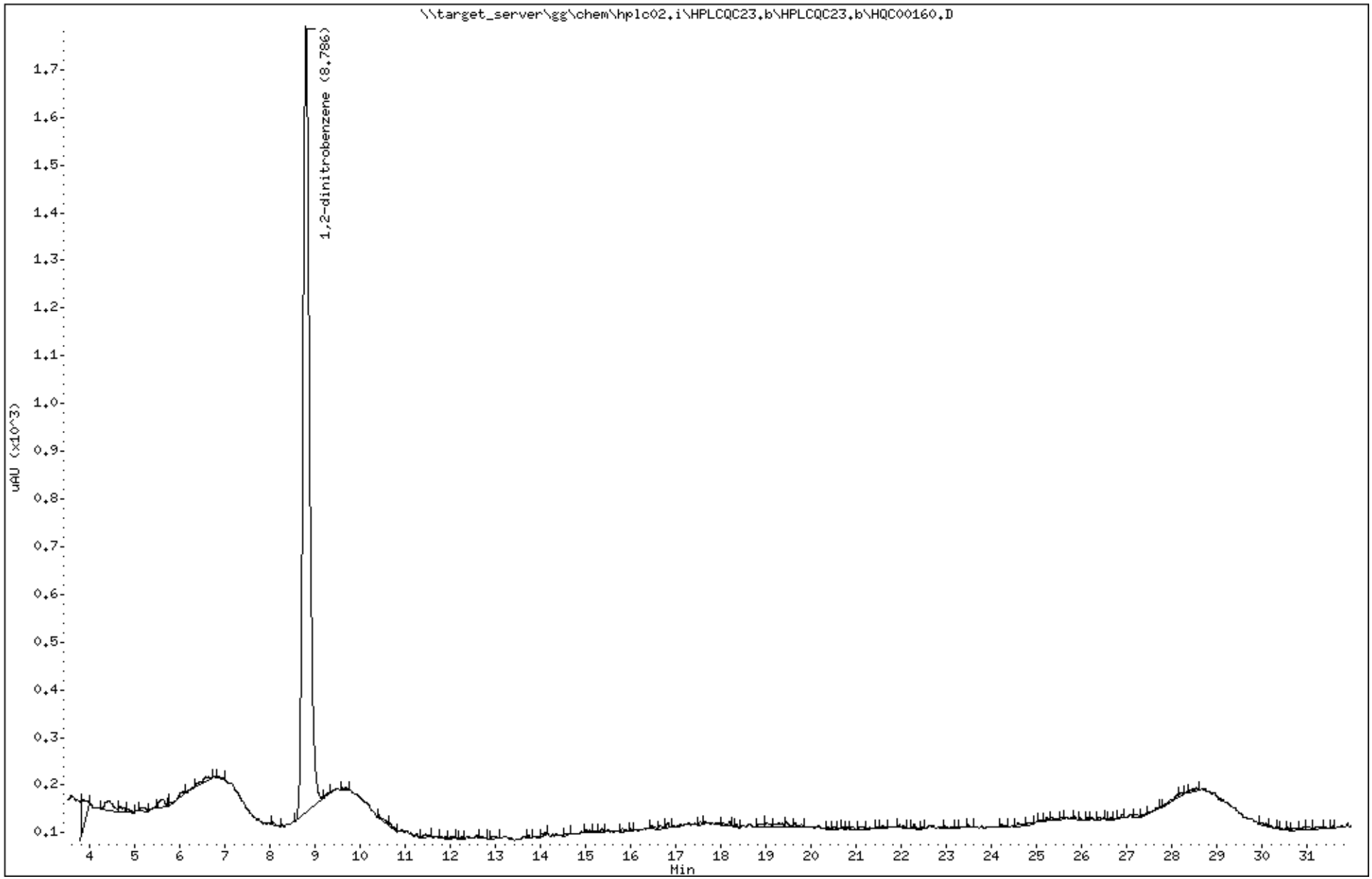
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00160.D
Lab Smp Id: SQ1188-9 Client Smp ID: JACKSON-SDCC4-DC-01
Inj Date : 23-MAR-2023 13:05
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-9
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01130	Weight of Sample (Kg)
M	19.730	% Moisture
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/Kgdrywt)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.785	8.754	0.031	1650	0.24708	545	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00160.D
Date : 23-MAR-2023 13:05
Client ID: JACKSON-SDCC4-DC-01
Instrument: hplc02.i
Sample Info: SQ1188-9
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-11
Client ID: JACKSON-SDJC1-DC-01
Matrix: SL
Lab File ID: HQC00161.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 80.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	57	ug/Kgdrywt	1	100	110	9.8	57.
RDX	U	57	ug/Kgdrywt	1	100	110	7.8	57.
1,3,5-Trinitrobenzene	U	57	ug/Kgdrywt	1	100	110	7.7	57.
1,3-Dinitrobenzene	U	57	ug/Kgdrywt	1	100	110	7.1	57.
Tetryl	UL	57	ug/Kgdrywt	1	100	110	6.2	57.
Nitrobenzene	U	57	ug/Kgdrywt	1	100	110	25.	57.
2,4,6-Trinitrotoluene	U	57	ug/Kgdrywt	1	100	110	7.7	57.
2-Am-DNT	U	57	ug/Kgdrywt	1	100	110	24.	57.
4-Am-DNT	U	57	ug/Kgdrywt	1	100	110	19.	57.
2,6-Dinitrotoluene	U	57	ug/Kgdrywt	1	100	110	31.	57.
2,4-Dinitrotoluene	U	57	ug/Kgdrywt	1	100	110	17.	57.
2-Nitrotoluene	U	57	ug/Kgdrywt	1	100	110	14.	57.
3-Nitrotoluene	U	57	ug/Kgdrywt	1	100	110	9.0	57.
4-Nitrotoluene	U	57	ug/Kgdrywt	1	100	110	31.	57.
Nitroglycerin	U	460	ug/Kgdrywt	1	800	920	140	460
1,2-Dinitrobenzene		107.	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00161.D
Report Date: 27-Mar-2023 11:56

Katahdin Analytical Services

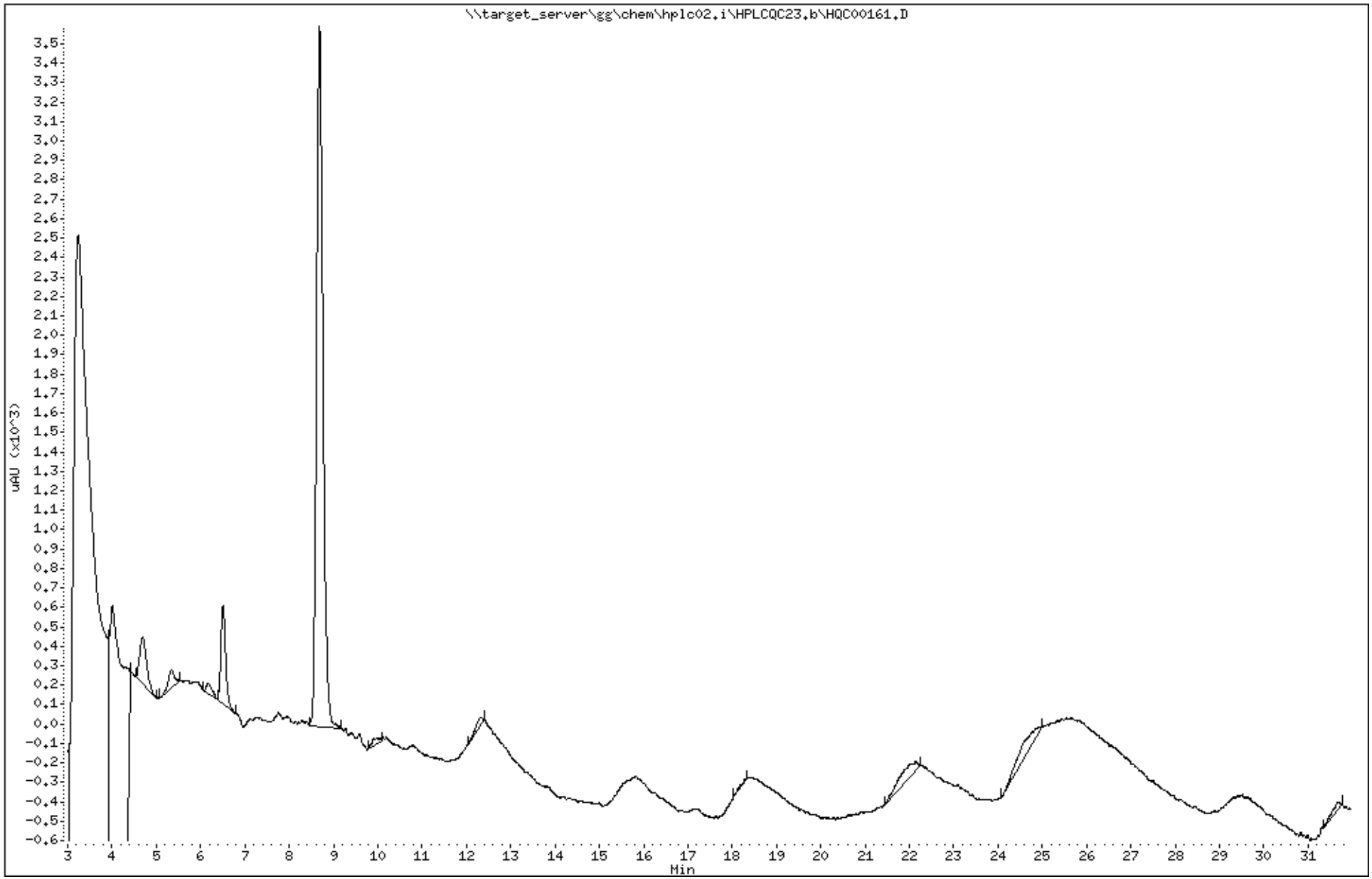
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00161.D
Lab Smp Id: SQ1188-11 Client Smp ID: JACKSON-SDJC1-DC-01
Inj Date : 23-MAR-2023 13:40
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-11
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01090	Weight of Sample (Kg)
M	19.879	% Moisture
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00161.D
Date : 23-MAR-2023 13:40
Client ID: JACKSON-SDJC1-DC-01
Instrument: hplc02.i
Sample Info: SQ1188-11
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: HQC00161.D
Report Date: 27-Mar-2023 11:50

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00161.D
Lab Smp Id: SQ1188-11 Client Smp ID: JACKSON-SDJC1-DC-01
Inj Date : 23-MAR-2023 13:40
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-11
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01090	Weight of Sample (Kg)
M	19.879	% Moisture
Cpnd Variable		Local Compound Variable

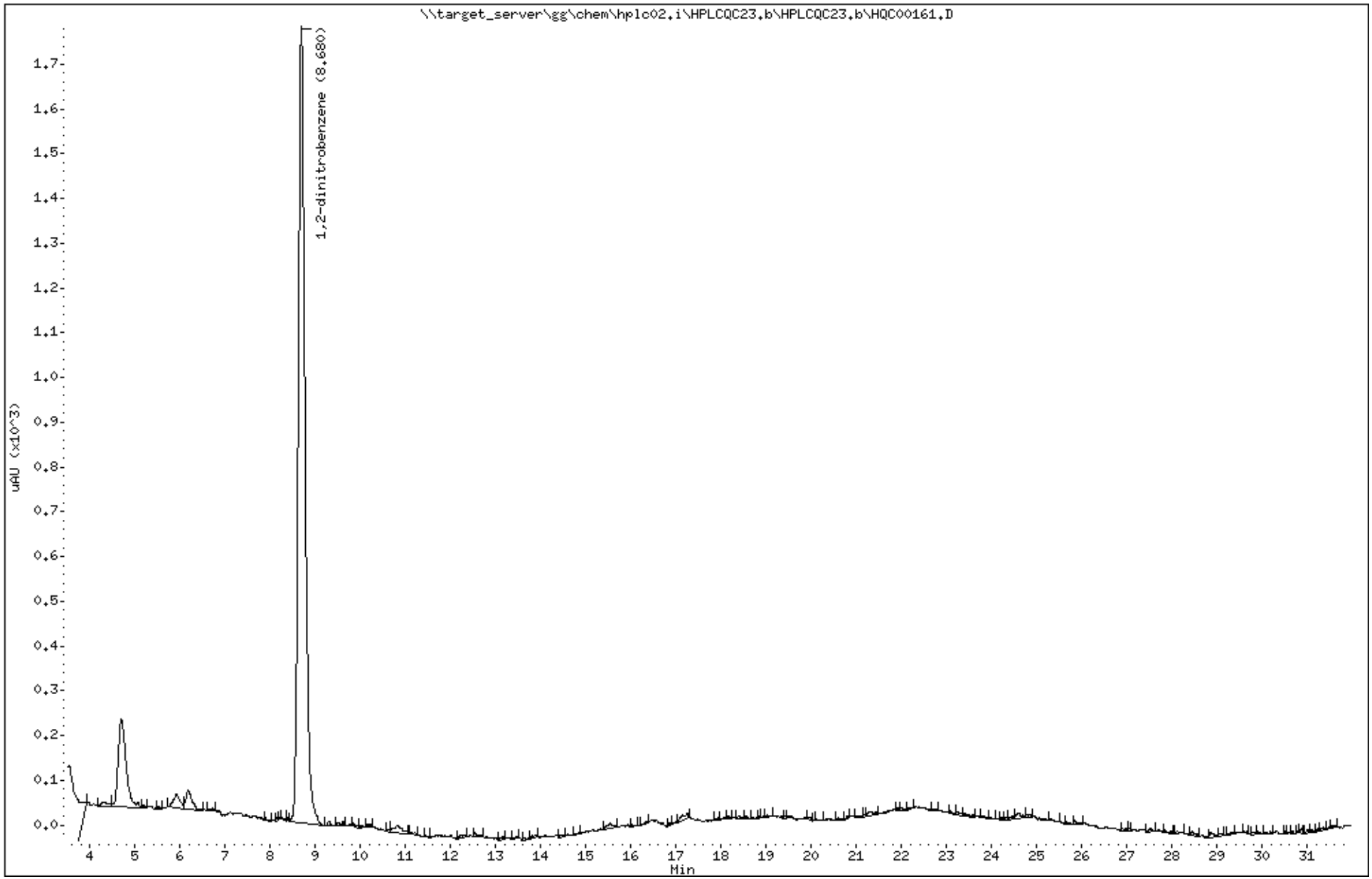
						CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE
$	2 1,2-dinitrobenzene	8.679	8.754	-0.075	1780	0.26654	610	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00161.D
Date : 23-MAR-2023 13:40
Client ID: JACKSON-SDJC1-DC-01
Sample Info: SQ1188-11

Instrument: hplc02.i

Operator: EP
Column diameter: 4.60

Column phase: Phenomenex Kinetex



Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-13
Client ID: JACKSON-SDMC2-DC-01
Matrix: SL
Lab File ID: HQC00162.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 84.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	56	ug/Kgdrywt	1	100	110	9.7	56.
RDX	U	56	ug/Kgdrywt	1	100	110	7.7	56.
1,3,5-Trinitrobenzene	U	56	ug/Kgdrywt	1	100	110	7.6	56.
1,3-Dinitrobenzene	U	56	ug/Kgdrywt	1	100	110	7.0	56.
Tetryl	UL	56	ug/Kgdrywt	1	100	110	6.1	56.
Nitrobenzene	U	56	ug/Kgdrywt	1	100	110	25.	56.
2,4,6-Trinitrotoluene	U	56	ug/Kgdrywt	1	100	110	7.6	56.
2-Am-DNT	U	56	ug/Kgdrywt	1	100	110	24.	56.
4-Am-DNT	U	56	ug/Kgdrywt	1	100	110	19.	56.
2,6-Dinitrotoluene	U	56	ug/Kgdrywt	1	100	110	30.	56.
2,4-Dinitrotoluene	U	56	ug/Kgdrywt	1	100	110	17.	56.
2-Nitrotoluene	U	56	ug/Kgdrywt	1	100	110	14.	56.
3-Nitrotoluene	U	56	ug/Kgdrywt	1	100	110	8.9	56.
4-Nitrotoluene	U	56	ug/Kgdrywt	1	100	110	30.	56.
Nitroglycerin	U	450	ug/Kgdrywt	1	800	900	140	450
1,2-Dinitrobenzene		106.	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00162.D
Report Date: 27-Mar-2023 11:56

Katahdin Analytical Services

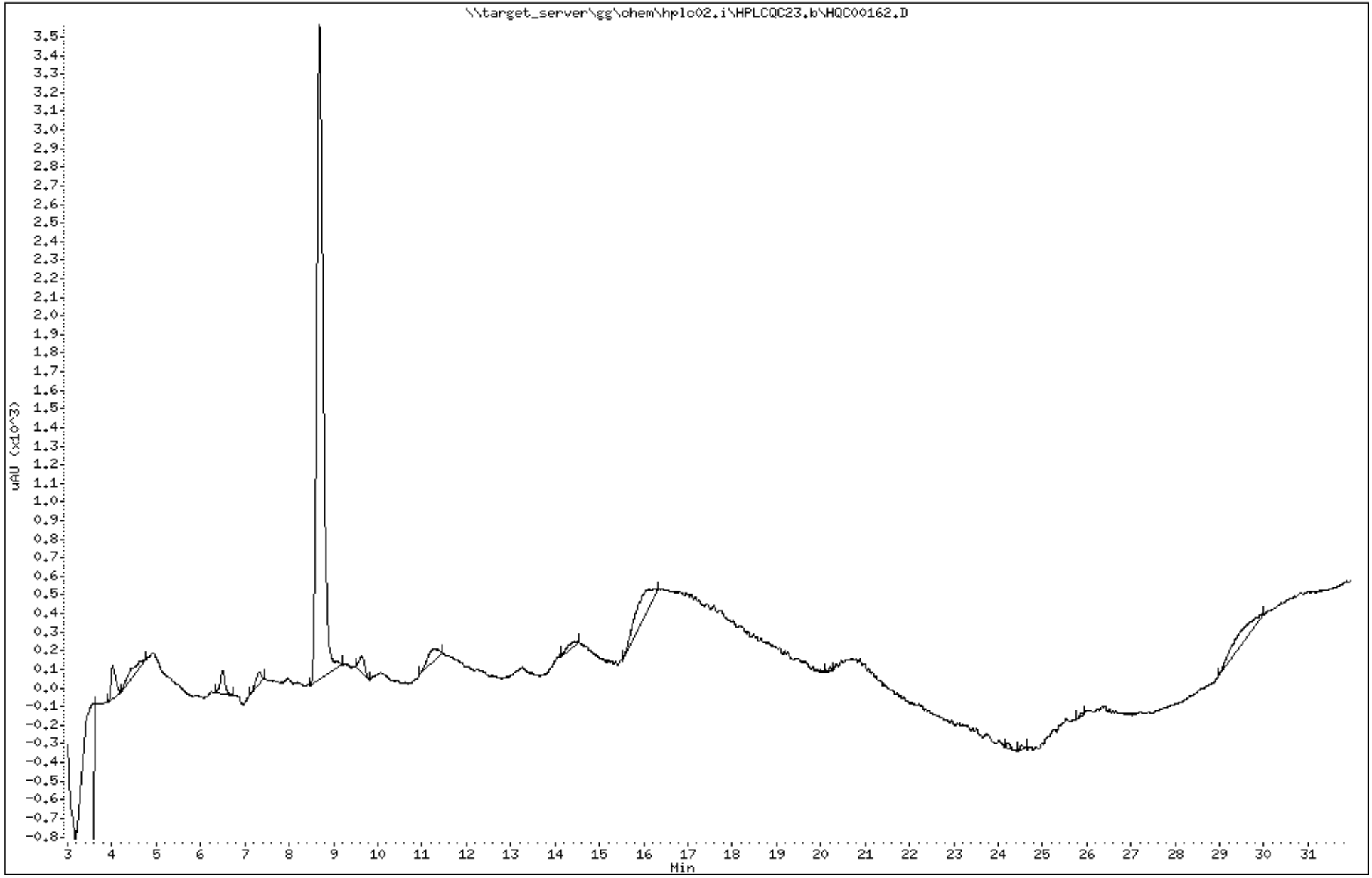
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00162.D
Lab Smp Id: SQ1188-13 Client Smp ID: JACKSON-SDMC2-DC-01
Inj Date : 23-MAR-2023 14:14
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-13
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01060	Weight of Sample (Kg)
M	16.304	% Moisture
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00162.D
Date : 23-MAR-2023 14:14
Client ID: JACKSON-SDMC2-DC-01
Instrument: hplc02.i
Sample Info: SQ1188-13
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: HQC00162.D
Report Date: 27-Mar-2023 11:50

Katahdin Analytical Services

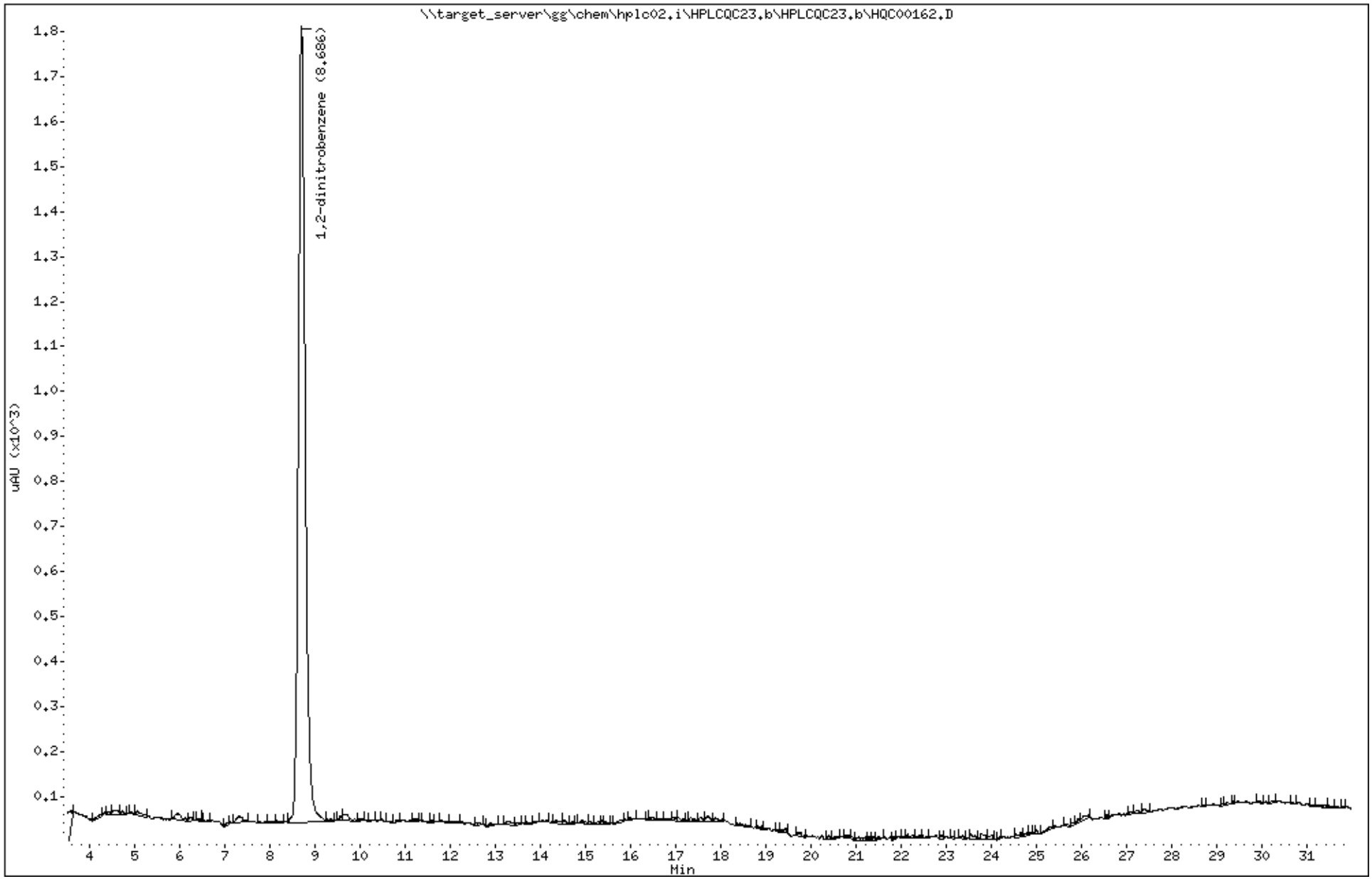
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00162.D
Lab Smp Id: SQ1188-13 Client Smp ID: JACKSON-SDMC2-DC-01
Inj Date : 23-MAR-2023 14:14
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-13
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01060	Weight of Sample (Kg)
M	16.304	% Moisture
Cpnd Variable		Local Compound Variable

						CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE
$	2 1,2-dinitrobenzene	8.685	8.754	-0.069	1769	0.26490	597	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00162.D
Date : 23-MAR-2023 14:14
Client ID: JACKSON-SDMC2-DC-01
Instrument: hplc02.i
Sample Info: SQ1188-13
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1188
Lab ID: SQ1188-15
Client ID: SDDUP
Matrix: SL
Lab File ID: HQC00163.D

Sample Date: 08-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: 74.

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	65	ug/Kgdrywt	1	100	130	11.	65.
RDX	U	65	ug/Kgdrywt	1	100	130	8.9	65.
1,3,5-Trinitrobenzene	U	65	ug/Kgdrywt	1	100	130	8.7	65.
1,3-Dinitrobenzene	U	65	ug/Kgdrywt	1	100	130	8.1	65.
Tetryl	UL	65	ug/Kgdrywt	1	100	130	7.0	65.
Nitrobenzene	U	65	ug/Kgdrywt	1	100	130	29.	65.
2,4,6-Trinitrotoluene	U	65	ug/Kgdrywt	1	100	130	8.7	65.
2-Am-DNT	U	65	ug/Kgdrywt	1	100	130	27.	65.
4-Am-DNT	U	65	ug/Kgdrywt	1	100	130	22.	65.
2,6-Dinitrotoluene	U	65	ug/Kgdrywt	1	100	130	35.	65.
2,4-Dinitrotoluene	U	65	ug/Kgdrywt	1	100	130	20.	65.
2-Nitrotoluene	U	65	ug/Kgdrywt	1	100	130	16.	65.
3-Nitrotoluene	U	65	ug/Kgdrywt	1	100	130	10.	65.
4-Nitrotoluene	U	65	ug/Kgdrywt	1	100	130	35.	65.
Nitroglycerin	U	520	ug/Kgdrywt	1	800	1000	160	520
1,2-Dinitrobenzene		92.2	%					

600 Technology Way
P.O. Box 540, Scarborough, ME 04070
Tel:(207) 874-2400 Fax:(207) 775-4029
http://www.katahdinlab.com

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00163.D
Report Date: 27-Mar-2023 11:56

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00163.D
Lab Smp Id: SQ1188-15 Client Smp ID: SDDUP
Inj Date : 23-MAR-2023 14:49
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-15
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

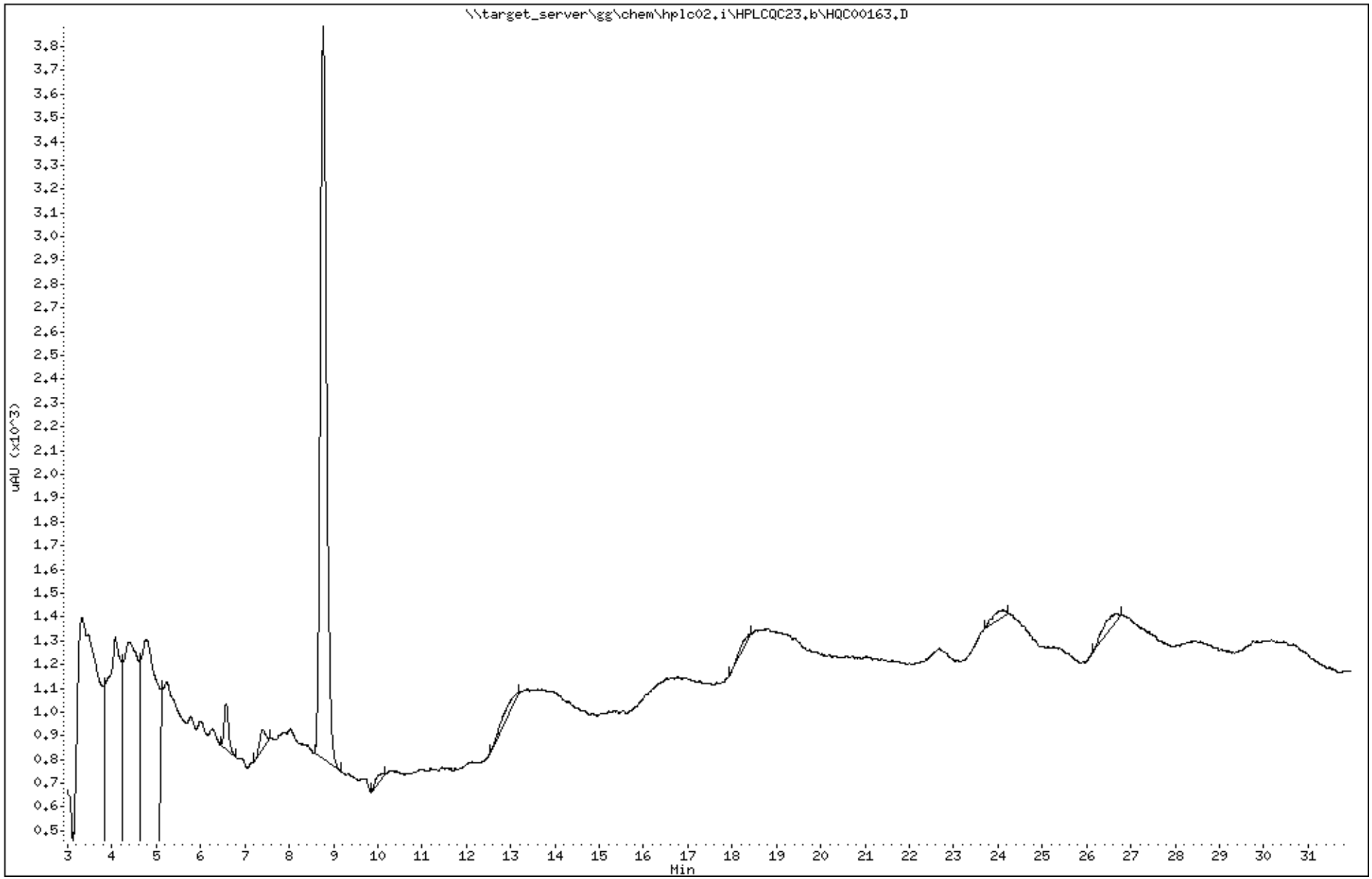
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01040	Weight of Sample (Kg)
M	26.355	% Moisture
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00163.D
Date : 23-MAR-2023 14:49
Client ID: SDDUP
Sample Info: SQ1188-15

Instrument: hplc02.i

Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: HQC00163.D
Report Date: 27-Mar-2023 11:50

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00163.D
Lab Smp Id: SQ1188-15 Client Smp ID: SDDUP
Inj Date : 23-MAR-2023 14:49
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1188-15
Misc Info : WG334249,WG333925,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

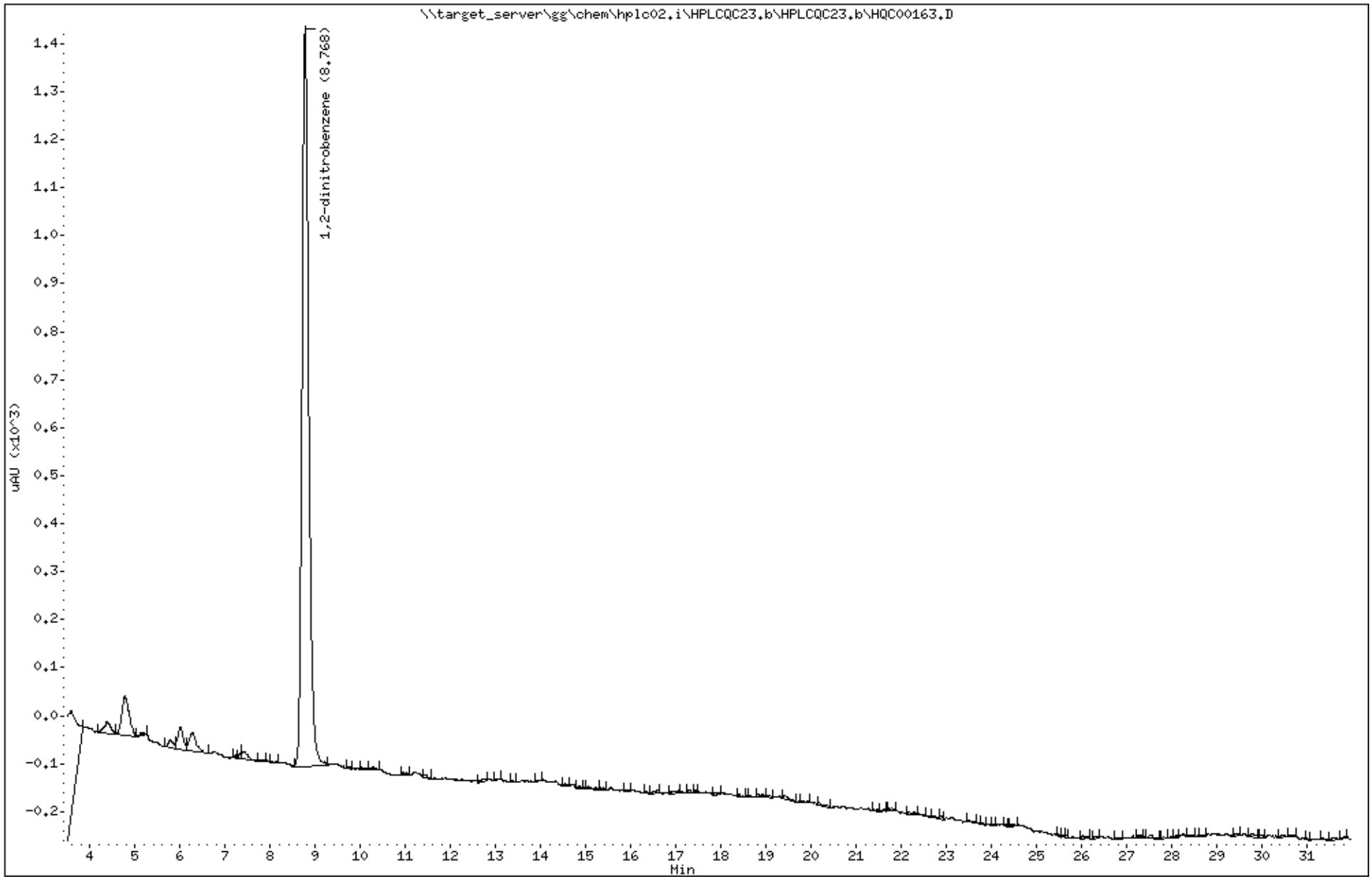
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01040	Weight of Sample (Kg)
M	26.355	% Moisture
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/Kgdrywt)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.767	8.754	0.013	1540	0.23061	602	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00163.D
Date : 23-MAR-2023 14:49
Client ID: SDDUP
Sample Info: SQ1188-15

Instrument: hplc02.i

Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Standards Data Section

Form 6
Initial Calibration Summary

Lab Name : Katahdin Analytical Services
SDG: SQ1188
Instrument ID: HPLC02
Calibration Date(s): 15-MAR-23 09:32
15-MAR-23 13:00
Lab File IDs : HQC00038.I,HQC00039.I,HQC00040.I
HQC00041.I,HQC00042.I,HQC00043.I
HQC00044.I

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7		Curve				%RSD or R^2		
	0.0250000	0.0500000	0.1000000	0.2500000	0.5000000	1.0000	2.0000		Type	b	m1	m2	Result	Limit	
NITROGLYCERIN	6230	6420	6913	6952	7130	7000	7155		AVG		6828		5.26	20	O

Legend: O = Acceptable; W = Failed %RSD Value; X = Failed R^2 Value; Y = Failed Minimum RF

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P.O. Box 540, Scarborough, ME 04070
Tel:(207) 874-2400 Fax:(207) 775-4029
http://katahdinlab.com
sales@katahdinlab.com

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00045.D
Report Date: 23-Mar-2023 10:18

Katahdin Analytical Services

RECOVERY REPORT

Client Name: Client SDG: SDGa00508
Sample Matrix: LIQUID Fraction: Explosives
Lab Smp Id: WG333590-8
Level: LOW Operator: EP
Data Type: LC DATA SampleType: INDSOURCE
SpikeList File: IND.spk Quant Type: ESTD
Sublist File: ngpetn.sub
Method File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Misc Info: WG333590,WG333590,WG333590-5

SPIKE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
3 Ethylene Glycol D	20.0	0.000	*	30-150
8 NITROGLYCERIN	20.0	19.6	98.29	80-120
18 PETN	20.0	20.2	101.06	80-120

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00038.D
Report Date: 23-Mar-2023 10:17

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00038.D
Lab Smp Id: WG333590-1
Inj Date : 15-MAR-2023 09:32
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-1
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:50   Cal File: HQC00042.D
Als bottle: 1   Calibration Sample, Level: 1
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

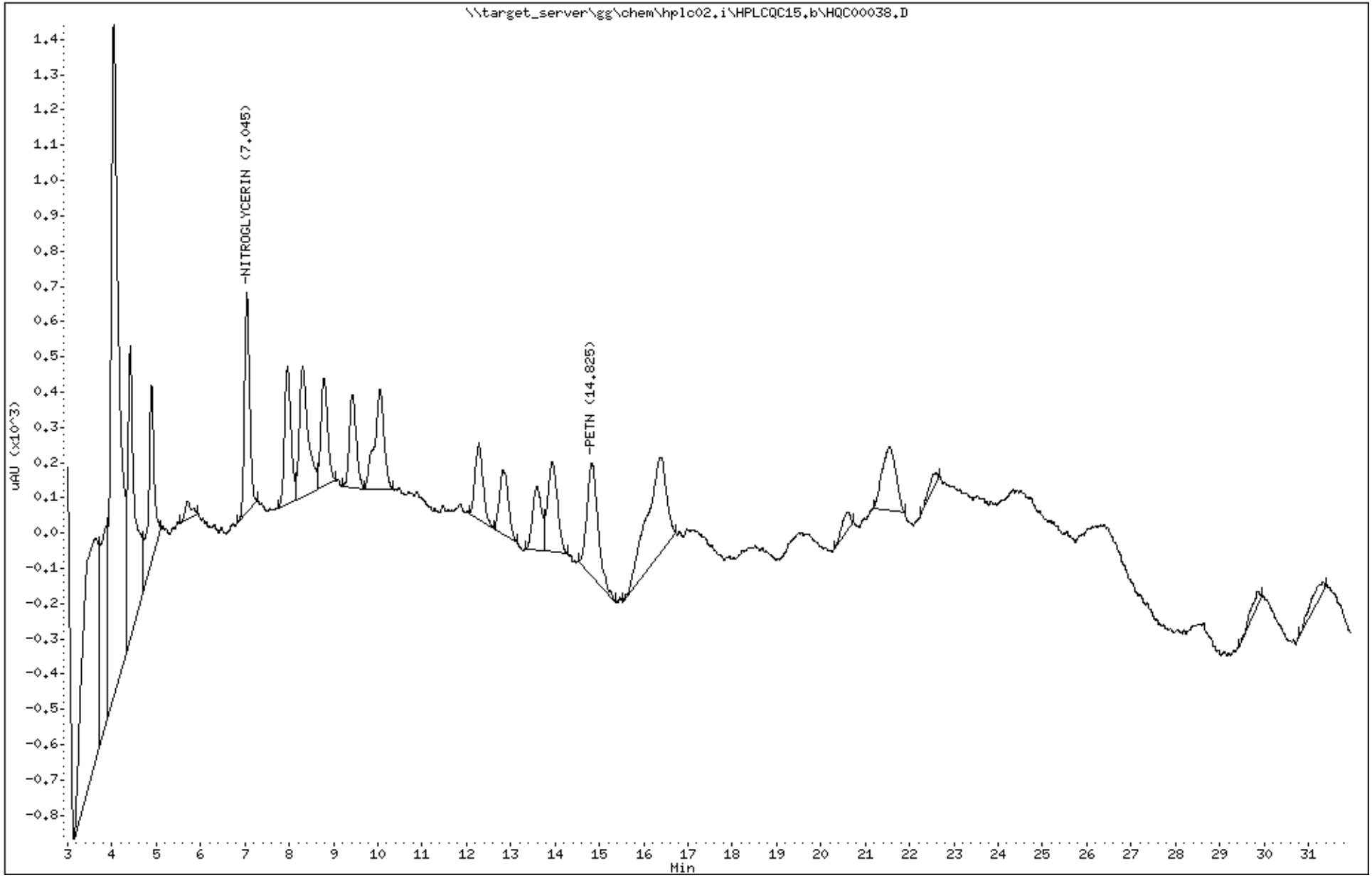
EP
11:19 am, Mar 23, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.044	7.031	0.013	623	0.10000	0.0920(aM)	M6
18 PETN	14.824	14.751	0.073	319	0.10000	0.0916(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00038.D
Date : 15-MAR-2023 09:32
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-1
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00039.D
Report Date: 23-Mar-2023 10:17

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00039.D
Lab Smp Id: WG333590-2
Inj Date : 15-MAR-2023 10:06
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-2
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:50   Cal File: HQC00042.D
Als bottle: 1   Calibration Sample, Level: 2
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

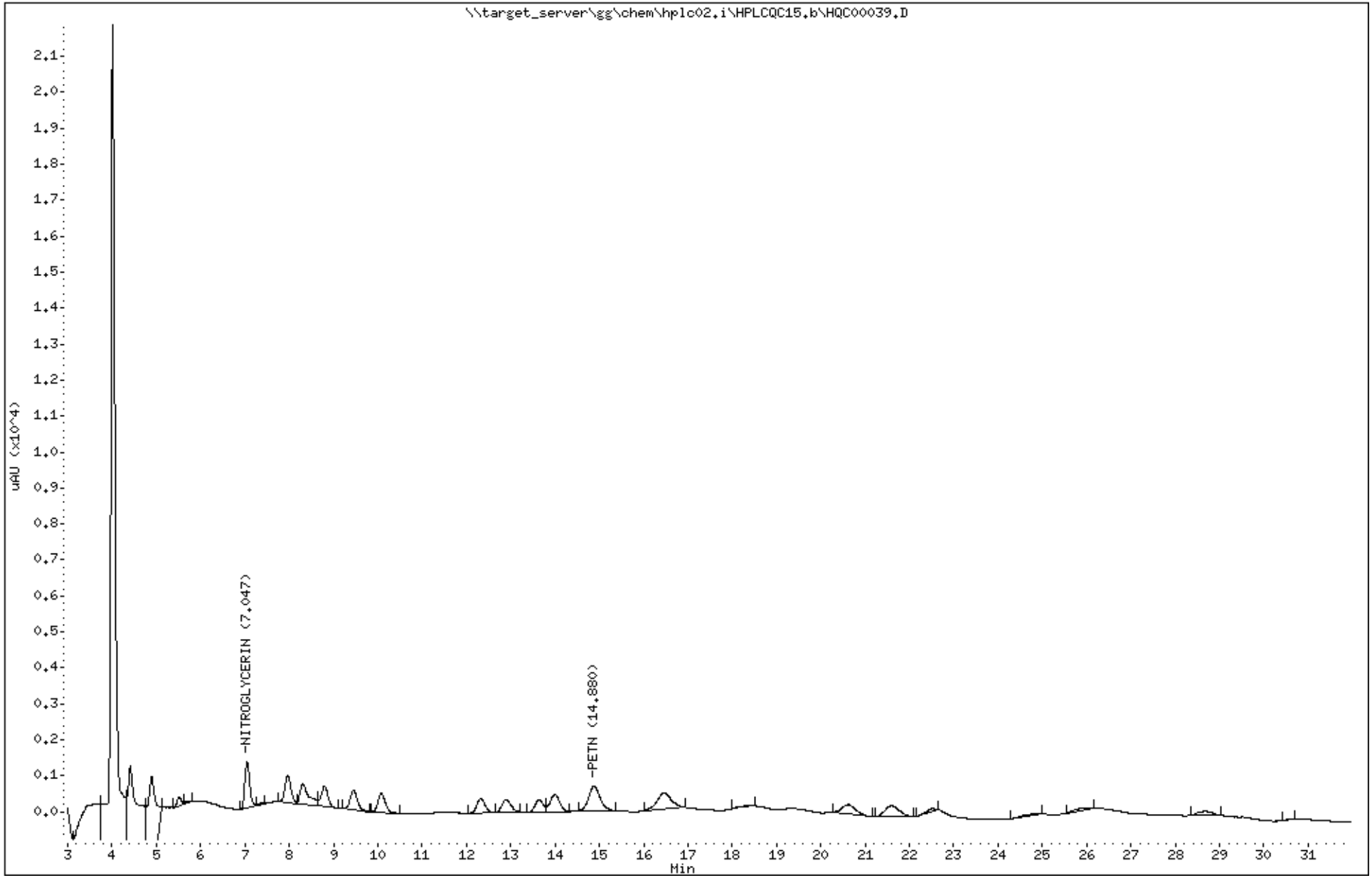
EP
11:19 am, Mar 23, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.046	7.031	0.015	1284	0.20000	0.192(aM)	M6
18 PETN	14.879	14.751	0.128	680	0.20000	0.196(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00039.D
Date : 15-MAR-2023 10:06
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-2
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00040.D
Report Date: 23-Mar-2023 10:17

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00040.D
Lab Smp Id: WG333590-3
Inj Date : 15-MAR-2023 10:41
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-3
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:50   Cal File: HQC00042.D
Als bottle: 1   Calibration Sample, Level: 3
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

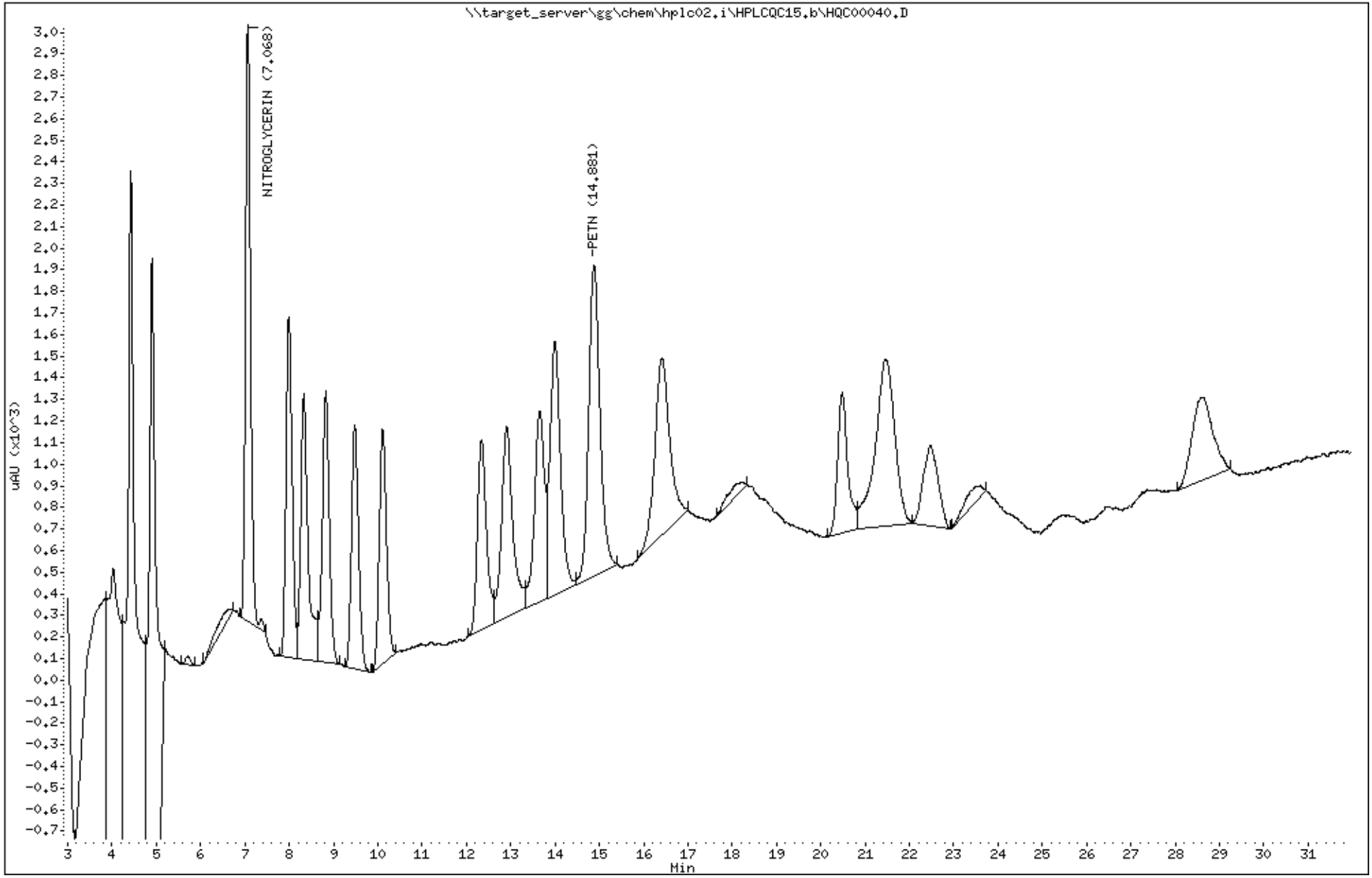
EP
11:19 am, Mar 23, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.067	7.031	0.036	2765	0.40000	0.411(aM)	M6
18 PETN	14.880	14.751	0.129	1439	0.40000	0.413(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00040.D
Date : 15-MAR-2023 10:41
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-3
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00041.D
Report Date: 23-Mar-2023 10:18

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00041.D
Lab Smp Id: WG333590-4
Inj Date : 15-MAR-2023 11:16
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-4
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:16   Cal File: HQC00041.D
Als bottle: 1   Calibration Sample, Level: 4
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

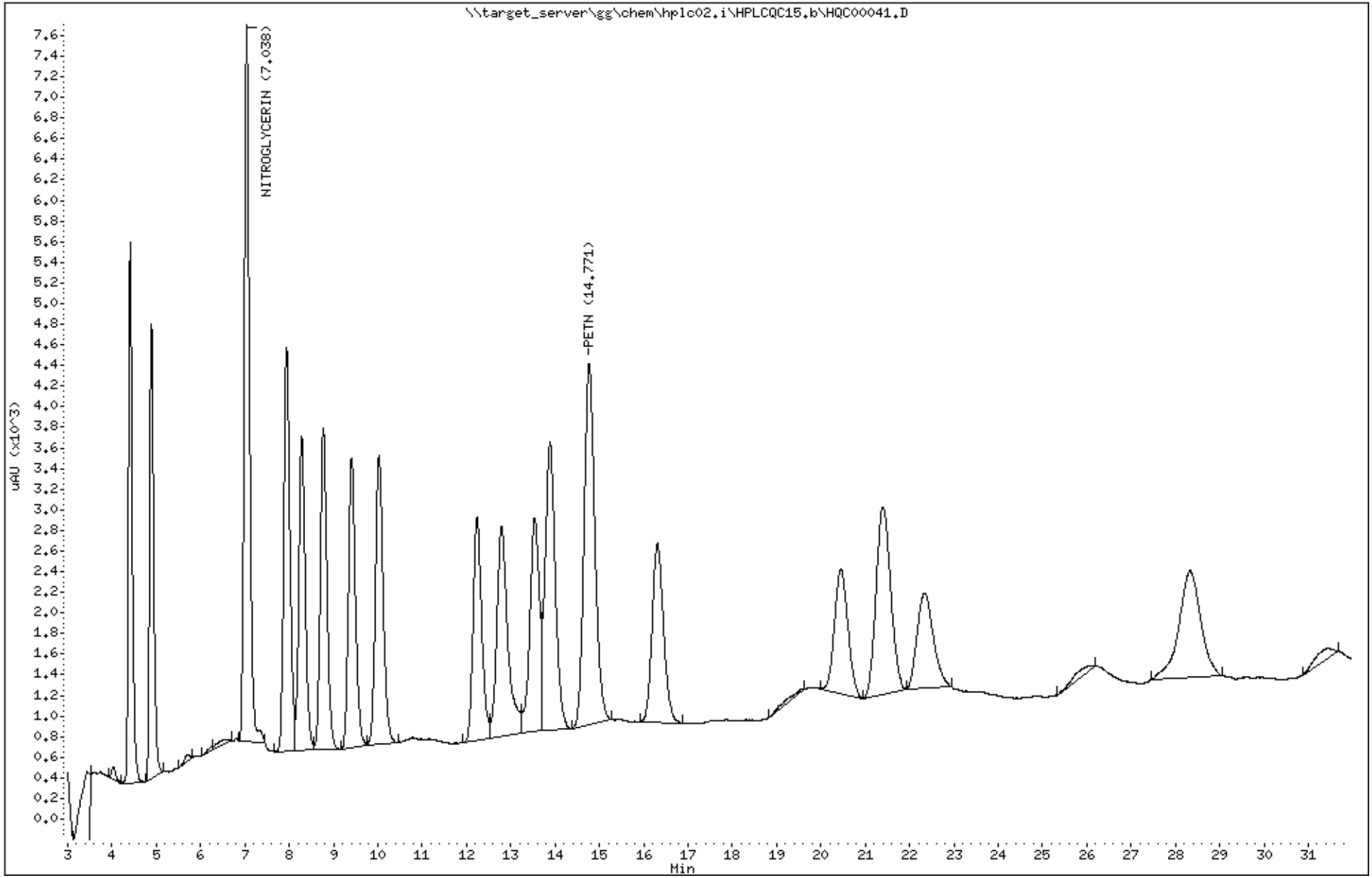
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.037	7.031	0.006	6952	1.00000	0.987(a)	
18 PETN	14.771	14.751	0.020	3498	1.00000	0.991(a)	

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00041.D
Date : 15-MAR-2023 11:16
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-4
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00042.D
Report Date: 23-Mar-2023 10:18

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00042.D
Lab Smp Id: WG333590-5
Inj Date : 15-MAR-2023 11:50
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-5
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:50   Cal File: HQC00042.D
Als bottle: 1   Calibration Sample, Level: 5
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

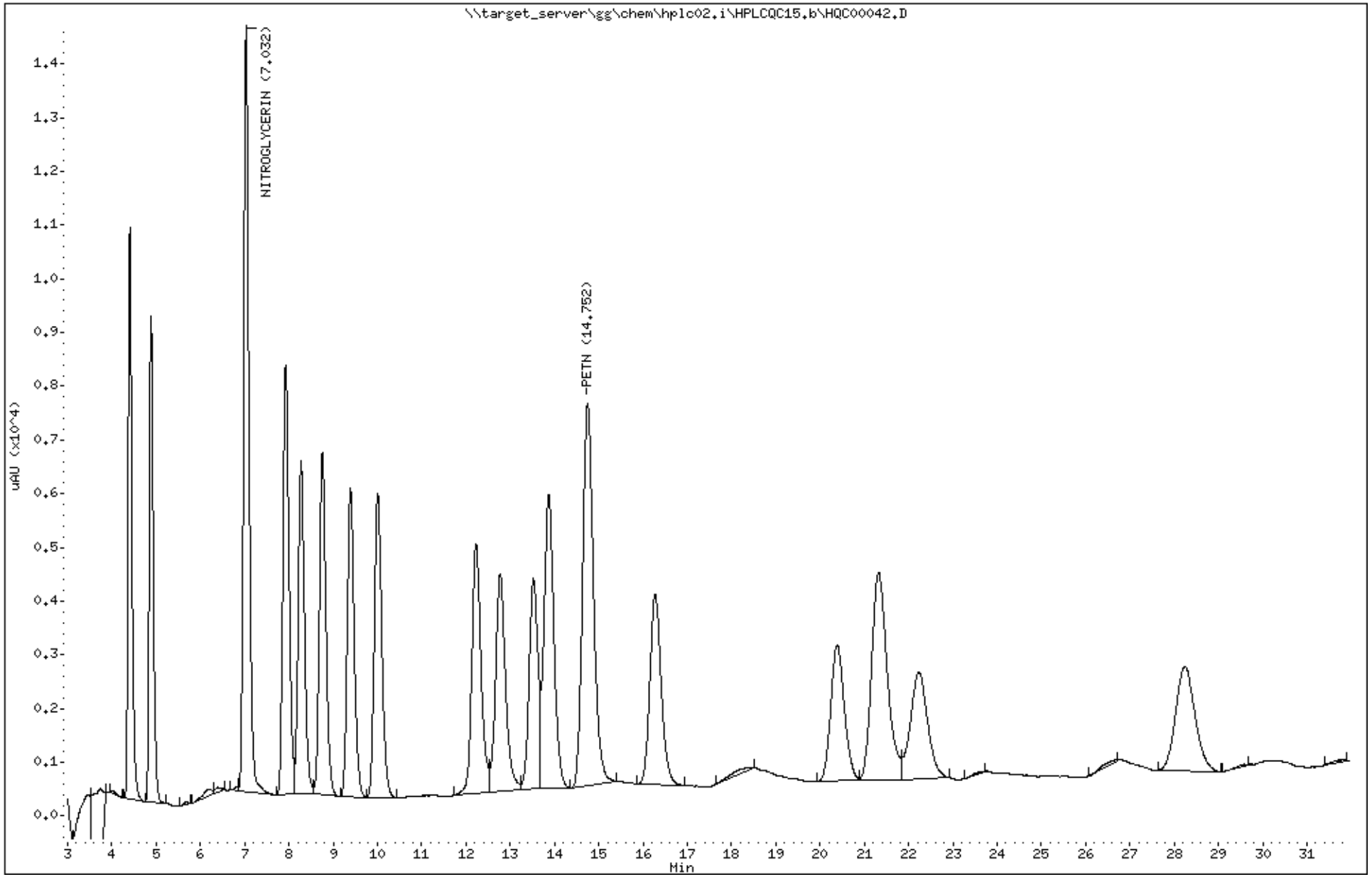
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.031	7.031	0.000	14259	2.00000	2.00(a)	
18 PETN	14.751	14.751	0.000	7120	2.00000	2.00(a)	

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00042.D
Date : 15-MAR-2023 11:50
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-5
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1188 Page 208 of 654

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00043.D
Report Date: 23-Mar-2023 10:18

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00043.D
Lab Smp Id: WG333590-6
Inj Date : 15-MAR-2023 12:25
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-6
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 12:25   Cal File: HQC00043.D
Als bottle: 1   Calibration Sample, Level: 6
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

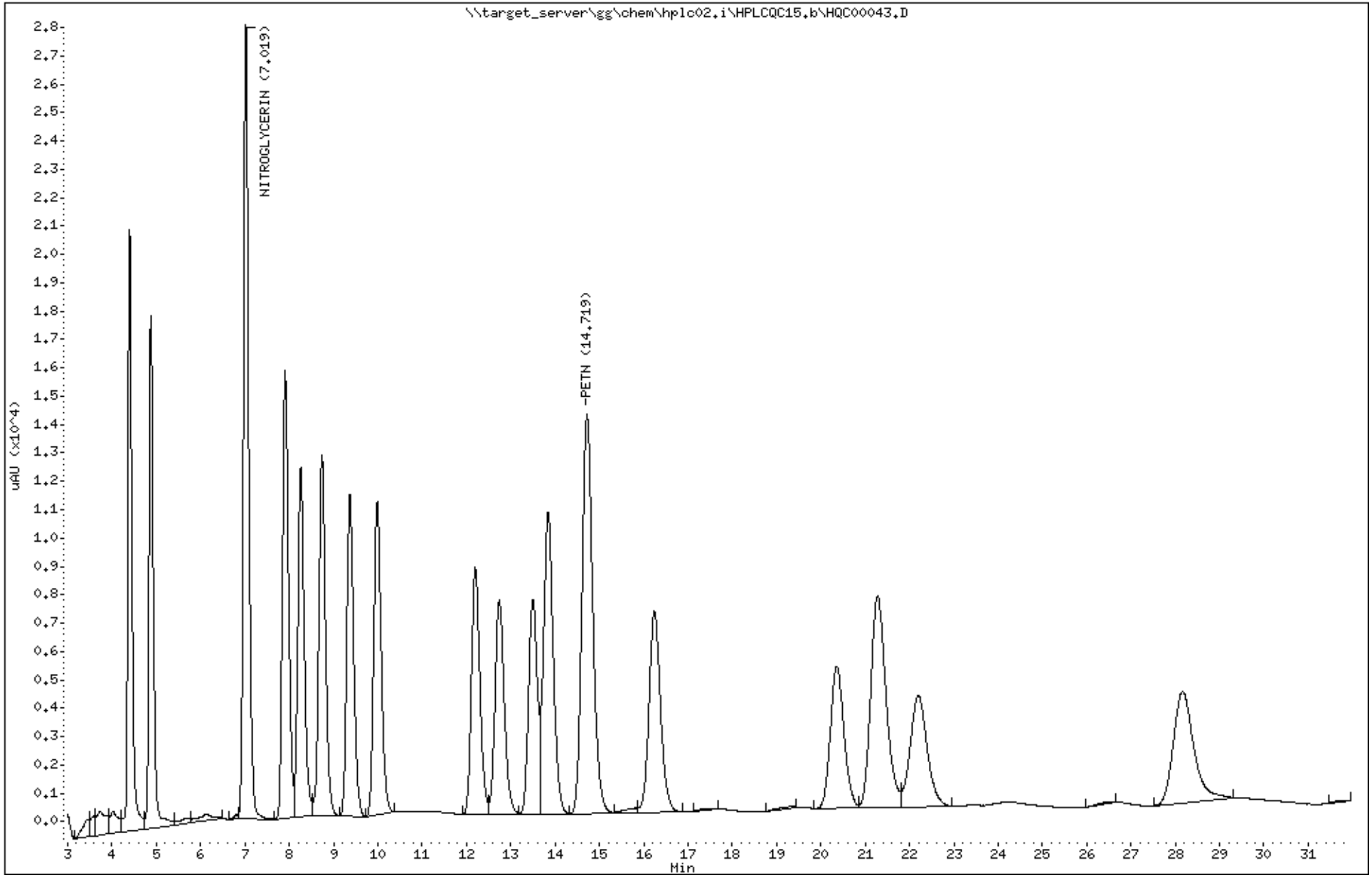
EP
11:19 am, Mar 23, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.018	7.031	-0.013	28000	4.00000	4.13(M)	M6
18 PETN	14.718	14.751	-0.033	14081	4.00000	4.04	

QC Flag Legend

M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00043.D
Date : 15-MAR-2023 12:25
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-6
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00044.D
Report Date: 23-Mar-2023 10:18

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00044.D
Lab Smp Id: WG333590-7
Inj Date : 15-MAR-2023 13:00
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-7
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Calibration Sample, Level: 7
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

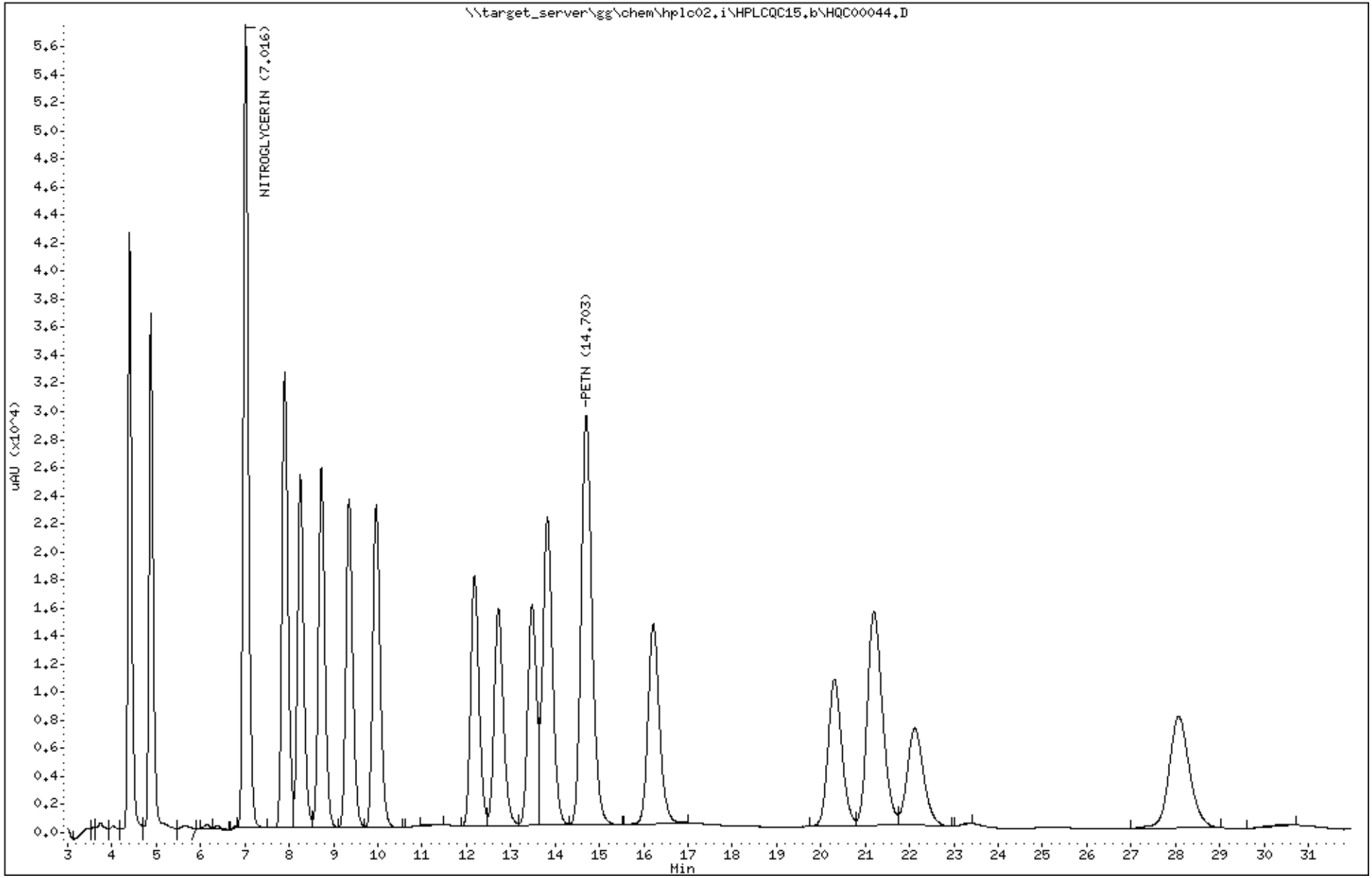
EP
11:19 am, Mar 23, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.016	7.031	-0.015	57241	8.00000	8.38(AM)	M6
18 PETN	14.702	14.751	-0.049	29150	8.00000	8.36(A)	

QC Flag Legend

A - Target compound detected but, quantitated amount
    exceeded maximum amount.
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00044.D
Date : 15-MAR-2023 13:00
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-7
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00045.D
Report Date: 23-Mar-2023 10:18

Katahdin Analytical Services

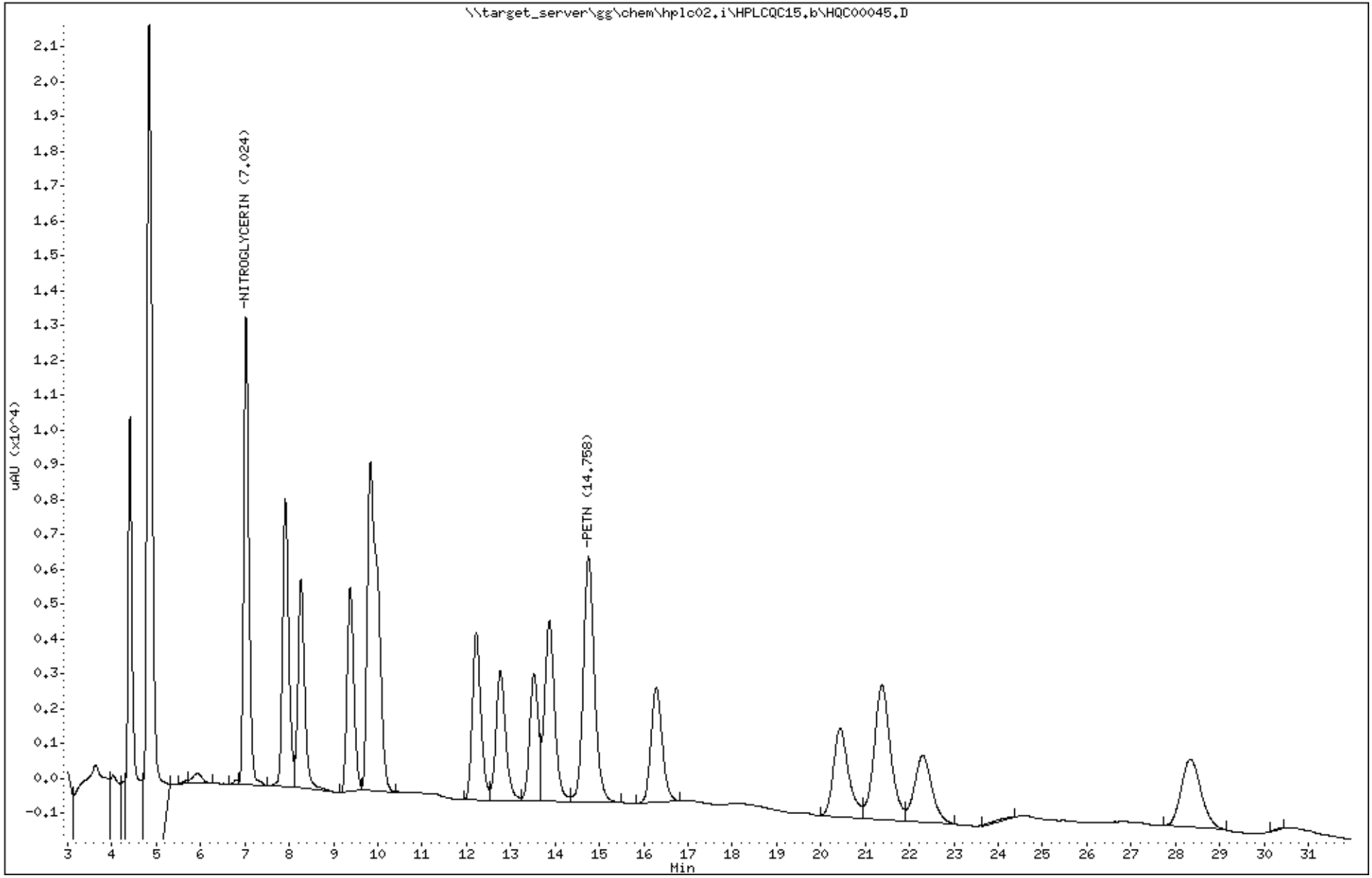
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00045.D
Lab Smp Id: WG333590-8
Inj Date : 15-MAR-2023 13:35
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-8
Misc Info : WG333590,WG333590,WG333590-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   QC Sample: INDSOURCE
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE
8 NITROGLYCERIN	7.024	7.031	-0.007	13423	1.96575	19.6	
18 PETN	14.757	14.751	0.006	7048	2.02118	20.2	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00045.D
Date : 15-MAR-2023 13:35
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-8
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Form 6
Initial Calibration Summary

Lab Name : Katahdin Analytical Services
SDG: SQ1188
Instrument ID: HPLC02
Calibration Date(s): 15-MAR-23 09:32
15-MAR-23 13:00
Lab File IDs : HQC00038.I,HQC00039.I,HQC00040.I
HQC00041.I,HQC00042.I,HQC00043.I
HQC00044.I

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7		Curve				%RSD or R^2		
	0.0250000	0.0500000	0.1000000	0.2500000	0.5000000	1.0000	2.0000		Type	b	m1	m2	Result	Limit	
HMX	7480	7760	7990	8004	8094	7940	8125		AVG		7913		2.842	15	O
RDX	8160	8240	8680	8624	8782	8611	8834		AVG		8562		3.044	15	O
1,3,5-trinitrobenzene	4800	4660	4600	5148	5210	5069	5161		AVG		4950		5.18	15	O
1,3-dinitrobenzene	10480	10720	11420	11344	11552	11296	11631		AVG		11210		3.883	15	O
nitrobenzene	15200	11500	10840	10600	10834	10558	10858		AVG		11480		14.52	15	O
TETRYL	2320	2300	2400	2276	2294	2324	+++++		AVG		2319		1.872	15	O
2,4,6-trinitrotoluene	2760	2920	3190	3164	3162	3128	3125		AVG		3064		5.269	15	O
4-AM-DNT	5760	5840	6140	6212	6326	6207	6372		AVG		6122		3.832	15	O
2-AM-DNT	8160	8200	8810	8800	8964	8778	9062		AVG		8682		4.122	15	O
2,6-dinitrotoluene	4200	3960	3990	4084	4104	4038	4042		AVG		4060		1.956	15	O
2,4-dinitrotoluene	6160	6220	9060	6664	6756	6626	6812		AVG		6900		14.29	15	O
2-nitrotoluene	3920	3800	3930	3932	4008	3912	4016		AVG		3931		1.82	15	O
4-nitrotoluene	3240	3440	3510	3552	3610	3522	3636		AVG		3501		3.779	15	O
3-nitrotoluene	4080	4320	4550	4572	4650	4535	4671		AVG		4483		4.707	15	O
1,2-dinitrobenzene	6280	7780	7390	6236	6330	6427	6304		AVG		6678		9.47	15	

Legend: O = Acceptable; W = Failed %RSD Value; X = Failed R^2 Value; Y = Failed Minimum RF

600 Technology Way
P.O. Box 540, Scarborough, ME 04070
Tel:(207) 874-2400 Fax:(207) 775-4029

http://katahdinlab.com
sales@katahdinlab.com

Data File: HQC00045.D
Report Date: 23-Mar-2023 10:10

Katahdin Analytical Services

RECOVERY REPORT

Client Name: Client SDG: SDGa00508
Sample Matrix: LIQUID Fraction: Explosives
Lab Smp Id: WG333590-8
Level: LOW Operator: EP
Data Type: LC DATA SampleType: INDSOURCE
SpikeList File: IND.spk Quant Type: ESTD
Sublist File: SW8330A.sub
Method File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Misc Info: WG333590,WG333590,WG333590-5

SPIKE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
1 HMX	5.00	5.18	103.52	80-120
4 RDX	5.00	5.00	99.96	80-120
5 1,3,5-trinitrobenz	5.00	4.92	98.43	80-120
6 1,3-dinitrobenzene	5.00	4.80	96.09	80-120
7 nitrobenzene	5.00	4.34	86.78	80-120
9 TETRYL	5.00	4.92	98.32	80-120
10 2,4,6-trinitrotolu	5.00	5.20	104.11	80-120
11 4-AM-DNT	5.00	5.29	105.78	80-120
12 2-AM-DNT	5.00	4.79	95.85	80-120
13 2,6-dinitrotoluene	5.00	4.77	95.48	80-120
14 2,4-dinitrotoluene	5.00	4.55	90.96	80-120
15 2-nitrotoluene	5.00	5.41	108.21	80-120
16 4-nitrotoluene	5.00	4.76	95.10	80-120
17 3-nitrotoluene	5.00	4.86	97.22	80-120
51 3,5-Dinitroaniline	5.00	5.16	103.27	80-120

SURROGATE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
$ 2 1,2-dinitrobenzene	10.0	0.000	*	83-119

Data File: HQC00038.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00038.D
Lab Smp Id: WG333590-1
Inj Date : 15-MAR-2023 09:32
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-1
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 09:32   Cal File: HQC00038.D
Als bottle: 1   Calibration Sample, Level: 1
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

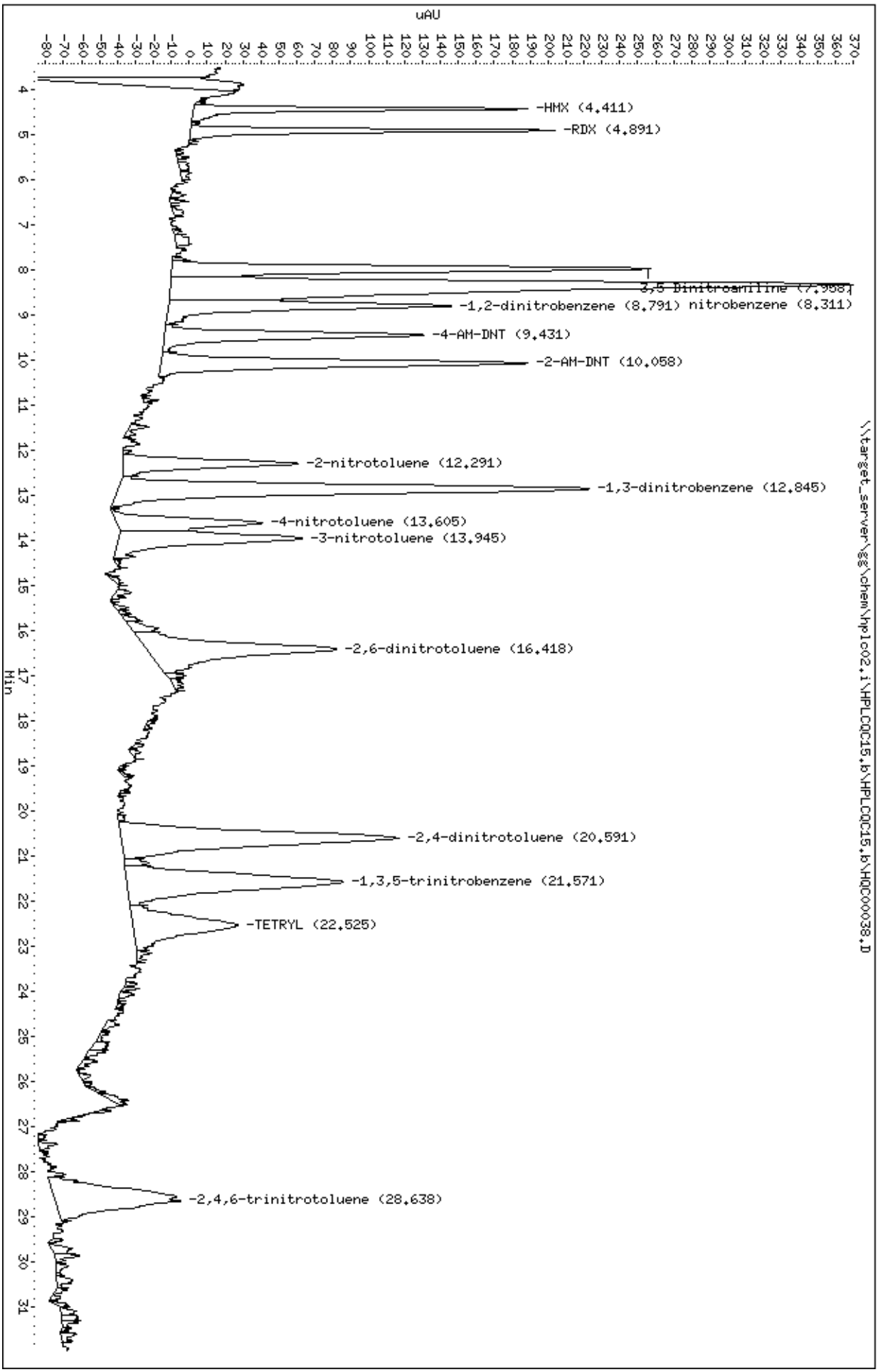
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.411	4.396	0.015	187	0.02500	0.0238(a)	
4	RDX	4.891	4.876	0.015	204	0.02500	0.0240(a)	
51	3,5-Dinitroaniline	7.958	7.896	0.062	266	0.02500	0.0235(aM)	M6
7	nitrobenzene	8.311	8.250	0.061	380	0.02500	0.0311(aM)	M6
$ 2	1,2-dinitrobenzene	8.791	8.723	0.068	157	0.02500	0.0192(a)	
11	4-AM-DNT	9.431	9.350	0.081	144	0.02500	0.0236(aM)	M6
12	2-AM-DNT	10.058	9.963	0.095	204	0.02500	0.0236(aM)	M6
15	2-nitrotoluene	12.291	12.183	0.108	98	0.02500	0.0250(a)	
6	1,3-dinitrobenzene	12.844	12.723	0.121	262	0.02500	0.0235(aM)	M6
16	4-nitrotoluene	13.604	13.483	0.121	81	0.02500	0.0234(aM)	M6
17	3-nitrotoluene	13.944	13.830	0.114	102	0.02500	0.0232(a)	
13	2,6-dinitrotoluene	16.418	16.216	0.202	105	0.02500	0.0254(aM)	M6
14	2,4-dinitrotoluene	20.591	20.310	0.281	154	0.02500	0.0215(aM)	M6
5	1,3,5-trinitrobenzene	21.571	21.196	0.375	120	0.02500	0.0237(aM)	M6
9	TETRYL	22.524	22.123	0.401	58	0.02500	0.0357(aM)	M6
10	2,4,6-trinitrotoluene	28.638	28.076	0.562	69	0.02500	0.0440(aM)	M9

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC000038.D
Date : 15-MAR-2023 09:32
Client ID:
Sample Info: WG333590-1
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC000038.D
uAU
Min
-HMX (4.411)
-RDX (4.891)
-1,2-dinitrobenzene (8.791) nitrobenzene (8.311)
-4-AM-DNT (9.431)
-2-AM-DNT (10.058)
-2-nitrotoluene (12.291)
-1,3-dinitrobenzene (12.845)
-4-nitrotoluene (13.605)
-3-nitrotoluene (13.945)
-2,6-dinitrotoluene (16.418)
-2,4-dinitrotoluene (20.591)
-1,3,5-trinitrobenzene (21.571)
-TETRYL (22.525)
-2,4,6-trinitrotoluene (28.638)

Data File: HQC00039.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00039.D
Lab Smp Id: WG333590-2
Inj Date : 15-MAR-2023 10:06
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-2
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 10:06   Cal File: HQC00039.D
Als bottle: 1   Calibration Sample, Level: 2
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

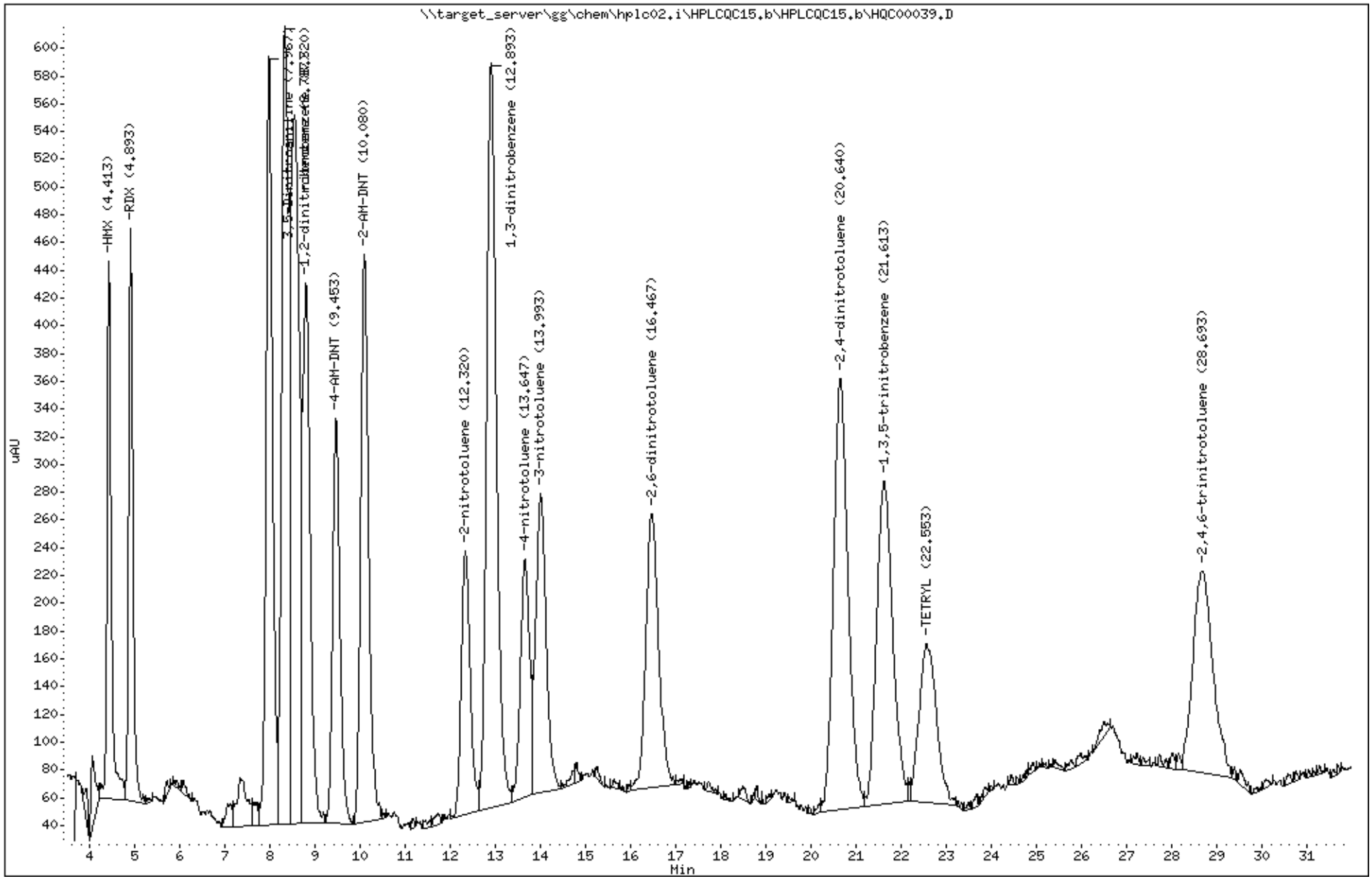
EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.413	4.396	0.017	388	0.05000	0.0493(a)	
4	RDX	4.893	4.876	0.017	412	0.05000	0.0485(a)	
51	3,5-Dinitroaniline	7.966	7.896	0.070	554	0.05000	0.0493(aM)	M6
7	nitrobenzene	8.319	8.250	0.069	575	0.05000	0.0478(aM)	M6
$ 2	1,2-dinitrobenzene	8.786	8.723	0.063	389	0.05000	0.0563(a)	
11	4-AM-DNT	9.453	9.350	0.103	292	0.05000	0.0484(aM)	M6
12	2-AM-DNT	10.079	9.963	0.116	410	0.05000	0.0481(aM)	M6
15	2-nitrotoluene	12.319	12.183	0.136	190	0.05000	0.0485(a)	
6	1,3-dinitrobenzene	12.893	12.723	0.170	536	0.05000	0.0486(aM)	M6
16	4-nitrotoluene	13.646	13.483	0.163	172	0.05000	0.0497(aM)	M6
17	3-nitrotoluene	13.993	13.830	0.163	216	0.05000	0.0491(a)	
13	2,6-dinitrotoluene	16.466	16.216	0.250	198	0.05000	0.0484(aM)	M6
14	2,4-dinitrotoluene	20.639	20.310	0.329	311	0.05000	0.0446(aM)	M6
5	1,3,5-trinitrobenzene	21.613	21.196	0.417	233	0.05000	0.0470(aM)	M6
9	TETRYL	22.553	22.123	0.430	115	0.05000	0.0499(aM)	M6
10	2,4,6-trinitrotoluene	28.693	28.076	0.617	146	0.05000	0.0652(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00039.D
Date : 15-MAR-2023 10:06
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-2
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: HQC00040.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00040.D
Lab Smp Id: WG333590-3
Inj Date : 15-MAR-2023 10:41
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-3
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 10:41   Cal File: HQC00040.D
Als bottle: 1   Calibration Sample, Level: 3
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

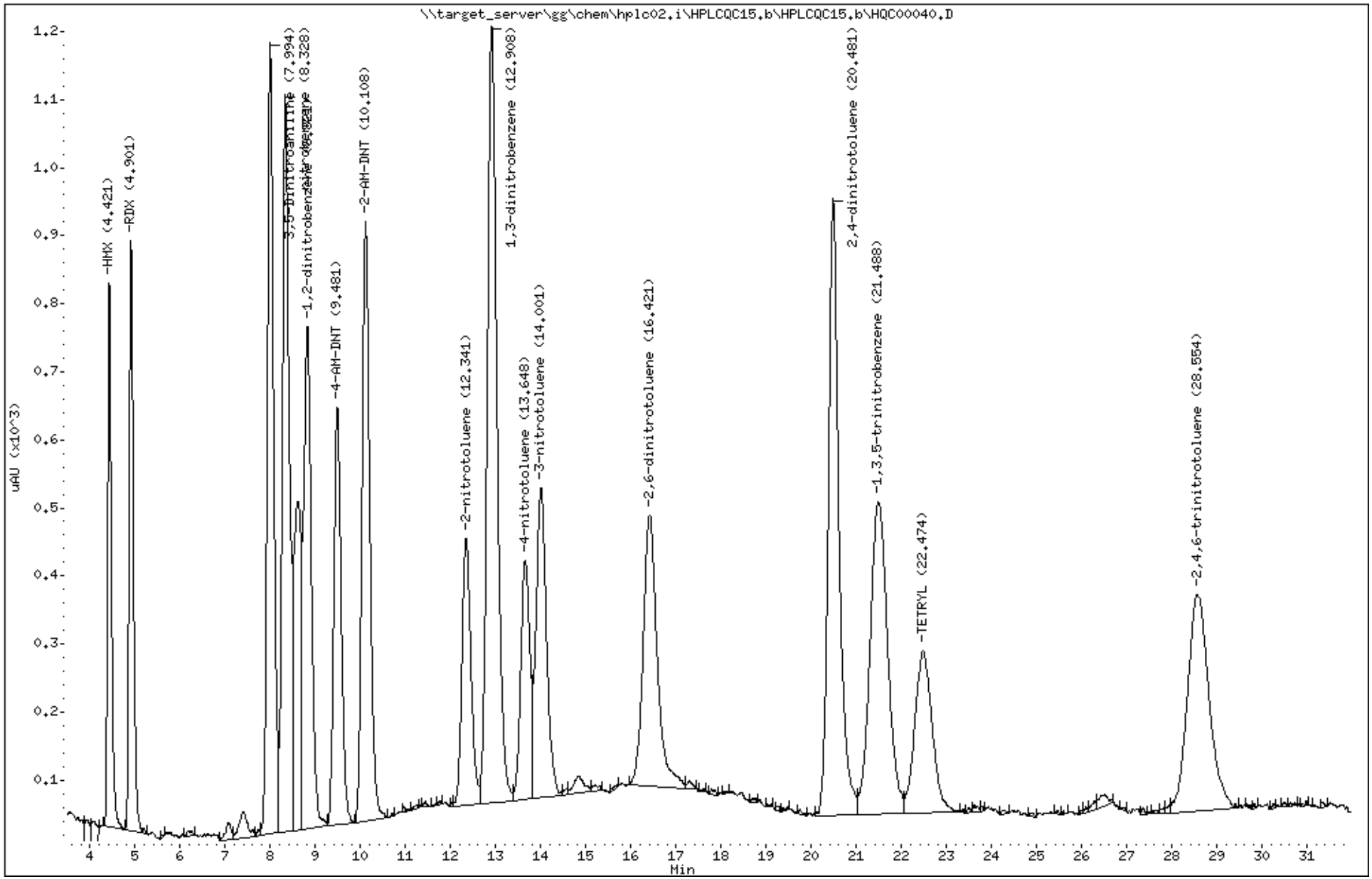
EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.420	4.396	0.024	799	0.10000	0.102(a)	
4	RDX	4.900	4.876	0.024	868	0.10000	0.102(a)	
51	3,5-Dinitroaniline	7.994	7.896	0.098	1162	0.10000	0.103(aM)	M6
7	nitrobenzene	8.327	8.250	0.077	1084	0.10000	0.0919(aM)	M6
$ 2	1,2-dinitrobenzene	8.820	8.723	0.097	739	0.10000	0.112(a)	
11	4-AM-DNT	9.480	9.350	0.130	614	0.10000	0.101(aM)	M6
12	2-AM-DNT	10.107	9.963	0.144	881	0.10000	0.102(aM)	M6
15	2-nitrotoluene	12.340	12.183	0.157	393	0.10000	0.100(a)	
6	1,3-dinitrobenzene	12.907	12.723	0.184	1142	0.10000	0.103(aM)	M6
16	4-nitrotoluene	13.647	13.483	0.164	351	0.10000	0.101(aM)	M6
17	3-nitrotoluene	14.000	13.830	0.170	455	0.10000	0.103(a)	
13	2,6-dinitrotoluene	16.420	16.216	0.204	399	0.10000	0.0981(aM)	M6
14	2,4-dinitrotoluene	20.480	20.310	0.170	906	0.10000	0.130(a)	
5	1,3,5-trinitrobenzene	21.487	21.196	0.291	460	0.10000	0.0942(aM)	M6
9	TETRYL	22.474	22.123	0.351	240	0.10000	0.103(aM)	M6
10	2,4,6-trinitrotoluene	28.554	28.076	0.478	319	0.10000	0.106(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00040.D
Date : 15-MAR-2023 10:41
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-3
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: HQC00041.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00041.D
Lab Smp Id: WG333590-4
Inj Date : 15-MAR-2023 11:16
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-4
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:16   Cal File: HQC00041.D
Als bottle: 1   Calibration Sample, Level: 4
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

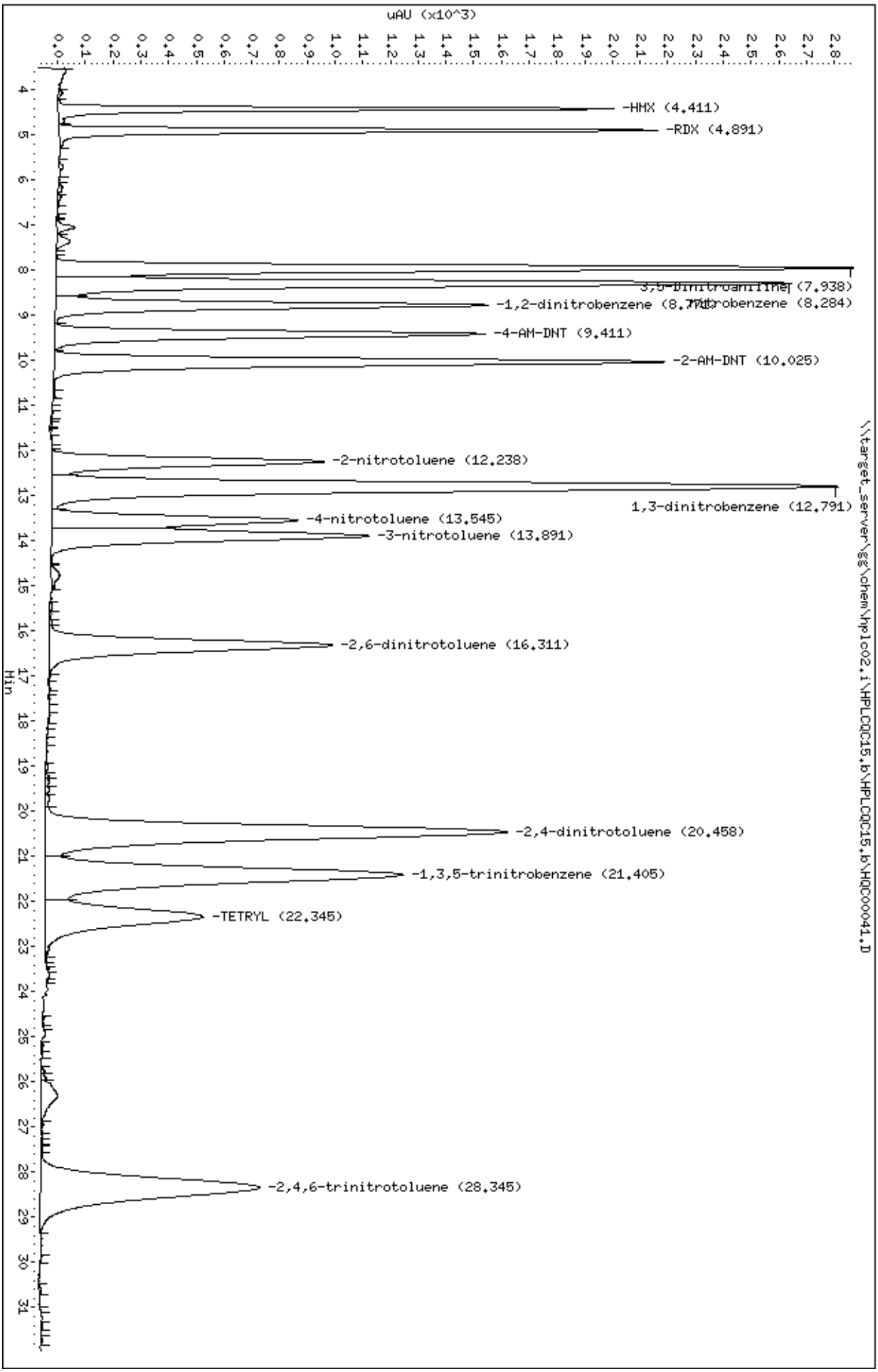
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.411	4.396	0.015	2001	0.25000	0.254	
4	RDX	4.891	4.876	0.015	2156	0.25000	0.254	
51	3,5-Dinitroaniline	7.937	7.896	0.041	2874	0.25000	0.254	
7	nitrobenzene	8.284	8.250	0.034	2650	0.25000	0.225(a)	
$ 2	1,2-dinitrobenzene	8.771	8.723	0.048	1559	0.25000	0.243(a)	
11	4-AM-DNT	9.411	9.350	0.061	1553	0.25000	0.256	
12	2-AM-DNT	10.024	9.963	0.061	2200	0.25000	0.256	
15	2-nitrotoluene	12.237	12.183	0.054	983	0.25000	0.251(M)	M6
6	1,3-dinitrobenzene	12.791	12.723	0.068	2836	0.25000	0.255	
16	4-nitrotoluene	13.544	13.483	0.061	888	0.25000	0.256	
17	3-nitrotoluene	13.891	13.830	0.061	1143	0.25000	0.258(M)	M6
13	2,6-dinitrotoluene	16.311	16.216	0.095	1021	0.25000	0.251	
14	2,4-dinitrotoluene	20.457	20.310	0.147	1666	0.25000	0.239(a)	
5	1,3,5-trinitrobenzene	21.404	21.196	0.208	1287	0.25000	0.264	
9	TETRYL	22.344	22.123	0.221	569	0.25000	0.245(aM)	M6
10	2,4,6-trinitrotoluene	28.344	28.076	0.268	791	0.25000	0.260(M)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00041.D
Date : 15-MAR-2023 11:16
Client ID:
Sample Info: WG333590-4
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00041.D
uAU (x10^3)
Min
-HMX (4.411)
-RDX (4.891)
3,5-Dinitroaniline (7.938)
-1,2-dinitrobenzene (8.284)
-4-AM-DNT (9.411)
-2-AM-DNT (10.025)
-2-nitrotoluene (12.238)
1,3-dinitrobenzene (12.791)
-4-nitrotoluene (13.545)
-3-nitrotoluene (13.891)
-2,6-dinitrotoluene (16.311)
-2,4-dinitrotoluene (20.458)
-1,3,5-trinitrobenzene (21.405)
-TETRYL (22.345)
-2,4,6-trinitrotoluene (28.345)

Data File: HQC00042.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00042.D
Lab Smp Id: WG333590-5
Inj Date : 15-MAR-2023 11:50
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-5
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:50   Cal File: HQC00042.D
Als bottle: 1   Calibration Sample, Level: 5
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

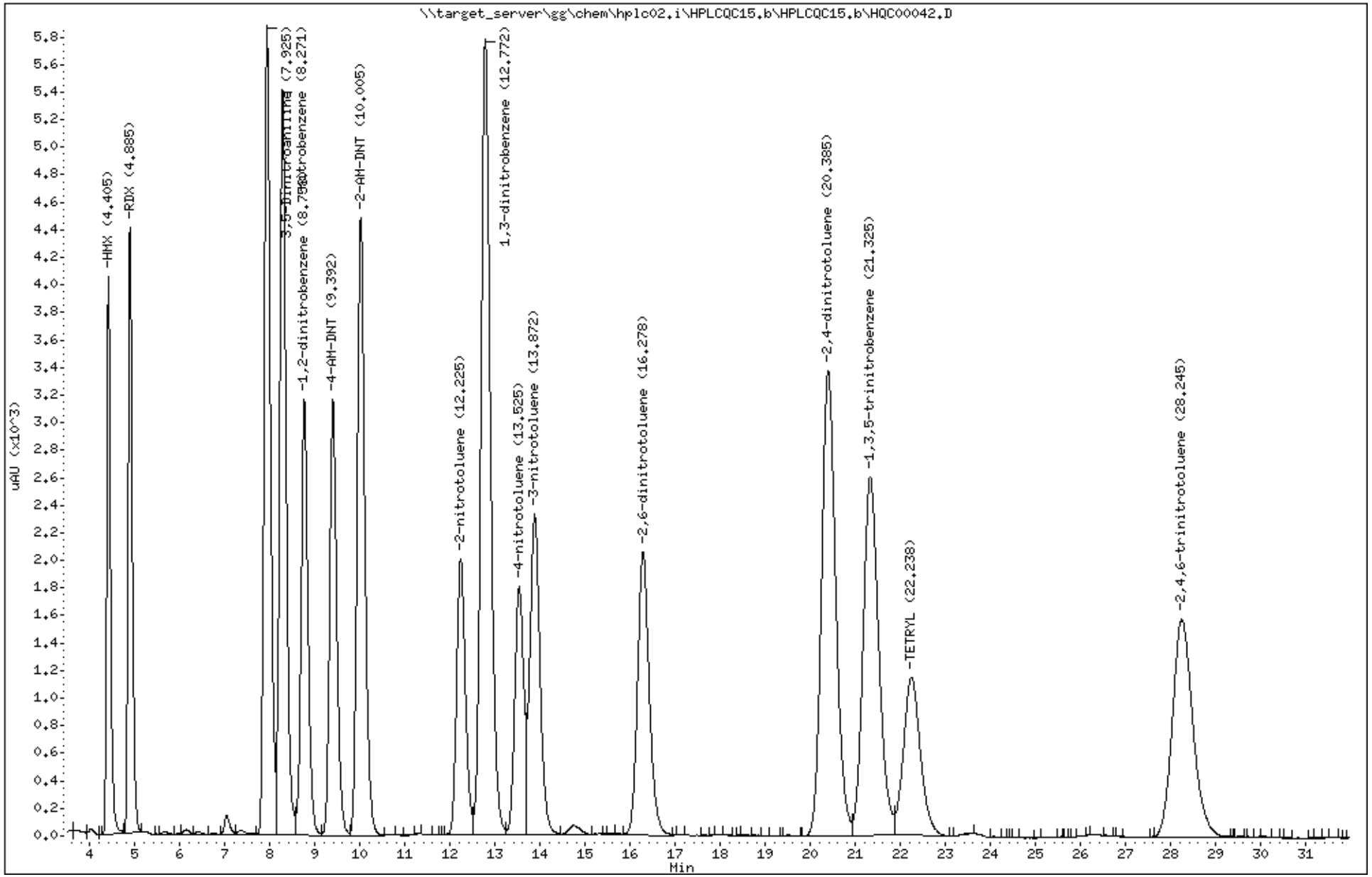
EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.404	4.396	0.008	4047	0.50000	0.500(M)	M2
4	RDX	4.884	4.876	0.008	4391	0.50000	0.500(M)	M2
51	3,5-Dinitroaniline	7.924	7.896	0.028	5881	0.50000	0.500	
7	nitrobenzene	8.271	8.250	0.021	5417	0.50000	0.500	
$ 2	1,2-dinitrobenzene	8.758	8.723	0.035	3165	0.50000	0.500	
11	4-AM-DNT	9.391	9.350	0.041	3163	0.50000	0.500	
12	2-AM-DNT	10.004	9.963	0.041	4482	0.50000	0.500	
15	2-nitrotoluene	12.224	12.183	0.041	2004	0.50000	0.500	
6	1,3-dinitrobenzene	12.771	12.723	0.048	5776	0.50000	0.500	
16	4-nitrotoluene	13.524	13.483	0.041	1805	0.50000	0.500	
17	3-nitrotoluene	13.871	13.830	0.041	2325	0.50000	0.500	
13	2,6-dinitrotoluene	16.278	16.216	0.062	2052	0.50000	0.500	
14	2,4-dinitrotoluene	20.384	20.310	0.074	3378	0.50000	0.500	
5	1,3,5-trinitrobenzene	21.324	21.196	0.128	2605	0.50000	0.500	
9	TETRYL	22.238	22.123	0.115	1147	0.50000	0.500	
10	2,4,6-trinitrotoluene	28.244	28.076	0.168	1581	0.50000	0.500	

QC Flag Legend

M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00042.D
Date : 15-MAR-2023 11:50
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-5
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: HQC00043.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00043.D
Lab Smp Id: WG333590-6
Inj Date : 15-MAR-2023 12:25
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-6
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 12:25   Cal File: HQC00043.D
Als bottle: 1   Calibration Sample, Level: 6
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

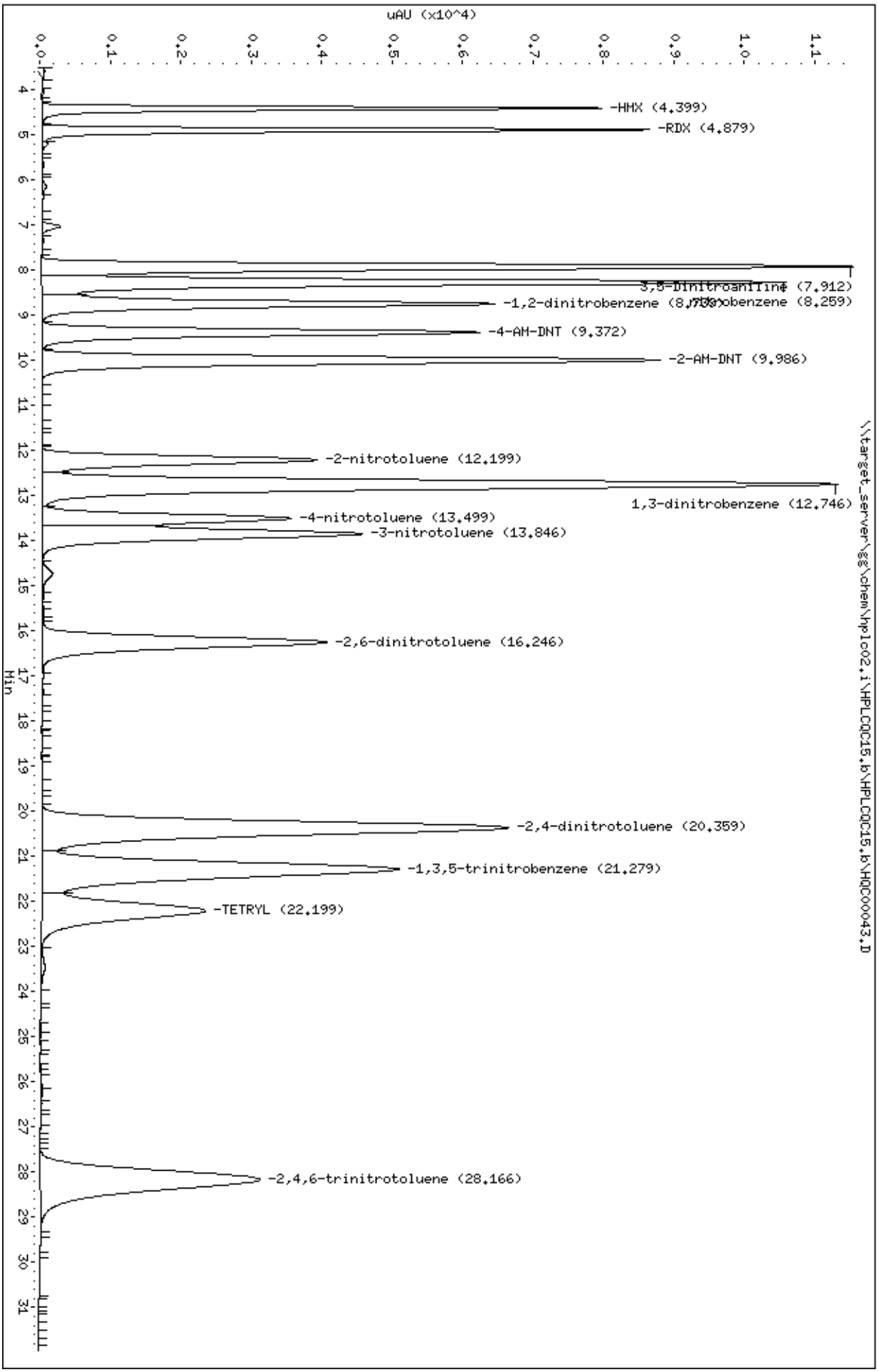
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.398	4.396	0.002	7940	1.00000	1.01(M)	M6
4	RDX	4.878	4.876	0.002	8611	1.00000	1.01(M)	M6
51	3,5-Dinitroaniline	7.912	7.896	0.016	11517	1.00000	1.01(M)	M6
7	nitrobenzene	8.258	8.250	0.008	10558	1.00000	0.911	
$ 2	1,2-dinitrobenzene	8.738	8.723	0.015	6427	1.00000	0.953	
11	4-AM-DNT	9.372	9.350	0.022	6207	1.00000	1.02(M)	M6
12	2-AM-DNT	9.985	9.963	0.022	8778	1.00000	1.02	
15	2-nitrotoluene	12.198	12.183	0.015	3912	1.00000	0.999	
6	1,3-dinitrobenzene	12.745	12.723	0.022	11296	1.00000	1.01	
16	4-nitrotoluene	13.498	13.483	0.015	3522	1.00000	1.01	
17	3-nitrotoluene	13.845	13.830	0.015	4535	1.00000	1.02	
13	2,6-dinitrotoluene	16.245	16.216	0.029	4038	1.00000	0.994	
14	2,4-dinitrotoluene	20.358	20.310	0.048	6626	1.00000	0.958	
5	1,3,5-trinitrobenzene	21.278	21.196	0.082	5069	1.00000	1.03	
9	TETRYL	22.198	22.123	0.075	2324	1.00000	1.00(M)	M6
10	2,4,6-trinitrotoluene	28.165	28.076	0.089	3128	1.00000	1.02	

QC Flag Legend

M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00043.D
Date : 15-MAR-2023 12:25
Client ID:
Sample Info: WG333590-6
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00043.D
uAU (x10^4)
Min
-HMX (4.399)
-RDX (4.879)
3,5-Dinitroaniline (7.912)
-1,2-dinitrobenzene (8.259)
-4-AM-DNT (9.372)
-2-AM-DNT (9.986)
-2-nitrotoluene (12.199)
1,3-dinitrobenzene (12.746)
-4-nitrotoluene (13.499)
-3-nitrotoluene (13.846)
-2,6-dinitrotoluene (16.246)
-2,4-dinitrotoluene (20.359)
-1,3,5-trinitrobenzene (21.279)
-TETRYL (22.199)
-2,4,6-trinitrotoluene (28.166)

Data File: HQC00044.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00044.D
Lab Smp Id: WG333590-7
Inj Date : 15-MAR-2023 13:00
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-7
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Calibration Sample, Level: 7
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

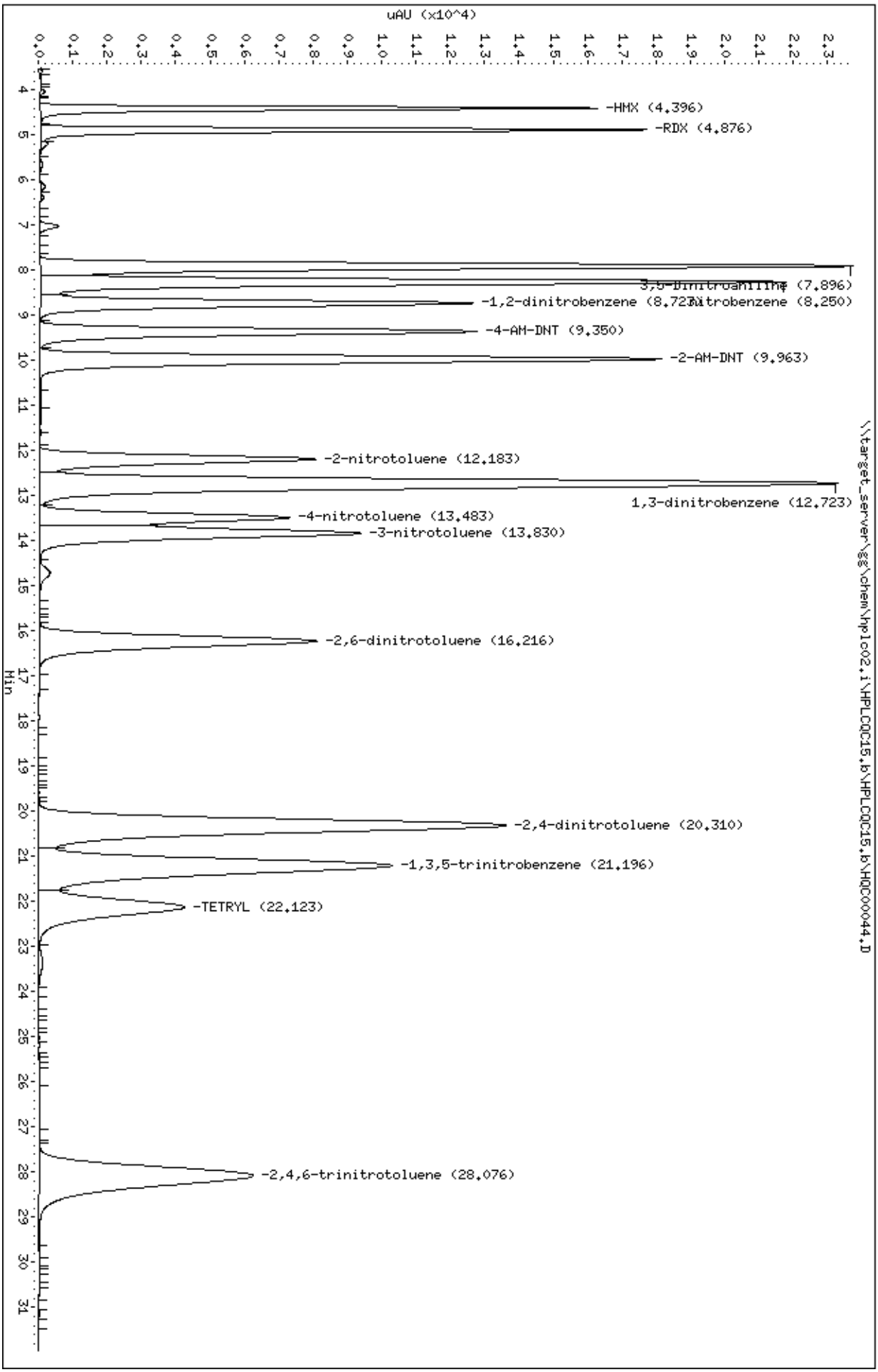
Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.396	4.396	0.000	16250	2.00000	2.05(A)	
4	RDX	4.876	4.876	0.000	17667	2.00000	2.06(A)	
51	3,5-Dinitroaniline	7.896	7.896	0.000	23689	2.00000	2.07(A)	
7	nitrobenzene	8.249	8.250	-0.001	21716	2.00000	1.89	
$ 2	1,2-dinitrobenzene	8.722	8.723	-0.001	12607	2.00000	1.89	
11	4-AM-DNT	9.349	9.350	-0.001	12744	2.00000	2.08(A)	
12	2-AM-DNT	9.962	9.963	-0.001	18124	2.00000	2.09(A)	
15	2-nitrotoluene	12.182	12.183	-0.001	8031	2.00000	2.04(A)	
6	1,3-dinitrobenzene	12.722	12.723	-0.001	23261	2.00000	2.08(A)	
16	4-nitrotoluene	13.482	13.483	-0.001	7272	2.00000	2.08(A)	
17	3-nitrotoluene	13.829	13.830	-0.001	9341	2.00000	2.08(A)	
13	2,6-dinitrotoluene	16.216	16.216	0.000	8083	2.00000	1.99	
14	2,4-dinitrotoluene	20.309	20.310	-0.001	13623	2.00000	1.97	
5	1,3,5-trinitrobenzene	21.196	21.196	0.000	10321	2.00000	2.08(A)	
9	TETRYL	22.122	22.123	-0.001	4257	2.00000	1.84	
10	2,4,6-trinitrotoluene	28.076	28.076	0.000	6249	2.00000	2.04(A)	

QC Flag Legend

A - Target compound detected but, quantitated amount
    exceeded maximum amount.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00044.D
Date : 15-MAR-2023 13:00
Client ID:
Sample Info: WG333590-7
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
uAU (x10^4)
Min
-HMX (4.396)
-RDX (4.876)
3,5-Dinitroaniline (7.896)
-1,2-dinitrobenzene (8.723)
Nitrobenzene (8.250)
-4-AM-DNT (9.350)
-2-AM-DNT (9.963)
-2-nitrotoluene (12.183)
1,3-dinitrobenzene (12.723)
-4-nitrotoluene (13.483)
-3-nitrotoluene (13.830)
-2,6-dinitrotoluene (16.216)
-2,4-dinitrotoluene (20.310)
-1,3,5-trinitrobenzene (21.196)
-TETRYL (22.123)
-2,4,6-trinitrotoluene (28.076)
\\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00044.D

Data File: HQC00045.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00045.D
Lab Smp Id: WG333590-8
Inj Date : 15-MAR-2023 13:35
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-8
Misc Info : WG333590,WG333590,WG333590-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   QC Sample: INDSOURCE
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

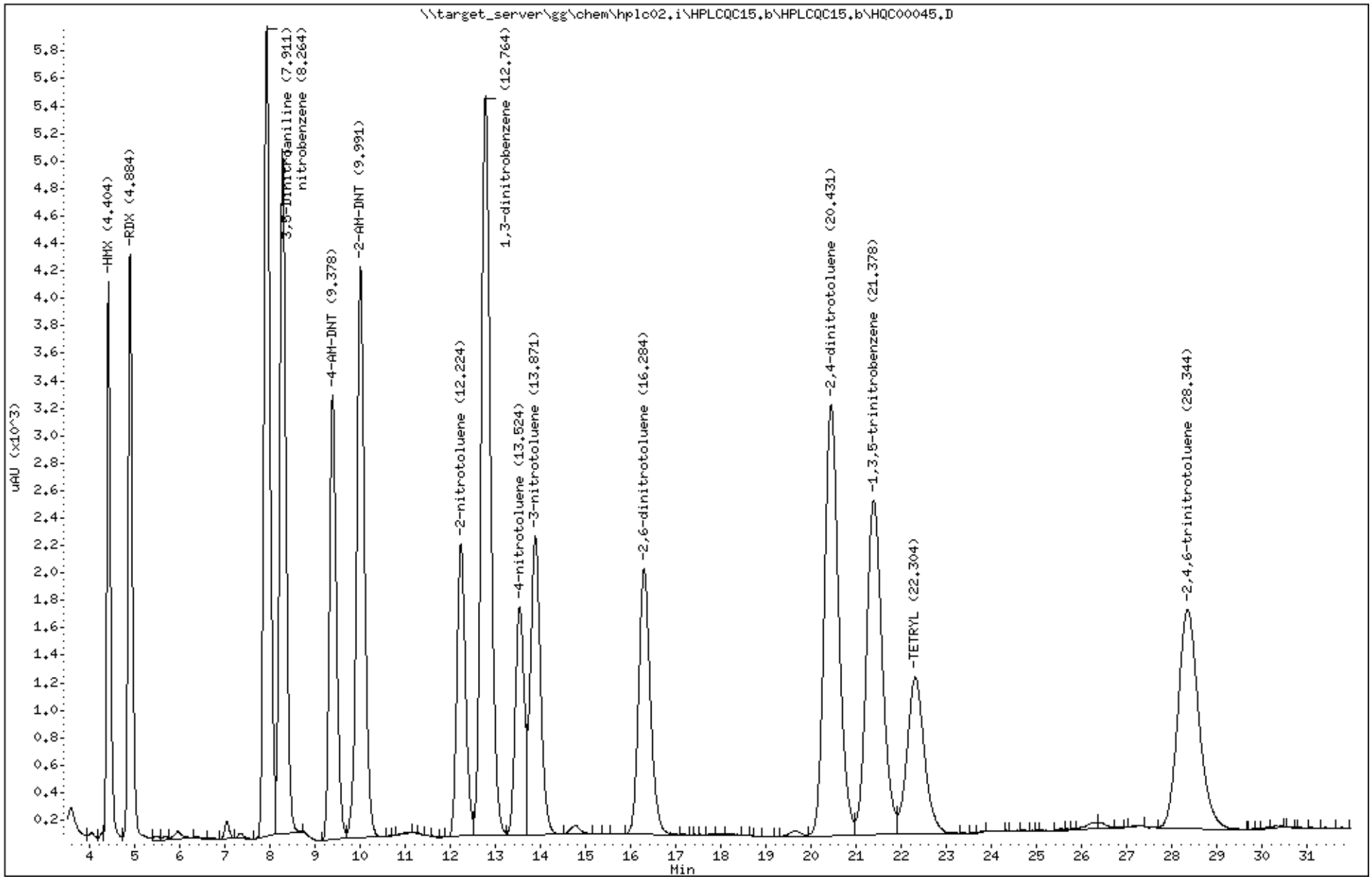
EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE
1	HMX	4.404	4.396	0.008	4096	0.51761	5.18	
4	RDX	4.884	4.876	0.008	4279	0.49980	5.00	
51	3,5-Dinitroaniline	7.910	7.896	0.014	5898	0.51634	5.16	
7	nitrobenzene	8.264	8.250	0.014	4983	0.43390	4.34	
11	4-AM-DNT	9.377	9.350	0.027	3238	0.52888	5.29	
12	2-AM-DNT	9.990	9.963	0.027	4161	0.47927	4.79	
15	2-nitrotoluene	12.224	12.183	0.041	2127	0.54107	5.41	
6	1,3-dinitrobenzene	12.764	12.723	0.041	5384	0.48045	4.80	
16	4-nitrotoluene	13.524	13.483	0.041	1665	0.47552	4.76	
17	3-nitrotoluene	13.870	13.830	0.040	2179	0.48611	4.86	
13	2,6-dinitrotoluene	16.284	16.216	0.068	1938	0.47738	4.77	
14	2,4-dinitrotoluene	20.430	20.310	0.120	3138	0.45481	4.55	
5	1,3,5-trinitrobenzene	21.377	21.196	0.181	2436	0.49216	4.92(M)	M6
9	TETRYL	22.304	22.123	0.181	1140	0.49159	4.92(M)	M6
10	2,4,6-trinitrotoluene	28.344	28.076	0.268	1595	0.52055	5.20(M)	M6

QC Flag Legend

M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00045.D
Date : 15-MAR-2023 13:35
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-8
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1188
Lab ID: WG334249-1
Analytical Date: 03/23/23 07:45
Lab File ID: HQC00151.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 210 um

Compound	RRF/Amount	RF0.500	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
NITROGLYCERIN	6828	7246	0.010	6.10759	20.00000	Averaged

*** = Compound out of QC criteria**

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00151.D
Report Date: 27-Mar-2023 11:56

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00151.D
Lab Smp Id: WG334249-1
Inj Date : 23-MAR-2023 07:45
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334249-1,SQ1188
Misc Info : WG334249,WG334249,WG333590-5,SQ1188-1
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01000	Weight of Sample (Kg)
M	0.00000	% Moisture
Cpnd Variable		Local Compound Variable

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.034	7.034	0.000	14491	2.00000	2.12(a)	
18 PETN	14.734	14.734	0.000	7367	2.00000	2.11(a)	

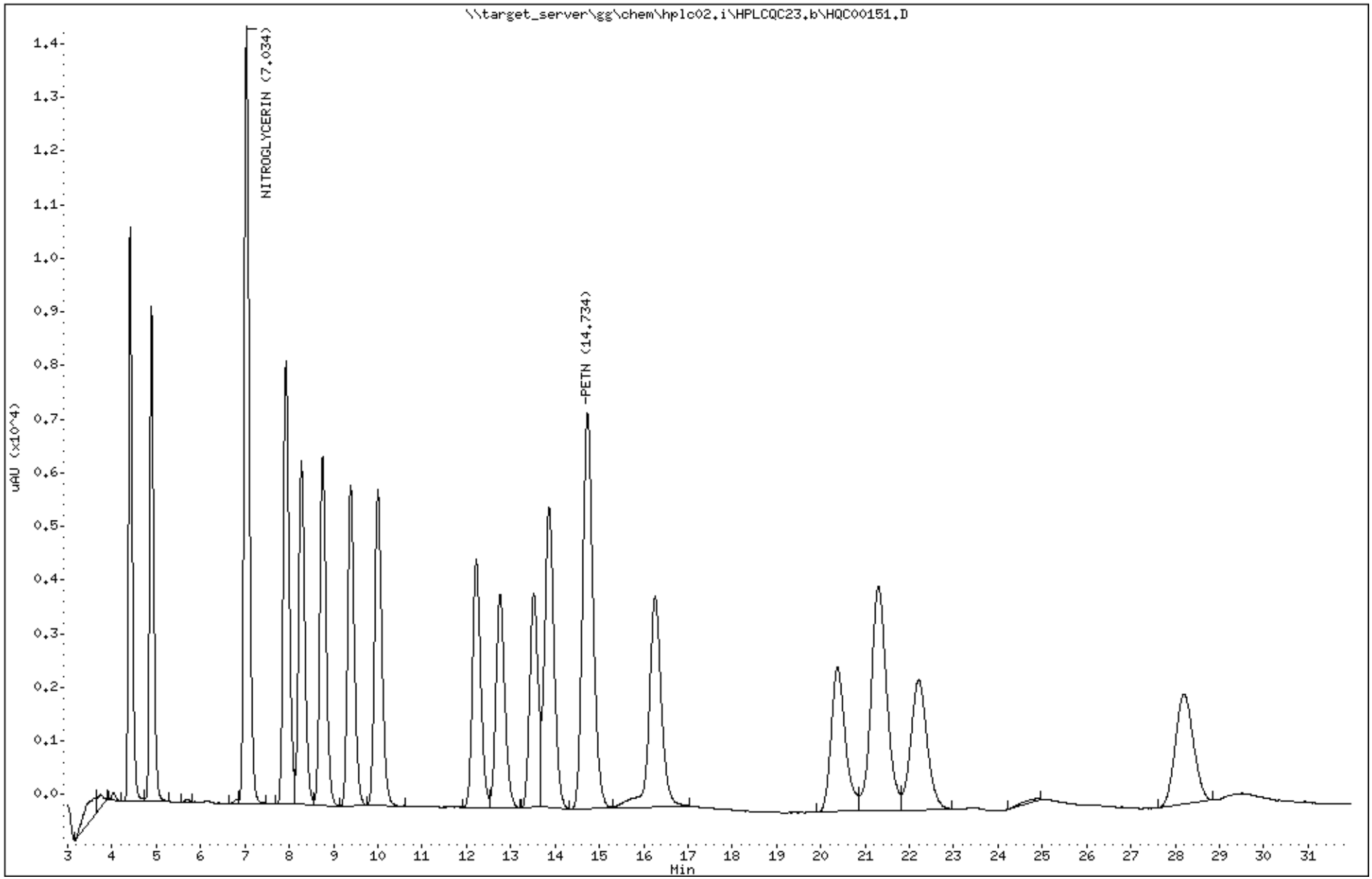
QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00151.D
Date : 23-MAR-2023 07:45
Client ID:
Sample Info: WG334249-1,SQ1188

Instrument: hplc02.i

Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1188
Lab ID: WG334249-1
Analytical Date: 03/23/23 07:45
Lab File ID: HQC00151.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 254 um

Compound	$\overline{RRF}$/Amount	RF0.500	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type	
HMX	7913	8134	0.010	2.78916	20.00000	Averaged	
RDX	8562	8864	0.010	3.53326	20.00000	Averaged	
1,3,5-trinitrobenzene	4950	5418	0.010	9.46244	20.00000	Averaged	
1,3-dinitrobenzene	11206	11936	0.010	6.51369	20.00000	Averaged	
nitrobenzene	11484	11050	0.010	-3.78156	20.00000	Averaged	
TETRYL	2319	2932	0.010	26.43381	20.00000	Averaged	<-
2,4,6-trinitrotoluene	3064	3374	0.010	10.11493	20.00000	Averaged	
4-AM-DNT	6122	6492	0.010	6.03635	20.00000	Averaged	
2-AM-DNT	8682	9220	0.010	6.19673	20.00000	Averaged	
2,6-dinitrotoluene	4060	4386	0.010	8.03906	20.00000	Averaged	
2,4-dinitrotoluene	6900	6994	0.010	1.36757	20.00000	Averaged	
2-nitrotoluene	3931	4188	0.010	6.53584	20.00000	Averaged	
4-nitrotoluene	3501	3724	0.010	6.35659	20.00000	Averaged	
3-nitrotoluene	4483	4794	0.010	6.94925	20.00000	Averaged	
1,2-dinitrobenzene	6678	6380	0.010	-4.46344	20.00000	Averaged	

*** = Compound out of QC criteria**

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Data File: HQC00151.D
Report Date: 27-Mar-2023 11:50

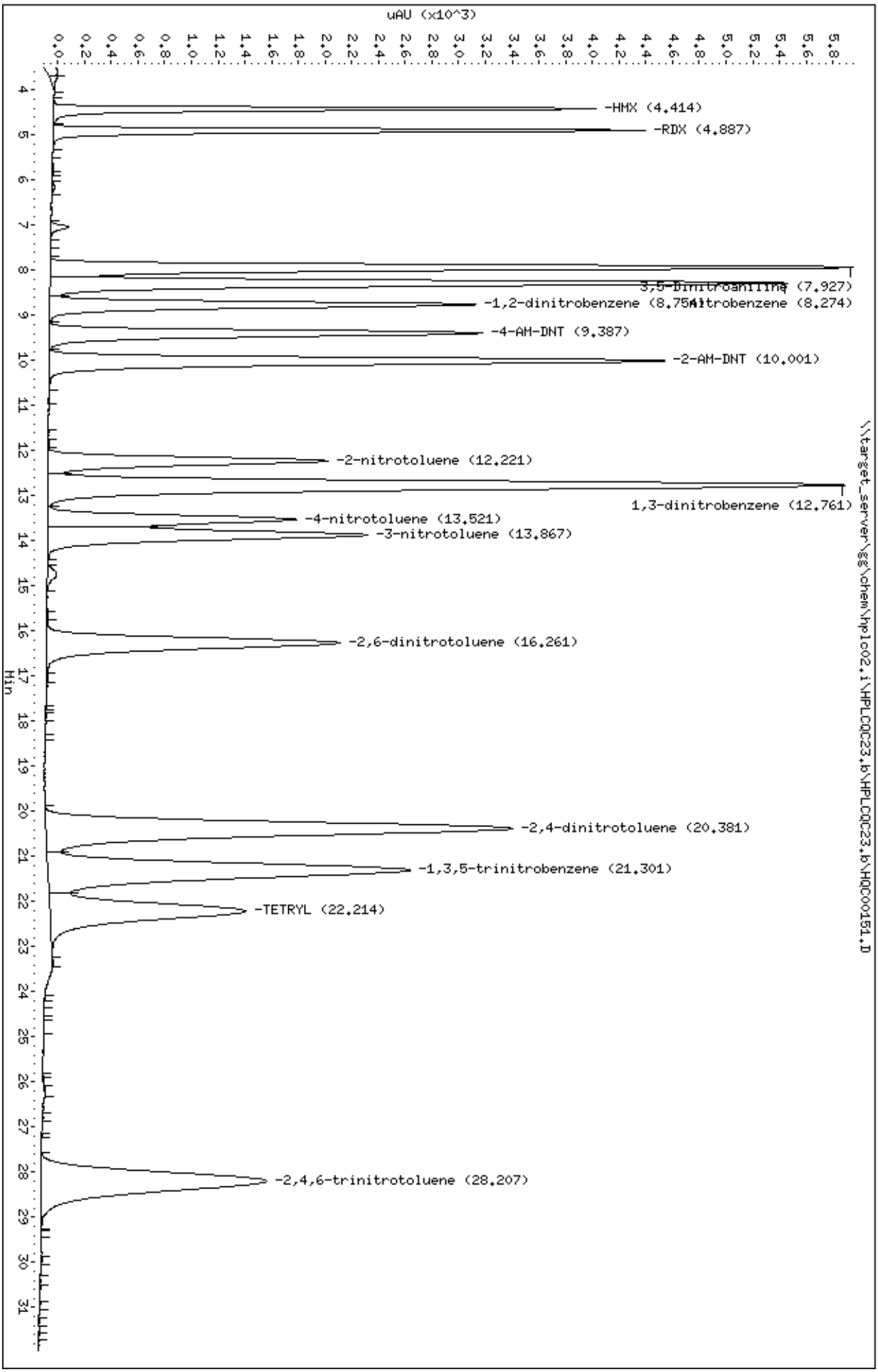
Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00151.D
Lab Smp Id: WG334249-1
Inj Date : 23-MAR-2023 07:45
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334249-1,SQ1188
Misc Info : WG334249,WG334249,WG333590-5,SQ1188-1
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01000	Weight of Sample (Kg)
M	0.00000	% Moisture
Cpnd Variable		Local Compound Variable

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.414	4.414	0.000	4067	0.50000	0.514	
4	RDX	4.887	4.887	0.000	4432	0.50000	0.518	
51	3,5-Dinitroaniline	7.927	7.927	0.000	6010	0.50000	0.526	
7	nitrobenzene	8.274	8.274	0.000	5525	0.50000	0.481	
$ 2	1,2-dinitrobenzene	8.754	8.754	0.000	3190	0.50000	0.478	
11	4-AM-DNT	9.387	9.387	0.000	3246	0.50000	0.530	
12	2-AM-DNT	10.000	10.000	0.000	4610	0.50000	0.531	
15	2-nitrotoluene	12.220	12.220	0.000	2094	0.50000	0.533	
6	1,3-dinitrobenzene	12.760	12.760	0.000	5968	0.50000	0.532	
16	4-nitrotoluene	13.520	13.520	0.000	1862	0.50000	0.532	
17	3-nitrotoluene	13.867	13.867	0.000	2397	0.50000	0.535	
13	2,6-dinitrotoluene	16.260	16.260	0.000	2193	0.50000	0.540	
14	2,4-dinitrotoluene	20.380	20.380	0.000	3497	0.50000	0.507	
5	1,3,5-trinitrobenzene	21.300	21.300	0.000	2709	0.50000	0.547	
9	TETRYL	22.214	22.214	0.000	1466	0.50000	0.632	
10	2,4,6-trinitrotoluene	28.207	28.207	0.000	1687	0.50000	0.550	


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00151.D
Date : 23-MAR-2023 07:45
Client ID:
Sample Info: WG334249-1,SQ1188
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
Column phase: Phenomenex Kinetex
uAU (x10^3)
Min
-HMX (4.414)
-RDX (4.887)
3,5-Dinitroaniline (7.927)
-1,2-dinitrobenzene (8.75
Nitrobenzene (8.274)
-4-AM-DNT (9.387)
-2-AM-DNT (10.001)
-2-nitrotoluene (12.221)
1,3-dinitrobenzene (12.761)
-4-nitrotoluene (13.521)
-3-nitrotoluene (13.867)
-2,6-dinitrotoluene (16.261)
-2,4-dinitrotoluene (20.381)
-1,3,5-trinitrobenzene (21.301)
-TETRYL (22.214)
-2,4,6-trinitrotoluene (28.207)
\\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00151.D

Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1188
Lab ID: WG334249-2
Analytical Date: 03/23/23 15:24
Lab File ID: HQC00164.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 210 um

Compound	RRF/Amount	RF0.250	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
NITROGLYCERIN	6828	7280	0.010	6.61283	20.00000	Averaged

*** = Compound out of QC criteria**

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00164.D
Report Date: 27-Mar-2023 11:59

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00164.D
Lab Smp Id: WG334249-2
Inj Date : 23-MAR-2023 15:24
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334249-2,SQ1188
Misc Info : WG334249,WG334249,WG333590-5,SQ1188-1
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 27-Mar-2023 11:58 hplc02.i   Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01000	Weight of Sample (Kg)
M	0.00000	% Moisture
Cpnd Variable		Local Compound Variable

EP
1:34 pm, Mar 27, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	6.972	7.034	-0.062	7280	1.00000	1.07(aM)	M6
18 PETN	14.578	14.734	-0.156	3815	1.00000	1.09(aM)	M6

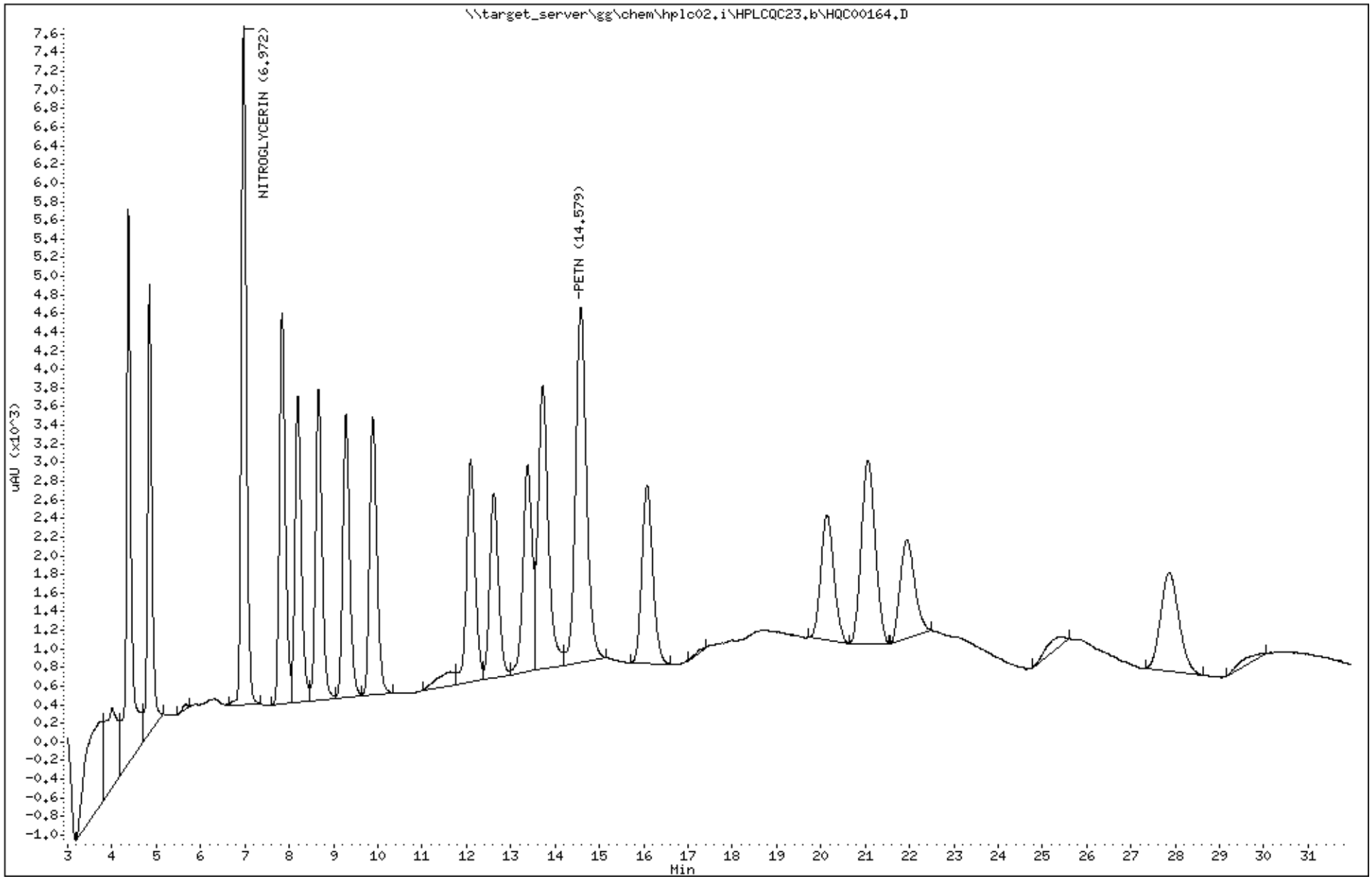
QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00164.D
Date : 23-MAR-2023 15:24
Client ID:
Sample Info: WG334249-2,SQ1188

Instrument: hplc02.i

Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1188 Page 241 of 654

Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1188
Lab ID: WG334249-2
Analytical Date: 03/23/23 15:24
Lab File ID: HQC00164.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 254 um

Compound	$\overline{RRF}$/Amount	RF0.250	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type	
HMX	7913	8284	0.010	4.68471	20.00000	Averaged	
RDX	8562	8956	0.010	4.60784	20.00000	Averaged	
1,3,5-trinitrobenzene	4950	5456	0.010	10.23018	20.00000	Averaged	
1,3-dinitrobenzene	11206	11992	0.010	7.01342	20.00000	Averaged	
nitrobenzene	11484	11032	0.010	-3.93830	20.00000	Averaged	
TETRYL	2319	2856	0.010	23.15653	20.00000	Averaged	<-
2,4,6-trinitrotoluene	3064	3420	0.010	11.61620	20.00000	Averaged	
4-AM-DNT	6122	6556	0.010	7.08169	20.00000	Averaged	
2-AM-DNT	8682	9288	0.010	6.97996	20.00000	Averaged	
2,6-dinitrotoluene	4060	4408	0.010	8.58098	20.00000	Averaged	
2,4-dinitrotoluene	6900	7100	0.010	2.90388	20.00000	Averaged	
2-nitrotoluene	3931	4176	0.010	6.23058	20.00000	Averaged	
4-nitrotoluene	3501	3708	0.010	5.89963	20.00000	Averaged	
3-nitrotoluene	4483	4788	0.010	6.81539	20.00000	Averaged	
1,2-dinitrobenzene	6678	6424	0.010	-3.80456	20.00000	Averaged	

*** = Compound out of QC criteria**

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Data File: HQC00164.D
Report Date: 27-Mar-2023 12:07

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00164.D
Lab Smp Id: WG334249-2
Inj Date : 23-MAR-2023 15:24
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334249-2,SQ1188
Misc Info : WG334249,WG334249,WG333590-5,SQ1188-1
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 27-Mar-2023 11:52 hplc02.i   Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

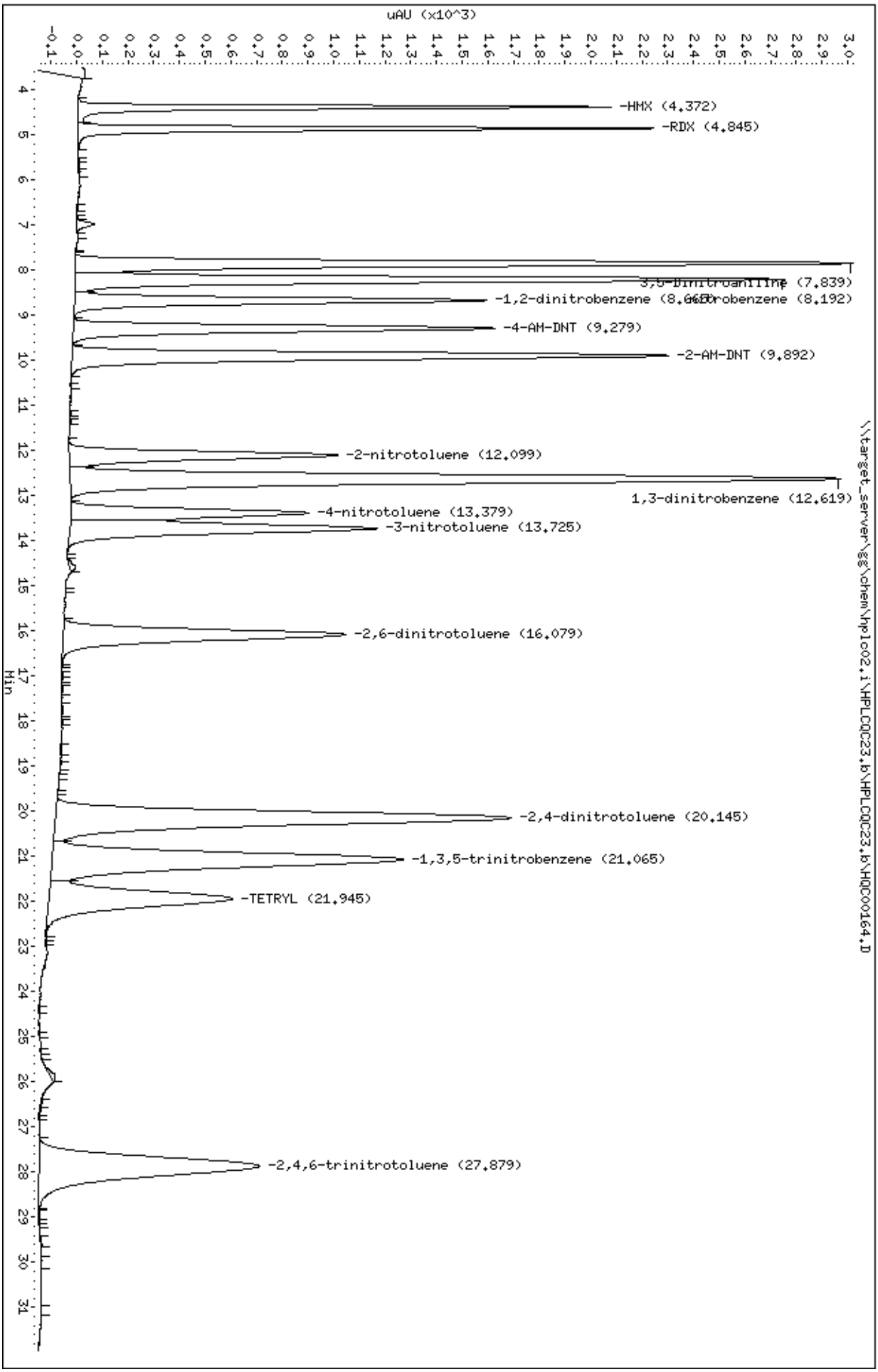
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01000	Weight of Sample (Kg)
M	0.00000	% Moisture
Cpnd Variable		Local Compound Variable

EP
1:34 pm, Mar 27, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.372	4.414	-0.042	2071	0.25000	0.262(aM)	M6
4	RDX	4.845	4.887	-0.042	2239	0.25000	0.262(aM)	M6
51	3,5-Dinitroaniline	7.838	7.927	-0.089	3024	0.25000	0.265(aM)	M6
7	nitrobenzene	8.192	8.274	-0.082	2758	0.25000	0.240(aM)	M6
$ 2	1,2-dinitrobenzene	8.665	8.754	-0.089	1606	0.25000	0.240(a)	
11	4-AM-DNT	9.278	9.387	-0.109	1639	0.25000	0.268(aM)	M6
12	2-AM-DNT	9.892	10.000	-0.108	2322	0.25000	0.267(aM)	M6
15	2-nitrotoluene	12.098	12.220	-0.122	1044	0.25000	0.266(aM)	M6
6	1,3-dinitrobenzene	12.618	12.760	-0.142	2998	0.25000	0.268(aM)	M6
16	4-nitrotoluene	13.378	13.520	-0.142	927	0.25000	0.265(aM)	M6
17	3-nitrotoluene	13.725	13.867	-0.142	1197	0.25000	0.267(aM)	M6
13	2,6-dinitrotoluene	16.078	16.260	-0.182	1102	0.25000	0.271(aM)	M6
14	2,4-dinitrotoluene	20.145	20.380	-0.235	1775	0.25000	0.257(aM)	M6
5	1,3,5-trinitrobenzene	21.065	21.300	-0.235	1364	0.25000	0.276(aM)	M6
9	TETRYL	21.945	22.214	-0.269	714	0.25000	0.308(aM)	M6
10	2,4,6-trinitrotoluene	27.878	28.207	-0.329	855	0.25000	0.279(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00164.D
Date : 23-MAR-2023 15:24
Client ID:
Sample Info: WG334249-2,SQ1188
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00164.D
uAU (x10^3)
Min
-HMX (4.372)
-RDX (4.845)
3,5-Dinitroaniline (7.839)
-1,2-dinitrobenzene (8.192)
-4-AM-DNT (9.279)
-2-AM-DNT (9.892)
-2-nitrotoluene (12.099)
1,3-dinitrobenzene (12.619)
-4-nitrotoluene (13.379)
-3-nitrotoluene (13.725)
-2,6-dinitrotoluene (16.079)
-2,4-dinitrotoluene (20.145)
-1,3,5-trinitrobenzene (21.065)
-TETRYL (21.945)
-2,4,6-trinitrotoluene (27.879)

Raw QC Data Section

Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1188
Lab ID: WG333925-1
Client ID: Method Blank
Matrix: SL
Lab File ID: HQC00152.D

Sample Date: N/A
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925

Report Date: 27-MAR-23
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	50	ug/Kgdrywt	1	100	100	8.6	50.
RDX	U	50	ug/Kgdrywt	1	100	100	6.8	50.
1,3,5-Trinitrobenzene	U	50	ug/Kgdrywt	1	100	100	6.7	50.
1,3-Dinitrobenzene	U	50	ug/Kgdrywt	1	100	100	6.2	50.
Tetryl	U	50	ug/Kgdrywt	1	100	100	5.4	50.
Nitrobenzene	U	50	ug/Kgdrywt	1	100	100	22.	50.
2,4,6-Trinitrotoluene	U	50	ug/Kgdrywt	1	100	100	6.7	50.
2-Am-DNT	U	50	ug/Kgdrywt	1	100	100	21.	50.
4-Am-DNT	U	50	ug/Kgdrywt	1	100	100	17.	50.
2,6-Dinitrotoluene	U	50	ug/Kgdrywt	1	100	100	27.	50.
2,4-Dinitrotoluene	U	50	ug/Kgdrywt	1	100	100	15.	50.
2-Nitrotoluene	U	50	ug/Kgdrywt	1	100	100	12.	50.
3-Nitrotoluene	U	50	ug/Kgdrywt	1	100	100	7.9	50.
4-Nitrotoluene	U	50	ug/Kgdrywt	1	100	100	27.	50.
Nitroglycerin	U	400	ug/Kgdrywt	1	800	800	120	400
1,2-Dinitrobenzene		104.	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00152.D
Report Date: 27-Mar-2023 11:56

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00152.D
Lab Smp Id: WG333925-1 Client Smp ID: WG333925-Blank
Inj Date : 23-MAR-2023 08:27
Operator : EP Inst ID: hplc02.i
Smp Info : WG333925-1,SQ1188
Misc Info : WG334249,WG333925,WG333590-5,SQ1188-1
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: BLANK
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01000	Weight of Sample (Kg)
M	0.00000	% Moisture
Cpnd Variable		Local Compound Variable

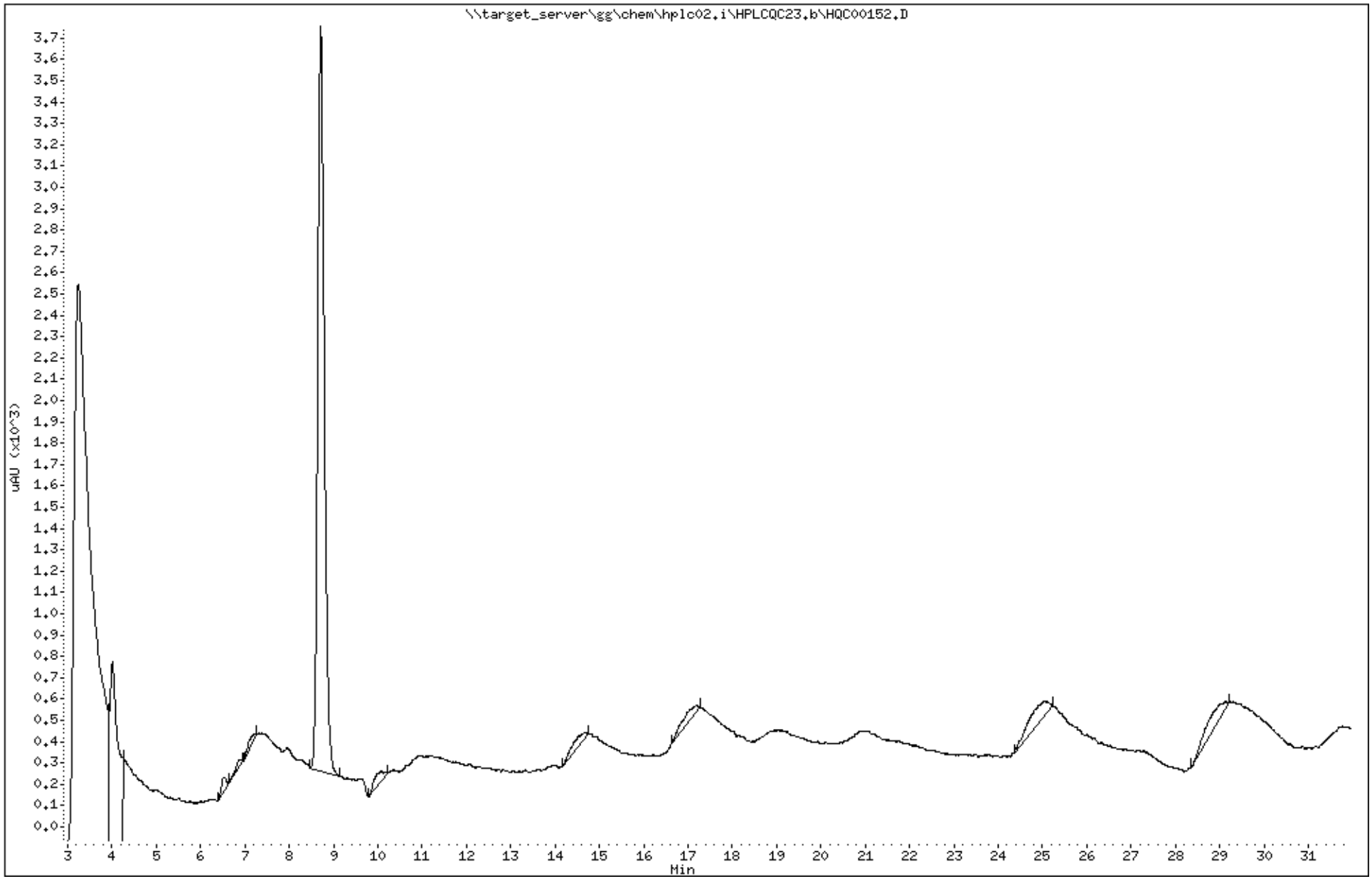
Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00152.D
Date : 23-MAR-2023 08:27
Client ID: WG333925-Blank
Sample Info: WG333925-1,SQ1188

Instrument: hplc02.i

Operator: EP
Column diameter: 4.60

Column phase: Phenomenex Kinetex



Data File: HQC00152.D
Report Date: 27-Mar-2023 11:50

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00152.D
Lab Smp Id: WG333925-1 Client Smp ID: WG333925-Blank
Inj Date : 23-MAR-2023 08:27
Operator : EP Inst ID: hplc02.i
Smp Info : WG333925-1,SQ1188
Misc Info : WG334249,WG333925,WG333590-5,SQ1188-1
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: BLANK
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01000	Weight of Sample (Kg)
M	0.00000	% Moisture
Cpnd Variable		Local Compound Variable

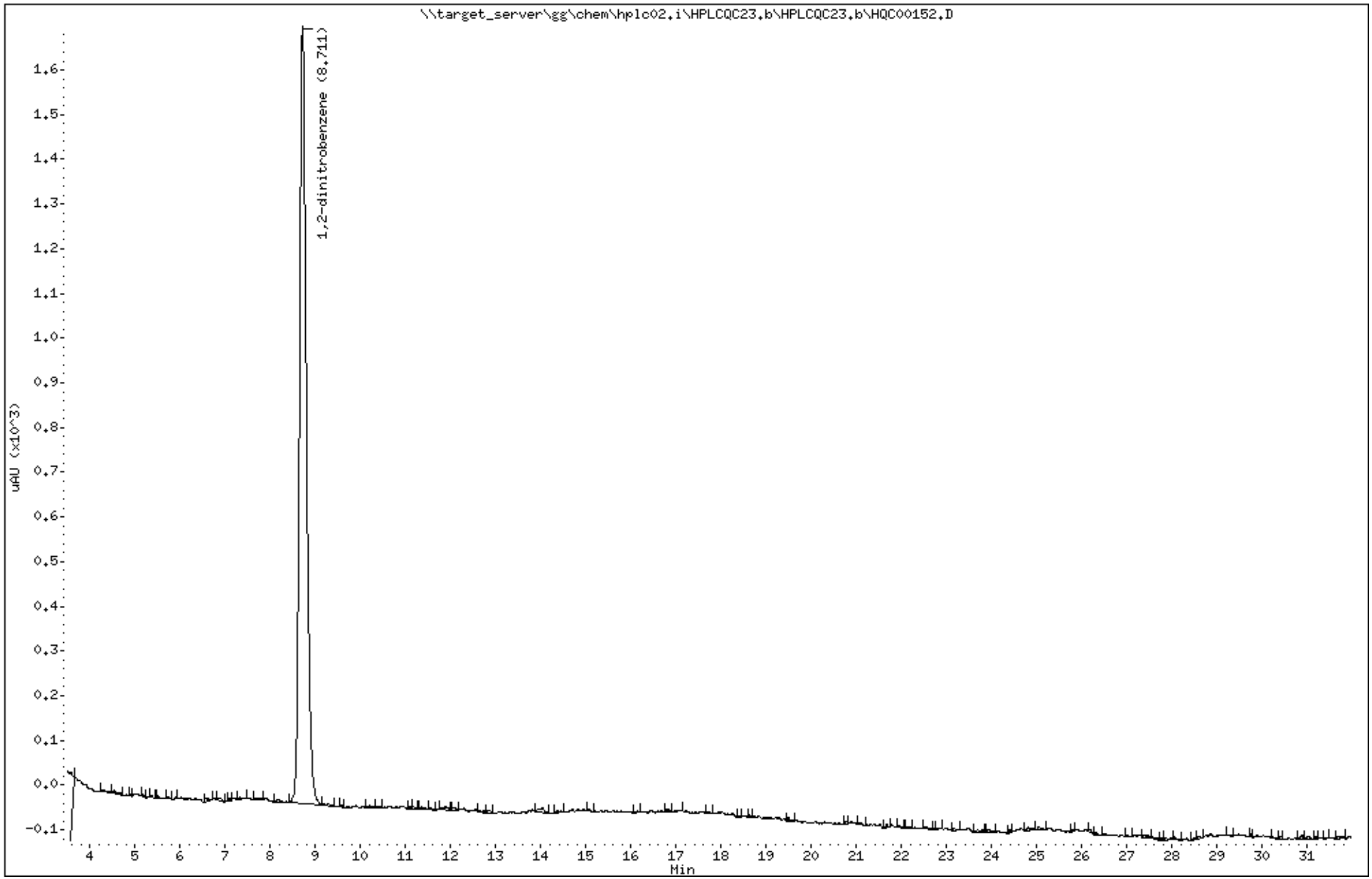
						CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	
Compounds	RT	EXP RT	DLT RT	RESPONSE				REVIEW CODE
$ 2 1,2-dinitrobenzene	8.710	8.754	-0.044	1739		0.26040	521	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00152.D
Date : 23-MAR-2023 08:27
Client ID: WG333925-Blank
Sample Info: WG333925-1,SQ1188

Instrument: hplc02.i

Operator: EP
Column diameter: 4.60

Column phase: Phenomenex Kinetex



Katahdin Analytical Services SQ1188 Page 250 of 654

Katahdin
ANALYTICAL SERVICES

LCS Recovery Report

Lab ID: WG333925-2
Client ID: LCS
SDG: SQ1188
LCS File ID: HQC00153.D
Report Date: 27-MAR-23
Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925
Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
Matrix: SL

Compound	Recovery (%)	Conc Added	Conc Recovered	Conc Units	Limits
HMX	97.6	1000	976.	ug/Kgdrywt	74-124
RDX	94.6	1000	946.	ug/Kgdrywt	67-129
1,3,5-Trinitrobenzene	102.	1000	1020	ug/Kgdrywt	80-116
1,3-Dinitrobenzene	97.7	1000	977.	ug/Kgdrywt	73-119
Tetryl	* 142.	1000	1420	ug/Kgdrywt	68-135
Nitrobenzene	88.1	1000	881.	ug/Kgdrywt	67-129
2,4,6-Trinitrotoluene	114.	1000	1140	ug/Kgdrywt	71-120
2-Am-DNT	96.8	1000	968.	ug/Kgdrywt	71-123
4-Am-DNT	108.	1000	1080	ug/Kgdrywt	64-127
2,6-Dinitrotoluene	101.	1000	1010	ug/Kgdrywt	79-117
2,4-Dinitrotoluene	94.4	1000	944.	ug/Kgdrywt	75-121
2-Nitrotoluene	113.	1000	1130	ug/Kgdrywt	70-124
3-Nitrotoluene	101.	1000	1010	ug/Kgdrywt	67-129
4-Nitrotoluene	99.4	1000	994.	ug/Kgdrywt	71-124
Nitroglycerin	102.	1000	1020	ug/Kgdrywt	73-124
1,2-Dinitrobenzene	101.				78-119

600 Technology Way
P.O. Box 540, Scarborough, ME 04070
Tel:(207) 874-2400 Fax:(207) 775-4029
http://www.katahdinlab.com

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00153.D
Report Date: 27-Mar-2023 11:56

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00153.D
Lab Smp Id: WG333925-2 Client Smp ID: WG333925-LCS
Inj Date : 23-MAR-2023 09:02
Operator : EP Inst ID: hplc02.i
Smp Info : WG333925-2,SQ1188
Misc Info : WG334249,WG333925,WG333590-5,SQ1188-1
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: LCS
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01000	Weight of Sample (Kg)
M	0.00000	% Moisture
Cpnd Variable		Local Compound Variable

EP
1:34 pm, Mar 27, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE
8 NITROGLYCERIN	7.001	7.034	-0.033	3475	0.50890	1020(M)	M6
18 PETN	14.667	14.734	-0.067	1728	0.49554	991(M)	M6

QC Flag Legend

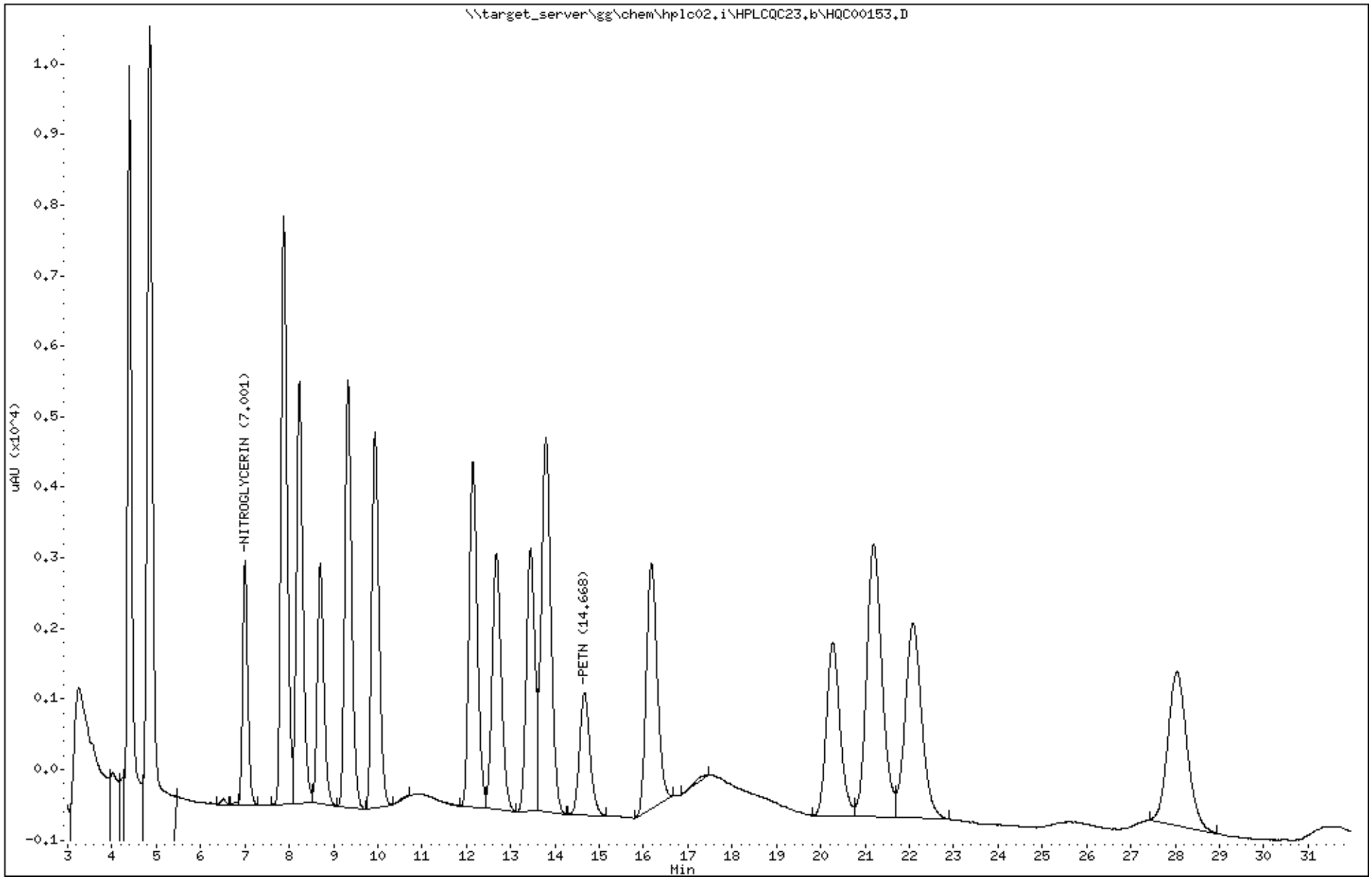
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00153.D
Date : 23-MAR-2023 09:02
Client ID: WG333925-LCS
Sample Info: WG333925-2,SQ1188

Instrument: hplc02.i

Operator: EP
Column diameter: 4.60

Column phase: Phenomenex Kinetex



Katahdin Analytical Services SQ1188 Page 253 of 654

Data File: HQC00153.D
Report Date: 27-Mar-2023 11:50

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00153.D
Lab Smp Id: WG333925-2 Client Smp ID: WG333925-LCS
Inj Date : 23-MAR-2023 09:02
Operator : EP Inst ID: hplc02.i
Smp Info : WG333925-2,SQ1188
Misc Info : WG334249,WG333925,WG333590-5,SQ1188-1
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: LCS
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

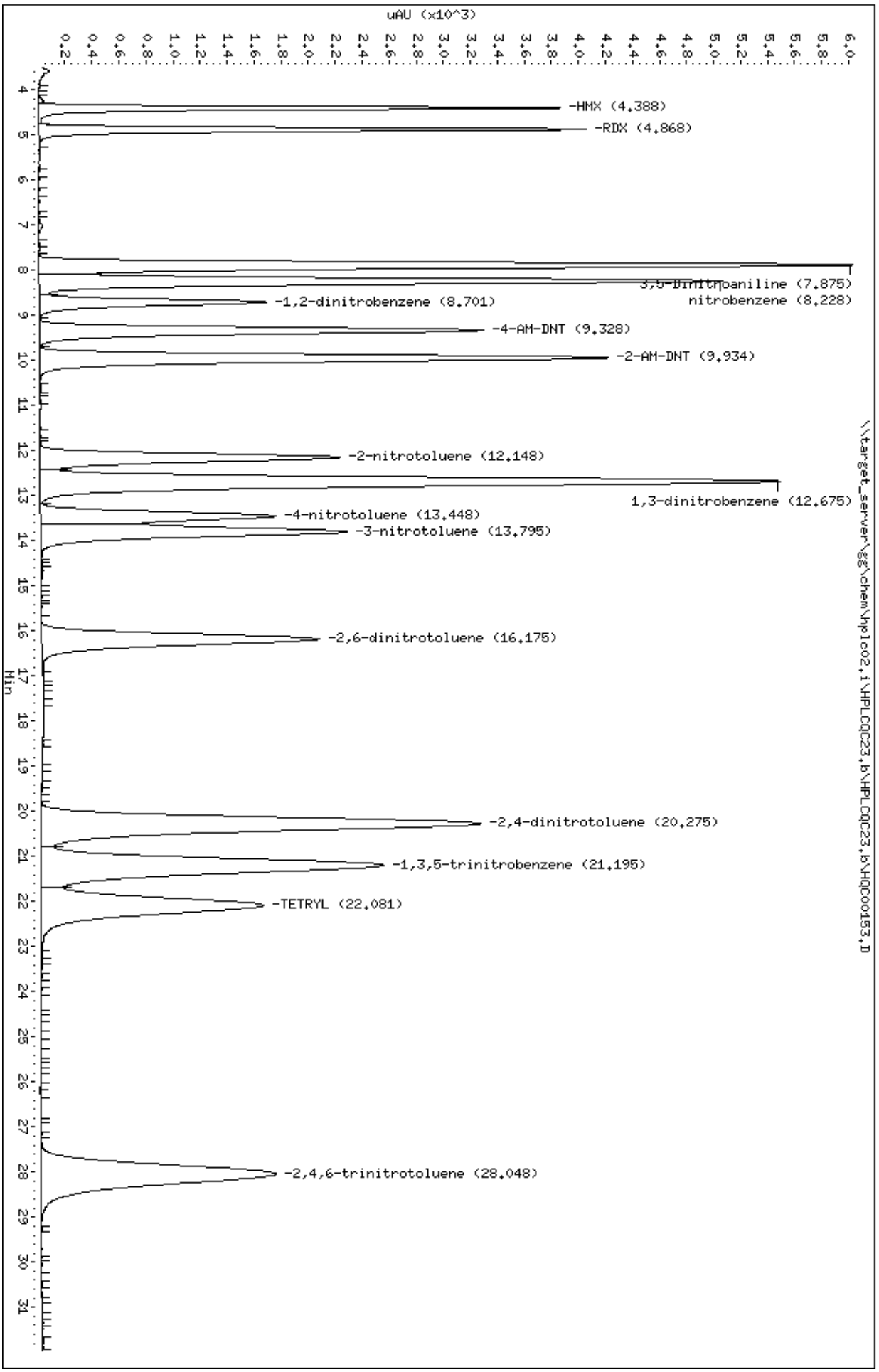
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01000	Weight of Sample (Kg)
M	0.00000	% Moisture
Cpnd Variable		Local Compound Variable

EP
1:34 pm, Mar 27, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE
1	HMX	4.387	4.414	-0.027	3864	0.48829	976(M)	M6
4	RDX	4.867	4.887	-0.020	4049	0.47293	946(M)	M6
51	3,5-Dinitroaniline	7.874	7.927	-0.053	6024	0.52737	1050(M)	M6
7	nitrobenzene	8.227	8.274	-0.047	5060	0.44060	881(M)	M6
$ 2	1,2-dinitrobenzene	8.701	8.754	-0.053	1686	0.25247	505	
11	4-AM-DNT	9.327	9.387	-0.060	3292	0.53770	1080(M)	M6
12	2-AM-DNT	9.934	10.000	-0.066	4204	0.48422	968(M)	M6
15	2-nitrotoluene	12.147	12.220	-0.073	2227	0.56651	1130(M)	M6
6	1,3-dinitrobenzene	12.674	12.760	-0.086	5475	0.48857	977(M)	M6
16	4-nitrotoluene	13.447	13.520	-0.073	1740	0.49694	994(M)	M6
17	3-nitrotoluene	13.794	13.867	-0.073	2274	0.50731	1010	
13	2,6-dinitrotoluene	16.174	16.260	-0.086	2056	0.50645	1010	
14	2,4-dinitrotoluene	20.274	20.380	-0.106	3256	0.47191	944	
5	1,3,5-trinitrobenzene	21.194	21.300	-0.106	2538	0.51276	1020	
9	TETRYL	22.081	22.214	-0.133	1644	0.70893	1420(R)	
10	2,4,6-trinitrotoluene	28.047	28.207	-0.160	1741	0.56820	1140	

QC Flag Legend

R - Spike/Surrogate failed recovery limits.
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00153.D
Date : 23-MAR-2023 09:02
Client ID: WG333925-LCS
Sample Info: WG333925-2,SQ1188
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
Column phase: Phenomenex Kinetex
\\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00153.D
uAU (x10^3)
Min
-HMX (4.388)
-RDX (4.868)
3,5-Dinitroaniline (7.875)
-1,2-dinitrobenzene (8.701)
nitrobenzene (8.228)
-4-AM-DNT (9.328)
-2-AM-DNT (9.934)
-2-nitrotoluene (12.148)
1,3-dinitrobenzene (12.675)
-4-nitrotoluene (13.448)
-3-nitrotoluene (13.795)
-2,6-dinitrotoluene (16.175)
-2,4-dinitrotoluene (20.275)
-1,3,5-trinitrobenzene (21.195)
-TETRYL (22.081)
-2,4,6-trinitrotoluene (28.048)

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ANALYTICAL SERVICES

MS/MSD Recovery Report

MS ID: WG333925-3
MSD ID: WG333925-4
Sample ID: SQ1188-5
Client ID: JACKSON-SDMC3-DC-01
SDG: SQ1188
MS File ID: HQC00157.D

Extract Date: 16-MAR-23
Extracted By: CMW
Extraction Method: SW846 8330B MOD
Lab Prep Batch: WG333925
Report Date: 27-MAR-23
MSD File ID: HQC00158.D

Analysis Date: 23-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
Matrix: SL
% Solids: 74.
Sample File ID: HQC00156.D

Compound	MS Spike	MSD Spike	Conc Units	Samp Conc	MS Conc	MSD Conc	MS Rec (%)	MSD Rec (%)	RPD (%)	RPD Limit	Limits
HMX	1290	1270	ug/Kgdrywt	U65	1300	1300	100.	102.	1	20	74-124
RDX	1290	1270	ug/Kgdrywt	U65	1200	1400	96.7	107.	8	20	67-129
1,3,5-Trinitrobenzene	1290	1270	ug/Kgdrywt	U65	1300	1200	98.2	96.2	4	20	80-116
1,3-Dinitrobenzene	1290	1270	ug/Kgdrywt	U65	1200	1200	95.9	96.9	1	20	73-119
Tetryl	1290	1270	ug/Kgdrywt	UL65	1700	1500	130.	117.	12	20	68-135
Nitrobenzene	1290	1270	ug/Kgdrywt	U65	1100	1100	87.4	89.8	1	20	67-129
2,4,6-Trinitrotoluene	1290	1270	ug/Kgdrywt	U65	1400	1400	111.	110.	3	20	71-120
2-Am-DNT	1290	1270	ug/Kgdrywt	U65	1300	1300	97.4	99.3	0	20	71-123
4-Am-DNT	1290	1270	ug/Kgdrywt	U65	1400	1400	106.	108.	0	20	64-127
2,6-Dinitrotoluene	1290	1270	ug/Kgdrywt	U65	1300	1300	100.	102.	0	20	79-117
2,4-Dinitrotoluene	1290	1270	ug/Kgdrywt	U65	1200	1200	92.8	94.6	0	20	75-121
2-Nitrotoluene	1290	1270	ug/Kgdrywt	U65	1400	1400	111.	114.	1	20	70-124
3-Nitrotoluene	1290	1270	ug/Kgdrywt	U65	1300	1300	99.0	102.	1	20	67-129
4-Nitrotoluene	1290	1270	ug/Kgdrywt	U65	1200	1300	96.7	99.3	1	20	71-124
Nitroglycerin	1290	1270	ug/Kgdrywt	U520	1400	1200	104.	93.8	12	20	73-124
1,2-Dinitrobenzene							103.	109.			78-119

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00157.D
Report Date: 27-Mar-2023 11:56

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Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00157.D
Lab Smp Id: WG333925-3 Client Smp ID: JACKSON-SDMC3-DC-01
Inj Date : 23-MAR-2023 11:21
Operator : EP Inst ID: hplc02.i
Smp Info : WG333925-3,SQ1188
Misc Info : WG334249,WG333925,WG333590-5,SQ1188-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: MS
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01050	Weight of Sample (Kg)
M	26.342	% Moisture
Cpnd Variable		Local Compound Variable

EP
1:34 pm, Mar 27, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE
8 NITROGLYCERIN	7.048	7.034	0.014	3556	0.52076	1350(M)	M6
18 PETN	14.695	14.734	-0.039	1882	0.53971	1400	

QC Flag Legend

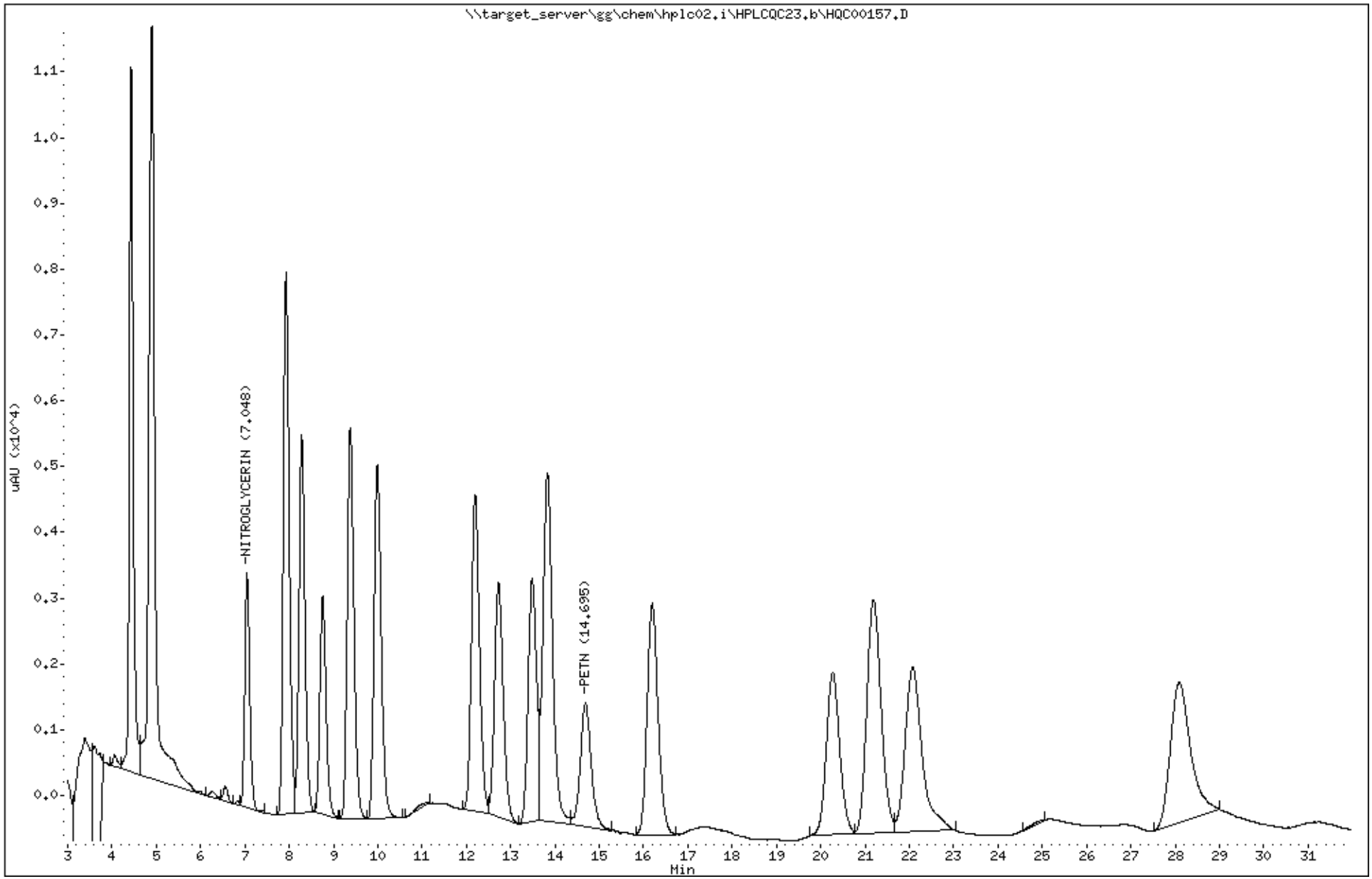
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00157.D
Date : 23-MAR-2023 11:21
Client ID: JACKSON-SDMC3-DC-01
Sample Info: WG333925-3,SQ1188

Instrument: hplc02.i

Operator: EP
Column diameter: 4.60

Column phase: Phenomenex Kinetex



Katahdin Analytical Services SQ1188 Page 258 of 654

Data File: HQC00157.D
Report Date: 27-Mar-2023 11:50

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00157.D
Lab Smp Id: WG333925-3 Client Smp ID: JACKSON-SDMC3-DC-01
Inj Date : 23-MAR-2023 11:21
Operator : EP Inst ID: hplc02.i
Smp Info : WG333925-3,SQ1188
Misc Info : WG334249,WG333925,WG333590-5,SQ1188-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: MS
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

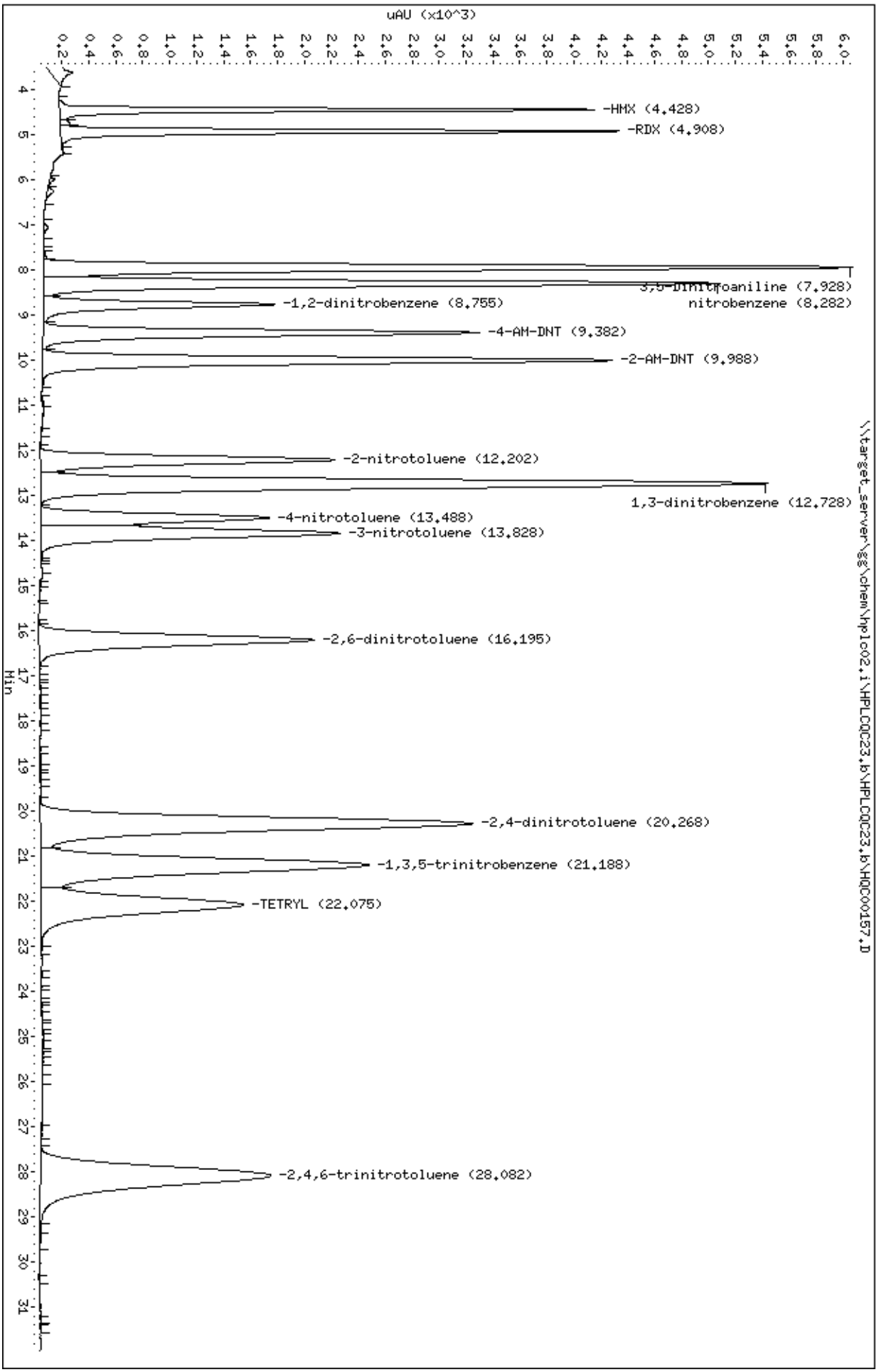
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01050	Weight of Sample (Kg)
M	26.342	% Moisture
Cpnd Variable		Local Compound Variable

EP
1:34 pm, Mar 27, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE
1	HMX	4.428	4.414	0.014	3979	0.50283	1300(M)	M6
4	RDX	4.908	4.887	0.021	4142	0.48379	1250(M)	M6
51	3,5-Dinitroaniline	7.928	7.927	0.001	6009	0.52605	1360	
7	nitrobenzene	8.281	8.274	0.007	5025	0.43755	1130	
$ 2	1,2-dinitrobenzene	8.755	8.754	0.001	1721	0.25771	666	
11	4-AM-DNT	9.381	9.387	-0.006	3237	0.52871	1370	
12	2-AM-DNT	9.988	10.000	-0.012	4227	0.48687	1260	
15	2-nitrotoluene	12.201	12.220	-0.019	2189	0.55685	1440	
6	1,3-dinitrobenzene	12.728	12.760	-0.032	5399	0.48179	1240	
16	4-nitrotoluene	13.488	13.520	-0.032	1697	0.48466	1250	
17	3-nitrotoluene	13.828	13.867	-0.039	2227	0.49682	1280	
13	2,6-dinitrotoluene	16.195	16.260	-0.065	2043	0.50325	1300	
14	2,4-dinitrotoluene	20.268	20.380	-0.112	3211	0.46539	1200	
5	1,3,5-trinitrobenzene	21.188	21.300	-0.112	2437	0.49236	1270	
9	TETRYL	22.075	22.214	-0.139	1506	0.64942	1680	
10	2,4,6-trinitrotoluene	28.081	28.207	-0.126	1709	0.55775	1440	

QC Flag Legend

M - Compound response manually integrated.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Date : 23-MAR-2023 11:21
Client ID: JACKSON-SDMC3-DC-01
Sample Info: WG333925-3,SQ1188
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00157.D
uAU (x10^3)
Min
-HMX (4.428)
-RDX (4.908)
3,5-Dinitroaniline (7.928)
nitrobenzene (8.282)
-1,2-dinitrobenzene (8.755)
-4-AM-DNT (9.382)
-2-AM-DNT (9.988)
-2-nitrotoluene (12.202)
1,3-dinitrobenzene (12.728)
-4-nitrotoluene (13.488)
-3-nitrotoluene (13.828)
-2,6-dinitrotoluene (16.195)
-2,4-dinitrotoluene (20.268)
-1,3,5-trinitrobenzene (21.188)
-TETRYL (22.075)
-2,4,6-trinitrotoluene (28.082)

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00158.D
Report Date: 27-Mar-2023 11:56

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00158.D
Lab Smp Id: WG333925-4 Client Smp ID: JACKSON-SDMC3-DC-01
Inj Date : 23-MAR-2023 11:55
Operator : EP Inst ID: hplc02.i
Smp Info : WG333925-4,SQ1188
Misc Info : WG334249,WG333925,WG333590-5,SQ1188-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m
Meth Date : 23-Mar-2023 07:20 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: MSD
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01070	Weight of Sample (Kg)
M	26.342	% Moisture
Cpnd Variable		Local Compound Variable

EP
1:34 pm, Mar 27, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	FINAL (ug/Kgdrywt)	REVIEW CODE
8 NITROGLYCERIN	6.995	7.034	-0.039	3201	0.46877	1190(M)	M6
18 PETN	14.622	14.734	-0.112	1640	0.47031	1190(M)	M6

QC Flag Legend

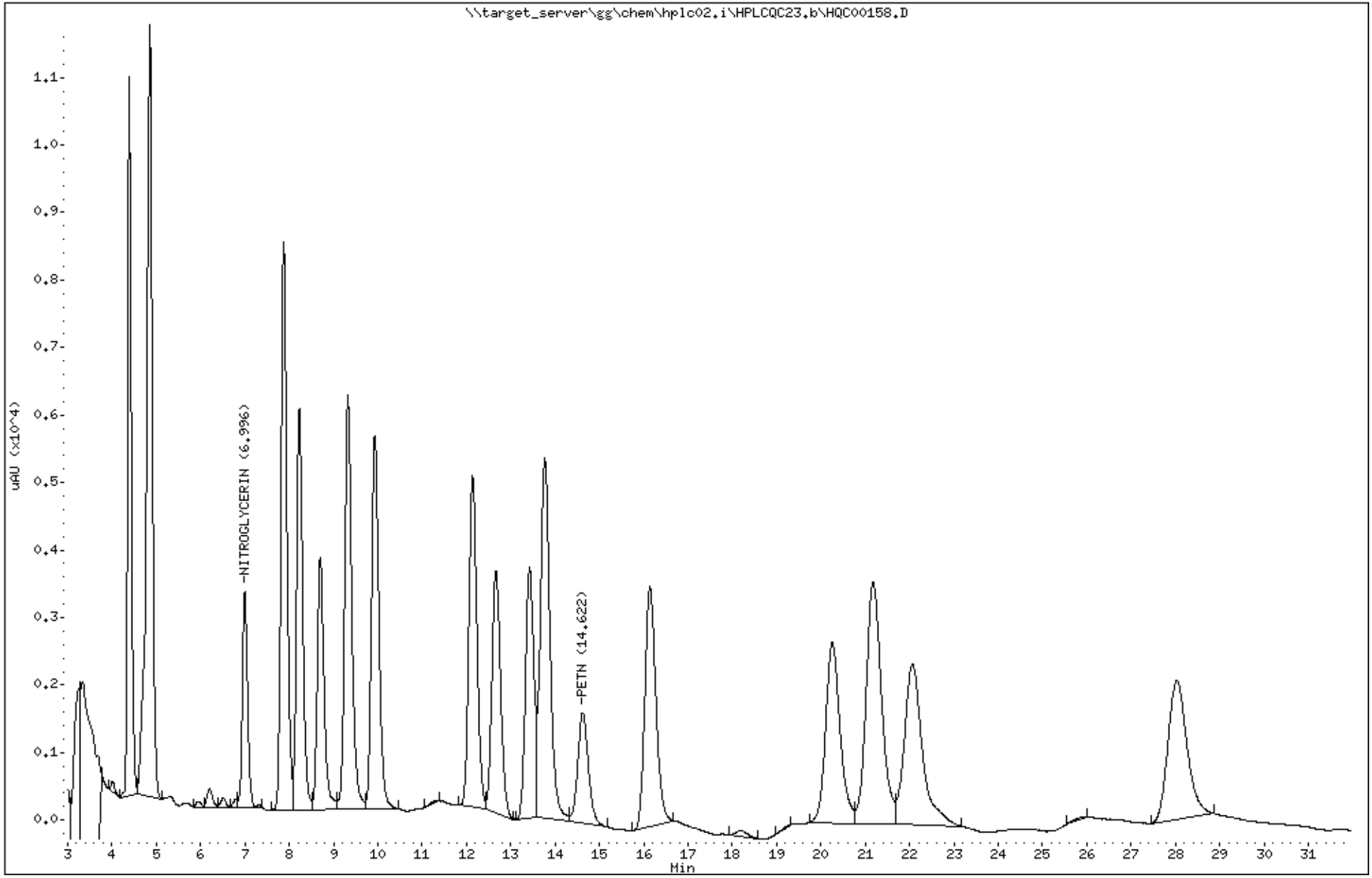
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HQC00158.D
Date : 23-MAR-2023 11:55
Client ID: JACKSON-SDMC3-DC-01
Sample Info: WG333925-4,SQ1188

Instrument: hplc02.i

Operator: EP
Column diameter: 4.60

Column phase: Phenomenex Kinetex



Katahdin Analytical Services SQ1188 Page 262 of 654

Data File: HQC00158.D
Report Date: 27-Mar-2023 11:50

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00158.D
Lab Smp Id: WG333925-4 Client Smp ID: JACKSON-SDMC3-DC-01
Inj Date : 23-MAR-2023 11:55
Operator : EP Inst ID: hplc02.i
Smp Info : WG333925-4,SQ1188
Misc Info : WG334249,WG333925,WG333590-5,SQ1188-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC23.b\EXPB23A.m\EXPB23A.m
Meth Date : 24-Mar-2023 05:29 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: MSD
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*Vt*(1/Ws)*(100/(100-M)) * CpndVariable

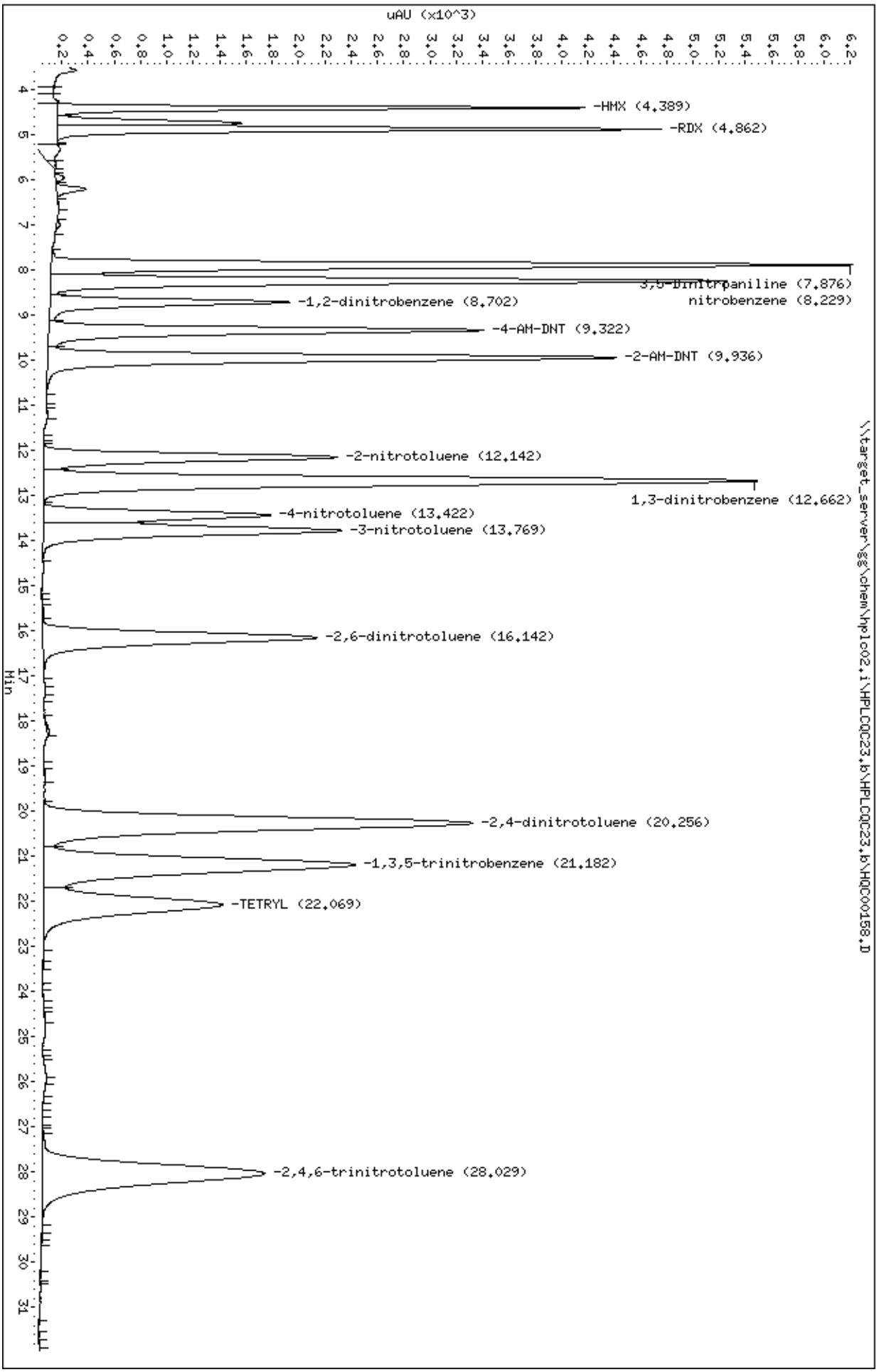
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.02000	Final Volume (L)
Ws	0.01070	Weight of Sample (Kg)
M	26.342	% Moisture
Cpnd Variable		Local Compound Variable

EP
1:34 pm, Mar 27, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/Kgdrywt)	REVIEW CODE
1	HMX	4.389	4.414	-0.025	4012	0.50700	1290(M)	M6
4	RDX	4.862	4.887	-0.025	4599	0.53717	1360(M)	M6
51	3,5-Dinitroaniline	7.875	7.927	-0.052	6095	0.53358	1350(M)	M6
7	nitrobenzene	8.229	8.274	-0.045	5139	0.44748	1140(M)	M6
$ 2	1,2-dinitrobenzene	8.702	8.754	-0.052	1823	0.27298	693	
11	4-AM-DNT	9.322	9.387	-0.065	3303	0.53949	1370(M)	M6
12	2-AM-DNT	9.935	10.000	-0.065	4327	0.49839	1260(M)	M6
15	2-nitrotoluene	12.142	12.220	-0.078	2242	0.57033	1450(M)	M6
6	1,3-dinitrobenzene	12.662	12.760	-0.098	5434	0.48492	1230(M)	M6
16	4-nitrotoluene	13.422	13.520	-0.098	1734	0.49523	1260(M)	M6
17	3-nitrotoluene	13.769	13.867	-0.098	2272	0.50686	1290(M)	M6
13	2,6-dinitrotoluene	16.142	16.260	-0.118	2089	0.51458	1300(M)	M6
14	2,4-dinitrotoluene	20.255	20.380	-0.125	3258	0.47220	1200	
5	1,3,5-trinitrobenzene	21.182	21.300	-0.118	2370	0.47882	1220	
9	TETRYL	22.069	22.214	-0.145	1363	0.58775	1490(M)	M6
10	2,4,6-trinitrotoluene	28.029	28.207	-0.178	1695	0.55319	1400	

QC Flag Legend

M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00158.D
Date : 23-MAR-2023 11:55
Client ID: JACKSON-SDMC3-DC-01
Sample Info: WG333925-4,SQ1188
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
uAU (x10^3)
Min
-HMX (4.389)
-RDX (4.862)
3,5-Dinitroaniline (7.876)
-1,2-dinitrobenzene (8.702)
nitrobenzene (8.229)
-4-AM-DNT (9.322)
-2-AM-DNT (9.936)
-2-nitrotoluene (12.142)
1,3-dinitrobenzene (12.662)
-4-nitrotoluene (13.422)
-3-nitrotoluene (13.769)
-2,6-dinitrotoluene (16.142)
-2,4-dinitrotoluene (20.256)
-1,3,5-trinitrobenzene (21.182)
-TETRYL (22.069)
-2,4,6-trinitrotoluene (28.029)
\\target_server\gg\chem\hplc02.i\HPLCQC23.b\HPLCQC23.b\HQC00158.D

Logbooks and Supporting Documents

Katahdin Analytical Services
Organic Extractions Log – Explosives (Soils)

Method SW846 8330B

Surrogate ID: LC2437	Acetonitrile (ACN) Lot # 21110	Filter Lot No: CX0113
Spike ID (15): LC2436		Vial Lot No: 318881
Spike ID (NG): LC2435		Syringe Lot No: CX0207
Spike ID (PETN): ↓	Extraction Start Time: 3/16 15:20	Balance SN: BAL-03
Spike ID (EGDN): ↓	Extraction End Time: 3/17 9:40	No. 30 Sieve S/N —

Date Extracted	Analyst	Sample Id.	Initial Amount (g)	Surrogate Volume (ml)	Spike Volume (ml)	Final Volume (mL)	Filter 5 ml of Extract	Add 10 ml of Water to ACN Extract	Tray Location	Comments
									QAP 340	R611447
3/16/23	CMW	WG333925-1	10.03	*0.5	.1	20	✓	✓	C4	
↓	↓	-2	10.05	↓	↓	↓	↓	↓	5	LCS
		-3	10.55						6	MS SB1188-5D
		-4	10.71						7	MSD ↓

AP 3/17/23

EX-022 – Revision 2 – 03/21/2018

QAEX453 - 000304 0000186

Date Extracted	Analyst	Sample Id.	Initial Amount (g)	Surrogate Volume (ml)	Spike Volume (ml)	Final Volume (mL)	Filter 5 ml of Extract	Add 10 ml of Water to ACN Extract	Tray Location	Comments
3/16/23	CMW	SB1188-1	11.74	.5	.1	20	✓	✓	C8	
↓	↓	-3	10.11	↓	↓	↓	↓	↓	9	
		-5	10.50						10	
		-7	11.41						11	
		-9	11.37						12	
		-11	10.89						D1	
		-13	10.60						2	
		-15	10.35	↓	↓	↓	↓	↓	3	

AP 3/17/23

EX-022 – Revision 2 – 03/21/2018

Katahdin Analytical Services

HPLC Runlog
Instrument: HPLC02

Method (circle): (8330B MOD.) (8330B)

Column: Phenomenex #559	Injection Volume: 100µL	Standard	Standard ID
Flow Rate: 1.0mL/min	Methanol lot #: EQ853-US EQ601-US	C5	P0786
Detector Wavelengths: 210/254nm ACN lot #: 211110		C4	P0787

Date	Init.	Result File	Sample ID	Y/N	Analyical Workgroup	Method	Comments
15Mar23	EP	HQC00038	C1 0.025/0.1 -1	Y	WL333590	EPA623A	P0787 100-1000
		39	C2 0.05/0.2 -2	Y			P0787 200-1000
		40	C3 0.1/0.4 -3	Y			P0786 200-1000
		41	C4 0.25/1.0 -4	Y			P0787
		42	C5 0.5/2.0 -5	Y			P0786
		43	C6 1.0/4.0 -6	Y			P0785 500-1000
		44	C7 2.0/8.0 -7	Y			P0785
		45	END -8	Y			P0670 Passed
		46	WL333475-1	Y			None
		47	WL333476-1	Y			None
		48	WL333429-1	Y			None
		49	WL333475-2	Y			LCS tetryl
		50	WL333475-3	Y			LCSD tetryl
		51	WL333476-2	Y			LCS tetryl
		52	WL333429-2	Y			LCS tetryl
		53	SQ0938-16RA	Y			None
		54	SQ0938-17RA	Y			None
		55	SQ0938-18RA	Y			None
		56	SQ0951-1	Y			HMX
		57	WL333429-5	Y			SQ0951-1 MS Passed
		58	WL333429-6	Y			SQ0951-1 MSD tetryl
		59	SQ0951-2	Y			RDX 4AM 246DNT NB 2AM 246TNT
		60	SQ0951-3	Y			RDX 4AM 246DNT NB 2AM 246TNT
		61	SQ0951-4	Y			None
		62	SQ0951-5	Y			4AM 2AM
		63	C4 -9	Y			Passed
		64	SQ0951-6	Y			4AM 2AM
		65	SQ0951-7	Y			None

Reviewed by/Date:

Katahdin Analytical Services

HPLC Runlog
Instrument: HPLC02

Method (circle): ~~8330B MOD.~~ (8330B)

Column: Acclaim E2 #577	Injection Volume: 150uL	Standard	Standard ID
Flow Rate: 1.0 mL/min	Methanol lot #: EDS57-US EDL01-US	C5	P0786
Detector Wavelengths: 210/254nm	ACN lot#: 211110	C4	P0787

Date	Init.	Result File	Sample ID	Y/N	Analyical Workgroup	Method	Comments
21Mar22	EP	HQC00145	SQ1137-5C	Y	WG334216	E2B23	None
		46	SQ1154-1C	Y			None
		47	SQ1154-2C	Y			None
		48	SQ1154-4C	Y			None
		49	SQ1154-5C	Y			None
		50	C5 -10	Y			Passed
Phenomenex #559 Primary Column installed 23Mar22							
23Mar22	EP	HQC00151	C5 -1	Y	WG334249	E2B23BA	retyl↑
		52	WG333925-1	Y			None
		53	WG333925-2	Y			LCS retyl↑
		54	SQ1188-1	Y			None
		55	SQ1188-3	Y			None
		56	SQ1188-5	Y			None
		57	WG333925-3	Y			SQ1188-5 MS Passed
		58	WG333925-4	Y			SQ1188-5 MSD Passed
		59	SQ1188-7	Y			Surr 1 (74.03%) None
		60	SQ1188-9	Y			None
		61	SQ1188-11	Y			None
		62	SQ1188-13	Y			None
		63	SQ1188-15	Y			None
		64	C4 -2	Y			retyl↑

Reviewed by/Date: EP 23Mar23

ExPB23A

FORM 8
EXPLOSIVES ANALYTICAL SEQUENCE

Lab Name: Lab Code:

Project: SDG No.: SDGA00508

GC Column: PHENOMENEX KINETEX ID: 4.60 (mm) Init. Calib. Date(s): 03/15/23 03/15/23

Instrument ID: HPLC02

THE ANALYTICAL SEQUENCE OF PERFORMANCE EVALUATION MIXTURES, BLANKS, SAMPLES, AND STANDARDS IS GIVEN BELOW:

MEAN SURROGATE RT FROM INITIAL CALIBRATION
S1 : 8.72

	CLIENT SAMPLE ID	LAB SAMPLE ID	DATE ANALYZED	TIME ANALYZED	S1 RT #	RT #
01		WG333590-1	03/15/23	0932	8.79	
02		WG333590-2	03/15/23	1006	8.79	
03		WG333590-3	03/15/23	1041	8.82	
04		WG333590-4	03/15/23	1116	8.77	
05		WG333590-5	03/15/23	1150	8.76	
06		WG333590-6	03/15/23	1225	8.74	
07		WG333590-7	03/15/23	1300	8.72	
08		WG333590-8	03/15/23	1335		
09						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

QC LIMITS
S1 = 1,2-dinitrobenzene (+/- 0.15 MINUTES)

Column used to flag retention time values with an asterisk.
* Values outside of QC limits.

FORM VIII EXPLOSIVES

FORM 8
EXPLOSIVES ANALYTICAL SEQUENCE

Lab Name: Lab Code:

Project: SDG No.: SQ1188

GC Column: PHENOMENEX KINETEX ID: 4.60 (mm) Init. Calib. Date(s): 03/15/23 03/15/23

Instrument ID: HPLC02

THE ANALYTICAL SEQUENCE OF PERFORMANCE EVALUATION MIXTURES, BLANKS, SAMPLES, AND STANDARDS IS GIVEN BELOW:

MEAN SURROGATE RT FROM INITIAL CALIBRATION
S1 : 8.75

	CLIENT SAMPLE ID	LAB SAMPLE ID	DATE ANALYZED	TIME ANALYZED	S1 RT	#	RT	#
01		WG334249-1	03/23/23	0745	8.75			
02	WG333925-BLA	WG333925-1	03/23/23	0827	8.71			
03	WG333925-LCS	WG333925-2	03/23/23	0902	8.70			
04	JACKSON-SDCC	SQ1188-1	03/23/23	0937	8.74			
05	JACKSON-SDCC	SQ1188-3	03/23/23	1011	8.71			
06	JACKSON-SDMC	SQ1188-5	03/23/23	1046	8.75			
07	JACKSON-SDMC	WG333925-3	03/23/23	1121	8.76			
08	JACKSON-SDMC	WG333925-4	03/23/23	1155	8.70			
09	JACKSON-SDMC	SQ1188-7	03/23/23	1230	8.73			
10	JACKSON-SDCC	SQ1188-9	03/23/23	1305	8.79			
11	JACKSON-SDJC	SQ1188-11	03/23/23	1340	8.68			
12	JACKSON-SDMC	SQ1188-13	03/23/23	1414	8.69			
13	SDDUP	SQ1188-15	03/23/23	1449	8.77			
14		WG334249-2	03/23/23	1524	8.67			
15								
16								
17								
18								
19								
20								

QC LIMITS
S1 = 1,2-dinitrobenzene (+/- 0.15 MINUTES)

Column used to flag retention time values with an asterisk.
* Values outside of QC limits.

FORM VIII EXPLOSIVES

GC EXTRACTION SPIKE STANDARD PREPARATION

Prep Info	Stock #	Stock Name	Amt Added	Stock Conc. ug/mL
GC2388	EPH spike			
AD	STD 9965, STD 9967, STD 9968	Aromatic	2.25 mL	1000 ug/mL
9/13/22	STD 9923, STD 9922, STD 9970	Aliphatic	2.25 mL	V
x 3/13/22	Diluted to 25 mL in Acetone #SOLV 0156			
GC 2389	~~Exp PAH + TPG Spike~~			
CMW	STD 9871	~~PAH~~ TN	~~1.2~~	
~~9/21/22~~	STD 9874	~~EGDN~~	~~1.0~~	
~~x 3/21/22~~	STD 9876	Nitroglycerin	1.2	
	~~Diluted to 4.8 mL in Ac~~			
GC2389	Exp LCS			
CMW	STD 9790 ↑	3,5 Dinitroaniline	0.5	1000 ug/mL
9/21/22	STD 9786 ↓	8330 Calibration	0.5	
x 3/21/23	Diluted to 5mL in ACN #216634			
GC2390	Herb Spike			
CMW	STD9908 - 9907	M-8151A	1.25mL	Various
9/22/22	Diluted to 25mL in MeOH Solv0173			
x 3/22/23	F.c 9.0 ug/mL			
GC 2391	Diazald			
9/26/22	STD 9910 9911	N-Nitro-N-Methylurea	17.2g	
CMW	STD 9927	Carbitol	50mL	
3/26/23	222207 ~~F.C~~	ether	50mL	
GC2392	EPH Surr			
9/26/22	STD 9863 - 9862 - 9864	Oterphenyl	2.25	1000 ug/mL
CMW	STD9602 9603	5 Alpha Androstane	↓	
x3/26/23	Diluted to 250 mL in Acetone / F.C 9.0 ug/mL			

EX-020 – Revision 1 – 07/25/2012

GC EXTRACTION SPIKE STANDARD PREPARATION

PREP INFO	STOCK NAME	AMT ADDED	STOCK CONC.	STOCK#
ID#: GC2434				
Prep Date: 2/28/23				
Initials: AP				STD0017, STD0018
Exp. Date: 8/28/23				
ID#: GC2435	Explosive	P+E+NG spike		
Prep Date: 2/28/23	PETN	1.0 mL	1000 ug/mL	STD 9098
Initials: AP	EGDN			STD 9096
Exp. Date: 8/28/23	Nitroglycerin			STD 9100
	Diluted to	4 mL in ACN	solvo 268	
ID#: GC2436	Explosive	LCS		
Prep Date: 2/28/23	3,5 Dinitroaniline	0.5 mL	1000 ug/mL	STD 9926
Initials: AP	#330 calibration			STD 8832
Exp. Date: 8/28/23	Diluted to	5 mL in ACN	# solvo268	

HERB SPIKE		
M-8151A	1.25 mL	Varied
Diluted to 25mL in MeOH#	Solvo ~~268~~ 275	F.C.: 5.0 ug/mL

#2/28/23 AP

Wrong

EX-020 - Revision 2 - 09/12/2022

*AP 2/28/23 GC EXTRACTION SPIKE STANDARD PREPARATION

PREP INFO	STOCK NAME	AMT ADDED	STOCK CONC.	STOCK#
ID#: GC2437	* ~~EXPOSURE~~ EXP SURR	1,2 DNB		
Prep Date: 2/28/23	1,2-Dinitrobenzene	1.0 mL	1000 ug/mL	STD00150, STD00151
Initials: AP	Diluted to 100 mL in ACN SDW02168			
Exp. Date: 8/28/23				
ID#: GC2438				
Prep Date: 3/17/23				
Initials: AP				STD00018, STD00019
Exp. Date: 9/17/23				
ID#: GC2439				
Prep Date: 3/17/23				
Initials: AP				STD0234, STD0243
Exp. Date: 9/17/23				

HERB SURR		
M-8151B-SS-10X	1.25 mL	1000 ug/mL
Diluted to 250mL in MeOH# ED-601-US		

HERB SPIKE		
M-8151A	1.25 mL	Varied
Diluted to 25mL in MeOH# ED 601-US		F.C.: 5.0 ug/mL

KATAHDIN ANALYTICAL SERVICES

GC PESTICIDES/PCB/HERBICIDES

STANDARD PREPARATION LOG

GC LABORATORY
REVIEWED BY/DATE:

P0664 | AR 1660 1.0 ppm — hexlot 0852 — 10/27/22 — X: 1/13/23 MG
1.0 ml P0652 → 10 ml hexane

P0665 | AR 1660 1.0 ppm — hexlot 0852 — 10/28/22 — X 1/18/23 MG
1.0 ml P0652 → 10 ml hexane

P0666 | AR 1254 1.0 ppm — 10/2/22 — X: 3/17/30 MG
10 ml P0660 → 10 ml hexane

P0667 | Explosives C7 2.0/8.0 — P: 04Nov22 — X: 01Apr23 — EP
+40uL M-8330-R-0.5x (STK6221)
+200uL M-8330-ADD-4 (STK6358)
+8uL M-8330-ADD-1 (STK6223)
+80uL M-8330-ADD-2-10X (STK6220) → into 10mL ACN lot#: 216631
+800uL M-8330-ADD-5 (STD9797) and 20mL DiH_2O
+20uL M-8330-5S (STK6195)
+200uL M-8330-ADD-13 (STK6353)
+200uL M-8330-ADD-12 (STK6354)

P0668 | Explosives C5 0.5/2.0
10mL P0667 into 10mL ACN lot# 216631
and 20mL DiH_2O

P0669 | Explosives C4 0.25/1.0
10mL P0668 into 10mL 1:2 v/v ACN lot 216631: diH_2O
(10mL : 20mL)

P0670 | Explosives Independent Std (IND 0.5/2.0) — P: 04NOV22 — X: 21Mar23 — EP
+20mL each of STD9099 (N6 Stock), STD9097 (PETN Stock) and STD9095 (EDGN Stock)
and 50mL of LCS Stock (6238) into 10mL ACN lot #: 216631
and 20mL DiH_2O

KATAHDIN ANALYTICAL SERVICES

GC PESTICIDES/PCB/HERBICIDES

STANDARD PREPARATION LOG

GC LABORATORY
REVIEWED BY/DATE:

P0780 | AR1268 10.0ppm — MG 2/22/23 — X:8/22/23
100 ul STK6261 → 10 ml hexane #222209

P0781 | AR1016 1.0 IND — MG 2/27/23 — X:8/27/23
290 ul STK6210 → 10 ml hexane
145 5 #222209

P0782 | AR1260 1.0 IND
290 ul STK6211 → 10 ml hexane
145 5 #222209

P0783 | AR1242 0.25 ppm — MG 3/3/23 — X 3/9/23 ~~3/3/23~~
250 ul P0607 → 10 ml hexane
#222209

P0784 | AR1660 1.0 ppm — MG 3/9/23 — X 7/16/23
1 ml P0731 → 10 ml hexane
#222209

P0785 | Explosives C7 2.0/8.0 — EP P:030923 X:060923
+40mL M8330-R-0.5x (STK6221)
+200mL M-8330-ADD-4 (STK6358)
+80mL M8330-ADD-1-10x (STK6223)
+80mL M-8330-ADD-2-10x (STK6220)
+20mL M-8330-SS (STK6195)
→ into 10mL ACN lot #211110 and 20mL di H2O

P0786 | Explosives C5 0.5/2.0
10mL P0785 into 10mL ACN lot #211110
and 20mL di H2O

P0787 | Explosives C4 0.25/1.0
10mL P0786 into 10mL 1:2 v/v 10mL ACN lot #211110
and 20mL di H2O

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

Extractions Laboratory

STD8832 — MP 5/5/20

RESTEK 110 Benner Circle, Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
33905 Danger 1 mL
Lot# A0157375
Expire: 09/2023 Store: 10°C or colder
8330 Calibration Standard
1000 µg/mL each in Acetonitrile
Full label information for the chemical is provided on the outside package.

STD8833 — MP 5/5/20

RESTEK 110 Benner Circle, Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
32005 Danger 1 mL
Lot# A0155324
Expire: 02/2024 Store: 10°C or colder
Toxaphene Standard
1000 µg/mL each in Hexane
Full label information for the chemical is provided on the outside package.

STD8834
8835
N-methyl-N-nitroso-p-toluenesulfonamide — MR — 5-20-20
Lot# 1D0353
$C_8H_{10}N_2O_3S$ 25g
MZZ72
CAS # 80-11-5

STD8836
8837

AccuStand® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
GRH-IS-10X 1 mL
5-alpha Androstane
10.0 mg/mL in CH_2Cl_2
Lot: 217091116 1 comp(s)
Exp: Sep 11, 2027 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H315 H336
H332 H302
H351 H350
P338 P360
P331 P233
P262 P202
Refer to SDS
Signal Word Warning

MR

STD8838
8839
8840

RESTEK 110 Benner Circle, Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31459 Danger 1 mL
Lot# A0151405
Expire: 08/2026 Store: 25°C nominal
MA EPH Aliphatic Hydrocarbon Standard
1000 µg/mL each in Hexane
Full label information for the chemical is provided on the outside package.

STD8841
8842
8843

RESTEK 110 Benner Circle, Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31458 Danger 1 mL
Lot# A0159443
Expire: 02/2026 Store: 25°C nominal
MA EPH Aromatic Hydrocarbon Standard
Sonication required. Mix is photosensitive.
1000 µg/mL each in Methylene chloride
Full label information for the chemical is provided on the outside package.

STD8844
8845
8846
8847

RESTEK 110 Benner Circle, Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31097 Warning 1 mL
Lot# A0158517
Expire: 10/2023 Store: 10°C or colder
o-Terphenyl Standard
Sonicate prior to use.
10000 µg/mL each in Methylene Chloride
Full label information for the chemical is provided on the outside package.

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

Extractions Laboratory

SR 9/27/22

STD9075
9076
9077
9078
9079

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

Z-014F 1 mL
Benzidine & 3,3'-Dichlorobenzidine
2.0 mg/mL in MeOH
Lot: 221091180 2 comp(s)
Exp: Sep 09, 2025 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H225 H370 H336 H320 H315 H311 H332 H301 H350 H360, H350 P338 Refer to SDS
Signal Word Danger

STD9080
9081
9082
9083
9084

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

APP-9-096-20X 1 mL
p-Dioxane Standard
2.0 mg/mL in MeOH
Lot: 219011122 1 comp(s)
Exp: Jan 10, 2029 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H225 H336 H370 H320 H315 H311 H332 H301 H351 H360, H350 P338 Refer to SDS
Signal Word Danger

STD9085
9086
9087
9088
9089

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

CLP-HC-A-R 1 mL
Acid Composite Mixture
2.0 mg/mL in CH2Cl2
Lot: 222041590 19 comp(s)
Exp: May 03, 2025 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H315 H335 H332 H302 H350 H350 P338 P360 P331 P233 P262 P202 Refer to SDS
Signal Word Danger

STD9090
9091
9092
9093

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

APP-9-191-10X 1 mL
1,2,4,5-Tetrachlorobenzene
1000 µg/mL in MeOH
Lot: 219041253 1 comp(s)
Exp: Apr 09, 2029 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H336 H225 H370 H320 H315 H311 H332 H301 H360 P338 P360 P331 Refer to SDS
Signal Word Danger

STD9094

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

P-233S-10X 1 mL
bis(2-Ethylhexyl)adipate
1000 µg/mL in MeOH
Lot: 222011504 *1 comp(s)
Exp: Jan 25, 2032 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H336 H225 H370 H320 H315 H311 H332 H301 H360 P338 P360 P331 Refer to SDS
Signal Word Danger

SR 9/28/22

STD9095
9096

RESTEK Made in USA For Laboratory Use Only
31601 Danger 1 mL
Lot# A0189256
Expire: 09/2027 Store: 10°C or colder
EGDN Standard
1000 µg/mL each in Methanol
Full label information for the chemical is provided on the outside package

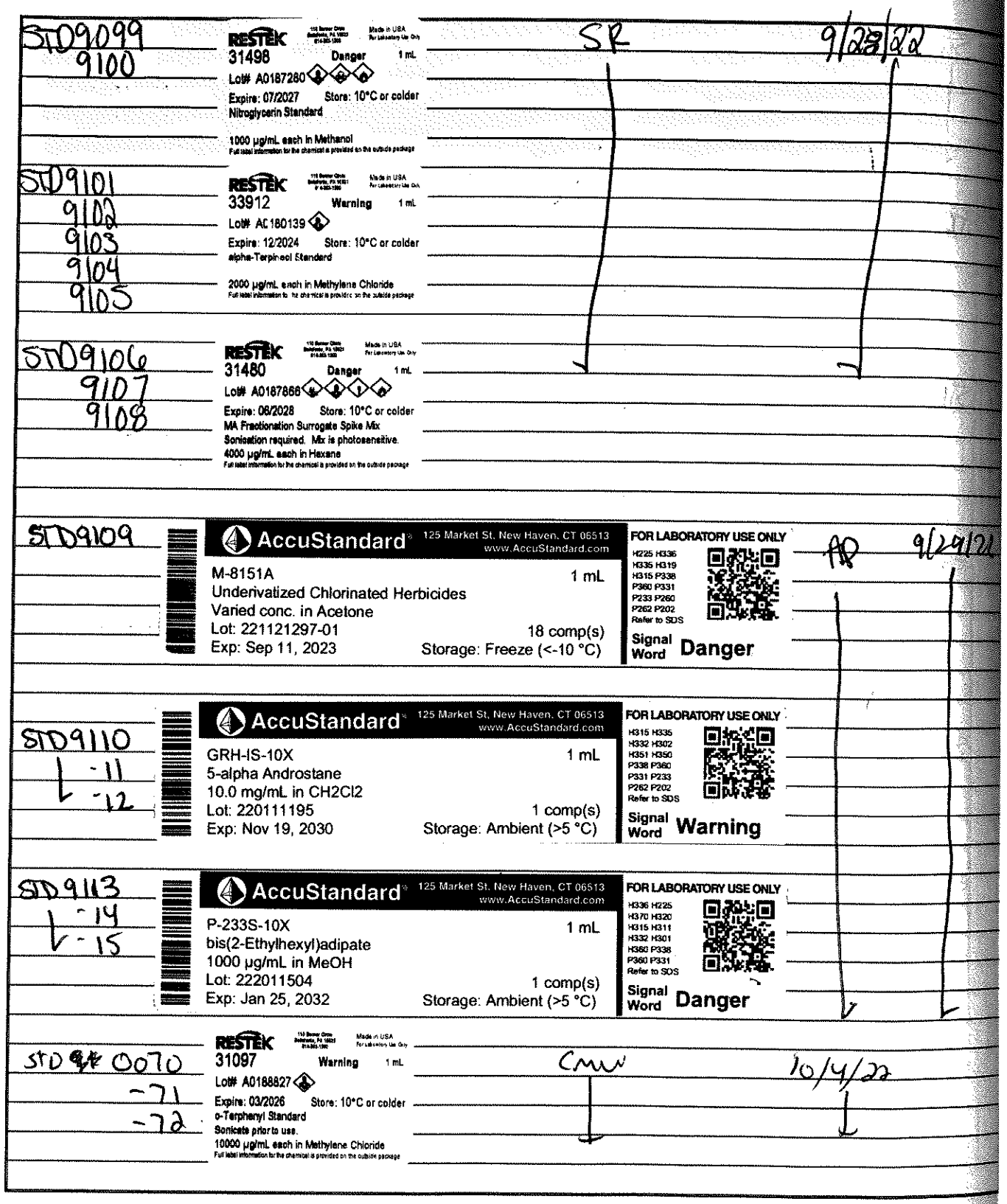
STD9097
9098

RESTEK Made in USA For Laboratory Use Only
31600 Danger 1 mL
Lot# A0187142
Expire: 07/2027 Store: 10°C or colder
PETN Standard
Sonicate prior to use.
1000 µg/mL each in Methanol
Full label information for the chemical is provided on the outside package

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

Extractions Laboratory



STD9099
9100

RESTEK
31498 Danger 1 mL
Lot# A0187280
Expire: 07/2027 Store: 10°C or colder
Nitroglycerin Standard
1000 µg/mL each in Methanol
Full label information for the chemical is provided on the outside package

SR 9/28/22

STD9101
9102
9103
9104
9105

RESTEK
33912 Warning 1 mL
Lot# AC180139
Expire: 12/2024 Store: 10°C or colder
alpha-Terpineol Standard
2000 µg/mL each in Methylene Chloride
Full label information for the chemical is provided on the outside package

STD9106
9107
9108

RESTEK
31480 Danger 1 mL
Lot# A0187866
Expire: 08/2028 Store: 10°C or colder
MA Fractionation Surrogate Spike Mix
Sonication required. Mix is photosensitive.
4000 µg/mL each in Hexane
Full label information for the chemical is provided on the outside package

STD9109

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
M-8151A 1 mL
Underivatized Chlorinated Herbicides
Varied conc. in Acetone
Lot: 221121297-01 18 comp(s)
Exp: Sep 11, 2023 Storage: Freeze (<-10 °C)
FOR LABORATORY USE ONLY
H225 H336 H335 H319 H315 P338 P360 P331 P233 P260 P262 P202 Refer to SDS
Signal Word Danger

AP 9/29/22

STD9110
-11
-12

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
GRH-IS-10X 1 mL
5-alpha Androstane
10.0 mg/mL in CH2Cl2
Lot: 220111195 1 comp(s)
Exp: Nov 19, 2030 Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H315 H335 H332 H302 H351 H350 P338 P360 P331 P233 P262 P202 Refer to SDS
Signal Word Warning

STD9113
-14
-15

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
P-233S-10X 1 mL
bis(2-Ethylhexyl)adipate
1000 µg/mL in MeOH
Lot: 222011504 1 comp(s)
Exp: Jan 25, 2032 Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H336 H225 H370 H320 H315 H311 H332 H301 H360 P338 P360 P331 Refer to SDS
Signal Word Danger

STD 9/# 0070
-71
-72

RESTEK
31097 Warning 1 mL
Lot# A0188827
Expire: 03/2026 Store: 10°C or colder
o-Terphenyl Standard
Sonicate prior to use.
10000 µg/mL each in Methylene Chloride
Full label information for the chemical is provided on the outside package

CMW 10/4/22

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

Extractions Laboratory

STD9914
9915
9916
9917
9918

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

DRH-FTRPH 1 mL
FTRPH Calibration/ Window Defining Standard
500 µg/mL in Hexane
Lot: 221121036 17 comp(s)
Exp: Dec 21, 2031 Storage: Ambient (>5 °C)/Sonicate

FOR LABORATORY USE ONLY
H304 H225
H336 H361
H315 H335
H332 H302
H360 P338
P352 P331
Refer to SDS
Signal Word Danger

SR 5/17/22

STD9919 Silicic Acid ~80 Mesh SR 5/18/22
9920 Lot#: MKCJ8025

STD9921
9922
9923
9924
9925

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31459 Danger 1 mL
Lot# A0180427
Expire: 02/2029 Store: 25°C nominal
MA EPH Aliphatic Hydrocarbon Standard
1000 µg/mL each in Hexane
Full label information for the chemical is provided on the outside package

SR 5/24/22

STD9926

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31661 Danger 1 mL
Lot# A017865?
Expire: 06/2026 Store: 10°C or colder
3,5-Dinitroaniline Standard
1000 µg/mL each in Acetonitrile
Full label information for the chemical is provided on the outside package

SR 5/24/22

STD9927 Diethylene glycol (Carbitol) SR 6/3/22
99% Lot # MKCQ2376

STD9928
9929
9930

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31097 Warning 1 mL
Lot# A0183688
Expire: 11/2025 Store: 10°C or colder
o-Terphenyl Standard
Sonicate prior to use.
10000 µg/mL each in Methylene Chloride
Full label information for the chemical is provided on the outside package

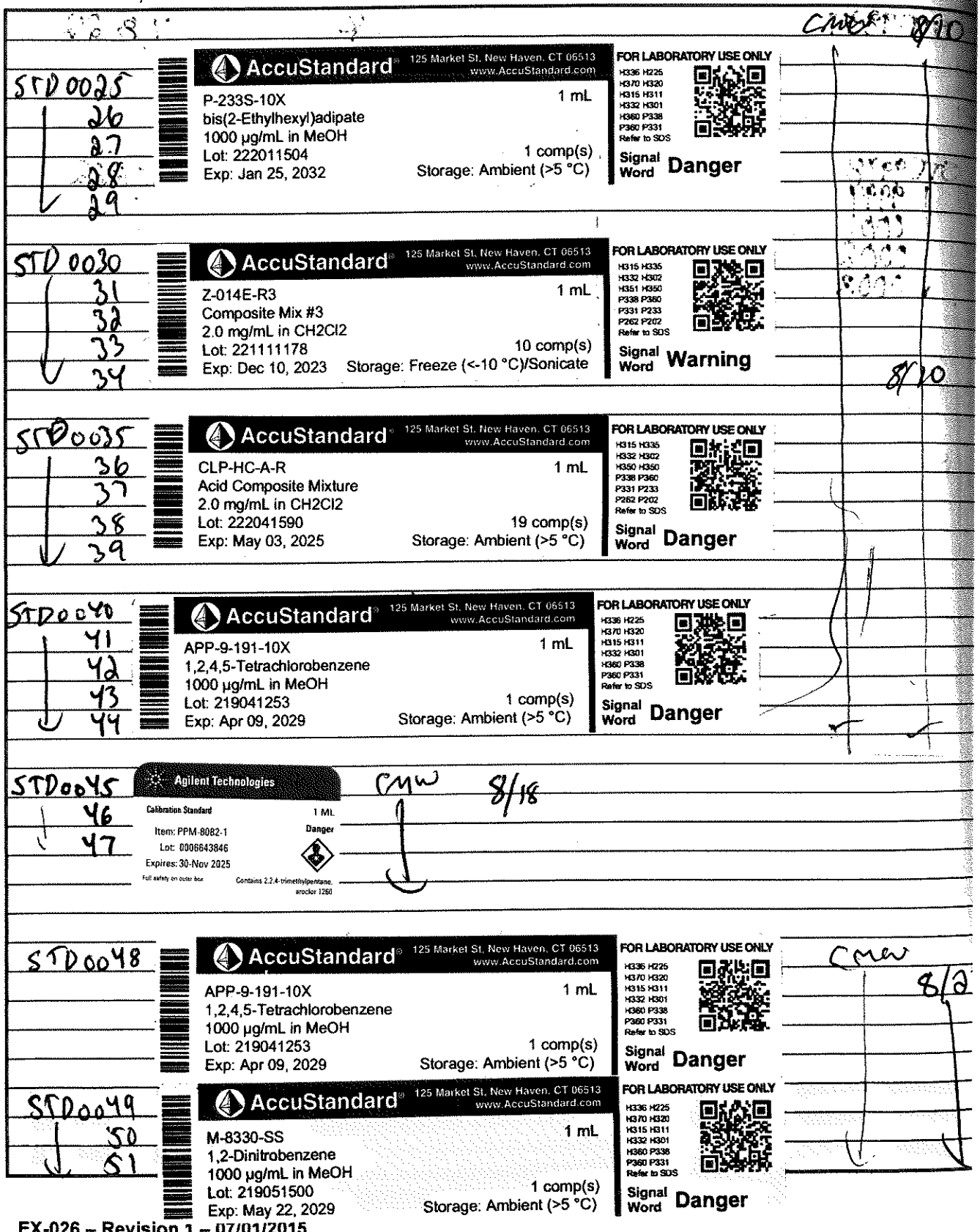
SR 6/3/22

STD9931 Silicic Acid SR 6/3/22
powder, ~80 Mesh
Lot # MKCJ8025

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

Extractions Laboratory



STD0025
26
27
28
29

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
P-233S-10X
bis(2-Ethylhexyl)adipate
1000 µg/mL in MeOH
Lot: 222011504
Exp: Jan 25, 2032
1 mL
1 comp(s)
Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

STD0030
31
32
33
34

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
Z-014E-R3
Composite Mix #3
2.0 mg/mL in CH2Cl2
Lot: 221111178
Exp: Dec 10, 2023
1 mL
10 comp(s)
Storage: Freeze (<-10 °C)/Sonicate
FOR LABORATORY USE ONLY
H315 H335
H332 H302
H351 H350
P338 P360
P331 P233
P262 P202
Refer to SDS
Signal Word Warning

8/10

STD0035
36
37
38
39

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
CLP-HC-A-R
Acid Composite Mixture
2.0 mg/mL in CH2Cl2
Lot: 222041590
Exp: May 03, 2025
1 mL
19 comp(s)
Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H315 H335
H332 H302
H350 H350
P338 P360
P331 P233
P262 P202
Refer to SDS
Signal Word Danger

STD0040
41
42
43
44

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
APP-9-191-10X
1,2,4,5-Tetrachlorobenzene
1000 µg/mL in MeOH
Lot: 219041253
Exp: Apr 09, 2029
1 mL
1 comp(s)
Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

STD0045
46
47

Agilent Technologies
Calibration Standard
Item: PPM-8082-1
Lot: 0006643846
Expires: 30-Nov 2025
Full safety on outer box
1 ML
Danger
Contains 2,2,4-trimethylpentane, aroclor 1260

CMW 8/18

STD0048

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
APP-9-191-10X
1,2,4,5-Tetrachlorobenzene
1000 µg/mL in MeOH
Lot: 219041253
Exp: Apr 09, 2029
1 mL
1 comp(s)
Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

CMW 8/2

STD0049
50
51

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
M-8330-SS
1,2-Dinitrobenzene
1000 µg/mL in MeOH
Lot: 219051500
Exp: May 22, 2029
1 mL
1 comp(s)
Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

GC and Semivolatile Extractables Laboratory

STK 6190

32251 US/EN
Dinoseb Standard
Lot# A0165987
Expire: 05/2022 Store: 10°C or colder 1 mL
1000 µg/mL each in Methanol
RESTEK

JLM 10/19/21

STK6191

31835 US/EN
3,3'- Dichlorobenzidine Standard
Lot# A0174073
Expire: 02/2026 Store: 10°C or colder 1 mL
2000 µg/mL each in Methylene Chloride
RESTEK
Containing carcinogen/reproductive toxin

JLM 10/19/21

STK6192

33913 US/EN
SOM01.0 SIM Analysis Standard
Lot# A0175442
Expire: 07/2027 Store: 10°C or colder 1 mL
2000 µg/mL each in Methylene Chloride
RESTEK
Sonication required. Mix is photosensitive.

JLM 10/19/21

STK6193

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
APP-9-191-10X 1 mL
1,2,4,5-Tetrachlorobenzene
1000 µg/mL in MeOH
Lot: 219041253 1 comp(s)
Exp: Apr 09, 2029 Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

JLM
10/25/21

STK6194

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
M-8330-SS 1 mL
1,2-Dinitrobenzene
1000 µg/mL in MeOH
Lot: 219051500 1 comp(s)
Exp: May 22, 2029 Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

MK
10/25/21

STK6195

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
M-8330-SS 1 mL
1,2-Dinitrobenzene
1000 µg/mL in MeOH
Lot: 219051500 1 comp(s)
Exp: May 22, 2029 Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

MK
10/25/21

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

GC and Semivolatile Extractables Laboratory

STK6211

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

C-260S 1 mL
Aroclor 1260
35 µg/mL in Isooctane
Lot: 221041549 1 comp(s)
Exp: Apr 27, 2031 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H305 H225
H336 H315
H302 H319
P338 P352
P331 P233
P260 P262
Refer to SDS
Signal Word Danger

11/2/21 DT

STK6212

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

C-248S-H 1 mL
Aroclor 1248
100 µg/mL in Hexane
Lot: 219111357 1 comp(s)
Exp: Dec 02, 2029 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H304 H225
H336 H361
H315 H336
H332 H302
H360 P338
P352 P331
Refer to SDS
Signal Word Danger

11/2/21 DT

STK6213

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

C-248S-H 1 mL
Aroclor 1248
100 µg/mL in Hexane
Lot: 219111357 1 comp(s)
Exp: Dec 02, 2029 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H304 H225
H336 H361
H315 H336
H332 H302
H360 P338
P352 P331
Refer to SDS
Signal Word Danger

11/4/21 DT

STK6214

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

M-8270-SS 1 mL
Method 8270 - Surrogate Standard
4.0 mg/mL in CH2Cl2
Lot: 221081696 6 comp(s)
Exp: Sep 03, 2031 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H315 H336
H332 H302
H351 H350
P338 P360
P331 P233
P262 P202
Refer to SDS
Signal Word Warning

STK6215

32460 US/EN
Methapyrilene Standard
Lot# A0170165
Expire: 09/2022 Store: 0°C or colder
2000 µg/mL each in Methylene Chloride 1 mL
RESTEK
This product is photosensitive

STK6216

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
32008 Danger 1 mL
Lot# A0170315
Expire: 08/2027 Store: 25°C nominal
Aroclor® 1232 Standard
This product contains PCBs
1000 µg/mL each in Hexane
Full label information for the chemical is provided on the outside package

11/8/21 SR

STK6217
6218

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

M-8330-ADD-5 1 mL
EGDN
100 µg/mL in Acetonitrile:Methanol (95:5)
Lot: 220031214-01 1 comp(s)
Exp: Apr 01, 2023 Storage: Freeze (<-10 °C)

FOR LABORATORY USE ONLY
H225 H370
H336 H315
H332 H319
H360 P338
P352 P340
P233 P260
Refer to SDS
Signal Word Danger

11/8/21 SR

STK6219
6220

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

M-8330-ADD-2-10X 1 mL
PETN
1000 µg/mL in Methanol
Lot: 221051166 1 comp(s)
Exp: Jun 10, 2023 Storage: Refrig (0-5 °C)

FOR LABORATORY USE ONLY
H226 H370
H336 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

11/8/21 SR

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

GC and Semivolatile Extractables Laboratory

STK6221
6222

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

M-8330-R-0.5X — 1 mL
Method 8330 - Explosives by HPLC
0.5 mg/mL in Methanol:Acetonitrile (50:50)
Lot: 221071166 — 14 comp(s)
Exp: Aug 15, 2023 — Storage: Freeze (<-10 °C)

FOR LABORATORY USE ONLY
H225 H370
H336 H315
H332 H319
H360 H360
P338 P352
P340 P233
Refer to SDS
Signal Word **Danger**

11/8/21 SR

STK6223
6224

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

M-8330-ADD-1-10X — 1 mL
Nitroglycerin
1000 µg/mL in Ethanol:Methanol (97:3)
Lot: 220041110-01 — 1 comp(s)
Exp: Jun 04, 2023 — Storage: Refrig (0-5 °C)

FOR LABORATORY USE ONLY
H225 H320
H315 H312
H336 H332
H302 H360
P338 P360
P340 P233
Refer to SDS
Signal Word **Danger**

11/9/21 SR

STK6225

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

S-279-5X — 1 mL
Tetrachloro-m-xylene
1000 µg/mL in MeOH
Lot: 221051625 — 1 comp(s)
Exp: May 28, 2031 — Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word **Danger**

11/10/21 DT

STK6226

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

M-504.1-CSS — 1 mL
Method 504.1 - Calibration Stock Solution
0.2 mg/mL in MeOH
Lot: 220081432 — 3 comp(s)
Exp: Aug 31, 2025 — Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word **Danger**

STK6227

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

P-398S-10X — 1 mL
Chloropicrin
1000 µg/mL in Methanol
Lot: 221091631 — 1 comp(s)
Exp: Sep 29, 2026 — Storage: Refrig (0-5 °C)

FOR LABORATORY USE ONLY
H225 H370
H336 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word **Danger**

STK6228

RESTEK Made in USA For Laboratory Use Only
31441 — Danger — 1 mL
Lot# A0176148
Expire: 04/2026 — Store: 10°C or colder
Benzidine Standard
1000 µg/mL each in Methanol
Full label information for the chemical is provided on the outside package

11/12/21 MK

STK6229
6230

RESTEK Made in USA For Laboratory Use Only
31480 — Danger — 1 mL
Lot# A0175042
Expire: 07/2027 — Store: 10°C or colder
MA Fractionation Surrogate Spike Mix
Sonication required. Mix is photosensitive.
4000 µg/mL each in Hexane
Full label information for the chemical is provided on the outside package

11/22/21 SR

STK6231
6232

RESTEK Made in USA For Laboratory Use Only
31458 — Danger — 1 mL
Lot# A0176586
Expire 08/2027 — Store: 25°C nominal
MA EPH Aromatic Hydrocarbon Standard
Sonication required. Mix is photosensitive.
1000 µg/mL each in Methylene chloride
Full label information for the chemical is provided on the outside package

11/22/21 SR

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

GC and Semivolatile Extractables Laboratory

STK6357

SPEX CertiPrep
Calibrate with Confidence™

Part # : S-911
Lot # : MP220919008
Date Opened: 10/13/22

10/13/22 DT

Chloropicrin
Contains the following in **Methanol**

Concentration	Compound
1000 µg/mL	Chloropicrin

S-911
MP220919008

*** END LIST ***

Danger

Storage: **Freezer**

Highly flammable liquid and vapour. Toxic if inhaled. Causes damage to the central nervous system and the visual organs.
If medical advice is needed, have product container or label at hand. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use explosion-proof electrical/ ventilating/ lighting/ equipment. Do not breathe dust/ fume/ gas/ mist/ vapours/ spray. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. Dispose of contents/container in accordance with local/regional/national/international regulations.

Phone: 732-549-7144

For Laboratory Use Only

STK6358
59
60
61

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

M-8330-ADD-4 1 mL
3,5-Dinitroaniline
0.1 mg/mL in Acetonitrile:Methanol
Lot: 222011692-01
Exp: Oct 06, 2023 1 comp(s)
Storage: Ambient (>5 °C)
PRODUCT OF THE USA **FOR LABORATORY USE ONLY**

H225 H370
H336 H315
H332 H319
H360 P338
P352 P340
P233 P260
Refer to SDS
Signal Word: Danger

R: 10/14/22 EP

STK6362
63

31806 US/EN
Appendix IX Mix #2
Lot# A0187840
Expire: 01/2024 Store: 0°C or colder 1 mL
1000 µg/mL each in Methylene chloride
RESTEK

STK6364

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

M-8330-ADD-3-50X 1 mL
Picric acid
5.0 mg/mL in AcCN:MeOH
Lot: 222021531
Exp: Mar 25, 2024 1 comp(s)
Storage: Ambient (>5 °C)
PRODUCT OF THE USA **FOR LABORATORY USE ONLY**

H225 H370
H336 H315
H332 H319
H360 P338
P352 P340
P233 P260
Refer to SDS
Signal Word: Danger

EP R: 10/17/22

METALS DATA

Sample Data Section

METALS SAMPLE FLAGGING

FLAG	SPECIFIED MEANING
E	The reported value is estimated because of the presence of interference (as indicated by serial dilution).
N	The pre-digestion spiked sample recovery is not within control limits.
*	The duplicate sample analysis relative percent difference (RPD) is not within control limits.
B	Indicates the analyte was detected in the laboratory method blank analyzed concurrently with the sample.
A	The post-digestion spiked sample recovery is not within control limits.
•	Analytical run QC sample (e.g. ICV, CCV, ICB, CCB, ICSA, ICSAB) not within control limits.
U	The analyte was not detected above the specified level. This level may be the Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client. Note: All results reported as "U" MDL have a 50% rate for false negatives compared to those results reported as "U" PQL, "U" LOQ or "U" LOD, where the rate of false negatives is <1%.
J	Estimated value. The analyte was detected in the sample at a concentration less than the laboratory Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), but above the Method Detection Limit (MDL).
Q	One or more quality control criteria failed (e.g., LCS recovery, surrogate spike recovery or CCV).

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: Katahdin Analytical Services

SDG Name: SQ1188 **SOW No.** SW846

Client Field ID	Lab Sample ID
JACKSON-SDCC2-DC-01	SQ1188-003
JACKSON-SDCC2-DC-01	SQ1188-004
JACKSON-SDCC3-DC-01	SQ1188-001
JACKSON-SDCC3-DC-01	SQ1188-002
JACKSON-SDCC4-DC-01	SQ1188-009
JACKSON-SDCC4-DC-01	SQ1188-010
JACKSON-SDJC1-DC-01	SQ1188-011
JACKSON-SDJC1-DC-01	SQ1188-012
JACKSON-SDMC1-DC-01	SQ1188-007
JACKSON-SDMC1-DC-01	SQ1188-008
JACKSON-SDMC1-DC-01D	SQ1188-008D
JACKSON-SDMC1-DC-01S	SQ1188-008S
JACKSON-SDMC2-DC-01	SQ1188-013
JACKSON-SDMC2-DC-01	SQ1188-014
JACKSON-SDMC3-DC-01	SQ1188-005
JACKSON-SDMC3-DC-01	SQ1188-006
JACKSON-SDMC3-DC-01P	SQ1188-005P
JACKSON-SDMC3-DC-01S	SQ1188-005S
SDDUP	SQ1188-015
SDDUP	SQ1188-016

Were ICP interelement corrections applied ?	Yes
Were ICP background corrections applied ?	Yes
If yes - were raw data generated before application of background corrections ?	No

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed in the case narrative. Release of the data contained in this hardcopy data package and in the computer-readable data submitted has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Edward A Mazza Name: Edward A. Mazza

Date: April 6, 2023 Title: Data Management

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDCC3-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 75.0 **Lab Sample ID:** SQ1188-001

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.025	J		MS	5	0.089	0.018	0.044
7440-50-8	COPPER, TOTAL	0.35			MS	5	0.27	0.062	0.18
7439-92-1	LEAD, TOTAL	1.78		B	MS	5	0.089	0.0062	0.044
7440-66-6	ZINC, TOTAL	0.60	J		MS	5	0.89	0.12	0.71

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDCC3-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 75.0 **Lab Sample ID:** SQ1188-002

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000025	J		P	1	0.00098	0.000015	0.00057
7440-50-8	COPPER, SEM	0.00269	J		P	1	0.0083	0.00054	0.0033
7439-92-1	LEAD, SEM	0.00273			P	1	0.00053	0.000087	0.00041
7440-02-0	NICKEL, SEM	0.00028	J		P	1	0.0036	0.00016	0.0014
7440-22-4	SILVER, SEM	0.00079	U		P	1	0.0019	0.000053	0.00079
7440-66-6	ZINC, SEM	0.00478	J	B	P	1	0.0064	0.00055	0.0032

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDCC2-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 22.7 **Lab Sample ID:** SQ1188-003

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-36-0	ANTIMONY, TOTAL	0.15	J		MS	5	0.23	0.046	0.12
7440-50-8	COPPER, TOTAL	21.6			MS	5	0.69	0.16	0.46
7439-92-1	LEAD, TOTAL	33.3		B	MS	5	0.23	0.016	0.12
7440-66-6	ZINC, TOTAL	8.50			MS	5	2.3	0.30	1.8

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDCC2-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 22.7 **Lab Sample ID:** SQ1188-004

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000470	J		P	1	0.0036	0.000058	0.0022
7440-50-8	COPPER, SEM	0.170			P	1	0.031	0.0020	0.013
7439-92-1	LEAD, SEM	0.134			P	1	0.0020	0.00034	0.0016
7440-02-0	NICKEL, SEM	0.00778	J		P	1	0.014	0.00061	0.0056
7440-22-4	SILVER, SEM	0.0030	U		P	1	0.0076	0.00020	0.0030
7440-66-6	ZINC, SEM	0.0587		B	P	1	0.024	0.0021	0.012

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-005

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.080	J	N*	MS	5	0.11	0.022	0.055
7440-50-8	COPPER, TOTAL	1.18		*	MS	5	0.33	0.077	0.22
7439-92-1	LEAD, TOTAL	7.84		B	MS	5	0.11	0.0077	0.055
7440-66-6	ZINC, TOTAL	4.11		*	MS	5	1.1	0.14	0.88

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-006

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000178	J		P	1	0.0012	0.000019	0.00070
7440-50-8	COPPER, SEM	0.00595	J		P	1	0.010	0.00066	0.0041
7439-92-1	LEAD, SEM	0.0286			P	1	0.00063	0.00011	0.00048
7440-02-0	NICKEL, SEM	0.00134	J		P	1	0.0044	0.00020	0.0017
7440-22-4	SILVER, SEM	0.00093	U		P	1	0.0024	0.000066	0.00093
7440-66-6	ZINC, SEM	0.0289		B	P	1	0.0081	0.00069	0.0040

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC1-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 52.5 **Lab Sample ID:** SQ1188-007

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.14	J		MS	5	0.18	0.036	0.091
7440-50-8	COPPER, TOTAL	4.81			MS	5	0.54	0.13	0.36
7439-92-1	LEAD, TOTAL	7.01		B	MS	5	0.18	0.013	0.091
7440-66-6	ZINC, TOTAL	4.66			MS	5	1.8	0.24	1.4

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC1-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 52.5 **Lab Sample ID:** SQ1188-008

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000512	J		P	1	0.0016	0.000025	0.00098
7440-50-8	COPPER, SEM	0.0311			P	1	0.014	0.00091	0.0057
7439-92-1	LEAD, SEM	0.0249		N	P	1	0.00087	0.00015	0.00068
7440-02-0	NICKEL, SEM	0.00165	J		P	1	0.0061	0.00027	0.0024
7440-22-4	SILVER, SEM	0.0013	U	N	P	1	0.0033	0.000090	0.0013
7440-66-6	ZINC, SEM	0.0341		B	P	1	0.011	0.00093	0.0055

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDCC4-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 80.3 **Lab Sample ID:** SQ1188-009

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.020	J		MS	5	0.072	0.014	0.036
7440-50-8	COPPER, TOTAL	1.42			MS	5	0.22	0.050	0.14
7439-92-1	LEAD, TOTAL	0.815		B	MS	5	0.072	0.0050	0.036
7440-66-6	ZINC, TOTAL	1.50			MS	5	0.72	0.094	0.58

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDCC4-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 80.3 **Lab Sample ID:** SQ1188-010

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000035	J		P	1	0.0011	0.000017	0.00063
7440-50-8	COPPER, SEM	0.00137	J		P	1	0.0093	0.00060	0.0038
7439-92-1	LEAD, SEM	0.00169			P	1	0.00058	0.00010	0.00046
7440-02-0	NICKEL, SEM	0.00019	J		P	1	0.0041	0.00017	0.0016
7440-22-4	SILVER, SEM	0.00088	U		P	1	0.0022	0.000059	0.00088
7440-66-6	ZINC, SEM	0.00298	J	B	P	1	0.0072	0.00061	0.0037

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDJC1-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 80.1 **Lab Sample ID:** SQ1188-011

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.023	J		MS	5	0.11	0.022	0.055
7440-50-8	COPPER, TOTAL	0.40			MS	5	0.33	0.077	0.22
7439-92-1	LEAD, TOTAL	0.747			MS	5	0.11	0.0077	0.055
7440-66-6	ZINC, TOTAL	2.78		B	MS	5	1.1	0.14	0.88

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDJC1-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 80.1 **Lab Sample ID:** SQ1188-012

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000073	J		P	1	0.0011	0.000018	0.00066
7440-50-8	COPPER, SEM	0.00096	J		P	1	0.0098	0.00063	0.0039
7439-92-1	LEAD, SEM	0.00417			P	1	0.00058	0.00010	0.00048
7440-02-0	NICKEL, SEM	0.00028	J		P	1	0.0042	0.00019	0.0017
7440-22-4	SILVER, SEM	0.00092	U		P	1	0.0023	0.000062	0.00092
7440-66-6	ZINC, SEM	0.00991		B	P	1	0.0075	0.00064	0.0038

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC2-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 83.7 **Lab Sample ID:** SQ1188-013

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.025	J		MS	5	0.11	0.021	0.053
7440-50-8	COPPER, TOTAL	0.32			MS	5	0.32	0.075	0.21
7439-92-1	LEAD, TOTAL	1.48			MS	5	0.11	0.0075	0.053
7440-66-6	ZINC, TOTAL	1.84		B	MS	5	1.1	0.14	0.85

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC2-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 83.7 **Lab Sample ID:** SQ1188-014

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-43-9	CADMIUM, SEM	0.000082	J		P	1	0.00098	0.000016	0.00060
7440-50-8	COPPER, SEM	0.0035	U		P	1	0.0088	0.00057	0.0035
7439-92-1	LEAD, SEM	0.000891			P	1	0.00053	0.000092	0.00043
7440-02-0	NICKEL, SEM	0.00021	J		P	1	0.0037	0.00017	0.0015
7440-22-4	SILVER, SEM	0.00082	U		P	1	0.0020	0.000056	0.00082
7440-66-6	ZINC, SEM	0.00583	J	B	P	1	0.0069	0.00058	0.0034

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** SDDUP

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-015

Concentration Units : mg/Kg drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, TOTAL	0.069	J		MS	5	0.13	0.026	0.065
7440-50-8	COPPER, TOTAL	0.79			MS	5	0.39	0.091	0.26
7439-92-1	LEAD, TOTAL	5.69		B	MS	5	0.13	0.0091	0.065
7440-66-6	ZINC, TOTAL	3.19			MS	5	1.3	0.17	1.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** SDDUP

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-016

Concentration Units : umole/g drywt

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-43-9	CADMIUM, SEM	0.000196	J		P	1	0.0012	0.000018	0.00068
7440-50-8	COPPER, SEM	0.00481	J		P	1	0.010	0.00064	0.0041
7439-92-1	LEAD, SEM	0.0244			P	1	0.00063	0.00011	0.00048
7440-02-0	NICKEL, SEM	0.00112	J		P	1	0.0044	0.00019	0.0017
7440-22-4	SILVER, SEM	0.00093	U		P	1	0.0024	0.000064	0.00093
7440-66-6	ZINC, SEM	0.0256		B	P	1	0.0078	0.00067	0.0040

Comments:

QC Summary Section

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICV

File: IQC24A Mar 24, 2023 15:10

Analyte	True	Found	%R (1)
ALUMINUM	10000.0	10350.00	103.5
CADMIUM	400.0	394.40	98.6
CALCIUM	10000.0	10310.00	103.1
COPPER	400.0	394.60	98.7
IRON	10000.0	10190.00	101.9
LEAD	400.0	403.50	100.9
MAGNESIUM	10000.0	10410.00	104.1
NICKEL	400.0	399.80	100.0
SILVER	400.0	392.70	98.2
ZINC	400.0	393.60	98.4

SAMPLE: CCV

File: IQC24A Mar 24, 2023 15:31

Analyte	True	Found	%R (1)	
ALUMINUM	12500.0	14410.00	115.3	•
CADMIUM	500.0	523.90	104.8	
CALCIUM	12500.0	14300.00	114.4	•
COPPER	500.0	520.30	104.1	
IRON	12500.0	14280.00	114.2	•
LEAD	500.0	529.40	105.9	
MAGNESIUM	12500.0	13120.00	105.0	
NICKEL	500.0	528.70	105.7	
SILVER	500.0	515.40	103.1	
ZINC	500.0	522.00	104.4	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: IQC24A Mar 24, 2023 15:49

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13110.00	104.9
CADMIUM	500.0	523.50	104.7
CALCIUM	12500.0	12930.00	103.4
COPPER	500.0	520.60	104.1
IRON	12500.0	12950.00	103.6
LEAD	500.0	529.40	105.9
MAGNESIUM	12500.0	13460.00	107.7
NICKEL	500.0	529.40	105.9
SILVER	500.0	514.10	102.8
ZINC	500.0	517.40	103.5

SAMPLE: CCV

File: IQC24A Mar 24, 2023 16:39

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12770.00	102.2
CADMIUM	500.0	505.80	101.2
CALCIUM	12500.0	12530.00	100.2
COPPER	500.0	508.90	101.8
IRON	12500.0	12630.00	101.0
LEAD	500.0	512.00	102.4
MAGNESIUM	12500.0	13170.00	105.4
NICKEL	500.0	510.60	102.1
SILVER	500.0	501.30	100.3
ZINC	500.0	498.90	99.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: IQC24A Mar 24, 2023 17:30

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12770.00	102.2
CADMIUM	500.0	510.10	102.0
CALCIUM	12500.0	12650.00	101.2
COPPER	500.0	514.50	102.9
IRON	12500.0	12800.00	102.4
LEAD	500.0	514.60	102.9
MAGNESIUM	12500.0	13270.00	106.2
NICKEL	500.0	513.80	102.8
SILVER	500.0	503.90	100.8
ZINC	500.0	504.10	100.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICV

File: LQC21A Mar 21, 2023 15:17

Analyte	True	Found	%R (1)
ALUMINUM	400.0	407.46	101.9
ANTIMONY	20.0	19.34	96.7
CALCIUM	4000.0	4114.37	102.9
COPPER	20.0	20.60	103.0
IRON	4000.0	4071.60	101.8
LEAD	20.0	19.62	98.1
MAGNESIUM	4000.0	4204.30	105.1
MOLYBDENUM	40.0	39.19	98.0
POTASSIUM	4000.0	4115.22	102.9
SODIUM	4000.0	4169.86	104.2
ZINC	20.0	21.04	105.2

SAMPLE: CCV

File: LQC21A Mar 21, 2023 16:23

Analyte	True	Found	%R (1)
ALUMINUM	500.0	528.13	105.6
ANTIMONY	25.0	23.53	94.1
CALCIUM	5000.0	5018.26	100.4
COPPER	25.0	26.38	105.5
IRON	5000.0	5009.43	100.2
LEAD	25.0	25.22	100.9
MAGNESIUM	5000.0	5458.86	109.2
MOLYBDENUM	25.0	26.34	105.4
POTASSIUM	5000.0	5190.28	103.8
SODIUM	5000.0	5478.25	109.6
ZINC	25.0	26.25	105.0

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC21A Mar 21, 2023 17:32

Analyte	True	Found	%R (1)
ALUMINUM	500.0	526.40	105.3
ANTIMONY	25.0	23.74	95.0
CALCIUM	5000.0	5057.03	101.1
COPPER	25.0	26.30	105.2
IRON	5000.0	4892.41	97.8
LEAD	25.0	24.94	99.8
MAGNESIUM	5000.0	5475.45	109.5
MOLYBDENUM	25.0	25.95	103.8
POTASSIUM	5000.0	5182.05	103.6
SODIUM	5000.0	5437.50	108.7
ZINC	25.0	25.86	103.4

SAMPLE: CCV

File: LQC21A Mar 21, 2023 18:48

Analyte	True	Found	%R (1)
ALUMINUM	500.0	527.12	105.4
ANTIMONY	25.0	24.00	96.0
CALCIUM	5000.0	5140.71	102.8
COPPER	25.0	26.38	105.5
IRON	5000.0	4983.56	99.7
LEAD	25.0	24.89	99.6
MAGNESIUM	5000.0	5470.18	109.4
MOLYBDENUM	25.0	26.18	104.7
POTASSIUM	5000.0	5150.29	103.0
SODIUM	5000.0	5477.25	109.5
ZINC	25.0	26.61	106.4

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC21A Mar 21, 2023 20:01

Analyte	True	Found	%R (1)
ALUMINUM	500.0	515.81	103.2
ANTIMONY	25.0	24.24	97.0
CALCIUM	5000.0	5126.70	102.5
COPPER	25.0	26.53	106.1
IRON	5000.0	5003.09	100.1
LEAD	25.0	25.13	100.5
MAGNESIUM	5000.0	5482.83	109.7
MOLYBDENUM	25.0	26.23	104.9
POTASSIUM	5000.0	5160.08	103.2
SODIUM	5000.0	5460.16	109.2
ZINC	25.0	26.57	106.3

SAMPLE: CCV

File: LQC21A Mar 21, 2023 21:07

Analyte	True	Found	%R (1)
ALUMINUM	500.0	514.90	103.0
ANTIMONY	25.0	23.97	95.9
CALCIUM	5000.0	5138.01	102.8
COPPER	25.0	26.38	105.5
IRON	5000.0	4914.15	98.3
LEAD	25.0	25.33	101.3
MAGNESIUM	5000.0	5452.90	109.1
MOLYBDENUM	25.0	26.10	104.4
POTASSIUM	5000.0	5106.79	102.1
SODIUM	5000.0	5458.77	109.2
ZINC	25.0	26.98	107.9

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC21A Mar 21, 2023 22:17

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	514.98	103.0	
ANTIMONY	25.0	24.15	96.6	
CALCIUM	5000.0	5143.18	102.9	
COPPER	25.0	26.01	104.0	
IRON	5000.0	4973.60	99.5	
LEAD	25.0	24.96	99.8	
MAGNESIUM	5000.0	5534.95	110.7	•
MOLYBDENUM	25.0	26.09	104.4	
POTASSIUM	5000.0	5158.29	103.2	
SODIUM	5000.0	5473.21	109.5	
ZINC	25.0	26.62	106.5	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICV

File: LQC24A Mar 24, 2023 16:38

Analyte	True	Found	%R (1)
ALUMINUM	400.0	398.74	99.7
CALCIUM	4000.0	4087.04	102.2
IRON	4000.0	3966.65	99.2
LEAD	20.0	19.63	98.1
MAGNESIUM	4000.0	4141.96	103.5
MOLYBDENUM	40.0	39.01	97.5
POTASSIUM	4000.0	4104.51	102.6
SODIUM	4000.0	4132.93	103.3

SAMPLE: CCV

File: LQC24A Mar 24, 2023 17:45

Analyte	True	Found	%R (1)
ALUMINUM	500.0	521.81	104.4
CALCIUM	5000.0	5192.91	103.9
IRON	5000.0	5107.87	102.2
LEAD	25.0	26.20	104.8
MAGNESIUM	5000.0	5300.54	106.0
MOLYBDENUM	25.0	24.82	99.3
POTASSIUM	5000.0	5233.65	104.7
SODIUM	5000.0	5315.47	106.3

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC24A Mar 24, 2023 18:21

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	558.41	111.7	•
CALCIUM	5000.0	5217.40	104.3	
IRON	5000.0	5148.44	103.0	
LEAD	25.0	26.12	104.5	
MAGNESIUM	5000.0	5388.17	107.8	
MOLYBDENUM	25.0	27.44	109.8	
POTASSIUM	5000.0	5253.99	105.1	
SODIUM	5000.0	5377.08	107.5	

SAMPLE: CCV

File: LQC24A Mar 24, 2023 19:32

Analyte	True	Found	%R (1)
ALUMINUM	500.0	508.75	101.8
CALCIUM	5000.0	5161.95	103.2
IRON	5000.0	5173.01	103.5
LEAD	25.0	25.77	103.1
MAGNESIUM	5000.0	5430.31	108.6
MOLYBDENUM	25.0	24.48	97.9
POTASSIUM	5000.0	5163.63	103.3
SODIUM	5000.0	5361.48	107.2

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC24A Mar 24, 2023 20:41

Analyte	True	Found	%R (1)
ALUMINUM	500.0	518.23	103.6
CALCIUM	5000.0	5198.22	104.0
IRON	5000.0	5088.11	101.8
LEAD	25.0	25.61	102.4
MAGNESIUM	5000.0	5346.63	106.9
MOLYBDENUM	25.0	24.48	97.9
POTASSIUM	5000.0	5183.10	103.7
SODIUM	5000.0	5318.75	106.4

SAMPLE: CCV

File: LQC24A Mar 24, 2023 21:58

Analyte	True	Found	%R (1)
ALUMINUM	500.0	515.41	103.1
CALCIUM	5000.0	5230.57	104.6
IRON	5000.0	5119.91	102.4
LEAD	25.0	25.45	101.8
MAGNESIUM	5000.0	5328.47	106.6
MOLYBDENUM	25.0	24.59	98.4
POTASSIUM	5000.0	5184.04	103.7
SODIUM	5000.0	5302.15	106.0

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC24A Mar 24, 2023 23:12

Analyte	True	Found	%R (1)
ALUMINUM	500.0	505.88	101.2
CALCIUM	5000.0	5106.43	102.1
IRON	5000.0	5185.49	103.7
LEAD	25.0	25.89	103.6
MAGNESIUM	5000.0	5284.48	105.7
MOLYBDENUM	25.0	24.57	98.3
POTASSIUM	5000.0	5223.49	104.5
SODIUM	5000.0	5301.01	106.0

(1) Control Limits: Mercury 80-120; Other Metals 90-110

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICV

File: LQC28E Mar 28, 2023 16:12

Analyte	True	Found	%R (1)
ALUMINUM	400.0	417.03	104.3
CALCIUM	4000.0	4163.20	104.1
IRON	4000.0	3985.48	99.6
MAGNESIUM	4000.0	4215.47	105.4
MOLYBDENUM	40.0	40.47	101.2
POTASSIUM	4000.0	4191.95	104.8
SODIUM	4000.0	4182.33	104.6
ZINC	20.0	21.28	106.4

SAMPLE: CCV

File: LQC28E Mar 28, 2023 17:20

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	551.70	110.3	
CALCIUM	5000.0	5307.23	106.1	
IRON	5000.0	5058.56	101.2	
MAGNESIUM	5000.0	5702.13	114.0	•
MOLYBDENUM	25.0	26.37	105.5	
POTASSIUM	5000.0	5350.41	107.0	
SODIUM	5000.0	5629.73	112.6	•
ZINC	25.0	27.04	108.2	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCV

File: LQC28E Mar 28, 2023 18:30

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	591.28	118.3	•
CALCIUM	5000.0	5337.61	106.8	
IRON	5000.0	5144.38	102.9	
MAGNESIUM	5000.0	5638.02	112.8	•
MOLYBDENUM	25.0	25.97	103.9	
POTASSIUM	5000.0	5403.97	108.1	
SODIUM	5000.0	5623.47	112.5	•
ZINC	25.0	26.60	106.4	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: PQL

File: IQC24A Mar 24, 2023 15:18

Analyte	TRUE	FOUND	% R
ALUMINUM	300.0	311.90	104.0
CADMIUM	5.0	4.78	95.6
CALCIUM	100.0	97.07	97.1
COPPER	25.0	24.24	97.0
IRON	100.0	105.80	105.8
LEAD	5.0	5.28	105.6
MAGNESIUM	100.0	108.90	108.9
NICKEL	10.0	9.58	95.8
SILVER	10.0	9.51	95.1
ZINC	20.0	19.42	97.1

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: PQL

File: LQC21A Mar 21, 2023 15:31

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	18.96	94.8
ANTIMONY	0.2	0.23	115.0
CALCIUM	20.0	20.84	104.2
COPPER	0.6	0.70	116.7
IRON	20.0	22.77	113.9
LEAD	0.2	0.19	95.0
MAGNESIUM	20.0	21.63	108.1
MOLYBDENUM	1.0	1.08	108.0
POTASSIUM	200.0	200.53	100.3
SODIUM	200.0	208.44	104.2
ZINC	2.0	2.15	107.5

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: PQL

File: LQC24A Mar 24, 2023 18:06

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	-1.54	-7.7•
CALCIUM	20.0	23.90	119.5
IRON	20.0	21.45	107.3
LEAD	0.2	0.22	110.0
MAGNESIUM	20.0	23.77	118.8
MOLYBDENUM	1.0	1.17	117.0
POTASSIUM	200.0	223.23	111.6
SODIUM	200.0	220.01	110.0

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: PQL

File: LQC28E Mar 28, 2023 16:26

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	20.71	103.6
CALCIUM	20.0	20.36	101.8
IRON	20.0	20.18	100.9
MAGNESIUM	20.0	20.47	102.3
MOLYBDENUM	1.0	1.03	103.0
POTASSIUM	200.0	197.56	98.8
SODIUM	200.0	200.03	100.0
ZINC	2.0	2.24	112.0

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICB

File: IQC24A Mar 24, 2023 15:14

Analyte	Result	C
ALUMINUM	25.170	J
CADMIUM	0.092	U
CALCIUM	11.000	U
COPPER	0.550	U
IRON	8.362	J
LEAD	1.000	U
MAGNESIUM	2.900	U
NICKEL	0.440	U
SILVER	0.530	U
ZINC	0.450	U

SAMPLE: CCB

File: IQC24A Mar 24, 2023 15:35

Analyte	Result	C
ALUMINUM	39.230	J
CADMIUM	0.092	U
CALCIUM	32.660	J
COPPER	0.550	U
IRON	13.760	J
LEAD	1.000	U
MAGNESIUM	7.765	J
NICKEL	0.440	U
SILVER	0.530	U
ZINC	0.450	U

SAMPLE: CCB

File: IQC24A Mar 24, 2023 15:53

Analyte	Result	C
ALUMINUM	12.510	J
CADMIUM	0.144	J
CALCIUM	11.000	U
COPPER	0.550	U
IRON	6.080	J
LEAD	1.000	U
MAGNESIUM	3.012	J
NICKEL	0.440	U
SILVER	0.530	U
ZINC	0.451	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCB

File: IQC24A Mar 24, 2023 16:44

Analyte	Result	C
ALUMINUM	18.980	J
CADMIUM	0.105	J
CALCIUM	11.660	J
COPPER	0.550	U
IRON	7.097	J
LEAD	1.000	U
MAGNESIUM	2.900	U
NICKEL	0.440	U
SILVER	0.530	U
ZINC	0.450	U

SAMPLE: CCB

File: IQC24A Mar 24, 2023 17:35

Analyte	Result	C
ALUMINUM	15.440	J
CADMIUM	0.124	J
CALCIUM	11.000	U
COPPER	0.550	U
IRON	8.215	J
LEAD	1.000	U
MAGNESIUM	2.900	U
NICKEL	0.440	U
SILVER	0.530	U
ZINC	0.551	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICB

File: LQC21A Mar 21, 2023 15:26

Analyte	Result	C
ALUMINUM	0.330	U
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.005	U
MAGNESIUM	3.178	J
MOLYBDENUM	0.170	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC21A Mar 21, 2023 16:33

Analyte	Result	C
ALUMINUM	0.428	J
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.006	J
MAGNESIUM	5.696	J
MOLYBDENUM	0.281	J
POTASSIUM	30.161	J
SODIUM	17.981	J
ZINC	0.220	U

SAMPLE: CCB

File: LQC21A Mar 21, 2023 17:41

Analyte	Result	C
ALUMINUM	0.330	U
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.005	U
MAGNESIUM	3.911	J
MOLYBDENUM	0.141	J
POTASSIUM	27.287	J
SODIUM	10.084	J
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCB
File: LQC21A Mar 21, 2023 18:57

Analyte	Result	C
ALUMINUM	0.330	U
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.005	U
MAGNESIUM	3.709	J
MOLYBDENUM	0.116	J
POTASSIUM	27.751	J
SODIUM	7.937	J
ZINC	0.220	U

SAMPLE: CCB
File: LQC21A Mar 21, 2023 20:11

Analyte	Result	C
ALUMINUM	-0.981	U
ANTIMONY	0.061	U
CALCIUM	9.383	J
COPPER	0.087	U
IRON	6.400	U
LEAD	0.009	J
MAGNESIUM	4.899	J
MOLYBDENUM	0.111	J
POTASSIUM	30.151	J
SODIUM	9.280	J
ZINC	0.220	U

SAMPLE: CCB
File: LQC21A Mar 21, 2023 21:16

Analyte	Result	C
ALUMINUM	-1.459	U
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	-0.005	U
MAGNESIUM	3.954	J
MOLYBDENUM	0.096	J
POTASSIUM	30.361	J
SODIUM	7.758	J
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCB

File: LQC21A Mar 21, 2023 22:27

Analyte	Result	C
ALUMINUM	-1.537	U
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.005	U
MAGNESIUM	3.316	J
MOLYBDENUM	0.066	J
POTASSIUM	29.556	J
SODIUM	6.600	U
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICB

File: LQC24A Mar 24, 2023 16:47

Analyte	Result	C
ALUMINUM	0.871	J
CALCIUM	6.800	U
IRON	6.400	U
LEAD	0.016	J
MAGNESIUM	2.632	J
MOLYBDENUM	0.201	J
POTASSIUM	12.000	U
SODIUM	6.600	U

SAMPLE: CCB

File: LQC24A Mar 24, 2023 17:56

Analyte	Result	C
ALUMINUM	-21.460	B
CALCIUM	6.800	U
IRON	6.400	U
LEAD	0.021	J
MAGNESIUM	6.490	J
MOLYBDENUM	0.334	J
POTASSIUM	24.074	J
SODIUM	14.108	J

SAMPLE: CCB

File: LQC24A Mar 24, 2023 18:30

Analyte	Result	C
ALUMINUM	-13.950	B
CALCIUM	14.188	B
IRON	13.554	B
LEAD	0.015	J
MAGNESIUM	12.790	B
MOLYBDENUM	0.682	B
POTASSIUM	29.969	J
SODIUM	23.010	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCB

File: LQC24A Mar 24, 2023 19:42

Analyte	Result	C
ALUMINUM	-23.769	B
CALCIUM	6.800	U
IRON	6.400	U
LEAD	0.008	J
MAGNESIUM	3.594	J
MOLYBDENUM	0.181	J
POTASSIUM	19.841	J
SODIUM	6.600	U

SAMPLE: CCB

File: LQC24A Mar 24, 2023 20:51

Analyte	Result	C
ALUMINUM	-19.559	B
CALCIUM	7.197	J
IRON	6.909	J
LEAD	0.029	J
MAGNESIUM	5.771	J
MOLYBDENUM	0.173	J
POTASSIUM	24.628	J
SODIUM	6.600	U

SAMPLE: CCB

File: LQC24A Mar 24, 2023 22:07

Analyte	Result	C
ALUMINUM	-21.258	B
CALCIUM	6.800	U
IRON	6.400	U
LEAD	0.018	J
MAGNESIUM	3.995	J
MOLYBDENUM	0.134	J
POTASSIUM	18.102	J
SODIUM	6.600	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: CCB

File: LQC24A Mar 24, 2023 23:21

Analyte	Result	C
ALUMINUM	-23.510	B
CALCIUM	6.800	U
IRON	6.400	U
LEAD	0.010	J
MAGNESIUM	3.720	J
MOLYBDENUM	0.144	J
POTASSIUM	18.367	J
SODIUM	6.600	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICB

File: LQC28E Mar 28, 2023 16:21

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	2.605	J
MOLYBDENUM	0.207	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC28E Mar 28, 2023 17:28

Analyte	Result	C
ALUMINUM	2.461	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	6.770	J
MOLYBDENUM	0.337	J
POTASSIUM	14.004	J
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC28E Mar 28, 2023 18:39

Analyte	Result	C
ALUMINUM	6.678	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	4.576	J
MOLYBDENUM	0.153	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

3P

PREPARATION BLANKS

Lab Name: Katahdin Analytical Services **Sample ID:** PBSQC14IMS2

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC14IMS2

Concentration Units : mg/Kg drywt

Analyte	RESULT	C
ANTIMONY	0.050	U
COPPER	0.077	J
LEAD	0.066	B
ZINC	0.30	J

3P

PREPARATION BLANKS

Lab Name: Katahdin Analytical Services **Sample ID:** PBSQC16IMS1

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC16IMS1

Concentration Units : mg/Kg drywt

Analyte	RESULT	C
ANTIMONY	0.050	U
COPPER	0.20	U
LEAD	0.016	J
ZINC	0.70	B

3P

PREPARATION BLANKS

Lab Name: Katahdin Analytical Services **Sample ID:** PBSQC21ICS2

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC21ICS2

Concentration Units : umole/g drywt

Analyte	RESULT	C
CADMIUM	0.000017	J
COPPER	0.0031	U
LEAD	0.00039	U
NICKEL	0.0014	U
SILVER	0.00074	U
ZINC	0.0126	B

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICSA

File: IQC24A Mar 24, 2023 15:23

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	527600.00	105.5
CADMIUM	0	0.11	
CALCIUM	500000.00	497700.00	99.5
COPPER	0	-3.44	
IRON	200000.00	203100.00	101.6
LEAD	0	-0.19	
MAGNESIUM	500000.00	429200.00	85.8
NICKEL	0	-0.16	
SILVER	0	0.15	
ZINC	0	1.25	

SAMPLE: ICSAB

File: IQC24A Mar 24, 2023 15:27

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	525200.00	105.0
CADMIUM	1000.00	932.70	93.3
CALCIUM	500000.00	501600.00	100.3
COPPER	500.00	526.90	105.4
IRON	200000.00	202100.00	101.1
LEAD	50.00	44.54	90.0
MAGNESIUM	500000.00	422800.00	84.6
NICKEL	1000.00	922.10	92.2
SILVER	200.00	214.40	107.0
ZINC	1000.00	921.50	92.2

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICSA

File: LQC21A Mar 21, 2023 15:36

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	107781.26	107.8
ANTIMONY	0.05	0.08	
CALCIUM	100000.00	104952.51	105.0
COPPER	0.08	0.10	
IRON	100000.00	101811.97	101.8
LEAD	0.02	0.04	
MAGNESIUM	100000.00	106190.33	106.2
MOLYBDENUM	2000.00	2264.96	113.3
POTASSIUM	100000.00	101679.39	101.7
SODIUM	100000.00	106379.19	106.4
ZINC	1.40	0.94	

SAMPLE: ICSAB

File: LQC21A Mar 21, 2023 15:41

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	105995.40	106.0
ANTIMONY	20.05	19.93	100.0
CALCIUM	100000.00	103377.12	103.4
COPPER	20.08	20.45	100.0
IRON	100000.00	99989.35	100.0
LEAD	20.02	20.37	100.0
MAGNESIUM	100000.00	104319.74	104.3
MOLYBDENUM	2000.00	2240.74	112.1
POTASSIUM	100000.00	100141.96	100.1
SODIUM	100000.00	104424.27	104.4
ZINC	21.40	20.41	95.2

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICSAB

File: LQC24A Mar 24, 2023 17:03

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	107389.78	107.4
CALCIUM	100000.00	104865.54	104.9
IRON	100000.00	99380.44	99.4
LEAD	20.02	20.40	100.0
MAGNESIUM	100000.00	101806.41	101.8
MOLYBDENUM	2000.00	2191.99	109.6
POTASSIUM	100000.00	99718.53	99.7
SODIUM	100000.00	102736.29	102.7

SAMPLE: ICSA

File: LQC24A Mar 24, 2023 18:11

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	108851.54	108.9
CALCIUM	100000.00	104615.12	104.6
IRON	100000.00	99903.75	99.9
LEAD	0.02	0.05	
MAGNESIUM	100000.00	102885.10	102.9
MOLYBDENUM	2000.00	2187.72	109.4
POTASSIUM	100000.00	100549.26	100.5
SODIUM	100000.00	103543.60	103.5

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Concentration Units: ug/L

SAMPLE: ICSA

File: LQC28E Mar 28, 2023 16:31

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	109818.77	109.8
CALCIUM	100000.00	105452.98	105.5
IRON	100000.00	98193.64	98.2
MAGNESIUM	100000.00	105545.44	105.5
MOLYBDENUM	2000.00	2237.00	111.9
POTASSIUM	100000.00	102270.05	102.3
SODIUM	100000.00	106470.40	106.5
ZINC	1.40	0.98	

SAMPLE: ICSAB

File: LQC28E Mar 28, 2023 16:36

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	109041.59	109.0
CALCIUM	100000.00	105049.96	105.1
IRON	100000.00	99444.93	99.4
MAGNESIUM	100000.00	105567.12	105.6
MOLYBDENUM	2000.00	2300.62	115.1
POTASSIUM	100000.00	102603.93	102.6
SODIUM	100000.00	105691.59	105.7
ZINC	21.40	24.56	119.0

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01P

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-005P

Concentration Units : mg/Kg drywt

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
ANTIMONY, TOTAL	6.45		0.080	J	10.36	61.5	N	72	124	MS
COPPER, TOTAL	27.2		1.18		25.91	100.3		84	119	MS
LEAD, TOTAL	17.4		7.84		10.36	92.6		84	118	MS
ZINC, TOTAL	53.5		4.11		51.82	95.4		82	119	MS

Comments:

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01S

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-005S

Concentration Units : mg/Kg drywt

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
ANTIMONY, TOTAL	4.68		0.080	J	8.18	56.3	N	72	124	MS
COPPER, TOTAL	21.5		1.18		20.45	99.4		84	119	MS
LEAD, TOTAL	15.9		7.84		8.18	98.9		84	118	MS
ZINC, TOTAL	43.5		4.11		40.89	96.4		82	119	MS

Comments:

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC1-DC-01S

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 52.5 **Lab Sample ID:** SQ1188-008S

Concentration Units : umole/g drywt

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
CADMIUM, SEM	0.0803		0.000512	J	0.08256	96.6		82	113	P
COPPER, SEM	0.165		0.0311		0.146	91.7		81	117	P
LEAD, SEM	0.0388		0.0249		0.0179	77.7	N	81	112	P
NICKEL, SEM	0.314		0.00165	J	0.3161	98.8		83	113	P
SILVER, SEM	0.0138		0.0013	U	0.01724	80.0	N	82	112	P
ZINC, SEM	0.299		0.0341		0.2839	93.3		82	113	P

Comments:

5B

POST DIGEST SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01A

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-005A

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
ANTIMONY, TOTAL	2.03		0.15	J	2	93.8		80	120	MS
COPPER, TOTAL	8.85		2.15		6	111.7		80	120	MS
LEAD, TOTAL	16.5		14.3		2	111.3		80	120	MS
ZINC, TOTAL	28.4		7.51		20	104.7		80	120	MS

Comments:

5B

POST DIGEST SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC1-DC-01A

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 52.5 **Lab Sample ID:** SQ1188-008A

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
CADMIUM, SEM	457		1.60	J	500	91.2		80	120	P
COPPER, SEM	517		54.9		500	92.4		80	120	P
LEAD, SEM	606		143		500	92.5		80	120	P
NICKEL, SEM	462		2.7	J	500	92.0		80	120	P
SILVER, SEM	461		0.27	U	500	92.2		80	120	P
ZINC, SEM	512		61.9		500	90.1		80	120	P

Comments:

5D

SPIKE DUPLICATES

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 73.6 **Lab Sample ID:** SQ1188-005

Concentration Units : mg/Kg drywt

Analyte	Control Limits	Spike Result	C	Spike Dup. Result	C	RPD	Q	M
ANTIMONY, TOTAL		4.68		6.45		31.8	*	MS
COPPER, TOTAL		21.5		27.2		23.2	*	MS
LEAD, TOTAL		15.9		17.4		9.0		MS
ZINC, TOTAL		43.5		53.5		20.6	*	MS

Comments:

FORM VD - IN

DUPLICATES

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC1-DC-01D

Matrix: SOIL **SDG Name:** SQ1188

Percent Solids: 52.5 **Lab Sample ID:** SQ1188-008D

Concentration Units : umole/g drywt

Analyte	Control Limits	Sample Result	C	Duplicate Result	C	RPD	Q	M
CADMIUM, SEM		0.000512	J	0.000480	J	6.5		P
COPPER, SEM		0.0311		0.0299		3.9		P
LEAD, SEM		0.0249		0.0255		2.4		P
NICKEL, SEM		0.00165	J	0.00173	J	4.7		P
SILVER, SEM		0.0013	U	0.0013	U			P
ZINC, SEM		0.0341		0.0338		0.9		P

Comments:

LABORATORY CONTROL SAMPLES

Lab Name: Katahdin Analytical Services **Sample ID:** LC2OQC14IMS2

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC14IMS2

Concentration Units : mg/Kg drywt

Analyte	TRUE	FOUND	% R	LIMITS (%)	
ANTIMONY	10.0	9.23	92.3	72	124
COPPER	25.0	27.1	108.5	84	119
LEAD	10.0	9.78	97.9	84	118
ZINC	50.0	52.0	103.9	82	119

LABORATORY CONTROL SAMPLES

Lab Name: Katahdin Analytical Services **Sample ID:** LCSOQC14IMS2

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC14IMS2

Concentration Units : mg/Kg drywt

Analyte	TRUE	FOUND	% R	LIMITS (%)	
ANTIMONY	10.0	9.08	90.8	72	124
COPPER	25.0	27.2	108.8	84	119
LEAD	10.0	9.84	98.5	84	118
ZINC	50.0	52.5	105.0	82	119

LABORATORY CONTROL SAMPLES

Lab Name: Katahdin Analytical Services **Sample ID:** LCSOQC16IMS1

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC16IMS1

Concentration Units : mg/Kg drywt

Analyte	TRUE	FOUND	% R	LIMITS (%)	
ANTIMONY	10.0	9.12	91.2	72	124
COPPER	25.0	27.0	107.9	84	119
LEAD	10.0	9.85	98.5	84	118
ZINC	50.0	51.3	102.6	82	119

LABORATORY CONTROL SAMPLES

Lab Name: Katahdin Analytical Services **Sample ID:** LCSOQC21ICS2

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC21ICS2

Concentration Units : umole/g drywt

Analyte	TRUE	FOUND	% R	LIMITS (%)	
CADMIUM	0.0445	0.0461	103.6	82	113
COPPER	0.0787	0.0825	104.8	81	117
LEAD	0.00965	0.0103	107.0	81	112
NICKEL	0.170	0.182	106.6	83	113
SILVER	0.00927	0.00961	104.0	82	112
ZINC	0.153	0.163	106.8	82	113

LABORATORY CONTROL SAMPLE DUPLICATES

Lab Name: Katahdin Analytical Services

Matrix: SOIL **SDG Name:** SQ1188

QC Batch ID: QC14IMS2 **Lab Sample ID:** LCSOQC14IMS2

Concentration Units: mg/Kg drywt

Analyte	Control Limit (%)	LCS Result	LCS Dup. Result	RPD(%)	Q
ANTIMONY	20.0	9.08	9.23	1.6	
COPPER	20.0	27.2	27.1	0.3	
LEAD	20.0	9.84	9.78	0.6	
ZINC	20.0	52.5	52.0	1.0	

ICP SERIAL DILUTION

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC3-DC-01L

Matrix: SOIL **SDG Name:** SQ1188

Lab Sample ID: SQ1188-005L

Concentration Units: ug/L

Analyte	Sample Result	C	Dilution Result	C	% Difference	Q	M
ANTIMONY, TOTAL	0.15	J	0.20	U	100.0		MS
COPPER, TOTAL	2.15		2.1	J	2.3		MS
LEAD, TOTAL	14.3		15.4		7.7		MS
ZINC, TOTAL	7.51		6.3	J	16.1		MS

ICP SERIAL DILUTION

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SDMC1-DC-01L

Matrix: SOIL **SDG Name:** SQ1188

Lab Sample ID: SQ1188-008L

Concentration Units: ug/L

Analyte	Sample Result	C	Dilution Result	C	% Difference	Q	M
CADMIUM, SEM	1.60	J	1.7	J	6.2		P
COPPER, SEM	54.9		57	J	3.8		P
LEAD, SEM	143		150		4.9		P
NICKEL, SEM	2.7	J	2.2	U	100.0		P
SILVER, SEM	0.27	U	1.4	U			P
ZINC, SEM	61.9		63	J	1.8		P

INSTRUMENT DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 01/23/2019

Concentration Units: ug/L

Analyte	PQL/LOQ	IDL	M
ALUMINUM	300	10	P
CADMIUM	5.0	0.092	P
CALCIUM	100	11	P
COPPER	25	0.55	P
IRON	100	3.6	P
LEAD	5.0	1.0	P
MAGNESIUM	100	2.9	P
MOLYBDENUM	10	0.41	P
NICKEL	10	0.44	P
POTASSIUM	1000	73	P
SILVER	10	0.53	P
SODIUM	1000	12	P
ZINC	20	0.45	P

INSTRUMENT DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 06/11/2018

Concentration Units: ug/L

Analyte	PQL/LOQ	IDL	M
ALUMINUM	20	0.33	MS
ANTIMONY	0.20	0.061	MS
CALCIUM	20	6.8	MS
COPPER	0.60	0.087	MS
IRON	20	6.4	MS
LEAD	0.20	0.0049	MS
MAGNESIUM	20	0.35	MS
MOLYBDENUM	1.0	0.020	MS
POTASSIUM	200	12	MS
SODIUM	200	6.6	MS
ZINC	2.0	0.22	MS

LIMITS of DETECTION

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 06/14/2010

Analyte	LOD	Units	M	EPA Prep./Anal. Method
CADMIUM	0.00053	umole/g	P	821/R-91-100 / SW846 6010C
COPPER	0.0031	umole/g	P	821/R-91-100 / SW846 6010C
LEAD	0.00039	umole/g	P	821/R-91-100 / SW846 6010C
NICKEL	0.0014	umole/g	P	821/R-91-100 / SW846 6010C
SILVER	0.00074	umole/g	P	821/R-91-100 / SW846 6010C
ZINC	0.0030	umole/g	P	821/R-91-100 / SW846 6010C

LIMITS of DETECTION

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 06/13/2010

Analyte	LOD	Units	M	EPA Prep./Anal. Method
ANTIMONY	0.010	mg/kg	MS	SW846 3050B / SW846 6020A
COPPER	0.040	mg/kg	MS	SW846 3050B / SW846 6020A
LEAD	0.010	mg/Kg	MS	SW846 3050B / SW846 6020A
ZINC	0.16	mg/kg	MS	SW846 3050B / SW846 6020A

METHOD DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 01/20/2011

Analyte	MDL	Units	M	EPA Prep./Anal. Method
CADMIUM	0.000014	umole/g	P	821/R-91-100 / SW846 6010C
COPPER	0.00050	umole/g	P	821/R-91-100 / SW846 6010C
LEAD	0.000084	umole/g	P	821/R-91-100 / SW846 6010C
NICKEL	0.00015	umole/g	P	821/R-91-100 / SW846 6010C
SILVER	0.000050	umole/g	P	821/R-91-100 / SW846 6010C
ZINC	0.00052	umole/g	P	821/R-91-100 / SW846 6010C

METHOD DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 01/26/2011

Analyte	MDL	Units	M	EPA Prep./Anal. Method
ANTIMONY	0.0040	mg/kg	MS	SW846 3050B / SW846 6020A
COPPER	0.014	mg/kg	MS	SW846 3050B / SW846 6020A
LEAD	0.0014	mg/kg	MS	SW846 3050B / SW846 6020A
ZINC	0.026	mg/kg	MS	SW846 3050B / SW846 6020A

ICP INTERELEMENT CORRECTION FACTORS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument Name: THERMO ICAP 6500 **Instrument ID:** I **Date:** 03/10/2021

Analyte	Wavelength (nm)	Interelement Correction Factors for: Al	Ca	Fe	Mg	As	Cr	Co	Cu	Mn	Mo	Ni	Ti	V
ALUMINUM	396.15	0.0	0.0006250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0293740	0.0	0.0	0.0
ANTIMONY	206.83	0.0000130	0.0	0.0000150	0.0	0.0000731	0.0160080	0.0	0.0	0.0	-0.0046490	-0.0008980	0.0	-0.0005030
ARSENIC	189.04	-0.0000090	0.0	-0.0001780	0.0	0.0	0.0001984	0.0	0.0	0.0	0.0015170	0.0	0.0	0.0
BARIUM	455.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERYLLIUM	313.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0006836	0.0001220
BORON	208.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0501700	0.0	0.0	0.0
CADMIUM	226.50	0.0	0.0	0.0000850	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0001140	0.0000801	0.0
CALCIUM	315.89	0.0	0.0	0.0	0.0	0.0	0.0026700	0.0008487	0.0	0.0	0.0	0.0	0.0	0.0
CHROMIUM	267.72	0.0	0.0	-0.0000010	0.0	0.0	0.0	0.0	0.0	0.0003640	0.0	0.0	0.0	-0.0000100
COBALT	228.62	0.0	0.0	0.0000050	0.0	0.0	0.0001670	0.0	0.0	0.0	0.0	0.0001562	0.0017840	0.0
COPPER	327.40	0.0000079	0.0	-0.0000147	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0006988	0.0004860
GOLD	242.79	0.0	0.0	0.0001110	0.0	0.0	0.0	0.0	0.0	0.0058700	0.0	0.0	0.0	0.0
IRON	259.94	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LEAD	220.35	-0.0001590	0.0	0.0000440	0.0	0.0001480	-0.0000772	-0.0000860	0.0004910	0.0	-0.0010840	0.0003270	-0.0000220	0.0
LITHIUM	670.78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAGNESIUM	202.58	0.0	0.0	0.0000300	0.0	0.0	0.0	0.1395100	0.0	0.0	0.0145280	0.0	0.0003530	0.0
MANGANESE	257.61	-0.0000050	0.0	0.0000100	0.0000391	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOLYBDENUM	202.03	0.0	0.0	0.0	0.0	0.0	0.0000270	0.0	0.0	-0.0000204	0.0	0.0	0.0	-0.0001163
NICKEL	231.60	0.0	0.0	-0.0000490	0.0	0.0	0.0	0.0000390	0.0	0.0	0.0034490	0.0	0.0	0.0
POTASSIUM	766.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SELENIUM	196.09	0.0000090	0.0	0.0000320	0.0	0.0003180	0.0	0.0002310	0.0	0.0006280	0.0	0.0	0.0	0.0003040
SILICON	251.61	0.0	0.0	-0.0000150	0.0	0.0	0.0	0.0	0.0	0.0	0.0132630	0.0	0.0105540	0.0
SILVER	328.07	0.0	0.0	-0.0002820	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0008413	0.0
SODIUM	589.59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STRONTIUM	421.55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THALLIUM	190.86	0.0000030	0.0	0.0000001	0.0	0.0	0.0	0.0023030	-0.0000680	-0.0024730	-0.0000880	0.0	-0.0009840	-0.0078940
TIN	189.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TITANIUM	334.90	0.0	0.0	0.0	0.0	0.0	0.0001510	0.0	0.0	0.0	0.0002130	0.0	0.0	0.0
VANADIUM	292.40	0.0	0.0	0.0000120	0.0	0.0	-0.0053650	0.0	0.0	-0.0001670	-0.0037960	0.0	0.0006990	0.0
ZINC	206.20	0.0	0.0	0.0	0.0	0.0	-0.0010444	0.0	0.0	0.0	0.0	0.0	0.0	0.0

FORM XI - IN

ICP LINEAR RANGES

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 08/11/2022

Concentration Units: ug/L

Analyte	Integration Time (sec)	Linear Range	M
ALUMINUM	5.00	500000	P
ANTIMONY	45.00	20000	P
CADMIUM	45.00	20000	P
CALCIUM	5.00	500000	P
COPPER	10.00	20000	P
IRON	5.00	250000	P
LEAD	45.00	20000	P
MAGNESIUM	45.00	200000	P
MOLYBDENUM	45.00	5000	P
NICKEL	10.00	20000	P
POTASSIUM	5.00	300000	P
SILVER	10.00	2000	P
SODIUM	5.00	200000	P
ZINC	45.00	20000	P

ICP LINEAR RANGES

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 10/06/2022

Concentration Units: ug/L

Analyte	Integration Time (sec)	Linear Range	M
ALUMINUM	0.30	200000	MS
ANTIMONY	0.10	1000	MS
CADMIUM	0.90	1000	MS
CALCIUM	0.30	200000	MS
COPPER	0.30	2000	MS
IRON	0.10	100000	MS
LEAD	0.10	2000	MS
MAGNESIUM	0.15	200000	MS
MOLYBDENUM	0.30	1000	MS
NICKEL	0.30	1000	MS
POTASSIUM	0.20	200000	MS
SILVER	0.30	100	MS
SODIUM	0.10	200000	MS
ZINC	0.30	2000	MS

PREPARATION LOG

Lab Name: Katahdin Analytical Services **QC Batch ID:** QC14IMS2

Matrix: SOIL **SDG Name:** SQ1188

Method: MS **Prep Date:** 03/14/2023

Client ID	Lab Sample ID	Initial (g)	Final (L)	Bottle ID
LC2OQC14IMS2	LC2OQC14IMS2	1	0.1	
LCSOQC14IMS2	LCSOQC14IMS2	1	0.1	
PBSQC14IMS2	PBSQC14IMS2	1	0.1	
JACKSON-SDCC3-DC-01	SQ1188-001	1.5	0.1	A
JACKSON-SDCC2-DC-01	SQ1188-003	1.91	0.1	A
JACKSON-SDMC3-DC-01	SQ1188-005	1.24	0.1	A
JACKSON-SDMC3-DC-01P	SQ1188-005P	1.31	0.1	A
JACKSON-SDMC3-DC-01S	SQ1188-005S	1.66	0.1	A
JACKSON-SDMC1-DC-01	SQ1188-007	1.05	0.1	A
JACKSON-SDCC4-DC-01	SQ1188-009	1.73	0.1	A
SDDUP	SQ1188-015	1.04	0.1	A

FORM XIII - IN

PREPARATION LOG

Lab Name: Katahdin Analytical Services **QC Batch ID:** QC16IMS1

Matrix: SOIL **SDG Name:** SQ1188

Method: MS **Prep Date:** 03/16/2023

Client ID	Lab Sample ID	Initial (g)	Final (L)	Bottle ID
LCSOQC16IMS1	LCSOQC16IMS1	1	0.1	
PBSQC16IMS1	PBSQC16IMS1	1	0.1	
JACKSON-SDJC1-DC-01	SQ1188-011	1.13	0.1	A
JACKSON-SDMC2-DC-01	SQ1188-013	1.12	0.1	A

PREPARATION LOG

Lab Name: Katahdin Analytical Services **QC Batch ID:** QC21ICS2

Matrix: SOIL **SDG Name:** SQ1188

Method: P **Prep Date:** 03/21/2023

Client ID	Lab Sample ID	Initial (g)	Final (L)	Bottle ID
LCSOQC21ICS2	LCSOQC21ICS2	10	0.2	
PBSQC21ICS2	PBSQC21ICS2	10	0.2	
JACKSON-SDCC3-DC-01	SQ1188-002	12.575	0.2	
JACKSON-SDCC2-DC-01	SQ1188-004	10.744	0.2	
JACKSON-SDMC3-DC-01	SQ1188-006	10.314	0.2	
JACKSON-SDMC1-DC-01	SQ1188-008	10.58	0.2	
JACKSON-SDMC1-DC-01D	SQ1188-008D	10.607	0.2	
JACKSON-SDMC1-DC-01S	SQ1188-008S	10.254	0.2	
JACKSON-SDCC4-DC-01	SQ1188-010	10.496	0.2	
JACKSON-SDJC1-DC-01	SQ1188-012	10.104	0.2	
JACKSON-SDMC2-DC-01	SQ1188-014	10.698	0.2	
SDDUP	SQ1188-016	10.61	0.2	

FORM XIII - IN

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: THERMO ICAP 6500 **File Name:** IQC24A

Date: 03/24/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements							
Blank		1	15:01	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
Std 1		1	15:06	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
ICV		1	15:10	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
ICB		1	15:14	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
PQL		1	15:18	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
ICSA		1	15:23	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
ICSAB		1	15:27	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
CCV		1	15:31	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
CCB		1	15:35	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
ZZZZZZ		1	15:40								
ZZZZZZ		1	15:44								
CCV		1	15:49	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
CCB		1	15:53	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
PBSQC21ICS2		1	15:58		CD	CU	PB		NI	AG	ZN
LCSOQC21ICS2		1	16:02		CD	CU	PB		NI	AG	ZN
SQ1188-002	JACKSON-SDCC3-DC-01	1	16:06		CD	CU	PB		NI	AG	ZN
SQ1188-004	JACKSON-SDCC2-DC-01	1	16:10		CD	CU	PB		NI	AG	ZN
SQ1188-006	JACKSON-SDMC3-DC-01	1	16:14		CD	CU	PB		NI	AG	ZN
SQ1188-008	JACKSON-SDMC1-DC-01	1	16:19		CD	CU	PB		NI	AG	ZN
SQ1188-008L	JACKSON-SDMC1-DC-01L	5	16:23		CD	CU	PB		NI	AG	ZN
SQ1188-008A	JACKSON-SDMC1-DC-01A	1	16:27		CD	CU	PB		NI	AG	ZN
SQ1188-008D	JACKSON-SDMC1-DC-01D	1	16:31		CD	CU	PB		NI	AG	ZN
SQ1188-008S	JACKSON-SDMC1-DC-01S	1	16:35		CD	CU	PB		NI	AG	ZN
CCV		1	16:39	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
CCB		1	16:44	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
SQ1188-010	JACKSON-SDCC4-DC-01	1	16:48		CD	CU	PB		NI	AG	ZN
SQ1188-012	JACKSON-SDJC1-DC-01	1	16:52		CD	CU	PB		NI	AG	ZN

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: THERMO ICAP 6500 **File Name:** IQC24A

Date: 03/24/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements							
SQ1188-014	JACKSON-SDMC2-DC-01	1	16:57		CD	CU	PB		NI	AG	ZN
SQ1188-016	SDDUP	1	17:01		CD	CU	PB		NI	AG	ZN
ZZZZZZ		2	17:05								
ZZZZZZ		2	17:09								
ZZZZZZ		2	17:13								
ZZZZZZ		2	17:18								
ZZZZZZ		1	17:22								
ZZZZZZ		1	17:26								
CCV		1	17:30	AL	CD CA	CU	FE PB	MG	NI	AG	ZN
CCB		1	17:35	AL	CD CA	CU	FE PB	MG	NI	AG	ZN

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC21A

Date: 03/21/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements								
CalBlank		1	15:00	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
CalStd		1	15:05	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ICV		1	15:17	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ICB		1	15:26	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
PQL		1	15:31	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ICSA		1	15:36	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ICSAB		1	15:41	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ZZZZZZ		1	15:49											
ZZZZZZ		1	16:01											
ZZZZZZ		1	16:12											
ZZZZZZ		1	16:18											
CCV		1	16:23	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
CCB		1	16:33	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ZZZZZZ		5	16:38											
ZZZZZZ		5	16:43											
ZZZZZZ		10	16:51											
ZZZZZZ		50	16:56											
ZZZZZZ		10	17:01											
ZZZZZZ		10	17:07											
ZZZZZZ		10	17:12											
ZZZZZZ		5	17:17											
ZZZZZZ		5	17:22											
PBSQC14IMS2		5	17:27		Sb		Cu							Zn
CCV		1	17:32	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
CCB		1	17:41	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
LC2OQC14IMS2		5	17:46		Sb		Cu							Zn
LCSOQC14IMS2		5	17:54		Sb		Cu							Zn

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC21A

Date: 03/21/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements										
SQ1188-001	JACKSON-SDCC3-DC-01	5	18:02		Sb			Cu						Zn
SQ1188-003	JACKSON-SDCC2-DC-01	5	18:07		Sb			Cu						Zn
SQ1188-005	JACKSON-SDMC3-DC-01	5	18:12		Sb			Cu						Zn
SQ1188-005L	JACKSON-SDMC3-DC-01L	25	18:17		Sb			Cu						Zn
SQ1188-005A	JACKSON-SDMC3-DC-01A	5	18:22		Sb			Cu						Zn
SQ1188-005P	JACKSON-SDMC3-DC-01P	5	18:27		Sb			Cu						Zn
SQ1188-005S	JACKSON-SDMC3-DC-01S	5	18:35		Sb			Cu						Zn
SQ1188-007	JACKSON-SDMC1-DC-01	5	18:43		Sb			Cu						Zn
CCV		1	18:48	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
CCB		1	18:57	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
SQ1188-009	JACKSON-SDCC4-DC-01	5	19:02		Sb			Cu						Zn
SQ1188-015	SDDUP	5	19:07		Sb			Cu						Zn
ZZZZZZ		5	19:12											
ZZZZZZ		5	19:17											
ZZZZZZ		5	19:25											
ZZZZZZ		5	19:30											
ZZZZZZ		25	19:35											
ZZZZZZ		5	19:40											
ZZZZZZ		5	19:45											
ZZZZZZ		5	19:53											
CCV		1	20:01	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
CCB		1	20:11	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na	Zn
ZZZZZZ		5	20:16											
ZZZZZZ		5	20:21											
ZZZZZZ		5	20:26											
ZZZZZZ		5	20:31											
ZZZZZZ		5	20:37											

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC21A

Date: 03/21/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements
ZZZZZZ		5	20:42	
ZZZZZZ		5	20:47	
ZZZZZZ		5	20:52	
ZZZZZZ		5	20:57	
ZZZZZZ		5	21:02	
CCV		1	21:07	Al Sb Ca Cu Fe Pb Mg Mo K Na Zn
CCB		1	21:16	Al Sb Ca Cu Fe Pb Mg Mo K Na Zn
ZZZZZZ		5	21:21	
ZZZZZZ		5	21:26	
ZZZZZZ		5	21:31	
ZZZZZZ		5	21:37	
PBSQC16IMS1		5	21:42	Sb Cu Pb
LCSOQC16IMS1		5	21:47	Sb Cu Pb
SQ1188-011	JACKSON-SDJC1-DC-01	5	21:54	Sb Cu Pb
SQ1188-013	JACKSON-SDMC2-DC-01	5	21:59	Sb Cu Pb
ZZZZZZ		5	22:05	
ZZZZZZ		5	22:10	
CCV		1	22:17	Al Sb Ca Cu Fe Pb Mg Mo K Na Zn
CCB		1	22:27	Al Sb Ca Cu Fe Pb Mg Mo K Na Zn

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC24A

Date: 03/24/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
CalBlank		1	16:21	Al	Ca	Fe Pb	Mg	Mo	K	Na
CalStd		1	16:27	Al	Ca	Fe Pb	Mg	Mo	K	Na
ICV		1	16:38	Al	Ca	Fe Pb	Mg	Mo	K	Na
ICB		1	16:47	Al	Ca	Fe Pb	Mg	Mo	K	Na
ZZZZZZ		1	16:52							
ZZZZZZ		1	16:58							
ICSAB		1	17:03	Al	Ca	Fe Pb	Mg	Mo	K	Na
ZZZZZZ		1	17:12							
ZZZZZZ		1	17:23							
ZZZZZZ		1	17:35							
ZZZZZZ		1	17:40							
CCV		1	17:45	Al	Ca	Fe Pb	Mg	Mo	K	Na
CCB		1	17:56	Al	Ca	Fe Pb	Mg	Mo	K	Na
ZZZZZZ		1	18:01							
PQL		1	18:06	Al	Ca	Fe Pb	Mg	Mo	K	Na
ICSA		1	18:11	Al	Ca	Fe Pb	Mg	Mo	K	Na
ZZZZZZ		1	18:16							
CCV		1	18:21	Al	Ca	Fe Pb	Mg	Mo	K	Na
CCB		1	18:30	Al	Ca	Fe Pb	Mg	Mo	K	Na
ZZZZZZ		5	18:35							
ZZZZZZ		5	18:41							
ZZZZZZ		5	18:49							
ZZZZZZ		5	18:54							
ZZZZZZ		5	18:59							
ZZZZZZ		5	19:04							
ZZZZZZ		5	19:09							
ZZZZZZ		25	19:14							

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC24A

Date: 03/24/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
ZZZZZZ		5	19:19							
ZZZZZZ		5	19:25							
CCV		1	19:32	Al	Ca	Fe Pb	Mg	Mo	K	Na
CCB		1	19:42	Al	Ca	Fe Pb	Mg	Mo	K	Na
ZZZZZZ		5	19:47							
ZZZZZZ		5	19:55							
ZZZZZZ		5	20:00							
ZZZZZZ		5	20:05							
ZZZZZZ		5	20:10							
ZZZZZZ		5	20:15							
ZZZZZZ		5	20:21							
ZZZZZZ		5	20:26							
ZZZZZZ		5	20:31							
PBSQC14IMS2		5	20:36			Pb				
CCV		1	20:41	Al	Ca	Fe Pb	Mg	Mo	K	Na
CCB		1	20:51	Al	Ca	Fe Pb	Mg	Mo	K	Na
LC2OQC14IMS2		5	20:56			Pb				
LCSOQC14IMS2		5	21:03			Pb				
SQ1188-001	JACKSON-SDCC3-DC-01	5	21:11			Pb				
SQ1188-003	JACKSON-SDCC2-DC-01	5	21:16			Pb				
SQ1188-005	JACKSON-SDMC3-DC-01	5	21:22			Pb				
SQ1188-005L	JACKSON-SDMC3-DC-01L	25	21:27			Pb				
SQ1188-005A	JACKSON-SDMC3-DC-01A	5	21:32			Pb				
SQ1188-005P	JACKSON-SDMC3-DC-01P	5	21:37			Pb				
SQ1188-005S	JACKSON-SDMC3-DC-01S	5	21:45			Pb				
SQ1188-007	JACKSON-SDMC1-DC-01	5	21:53			Pb				
CCV		1	21:58	Al	Ca	Fe Pb	Mg	Mo	K	Na

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC24A

Date: 03/24/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
CCB		1	22:07	Al	Ca	Fe	Pb	Mg	Mo	K	Na
SQ1188-009	JACKSON-SDCC4-DC-01	5	22:12				Pb				
SQ1188-015	SDDUP	5	22:17				Pb				
ZZZZZZ		5	22:22								
ZZZZZZ		5	22:28								
ZZZZZZ		5	22:35								
ZZZZZZ		5	22:41								
ZZZZZZ		5	22:46								
ZZZZZZ		5	22:51								
ZZZZZZ		5	22:59								
ZZZZZZ		5	23:07								
CCV		1	23:12	Al	Ca	Fe	Pb	Mg	Mo	K	Na
CCB		1	23:21	Al	Ca	Fe	Pb	Mg	Mo	K	Na

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC28E

Date: 03/28/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
ZZZZZZ		1	15:39								
ZZZZZZ		1	15:44								
ZZZZZZ		1	15:49								
CalBlank		1	15:55	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CalStd		1	16:00	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICV		1	16:12	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICB		1	16:21	Al	Ca	Fe	Mg	Mo	K	Na	Zn
PQL		1	16:26	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSA		1	16:31	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSAB		1	16:36	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	16:45								
ZZZZZZ		1	16:57								
ZZZZZZ		1	17:04								
ZZZZZZ		1	17:09								
ZZZZZZ		1	17:14								
CCV		1	17:20	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	17:28	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	17:33								
ZZZZZZ		5	17:38								
ZZZZZZ		5	17:43								
PBSQC16IMS1		5	17:48								Zn
LCSOQC16IMS1		5	17:54								Zn
SQ1188-011	JACKSON-SDJC1-DC-01	5	18:01								Zn
SQ1188-013	JACKSON-SDMC2-DC-01	5	18:07								Zn
ZZZZZZ		5	18:12								
ZZZZZZ		5	18:17								
ZZZZZZ		5	18:25								

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1188

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC28E

Date: 03/28/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
CCV		1	18:30	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	18:39	Al	Ca	Fe	Mg	Mo	K	Na	Zn

Raw Data Section

KATAHDIN ANALYTICAL SERVICES, LLC
METALS ANALYSIS RUN INFORMATION SHEET

INSTR. ID: I (Thermo iCAP 6500) **ANALYST**: EAM **ANALYSIS DATE**: 03/24/2023

METHOD: **ICP**
- ☑ 200.7
- ☑ 6010
- ☑ DOD
- ☐ _____

FILE NAME: IQC24A

Reviewed By: KS 3/29/23

The pHs of all samples that were tested by direct analysis in this analytical run were checked just prior to analysis and confirmed to be <2. The time of preservation of these samples was checked in the "Measured Turbidity and Preservation of Incoming Samples" logbook to verify that they had been preserved at least 16 hours prior to analysis. These verifications were performed by_____ (initials) on _____ (date).

STANDARDS USED:

Standard Name	Standard ID	Prep Date	Expiration Date	Standard Conc.
Cal. Blk/ICB/CCB	MW21420	03/03/2023	06/03/2023	0 ug/L
Standard 1	MW21417	03/02/2023	06/02/2023	Varies by Element
ICV	MW21424	03/08/2023	03/31/2023	Varies by Element
PQL	MW21396409 3/1	~~02/24~~/2023	3/1 ~~05/24~~/2023	Varies by Element
LRS1	MW21390	02/20/2023	05/20/2023	Varies by Element
LRS2	MW21434	03/20/2023	05/31/2023	Varies by Element
ICSA	MW21384	02/16/2023	05/16/2023	Varies by Element
ICSAB	MW21317	01/11/2023	04/11/2023	Varies by Element
CCV*	MW21433	03/17/2023	06/17/2023	Varies by Element
Internal Standard	MW21375	02/09/2023	05/09/2023	5.0 mg/L Yttrium

fm 033023

Additional Comments and Notes:

*- New CCV (MW21440) made on 03/24/2023 and used starting at 16:39. This ccv was used as 1st ccv (±5%) for 200.7 analysis.

3x diln.: 3.0 mL of sample (pipet M30) + 6.0 mL of MW21420 (pipet M31)

2x diln.: 4.0 mL of sample (pipet M30) + 4.0 mL of MW21420 (pipet M31)

10x diln.: 0.8 mL of sample (pipet M19) + 7.2 mL of MW21420 (pipet M31)

5x diln.: 1.6 mL of sample (pipet M30) + 6.4 mL of MW21420 (pipet M31)

25x diln.: 0.4mL of (pipet M19) + 9.6 mL of MW21420 (pipet M31)

Post Spike: 4ul MS2399 (pipet M17), 80ul MS2411 (pipet M27), 40ul MS2444 (pipet M27), 40ul MS2401 (pipet M27) to 8.0mL of sample (pipet M31)

INSTRUMENT RUNLOG

Instrument: ICAP 6500

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
Blank	1.000	IQC24A	03/24/2023	15:01	EAM
Std 1	1.000	IQC24A	03/24/2023	15:06	EAM
ICV	1.000	IQC24A	03/24/2023	15:10	EAM
ICB	1.000	IQC24A	03/24/2023	15:14	EAM
PQL	1.000	IQC24A	03/24/2023	15:18	EAM
ICSA	1.000	IQC24A	03/24/2023	15:23	EAM
ICSAB	1.000	IQC24A	03/24/2023	15:27	EAM
CCV	1.000	IQC24A	03/24/2023	15:31	EAM
CCB	1.000	IQC24A	03/24/2023	15:35	EAM
LRS1	1.000	IQC24A	03/24/2023	15:40	EAM
LRS2	1.000	IQC24A	03/24/2023	15:44	EAM
CCV	1.000	IQC24A	03/24/2023	15:49	EAM
CCB	1.000	IQC24A	03/24/2023	15:53	EAM
PBSQC21ICS2	1.000	IQC24A	03/24/2023	15:58	EAM
LCSOQC21ICS2	1.000	IQC24A	03/24/2023	16:02	EAM
SQ1188-002	1.000	IQC24A	03/24/2023	16:06	EAM
SQ1188-004	1.000	IQC24A	03/24/2023	16:10	EAM
SQ1188-006	1.000	IQC24A	03/24/2023	16:14	EAM
SQ1188-008	1.000	IQC24A	03/24/2023	16:19	EAM
SQ1188-008L	5.000	IQC24A	03/24/2023	16:23	EAM
SQ1188-008A	1.000	IQC24A	03/24/2023	16:27	EAM
SQ1188-008D	1.000	IQC24A	03/24/2023	16:31	EAM
SQ1188-008S	1.000	IQC24A	03/24/2023	16:35	EAM
CCV	1.000	IQC24A	03/24/2023	16:39	EAM
CCB	1.000	IQC24A	03/24/2023	16:44	EAM
SQ1188-010	1.000	IQC24A	03/24/2023	16:48	EAM
SQ1188-012	1.000	IQC24A	03/24/2023	16:52	EAM
SQ1188-014	1.000	IQC24A	03/24/2023	16:57	EAM
SQ1188-016	1.000	IQC24A	03/24/2023	17:01	EAM
LCSWQC17ICW1	2.000	IQC24A	03/24/2023	17:05	EAM
LC2WQC17ICW1	2.000	IQC24A	03/24/2023	17:09	EAM
SQ1218-001	1.000	IQC24A	03/24/2023	17:13	EAM
SQ1281-001	1.000	IQC24A	03/24/2023	17:18	EAM
PBSQC21ICS1	1.000	IQC24A	03/24/2023	17:22	EAM
LCSOQC21ICS1	1.000	IQC24A	03/24/2023	17:26	EAM
CCV	1.000	IQC24A	03/24/2023	17:30	EAM
CCB	1.000	IQC24A	03/24/2023	17:35	EAM
SQ1266-001	1.000	IQC24A	03/24/2023	17:39	EAM
SQ1299-001	1.000	IQC24A	03/24/2023	17:43	EAM
SQ1299-003	1.000	IQC24A	03/24/2023	17:47	EAM
PBWQC23ICW1	1.000	IQC24A	03/24/2023	17:52	EAM
LCSWQC23ICW1	2.000	IQC24A	03/24/2023	17:56	EAM
LC2WQC23ICW1	2.000	IQC24A	03/24/2023	18:00	EAM
SQ1310-001	1.000	IQC24A	03/24/2023	18:04	EAM

Intensity Report

Author:

Published: 3/27/2023 10:12:27AM

Notes:

Blank

Method Name: FAST-2022_POP Method Revision: 176

Analyst Name: EAM

Acquire Date: 3/24/2023 3:01:49PM Sample Type: Standard

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		#########	Cts/S	0.00003400	63.76	-9.109
Al3961_R		-0.001580	Cts/S	0.0004530	28.65	-14.79
As1891_A		-0.0004400	Cts/S	0.00001900	4.415	-2.943
B_2089_A		0.0005530	Cts/S	0.000001000	0.1624	3.702
Ba4554_R		0.001511	Cts/S	0.0005210	34.48	14.14
Be3130_R		-0.0009070	Cts/S	0.0002920	32.20	-8.496
Ca3158_R		-0.004119	Cts/S	0.0003560	8.644	-38.56
Cd2265_A		-0.0003040	Cts/S	0.00006000	19.64	-2.033
Co2286_A		-0.0001240	Cts/S	0.000008000	6.481	-0.8333
Cr2677_A		#########	Cts/S	0.00001500	215.5	-1.205
Cu3273_A		#########	Cts/S	0.00003300	45.03	-12.34
Fe2599_R		-0.0002030	Cts/S	0.00002200	10.97	-1.898
K_7664_R		-0.002596	Cts/S	0.0001610	6.187	-24.30
Li6707_R		-0.0004200	Cts/S	0.001514	360.4	-3.944
Mg2795		0.003103	Cts/S	0.00004400	1.416	29.05
Mg2025_A		-0.001134	Cts/S	0.00006500	5.755	-7.592
Mn2576_R		-0.0003760	Cts/S	0.00009900	26.29	-3.520
Mo2020_A		#########	Cts/S	0.00002400	38.43	0.4221
Na5895_R		0.005315	Cts/S	0.00002700	0.5072	49.75
Ni2316_A		0.0001450	Cts/S	0.0001070	73.80	0.9693
Pb2203_A		-0.0002640	Cts/S	0.00005100	19.39	-1.765
Sb2068_A		0.0003100	Cts/S	0.00007800	25.02	2.076
Se1960_A		0.0003080	Cts/S	0.00008000	25.89	2.064
Si2516_R		0.002067	Cts/S	0.00007000	3.407	19.35
Sn1899_A		0.0003050	Cts/S	0.00003100	10.28	2.044
Sr4215_R		-0.0005450	Cts/S	0.00007800	14.39	-5.100
Ti3349_A		-0.0002430	Cts/S	0.00004300	17.51	-41.21
Tl1908_A		-0.0004480	Cts/S	0.00005000	11.14	-3.002
V_2924_A		#########	Cts/S	0.00004600	98.43	-7.980
Zn2062_A		0.0001040	Cts/S	0.00003400	32.29	0.6968
Y_3600_R		9,360.3	Cts/S	14.082	0.15044	9,360.3
Y_2243_A		6,693.8	Cts/S	6.0535	0.090435	6,693.8
Y_3600_A		169,560	Cts/S	585.46	0.34528	169,560

Std 1

Method Name: FAST-2022_POP Method Revision: 176

Analyst Name: EAM

Acquire Date: 3/24/2023 3:06:05PM Sample Type: Standard

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1625	Cts/S	0.0002910	0.1791	26,290
Al3961_R		1.915	Cts/S	0.01577	0.8237	17,490
As1891_A		0.04851	Cts/S	0.0002390	0.4919	312.0
B_2089_A		0.1823	Cts/S	0.001150	0.6306	1,173
Ba4554_R		3.026	Cts/S	0.01002	0.3313	27,650
Be3130_R		6.432	Cts/S	0.03015	0.4687	58,780
Ca3158_R		1.710	Cts/S	0.005720	0.3346	15,620
Cd2265_A		2.744	Cts/S	0.008381	0.3054	17,650
Co2286_A		0.6449	Cts/S	0.004559	0.7069	4,148
Cr2677_A		0.09297	Cts/S	0.0002640	0.2836	15,030
Cu3273_A		0.1132	Cts/S	0.00008100	0.07197	18,310
Fe2599_R		2.372	Cts/S	0.006959	0.2934	21,670
K_7664_R		0.9377	Cts/S	0.004060	0.4330	8,568

Std 1

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:06:05PM Sample Type: Standard

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Li6707_R		0.8119	Cts/S	0.005082	0.6260	7,419
Mg2795		121.7	Cts/S	1.124	0.9237	1,112,000
Mg2025_A		1.411	Cts/S	0.002896	0.2052	9,076
Mn2576_R		0.7048	Cts/S	0.005596	0.7939	6,440
Mo2020_A		0.5002	Cts/S	0.0001020	0.02042	3,217
Na5895_R		2.418	Cts/S	0.003298	0.1364	22,090
Ni2316_A		0.2895	Cts/S	0.001467	0.5065	1,862
Pb2203_A		0.2051	Cts/S	0.0001080	0.05286	1,319
Sb2068_A		0.09261	Cts/S	0.0003970	0.4288	595.6
Se1960_A		0.03747	Cts/S	0.00007300	0.1955	241.0
Si2516_R		1.087	Cts/S	0.007589	0.6982	9,932
Sn1899_A		0.08927	Cts/S	0.0001590	0.1785	574.1
Sr4215_R		3.927	Cts/S	0.01122	0.2858	35,890
Ti3349_A		0.1478	Cts/S	0.0003200	0.2168	23,900
Tl1908_A		0.08335	Cts/S	0.0001790	0.2147	536.1
V_2924_A		0.1058	Cts/S	0.0004050	0.3829	17,110
Zn2062_A		0.6042	Cts/S	0.0006540	0.1082	3,886
Y_3600_R		9,137.7	Cts/S	75.881	0.83042	9,137.7
Y_2243_A		6,431.9	Cts/S	18.794	0.29220	6,431.9
Y_3600_A		161,710	Cts/S	504.15	0.31176	161,710

ICV

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:10:15PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		392.7	ug/L	0.6681	0.1701	10,590
Al3961_R		10,350	ug/L	36.79	0.3555	7,319
As1891_A		382.2	ug/L	2.716	0.7106	120.1
B_2089_A		392.0	ug/L	1.950	0.4974	472.6
Ba4554_R		396.0	ug/L	0.7447	0.1880	11,090
Be3130_R		401.9	ug/L	1.245	0.3098	23,900
Ca3158_R		10,310	ug/L	10.58	0.1026	6,497
Cd2265_A		394.4	ug/L	1.776	0.4503	7,115
Co2286_A		399.3	ug/L	2.316	0.5801	1,692
Cr2677_A		390.7	ug/L	0.2465	0.06309	6,030
Cu3273_A		394.6	ug/L	0.07852	0.01990	7,410
Fe2599_R		10,190	ug/L	6.635	0.06513	8,937
K_7664_R		13,780	ug/L	22.92	0.1664	4,768
Li6707_R		420.7	ug/L	0.6527	0.1551	3,157
Mg2795		10,470	ug/L	175.9	1.680	471,300
Mg2025_A		10,410	ug/L	71.91	0.6908	3,858
Mn2576_R		396.9	ug/L	1.838	0.4631	2,585
Mo2020_A		400.3	ug/L	1.632	0.4076	1,317
Na5895_R		10,170	ug/L	24.81	0.2438	9,129
Ni2316_A		399.8	ug/L	3.290	0.8230	761.7
Pb2203_A		403.5	ug/L	3.060	0.7583	543.1
Sb2068_A		395.0	ug/L	1.845	0.4671	241.6
Se1960_A		388.3	ug/L	0.6816	0.1755	96.90
Si2516_R		10,190	ug/L	62.51	0.6136	4,027
Sn1899_A		418.8	ug/L	3.209	0.7662	247.0
Sr4215_R		416.4	ug/L	1.115	0.2677	15,120
Ti3349_A		394.1	ug/L	1.207	0.3062	9,646
Tl1908_A		405.0	ug/L	0.1512	0.03734	220.2
V_2924_A		398.9	ug/L	0.4526	0.1135	7,002
Zn2062_A		393.6	ug/L	1.915	0.4864	1,564
Y_3600_R		9,248.2	Cts/S	28.513	0.30831	9,248.2
Y_2243_A		6,575.2	Cts/S	37.529	0.57077	6,575.2

ICV

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:10:15PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Y_3600_A		166,030	Cts/S	159.52	0.096079	166,030

ICB

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:14:26PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.3792	ug/L	0.2799	73.82	1.335
Al3961_R		25.17	ug/L	9.128	36.27	3.206
As1891_A		0.5896	ug/L	1.623	275.3	-2.727
B_2089_A		0.01815	ug/L	0.1936	1,067	3.722
Ba4554_R		0.1374	ug/L	0.2235	162.7	17.91
Be3130_R		0.2126	ug/L	0.04441	20.89	4.263
Ca3158_R		2.475	ug/L	7.620	307.9	-36.81
Cd2265_A		0.04366	ug/L	0.02961	67.82	-1.207
Co2286_A		0.04895	ug/L	0.1747	357.0	-0.6147
Cr2677_A		0.2982	ug/L	0.1313	44.01	3.483
Cu3273_A		0.1782	ug/L	0.06374	35.77	-8.895
Fe2599_R		8.362	ug/L	2.343	28.02	5.491
K_7664_R		37.77	ug/L	16.41	43.44	-10.97
Li6707_R		-0.08568	ug/L	0.7460	870.7	-4.590
Mg2795		2.787	ug/L	0.3141	11.27	155.3
Mg2025_A		0.5430	ug/L	0.2946	54.26	-7.321
Mn2576_R		0.7639	ug/L	0.4344	56.86	1.528
Mo2020_A		0.5864	ug/L	0.05018	8.558	2.366
Na5895_R		5.087	ug/L	0.2356	4.632	54.08
Ni2316_A		0.1525	ug/L	0.1995	130.8	1.255
Pb2203_A		0.2270	ug/L	0.1740	76.67	-1.444
Sb2068_A		0.3657	ug/L	0.04043	11.05	2.285
Se1960_A		-1.545	ug/L	1.774	114.8	1.667
Si2516_R		11.43	ug/L	9.061	79.24	23.80
Sn1899_A		-0.1172	ug/L	0.5002	426.7	1.958
Sr4215_R		0.09037	ug/L	0.0003030	0.3356	-1.768
Ti3349_A		0.2782	ug/L	0.09278	33.35	-34.07
Tl1908_A		1.220	ug/L	0.6767	55.48	-2.300
V_2924_A		0.01699	ug/L	0.1303	767.0	-7.712
Zn2062_A		0.07012	ug/L	0.05379	76.71	0.9715
Y_3600_R		9,313.7	Cts/S	93.209	1.0008	9,313.7
Y_2243_A		6,638.6	Cts/S	1.1125	0.016758	6,638.6
Y_3600_A		168,760	Cts/S	291.79	0.17291	168,760

PQL

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:18:43PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		9.511	ug/L	0.2214	2.328	254.4
Al3961_R		311.9	ug/L	1.943	0.6229	209.6
As1891_A		7.903	ug/L	0.6365	8.054	-0.3341
B_2089_A		46.17	ug/L	0.2997	0.6491	57.74
Ba4554_R		5.029	ug/L	0.2423	4.818	157.0
Be3130_R		4.922	ug/L	0.1294	2.629	288.5
Ca3158_R		97.07	ug/L	1.937	1.995	23.80
Cd2265_A		4.782	ug/L	0.05177	1.083	85.43
Co2286_A		9.747	ug/L	0.2178	2.235	41.12
Cr2677_A		9.984	ug/L	0.2501	2.505	157.0
Cu3273_A		24.24	ug/L	0.1936	0.7986	455.3

PQL

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:18:43PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Fe2599_R		105.8	ug/L	1.064	1.005	92.38
K_7664_R		1,032	ug/L	12.52	1.214	340.0
Li6707_R		102.4	ug/L	1.671	1.631	777.5
Mg2795		104.5	ug/L	1.080	1.033	4,805
Mg2025_A		108.9	ug/L	0.006675	0.006128	33.78
Mn2576_R		4.899	ug/L	0.6035	12.32	28.91
Mo2020_A		9.827	ug/L	0.03820	0.3888	33.18
Na5895_R		992.5	ug/L	18.76	1.890	949.4
Ni2316_A		9.584	ug/L	0.007690	0.08023	19.46
Pb2203_A		5.275	ug/L	0.3495	6.625	5.441
Sb2068_A		7.310	ug/L	0.05166	0.7068	6.115
Se1960_A	F	5.624	ug/L	0.9207	16.37	3.450
Si2516_R		189.4	ug/L	1.951	1.030	95.08
Sn1899_A		95.85	ug/L	0.3933	0.4103	58.88
Sr4215_R		9.377	ug/L	0.2503	2.669	340.8
Ti3349_A		14.22	ug/L	0.07148	0.5026	317.4
Tl1908_A		16.28	ug/L	1.063	6.531	6.104
V_2924_A		9.298	ug/L	0.03034	0.3263	159.8
Zn2062_A		19.42	ug/L	0.002909	0.01498	78.94
Y_3600_R		9,391.7	Cts/S	8.3791	0.089219	9,391.7
Y_2243_A		6,666.2	Cts/S	8.9003	0.13351	6,666.2
Y_3600_A		170,470	Cts/S	239.63	0.14057	170,470

ICSA

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:23:00PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1508	ug/L	0.1127	74.71	-5.286
Al3961_R		527,600	ug/L	3,064	0.5807	357,000
As1891_A		-0.6824	ug/L	0.2168	31.77	-12.96
B_2089_A		0.8212	ug/L	0.1815	22.10	3.901
Ba4554_R		2.588	ug/L	0.02384	0.9214	82.57
Be3130_R		0.06439	ug/L	0.05653	87.79	-4.479
Ca3158_R		497,700	ug/L	2,756	0.5537	301,700
Cd2265_A		0.1139	ug/L	0.04177	36.67	340.0
Co2286_A		-0.04591	ug/L	0.02488	54.20	1.938
Cr2677_A		4.992	ug/L	0.2645	5.297	47.95
Cu3273_A		-3.435	ug/L	0.1121	3.265	-24.65
Fe2599_R		203,100	ug/L	192.9	0.09498	170,400
K_7664_R	W	717.0	ug/L	140.6	19.61	215.4
Li6707_R		12.60	ug/L	2.098	16.65	86.87
Mg2795	^F	0.0000	ug/L	0.0000	0.0000	1,690,000
Mg2025_A		429,200	ug/L	1,468	0.3419	139,900
Mn2576_R		-1.573	ug/L	0.6268	39.83	4.179
Mo2020_A		-3.080	ug/L	0.5034	16.35	-8.585
Na5895_R		216.8	ug/L	5.672	2.617	232.0
Ni2316_A		-0.1584	ug/L	0.3311	209.0	-4.824
Pb2203_A		-0.1921	ug/L	1.125	585.5	-50.48
Sb2068_A		3.273	ug/L	0.3092	9.447	8.371
Se1960_A		-3.276	ug/L	2.377	72.54	3.838
Si2516_R		2.708	ug/L	3.446	127.3	8.914
Sn1899_A		6.578	ug/L	0.3857	5.863	5.172
Sr4215_R		4.784	ug/L	0.4952	10.35	161.4
Ti3349_A		2.394	ug/L	0.1250	5.222	16.27
Tl1908_A		0.2483	ug/L	0.5225	210.4	-1.322
V_2924_A		0.2665	ug/L	0.04773	17.91	16.16
Zn2062_A		1.254	ug/L	0.2163	17.25	4.991

ICSA

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:23:00PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Y_3600_R		8,843.4	Cts/S	56.946	0.64393	8,843.4
Y_2243_A		5,807.9	Cts/S	21.124	0.36371	5,807.9
Y_3600_A		146,940	Cts/S	672.80	0.45786	146,940

ICSAB

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:27:25PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		214.4	ug/L	0.1853	0.08642	5,113
Al3961_R		525,200	ug/L	1,961	0.3733	353,500
As1891_A		100.6	ug/L	3.524	3.504	16.26
B_2089_A		462.6	ug/L	1.512	0.3268	492.9
Ba4554_R		518.1	ug/L	5.338	1.030	13,790
Be3130_R		511.4	ug/L	0.8970	0.1754	28,930
Ca3158_R		501,600	ug/L	5,551	1.107	302,300
Cd2265_A		932.7	ug/L	2.416	0.2591	15,220
Co2286_A		467.0	ug/L	0.05343	0.01144	1,758
Cr2677_A		482.8	ug/L	2.679	0.5548	6,578
Cu3273_A		526.9	ug/L	1.469	0.2788	8,798
Fe2599_R		202,100	ug/L	2,492	1.233	168,600
K_7664_R		21,420	ug/L	211.5	0.9871	7,063
Li6707_R		547.6	ug/L	0.9664	0.1765	3,908
Mg2795	^F	0.0000	ug/L	0.0000	0.0000	1,655,000
Mg2025_A		422,800	ug/L	2,337	0.5528	138,400
Mn2576_R		486.0	ug/L	2.114	0.4350	3,027
Mo2020_A		451.4	ug/L	2.175	0.4817	1,316
Na5895_R		21,180	ug/L	206.1	0.9731	18,020
Ni2316_A		922.1	ug/L	0.9989	0.1083	1,551
Pb2203_A		44.54	ug/L	0.5851	1.314	3.037
Sb2068_A		606.2	ug/L	0.8544	0.1409	332.7
Se1960_A		47.87	ug/L	1.314	2.744	14.97
Si2516_R		2,014	ug/L	6.534	0.3244	760.7
Sn1899_A		460.3	ug/L	3.411	0.7410	240.5
Sr4215_R		516.3	ug/L	4.417	0.8556	17,830
Ti3349_A		470.3	ug/L	1.564	0.3326	10,200
Tl1908_A		83.71	ug/L	0.5172	0.6178	39.53
V_2924_A		501.3	ug/L	1.229	0.2452	7,815
Zn2062_A		921.5	ug/L	2.024	0.2197	3,247
Y_3600_R		8,795.3	Cts/S	93.228	1.0600	8,795.3
Y_2243_A		5,828.6	Cts/S	17.801	0.30541	5,828.6
Y_3600_A		146,970	Cts/S	72.786	0.049523	146,970

CCV

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:31:45PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		515.4	ug/L	1.492	0.2894	13,700
Al3961_R	F	14,410	ug/L	1,835	12.74	9,299
As1891_A		518.2	ug/L	5.082	0.9806	159.7
B_2089_A		521.5	ug/L	2.159	0.4140	611.0
Ba4554_R	F	580.4	ug/L	80.03	13.79	14,810
Be3130_R	F	577.4	ug/L	76.55	13.26	31,300
Ca3158_R	F	14,300	ug/L	1,935	13.53	8,227
Cd2265_A		523.9	ug/L	1.662	0.3173	9,215
Co2286_A	W	530.1	ug/L	1.541	0.2907	2,191

CCV

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:31:45PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Cr2677_A		517.9	ug/L	1.426	0.2752	7,875
Cu3273_A		520.3	ug/L	1.166	0.2241	9,631
Fe2599_R	F	14,280	ug/L	1,954	13.68	11,420
K_7664_R	F	14,480	ug/L	1,881	12.99	4,569
Li6707_R	F	577.5	ug/L	73.05	12.65	3,952
Mg2795	F	14,550	ug/L	1,530	10.51	597,700
Mg2025_A		13,120	ug/L	102.2	0.7789	4,744
Mn2576_R	F	580.2	ug/L	75.55	13.02	3,446
Mo2020_A		520.3	ug/L	3.954	0.7599	1,668
Na5895_R	F	14,320	ug/L	1,984	13.85	11,690
Ni2316_A	W	528.7	ug/L	1.864	0.3525	981.5
Pb2203_A	W	529.4	ug/L	0.2676	0.05055	695.0
Sb2068_A		522.4	ug/L	0.09572	0.01832	311.0
Se1960_A		511.3	ug/L	8.169	1.598	123.8
Si2516_R	F	14,540	ug/L	1,953	13.43	5,232
Sn1899_A		519.5	ug/L	4.525	0.8709	298.2
Sr4215_R	F	575.2	ug/L	78.21	13.60	19,040
Ti3349_A		517.2	ug/L	0.5018	0.09701	12,480
Tl1908_A		518.7	ug/L	16.30	3.142	275.6
V_2924_A		521.2	ug/L	0.8948	0.1717	9,016
Zn2062_A		522.0	ug/L	2.675	0.5125	2,022
Y_3600_R		8,484.8	Cts/S	831.32	9.7977	8,484.8
Y_2243_A		6,408.8	Cts/S	20.578	0.32109	6,408.8
Y_3600_A		163,570	Cts/S	306.92	0.18764	163,570

CCB

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:35:54PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.2622	ug/L	0.01380	5.262	-1.862
Al3961_R		39.23	ug/L	15.14	38.59	13.26
As1891_A		0.4518	ug/L	0.3253	72.00	-2.728
B_2089_A		0.04674	ug/L	0.2853	610.4	3.693
Ba4554_R		0.2422	ug/L	0.03888	16.05	20.91
Be3130_R		0.07994	ug/L	0.01268	15.87	-3.673
Ca3158_R		32.66	ug/L	6.868	21.03	-17.53
Cd2265_A		0.07949	ug/L	0.01752	22.03	-0.5355
Co2286_A		-0.05888	ug/L	0.08182	139.0	-1.060
Cr2677_A		0.3287	ug/L	0.2061	62.71	3.915
Cu3273_A		0.1715	ug/L	0.06256	36.47	-8.920
Fe2599_R		13.76	ug/L	8.320	60.45	10.27
K_7664_R		141.5	ug/L	19.98	14.13	25.40
Li6707_R		1.664	ug/L	2.507	150.6	8.707
Mg2795		30.41	ug/L	17.21	56.61	1,407
Mg2025_A		7.765	ug/L	1.770	22.80	-4.561
Mn2576_R		0.8559	ug/L	0.2818	32.92	2.117
Mo2020_A		0.5212	ug/L	0.1800	34.54	2.117
Na5895_R		20.42	ug/L	5.668	27.76	67.91
Ni2316_A		-0.3603	ug/L	0.04776	13.26	0.2647
Pb2203_A		0.1158	ug/L	0.6960	600.8	-1.569
Sb2068_A		0.1833	ug/L	0.8658	472.2	2.140
Se1960_A		-3.001	ug/L	0.1426	4.753	1.288
Si2516_R		5.323	ug/L	7.365	138.4	21.37
Sn1899_A		-0.4620	ug/L	0.5463	118.2	1.726
Sr4215_R		0.1778	ug/L	0.09105	51.21	1.437
Ti3349_A		0.2647	ug/L	0.09299	35.13	-34.02
Tl1908_A		0.5833	ug/L	1.308	224.2	-2.613

CCB

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:35:54PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
V_2924_A		0.09068	ug/L	0.09808	108.2	-6.307
Zn2062_A		0.3235	ug/L	0.02721	8.412	1.957
Y_3600_R		9,319.8	Cts/S	25.583	0.27451	9,319.8
Y_2243_A		6,533.2	Cts/S	30.146	0.46143	6,533.2
Y_3600_A		166,870	Cts/S	201.64	0.12083	166,870

LRS1

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:40:11PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		1,959	ug/L	10.87	0.5547	51,720
Al3961_R		18.78	ug/L	0.5349	2.848	137.2
As1891_A		20,080	ug/L	33.62	0.1674	6,069
B_2089_A		20,580	ug/L	43.09	0.2093	22,280
Ba4554_R		19,760	ug/L	143.5	0.7260	556,500
Be3130_R		19,460	ug/L	276.7	1.421	1,166,000
Ca3158_R		31.15	ug/L	4.233	13.59	-10.93
Cd2265_A		19,020	ug/L	36.26	0.1906	320,400
Co2286_A		19,900	ug/L	44.37	0.2230	78,960
Cr2677_A		18,890	ug/L	82.07	0.4344	285,700
Cu3273_A		19,340	ug/L	77.94	0.4031	355,900
Fe2599_R		5.591	ug/L	3.225	57.68	2.537
K_7664_R		-19.24	ug/L	47.16	245.2	-30.91
Li6707_R		20,720	ug/L	29.30	0.1414	156,700
Mg2795		2.544	ug/L	0.1363	5.357	144.2
Mg2025_A		1,889	ug/L	14.04	0.7431	1,644
Mn2576_R		19,190	ug/L	89.59	0.4670	126,000
Mo2020_A		5,020	ug/L	7.611	0.1516	15,450
Na5895_R		11.92	ug/L	10.76	90.21	60.21
Ni2316_A		19,750	ug/L	56.72	0.2872	35,180
Pb2203_A		20,590	ug/L	30.93	0.1502	26,060
Sb2068_A		20,330	ug/L	38.17	0.1877	11,550
Se1960_A		20,280	ug/L	18.53	0.09138	4,633
Si2516_R		332.3	ug/L	9.106	2.740	87.95
Sn1899_A		20,480	ug/L	29.67	0.1448	11,220
Sr4215_R		20,060	ug/L	279.8	1.395	733,900
Ti3349_A		19,170	ug/L	152.7	0.7964	461,200
Tl1908_A		20,230	ug/L	72.30	0.3575	10,430
V_2924_A		19,170	ug/L	151.5	0.7903	331,700
Zn2062_A		19,120	ug/L	53.60	0.2804	71,080
Y_3600_R		9,312.9	Cts/S	0.95070	0.010208	9,312.9
Y_2243_A		6,153.8	Cts/S	14.000	0.22750	6,153.8
Y_3600_A		162,640	Cts/S	858.01	0.52755	162,640

LRS2

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:44:56PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1706	ug/L	0.03067	17.98	-5.070
Al3961_R		515,100	ug/L	346.9	0.06735	357,600
As1891_A		4.429	ug/L	0.8189	18.49	-13.83
B_2089_A		8.946	ug/L	1.529	17.09	12.49
Ba4554_R		2.122	ug/L	0.2301	10.85	71.95
Be3130_R		1.457	ug/L	0.5288	36.30	76.75
Ca3158_R		477,100	ug/L	5,703	1.196	296,600

LRS2

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:44:56PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Cd2265_A		1.113	ug/L	0.07961	7.151	423.6
Co2286_A		1.742	ug/L	0.07690	4.415	9.267
Cr2677_A		1.154	ug/L	0.07586	6.572	-8.122
Cu3273_A		-7.149	ug/L	0.09236	1.292	-42.02
Fe2599_R		240,300	ug/L	978.9	0.4073	206,900
K_7664_R		306,500	ug/L	1,744	0.5690	104,600
Li6707_R		14.94	ug/L	1.136	7.603	106.3
Mg2795	^F	0.0000	ug/L	0.0000	0.0000	4,412,000
Mg2025_A	F	176,200	ug/L	196.0	0.1113	58,190
Mn2576_R		0.7964	ug/L	0.7082	88.93	19.45
Mo2020_A		1.773	ug/L	0.9875	55.70	5.592
Na5895_R		210,100	ug/L	3,659	1.742	184,000
Ni2316_A		-0.2120	ug/L	0.6297	297.1	-5.978
Pb2203_A		3.020	ug/L	0.9771	32.36	-43.47
Sb2068_A		6.761	ug/L	0.1408	2.083	10.19
Se1960_A		5.010	ug/L	0.05330	1.064	5.887
Si2516_R		50,240	ug/L	103.6	0.2062	19,410
Sn1899_A		8.900	ug/L	0.6434	7.229	6.454
Sr4215_R		7.845	ug/L	0.8023	10.23	274.7
Ti3349_A		3.581	ug/L	0.3209	8.963	42.67
Tl1908_A		2.053	ug/L	0.2156	10.50	-0.5101
V_2924_A		0.7325	ug/L	0.1445	19.73	26.99
Zn2062_A		4.828	ug/L	0.1437	2.977	17.79
Y_3600_R		9,073.3	Cts/S	51.002	0.56211	9,073.3
Y_2243_A		5,883.5	Cts/S	16.201	0.27537	5,883.5
Y_3600_A		148,780	Cts/S	812.69	0.54625	148,780

CCV

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:49:33PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		514.1	ug/L	5.690	1.107	13,920
Al3961_R		13,110	ug/L	178.1	1.359	9,438
As1891_A		523.4	ug/L	1.845	0.3525	163.2
B_2089_A	W	527.9	ug/L	1.119	0.2120	625.5
Ba4554_R	W	528.0	ug/L	4.238	0.8027	15,040
Be3130_R	W	530.4	ug/L	0.9546	0.1800	32,100
Ca3158_R		12,930	ug/L	117.9	0.9122	8,298
Cd2265_A		523.5	ug/L	1.529	0.2921	9,308
Co2286_A	W	531.3	ug/L	1.530	0.2879	2,220
Cr2677_A		510.9	ug/L	7.465	1.461	7,916
Cu3273_A		520.6	ug/L	3.888	0.7468	9,819
Fe2599_R		12,950	ug/L	129.7	1.001	11,560
K_7664_R	W	13,410	ug/L	143.4	1.069	4,723
Li6707_R	W	537.5	ug/L	2.144	0.3989	4,105
Mg2795	W	13,220	ug/L	277.1	2.096	605,200
Mg2025_A	W	13,460	ug/L	46.35	0.3444	4,919
Mn2576_R		526.9	ug/L	2.206	0.4187	3,493
Mo2020_A	W	529.9	ug/L	1.888	0.3563	1,718
Na5895_R	W	13,200	ug/L	110.0	0.8335	12,040
Ni2316_A	W	529.4	ug/L	1.194	0.2256	993.7
Pb2203_A	W	529.4	ug/L	1.879	0.3550	702.8
Sb2068_A	W	527.3	ug/L	2.399	0.4551	317.3
Se1960_A		522.6	ug/L	1.533	0.2934	127.8
Si2516_R		13,230	ug/L	83.22	0.6292	5,315
Sn1899_A		522.2	ug/L	1.082	0.2072	303.0
Sr4215_R		524.8	ug/L	3.100	0.5907	19,390

CCV

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:49:33PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ti3349_A		517.4	ug/L	2.546	0.4921	12,720
Tl1908_A	W	547.2	ug/L	3.707	0.6774	294.3
V_2924_A		518.4	ug/L	3.450	0.6655	9,137
Zn2062_A		517.4	ug/L	1.109	0.2143	2,026
Y_3600_R		9,409.5	Cts/S	163.13	1.7337	9,409.5
Y_2243_A		6,480.4	Cts/S	20.447	0.31552	6,480.4
Y_3600_A		166,670	Cts/S	1,099.7	0.65978	166,670

CCB

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:53:42PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.03658	ug/L	0.02260	61.78	-8.059
Al3961_R		12.51	ug/L	1.968	15.73	-5.856
As1891_A		-0.1807	ug/L	0.3720	205.9	-2.965
B_2089_A		1.928	ug/L	0.1651	8.564	5.935
Ba4554_R		0.5390	ug/L	0.01417	2.629	29.77
Be3130_R		0.1994	ug/L	0.01160	5.818	3.548
Ca3158_R		1.250	ug/L	2.493	199.4	-38.24
Cd2265_A		0.1444	ug/L	0.02180	15.09	0.6167
Co2286_A		-0.004105	ug/L	0.2390	5,823	-0.8361
Cr2677_A		0.3264	ug/L	0.03918	12.00	3.919
Cu3273_A		0.3960	ug/L	0.1092	27.58	-4.722
Fe2599_R		6.080	ug/L	2.224	36.57	3.533
K_7664_R		178.4	ug/L	8.326	4.667	38.97
Li6707_R		2.103	ug/L	0.2162	10.28	12.20
Mg2795		2.388	ug/L	0.2250	9.424	139.5
Mg2025_A		3.012	ug/L	0.4447	14.76	-6.373
Mn2576_R		0.5335	ug/L	0.7837	146.9	-0.03204
Mo2020_A		1.208	ug/L	0.1135	9.398	4.410
Na5895_R		36.30	ug/L	16.10	44.35	83.67
Ni2316_A		0.1706	ug/L	0.1336	78.33	1.284
Pb2203_A		0.03124	ug/L	0.04039	129.3	-1.703
Sb2068_A		0.4238	ug/L	0.1310	30.91	2.311
Se1960_A		-0.8430	ug/L	0.05708	6.772	1.832
Si2516_R		0.06252	ug/L	8.459	13,530	19.64
Sn1899_A		-0.2679	ug/L	0.3612	134.8	1.861
Sr4215_R		0.02230	ug/L	0.03464	155.4	-4.341
Ti3349_A		0.4272	ug/L	0.4246	99.38	-30.28
Tl1908_A		0.6170	ug/L	0.3953	64.06	-2.624
V_2924_A		0.1044	ug/L	0.3039	291.2	-6.197
Zn2062_A		0.4511	ug/L	0.09454	20.96	2.490
Y_3600_R		9,477.5	Cts/S	118.61	1.2515	9,477.5
Y_2243_A		6,610.3	Cts/S	6.6940	0.10127	6,610.3
Y_3600_A		168,430	Cts/S	119.57	0.070990	168,430

PBSQC21ICS2

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:58:00PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.05777	ug/L	0.2575	445.8	-10.82
Al3961_R		33.51	ug/L	0.8666	2.586	9.513
As1891_A		3.205	ug/L	0.6211	19.38	-1.891
B_2089_A		0.9774	ug/L	0.6294	64.40	4.861
Ba4554_R		0.5493	ug/L	0.1629	29.65	30.60

PBSQC21ICS2

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 3:58:00PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Be3130_R		0.2855	ug/L	0.05792	20.29	8.956
Ca3158_R	W	76.16	ug/L	0.5755	0.7557	10.61
Cd2265_A		0.09311	ug/L	0.01053	11.31	-0.2478
Co2286_A		0.4569	ug/L	0.03341	7.312	1.142
Cr2677_A		0.4903	ug/L	0.07963	16.24	6.576
Cu3273_A		1.083	ug/L	0.04685	4.326	8.535
Fe2599_R		41.06	ug/L	0.4241	1.033	35.56
K_7664_R		95.18	ug/L	7.610	7.996	9.450
Li6707_R		1.907	ug/L	0.1643	8.617	10.86
Mg2795		7.805	ug/L	0.2880	3.690	395.5
Mg2025_A		12.72	ug/L	0.9288	7.303	-2.764
Mn2576_R		1.141	ug/L	0.1628	14.27	4.138
Mo2020_A		0.4693	ug/L	0.2566	54.69	1.991
Na5895_R		56.68	ug/L	8.060	14.22	103.8
Ni2316_A		-0.1082	ug/L	0.1370	126.6	0.7583
Pb2203_A		0.5498	ug/L	0.5943	108.1	-1.008
Sb2068_A		-0.5166	ug/L	0.1777	34.40	1.760
Se1960_A		-2.250	ug/L	0.1887	8.385	1.506
Si2516_R		1.621	ug/L	8.014	494.3	20.60
Sn1899_A		-0.3194	ug/L	0.1138	35.63	1.853
Sr4215_R		0.2242	ug/L	0.04618	20.60	3.251
Ti3349_A		0.8119	ug/L	0.03997	4.922	-21.02
Tl1908_A		2.694	ug/L	0.2670	9.912	-1.492
V_2924_A		0.3246	ug/L	0.06633	20.43	-2.184
Zn2062_A	F	41.17	ug/L	0.04671	0.1135	167.3
Y_3600_R		9,630.8	Cts/S	189.29	1.9655	9,630.8
Y_2243_A		6,691.2	Cts/S	15.718	0.23490	6,691.2
Y_3600_A		170,940	Cts/S	760.19	0.44471	170,940

LCSOQC21ICS2

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:02:17PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		51.82	ug/L	0.04928	0.09509	1,412
Al3961_R		2,194	ug/L	5.230	0.2384	1,606
As1891_A		108.3	ug/L	0.5371	0.4959	32.40
B_2089_A		549.6	ug/L	0.2104	0.03829	642.8
Ba4554_R		2,059	ug/L	3.100	0.1506	60,020
Be3130_R		52.63	ug/L	0.3243	0.6162	3,248
Ca3158_R		2,645	ug/L	5.241	0.1982	1,708
Cd2265_A		259.0	ug/L	0.4282	0.1653	4,700
Co2286_A		530.1	ug/L	0.3223	0.06079	2,266
Cr2677_A		204.3	ug/L	3.972	1.944	3,209
Cu3273_A		262.1	ug/L	2.496	0.9521	4,997
Fe2599_R		1,095	ug/L	5.766	0.5266	999.3
K_7664_R		10,490	ug/L	61.03	0.5820	3,776
Li6707_R		540.3	ug/L	1.567	0.2900	4,226
Mg2795		5,536	ug/L	12.28	0.2218	259,600
Mg2025_A	F	5,818	ug/L	7.975	0.1371	2,186
Mn2576_R		514.5	ug/L	7.665	1.490	3,492
Mo2020_A		101.8	ug/L	0.1823	0.1790	337.9
Na5895_R		8,022	ug/L	39.22	0.4889	7,512
Ni2316_A		533.0	ug/L	1.794	0.3366	1,024
Pb2203_A		107.1	ug/L	0.03947	0.03686	144.1
Sb2068_A		105.3	ug/L	0.09603	0.09119	64.42
Se1960_A		109.9	ug/L	1.107	1.008	29.18
Si2516_R		1,054	ug/L	20.75	1.968	450.5

LCSOQC21ICS2

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:02:17PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Sn1899_A		541.1	ug/L	1.071	0.1978	321.2
Sr4215_R		527.1	ug/L	0.9209	0.1747	19,950
Ti3349_A		495.0	ug/L	0.2596	0.05245	12,330
Tl1908_A	F	112.7	ug/L	0.4239	0.3762	59.80
V_2924_A		514.7	ug/L	2.029	0.3942	9,267
Zn2062_A		533.9	ug/L	2.019	0.3781	2,140
Y_3600_R		9,637.0	Cts/S	35.079	0.36401	9,637.0
Y_2243_A		6,629.9	Cts/S	7.6670	0.11564	6,629.9
Y_3600_A		168,920	Cts/S	1,602.5	0.94864	168,920

SQ1188-002

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:06:24PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1096	ug/L	0.2675	244.0	-6.304
Al3961_R		2,886	ug/L	17.64	0.6111	2,159
As1891_A		3.724	ug/L	0.2157	5.791	-2.010
B_2089_A		1.049	ug/L	0.02437	2.324	4.991
Ba4554_R		25.40	ug/L	0.09549	0.3759	771.2
Be3130_R		0.3927	ug/L	0.06045	15.39	15.84
Ca3158_R		499.9	ug/L	5.246	1.049	296.8
Cd2265_A		0.1336	ug/L	0.01099	8.222	8.655
Co2286_A		0.5133	ug/L	0.03445	6.712	1.583
Cr2677_A		1.421	ug/L	0.1197	8.425	21.14
Cu3273_A		8.055	ug/L	0.03222	0.4001	149.1
Fe2599_R		4,220	ug/L	11.71	0.2775	3,940
K_7664_R		125.6	ug/L	47.67	37.97	20.96
Li6707_R		2.489	ug/L	0.4086	16.41	15.77
Mg2795		97.06	ug/L	0.2854	0.2941	4,681
Mg2025_A		108.7	ug/L	1.862	1.713	33.75
Mn2576_R		8.622	ug/L	0.1073	1.245	56.41
Mo2020_A		0.2246	ug/L	0.06079	27.06	1.181
Na5895_R		105.4	ug/L	11.79	11.19	152.4
Ni2316_A		0.7853	ug/L	0.2447	31.16	2.389
Pb2203_A		26.66	ug/L	0.1612	0.6048	35.25
Sb2068_A		0.1470	ug/L	0.4091	278.2	2.221
Se1960_A		-3.750	ug/L	0.9676	25.80	1.187
Si2516_R		304.4	ug/L	0.7675	0.2521	147.6
Sn1899_A		-0.01464	ug/L	0.5221	3,567	2.058
Sr4215_R		6.008	ug/L	0.04686	0.7800	227.0
Ti3349_A		13.48	ug/L	0.1202	0.8916	302.4
Tl1908_A		2.719	ug/L	0.7893	29.03	-1.501
V_2924_A		16.12	ug/L	0.1894	1.175	290.1
Zn2062_A		14.75	ug/L	0.09692	0.6571	61.09
Y_3600_R		9,845.7	Cts/S	20.845	0.21172	9,845.7
Y_2243_A		6,770.1	Cts/S	5.4956	0.081176	6,770.1
Y_3600_A		172,720	Cts/S	273.47	0.15834	172,720

SQ1188-004

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:10:40PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.1417	ug/L	0.1251	88.29	-14.67
Al3961_R	W	55,550	ug/L	281.1	0.5060	42,550
As1891_A		9.351	ug/L	0.4429	4.736	-0.9500

SQ1188-004

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:10:40PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
B_2089_A		5.213	ug/L	0.2998	5.750	10.15
Ba4554_R		150.7	ug/L	1.148	0.7622	4,578
Be3130_R		3.474	ug/L	0.05785	1.666	215.5
Ca3158_R		695.1	ug/L	0.4135	0.05949	435.9
Cd2265_A		0.6439	ug/L	0.05439	8.448	47.12
Co2286_A		1.550	ug/L	0.07200	4.645	8.200
Cr2677_A		19.23	ug/L	0.2123	1.104	309.5
Cu3273_A		131.3	ug/L	0.5172	0.3941	2,588
Fe2599_R		18,450	ug/L	156.6	0.8484	17,530
K_7664_R		677.0	ug/L	0.6606	0.09757	229.0
Li6707_R		4.729	ug/L	0.8129	17.19	34.27
Mg2795		598.6	ug/L	1.205	0.2013	29,200
Mg2025_A		626.6	ug/L	0.4129	0.06591	237.0
Mn2576_R		58.10	ug/L	0.07488	0.1289	408.0
Mo2020_A		0.01757	ug/L	0.07413	421.9	0.3747
Na5895_R		299.5	ug/L	4.844	1.617	342.7
Ni2316_A		5.566	ug/L	0.1789	3.214	11.61
Pb2203_A		339.3	ug/L	0.3073	0.09056	476.9
Sb2068_A		-0.5974	ug/L	0.4101	68.65	2.370
Se1960_A		-3.662	ug/L	1.873	51.14	1.532
Si2516_R		3,632	ug/L	33.59	0.9248	1,567
Sn1899_A		0.6243	ug/L	0.4536	72.65	2.508
Sr4215_R		9.626	ug/L	0.009153	0.09509	373.2
Ti3349_A		197.6	ug/L	0.9822	0.4970	5,072
Tl1908_A		2.057	ug/L	0.6650	32.34	-1.886
V_2924_A		301.7	ug/L	0.9389	0.3112	5,640
Zn2062_A		46.75	ug/L	0.04784	0.1023	197.1
Y_3600_R		10,014	Cts/S	29.061	0.29020	10,014
Y_2243_A		6,948.9	Cts/S	8.9030	0.12812	6,948.9
Y_3600_A		175,000	Cts/S	829.41	0.47396	175,000

SQ1188-006

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:14:54PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.1447	ug/L	0.05163	35.69	-13.68
Al3961_R		6,875	ug/L	0.9082	0.01321	5,030
As1891_A		15.55	ug/L	0.5252	3.376	-0.3731
B_2089_A		1.803	ug/L	0.2600	14.42	5.796
Ba4554_R		127.3	ug/L	0.1941	0.1525	3,706
Be3130_R		1.243	ug/L	0.08965	7.212	66.94
Ca3158_R		1,707	ug/L	14.11	0.8263	1,083
Cd2265_A		0.7618	ug/L	0.08959	11.76	87.37
Co2286_A		6.684	ug/L	0.1227	1.836	28.96
Cr2677_A		5.164	ug/L	0.08089	1.566	77.16
Cu3273_A		14.36	ug/L	0.1553	1.082	312.1
Fe2599_R	W	39,120	ug/L	115.8	0.2961	35,590
K_7664_R		320.9	ug/L	48.87	15.23	90.76
Li6707_R		0.8850	ug/L	2.073	234.2	2.968
Mg2795		396.6	ug/L	1.035	0.2610	18,550
Mg2025_A		432.5	ug/L	0.7032	0.1626	155.9
Mn2576_R		437.2	ug/L	5.290	1.210	2,954
Mo2020_A		-0.04982	ug/L	0.08281	166.2	0.2133
Na5895_R		184.9	ug/L	5.042	2.726	222.2
Ni2316_A		2.992	ug/L	0.2354	7.865	5.567
Pb2203_A		225.4	ug/L	0.5665	0.2513	310.3
Sb2068_A		0.9744	ug/L	0.7285	74.76	2.728

SQ1188-006

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:14:54PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Se1960_A		-3.330	ug/L	2.010	60.36	1.609
Si2516_R		970.9	ug/L	9.796	1.009	413.8
Sn1899_A		0.3624	ug/L	0.07703	21.26	2.259
Sr4215_R		12.25	ug/L	0.1392	1.136	456.2
Ti3349_A		43.19	ug/L	0.08905	0.2062	1,051
Tl1908_A		2.072	ug/L	0.2139	10.32	-2.207
V_2924_A		31.90	ug/L	0.05849	0.1833	577.0
Zn2062_A		71.69	ug/L	0.3006	0.4192	290.8
Y_3600_R		9,590.1	Cts/S	122.93	1.2818	9,590.1
Y_2243_A		6,691.2	Cts/S	0.46021	0.0068780	6,691.2
Y_3600_A		170,980	Cts/S	64.649	0.037812	170,980

SQ1188-008

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:19:06PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-1.635	ug/L	0.1285	7.859	-55.70
Al3961_R	W	45,680	ug/L	414.1	0.9065	34,100
As1891_A		36.21	ug/L	0.8430	2.328	1.938
B_2089_A		9.632	ug/L	0.04406	0.4575	14.95
Ba4554_R		502.7	ug/L	6.812	1.355	14,850
Be3130_R		3.736	ug/L	0.005332	0.1427	237.1
Ca3158_R		2,293	ug/L	33.19	1.448	1,494
Cd2265_A		1.600	ug/L	0.1564	9.779	237.6
Co2286_A		3.242	ug/L	0.1096	3.381	16.58
Cr2677_A		24.87	ug/L	0.04273	0.1718	378.2
Cu3273_A		54.93	ug/L	0.6266	1.141	1,157
Fe2599_R	W	109,200	ug/L	2,151	1.970	101,100
K_7664_R		373.8	ug/L	10.19	2.725	111.9
Li6707_R		2.076	ug/L	1.403	67.61	12.37
Mg2795		494.6	ug/L	3.751	0.7583	23,550
Mg2025_A		514.9	ug/L	2.153	0.4182	187.7
Mn2576_R		522.9	ug/L	5.284	1.010	3,601
Mo2020_A		1.105	ug/L	0.1548	14.00	3.860
Na5895_R		208.6	ug/L	10.72	5.141	248.3
Ni2316_A		2.689	ug/L	0.2599	9.666	2.832
Pb2203_A		143.4	ug/L	0.6448	0.4496	197.0
Sb2068_A		0.3253	ug/L	0.5199	159.8	2.581
Se1960_A		-4.977	ug/L	0.5525	11.10	1.820
Si2516_R		4,080	ug/L	26.74	0.6554	1,708
Sn1899_A		1.384	ug/L	0.8814	63.70	2.864
Sr4215_R		34.79	ug/L	0.2680	0.7702	1,329
Ti3349_A		193.9	ug/L	0.8395	0.4330	4,804
Tl1908_A		-1.904	ug/L	0.06969	3.661	-4.419
V_2924_A		576.1	ug/L	2.390	0.4148	10,410
Zn2062_A		61.92	ug/L	0.2726	0.4401	250.9
Y_3600_R		9,760.2	Cts/S	25.056	0.25671	9,760.2
Y_2243_A		6,684.5	Cts/S	3.2824	0.049104	6,684.5
Y_3600_A		168,970	Cts/S	111.39	0.065928	168,970

SQ1188-008L

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:23:17PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-1.482	ug/L	0.5268	35.54	-17.60

SQ1188-008L

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:23:17PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Al3961_R		47,730	ug/L	2,343	4.908	6,781
As1891_A		31.82	ug/L	9.398	29.54	-2.267
B_2089_A		9.395	ug/L	1.848	19.68	5.793
Ba4554_R		530.7	ug/L	26.51	4.995	3,001
Be3130_R		4.240	ug/L	0.01426	0.3364	44.61
Ca3158_R		2,435	ug/L	46.24	1.899	272.4
Cd2265_A		1.692	ug/L	0.5081	30.03	47.08
Co2286_A		3.146	ug/L	0.8184	26.01	2.540
Cr2677_A		27.40	ug/L	0.3860	1.408	82.69
Cu3273_A		57.19	ug/L	1.855	3.243	231.5
Fe2599_R		113,600	ug/L	5,291	4.656	20,060
K_7664_R		406.7	ug/L	123.0	30.24	4.495
Li6707_R		10.92	ug/L	6.856	62.79	12.39
Mg2795		533.5	ug/L	23.06	4.324	4,865
Mg2025_A		539.3	ug/L	8.363	1.551	32.73
Mn2576_R		563.6	ug/L	24.09	4.273	737.3
Mo2020_A		1.709	ug/L	1.251	73.17	1.484
Na5895_R		264.2	ug/L	36.37	13.76	97.14
Ni2316_A		1.925	ug/L	2.268	117.8	0.9993
Pb2203_A		150.0	ug/L	1.612	1.075	39.09
Sb2068_A		-4.458	ug/L	3.105	69.65	1.560
Se1960_A		-2.798	ug/L	1.998	71.41	2.092
Si2516_R		4,219	ug/L	243.1	5.763	352.0
Sn1899_A		0.8673	ug/L	1.532	176.7	2.105
Sr4215_R		36.64	ug/L	2.746	7.496	262.6
Ti3349_A		197.2	ug/L	0.2353	0.1193	946.1
Tl1908_A		1.651	ug/L	7.029	425.8	-2.837
V_2924_A		589.8	ug/L	1.383	0.2345	2,128
Zn2062_A		63.00	ug/L	0.6389	1.014	50.67
Y_3600_R		9,314.0	Cts/S	381.61	4.0971	9,314.0
Y_2243_A		6,563.5	Cts/S	3.0362	0.046259	6,563.5
Y_3600_A		169,220	Cts/S	183.49	0.10844	169,220

SQ1188-008A

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:27:32PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		461.3	ug/L	3.005	0.6515	12,660
Al3961_R	W	45,520	ug/L	170.5	0.3745	33,900
As1891_A		485.5	ug/L	1.047	0.2157	149.0
B_2089_A		484.7	ug/L	0.4156	0.08575	588.3
Ba4554_R		950.7	ug/L	3.079	0.3239	28,000
Be3130_R		463.0	ug/L	0.2752	0.05944	29,000
Ca3158_R		2,740	ug/L	0.5791	0.02113	1,788
Cd2265_A		457.4	ug/L	1.647	0.3602	8,536
Co2286_A		459.0	ug/L	0.7492	0.1632	1,972
Cr2677_A		470.7	ug/L	2.948	0.6264	7,383
Cu3273_A		516.7	ug/L	0.1615	0.03125	9,986
Fe2599_R	W	108,300	ug/L	26.56	0.02453	100,000
K_7664_R		5,056	ug/L	48.61	0.9613	1,826
Li6707_R		490.2	ug/L	2.639	0.5383	3,872
Mg2795		981.0	ug/L	2.600	0.2650	46,530
Mg2025_A		1,056	ug/L	0.07068	0.006692	415.6
Mn2576_R		972.0	ug/L	3.703	0.3810	6,674
Mo2020_A		454.7	ug/L	0.2548	0.05605	1,514
Na5895_R		675.9	ug/L	13.69	2.026	686.7
Ni2316_A		462.5	ug/L	1.152	0.2490	888.7

SQ1188-008A

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:27:32PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Pb2203_A		605.7	ug/L	1.206	0.1990	828.7
Sb2068_A		460.6	ug/L	0.7283	0.1581	287.5
Se1960_A		486.1	ug/L	1.799	0.3701	123.1
Si2516_R		4,302	ug/L	11.46	0.2663	1,794
Sn1899_A		1.286	ug/L	0.7384	57.43	2.793
Sr4215_R		508.8	ug/L	1.109	0.2179	19,450
Ti3349_A		635.9	ug/L	5.319	0.8366	15,860
Tl1908_A		478.5	ug/L	3.395	0.7096	263.4
V_2924_A	W	1,020	ug/L	3.512	0.3442	18,350
Zn2062_A		512.2	ug/L	2.082	0.4065	2,060
Y_3600_R		9,734.9	Cts/S	20.736	0.21301	9,734.9
Y_2243_A		6,654.3	Cts/S	1.6390	0.024630	6,654.3
Y_3600_A		168,950	Cts/S	989.90	0.58590	168,950

SQ1188-008D

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:31:37PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-1.444	ug/L	0.1315	9.106	-50.64
Al3961_R	W	47,640	ug/L	8.515	0.01788	35,370
As1891_A		32.09	ug/L	0.02246	0.07000	1.363
B_2089_A		8.443	ug/L	0.7319	8.669	13.60
Ba4554_R		412.4	ug/L	1.775	0.4303	12,120
Be3130_R		3.901	ug/L	0.02004	0.5136	246.2
Ca3158_R		2,172	ug/L	4.662	0.2147	1,406
Cd2265_A		1.501	ug/L	0.1463	9.749	213.0
Co2286_A		2.633	ug/L	0.1038	3.941	13.93
Cr2677_A		24.75	ug/L	0.2656	1.073	378.7
Cu3273_A		52.90	ug/L	0.01905	0.03600	1,106
Fe2599_R	W	97,380	ug/L	708.1	0.7272	89,710
K_7664_R		341.4	ug/L	46.76	13.70	99.42
Li6707_R		2.773	ug/L	0.2491	8.982	17.80
Mg2795		457.3	ug/L	0.2881	0.06301	21,660
Mg2025_A		473.4	ug/L	2.793	0.5900	171.8
Mn2576_R		484.2	ug/L	0.1754	0.03622	3,317
Mo2020_A		1.780	ug/L	0.1758	9.880	6.105
Na5895_R		194.1	ug/L	1.130	0.5822	233.5
Ni2316_A		2.833	ug/L	0.06992	2.468	3.469
Pb2203_A		147.3	ug/L	2.127	1.444	201.2
Sb2068_A		-0.9864	ug/L	0.3338	33.84	1.795
Se1960_A		-3.049	ug/L	3.117	102.2	2.216
Si2516_R		4,376	ug/L	3.535	0.08078	1,822
Sn1899_A		0.9381	ug/L	0.7125	75.95	2.598
Sr4215_R		30.51	ug/L	0.3241	1.062	1,158
Ti3349_A		212.4	ug/L	0.2338	0.1101	5,281
Tl1908_A		-2.059	ug/L	0.09004	4.373	-4.466
V_2924_A		600.4	ug/L	2.524	0.4204	10,880
Zn2062_A		61.61	ug/L	0.04733	0.07683	249.5
Y_3600_R		9,709.9	Cts/S	50.942	0.52463	9,709.9
Y_2243_A		6,681.0	Cts/S	8.2755	0.12387	6,681.0
Y_3600_A		169,450	Cts/S	734.00	0.43316	169,450

SQ1188-008S

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:35:50PM Sample Type: Unknown

SQ1188-008S

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:35:50PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		40.25	ug/L	0.09058	0.2250	1,089
Al3961_R	W	48,100	ug/L	2,845	5.916	34,690
As1891_A		113.6	ug/L	1.238	1.089	29.15
B_2089_A		499.2	ug/L	0.1098	0.02199	583.2
Ba4554_R	W	2,381	ug/L	155.2	6.518	67,920
Be3130_R		55.27	ug/L	3.247	5.874	3,351
Ca3158_R		4,239	ug/L	245.5	5.790	2,702
Cd2265_A		243.3	ug/L	0.5410	0.2223	4,586
Co2286_A		494.6	ug/L	1.101	0.2226	2,125
Cr2677_A		224.0	ug/L	0.4419	0.1973	3,495
Cu3273_A		283.3	ug/L	1.065	0.3757	5,463
Fe2599_R	W	80,970	ug/L	5,194	6.415	72,450
K_7664_R		10,540	ug/L	608.3	5.773	3,714
Li6707_R		534.0	ug/L	32.86	6.154	4,087
Mg2795		5,731	ug/L	340.0	5.933	263,100
Mg2025_A		5,659	ug/L	2.807	0.04960	2,135
Mn2576_R		870.7	ug/L	49.75	5.714	5,791
Mo2020_A		27.48	ug/L	0.2611	0.9501	91.51
Na5895_R		8,447	ug/L	555.5	6.577	7,737
Ni2316_A		496.6	ug/L	0.7394	0.1489	955.4
Pb2203_A		216.4	ug/L	0.5277	0.2438	294.0
Sb2068_A		42.67	ug/L	0.1163	0.2726	27.66
Se1960_A		6.680	ug/L	1.275	19.09	4.568
Si2516_R		5,401	ug/L	316.7	5.865	2,181
Sn1899_A		330.7	ug/L	0.1332	0.04027	197.9
Sr4215_R		541.9	ug/L	35.51	6.552	20,070
Ti3349_A		573.4	ug/L	1.195	0.2084	14,220
Tl1908_A		96.75	ug/L	1.541	1.592	50.96
V_2924_A		967.7	ug/L	0.6457	0.06673	17,390
Zn2062_A		526.1	ug/L	1.165	0.2215	2,118
Y_3600_R		9,442.8	Cts/S	369.95	3.9178	9,442.8
Y_2243_A		6,657.2	Cts/S	16.178	0.24302	6,657.2
Y_3600_A		168,220	Cts/S	261.73	0.15559	168,220

CCV

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:39:59PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		501.3	ug/L	1.079	0.2152	13,450
Al3961_R		12,770	ug/L	131.5	1.029	9,162
As1891_A		505.4	ug/L	2.564	0.5074	156.8
B_2089_A		507.4	ug/L	0.4390	0.08652	599.2
Ba4554_R		506.1	ug/L	0.8193	0.1619	14,360
Be3130_R		508.4	ug/L	2.528	0.4972	30,650
Ca3158_R		12,530	ug/L	39.42	0.3146	8,012
Cd2265_A		505.8	ug/L	0.05543	0.01096	8,958
Co2286_A		509.5	ug/L	1.160	0.2277	2,121
Cr2677_A		501.0	ug/L	0.4489	0.08960	7,688
Cu3273_A		508.9	ug/L	1.284	0.2523	9,505
Fe2599_R		12,630	ug/L	17.46	0.1382	11,230
K_7664_R		12,690	ug/L	45.65	0.3598	4,448
Li6707_R		523.0	ug/L	3.874	0.7407	3,978
Mg2795		12,880	ug/L	206.1	1.601	587,300
Mg2025_A		13,170	ug/L	73.03	0.5545	4,794
Mn2576_R		501.1	ug/L	2.606	0.5202	3,308
Mo2020_A		512.9	ug/L	1.107	0.2157	1,657
Na5895_R		12,700	ug/L	44.27	0.3487	11,530

CCV

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:39:59PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ni2316_A		510.6	ug/L	0.2881	0.05643	954.8
Pb2203_A		512.0	ug/L	0.4834	0.09443	677.0
Sb2068_A		507.1	ug/L	0.5184	0.1022	304.1
Se1960_A		503.7	ug/L	2.414	0.4793	122.8
Si2516_R		12,800	ug/L	28.69	0.2242	5,124
Sn1899_A		509.0	ug/L	1.315	0.2583	294.3
Sr4215_R		509.7	ug/L	1.316	0.2581	18,760
Ti3349_A		500.0	ug/L	0.04680	0.009360	12,180
Tl1908_A		522.1	ug/L	2.696	0.5165	279.5
V_2924_A		502.2	ug/L	0.5996	0.1194	8,765
Zn2062_A		498.9	ug/L	1.415	0.2837	1,946
Y_3600_R		9,372.8	Cts/S	30.785	0.32845	9,372.8
Y_2243_A		6,455.2	Cts/S	23.739	0.36775	6,455.2
Y_3600_A		165,060	Cts/S	2.7417	0.0016610	165,060

CCB

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:44:08PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1774	ug/L	0.05867	33.06	-4.212
Al3961_R		18.98	ug/L	6.277	33.07	-1.166
As1891_A		0.01834	ug/L	0.2100	1,145	-2.888
B_2089_A		0.1786	ug/L	0.3534	197.9	3.879
Ba4554_R		0.4313	ug/L	0.1895	43.93	26.98
Be3130_R		0.1901	ug/L	0.02163	11.38	3.000
Ca3158_R		11.66	ug/L	4.844	41.54	-31.84
Cd2265_A		0.1045	ug/L	0.02033	19.45	-0.1024
Co2286_A		0.02259	ug/L	0.03919	173.5	-0.7197
Cr2677_A		0.2171	ug/L	0.2040	93.96	2.196
Cu3273_A		0.3344	ug/L	0.2422	72.42	-5.924
Fe2599_R		7.097	ug/L	3.395	47.84	4.493
K_7664_R		50.35	ug/L	14.37	28.54	-6.697
Li6707_R		1.184	ug/L	1.137	96.06	5.128
Mg2795		2.279	ug/L	0.009780	0.4291	136.2
Mg2025_A		-0.1099	ug/L	0.4682	426.1	-7.502
Mn2576_R		0.8321	ug/L	0.1586	19.06	2.030
Mo2020_A		0.6718	ug/L	0.1186	17.65	2.627
Na5895_R		-15.27	ug/L	2.311	15.13	36.85
Ni2316_A		-0.1364	ug/L	0.06138	45.00	0.6937
Pb2203_A		0.3427	ug/L	0.004238	1.237	-1.274
Sb2068_A		-0.02695	ug/L	0.6095	2,262	2.027
Se1960_A		-1.590	ug/L	1.577	99.17	1.642
Si2516_R		-1.832	ug/L	4.068	222.0	19.08
Sn1899_A		-0.2999	ug/L	0.4825	160.9	1.834
Sr4215_R		-0.06547	ug/L	0.1048	160.1	-7.728
Ti3349_A		0.4682	ug/L	0.01341	2.864	-29.30
Tl1908_A		1.100	ug/L	0.8623	78.37	-2.346
V_2924_A		0.1648	ug/L	0.05753	34.90	-5.048
Zn2062_A		0.4328	ug/L	0.04544	10.50	2.407
Y_3600_R		9,598.3	Cts/S	149.02	1.5526	9,598.3
Y_2243_A		6,582.5	Cts/S	0.73572	0.011177	6,582.5
Y_3600_A		168,610	Cts/S	1,394.2	0.82691	168,610

SQ1188-010

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM

SQ1188-010

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:48:27PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1813	ug/L	0.2423	133.7	-4.170
Al3961_R		1,115	ug/L	2.627	0.2355	809.5
As1891_A		3.579	ug/L	0.06735	1.882	-2.061
B_2089_A		-0.02653	ug/L	0.09372	353.3	3.675
Ba4554_R		24.65	ug/L	0.3231	1.311	735.2
Be3130_R		0.1983	ug/L	0.05007	25.24	3.442
Ca3158_R		214.5	ug/L	6.217	2.898	102.3
Cd2265_A		0.1645	ug/L	0.04166	25.32	9.792
Co2286_A		0.4859	ug/L	0.01053	2.168	1.392
Cr2677_A		0.9583	ug/L	0.008793	0.9176	13.46
Cu3273_A		3.660	ug/L	0.1916	5.233	63.41
Fe2599_R		4,573	ug/L	40.96	0.8956	4,192
K_7664_R		93.86	ug/L	22.97	24.47	9.039
Li6707_R		0.7767	ug/L	0.5792	74.58	2.040
Mg2795		57.26	ug/L	0.3102	0.5417	2,724
Mg2025_A		67.38	ug/L	0.3250	0.4824	17.82
Mn2576_R		5.820	ug/L	0.3791	6.513	36.28
Mo2020_A		0.1511	ug/L	0.2047	135.5	0.9221
Na5895_R		115.8	ug/L	2.625	2.267	159.4
Ni2316_A		0.4691	ug/L	0.03377	7.199	1.737
Pb2203_A		14.72	ug/L	0.1823	1.239	18.65
Sb2068_A		-0.7639	ug/L	0.9872	129.2	1.617
Se1960_A		-1.936	ug/L	0.2497	12.89	1.619
Si2516_R		128.1	ug/L	11.25	8.785	72.38
Sn1899_A		-0.6507	ug/L	0.2372	36.46	1.654
Sr4215_R		2.469	ug/L	0.08456	3.424	88.47
Ti3349_A		6.748	ug/L	0.4374	6.483	128.4
Tl1908_A		2.710	ug/L	0.6040	22.29	-1.490
V_2924_A		6.248	ug/L	0.2406	3.851	106.1
Zn2062_A		8.194	ug/L	0.06582	0.8032	33.83
Y_3600_R		9,664.9	Cts/S	16.563	0.17137	9,664.9
Y_2243_A		6,687.4	Cts/S	40.605	0.60718	6,687.4
Y_3600_A		170,120	Cts/S	1,367.1	0.80364	170,120

SQ1188-012

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:52:45PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.05427	ug/L	0.01701	31.33	-7.827
Al3961_R		3,162	ug/L	9.440	0.2985	2,355
As1891_A		7.344	ug/L	0.2067	2.815	-1.396
B_2089_A		-0.03153	ug/L	0.1893	600.4	3.652
Ba4554_R		32.33	ug/L	0.3787	1.172	972.4
Be3130_R		0.3561	ug/L	0.04369	12.27	12.81
Ca3158_R		362.4	ug/L	1.543	0.4259	202.9
Cd2265_A		0.3335	ug/L	0.0003540	0.1060	29.94
Co2286_A		1.788	ug/L	0.01980	1.107	7.250
Cr2677_A		4.184	ug/L	0.2302	5.503	63.46
Cu3273_A		2.479	ug/L	0.4461	17.99	50.79
Fe2599_R		13,460	ug/L	80.57	0.5987	12,510
K_7664_R		148.3	ug/L	5.363	3.615	29.23
Li6707_R		0.9221	ug/L	0.3260	35.36	3.224
Mg2795		86.15	ug/L	0.3837	0.4454	4,140
Mg2025_A		99.45	ug/L	0.9006	0.9056	30.02
Mn2576_R		67.80	ug/L	0.3828	0.5647	465.3
Mo2020_A		-0.006150	ug/L	0.07252	1,179	0.3915
Na5895_R		93.22	ug/L	4.394	4.714	140.2

SQ1188-012

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:52:45PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ni2316_A		0.6570	ug/L	0.1641	24.98	1.824
Pb2203_A		34.94	ug/L	0.5487	1.570	46.71
Sb2068_A		-0.6021	ug/L	0.2210	36.70	1.740
Se1960_A		-3.904	ug/L	3.535	90.55	1.206
Si2516_R		780.0	ug/L	5.127	0.6573	344.6
Sn1899_A		-0.6092	ug/L	0.3353	55.04	1.675
Sr4215_R		2.469	ug/L	0.1121	4.539	89.67
Ti3349_A		21.61	ug/L	0.02403	0.1112	501.4
Tl1908_A		2.984	ug/L	0.2733	9.159	-1.390
V_2924_A		11.14	ug/L	0.1080	0.9692	195.4
Zn2062_A		26.22	ug/L	0.1961	0.7479	106.4
Y_3600_R		9,795.6	Cts/S	26.300	0.26849	9,795.6
Y_2243_A		6,670.8	Cts/S	2.8878	0.043290	6,670.8
Y_3600_A		169,770	Cts/S	198.19	0.11674	169,770

SQ1188-014

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 4:57:02PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.6225	ug/L	0.1015	16.31	-27.89
Al3961_R		3,554	ug/L	47.91	1.348	2,618
As1891_A		11.19	ug/L	1.491	13.33	-0.8763
B_2089_A		-0.3910	ug/L	0.1127	28.82	3.277
Ba4554_R		70.79	ug/L	0.1081	0.1528	2,088
Be3130_R		0.3490	ug/L	0.07899	22.63	2.731
Ca3158_R		2,680	ug/L	19.03	0.7102	1,739
Cd2265_A		0.4120	ug/L	0.08717	21.16	53.34
Co2286_A		1.860	ug/L	0.03841	2.065	9.428
Cr2677_A		5.013	ug/L	0.05722	1.141	76.29
Cu3273_A		1.095	ug/L	0.2068	18.89	36.17
Fe2599_R		24,700	ug/L	97.32	0.3940	22,700
K_7664_R		983.1	ug/L	8.124	0.8264	333.0
Li6707_R		5.915	ug/L	0.7575	12.81	42.43
Mg2795		879.1	ug/L	3.621	0.4119	41,470
Mg2025_A		960.8	ug/L	1.557	0.1621	354.9
Mn2576_R		190.4	ug/L	0.6708	0.3524	1,298
Mo2020_A		0.4379	ug/L	0.02034	4.644	1.873
Na5895_R		167.4	ug/L	3.306	1.975	208.0
Ni2316_A		0.5616	ug/L	0.2055	36.60	1.305
Pb2203_A		8.263	ug/L	0.6646	8.043	10.90
Sb2068_A		-0.4078	ug/L	0.4958	121.6	1.861
Se1960_A		-3.991	ug/L	0.4544	11.39	1.294
Si2516_R		2,939	ug/L	25.25	0.8593	1,229
Sn1899_A		0.05541	ug/L	0.5802	1,047	2.082
Sr4215_R		8.795	ug/L	0.04659	0.5297	329.4
Ti3349_A		205.0	ug/L	1.255	0.6120	5,162
Tl1908_A		2.161	ug/L	0.1661	7.687	-2.096
V_2924_A		19.10	ug/L	0.03237	0.1695	347.0
Zn2062_A		17.07	ug/L	0.1087	0.6369	69.93
Y_3600_R		9,686.3	Cts/S	142.23	1.4683	9,686.3
Y_2243_A		6,709.8	Cts/S	11.451	0.17066	6,709.8
Y_3600_A		171,600	Cts/S	473.11	0.27571	171,600

SQ1188-016

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM

SQ1188-016

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 5:01:16PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2178	ug/L	0.1946	89.37	-15.65
Al3961_R		7,451	ug/L	30.57	0.4102	5,514
As1891_A		15.13	ug/L	0.7878	5.206	-0.5834
B_2089_A		0.6722	ug/L	0.01733	2.579	4.460
Ba4554_R		114.2	ug/L	0.6548	0.5733	3,364
Be3130_R		1.177	ug/L	0.02917	2.478	63.25
Ca3158_R		2,192	ug/L	5.041	0.2300	1,417
Cd2265_A		0.8614	ug/L	0.04450	5.166	91.02
Co2286_A		8.117	ug/L	0.08188	1.009	35.06
Cr2677_A		5.298	ug/L	0.1041	1.965	78.82
Cu3273_A		11.95	ug/L	0.03412	0.2855	264.8
Fe2599_R	W	40,290	ug/L	159.5	0.3960	37,070
K_7664_R		273.2	ug/L	33.05	12.10	74.53
Li6707_R		1.533	ug/L	0.9802	63.94	8.032
Mg2795		526.4	ug/L	0.2404	0.04567	24,880
Mg2025_A		578.4	ug/L	5.155	0.8913	209.8
Mn2576_R		619.0	ug/L	0.8945	0.1445	4,231
Mo2020_A		-0.03510	ug/L	0.1685	480.1	0.2471
Na5895_R		216.5	ug/L	4.937	2.280	254.2
Ni2316_A		2.582	ug/L	0.1017	3.937	4.715
Pb2203_A		197.3	ug/L	0.6677	0.3385	270.3
Sb2068_A		1.258	ug/L	0.3888	30.90	2.894
Se1960_A		-2.587	ug/L	1.018	39.34	1.828
Si2516_R		944.8	ug/L	14.49	1.534	407.6
Sn1899_A		0.4518	ug/L	0.1581	34.98	2.301
Sr4215_R		15.25	ug/L	0.2049	1.344	575.4
Ti3349_A		51.42	ug/L	0.3535	0.6874	1,250
Tl1908_A		1.257	ug/L	0.1072	8.527	-2.794
V_2924_A		36.14	ug/L	0.2015	0.5575	649.1
Zn2062_A		65.36	ug/L	0.04756	0.07277	263.9
Y_3600_R		9,697.8	Cts/S	75.674	0.78032	9,697.8
Y_2243_A		6,660.0	Cts/S	6.0253	0.090470	6,660.0
Y_3600_A		169,770	Cts/S	459.50	0.27065	169,770

LCSWQC17ICW1

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 5:05:28PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		52.77	ug/L	0.08903	0.1687	710.3
Al3961_R		2,248	ug/L	13.80	0.6138	800.2
As1891_A		104.8	ug/L	1.895	1.808	14.06
B_2089_A		520.9	ug/L	0.3047	0.05850	304.2
Ba4554_R		2,093	ug/L	12.03	0.5746	29,950
Be3130_R		52.79	ug/L	0.3274	0.6202	1,594
Ca3158_R		2,650	ug/L	1.111	0.04194	820.1
Cd2265_A		261.5	ug/L	0.1957	0.07483	2,352
Co2286_A		537.2	ug/L	0.1066	0.01984	1,138
Cr2677_A		208.9	ug/L	0.1759	0.08419	1,630
Cu3273_A		268.1	ug/L	0.3091	0.1153	2,535
Fe2599_R		1,092	ug/L	0.3861	0.03535	488.2
K_7664_R		10,870	ug/L	27.91	0.2567	1,909
Li6707_R		560.5	ug/L	0.8638	0.1541	2,150
Mg2795		5,592	ug/L	15.37	0.2749	128,700
Mg2025_A	F	5,919	ug/L	13.82	0.2334	1,099
Mn2576_R		519.5	ug/L	3.127	0.6019	1,729
Mo2020_A		104.5	ug/L	0.2509	0.2400	172.1
Na5895_R		8,204	ug/L	104.3	1.271	3,794

LCSWQC17ICW1

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 5:05:28PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ni2316_A		538.8	ug/L	0.5636	0.1046	513.6
Pb2203_A		109.4	ug/L	0.4375	0.4000	72.14
Sb2068_A		104.7	ug/L	0.7985	0.7625	32.77
Se1960_A		99.93	ug/L	2.782	2.784	14.26
Si2516_R		1,038	ug/L	15.03	1.447	227.7
Sn1899_A		547.8	ug/L	3.686	0.6729	162.2
Sr4215_R		541.9	ug/L	4.434	0.8182	10,060
Ti3349_A		508.8	ug/L	2.094	0.4117	6,279
Tl1908_A		110.6	ug/L	0.3703	0.3349	27.60
V_2924_A		523.5	ug/L	0.5683	0.1086	4,682
Zn2062_A		521.0	ug/L	0.6594	0.1266	1,036
Y_3600_R		9,458.9	Cts/S	1.6534	0.017480	9,458.9
Y_2243_A		6,574.3	Cts/S	1.5550	0.023652	6,574.3
Y_3600_A		167,960	Cts/S	620.50	0.36944	167,960

LC2WQC17ICW1

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 5:09:39PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		52.73	ug/L	0.8274	1.569	715.3
Al3961_R		2,217	ug/L	47.54	2.144	800.5
As1891_A		103.3	ug/L	2.432	2.354	13.94
B_2089_A		517.1	ug/L	0.5203	0.1006	304.8
Ba4554_R		2,080	ug/L	17.64	0.8479	30,190
Be3130_R		52.30	ug/L	0.6588	1.260	1,602
Ca3158_R		2,667	ug/L	40.36	1.514	837.5
Cd2265_A		261.0	ug/L	0.7599	0.2912	2,368
Co2286_A		532.7	ug/L	0.4895	0.09190	1,139
Cr2677_A		206.8	ug/L	1.170	0.5656	1,627
Cu3273_A		267.3	ug/L	2.770	1.036	2,547
Fe2599_R		1,087	ug/L	13.46	1.238	492.8
K_7664_R		10,820	ug/L	57.51	0.5315	1,928
Li6707_R		556.3	ug/L	0.1897	0.03410	2,164
Mg2795		5,587	ug/L	56.22	1.006	130,500
Mg2025_A	F	5,888	ug/L	8.436	0.1433	1,103
Mn2576_R		517.5	ug/L	1.904	0.3679	1,747
Mo2020_A		104.4	ug/L	0.1351	0.1294	173.6
Na5895_R		8,246	ug/L	81.58	0.9894	3,869
Ni2316_A		534.6	ug/L	0.7850	0.1468	514.3
Pb2203_A		109.6	ug/L	0.5048	0.4607	72.93
Sb2068_A		104.1	ug/L	1.464	1.407	32.88
Se1960_A		98.53	ug/L	0.1349	0.1369	14.22
Si2516_R		1,017	ug/L	0.8197	0.08056	226.7
Sn1899_A		542.9	ug/L	2.099	0.3865	162.2
Sr4215_R		542.8	ug/L	2.476	0.4562	10,220
Ti3349_A		511.2	ug/L	0.6435	0.1259	6,360
Tl1908_A		108.9	ug/L	1.257	1.154	27.39
V_2924_A		520.6	ug/L	1.640	0.3151	4,692
Zn2062_A		517.1	ug/L	0.6559	0.1268	1,038
Y_3600_R		9,596.2	Cts/S	42.634	0.44428	9,596.2
Y_2243_A		6,634.0	Cts/S	9.4946	0.14312	6,634.0
Y_3600_A		169,280	Cts/S	250.85	0.14819	169,280

SQ1218-001

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM

SQ1218-001

Wrong DF entered, results should be multiplied by 2, Ea 032723

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 5:13:48PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.003852	ug/L	0.07411	1,924	-8.791
Al3961_R		28.63	ug/L	2.440	8.524	9.742
As1891_A		2.262	ug/L	1.567	69.28	-2.173
B_2089_A		5.831	ug/L	0.1002	1.718	10.21
Ba4554_R		8.331	ug/L	0.2207	2.649	250.2
Be3130_R		0.06666	ug/L	0.06953	104.3	-4.473
Ca3158_R		23,460	ug/L	113.6	0.4844	15,020
Cd2265_A		-0.03231	ug/L	0.03296	102.0	-1.519
Co2286_A		0.2222	ug/L	0.04402	19.81	0.1274
Cr2677_A		0.09914	ug/L	0.06933	69.94	0.3893
Cu3273_A		0.4413	ug/L	0.3465	78.52	-3.121
Fe2599_R		551.2	ug/L	4.752	0.8621	488.0
K_7664_R		1,431	ug/L	22.49	1.571	479.8
Li6707_R		3.372	ug/L	0.8908	26.42	21.71
Mg2795		10,920	ug/L	24.82	0.2273	497,800
Mg2025_A		11,370	ug/L	69.60	0.6123	4,143
Mn2576_R		73.61	ug/L	0.3890	0.5285	482.7
Mo2020_A		0.2007	ug/L	0.02706	13.48	1.059
Na5895_R		8,292	ug/L	6.618	0.07982	7,544
Ni2316_A		0.007159	ug/L	0.03071	428.9	0.9394
Pb2203_A		-0.1536	ug/L	0.7981	519.5	-1.888
Sb2068_A		0.6765	ug/L	0.3754	55.50	2.424
Se1960_A		-1.507	ug/L	0.4042	26.81	1.659
Si2516_R		3,796	ug/L	20.98	0.5527	1,533
Sn1899_A		0.2915	ug/L	0.1683	57.73	2.155
Sr4215_R		193.2	ug/L	0.002404	0.001244	7,105
Ti3349_A		-0.2129	ug/L	0.1240	58.24	-45.38
Tl1908_A		1.615	ug/L	0.9912	61.38	-2.094
V_2924_A		0.1315	ug/L	0.1001	76.10	-5.866
Zn2062_A		0.9329	ug/L	0.02869	3.075	4.347
Y_3600_R		9,366.8	Cts/S	27.715	0.29589	9,366.8
Y_2243_A		6,505.6	Cts/S	21.665	0.33301	6,505.6
Y_3600_A		165,300	Cts/S	347.43	0.21018	165,300

SQ1281-001

Wrong DF entered, results should be multiplied by 2. Ea 032723

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 5:18:10PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.3592	ug/L	0.04148	11.55	0.7744
Al3961_R		16.73	ug/L	3.020	18.05	-2.320
As1891_A		3.961	ug/L	0.9689	24.46	-1.599
B_2089_A		15.83	ug/L	0.5444	3.439	21.57
Ba4554_R		0.3745	ug/L	0.4651	124.2	25.03
Be3130_R		0.07110	ug/L	0.09291	130.7	-4.277
Ca3158_R		2,941	ug/L	28.80	0.9792	1,868
Cd2265_A		0.03981	ug/L	0.03980	99.98	-1.257
Co2286_A		-0.05776	ug/L	0.09500	164.5	-1.052
Cr2677_A		0.07916	ug/L	0.2956	373.4	0.05384
Cu3273_A		1.367	ug/L	0.4085	29.89	13.69
Fe2599_R		6.163	ug/L	0.9000	14.60	3.615
K_7664_R		1,245	ug/L	10.23	0.8220	418.4
Li6707_R		3.707	ug/L	1.337	36.08	24.50
Mg2795		374.6	ug/L	0.8465	0.2260	17,270
Mg2025_A		382.2	ug/L	1.448	0.3789	132.5
Mn2576_R		0.6641	ug/L	0.2383	35.88	0.8730
Mo2020_A		0.2469	ug/L	0.1269	51.38	1.216
Na5895_R	W	27,110	ug/L	37.87	0.1397	24,800

SQ1281-001 wrong DF entered, results should be multiplied by 2.

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 5:18:10PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ni2316_A		-0.2340	ug/L	0.07939	33.93	0.5027
Pb2203_A		0.2536	ug/L	0.7286	287.3	-1.381
Sb2068_A		-0.04391	ug/L	0.4310	981.7	1.997
Se1960_A		-1.611	ug/L	1.399	86.84	1.621
Si2516_R		3,140	ug/L	35.96	1.145	1,284
Sn1899_A		-0.2135	ug/L	0.5352	250.7	1.867
Sr4215_R		4.185	ug/L	0.2822	6.743	150.4
Ti3349_A		0.1997	ug/L	0.2681	134.3	-35.68
Tl1908_A		1.240	ug/L	0.1205	9.719	-2.247
V_2924_A		-0.09156	ug/L	0.1018	111.2	-9.520
Zn2062_A		0.5426	ug/L	0.05771	10.64	2.818
Y_3600_R		9,460.9	Cts/S	19.347	0.20450	9,460.9
Y_2243_A		6,519.9	Cts/S	10.940	0.16779	6,519.9
Y_3600_A		167,010	Cts/S	520.38	0.31159	167,010

PBSQC21ICS1

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 5:22:27PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1825	ug/L	0.09382	51.40	-4.097
Al3961_R		22.05	ug/L	0.5166	2.342	1.037
As1891_A		-1.064	ug/L	0.4283	40.27	-3.242
B_2089_A		0.6701	ug/L	0.03485	5.200	4.424
Ba4554_R		0.3100	ug/L	0.1149	37.08	23.35
Be3130_R		0.1042	ug/L	0.01870	17.94	-2.277
Ca3158_R		32.73	ug/L	0.8072	2.466	-17.89
Cd2265_A		-0.04257	ug/L	0.01834	43.07	-2.733
Co2286_A		-0.08908	ug/L	0.02974	33.38	-1.197
Cr2677_A		0.7516	ug/L	0.02099	2.793	10.69
Cu3273_A		0.4786	ug/L	0.2707	56.56	-3.173
Fe2599_R		21.37	ug/L	0.1879	0.8793	17.41
K_7664_R		37.10	ug/L	31.32	84.41	-11.47
Li6707_R		1.721	ug/L	0.004368	0.2538	9.329
Mg2795		14.72	ug/L	0.02943	0.1999	712.9
Mg2025_A		14.00	ug/L	0.8671	6.194	-2.303
Mn2576_R		0.9274	ug/L	0.2298	24.78	2.647
Mo2020_A		0.1061	ug/L	0.03266	30.79	0.7660
Na5895_R		20.97	ug/L	5.252	25.04	70.02
Ni2316_A		0.3649	ug/L	0.2994	82.03	1.652
Pb2203_A		0.4705	ug/L	0.6994	148.7	-1.101
Sb2068_A		-0.1405	ug/L	0.1985	141.3	1.741
Se1960_A		-1.511	ug/L	0.1242	8.216	1.666
Si2516_R		-10.02	ug/L	0.6925	6.912	15.65
Sn1899_A		43.43	ug/L	0.5433	1.251	27.51
Sr4215_R		0.05685	ug/L	0.1958	344.4	-3.081
Ti3349_A		0.3352	ug/L	0.07606	22.69	-32.93
Tl1908_A		0.5786	ug/L	0.1076	18.59	-2.641
V_2924_A		0.03064	ug/L	0.3220	1,051	-7.517
Zn2062_A		0.7862	ug/L	0.03822	4.861	3.822
Y_3600_R		9,539.7	Cts/S	36.937	0.38719	9,539.7
Y_2243_A		6,599.6	Cts/S	21.581	0.32701	6,599.6
Y_3600_A		170,170	Cts/S	761.48	0.44749	170,170

LCSOQC21ICS1

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM

LCSOQC21ICS1

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 5:26:47PM Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		46.01	ug/L	0.1089	0.2368	1,232
Al3961_R		2,083	ug/L	0.2908	0.01396	1,504
As1891_A		96.71	ug/L	1.033	1.068	27.93
B_2089_A		487.1	ug/L	0.8457	0.1736	556.8
Ba4554_R		2,009	ug/L	10.94	0.5448	57,780
Be3130_R		50.33	ug/L	0.04791	0.09518	3,064
Ca3158_R		2,554	ug/L	3.280	0.1285	1,625
Cd2265_A		250.0	ug/L	1.228	0.4912	4,426
Co2286_A		510.5	ug/L	1.349	0.2643	2,129
Cr2677_A		198.1	ug/L	0.2956	0.1492	3,060
Cu3273_A		254.7	ug/L	0.8001	0.3141	4,775
Fe2599_R		1,040	ug/L	2.856	0.2746	936.4
K_7664_R		10,260	ug/L	15.44	0.1505	3,644
Li6707_R		524.1	ug/L	0.5121	0.09770	4,044
Mg2795		5,300	ug/L	2.560	0.04831	245,200
Mg2025_A		5,398	ug/L	8.396	0.1556	1,979
Mn2576_R		494.0	ug/L	3.015	0.6104	3,308
Mo2020_A		101.4	ug/L	0.06979	0.06884	328.3
Na5895_R		7,861	ug/L	23.22	0.2954	7,263
Ni2316_A		510.9	ug/L	1.905	0.3729	957.5
Pb2203_A		101.8	ug/L	0.3353	0.3292	133.7
Sb2068_A		99.45	ug/L	1.355	1.363	59.23
Se1960_A		94.46	ug/L	1.083	1.146	24.76
Si2516_R		922.0	ug/L	3.776	0.4095	391.1
Sn1899_A		561.4	ug/L	0.9559	0.1703	325.1
Sr4215_R		519.9	ug/L	3.278	0.6305	19,410
Ti3349_A		483.9	ug/L	2.900	0.5992	11,850
Tl1908_A		99.81	ug/L	0.5794	0.5805	51.37
V_2924_A		496.8	ug/L	1.518	0.3057	8,796
Zn2062_A		494.8	ug/L	2.767	0.5592	1,936
Y_3600_R		9,508.2	Cts/S	40.582	0.42681	9,508.2
Y_2243_A		6,468.7	Cts/S	5.1889	0.080216	6,468.7
Y_3600_A		166,160	Cts/S	360.45	0.21693	166,160

CCV

Method Name: FAST-2022_POP Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 5:30:55PM Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		503.9	ug/L	1.294	0.2568	13,570
Al3961_R		12,770	ug/L	182.3	1.428	9,221
As1891_A		508.3	ug/L	0.1109	0.02183	158.3
B_2089_A		509.8	ug/L	1.205	0.2364	604.2
Ba4554_R		515.7	ug/L	1.963	0.3806	14,730
Be3130_R		507.4	ug/L	3.577	0.7049	30,800
Ca3158_R		12,650	ug/L	75.08	0.5935	8,146
Cd2265_A		510.1	ug/L	1.466	0.2875	9,068
Co2286_A		515.8	ug/L	1.266	0.2454	2,155
Cr2677_A		505.4	ug/L	1.577	0.3120	7,789
Cu3273_A		514.5	ug/L	2.241	0.4355	9,653
Fe2599_R		12,800	ug/L	138.2	1.080	11,460
K_7664_R		12,880	ug/L	50.83	0.3945	4,549
Li6707_R		516.5	ug/L	4.051	0.7844	3,956
Mg2795		12,940	ug/L	213.6	1.651	594,100
Mg2025_A	W	13,270	ug/L	13.59	0.1024	4,849
Mn2576_R		507.2	ug/L	4.156	0.8195	3,372
Mo2020_A		513.7	ug/L	0.3086	0.06007	1,665
Na5895_R		12,940	ug/L	64.19	0.4959	11,840

CCV

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 5:30:55PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ni2316_A		513.8	ug/L	1.514	0.2947	964.5
Pb2203_A		514.6	ug/L	3.011	0.5851	683.1
Sb2068_A		510.4	ug/L	1.583	0.3101	307.2
Se1960_A		505.9	ug/L	0.4900	0.09685	123.8
Si2516_R		12,820	ug/L	85.60	0.6676	5,168
Sn1899_A		510.8	ug/L	0.1786	0.03496	296.4
Sr4215_R		515.9	ug/L	2.277	0.4414	19,120
Ti3349_A		499.4	ug/L	1.405	0.2813	12,220
Tl1908_A		519.8	ug/L	0.05683	0.01093	279.3
V_2924_A		506.3	ug/L	0.4498	0.08885	8,875
Zn2062_A		504.1	ug/L	1.050	0.2083	1,974
Y_3600_R		9,438.0	Cts/S	103.82	1.1000	9,438.0
Y_2243_A		6,479.5	Cts/S	0.85259	0.013158	6,479.5
Y_3600_A		165,780	Cts/S	294.85	0.17786	165,780

CCB

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM
Acquire Date: 3/24/2023 5:35:05PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1071	ug/L	0.1378	128.7	-6.082
Al3961_R		15.44	ug/L	9.850	63.79	-3.739
As1891_A		-0.1461	ug/L	0.4777	327.1	-2.895
B_2089_A		-0.1255	ug/L	0.1823	145.2	3.460
Ba4554_R		0.6311	ug/L	0.01065	1.687	32.07
Be3130_R		0.2425	ug/L	0.04061	16.75	6.091
Ca3158_R		1.259	ug/L	4.740	376.6	-37.83
Cd2265_A		0.1236	ug/L	0.05871	47.51	0.2385
Co2286_A		0.08312	ug/L	0.1390	167.2	-0.4560
Cr2677_A		0.4962	ug/L	0.05300	10.68	6.527
Cu3273_A		0.3338	ug/L	0.1361	40.76	-5.856
Fe2599_R		8.215	ug/L	1.002	12.20	5.411
K_7664_R		42.75	ug/L	18.46	43.19	-9.282
Li6707_R		0.8820	ug/L	0.5053	57.28	2.770
Mg2795		4.605	ug/L	0.1399	3.038	239.3
Mg2025_A		0.07454	ug/L	0.6098	818.1	-7.315
Mn2576_R		1.175	ug/L	0.1308	11.13	4.243
Mo2020_A		0.3790	ug/L	0.2105	55.53	1.636
Na5895_R		6.645	ug/L	6.568	98.85	55.88
Ni2316_A		-0.06475	ug/L	0.2384	368.2	0.8173
Pb2203_A		0.04278	ug/L	0.3416	798.4	-1.653
Sb2068_A		0.004248	ug/L	0.01924	452.9	2.013
Se1960_A		-1.377	ug/L	0.7516	54.57	1.668
Si2516_R		1.150	ug/L	6.170	536.5	19.84
Sn1899_A		0.1982	ug/L	0.3482	175.7	2.093
Sr4215_R		0.1189	ug/L	0.1646	138.5	-0.7446
Ti3349_A		0.5216	ug/L	0.2600	49.85	-27.71
Tl1908_A		0.9319	ug/L	0.3734	40.07	-2.401
V_2924_A		0.04069	ug/L	0.1949	479.0	-7.206
Zn2062_A		0.5506	ug/L	0.02409	4.374	2.830
Y_3600_R		9,379.7	Cts/S	42.171	0.44960	9,379.7
Y_2243_A		6,479.2	Cts/S	7.5621	0.11672	6,479.2
Y_3600_A		167,070	Cts/S	474.07	0.28377	167,070

SQ1266-001

Method Name: FAST-2022_POP
Method Revision: 176
Analyst Name: EAM

KATAHDIN ANALYTICAL SERVICES, LLC
METALS ANALYSIS RUN INFORMATION SHEET

INSTR. ID: L (Agilent 7800) **ANALYST**: KS **ANALYSIS DATE**: 03/21/23

METHOD: ICP-MS
- ☐ 200.8
- ☑ 6020
- ☑ DOD

FILE NAME: LQC21A

Reviewed By: EA 03/21/23

The pHs of all samples that were tested by direct analysis in this analytical run were checked just prior to analysis and confirmed to be <2. The time of preservation of these samples was checked in the "Measured Turbidity and Preservation of Incoming Samples" logbook to verify that they had been preserved at least 16 hours prior to analysis. These verifications were performed by ____ (initials) on ____ (date).

STANDARDS USED:

Standard Name	Standard ID	Prep Date	Expiration Date	Standard Conc.
Cal Blk/ICB/CCB	MW21411	03/02/23	03/02/24	0 ug/L
Cal Std	MW21414	03/02/23	03/25/23	Varies by Element
ICV	MW21429	03/15/23	06/14/23	Varies by Element
PQL	MW21412	03/02/23	03/25/23	Varies by Element
LRS1	MW21330	01/17/23	03/25/23	Varies by Element
LRS2	MW21331	01/17/23	04/17/23	Varies by Element
ICSA	MW21432	03/16/23	03/23/23	Varies by Element
ICSAB	MW21435	03/20/23	03/27/23	Varies by Element
CCV	MW21415	03/02/23	03/25/23	Varies by Element
Internal Standard (ISTD)	N/A	N/A	N/A	0.2 mg/L (Li,Sc,Ge/Y,Tb,Bi)

Additional Comments and Notes:

Samples with ISTD RSDs > 8% were reanalyzed immediately.

ISTD was manually added to all standards and samples (0.08 mL of MS2459 to 8 mL).

Dilutions: Some samples were diluted based on history or due to interfering element concentrations.

Dilution preparations are as follows:

5x diln.: 1.6 mL of sample (pipet M30) + 6.4 mL of MW21411 (pipet M31)

10x diln.: 0.8 mL of sample (pipet M19) + 7.2 mL of MW21411 (pipet M31)

25x diln.: 0.32 mL of sample(pipet M19) + 7.68 mL of MW21411 (pipet M31)

Post Spike: 0.08 mL of MW21329 (pipet M27) into 8 mL final volume of appropriately diluted sample (pipet M31)

INSTRUMENT RUNLOG

Instrument: AGILENT 7800

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
CalBlank	1	LQC21A	03/21/2023	15:00	KS
CalStd	1	LQC21A	03/21/2023	15:05	KS
ICV	1	LQC21A	03/21/2023	15:17	KS
ICB	1	LQC21A	03/21/2023	15:26	KS
PQL	1	LQC21A	03/21/2023	15:31	KS
ICSA	1	LQC21A	03/21/2023	15:36	KS
ICSAB	1	LQC21A	03/21/2023	15:41	KS
LRS1	1	LQC21A	03/21/2023	15:49	KS
LRS2	1	LQC21A	03/21/2023	16:01	KS
RINSE	1	LQC21A	03/21/2023	16:12	KS
RINSE	1	LQC21A	03/21/2023	16:18	KS
CCV	1	LQC21A	03/21/2023	16:23	KS
CCB	1	LQC21A	03/21/2023	16:33	KS
PBSQC14IMS1	5	LQC21A	03/21/2023	16:38	KS
LCSOQC14IMS1	5	LQC21A	03/21/2023	16:43	KS
SQ0876-001	10	LQC21A	03/21/2023	16:51	KS
SQ0876-001L	50	LQC21A	03/21/2023	16:56	KS
SQ0876-001A	10	LQC21A	03/21/2023	17:01	KS
SQ0876-001P	10	LQC21A	03/21/2023	17:07	KS
SQ0876-001S	10	LQC21A	03/21/2023	17:12	KS
SQ0908-017	5	LQC21A	03/21/2023	17:17	KS
SQ0908-019	5	LQC21A	03/21/2023	17:22	KS
PBSQC14IMS2	5	LQC21A	03/21/2023	17:27	KS
CCV	1	LQC21A	03/21/2023	17:32	KS
CCB	1	LQC21A	03/21/2023	17:41	KS
LC2OQC14IMS2	5	LQC21A	03/21/2023	17:46	KS
LCSOQC14IMS2	5	LQC21A	03/21/2023	17:54	KS
SQ1188-001	5	LQC21A	03/21/2023	18:02	KS
SQ1188-003	5	LQC21A	03/21/2023	18:07	KS
SQ1188-005	5	LQC21A	03/21/2023	18:12	KS
SQ1188-005L	25	LQC21A	03/21/2023	18:17	KS
SQ1188-005A	5	LQC21A	03/21/2023	18:22	KS
SQ1188-005P	5	LQC21A	03/21/2023	18:27	KS
SQ1188-005S	5	LQC21A	03/21/2023	18:35	KS
SQ1188-007	5	LQC21A	03/21/2023	18:43	KS
CCV	1	LQC21A	03/21/2023	18:48	KS
CCB	1	LQC21A	03/21/2023	18:57	KS
SQ1188-009	5	LQC21A	03/21/2023	19:02	KS
SQ1188-015	5	LQC21A	03/21/2023	19:07	KS
PBWQC14IMW1	5	LQC21A	03/21/2023	19:12	KS
LCSWQC14IMW1	5	LQC21A	03/21/2023	19:17	KS
SQ0875-001	5	LQC21A	03/21/2023	19:25	KS
SQ0875-002	5	LQC21A	03/21/2023	19:30	KS
SQ0875-002L	25	LQC21A	03/21/2023	19:35	KS

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
SQ0875-002A	5	LQC21A	03/21/2023	19:40	KS
SQ0875-002P	5	LQC21A	03/21/2023	19:45	KS
SQ0875-002S	5	LQC21A	03/21/2023	19:53	KS
CCV	1	LQC21A	03/21/2023	20:01	KS
CCB	1	LQC21A	03/21/2023	20:11	KS
SQ0875-003	5	LQC21A	03/21/2023	20:16	KS
SQ0875-004	5	LQC21A	03/21/2023	20:21	KS
SQ0875-005	5	LQC21A	03/21/2023	20:26	KS
SQ0875-006	5	LQC21A	03/21/2023	20:31	KS
SQ0875-007	5	LQC21A	03/21/2023	20:37	KS
SQ0875-008	5	LQC21A	03/21/2023	20:42	KS
SQ0875-009	5	LQC21A	03/21/2023	20:47	KS
SQ0875-010	5	LQC21A	03/21/2023	20:52	KS
SQ0875-011	5	LQC21A	03/21/2023	20:57	KS
SQ0875-012	5	LQC21A	03/21/2023	21:02	KS
CCV	1	LQC21A	03/21/2023	21:07	KS
CCB	1	LQC21A	03/21/2023	21:16	KS
SQ0875-013	5	LQC21A	03/21/2023	21:21	KS
SQ0875-014	5	LQC21A	03/21/2023	21:26	KS
SQ0876-007	5	LQC21A	03/21/2023	21:31	KS
SQ0876-008	5	LQC21A	03/21/2023	21:37	KS
PBSQC16IMS1	5	LQC21A	03/21/2023	21:42	KS
LCSOQC16IMS1	5	LQC21A	03/21/2023	21:47	KS
SQ1188-011	5	LQC21A	03/21/2023	21:54	KS
SQ1188-013	5	LQC21A	03/21/2023	21:59	KS
PBWQC16IMW1	5	LQC21A	03/21/2023	22:05	KS
LC2WQC16IMW1	5	LQC21A	03/21/2023	22:10	KS
CCV	1	LQC21A	03/21/2023	22:17	KS
CCB	1	LQC21A	03/21/2023	22:27	KS
LCSWQC16IMW1	5	LQC21A	03/21/2023	22:32	KS
SQ0907-003	5	LQC21A	03/21/2023	22:40	KS
SQ0907-004	5	LQC21A	03/21/2023	22:45	KS
SQ0907-007	5	LQC21A	03/21/2023	22:50	KS
SQ0907-010	5	LQC21A	03/21/2023	22:56	KS
SQ0907-011	5	LQC21A	03/21/2023	23:01	KS
SQ0908-001	5	LQC21A	03/21/2023	23:06	KS
SQ0908-002	5	LQC21A	03/21/2023	23:11	KS
SQ0908-003	5	LQC21A	03/21/2023	23:16	KS
SQ0908-004	5	LQC21A	03/21/2023	23:21	KS
CCV	1	LQC21A	03/21/2023	23:26	KS
CCB	1	LQC21A	03/21/2023	23:35	KS
SQ0908-005	5	LQC21A	03/21/2023	23:41	KS
SQ0908-006	5	LQC21A	03/21/2023	23:46	KS
SQ0908-007	5	LQC21A	03/21/2023	23:51	KS
SQ0908-008	5	LQC21A	03/21/2023	23:56	KS
SQ0908-009	5	LQC21A	03/22/2023	00:01	KS
SQ0908-010	5	LQC21A	03/22/2023	00:06	KS

US EPA Tune Check Report

Operator Name	admin
Acq/Data Batch	D:\Agilent\ICPMH\1\DATA\2023\03-MAR\LQC21A.b
Acq. Date-Time	3/21/2023 14:08:21
Report Comment	---
Instrument Name	G8421A SG18503526

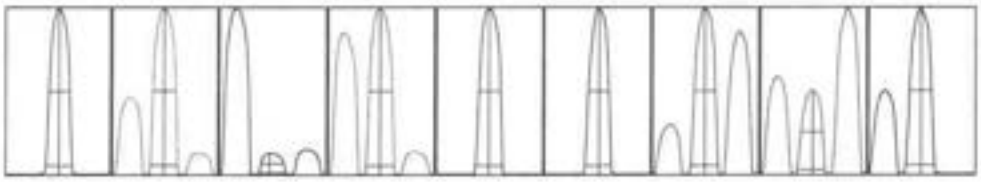
[No Gas]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
9	10.00	69482	694818.74	2.621	5.000	
24	10.00	294261	2942611.11	3.382	5.000	
25	10.00	37159	371589.61	2.621	5.000	
26	10.00	43898	438983.83	3.039	5.000	
59	10.00	545905	5459053.83	2.727	5.000	
115	10.00	577743	5777428.65	2.891	5.000	
206	10.00	100396	1003963.92	3.431	5.000	
207	10.00	85725	857247.60	3.565	5.000	
208	10.00	166099	1660993.35	3.081	5.000	

Integration Time [sec] 0.1

Resolution/Axis



Mass	Peak Height	Axis	Axis (Required)	Axis (Flag)
9	79562.08	9.05	8.90 - 9.10	
24	296789.81	24.00	23.90 - 24.10	
25	37431.51	24.95	24.90 - 25.10	
26	43931.59	26.00	25.90 - 29.10	
59	547993.72	59.00	58.90 - 59.10	
115	586477.67	115.05	114.90 - 115.10	
206	102642.60	206.00	205.90 - 206.10	
207	88201.98	207.00	206.90 - 207.10	
208	174899.42	208.00	207.90 - 208.10	

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
9	0.60	0.776	0.900	
24	0.66	0.787	0.900	
25	0.64	0.744	0.900	

US EPA Tune Check Report

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
26	0.65	0.785	0.900	
59	0.63	0.780	0.900	
115	0.59	0.739	0.900	
206	0.61	0.782	0.900	
207	0.61	0.781	0.900	
208	0.61	0.814	0.900	

Integration Time [sec] 0.1
Acquisition Time [sec] 47.0000000000001
Y Axis Linear

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	13.0 V
Extract 2	-250.0 V	Cell Entrance	-40 V	Plate Bias	-40 V
Omega Bias	-85 V	Cell Exit	-60 V		

Cell Parameters

Use Gas	No	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-8.0 V		
H2 Flow	0.0 mL/min	OctP RF	130 V		

QP Parameters

Mass Gain	120	Axis Gain	0.9982	QP Bias	-3.0 V
Mass Offset	126	Axis Offset	0.12		

Hardware Settings

Torch

Torch H	-0.1 mm	Torch V	0.7 mm

EM

Discriminator	3.5 mV	Analog HV	2216 V	Pulse HV	1191 V

[H2]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	62397	623973.05	3.194	5.000	
89	10.00	56727	567274.19	2.236	5.000	
205	10.00	43740	437400.16	3.075	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

US EPA Tune Check Report

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-18.0 V		
H2 Flow	5.0 mL/min	OctP RF	200 V		

QP Parameters

Mass Gain	120	Axis Gain	0.9982	QP Bias	-13.0 V
Mass Offset	126	Axis Offset	0.12		

Hardware Settings

Torch

Torch H	-0.1 mm	Torch V	0.7 mm		

EM

Discriminator	3.5 mV	Analog HV	2216 V	Pulse HV	1191 V

[He]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	127297	1272974.87	2.743	5.000	
89	10.00	9947	99465.01	2.899	5.000	
205	10.00	19667	196672.68	3.084	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	4.5 mL/min	OctP Bias	-18.0 V		
H2 Flow	0.0 mL/min	OctP RF	200 V		

QP Parameters

US EPA Tune Check Report

Mass Gain	120	Axis Gain	0.9982	QP Bias	-13.0 V
Mass Offset	126	Axis Offset	0.12		

Hardware Settings

Torch

Torch H	-0.1 mm	Torch V	0.7 mm		

EM

Discriminator	3.5 mV	Analog HV	2216 V	Pulse HV	1191 V

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^Åè=qáã É	PLONLOMOP=NRVMVMVD
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fpqa=n`=m~ëëlc~ãä	m~ëë
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n`=^å~äöíÉ=q~ÄáÉ

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V	_É	S	kç=el~ë	NVTKTU	OOKQ
NN	_	S	kç=el~ë	NRNQKRR	OKU
OP	k~	QR	eÉ	RQUOTKUQ	MKV
OQ	j Ö	QR	eÉ	RQUKVO	NPKP
OT	^ä	QR	eÉ	USNKNR	NPKU
OU	pá	QR	eO	NRURKMV	NSKV
PV	h	QR	eÉ	PNQUNKQT	NKM
QM	`~	QR	eO	NVQSUKMO	NKN
RN	s	UV	eÉ	PPMKMN	QKQ
RO	`ê	UV	eÉ	VNRKMV	NKN
RR	j å	UV	eÉ	OPSKSO	TKO
RS	cÉ	UV	eO	SPRQSKVO	PKU
RV	`ç	UV	eÉ	PMOKOQ	VKV
SM	ká	UV	eÉ	NSSKST	UKM
SP	`ì	UV	eÉ	NNTTKUR	PKT
SS	wá	UV	eÉ	NRVMKNP	RKQ
TR	^ë	UV	eÉ	ONKST	NQKU
TU	pÉ	UV	eO	PKMM	QQKN
UU	pê	UV	eÉ	PTKTU	PRKT
VR	j ç	UV	eÉ	VPKPQ	NSKQ
NMT	^Ö	UV	eÉ	OOKOO	QRKU
NNN	`Ç	UV	eÉ	NKUR	NOQKV
NNU	på	NRV	eÉ	NMNQKRM	RKN
NON	pÄ	NRV	kç=el~ë	OPPKUM	PKR
NPT	_~	NRV	kç=el~ë	NMMKOM	NPKV
NUO	t	NRV	kç=el~ë	VVQKQP	NQKP
OMR	qä	OMV	kç=el~ë	ROMKRS	ONKO
OMU	mÄ	OMV	kç=el~ë	NRURKMR	NUKQ
OPO	qÜ	OMV	kç=el~ë	ONPVKNN	NMKR
OPU	r	OMV	kç=el~ë	QMKMQ	NMVKM

n`=fpqa=q~ÄáÉ

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iá	S	kç=el~ë	OTRVPMMKUR	NKR
pÅ	QR	kç=el~ë	SMQUSNNKOM	OKN
pÅ	QR	eO	NRCUORRKRV	MKU
pÅ	QR	eÉ	OPPVRPKQR	MKS
dÉ	TO	kç=el~ë	NQNOURSKNU	NKN
dÉ	TO	eO	SMTRNTKON	MKV
dÉ	TO	eÉ	NTUUOVKVT	MKP
v	UV	eO	SRRTRURKQP	MKU
v	UV	eÉ	NOSROOTKVR	NKO
qÄ	NRV	kç=el~ë	UQQSUONKNN	NKM
qÄ	NRV	eÉ	QNMSRTOKVO	OKM
_á	OMV	kç=el~ë	PUSSRTUKPV	NKN
_á	OMV	eÉ	OPPPTRQKRV	NKO

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^Åè=qãã É	PLONLOMOP=NRMRMRS
p~ã éäÉ=qóéÉ	` ~äpíÇ
qçí~ä=a ãä íáçå	NKMMMM
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fpqa=oÉÑ=cãÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	m~ëë
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n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	==` mp==	o pa
V	_É	S	k ç=d ~ë	QNNQUTKRR	MKS
NN	_	S	k ç=d ~ë	OSUTURKMU	MKO
OP	k~	QR	e É	NMOUNTNUKRQ	MKQ
OQ	j Ö	QR	e É	RQSURPNKRV	MKV
OT	^ä	QR	e É	ONOVVNKVP	MKQ
OU	pá	QR	e O	TQSPMPKOO	NKS
PV	h	QR	e É	QUVUPNTKOQ	NKV
QM	` ~	QR	e O	RQUMTMQSKQN	NKN
RN	s	UV	e É	PPRQSPKRQ	NKO
RO	` ê	UV	e É	QORNMTKQR	NKQ
RR	j å	UV	e É	ONRTNMKTP	MKV
RS	cÉ	UV	e O	NUTPQRNPMKOM	NKS
RV	` ç	UV	e É	TPOTTQKUR	NKM
SM	k á	UV	e É	OMQVPOKOS	MKR
SP	` ì	UV	e É	RSRNOMKQT	MKV
SS	wå	UV	e É	VTOORKVT	MKT
TR	^ë	UV	e É	TOTQNKSM	MKT
TU	pÉ	UV	e O	PUNUVKRU	NKO
UU	pê	UV	e É	ORUUVRKPR	NKO
VR	j ç	UV	e É	OQTQQMKQV	MKT
NMT	^Ö	UV	e É	UUNUOPKNR	MKR
NNN	` Ç	UV	e É	NOMTPMKVQ	MKR
NNU	på	NRV	e É	OPUTVUKTM	NKN
NON	pÄ	NRV	k ç=d ~ë	NRQMROQKSQ	NKT
NPT	_~	NRV	k ç=d ~ë	QQNMQTKPU	NKS
NUO	t	NRV	k ç=d ~ë	UUQTRNKNR	NKO
OMR	qä	OMV	k ç=d ~ë	NTTMVMTKTM	NKO
OMU	mÄ	OMV	k ç=d ~ë	OQRNTRMKVP	NKS
OPO	qÜ	OMV	k ç=d ~ë	ONOVOPVKRS	NKO
OPU	r	OMV	k ç=d ~ë	NVVNSRTKTT	MKT

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ= mp	B=o ÉÅ	B n` =i çï	B n` =e äÖÜ	n` =cä~Ö
i á	S	k ç=d ~ë	OVPRNQOKMQ	NKR	OTRVPMMKUR	NMSKPT	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	SPNSSMPKOO	MKS	SMQUSNNKO	NMQKQP	RVKR	NOMKQ	
pÅ	QR	e O	NRUMMQMKUP	NKN	NROUORRKRV	NMPKPV	RVKR	NOMKQ	
pÅ	QR	e É	OPURRRKVR	MKO	OPPVRPKQR	NMNKVT	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	NQVSQSUKNU	NKO	NQNOURSKNU	NMRKVO	RVKR	NOMKQ	
d É	TO	e O	SPMMSOKPS	NKR	SMTRNTKON	NMPKTN	RVKR	NOMKQ	
d É	TO	e É	NUPQOTKSU	NKO	NTUUOVKVT	NMOKRT	RVKR	NOMKQ	
v	UV	e O	SUNOUNMKRR	NKQ	SRRTRURKQP	NMPKUV	RVKR	NOMKQ	
v	UV	e É	NOSTORMKVO	MKT	NOSROOTKVR	NMMKNS	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	VMTVSTNKOS	NKQ	UQQSUONKNN	NMTKQV	RVKR	NOMKQ	
qÄ	NRV	e É	QPPRMVVKOV	MKU	QNMSRTOKVO	NMRKRS	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	QOROMNOKQN	MKO	PUSSRTUKPV	NMVKVT	RVKR	NOMKQ	
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NN	_	S	kç=cl~ë	ONKMSN	éëÄ	MKU	NMSNPTKPN	OM	NMRKP	UVK	NNMQ	
OP	k~	QR	eÉ	QNSVKURU	éëÄ	MKQ	PUSNTTSKOT	QMMM	NMQKQR	UVK	NNMQ	
OQ	j Ö	QR	eÉ	QOMQKPMQ	éëÄ	NKT	OMRSMQQKSQ	QMMM	NMRKSN	UVK	NNMQ	
OT	^ä	QR	eÉ	QMTKQRU	éëÄ	MKQ	TUMSSKSN	QMM	NMNKUS	UVK	NNMQ	
OU	pá	QR	eO	QMVKSOP	éëÄ	MKN	OTPRSRKPM	QMM	NMOKQN	UVK	NNMQ	
PV	h	QR	eÉ	QNNRKONU	éëÄ	MKQ	NUNVPTSKON	QMMM	NMOKUU	UVK	NNMQ	
QM	`~	QR	eO	QNNQKPSS	éëÄ	MKU	OMNORNTRKPV	QMMM	NMOKUS	UVK	NNMQ	
RN	s	UV	eÉ	OMKQNM	éëÄ	NKN	NCOVPUKPM	OM	NMOKMR	UVK	NNMQ	
RO	`ê	UV	eÉ	OMKNVO	éëÄ	NKN	NRQPUSKMU	OM	NMVKVS	UVK	NNMQ	
RR	j å	UV	eÉ	OMKOSR	éëÄ	NKT	TURMPKMU	OM	NMNKPO	UVK	NNMQ	
RS	cÉ	UV	eO	QMTNKRVS	éëÄ	MKR	SVPMNVOSKMR	QMMM	NMNKTV	UVK	NNMQ	
RV	`ç	UV	eÉ	OMKOVS	éëÄ	NKU	OSSTVVKTQ	OM	NMNKQU	UVK	NNMQ	
SM	ká	UV	eÉ	OMKPOM	éëÄ	MKT	TQTRVKUP	OM	NMNKS	UVK	NNMQ	
SP	`ì	UV	eÉ	OMKSMP	éëÄ	NKU	OMVPTTKRN	OM	NMPKMD	UVK	NNMQ	
SS	wå	UV	eÉ	ONKMPS	éëÄ	OKV	PTQVMKR	OM	NMRKNU	UVK	NNMQ	
TR	^ë	UV	eÉ	OMKPPM	éëÄ	OKS	OSRONKRU	OM	NMNKGR	UVK	NNMQ	
TU	pÉ	UV	eO	NVKRPO	éëÄ	MKO	NPRQUKQQ	OM	VTKSS	UVK	NNMQ	
UU	pê	UV	eÉ	OMKRSR	éëÄ	NKT	VRQTUKMN	OM	NMOKUP	UVK	NNMQ	
VR	j ç	UV	eÉ	PVKMVO	éëÄ	NKP	NTPUVOKOR	QM	VTKVU	UVK	NNMQ	
NMT	^Ö	UV	eÉ	OMKMOQ	éëÄ	NKR	PNSRUTKUU	OM	NMMKNO	UVK	NNMQ	
NNN	`Ç	UV	eÉ	OMKMQR	éëÄ	OKR	QPPUSKQQ	OM	NMMKOO	UVK	NNMQ	
NNU	på	NRV	eÉ	NVKUNR	éëÄ	MKV	UQTPTKVU	OM	VVKMU	UVK	NNMQ	
NON	pÄ	NRV	kç=cl~ë	NVKPQM	éëÄ	MKV	RQRVRPKMP	OM	VSKT	UVK	NNMQ	
NPT	_~	NRV	kç=cl~ë	NVKVTP	éëÄ	NKT	NSNQSSKVT	OM	VVKUS	UVK	NNMQ	
NUO	t	NRV	kç=cl~ë	OMKQNM	éëÄ	NKM	PPNPMVKVU	OM	NMOKMR	UVK	NNMQ	
OMR	qä	OMV	kç=cl~ë	OMKPNP	éëÄ	NKV	SRVTRQKVV	OM	NMNKRS	UVK	NNMQ	
OMU	mÄ	OMV	kç=cl~ë	NVKSOM	éëÄ	NKS	UUCURSKSM	OM	VUKM	UVK	NNMQ	
OPO	qÜ	OMV	kç=cl~ë	NVKSMV	éëÄ	NKQ	TSSTVSKRS	OM	VUKMQ	UVK	NNMQ	
OPU	r	OMV	kç=cl~ë	NVKRUM	éëÄ	OKM	TNQUVRKVP	OM	VTKV	UVK	NNMQ	

n`=fpqa=q~ÄáÉ

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iá	S	kç=cl~ë	OTOUTOUKOQ	NKR	OTRVPMVKUR	VUKUV	RVKR	NOMQ	
pÅ	QR	kç=cl~ë	RTVOTTQKSP	MKP	SMQUSNNKO	VRKTT	RVKR	NOMQ	
pÅ	QR	eO	NQMVRNQKMU	NKT	NROUORRKRV	VOKOP	RVKR	NOMQ	
pÅ	QR	eÉ	ONPPNRKON	MKU	OPPVRPKQR	VNKMU	RVKR	NOMQ	
dÉ	TO	kç=cl~ë	NPSPMSUKOR	MKU	NQNOURSKMU	VSKQU	RVKR	NOMQ	
dÉ	TO	eO	RSNORQKRM	MKU	SMTRNTKON	VOKPU	RVKR	NOMQ	
dÉ	TO	eÉ	NSRMPOKVO	MKR	NTUUOVKVT	VOKOU	RVKR	NOMQ	
v	UV	eO	SNUSNVSKUV	MKU	SRRTRURKQP	VQKPQ	RVKR	NOMQ	
v	UV	eÉ	NNPSOMNKPQ	NKU	NOSRCOTKVR	UVKU	RVKR	NOMQ	
qÄ	NRV	kç=cl~ë	UPNQVONKTQ	MKS	UQQSUONKMN	VUKQQ	RVKR	NOMQ	
qÄ	NRV	eÉ	PURROTOKSR	MKS	QNMSRTOKVO	VPKUU	RVKR	NOMQ	
_á	OMV	kç=cl~ë	PUVURMRKQS	OKQ	PUSSRTUKPV	NMMKUP	RVKR	NOMQ	
_á	OMV	eÉ	OOPNQVSKTN	NKP	OPPPTRQKRV	VRKSO	RVKR	NOMQ	

fåáá~ä=`~ãÄÂê~íáçå=_ä~åâ=Ef`_F=oÉéçã

p~ã éâÉ=k~ã É	f`_
cãÉ=k~ã É	MVM/f`_ÍÇ
a~í~=m~íÜ=k~ã É	aWj^ÖãÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyi n`ON^hÂ
^Åè=qãã É	PLONLOMCP=NRV0SW0O
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fpqa=o ÉÑ¬cãÉk~ã É	MVS`^i_ÍÇ
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fpqa=n`=m~ëëlc~ãä	m~ëë
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n`=^å~äöíÉ=q~ÄåÉ

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V	_É	S	kç=d~ë	MKMMT	ééÄ	QOKN	OSMKMN	MO	
NN	_	S	kç=d~ë	MKNSP	ééÄ	OKP	OPVQKSV	Q	
OP	k~	QR	eÉ	OKSQS	ééÄ	QOKN	ROSVTHPR	QMM	
OQ	j Ö	QR	eÉ	PKNTU	ééÄ	SKT	ONQMKCR	QM	
OT	^ä	QR	eÉ	MKPNM	ééÄ	NMUKU	UTUKVQ	QM	
OU	pá	QR	eO	NKURS	ééÄ	QUKR	OTVPKOS	NMM	
PV	h	QR	eÉ	QKTSS	ééÄ	OTHP	POMSMKTV	QMM	
QM	`~	QR	eO	PKQVS	ééÄ	VKV	PSPTUKQR	QM	
RN	s	UV	eÉ	JMKMN	ééÄ	kL^	PMTKTV	N	
RO	`ê	UV	eÉ	MKMNT	ééÄ	PMP	NMNNKNU	N	
RR	j å	UV	eÉ	MKMNS	ééÄ	PSKV	OUVKVR	MQ	
RS	cÉ	UV	eO	PKPPP	ééÄ	NQKR	NONSUUKSP	QM	
RV	`ç	UV	eÉ	JMKMN	ééÄ	kL^	OSUKVM	MO	
SM	ká	UV	eÉ	MKMNR	ééÄ	TNKT	ONTKTU	MQ	
SP	`ì	UV	eÉ	MKMMQ	ééÄ	NQMKS	NNSMKMT	MKS	
SS	wå	UV	eÉ	JMKMNS	ééÄ	kL^	NQUQKPP	O	
TR	^ë	UV	eÉ	MKMOV	ééÄ	UKN	SMKMN	N	
TU	pÉ	UV	eO	MKMQU	ééÄ	UKQ	PTHKRM	N	
UU	pê	UV	eÉ	MKMNT	ééÄ	OVKM	NONKKN	N	
VR	j ç	UV	eÉ	MKNTM	ééÄ	QKU	UURKSM	N	
NMT	^Ö	UV	eÉ	MKMNS	ééÄ	NSKS	OUQKQR	MO	
NNN	`Ç	UV	eÉ	MKMNT	ééÄ	NMP	ONKKN	MO	
NNU	på	NRV	eÉ	MKMOQ	ééÄ	RPKQ	NNMPKQM	N	
NON	pÄ	NRV	kç=d~ë	MKMPQ	ééÄ	NSKN	NQPNKSN	MO	
NPT	_~	NRV	kç=d~ë	MKMNN	ééÄ	NRNKT	OUMKPM	MQ	
NUO	t	NRV	kç=d~ë	MKNQM	ééÄ	VKU	PPRMKSR	N	
OMR	qä	OMV	kç=d~ë	MKMRQ	ééÄ	TKT	OPUQKTR	MO	
OMU	mÄ	OMV	kç=d~ë	MKMMQ	ééÄ	SMKT	NUSRKPR	MO	
OPO	qÜ	OMV	kç=d~ë	MKMOT	ééÄ	NQKR	PPRQKMN	N	
OPU	r	OMV	kç=d~ë	MKMNT	ééÄ	UKV	STTKQN	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=íçï	Bn`=cëÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	OUPMSNQKST	OKP	OTRVPMMKUR	NMOKRU	RVMR	NOMQ	
pÅ	QR	kç=d~ë	SMPPVNQKNQ	OKV	SMQUSNNKO	VVRTS	RVMR	NOMQ	
pÅ	QR	eO	NQSPSNSKVO	NKM	NRCUCRRKRV	VRKTT	RVMR	NOMQ	
pÅ	QR	eÉ	OOOONMKOU	MKR	OPPVRPKQR	VQKVU	RVMR	NOMQ	
dÉ	TO	kç=d~ë	NQPRMSOKNS	PKN	NQNOURSKNU	NMNKRT	RVMR	NOMQ	
dÉ	TO	eO	RUONSVKQS	NKQ	SMTRNTKON	VRKUP	RVMR	NOMQ	
dÉ	TO	eÉ	NTMRVSKNM	NKV	NTUUOVKVT	VRKQ	RVMR	NOMQ	
v	UV	eO	SQRSVMUKUO	MKU	SRRTRURKQP	VUKQS	RVMR	NOMQ	
v	UV	eÉ	NOMPQPNKQR	NKM	NOSRQOTKVR	VRKNO	RVMR	NOMQ	
qÄ	NRV	kç=d~ë	URUMNRRKSM	NKQ	UQQSUONKNN	NMNKRU	RVMR	NOMQ	
qÄ	NRV	eÉ	QMQOSOSKVO	NKU	QNMSRTOKVO	VUKQQ	RVMR	NOMQ	
_á	OMV	kç=d~ë	QMRPQSTKQO	MKS	PUSSRTUKPV	NMQKUP	RVMR	NOMQ	
_á	OMV	eÉ	OPRMNVVKPQ	NKO	OPPPTRQKRV	NMMKT	RVMR	NOMQ	

p~ã éáÉ=k~ã É	mmi
cäÉ=k~ã É	MNMf` sKÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJ ^oyi n ` ON^kÂ
^Åè=qáã É	PLONLOMOP=NRVRPNMQV
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qçí~äa ãäí íáçå	NKMMMM
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fpqa=o ÉÑ¤cäÉk~ã É	MVS` ^i _KÇ
p~ã éáÉ=n ` =m~ëëLcá~ä	m~ëë
fpqa=n ` =m~ëëLc~áä	m~ëë
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OU	p á	OR	e O	VVKQTR	éé Ä	OKR	TOTSRKVM	NMM	VVKQU	TVfR	NOMQ	
PV	h	OR	e É	OMMKRPQ	éé Ä	MQ	NOQUTVKV	OMM	NMMOT	TVfR	NOMQ	
QM	` ~	OR	e O	OMKUPV	éé Ä	NKM	NOVMRQKOP	OM	NVQKO	TVfR	NOMQ	
RN	s	UV	e É	NKMMN	éé Ä	NKT	SUSVKRT	N	NMMKN	TVfR	NOMQ	
RO	` ê	UV	e É	NKMPQ	éé Ä	MS	VQRRKPU	N	NVPKQ	TVfR	NOMQ	
RR	j å	UV	e É	MQQN	éé Ä	PKT	OMVPKMV	MQ	NVRKOR	TVfR	NOMQ	
RS	c É	UV	e O	OORTTM	éé Ä	NKQ	QTUSQRKNS	OM	NNPKUR	TVfR	NOMQ	
RV	` ç	UV	e É	MKMVM	éé Ä	NKQ	PMVNPKTT	MO	VR	TVfR	NOMQ	
SM	k á	UV	e É	MQQR	éé Ä	OKR	NUSPKQV	MQ	NVSKOR	TVfR	NOMQ	
SP	` ì	UV	e É	MRTMR	éé Ä	MR	UVNVKTT	MS	NNTHR	TVfR	NOMQ	
SS	wå	UV	e É	OKNQV	éé Ä	SKO	RRSRKSS	O	NMTKQR	TVfR	NOMQ	
TR	^ ë	UV	e É	NKMOO	éé Ä	OKT	NQTNKVM	N	NMOKO	TVfR	NOMQ	
TU	p É	UV	e O	NKMNO	éé Ä	NKV	TRQKPO	N	NMNKO	TVfR	NOMQ	
UU	p ê	UV	e É	MKVVR	éé Ä	OKN	RVSPKOR	N	VVHR	TVfR	NOMQ	
VR	j ç	UV	e É	NKMUQ	éé Ä	NKS	RPORKRT	N	NMUKQ	TVfR	NOMQ	
NMT	^ Ö	UV	e É	MONO	éé Ä	NKS	PSTTKOQ	MO	NMS	TVfR	NOMQ	
NNN	` Ç	UV	e É	MONU	éé Ä	UKV	RNQKUP	MO	NMV	TVfR	NOMQ	
NNU	p å	NRV	e É	NKNNO	éé Ä	NKN	SMVNKQV	N	NNNKO	TVfR	NOMQ	
NON	p Ä	NRV	k ç=d ~ë	MOOOS	éé Ä	PHR	TNROKTV	MO	NNP	TVfR	NOMQ	
NPT	_~	NRV	k ç=d ~ë	MKPVQ	éé Ä	RKV	PRQQKNV	MQ	VUHR	TVfR	NOMQ	
NUO	t	NRV	k ç=d ~ë	NKMQN	éé Ä	PKS	NUTRSHRN	N	NVQKN	TVfR	NOMQ	
OVR	qä	OMV	k ç=d ~ë	MONT	éé Ä	OKP	TVSMKVM	MO	NMUHR	TVfR	NOMQ	
OMU	mÄ	OMV	k ç=d ~ë	MKMVN	éé Ä	SKM	NMSSSHPV	MO	VRHR	TVfR	NOMQ	
OPO	qÜ	OMV	k ç=d ~ë	MKMVS	éé Ä	NOKT	NMOUNKTR	MO	VU	TVfR	NOMQ	
OPU	r	OMV	k ç=d ~ë	MKMVO	éé Ä	PKU	TQMSKST	MO	VS	TVfR	NOMQ	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B=o ÉÅ	B n ` = ç ï	B n ` =e äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OUUVUPNOM	NHP	OTRVPMVKUR	NVQKTP	RVfR	NOMQ	
pÅ	OR	k ç=d ~ë	SNRVSVPKNN	NKT	SMQUSNNHO	NMNKUQ	RVfR	NOMQ	
pÅ	OR	e O	NRNUPNRKTM	NHO	NRQUORRKRV	VVHPR	RVfR	NOMQ	
pÅ	OR	e É	OOVTONMSR	MKV	OPPVRPKQR	VUKNV	RVfR	NOMQ	
d É	TO	k ç=d ~ë	NQRMOUTKNV	OKN	NQNOURSKNU	NVOKSR	RVfR	NOMQ	
d É	TO	e O	RVSUSPKNT	MHP	SMTRNTKON	VUKOR	RVfR	NOMQ	
d É	TO	e É	NTQPNNRRS	MKN	NTUUOVKVT	VTKQT	RVfR	NOMQ	
v	UV	e O	SSONVVNKVT	MKT	SRRTRURKQP	NMMKVU	RVfR	NOMQ	
v	UV	e É	NOPSURQKNM	MKQ	NOSROOTKVR	VTKTS	RVfR	NOMQ	
qÄ	NRV	k ç=d ~ë	UTQPROKRRM	MKU	UQQSUONKNN	NVPKRN	RVfR	NOMQ	
qÄ	NRV	e É	QNRQOMQKPS	NKM	QNVSRTOKVO	NMNKNS	RVfR	NOMQ	
_á	OMV	k ç=d ~ë	QMVPTMVKRQ	OKN	PUSSRTUHPV	NVRKUT	RVfR	NOMQ	
_á	OMV	e É	OOPPOTRKRN	NKQ	OPPPTRQKRV	NVQKOS	RVfR	NOMQ	

fåíÉâÑÉêÉåÅÉ= ÜÉÅâ=pçàíç=^=Ef`pJ^F=oÉéçëí

p~ã éáÉ=k~ã É	f`p^
cäÉ=k~ã É	MNNf`p^KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyjn`ON^kÅ
^Åè=qáã É	PLONLOMCP=NRNRSWRR
p~ã éáÉ=qóéÉ	f`p^
qçí~äaäã íáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MMS`^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄäÉ

k~ã É	j~ëë	fpqa	qìåÉ	`çåÅK	råáë	opa	==mp==	bñés~ä	Bi çï	BeäÖÜ	n`=ëä~Ö
_É	V	S	kç=ël~ë	JMKMJ	éé¿Ä	klᴬ	NOMKMM	JMKN	NMM	NMM	
_	NN	S	kç=ël~ë	MKQST	éé¿Ä	SHR	PQTPKUN	JO	NMM	NMM	
k~	OP	QR	eÉ	NVSPTVKMVO	éé¿Ä	MKO	UNNORCMQKUR	NMMMMM	UM	NOM	
jÖ	OQ	QR	eÉ	NVSNVMKPPO	éé¿Ä	MKQ	QPOTORVUKQQ	NMMMMM	UM	NOM	
^ä	OT	QR	eÉ	NVITTUNKORV	éé¿Ä	NKS	NTMPTUSTHST	NMMMMM	UM	NOM	
pá	QU	QR	eO	QKPMJ	éé¿Ä	QKN	PSNTHSO	JRM	NMM	NMM	
h	PV	QR	eÉ	NVNSTVHPVN	éé¿Ä	NKT	PSUVSUQUKQS	NMMMMM	UM	NOM	
`~	QM	QR	eO	NVQVROKRMT	éé¿Ä	NHR	QOVPTQQQSKVP	NMMMMM	UM	NOM	
s	RN	UV	eÉ	MKMQU	éé¿Ä	NPKU	QTTKTV	JMKR	NMM	NMM	
`ê	RO	UV	eÉ	QKQMR	éé¿Ä	NHR	NQPRVKQQ	NHR	NMM	NMM	
jå	RR	UV	eÉ	MQOSU	éé¿Ä	RHO	NMNVKUQ	MKNT	NMM	NMM	
cÉ	RS	UV	eO	NVNUNNKVSR	éé¿Ä	MKT	NQRNTNTRUSKQR	NMMMMM	UM	NOM	
`ç	RV	UV	eÉ	MKNNP	éé¿Ä	PKV	NQOVKMO	M	NMM	NMM	
ká	SM	UV	eÉ	MKQQM	éé¿Ä	QNS	NQQQHPO	MKNU	NMM	NMM	
`ì	SP	UV	eÉ	MKMVV	éé¿Ä	QKQ	NSUMKNP	JMKOO	NMM	NMM	
wå	SS	UV	eÉ	MKVQP	éé¿Ä	THO	OQURKUP	MKQ	NMM	NMM	
^ë	TR	UV	eÉ	MKMTS	éé¿Ä	RKT	VTHUN	JMKR	NMM	NMM	
pÉ	TU	UV	eO	MKMSN	éé¿Ä	NPKN	PTKUP	JMKR	NMM	NMM	
pê	UU	UV	eÉ	MKUSU	éé¿Ä	QKR	PPNUKQQ	MKPT	NMM	NMM	
jç	VR	UV	eÉ	OOSQKVSN	éé¿Ä	NKM	UNVVQVTKQQ	OMMM	UM	NOM	
^Ö	NMT	UV	eÉ	MKMNT	éé¿Ä	NQKT	OQNKNO	JMKN	NMM	NMM	
`Ç	NNN	UV	eÉ	MKPRM	éé¿Ä	UKP	SOMKPV	MKOU	NMM	NMM	
på	NNU	NRV	eÉ	JMKMOV	éé¿Ä	klᴬ	TNUKVO	JMKR	NMM	NMM	
pÄ	NON	NRV	kç=ël~ë	MKMUN	éé¿Ä	VHN	OQRVKQV	JMKMR	NMM	NMM	
_~	NPT	NRV	kç=ël~ë	MKRNN	éé¿Ä	QKM	PVPNKQN	MKPP	NMM	NMM	
t	NUO	NRV	kç=ël~ë	MKORT	éé¿Ä	NOHS	QSUOKQQ	JMKPP	NMM	NMM	
qä	OMR	OMV	kç=ël~ë	MKMNO	éé¿Ä	NPKV	UTTHSP	JMKN	NMM	NMM	
mÄ	OMU	OMV	kç=ël~ë	MKMPS	éé¿Ä	NNHS	PMPPHPQ	JMKMU	NMM	NMM	
qÜ	OPO	OMV	kç=ël~ë	MKMNP	éé¿Ä	SQHS	ORPSKOV	JMKN	NMM	NMM	
r	OPU	OMV	kç=ël~ë	MKMOO	éé¿Ä	THV	TVQKOM	JMKMU	NMM	NMM	

n`=fpqa=q~ÄäÉ

k~ã É	j~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=ïçï	Bn`=eäÖÜ	n`=ëä~Ö
iá	S	kç=ël~ë	OQUNTTOKPP	MKO	OTRVPMMKUR	UVKVQ	RVMR	NOMQ	
pÅ	QR	kç=ël~ë	QVSTQRPHMV	MHS	SMQUSNNKO	UOKNP	RVMR	NOMQ	
pÅ	QR	eO	NNUMMPSKNN	OKQ	NRQUORRKRV	TTKON	RVMR	NOMQ	
pÅ	QR	eÉ	NTTTUPKOQ	MKQ	OPPVRPKQR	TRKVV	RVMR	NOMQ	
dÉ	TO	kç=ël~ë	NNVVPPQKTO	NKN	NQNCURSKNU	UQKUV	RVMR	NOMQ	
dÉ	TO	eO	QSQMSUKRM	NKV	SMTRNTKON	TSHPV	RVMR	NOMQ	
dÉ	TO	eÉ	NPTROOKVR	MKR	NTUUOVKVT	TSKV	RVMR	NOMQ	
v	UV	eO	RNUSUMVKUQ	MKU	SRRTRURKQP	TVKN	RVMR	NOMQ	
v	UV	eÉ	VOTPQPKPN	MKO	NOSROOTKVR	TPKOV	RVMR	NOMQ	
qÄ	NRV	kç=ël~ë	TRTPVROKQS	MKQ	UQQSUONKNN	UVHST	RVMR	NOMQ	
qÄ	NRV	eÉ	PPQPPSVKQT	MKR	QNVSRTOKVO	UNKQO	RVMR	NOMQ	
_á	OMV	kç=ël~ë	PTMPOPMHSV	MKU	PUSSRTUKPV	VRKTU	RVMR	NOMQ	
_á	OMV	eÉ	NUQTSOPKTQ	MKQ	OPPPTRQKRV	TVKNT	RVMR	NOMQ	

fåíÉêÑÉêÉåÅÉ=ÜÉÅâ=pçäîáåí=^_=Ef`pJ^_F=oÉéçêí

p~ã éáÉ=k~ã É	f`p^_
cäÉ=k~ã É	MVNOf`p_KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOMOPyMPJ ^oyi n`ONVhÅ
^Åè=qáã É	PLONLOMOP=NRVQNVQO
p~ã éáÉ=qóéÉ	f`p_
qçí~äa ãäíáçå	NVMMMM
`çã ã ÉåáÍ	JJJ
fpqa=oÉÑÉcäÉk~ã É	MVMS^i_KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã ãä**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeáÖÜ	n`=c ä~Ö
V	_É	S	kç=d~ë	OMKQCR	éé Ä	NKM	NNUUPPHPN	OM	TVfR	NOMQ	
NN	_	S	kç=d~ë	OMKQVU	éé Ä	NKO	TUQPVKUN	OM	TVfR	NOMQ	
OP	k~	QR	eÉ	NVQQQQKOTO	éé Ä	MfR	STRRRSMOKPV	NMMMMM	TVfR	NOMQ	
OQ	j Ö	QR	eÉ	NVQPNVRTPT	éé Ä	MfP	PSMSOVVUKVN	NMMMMM	TVfR	NOMQ	
OT	^ä	QR	eÉ	NVRVVRHPVS	éé Ä	MfR	NQONRQPRKOM	NMMMMM	TVfR	NOMQ	
OU	pá	QR	eO	SNUMVQQ	éé Ä	OKQ	OVRVOQKVT	RVM	TVfR	NOMQ	[=HLJ=NMB
PV	h	QR	eÉ	NMMNQNKVSP	éé Ä	MfO	PMUOTSTQHSO	NMMMMM	TVfR	NOMQ	
QM	`~	QR	eO	NVPPTTKNOO	éé Ä	NKN	PSOVSUVRMKNR	NMMMMM	TVfR	NOMQ	
RN	s	UV	eÉ	OMKVNV	éé Ä	NHP	UTUVQKOO	OM	TVfR	NOMQ	
RO	`ê	UV	eÉ	OOKTSP	éé Ä	MfS	NONPRSKOT	OO	TVfR	NOMQ	
RR	j å	UV	eÉ	OMKQRM	éé Ä	MfS	RROSSKTR	OM	TVfR	NOMQ	
RS	cÉ	UV	eO	VVVUVHPQT	éé Ä	OKN	NOPPPURQONKTT	NMMMMM	TVfR	NOMQ	
RV	`ç	UV	eÉ	OMKUNQ	éé Ä	NKU	NVMUSTKOU	OM	TVfR	NOMQ	
SM	ká	UV	eÉ	OMKVMM	éé Ä	OHP	RPSOVKNU	OM	TVfR	NOMQ	
SP	`ì	UV	eÉ	OMKQQS	éé Ä	NHT	NQQVSPHSO	OM	TVfR	NOMQ	
SS	wå	UV	eÉ	OMKQMS	éé Ä	PHM	ORQMNKNU	ONKQ	TVfR	NOMQ	
TR	^ë	UV	eÉ	OMKUVO	éé Ä	MHT	NVMNUfSM	OM	TVfR	NOMQ	
TU	pÉ	UV	eO	NVHTNR	éé Ä	MHT	VVNVKVM	OM	TVfR	NOMQ	
UU	pê	UV	eÉ	OOKMVN	éé Ä	MfS	TNRSPKQU	OMKV	TVfR	NOMQ	
VR	j ç	UV	eÉ	OOQMHTPV	éé Ä	MfS	SVPOUTTKQT	OMMM	TVfR	NOMQ	
NMT	^Ö	UV	eÉ	OMKORU	éé Ä	NKN	OOPQRSKNR	OM	TVfR	NOMQ	
NNN	`Ç	UV	eÉ	OMKUPT	éé Ä	NKM	PNQTNKOP	OM	TVfR	NOMQ	
NNU	på	NRV	eÉ	NVKVTO	éé Ä	MfP	SOUNRKUT	OM	TVfR	NOMQ	
NON	pÄ	NRV	kç=d~ë	NVKVOV	éé Ä	NHR	QPUPRVHRS	OM	TVfR	NOMQ	
NPT	_~	NRV	kç=d~ë	OMHTQR	éé Ä	MfS	NPMSSTKMT	OM	TVfR	NOMQ	
NUO	t	NRV	kç=d~ë	OOKSPV	éé Ä	NHS	OUSOUSKPQ	OM	TVfR	NOMQ	
OMR	qä	OMV	kç=d~ë	OMKVRQ	éé Ä	MfN	RPTVROKPS	OM	TVfR	NOMQ	
OMU	mÄ	OMV	kç=d~ë	OMKPTQ	éé Ä	MfR	TRTMUORTS	OM	TVfR	NOMQ	
OPO	qÜ	OMV	kç=d~ë	ONKSRN	éé Ä	MKU	SVUVVRKNR	OM	TVfR	NOMQ	
OPU	r	OMV	kç=d~ë	ONKNSS	éé Ä	MfS	SPUORMKSP	OM	TVfR	NOMQ	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eáÖÜ	n`=c ä~Ö
iá	S	kç=d~ë	OMTNOMQKPN	MKQ	OTRVPMMKUR	TRMVS	RVfR	NOMQ	
pÅ	QR	kç=d~ë	QORRQQUKOT	MfR	SMQUSNNKO	TMfPR	RVfR	NOMQ	
pÅ	QR	eO	NVNOSSPKMN	NKU	NRQUORRKRV	SSKOS	RVfR	NOMQ	
pÅ	QR	eÉ	NRMUNUfPN	NKU	OPPVRPKQR	SQKQT	RVfR	NOMQ	
dÉ	TO	kç=d~ë	NMOUSMUKOM	NKN	NQNOURSKNU	TOKU	RVfR	NOMQ	
dÉ	TO	eO	PVTMUQKUQ	MHT	SMTRNTKON	SRHPS	RVfR	NOMQ	
dÉ	TO	eÉ	NNSOONHPQ	MfR	NTUUOVKVT	SQKVV	RVfR	NOMQ	
v	UV	eO	QQUTPTUKVO	MfS	SRRTRURKQP	SUKQP	RVfR	NOMQ	
v	UV	eÉ	TVOSNRKMN	NKQ	NOSROOTKVR	SOHSR	RVfR	NOMQ	
qÄ	NRV	kç=d~ë	SQTVQTTHRS	MKV	UQQSUONKNN	TSHTN	RVfR	NOMQ	
qÄ	NRV	eÉ	OUPRUUVHRO	NKN	ONMSRTOKVO	SVHMS	RVfR	NOMQ	
_á	OMV	kç=d~ë	PONUVQPKVM	NKO	PUSSRTUHPV	UPHOR	RVfR	NOMQ	
_á	OMV	eÉ	NRRSQONKVS	MHP	OPPPTRQHRV	SSHSV	RVfR	NOMQ	

ïæåÉ~ê¤o~åÖÉ¤p~ã éäÉ¤Ei opF¤oÉéçã

p~ã éäÉ¤k~ã É	i opN
cäÉ¤k~ã É	MNPj i opKÇ
a~í~¤m~íÜ¤k~ã É	aWy^ÖäÉáíyf^ mj eyNya^q^yOMOPyMPJ ^o yi n` ON^kÅ
^Åè¤qãä É	PLONLOMOP¤NRVQMQQ
p~ã éäÉ¤qóéÉ	i op
qçí~äaãä íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa¤oÉÑcäÉk~ã É	MVS^ i _KÇ
p~ã éäÉ¤n` ¤m~ëëlcá~ä	c~ää
fpqa¤n` ¤m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áã**

n` =^å~äöíÉ¤q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¾ mp==	bñés~ä	B oÉÅ	B i çï	B eäÖÜ	n` ¤c ä~Ö
V	_É	S	k ç¤d ~ë	VRKTNM	éëÄ	NKO	RUPOOPKNS	NMM	VRKTN	UVfR	NNMQ	
NN	_	S	k ç¤d ~ë	RNSKUUS	éëÄ	NKM	OMOSVTMQT	RMM	NMPKPU	UVfR	NNMQ	
RN	s	UV	e É	NMRTKMN	éëÄ	MO	QQOSNOQKQO	NMMM	NMRKTO	UVfR	NNMQ	
RO	` ê	UV	e É	ONOMKMU	éëÄ	MKV	NNOPQUNPKRU	OMMM	NMSKMN	UVfR	NNMQ	
RR	j å	UV	e É	OMSMOMN	éëÄ	NKN	RRQRRNVMST	OMMM	NMPKMN	UVfR	NNMQ	
RV	` ç	UV	e É	NMTTKMP	éëÄ	MKT	VURQSQSKOQ	NMMM	NMTKT	UVfR	NNMQ	
SM	k á	UV	e É	NNNOKNOP	éëÄ	MKS	OUQQVRQKPM	NMMM	NNNKON	UVfR	NNMQ	[¤HLJ¤NMB
SP	` ì	UV	e É	ONVSKONN	éëÄ	MKV	NRQTPSNUKPU	OMMM	NMVKUN	UVfR	NNMQ	
SS	wå	UV	e É	ONRMfRNR	éëÄ	MKS	ORTMNQUKRO	OMMM	NMTKRP	UVfR	NNMQ	
TR	^ë	UV	e É	NMQRfRVP	éëÄ	MKP	VQVUSUfRU	NMMM	NMQKRS	UVfR	NNMQ	
TU	pÉ	UV	e O	NMMUKOSQ	éëÄ	MKT	RNNUUQKQM	NMMM	NMMKUP	UVfR	NNMQ	
UU	pê	UV	e É	OMTMKOOU	éëÄ	MKR	SSVRMSTKNO	OMMM	NMPKRN	UVfR	NNMQ	
VR	j ç	UV	e É	NNPPKMPO	éëÄ	NKM	PRMNMRSKNP	NMMM	NNPKP	UVfR	NNMQ	[¤HLJ¤NMB
NMT	^Ö	UV	e É	NNPKTTQ	éëÄ	MKU	NORPPNVKVP	NMM	NNPKTT	UVfR	NNMQ	[¤HLJ¤NMB
NNN	` Ç	UV	e É	NNORKQQR	éëÄ	OKR	NSVTRMUKSR	NMMM	NNOKRQ	UVfR	NNMQ	[¤HLJ¤NMB
NNU	på	NRV	e É	VUQKUTP	éëÄ	OKO	PNTMQSNKOT	NMMM	VUKQV	UVfR	NNMQ	
NON	pÄ	NRV	k ç¤d ~ë	VSUKSMT	éëÄ	MKS	OPPNMRUOKOS	NMMM	VSKUS	UVfR	NNMQ	
NPT	_~	NRV	k ç¤d ~ë	OMNMSVN	éëÄ	MKR	NPURNNOUKQS	OMMM	NMMKRP	UVfR	NNMQ	
NUO	t	NRV	k ç¤d ~ë	NMPSKMUN	éëÄ	MKT	NQPMVPRQKSU	NMMM	NMPKSO	UVfR	NNMQ	
OMR	qä	OMV	k ç¤d ~ë	NMPMKUPM	éëÄ	OKO	PMUVPTRMKNS	NMMM	NMPKMU	UVfR	NNMQ	
OMU	mÄ	OMV	k ç¤d ~ë	OMQMSOM	éëÄ	NKT	UQSQNONNKNQ	OMMM	NMOKMP	UVfR	NNMQ	
OPO	qÜ	OMV	k ç¤d ~ë	NMNTKUPS	éëÄ	NKM	PSSROTUPKNS	NMMM	NMNKTU	UVfR	NNMQ	
OPU	r	OMV	k ç¤d ~ë	NMOVKOUS	éëÄ	NKP	PQTMRPQQKNO	NMMM	NMOKVP	UVfR	NNMQ	

n` =fpqa¤q~ÄäÉ

k~ã É	j ~ëë	qì åÉ¤j çÇÉ	` mp	` mp¤o pa	oÉÑ¤ mp	B ¤o ÉÅ	B n` =¤ çï	B n` ¤c äÖÜ	n` ¤c ä~Ö
i á	S	k ç¤d ~ë	ONTPTRSKNR	MKU	OTRVPMMKUR	TUKTU	RVfR	NOMQ	
pÅ	QR	k ç¤d ~ë	QOVNMOVKVQ	MKV	SMQUSNNKO	TMKVQ	RVfR	NOMQ	
d É	TO	k ç¤d ~ë	NMPRTVQKVM	MKO	NQNOURSKNU	TPHPN	RVfR	NOMQ	
qÄ	NRV	k ç¤d ~ë	TMVPVPUKVU	MKR	UQQSUONKNN	UPKVU	RVfR	NOMQ	
_á	OMV	k ç¤d ~ë	PRVVOVUKRS	MKR	PUSSRTUKPV	VPHMV	RVfR	NOMQ	
pÅ	QR	e O	VVPMITVKQS	NKM	NRQUORRKRV	SQKVU	RVfR	NOMQ	
d É	TO	e O	PVSUPSKSM	MKR	SMTRNTKON	SRHPO	RVfR	NOMQ	
v	UV	e O	QROUUQNKON	NKQ	SRRTRURKQP	SVHMS	RVfR	NOMQ	
pÅ	QR	e É	NQSMVQKQN	NKP	OPPVRPKQR	SOKQN	RVfR	NOMQ	
d É	TO	e É	NNRMITMKNS	MKT	NTUUOVKVT	SQHPR	RVfR	NOMQ	
v	UV	e É	TVNRQOKNV	MKS	NOSROOTKVR	SOKRS	RVfR	NOMQ	
qÄ	NRV	e É	OVPQTONKVQ	NKS	QNMSRTOKVO	TNKQS	RVfR	NOMQ	
_á	OMV	e É	NTOVUSMOQQ	NKV	OPPPTRQKRV	TQKNO	RVfR	NOMQ	

p~ã éäÉ=k~ã É i o p O

cãÉ=k~ã É MNQ p j m i K Ç

a~í~=m~íÜ=k~ã É a \ y t Ö ä É å í y f ` m j e y N y a ^ q ^ y O M C P y M P J ^ o y j n ` C N ^ K Å

^Åè=qãã É P L C N L C M C P = N S M N M N S

p~ã éäÉ=qóéÉ p ~ ã é ä É

qçí~äaãã íáçå N M M M M

p~ã éäÉ=n` =m~ëëlc á~ä c ~ ã ä

fpqa=n` =m~ëëlc~ãä m ~ ë ë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k ~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==́ mp==	iao	n` =c ä~Ö
V	_É	S	k ç=d ~ë	MMVCM	éé Ä	VKO	PVUKVM	NMM	
NN	_	S	k ç=d ~ë	PKCSU	éé Ä	MKU	NQMNUKNP	NMMM	
CP	k ~	CR	e É	CMNPVNKNCR	éé Ä	CKP	NPPNQMQNRKTO	CMMMMM	[i a o
CQ	j Ö	CR	e É	CMCRUMKMNS	éé Ä	CKM	TNRUPMVCKUO	CMMMMM	[i a o
CT	^ ä	CR	e É	CNNPNTKRSQ	éé Ä	CKM	CUVSVMVCKRT	CMMMMM	[i a o
CU	p á	CR	e O	NVCPUKCVR	éé Ä	NKT	QVVURSSKQN	NMMMM	[i a o
PV	h	CR	e É	NVRQTVMPVT	éé Ä	MKU	SNRMPSTQKCO	CMMMMM	
QM	` ~	CR	e O	NVSSOVMVRM	éé Ä	NKM	SVOSTMNPSHPQ	CMMMMM	
RN	s	UV	e É	MKPRV	éé Ä	PKT	NTPNKCR	NMMM	
RO	` ê	UV	e É	NKOVM	éé Ä	QKR	TRMQKRT	CMMM	
RR	j å	UV	e É	NKUVP	éé Ä	PKV	RPNNHPP	CMMM	
RS	c É	UV	e O	VRVTQKNCP	éé Ä	NKV	NNSVCMPMUNKVM	NMMMMM	
RV	` ç	UV	e É	NHSPP	éé Ä	MKU	NRPQMKMM	NMMM	
SM	k á	UV	e É	NKCMR	éé Ä	RKR	PCOTHMM	NMMM	
SP	` ì	UV	e É	NKOTS	éé Ä	PKR	VURCKRR	CMMM	
SS	w å	UV	e É	SKVSO	éé Ä	RKN	VCPQKCP	CMMM	
TR	^ ë	UV	e É	MKRTT	éé Ä	UKU	RCRKCM	NMMM	
TU	p É	UV	e O	MKRUV	éé Ä	QKV	OVCKUO	NMMM	
UU	p ê	UV	e É	PKCMV	éé Ä	CKM	NVRQMKUV	CMMM	
VR	j ç	UV	e É	CKMTS	éé Ä	CKV	SRRVKQS	NMMM	
NMT	^ Ö	UV	e É	MKMSN	éé Ä	RKO	SVNKNQ	NMM	
NNN	` Ç	UV	e É	MKPSV	éé Ä	RKT	RSRHRT	NMMM	
NNU	p å	NRV	e É	MKRSO	éé Ä	UKT	CQRCKQV	NMMM	
NCN	p Ä	NRV	k ç=d ~ë	MKRPN	éé Ä	NKM	NCQTVMKV	NMMM	
NPT	_ ~	NRV	k ç=d ~ë	NKCRQ	éé Ä	NKV	VSRSKVQ	CMMM	
NUO	t	NRV	k ç=d ~ë	NKTCP	éé Ä	PKT	CPPTRKRU	NMMM	
OMR	q ä	OMV	k ç=d ~ë	MKRUN	éé Ä	CKN	NSPSNKCM	NMMM	
OMU	m Ä	OMV	k ç=d ~ë	NKTNR	éé Ä	CKT	SSPCMKTN	CMMM	
OPO	q Ü	OMV	k ç=d ~ë	MKVTT	éé Ä	PKU	PPVPUKCV	NMMM	
OPU	r	OMV	k ç=d ~ë	MKQUO	éé Ä	CKM	NQUUQKTN	NMMM	

n` =fpqa=q~ÄäÉ

k ~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÅ	B n` =ï çï	B n` =eåÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	CNRTMRSKMQ	MKN	OTRVPMMKUR	TUKNT	RVHR	NCMCQ	
p Å	CR	k ç=d ~ë	CNSSRVMKST	NKM	SMQUSNNKO	SUKUV	RVHR	NCMCQ	
p Å	CR	e O	NMNRVMMKQS	MKO	NRCUCRRHRV	SSKQT	RVHR	NCMCQ	
p Å	CR	e É	NRQNVCKVQ	NHS	CPPVRPKQR	SRKVN	RVHR	NCMCQ	
d É	TO	k ç=d ~ë	NMMOTPNHRT	NKM	NQNCURSKNU	TMKVT	RVHR	NCMCQ	
d É	TO	e O	PVTPSNKVQ	NKM	SMTRNTKCN	SRKQN	RVHR	NCMCQ	
d É	TO	e É	NNVMCSKVM	NKM	NTUUCVKVT	SSHRT	RVHR	NCMCQ	
v	UV	e O	QQPCONUKRU	NHP	SRRTRURKQP	STHRV	RVHR	NCMCQ	
v	UV	e É	UMCCVUKPV	NKV	NCSRCOTKVR	SPKQN	RVHR	NCMCQ	
q Ä	NRV	k ç=d ~ë	STPMVSQKVO	NKQ	UQQSUCNKNN	TVHSV	RVHR	NCMCQ	
q Ä	NRV	e É	CUPTTCNHSN	NHP	QNMSRTCKVO	SVHN	RVHR	NCMCQ	
_ á	OMV	k ç=d ~ë	PCUTTSUKNP	MKQ	PUSSRTUHPV	URHMP	RVHR	NCMCQ	
_ á	OMV	e É	NRCSRURKTM	MKV	CPPPTRQKRV	SRKQN	RVHR	NCMCQ	

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É ofkpb

cãÉ=k~ã É MNRpj mi kÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` CN^kA

^Åè=qãã É PLCNLCMCP=NSMNCMRQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå NKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä c~åä

fpqa=n` =m~ëëlc~åä c~åä

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==mp==	iao	n` =cä~Ö
V	_É	S	kç=d ~ë	UKMTO	éé Ä	NMKP	NVNKNO	NMM	
NN	_	S	kç=d ~ë	CNUKCUO	éé Ä	CKM	PPRCKSU	NMMM	
CP	k~	CR	eÉ	NNPSPMK/PP	éé Ä	SKV	VNCSSKVT	CMMMMM	
CQ	j Ö	CR	eÉ	CV/PSPKCCS	éé Ä	CKS	CNCNCKTP	CMMMMM	
CT	^ä	CR	eÉ	RMSRQKNUV	éé Ä	CKU	UCRUKCQ	CMMMMM	
CU	pá	CR	eO	CV/UTKQMR	éé Ä	NMKP	PNMPKSO	NMMMM	
PV	h	CR	eÉ	NCTNRSKQMU	éé Ä	QKV	CLUSCLUKTM	CMMMMM	
QM	` ~	CR	eO	QRSRMKPQN	éé Ä	NKU	CMVNCLUKPV	CMMMMM	
RN	s	UV	eÉ	PCTKPUQ	éé Ä	NUKR	RTQKQT	NMMM	
RO	` ê	UV	eÉ	NPVQKRPS	éé Ä	TKM	PMVPKTR	CMMM	
RR	j å	UV	eÉ	RCRKCUS	éé Ä	SKP	RVPKCP	CMMM	
RS	cÉ	UV	eO	USVRRKVQP	éé Ä	NKO	PVUCMCKMS	NMMMMM	
RV	` ç	UV	eÉ	NPTKTRV	éé Ä	NMKS	RCUKVN	NMMM	
SM	ká	UV	eÉ	CRRKMTQ	éé Ä	SKP	OTPKPQ	NMMM	
SP	` ì	UV	eÉ	SCPKCVM	éé Ä	QKS	NUQNKOT	CMMM	
SS	wå	UV	eÉ	TCQVKMQM	éé Ä	UKM	PSCCKTS	CMMM	[i a o
TR	^ë	UV	eÉ	PPTKPTT	éé Ä	SKM	NCUKPQ	NMMM	
TU	pÉ	UV	eO	PCPKMTR	éé Ä	SKM	SMKPP	NMMM	
UU	pê	UV	eÉ	NVNKPCP	éé Ä	CPKR	CRUKVM	CMMM	
VR	j ç	UV	eÉ	NSVMKQMT	éé Ä	VKS	CNUCKST	NMMM	[i a o
NMT	^Ö	UV	eÉ	NNKSPP	éé Ä	CNKU	RCKQQ	NMM	
NNN	` Ç	UV	eÉ	SRKTUV	éé Ä	NSKS	CNKUR	NMMM	
NNU	på	NRV	eÉ	CMCVKRRV	éé Ä	UKO	COVCKQS	NMMM	[i a o
NCN	pÄ	NRV	kç=d ~ë	CCUKNSV	éé Ä	PKV	NUVUKUM	NMMM	
NPT	_~	NRV	kç=d ~ë	NCPSKTNO	éé Ä	UKO	OVCPKQQ	CMMM	
NUO	t	NRV	kç=d ~ë	NUTRKVQS	éé Ä	SKN	UVCRKUQ	NMMM	[i a o
OMR	qä	OMV	kç=d ~ë	NQQKMMV	éé Ä	CKM	OVMMKMT	NMMM	
OMU	mÄ	OMV	kç=d ~ë	NRPKVCP	éé Ä	NMKM	QCTNKQV	CMMM	
OPO	qÜ	OMV	kç=d ~ë	NUUKCSR	éé Ä	SKS	CRQCKPP	NMMM	
OPU	r	OMV	kç=d ~ë	QRKSCM	éé Ä	TKP	NVPNKNQ	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=opa	oÉÑ=mp	B=oÉÅ	Bn` =içï	Bn` =eáÜÜ	n` =cä~Ö
iá	S	kç=d ~ë	UQCQKRP	MKS	OTRVPMMKUR	MKPN	RVKR	NCMKQ	SMCMa ça
pÅ	CR	kç=d ~ë	STTQKVV	PKQ	SMCUSNNKO	MKNN	RVKR	NCMKQ	SMCMa ça
pÅ	CR	eO	NPCNKNQ	NKR	NRCUCRRKRV	MKMV	RVKR	NCMKQ	SMCMa ça
pÅ	CR	eÉ	NUTKVT	UKP	CPPVRPKQR	MKMU	RVKR	NCMKQ	SMCMa ça& eáÜÜ=fpqa=opa
dÉ	TO	kç=d ~ë	PUVNKNQ	MKV	NQNCURSKNU	MKCU	RVKR	NCMKQ	SMCMa ça
dÉ	TO	eO	PRRKVQ	NMKN	SMTRNTKQN	MKMS	RVKR	NCMKQ	SMCMa ça& eáÜÜ=fpqa=opa
dÉ	TO	eÉ	VRKVU	NPKT	NTUUCVKVT	MKMR	RVKR	NCMKQ	SMCMa ça& eáÜÜ=fpqa=opa
v	UV	eO	NSSRKTV	MKO	SRRTRURKCP	MKMP	RVKR	NCMKQ	SMCMa ça
v	UV	eÉ	PPCKSN	UKT	NCSRCOTKVR	MKMP	RVKR	NCMKQ	SMCMa ça& eáÜÜ=fpqa=opa
qÄ	NRV	kç=d ~ë	CQRNKTT	CKP	UCQSUCNKNN	MKMP	RVKR	NCMKQ	SMCMa ça
qÄ	NRV	eÉ	NVPRKUR	NVKU	QNVSRTCKVO	MKMP	RVKR	NCMKQ	SMCMa ça& eáÜÜ=fpqa=opa
_á	OMV	kç=d ~ë	CQNSKQQ	RKT	PUSSRTUKPV	MKMS	RVKR	NCMKQ	SMCMa ça
_á	OMV	eÉ	NPTNKUO	PKR	CPPPTRQKRV	MKMS	RVKR	NCMKQ	SMCMa ça

p~ã éäÉ=k~ã É ofk pb

cãÉ=k~ã É MNSpj mi kÇ

a~í~=m~íÜ=k~ã É aWyÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` ON^kÅ

^Åè=qãã É PLONLOMCP=NSMUMW

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå NKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä c~ãä

fpqa=n` =m~ëëlc~ãä c~ãä

n` =^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =cä~Ö
V	_É	S	k ç=d ~ë	RKVOT	éé Ä	NUKM	NNNKNN	NMM	
NN	_	S	k ç=d ~ë	COVKSVN	éé Ä	PKO	OTVPKSR	NMMM	
OP	k ~	QR	e É	NCQSCQKMUO	éé Ä	NNKR	SURSSKNQ	OMMMMM	
OQ	j Ö	QR	e É	PPVRPKPRM	éé Ä	NOKM	VVTVKRQ	OMMMMM	
OT	^ ä	QR	e É	QNTPVKTVU	éé Ä	NNKR	QTSMKUV	OMMMMM	
OU	pá	QR	e O	QSPTKPPV	éé Ä	PKU	OPQOKSV	NMMMM	
PV	h	QR	e É	NQUPTRKTTQ	éé Ä	NMKR	PUUSSKNQ	OMMMMM	
QM	` ~	QR	e O	PMPPMKMPT	éé Ä	PKV	NNOSSRKOQ	OMMMMM	
RN	s	UV	e É	SMQKSMQ	éé Ä	OPKT	QUOKOQ	NMMM	
RO	` ê	UV	e É	POMRKPOS	éé Ä	OUKM	POMPKTS	OMMM	[i a o
RR	j å	UV	e É	NNQMQNN	éé Ä	OSKT	RUNKVM	OMMM	
RS	cÉ	UV	e O	NPVMMOKTPR	éé Ä	UKQ	PNRQUTKTO	NMMMMM	[i a o
RV	` ç	UV	e É	NQTKTOR	éé Ä	QOKU	OQSKSU	NMMM	
SM	k á	UV	e É	RMSKNOM	éé Ä	ORKV	OQTKTV	NMMM	
SP	` ì	UV	e É	NNRUKSNP	éé Ä	ORKT	NRQTKUV	OMMM	
SS	wå	UV	e É	UMURKSUO	éé Ä	OTKU	NUOPKQV	OMMM	[i a o
TR	^ ë	UV	e É	RMUKOOP	éé Ä	OUKV	UTKMN	NMMM	
TU	pÉ	UV	e O	QOQKVTU	éé Ä	NTKP	PVKNT	NMMM	
UU	pê	UV	e É	OSVKMVV	éé Ä	PPKS	NSPKPQ	OMMM	
VR	j ç	UV	e É	OUSOKUPS	éé Ä	OQKR	NSUOKPS	NMMM	[i a o
NMT	^ Ö	UV	e É	NSKSNS	éé Ä	QRKR	PSKST	NMM	
NNN	` Ç	UV	e É	VMKOUV	éé Ä	OUKN	ORKVP	NMMM	
NNU	på	NRV	e É	PUOTKUNU	éé Ä	TKQ	OOORKTU	NMMM	[i a o
NON	pÄ	NRV	k ç=d ~ë	POQKQSS	éé Ä	PKP	NPPUKNQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	PQTKVSM	éé Ä	VKN	QNMKQQ	OMMM	
NUO	t	NRV	k ç=d ~ë	OUMOKPTO	éé Ä	UKT	SSONKVV	NMMM	[i a o
OMR	qä	OMV	k ç=d ~ë	NPVKQMS	éé Ä	RKO	NTOUKSN	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NRNKQVT	éé Ä	NMKM	ORVSKOM	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	ONOKOMP	éé Ä	OKV	PNSTKNN	NMMM	
OPU	r	OMV	k ç=d ~ë	PTKRVP	éé Ä	SKR	ROPKVM	NMMM	

n` =fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B¤éÉÅ	B n` =¡çï	B n` =¤ëÜÜ	n` =cä~Ö
i á	S	k ç=d ~ë	SSTPKSR	OKM	OTRVPMMKUR	MKOQ	RVKR	NOMKQ	SMOMa ça
pÅ	QR	k ç=d ~ë	RSMRKPU	NKP	SMQUSNNKO	MKW	RVKR	NOMKQ	SMOMa ça
pÅ	QR	e O	NMTOKRM	RKR	NROUORRKRV	MKMT	RVKR	NOMKQ	SMOMa ça
pÅ	QR	e É	NOVKPN	NMKR	OPPVRPKQR	MKMS	RVKR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=¤pa
d É	TO	k ç=d ~ë	PTQPKTV	PKV	NQNOURSKNU	MKOS	RVKR	NOMKQ	SMOMa ça
d É	TO	e O	OQOKSO	VKN	SMTRNTKON	MKMQ	RVKR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=¤pa
d É	TO	e É	QTKPO	VKU	NTUUOVKVT	MKMP	RVKR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=¤pa
v	UV	e O	UOTKUT	SKN	SRRTRURKQP	MKMN	RVKR	NOMKQ	SMOMa ça
v	UV	e É	NRUKSQ	PNKR	NOSROOTKVR	MKMN	RVKR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=¤pa
qÄ	NRV	k ç=d ~ë	NONRKNS	OKV	UQQSUONKNN	MKMN	RVKR	NOMKQ	SMOMa ça
qÄ	NRV	e É	RPNKVN	UKN	QNMSRTOKVO	MKMN	RVKR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=¤pa
_á	OMV	k ç=d ~ë	NQVMKQT	QKR	PUSSRTUKPV	MKMQ	RVKR	NOMKQ	SMOMa ça
_á	OMV	e É	UTOKRQ	UKU	OPPPTRQKRV	MKMQ	RVKR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=¤pa

`çåíáåìåÖ=~äÄê~íáç=sÉêëÑÅ~íáç=É``sF=oÉéçê

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MNT]``skÇ
a~í~=m~íÜ=k~ã É	aWj^ÖãÉáíÿ^ mj eyNya^q^yOMOPyMPJ ^oyi n`ON^hÅ
^Åè=qáã É	PLONLOMOP=NSWPWOP
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MVS^i_kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~áä	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c~ä-Ö
V	_É	S	k ç=d ~ë	ORKNRQ	éëÄ	NKN	OMURPNKRQ	CR	NMMSO	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OQKVNN	éëÄ	MKR	NPRSRTKRQ	CR	VVKSQ	UVKU	NNMO	
OP	k ~	QR	e É	RQTUKOQS	éëÄ	NKP	QTTUTTSKMR	RMMM	NMVKRS	UVKU	NNMO	
OQ	j Ö	QR	e É	RQRUKUSO	éëÄ	MKR	ORQOMOPKRV	RMMM	NMVKNU	UVKU	NNMO	
OT	^ä	QR	e É	RQUKNPR	éëÄ	MKU	VRPTTKNP	RMM	NMRKSP	UVKU	NNMO	
OU	pá	QR	e O	RMNKNOM	éëÄ	MKU	POOOVOKNU	RMM	NMMKOO	UVKU	NNMO	
PV	h	QR	e É	RNVMKOUN	éëÄ	NKR	ONSMTONKUU	RMMM	NMPKUN	UVKU	NNMO	
QM	` ~	QR	e O	RMNUKOSO	éëÄ	MKV	OPSSMNRQKVO	RMMM	NMMKPT	UVKU	NNMO	
RN	s	UV	e É	ORKSQR	éëÄ	NKU	NQTSTRKQQ	CR	NMOKRU	UVKU	NNMO	
RO	` ê	UV	e É	ORKVTP	éëÄ	MKQ	NUVTRSKRO	CR	NMPKUV	UVKU	NNMO	
RR	j å	UV	e É	ORKPQV	éëÄ	MKS	VPUUTKRR	CR	NMNKQ	UVKU	NNMO	
RS	cÉ	UV	e O	RMMVKQOT	éëÄ	NKQ	UPTOTNTSKTP	RMMM	NMMKNV	UVKU	NNMO	
RV	` ç	UV	e É	ORKVQT	éëÄ	NKR	POSOMPKMS	CR	NMPKTV	UVKU	NNMO	
SM	k á	UV	e É	ORKURT	éëÄ	MKQ	VMVSQHPS	CR	NMPKQP	UVKU	NNMO	
SP	` ì	UV	e É	OSKPUO	éëÄ	NKV	ORSNTRKTQ	CR	NMRKRP	UVKU	NNMO	
SS	wå	UV	e É	OSKORP	éëÄ	NKN	QQQQSKQM	CR	NMRKMN	UVKU	NNMO	
TR	^ë	UV	e É	ORKSVQ	éëÄ	OKN	POMSOKMV	CR	NMOKTU	UVKU	NNMO	
TU	pÉ	UV	e O	OQKTQN	éëÄ	OKS	NSURQKTN	CR	VUKVS	UVKU	NNMO	
UU	pê	UV	e É	ORKQMP	éëÄ	MKU	NNOUOOKTM	CR	NMNKSN	UVKU	NNMO	
VR	j ç	UV	e É	OSKPQN	éëÄ	OKO	NNNUNSKQQ	CR	NMRKPS	UVKU	NNMO	
NMT	^Ö	UV	e É	OSKSNV	éëÄ	MKV	QMOSNOKST	CR	NMSKQU	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKNMR	éëÄ	NKP	RQMRTKUN	CR	NMQKQO	UVKU	NNMO	
NNU	på	NRV	e É	OQKOSP	éëÄ	NKP	NMSVUNKPO	CR	VTKMR	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OPKRPO	éëÄ	NKN	TQVQMOKRU	CR	VQKNP	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	OQKTMN	éëÄ	MKV	OORQOVKMU	CR	VUKU	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKMOP	éëÄ	NKO	QTSPMUKPR	CR	NMQKMV	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKMTS	éëÄ	NKU	VTNMRUKVM	CR	NMMKP	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	ORKOON	éëÄ	NKO	NPROUNVKNM	CR	NMMKUU	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKOTT	éëÄ	NKV	NOOQOUPKVR	CR	NMRKNN	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKQOO	éëÄ	NKP	NNRMSPPKTP	CR	NMRKSV	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ï çï	B n`=eäÜÜ	n`=c~ä-Ö
i á	S	k ç=d ~ë	OVRRMRPHSR	MKU	OTRVPMMKUR	NMTHKV	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	RSVOMSUKOT	MKT	SMQUSNNKO	VQKNN	RVHR	NOMQ	
pÅ	QR	e O	NPRUTOMMMT	MKR	NRQUORRKRV	UUKVN	RVHR	NOMQ	
pÅ	QR	e É	OMNRQQKVS	MKN	OPPVRPKQR	USKNQ	RVHR	NOMQ	
d É	TO	k ç=d ~ë	NPTTRSVKUU	MKU	NQNOURSKNU	VTHR	RVHR	NOMQ	
d É	TO	e O	RPOTQVKTQ	NKQ	SMTRNTKON	UTHSV	RVHR	NOMQ	
d É	TO	e É	NRRNVVKRV	NKO	NTUUOVKVT	USKTV	RVHR	NOMQ	
v	UV	e O	SMTSRMQKPP	NKQ	SRRTRURKQP	VOHSS	RVHR	NOMQ	
v	UV	e É	NMUSUSQKVQ	NKR	NOSROOTKVR	URKV	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	VPUNOVPKTS	MKR	UQQSUONKNN	NNNHMS	RVHR	NOMQ	
qÄ	NRV	e É	PVUPRTSKPS	NKP	QNMSRTOKVO	VT	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	QSQUNPPKRR	NKO	PUSSRTUKPV	NOMOON	RVHR	NOMQ	
_á	OMV	e É	OPOVQVOKTP	NKS	OPPPTRQKRV	VVKUO	RVHR	NOMQ	

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MNUJ``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`ON^kÂ

^Åè=qáã É PLONLOMOP=NSWPPMS

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáç~å NKMMMM

`çã ã Éåí JJJ

fpqa=oÉÑc äÉk~ã É MVS^i_KÇ

p~ã éáÉ=n`=m~ëëlc á~ä m~ëë

fpqa=n`=m~ëëlc~áä m~ëë

l éÉê~íçê **~Çã áä**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÄK	r åáë	opa	==\ mp==	i ãäá	n`=c ä~Ö
V	_É	S	k ç=d ~ë	MKMMN	éé Ä	OUMR	NUTKTU	MO	
NN	_	S	k ç=d ~ë	MKNUS	éé Ä	NOKS	COOSKUV	Q	
OP	k~	QR	e É	NTKVUN	éé Ä	NQKM	RMMQUKSR	OMM	
OQ	j Ö	QR	e É	RKSVS	éé Ä	QKO	CRQQKTT	OM	
OT	^ä	QR	e É	MKQQU	éé Ä	SMR	STNKNQ	OM	
OU	pá	QR	e O	MKUUO	éé Ä	NTOKP	NOMNKPO	NMM	
PV	h	QR	e É	PMKNSN	éé Ä	NQKT	POPVUKMR	OMM	
QM	`~	QR	e O	SKSPO	éé Ä	OKM	PVVNMKN	OM	
RN	s	UV	e É	MKUNS	éé Ä	UKR	PMSKSU	N	
RO	`ê	UV	e É	MKMRQ	éé Ä	NTKT	VSQKRO	N	
RR	j å	UV	e É	MKUNQ	éé Ä	PVKT	OMUKSP	MQ	
RS	cÉ	UV	e O	OKTUP	éé Ä	SKM	UUMNTKUO	OM	
RV	` ç	UV	e É	JMKMMN	éé Ä	k L^	NVTKTV	MO	
SM	k á	UV	e É	MKMOP	éé Ä	NRKM	NUPKPQ	MQ	
SP	` ì	UV	e É	MKMON	éé Ä	OMP	VVQKRM	MS	
SS	wå	UV	e É	JMKNTO	éé Ä	k L^	UUTKUO	O	
TR	^ë	UV	e É	MKMQQ	éé Ä	NSKN	SMKSU	N	
TU	pÉ	UV	e O	MKURS	éé Ä	NVKU	PQKPP	N	
UU	pê	UV	e É	MKMOM	éé Ä	NMKN	VTKTU	N	
VR	j ç	UV	e É	MKOUN	éé Ä	OKN	NMQQKOU	N	
NMT	^Ö	UV	e É	MKUNT	éé Ä	NKU	CPOKCP	MO	
NNN	` Ç	UV	e É	MKUNS	éé Ä	VKT	OVKOS	MO	
NNU	på	NRV	e É	JMKMOO	éé Ä	k L^	TOTKUN	N	
NON	pÄ	NRV	k ç=d ~ë	MKMOU	éé Ä	SKP	NNPNKQQ	MO	
NPT	_~	NRV	k ç=d ~ë	MKUNT	éé Ä	RNKQ	PMMKPO	MQ	
NUO	t	NRV	k ç=d ~ë	MKOSO	éé Ä	OKP	QUMRKVV	N	
OMR	qä	OMV	k ç=d ~ë	MKURU	éé Ä	RKO	CPTSKMS	MO	
OMU	mÄ	OMV	k ç=d ~ë	MKUMS	éé Ä	OVKM	NURCKUN	MO	
OPO	qÜ	OMV	k ç=d ~ë	MKUQN	éé Ä	RKM	PTPQKRO	N	
OPU	r	OMV	k ç=d ~ë	MKMOM	éé Ä	NQKO	TSMKUP	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=ç ïï	B n`=cåÜÜ	n`=c ä~Ö
i á	S	k ç=d ~ë	CRMTQNMKUS	NKQ	OTRVPMMKUR	VMKUT	RVMR	NOMQ	
pÅ	QR	k ç=d ~ë	QTCUUMNKUP	NKN	SMQUSNNKO	TUKNU	RVMR	NOMQ	
pÅ	QR	e O	NNNTMTUKMP	MKR	NRCUCRRKRV	TPKMV	RVMR	NOMQ	
pÅ	QR	e É	NSRCUOKSM	NKQ	OPPVRPKQR	TMKSR	RVMR	NOMQ	
d É	TO	k ç=d ~ë	NNRQMPQKRT	MKV	NQNCURSKNU	UNKSU	RVMR	NOMQ	
d É	TO	e O	QQQQNOKNO	MKT	SMTRNTKQN	TPKNR	RVMR	NOMQ	
d É	TO	e É	NOVQSPKNU	MKR	NTUUOVKVT	TOKPV	RVMR	NOMQ	
v	UV	e O	RMTRTPVKSM	MKS	SRRTRURKQP	TTKQ	RVMR	NOMQ	
v	UV	e É	UVMQCSKVR	MKS	NOSRCOTKVR	TMKPU	RVMR	NOMQ	
qÄ	NRV	k ç=d ~ë	TSQTNPSKNR	MKS	UQQSUCNKNN	VMKRP	RVMR	NOMQ	
qÄ	NRV	e É	POTCUPVKUT	NKR	QNMSRTCKVO	TVKT	RVMR	NOMQ	
_á	OMV	k ç=d ~ë	PUTCMPSKRV	MKU	PUSSRTUKPV	NMMKNQ	RVMR	NOMQ	
_á	OMV	e É	NVPRVTQKUR	NKO	CPPPTRQKRV	UCKVS	RVMR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` NQfj pN
cáÉ=k~ã É	MNV| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJj ^oyin` ON^kÄ
^Åè=qáã É	PLONLOMOP=NSVPUVOQ
p~ã éäÉ=qóéÉ	m_
qçí~ä=aáäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iáã á	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMPT	ééÄ	kL^	NNNKNO	MKR	
_	NN	S	kç=d~ë	NKSMS	ééÄ	VKV	OQUUKMP	NM	
k~	OP	QR	eÉ	NSRKQMS	ééÄ	QKO	RNSTOKON	RMM	
jÖ	OQ	QR	eÉ	POKOSV	ééÄ	OKR	OQMVKNU	RM	
^ä	OT	QR	eÉ	ONKQOO	ééÄ	NRKM	NMROKOU	RM	
pá	OU	QR	eO	VKVRV	ééÄ	NPKQ	NUTRKQQ	ORM	
h	PV	QR	eÉ	OQUKTOT	ééÄ	QKN	PPNTTKTS	RMM	
`~	QM	QR	eO	SRKOMR	ééÄ	MKU	RRMSQKPS	RM	m_=SMOM=c~âë=aça
s	RN	UV	eÉ	MKQON	ééÄ	NMKU	RPUKVN	OKR	
`ê	RO	UV	eÉ	MKTRR	ééÄ	MKU	NPOPKUN	OKR	
jå	RR	UV	eÉ	MKVOR	ééÄ	PKT	SOPKOP	N	
cÉ	RS	UV	eO	OUKRMP	ééÄ	NKU	NNMNTUKRT	RM	
`ç	RV	UV	eÉ	MKMMN	ééÄ	PMSSKU	NUQKQS	MKR	
ká	SM	UV	eÉ	MKROM	ééÄ	ONKS	PRSKSU	N	
`ì	SP	UV	eÉ	MKQRT	ééÄ	TKN	NPPOKPN	NKR	
wå	SS	UV	eÉ	JNKNPU	ééÄ	kL^	SVSKTM	R	
^ë	TR	UV	eÉ	MKOTS	ééÄ	VKN	SNKPQ	OKR	
pÉ	TU	UV	eO	MKOTO	ééÄ	SKU	OUKRM	OKR	
pê	UU	UV	eÉ	MKONQ	ééÄ	NOKP	NRSKST	OKR	
jç	VR	UV	eÉ	NKOTQ	ééÄ	PKV	UNRKSM	OKR	
^Ö	NMT	UV	eÉ	MKMPT	ééÄ	QKQ	VNKNO	MKR	
`Ç	NNN	UV	eÉ	MKMSM	ééÄ	QOKO	NUKRO	MKR	
på	NNU	NRV	eÉ	PTKQSU	ééÄ	MKS	OQQTQKTU	OKR	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKNUO	ééÄ	TKM	NNTTKVS	MKR	
_~	NPT	NRV	kç=d~ë	MKOQS	ééÄ	NQKS	QTPKUQ	N	
t	NUO	NRV	kç=d~ë	NKNVU	ééÄ	QKO	PVPNKQQ	OKR	
qä	OMR	OMV	kç=d~ë	MKNPN	ééÄ	NNKS	NOOUKMO	MKR	
mÄ	OMU	OMV	kç=d~ë	MKQNO	ééÄ	RKP	QTPRKPT	MKR	
qÜ	OPO	OMV	kç=d~ë	MKNQU	ééÄ	OSKT	OVSMKNQ	OKR	
r	OPU	OMV	kç=d~ë	MKMRP	ééÄ	OKR	PUMKQN	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä-Ö
iá	S	kç=dl~ë	ONVRNMMKNT	NKQ	OTRVPMMKUR	TVKRR	RVKR	NOMKQ	
pÅ	QR	kç=dl~ë	QMRVRCPKCR	MKQ	SMQUSNNKO	STKNN	RVKR	NOMKQ	
pÅ	QR	eO	VRMMQPKVO	NKR	NRCUCRRKRV	SOKNT	RVKR	NOMKQ	
pÅ	QR	eÉ	NQMRSTKVO	NKM	OPPVRPKQR	SMKMU	RVKR	NOMKQ	
dÉ	TO	kç=dl~ë	VTTTQVKVS	MKP	NQNCURSKNU	SVKO	RVKR	NOMKQ	
dÉ	TO	eO	PTVSTMKTQ	NKN	SMTRNTKON	SOKR	RVKR	NOMKQ	
dÉ	TO	eÉ	NNMQCSKUN	MKU	NTUUCVKVT	SNKTR	RVKR	NOMKQ	
v	UV	eO	QPQCPVNKMV	MKQ	SRRTRURKCP	SSKCR	RVKR	NOMKQ	
v	UV	eÉ	TSPQTPKSO	NKM	NCSRCOTKVR	SMKPQ	RVKR	NOMKQ	
qÄ	NRV	kç=dl~ë	STPCSRQKMM	MKQ	UCQSUCNKNN	TVKTN	RVKR	NOMKQ	
qÄ	NRV	eÉ	OUVNCPCKTU	NKM	QNMSRTCKVO	TMKQN	RVKR	NOMKQ	
_á	OMV	kç=dl~ë	PQURQPMKPU	MKQ	PUSSRTUKPV	VMKNQ	RVKR	NOMKQ	
_á	OMV	eÉ	NSVURNRKMR	MKV	OPPPTRQKRV	TCKTU	RVKR	NOMKQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` pl n ` NQÍj pN
cáÉ=k~ã É	MOM ` pl kÇ
a~í~=m~íÜ=k~ã É	aWª ÖäÉáíÿ` mj eyNya ^q^ yOMOPyMPJ ^oyi n ` ON^ kÄ
^Åè=qáã É	PLONLOMOP=NSWPMRO
p~ã éäÉ=qóéÉ	i ` pl
qçí~äaäãíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MMS ` ^i _kÇ
p~ã éäÉ=n ` =m~ëëlcá~ä	m~ëë
fpqa=n ` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åä**

n ` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n ` =c~ä-Ö
_É	V	S	k ç=dl ~ë	QVKVQV	ééÄ	NKP	RVSPOKRR	RM	NVKVU	TVKR	NOMQ	
_	NN	S	k ç=dl ~ë	QUVKTQN	ééÄ	MKV	PUMVSPKTV	RMM	NVKRV	TVKR	NOMQ	
k~	OP	QR	e É	UPSRKVNV	ééÄ	OKV	NMQVSRTHSR	TRMM	COKPN	TVKR	NOMQ	
j Ö	OQ	QR	e É	RPMNKNVN	ééÄ	NKU	PQRNNVMSV	RMMM	ONKO	TVKR	NOMQ	
^ä	OT	QR	e É	OMURKORT	ééÄ	MKU	RPNPVKVO	OMMM	OMKUR	TVKR	NOMQ	
pá	QU	QR	e O	UVRKOTO	ééÄ	NKT	UCORTHMO	NMMM	NTKVN	TVKR	NOMQ	
h	PV	QR	e É	VUPMVMQR	ééÄ	MKS	RUUNSRKQT	NMMMM	NVKSS	TVKR	NOMQ	
` ~	QM	QR	e O	ORRTKTTS	ééÄ	MKV	NTOMPNVKON	ORMM	OMKQS	TVKR	NOMQ	
s	RN	UV	e É	RNOKTSR	ééÄ	MKT	QNQVTRKQS	RMM	OMKRN	TVKR	NOMQ	
` ê	RO	UV	e É	OMUKMUR	ééÄ	MKO	ONPSMQKSR	OMM	OMKUN	TVKR	NOMQ	
j å	RR	UV	e É	ROQKSSV	ééÄ	MKS	OTPMONKMN	RMM	OMKVV	TVKR	NOMQ	
cÉ	RS	UV	e O	NMPOKTSS	ééÄ	OKO	ORMMPSNKSU	NMMM	OMKSS	TVKR	NOMQ	
` ç	RV	UV	e É	RPSKTMR	ééÄ	MKS	VQVNMRKTV	RMM	ONKQT	TVKR	NOMQ	
ká	SM	UV	e É	RPTKRRP	ééÄ	NKM	OSRTUVKVT	RMM	ONKR	TVKR	NOMQ	
` ì	SP	UV	e É	OTQKRPQ	ééÄ	NKM	PTQQQUKNT	ORM	ONKVS	TVKR	NOMQ	
wå	SS	UV	e É	RORKNTP	ééÄ	NKU	NOONUTHRM	RMM	ONKMN	TVKR	NOMQ	
^ë	TR	UV	e É	NMMKPNQ	ééÄ	NKN	NTSONKVR	NMM	OMKMS	TVKR	NOMQ	
pÉ	TU	UV	e O	VSKOPU	ééÄ	OKP	VPQQKSV	NMM	NVKOR	TVKR	NOMQ	
pê	UU	UV	e É	RMMKVON	ééÄ	MKN	PNPMOUKRR	RMM	OMMVQ	TVKR	NOMQ	
j ç	VR	UV	e É	NMPKVVS	ééÄ	NKQ	SONQQKMV	NMM	OMKU	TVKR	NOMQ	
^Ö	NMT	UV	e É	RQKUVU	ééÄ	NKN	NNSUSPKVO	RM	ONKVS	TVKR	NOMQ	
` Ç	NNN	UV	e É	OSRKOSN	ééÄ	MKO	TTPMRKNR	ORM	ONKOO	TVKR	NOMQ	
på	NNU	NRV	e É	RMMKNMU	ééÄ	NKV	PNUTMSKOR	RMM	OM	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl ~ë	UUKUTU	ééÄ	NKM	ONNOQQKUM	NMM	NTKTU	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl ~ë	NVTOKOMV	ééÄ	MKR	OSNMNQQKSP	OMMM	NVKTO	TVKR	NOMQ	
t	NUO	NRV	k ç=dl ~ë	NMNKUPP	ééÄ	MKS	OTMVQUKOS	NMM	OMKPT	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl ~ë	VSKUQQ	ééÄ	OKM	RSUSQQKRT	NMM	NVKPT	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl ~ë	VVKQRR	ééÄ	MKU	UMVMTMVST	NMM	NVKUV	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl ~ë	VPKOUT	ééÄ	NKU	SRVSPSKMM	NMM	NUKSS	TVKR	NOMQ	
r	OPU	OMV	k ç=dl ~ë	NMNKRQV	ééÄ	NKS	STMPSPKOR	NMM	OMKPN	TVKR	NOMQ	

n ` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä=Ö
iá	S	kç=d~ë	ONOQSQRKMU	NKO	OTRVPMMKUR	TT	RVKR	NOMKQ	
pÅ	QR	kç=d~ë	QMSPOPPKNQ	MKV	SMQUSNNKO	STKNU	RVKR	NOMKQ	
pÅ	QR	eO	VSOVOVKMN	MKP	NRQUORRKRV	SPKMN	RVKR	NOMKQ	
pÅ	QR	eÉ	NQNVMUKUS	OKM	OPPVRPKQR	SMKSS	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	VUUUSSKQO	NKU	NQNOURSKNU	SVKVV	RVKR	NOMKQ	
dÉ	TO	eO	PTUQROKPN	NKO	SMTRNTKON	SOKOV	RVKR	NOMKQ	
dÉ	TO	eÉ	NNMNUOKQM	NKO	NTUUOVKVT	SNKSN	RVKR	NOMKQ	
v	UV	eO	QPPMOUVKMN	NKS	SRRTRURKQP	SSKMP	RVKR	NOMKQ	
v	UV	eÉ	TSQTOMKVN	MKV	NOSROOTKVR	SMKQQ	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	SUNQPSQKUO	NKR	UQQSUONKNN	UMKST	RVKR	NOMKQ	
qÄ	NRV	eÉ	OUVUUQRKVV	MKP	QNMSRTOKVO	TMKRV	RVKR	NOMKQ	
_á	OMV	kç=d~ë	PROPSOUKSS	OKM	PUSSRTUKPV	VNKNP	RVKR	NOMKQ	
_á	OMV	eÉ	NSVUPOOKRT	MKQ	OPPPTRQKRV	TOKTT	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MUTSJMMN

cãÉ=k~ã É MON pj mi lÇ

a~í~=m~íÜ=k~ã É a\ÿ^ÖäÉáíÿ^ mj eyNya^q^yOMCPyMPJ ^oyi n ` ON^HÅ

^Åè=qãã É PLONLOMCP=NSVRNMQO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå NMKMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	QKNUQ	ééÄ	RKN	OTCUKMU	NMM	
NN	_	S	k ç=d ~ë	PNKTPO	ééÄ	NKV	NPUTTKVT	NMMM	
OP	k ~	QR	e É	TRRKPTM	ééÄ	OKS	TVQVMKMN	OMMMMM	
OQ	j Ö	QR	e É	VPQSKPQR	ééÄ	NKT	PNMNSMRRT	OMMMMM	
OT	^ ä	QR	e É	NPOUMRKPRU	ééÄ	MKQ	NTMUOVMKPM	OMMMMM	
OU	pá	QR	e O	NSNMKVTU	ééÄ	RKU	TQNNSKQQ	NMMMM	
PV	h	QR	e É	TPNVKNSM	ééÄ	MKV	OPRPUMKVO	OMMMMM	
QM	` ~	QR	e O	NVQNTKOPS	ééÄ	MKU	SQVRPUMKNN	OMMMMM	
RN	s	UV	e É	OMOKVTU	ééÄ	MKU	UTVNOKVS	NMMM	
RO	` ê	UV	e É	NSQKSOP	ééÄ	OKO	VMSNVKUU	OMMM	
RR	j å	UV	e É	OUOKRVN	ééÄ	NKM	TUSRTKPO	OMMM	
RS	cÉ	UV	e O	RRUMVKMVR	ééÄ	NKM	TNRNONRPKUM	NMMMMM	
RV	` ç	UV	e É	PNKNOM	ééÄ	OKP	OVRUPKQQ	NMMM	
SM	k á	UV	e É	UTKQOQ	ééÄ	NKN	OPNUUKPU	NMMM	
SP	` ì	UV	e É	NQTKOTM	ééÄ	NKP	NMTUQOKVS	OMMM	
SS	wå	UV	e É	RNTKQUR	ééÄ	NKM	SQUPMKTS	OMMM	
TR	^ ë	UV	e É	OTKRMP	ééÄ	MKT	ORVOKRN	NMMM	
TU	pÉ	UV	e O	PKTRP	ééÄ	OKM	NVUKNS	NMMM	
UU	pê	UV	e É	NNQKRQV	ééÄ	NKM	PUORRKTQ	OMMM	
VR	j ç	UV	e É	UKRTN	ééÄ	OKR	OTVPKST	NMMM	
NMT	^ Ö	UV	e É	MKRVT	ééÄ	NNKM	SVPKPT	NMM	
NNN	` Ç	UV	e É	PKPOU	ééÄ	PKV	RNVKOT	NMMM	
NNU	på	NRV	e É	PVKOUV	ééÄ	NKQ	NOVUTKSQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKVUT	ééÄ	OKT	OSNPKMM	NMMM	
NPT	_~	NRV	k ç=d ~ë	SOTKUMP	ééÄ	NKQ	QNOTQQKOP	OMMM	
NUO	t	NRV	k ç=d ~ë	OKVPM	ééÄ	PKM	QSRRKTT	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKTUV	ééÄ	VKS	RUNMKTS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NTOKUUM	ééÄ	MKS	TNQNPSKRM	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OUKNSS	ééÄ	NKM	NMOTTMKVR	NMMM	
OPU	r	OMV	k ç=d ~ë	NVKUVN	ééÄ	NKP	PSRPNKPS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ¹ mp	B=oÉÁ	B n ` =i çï	B n ` =eáÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	ONVQNOUKQN	OKR	OTRVPMVKUR	TVKRO	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QNSROPRKTP	OKO	SMQUSNNKO	SUKUS	RVKR	NOMKQ	
pÅ	QR	e O	VSOVTNKNU	OKQ	NROUORRKRV	SPKMN	RVKR	NOMKQ	
pÅ	QR	e É	NQQSOMKMS	MKQ	OPPVRPKQR	SNKUO	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VUQMNPKUM	NKT	NQNOURSKNU	SVKSR	RVKR	NOMKQ	
d É	TO	e O	PTPTNSKMV	OKN	SMTRNTKON	SNKRO	RVKR	NOMKQ	
d É	TO	e É	NNMRSPKMM	MKO	NTUUOVKVT	SNKUP	RVKR	NOMKQ	
v	UV	e O	QSRUONMKOV	OKO	SRRTRURKQP	TNKMQ	RVKR	NOMKQ	
v	UV	e É	UNSVNNKQO	MKM	NOSROOTKVR	SQKRT	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	STSTTPVKNR	MKN	UQQSUONKNN	UMKNO	RVKR	NOMKQ	
qÄ	NRV	e É	OURNMSNKMT	NKQ	QNMSRTOKVO	SVKQP	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRTTONQKQP	MKS	PUSSRTUKPV	VOKRO	RVKR	NOMKQ	
_á	OMV	e É	NSVRMNQKRV	NKM	OPPPTRQKRV	TOKSP	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MUTSJMMN

cãÉ=k~ã É MOOpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMOPyMPJ ^oyi n ` ONl^hÅ

^Åè=qãã É PLONLOMOP=NSWRSWQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMkMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	PKTSS	éé Ä	PKT	SPSKSV	NMM	
NN	_	S	k ç=d ~ë	QPKMOO	éé Ä	OKN	QTSPKMU	NMMM	
OP	k ~	QR	e É	NOUUKTTT	éé Ä	NKS	QUSUOKRT	OMMMMM	
OQ	j Ö	QR	e É	VVTOKVTS	éé Ä	MKV	SSRNRKSQ	OMMMMM	
OT	^ ä	QR	e É	NPRUOUKPUR	éé Ä	NKN	PRMNSMOU	OMMMMM	
OU	pá	QR	e O	NTOMKRTQ	éé Ä	UKP	NSUMOKVS	NMMMM	
PV	h	QR	e É	VNNMKNSP	éé Ä	MKR	TPOTSKPT	OMMMMM	
QM	` ~	QR	e O	ONOQNKOMN	éé Ä	OKQ	NQPUUTMKNV	OMMMMM	
RN	s	UV	e É	OOOKRPQ	éé Ä	NKN	NURNNKOS	NMMM	
RO	` ê	UV	e É	NUNKVTS	éé Ä	NKM	NVRNNKTQ	OMMM	
RR	j å	UV	e É	PNMKSSP	éé Ä	NKQ	NSRTSKSN	OMMM	
RS	cÉ	UV	e O	SMMMSKUSN	éé Ä	NKT	NRNQMQRUKUU	NMMMMM	
RV	` ç	UV	e É	PQKPUU	éé Ä	OKQ	SPSUKPQ	NMMM	
SM	k á	UV	e É	VPKSVR	éé Ä	OKT	QUNOKMR	NMMM	
SP	` ì	UV	e É	NRUKONV	éé Ä	NKP	OOSPMKUQ	OMMM	
SS	wå	UV	e É	RQNKOOS	éé Ä	OKT	NPSURKUM	OMMM	
TR	^ ë	UV	e É	POKQPM	éé Ä	QKT	RVOKMT	NMMM	
TU	pÉ	UV	e O	QKTRT	éé Ä	NOKU	RMKNT	NMMM	
UU	pê	UV	e É	NOQKQSN	éé Ä	PKS	TVPNKPO	OMMM	
VR	j ç	UV	e É	NQKSNS	éé Ä	NNKS	VQQKRM	NMMM	
NMT	^ Ö	UV	e É	MKSRR	éé Ä	NOKU	NRRKRS	NMM	
NNN	` Ç	UV	e É	PKUSR	éé Ä	NSKS	NNRKRS	NMMM	
NNU	på	NRV	e É	PPKSRN	éé Ä	OKO	OUOPKSU	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NKQQN	éé Ä	NVKM	NMMNKMV	NMMM	
NPT	_~	NRV	k ç=d ~ë	SRRRTMV	éé Ä	NKO	URSTQKNV	OMMM	
NUO	t	NRV	k ç=d ~ë	VKMQQ	éé Ä	NSKO	PNRMKPU	NMMM	
OMR	qä	OMV	k ç=d ~ë	OKRVV	éé Ä	PKP	OMMUKVQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NTUKUSS	éé Ä	MKQ	NQTPSUKNR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OQKPRM	éé Ä	NKP	NVOMNKRR	NMMM	
OPU	r	OMV	k ç=d ~ë	NNKMOU	éé Ä	OKM	TPQVKVP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OORNRUVKVP	OKU	OTRVPMMVUR	UNKS	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QNQPTRUKSN	NKR	SMQUSNNKO	SUKRN	RVKR	NOMQ	
pÅ	QR	e O	VSUQONKUN	NKQ	NRQUORRKRV	SPKPT	RVKR	NOMQ	
pÅ	QR	e É	NQQTRPKMS	NKN	OPPVRPKQR	SNKUT	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VUQNOUKNT	MKU	NQNOURSKNU	SVKSS	RVKR	NOMQ	
d É	TO	e O	PUPONPKQP	NKQ	SMTRNTKON	SPKMU	RVKR	NOMQ	
d É	TO	e É	NNMVPOKRR	NKN	NTUUOVKVT	SOKMP	RVKR	NOMQ	
v	UV	e O	QRMTVSRKQO	MKT	SRRTRURKQP	SUKTQ	RVKR	NOMQ	
v	UV	e É	TTTTPMKPO	NKM	NOSROOTKVR	SNKQT	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	STNRTNQKUM	MKQ	UQQSUONKNN	TVKRN	RVKR	NOMQ	
qÄ	NRV	e É	OUSSPSTKUS	MKU	QNMSRTOKVO	SVKU	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRPVRNSKMS	MKR	PUSSRTUKPV	VNKRQ	RVKR	NOMQ	
_á	OMV	e É	NTNTURQKOV	OKN	OPPPTRQKRV	TPKSN	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MUTSJMMN^

cãÉ=k~ã É MOPpj mi hÇ

a~í~=m~íÜ=k~ã É a\yt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` ON^ hÅ

^Åè=qãã É PLONLOMOP=NTWMNMQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå NMKMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	OOKNUU	éé Ä	NKV	NQVNRKST	NMM	
NN	_	S	k ç=d ~ë	QOUKSMP	éé Ä	MKT	NTNNNUKOO	NMMM	
OP	k ~	QR	e É	OOUOQKQRP	éé Ä	MKQ	NQOMTPQKTU	OMMMMM	
OQ	j Ö	QR	e É	NNQNRKSSU	éé Ä	MKV	PTNSQUKTP	OMMMMM	
OT	^ ä	QR	e É	NPTRQTHKROS	éé Ä	MKO	NTPSNNSKUP	OMMMMM	
OU	pá	QR	e O	NNQSPKPMU	éé Ä	MKU	RNPNOMKRV	NMMMM	
PV	h	QR	e É	OSVVUKRSR	éé Ä	MKU	UMMSOSKTT	OMMMMM	
QM	` ~	QR	e O	ONQTQKRTO	éé Ä	NKM	TMTMSRPKMV	OMMMMM	
RN	s	UV	e É	PMOKUNN	éé Ä	MKV	NOTROOKPV	NMMM	
RO	` ê	UV	e É	OSPKURR	éé Ä	MKS	NQMVVNKCR	OMMM	
RR	j å	UV	e É	PORKQST	éé Ä	MKQ	UUNPQKRM	OMMM	
RS	c É	UV	e O	RUOUQKUOV	éé Ä	MKT	TPOQMUSMKTU	NMMMMM	
RV	` ç	UV	e É	RMKQPR	éé Ä	NKR	QSRPUKST	NMMM	
SM	k á	UV	e É	NOUMKQQ	éé Ä	MKV	PPMMNKQM	NMMM	
SP	` ì	UV	e É	OMTHSTP	éé Ä	NKO	NQTSUPKSM	OMMM	
SS	wå	UV	e É	TNTKUNP	éé Ä	MKS	UTNOPKPN	OMMM	
TR	^ ë	UV	e É	NORKUVS	éé Ä	NKM	NNQVVKSM	NMMM	
TU	pÉ	UV	e O	VRKVVQ	éé Ä	MKT	QVNUKQT	NMMM	
UU	pê	UV	e É	OMVKPOM	éé Ä	MKS	SUMVSKRT	OMMM	
VR	j ç	UV	e É	NVRKTUQ	éé Ä	MKR	POUUSKQO	NMMM	
NMT	^ Ö	UV	e É	ONKSRT	éé Ä	MKR	OPVTPKSV	NMM	
NNN	` Ç	UV	e É	OPKUVQ	éé Ä	OKP	PSOMKRM	NMMM	
NNU	på	NRV	e É	NPOKVVO	éé Ä	MKT	QNRVNKMP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NVKVUP	éé Ä	NKT	QROMVKOU	NMMM	
NPT	_~	NRV	k ç=d ~ë	SSPKQVT	éé Ä	MKT	QOSSMRKUR	OMMM	
NUO	t	NRV	k ç=d ~ë	NMUKQRO	éé Ä	MKV	NQMRMUKQP	NMMM	
OMR	qä	OMV	k ç=d ~ë	OMKURM	éé Ä	NKT	SMTUVKTS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NVQKOQU	éé Ä	MKU	TTVNPQKUU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	RMSUO	éé Ä	NKT	NTUNMSKNO	NMMM	
OPU	r	OMV	k ç=d ~ë	POKMMP	éé Ä	PKR	NMQRONKMQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	ONTTQSOKUO	NKO	OTRVPMMKUR	TUKVN	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QNMQMTRKUQ	NKP	SMQUSNNKO	STKUR	RVKR	NOMKQ	
pÅ	QR	e O	VQTVSOKRN	MKU	NRCUCRRKRV	SOKMP	RVKR	NOMKQ	
pÅ	QR	e É	NQNVNMKNQ	MKR	OPPVRPKQR	SMKSS	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VSSOPSKSN	NKO	NQNOURSKNU	SUKPV	RVKR	NOMKQ	
d É	TO	e O	PSVPOVKQO	MKT	SMTRNTKON	SMKTV	RVKR	NOMKQ	
d É	TO	e É	NMUTQOKMR	MKT	NTUUOVKVT	SMKUN	RVKR	NOMKQ	
v	UV	e O	QRSUQNSKOR	MKN	SRRTRURKQP	SVKST	RVKR	NOMKQ	
v	UV	e É	TVQVRNKSS	MKP	NOSROOTKVR	SOKUP	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SSNUUQUKNU	MKO	UQQSUONKNN	TUKPS	RVKR	NOMKQ	
qÄ	NRV	e É	OUMQMPUKUV	MKU	QNMSRTOKVO	SUKOU	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PQTQQPMKTV	NKQ	PUSSRTUKPV	UVKUS	RVKR	NOMKQ	
_á	OMV	e É	NSQTVVVKOO	MKV	OPPPTRQKRV	TMKSO	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MUTSJMMNm

cãÉ=k~ã É MOQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMOPyMPJ ^oyi n` ONˆHÅ

^Åè=qãã É PLONLOMOP=NTWMTMM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå NMKMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	RQKUNS	ééÄ	NMS	PPSRUKOT	NMM	
NN	_	S	k ç=d ~ë	QQQKMSV	ééÄ	MKU	NTTRSOKRM	NMMM	
OP	k ~	QR	e É	URTQKMSO	ééÄ	NKN	RTMNPRKQT	OMMMMM	
OQ	j Ö	QR	e É	OMVTOKORM	ééÄ	MKT	TMOTSMKTR	OMMMMM	
OT	^ ä	QR	e É	OQUVNTKTNT	ééÄ	OKO	POPQPQTKQO	OMMMMM	
OU	pá	QR	e O	OPRTKVSS	ééÄ	OKT	NNMTMOKPQ	NMMMM	
PV	h	QR	e É	ONVUTKQUT	ééÄ	NMS	STQVUVKPP	OMMMMM	
QM	` ~	QR	e O	OTVPSKQTQ	ééÄ	OKM	VRTPOOQKMV	OMMMMM	
RN	s	UV	e É	TSNKMMN	ééÄ	MKR	PPTMSOKRN	NMMM	
RO	` ê	UV	e É	QRRVKRUR	ééÄ	MKV	ORRURONMS	OMMM	
RR	j å	UV	e É	UTQKPRO	ééÄ	MKU	OQUVUNKMO	OMMM	
RS	cÉ	UV	e O	VNQQRKUPM	ééÄ	NKU	NOMMTUQUPKQO	NMMMMM	
RV	` ç	UV	e É	RMUKQVS	ééÄ	MKU	QVONNOKST	NMMM	
SM	k á	UV	e É	SMQKQVN	ééÄ	NKO	NSPRVMKTU	NMMM	
SP	` ì	UV	e É	QNTKPOR	ééÄ	NKP	PNNSNQKTO	OMMM	
SS	wå	UV	e É	NPQVKNQN	ééÄ	NKP	NTNQRPKSO	OMMM	
TR	^ ë	UV	e É	NPPKMTQ	ééÄ	MKV	NOTVRKNV	NMMM	
TU	pÉ	UV	e O	UPKSSR	ééÄ	OKM	QQUNKMN	NMMM	
UU	pê	UV	e É	RVOKTUP	ééÄ	NKV	OMOSUOKSO	OMMM	
VR	j ç	UV	e É	VQKMRT	ééÄ	OKM	PMTVPKVQ	NMMM	
NMT	^ Ö	UV	e É	QTKMSQ	ééÄ	NKM	RQUOTKOV	NMM	
NNN	` Ç	UV	e É	OPQKUPR	ééÄ	MKU	PTQQSKSP	NMMM	
NNU	på	NRV	e É	QPRKOQO	ééÄ	MKP	NPRTTQKRT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	ORKVUP	ééÄ	NKQ	SMPMMKMQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	OUUSKNRR	ééÄ	NKR	NVMSNOTKNU	OMMM	
NUO	t	NRV	k ç=d ~ë	QRKSRR	ééÄ	MKU	SNOQMKPV	NMMM	
OMR	qä	OMV	k ç=d ~ë	VPKTRR	ééÄ	MKN	OTTUTUKVR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	PPSKNRM	ééÄ	MKP	NPTTUUTKRT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NOQKOTQ	ééÄ	NKV	QQPTPMKMU	NMMM	
OPU	r	OMV	k ç=d ~ë	NNOKNTP	ééÄ	MKP	PTPQNRKSO	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ¹ mp	B=oÉÁ	B n` =¹ çï	B n` =eáÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	ONUMTRNKSM	MKQ	OTRVPMMKUR	TVMKP	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QOORQQSKSQ	NKN	SMQUSNNKO	SVKUR	RVKR	NOMKQ	
pÅ	QR	e O	VUTNVVKMT	OKO	NRQUQRRKRV	SQKS	RVKR	NOMKQ	
pÅ	QR	e É	NQSNOTKMP	NKM	OPPVRPKQR	SOKQS	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VTNVTMKSO	MKR	NQNQURSKNU	SUKTV	RVKR	NOMKQ	
d É	TO	e O	PTQTNNKST	MKU	SMTRNTKON	SNKSU	RVKR	NOMKQ	
d É	TO	e É	NNMPOPKPO	NKN	NTUUOVKVT	SNKSV	RVKR	NOMKQ	
v	UV	e O	QTTRQQTKQS	MKS	SRRTRURKQP	TOKUO	RVKR	NOMKQ	
v	UV	e É	UPSUVNKTO	NKN	NOSROOTKVR	SSKNR	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SUMNMTOKSQ	MKV	UQQSUONKNN	UMKRO	RVKR	NOMKQ	
qÄ	NRV	e É	OUOVSVSKNS	MKP	QNMSRTOKVO	SUKVN	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRRPNUTKVN	MKU	PUSSRTUKPV	VNKUV	RVKR	NOMKQ	
_á	OMV	e É	NSTOMNRKTV	MKT	OPPPTRQKRV	TNKSQ	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MUTSJMMNp

cãÉ=k~ã É MORpj mi hÇ

a~í~=m~íÜ=k~ã É a\ÿt ÖäÉåíyî mj eyNya^q^yOMOPyMPJ ^oyi n ` ONˆHÅ

^Åè=qáã É PLONLOMOP=NTMNOMS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå NMKMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==mp==	iao	n ` =cä-Ö
V	_É	S	kç=d~ë	RRKQRP	éé¿Ä	NKM	PQPTRKRO	NMM	
NN	_	S	kç=d~ë	QUNKTRT	éé¿Ä	NKS	NVQPNMKKT	NMMM	
OP	k~	QR	eÉ	USPPKURT	éé¿Ä	MKN	RUVNVPKQU	OMMMMM	
OQ	j Ö	QR	eÉ	OMPSOKMOT	éé¿Ä	MKO	TMMRQQKUN	OMMMMM	
OT	^ä	QR	eÉ	OPQMMNKMTO	éé¿Ä	NKQ	PNONTMVKUO	OMMMMM	
OU	pá	QR	eO	PMOOKNVV	éé¿Ä	NPKN	NQPNMQKPU	NMMMM	
PV	h	QR	eÉ	OOPPRKVVV	éé¿Ä	MKV	TMPSSUKQM	OMMMMM	
QM	` ~	QR	eO	OSOPSKTSV	éé¿Ä	MKT	VMVNTPSKTQ	OMMMMM	
RN	s	UV	eÉ	TROKOQS	éé¿Ä	NKO	PPUQRSKQT	NMMM	
RO	` ê	UV	eÉ	QQPKSNN	éé¿Ä	NKQ	ORPMTTKUN	OMMM	
RR	j å	UV	eÉ	UQUKPUQ	éé¿Ä	OKO	OQRQNSKUP	OMMM	
RS	cÉ	UV	eO	UOSRVKUMV	éé¿Ä	NKQ	NMUVSPOMUKRQ	NMMMMM	
RV	` ç	UV	eÉ	RONKOTP	éé¿Ä	OKQ	RNOQRVKVU	NMMM	
SM	k á	UV	eÉ	SNOKOTS	éé¿Ä	NKO	NSUPPMKOU	NMMM	
SP	` ì	UV	eÉ	QOVKTVR	éé¿Ä	NKP	POSMNNKMP	OMMM	
SS	wå	UV	eÉ	NNUOKVQT	éé¿Ä	NKP	NRQURNKRS	OMMM	
TR	^ë	UV	eÉ	NPOKSNM	éé¿Ä	NKN	NOVRPKMP	NMMM	
TU	pÉ	UV	eO	UUKQSR	éé¿Ä	OKV	QTRRKQO	NMMM	
UU	pê	UV	eÉ	SMPKONO	éé¿Ä	MKT	OMVRQQKMT	OMMM	
VR	j ç	UV	eÉ	VSKQQM	éé¿Ä	MKU	POMSUKVN	NMMM	
NMT	^Ö	UV	eÉ	QUUKPUV	éé¿Ä	NKN	RTOSSKOO	NMM	
NNN	` Ç	UV	eÉ	OPTKNPU	éé¿Ä	NKP	PUQNSKTM	NMMM	
NNU	på	NRV	eÉ	QSNKRNO	éé¿Ä	MKR	NQSOQUKMS	NMMM	
NON	pÄ	NRV	kç=d~ë	OSKVTO	éé¿Ä	OKO	SNTUNKRN	NMMM	
NPT	_~	NRV	kç=d~ë	OVNOKRNP	éé¿Ä	NKO	NUVVONSKMV	OMMM	
NUO	t	NRV	kç=d~ë	QPKRQR	éé¿Ä	NKU	RTTMNKPP	NMMM	
OMR	qä	OMV	kç=d~ë	VRKRTO	éé¿Ä	NKO	OUPRNTKVU	NMMM	
OMU	mÄ	OMV	kç=d~ë	PNSKPSM	éé¿Ä	MKS	NOVUNSSKUV	OMMM	
OPO	qÜ	OMV	kç=d~ë	NOOKQOR	éé¿Ä	NKN	QPTRRSKQT	NMMM	
OPU	r	OMV	kç=d~ë	NNRKQPS	éé¿Ä	NKQ	PUQSPMKNN	NMMM	

n ` =fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÅ	B n ` =i çï	B n ` =eáÜÜ	n ` =cä-Ö
iá	S	kç=d~ë	OOMNSRMVRU	NKO	OTRVPMMKUR	TVRTV	RVRR	NOMQ	
pÅ	QR	kç=d~ë	QORUSURRTR	MRT	SMQUSNNKO	TMQQN	RVRR	NOMQ	
pÅ	QR	eO	VVTVTTKUS	NKQ	NRQUORRKRV	SRNP	RVRR	NOMQ	
pÅ	QR	eÉ	NRMMNTKST	MKS	OPPVRPKQR	SQKNO	RVRR	NOMQ	
dÉ	TO	kç=d~ë	VTTUPUKPS	NRT	NQNOURSKNU	SVKON	RVRR	NOMQ	
dÉ	TO	eO	PTUUUOKOM	MKV	SMTRNTKON	SOKPT	RVRR	NOMQ	
dÉ	TO	eÉ	NNORMMKNS	NKM	NTUUOVKVT	SOKVN	RVRR	NOMQ	
v	UV	eO	QTVQMPUKVR	NKV	SRRTRURKQP	TPKNN	RVRR	NOMQ	
v	UV	eÉ	URMNSMKQT	MKR	NOSROOTKVR	STKNV	RVRR	NOMQ	
qÄ	NRV	kç=d~ë	STNQROMOV	MKU	UQQSUONKNN	TVKQV	RVRR	NOMQ	
qÄ	NRV	eÉ	OUTRQRVKMU	NKQ	QNMSRTOKVO	TMKMO	RVRR	NOMQ	
_á	OMV	kç=d~ë	PRRSVOTKNS	NKR	PUSSRTUKPV	VNKVV	RVRR	NOMQ	
_á	OMV	eÉ	NTMNOTVKMU	MKQ	OPPPTRQKRV	TOKV	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn MMMUUMNT

cãÉ=k~ã É MOSpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` ONˆHÅ

^Åè=qáã É PLONLOMOP=NTNMTMN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	PKMTT	éé Ä	RKR	QMMSKNU	NMM	
NN	_	S	k ç=d ~ë	NOKVTP	éé Ä	PKP	NNTSPKUU	NMMM	
OP	k ~	QR	e É	QNOKMSM	éé Ä	OKN	UQPNRKON	OMMMMM	
OQ	j Ö	QR	e É	PPPVKTVO	éé Ä	MKU	OOPORQKOV	OMMMMM	
OT	^ ä	QR	e É	QQTTVKTNR	éé Ä	MKS	NNRVVQNKRV	OMMMMM	
OU	pá	QR	e O	QRCQKRMP	éé Ä	NKQ	OPPUQLUKTT	NMMMM	
PV	h	QR	e É	QRMSKUNN	éé Ä	NKM	NSURMQKRR	OMMMMM	
QM	` ~	QR	e O	TPNQKQRS	éé Ä	MKS	QVTRVSQKPQ	OMMMMM	
RN	s	UV	e É	RMKMOP	éé Ä	NKM	OPTMNKPU	NMMM	
RO	` ê	UV	e É	PRKMMM	éé Ä	NKV	PVOMQKUP	OMMM	
RR	j å	UV	e É	SSKSMO	éé Ä	MKQ	PTPUQKOT	OMMM	
RS	cÉ	UV	e O	TVPSKSCQ	éé Ä	NKS	OMSCUMVQKOQ	NMMMMM	
RV	` ç	UV	e É	QKTTV	éé Ä	MKU	VOTSKTP	NMMM	
SM	k á	UV	e É	NSKTRN	éé Ä	NKP	VMMSKPU	NMMM	
SP	` ì	UV	e É	NRKQTT	éé Ä	NKQ	OPQMUKTS	OMMM	
SS	wå	UV	e É	NNQKMPP	éé Ä	NKQ	OVPOOKNU	OMMM	
TR	^ ë	UV	e É	QKVNM	éé Ä	PKU	VQMKNP	NMMM	
TU	pÉ	UV	e O	RKNVQ	éé Ä	QKT	RRNKPO	NMMM	
UU	pê	UV	e É	RRKOMP	éé Ä	MKT	PTMVRKTR	OMMM	
VR	j ç	UV	e É	OKNNN	éé Ä	RKV	NQNQKRR	NMMM	
NMT	^ Ö	UV	e É	MKOUP	éé Ä	RKU	SSOKOR	NMM	
NNN	` Ç	UV	e É	MKTTS	éé Ä	UKT	OQQKQR	NMMM	
NNU	på	NRV	e É	QNKPQS	éé Ä	MKO	OTNPQKPN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOVV	éé Ä	NKU	NTPNKVP	NMMM	
NPT	_~	NRV	k ç=d ~ë	NVRKUVN	éé Ä	MKT	ORVSRPKVO	OMMM	
NUO	t	NRV	k ç=d ~ë	NKMMO	éé Ä	UKP	PQSQKNP	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKOMS	éé Ä	NKR	TTRMKRP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QQKSCS	éé Ä	MKP	PTPPPMKQV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NOKQVO	éé Ä	NKP	VOPSOKOM	NMMM	
OPU	r	OMV	k ç=d ~ë	OKQSV	éé Ä	PKT	NSTSOKOP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤pÉÅ	B n ` =i çï	B n ` =¤ëÅÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	OOPNOQMOU	NKT	OTRVPMMVUR	UMKUS	RVMR	NOMQ	
pÅ	QR	k ç=d ~ë	QONMRSVKQN	NNS	SMQUSNNNO	SVHSN	RVMR	NOMQ	
pÅ	QR	e O	VTURMNKVP	MRR	NRCUCRRHRV	SQMVP	RVMR	NOMQ	
pÅ	QR	e É	NQRRVVKNR	NKM	OPPVRPKQR	SOKCP	RVMR	NOMQ	
d É	TO	k ç=d ~ë	VVUUMSKMM	NHR	NQNCURSKNU	TMHSV	RVMR	NOMQ	
d É	TO	e O	PUMORTKUV	MKQ	SMTRNTKON	SOHRV	RVMR	NOMQ	
d É	TO	e É	NNOOPTKNN	MKO	NTUUOVKVT	SOKTS	RVMR	NOMQ	
v	UV	e O	QTNTQMTKTU	NKO	SRRTRURKCP	TNKVQ	RVMR	NOMQ	
v	UV	e É	UONUUNKMO	NKM	NOSROOTKVR	SQKVS	RVMR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUOMTVPKVR	MKQ	UQQSUONKNN	UMKTR	RVMR	NOMQ	
qÄ	NRV	e É	OVNORVUKMN	NKT	QNMSRTOKVO	TMKVP	RVMR	NOMQ	
_á	OMV	k ç=d ~ë	PSNRNUSKMN	MKS	PUSSRTUKPV	VPHR	RVMR	NOMQ	
_á	OMV	e É	NTRQRUTKVU	MKV	OPPPTRQKRV	TRKNU	RVMR	NOMQ	

p~ã éäÉ=k~ã É pn MMVMJMNV

cãÉ=k~ã É MOTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` CN^hÅ

^Åè=qáã É PLONLOMCP=NTWOONU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	PKPTT	ééÄ	CKT	CPCRKNT	NMM	
NN	_	S	k ç=d ~ë	NMKPNN	ééÄ	CKU	VRNVKVS	NMMM	
CP	k ~	CR	e É	PUNKOTO	ééÄ	NKT	UNRSPKUM	CMMMMM	
CQ	j Ö	CR	e É	PVNMKCPO	ééÄ	CKM	OSCQURVKTO	CMMMMM	
CT	^ ä	CR	e É	RCQSCQSKSVV	ééÄ	MKT	NCPCQTSSKNV	CMMMMM	
CU	pá	CR	e O	CCCNKCCM	ééÄ	CKQ	CMTUMTKSS	NMMMM	
PV	h	CR	e É	CRCQVKVSV	ééÄ	NKQ	NTPPSNKCN	CMMMMM	
QM	` ~	CR	e O	TMVCKQLP	ééÄ	MKQ	QUMTUCCKVU	CMMMMM	
RN	s	UV	e É	RCKNNT	ééÄ	NKP	QUNCRKTR	NMMM	
RO	` ê	UV	e É	CPKPVT	ééÄ	NKP	QV/CPMKUN	CMMM	
RR	j å	UV	e É	TUKVMN	ééÄ	NKQ	CRMSSKQS	CMMM	
RS	cÉ	UV	e O	VPVUKQMM	ééÄ	MKQ	CQUMPRQSKSP	NMMMM	
RV	` ç	UV	e É	RKSOT	ééÄ	NKU	NNMUTKMN	NMMM	
SM	k á	UV	e É	CNKRNV	ééÄ	CKN	NNTQVKRR	NMMM	
SP	` ì	UV	e É	CMKQLP	ééÄ	NKM	PNOVQKCM	CMMM	
SS	wå	UV	e É	NPRKMVS	ééÄ	NKM	PRCMNKPQ	CMMM	
TR	^ ë	UV	e É	RKMUS	ééÄ	CKN	VVNKQT	NMMM	
TU	pÉ	UV	e O	RKVNT	ééÄ	CKP	SQCMKPN	NMMM	
UU	pê	UV	e É	RSKUCO	ééÄ	CKT	PUUUCKVT	CMMM	
VR	j ç	UV	e É	NKSCO	ééÄ	PKV	NNCNKNU	NMMM	
NMT	^ Ö	UV	e É	MKCUO	ééÄ	CKV	STNKNQ	NMM	
NNN	` Ç	UV	e É	MKUNU	ééÄ	NCKP	OSCKCO	NMMM	
NNU	på	NRV	e É	PTKSCQQ	ééÄ	NKR	CQUSQKRO	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKOTP	ééÄ	UKU	NSMNKTU	NMMM	
NPT	_~	NRV	k ç=d ~ë	COVKTVS	ééÄ	MKP	PMOTTPKNP	CMMM	
NUO	t	NRV	k ç=d ~ë	MKSPM	ééÄ	NMKN	CQSCKUQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKVRM	ééÄ	PKM	SNPQKSN	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	TNKNMS	ééÄ	NKN	RUSVMMKVS	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	NQKNUN	ééÄ	NKT	NVPPPNKRN	NMMM	
OPU	r	OMV	k ç=d ~ë	OKVVR	ééÄ	NKT	CMMUPKUP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	CCNCSQQKCQ	CKM	OTRVPMMKUR	UMKNV	RVRR	NCMKQ	
pÅ	CR	k ç=d ~ë	QCMQCPMKCO	MKV	SMQUSNNKO	SVHRN	RVRR	NCMKQ	
pÅ	CR	e O	VUTQPVKVQ	MKV	NRCUCRRHRV	SQHSN	RVRR	NCMKQ	
pÅ	CR	e É	NQTRUNKTR	CKM	CPPVRPKQR	SPHMU	RVRR	NCMKQ	
d É	TO	k ç=d ~ë	NMMPSURHRQ	CKM	NQNCURSKNU	TNHMQ	RVRR	NCMKQ	
d É	TO	e O	PUCSVCKNT	NKP	SMTRNTKCN	SCKVV	RVRR	NCMKQ	
d É	TO	e É	NNPCPURS	MKS	NTUUCVKVT	SPKQP	RVRR	NCMKQ	
v	UV	e O	QUNMSMQKQT	NKS	SRRTRURKQP	TPHPS	RVRR	NCMKQ	
v	UV	e É	UPSUCUKCR	MKU	NOSRCOTKVR	SSHNQ	RVRR	NCMKQ	
qÄ	NRV	k ç=d ~ë	STUMUCSKUS	MKV	UCQSUCNKNN	UMKCU	RVRR	NCMKQ	
qÄ	NRV	e É	OVPRTPSKRV	MKU	QNMSRTCKVO	TNKQV	RVRR	NCMKQ	
_á	OMV	k ç=d ~ë	PRTCSUMKRN	NKV	PUSSRTUHPV	VCKQ	RVRR	NCMKQ	
_á	OMV	e É	NTCVMUUKNO	MKR	CPPPTRQKRV	TQHMV	RVRR	NCMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` NQfj pO
cáÉ=k~ã É	MOU| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJ ^oyin` ON^kÄ
^Åè=qáã É	PLONLOMOP=NTWOTWOQ
p~ã éäÉ=qóéÉ	m_
qçí~ä=aáä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iáã á	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMST	ééÄ	kL^	TPKPP	MKR	
_	NN	S	kç=d~ë	NKVRR	ééÄ	RKU	OTNVKNV	NM	
k~	OP	QR	eÉ	NTSKMUU	ééÄ	NOKV	RPUVQKPQ	RMM	
jÖ	OQ	QR	eÉ	PUKNSV	ééÄ	RNKS	OUQOKVV	RM	
^ä	OT	QR	eÉ	NTVKMUQ	ééÄ	ROKN	RMUVKVT	RM	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
pá	OU	QR	eO	OMKPVV	ééÄ	NKP	OUOPKOU	ORM	
h	PV	QR	eÉ	OPRKSOP	ééÄ	NMKO	POVVSKNR	RMM	
`~	QM	QR	eO	VMKVUN	ééÄ	PKN	TOPPMKRU	RM	m_=SMOM=c~âë=aça
s	RN	UV	eÉ	MKTTV	ééÄ	ONKM	UPQKQV	OKR	
`ê	RO	UV	eÉ	NKMOM	ééÄ	NPKN	NSMRKNP	OKR	
jå	RR	UV	eÉ	NNKTQT	ééÄ	RKN	SOUQKON	N	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
cÉ	RS	UV	eO	QOKNQU	ééÄ	RKQ	NQPTPRKSO	RM	
`ç	RV	UV	eÉ	MKMUV	ééÄ	NMMKR	PQOKOR	MKR	
ká	SM	UV	eÉ	MKTPT	ééÄ	NVKN	QSTKTV	N	
`ì	SP	UV	eÉ	MKTSV	ééÄ	OPKS	NTSTKVQ	NKR	
wå	SS	UV	eÉ	OKVUM	ééÄ	ORKO	NSRTKVO	R	
^ë	TR	UV	eÉ	MKOPP	ééÄ	NSKR	RQKPQ	OKR	
pÉ	TU	UV	eO	MKNPO	ééÄ	NUKV	NRKMM	OKR	
pê	UU	UV	eÉ	MKQUR	ééÄ	OVKM	POTKTV	OKR	
jç	VR	UV	eÉ	MKTMU	ééÄ	POKR	QUOKOQ	OKR	
^Ö	NMT	UV	eÉ	MKMOS	ééÄ	QTKT	TMKMM	MKR	
`Ç	NNN	UV	eÉ	MKMQU	ééÄ	UUKT	NRKNU	MKR	
på	NNU	NRV	eÉ	PUKOMU	ééÄ	OKM	OQUUNKMR	OKR	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKNPM	ééÄ	ORKV	VPTKSV	MKR	
_~	NPT	NRV	kç=d~ë	NKNOQ	ééÄ	TKU	NSNUKQU	N	m_=SMOM=c~âë=aça
t	NUO	NRV	kç=d~ë	MKQOO	ééÄ	OQKT	NUVRKQV	OKR	
qä	OMR	OMV	kç=d~ë	MKMUS	ééÄ	SKP	VTQKQN	MKR	
mÄ	OMU	OMV	kç=d~ë	MKQTT	ééÄ	SKP	ROTSKMM	MKR	
qÜ	OPO	OMV	kç=d~ë	MKQTP	ééÄ	NKU	ROQPKOR	OKR	
r	OPU	OMV	kç=d~ë	MKMOT	ééÄ	NVKM	ONPKRS	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eäÖÜ	n`=cä-Ö
iá	S	kç=dl~ë	ONRSSPNKMN	MKU	OTRVPMMKUR	TUKNS	RVMR	NOMQ	
pÅ	QR	kç=dl~ë	QMRRPOMCO	NKN	SMQUSNNKO	STKMR	RVMR	NOMQ	
pÅ	QR	eO	VRQNTSKQU	OKT	NRCUCRRKRV	SOKQQ	RVMR	NOMQ	
pÅ	QR	eÉ	NQPMNMKRV	MKS	OPPVRPKQR	SNKNP	RVMR	NOMQ	
dÉ	TO	kç=dl~ë	VTQSMMKMO	MKU	NQNCURSKNU	SUKVU	RVMR	NOMQ	
dÉ	TO	eO	PTVRRTKMM	MKO	SMTRNTKON	SOKQU	RVMR	NOMQ	
dÉ	TO	eÉ	NNONSUKTM	MKT	NTUUCVKVT	SOKTO	RVMR	NOMQ	
v	UV	eO	QPTQUTUKPQ	NKV	SRRTRURKQP	SSKTN	RVMR	NOMQ	
v	UV	eÉ	TSURUQKVS	NKM	NCSRCOTKVR	SMKTR	RVMR	NOMQ	
qÄ	NRV	kç=dl~ë	STOMVVMKMU	MKQ	UQQSUONKNN	TVKRT	RVMR	NOMQ	
qÄ	NRV	eÉ	OUUPTTSKQS	MKP	QNMSRTOKVO	TMKCO	RVMR	NOMQ	
_á	OMV	kç=dl~ë	PQVSSRSKMR	NKR	PUSSRTUKPV	VMKQP	RVMR	NOMQ	
_á	OMV	eÉ	NTNMMQOKQU	MKS	OPPPTRQKRV	TPKOT	RVMR	NOMQ	

`çåíaåì åaÖ=~ëäÄê~íáç=sÉêëÑÅ~íáç=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cäÉ=k~ã É	MOV|``skÇ
a~í~=m~íÜk~ã É	aWj^ÖäÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`ON^hÄ
^Åè=qáã É	PLONLOMOP=NTWROMN
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç=å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVS^i_Ç
p~ã éáÉ=n`=m~ëëlc á~ä	m~ëë
fpqa=n`=m~ëëlc~äí	c~äí
l éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	OQKSOO	ééÄ	OKR	OMRSNTKSP	CR	VUKQV	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKMON	ééÄ	NKU	NPTOSNKPO	CR	NMMKMU	UVKU	NNMO	
OP	k ~	QR	e É	RQPTKQVS	ééÄ	NKU	QSTVVUUKMM	RMMM	NMUKTR	UVKU	NNMO	
OQ	j Ö	QR	e É	RQTRKQRO	ééÄ	NKR	OQVRSRMKVM	RMMM	NMVKRN	UVKU	NNMO	
OT	^ä	QR	e É	ROSKQMO	ééÄ	NKV	VPTUTKSR	RMM	NMRKOU	UVKU	NNMO	
OU	pá	QR	e O	RMQKSQR	ééÄ	NKM	PNSUSPKMM	RMM	NMMKVP	UVKU	NNMO	
PV	h	QR	e É	RNUOKMQS	ééÄ	NKP	ONOUPOUKUN	RMMM	NMPKSQ	UVKU	NNMO	
QM	` ~	QR	e O	RMRTKMPO	ééÄ	MKV	OPOTUOVVKVP	RMMM	NMNKNQ	UVKU	NNMO	
RN	s	UV	e É	ORKSMV	ééÄ	MKR	NQSTSOKRO	CR	NMOKQQ	UVKU	NNMO	
RO	` ê	UV	e É	ORKRQT	ééÄ	NKT	NURTOTKNR	CR	NMOKNV	UVKU	NNMO	
RR	j å	UV	e É	ORKQMU	ééÄ	MKT	VPSQPKPR	CR	NMNKSP	UVKU	NNMO	
RS	cÉ	UV	e O	QUVOKQNP	ééÄ	MKS	UNUPRSQNKVP	RMMM	VTKUR	UVKU	NNMO	
RV	` ç	UV	e É	OSKMMQ	ééÄ	MKV	PORPQOKUQ	CR	NMQKMO	UVKU	NNMO	
SM	ká	UV	e É	ORKTTT	ééÄ	MKS	VMOPQKQU	CR	NMPKNN	UVKU	NNMO	
SP	` ì	UV	e É	OSKPMO	ééÄ	MKV	ORQNTRKVN	CR	NMRKON	UVKU	NNMO	
SS	wå	UV	e É	ORKUSN	ééÄ	OKR	OPRSUKOT	CR	NMPKQQ	UVKU	NNMO	
TR	^ë	UV	e É	ORKRQR	ééÄ	OKN	PNTONKSM	CR	NMOKNU	UVKU	NNMO	
TU	pÉ	UV	e O	OQKNPR	ééÄ	NKP	NSQRPKQO	CR	VSKRQ	UVKU	NNMO	
UU	pê	UV	e É	ORKOQU	ééÄ	NKV	NNNRTTKQM	CR	NMMKVV	UVKU	NNMO	
VR	j ç	UV	e É	ORKVQR	ééÄ	OKQ	NMVSMNKNQ	CR	NMPKTU	UVKU	NNMO	
NMT	^Ö	UV	e É	OSKUNQ	ééÄ	OKM	OMPRRPKRU	CR	NMTKOS	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKNOR	ééÄ	NKS	RPUPOKOO	CR	NMQKR	UVKU	NNMO	
NNU	på	NRV	e É	OQKOMV	ééÄ	NKT	NMRNQQKUN	CR	VSKUQ	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OPKTPT	ééÄ	NKM	TQTSTTKOO	CR	VQKVR	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	OQKRQM	ééÄ	MKU	OONPOQKSV	CR	VUKNS	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKONT	ééÄ	NKO	QTQSPMKRU	CR	NMQKUT	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	OQKQOU	ééÄ	NKO	VSSUQSKUQ	CR	VTKTN	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OQKVQP	ééÄ	MKR	NPSTPORKTT	CR	VVKTT	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKMQN	ééÄ	NKS	NOQMMSMPQ	CR	NMQKNS	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKMRT	ééÄ	OKO	NNRVQRQKVO	CR	NMQKOP	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ïçï	B n`=eäÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	OVTTTSNKMP	OKQ	OTRVPMMKUR	NMTKVO	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	RSUUTMOKMT	MKV	SMQUSNNKO	VQKMR	RVKR	NOMQ	
pÅ	QR	e O	NPOSSNQKUU	MKV	NRQUORRKRV	USKUN	RVKR	NOMQ	
pÅ	QR	e É	NVUUOUKQO	MKU	OPPVRPKQR	UQKVV	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NPUNUUUKOQ	MKV	NQNOURSKNU	VTKUN	RVKR	NOMQ	
dÉ	TO	e O	ROSSRQKTQ	MKT	SMTRNTKON	USKSV	RVKR	NOMQ	
dÉ	TO	e É	NRQUSTMKU	MKT	NTUUOVKVT	URKQU	RVKR	NOMQ	
v	UV	e O	SMUMRUNKPN	MKV	SRRTRURKQP	VOKTP	RVKR	NOMQ	
v	UV	e É	NMUNQRVKUN	MKS	NOSRQOTKVR	URKQU	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	VOTUTVRKTT	MKS	UQQSUONKNN	NMVKUR	RVKR	NOMQ	
qÄ	NRV	e É	PVOPVPPKPU	MKV	QNMSRTOKVO	VRKRR	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	QTRMNQTKOT	MKT	PUSSRTUKPV	NOOKUR	RVKR	NOMQ	SMOMa ça
_á	OMV	e É	OOVVPNRKVQ	MKU	OPPPTRQKRV	VUKRO	RVKR	NOMQ	

`çåíáåì åÖ=~äáÄê~íáç=_ä~åâ=É`_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cáÉ=k~ã É MPM``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖáÉáíyf^mj eyNya^q^yOMCPyMPJ^oyin`ON^kÅ

^Åè=qáã É PLONLOMCP=NTVQNMRU

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáç~å NKMMMM

`çã ã ÉâáÍ JJJ

fpqa=oÉÑ=cáÉk~ã É MVS^i_KÇ

p~ã éáÉ=n`=m~ëëlc á~ä m~ëë

fpqa=n`=m~ëëlc~áä m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äóíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==\ mp==	iãäá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MKMVR	éé Ä	STKO	ONTKTU	MO	
NN	_	S	kç=d~ë	MKONQ	éé Ä	OKN	OPSNVPQ	Q	
OP	k~	QR	eÉ	NVKMUQ	éé Ä	NVMO	QRNQMKTU	OMM	
OQ	j Ö	QR	eÉ	PKVNN	éé Ä	OKN	NUVTKVU	OM	
OT	^ä	QR	eÉ	MKOPR	éé Ä	NSNKN	SROKOR	OM	
OU	pá	QR	eO	MKMNO	éé Ä	SNNKQ	NNSNKOT	NVM	
PV	h	QR	eÉ	OTKOUT	éé Ä	OKN	PNVNUKVS	OMM	
QM	`~	QR	eO	RKRUT	éé Ä	OKQ	PRTUVKVS	OM	
RN	s	UV	eÉ	MKMOV	éé Ä	NUKN	PSTKTV	N	
RO	`ê	UV	eÉ	MKMQR	éé Ä	NKU	VNPKUS	N	
RR	j å	UV	eÉ	MKMNO	éé Ä	QVKQ	OMQKSP	MQ	
RS	cÉ	UV	eO	OKSUO	éé Ä	UKN	UTUSTKRV	OM	
RV	`ç	UV	eÉ	MKMVP	éé Ä	RTKT	OQSKSU	MO	
SM	k á	UV	eÉ	MKMNP	éé Ä	TOKS	NRRKRS	MQ	
SP	`ì	UV	eÉ	MKMOO	éé Ä	PNKO	NMVSKTO	MS	
SS	wå	UV	eÉ	JMKMJM	éé Ä	k L^	UTUKVP	O	
TR	^ë	UV	eÉ	MKMQN	éé Ä	UKQ	RTHKMN	N	
TU	pÉ	UV	eO	MKMOV	éé Ä	THKM	PMVST	N	
UU	pê	UV	eÉ	MKMOQ	éé Ä	ONKU	NNPHPQ	N	
VR	j ç	UV	eÉ	MKMQN	éé Ä	NNHP	RRRKRU	N	
NMT	^Ö	UV	eÉ	MKMNU	éé Ä	TKO	OQQKQR	MO	
NNN	`Ç	UV	eÉ	MKMNV	éé Ä	NOKM	POKVS	MO	
NNU	på	NRV	eÉ	JMKMRO	éé Ä	k L^	SPNKNQ	N	
NON	pÄ	NRV	kç=d~ë	MKMPM	éé Ä	OOKV	NNSQKSO	MO	
NPT	_~	NRV	kç=d~ë	MKMOP	éé Ä	NQKO	PQPKTM	MQ	
NUO	t	NRV	kç=d~ë	MKNPO	éé Ä	NVHP	OUQSKSU	N	
OMR	qä	OMV	kç=d~ë	MKMRS	éé Ä	NRKV	OPMRKVU	MO	
OMU	mÄ	OMV	kç=d~ë	MKMMN	éé Ä	VQKR	NSOUKQP	MO	
OPO	qÜ	OMV	kç=d~ë	MKMRP	éé Ä	PKT	QNSNKTT	N	
OPU	r	OMV	kç=d~ë	MKMOO	éé Ä	SKP	UOMKVM	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j ÇÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=cäÜÜ	n`=c~ä~Ö
iá	S	kç=d~ë	QRNTVQRKOV	MKT	OTRVPMVKUR	VNKQR	RVHR	NOMQ	
pÅ	QR	kç=d~ë	QTMQRURKSO	NKQ	SMQUSNNKO	TTKTR	RVHR	NOMQ	
pÅ	QR	eO	NNNQSMUKUM	OKQ	NRQUQRRKRV	TOKVP	RVHR	NOMQ	
pÅ	QR	eÉ	NSTTUTKUQ	MKU	OPPVRPKQR	TNKTO	RVHR	NOMQ	
dÉ	TO	kç=d~ë	NNQRRQTKMO	PKT	NQNQURSKNU	UNKMU	RVHR	NOMQ	
dÉ	TO	eO	QRNRQQKMS	MKQ	SMTRNTKQN	TQKPP	RVHR	NOMQ	
dÉ	TO	eÉ	NPMPMNKUR	MKS	NTUUQVKVT	TOKUS	RVHR	NOMQ	
v	UV	eO	RNQVUTQKNQ	MKU	SRRTRURKQP	TUKRP	RVHR	NOMQ	
v	UV	eÉ	UVQQVPKMS	MKP	NOSRQQTKVR	TMKRO	RVHR	NOMQ	
qÄ	NRV	kç=d~ë	TRUTQNNKQP	MKQ	UQQSUQNKNN	UVKUP	RVHR	NOMQ	
qÄ	NRV	eÉ	PPQNVTNKRU	MKU	QNMSRTQKVO	UMKUV	RVHR	NOMQ	
_á	OMV	kç=d~ë	PUPQUPMKPR	NKU	PUSSRTUKPV	VVKNP	RVHR	NOMQ	
_á	OMV	eÉ	NVPTPVNKPR	OKQ	OPPPTRQKRV	UPKMO	RVHR	NOMQ	

i ~Äçê~íçêó=`çåíêçäåp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` Cl n ` NQTj pO
cáÉ=k~ã É	MPN ` pl kÇ
a~í~=m~íÜ=k~ã É	aWi^ÖäÉáíy^ mj eyNya^q^yOMOPyMPJ ^oyi n ` ONi^kÄ
^Åè=qáã É	PLONLOMOP=NTWQSWQR
p~ã éäÉ=qóéÉ	i ` pl
qçí~äaäãíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MMS` ^i _kÇ
p~ã éäÉ=n ` =m~ëëlcá~ä	m~ëë
fpqa=n ` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åä**

n ` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==i mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n ` =c~ä-Ö
_É	V	S	k ç=dl ~ë	QVKVQO	ééÄ	NKO	SMUMRKNT	RM	NVKVU	TVKR	NOMQ	
_	NN	S	k ç=dl ~ë	QVMMVPT	ééÄ	OKO	PUTTTRKSM	RMM	NVKS	TVKR	NOMQ	
k~	OP	QR	e É	URNSKSUU	ééÄ	MKV	NMURCSPKOO	TRMM	OOKTN	TVKR	NOMQ	
j Ö	OQ	QR	e É	RPSNKTUO	ééÄ	NKS	PRQSPQKRM	RMMM	ONKQR	TVKR	NOMQ	
^ä	OT	QR	e É	ONMRKQMN	ééÄ	MKU	RQQVVKQU	OMMM	ONKMR	TVKR	NOMQ	
pá	QU	QR	e O	VRSKTRU	ééÄ	QKM	UVQNUKMP	NMMM	NVKNQ	TVKR	NOMQ	
h	PV	QR	e É	VVNPKPUS	ééÄ	NKM	SMOPVQKSN	NMMMM	NVKUP	TVKR	NOMQ	
` ~	QM	QR	e O	OSMPKRMQ	ééÄ	MKR	NTUOTRUKPO	ORMM	OMKUP	TVKR	NOMQ	
s	RN	UV	e É	RNPKNPN	ééÄ	MKO	QNRRNQKSP	RMM	OMKRP	TVKR	NOMQ	
` ê	RO	UV	e É	ONMKTQO	ééÄ	MKS	ONSQQSKNP	OMM	ONKMT	TVKR	NOMQ	
j å	RR	UV	e É	ROMKTUS	ééÄ	NKN	OTNNRQKOM	RMM	OMKUP	TVKR	NOMQ	
cÉ	RS	UV	e O	NMMUKTNO	ééÄ	NKT	ORMMQRPKUP	NMMM	OMKNT	TVKR	NOMQ	
` ç	RV	UV	e É	RPUKVTM	ééÄ	OKR	VRPSNNKMR	RMM	ONKRS	TVKR	NOMQ	
ká	SM	UV	e É	RPSKUTT	ééÄ	NKN	OSRSNPKVN	RMM	ONKQU	TVKR	NOMQ	
` ì	SP	UV	e É	OTNKPPU	ééÄ	NKN	PTMOUUKMT	ORM	ONKTN	TVKR	NOMQ	
wå	SS	UV	e É	RNVKTQT	ééÄ	MKS	NONMMTKOM	RMM	OMKTV	TVKR	NOMQ	
^ë	TR	UV	e É	NMNKSRU	ééÄ	NKO	NTUSSKVT	NMM	OMKPP	TVKR	NOMQ	
pÉ	TU	UV	e O	VSKPPU	ééÄ	NKP	VRTQKPP	NMM	NVKOT	TVKR	NOMQ	
pê	UU	UV	e É	RMRKRRQ	ééÄ	MKS	PNSNMOKSV	RMM	OMKOO	TVKR	NOMQ	
j ç	VR	UV	e É	NMRKVSR	ééÄ	MKT	SPPRTHRR	NMM	ONKNV	TVKR	NOMQ	
^Ö	NMT	UV	e É	RQKVRM	ééÄ	MKT	NNTMQMQR	RM	ONKVU	TVKR	NOMQ	
` Ç	NNN	UV	e É	OSPKMMN	ééÄ	MKP	TSSUUKQT	ORM	ONKMQ	TVKR	NOMQ	
på	NNU	NRV	e É	RMTKSMS	ééÄ	MKR	POMVVRKVN	RMM	OMKP	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl ~ë	VOKOVO	ééÄ	NKP	QNRRNMKMT	NMM	NUKQS	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl ~ë	OMPOKOOP	ééÄ	MKU	OSNTMVSKQS	OMMM	OMKPO	TVKR	NOMQ	
t	NUO	NRV	k ç=dl ~ë	NMRKRPR	ééÄ	MKO	OTPOMPKPN	NMM	ONKNN	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl ~ë	VUKPQN	ééÄ	NKR	RSQMMMKVN	NMM	NVKST	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl ~ë	NMMKPSS	ééÄ	MKP	TVTQOMKTM	NMM	OMKMT	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl ~ë	VSKONV	ééÄ	MKV	SSQPSOKMN	NMM	NVKOQ	TVKR	NOMQ	
r	OPU	OMV	k ç=dl ~ë	NMOKQQT	ééÄ	OKM	SSMQSUKUS	NMM	OMKQV	TVKR	NOMQ	

n ` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä=Ö
iá	S	kç=d~ë	ONSSSSTKQV	NKN	OTRVPMMKUR	TUKRO	RVKR	NOMKQ	
pÅ	QR	kç=d~ë	QMVTOVTKOU	MKT	SMQUSNNKO	STKTQ	RVKR	NOMKQ	
pÅ	QR	eO	VUMQVSKUR	NKO	NRCUCRRKRV	SQKNS	RVKR	NOMKQ	
pÅ	QR	eÉ	NQQNQUKOV	MKR	OPPVRPKQR	SNKSN	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	VSPTUNKOM	MKV	NQNCURSKNU	SUKCO	RVKR	NOMKQ	
dÉ	TO	eO	PURUQMKNU	MKU	SMTRNTKON	SPKRN	RVKR	NOMKQ	
dÉ	TO	eÉ	NMVSVNKNQ	MKT	NTUUCVKVT	SNKPQ	RVKR	NOMKQ	
v	UV	eO	QQPNUSVKTT	NKP	SRRTRURKCP	STKRU	RVKR	NOMKQ	
v	UV	eÉ	TSRNRMKPR	MKQ	NCSRCOTKVR	SMKQU	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	SSPMRQRKQO	MKV	UQQSUCNKNN	TUKR	RVKR	NOMKQ	
qÄ	NRV	eÉ	OUTSRTCKCU	MKN	QNMSRTCKVO	TMKMR	RVKR	NOMKQ	
_á	OMV	kç=d~ë	PQQNNCMSO	MKU	PUSSRTUKPV	UV	RVKR	NOMKQ	
_á	OMV	eÉ	NSVPPTCKQS	MKT	OPPPTRQKRV	TCKRS	RVKR	NOMKQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` pl n ` NQÍj pO
cáÉ=k~ã É	MPCl ` pl IÇ
a~í~=m~íÜ=k~ã É	aWi^ÖäÉáíy^ mj eyNya^q^yOMCPyMPJj ^oyi n ` ON^IÄ
^Åè=qáã É	PLONLOMCP=NTWRQMU
p~ã éäÉ=qóéÉ	i ` pl
qçí~äæáãíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MMS` ^i _IÇ
p~ã éäÉ=n ` =m~ëëlcá~ä	m~ëë
fpqa=n ` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åä**

n ` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==i mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n ` =c~ä-Ö
_É	V	S	k ç=dl ~ë	RMRRCP	éëÄ	OKV	SMCCUKRN	RM	OMKON	TVKR	NOMKQ	
_	NN	S	k ç=dl ~ë	RMMKCRU	éëÄ	OKM	PUTSQQKOM	RMM	OMKMN	TVKR	NOMKQ	
k~	CP	QR	e É	UQNCKQNN	éëÄ	NKR	NMRRVSVKUM	TRMM	COKQP	TVKR	NOMKQ	
j Ö	CQ	QR	e É	RQNUKMUR	éëÄ	NKQ	PRCUVTKVR	RMMM	ONKST	TVKR	NOMKQ	
^ä	OT	QR	e É	ONOTKTVM	éëÄ	MKT	RQCPTKNT	OMMM	ONKCU	TVKR	NOMKQ	
pá	CU	QR	e O	VVCKSTR	éëÄ	NKS	UVCPTKVN	NMMM	NVKUR	TVKR	NOMKQ	
h	PV	QR	e É	NMMTQKUNP	éëÄ	MKU	SMCRQTKRQ	NMMMM	OMKNR	TVKR	NOMKQ	
` ~	QM	QR	e O	CRVUKVCQ	éëÄ	OKV	NTNNTVUKSQ	CRMM	OMKTV	TVKR	NOMKQ	
s	RN	UV	e É	RNMKUSV	éëÄ	MKS	QNCUNMKMP	RMM	OMKCP	TVKR	NOMKQ	
`ê	RO	UV	e É	ONNKTPM	éëÄ	MKR	ONTMMNKPQ	OMM	ONKNT	TVKR	NOMKQ	
j å	RR	UV	e É	RCMKCRR	éëÄ	MKT	OTMQNQKPR	RMM	OMKUO	TVKR	NOMKQ	
cÉ	RS	UV	e O	NMMVKNVV	éëÄ	OKP	CQSUCMTKCP	NMMM	OMKNU	TVKR	NOMKQ	
` ç	RV	UV	e É	RPVKCRO	éëÄ	NKP	VRCMVOKVN	RMM	ONKRT	TVKR	NOMKQ	
ká	SM	UV	e É	RQNKUUT	éëÄ	MKR	OSTRPNKVS	RMM	ONKSU	TVKR	NOMKQ	
` ì	SP	UV	e É	OTOKMTN	éëÄ	MKV	PTMRMUKUV	CRM	ONKTT	TVKR	NOMKQ	
wå	SS	UV	e É	RCQKTTM	éëÄ	MKS	NCNVMUKNU	RMM	OMKVV	TVKR	NOMKQ	
^ë	TR	UV	e É	NMCKVCN	éëÄ	MKV	NUMRMKUS	NMM	OMKRU	TVKR	NOMKQ	
pÉ	TU	UV	e O	VSKRVS	éëÄ	PKN	VQSVKSM	NMM	NVKPO	TVKR	NOMKQ	
pê	UU	UV	e É	RNNKVPM	éëÄ	NKN	PNVCMUKVT	RMM	OMKQU	TVKR	NOMKQ	
j ç	VR	UV	e É	NMTKMTM	éëÄ	MKV	SPUUPKNO	NMM	ONKQN	TVKR	NOMKQ	
^Ö	NMT	UV	e É	RQKSOV	éëÄ	MKS	NNSNNNKNM	RM	ONKUR	TVKR	NOMKQ	
` Ç	NNN	UV	e É	OSQKMVN	éëÄ	MKU	TSUTOKSR	CRM	ONKUQ	TVKR	NOMKQ	
på	NNU	NRV	e É	RNUKUVU	éëÄ	NKU	PCPCMUKTV	RMM	OMKTS	TVKR	NOMKQ	
pÄ	NCN	NRV	k ç=dl ~ë	VMKUCU	éëÄ	MKV	QCMQMVKSM	NMM	NUKNT	TVKR	NOMKQ	
_~	NPT	NRV	k ç=dl ~ë	CMNCKUCU	éëÄ	NKM	OSSQTNVKPV	OMMM	OMKNP	TVKR	NOMKQ	
t	NUO	NRV	k ç=dl ~ë	NMRKPNV	éëÄ	NKV	CUMCQSKCN	NMM	ONKMS	TVKR	NOMKQ	
qä	OMR	OMV	k ç=dl ~ë	VVKVCN	éëÄ	NKU	RTSTQMKPU	NMM	NVKVU	TVKR	NOMKQ	
mÄ	OMU	OMV	k ç=dl ~ë	NMCKNQU	éëÄ	NKV	UNSSUMKPQ	NMM	OMKCP	TVKR	NOMKQ	
qÜ	OPO	OMV	k ç=dl ~ë	NMMKCPS	éëÄ	MKR	SVSQTSKQM	NMM	OMKMR	TVKR	NOMKQ	
r	OPU	OMV	k ç=dl ~ë	NMRKSRO	éëÄ	MKS	SURRTSKUU	NMM	ONKNP	TVKR	NOMKQ	

n ` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä=Ö
iá	S	kç=d~ë	ONONUMOKTU	NKO	OTRVPMMKUR	TSKV	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QMVOVVUKQT	MKQ	SMQUSNNKO	STKST	RVKR	NOMQ	
pÅ	QR	eO	VQPRNTKUN	OKQ	NRCUCRRKRV	SNKTQ	RVKR	NOMQ	
pÅ	QR	eÉ	NQNVRTKQN	NKM	OPPVRPKQR	SMKSU	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VSVVMUKTP	NKO	NQNCURSKNU	SUKSR	RVKR	NOMQ	
dÉ	TO	eO	PUCQPRKSP	MKS	SMTRNTKQN	SOKVR	RVKR	NOMQ	
dÉ	TO	eÉ	NNNNUMKPS	MKU	NTUUCVKVT	SOKNT	RVKR	NOMQ	
v	UV	eO	QPTPQQNKVS	OKP	SRRTRURKQP	SSKSV	RVKR	NOMQ	
v	UV	eÉ	TSPRPTKVP	MKP	NCSRCOTKVR	SMKPR	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SUNTNVPKRV	OKP	UQQSUCNKNN	UMKTN	RVKR	NOMQ	
qÄ	NRV	eÉ	CUPPTSNKTQ	MKU	QNMSRTCKVO	SVKMN	RVKR	NOMQ	
_á	QMV	kç=d~ë	PQSPPCVKVT	NKO	PUSSRTUKPV	UVKRT	RVKR	NOMQ	
_á	QMV	eÉ	NSUCVNNKPU	MKQ	OPPPTRQKRV	TQKNN	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMMN

cãÉ=k~ã É MPPpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` ON^hÅ

^Åè=qãã É PLONLOMCP=NUMOMT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKNRS	ééÄ	OKT	PQSKSU	NMM	
NN	_	S	k ç=d ~ë	RKOVV	ééÄ	MKT	RQMQKQQ	NMMM	
OP	k ~	QR	e É	NRUKNSM	ééÄ	PKP	RNOUMKQQ	OMMMMM	
OQ	j Ö	QR	e É	NNPKMOM	ééÄ	OKR	TSUQKRT	OMMMMM	
OT	^ ä	QR	e É	RPNSKVNP	ééÄ	NKS	NPQSTRKNU	OMMMMM	
OU	pá	QR	e O	NUCRKPST	ééÄ	OKM	NSPNVMKVV	NMMMM	
PV	h	QR	e É	PPMKOUR	ééÄ	NKR	PUONNKNU	OMMMMM	
QM	` ~	QR	e O	NSPKMVR	ééÄ	NKU	NNUSRRKTU	OMMMMM	
RN	s	UV	e É	NTKSSN	ééÄ	OKP	NRRUVKVT	NMMM	
RO	` ê	UV	e É	NUKSPU	ééÄ	NKS	ONNPRKVS	OMMM	
RR	j å	UV	e É	OUKQTR	ééÄ	NKO	NSMVOKUO	OMMM	
RS	cÉ	UV	e O	OPQUKVRU	ééÄ	NKS	SNOPVROKTR	NMMMMM	
RV	` ç	UV	e É	MRTSP	ééÄ	SKU	NSQVKVR	NMMM	
SM	k á	UV	e É	OKNOV	ééÄ	PKR	NOQNKNV	NMMM	
SP	` ì	UV	e É	PKVUV	ééÄ	QKR	SSMVKQR	OMMM	
SS	wå	UV	e É	SRTMN	ééÄ	RKQ	OSVVKOM	OMMM	
TR	^ ë	UV	e É	QKQTR	ééÄ	RKV	URVRTV	NMMM	
TU	pÉ	UV	e O	MKSOP	ééÄ	NMKS	SUKMM	NMMM	
UU	pê	UV	e É	SKUSU	ééÄ	QKS	QSQQKOM	OMMM	
VR	j ç	UV	e É	NKSNO	ééÄ	RKM	NMVSRTP	NMMM	
NMT	^ Ö	UV	e É	MKMTM	ééÄ	TKV	NTRKRS	NMM	
NNN	` Ç	UV	e É	MKONV	ééÄ	VKS	TMKMM	NMMM	
NNU	på	NRV	e É	PTKNRP	ééÄ	NKS	OQNOOKVV	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOUP	ééÄ	QKU	NSPUKRN	NMMM	
NPT	_~	NRV	k ç=d ~ë	OPKMNV	ééÄ	NKS	PMOUOKSV	OMMM	
NUO	t	NRV	k ç=d ~ë	MKUTM	ééÄ	NRKP	PMTPKSP	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKPRP	ééÄ	PKO	ORSOKVS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NVKVRU	ééÄ	MKO	NSQRMNKPV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NNPKPQO	ééÄ	NKN	UMRTQNKSQ	NMMM	
OPU	r	OMV	k ç=d ~ë	ONKPTO	ééÄ	MKR	NQNVTMKNO	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n` =ï çï	B n` =¤ä~Ü	n` =¤ä~Ö
i á	S	k ç=d ~ë	ONUMCRTKNU	NKR	OTRVPMMKUR	TVKMO	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QMRNORRKQN	NKM	SMQUSNNKO	SSKVU	RVKR	NOMQ	
pÅ	QR	e O	VQPMMOKMV	NKQ	NRCUCRRKRV	SNKT	RVKR	NOMQ	
pÅ	QR	e É	NQNUUVKVV	MKU	OPPVRPKQR	SMKSR	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VTRUMUKRT	NKO	NQNCURSKNU	SVKMT	RVKR	NOMQ	
d É	TO	e O	PTQPPSKUQ	NKM	SMTRNTKON	SNKSO	RVKR	NOMQ	
d É	TO	e É	NNNSQVKNO	MKS	NTUUOVKVT	SOKQP	RVKR	NOMQ	
v	UV	e O	QTMUUSUKSR	NKQ	SRRTRURKQP	TNKUN	RVKR	NOMQ	
v	UV	e É	UOPMQQKPP	MKU	NOSRCOTKVR	SRKMR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	STPVPCQKNS	NKN	UQQSUCNKNN	TVKTV	RVKR	NOMQ	
qÄ	NRV	e É	OUTPMTVKQS	NKM	QNVSRTCKVO	SVKVS	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRQQRTCKMN	NKN	PUSSRTUKPV	VNKST	RVKR	NOMQ	
_á	OMV	e É	NTNTTCQKSN	MKU	OPPPTRQKRV	TPKS	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMMP

cãÉ=k~ã É MPQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyi ÖäÉåíyî mj eyNya^q^yOMCPyMPJ ^oyi n` ON^HÅ

^Åè=qãã É PLONLOMCP=NUMMTNMQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	OKMVU	ééÄ	PKS	OTPRKUT	NMM	
NN	_	S	k ç=d ~ë	TKGRQ	ééÄ	NKT	TPNSKQO	NMMM	
CP	k~	CR	e É	CPQKTMP	ééÄ	NKQ	SNCQVKQV	CMMMMM	
CQ	j Ö	CR	e É	NCMNKNTM	ééÄ	CKO	TVPNRKVP	CMMMMM	
CT	^ä	CR	e É	VNRCSKRNP	ééÄ	PKN	CPPRMUQKNM	CMMMMM	
CU	pá	CR	e O	CCUNKPQD	ééÄ	NKT	CMSVTNKRV	NMMMM	
PV	h	CR	e É	NPSMKMTO	ééÄ	MKS	VUUUNKSN	CMMMMM	
QM	` ~	CR	e O	CPVKKVP	ééÄ	MKR	PMPVVUKUN	CMMMMM	
RN	s	UV	e É	NVMKQNU	ééÄ	MKV	NRTUSNKRT	NMMM	
RO	` ê	UV	e É	UVKUMR	ééÄ	MKV	VQSUQKPM	CMMM	
RR	j å	UV	e É	RRKCPN	ééÄ	NKP	OVRQUKRO	CMMM	
RS	cÉ	UV	e O	NSCQSKVNV	ééÄ	MKV	QMVTQUMMKMO	NMMMM	
RV	` ç	UV	e É	CKVST	ééÄ	NKV	RRRSKUT	NMMM	
SM	k á	UV	e É	NRKVUR	ééÄ	PKM	UNUVKCN	NMMM	
SP	` ì	UV	e É	VPKTTQ	ééÄ	MKT	NPNPVVKRS	CMMM	
SS	wå	UV	e É	PSKTVP	ééÄ	PKM	VSTRKTP	CMMM	
TR	^ë	UV	e É	NVKMVS	ééÄ	MKQ	NUQRKPO	NMMM	
TU	pÉ	UV	e O	PKPUS	ééÄ	PKR	PQVKVV	NMMM	
UU	pê	UV	e É	CNKTNV	ééÄ	NKM	NPVNPKVN	CMMM	
VR	j ç	UV	e É	UKMPV	ééÄ	NKR	QVTMKVU	NMMM	
NMT	^Ö	UV	e É	MKNSS	ééÄ	NUKU	PTQKQS	NMM	
NNN	` Ç	UV	e É	MKCRU	ééÄ	PKT	TUKNR	NMMM	
NNU	på	NRV	e É	QMRKQT	ééÄ	CKN	CRRTMKNN	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKSPT	ééÄ	VKR	PONPKTT	NMMM	
NPT	_~	NRV	k ç=d ~ë	NPNKNVQ	ééÄ	NKN	NSVSTMKPU	CMMM	
NUO	t	NRV	k ç=d ~ë	MKURM	ééÄ	NQKQ	OVUPKRM	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKRUM	ééÄ	PKU	PUSQKST	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NQQKUST	ééÄ	MKO	NNTPNUSKTO	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	OVKNRQ	ééÄ	CKV	OMSRUCKCM	NMMM	
OPU	r	OMV	k ç=d ~ë	TKUVN	ééÄ	NKU	RNVNMKVN	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n` =ï çï	B n` =¤ëÛÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	CNVCUQPKRP	MKT	OTRVPMMVUR	TVKQT	RVMR	NOMQ	
pÅ	CR	k ç=d ~ë	QNNMTCQKUU	MKU	SMQUSNNKO	STKVS	RVMR	NOMQ	
pÅ	CR	e O	VRUMMOKSS	MKV	NRCUCRRKRV	SOKSV	RVMR	NOMQ	
pÅ	CR	e É	NQPQQTKSV	MKV	CPPVRPKQR	SNKPN	RVMR	NOMQ	
d É	TO	k ç=d ~ë	VSUUNQKSM	NKR	NQNCURSKNU	SUKRT	RVMR	NOMQ	
d É	TO	e O	PTMQQTRTV	MKS	SMTRNTKCN	SMKVU	RVMR	NOMQ	
d É	TO	e É	NMTSVVKPS	MKU	NTUUCVKVT	SMKCO	RVMR	NOMQ	
v	UV	e O	QRUCCQCKRT	MKO	SRRTRURKQP	SVKUU	RVMR	NOMQ	
v	UV	e É	TUOTRTKRR	NKM	NOSRCOTKVR	SNKUT	RVMR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSRQNPCKTU	CKN	UQQSUCNKNN	TUKTU	RVMR	NOMQ	
qÄ	NRV	e É	OTVTCPPKOS	NKP	QNMSRTCKVO	SUKNO	RVMR	NOMQ	
_á	OMV	k ç=d ~ë	PRMVQNTHST	NKU	PUSSRTUKPV	VMKTS	RVMR	NOMQ	
_á	OMV	e É	NSTQUNTKRO	NKQ	CPPPTRQKRV	TNKTS	RVMR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMMR

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^Åè=qãã É PLONLOMCP=NUMNOMON

p~ã éäÉ=qóéÉ p~ã éäÉ

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n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	MCRU	ééÄ	TKN	TMCKCR	NMM	
NN	_	S	k ç=d ~ë	PKPPU	ééÄ	CKV	PTSVKCR	NMMM	
CP	k ~	CR	e É	NSSKUUO	ééÄ	SKQ	RNMSPKCO	OMMMMM	
CQ	j Ö	CR	e É	PRVKSRO	ééÄ	NKR	CPNQSKNQ	OMMMMM	
CT	^ ä	CR	e É	NNUNSKVTT	ééÄ	NKM	OVNPUVKPU	OMMMMM	
CU	pá	CR	e O	OSQVKURO	ééÄ	CKS	CPRSSQKRU	NMMMM	
PV	h	CR	e É	QSMSMM	ééÄ	CKO	QQSPUKTV	OMMMMM	
QM	` ~	CR	e O	TURKCPR	ééÄ	NKR	RCPSOTKCR	OMMMMM	
RN	s	UV	e É	OTKCRQ	ééÄ	MKV	ONVTSKPU	NMMM	
RO	` ê	UV	e É	ONKRTR	ééÄ	NKO	CCPSUKNP	OMMM	
RR	j å	UV	e É	ONMKOTP	ééÄ	MKQ	NMUNTVKUO	OMMM	
RS	cÉ	UV	e O	NTTRCKPMT	ééÄ	NKM	QCQSMTPTKVV	NMMMMM	
RV	` ç	UV	e É	PKSNO	ééÄ	CKN	SQUUKQN	NMMM	
SM	k á	UV	e É	RKOVV	ééÄ	SKM	OSUSKVU	NMMM	
SP	` ì	UV	e É	NMKTTO	ééÄ	NKN	NRNUVKRT	OMMM	
SS	wå	UV	e É	PTKRPR	ééÄ	NKO	VRMUKVR	OMMM	
TR	^ ë	UV	e É	UKPQT	ééÄ	RKV	NQSMKCP	NMMM	
TU	pÉ	UV	e O	NKTMP	ééÄ	PKV	NSTKVV	NMMM	
UU	pê	UV	e É	TKUNS	ééÄ	NKQ	QUQTKSU	OMMM	
VR	j ç	UV	e É	NKSNP	ééÄ	NMKT	NMMSKTO	NMMM	
NMT	^ Ö	UV	e É	MKMSS	ééÄ	NNKM	NRCKCP	NMM	
NNN	` Ç	UV	e É	MKCPO	ééÄ	NRKV	STKTU	NMMM	
NNU	på	NRV	e É	PTKPMQ	ééÄ	NKQ	CPRVTKRM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKTPP	ééÄ	CKQ	PSMCKPM	NMMM	
NPT	_~	NRV	k ç=d ~ë	SSKNNS	ééÄ	CKV	UQRNCKVT	OMMM	
NUO	t	NRV	k ç=d ~ë	MKRMQ	ééÄ	NSKP	OMSCKPP	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNQR	ééÄ	NMKO	NPMNKQR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	TPKRRP	ééÄ	NKR	RUUCUPKTN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	PRKONO	ééÄ	MKV	CQRUNVKTR	NMMM	
OPU	r	OMV	k ç=d ~ë	RKQMO	ééÄ	NKP	PRMTSKVR	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n` =ï çï	B n` =¤ä~Ü	n` =¤ä~Ö
i á	S	k ç=d ~ë	ONPSRPCKCO	NKU	OTRVPMVKUR	TTKQP	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVTSRSUKNM	MKV	SMQUSNNKO	SRKTQ	RVKR	NOMQ	
pÅ	CR	e O	VPVUMVKUR	CKT	NRCUCRRKRV	SNKR	RVKR	NOMQ	
pÅ	CR	e É	NPUQQTKVM	MKV	CPPVRPKQR	RVKNT	RVKR	NOMQ	SMOMa ça
d É	TO	k ç=d ~ë	VQURQTKOT	NKO	NQNCURSKNU	STKNQ	RVKR	NOMQ	
d É	TO	e O	PSRMRNKCU	NKR	SMTRNTKCN	SMMMV	RVKR	NOMQ	
d É	TO	e É	NMTVNRNST	NKM	NTUUCVKVT	SMPPR	RVKR	NOMQ	
v	UV	e O	QPQRVQVKVS	MKR	SRRTRURKQP	SSKOT	RVKR	NOMQ	
v	UV	e É	TRRQRNKUM	MKP	NOSRCOTKVR	RVKTN	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SRTMVMOMKNN	MKO	UQQSUCNKNN	TTKTU	RVKR	NOMQ	
qÄ	NRV	e É	OTVVQSCKPV	MKU	QNMSRTCKVO	SUKNT	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQSCMRCKMO	MKU	PUSSRTUKPV	UVKRQ	RVKR	NOMQ	
_á	OMV	e É	NSUSTCSKUP	CKQ	CPPPTRQKRV	TCKCU	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMMR

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^Åè=qáã É PLONLOMCP=NUMTWQU

p~ã éäÉ=qóéÉ p~ã éäÉ

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fpqa=n ` =m~ëëlc~ãä m~ëë

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j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=¤ì ~ë	MKVSM	éé Ä	NPMKV	NTMKMM	NMM	
NN	_	S	k ç=¤ì ~ë	RKMSV	éé Ä	NPKN	NVVRKTO	NMMM	
OP	k ~	QR	e É	PRUKVNS	éé Ä	NMS	QMVTQKNP	OMMMMM	
OQ	j Ö	QR	e É	PSSKNCO	éé Ä	OKV	RNONKMU	OMMMMM	
OT	^ ä	QR	e É	NORVPKTPN	éé Ä	MKR	SQPVOKRN	OMMMMM	
OU	pá	QR	e O	OVVMKPQR	éé Ä	SKU	RQVSRKRS	NMMMM	
PV	h	QR	e É	NNUVKPSP	éé Ä	PKM	PPMORKUV	OMMMMM	
QM	` ~	QR	e O	USVKUST	éé Ä	NKM	NOTSOVKUP	OMMMMM	
RN	s	UV	e É	OVKQTN	éé Ä	OKQ	QVTQKPM	NMMM	
RO	` ê	UV	e É	OPKMSP	éé Ä	MKS	RCUPKPO	OMMM	
RR	j å	UV	e É	OOPKUVQ	éé Ä	MKT	OPQSRKMP	OMMM	
RS	cÉ	UV	e O	NUTSVKSUS	éé Ä	MKP	VMUTQSNKRN	NMMMMM	
RV	` ç	UV	e É	PKORR	éé Ä	RKP	NPPRKST	NMMM	
SM	k á	UV	e É	RKQNP	éé Ä	TKM	SPSKSV	NMMM	
SP	` ì	UV	e É	NVKTNN	éé Ä	RKQ	PSPOKTR	OMMM	
SS	wå	UV	e É	PNKTPP	éé Ä	OKT	OQQVKNQ	OMMM	
TR	^ ë	UV	e É	UKUQS	éé Ä	SKM	POQKMQ	NMMM	
TU	pÉ	UV	e O	OKMVR	éé Ä	SKR	OPKNT	NMMM	
UU	pê	UV	e É	UKSTS	éé Ä	PKU	NNMUKVS	OMMM	
VR	j ç	UV	e É	OKRUQ	éé Ä	NNKS	PSRKRT	NMMM	
NMT	^ Ö	UV	e É	MKNMQ	éé Ä	NUKQ	RTKTU	NMM	
NNN	` Ç	UV	e É	MKPOQ	éé Ä	SKV	OMKMM	NMMM	
NNU	på	NRV	e É	PRKPRN	éé Ä	OKM	RMURKRM	NMMM	
NON	pÄ	NRV	k ç=¤ì ~ë	MKUMP	éé Ä	NMKM	NMSNKNS	NMMM	
NPT	_~	NRV	k ç=¤ì ~ë	SUKMTM	éé Ä	NKT	NTSQSKVV	OMMM	
NUO	t	NRV	k ç=¤ì ~ë	NKOVT	éé Ä	ORKP	NQQUKCU	NMMM	
OMR	qä	OMV	k ç=¤ì ~ë	MKNUS	éé Ä	PRKQ	STQKMS	NMMM	
OMU	mÄ	OMV	k ç=¤ì ~ë	TSKNUV	éé Ä	NKP	NONSVPKMM	OMMM	
OPO	qÜ	OMV	k ç=¤ì ~ë	PNKRPO	éé Ä	PKQ	QRNOQKNN	NMMM	
OPU	r	OMV	k ç=¤ì ~ë	RKQSP	éé Ä	PKS	TMQSKMV	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=¡ çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =¡ çï	B n ` =¤ äÜÜ	n ` =¤ä~Ö
i á	S	k ç=¤ì ~ë	ONTPUURKVN	NKM	OTRVPMMVUR	TURTU	RVRR	NOMQ	
pÅ	QR	k ç=¤ì ~ë	QMQSTTVKTO	NKT	SMQUSNNKO	SSKV	RVRR	NOMQ	
pÅ	QR	e O	VRSUVOKNV	NKT	NRCUCRRKRV	SOKSN	RVRR	NOMQ	
pÅ	QR	e É	NQQRVMKCP	MKO	CPPVRPKQR	SMKVR	RVRR	NOMQ	
d É	TO	k ç=¤ì ~ë	VSPQMSKTU	NKO	NQNCURSKNU	SUKNV	RVRR	NOMQ	
d É	TO	e O	PUCVOVKUR	NKM	SMTRNTKON	SPKMP	RVRR	NOMQ	
d É	TO	e É	NNMSVQKSV	NKM	NTUUOVKVT	SNKV	RVRR	NOMQ	
v	UV	e O	QPUCRPOKVP	MKV	SRRTRURKQP	SSKUP	RVRR	NOMQ	
v	UV	e É	TSRTTNKMT	NKM	NOSRCOTKVR	SMRRO	RVRR	NOMQ	
qÄ	NRV	k ç=¤ì ~ë	SSNTNUUKNU	NKP	UQQSUCNKNN	TUKPQ	RVRR	NOMQ	
qÄ	NRV	e É	CUCUVVRKPO	MKU	QNVSRTOKVO	SUKUV	RVRR	NOMQ	
_á	OMV	k ç=¤ì ~ë	PQCROVRKTM	NKO	PUSSRTUKPV	UUKRV	RVRR	NOMQ	
_á	OMV	e É	NTMVOVQKUS	MKV	OPPPTRQKRV	TPKCQ	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMMR^

cãÉ=k~ã É MPTpj mi hÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíyî mj eyNya^q^yOMCPyMPJ ^oyi n` ON^hÅ

^Åè=qãã É PLONLOMCP=NUWOOMRR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

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j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	NMRPQV	ééÄ	NKQ	NOQNQKPV	NMM	
NN	_	S	k ç=d ~ë	OMSKKMVU	ééÄ	OKS	NRVUSSKQO	NMMM	
OP	k ~	QR	e É	NNUCRKOSS	ééÄ	NKT	NQQTOVVKSU	OMMMMM	
OQ	j Ö	QR	e É	NQTPKUMS	ééÄ	NKU	VPPROKVU	OMMMMM	
OT	^ ä	QR	e É	NOTVSKTVT	ééÄ	MKR	PNPURTKPU	OMMMMM	
OU	pá	QR	e O	TUPSKMNP	ééÄ	OKQ	SUSNUSKVR	NMMMM	
PV	h	QR	e É	NMRCUKSQQ	ééÄ	MKP	SMVVSUKQP	OMMMMM	
QM	` ~	QR	e O	NUPPKNVV	ééÄ	NKM	NNVNRPQKNN	OMMMMM	
RN	s	UV	e É	TTKUPM	ééÄ	MKN	SOMUSKUN	NMMM	
RO	` ê	UV	e É	TPKNNV	ééÄ	MKU	TQNPUKNS	OMMM	
RR	j å	UV	e É	COVKOSM	ééÄ	NKU	NNTPRRKSR	OMMM	
RS	cÉ	UV	e O	NURQUKCRQ	ééÄ	NKN	QPVNVQNVKVS	NMMMMM	
RV	` ç	UV	e É	NQKCRQ	ééÄ	OKM	COQVRNKVU	NMMM	
SM	k á	UV	e É	OSKSCU	ééÄ	NKQ	NPMPTHPT	NMMM	
SP	` ì	UV	e É	QQKOSU	ééÄ	OKM	RVVQNKST	OMMM	
SS	wå	UV	e É	NQCKOMT	ééÄ	NKT	PPONRKSQ	OMMM	
TR	^ ë	UV	e É	SMPPNV	ééÄ	NKM	NMQQMKVU	NMMM	
TU	pÉ	UV	e O	RNKMNN	ééÄ	PKP	QVONKSP	NMMM	
UU	pê	UV	e É	RTKTQU	ééÄ	NKQ	PRQVQKVP	OMMM	
VR	j ç	UV	e É	RQKPUM	ééÄ	NKM	PNVTPKNR	NMMM	
NMT	^ Ö	UV	e É	NMKVQV	ééÄ	PKO	COVCQKMQ	NMM	
NNN	` Ç	UV	e É	NMKUTO	ééÄ	MKU	PNNRKRS	NMMM	
NNU	på	NRV	e É	USKTRU	ééÄ	MKV	RPRNQKVT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NMKNPO	ééÄ	PKT	QRPNSKCU	NMMM	
NPT	_~	NRV	k ç=d ~ë	UQKMRT	ééÄ	MKQ	NMSVUPKNP	OMMM	
NUO	t	NRV	k ç=d ~ë	RQKCQQ	ééÄ	MKT	NPUVTNKPR	NMMM	
OMR	qä	OMV	k ç=d ~ë	VKUQT	ééÄ	OKU	RSTPPKVT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	UPKSMR	ééÄ	MKU	SSOSRNKNV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	QTKTVR	ééÄ	MKQ	PPMMSNKUU	NMMM	
OPU	r	OMV	k ç=d ~ë	NRKTNM	ééÄ	NKP	NMNMPTKQN	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n` =i çï	B n` =¤ä-Ö	n` =¤ä-Ö
i á	S	k ç=d ~ë	ONNQQPTKPR	NKV	OTRVPMMVUR	TSKSO	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PVRPMNRKSU	MKV	SMQUSNNKO	SRKPR	RVKR	NOMQ	
pÅ	QR	e O	VOTVSRKNT	NKQ	NRCUCRRKRV	SMKTO	RVKR	NOMQ	
pÅ	QR	e É	NPTSVQKOV	MKP	OPPVRPKQR	RUKUS	RVKR	NOMQ	SMOMa ça
d É	TO	k ç=d ~ë	VQMCPNKTU	NKR	NQNCURSKNU	SSKRR	RVKR	NOMQ	
d É	TO	e O	PSUPSUKPT	MKQ	SMTRNTKON	SMKSQ	RVKR	NOMQ	
d É	TO	e É	NMSRRRKNV	MKT	NTUUOVKVT	RVKRU	RVKR	NOMQ	
v	UV	e O	QPMPNQVKRS	NKV	SRRTRURKQP	SRKSO	RVKR	NOMQ	
v	UV	e É	TRNTQVKUV	MKO	NOSRCOTKVR	RVKQO	RVKR	NOMQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SRQQOSSKTS	MKT	UQQSUCNKNN	TTKQU	RVKR	NOMQ	
qÄ	NRV	e É	OTTSNTQKMP	NKP	QNMSRTCKVO	STKS	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQPNSMCKCP	MKQ	PUSSRTUKPV	UUKTR	RVKR	NOMQ	
_á	OMV	e É	NSQUCVSKUR	NKP	CPPPTRQKRV	TMKSP	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMMRm

cãÉ=k~ã É MPUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` ONˆHÅ

^Åè=qãã É PLONLOMCP=NUWTWQN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	QVKQSP	éé Ä	NKV	RURVMKNV	NMM	
NN	_	S	k ç=d ~ë	QUNKRTT	éé Ä	NKP	PTMOQQKSP	NMMM	
OP	k ~	QR	e É	UQQRKVPT	éé Ä	OKN	NMPONMOKVQ	OMMMMM	
OQ	j Ö	QR	e É	RRVNKSRU	éé Ä	NKP	PSOVPPKNN	OMMMMM	
OT	^ ä	QR	e É	OQQNPKRVO	éé Ä	OKN	RSQQSUKOS	OMMMMM	
OU	pá	QR	e O	ONSPKPUR	éé Ä	NKT	NVQNNRKUN	NMMMM	
PV	h	QR	e É	VVPRKONT	éé Ä	NKS	RVOPSMKVT	OMMMMM	
QM	` ~	QR	e O	PMOVKTRQ	éé Ä	NKQ	OMMNOUNKNP	OMMMMM	
RN	s	UV	e É	RMPKPVQ	éé Ä	NKO	QNQSTNKSP	NMMM	
RO	` ê	UV	e É	ONRKQQT	éé Ä	NKN	OOQUUOKVS	OMMM	
RR	j å	UV	e É	SNUKOUM	éé Ä	MKR	POTQSRKRN	OMMM	
RS	cÉ	UV	e O	OPVNVKQVQ	éé Ä	NKP	RVOPSPOVKOQ	NMMMMM	
RV	` ç	UV	e É	RMOKSNT	éé Ä	NKQ	VMQSSMKNV	NMMM	
SM	k á	UV	e É	RMUKRQS	éé Ä	NKO	ORRVQUKRT	NMMM	
SP	` ì	UV	e É	OSOKNQO	éé Ä	NKM	PSPVRMKPV	OMMM	
SS	wå	UV	e É	RNSKQPP	éé Ä	MKV	NOOPNUKSM	OMMM	
TR	^ ë	UV	e É	NMQKONS	éé Ä	MKQ	NUSPPKSU	NMMM	
TU	pÉ	UV	e O	UUKNPQ	éé Ä	NKS	UUVSKMV	NMMM	
UU	pê	UV	e É	QUOKURP	éé Ä	MKS	PMTNRNKQV	OMMM	
VR	j ç	UV	e É	VTKMNQ	éé Ä	MKS	RVMNVKOR	NMMM	
NMT	^ Ö	UV	e É	RNKMSO	éé Ä	NKQ	NNMSQVKVU	NMM	
NNN	` Ç	UV	e É	OQUKMVU	éé Ä	MKN	TPRVSKVP	NMMM	
NNU	på	NRV	e É	QUTKMVV	éé Ä	MKR	PMPSQRKMP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	SOKORN	éé Ä	MKT	OUNOQMKNR	NMMM	
NPT	_~	NRV	k ç=d ~ë	NVUQKVQO	éé Ä	MKS	ORSPVSSKSS	OMMM	
NUO	t	NRV	k ç=d ~ë	TVKUNP	éé Ä	NKP	OMTQOTKMO	NMMM	
OMR	qä	OMV	k ç=d ~ë	VQKNUP	éé Ä	MKN	RPVNTPKNU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NTPKQSQ	éé Ä	NKN	NPTQQPVKQP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NRUKTQR	éé Ä	NKM	NMVOTPRKMN	NMMM	
OPU	r	OMV	k ç=d ~ë	NMVKTNV	éé Ä	NKP	TMSMMMKMQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ ÉÅ	B n ` =í çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	ONMQTPTKNT	MKU	OTRVPMMKUR	TSKOU	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	QMONMORKRU	MRR	SMQUSNNKO	SSKQU	RVRR	NOMQ	
pÅ	QR	e O	VQSVNOKPQ	OKO	NROUORRKRV	SNKVS	RVRR	NOMQ	
pÅ	QR	e É	NQNQTQKQV	NKV	OPPVRPKQR	SMKQT	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VSQTSNKMM	MRR	NQNOURSKNU	SUKOU	RVRR	NOMQ	
d É	TO	e O	PTNTNUKQM	MKU	SMTRNTKON	SNKNV	RVRR	NOMQ	
d É	TO	e É	NNNMSRKMO	NKN	NTUUOVKVT	SOKNN	RVRR	NOMQ	
v	UV	e O	QRMNQORKPS	NKO	SRRTRURKQP	SUKSQ	RVRR	NOMQ	
v	UV	e É	TTUQNOKOU	NKM	NOSROOTKVR	SNKRO	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSRMQTNKNM	MKQ	UQQSUONKNN	TUKTP	RVRR	NOMQ	
qÄ	NRV	e É	OUPQTSNKTO	MRR	QNMSRTOKVO	SVKMP	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PQPQQTMKQV	NKN	PUSSRTUKPV	UUKUO	RVRR	NOMQ	
_á	OMV	e É	NSRRMPOKOT	MKV	OPPPTRQKRV	TMKVO	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMMRp

cãÉ=k~ã É MPVpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` ON^HÅ

^Åè=qãã É PLONLOMCP=NUMRRNMQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	QVMMNV	ééÄ	NMS	RTVNSMVU	NMM	
NN	_	S	k ç=d ~ë	QTQMMMD	ééÄ	NMR	PSQMVRMVM	NMMM	
OP	k ~	QR	e É	UNVPMOVM	ééÄ	NMN	NMNQNMVRMMN	OMMMMM	
OQ	j Ö	QR	e É	RURNMVPM	ééÄ	MMS	PTRQPPMTN	OMMMMM	
OT	^ä	QR	e É	OUSVTMVMU	ééÄ	MMN	TNQONSMQM	OMMMMM	
OU	pá	QR	e O	ORNTMURU	ééÄ	OMN	OORQVRMMV	NMMMM	
PV	h	QR	e É	NMDOOMUNS	ééÄ	MMT	SMOMSPMSQ	OMMMMM	
QM	` ~	QR	e O	PQQMMOTP	ééÄ	NMO	OORQMSSMTR	OMMMMM	
RN	s	UV	e É	RNNMQSN	ééÄ	MMQ	QOMURRMTN	NMMM	
RO	` ê	UV	e É	OOPMQSP	ééÄ	MMO	OPPNUOMRP	OMMM	
RR	j å	UV	e É	SUNMTMS	ééÄ	MMS	PSMSNUMSO	OMMM	
RS	cÉ	UV	e O	OPSRRMUQQ	ééÄ	MMN	RUURONVSMTV	NMMMMM	
RV	` ç	UV	e É	RMVRMRMM	ééÄ	MMN	VMUUQOMSM	NMMM	
SM	k á	UV	e É	RMUMOMD	ééÄ	NMM	ORRQUUMRQ	NMMM	
SP	` ì	UV	e É	OSPMMSM	ééÄ	NMP	PSQTVNMTR	OMMM	
SS	wå	UV	e É	RPOMOSQ	ééÄ	MMR	NORUVPMRP	OMMM	
TR	^ë	UV	e É	VTMSNS	ééÄ	NMT	NTQPOMSV	NMMM	
TU	pÉ	UV	e O	UUMRUR	ééÄ	MMT	UVUPMNQ	NMMM	
UU	pê	UV	e É	QUQMRSM	ééÄ	MMR	PMTUSRMSS	OMMM	
VR	j ç	UV	e É	VSMVPT	ééÄ	MMS	RUUVVMVT	NMMM	
NMT	^Ö	UV	e É	RMMROV	ééÄ	MMT	NMVPSNMPV	NMM	
NNN	` Ç	UV	e É	OQSMTRP	ééÄ	MMU	TPNNMMRS	NMMM	
NNU	på	NRV	e É	RMOMVQR	ééÄ	MMU	PMUQLPMNQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	RTMORU	ééÄ	NMM	ORSVMVMPP	NMMM	
NPT	_~	NRV	k ç=d ~ë	OMQMVMP	ééÄ	MMV	OSNTTSNMVP	OMMM	
NUO	t	NRV	k ç=d ~ë	TSMVMTP	ééÄ	NMO	NVSPRVMVT	NMMM	
OMR	qä	OMV	k ç=d ~ë	VQMVVS	ééÄ	NMR	RQPUNPMRO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OMMMQQT	ééÄ	MMU	NRUUOTOMSP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NSTMUTQ	ééÄ	NMQ	NNRRSQRMNM	NMMM	
OPU	r	OMV	k ç=d ~ë	NNNMTPV	ééÄ	NMO	TNVMVOMQV	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n` =ï çï	B n` =¤äÜÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	ONMOSMPMTQ	NMN	OTRVPMMVUR	TSMO	RVMR	NOMQ	
pÅ	QR	k ç=d ~ë	PVTQQMPMSV	OMT	SMQUSNNMO	SRMTN	RVMR	NOMQ	
pÅ	QR	e O	VQRQPRMNQ	MMR	NRQUQRRMRV	SNMUR	RVMR	NOMQ	
pÅ	QR	e É	NPVUQUMPM	MMO	OPPVRPMQR	RVMTU	RVMR	NOMQ	
d É	TO	k ç=d ~ë	VSNRSUMPM	NMP	NQNOURSMNU	SUMVS	RVMR	NOMQ	
d É	TO	e O	PTQNSPMRN	MMT	SMTRNTMON	SNMRV	RVMR	NOMQ	
d É	TO	e É	NNMRQSMPQ	NMQ	NTUUOVMVT	SNMUO	RVMR	NOMQ	
v	UV	e O	QRONSSVMVP	MMQ	SRRTRURMQP	SUMVR	RVMR	NOMQ	
v	UV	e É	TTTQVRMMD	MMU	NOSRQOTMVR	SNMQR	RVMR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSMQPNNMNT	NMM	UQQSUONMNN	TUMNV	RVMR	NOMQ	
qÄ	NRV	e É	OTVMNRVMPR	NMO	QNMSRTOMVO	STMVQ	RVMR	NOMQ	
_á	OMV	k ç=d ~ë	PQPQVTMMSM	NMS	PUSSRTUMPV	UUMUQ	RVMR	NOMQ	
_á	OMV	e É	NSRNPNTMQP	NMM	OPPPTRQMRV	TMMTS	RVMR	NOMQ	

p~ã éäÉ=k~ã É	pn NNUUUMMT
cãÉ=k~ã É	MQMpj mi hÇ
a~í~=m~íÜ=k~ã É	aWÿ ÖäÉåíÿ mj eyNya^q^yOMCPyMPJ ^oyi n ` CN^hÅ
^Åè=qãã É	PLCNLCMCP=NUMPMU
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==i mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	NKQVU	éé Ä	CKM	NMVRKTO	NMM	
NN	_	S	k ç=d ~ë	NCKTPQ	éé Ä	NKP	NMUQQKCO	NMMM	
CP	k ~	CR	e É	NTMKMSP	éé Ä	RKT	RPNNCKNT	CMMMMM	
CQ	j Ö	CR	e É	RUPKSMM	éé Ä	CKM	PURTRKNQ	CMMMMM	
CT	^ ä	CR	e É	QNPUSKCSO	éé Ä	CKQ	NMRCQMRKCM	CMMMMM	
CU	pá	CR	e O	OTCPKVVN	éé Ä	PKM	CQSCSCQKTO	NMMMM	
PV	h	CR	e É	SPPKSUU	éé Ä	CKU	RSNUNKMD	CMMMMM	
QM	` ~	CR	e O	TPMKNPT	éé Ä	MKU	QVRTNUKSV	CMMMMM	
RN	s	UV	e É	NSPKNVT	éé Ä	NKT	NPPNPVKUO	NMMM	
RO	` ê	UV	e É	RRKCST	éé Ä	NKQ	RTRPUKVN	CMMM	
RR	j å	UV	e É	NNUKQNS	éé Ä	NKU	SCNSNKUS	CMMM	
RS	cÉ	UV	e O	OSCVVKNPS	éé Ä	MKQ	SQNTSNMPKCP	NMMMMM	
RV	` ç	UV	e É	CKQMS	éé Ä	NKU	QCSTHRP	NMMM	
SM	k á	UV	e É	VRRSP	éé Ä	CKR	CLUSPKNR	NMMM	
SP	` ì	UV	e É	OSKRRS	éé Ä	PKN	PTNNUKCR	CMMM	
SS	wå	UV	e É	CRKSVR	éé Ä	CKQ	SVPVKSN	CMMM	
TR	^ ë	UV	e É	NQKMTM	éé Ä	RKN	CCQVVKQV	NMMM	
TU	pÉ	UV	e O	PKMTO	éé Ä	NKP	PMTKQV	NMMM	
UU	pê	UV	e É	NQKUPP	éé Ä	NKV	VPRSKSU	CMMM	
VR	j ç	UV	e É	SKSUN	éé Ä	MKV	QMTQKMD	NMMM	
NMT	^ Ö	UV	e É	MKNCQ	éé Ä	CCRT	CUMKMN	NMM	
NNN	` Ç	UV	e É	MKQMV	éé Ä	NCKS	NCNKNN	NMMM	
NNU	på	NRV	e É	PVRTRQ	éé Ä	CKQ	CQVQTRTR	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MRTSS	éé Ä	CKN	PUPQKSN	NMMM	
NPT	_~	NRV	k ç=d ~ë	NQNKVVR	éé Ä	MRT	NURCPMSS	CMMM	
NUO	t	NRV	k ç=d ~ë	MRRTM	éé Ä	CUKN	CCTVKCV	NMMM	
OMR	qä	OMV	k ç=d ~ë	MRRMD	éé Ä	NMKP	PQNMRTQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QMKQNO	éé Ä	MKQ	PCURVRKNU	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	NVKNSR	éé Ä	NKV	NPSSQPKVP	NMMM	
OPU	r	OMV	k ç=d ~ë	CKUVO	éé Ä	NRT	NVMSTKVO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c ä ÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMVNMVPKSO	NKN	OTRVPMMKUR	TRRTU	RVRR	NOMQ	
pÅ	CR	k ç=d ~ë	QMTMUTRKVU	NRR	SMQUSNNKO	STHP	RVRR	NOMQ	
pÅ	CR	e O	VRQVUMKNM	NRV	NRCUCRRKRV	SCKQV	RVRR	NOMQ	
pÅ	CR	e É	NQCVCRKNV	NKQ	CPPVRPKQR	SNKN	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VSRRSCKRP	MKU	NQNCURSKNU	SUPQ	RVRR	NOMQ	
d É	TO	e O	PTMPSMKCS	NRT	SMTRNTKCN	SMKVS	RVRR	NOMQ	
d É	TO	e É	NMUTPQRRO	MKQ	NTUUCVKVT	SMKU	RVRR	NOMQ	
v	UV	e O	QCPRPRUKQR	NKN	SRRTRURKQP	STHSQ	RVRR	NOMQ	
v	UV	e É	TTMNPSKCP	NKM	NCSRCOTKVR	SMKUT	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	STNNPQNKSU	MRP	UQQSUCNKNN	TVKQR	RVRR	NOMQ	
qÄ	NRV	e É	OTUPMSMKTP	CKM	QNMSRTCKVO	STRTT	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PRNCPSPKSO	NKO	PUSSRTUKPV	VMKUQ	RVRR	NOMQ	
_á	OMV	e É	NSURNNCKRM	CKO	CPPPTRQKRV	TCKCN	RVRR	NOMQ	

`çåíaåì åaÖ=~ëäÁê~íáç=sÉêäÑÅ~íáç=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cäÉ=k~ã É	MQN``skÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf^mj eyNya^q^yQMCPyMPJ ^oyi n`CN^hÁ
^Åè=qáã É	PLCNLCMCP=NUAQUMR
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVS^i_kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äí	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	B=oÉÁ	B içï	B eäÜÜ	n`=cä-Ö
V	_É	S	kç=d~ë	CQKTVS	ééÄ	CKS	NVSMUNKUO	CR	VVKNU	UVKU	NNMO	
NN	_	S	kç=d~ë	CRKMPU	ééÄ	CKO	NPMMRSKUV	CR	NMMKNR	UVKU	NNMO	
CP	k~	CR	eÉ	RQTTKCRQ	ééÄ	NKQ	CQSSTTCNKSP	RMMM	NMVRRR	UVKU	NNMO	
CQ	j Ö	CR	eÉ	RQTMKNUO	ééÄ	NKR	CPSPNTRKMT	RMMM	NMVKQ	UVKU	NNMO	
CT	^ä	CR	eÉ	ROTKNCP	ééÄ	NKM	UVMNQKUM	RMM	NMRKQO	UVKU	NNMO	
CU	pá	CR	eO	RMRKTPT	ééÄ	CKQ	PNMMCUKTM	RMM	NMNKNR	UVKU	NNMO	
PV	h	CR	eÉ	RNRMCUV	ééÄ	MKP	CMVRMURRRO	RMMM	NMPKMN	UVKU	NNMO	
QM	`~	CR	eO	RNQMKTNN	ééÄ	CKO	CPNMQVCQKMM	RMMM	NMCKUN	UVKU	NNMO	
RN	s	UV	eÉ	CRKVQR	ééÄ	CKN	NQMMUQKVO	CR	NMPKTU	UVKU	NNMO	
RO	`ê	UV	eÉ	OSKMCU	ééÄ	CKO	NTUOTNKTV	CR	NMQKNN	UVKU	NNMO	
RR	j å	UV	eÉ	CRKSUN	ééÄ	CKM	UVNTQKTP	CR	NMCKTO	UVKU	NNMO	
RS	cÉ	UV	eO	QVUPKRSR	ééÄ	MKT	UMMTVQMRKTR	RMMM	VVKST	UVKU	NNMO	
RV	`ç	UV	eÉ	OSKNOT	ééÄ	NKR	PMTVVNKSS	CR	NMQKRN	UVKU	NNMO	
SM	ká	UV	eÉ	CRKVVM	ééÄ	NKO	URTCRKRP	CR	NMPKVS	UVKU	NNMO	
SP	`ì	UV	eÉ	OSKPUO	ééÄ	NKM	CQMCPVKCQ	CR	NMRKRP	UVKU	NNMO	
SS	wå	UV	eÉ	OSKSNP	ééÄ	NKV	QCCCMUKRT	CR	NMSKQR	UVKU	NNMO	
TR	^ë	UV	eÉ	CRKUCV	ééÄ	CKM	PMCCNKTV	CR	NMPKPO	UVKU	NNMO	
TU	pÉ	UV	eO	CQKSTV	ééÄ	NKQ	NSNSCKSM	CR	VUKTO	UVKU	NNMO	
UU	pê	UV	eÉ	CRKPQT	ééÄ	NKP	NMRRRSKMN	CR	NMNKPV	UVKU	NNMO	
VR	j ç	UV	eÉ	OSKMUN	ééÄ	NKR	NMQCCMCUU	CR	NMQKTO	UVKU	NNMO	
NMT	^Ö	UV	eÉ	OTKMTP	ééÄ	CKM	PUPVNSKNO	CR	NMUKCV	UVKU	NNMO	
NNN	`Ç	UV	eÉ	OSKQRT	ééÄ	NKO	RNPTQKVO	CR	NMRKUP	UVKU	NNMO	
NNU	på	NRV	eÉ	CQKTCP	ééÄ	MKS	NMMRSCKQV	CR	VUKUV	UVKU	NNMO	
NCN	pÄ	NRV	kç=d~ë	CQKMMO	ééÄ	NKO	TNPRTQKSO	CR	VSKMN	UVKU	NNMO	
NPT	_~	NRV	kç=d~ë	CQKVTT	ééÄ	CKP	CNCSMNKCQ	CR	VVKVN	UVKU	NNMO	
NUO	t	NRV	kç=d~ë	OSKNPV	ééÄ	NKO	QQSSRPKVO	CR	NMQKRS	UVKU	NNMO	
CMR	qä	CMV	kç=d~ë	CQKQPT	ééÄ	NKQ	VCQVMMKOV	CR	VTKTR	UVKU	NNMO	
CMU	mÄ	CMV	kç=d~ë	CQKUUU	ééÄ	MKS	NPMQSCRKNQ	CR	VVKRR	UVKU	NNMO	
CPO	qÜ	CMV	kç=d~ë	OSKNTS	ééÄ	MKQ	NNVCMCNKCR	CR	NMQKT	UVKU	NNMO	
CPU	r	CMV	kç=d~ë	OSKNMT	ééÄ	MKN	NNNMVVMKPV	CR	NMQKQP	UVKU	NNMO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=ïçï	B n`=eäÜÜ	n`=cä-Ö
iá	S	kç=d~ë	CUNVCPPKUV	NKS	OTRVPMVKUR	NMCKNU	RVKR	NCMQ	
pÅ	CR	kç=d~ë	RQMNSUPKRO	MKR	SMQUSNNKO	UVKP	RVKR	NCMQ	
pÅ	CR	eO	NCVRPVSKSO	NKM	NRCUCRKRV	UQKTS	RVKR	NCMQ	
pÅ	CR	eÉ	NUUQCPKQV	MKP	CPPVRPKQR	UMKRR	RVKR	NCMQ	
dÉ	TO	kç=d~ë	NPMNNTRKCP	MKQ	NQNCURSKNU	VCKN	RVKR	NCMQ	
dÉ	TO	eO	RNNSTUKUQ	NKQ	SMTRNTKCN	UQKCO	RVKR	NCMQ	
dÉ	TO	eÉ	NQSSRMKVP	MKU	NTUUCVKVT	UCKMN	RVKR	NCMQ	
v	UV	eO	RUCNQCRKNV	MKV	SRRTRURKCP	UVKMU	RVKR	NCMQ	
v	UV	eÉ	NMNVNCVKQS	NKS	NCSRCOTKVR	UMKRR	RVKR	NCMQ	
qÄ	NRV	kç=d~ë	UTRURSUKNS	NKM	UQQSUCNKNN	NVPKSV	RVKR	NCMQ	
qÄ	NRV	eÉ	PSTRQNMKUQ	MKT	QNMSRTCKVO	UVKR	RVKR	NCMQ	
_á	CMV	kç=d~ë	QRQCPUQKRM	MKQ	PUSSRTUKPV	NNTKQU	RVKR	NCMQ	
_á	CMV	eÉ	CNUUPVSKNR	MKQ	CPPPTRQKRV	VPKTT	RVKR	NCMQ	

p~ã éáÉ=k~ã É ` ` _

cäÉ=k~ã É MQQ ` ` _ KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíyf^ mj eyNya^q^yOMOPyMPJ ^oyi n ` ON^ kÅ

^Åè=qáã É PLONLOMOP=NUURTWU

p~ã éáÉ=qóéÉ ` ` _

qçí~äa äi íáçå NKMMMM

` çã ã Éåí JJJ

fpqa=oÉÑcäÉk~ã É MVS ^ i _ KÇ

p~ã éáÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~äi m~ëë

l éÉê~íçê **~Çã áå**

n ` =^ å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==` mp==	i äi á	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMVR	éé Ä	RSKV	OMTKTU	MO	
NN	_	S	k ç=d ~ë	MKPCQ	éé Ä	TKU	OTSSRKUT	Q	
CP	k ~	CR	e É	TKVPT	éé Ä	NOKU	CPMPOKPP	CMM	
CQ	j Ö	CR	e É	PKTMV	éé Ä	NTKV	NTVRKTQ	CM	
OT	^ ä	CR	e É	MKPMS	éé Ä	NUOKS	SRQKQT	CM	
CU	pá	CR	e O	JMKVSO	éé Ä	k L^	NNONKCP	NMM	
PV	h	CR	e É	OTKTRN	éé Ä	NMKM	PNSSMKVR	CMM	
QM	` ~	CR	e O	RKCRM	éé Ä	NKU	PQQRNKMM	CM	
RN	s	UV	e É	MKVOV	éé Ä	RRKT	PSPKPR	N	
RO	` ê	UV	e É	MKVRU	éé Ä	NMS	VUMKRN	N	
RR	j å	UV	e É	MKVOV	éé Ä	QMKN	ORMSO	MQ	
RS	cÉ	UV	e O	PKUVU	éé Ä	PKU	NVQMUVKRQ	CM	
RV	` ç	UV	e É	MKMVR	éé Ä	SOKM	ORTKTV	MO	
SM	k á	UV	e É	MKMNQ	éé Ä	UKN	NRSKST	MQ	
SP	` ì	UV	e É	MKVCU	éé Ä	CUKS	NVPSKTP	MS	
SS	wå	UV	e É	JMKNRV	éé Ä	k L^	UVRKSM	O	
TR	^ ë	UV	e É	MKVPN	éé Ä	NQKP	QSKMM	N	
TU	pÉ	UV	e O	MKVRO	éé Ä	NOKT	PNKUP	N	
UU	pê	UV	e É	MKVCP	éé Ä	QOKV	NNMKMM	N	
VR	j ç	UV	e É	MKNNS	éé Ä	PKN	QSQKQS	N	
NMT	^ Ö	UV	e É	MKVCM	éé Ä	NQKV	QSQKQR	MO	
NNN	` Ç	UV	e É	MKVOR	éé Ä	NTKO	QPKPQ	MO	
NNU	på	NRV	e É	JMKVPO	éé Ä	k L^	SVPKPT	N	
NON	pÄ	NRV	k ç=d ~ë	MKVPM	éé Ä	SKO	NNQQKRV	MO	
NPT	_~	NRV	k ç=d ~ë	MKVRQ	éé Ä	ONKS	RRTKOS	MQ	
NUO	t	NRV	k ç=d ~ë	MKNQN	éé Ä	PTKQ	OVOSKTT	N	
OMR	qä	OMV	k ç=d ~ë	MKVSM	éé Ä	SKT	OQQVKQU	MO	
OMU	mÄ	OMV	k ç=d ~ë	MKVMQ	éé Ä	NMTKT	NTPNKUV	MO	
OPO	qÜ	OMV	k ç=d ~ë	MKVTU	éé Ä	QOKV	RNOSKRM	N	
OPU	r	OMV	k ç=d ~ë	MKVOS	éé Ä	NNKM	VUQKQO	MO	

n ` =fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÁ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OQOVRMNKNO	MKT	OTRVPMMKUR	UUKVR	RVKR	NOMKQ	
pÅ	CR	k ç=d ~ë	ORURMQPKPQ	OKM	SMQUSNNKO	TRKU	RVKR	NOMKQ	
pÅ	CR	e O	NNNPRMQKNR	NKV	NRQUORRKRV	TOKUS	RVKR	NOMKQ	
pÅ	CR	e É	NSRSOMKOS	MKQ	OPPVRPKQR	TMKTV	RVKR	NOMKQ	
dÉ	TO	k ç=d ~ë	NNONOMTKOV	MKT	NQNOURSKNU	TVKPS	RVKR	NOMKQ	
dÉ	TO	e O	QQRSNVKRM	MKU	SMTRNTKON	TPKPR	RVKR	NOMKQ	
dÉ	TO	e É	NOUUMVKPQ	MKS	NTUUOVKVT	TOKMP	RVKR	NOMKQ	
v	UV	e O	RNMNOMOKPQ	MKO	SRRTRURKQP	TTKTV	RVKR	NOMKQ	
v	UV	e É	UUMRMTKPQ	MKU	NOSROOTKVR	SVKRV	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	TQRUTROKPP	NKO	UQQSUONKNN	UUKP	RVKR	NOMKQ	
qÄ	NRV	e É	POTNMNUKTT	MKT	QNMSRTOKVO	TVKSR	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PUPUQQRKOT	MKP	PUSSRTUKPV	VVKOT	RVKR	NOMKQ	
_á	OMV	e É	NUUSTURKQU	MKU	OPPPTRQKRV	UMKUR	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NNUUUMMV

cãÉ=k~ã É MOPpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n` ON^hÅ

^Åè=qáã É PLONLOMOP=NVMMONR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKMON	ééÄ	OSKU	OMNKNO	NMM	
NN	_	S	k ç=d ~ë	OKNQS	ééÄ	UKN	OUOTKMM	NMMM	
OP	k ~	QR	e É	NOMKUCR	ééÄ	RKQ	QSVOQHSN	OMMMMM	
OQ	j Ö	QR	e É	UNKRSU	ééÄ	TKN	RSRVKNM	OMMMMM	
OT	^ ä	QR	e É	PSMQKRPR	ééÄ	MKS	VNUQUKNO	OMMMMM	
OU	pá	QR	e O	NOQSKRUP	ééÄ	NKU	NNQTTTKRP	NMMMM	
PV	h	QR	e É	OUMSNS	ééÄ	RKP	PRQTTKOS	OMMMMM	
QM	` ~	QR	e O	NNSKSNO	ééÄ	MKU	VMSOTKMQ	OMMMMM	
RN	s	UV	e É	UKTPT	ééÄ	OKS	TPRVKUP	NMMM	
RO	` ê	UV	e É	NNKSSS	ééÄ	MKU	NOSRSKSM	OMMM	
RR	j å	UV	e É	NUKMDQ	ééÄ	NKV	VSPUKUM	OMMM	
RS	cÉ	UV	e O	NRNNKUCP	ééÄ	NKS	PTSOUSVRV	NMMMMM	
RV	` ç	UV	e É	MKCPQ	ééÄ	NPKO	SMQKQV	NMMM	
SM	k á	UV	e É	NKTSP	ééÄ	RKP	VUQKRM	NMMM	
SP	` ì	UV	e É	NVKTNR	ééÄ	NKO	OTUVVKOQ	OMMM	
SS	wå	UV	e É	OMKTUO	ééÄ	NKN	RUPNKPO	OMMM	
TR	^ ë	UV	e É	NKSVU	ééÄ	PKU	PNRKMQ	NMMM	
TU	pÉ	UV	e O	MKPMR	ééÄ	UKV	POKST	NMMM	
UU	pê	UV	e É	PKSNU	ééÄ	PKR	OPNOKQS	OMMM	
VR	j ç	UV	e É	NKMPT	ééÄ	RKT	SUQKQT	NMMM	
NMT	^ Ö	UV	e É	MKMRV	ééÄ	NTKU	NQMKMM	NMM	
NNN	` Ç	UV	e É	MKMRN	ééÄ	PQKQ	NSKOV	NMMM	
NNU	på	NRV	e É	PTKSUQ	ééÄ	NKS	OQNTVKST	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOTO	ééÄ	PKO	NRPRKMP	NMMM	
NPT	_~	NRV	k ç=d ~ë	VKSVR	ééÄ	PKU	NOQMOKOP	OMMM	
NUO	t	NRV	k ç=d ~ë	MKSUO	ééÄ	NMKS	OQVSKPQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNQU	ééÄ	OSKP	NPOQKUM	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NNKRSV	ééÄ	NKV	VPVMTHRN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	PPKNUP	ééÄ	OKT	OPOOMSKQU	NMMM	
OPU	r	OMV	k ç=d ~ë	RKQUN	ééÄ	MKS	PRSSNKMM	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n` =ï çï	B n` =¤eåÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	ONOQUMPKVO	MKS	OTRVPMMKUR	TTKMN	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVVUTNSKUT	MKT	SMQUSNNKO	SSKNN	RVKR	NOMKQ	
pÅ	QR	e O	VSUNUOKOM	NKR	NRCUCRRKRV	SPKPR	RVKR	NOMKQ	
pÅ	QR	e É	NQQQSTKQS	NKM	OPPVRPKQR	SMKV	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VSRMOPRTV	MKT	NQNOURSKNU	SUKP	RVKR	NOMKQ	
d É	TO	e O	PUNSUTKMR	MKU	SMTRNTKON	SOKUP	RVKR	NOMKQ	
d É	TO	e É	NNMRMUKMP	NKV	NTUUOVKVT	SNKU	RVKR	NOMKQ	
v	UV	e O	QQTRMNVKNU	NKO	SRRTRURKQP	SUKCQ	RVKR	NOMKQ	
v	UV	e É	TTQQOTKMV	MKR	NOSROOTKVR	SNKON	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SRNNNOVKPN	NKQ	UQQSUONKNN	TTKMU	RVKR	NOMKQ	
qÄ	NRV	e É	OUQMOTOKUN	MKQ	QNMSRTOKVO	SVKNS	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PQSUUOPKTR	MKU	PUSSRTUKPV	UVKTN	RVKR	NOMKQ	
_á	OMV	e É	NSTUSNPKPO	NKQ	OPPPTRQKRV	TNKVP	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NNUUUMNR

cãÉ=k~ã É MQQpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` ONˆHÅ

^Åè=qáã É PLONLOMCP=NVMMTMQN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	MCRT	ééÄ	CKR	QSCKCQ	NMM	
NN	_	S	k ç=d ~ë	CKSPQ	ééÄ	CKU	PCPRKVT	NMMM	
CP	k ~	CR	e É	NQMCSS	ééÄ	CKS	QVMTMKUT	OMMMMM	
CQ	j Ö	CR	e É	CQTHRQM	ééÄ	NKQ	NSQQPKCV	OMMMMM	
CT	^ ä	CR	e É	UPCRKCSU	ééÄ	MKQ	ONMQQQCKQT	OMMMMM	
CU	pá	CR	e O	CMNRKCNP	ééÄ	PKO	NUMPSNKMV	NMMMM	
PV	h	CR	e É	PUMKCVT	ééÄ	NKU	QNRVVKNQ	OMMMMM	
QM	` ~	CR	e O	QQUKQCO	ééÄ	CKN	PMRTRQKNP	OMMMMM	
RN	s	UV	e É	OMPMQ	ééÄ	NKS	NSUUTKMM	NMMM	
RO	` ê	UV	e É	NTKMTS	ééÄ	CKQ	NUPCNKMS	OMMM	
RR	j å	UV	e É	NNVKNTO	ééÄ	NKN	SPNMRKVP	OMMM	
RS	cÉ	UV	e O	NPNSVKNTR	ééÄ	NKN	POTVQNPCKVU	NMMMM	
RV	` ç	UV	e É	CKCQM	ééÄ	PKT	QCMTKQR	NMMM	
SM	k á	UV	e É	PKPNP	ééÄ	SKR	NTSRKTM	NMMM	
SP	` ì	UV	e É	SKMCS	ééÄ	CKT	VMRSKQM	OMMM	
SS	wå	UV	e É	CQKQNN	ééÄ	PKS	STMMKSO	OMMM	
TR	^ ë	UV	e É	TKVUM	ééÄ	CKO	NQPSKCP	NMMM	
TU	pÉ	UV	e O	NKRTM	ééÄ	NPKU	NSNKNS	NMMM	
UU	pê	UV	e É	CKUPV	ééÄ	MKT	PMVCKUT	OMMM	
VR	j ç	UV	e É	NKPCO	ééÄ	NPKV	URUKVP	NMMM	
NMT	^ Ö	UV	e É	MKMTR	ééÄ	NNKS	NTSKST	NMM	
NNN	` Ç	UV	e É	MKMVQ	ééÄ	NVKU	OUKUV	NMMM	
NNU	på	NRV	e É	PUKMPS	ééÄ	NKP	CQNTQKCO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKRPN	ééÄ	NMKP	OTPPKNS	NMMM	
NPT	_~	NRV	k ç=d ~ë	PRKQUO	ééÄ	CKQ	QRVOVKQN	OMMM	
NUO	t	NRV	k ç=d ~ë	MKPMT	ééÄ	UKT	NRTRKMV	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNMU	ééÄ	PSKT	NMVTKUU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QPKCOT	ééÄ	MKV	PQVSCCKPM	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	RQKNCU	ééÄ	NKM	PUMQNTKUN	NMMM	
OPU	r	OMV	k ç=d ~ë	UKQCR	ééÄ	MKU	RRCMRKCP	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n` =¨çï	B n` =¤äÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	ONQRTRSKRU	NKO	OTRVPMMVUR	TTKTS	RVMR	NOMQ	
pÅ	CR	k ç=d ~ë	PVRRRUUKRM	MKT	SMQUSNNKO	SRKQ	RVMR	NOMQ	
pÅ	CR	e O	VQQTOMKNN	NKU	NRCUCRRKRV	SNKUO	RVMR	NOMQ	
pÅ	CR	e É	NQNTVNKUM	MKS	OPPVRPKQR	SMKSN	RVMR	NOMQ	
d É	TO	k ç=d ~ë	VSRPPUMVS	MKS	NQNCURSKNU	SUKPP	RVMR	NOMQ	
d É	TO	e O	PTVPUVKUR	MKS	SMTRNTKON	SOKQR	RVMR	NOMQ	
d É	TO	e É	NNNOTSKPO	MKO	NTUUCVKVT	SOKCO	RVMR	NOMQ	
v	UV	e O	QRCPTPNKRO	NKP	SRRTRURKQP	SUKVU	RVMR	NOMQ	
v	UV	e É	TTSUMCKVO	MKQ	NOSRCOTKVR	SNKQ	RVMR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSQPCNUKUM	NKR	UQQSUCNKNN	TUKSR	RVMR	NOMQ	
qÄ	NRV	e É	OUNQQCCKNT	NKP	QNMSRTCKVO	SUKRP	RVMR	NOMQ	
_á	OMV	k ç=d ~ë	PQVCQVSMKNM	NKM	PUSSRTUKPV	VMKPV	RVMR	NOMQ	
_á	OMV	e É	NSUSTRQKNQ	MKT	OPPPTRQKRV	TCKCU	RVMR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` NQfj t N
cáÉ=k~ã É	MQR| m_KÇ
a~í~=m~íÜ=k~ã É	a Wy^ÖäÉáíyf` mj e yNya^q^yOMOPyMPJ ^o yi n` ON^kÄ
^Åè=qáã É	PLONLOMOP=NVMNOVOV
p~ã éäÉ=qóéÉ	m_
qçí~ä=a áä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~áä
fpqa=n` =m~ëëLc~áä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==` mp==	i áã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	JMKMUQ	ééÄ	k L^	RCKCO	MKR	
_	NN	S	k ç=d ~ë	MKUVR	ééÄ	SKT	NURCKPT	NM	
k~	OP	QR	e É	UQKMON	ééÄ	OKU	QPMQRKOS	RMM	
j Ö	OQ	QR	e É	SKTRS	ééÄ	NKO	TUSKTO	RM	
^ä	OT	QR	e É	PNKUQU	ééÄ	NRKN	NPRMKMV	RM	
pá	OU	QR	e O	NQKVNS	ééÄ	NOKV	OPRSKMP	ORM	
h	PV	QR	e É	NTVKQNP	ééÄ	RKP	PMMOPKVO	RMM	
` ~	QM	QR	e O	NMSKVPV	ééÄ	MKT	UPUTTKST	RM	m_=SMOM=c~áë=a ça & m_=SMOM=c~áë=k çåJa ça
s	RN	UV	e É	MKPUR	ééÄ	NTKN	RNSKSV	OKR	
` ê	RO	UV	e É	MKPQQ	ééÄ	NNKR	VNRKNV	OKR	
j å	RR	UV	e É	MKPVO	ééÄ	NMKU	PRMKSN	N	
cÉ	RS	UV	e O	ONKSPR	ééÄ	VKR	VQVUVKNS	RM	
` ç	RV	UV	e É	JMKMQV	ééÄ	k L^	VTKTU	MKR	
k á	SM	UV	e É	MKMSP	ééÄ	RMKU	NPPKPP	N	
` ì	SP	UV	e É	MKMRT	ééÄ	RVKU	TVTKUN	NKR	
wå	SS	UV	e É	RKQQV	ééÄ	OKU	OOQPKRS	R	m_=SMOM=c~áë=a ça
^ë	TR	UV	e É	MKNQT	ééÄ	OPKV	PVKPP	OKR	
pÉ	TU	UV	e O	MKMQT	ééÄ	SKV	SKST	OKR	
pê	UU	UV	e É	MKNVT	ééÄ	RKS	NQTKTU	OKR	
j ç	VR	UV	e É	MKOTP	ééÄ	PPKS	OOOKOP	OKR	
^Ö	NMT	UV	e É	MKMMU	ééÄ	UOKP	PMKMM	MKR	
` Ç	NNN	UV	e É	MKMNN	ééÄ	RTKP	QKQQ	MKR	
på	NNU	NRV	e É	JMKPTO	ééÄ	k L^	QTRKRT	OKR	
pÄ	NON	NRV	k ç=d ~ë	MKMTO	ééÄ	PQKM	STMKTP	MKR	
_~	NPT	NRV	k ç=d ~ë	MKPVS	ééÄ	NNKN	SSQKMR	N	
t	NUO	NRV	k ç=d ~ë	MKNNU	ééÄ	PSKU	NMVQKRQ	OKR	
qä	OMR	OMV	k ç=d ~ë	MKMOP	ééÄ	PNKV	RVTKPO	MKR	
mÄ	OMU	OMV	k ç=d ~ë	MKMNR	ééÄ	NMQKS	NRQNKST	MKR	
qÜ	OPO	OMV	k ç=d ~ë	MKVSU	ééÄ	TKR	USNUKTR	OKR	
r	OPU	OMV	k ç=d ~ë	MKMOO	ééÄ	QPKR	NTSKUS	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eáÜÜ	n`=cä-Ö
iá	S	kç=dl~ë	CNNTNPPMVN	MKT	OTRVPMMKUR	TSKTP	RVMR	NOMQ	
pÅ	QR	kç=dl~ë	QMVPRNNMVU	OMP	SMQUSNNKO	STKSU	RVMR	NOMQ	
pÅ	QR	eO	VSRNTTMVS	NKO	NRQUQRRMRV	SPMVS	RVMR	NOMQ	
pÅ	QR	eÉ	NQQRQQKUO	MKU	QPPVRPMQR	SNMTT	RVMR	NOMQ	
dÉ	TO	kç=dl~ë	VURQNVMVP	NMR	NQNQURSMVU	SVMTR	RVMR	NOMQ	
dÉ	TO	eO	PUQUTQMVO	MMR	SMTRNTMQN	SPMPR	RVMR	NOMQ	
dÉ	TO	eÉ	NNQRQNMQP	MMV	NTUUQVMVT	SQMVP	RVMR	NOMQ	
v	UV	eO	QQNVQSRMTT	MMS	SRRTRURMQP	STMVO	RVMR	NOMQ	
v	UV	eÉ	TTPQNPMRQ	MMS	NQSRQQTMVR	SNMVN	RVMR	NOMQ	
qÄ	NRV	kç=dl~ë	SSUQSQVMVU	NMM	UQQSUQNMVN	TVMVQ	RVMR	NOMQ	
qÄ	NRV	eÉ	QUTSTTSMRN	MMP	QNMVSRTQMVO	TMMVR	RVMR	NOMQ	
_á	QMV	kç=dl~ë	PQSQVMNPMUP	NMU	PUSSRTUMPV	UVMRV	RVMR	NOMQ	
_á	QMV	eÉ	NSVUUSQMTN	MMV	QPPPTRQMRV	TQMU	RVMR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i `pt n` NQfj t N
cäÉ=k~ã É	MQSi `pt kÇ
a~í~=m~íÜ=k~ã É	aWf^ÖäÉáíyf` mj eyNya^q^yQMQPyMPuj ^oyi n` QN^kÄ
^Åè=qã É	PLQNLQMQP=NVNNTWS
p~ã éäÉ=qóéÉ	i `pt
qçí~äaãäíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MVS` ^i _kÇ
p~ã éäÉ=n` =m~ëëlc á~ä	c~äà
fpqa=n` =m~ëëlc~äà	m~ëë
l éÉê~íçê	**~Çã åà**

n` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==i mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n` =c ä-Ö
_É	V	S	k ç=d ~ë	RPKRVO	éëÄ	QKN	SQMPQKRU	RM	QNKQQ	TVKR	NQMQ	
_	NN	S	k ç=d ~ë	RPNKTQP	éëÄ	PKO	QNQUPMQS	RMM	QNKOT	TVKR	NQMQ	
k~	QP	QR	e É	UVTPKRPT	éëÄ	QKV	NNQMQRQKRM	TRMM	QPKVP	TVKR	NQMQ	a ça
j Ö	QQ	QR	e É	RSVPKMQP	éëÄ	NKT	PTSMUUKVR	RMMM	QQKTT	TVKR	NQMQ	
^ä	OT	QR	e É	QQRTKUNR	éëÄ	MKS	RUPQQKRS	QMMM	QQKRU	TVKR	NQMQ	
pá	QU	QR	e O	NVRUKMPN	éëÄ	NKO	VUPSNKQQ	NMMM	QNKNS	M	QMM	
h	PV	QR	e É	NVSNQKVSV	éëÄ	MKS	SQQVQRKVO	NMMMM	QNKQP	TVKR	NQMQ	
` ~	QM	QR	e O	OTPQKMQV	éëÄ	MKV	NUSQMQVKVM	QRMM	QNKUS	TVKR	NQMQ	
s	RN	UV	e É	RRQKQNS	éëÄ	QKM	QQVTNUKRP	RMM	QQKN	TVKR	NQMQ	
` ê	RO	UV	e É	QQQKQQN	éëÄ	QKM	QQVQRQKQS	QMM	QQKQO	TVKR	NQMQ	
j å	RR	UV	e É	RRPKMPO	éëÄ	NKT	QUVRMPKUS	RMM	QQKNO	TVKR	NQMQ	
cÉ	RS	UV	e O	NVUSKRNU	éëÄ	QKT	QSTPNSTKNV	NMMM	QNKTP	TVKR	NQMQ	
` ç	RV	UV	e É	RTUKPTS	éëÄ	PKT	NMQUSTRKNQ	RMM	QPKNQ	TVKR	NQMQ	a ça
ká	SM	UV	e É	RTQKQSM	éëÄ	QKN	QUQTPPKMQ	RMM	QQKV	TVKR	NQMQ	
` ì	SP	UV	e É	QUUKUPS	éëÄ	NKT	PVSQRSKNV	QRM	QPKNN	TVKR	NQMQ	
wå	SS	UV	e É	RSMKNTM	éëÄ	NKS	NPNMQTKSO	RMM	QQKQN	TVKR	NQMQ	
^ë	TR	UV	e É	NVMKVQS	éëÄ	MKV	NVQQQKUR	NMM	QNKVU	TVKR	NQMQ	
pÉ	TU	UV	e O	NVQKVQQ	éëÄ	MKR	NMPSRKPS	NMM	QMKVV	TVKR	NQMQ	
pê	UU	UV	e É	RQQKPUQ	éëÄ	MKS	PQMVVMKUS	RMM	QNKT	TVKR	NQMQ	
j ç	VR	UV	e É	NNNKPMU	éëÄ	MKU	SSVNQKPV	NMM	QQKQS	TVKR	NQMQ	
^Ö	NMT	UV	e É	RUKPQV	éëÄ	QKQ	NQQVRQKRP	RM	QPKPQ	TVKR	NQMQ	a ça
` Ç	NNN	UV	e É	QUPKPSU	éëÄ	NKO	UPMTTKQM	QRM	QQKST	TVKR	NQMQ	
på	NNU	NRV	e É	RNMKPNR	éëÄ	MKR	PNUSTQKPP	RMM	QMKQN	TVKR	NQMQ	
pÄ	NON	NRV	k ç=d ~ë	VUKNQM	éëÄ	QKQ	QQUUNQKUQ	NMM	NVKSP	TVKR	NQMQ	
_~	NPT	NRV	k ç=d ~ë	ONONKTTR	éëÄ	PKU	OTTRNRQKTV	QMMM	QNKQO	TVKR	NQMQ	
t	NUO	NRV	k ç=d ~ë	NVMKQSM	éëÄ	NKT	QUTPMRKTQ	NMM	QNKUR	TVKR	NQMQ	
qä	QMR	QMV	k ç=d ~ë	NVQKTUQ	éëÄ	PKO	SMQVPPKUQ	NMM	QMKVS	TVKR	NQMQ	
mÄ	QMU	QMV	k ç=d ~ë	NVSKTUU	éëÄ	NKQ	URQNQPKNT	NMM	QNKPS	TVKR	NQMQ	
qÜ	QPO	QMV	k ç=d ~ë	NVQKTMQ	éëÄ	NKR	TOTTQRKRQ	NMM	QMKVQ	TVKR	NQMQ	
r	QPU	QMV	k ç=d ~ë	NNMKNRR	éëÄ	QKP	TNRMQMQQO	NMM	QQKMP	TVKR	NQMQ	

n` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä-Ö
iá	S	kç=d~ë	ONOSUVSKQU	OKQ	OTRVPMMKUR	TTKMU	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QMURQQUKVM	NKO	SMQUSNNKO	STKRQ	RVKR	NOMQ	
pÅ	QR	eO	VTSONVKMO	MKT	NRCUCRRKRV	SPKUU	RVKR	NOMQ	
pÅ	QR	eÉ	NQPVVRKRT	NKP	OPPVRPKQR	SNKRR	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VUNSVMKQM	MKS	NQNCURSKNU	SVKQU	RVKR	NOMQ	
dÉ	TO	eO	PVOSPTKMN	MKP	SMTRNTKON	SQKSP	RVKR	NOMQ	
dÉ	TO	eÉ	NNCOVMKUT	MKQ	NTUUCVKVT	SOKTV	RVKR	NOMQ	
v	UV	eO	QQMQCSSKTN	NKM	SRRTRURKQP	STKNS	RVKR	NOMQ	
v	UV	eÉ	TSVPVSKMN	NKQ	NCSRCOTKVR	SMKUN	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	STPSRTUKUU	NKR	UQQSUCNKNN	TVKTR	RVKR	NOMQ	
qÄ	NRV	eÉ	CUQMTRMKVM	NKR	QNMSRTCKVO	SVKNU	RVKR	NOMQ	
_á	QW	kç=d~ë	PQSRMCCKW	NKS	PUSSRTUKPV	UVKSN	RVKR	NOMQ	
_á	QW	eÉ	NSSCNCUKSU	MKU	OPPPTRQKRV	TNKCO	RVKR	NOMQ	

p~ã éäÉ=k~ã É	pn MUTRJMMN
cãÉ=k~ã É	MQTpj mi hÇ
a~í~=m~íÜ=k~ã É	aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` ONˆHÅ
^Åè=qãã É	PLONLOMCP=NMØRMOV
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=¤ ~ë	MKMPS	éé Ä	ROKR	NVQKQR	NMM	
NN	_	S	k ç=¤ ~ë	TPKTUM	éé Ä	OKN	RUOVTKQO	NMMM	
OP	k ~	QR	e É	NVNSTKTOQ	éé Ä	MKT	OQPVNOMKRR	OMMMMM	
OQ	j Ö	QR	e É	NMSMTKRQS	éé Ä	MKV	TNONUQKUN	OMMMMM	
OT	^ ä	QR	e É	RNSKQNM	éé Ä	OKS	NPVUNKQS	OMMMMM	
OU	pá	QR	e O	VMQTKVQT	éé Ä	MKS	UOVPONKST	NMMMM	
PV	h	QR	e É	SNQRKURR	éé Ä	NKM	PUSTQUKNQ	OMMMMM	
QM	` ~	QR	e O	TNSSOKRRU	éé Ä	NKR	QUOTVUPRKPV	OMMMMM	
RN	s	UV	e É	OKTRU	éé Ä	OKM	OQROKQU	NMMM	
RO	` ê	UV	e É	OKUQV	éé Ä	NKM	PRMNKNM	OMMM	
RR	j å	UV	e É	OPPKMTV	éé Ä	NKP	NOOQPTKQO	OMMM	
RS	cÉ	UV	e O	ORQSKUPQ	éé Ä	OKT	SPSPQRMQN	NMMMMM	
RV	` ç	UV	e É	OKPMN	éé Ä	OKP	QOUTKQU	NMMM	
SM	k á	UV	e É	PKURU	éé Ä	NKM	OMORKTQ	NMMM	
SP	` ì	UV	e É	OKRPM	éé Ä	PKQ	QNVOKVP	OMMM	
SS	wå	UV	e É	RKQOR	éé Ä	VKR	OOPOKQQ	OMMM	
TR	^ ë	UV	e É	QKUVR	éé Ä	NKN	UUMKNO	NMMM	
TU	pÉ	UV	e O	MKRNR	éé Ä	TKV	RQKNT	NMMM	
UU	pê	UV	e É	OOVKRQN	éé Ä	NKO	NQQTNRKUP	OMMM	
VR	j ç	UV	e É	NKMQN	éé Ä	VKU	SUQKQT	NMMM	
NMT	^ Ö	UV	e É	MKMRV	éé Ä	VKQ	NQMKMM	NMM	
NNN	` Ç	UV	e É	MKOOM	éé Ä	NVKO	TNKQU	NMMM	
NNU	på	NRV	e É	MKMRO	éé Ä	NSSKS	TQPHPT	NMMM	
NON	pÄ	NRV	k ç=¤ ~ë	MKRPS	éé Ä	NPKO	OTVVKVO	NMMM	
NPT	_~	NRV	k ç=¤ ~ë	ROKPMV	éé Ä	NKT	SUTOPHPR	OMMM	
NUO	t	NRV	k ç=¤ ~ë	MKRSM	éé Ä	THP	OOSRKVO	NMMM	
OMR	qä	OMV	k ç=¤ ~ë	MKOTP	éé Ä	NPKU	OMSRKSV	NMMM	
OMU	mÄ	OMV	k ç=¤ ~ë	MKSSM	éé Ä	NKQ	STTNKNV	OMMM	
OPO	qÜ	OMV	k ç=¤ ~ë	NKNTS	éé Ä	OKU	NMNUUKCP	NMMM	
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n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ ÉÅ	B n ` =¡ çï	B n ` =¤ äÜÜ	n ` =¤ä~Ö
i á	S	k ç=¤ ~ë	ONOSSRPKOQ	NKN	OTRVPMMKUR	TTKMT	RVKR	NOMQ	
pÅ	QR	k ç=¤ ~ë	OMQQVQNKRM	MKV	SMQUSNNKO	SSKUT	RVKR	NOMQ	
pÅ	QR	e O	VTNOVVKQN	NKO	NRCUCRRKRV	SPKRS	RVKR	NOMQ	
pÅ	QR	e É	NQSPVMKON	MKQ	OPPVRPKQR	SOKRT	RVKR	NOMQ	
d É	TO	k ç=¤ ~ë	VUCUVRMVO	NKU	NQNCURSKNU	SVKRT	RVKR	NOMQ	
d É	TO	e O	PVNQPOKST	NKO	SMTRNTKON	SQKQP	RVKR	NOMQ	
d É	TO	e É	NNQCCQKMM	MKP	NTUUOVKVT	SPKUT	RVKR	NOMQ	
v	UV	e O	QRNQNCSKVU	NKM	SRRTRURKQP	SUKUQ	RVKR	NOMQ	
v	UV	e É	TTNRNQKMP	NKO	NOSRCOTKVR	SMKVU	RVKR	NOMQ	
qÄ	NRV	k ç=¤ ~ë	STQVQCCKUV	MKV	UQQSUCNKNN	TVKV	RVKR	NOMQ	
qÄ	NRV	e É	OUTVPVPKMV	NKO	QNMSRTOKVO	TMKNO	RVKR	NOMQ	
_á	OMV	k ç=¤ ~ë	PRMSVCUKRM	NKM	PUSSRTUKPV	VMKT	RVKR	NOMQ	
_á	OMV	e É	NSUTRRNKRS	NKM	OPPPTRQKRV	TOKPN	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MUTRJMMO

cãÉ=k~ã É MQLpj mi hÇ

a~í~=m~íÜ=k~ã É aWjtÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` ON^HÅ

^Åè=qãã É PLONLOMCP=NVARMMPT

p~ã éäÉ=qóéÉ p~ã éäÉ

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p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKMPU	ééÄ	k L^	NVRKRS	NMM	
NN	_	S	k ç=d ~ë	TMKQST	ééÄ	OKO	RRNOVKQV	NMMM	
OP	k ~	QR	e É	NUUVPKSOT	ééÄ	NKU	OPVRMUOKOV	OMMMMM	
OQ	j Ö	QR	e É	NMPQQKNQQ	ééÄ	MKS	SVNTSUKMM	OMMMMM	
OT	^ ä	QR	e É	NRNKPUQ	ééÄ	NKS	QQSNKVM	OMMMMM	
OU	pá	QR	e O	UNNQKVQM	ééÄ	NKR	TRUQPQKPV	NMMMM	
PV	h	QR	e É	RVRVKVUM	ééÄ	NKQ	PTQNNTKQS	OMMMMM	
QM	` ~	QR	e O	SVPMPKOPP	ééÄ	MKR	QTSMTNVVKUR	OMMMMM	
RN	s	UV	e É	NKUOT	ééÄ	TKU	NSURKSV	NMMM	
RO	` ê	UV	e É	OKNSQ	ééÄ	QKP	OTUOKQO	OMMM	
RR	j å	UV	e É	OOSKMQN	ééÄ	NKM	NNUOSUKSV	OMMM	
RS	cÉ	UV	e O	NVPSKQOR	ééÄ	NKR	QUPRMUVKRR	NMMMM	
RV	` ç	UV	e É	NKVOR	ééÄ	OKN	PSMOKUO	NMMM	
SM	k á	UV	e É	PKMRQ	ééÄ	PKN	NSNTKVM	NMMM	
SP	` ì	UV	e É	NKMQS	ééÄ	NKU	ONQRKTS	OMMM	
SS	wå	UV	e É	NKQTS	ééÄ	NNKO	NPVMTKUS	OMMM	
TR	^ ë	UV	e É	PKVTR	ééÄ	PKP	TNQKMV	NMMM	
TU	pÉ	UV	e O	MKPRS	ééÄ	NUKO	PUKMM	NMMM	
UU	pê	UV	e É	OOQKSTV	ééÄ	MKR	NQNMTUKOV	OMMM	
VR	j ç	UV	e É	MKSRU	ééÄ	VKT	QRNKMP	NMMM	
NMT	^ Ö	UV	e É	MKMON	ééÄ	OVKN	RUKUV	NMM	
NNN	` Ç	UV	e É	MKMTR	ééÄ	PVKV	OOKVS	NMMM	
NNU	på	NRV	e É	JMKQOP	ééÄ	k L^	QOTKUM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKQOS	ééÄ	PKT	OPPRKVV	NMMM	
NPT	_~	NRV	k ç=d ~ë	QUKMON	ééÄ	OKM	SNUOPKQT	OMMM	
NUO	t	NRV	k ç=d ~ë	MKQOT	ééÄ	OOKO	NUTOKMN	NMMM	
OVR	qä	OMV	k ç=d ~ë	MKMMU	ééÄ	NTKQ	NMVTKUU	NMMM	
OVU	mÄ	OMV	k ç=d ~ë	MKMMM	ééÄ	NSKU	OOPVKMN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKQQU	ééÄ	NSKR	RVSSKQN	NMMM	
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n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ ÉÅ	B n` =¨ çï	B n` =¤ä ÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	ONVPQRNKPT	NKM	OTRVPMVKUR	TSKOP	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QNRPNSSKQQ	OKS	SMQUSNNKO	SUKSS	RVKR	NOMQ	
pÅ	QR	e O	VVMOUPKVR	MKR	NRCUCRRKRV	SQKU	RVKR	NOMQ	
pÅ	QR	e É	NQRUNMKQU	NKT	OPPVRPKQR	SOKPO	RVKR	NOMQ	
d É	TO	k ç=d ~ë	NMVPRUOKUO	NKT	NQNOURSKNU	TNMVP	RVKR	NOMQ	
d É	TO	e O	PVQOPTRTN	MKR	SMTRNTKON	SQKUV	RVKR	NOMQ	
d É	TO	e É	NNPRRMKNR	MKS	NTUUOVKVT	SPKR	RVKR	NOMQ	
v	UV	e O	QRMNMOMKUS	NKM	SRRTRURKQP	SUKSQ	RVKR	NOMQ	
v	UV	e É	TSUPPQKQR	MKQ	NOSROOTKVR	SMKTP	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSMOPQNKTP	NKV	UQQSUONKNN	TUKNS	RVKR	NOMQ	
qÄ	NRV	e É	OURQSURKOM	OKR	QNMSRTOKVO	SVKRO	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQVRVOVKOM	NKS	PUSSRTUKPV	VMKQN	RVKR	NOMQ	
_á	OMV	e É	NSVVMURKPR	OKM	OPPPTRQKRV	TOKU	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MUTRJMMO

cãÉ=k~ã É MQVpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf^ mj eyNya^q^yOMOPyMPJ ^oyi n` ON^hÅ

^Åè=qáã É PLONLOMOP=NVMRRVQP

p~ã éäÉ=qóéÉ p~ã éäÉ

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fpqa=n` =m~ëëlc~ää m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==i mp==	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	JMQNJ	éé Ä	k L^	RPKPP	NMM	
NN	_	S	k ç=d ~ë	TVKOOM	éé Ä	OKQ	NPSTSKSS	NMMM	
OP	k ~	OR	e É	NVQSVKPSQ	éé Ä	NKR	ROUTSPKUS	OMMMMM	
OQ	j Ö	OR	e É	NMVNRKQOT	éé Ä	MKQ	NQUUMNKPR	OMMMMM	
OT	^ ä	OR	e É	NPRKVOQ	éé Ä	NSKO	NOSOKPN	OMMMMM	
OU	pá	OR	e O	URURKVMO	éé Ä	NKP	NSPSTSKRM	NMMMM	
PV	h	OR	e É	SVOTKUPO	éé Ä	NKP	NMPUMRKOP	OMMMMM	
QM	` ~	OR	e O	TORUUKOQS	éé Ä	NKV	NMNOVRUMKPP	OMMMMM	
RN	s	UV	e É	OKPNR	éé Ä	OOKO	RVSKSV	NMMM	
RO	` ê	UV	e É	OKSQP	éé Ä	SKR	NNPUKRM	OMMM	
RR	j å	UV	e É	OPRKRVM	éé Ä	MKQ	ORSPVKTN	OMMM	
RS	cÉ	UV	e O	OMNVKRNU	éé Ä	NKQ	NMSVRUPKPO	NMMMM	
RV	` ç	UV	e É	NKUUU	éé Ä	RKQ	UUQKRN	NMMM	
SM	k á	UV	e É	PKQPM	éé Ä	NPKV	QRTKTV	NMMM	
SP	` ì	UV	e É	NKPST	éé Ä	PKU	NNOTKUQ	OMMM	
SS	wå	UV	e É	NVQKORU	éé Ä	NKT	SMVRKUP	OMMM	
TR	^ ë	UV	e É	OKNPT	éé Ä	NQKN	NSQKSV	NMMM	
TU	pÉ	UV	e O	MKRVN	éé Ä	OKO	NQKPP	NMMM	
UU	pê	UV	e É	OPOKOOQ	éé Ä	NKP	PMONOKPN	OMMM	
VR	j ç	UV	e É	NKSTQ	éé Ä	PKV	OSSKST	NMMM	
NMT	^ Ö	UV	e É	MKMRN	éé Ä	QRKO	PSKST	NMM	
NNN	` Ç	UV	e É	MKNPQ	éé Ä	ONKQ	VKOS	NMMM	
NNU	på	NRV	e É	JPKSNT	éé Ä	k L^	ORUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKRUM	éé Ä	NQKM	UTQKOV	NMMM	
NPT	_~	NRV	k ç=d ~ë	ROKNRT	éé Ä	OKU	NPTSUKPP	OMMM	
NUO	t	NRV	k ç=d ~ë	MKTVQ	éé Ä	ONKQ	NOMUKMM	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNVM	éé Ä	PMKS	SUTKQO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMOOQT	éé Ä	k L^	NMOTKTT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKONM	éé Ä	NUKP	OONOKRQ	NMMM	
OPU	r	OMV	k ç=d ~ë	MKTUQ	éé Ä	NOKR	NMRTKUQ	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n` =i çï	B n` =e ãÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	ONSQUNVKSQ	NKQ	OTRVPMMKUR	TUKQS	RVKR	NOMKQ	
pÅ	OR	k ç=d ~ë	QNRUNOVKNV	NKT	SMQUSNNKO	SUKTR	RVKR	NOMKQ	
pÅ	OR	e O	NMMQUMPKSS	MKQ	NROUOORKRV	SRKTR	RVKR	NOMKQ	
pÅ	OR	e É	NQUPPSKMM	MKV	OPPVRPKQR	SPKQ	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VVMQMVKSP	NKM	NQNOURSKNU	TMKN	RVKR	NOMKQ	
d É	TO	e O	QMRCPVKSR	NKM	SMTRNTKON	SSKT	RVKR	NOMKQ	
d É	TO	e É	NNSSSOKVN	NKP	NTUUOVKVT	SRKOQ	RVKR	NOMKQ	
v	UV	e O	QSNRRPPKVR	NKQ	SRRTRURKQP	TMKPU	RVKR	NOMKQ	
v	UV	e É	TVRQOSKMN	MKU	NOSROOTKVR	SOKUT	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	STOPPUNKSM	NKT	UQQSUONKNN	TVKS	RVKR	NOMKQ	
qÄ	NRV	e É	OVPPUMOKOV	NKO	QNMSRTOKVO	TNKQQ	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PQTPUVRKSM	NKT	PUSSRTUKPV	UVKUQ	RVKR	NOMKQ	
_á	OMV	e É	NTMOURUKON	MKT	OPPPTRQKRV	TOKVT	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MUTRJMMO^

cãÉ=k~ã É MRMpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf^ mj eyNya^q^yOMOPyMPJ ^oyi n` ON^ hÅ

^Åè=qãã É PLONLOMOP=NVMQMMQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	NVKNPV	ééÄ	OKO	NONVSHPP	NMM	
NN	_	S	k ç=d ~ë	OTNKNTQ	ééÄ	OKO	OMUVNVKUN	NMMM	
OP	k ~	QR	e É	PMNNOKTUN	ééÄ	OHP	PTMQTMOKPS	OMMMMM	
OQ	j Ö	QR	e É	NNTVPHROV	ééÄ	MKQ	TSVNUSKOR	OMMMMM	
OT	^ ä	QR	e É	NOMSKRRV	ééÄ	NKR	PNMPPKUU	OMMMMM	
OU	pá	QR	e O	NPRQQKNPP	ééÄ	MKU	NOPVUUOKMU	NMMMM	
PV	h	QR	e É	NSUTVKRNN	ééÄ	MKU	VVUQNSKSP	OMMMMM	
QM	` ~	QR	e O	TMUPSKPQS	ééÄ	MKR	QTSUSUSOROKSO	OMMMMM	
RN	s	UV	e É	RRKOSO	ééÄ	NHP	QQSPRHPR	NMMM	
RO	` ê	UV	e É	RRKPVR	ééÄ	NKT	RSVORKVP	OMMM	
RR	j å	UV	e É	OQTKVPS	ééÄ	NKQ	NOUPOTKVS	OMMM	
RS	cÉ	UV	e O	OVPSKQRT	ééÄ	NHP	TONMNQMKTT	NMMMMM	
RV	` ç	UV	e É	NOKROV	ééÄ	NKU	OOOMOHSQ	NMMM	
SM	k á	UV	e É	OQKRVP	ééÄ	OKV	NONUOKNU	NMMM	
SP	` ì	UV	e É	PQKPSN	ééÄ	NKO	QTOMTHSO	OMMM	
SS	wå	UV	e É	NVUKQTN	ééÄ	NKT	ORUQQKOR	OMMM	
TR	^ ë	UV	e É	RSKUVM	ééÄ	MKV	VVQMRU	NMMM	
TU	pÉ	UV	e O	RMKTQP	ééÄ	MKU	RMRPKMN	NMMM	
UU	pê	UV	e É	OTSKQPT	ééÄ	MKQ	NTNSNPKUP	OMMM	
VR	j ç	UV	e É	RQKSMN	ééÄ	MKU	PQQSQKOO	NMMM	
NMT	^ Ö	UV	e É	NNKMTU	ééÄ	MKR	QPQRPKUP	NMM	
NNN	` Ç	UV	e É	NNKMTR	ééÄ	NKU	PQPUKNU	NMMM	
NNU	på	NRV	e É	QVKNRP	ééÄ	NKT	PNMVOKTQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	VKVNO	ééÄ	OKU	QQNVNKOT	NMMM	
NPT	_~	NRV	k ç=d ~ë	SUKONM	ééÄ	NHM	USRQRHMP	OMMM	
NUO	t	NRV	k ç=d ~ë	RQKROV	ééÄ	MKV	NPVONVKQT	NMMM	
OMR	qä	OMV	k ç=d ~ë	VRTPO	ééÄ	OKQ	RSPRURTV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NMRPMM	ééÄ	OKQ	UPPNPKOU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NMRRMO	ééÄ	NKT	TQQMRKUU	NMMM	
OPU	r	OMV	k ç=d ~ë	NNKONR	ééÄ	NHS	TORPTHPR	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n` =¨çï	B n` =¤ëÛÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	ONMQORRKTS	NKU	OTRVPMMKUR	TSKOS	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	QMPOOVMRU	NHP	SMQUSNNHO	SSHSS	RVHR	NOMQ	
pÅ	QR	e O	VTMQUNRRS	MKV	NROUORRHRV	SPHR	RVHR	NOMQ	
pÅ	QR	e É	NQQONNKUT	NHM	OPPVRPKQR	SMRTV	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VSNPTSKVM	MKV	NQNOURSKNU	SUMVQ	RVHR	NOMQ	
d É	TO	e O	PVMVNNKQT	MHP	SMTRNTKON	SQHPR	RVHR	NOMQ	
d É	TO	e É	NNOSMQKUP	NHR	NTUUOVKVT	SOKVT	RVHR	NOMQ	
v	UV	e O	QQPVQVRKOQ	MKQ	SRRTRURKQP	STHT	RVHR	NOMQ	
v	UV	e É	TSMOOSKVQ	NKQ	NOSROOTKVR	SMMMV	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SROONTUKTS	MKU	UQQSUONHKN	TTHON	RVHR	NOMQ	
qÄ	NRV	e É	OUNVRVPKUO	NKQ	QNVSRTOKVO	SUHSS	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PQRNNMQKMQ	OKQ	PUSSRTUHPV	UVKOR	RVHR	NOMQ	
_á	OMV	e É	NSRPSNOKRU	OKM	OPPPTRQKRV	TMKUS	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MUTRJMMOm

cãÉ=k~ã É MRNpj mi HÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` ONˆHÅ

^Åè=qãã É PLONLOMOP=NVMQRVMR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=¤l ~ë	RPHOTN	ééÄ	NMN	SPRURKUR	NMM	
NN	_	S	k ç=¤l ~ë	RVRKURR	ééÄ	NMM	QSOMSTHMT	NMMM	
OP	k ~	QR	e É	OTRVMKRUN	ééÄ	MKQ	PQSSTPRKOS	OMMMMM	
OQ	j Ö	QR	e É	NSQSQKMSV	ééÄ	MKQ	NMVRUPSKOM	OMMMMM	
OT	^ ä	QR	e É	OPVUMSRS	ééÄ	NMN	SOQQTHPM	OMMMMM	
OU	pá	QR	e O	VRVRKPVS	ééÄ	OKM	UUUSPVKRV	NMMMM	
PV	h	QR	e É	NSTTRKQSP	ééÄ	NMT	NMNOUTOKSO	OMMMMM	
QM	` ~	QR	e O	TORPVKQPT	ééÄ	MKQ	QVPVOPOOKSM	OMMMMM	
RN	s	UV	e É	RSMMNPM	ééÄ	NMM	QRVOSUMVO	NMMM	
RO	` ê	UV	e É	OORMPPN	ééÄ	MMS	OPQPMVKUU	OMMM	
RR	j å	UV	e É	TTVMTRU	ééÄ	MMT	QNNMPTMU	OMMM	
RS	cÉ	UV	e O	OVTNMUNP	ééÄ	MMR	TPTQSQMMMN	NMMMMM	
RV	` ç	UV	e É	RTQHPMP	ééÄ	NMR	NMOUUVMPP	NMMM	
SM	k á	UV	e É	RSPHRPR	ééÄ	NMT	OUOPMUMNP	NMMM	
SP	` ì	UV	e É	OUQKUN	ééÄ	MMR	PVPSPVMU	OMMM	
SS	wå	UV	e É	RRUMVTN	ééÄ	NMT	NPNTMMMNO	OMMM	
TR	^ ë	UV	e É	NNOMTNU	ééÄ	NMR	OMVRVKQV	NMMM	
TU	pÉ	UV	e O	NVOMPVS	ééÄ	MMP	NMPMPHPO	NMMM	
UU	pê	UV	e É	TRRKSSM	ééÄ	MMO	QTUQOMSV	OMMM	
VR	j ç	UV	e É	NNPMMPP	ééÄ	NMR	SUQOVMRV	NMMM	
NMT	^ Ö	UV	e É	RTMQNM	ééÄ	MKU	NOPUNTMVU	NMM	
NNN	` Ç	UV	e É	OUMMUPS	ééÄ	MMP	UOVOMMRV	NMMM	
NNU	på	NRV	e É	RNNMOUN	ééÄ	NMN	POMTSOMOR	NMMM	
NON	pÄ	NRV	k ç=¤l ~ë	VVMOTN	ééÄ	NMT	QRPSVPMST	NMMM	
NPT	_~	NRV	k ç=¤l ~ë	ONTTMSMP	ééÄ	NMO	OUQSUSQMN	OMMM	
NUO	t	NRV	k ç=¤l ~ë	NNMMPOM	ééÄ	MKQ	OUVUTNMQM	NMMM	
OMR	qä	OMV	k ç=¤l ~ë	NMRMTPS	ééÄ	NMQ	SMUMMQMNT	NMMM	
OMU	mÄ	OMV	k ç=¤l ~ë	NMTMQNS	ééÄ	NMM	URRRVRMMT	OMMM	
OPO	qÜ	OMV	k ç=¤l ~ë	NMSMQRT	ééÄ	MMS	TPSUNTMSS	NMMM	
OPU	r	OMV	k ç=¤l ~ë	NNOMORO	ééÄ	MMS	TORTNRMSU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¨ çï	B n ` =¤eåÜÜ	n ` =¤ä~Ö
i á	S	k ç=¤l ~ë	ONOQQTSKQR	NMQ	OTRVPMMVUR	TSMVV	RVMR	NOMMQ	
pÅ	QR	k ç=¤l ~ë	QNPOVSUMVU	OMM	SMQUSNNMO	SUMPP	RVMR	NOMMQ	
pÅ	QR	e O	VUNRQSRTU	NMR	NRQUQRRMRV	SQMQP	RVMR	NOMMQ	
pÅ	QR	e É	NQRNQSMSO	MMO	OPPVRPMQR	SOMMQ	RVMR	NOMMQ	
d É	TO	k ç=¤l ~ë	VUSQMPMVM	OMT	NQNOURSMNU	SVMUO	RVMR	NOMMQ	
d É	TO	e O	PVMSUVMNS	MMU	SMTRNTMON	SQMPN	RVMR	NOMMQ	
d É	TO	e É	NNPRVPMUO	MMV	NTUUOVMVT	SPMRO	RVMR	NOMMQ	
v	UV	e O	QQUSVTTMRU	NMM	SRRTRURMQP	SUMQO	RVMR	NOMMQ	
v	UV	e É	TTQTUMMVS	MMP	NOSRQOTMVR	SNMCQ	RVMR	NOMMQ	
qÄ	NRV	k ç=¤l ~ë	STPMTONMPM	MMV	UQQSUONMNN	TVMSU	RVMR	NOMMQ	
qÄ	NRV	e É	OURPVUQMRP	MMT	QNMSRTOMVO	SVMR	RVMR	NOMMQ	
_á	OMV	k ç=¤l ~ë	PQRMPPQMQU	MMU	PUSSRTUMPV	UVMCP	RVMR	NOMMQ	
_á	OMV	e É	NSSVSUQMRP	MMO	OPPPTRQMRV	TNMRQ	RVMR	NOMMQ	

p~ã éäÉ=k~ã É pn MUTRJMMQp

cãÉ=k~ã É MRQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n` ON^hÅ

^Åè=qáã É PLONLOMCP=NVMPVMS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	RPKTRO	ééÄ	OKR	SNMTRKQO	NMM	
NN	_	S	k ç=d ~ë	SMTHOUT	ééÄ	OKT	QQLUPNNKVS	NMMM	
OP	k ~	QR	e É	OTPSQHPVU	ééÄ	MKT	PPQMNPVKQQ	OMMMMM	
OQ	j Ö	QR	e É	NSQRMPNO	ééÄ	NHP	NMSPRUVRU	OMMMMM	
OT	^ä	QR	e É	OPTRHPVN	ééÄ	MKT	SMMTRKVO	OMMMMM	
OU	pá	QR	e O	VQLUOMSQ	ééÄ	NKQ	USMRRPKQQ	NMMMM	
PV	h	QR	e É	NSSVMKOVV	ééÄ	NKR	VTUUURKUO	OMMMMM	
QM	` ~	QR	e O	TNVUNKOSR	ééÄ	NKM	QUMOLPQOKMS	OMMMMM	
RN	s	UV	e É	RRNKQVQ	ééÄ	NKQ	QQNVRPKSU	NMMM	
RO	` ê	UV	e É	OONKQSU	ééÄ	MHP	OORMUMOU	OMMM	
RR	j å	UV	e É	TSMKQTQ	ééÄ	MKQ	PVNTTVKVM	OMMM	
RS	cÉ	UV	e O	OVSQHPVR	ééÄ	OHP	TOQQTOVHSP	NMMMMM	
RV	` ç	UV	e É	RSTHRPS	ééÄ	MKU	VVPTVRKUS	NMMM	
SM	k á	UV	e É	RRUHSMQ	ééÄ	MKO	OTPQVVKNO	NMMM	
SP	` ì	UV	e É	OUNHSSR	ééÄ	NKM	PUMPROHMU	OMMM	
SS	wå	UV	e É	RQUHRUV	ééÄ	NKQ	NOSPPSKQS	OMMM	
TR	^ë	UV	e É	NNNHTUU	ééÄ	NKO	NVQQPKUT	NMMM	
TU	pÉ	UV	e O	VVKUTV	ééÄ	OHP	VUVSKUU	NMMM	
UU	pê	UV	e É	TRMKQMV	ééÄ	MKU	QSQPQVKOQ	OMMM	
VR	j ç	UV	e É	NNMKUPS	ééÄ	NKO	SRRUOHPN	NMMM	
NMT	^Ö	UV	e É	RSHSTP	ééÄ	MKO	NNVQRVMRT	NMM	
NNN	` Ç	UV	e É	OTTHROS	ééÄ	MHT	UMMUUKUR	NMMM	
NNU	på	NRV	e É	RMPHNMT	ééÄ	MKQ	PNMRNSKNN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	VUHSVS	ééÄ	NKU	QQNOMPHSV	NMMM	
NPT	_~	NRV	k ç=d ~ë	ONRNHNTV	ééÄ	NHP	OTRMUMPKQQ	OMMM	
NUO	t	NRV	k ç=d ~ë	NMVHPNN	ééÄ	NKQ	OUMVRRHRS	NMMM	
OMR	qä	OMV	k ç=d ~ë	NMQHTNU	ééÄ	MKV	RUTNOTKUS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NMSHNPN	ééÄ	MKV	UQQOTRHPV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NMRKUOV	ééÄ	MKV	TNQNTMKMO	NMMM	
OPU	r	OMV	k ç=d ~ë	NNNHVNU	ééÄ	NHM	TMRQONKUT	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B¤pÉÅ	B n` =¡çï	B n` =¤ëÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	OMOOUPQHPN	NKV	OTRVPMMKUR	TPHPN	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	QMMVRQMKRM	MKU	SMQUSNNHO	SSHOV	RVHR	NOMQ	
pÅ	QR	e O	VSNUTVHPR	NKQ	NRCUCRRHRV	SOKVQ	RVHR	NOMQ	
pÅ	QR	e É	NQMVUSKQV	MKU	OPPVRPKQR	SMOOS	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VTMSCRKOR	NHP	NQNOURSKNU	SUHT	RVHR	NOMQ	
d É	TO	e O	PURRTPHSO	MKQ	SMTRNTKON	SPKQT	RVHR	NOMQ	
d É	TO	e É	NNNQOTKUM	NKN	NTUUOVKVT	SOHPN	RVHR	NOMQ	
v	UV	e O	QQNVQRMKRM	NHR	SRRTRURKQP	STHPV	RVHR	NOMQ	
v	UV	e É	TRTONPKVQ	NKN	NOSROOTKVR	RVKUR	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SRUQVPOKQS	OKM	UQQSUONKNN	TTKVS	RVHR	NOMQ	
qÄ	NRV	e É	OUMTRQSHPU	NKQ	QNMSRTOKVO	SUHPT	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PPSQQQPKNO	NHR	PUSSRTUHPV	UTHMN	RVHR	NOMQ	
_á	OMV	e É	NSPUPVMKMQ	NKM	OPPPTRQHRV	TMVO	RVHR	NOMQ	

`çåíáåìåÖ=~äáÄê~íáçå=sÉêáÑáÅ~íáçå=E``sF=oÉéçêí

p~ã éáÉ=k~ã É	``s
cáÉ=k~ã É	MRP|``skÇ
a~í~=m~íÜ=k~ã É	aWj^ÖáÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`ON^hÅ
^Åè=qáã É	PLONLOMOP=OMMNKQV
p~ã éáÉ=qóéÉ	``s
qçí~äa ãáíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑ¥cáÉk~ã É	MVS^i_kÇ
p~ã éáÉ=n`=m~ëëlc á~ä	m~ëë
fpqa=n`=m~ëëlc~áä	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÅ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	OQKRSQ	ééÄ	OKO	NVONNOKNT	OR	VUKOS	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKSPU	ééÄ	OKP	NPNSRTKVV	OR	NVOKRR	UVKU	NNMO	
OP	k ~	OR	e É	RQSMKNRU	ééÄ	OKP	ORMNUMSKPV	RMMM	NMVKO	UVKU	NNMO	
OQ	j Ö	OR	e É	RQUOKUPQ	ééÄ	NKN	OPVQQNSKTQ	RMMM	NMVKSS	UVKU	NNMO	
OT	^ä	OR	e É	RNRKUMU	ééÄ	PKN	UUMRMKQP	RMM	NMPKNS	UVKU	NNMO	
OU	pá	OR	e O	RMSKOSP	ééÄ	MKR	PNOPMVKMU	RMM	NMNKOR	UVKU	NNMO	
PV	h	OR	e É	RNSMKMUQ	ééÄ	NKO	OMPMRTTKSM	RMMM	NMPKO	UVKU	NNMO	
QM	`~	OR	e O	RNOSKTMP	ééÄ	MKV	OPNUSNVOKNS	RMMM	NMOKRP	UVKU	NNMO	
RN	s	UV	e É	ORKVQM	ééÄ	MKP	NPVTTOKMS	OR	NMPKTS	UVKU	NNMO	
RO	`ê	UV	e É	OSKNOM	ééÄ	MKU	NTURPTKQU	OR	NMQKQU	UVKU	NNMO	
RR	j å	UV	e É	ORKUUT	ééÄ	MKQ	UVTMRKPR	OR	NMPKRR	UVKU	NNMO	
RS	cÉ	UV	e O	RMMPKMVN	ééÄ	NKR	UMVSQVNSKOP	RMMM	NMMKMS	UVKU	NNMO	
RV	`ç	UV	e É	OSKNTM	ééÄ	NKO	PMTUSSKVN	OR	NMQKSU	UVKU	NNMO	
SM	ká	UV	e É	OSKOQQ	ééÄ	MKT	USMQVKSN	OR	NMQKRU	UVKU	NNMO	
SP	`ì	UV	e É	OSKRPP	ééÄ	MKP	OQNMUNKUN	OR	NMSKNP	UVKU	NNMO	
SS	wå	UV	e É	OSKRSV	ééÄ	NKM	QQMROKQR	OR	NMSKOU	UVKU	NNMO	
TR	^ë	UV	e É	ORKTOO	ééÄ	NKS	PMMPPKQM	OR	NMOKUV	UVKU	NNMO	
TU	pÉ	UV	e O	OQKQNR	ééÄ	NKO	NSNMPKPR	OR	VTKSS	UVKU	NNMO	
UU	pê	UV	e É	ORKPPS	ééÄ	MKT	NMRQUSKVU	OR	NMNKPQ	UVKU	NNMO	
VR	j ç	UV	e É	OSKOOU	ééÄ	MKO	NMQNUPKSQ	OR	NMQKVN	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKNRS	ééÄ	MKU	PUQPMQKQP	OR	NMUKSO	UVKU	NNMO	
NNN	`Ç	UV	e É	OSKRMR	ééÄ	NKP	RNPROKOO	OR	NMSKMO	UVKU	NNMO	
NNU	på	NRV	e É	OQKUOV	ééÄ	MKQ	NMNSSUKRU	OR	VVKPO	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKOQN	ééÄ	NKR	TONOTNKQU	OR	VSKVS	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKNPO	ééÄ	MKP	ONQNPQKMR	OR	NMMKRP	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKQOT	ééÄ	MKV	QRNVQVKMV	OR	NMRKTN	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	OQKOTQ	ééÄ	MKT	VNURMRKPQ	OR	VTKN	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	ORKNOU	ééÄ	MKO	NPNSVOPKUN	OR	NMMKRN	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	ORKSRO	ééÄ	OKN	NNSTVSVKNU	OR	NMOKSN	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	ORKPTP	ééÄ	MKS	NMTVQRNKQQ	OR	NMNKQV	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=o pa	oÉÑ¥mp	B=oÉÅ	B n`=ï çï	B n`=c äÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	OTUUQSMKVT	OKO	OTRVPMMKUR	NMNKMS	RVKR	NOMQ	
pÅ	OR	k ç=d ~ë	RQMSRVPKMQ	NKU	SMQUSNNKO	UVKPV	RVKR	NOMQ	
pÅ	OR	e O	NPMPOVQKRT	MKU	NRCUCRRKRV	URKOU	RVKR	NOMQ	
pÅ	OR	e É	NVMQVUKNM	NKO	OPPVRPKQR	UNKQP	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NPMNOSVKUQ	MKS	NQNOURSKNU	VOKN	RVKR	NOMQ	
dÉ	TO	e O	RNPSNNKSO	MKS	SMTRNTKON	UQKRQ	RVKR	NOMQ	
dÉ	TO	e É	NQTQRTKVP	MKN	NTUUOVKVT	UOKQS	RVKR	NOMQ	
v	UV	e O	RUUOTROKPM	MKT	SRRTRURKQP	UVKTN	RVKR	NOMQ	
v	UV	e É	NMNSUCPKMO	MKQ	NOSROOTKVR	UMKPT	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	UTSSMMVKST	NKM	UQQSUONKNN	NVPKTU	RVKR	NOMQ	
qÄ	NRV	e É	PSVVVQTHPM	MKV	QNMSRTOKVO	VMKN	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	QRQNOTNKMR	MKT	PUSSRTUKPV	NNTKQR	RVKR	NOMQ	
_á	OMV	e É	ONVPOQMKMT	MKR	OPPPTRQKRV	VPKVU	RVKR	NOMQ	

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MRQ``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíÝ^mj eyNya^q^yOMCPyMPJ ^oyi n`ON^kÅ

^Åè=qáã É PLONLOMCP=OMMNMQU

p~ã éáÉ=qóéÉ ``_

qçí~äa äáçå NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑc äÉk~ã É MVS^i_KÇ

p~ã éáÉ=n`=m~ëëlc á~ä m~ëë

fpqa=n`=m~ëëlc~áä m~ëë

l éÉê~íçê **~Çã áå**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==\ mp==	iäìá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MKMMV	ééÄ	NNKQ	OPRKRS	MO	
NN	_	S	kç=d~ë	MKQTQ	ééÄ	SKM	PQQPKUM	Q	
OP	k~	QR	eÉ	VKOUM	ééÄ	PKT	OPMVRKOT	OMM	
OQ	j Ö	QR	eÉ	QKUVV	ééÄ	RKN	ONVUKMP	OM	
OT	^ä	QR	eÉ	JMKVUN	ééÄ	kL^	QRQKQS	OM	
OU	pá	QR	eO	MKQSU	ééÄ	QQKU	NQNUKQQ	NMM	
PV	h	QR	eÉ	PMKNRN	ééÄ	RKR	PNTQSKVR	OMM	
QM	`~	QR	eO	VKPUP	ééÄ	SKR	RNNMUKPV	OM	
RN	s	UV	eÉ	MKMPS	ééÄ	QOKR	PVRKRT	N	
RO	`ê	UV	eÉ	MKMSR	ééÄ	PKR	NVOMKRN	N	
RR	j å	UV	eÉ	MKMQS	ééÄ	NMKR	PMNKVR	MQ	
RS	cÉ	UV	eO	OKVNU	ééÄ	VKN	VNQRPKOM	OM	
RV	`ç	UV	eÉ	MKMOT	ééÄ	OMKT	QUUKVO	MO	
SM	k á	UV	eÉ	MKMQM	ééÄ	PUKT	OPMKMN	MQ	
SP	`ì	UV	eÉ	MKMRN	ééÄ	VKT	NONSKTQ	MS	
SS	wå	UV	eÉ	JMKNST	ééÄ	kL^	UUQKQV	O	
TR	^ë	UV	eÉ	MKMQM	ééÄ	NSKO	RRKSU	N	
TU	pÉ	UV	eO	MKMQU	ééÄ	NMKR	PMKNT	N	
UU	pê	UV	eÉ	MKMSM	ééÄ	NVKO	OQNKNO	N	
VR	j ç	UV	eÉ	MKNNN	ééÄ	QKS	QQRKRT	N	
NMT	^Ö	UV	eÉ	MKMOM	ééÄ	NKP	OSOKOP	MO	
NNN	`Ç	UV	eÉ	MKMPN	ééÄ	OPKT	ROKRV	MO	
NNU	på	NRV	eÉ	JMKMMP	ééÄ	kL^	TTOKOT	N	
NON	pÄ	NRV	kç=d~ë	MKMQM	ééÄ	UKO	NPUNKRP	MO	
NPT	_~	NRV	kç=d~ë	MKNPR	ééÄ	TKP	NNQNKOR	MQ	
NUO	t	NRV	kç=d~ë	MKNOQ	ééÄ	PKS	OSSPKNM	N	
OMR	qä	OMV	kç=d~ë	MKMSM	ééÄ	PKU	OQQOKTV	MO	
OMU	mÄ	OMV	kç=d~ë	MKMMV	ééÄ	NSKN	NVRRKQT	MO	
OPO	qÜ	OMV	kç=d~ë	MKMTQ	ééÄ	SKQ	QVQOKUS	N	
OPU	r	OMV	kç=d~ë	MKMOU	ééÄ	NTKN	NVPNKNP	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j ÇÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=cäÜÜ	n`=c~ä~Ö
iá	S	kç=d~ë	OQPUSPVRRQ	NKQ	OTRVPMMKUR	UUKPU	RVRR	NOMQ	
pÅ	QR	kç=d~ë	QRPVNNPKVQ	MKS	SMQUSNNKO	TRKMQ	RVRR	NOMQ	
pÅ	QR	eO	NNOUQQQKTQ	NKS	NRQUORRKRV	TPKUQ	RVRR	NOMQ	
pÅ	QR	eÉ	NSNVORKUU	MKS	OPPVRPKQR	SVKON	RVRR	NOMQ	
dÉ	TO	kç=d~ë	NNMRTTUKRN	NKO	NQNOURSKNU	TUKOT	RVRR	NOMQ	
dÉ	TO	eO	QQTPOOKOO	MKS	SMTRNTKON	TPKSP	RVRR	NOMQ	
dÉ	TO	eÉ	NORVRRKPV	MKS	NTUUOVKVT	TMKQP	RVRR	NOMQ	
v	UV	eO	RNSOUQPKQT	MKU	SRRTRURKQP	TUKTP	RVRR	NOMQ	
v	UV	eÉ	UUMRMSKVN	MKT	NOSROOTKVR	SVKRV	RVRR	NOMQ	
qÄ	NRV	kç=d~ë	TQPOMNUKUR	NKV	UQQSUONKNN	UTKVV	RVRR	NOMQ	
qÄ	NRV	eÉ	PNTNPRMKRU	NKS	QNMSRTOKVO	TTKOP	RVRR	NOMQ	
_á	OMV	kç=d~ë	PUNURPPKOR	NKS	PUSSRTUKPV	VUKTS	RVRR	NOMQ	
_á	OMV	eÉ	NUUMOVQKRR	NKN	OPPPTRQKRV	UMKRT	RVRR	NOMQ	

p~ã éäÉ=k~ã É	pn MUTRJMMP
cãÉ=k~ã É	MRRpj mi lÇ
a~í~=m~íÜ=k~ã É	aWjt ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` ONˆHÅ
^Åè=qãã É	PLONLOMCP=OMNMSMRR
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãä	c~ãä

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKMMT	ééÄ	k L^	NQMKMM	NMM	
NN	_	S	k ç=d ~ë	QMKNPV	ééÄ	NKN	PUMUQKUP	NMMM	
OP	k ~	QR	e É	RQPNNKSVS	ééÄ	NKM	SRSTQUKUU	OMMMMM	
OQ	j Ö	QR	e É	SSSRKUPU	ééÄ	MKR	QOVNMUKVV	OMMMMM	
OT	^ ä	QR	e É	NMMVKCPR	ééÄ	OKN	ORTMPHPV	OMMMMM	
OU	pá	QR	e O	NTSPUKMOU	ééÄ	NKO	NRVVPUMRTT	NMMMM	
PV	h	QR	e É	QUTSHPQR	ééÄ	MHP	OVUMURKCP	OMMMMM	
QM	` ~	QR	e O	RQORMKUVU	ééÄ	NKT	PSNUQQUPHPR	OMMMMM	
RN	s	UV	e É	OKRPT	ééÄ	PKN	ONVTKVV	NMMM	
RO	` ê	UV	e É	OKMOT	ééÄ	OHP	ORSRKTQ	OMMM	
RR	j å	UV	e É	PRKSRR	ééÄ	NKT	NUCPSKVU	OMMM	
RS	cÉ	UV	e O	VMMKCPP	ééÄ	NKV	COORSUOKSS	NMMMMM	
RV	` ç	UV	e É	MKRVN	ééÄ	OKU	NNVTKUT	NMMM	
SM	k á	UV	e É	NKRUO	ééÄ	NOKR	USNKNS	NMMM	
SP	` ì	UV	e É	NKVTU	ééÄ	OKV	PPONKRT	OMMM	
SS	wå	UV	e É	THMOM	ééÄ	PKV	ORNVKNS	OMMM	
TR	^ ë	UV	e É	NKUNR	ééÄ	TKV	POPKTN	NMMM	
TU	pÉ	UV	e O	MKNTQ	ééÄ	ORKU	NVKNT	NMMM	
UU	pê	UV	e É	PUUKTOR	ééÄ	MKU	OPTMUVKUU	OMMM	
VR	j ç	UV	e É	MHSQM	ééÄ	RKV	QOTKTV	NMMM	
NMT	^ Ö	UV	e É	MKMQU	ééÄ	NTKT	NNPHPQ	NMM	
NNN	` Ç	UV	e É	MKMVT	ééÄ	OUKN	OUKRO	NMMM	
NNU	på	NRV	e É	JMQRM	ééÄ	k L^	QNNKNO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MOSR	ééÄ	NNHP	NRORKMO	NMMM	
NPT	_~	NRV	k ç=d ~ë	ONKNUR	ééÄ	NKM	OTOVVKVP	OMMM	
NUO	t	NRV	k ç=d ~ë	MRQT	ééÄ	NQKT	ONUOKQV	NMMM	
OVR	qä	OMV	k ç=d ~ë	MKNQM	ééÄ	NTHP	NOQQKTN	NMMM	
OVU	mÄ	OMV	k ç=d ~ë	NKMVO	ééÄ	OKR	NVSUVKTP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKQMT	ééÄ	OHS	QSORKTP	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMVN	ééÄ	VKO	NOQUKVR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤pÉÅ	B n ` =i çï	B n ` =c ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMSQVMSKOV	MKQ	OTRVPMMVUR	TQKUP	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PVRMOOQRKSN	NKN	SMQUSNNKO	SRHPN	RVHR	NOMQ	
pÅ	QR	e O	VSNQQTKVT	MKO	NROUORRHRV	SOKVN	RVHR	NOMQ	
pÅ	QR	e É	NQMPQSRTU	MKU	OPPVRPKQR	RVKVV	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VSMQUMPN	MKQ	NQNOURSKNU	STKVU	RVHR	NOMQ	
d É	TO	e O	PUQOUMKQU	MHR	SMTRNTKON	SPKOR	RVHR	NOMQ	
d É	TO	e É	NMVSOPKQQ	MKN	NTUUOVKVT	SNHP	RVHR	NOMQ	
v	UV	e O	QQMVVSNHSN	MKU	SRRTRURKCP	STKOR	RVHR	NOMQ	
v	UV	e É	TQSPUNHSN	NKN	NOSROOTKVR	RUKVV	RVHR	NOMQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SRVVPMOKMM	NHP	UQQSUONKNN	TUKNP	RVHR	NOMQ	
qÄ	NRV	e É	OTTOUNOKRT	MKO	QNMVSRTOKVO	STHRO	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PPUSNPVKUP	MKT	PUSSRTUHPV	UTHRT	RVHR	NOMQ	
_á	OMV	e É	NSPVMUPKRN	NKM	OPPPTRQKRV	TMKCP	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MUTRJMMQ

cãÉ=k~ã É MRSpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` ONˆHÅ

^Åè=qãã É PLONLOMCP=OMQNNQCO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	JMMVRT	ééÄ	k L^	UCKCP	NMM	
NN	_	S	k ç=d ~ë	QUKRCS	ééÄ	PKN	PTSUPKTU	NMMM	
CP	k ~	CR	e É	PPPRVKPOT	ééÄ	NKV	CMRVRSUKCP	CMMMMM	
CQ	j Ö	CR	e É	SSNSKPVM	ééÄ	NKN	CQTQRMKRP	CMMMMM	
CT	^ ä	CR	e É	NMCMKMTN	ééÄ	CKN	PMTQKUU	CMMMMM	
CU	pá	CR	e O	NSRUVKQVR	ééÄ	MKO	NRMRUUTKQD	NMMMM	
PV	h	CR	e É	QUTRKSPP	ééÄ	NKU	OVVMPCKTR	CMMMMM	
QM	` ~	CR	e O	RQRQMSQCO	ééÄ	MKU	PSQNRRMMKUR	CMMMMM	
RN	s	UV	e É	NKPMT	ééÄ	CKO	NCPUKVT	NMMM	
RO	` ê	UV	e É	MKTNV	ééÄ	PKR	NCTNKNR	CMMM	
RR	j å	UV	e É	PCKMRP	ééÄ	CKN	NSRTUKSM	CMMM	
RS	cÉ	UV	e O	NTPKMPS	ééÄ	MKV	QSPUTCKVN	NMMMM	
RV	` ç	UV	e É	MKPPS	ééÄ	NUKO	TSSKTO	NMMM	
SM	k á	UV	e É	NKPNM	ééÄ	NRKP	TPTKUN	NMMM	
SP	` ì	UV	e É	NKPMR	ééÄ	CKU	CCRPKRV	CMMM	
SS	wå	UV	e É	NSKRNR	ééÄ	SKV	CTMSKQQ	CMMM	
TR	^ ë	UV	e É	NKPQN	ééÄ	CKU	CCRKMP	NMMM	
TU	pÉ	UV	e O	MKNPQ	ééÄ	CNKP	NRKPP	NMMM	
UU	pê	UV	e É	PUTKTMV	ééÄ	MKT	CPUUUUKUT	CMMM	
VR	j ç	UV	e É	MKRQR	ééÄ	RKS	PTSKSU	NMMM	
NMT	^ Ö	UV	e É	MKMCP	ééÄ	CNKN	SNKNN	NMM	
NNN	` Ç	UV	e É	MKMPO	ééÄ	RRKQ	NMKPT	NMMM	
NNU	på	NRV	e É	JMKQVT	ééÄ	k L^	PUNKNO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNMU	ééÄ	NQKM	NCONKPR	NMMM	
NPT	_~	NRV	k ç=d ~ë	NUKRNN	ééÄ	NKT	CPTUCKUV	CMMM	
NUO	t	NRV	k ç=d ~ë	MKPTR	ééÄ	SKQ	NTPNKVR	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMSU	ééÄ	COKU	UQQKOS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMTO	ééÄ	PPKN	NVSCKNP	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNPV	ééÄ	NMKO	CUCPKPO	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNPQ	ééÄ	TKM	UVMKVU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¡ çï	B n ` =¢äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	OMSUVNRKOM	NKT	OTRVPMMKUR	TQKVU	RVKR	NOMKQ	
pÅ	CR	k ç=d ~ë	PVUVUTTKTO	NKR	SMQUSNNKO	SRKVS	RVKR	NOMKQ	
pÅ	CR	e O	VSCQPNKVM	NKO	NRCUCRRKRV	SOKVU	RVKR	NOMKQ	
pÅ	CR	e É	NQMUPTKPP	NKU	CPPVRPKQR	SMKO	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VSRQUPKPM	MKQ	NQNCURSKNU	SUKPQ	RVKR	NOMKQ	
d É	TO	e O	PUCTRRKPT	MKS	SMTRNTKON	SP	RVKR	NOMKQ	
d É	TO	e É	NNMMRVKPO	MKS	NTUUCVKVT	SNKRQ	RVKR	NOMKQ	
v	UV	e O	QQCRNPSKCQ	MKP	SRRTRURKCP	STKQU	RVKR	NOMKQ	
v	UV	e É	TRPVVCKMO	MKO	NOSRCOTKVR	RVKRV	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SRTRNTNKVN	NKR	UQQSUCNKNN	TTKUQ	RVKR	NOMKQ	
qÄ	NRV	e É	OTSMQUTKVS	NKT	QNMSRTCKVO	STKCO	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PQMMNCUKRP	MKU	PUSSRTUKPV	UTKVQ	RVKR	NOMKQ	
_á	OMV	e É	NSNSPNMKQV	NKM	CPPPTRQKRV	SVKOS	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MUTRJMMR

cãÉ=k~ã É MRTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` ONˆHÅ

^Åè=qãã É PLONLOMCP=OMØSMRM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMMCP	ééÄ	k L^	VSHST	NMM	
NN	_	S	k ç=d ~ë	RMRUU	ééÄ	MP	PUQQTK/O	NMMM	
CP	k ~	CR	e É	PRMRMKNOT	ééÄ	MU	CCCCQMUKTV	CMMMMM	
CQ	j Ö	CR	e É	TMUUKCRV	ééÄ	MT	CRPSTRKCN	CMMMMM	
CT	^ ä	CR	e É	NTNCKTRO	ééÄ	MS	CPMMRKCO	CMMMMM	
CU	pá	CR	e O	NVRCQKQQQ	ééÄ	NKQ	NTPNUCUKCP	NMMMM	
PV	h	CR	e É	RCCRKCNP	ééÄ	NKM	PNSNRMKTP	CMMMMM	
QM	` ~	CR	e O	RQVCPKSNU	ééÄ	MT	PRURNUVPKSP	CMMMMM	
RN	s	UV	e É	PKTQS	ééÄ	RKV	PNCCKSQ	NMMM	
RO	` ê	UV	e É	CKQQU	ééÄ	CKT	CVRVMMU	CMMM	
RR	j å	UV	e É	QRKNVO	ééÄ	CKS	CCUSVKTP	CMMM	
RS	cÉ	UV	e O	NMVUKCRQ	ééÄ	MKV	CSRUUCMQR	NMMMM	
RV	` ç	UV	e É	MRTQO	ééÄ	SKO	NQQSKUM	NMMM	
SM	k á	UV	e É	NKUCR	ééÄ	SKM	VTMMVR	NMMM	
SP	` ì	UV	e É	CKMPM	ééÄ	SKO	PPSNMSN	CMMM	
SS	wå	UV	e É	CNKQRO	ééÄ	PKP	RTNVMVS	CMMM	
TR	^ ë	UV	e É	NKUTP	ééÄ	PKV	PPMKTN	NMMM	
TU	pÉ	UV	e O	MKNSN	ééÄ	CPKT	NTKST	NMMM	
UU	pê	UV	e É	PVRKRMS	ééÄ	MKQ	CPVMRTKTQ	CMMM	
VR	j ç	UV	e É	MKSMV	ééÄ	NMKM	QMSKSU	NMMM	
NMT	^ Ö	UV	e É	MKMNU	ééÄ	SQKO	RNKSN	NMM	
NNN	` Ç	UV	e É	MKMRN	ééÄ	TKO	NRKRS	NMMM	
NNU	på	NRV	e É	JMQST	ééÄ	k L^	QMNKNO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKONQ	ééÄ	NKM	NORNKPU	NMMM	
NPT	_~	NRV	k ç=d ~ë	QUKMVV	ééÄ	CKV	PQLPRKMN	CMMM	
NUO	t	NRV	k ç=d ~ë	MKPVQ	ééÄ	UKT	NTCRKPM	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMQO	ééÄ	COKR	SUQKMU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NKOUU	ééÄ	NKS	NNPNTKCU	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKOUP	ééÄ	PKM	PTRNKCP	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMVR	ééÄ	VKM	NOSNKON	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMOSSPUKSS	MKQ	OTRVPMMVUR	TPKQR	RVMR	NOMKQ	
pÅ	CR	k ç=d ~ë	PVUQTOVKNP	MKS	SMQUSNNKO	SRKUU	RVMR	NOMKQ	
pÅ	CR	e O	VQMSORKQS	NKM	NRCUCRRKRV	SNKRR	RVMR	NOMKQ	
pÅ	CR	e É	NPVRNUKRT	NKU	OPPVRPKQR	RVKSQ	RVMR	NOMKQ	
d É	TO	k ç=d ~ë	VRNCOTKMO	NKM	NQNCURSKNU	STKPP	RVMR	NOMKQ	
d É	TO	e O	PTVUSPKMP	MKU	SMTRNTKON	SOKRP	RVMR	NOMKQ	
d É	TO	e É	NMVPONKOS	MKU	NTUUCVKVT	SNKNP	RVMR	NOMKQ	
v	UV	e O	QPPPNVRKPM	MKS	SRRTRURKQP	SSKMU	RVMR	NOMKQ	
v	UV	e É	TPVSTNKPR	NKN	NOSRCOTKVR	RUKQS	RVMR	NOMKQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SPRUTPSKQO	NKQ	UQQSUCNKNN	TRKCU	RVMR	NOMKQ	
qÄ	NRV	e É	OTTQNSSKVR	MKR	QNMSRTCKVO	STKRR	RVMR	NOMKQ	
_á	OMV	k ç=d ~ë	PPRMNNMKPP	NKS	PUSSRTUKPV	USKSQ	RVMR	NOMKQ	
_á	OMV	e É	NSPNUNMKVU	MKR	OPPPTRQKRV	SVKVO	RVMR	NOMKQ	

p~ã éäÉ=k~ã É pn MUTRJMMS

cãÉ=k~ã É MRUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl^ mj eyNya^q^yOMCPyMPJ ^oyi n` ONˆHÅ

^Åè=qáã É PLONLOMCP=OMRPNMRT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RHMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä c~ãä

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMMSP	ééÄ	k L^	TPHPQ	NMM	
NN	_	S	k ç=d ~ë	QMKMRR	ééÄ	NKN	PTCQLJKCR	NMMM	
CP	k ~	CR	e É	PPQLJSKNSU	ééÄ	NKM	CMCLJLJSNKTV	CMMMMM	
CQ	j Ö	CR	e É	STSCKCNM	ééÄ	NKO	CPCQMPPHSS	CMMMMM	
CT	^ ä	CR	e É	OTHPPU	ééÄ	CPHR	NNVCKRS	CMMMMM	
CU	pá	CR	e O	NSSNMKVPV	ééÄ	NKO	NRMNROVKVS	NMMMM	
PV	h	CR	e É	QMVSKOST	ééÄ	CKN	OVUURMKTQ	CMMMMM	
QM	` ~	CR	e O	ROSSOKCUU	ééÄ	MKT	PRMNRCQMKRV	CMMMMM	
RN	s	UV	e É	NHPUN	ééÄ	NQKV	NOTRHSQ	NMMM	
RO	` ê	UV	e É	MHSCP	ééÄ	UHM	NNRRHKNS	CMMM	
RR	j å	UV	e É	QNHPVS	ééÄ	MHS	ONMCMHPM	CMMM	
RS	cÉ	UV	e O	CPCQHPPS	ééÄ	NKU	RVURNMKTO	NMMMM	
RV	` ç	UV	e É	MCQRS	ééÄ	NCHP	VRTKUR	NMMM	
SM	k á	UV	e É	NKNRR	ééÄ	NCKO	SRNKNQ	NMMM	
SP	` ì	UV	e É	MKUPP	ééÄ	SHR	NTVMKNQ	CMMM	
SS	wå	UV	e É	PHMNN	ééÄ	NCHR	NSMRHST	CMMM	
TR	^ ë	UV	e É	NKQVT	ééÄ	TKV	OSTKTM	NMMM	
TU	pÉ	UV	e O	MHNCV	ééÄ	NQCO	NQCRM	NMMM	
UU	pê	UV	e É	PTUHSRQ	ééÄ	NKM	COVRMCKMU	CMMM	
VR	j ç	UV	e É	MCQVP	ééÄ	NMKV	PQMKMN	NMMM	
NMT	^ Ö	UV	e É	MHMMV	ééÄ	PTHM	PNKNN	NMM	
NNN	` Ç	UV	e É	MHMMV	ééÄ	SSKO	PKTM	NMMM	
NNU	på	NRV	e É	JMSCR	ééÄ	k L^	CUUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MHMU	ééÄ	NSKO	NONNKPP	NMMM	
NPT	_~	NRV	k ç=d ~ë	CPKONS	ééÄ	CHP	OVRPSKTQ	CMMM	
NUO	t	NRV	k ç=d ~ë	MKPNO	ééÄ	PSKT	NRRUKCN	NMMM	
OMR	qä	OMV	k ç=d ~ë	MHMU	ééÄ	COQVHP	RMMRQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MHVCS	ééÄ	OTKV	NTPNKUU	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MHMTR	ééÄ	PRKV	OPSSHMR	NMMM	
OPU	r	OMV	k ç=d ~ë	MHNCS	ééÄ	RKU	UOTHRT	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n` =¨çï	B n` =¤ëÜÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	OMCOVTCKNM	MKQ	OTRVPMMKUR	TPHPN	RVHR	NOMKQ	
pÅ	CR	k ç=d ~ë	PVSQLJUPKQU	NKO	SMQLJSNNKO	SRHRR	RVHR	NOMKQ	
pÅ	CR	e O	VRUQNMHSS	MKP	NRCUCRRHRV	SOKTN	RVHR	NOMKQ	
pÅ	CR	e É	NPVVNMKVV	MKT	CPPVRPKQR	RVKU	RVHR	NOMKQ	
d É	TO	k ç=d ~ë	VSNVTRMKQ	MKP	NQNCURSKNU	SUHMV	RVHR	NOMKQ	
d É	TO	e O	PUCVNPHRO	NKN	SMTRNTKCN	SPHMP	RVHR	NOMKQ	
d É	TO	e É	NMVQSNKUM	MKQ	NTUUCVKVT	SNKCN	RVHR	NOMKQ	
v	UV	e O	QPCNMNVKVQ	NKN	SRRTRURKQP	SRKUV	RVHR	NOMKQ	
v	UV	e É	TQNTTMMHSO	NKN	NOSRCOTKVR	RUHSO	RVHR	NOMKQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SRNURSPKQN	NKM	UQQSUCNKNN	TTHNT	RVHR	NOMKQ	
qÄ	NRV	e É	OTQQCVCKRN	NKV	QNVSRTCKVO	SSKUP	RVHR	NOMKQ	
_á	OMV	k ç=d ~ë	PPSNUVNKMV	NKN	PUSSRTUHPV	USKVR	RVHR	NOMKQ	
_á	OMV	e É	NSPTURUKMO	NKO	CPPPTRQKRV	TMKNU	RVHR	NOMKQ	

p~ã éäÉ=k~ã É pn MUTRJMMT

cãÉ=k~ã É MRVpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` ON^HÅ

^Åè=qãã É PLONLOMCP=OMWTWMQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMWDS	ééÄ	k L^	VPHPQ	NMM	
NN	_	S	k ç=d ~ë	QUJPCP	ééÄ	MKT	PSVPVHSR	NMMM	
CP	k ~	CR	e É	PRNPVHRMN	ééÄ	NKV	QCNPPTNKUO	CMMMMM	
CQ	j Ö	CR	e É	TQQPHCRQ	ééÄ	NKN	QTPVPMHSV	CMMMMM	
CT	^ ä	CR	e É	VCUHRTQ	ééÄ	NKR	CPCPMHSO	CMMMMM	
CU	pá	CR	e O	NTCMMKVCR	ééÄ	NHO	NRPNSNVKTV	NMMMM	
PV	h	CR	e É	QTPSKVOS	ééÄ	MKU	CUSVNPKVO	CMMMMM	
QM	` ~	CR	e O	QUSVTKUSQ	ééÄ	NHO	PNUVSMTNKNV	CMMMMM	
RN	s	UV	e É	CKUCP	ééÄ	SHP	CQCVKNQ	NMMM	
RO	` ê	UV	e É	NKVRM	ééÄ	TKV	CQTVKMU	CMMM	
RR	j å	UV	e É	UVKNST	ééÄ	NHO	CRCCNHSR	CMMM	
RS	cÉ	UV	e O	NSUPHSVT	ééÄ	NKU	CMCVNCPHOT	NMMMMM	
RV	` ç	UV	e É	NHPUO	ééÄ	NMKQ	CRRPHSS	NMMM	
SM	k á	UV	e É	NKUNP	ééÄ	TKU	VSUKVQ	NMMM	
SP	` ì	UV	e É	NHSQS	ééÄ	CKU	CUTMPR	CMMM	
SS	wå	UV	e É	NMKQCS	ééÄ	CKM	POTUKCO	CMMM	
TR	^ ë	UV	e É	CKMPP	ééÄ	PKT	PRVRTN	NMMM	
TU	pÉ	UV	e O	MKNPM	ééÄ	NPKV	NQHRM	NMMM	
UU	pê	UV	e É	PRCHRUQ	ééÄ	NHO	CNQCMTHCP	CMMM	
VR	j ç	UV	e É	MQSN	ééÄ	QHS	PCCKCP	NMMM	
NMT	^ Ö	UV	e É	MKNNM	ééÄ	RTHP	PPHPQ	NMM	
NNN	` Ç	UV	e É	MKMCV	ééÄ	PMRT	VHCS	NMMM	
NNU	på	NRV	e É	JMRQCQ	ééÄ	k L^	PRCKCQ	NMMM	
NQN	pÄ	NRV	k ç=d ~ë	MKNST	ééÄ	NQHS	NMTNKNU	NMMM	
NPT	_~	NRV	k ç=d ~ë	QUKNRV	ééÄ	PKT	PRTPQKUT	CMMM	
NUO	t	NRV	k ç=d ~ë	MCCOT	ééÄ	NQKU	NPQNKQU	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMCQ	ééÄ	USKV	RVPKVU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NKMNU	ééÄ	SHO	VPRNHCN	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNTQ	ééÄ	RKU	PMRSKVQ	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNSO	ééÄ	NQKV	NMSTKUS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	CMPRSVNHUO	NHN	OTRVPMMKUR	TPHTU	RVHR	NOMHQ	
pÅ	CR	k ç=d ~ë	PVQTSNVHPQ	MKV	SMQUSNNHO	SRHOS	RVHR	NOMHQ	
pÅ	CR	e O	VQQMUVKOQ	MKM	NRCUCRRHRV	SNHTU	RVHR	NOMHQ	
pÅ	CR	e É	NPUUNMKVS	NHN	CPPVRPHQR	RVHPP	RVHR	NOMHQ	SMOMa ça
d É	TO	k ç=d ~ë	VSNSPNHTU	MKU	NQNCURSHNU	SUHVS	RVHR	NOMHQ	
d É	TO	e O	PUCVTUKUN	MKV	SMTRNTHCN	SPHMQ	RVHR	NOMHQ	
d É	TO	e É	NMVSMRHNU	NHP	NTUUCVKVT	SNHOV	RVHR	NOMHQ	
v	UV	e O	QPMTSCQHNT	MHR	SRRTRURHQP	SRHSV	RVHR	NOMHQ	
v	UV	e É	TQPQMVKMT	MHR	NOSRCOTHVR	RUHTS	RVHR	NOMHQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SRMUCPNHTS	NHO	UQQSUCNHNN	TTHMR	RVHR	NOMHQ	
qÄ	NRV	e É	OTQUTPVHTM	NHN	QNMSRTCHVO	SSHVQ	RVHR	NOMHQ	
_á	OMV	k ç=d ~ë	PPVCRNTHQV	MHP	PUSSRTUHPV	UTHTV	RVHR	NOMHQ	
_á	OMV	e É	NSPUSQMHOS	NHN	CPPPTRQHRV	TMHCN	RVHR	NOMHQ	

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É pn MUTRJMMU

cãÉ=k~ã É MSMpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` ON^hÅ

^Åè=qãã É PLONLOMCP=OMQQONN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä c~ãä

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMMVTN	ééÄ	k L^	SQKQR	NMM	
NN	_	S	k ç=d ~ë	QTHKNPM	ééÄ	PKT	PRUNQKSQ	NMMM	
OP	k ~	QR	e É	PQSUOKSSV	ééÄ	NKT	QNRQQSRRTP	OMMMMM	
OQ	j Ö	QR	e É	TPNSKSNV	ééÄ	OKN	QSROVSKOU	OMMMMM	
OT	^ ä	QR	e É	QQKPPR	ééÄ	VKN	NSMOKPR	OMMMMM	
OU	pá	QR	e O	NRURQKRMM	ééÄ	NKS	NQPNSRSKSQ	NMMMM	
PV	h	QR	e É	QRQQKTQN	ééÄ	NKM	OTRSQRKOV	OMMMMM	
QM	` ~	QR	e O	QUNMTKUVN	ééÄ	MKU	PNVRRVVVKUM	OMMMMM	
RN	s	UV	e É	NKSPR	ééÄ	PKM	NQTPKQQ	NMMM	
RO	` ê	UV	e É	UKVTN	ééÄ	MKR	VQQTHPR	OMMM	
RR	j å	UV	e É	UVKTQO	ééÄ	MKO	QRPOQHRV	OMMM	
RS	cÉ	UV	e O	VURKUOV	ééÄ	NKQ	OQMUUPSKVS	NMMMM	
RV	` ç	UV	e É	NKORT	ééÄ	SKT	OPOVKNT	NMMM	
SM	k á	UV	e É	NKRSN	ééÄ	NNKM	UQQQQV	NMMM	
SP	` ì	UV	e É	MKUVS	ééÄ	NKN	NUTMKNS	OMMM	
SS	wå	UV	e É	PMKTQS	ééÄ	OKP	TUMNKOO	OMMM	
TR	^ ë	UV	e É	NKQNQ	ééÄ	SKQ	ORPKMP	NMMM	
TU	pÉ	UV	e O	MKNMS	ééÄ	UKO	NOKPP	NMMM	
UU	pê	UV	e É	PQOKUTU	ééÄ	NKM	OMTQPUKTO	OMMM	
VR	j ç	UV	e É	MKQSV	ééÄ	NNKO	POKRRS	NMMM	
NMT	^ Ö	UV	e É	MKMMV	ééÄ	PSKP	POKOO	NMM	
NNN	` Ç	UV	e É	MKMMV	ééÄ	SQKS	PKTM	NMMM	
NNU	på	NRV	e É	JMKRTO	ééÄ	k L^	PPPHPQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNSV	ééÄ	NTHT	NMTTKUQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	OSKMMM	ééÄ	PKS	POVQUHPR	OMMM	
NUO	t	NRV	k ç=d ~ë	MKOPN	ééÄ	OPKQ	NPQUKNS	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMNP	ééÄ	k L^	PUPKTQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMMU	ééÄ	OMVKR	NQQQKUV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMUO	ééÄ	PRKN	OQNSKNP	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNOU	ééÄ	NQHP	UQQQOS	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n` =i çï	B n` =¤ä~Ü	n` =¤ä~Ö
i á	S	k ç=d ~ë	OMOOUVNKSN	NKU	OTRVPMMVUR	TPHPN	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PUVNRQTHRS	MKO	SMQUSNNKO	SQHPQ	RVHR	NOMQ	
pÅ	QR	e O	VRTRMPRTU	NKO	NRQUORRHRV	SOKSR	RVHR	NOMQ	
pÅ	QR	e É	NPUSSRKMU	OKM	OPPVRPKQR	RVHOT	RVHR	NOMQ	SMOMa ça
d É	TO	k ç=d ~ë	VRSUTOKNO	MKT	NQNOURSKNU	STHTP	RVHR	NOMQ	
d É	TO	e O	PUOUPSKMT	NHP	SMTRNTKON	SPHMO	RVHR	NOMQ	
d É	TO	e É	NMVVQMKVR	NKQ	NTUUOVKVT	SNKQU	RVHR	NOMQ	
v	UV	e O	QPSSTVSKMM	NKQ	SRRTRURKQP	SSHRV	RVHR	NOMQ	
v	UV	e É	TQMPNUKTM	MKN	NOSROOTKVR	RUHRN	RVHR	NOMQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SQVSVSPKSQ	MKV	UQQSUONKNN	TSKVO	RVHR	NOMQ	
qÄ	NRV	e É	OTQQQSOKMS	NKU	QNMSRTOKVO	SSKUP	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PPTNPPNKOR	NKM	PUSSRTUHPV	UTHKV	RVHR	NOMQ	
_á	OMV	e É	NSPUMOSKPS	OKO	OPPPTRQKRV	TMKNV	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MUTRJMMV

cãÉ=k~ã É MSNpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` CN^HÅ

^Åè=qãã É PLONLOMCP=OMMQTMV

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKMVO	ééÄ	k L^	CNKKN	NMM	
NN	_	S	k ç=d ~ë	UKUTR	ééÄ	NKT	TTRSHST	NMMM	
CP	k ~	CR	e É	CCQCMKTOT	ééÄ	MKR	PCQNCVKTM	CMMMMM	
CQ	j Ö	CR	e É	UCRKUPU	ééÄ	NKU	RQROTHKM	CMMMMM	
CT	^ ä	CR	e É	NTPHQMR	ééÄ	CKN	CUCRHPR	CMMMMM	
CU	pá	CR	e O	RSQHMTM	ééÄ	PHS	RNQVPHMV	NMMMM	
PV	h	CR	e É	NVUVKNUR	ééÄ	MHP	NPCCRMHPP	CMMMMM	
QM	` ~	CR	e O	QCQCRKQRP	ééÄ	NKT	CVQNRPNHSV	CMMMMM	
RN	s	UV	e É	NKCRT	ééÄ	MHS	NNUCHPM	NMMM	
RO	` ê	UV	e É	MKURU	ééÄ	RKN	NPVNKNQ	CMMM	
RR	j å	UV	e É	TSHRUR	ééÄ	NKM	PUURPHPR	CMMM	
RS	cÉ	UV	e O	RMTHRMP	ééÄ	MKR	NCTNRQPRTS	NMMMMM	
RV	` ç	UV	e É	MKNUV	ééÄ	CCKO	RMCKCR	NMMM	
SM	k á	UV	e É	MRTPP	ééÄ	NCKV	QRMKMN	NMMM	
SP	` ì	UV	e É	NKMRO	ééÄ	QHS	CMUQHSQ	CMMM	
SS	wå	UV	e É	UKVRO	ééÄ	QHM	CVQCHRV	CMMM	
TR	^ ë	UV	e É	NKOVP	ééÄ	UKT	CPPHPS	NMMM	
TU	pÉ	UV	e O	MKNNN	ééÄ	NSHP	NPHKM	NMMM	
UU	pê	UV	e É	NUKTPO	ééÄ	CKV	NNPVUKCQ	CMMM	
VR	j ç	UV	e É	MCCCV	ééÄ	NKT	NUTKTU	NMMM	
NMT	^ Ö	UV	e É	MKMMP	ééÄ	NCTHN	CMKMM	NMM	
NNN	` Ç	UV	e É	MKMNS	ééÄ	CRKM	RKRS	NMMM	
NNU	på	NRV	e É	JMKRVP	ééÄ	k L^	PCPHPQ	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKNPS	ééÄ	CUKQ	VNTHST	NMMM	
NPT	_~	NRV	k ç=d ~ë	UKNUS	ééÄ	CKQ	NMPMUKNQ	CMMM	
NUO	t	NRV	k ç=d ~ë	MKNCP	ééÄ	TVKQ	NMRTKUP	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMMN	ééÄ	k L^	QRMKQV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKNSM	ééÄ	VHP	OSOVKRS	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMUQ	ééÄ	QQKQ	CQCOVKQV	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMCR	ééÄ	CRKQ	NVPHRQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ¤ mp	B =o ÉÅ	B n ` =i çï	B n ` =c ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMRNVPVKUP	PHR	OTRVPMMKUR	TQHPS	RVHR	NOMKQ	
pÅ	CR	k ç=d ~ë	PVPNVRPKMM	NKV	SMQUSNNHO	SRHMN	RVHR	NOMKQ	
pÅ	CR	e O	VRMQPRKNM	CKO	NRCUCRRHRV	SOKNV	RVHR	NOMKQ	
pÅ	CR	e É	NPVTUUKMO	MHS	CPPVRPKQR	RVHTR	RVHR	NOMKQ	
d É	TO	k ç=d ~ë	VRSPQSKMU	MHP	NQNCURSKNU	STHSV	RVHR	NOMKQ	
d É	TO	e O	PUMVMTHMR	MKT	SMTRNTKON	SOHT	RVHR	NOMKQ	
d É	TO	e É	NMVPQSKQT	MKQ	NTUUCVKVT	SNKNR	RVHR	NOMKQ	
v	UV	e O	QQMQCNQKOO	MKT	SRRTRURKQP	STHNS	RVHR	NOMKQ	
v	UV	e É	TQPOTPKQQ	MHP	NOSRCOTKVR	RUHTR	RVHR	NOMKQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SPVQRSPHTV	MKU	UQQSUCNHNN	TRHT	RVHR	NOMKQ	
qÄ	NRV	e É	OTSQUVSHSS	NHR	QNVSRTCKVO	STHPP	RVHR	NOMKQ	
_á	OMV	k ç=d ~ë	PPTOVQRKMV	CKQ	PUSSRTUHPV	UTHCP	RVHR	NOMKQ	
_á	OMV	e É	NSPVRNSHPP	MHR	CPPPTRQKRV	TMVCR	RVHR	NOMKQ	

p~ã éäÉ=k~ã É pn MUTRJMNM

cãÉ=k~ã É MSQpj mi lÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` ONl^HÅ

^Åè=qáã É PLONLOMCP=OMRCOMS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKUU	ééÄ	k L^	QRKRS	NMM	
NN	_	S	k ç=d ~ë	UKSNU	ééÄ	CKQ	TRNQKCV	NMMM	
CP	k ~	QR	e É	CPCQKQSR	ééÄ	NKN	PNNQUCKSN	OMMMMM	
CQ	j Ö	QR	e É	UPNKSCP	ééÄ	NKP	RPURNKMM	OMMMMM	
CT	^ ä	QR	e É	RPKQRR	ééÄ	NKT	NURNKOT	OMMMMM	
CU	pá	QR	e O	QQPKSPV	ééÄ	CKQ	PUSMCRRM	NMMMM	
PV	h	QR	e É	NVUQKRTQ	ééÄ	CKM	NPCRCPKPQ	OMMMMM	
QM	` ~	QR	e O	QQMPKTMQ	ééÄ	CKP	CUUVQLUUKTQ	OMMMMM	
RN	s	UV	e É	NKMMV	ééÄ	RKP	NMTCKCU	NMMM	
RO	` ê	UV	e É	MKSMO	ééÄ	SKT	NNQPKUP	OMMM	
RR	j å	UV	e É	TCKPCR	ééÄ	MKS	PSVPUHRS	OMMM	
RS	cÉ	UV	e O	OOSKMNP	ééÄ	CKQ	RUVUQNKPO	NMMMM	
RV	` ç	UV	e É	MKNCU	ééÄ	NSKR	QMMKMO	NMMM	
SM	k á	UV	e É	MKTNO	ééÄ	NVKS	QQQKCQ	NMMM	
SP	` ì	UV	e É	MKVKS	ééÄ	SKR	NVMCKPU	OMMM	
SS	wå	UV	e É	VKNPR	ééÄ	UKM	PMMCKSM	OMMM	
TR	^ ë	UV	e É	NKNNO	ééÄ	NNKP	OMQKMO	NMMM	
TU	pÉ	UV	e O	MKMSS	ééÄ	OMR	UHRM	NMMM	
UU	pê	UV	e É	NUKSRU	ééÄ	MKS	NNQOTHNT	OMMM	
VR	j ç	UV	e É	MKNUR	ééÄ	NRKR	NSPKPQ	NMMM	
NMT	^ Ö	UV	e É	MKMNM	ééÄ	TTHP	PPKPQ	NMM	
NNN	` Ç	UV	e É	MKMON	ééÄ	PMKM	THMQ	NMMM	
NNU	på	NRV	e É	JMSCR	ééÄ	k L^	OVNKNO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNSP	ééÄ	CUHR	NMQCKUO	NMMM	
NPT	_~	NRV	k ç=d ~ë	THKPN	ééÄ	PKV	NMNOTHTU	OMMM	
NUO	t	NRV	k ç=d ~ë	MKMMQ	ééÄ	NNRSKU	TTMKUP	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMR	ééÄ	k L^	QPMKQT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMNQ	ééÄ	PMKP	NRMCKVS	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMCP	ééÄ	TTHN	OMQCKPQ	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMNS	ééÄ	OVKS	NPSKUN	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMPTTSRKPM	MKS	OTRVPMMKUR	TPKUR	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PVPTSTSKVO	MKT	SMQUSNNKO	SRKN	RVKR	NOMQ	
pÅ	QR	e O	VQQOVQKSO	NKM	NRCUCRRKRV	SNKSS	RVKR	NOMQ	
pÅ	QR	e É	NQMPTUKVN	NKR	OPPVRPKQR	SM	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VRSMVCKUU	MKQ	NQNCURSKNU	STHST	RVKR	NOMQ	
d É	TO	e O	PUMSOTKUN	MKP	SMTRNTKON	SOHSR	RVKR	NOMQ	
d É	TO	e É	NNMPNQKPP	NKQ	NTUUCVKVT	SNKSV	RVKR	NOMQ	
v	UV	e O	QQMCPVNKUR	NKR	SRRTRURKCP	STKNS	RVKR	NOMQ	
v	UV	e É	TQUNNVMKQ	NKP	NOSRCOTKVR	RVKNP	RVKR	NOMQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SQUPVPQKMQ	CKO	UQQSUCNKNN	TSKTS	RVKR	NOMQ	
qÄ	NRV	e É	OTRVVRUKRQ	NKV	QNMSRTCKVO	STKON	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQMRUVRKST	NKM	PUSSRTUHPV	UUKW	RVKR	NOMQ	
_á	OMV	e É	NSPURSTKRM	MKU	CPPPTRQKRV	TMKON	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MUTRJMNN

cãÉ=k~ã É MSPpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` ONˆHÅ

^Åè=qãã É PLONLOMCP=OMRTWP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKUU	éé Ä	k L^	QRKRR	NMM	
NN	_	S	k ç=d ~ë	MRTVT	éé Ä	TKV	NTOVKMD	NMMM	
OP	k ~	QR	e É	VSKRQP	éé Ä	SKU	OPQMPKQT	OMMMMM	
OQ	j Ö	QR	e É	TKUUN	éé Ä	OQKN	UPTKUP	OMMMMM	
OT	^ ä	QR	e É	UKURO	éé Ä	NRKP	TPUKVO	OMMMMM	
OU	pá	QR	e O	OPKMUR	éé Ä	NOKU	PMOPKRP	NMMMM	
PV	h	QR	e É	OMTKQVS	éé Ä	PKO	PMUPMKQD	OMMMMM	
QM	` ~	QR	e O	RSKUQR	éé Ä	OKO	QVNMNKVO	OMMMMM	
RN	s	UV	e É	MKQVR	éé Ä	QKS	RUSKSV	NMMM	
RO	` ê	UV	e É	MKPMR	éé Ä	NNKV	UQSKRP	OMMM	
RR	j å	UV	e É	MKQPT	éé Ä	OOKO	PSNKVQ	OMMM	
RS	cÉ	UV	e O	JVRTUQ	éé Ä	k L^	NUUTOKQQ	NMMMMM	
RV	` ç	UV	e É	JMKVRR	éé Ä	k L^	UQKQR	NMMM	
SM	k á	UV	e É	MKOVM	éé Ä	RKV	OPUKVM	NMMM	
SP	` ì	UV	e É	MKNUQ	éé Ä	NPKQ	VQNKNS	OMMM	
SS	wå	UV	e É	PKMVR	éé Ä	NQKO	NSNVKMN	OMMM	
TR	^ ë	UV	e É	MKNNT	éé Ä	QSRT	PPKMM	NMMM	
TU	pÉ	UV	e O	MKVRN	éé Ä	TTKO	TKVM	NMMM	
UU	pê	UV	e É	MKNVQ	éé Ä	NPKO	NQNKNN	OMMM	
VR	j ç	UV	e É	MKVVM	éé Ä	RUKS	NMTKTU	NMMM	
NMT	^ Ö	UV	e É	MKVVR	éé Ä	RTKU	OPKPQ	NMM	
NNN	` Ç	UV	e É	MKVMQ	éé Ä	NSVKQ	OKOO	NMMM	
NNU	på	NRV	e É	JMKRRQ	éé Ä	k L^	PRMKVN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKVQU	éé Ä	SQKU	RQPKVO	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKPOQ	éé Ä	NQKQ	RRPKVP	OMMM	
NUO	t	NRV	k ç=d ~ë	MKVNP	éé Ä	PMQKV	TVQKOM	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKVOV	éé Ä	k L^	PMMKRP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKVUS	éé Ä	k L^	TPMKTU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKVNS	éé Ä	k L^	NTUUKSU	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKVMO	éé Ä	k L^	OMKVO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¨çï	B n ` =¤eåÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	OMRVSSNKVO	MKQ	OTRVPMMKUR	TQKSQ	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVQVSMNKNO	MKU	SMQUSNNKO	SRKP	RVKR	NOMKQ	
pÅ	QR	e O	VQNPROKQT	MKR	NRCUCRRKRV	SNKS	RVKR	NOMKQ	
pÅ	QR	e É	NQMSQTKSS	MKU	OPPVRPKQR	SMKNO	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VRSTQOKUN	MKV	NQNCURSKNU	STKTO	RVKR	NOMKQ	
d É	TO	e O	PTRRQVKRT	MKP	SMTRNTKON	SNKUO	RVKR	NOMKQ	
d É	TO	e É	NMVRNPKOT	NKN	NTUUCVKVT	SNKCQ	RVKR	NOMKQ	
v	UV	e O	QPTTPPTKUM	MKT	SRRTRURKQP	SSKTR	RVKR	NOMKQ	
v	UV	e É	TQUCSPKNM	MKS	NOSRCOTKVR	RVKNQ	RVKR	NOMKQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SQTCQQMKQS	NKS	UQQSUCNKNN	TSKSP	RVKR	NOMKQ	
qÄ	NRV	e É	OTUUPVPKNN	MKT	QNMSRTCKVO	STKV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PQQCCPQKPR	NKQ	PUSSRTUKPV	UVKMP	RVKR	NOMKQ	
_á	OMV	e É	NSQUCSNKNV	MKQ	CPPPTRQKRV	TMKSP	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MUTRJMNO

cãÉ=k~ã É MSQpj mi hÇ

a~í~=m~íÜ=k~ã É aWjtÖäÉåíyî mj eyNya^q^yOMCPyMPJ ^oyi n ` ONˆHÅ

^Åè=qãã É PLONLOMCP=ONMOMQM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKMVQ	éé Ä	k L^	PUKUV	NMM	
NN	_	S	k ç=d ~ë	MKSQS	éé Ä	NSKS	NSNNKCP	NMMM	
CP	k ~	CR	e É	VCKUTR	éé Ä	THP	QCSTMHPR	CMMMMM	
CQ	j Ö	CR	e É	RHRTM	éé Ä	UKV	SUCQCQV	CMMMMM	
CT	^ ä	CR	e É	JCKCCN	éé Ä	k L^	CRUKVN	CMMMMM	
CU	pá	CR	e O	CQCKMVT	éé Ä	NCRT	PNCMHRV	NMMMM	
PV	h	CR	e É	CMTRTNR	éé Ä	CKU	PMSPSHSO	CMMMMM	
QM	` ~	CR	e O	CRRTPR	éé Ä	NKN	CNURCKVV	CMMMMM	
RN	s	UV	e É	MKRRO	éé Ä	NPHP	SPNKNQ	NMMM	
RO	` ê	UV	e É	MCOSP	éé Ä	NMKU	UMPKUT	CMMM	
RR	j å	UV	e É	MKNCM	éé Ä	CRHP	CMMHSP	CMMM	
RS	cÉ	UV	e O	JNNHPMU	éé Ä	k L^	NRCOTHQV	NMMMM	
RV	` ç	UV	e É	JMKMTQ	éé Ä	k L^	RNHKN	NMMM	
SM	k á	UV	e É	MKNNU	éé Ä	QNRT	NRRHRS	NMMM	
SP	` ì	UV	e É	MKMOT	éé Ä	RUKV	TPCKCS	CMMM	
SS	wå	UV	e É	NHRPV	éé Ä	NQKQ	NCUSHTR	CMMM	
TR	^ ë	UV	e É	MKNRN	éé Ä	CMHS	PUHST	NMMM	
TU	pÉ	UV	e O	MKMPT	éé Ä	PPHP	RHST	NMMM	
UU	pê	UV	e É	MKNNO	éé Ä	NMKU	VNHKN	CMMM	
VR	j ç	UV	e É	MKMVS	éé Ä	OTHV	NNNHKN	NMMM	
NMT	^ Ö	UV	e É	MKMMN	éé Ä	QMPHN	NQKQQ	NMM	
NNN	` Ç	UV	e É	MKMMT	éé Ä	PQKU	CKVS	NMMM	
NNU	på	NRV	e É	JMHSPP	éé Ä	k L^	PMMKMN	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKMSQ	éé Ä	PCKV	SCMHST	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKNTM	éé Ä	NNKN	PSPKTO	CMMM	
NUO	t	NRV	k ç=d ~ë	MKMCO	éé Ä	CMMKQ	UCQKCP	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMCV	éé Ä	k L^	OVPHSR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKNMS	éé Ä	k L^	RSPKVP	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKMNP	éé Ä	k L^	NTVCKMQ	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMMN	éé Ä	k L^	OSHSV	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¨ çï	B n ` =¤ëÛÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	CMRQLPCKPN	MKU	OTRVPMMKUR	TQKQT	RVHR	NCMKQ	
pÅ	CR	k ç=d ~ë	PVRCMQQKPP	MHS	SMQLUSNNHO	SRHPQ	RVHR	NCMKQ	
pÅ	CR	e O	VQNPUMKTR	NHP	NRCUCRRHRV	SNHS	RVHR	NCMKQ	
pÅ	CR	e É	NPVSVTHSQ	MKQ	CPPVRPKQR	RVKTN	RVHR	NCMKQ	
d É	TO	k ç=d ~ë	VRNCSSKTT	MKT	NQNCURSKNU	STHPP	RVHR	NCMKQ	
d É	TO	e O	PTUSPPMKU	NHR	SMTRNTKCN	SCKPO	RVHR	NCMKQ	
d É	TO	e É	NMVCPCKPP	MHS	NTUUCVKVT	SNKNV	RVHR	NCMKQ	
v	UV	e O	QPUQTRCKSN	NHR	SRRTRURKQP	SSKUT	RVHR	NCMKQ	
v	UV	e É	TQTSCUKNR	MKT	NOSRCOTKVR	RVKMV	RVHR	NCMKQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SRRCRRSKQQ	CHR	UQQSUCNKNN	TTHRT	RVHR	NCMKQ	
qÄ	NRV	e É	OTTQSCSKRP	MHS	QNVSRTCKVO	STHRT	RVHR	NCMKQ	
_á	OMV	k ç=d ~ë	PQMCPSTHPT	NKN	PUSSRTUHPV	UTKVV	RVHR	NCMKQ	
_á	OMV	e É	NSQVPNQKTP	NKQ	CPPPTRQKRV	TMHST	RVHR	NCMKQ	

`çåíáåìåÖ=~äÄê~íáç=sÉêÑÑÅ~íáç=É``sF=oÉéçê

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MSRj``skÇ
a~í~=m~íÜ=k~ã É	aWj^ÖãÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`ON^hÅ
^Åè=qáã É	PLONLOMOP=ONMMTWQT
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç=å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MVS^i_kÇ
p~ã éáÉ=n`=m~ëëlc á~ä	m~ëë
fpqa=n`=m~ëëlc~ãä	m~ëë
l éÉê~íçê	**~Çã ãå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==`mp==	bñés~ä	B=oÉÅ	Bi çï	Be åÜÜ	n`=c ä~Ö
V	_É	S	k ç=d ~ë	ORKMOS	ééÄ	MKO	NVQQSUKUP	OR	NMMKN	UVKU	NNMKO	
NN	_	S	k ç=d ~ë	OQKVSM	ééÄ	MKV	NOTOSUKVP	OR	VVKUQ	UVKU	NNMKO	
OP	k~	OR	e É	RQRUKTTP	ééÄ	NKP	QQRSPNMKTV	RMMM	NMVKNU	UVKU	NNMKO	
OQ	j Ö	OR	e É	RQRQKUVS	ééÄ	OKO	OPRTOVPKQR	RMMM	NMVMVS	UVKU	NNMKO	
OT	^ä	OR	e É	RNQKVMQ	ééÄ	MKU	UTMQQHPN	RMM	NMOKVU	UVKU	NNMKO	
OU	pá	OR	e O	RMNHRMR	ééÄ	NKO	PMPPTOKMT	RMM	NMMHP	UVKU	NNMKO	
PV	h	OR	e É	RNMVSKTUR	ééÄ	MKU	NVVMMVTKTS	RMMM	NMOKNQ	UVKU	NNMKO	
QM	` ~	OR	e O	RNPUKMNM	ééÄ	NKM	OOTURPSQKPU	RMMM	NMOKTS	UVKU	NNMKO	
RN	s	UV	e É	OSKMQS	ééÄ	OKU	NPUPNMQQ	OR	NMQKNU	UVKU	NNMKO	
RO	` ê	UV	e É	OSKNOP	ééÄ	PKQ	NTRVRQKOR	OR	NMQKQV	UVKU	NNMKO	
RR	j å	UV	e É	ORKSPR	ééÄ	OKU	UTRQQKUR	OR	NMOKRQ	UVKU	NNMKO	
RS	cÉ	UV	e O	QVNQKNRQ	ééÄ	NKT	TUTTMOQPHPM	RMMM	VUKOU	UVKU	NNMKO	
RV	` ç	UV	e É	ORKTNM	ééÄ	OKM	OVUNPTKVQ	OR	NMOKUQ	UVKU	NNMKO	
SM	ká	UV	e É	ORKVMO	ééÄ	OKR	UQMOPKQV	OR	NMPHSN	UVKU	NNMKO	
SP	` ì	UV	e É	OSKPUM	ééÄ	OKU	OPSOPUKTR	OR	NMRHRO	UVKU	NNMKO	
SS	wå	UV	e É	OSKVUO	ééÄ	OKP	QOMTOKRP	OR	NMTKVP	UVKU	NNMKO	
TR	^ë	UV	e É	ORHSON	ééÄ	OKP	OVQUTMNP	OR	NMOKQU	UVKU	NNMKO	
TU	pÉ	UV	e O	OQKOOQ	ééÄ	NKN	NRUOTHRS	OR	VSKV	UVKU	NNMKO	
UU	pê	UV	e É	ORKQOU	ééÄ	NKV	NMQNRPKVQ	OR	NMNHTN	UVKU	NNMKO	
VR	j ç	UV	e É	OSKNMQ	ééÄ	OKP	NMONVUKUT	OR	NMQKQO	UVKU	NNMKO	
NMT	^Ö	UV	e É	OSKVUN	ééÄ	NKT	PTSPTMHST	OR	NMTKVO	UVKU	NNMKO	
NNN	` Ç	UV	e É	OSHSPN	ééÄ	NKU	RMURVHST	OR	NMSHRO	UVKU	NNMKO	
NNU	på	NRV	e É	OQKPQU	ééÄ	MKQ	VVRONHRO	OR	VTHPV	UVKU	NNMKO	
NON	pÄ	NRV	k ç=d ~ë	OPKVTN	ééÄ	NKQ	TMTPUSKPP	OR	VRKUU	UVKU	NNMKO	
NPT	_~	NRV	k ç=d ~ë	OQKUSM	ééÄ	NKR	ONMVRTKQU	OR	VVKQQ	UVKU	NNMKO	
NUO	t	NRV	k ç=d ~ë	OSKNUV	ééÄ	MKU	QQQQOMSKTT	OR	NMQKTS	UVKU	NNMKO	
OMR	qä	OMV	k ç=d ~ë	OQKUUP	ééÄ	MKV	VPOSPQHST	OR	VVHRP	UVKU	NNMKO	
OMU	mÄ	OMV	k ç=d ~ë	ORKPOT	ééÄ	MKV	NPNQTPVKOP	OR	NMNHPN	UVKU	NNMKO	
OPO	qÜ	OMV	k ç=d ~ë	ORKPRR	ééÄ	MKV	NNQPRPRKVP	OR	NMNKQO	UVKU	NNMKO	
OPU	r	OMV	k ç=d ~ë	OSKPNM	ééÄ	NKN	NNMUTRNKUQ	OR	NMRKQQ	UVKU	NNMKO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÅ	Bn`=ç	Bn`=ÆäÜÜ	n`=c ä~Ö
iá	S	k ç=d ~ë	OTSSVSNKQT	MKS	OTRVPMMKUR	NMMKOU	RVHR	NOMQ	
pÅ	OR	k ç=d ~ë	ROOURPPKVN	NKN	SMQUSNNKO	USKQQ	RVHR	NOMQ	
pÅ	OR	e O	NOTUNMTHRR	NKP	NRQUORRKRV	UPHSP	RVHR	NOMQ	
pÅ	OR	e É	NUUSNRKUP	NKU	OPPVRPKQR	UMHSO	RVHR	NOMQ	
dÉ	TO	k ç=d ~ë	NOTUMSRHSQ	MKP	NQNOURSKNU	VMKQS	RVHR	NOMQ	
dÉ	TO	e O	RMOMTTKOS	MKQ	SMTRNTKON	UOHSQ	RVHR	NOMQ	
dÉ	TO	e É	NQSMOSKUN	MKR	NTUUOVKVT	UNHST	RVHR	NOMQ	
v	UV	e O	RUOTROPKMN	NKN	SRRTRURKQP	UUKUT	RVHR	NOMQ	
v	UV	e É	NMMORNMHSV	OKO	NOSROOTKVR	TVKQQ	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	USVPVVQKMU	NKO	UQQSUONKNN	NMOKVP	RVHR	NOMQ	
qÄ	NRV	e É	PSVOUNOKOP	NKM	QNMSRTOKVO	UVKVO	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	QQVUOSSKTQ	MKR	PUSSRTUHPV	NNSHPQ	RVHR	NOMQ	
_á	OMV	e É	ONVNOOMKMS	MKP	OPPPTRQKRV	VPKUV	RVHR	NOMQ	

`çåíáåì åÖ=~äÄê~íáçå=_ä~åâ=É``_F=oÉéçê

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MSS|``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíÝ^mj eyNya^q^yOMCPyMPJ ^oyi n`ON^kÂ

^Åè=qáã É PLONLOMCP=ONWNSWRU

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáçå NKWMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑ=cäÉk~ã É MWS^i_KÇ

p~ã éáÉ=n`=m~ëëlc á~ä m~ëë

fpqa=n`=m~ëëlc~áä m~ëë

I éÉê~íçê **~Çã áä**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==\ mp==	iãäá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MKWMQ	ééÄ	NNWMO	OMWKWN	MO	
NN	_	S	kç=d~ë	MKWUR	ééÄ	UKN	NSVWKNP	Q	
CP	k~	CR	eÉ	TKTRU	ééÄ	CKU	CNSUSHSS	CMM	
CQ	j Ö	CR	eÉ	PKVRQ	ééÄ	NWKM	NUPRKTQ	CM	
CT	^ä	CR	eÉ	JNKCRV	ééÄ	kL^	PUPHPQ	CM	
CU	pá	CR	eO	JMKCRP	ééÄ	kL^	NVPNKNO	NWM	
PV	h	CR	eÉ	PMPSN	ééÄ	THS	PNSCMKWT	CMM	
QM	`~	CR	eO	RHSNS	ééÄ	PKN	PSNVVKUN	CM	
RN	s	UV	eÉ	MKWCQ	ééÄ	PQCP	PPSHSU	N	
RO	`ê	UV	eÉ	MKWRU	ééÄ	NPKM	VSCKRO	N	
RR	j å	UV	eÉ	MKWNT	ééÄ	PMHS	CNNHPM	MQ	
RS	cÉ	UV	eO	CKTUP	ééÄ	SKM	UTUPRKQV	CM	
RV	`ç	UV	eÉ	MKWMQ	ééÄ	CPCQP	CCQJKVM	MO	
SM	ká	UV	eÉ	MKWNV	ééÄ	RUKM	NSTKTU	MQ	
SP	`ì	UV	eÉ	MKWNR	ééÄ	NSHR	VCNKWS	MHS	
SS	wå	UV	eÉ	JMKWT	ééÄ	kL^	UPCKOS	O	
TR	^ë	UV	eÉ	MKWPO	ééÄ	NNKN	QSHPQ	N	
TU	pÉ	UV	eO	MKWPV	ééÄ	NQHS	CCQHST	N	
UU	pê	UV	eÉ	MKWNS	ééÄ	PPHS	UCKCP	N	
VR	j ç	UV	eÉ	MKWVS	ééÄ	CKR	PUTKTV	N	
NWT	^Ö	UV	eÉ	MKWCN	ééÄ	UKQ	OTPHPQ	MO	
NNN	`Ç	UV	eÉ	MKWCO	ééÄ	NWHS	PUKNR	MO	
NNU	på	NRV	eÉ	JMKWPU	ééÄ	kL^	SRPHPT	N	
NON	pÄ	NRV	kç=d~ë	MKWOS	ééÄ	CRKO	NVPCKQT	MO	
NPT	_~	NRV	kç=d~ë	MKWVR	ééÄ	STKN	CMWKCN	MQ	
NUO	t	NRV	kç=d~ë	MKNWR	ééÄ	VKV	CPUVKQO	N	
OWR	qä	OMV	kç=d~ë	MKWRN	ééÄ	SKU	CNSRKUN	MO	
OWU	mÄ	OMV	kç=d~ë	JMKWR	ééÄ	kL^	NPUQKUP	MO	
OPO	qÜ	OMV	kç=d~ë	MKWSM	ééÄ	TKM	QQTRKRO	N	
OPU	r	OMV	kç=d~ë	MKWCP	ééÄ	NSHP	UVWKVT	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=cäÜÜ	n`=c~ä~Ö
iá	S	kç=d~ë	CQMPVMSKUO	MKU	OTRVPMWKUR	UTKNO	RVHR	NOMQ	
pÅ	CR	kç=d~ë	CRPCONQKUS	NHP	SMQUSNNHO	TQKVP	RVHR	NOMQ	
pÅ	CR	eO	NNCQMUTKTO	OHS	NRCUCRRHRV	TPHRR	RVHR	NOMQ	
pÅ	CR	eÉ	NSMVNWKWT	MHP	CPPVRPKQR	SUKTU	RVHR	NOMQ	
dÉ	TO	kç=d~ë	NNWUMSUKWR	NKU	NQNCURSKNU	TUKQP	RVHR	NOMQ	
dÉ	TO	eO	CQMMUVKNS	MKU	SMTRNTKON	TOKQQ	RVHR	NOMQ	
dÉ	TO	eÉ	NCRUUSKVT	NHO	NTUUCVKVT	TMHPV	RVHR	NOMQ	
v	UV	eO	RMSRTSPHPQ	OHN	SRRTRURKQP	TTKCR	RVHR	NOMQ	
v	UV	eÉ	USUNUMKVS	MHN	NOSRCOTKVR	SUHSO	RVHR	NOMQ	
qÄ	NRV	kç=d~ë	TQNSSMTKVP	NHO	UQQSUCNKNN	UTKU	RVHR	NOMQ	
qÄ	NRV	eÉ	PNUCRNUKPT	MKV	QNWSRTCKVO	TTHR	RVHR	NOMQ	
_á	OMV	kç=d~ë	PUTUSMQKVQ	MKT	PUSSRTUHPV	NWMHPN	RVHR	NOMQ	
_á	OMV	eÉ	NUTCNWKMM	MKU	CPPPTRQKRV	UMCO	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MUTRJMNP

cãÉ=k~ã É MSTpj mi lÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` ONˆHÅ

^Åè=qãã É PLONLOMCP=ONMNMQQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKMP	ééÄ	k L^	NQCKCP	NMM	
NN	_	S	k ç=d ~ë	TMKURT	ééÄ	NKN	RPCPUKUT	NMMM	
CP	k ~	CR	e É	OMCNRKMUV	ééÄ	CKV	CQCQNPVUKCV	CMMMMM	
CQ	j Ö	CR	e É	NMQTUKPCM	ééÄ	CKS	SSUNTCKUO	CMMMMM	
CT	^ ä	CR	e É	TVCKRTO	ééÄ	CKT	CMNRUKMN	CMMMMM	
CU	pá	CR	e O	VMMMSPM	ééÄ	MKT	UMVTPPKRN	NMMMM	
PV	h	CR	e É	SNCNKCPN	ééÄ	MKS	PSTNCNKMV	CMMMMM	
QM	` ~	CR	e O	TMNNRKCCR	ééÄ	NKM	CRVMPVCCKUT	CMMMMM	
RN	s	UV	e É	CKVCT	ééÄ	VKN	CRMPKSN	NMMM	
RO	` ê	UV	e É	CKUPU	ééÄ	CKR	PPRPKTT	CMMM	
RR	j å	UV	e É	CCSKNCR	ééÄ	NKU	NNCNUNKSO	CMMM	
RS	cÉ	UV	e O	CRNSKCMP	ééÄ	MKR	SNMCTVCKTV	NMMMM	
RV	` ç	UV	e É	NKUCM	ééÄ	CKU	PCVUKCV	NMMM	
SM	k á	UV	e É	PKOTN	ééÄ	PKQ	NSSRKSU	NMMM	
SP	` ì	UV	e É	CKCPO	ééÄ	UKU	PSPCKVV	CMMM	
SS	wå	UV	e É	NCKNUQ	ééÄ	PKN	CNMSKCP	CMMM	
TR	^ ë	UV	e É	CKRMS	ééÄ	RKR	TTVKQQ	NMMM	
TU	pÉ	UV	e O	MKPUP	ééÄ	CKT	PVKST	NMMM	
UU	pê	UV	e É	CCRKTRN	ééÄ	NKO	NPSTVVKNV	CMMM	
VR	j ç	UV	e É	MKTCU	ééÄ	RKO	CTSKSU	NMMM	
NMT	^ Ö	UV	e É	MKMRU	ééÄ	PUKT	NPPHPQ	NMM	
NNN	` Ç	UV	e É	MKMTQ	ééÄ	CQKT	CNKUR	NMMM	
NNU	på	NRV	e É	JMKQUT	ééÄ	k L^	PUUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKQCP	ééÄ	RKM	CONRKUP	NMMM	
NPT	_~	NRV	k ç=d ~ë	QVKVVM	ééÄ	MKT	SPTTTKOT	CMMM	
NUO	t	NRV	k ç=d ~ë	MKOSP	ééÄ	CQKS	NQCNKSN	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMVN	ééÄ	CKU	VUTKTR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKSPQ	ééÄ	SKR	SQPTKRR	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKPTM	ééÄ	VKR	CQCRKQV	NMMM	
OPU	r	OMV	k ç=d ~ë	MKTTO	ééÄ	NKN	RVNCKVS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c ä~Ö	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMOTVNRKST	MKV	OTRVPMMKUR	TPKQV	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVUOVRMKNN	MKU	SMQUSNNKO	SRKUR	RVKR	NOMQ	
pÅ	CR	e O	VCPUPTRTU	NKM	NRCUCRRKRV	SNKTS	RVKR	NOMQ	
pÅ	CR	e É	NPVMSSRTU	NKR	CPPVRPKQR	RVKQQ	RVKR	NOMQ	SMOMa ça
d É	TO	k ç=d ~ë	VRPSPUKVU	MKR	NQNCURSKNU	STKR	RVKR	NOMQ	
d É	TO	e O	PTVRPTKSQ	MKU	SMTRNTKCN	SOKQT	RVKR	NOMQ	
d É	TO	e É	NMVTRRKMU	MKT	NTUUCVKVT	SNKPT	RVKR	NOMQ	
v	UV	e O	CPUNVPQKPQ	MKS	SRRTRURKCP	SSKUO	RVKR	NOMQ	
v	UV	e É	TQNRQTKUR	NKO	NOSRCOTKVR	RUKSN	RVKR	NOMQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SRRPRVPKRS	NKN	UQQSUCNKNN	TTHRV	RVKR	NOMQ	
qÄ	NRV	e É	OTTQTRTKUR	MKT	QNMSRTCKVO	STHRT	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQQMPSSKSV	NKP	PUSSRTUKPV	UUKVU	RVKR	NOMQ	
_á	OMV	e É	NSPMQNQKRP	MKS	CPPPTRQKRV	SVKUS	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MUTRJMNQ

cãÉ=k~ã É MSUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` ONˆHÅ

^Åè=qãã É PLONLOMCP=ONWØSWRN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKMPN	éé Ä	k L^	NMTKTU	NMM	
NN	_	S	k ç=d ~ë	TCKVOT	éé Ä	PKQ	RQCMTHPT	NMMM	
OP	k ~	QR	e É	NVCLJQKVMT	éé Ä	NKT	OPRQVRVKQU	OMMMMM	
OQ	j Ö	QR	e É	NVRQQKTMQ	éé Ä	OKM	STORPRKVP	OMMMMM	
OT	^ ä	QR	e É	NJURKOSS	éé Ä	OKN	RMVPKOR	OMMMMM	
OU	pá	QR	e O	UPTPHPTQ	éé Ä	NHP	TQSPUJJKMO	NMMMM	
PV	h	QR	e É	SNMVRKRNN	éé Ä	NKN	PSRNNVKMS	OMMMMM	
QM	` ~	QR	e O	TNOVVKUTV	éé Ä	MKV	QSTNPTQNKRO	OMMMMM	
RN	s	UV	e É	NKUSO	éé Ä	OKP	NSQSKTV	NMMM	
RO	` ê	UV	e É	OKOTO	éé Ä	QKU	OTTVKTR	OMMM	
RR	j å	UV	e É	OPMKRVR	éé Ä	MKU	NNRVOTKMU	OMMM	
RS	cÉ	UV	e O	OMRRKOVM	éé Ä	OKR	RMNQNPPKPU	NMMMM	
RV	` ç	UV	e É	NKUSN	éé Ä	RKP	PPRPKUS	NMMM	
SM	k á	UV	e É	PKMUQ	éé Ä	PKU	NRSVKMN	NMMM	
SP	` ì	UV	e É	NKSQN	éé Ä	OKR	CUQPKST	OMMM	
SS	wå	UV	e É	VKTVP	éé Ä	PKO	PNNMKQM	OMMM	
TR	^ ë	UV	e É	QKMTN	éé Ä	OKP	TMOKQO	NMMM	
TU	pÉ	UV	e O	MKPNR	éé Ä	NQKP	PPKNT	NMMM	
UU	pê	UV	e É	COTKNPV	éé Ä	MKS	NPTMQUKPT	OMMM	
VR	j ç	UV	e É	MKSNR	éé Ä	NNKV	QMUKVM	NMMM	
NMT	^ Ö	UV	e É	MKMCQ	éé Ä	RNKQ	SOKCO	NMM	
NNN	` Ç	UV	e É	MKMON	éé Ä	PVKM	TKMQ	NMMM	
NNU	på	NRV	e É	JMRQCO	éé Ä	k L^	PRRKRT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKQMM	éé Ä	RKN	ONQVKMV	NMMM	
NPT	_~	NRV	k ç=d ~ë	QUKTUP	éé Ä	OKN	SPNJUJKMO	OMMM	
NUO	t	NRV	k ç=d ~ë	MKNTP	éé Ä	QTKV	NOPNKPT	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMQO	éé Ä	NNKR	TMTKQP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMVS	éé Ä	NOKM	ONSVKMQ	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNVU	éé Ä	NUKP	POSTKOO	NMMM	
OPU	r	OMV	k ç=d ~ë	MKTPR	éé Ä	NKT	QTTOKSO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMMVCPPKMP	NKR	OTRVPMVKUR	TOKR	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PVRSTNNKRP	MKU	SMQUSNNKO	SRKQO	RVKR	NOMQ	
pÅ	QR	e O	VQQRORKRM	MKU	NROUOCRRKRV	SNKU	RVKR	NOMQ	
pÅ	QR	e É	NPVMITVKRV	NKO	OPPVRPKQR	RVKQR	RVKR	NOMQ	SMOMa ça
d É	TO	k ç=d ~ë	VSMOMMKNU	MKU	NQNOURSKNU	STKVS	RVKR	NOMQ	
d É	TO	e O	PTVVRQKVQ	MKS	SMTRNTKON	SOKRQ	RVKR	NOMQ	
d É	TO	e É	NNMMMTKQN	MKT	NTUUOVKVT	SNKRO	RVKR	NOMQ	
v	UV	e O	QQMMUOTHPN	NKT	SRRTRURKQP	STKNN	RVKR	NOMQ	
v	UV	e É	TPUPNQKTP	MKT	NOSROOTKVR	RUKPR	RVKR	NOMQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SSRPQSMKNT	MKS	UQQSUONKNN	TUKTT	RVKR	NOMQ	
qÄ	NRV	e É	OTTQTPOKPS	MKQ	QNMSRTOKVO	STHRT	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQQMPRQKVM	MKU	PUSSRTUKPV	UUKVU	RVKR	NOMQ	
_á	OMV	e É	NSPUMRMKQS	NKO	OPPPTRQKRV	TMKNV	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MUTSJMMT

cãÉ=k~ã É MSVpj mi hÇ

a~í~=m~íÜ=k~ã É a\yt ÖäÉáíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` ONˆHÅ

^Åè=qãã É PLONLOMCP=ONAPNMRT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==: mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKUV	ééÄ	k L^	QPHPP	NMM	
NN	_	S	k ç=d ~ë	NKMCR	ééÄ	RKM	NUSSKUO	NMMM	
CP	k ~	CR	e É	NQQRTSP	ééÄ	SKQ	QUUVMKPU	CMMMMM	
CQ	j Ö	CR	e É	OVKOTV	ééÄ	VKN	COMCKQT	CMMMMM	
CT	^ ä	CR	e É	JMKNNS	ééÄ	k L^	RNNKNP	CMMMMM	
CU	pá	CR	e O	OVKUMU	ééÄ	RKO	PSQMKVT	NMMMM	
PV	h	CR	e É	CPRKUCO	ééÄ	RKQ	PCCCQRTM	CMMMMM	
QM	` ~	CR	e O	CNVKCUS	ééÄ	CKQ	NRSMSPKQM	CMMMMM	
RN	s	UV	e É	MKPUM	ééÄ	NCKQ	QVPKPR	NMMM	
RO	` ê	UV	e É	MKPPM	ééÄ	NQKQ	USTKQM	CMMM	
RR	j å	UV	e É	MKTPR	ééÄ	PKU	RNNKCQ	CMMM	
RS	cÉ	UV	e O	CKNSV	ééÄ	SKR	RCCVRKMN	NMMMM	
RV	` ç	UV	e É	JMKVSU	ééÄ	k L^	SMKMM	NMMM	
SM	k á	UV	e É	MCCCP	ééÄ	NMKR	CMRKRS	NMMM	
SP	` ì	UV	e É	MCTT	ééÄ	CKO	NMSMKMS	CMMM	
SS	wå	UV	e É	NKCUR	ééÄ	CNKM	NCCCQKRO	CMMM	
TR	^ ë	UV	e É	MKNNN	ééÄ	NQKO	PNNST	NMMM	
TU	pÉ	UV	e O	MKMSN	ééÄ	SSKM	UKVM	NMMM	
UU	pê	UV	e É	MKRTV	ééÄ	NRKO	PTQKQS	CMMM	
VR	j ç	UV	e É	MKNVQ	ééÄ	NRKQ	NSTKTU	NMMM	
NMT	^ Ö	UV	e É	MKMNR	ééÄ	PVKM	QPHPP	NMM	
NNN	` Ç	UV	e É	MKMNO	ééÄ	SSKV	QKQQ	NMMM	
NNU	på	NRV	e É	JMKQRR	ééÄ	k L^	QMUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMUN	ééÄ	SKR	SUMKTQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKSPM	ééÄ	NPKV	VOTHSU	CMMM	
NUO	t	NRV	k ç=d ~ë	MKMOV	ééÄ	NVTKM	UOTHRT	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMMP	ééÄ	k L^	QQPKUN	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKMOT	ééÄ	k L^	NNUTKVR	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMPP	ééÄ	QQKM	ONMVMU	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMMQ	ééÄ	NPRKU	SPKQM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=ɵpa	oÉÑ= mp	B=ɵ ÉÅ	B n ` =ï çï	B n ` =c ä~Ö	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMQQQQVKN	NKS	OTRVPMMVUR	TPHPS	RVHR	NOMQ	
pÅ	CR	k ç=d ~ë	PVNTVQSKSS	NKN	SMQUSNNKO	SQRTT	RVHR	NOMQ	
pÅ	CR	e O	VQSUONKNO	MKT	NRCUCRRHRV	SNKVR	RVHR	NOMQ	
pÅ	CR	e É	NPVTCUNSQ	MKU	CPPVRPKQR	RVRTO	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VRQVUMKMU	MKU	NQNCURSKNU	STHRV	RVHR	NOMQ	
d É	TO	e O	PUNNTUKCS	MHR	SMTRNTKON	SQRTQ	RVHR	NOMQ	
d É	TO	e É	NMVNTRRTS	MKU	NTUUCVKVT	SNMVR	RVHR	NOMQ	
v	UV	e O	QPSQMRMRTS	MHR	SRRTRURKQP	SSHRR	RVHR	NOMQ	
v	UV	e É	TQQQTTKNP	MKU	NOSRCOTKVR	RUKUQ	RVHR	NOMQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SQMSMPVKNO	NKS	UQQSUCNKNN	TRKUQ	RVHR	NOMQ	
qÄ	NRV	e É	OTTUUQVKOO	MKO	QNMSRTCKVO	STHST	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PQNCQQMKUO	NRT	PUSSRTUHPV	UUKCR	RVHR	NOMQ	
_á	OMV	e É	NSPRRPMKCU	MRT	CPPPTRQKRV	TMMVU	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MUTSJMMU

cãÉ=k~ã É MTMpj mi hÇ

a~í~=m~íÜ=k~ã É aWjtÖäÉáíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` ONˆHÅ

^Åè=qãã É PLONLOMCP=ONWTWQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKMVQ	ééÄ	k L^	PUKUV	NMM	
NN	_	S	k ç=d ~ë	MKSTT	ééÄ	NRKN	NSPMKNN	NMMM	
CP	k ~	CR	e É	NPNKMQT	ééÄ	CKV	QTNMCKPP	CMMMMM	
CQ	j Ö	CR	e É	NCKNUM	ééÄ	TKT	NNMCKRP	CMMMMM	
CT	^ ä	CR	e É	CKCTS	ééÄ	TSKO	RSUKVN	CMMMMM	
CU	pá	CR	e O	NSKUUN	ééÄ	VKS	CQLUVKRN	NMMMM	
PV	h	CR	e É	CNVKURP	ééÄ	CKV	PNCPQKQQ	CMMMMM	
QM	` ~	CR	e O	NMMKOVR	ééÄ	MKQ	TUMMQKPS	CMMMMM	
RN	s	UV	e É	MKPUS	ééÄ	NNKU	RMPKPR	NMMM	
RO	` ê	UV	e É	MKPOS	ééÄ	NVKN	UTPKOM	CMMM	
RR	j å	UV	e É	MKOTU	ééÄ	NUKO	CUPKOU	CMMM	
RS	cÉ	UV	e O	JTKSVU	ééÄ	k L^	CQNUVKRQ	NMMMM	
RV	` ç	UV	e É	JMKMSO	ééÄ	k L^	TNKNN	NMMM	
SM	k á	UV	e É	MKNCR	ééÄ	NVKR	NSMKMM	NMMM	
SP	` ì	UV	e É	MKNPR	ééÄ	OSKN	UUNKNS	CMMM	
SS	wå	UV	e É	CKTUO	ééÄ	PKS	OMPOKQN	CMMM	
TR	^ ë	UV	e É	MKMVT	ééÄ	PTKN	OVKST	NMMM	
TU	pÉ	UV	e O	MKMPR	ééÄ	SOKT	RKRM	NMMM	
UU	pê	UV	e É	MKONS	ééÄ	SKR	NRRKRS	CMMM	
VR	j ç	UV	e É	MKNNN	ééÄ	RQKV	NONKNN	NMMM	
NMT	^ Ö	UV	e É	MKMNM	ééÄ	TVKV	PQKQR	NMM	
NNN	` Ç	UV	e É	MKMMN	ééÄ	POUKM	NKQU	NMMM	
NNU	på	NRV	e É	JMKRCP	ééÄ	k L^	PSTKTV	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMRM	ééÄ	QPKM	RRPKVP	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKNUT	ééÄ	PNKU	PUPKTQ	CMMM	
NUO	t	NRV	k ç=d ~ë	MKMQU	ééÄ	QRNKU	UVMKVU	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMNM	ééÄ	k L^	QMTKNM	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKMUR	ééÄ	k L^	TPQKNO	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMMR	ééÄ	QPMKO	NVPOKNV	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMMP	ééÄ	QRNS	RSKTO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMQVNQQKNQ	NKT	OTRVPMMKUR	TQKOS	RVKR	NOMKQ	
pÅ	CR	k ç=d ~ë	QMNUTRVKTM	NNS	SMQUSNNKO	SSKQQ	RVKR	NOMKQ	
pÅ	CR	e O	VQTUTMKUS	NKN	NRCUCRRKRV	SOKMO	RVKR	NOMKQ	
pÅ	CR	e É	NPVCUCKVS	MKR	CPPVRPKQR	RVKRP	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VRCQSUKUO	MKP	NQNCURSKNU	STKQN	RVKR	NOMKQ	
d É	TO	e O	PUPUCOKPT	NKN	SMTRNTKON	SPKNU	RVKR	NOMKQ	
d É	TO	e É	NMUVSMKQR	NKN	NTUUCVKVT	SMKVP	RVKR	NOMKQ	
v	UV	e O	QQPCOVTKQT	MKS	SRRTRURKQP	STKRV	RVKR	NOMKQ	
v	UV	e É	TRCSTUKVN	MKT	NOSRCOTKVR	RVKQV	RVKR	NOMKQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SRCMVRRKTS	MKQ	UQQSUCNKNN	TTKO	RVKR	NOMKQ	
qÄ	NRV	e É	OTTVMUSKRV	NKO	QNMSRTCKVO	STKST	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PQCVCNMKUU	NKN	PUSSRTUKPV	UUKSV	RVKR	NOMKQ	
_á	OMV	e É	NSQTVRVKVS	MKS	CPPPTRQKRV	TMKSN	RVKR	NOMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` NSfj pN
cáÉ=k~ã É	MTN| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJj ^oyin` ON^kÄ
^Åè=qáã É	PLONLOMOP=ONWQOMO
p~ã éäÉ=qóéÉ	m_
qçí~ä=aáäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	c~ãä
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iáãáí	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMVP	ééÄ	kL^	PUKUV	MKR	
_	NN	S	kç=d~ë	MKTOM	ééÄ	RKV	NSPTKVM	NM	
k~	OP	QR	eÉ	NUSKONO	ééÄ	QKS	RPVSVKUO	RMM	
jÖ	OQ	QR	eÉ	NTKTSP	ééÄ	UKU	NQSVKMO	RM	
^ä	OT	QR	eÉ	NMKVUV	ééÄ	NQKS	TUUKVO	RM	
pá	OU	QR	eO	NMKURO	ééÄ	VKM	NVRRKRR	ORM	
h	PV	QR	eÉ	OPUKSUP	ééÄ	OKO	POQTQKUR	RMM	
`~	QM	QR	eO	UQKUSU	ééÄ	NKT	STVVQKTS	RM	m_=SMOM=c~ãë=aça
s	RN	UV	eÉ	MKQVO	ééÄ	NNKO	RUQKQT	OKR	
`ê	RO	UV	eÉ	MKSUT	ééÄ	RKO	NOOVKNR	OKR	
jå	RR	UV	eÉ	MKSPU	ééÄ	SKN	QSQKRV	N	
cÉ	RS	UV	eO	QKURM	ééÄ	RKP	RQTSVKSN	RM	
`ç	RV	UV	eÉ	JMKMQU	ééÄ	kL^	VRKRS	MKR	
ká	SM	UV	eÉ	MKQRS	ééÄ	NMKO	PNUKVM	N	
`ì	SP	UV	eÉ	MKQRO	ééÄ	TKQ	NOVTKUS	NKR	
wå	SS	UV	eÉ	VKMQR	ééÄ	TKO	OVUNKQU	R	m_=SMOM=c~ãë=aça
^ë	TR	UV	eÉ	MKNNU	ééÄ	OVKV	PPKMM	OKR	
pÉ	TU	UV	eO	MKMPM	ééÄ	NSKS	RKMM	OKR	
pê	UU	UV	eÉ	MKOQO	ééÄ	NMKN	NTMKMM	OKR	
jç	VR	UV	eÉ	MKNUT	ééÄ	NNKV	NSQKQR	OKR	
^Ö	NMT	UV	eÉ	MKMVQ	ééÄ	NONKR	ONKNN	MKR	
`Ç	NNN	UV	eÉ	MKMVP	ééÄ	UPKU	NKUR	MKR	
på	NNU	NRV	eÉ	PTKRTO	ééÄ	PKT	OPTSSKTV	OKR	m_=SMOM=c~ãë=aça & m_=SMOM=c~ãë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKMRT	ééÄ	RTKR	RUMKSP	MKR	
_~	NPT	NRV	kç=d~ë	MKPTN	ééÄ	OKQ	SNMKSS	N	
t	NUO	NRV	kç=d~ë	MKMTM	ééÄ	RRKR	VPTKSV	OKR	
qä	OMR	OMV	kç=d~ë	JMKMOM	ééÄ	kL^	PQTKMQ	MKR	
mÄ	OMU	OMV	kç=d~ë	MKNRT	ééÄ	OMKT	OSNOKUT	MKR	
qÜ	OPO	OMV	kç=d~ë	MKMNQ	ééÄ	SMKP	NVSRKRS	OKR	
r	OPU	OMV	kç=d~ë	MKMMO	ééÄ	OVVKP	RMKMR	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	OMVNRQKUQ	NMS	OTRVPMMKUR	TPKNU	RVMR	NOMQ	
pÅ	QR	kç=dl~ë	PVQVUUUKNU	MKU	SMQUSNNKO	SRHP	RVMR	NOMQ	
pÅ	QR	eO	VQVTQNKVS	MKR	NRQUCRRKRV	SOKNR	RVMR	NOMQ	
pÅ	QR	eÉ	NQMMMVKSP	MKS	OPPVRPKQR	RVKUR	RVMR	NOMQ	
dÉ	TO	kç=dl~ë	VRUMURKOT	MKQ	NQNCURSKNU	STKUN	RVMR	NOMQ	
dÉ	TO	eO	PTTSOVKVS	MKP	SMTRNTKON	SOKNS	RVMR	NOMQ	
dÉ	TO	eÉ	NMUPQOKPN	NKP	NTUUOVKVT	SMKRU	RVMR	NOMQ	
v	UV	eO	QQPOORQKUS	MKV	SRRTRURKQP	STKRV	RVMR	NOMQ	
v	UV	eÉ	TQTUTNKSM	MKP	NOSRCOTKVR	RVKNN	RVMR	NOMQ	SMOMa ça
qÄ	NRV	kç=dl~ë	SQSONTQKMO	NKQ	UQQSUONKNN	TSHR	RVMR	NOMQ	
qÄ	NRV	eÉ	OUMMRMVKSU	MKV	QNMSRTOKVO	SUHO	RVMR	NOMQ	
_á	OMV	kç=dl~ë	PPUSUVUKNQ	OKS	PUSSRTUKPV	UTKRV	RVMR	NOMQ	
_á	OMV	eÉ	NSPTRNPKVR	NKQ	OPPPTRQKRV	TMKNT	RVMR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` pl n ` NSfj pN
cáÉ=k~ã É	MTCl ` pl kÇ
a~í~=m~íÜ=k~ã É	aWf^ÖäÉáíyf` mj eyNya ^q^ yOMOPyMPJ ^o yi n ` ONf^kÄ
^Åè=qáã É	PLONLOMOP=ONMQTWV
p~ã éäÉ=qóéÉ	i ` pl
qçí~äa ãäíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MVS` ^i _kÇ
p~ã éäÉ=n ` =m~ëëlcá~ä	m~ëë
fpqa=n ` =m~ëëlc~äà	c~äà
l éÉê~íçê	**~Çã åà**

n ` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÄK	r åáë	opa	==` mp==	bñés~ä	B=oÉÁ	B i çï	B eáÖÜ	n ` =c~ä-Ö
_É	V	S	k ç=dl ~ë	QVKTPU	ééÄ	NKM	RRONPKNP	RM	NVKV	TVKR	NOMQ	
_	NN	S	k ç=dl ~ë	QUPKPPM	ééÄ	OKP	PQUTPVKSP	RMM	NVKPP	TVKR	NOMQ	
k~	OP	QR	e É	UPNNKSUV	ééÄ	OKO	NMMUQPPKQN	TRMM	OOKNS	TVKR	NOMQ	
j Ö	OQ	QR	e É	RPQPKPTQ	ééÄ	NKP	PPSQUSKRO	RMMM	ONKPT	TVKR	NOMQ	
^ä	OT	QR	e É	OMTOKSMM	ééÄ	MKV	RNMSNKNR	OMMM	OMKTP	TVKR	NOMQ	
pá	QU	QR	e O	UVSKTVV	ééÄ	OKU	TVOPSKOS	NMMM	NTKVQ	TVKR	NOMQ	
h	PV	QR	e É	NMMNSKMRS	ééÄ	MKV	RTUVNPKPV	NMMMM	OMMVP	TVKR	NOMQ	
` ~	QM	QR	e O	OSPUKSPT	ééÄ	MKU	NTMSRQQKNQ	ORMM	ONKNN	TVKR	NOMQ	
s	RN	UV	e É	RMVKMST	ééÄ	NKQ	PVOSPRKTU	RMM	OMPS	TVKR	NOMQ	
` ê	RO	UV	e É	OMSKMSR	ééÄ	NKV	OMNRTUKQM	OMM	OMSN	TVKR	NOMQ	
j å	RR	UV	e É	RNUKOUS	ééÄ	MKS	ORTMQMKVV	RMM	OMKTP	TVKR	NOMQ	
cÉ	RS	UV	e O	VTUKUVT	ééÄ	NKO	OQMNSPSKPO	NMMM	NVKRU	TVKR	NOMQ	
` ç	RV	UV	e É	RPSKVRT	ééÄ	NKQ	VMQUVPKSM	RMM	ONKQU	TVKR	NOMQ	
ká	SM	UV	e É	RPPKUNO	ééÄ	OKN	ORNRCSKUV	RMM	ONKPR	TVKR	NOMQ	
` ì	SP	UV	e É	OSVKSUN	ééÄ	NKR	PRMRCQKSM	ORM	ONKRT	TVKR	NOMQ	
wå	SS	UV	e É	RPMKPNT	ééÄ	MKR	NNTRURKVV	RMM	ONKON	TVKR	NOMQ	
^ë	TR	UV	e É	NMPKPPU	ééÄ	MKQ	NTOVVKUQ	NMM	OMKST	TVKR	NOMQ	
pÉ	TU	UV	e O	VPKTUN	ééÄ	MKS	VONVKCU	NMM	NUKTS	TVKR	NOMQ	
pê	UU	UV	e É	RNOKOMN	ééÄ	MKS	PMRMRVKUO	RMM	OMKQV	TVKR	NOMQ	
j ç	VR	UV	e É	NMOKUTT	ééÄ	MKV	RURUVKSV	NMM	OMKRU	TVKR	NOMQ	
^Ö	NMT	UV	e É	RQKSMT	ééÄ	NKP	NNMTUSKRO	RM	ONKUQ	TVKR	NOMQ	
` Ç	NNN	UV	e É	OTMKVON	ééÄ	MKV	TRCQOKPQ	ORM	ONKST	TVKR	NOMQ	
på	NNU	NRV	e É	RMQKPVP	ééÄ	NKV	PMPSSPKVM	RMM	OMKNU	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl ~ë	VNKOMP	ééÄ	MKS	QMNQUQKVR	NMM	NUKCQ	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl ~ë	OMMMKNRQ	ééÄ	MKT	ORNURNVKSU	OMMM	OOM	TVKR	NOMQ	
t	NUO	NRV	k ç=dl ~ë	NMMKOPM	ééÄ	MKP	ORPTCOKUR	NMM	OMKVR	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl ~ë	VQKSPN	ééÄ	NKO	RQMMVKSV	NMM	NUKVP	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl ~ë	VUKQTU	ééÄ	MKM	TTURVSKNM	NMM	NVKT	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl ~ë	VNKSPU	ééÄ	MKQ	SOVTMUKRN	NMM	NUKPP	TVKR	NOMQ	
r	OPU	OMV	k ç=dl ~ë	VVKNVT	ééÄ	NKR	SPSQNUKVR	NMM	NVKUQ	TVKR	NOMQ	

n ` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=i çï	Bn`=eäÜÜ	n`=ä=Ö
iá	S	kç=d~ë	NVTRQCUKSS	NKO	OTRVPMMKUR	TNKRV	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PUURNTNKRM	NKV	SMQUSNNKO	SQKCP	RVKR	NOMQ	
pÅ	QR	eO	VOSNUUKVU	NKO	NRCUCRRKRV	SMKS	RVKR	NOMQ	
pÅ	QR	eÉ	NPTNSQKVR	MKV	OPPVRPKQR	RUKSP	RVKR	NOMQ	SMOMaça
dÉ	TO	kç=d~ë	VQVUSSKPT	MKR	NQNCURSKKU	STKCP	RVKR	NOMQ	
dÉ	TO	eO	PTSTNRKPO	MKV	SMTRNTKON	SOKMN	RVKR	NOMQ	
dÉ	TO	eÉ	NNMONTKVU	NKN	NTUUCVKVT	SNKSP	RVKR	NOMQ	
v	UV	eO	QPUPTSRKRS	NKO	SRRTRURKQP	SSKUR	RVKR	NOMQ	
v	UV	eÉ	TCUUNUKVM	NKO	NCSRCOTKVR	RTHS	RVKR	NOMQ	SMOMaça
qÄ	NRV	kç=d~ë	SQUOTVMKUV	MKT	UQQSUCNKNN	TSKTR	RVKR	NOMQ	
qÄ	NRV	eÉ	OTPVMTRKQV	NKS	QNMSRTOKVO	SSKT	RVKR	NOMQ	
_á	QW	kç=d~ë	PQCQNNNKUO	MKO	PUSSRTUKPV	UUKRS	RVKR	NOMQ	
_á	QW	eÉ	NSOTPRCKOT	MKN	OPPPTRQKRV	SVKTP	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMNN

cãÉ=k~ã É MTPpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` ONˆHÅ

^Åè=qãã É PLONLOMCP=ONMRQMQR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RHMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä c~ãä

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	MCOSQ	éé Ä	NNKN	QQQKOQ	NMM	
NN	_	S	k ç=d ~ë	PKTUV	éé Ä	PKM	PUUPKVP	NMMM	
CP	k ~	QR	e É	NVTKNNU	éé Ä	CKO	RQROVKMQ	OMMMMM	
CQ	j Ö	QR	e É	NTUCKVOT	éé Ä	MKR	NNPOMUKRR	OMMMMM	
OT	^ ä	QR	e É	URUSKOTM	éé Ä	NKN	ONNPUVKSR	OMMMMM	
OU	pá	QR	e O	NQCQKQNP	éé Ä	PKR	NOSQRNKUU	NMMMM	
PV	h	QR	e É	NVMNKUVM	éé Ä	NKT	NORTPUKTQ	OMMMMM	
QM	` ~	QR	e O	NQTSKTPQ	éé Ä	NKN	VSVMCQKTP	OMMMMM	
RN	s	UV	e É	CPKQNP	éé Ä	PKP	NUSSRKVU	NMMM	
RO	` ê	UV	e É	NQKTNS	éé Ä	CKP	NRCPQKSR	OMMM	
RR	j å	UV	e É	NRRKVUS	éé Ä	CKM	TVOSTKNV	OMMM	
RS	cÉ	UV	e O	NSMSSKVTV	éé Ä	MKO	PUVRCPCRKRQ	NMMMMM	
RV	` ç	UV	e É	CKRPR	éé Ä	CKQ	QRQVKTU	NMMM	
SM	k á	UV	e É	PKOTV	éé Ä	CKN	NSTVKMD	NMMM	
SP	` ì	UV	e É	PKSOV	éé Ä	NKU	RRNPKQN	OMMM	
SS	wå	UV	e É	PPKOSM	éé Ä	CKR	UQQSKMN	OMMM	
TR	^ ë	UV	e É	QKQMV	éé Ä	RKT	TSTKQQ	NMMM	
TU	pÉ	UV	e O	MKPTR	éé Ä	RKQ	PVKMM	NMMM	
UU	pê	UV	e É	VKOSV	éé Ä	CKU	RSTNKOT	OMMM	
VR	j ç	UV	e É	QKMRU	éé Ä	CKR	OQTSKVQ	NMMM	
NMT	^ Ö	UV	e É	MKMTN	éé Ä	CRKQ	NSMKMM	NMM	
NNN	` Ç	UV	e É	MKNUR	éé Ä	CRKO	RPKTM	NMMM	
NNU	på	NRV	e É	PTKUNS	éé Ä	MKR	CPRRSKPV	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOMS	éé Ä	NPKS	NOPUKMQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	RQKPUT	éé Ä	TKR	SURUMKUT	OMMM	
NUO	t	NRV	k ç=d ~ë	MKQNS	éé Ä	OMKN	NUNOKMQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKPUN	éé Ä	SKV	OSQSKQN	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	SKTSR	éé Ä	NMKO	RRMPUKVT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NQKTQQ	éé Ä	NKP	NMPPURKQR	NMMM	
OPU	r	OMV	k ç=d ~ë	CKQMQ	éé Ä	NKQ	NRROVKPR	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B¤pÉÅ	B n` =¨ çï	B n` =¤ëÛÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	OMNPUPSKPP	MKT	OTRVPMMKUR	TOKVU	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PVMUNOQKSS	NKN	SMQUSNNKO	SQKSN	RVHR	NOMQ	
pÅ	QR	e O	VPQRVMKON	NKP	NRCUCRRKRV	SNKNR	RVHR	NOMQ	
pÅ	QR	e É	NPUNNPKRS	NKM	CPPVRPKQR	RVMVP	RVHR	NOMQ	SMOMa ça
d É	TO	k ç=d ~ë	VOUCSOKRP	CKQ	NQNCURSKNU	SRKT	RVHR	NOMQ	
d É	TO	e O	PTNNNOKMM	MKU	SMTRNTKON	SNKMV	RVHR	NOMQ	
d É	TO	e É	NMSRRRHRS	MKV	NTUUOVKVT	RVHRU	RVHR	NOMQ	
v	UV	e O	QQMQUNOKSM	NKM	SRRTRURKQP	STHKT	RVHR	NOMQ	
v	UV	e É	TQRVNSKRN	MKT	NOSROOTKVR	RUKVS	RVHR	NOMQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SQTVUTQKSV	MKQ	UQQSUONKNN	TSKTN	RVHR	NOMQ	
qÄ	NRV	e É	OTRTSMUKPM	NKR	QNMSRTOKVO	STHKR	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PQQMTUUKRO	CKQ	PUSSRTUKPV	UUKVV	RVHR	NOMQ	
_á	OMV	e É	NSPQTQRKQS	NKS	OPPPTRQKRV	TMMVR	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMNP

cãÉ=k~ã É MTQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` ONˆHÅ

^Åè=qãã É PLONLOMCP=ONARVMRP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä c~ãä

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	MMVSS	ééÄ	OVKQ	ONRKRS	NMM	
NN	_	S	k ç=d ~ë	OKQVQ	ééÄ	RKO	OUVTKMM	NMMM	
CP	k ~	CR	e É	NNNMVPQ	ééÄ	PKV	QQCUPKSV	OMMMMM	
CQ	j Ö	CR	e É	OSNMKRT	ééÄ	OKN	NSUPVKPQ	OMMMMM	
CT	^ ä	CR	e É	TUOVKTTV	ééÄ	NKV	NVCRUUKSP	OMMMMM	
CU	pá	CR	e O	NRUPKSNR	ééÄ	NKR	NQMUOMKNQ	NMMMM	
PV	h	CR	e É	QQSKVQS	ééÄ	OKV	QQRVNKSV	OMMMMM	
QM	` ~	CR	e O	NTPKPTO	ééÄ	MKV	NCQRUUKKN	OMMMMM	
RN	s	UV	e É	NSKQTQ	ééÄ	NKO	NPNORKCO	NMMM	
RO	` ê	UV	e É	NPKCOM	ééÄ	MKP	NPSTNKPT	OMMM	
RR	j å	UV	e É	PRKNPP	ééÄ	MKT	NTUTNKCR	OMMM	
RS	cÉ	UV	e O	VMMNKVTU	ééÄ	OKP	ONSRVVTRKST	NMMMMM	
RV	` ç	UV	e É	NKMMO	ééÄ	OKV	NUVRKTS	NMMM	
SM	k á	UV	e É	PKCRU	ééÄ	RKV	NSSMKNP	NMMM	
SP	` ì	UV	e É	PKMRO	ééÄ	NKU	QTCPKMV	OMMM	
SS	wå	UV	e É	NSKOMU	ééÄ	PKU	QTNTKRR	OMMM	
TR	^ ë	UV	e É	QKNNO	ééÄ	RKU	TNPKMV	NMMM	
TU	pÉ	UV	e O	MCOSS	ééÄ	NMKV	OUKMM	NMMM	
UU	pê	UV	e É	PKPPO	ééÄ	PKU	OMQCKQN	OMMM	
VR	j ç	UV	e É	MKVPM	ééÄ	PKN	RVPKPS	NMMM	
NMT	^ Ö	UV	e É	MKMPP	ééÄ	OMRT	UNKNN	NMM	
NNN	` Ç	UV	e É	MKNPS	ééÄ	POKN	PVKSP	NMMM	
NNU	på	NRV	e É	PUKQUT	ééÄ	CKO	CPTUNKPN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MCPU	ééÄ	TKN	NPTNKRO	NMMM	
NPT	_~	NRV	k ç=d ~ë	OMSCN	ééÄ	OKV	CRUURKTT	OMMM	
NUO	t	NRV	k ç=d ~ë	MKPOV	ééÄ	OTKV	NRTUKQQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNCN	ééÄ	NSKN	NNPQKRU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NPKVNV	ééÄ	MKT	NMVTTRKRU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NCKMMR	ééÄ	NKS	UPTPMKQN	NMMM	
OPU	r	OMV	k ç=d ~ë	NKQMT	ééÄ	MKU	UVQCKSQ	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¤ mp	B¤pÉÅ	B n` =¤çï	B n` =¤ëÛÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	NVUUUMMSU	NKU	OTRVPMMVUR	TOKMU	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PUNVVMSKQT	CKO	SMQUSNNKO	SPKNR	RVKR	NOMQ	
pÅ	CR	e O	VPSVSPKON	NKO	NRCUCRRKRV	SNKPN	RVKR	NOMQ	
pÅ	CR	e É	NPTVSNKCR	NKN	CPPVRPKQR	RUKVT	RVKR	NOMQ	SMOMa ça
d É	TO	k ç=d ~ë	VOTSNQKQU	OKN	NQNCURSKNU	SRKSS	RVKR	NOMQ	
d É	TO	e O	PSVTRSKON	NKM	SMTRNTKON	SMKUS	RVKR	NOMQ	
d É	TO	e É	NMTPVURKM	NKM	NTUUCVKVT	SMMVS	RVKR	NOMQ	
v	UV	e O	QPSUOTRKTU	MKS	SRRTRURKQP	SSKSN	RVKR	NOMQ	
v	UV	e É	TQCMUNKTN	MKQ	NOSRCOTKVR	RUKSR	RVKR	NOMQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SQCVNTUKVR	NKU	UQQSUCNKNN	TSKNN	RVKR	NOMQ	
qÄ	NRV	e É	OTPTPSPKRV	NKP	QNMSRTCKVO	SSKSS	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PPTVMQMKPP	OKS	PUSSRTUKPV	UTKPV	RVKR	NOMQ	
_á	OMV	e É	NSQMVSSKRO	MKV	OPPPTRQKRV	TMKPN	RVKR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` NSfj t N
cáÉ=k~ã É	MTR| m_KÇ
a~í~=m~íÜ=k~ã É	a Wy^ ÖäÉáíyf` mj e yNya^q^yOMOPyMPJ ^o yi n` ON^ kÄ
^Åè=qáã É	PLONLOMOP=OOMRMN
p~ã éäÉ=qóéÉ	m_
qçí~ä=a áä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	c~ãä
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==` mp==	i áã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	JMKMVO	ééÄ	k L^	QMKMM	MKR	
_	NN	S	k ç=d ~ë	NKNMQ	ééÄ	TKN	NVNVKMR	NM	
k~	OP	QR	e É	TRKNUV	ééÄ	VKM	PVVQPKPN	RMM	
j Ö	OQ	QR	e É	SKQPP	ééÄ	OSKN	TOUKVP	RM	
^ä	OT	QR	e É	NSKNQS	ééÄ	NRKR	VMNKNS	RM	
pá	OU	QR	e O	NSKSMO	ééÄ	NQKO	OQROKUO	ORM	
h	PV	QR	e É	ONTKVNP	ééÄ	NKP	PMTRNKTV	RMM	
` ~	QM	QR	e O	VTKNPP	ééÄ	NKV	TRQVMKPO	RM	m_=SMOM=c~ãë=a ça
s	RN	UV	e É	MKQOV	ééÄ	NPKM	ROSKSV	OKR	
` ê	RO	UV	e É	MKORR	ééÄ	VKQ	TUQKRQ	OKR	
j å	RR	UV	e É	MKPVM	ééÄ	NTKM	PPPKOT	N	
cÉ	RS	UV	e O	NQKRUO	ééÄ	OKT	TTTSTKMT	RM	
` ç	RV	UV	e É	MKMNQ	ééÄ	NVQKT	OMMKMN	MKR	
k á	SM	UV	e É	MKNSO	ééÄ	RQKM	NTQKQR	N	
` ì	SP	UV	e É	MKMOQ	ééÄ	NUUKU	TNTKUN	NKR	
wå	SS	UV	e É	JNKPMS	ééÄ	k L^	SPRKRU	R	
^ë	TR	UV	e É	MKNQQ	ééÄ	NOKO	PTKMM	OKR	
pÉ	TU	UV	e O	MKMOR	ééÄ	NKQ	QKRM	OKR	
pê	UU	UV	e É	MKPON	ééÄ	NUKP	ONRKRS	OKR	
j ç	VR	UV	e É	MKNTS	ééÄ	PUKN	NRRKRS	OKR	
^Ö	NMT	UV	e É	MKMNN	ééÄ	RSKO	PRKRS	MKR	
` Ç	NNN	UV	e É	MKMQQ	ééÄ	PVKR	NPKPP	MKR	
på	NNU	NRV	e É	JMKQOO	ééÄ	k L^	QOOKOQ	OKR	
pÄ	NON	NRV	k ç=d ~ë	MKMQU	ééÄ	PTKP	RQPKVO	MKR	
_~	NPT	NRV	k ç=d ~ë	MKSMS	ééÄ	ONKV	VMTKSS	N	
t	NUO	NRV	k ç=d ~ë	MKMRO	ééÄ	UPKS	UVQKPN	OKR	
qä	OMR	OMV	k ç=d ~ë	MKMON	ééÄ	UQKN	RTTKOV	MKR	
mÄ	OMU	OMV	k ç=d ~ë	JMKMQM	ééÄ	k L^	NMTQKQU	MKR	
qÜ	OPO	OMV	k ç=d ~ë	MKROS	ééÄ	VKR	RQQSKVO	OKR	
r	OPU	OMV	k ç=d ~ë	MKMOS	ééÄ	PTKR	OMMKON	MKR	

n` =fpqa=q~ÄäÉ

mêÉé=_ä~åâ=Em_F=oÉéçã

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=opa	oÉÑ=mp	B=oÉÄ	Bn` =içï	Bn` =eäÖÜ	n` =cä-Ö
iá	S	kç=dl~ë	QMNTRPSKPR	NKV	OTRVPMMKUR	TPKNO	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	PUVRMTOKNV	MKV	SMQUSNNKO	SQQQ	RVKR	NOMQ	
pÅ	QR	eO	VQORNMKNO	NKT	NRQUORRKRV	SNKST	RVKR	NOMQ	
pÅ	QR	eÉ	NPTSNMKRO	MKV	OPPVRPKQR	RUKUO	RVKR	NOMQ	SMOMa ça
dÉ	TO	kç=dl~ë	VPQRVVKUM	NKP	NQNOURSKNU	SSKNR	RVKR	NOMQ	
dÉ	TO	eO	PTSSURKNQ	MKR	SMTRNTKON	SO	RVKR	NOMQ	
dÉ	TO	eÉ	NMUNQNKVT	MKQ	NTUUOVKVT	SMKQT	RVKR	NOMQ	
v	UV	eO	QPVNVNSKUR	MKU	SRRTRURKQP	SSKVT	RVKR	NOMQ	
v	UV	eÉ	TPSVPOKSM	MKO	NOSRCOTKVR	RUKCR	RVKR	NOMQ	SMOMa ça
qÄ	NRV	kç=dl~ë	SQTSOMNKPU	NKM	UQQSUONKNN	TSKST	RVKR	NOMQ	
qÄ	NRV	eÉ	OTPSUMNKSR	MKU	QNMSRTOKVO	SSKSQ	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PPVQTRVKSM	MKQ	PUSSRTUKPV	UTKU	RVKR	NOMQ	
_á	OMV	eÉ	NSPSTSOKRP	NKM	OPPPTRQKRV	TMKNP	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` Ot n ` NSfj t N
cáÉ=k~ã É	MTSi ` pt kÇ
a~í~=m~íÜ=k~ã É	aWi^ÖäÉáíy^ mj eyNya^q^yOMOPyMPJ ^oyi n ` ONi^kÄ
^Åè=qáã É	PLONLOMOP=OOMMMMU
p~ã éäÉ=qóéÉ	i ` pt
qçí~äaäãíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MMS ^i _kÇ
p~ã éäÉ=n ` =m~ëëlcá~ä	c~äà
fpqa=n ` =m~ëëlc~äà	c~äà
l éÉê~íçê	**~Çã åà**

n ` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==i mp==	bñés~ä	B=oÉÁ	B i çï	B eáÖÜ	n ` =c~ä-Ö
_É	V	S	k ç=dl~ë	RQKNOM	éëÄ	OKN	SMPNUKVN	RM	ONKSR	TVKR	NOMQ	
_	NN	S	k ç=dl~ë	RPTKSNT	éëÄ	NKS	PUVQSVKMT	RMM	ONKR	TVKR	NOMQ	
k~	OP	QR	eÉ	UVUOKNRU	éëÄ	MKV	NMVMUNUKUQ	TRMM	OPKVR	TVKR	NOMQ	a ça
j Ö	OQ	QR	eÉ	RTOUKMNU	éëÄ	MKT	PSNSRVKQO	RMMM	OOKVN	TVKR	NOMQ	
^ä	OT	QR	eÉ	OOMMKUQR	éëÄ	NKR	RQPSRKUM	OMMM	OOKMN	TVKR	NOMQ	
pá	OU	QR	eO	NVQUKUOR	éëÄ	NKS	VPUQVKMM	NMMM	ONKVU	M	OMM	
h	PV	QR	eÉ	NMRVVKOTR	éëÄ	NKU	SNPRROKPO	NMMMM	ONKO	TVKR	NOMQ	
` ~	QM	QR	eO	OTSVKMPR	éëÄ	MKS	NUNSNSSKRV	ORMM	OOKNR	TVKR	NOMQ	
s	RN	UV	eÉ	RQTKUUU	éëÄ	MKP	QPMRPTKMO	RMM	ONKVO	TVKR	NOMQ	
`ê	RO	UV	eÉ	ONUKPTQ	éëÄ	MKS	ONTSQMKPM	OMM	ONKUQ	TVKR	NOMQ	
j å	RR	UV	eÉ	RRMKUQP	éëÄ	MKO	OTUPOTKVU	RMM	OOKMP	TVKR	NOMQ	
cÉ	RS	UV	eO	NVRPKPSN	éëÄ	MKR	ORUNMPQKPU	NMMM	ONKMT	TVKR	NOMQ	
` ç	RV	UV	eÉ	RSSKPRV	éëÄ	NKQ	VTOQUPKPR	RMM	OOKSR	TVKR	NOMQ	
ká	SM	UV	eÉ	RSMKPCQ	éëÄ	MKV	OSVMOTKQM	RMM	OOKQN	TVKR	NOMQ	
` ì	SP	UV	eÉ	OUNKRUU	éëÄ	NKN	PTOUVQKRP	ORM	OOKRP	TVKR	NOMQ	
wå	SS	UV	eÉ	RQVKQRU	éëÄ	MKU	NOQMUUKUR	RMM	ONKVU	TVKR	NOMQ	
^ë	TR	UV	eÉ	NMUKTNV	éëÄ	NKR	NURQOKOR	NMM	ONKTQ	TVKR	NOMQ	
pÉ	TU	UV	eO	NMNKQTO	éëÄ	NKM	VVTQKRV	NMM	OMKOV	TVKR	NOMQ	
pê	UU	UV	eÉ	RQOKQNP	éëÄ	NKT	POVNOVKOP	RMM	ONKT	TVKR	NOMQ	
j ç	VR	UV	eÉ	NNMKQVQ	éëÄ	NKN	SQNNQKNQ	NMM	OOKN	TVKR	NOMQ	
^Ö	NMT	UV	eÉ	RTKVNR	éëÄ	MKT	NNVTMVKUO	RM	OPKNT	TVKR	NOMQ	
` Ç	NNN	UV	eÉ	OUMKNPQ	éëÄ	MKV	TVOSVKQP	ORM	OOKQN	TVKR	NOMQ	
på	NNU	NRV	eÉ	RMQKPTU	éëÄ	MKU	PMTVMTKSP	RMM	OMKNU	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl~ë	VSKTSR	éëÄ	OKM	QPOSNUKNV	NMM	NVKPR	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl~ë	ONNSKQNP	éëÄ	OKP	OTMSRNTKUR	OMMM	ONKNS	TVKR	NOMQ	
t	NUO	NRV	k ç=dl~ë	NMUKTNT	éëÄ	NKM	OTVQSOKVU	NMM	ONKTQ	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl~ë	NMPKURM	éëÄ	MKU	RURSTUKNO	NMM	OMKTT	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl~ë	NMSKTMS	éëÄ	MKP	UPPRVUKRM	NMM	ONKPQ	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl~ë	NMQKUUS	éëÄ	NKS	TNNVSTKRT	NMM	OMKVU	TVKR	NOMQ	
r	OPU	OMV	k ç=dl~ë	NNNKUUN	éëÄ	NKO	TMVPNUKTN	NMM	OOKPU	TVKR	NOMQ	

n ` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä-Ö
iá	S	kç=d~ë	NVUPVUUKUO	NKO	OTRVPMMKUR	TNKV	RVKR	NOMKQ	
pÅ	QR	kç=d~ë	PVPSVMRKQR	NKO	SMQUSNNKO	SRKMV	RVKR	NOMKQ	
pÅ	QR	eO	VPVRSUKPT	NKP	NRQUORRKRV	SNKQU	RVKR	NOMKQ	
pÅ	QR	eÉ	NPTSMMKUM	NKM	OPPVRPKQR	RUKUO	RVKR	NOMKQ	SMOMa ça
dÉ	TO	kç=d~ë	VRMNRPKTT	NKM	NQNOURSKNU	STKOR	RVKR	NOMKQ	
dÉ	TO	eO	PTVVUPKSS	MKS	SMTRNTKON	SOKRR	RVKR	NOMKQ	
dÉ	TO	eÉ	NMUOSMKVM	NKP	NTUUOVKVT	SMKRQ	RVKR	NOMKQ	
v	UV	eO	QPUPPTTKVT	MKP	SRRTRURKQP	SSKUQ	RVKR	NOMKQ	
v	UV	eÉ	TQQRQPKNP	MKQ	NOSRQOTKVR	RUKSV	RVKR	NOMKQ	SMOMa ça
qÄ	NRV	kç=d~ë	SRUQVNPKVT	MKV	UQQSUONKNN	TTKVS	RVKR	NOMKQ	
qÄ	NRV	eÉ	OTTSUSMKNS	MKQ	QNMVSRTOKVO	STKSO	RVKR	NOMKQ	
_á	QMV	kç=d~ë	PPUPUTPKVN	MKV	PUSSRTUKPV	UTKRO	RVKR	NOMKQ	
_á	QMV	eÉ	NSNVQNNKTT	MKQ	OPPPTRQKRV	SVKPV	RVKR	NOMKQ	

`çåíaåì åaÖ=~ëäÄê~íáç=sÉêëÑÅ~íáç=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cäÉ=k~ã É	MTT|``skÇ
a~í~=m~íÜk~ã É	aWyªÖäÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyi n`ON^kÄ
^Åè=qáã É	PLONLOMCP=OONMTWRN
p~ã éáÉ=qóéÉ	``s
qçí~äaãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVS^i_kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	ORKCRT	éëÄ	NKO	NVPCUVKNO	CR	NVNKMP	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKVRR	éëÄ	MKP	NPMCQVKQV	CR	NVPKUO	UVKU	NNMO	
CP	k ~	CR	e É	RQTPKCMU	éëÄ	NKU	CQQTMVUMCQQ	RMMM	NMVKQS	UVKU	NNMO	
CQ	j Ö	CR	e É	RRPQKVRM	éëÄ	NKQ	CPVCPMTKCM	RMMM	NNMKT	UVKU	NNMO	[=HLHNMB
CT	^ä	CR	e É	RNQKVTS	éëÄ	NKO	UTMVPKTR	RMM	NMP	UVKU	NNMO	
CU	pá	CR	e O	QVVKCSP	éëÄ	NKN	PMQNRCKUV	RMM	VVKUR	UVKU	NNMO	
PV	h	CR	e É	RNRUKCUS	éëÄ	NKV	CMNMRQMCQU	RMMM	NMPKNT	UVKU	NNMO	
QM	` ~	CR	e O	RNQPKNUN	éëÄ	MKS	COVSUSMSKPO	RMMM	NMCKUS	UVKU	NNMO	
RN	s	UV	e É	ORKSPO	éëÄ	MKR	NPUPQVKCP	CR	NMCKRP	UVKU	NNMO	
RO	` ê	UV	e É	ORKTVT	éëÄ	MKT	NTSSPNKQV	CR	NMPKNV	UVKU	NNMO	
RR	j å	UV	e É	ORKCPP	éëÄ	MKR	UUCUMKVQ	CR	NMNKTP	UVKU	NNMO	
RS	cÉ	UV	e O	QVTPKRVS	éëÄ	NKN	UMQTVPTVKMQ	RMMM	VVKQT	UVKU	NNMO	
RV	` ç	UV	e É	ORKURU	éëÄ	MKU	PMQSVTKTP	CR	NMPKCP	UVKU	NNMO	
SM	k á	UV	e É	ORKSRT	éëÄ	MKU	UQRURKSP	CR	NMCKSP	UVKU	NNMO	
SP	` ì	UV	e É	OSKMNM	éëÄ	MKT	CPSTQCKQM	CR	NMQKMQ	UVKU	NNMO	
SS	wå	UV	e É	OSKSCM	éëÄ	NKP	QCCMCKUV	CR	NMSKQU	UVKU	NNMO	
TR	^ë	UV	e É	ORKRRT	éëÄ	MKV	CVUVMSV	CR	NMCKCP	UVKU	NNMO	
TU	pÉ	UV	e O	OQKRCR	éëÄ	NKQ	NSNTRKNN	CR	VUKN	UVKU	NNMO	
UU	pê	UV	e É	ORKRPN	éëÄ	MKR	NMSCTQKSP	CR	NMCKNO	UVKU	NNMO	
VR	j ç	UV	e É	OSKMVP	éëÄ	MKS	NMPUNTKMU	CR	NMQKPT	UVKU	NNMO	
NMT	^Ö	UV	e É	OSKVMP	éëÄ	MKM	PUNPRRKPT	CR	NMTKSN	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKQUQ	éëÄ	NKM	RNPVSKUT	CR	NMRKVQ	UVKU	NNMO	
NNU	på	NRV	e É	OQKSTV	éëÄ	NKO	NMNSRTKQM	CR	VUKTO	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKNQT	éëÄ	NKP	TCPRVNKPP	CR	VSKRV	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	OQKVPO	éëÄ	NKO	ONPVPTKMM	CR	VVKTP	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKQCQ	éëÄ	NKP	CRRMVSKMV	CR	NMRKT	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	OQKQMP	éëÄ	MKS	VPUVMQKCO	CR	VTKSN	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OQKVSM	éëÄ	NKR	NPPMVPRKTU	CR	VVKUQ	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKMCP	éëÄ	CKO	NCMQRNSKTN	CR	NMQKMV	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKNQN	éëÄ	CKO	NNPMSQNKQP	CR	NMQKRS	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ç ï	B n`=eäÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	OTOTSVPKVT	MKR	OTRVPMVKUR	VUKUR	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	RPTTVUVKRN	NKP	SMQUSNNKO	UUKVN	RVKR	NOMQ	
pÅ	CR	e O	NOUSVSTKPR	MKQ	NRCUCRKRV	UQKCN	RVKR	NOMQ	
pÅ	CR	e É	NUUTNQKCM	CKM	CPPVRPKCR	UMKSS	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NPMPUVPKRS	CKM	NQNCURSKNU	VCKCV	RVKR	NOMQ	
dÉ	TO	e O	RNQTRNKVS	MKV	SMTRNTKCN	UQKTP	RVKR	NOMQ	
dÉ	TO	e É	NQTQQSKNR	MKS	NTUUCVKVT	UCKQR	RVKR	NOMQ	
v	UV	e O	RUUCVSRKRO	MKO	SRRTRURKQP	UVKT	RVKR	NOMQ	
v	UV	e É	NMNURNTKRS	MKU	NOSRCOTKVR	UMKR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	UUCUPVCKQQ	NKN	UQQSUCNKNN	NVQKRO	RVKR	NOMQ	
qÄ	NRV	e É	PTCCCSQKVT	NKQ	QNVSRTCKVO	VMKSQ	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	QSNTRMMKVR	NKN	PUSSRTUKPV	NNVKQO	RVKR	NOMQ	
_á	OMV	e É	CONRUQMKNR	NKR	CPPPTRQKRV	VQKVR	RVKR	NOMQ	

`çåíáåì åÖ=~ëÄê~íáçå=_ä~åâ=É``_F=oÉéçê

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MTU``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíÝ^mj eyNya^q^yOMCPyMPJ^oyin`ON^kÂ

^Åè=qáã É PLONLOMCP=COAWTWQR

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáçå NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑcäÉk~ã É MMS^i_KÇ

p~ã éáÉ=m`=m~ëëlcá~ä m~ëë

fpqa=m`=m~ëëlc~äí m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	råáë	opa	==\ mp==	iãäá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MKMMP	éé Ä	UVKU	NVPHPQ	MO	
NN	_	S	kç=d~ë	MOSN	éé Ä	NUKU	CQTMCS	Q	
CP	k~	CR	eÉ	CKMRU	éé Ä	NCKT	PUTVRHSM	CMM	
CQ	j Ö	CR	eÉ	PHPNS	éé Ä	THS	NRUSKUO	CM	
CT	^ä	CR	eÉ	JNKRPT	éé Ä	kL^	PSUKVM	CM	
CU	pá	CR	eO	JMKQVO	éé Ä	kL^	VMMKVU	NMM	
PV	h	CR	eÉ	OMKRRS	éé Ä	PKU	PNMUQKW	CMM	
QM	`~	CR	eO	CKTUT	éé Ä	NHP	PCUSTHPO	CM	
RN	s	UV	eÉ	MKMCT	éé Ä	CNKN	PCUKVM	N	
RO	`ê	UV	eÉ	MKMRU	éé Ä	NCKO	VSRKNU	N	
RR	j å	UV	eÉ	MKMNQ	éé Ä	NSKT	CMPKVS	MQ	
RS	cÉ	UV	eO	CKMCQ	éé Ä	NKV	TURNUKVS	CM	
RV	` ç	UV	eÉ	MKMNQ	éé Ä	RRKU	PQSKSU	MO	
SM	k á	UV	eÉ	MKMCU	éé Ä	RCKT	NVCKCP	MQ	
SP	` ì	UV	eÉ	MKMCQ	éé Ä	NSKN	VVMKMR	MS	
SS	wå	UV	eÉ	JMKNTU	éé Ä	kL^	URTKUO	O	
TR	^ë	UV	eÉ	MKMPT	éé Ä	PCKN	RNKST	N	
TU	pÉ	UV	eO	MKMCO	éé Ä	NRKS	OSKPP	N	
UU	pê	UV	eÉ	MKMCT	éé Ä	NUKU	NCPHPQ	N	
VR	j ç	UV	eÉ	MKMSS	éé Ä	NUKN	CUSKST	N	
NMT	^Ö	UV	eÉ	MKMCM	éé Ä	NVKM	CRTKTV	MO	
NNN	`Ç	UV	eÉ	MKMCN	éé Ä	PKV	PRKNU	MO	
NNU	på	NRV	eÉ	JMKMCP	éé Ä	kL^	SPPHPS	N	
NCN	pÄ	NRV	kç=d~ë	MKMPN	éé Ä	NTKQ	NNUNKPM	MO	
NPT	_~	NRV	kç=d~ë	MKMRM	éé Ä	NVKV	RPPKVN	MQ	
NUO	t	NRV	kç=d~ë	MKMMN	éé Ä	SKR	CPRCKTM	N	
CMR	qä	CMV	kç=d~ë	MKMRP	éé Ä	NUKP	CCURKVS	MO	
CMU	mÄ	CMV	kç=d~ë	JMKMMO	éé Ä	kL^	NRPRKMM	MO	
CPO	qÜ	CMV	kç=d~ë	MKMTS	éé Ä	NCKN	RCMSKSN	N	
CPU	r	CMV	kç=d~ë	MKMCS	éé Ä	PKU	VVCKCP	MO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j ÇÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=cäÜÜ	n`=c~ä~Ö
iá	S	kç=d~ë	CQNQCVTKUM	CKP	OTRVPMMKUR	UTHR	RVHR	NCMKQ	
pÅ	CR	kç=d~ë	CRPSMCVKNQ	NKO	SMQUSNNKO	TQKVV	RVHR	NCMKQ	
pÅ	CR	eO	NNCMCURKW	MKS	NRCUCRRKRV	TPHP	RVHR	NCMKQ	
pÅ	CR	eÉ	NRVRCCKQV	MKP	CPPVRPKCR	SUKNV	RVHR	NCMKQ	
dÉ	TO	kç=d~ë	NNNPSVSKQT	NHR	NQNCURSKNU	TUKUP	RVHR	NCMKQ	
dÉ	TO	eO	CQRUQNHPQ	MKV	SMTRNTKCN	TPHPV	RVHR	NCMKQ	
dÉ	TO	eÉ	NCSTCNKMV	MKS	NTUUCVKVT	TMKUS	RVHR	NCMKQ	
v	UV	eO	RNQTTUMKTU	MKQ	SRRTRURKCP	TUHR	RVHR	NCMKQ	
v	UV	eÉ	USTUPCKOT	MKP	NCSRCCTKVR	SUHRV	RVHR	NCMKQ	
qÄ	NRV	kç=d~ë	TQUMNPTKNQ	CHR	UQQSUCNKNN	UUHRS	RVHR	NCMKQ	
qÄ	NRV	eÉ	PNTTVMRHPQ	NHP	QNMSRTCKVO	TTHPV	RVHR	NCMKQ	
_á	CMV	kç=d~ë	PVSVRQNHPU	NKU	PUSSRTUHPV	NMCKSS	RVHR	NCMKQ	
_á	CMV	eÉ	NUSTVUPKTO	MKV	CPPPTRQKRV	UMMKQ	RVHR	NCMKQ	

KATAHDIN ANALYTICAL SERVICES, LLC
METALS ANALYSIS RUN INFORMATION SHEET

INSTR. ID: L (Agilent 7800) **ANALYST:** KS **ANALYSIS DATE:** 03/23/23

METHOD: ICP-MS
- ☐ 200.8
- ☑ 6020
- ☑ DOD

FILE NAME: LQC24A

Reviewed By: 4-03-27-23

The pHs of all samples that were tested by direct analysis in this analytical run were checked just prior to analysis and confirmed to be <2. The time of preservation of these samples was checked in the "Measured Turbidity and Preservation of Incoming Samples" logbook to verify that they had been preserved at least 16 hours prior to analysis. These verifications were performed by _____ (initials) on _____ (date).

STANDARDS USED:

Standard Name	Standard ID	Prep Date	Expiration Date	Standard Conc.
Cal Blk/ICB/CCB	MW21411	03/02/23	03/02/24	0 ug/L
Cal Std	MW21414	03/02/23	03/25/23	Varies by Element
ICV	MW21429	03/15/23	06/14/23	Varies by Element
PQL	MW21436	03/23/23	03/25/23	Varies by Element
LRS1	MW21330	01/17/23	03/25/23	Varies by Element
LRS2	MW21331	01/17/23	04/17/23	Varies by Element
ICSA	MW21441	03/24/23	03/31/23	Varies by Element
ICSAB	MW21438	03/23/23	03/25/23	Varies by Element
CCV	MW21439	03/23/23	03/25/23	Varies by Element
Internal Standard (ISTD)	N/A	N/A	N/A	0.2 mg/L (Li,Sc,Ge/Y,Tb,Bi)

Additional Comments and Notes:

Samples with ISTD RSDs > 8% were reanalyzed immediately.

ISTD was manually added to all standards and samples (0.08 mL of MS2459 to 8 mL).

Dilutions: Some samples were diluted based on history or due to interfering element concentrations.

Dilution preparations are as follows:

5x diln.: 1.6 mL of sample (pipet M30) + 6.4 mL of MW21411 (pipet M31)

10x diln.: 0.8 mL of sample (pipet M19) + 7.2 mL of MW21411 (pipet M31)

25x diln.: 0.32 mL of sample(pipet M19) + 7.68 mL of MW21411 (pipet M31)

Post Spike: 0.08 mL of MW21329 (pipet M27) into 8 mL final volume of appropriately diluted sample (pipet M31)

INSTRUMENT RUNLOG

Instrument: AGILENT 7800

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
CalBlank	1	LQC24A	03/24/2023	16:21	KS
CalStd	1	LQC24A	03/24/2023	16:27	KS
ICV	1	LQC24A	03/24/2023	16:38	KS
ICB	1	LQC24A	03/24/2023	16:47	KS
PQL	1	LQC24A	03/24/2023	16:52	KS
ICSA	1	LQC24A	03/24/2023	16:58	KS
ICSAB	1	LQC24A	03/24/2023	17:03	KS
LRS1	1	LQC24A	03/24/2023	17:12	KS
LRS2	1	LQC24A	03/24/2023	17:23	KS
RINSE	1	LQC24A	03/24/2023	17:35	KS
RINSE	1	LQC24A	03/24/2023	17:40	KS
CCV	1	LQC24A	03/24/2023	17:45	KS
CCB	1	LQC24A	03/24/2023	17:56	KS
PQL	1	LQC24A	03/24/2023	18:01	KS
PQL	1	LQC24A	03/24/2023	18:06	KS
ICSA	1	LQC24A	03/24/2023	18:11	KS
RINSE	1	LQC24A	03/24/2023	18:16	KS
CCV	1	LQC24A	03/24/2023	18:21	KS
CCB	1	LQC24A	03/24/2023	18:30	KS
PBWQC21IMW2	5	LQC24A	03/24/2023	18:35	KS
LCSWQC21IMW2	5	LQC24A	03/24/2023	18:41	KS
SQ1015-024	5	LQC24A	03/24/2023	18:49	KS
SQ1201-009	5	LQC24A	03/24/2023	18:54	KS
SQ1201-010	5	LQC24A	03/24/2023	18:59	KS
SQ1201-011	5	LQC24A	03/24/2023	19:04	KS
SQ1201-012	5	LQC24A	03/24/2023	19:09	KS
SQ1201-012L	25	LQC24A	03/24/2023	19:14	KS
SQ1201-012A	5	LQC24A	03/24/2023	19:19	KS
SQ1201-012P	5	LQC24A	03/24/2023	19:25	KS
CCV	1	LQC24A	03/24/2023	19:32	KS
CCB	1	LQC24A	03/24/2023	19:42	KS
SQ1201-012S	5	LQC24A	03/24/2023	19:47	KS
SQ1201-013	5	LQC24A	03/24/2023	19:55	KS
SQ1201-014	5	LQC24A	03/24/2023	20:00	KS
SQ1201-015	5	LQC24A	03/24/2023	20:05	KS
SQ1201-016	5	LQC24A	03/24/2023	20:10	KS
SQ1201-017	5	LQC24A	03/24/2023	20:15	KS
SQ1201-018	5	LQC24A	03/24/2023	20:21	KS
SQ0876-001P	5	LQC24A	03/24/2023	20:26	KS
SQ0876-001S	5	LQC24A	03/24/2023	20:31	KS
PBSQC14IMS2	5	LQC24A	03/24/2023	20:36	KS
CCV	1	LQC24A	03/24/2023	20:41	KS
CCB	1	LQC24A	03/24/2023	20:51	KS
LC2OQC14IMS2	5	LQC24A	03/24/2023	20:56	KS

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
LCSOQC14IMS2	5	LQC24A	03/24/2023	21:03	KS
SQ1188-001	5	LQC24A	03/24/2023	21:11	KS
SQ1188-003	5	LQC24A	03/24/2023	21:16	KS
SQ1188-005	5	LQC24A	03/24/2023	21:22	KS
SQ1188-005L	25	LQC24A	03/24/2023	21:27	KS
SQ1188-005A	5	LQC24A	03/24/2023	21:32	KS
SQ1188-005P	5	LQC24A	03/24/2023	21:37	KS
SQ1188-005S	5	LQC24A	03/24/2023	21:45	KS
SQ1188-007	5	LQC24A	03/24/2023	21:53	KS
CCV	1	LQC24A	03/24/2023	21:58	KS
CCB	1	LQC24A	03/24/2023	22:07	KS
SQ1188-009	5	LQC24A	03/24/2023	22:12	KS
SQ1188-015	5	LQC24A	03/24/2023	22:17	KS
PBSQC16IMS1	5	LQC24A	03/24/2023	22:22	KS
LCSOQC16IMS1	5	LQC24A	03/24/2023	22:28	KS
SQ1188-011	5	LQC24A	03/24/2023	22:35	KS
SQ1188-013	5	LQC24A	03/24/2023	22:41	KS
PBWQC16IMW1	5	LQC24A	03/24/2023	22:46	KS
LC2WQC16IMW1	5	LQC24A	03/24/2023	22:51	KS
LCSWQC16IMW1	5	LQC24A	03/24/2023	22:59	KS
SQ0907-007	5	LQC24A	03/24/2023	23:07	KS
CCV	1	LQC24A	03/24/2023	23:12	KS
CCB	1	LQC24A	03/24/2023	23:21	KS
SQ0907-010	5	LQC24A	03/24/2023	23:26	KS
SQ0907-011	5	LQC24A	03/24/2023	23:31	KS
SQ0908-001	5	LQC24A	03/24/2023	23:37	KS
SQ0908-002	5	LQC24A	03/24/2023	23:42	KS
SQ0908-003	5	LQC24A	03/24/2023	23:47	KS
SQ0908-004	5	LQC24A	03/24/2023	23:52	KS
SQ0908-005	5	LQC24A	03/24/2023	23:57	KS
SQ0908-006	5	LQC24A	03/25/2023	00:02	KS
SQ0908-007	5	LQC24A	03/25/2023	00:07	KS
SQ0908-009	5	LQC24A	03/25/2023	00:12	KS
CCV	1	LQC24A	03/25/2023	00:18	KS
CCB	1	LQC24A	03/25/2023	00:26	KS
SQ0908-010	5	LQC24A	03/25/2023	00:31	KS
SQ0908-011	5	LQC24A	03/25/2023	00:36	KS
SQ0908-012	5	LQC24A	03/25/2023	00:41	KS
SQ0908-013	5	LQC24A	03/25/2023	00:47	KS
PBWQC16IMW2	5	LQC24A	03/25/2023	00:52	KS
LCSWQC16IMW2	5	LQC24A	03/25/2023	00:57	KS
SQ0943-001	5	LQC24A	03/25/2023	01:04	KS
SQ0943-002	5	LQC24A	03/25/2023	01:10	KS
SQ0943-003	5	LQC24A	03/25/2023	01:15	KS
SQ0943-004	5	LQC24A	03/25/2023	01:20	KS
CCV	1	LQC24A	03/25/2023	01:25	KS
CCB	1	LQC24A	03/25/2023	01:33	KS

US EPA Tune Check Report

Operator Name	admin
Acq/Data Batch	D:\Agilent\ICPMH\1\DATA\2023\03-MAR\LQC24A.b
Acq. Date-Time	3/24/2023 15:23:31
Report Comment	---
Instrument Name	G8421A SG18503526

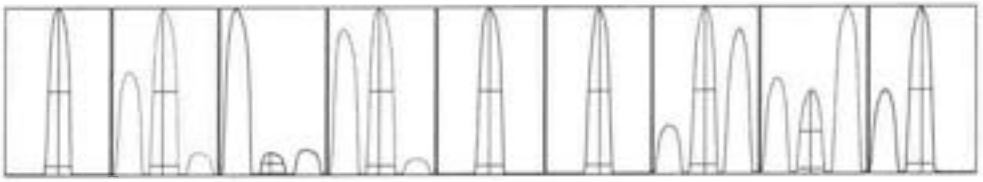
[No Gas]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
9	10.00	61525	615248.87	2.835	5.000	
24	10.00	253127	2531271.90	3.240	5.000	
25	10.00	32286	322863.28	2.984	5.000	
26	10.00	37819	378187.14	2.880	5.000	
59	10.00	469066	4690658.06	3.077	5.000	
115	10.00	528767	5287669.12	2.843	5.000	
206	10.00	101079	1010789.44	3.011	5.000	
207	10.00	86430	864301.69	2.919	5.000	
208	10.00	172260	1722604.60	3.712	5.000	

Integration Time [sec] 0.1

Resolution/Axis



Mass	Peak Height	Axis	Axis (Required)	Axis (Flag)
9	62200.58	9.05	8.90 - 9.10	
24	254532.13	23.95	23.90 - 24.10	
25	32402.89	24.95	24.90 - 25.10	
26	37066.12	25.95	25.90 - 29.10	
59	467258.59	59.00	58.90 - 59.10	
115	536321.87	115.05	114.90 - 115.10	
206	101527.18	206.00	205.90 - 206.10	
207	88219.30	206.95	206.90 - 207.10	
208	177273.89	208.00	207.90 - 208.10	

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
9	0.59	0.731	0.900	
24	0.66	0.786	0.900	
25	0.64	0.743	0.900	

US EPA Tune Check Report

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
26	0.65	0.785	0.900	
59	0.63	0.781	0.900	
115	0.59	0.740	0.900	
206	0.60	0.775	0.900	
207	0.61	0.782	0.900	
208	0.61	0.782	0.900	

Integration Time [sec] 0.1
Acquisition Time [sec] 47.0000000000001
Y Axis Linear

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	13.0 V
Extract 2	-250.0 V	Cell Entrance	-40 V	Plate Bias	-40 V
Omega Bias	-85 V	Cell Exit	-60 V		

Cell Parameters

Use Gas	No	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-8.0 V		
H2 Flow	0.0 mL/min	OctP RF	130 V		

QP Parameters

Mass Gain	120	Axis Gain	0.9982	QP Bias	-3.0 V
Mass Offset	126	Axis Offset	0.12		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.8 mm

EM

Discriminator	3.7 mV	Analog HV	2210 V	Pulse HV	1204 V

[H2]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	43880	438800.14	3.734	5.000	
89	10.00	45181	451806.87	3.235	5.000	
205	10.00	37242	372416.01	2.938	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

US EPA Tune Check Report

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-18.0 V		
H2 Flow	5.0 mL/min	OctP RF	200 V		

QP Parameters

Mass Gain	120	Axis Gain	0.9982	QP Bias	-13.0 V
Mass Offset	126	Axis Offset	0.12		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.8 mm

EM

Discriminator	3.7 mV	Analog HV	2210 V	Pulse HV	1204 V

[He]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	109178	1091781.93	3.582	5.000	
89	10.00	8489	84891.76	2.676	5.000	
205	10.00	16537	165365.55	2.845	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	4.5 mL/min	OctP Bias	-18.0 V		
H2 Flow	0.0 mL/min	OctP RF	200 V		

QP Parameters

US EPA Tune Check Report

Mass Gain	120	Axis Gain	0.9982	QP Bias	-13.0 V
Mass Offset	126	Axis Offset	0.12		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.8 mm		

EM

Discriminator	3.7 mV	Analog HV	2210 V	Pulse HV	1204 V

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^Åè=qãã É	PLOQLOMOP=NSWQNWPN
p~ã éäÉ=qóéÉ	` ~ä_äâ
qçí~ä=aãã íáçå	NKMMMM
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OT	^ä	QR	e É	PRPVKPV	PKV
OU	pá	QR	e O	RPTKOQ	NRKR
PV	h	QR	e É	POSQSKUN	NKV
QM	` ~	QR	e O	NQOVSKOV	NKS
RN	s	UV	e É	OTPKPQ	QKQ
RO	` ê	UV	e É	UPMKRP	SKV
RR	j å	UV	e É	POVKOU	VKT
RS	cÉ	UV	e O	VVUMKST	OKM
RV	` ç	UV	e É	NPNKNO	ORKN
SM	k á	UV	e É	OPNKNO	NNKO
SP	` ì	UV	e É	QVNKNP	NMKR
SS	wå	UV	e É	OVMTKMO	OKM
TR	^ë	UV	e É	OMKMM	OSKR
TU	pÉ	UV	e O	PKNT	OQKN
UU	pê	UV	e É	OMKMM	QQKN
VR	j ç	UV	e É	VTKTU	TKN
NMT	^Ö	UV	e É	TKTU	SRKR
NNN	` Ç	UV	e É	NKNN	NMMKM
NNU	på	NRV	e É	RPNKNP	UKO
NON	pÄ	NRV	k ç=d ~ë	OUSKVT	TKP
NPT	_~	NRV	k ç=d ~ë	PPKPT	PQKS
NUO	t	NRV	k ç=d ~ë	TRQKNS	NMKN
OMR	qä	OMV	k ç=d ~ë	RPPKVN	NPKP
OMU	mÄ	OMV	k ç=d ~ë	USTKRV	NQKS
OPO	qÜ	OMV	k ç=d ~ë	NTMRKOS	OKT
OPU	r	OMV	k ç=d ~ë	OPKPS	VVKM

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pÅ	QR	k ç=d ~ë	QRNVVMMKMQ	MKQ
pÅ	QR	e O	NMSVRVUKVR	PKN
pÅ	QR	e É	NRTTPRKMO	MKR
d É	TO	k ç=d ~ë	NMSQPUQKUO	NKT
d É	TO	e O	QOOMNTKMN	MKV
d É	TO	e É	NOORSPKSN	MKQ
v	UV	e O	QTSOUURKNQ	NKU
v	UV	e É	UOVQMOKQU	MKV
qÄ	NRV	k ç=d ~ë	SRQQMSTKOO	NKS
qÄ	NRV	e É	OURMTNTKVP	MKS
_á	OMV	k ç=d ~ë	PONUTOUKRU	NKM
_á	OMV	e É	NRVQNVSKTN	NKN

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qçí~ä=a ãä íáçå	NKMMMM
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fpqa=oÉÑ=cãÉk~ã É	MMS` ^i _KÇ
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V	_É	S	k ç=d ~ë	OVTMMPKNR	NKN
NN	_	S	k ç=d ~ë	NVQORSKVU	MKT
OP	k~	QR	e É	TONSUSQKMM	NKP
OQ	j Ö	QR	e É	PTTSOUPKUP	NKN
OT	^ä	QR	e É	NQNUQOKQP	NKQ
OU	pá	QR	e O	QVRTVQKMP	MKT
PV	h	QR	e É	POTQQQMKOT	MKU
QM	` ~	QR	e O	PTORVSRSKNN	MKS
RN	s	UV	e É	OOQPOQKNT	MKV
RO	` ê	UV	e É	OUOPUNKQM	MKS
RR	j å	UV	e É	NQOMNRKQS	MKS
RS	cÉ	UV	e O	NPMTQQTSPKQV	MKQ
RV	` ç	UV	e É	QUNSTSKMV	MKT
SM	k á	UV	e É	NPPVSNKMU	NKO
SP	` ì	UV	e É	PTNQPRKMP	MKQ
SS	wå	UV	e É	SOUMSKUU	NKT
TR	^ë	UV	e É	QTTRVKQS	MKS
TU	pÉ	UV	e O	ORVQSKPT	MKQ
UU	pê	UV	e É	NSUTRUKTP	MKQ
VR	j ç	UV	e É	NSQTNRKSM	NKR
NMT	^Ö	UV	e É	RVNMPUKSO	NKT
NNN	` Ç	UV	e É	TVNTUKPU	MKR
NNU	på	NRV	e É	NRPUUSKUV	MKU
NON	pÄ	NRV	k ç=d ~ë	NNNQVUVKUT	OKN
NPT	_~	NRV	k ç=d ~ë	PNVQSSKTQ	MKO
NUO	t	NRV	k ç=d ~ë	SPNOQSKVR	MKQ
OMR	qä	OMV	k ç=d ~ë	NPPPVOSKUV	OKM
OMU	mÄ	OMV	k ç=d ~ë	NURQUPUKPQ	NKP
OPO	qÜ	OMV	k ç=d ~ë	NSRMPOTKSM	NKS
OPU	r	OMV	k ç=d ~ë	NROPPOSKSP	MKR

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÅ	B n` =i çï	B n` =eãÖÜ	n` =cä~Ö
i á	S	k ç=d ~ë	OMQOQPUKPN	OKV	ONOOPOPKQO	VSKOQ	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QQVRPNNKUT	NKU	QRNVVMMKMQ	VVKQS	RVKR	NOMKQ	
pÅ	QR	e O	NMSNUOSKRT	MKS	NMSVRVUKVR	VVKOT	RVKR	NOMKQ	
pÅ	QR	e É	NRSNNMKNQ	MKR	NRTTPRKMO	VUKVT	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	NMQPQNQKOQ	MKU	NMSQPUQKUO	VUKMP	RVKR	NOMKQ	
d É	TO	e O	QOMVUNKQS	MKM	QOOMNTKMN	VVKTR	RVKR	NOMKQ	
d É	TO	e É	NONQNUKTN	NKM	NOORSPKSN	VVKMT	RVKR	NOMKQ	
v	UV	e O	QTOMMQOKNP	MKU	QTSOUURKNQ	VVKN	RVKR	NOMKQ	
v	UV	e É	UMRSVMKQV	NKO	UOVQMOKQU	VTKNQ	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SRUQRQTKNO	MKN	SRQQMSTKOO	NMMKSO	RVKR	NOMKQ	
qÄ	NRV	e É	OTUSVONKMO	MKP	OURMTNTKVP	VTKTS	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PNVSMTNKOQ	OKM	PONUTOUKRU	VVKP	RVKR	NOMKQ	
_á	OMV	e É	NRUMMTUKPQ	NKU	NRVQNVSKTN	VVKNN	RVKR	NOMKQ	

fåáíá~ë=`~äáÄê~íáçå=sÉêáÑáÅ~íáçå=Ef`sF=oÉéçêí

p~ãéäÉ=k~ãÉ	f`s
cäáÉ=k~ãÉ	MVUJf`sKÇ
a~í~=m~íÜ=k~ãÉ	aWÿÖäÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyi n`CC^kÅ
^Åè=qáãÉ	PLCCLCMCP=NSWPUMRN
p~ãéäÉ=qóéÉ	f`s
qçí~äaãäíáçå	NKMMMM
`çããÉáí	JJJ
fpqa=oÉÑcäÉk~ãÉ	MVS`^i_KÇ
p~ãéäÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äí	m~ëë
léÉê~íçê	~Çãáå

n`=^å~äöíÉ=q~ÄäÉ

j~ëë	k~ãÉ	fpqa	qìåÉ	`çåÅK	råäë	opa	==mp==	bñés~ä	B=oÉÅ	Bíçï	BeáÖÜ	n`=cä~Ö
V	_É	S	kç=cl~ë	NVRTUT	éëÄ	NRT	NNUCSQKMM	QM	VUKVQ	UVIS	NNMQ	
NN	_	S	kç=cl~ë	QMRUQ	éëÄ	NKO	UMVNCKCU	QM	NMCKVO	UVIS	NNMQ	
QP	k~	QR	eÉ	QNPQKVQT	éëÄ	QKN	PMMCUNVKQM	QMMM	NMPHPO	UVIS	NNMQ	
QQ	jÖ	QR	eÉ	QNQNKVSN	éëÄ	QKO	NRRVQPRKQR	QMMM	NMPHRR	UVIS	NNMQ	
QT	^ä	QR	eÉ	PVUKTQM	éëÄ	MRT	RUQLJVRRS	QMM	VVISU	UVIS	NNMQ	
QU	pá	QR	eO	PVSKUCP	éëÄ	MKU	NVUPSMKVS	QMM	VVKCN	UVIS	NNMQ	
PV	h	QR	eÉ	QNMQHRNQ	éëÄ	NKO	NPRUVPVKVQ	QMMM	NMCHSN	UVIS	NNMQ	
QM	`~	QR	eO	QMUTHMQQ	éëÄ	MRR	NRPPSQNRKMV	QMMM	NMCKMU	UVIS	NNMQ	
RN	s	UV	eÉ	QMRMJ	éëÄ	NKO	VNVMTKMJ	QM	NMCHRQ	UVIS	NNMQ	
RO	`ê	UV	eÉ	QMMPP	éëÄ	MRR	NNPUTQHPN	QM	NMMHSS	UVIS	NNMQ	
RR	jå	UV	eÉ	NVKVTQ	éëÄ	MKV	RSTSVKTO	QM	VVKUT	UVIS	NNMQ	
RS	cÉ	UV	eO	PVSSHSRQ	éëÄ	NKM	RCPPUMRCHMQ	QMMM	VVKMT	UVIS	NNMQ	
RV	`ç	UV	eÉ	QMQQN	éëÄ	NKQ	NVSQQSHPN	QM	NMCHO	UVIS	NNMQ	
SM	ká	UV	eÉ	QMQRN	éëÄ	QKN	RQTTPKTV	QM	NMCHCS	UVIS	NNMQ	
SP	`ì	UV	eÉ	QMQUS	éëÄ	NHS	NRQMPSKMQ	QM	NMCHCP	UVIS	NNMQ	
SS	wå	UV	eÉ	NVHSQQ	éëÄ	NHS	OSPNTHPM	QM	VUKOO	UVIS	NNMQ	
TR	^ë	UV	eÉ	NVKUTS	éëÄ	NHS	NUVQQHMS	QM	VVHPU	UVIS	NNMQ	
TU	pÉ	UV	eO	NVKQQM	éëÄ	MRT	NMNSVKTP	QM	VTHKI	UVIS	NNMQ	
UU	pê	UV	eÉ	QMKOVU	éëÄ	MRR	SUPQMHSP	QM	NMNHQV	UVIS	NNMQ	
VR	jç	UV	eÉ	PVHMNN	éëÄ	NHS	NCUNSPHRU	QM	VTHRP	UVIS	NNMQ	
NMT	^Ö	UV	eÉ	NVKVQN	éëÄ	NKM	OPRMVCHMU	QM	VVRT	UVIS	NNMQ	
NNN	`Ç	UV	eÉ	QMHMN	éëÄ	NKV	PNRUCHRR	QM	NMMHMN	UVIS	NNMQ	
NNU	på	NRV	eÉ	NVKURR	éëÄ	PHM	SNMTNHMQ	QM	VVKCU	UVIS	NNMQ	
NON	pÄ	NRV	kç=cl~ë	NVKQSS	éëÄ	QKU	QPQSQTHPN	QM	VTHPP	UVIS	NNMQ	
NPT	_~	NRV	kç=cl~ë	QMRPQQ	éëÄ	NKV	NPMNOTHPU	QM	NMNHTO	UVIS	NNMQ	
NUO	t	NRV	kç=cl~ë	QMQST	éëÄ	NKU	QRVQMPHPM	QM	NMCHPQ	UVIS	NNMQ	
QMR	qä	QMV	kç=cl~ë	NVKTRQ	éëÄ	QKP	RQRTVVHRU	QM	VUKTT	UVIS	NNMQ	
QMU	mÄ	QMV	kç=cl~ë	NVHSOT	éëÄ	QKO	TQSPQMKUT	QM	VUKMQ	UVIS	NNMQ	
QPO	qÜ	QMV	kç=cl~ë	NVKPNV	éëÄ	NHR	SPSUMMQS	QM	VSHS	UVIS	NNMQ	
QPU	r	QMV	kç=cl~ë	NVHRTT	éëÄ	QKU	RVQPSUHSM	QM	VTKUU	UVIS	NNMQ	

n`=fpqa=q~ÄäÉ

k~ãÉ	j~ëë	qìåÉ=jçÇÉ	`mp	`mp=opa	oÉÑëmp	B=oÉÅ	Bn`=içï	Bn`=eáÖÜ	n`=cä~Ö
iá	S	kç=cl~ë	QMRPPSQKVV	NKQ	QNQQPQPKQD	VSHTR	RVHR	NQMQ	
pÅ	QR	kç=cl~ë	QRNTUNRHSS	QMM	QRNVVMMMQ	VVKVR	RVHR	NQMQ	
pÅ	QR	eO	NMSUUNMQR	NKQ	NMSVRVUKVR	VVKVP	RVHR	NQMQ	
pÅ	QR	eÉ	NRRSRQKQN	NKO	NRTTPRMVD	VUHSU	RVHR	NQMQ	
dÉ	TO	kç=cl~ë	NMRUQRQHSP	MRT	NMSQPUQKUO	VVKQQ	RVHR	NQMQ	
dÉ	TO	eO	QNUPPVKUM	NHN	QQQMNTHMN	VVHMP	RVHR	NQMQ	
dÉ	TO	eÉ	NNUTVVRTT	MKQ	NQQRSPHSN	VSKVP	RVHR	NQMQ	
v	UV	eO	QTSQPVQKVV	MRR	QTSQUURMKQ	VVKVV	RVHR	NQMQ	
v	UV	eÉ	UMPQTNKQM	NHP	UQVQMQKQU	VSKUT	RVHR	NQMQ	
qÄ	NRV	kç=cl~ë	SRVQQPQHRQ	NKU	SRQQMSTKQO	NMMRTQ	RVHR	NQMQ	
qÄ	NRV	eÉ	OTTNRMPRTT	NHS	QURMTNTKVP	VTKQO	RVHR	NQMQ	
_á	QMV	kç=cl~ë	PNUTPTVKUN	PHP	PQNUTQUKRU	VVHMP	RVHR	NQMQ	
_á	QMV	eÉ	NRTQMQNKQU	NHN	NRVQNVSHTN	VUHSN	RVHR	NQMQ	

fåáá<ë=~ëÄÂê~íáçå=_ä<åâ=Ef`_F=oÉéçã

p~ã éäÉ=k~ã É	f`_
cäÉ=k~ã É	MVM/f`_ÍÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyi n`OQ^hÂ
^Åè=qáã É	PLOQLOMCP=NSVØTVRN
p~ã éäÉ=qóéÉ	f`_
qçí~äa ãäíáç å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑncäÉk~ã É	MVS`^i_ÍÇ
p~ã éäÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äã	m~ëë
I éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	råáë	opa	==\ mp==	iãäá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MKMNQ	ééÄ	NSKO	OMUKVM	MO	
NN	_	S	kç=d~ë	MKNTV	ééÄ	NSKM	NQVRKSS	Q	
CP	k~	CR	eÉ	CKVCR	ééÄ	TKM	RPVNVKCP	CMM	
CQ	j Ö	CR	eÉ	CKSPO	ééÄ	NRRT	NCQMKVV	CM	
OT	^ä	CR	eÉ	MKUTN	ééÄ	PMO	PSPNKSP	CM	
CU	pá	CR	eO	MKSVS	ééÄ	CPKO	USCQKOT	NMM	
PV	h	CR	eÉ	UKMUV	ééÄ	POKV	PRNMSKNP	CMM	
QM	`~	CR	eO	PKNVU	ééÄ	RKM	CRTNPKSM	CM	
RN	s	UV	eÉ	MKMMS	ééÄ	CMR	OVRKRS	N	
RO	`ê	UV	eÉ	MKMMV	ééÄ	VSKM	USRKUS	N	
RR	j å	UV	eÉ	MKMMT	ééÄ	NRCKO	PCPKOT	MQ	
RS	cÉ	UV	eO	PKNVV	ééÄ	PKS	RNRVCKTU	CM	
RV	`ç	UV	eÉ	MKMNM	ééÄ	OVKN	CCQKQS	MO	
SM	ká	UV	eÉ	MKMOM	ééÄ	NSKT	CUMKMN	MQ	
SP	`ì	UV	eÉ	MKMCP	ééÄ	PNKR	SRCKCR	MS	
SS	wå	UV	eÉ	JMKMQQ	ééÄ	kL^	CUMNKQQ	O	
TR	^ë	UV	eÉ	MKMCN	ééÄ	CCKO	PVKST	N	
TU	pÉ	UV	eO	MKMQQ	ééÄ	CKV	OSKMM	N	
UU	pê	UV	eÉ	MKMNS	ééÄ	CCKR	TPKPQ	N	
VR	j ç	UV	eÉ	MKCMN	ééÄ	UKV	TSQKQU	N	
NMT	^Ö	UV	eÉ	MKMNQ	ééÄ	NKP	NTPKPQ	MO	
NNN	`Ç	UV	eÉ	MKMNT	ééÄ	NPKQ	CUKKR	MO	
NNU	på	NRV	eÉ	MKMPN	ééÄ	OVKR	SNSKSV	N	
NCN	pÄ	NRV	kç=d~ë	MKMPR	ééÄ	NTKS	NMSQKRM	MO	
NPT	_~	NRV	kç=d~ë	MKMCM	ééÄ	UKV	NSPKRN	MQ	
NUO	t	NRV	kç=d~ë	MKNRT	ééÄ	NKM	OTOVKUS	N	
OMR	qä	OMV	kç=d~ë	MKMSM	ééÄ	SKP	ONOVKNO	MO	
OMU	mÄ	OMV	kç=d~ë	MKMNS	ééÄ	CUKN	NQQUKQQ	MO	
OPO	qÜ	OMV	kç=d~ë	MKMPT	ééÄ	OVKU	CUTPKPR	N	
OPU	r	OMV	kç=d~ë	MKMNV	ééÄ	OMKM	SMTKPP	MO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j ÇÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=cäÜÜ	n`=c~ä~Ö
iá	S	kç=d~ë	OMPQRMPKMR	MKV	ONCCPCPKQO	VRKUS	RVKR	NOMKQ	
pÅ	CR	kç=d~ë	QQRSQQUKNQ	NKU	QRNVVMMKMQ	VUKS	RVKR	NOMKQ	
pÅ	CR	eO	NMQRTCQKQN	MKT	NMSVRVUKVR	VTKTT	RVKR	NOMKQ	
pÅ	CR	eÉ	NRSQRTKNQ	NKR	NRTTPRKMO	VVKNV	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	NMQCMUMKVM	OKR	NMSQPUQKUO	VTKV	RVKR	NOMKQ	
dÉ	TO	eO	QNRUTNKVQ	NKN	QCCMNTKMN	VUKRQ	RVKR	NOMKQ	
dÉ	TO	eÉ	NOMRRNKSR	NKN	NCCRSPKSN	VUKPS	RVKR	NOMKQ	
v	UV	eO	QTMUSQSKMT	MKT	QTSCUURKNQ	VUKUS	RVKR	NOMKQ	
v	UV	eÉ	UNQTSTKVU	NKN	UCVQMCKQU	VUKCQ	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	SRTMMVRKSU	OKM	SRQQMSTKOO	NMMKQ	RVKR	NOMKQ	
qÄ	NRV	eÉ	OTVPQQCKVP	NKO	CURMTNTKVP	VTKVV	RVKR	NOMKQ	
_á	OMV	kç=d~ë	PNTNPSSKPR	PKP	PCNUTCUKRU	VUKRP	RVKR	NOMKQ	
_á	OMV	eÉ	NRTUUMTKUQ	MKT	NRVQNVSKTN	VVKMP	RVKR	NOMKQ	

p~ã éáÉ=k~ã É	mmi
cäÉ=k~ã É	MNM f ` s kÇ
a~í~=m~íÜ=k~ã É	a W ^ Ö ä É á i y f ` m j e y N y a ^ q ^ y O M C P y M P J ^ o y i n ` O Q ^ k Å
^Åè=qãä É	PLOQLOMOP=NSVROMRU
p~ã éáÉ=qóéÉ	i i f ` s
qçí~äa ää íáç å	NKMMMM
` çã ã Éåí	JJJ
fpqa=o ÉÑ¤cäÉk~ã É	MVS ^ i _ kÇ
p~ã éáÉ=n ` =m~ëëlcá~ä	c~ää
fpqa=n ` =m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áá**

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çåÅK	r åáë	o p a	==ì mp==	bñés~ä	B o ÉÅ	B i çï	B e äÜÜ
V	_É	S	k ç=d ~ë	MKNVT	éé Ä	PKP	NOVOKPM	MO	VUR	TVfR	NOMQ
NN	_	S	k ç=d ~ë	PKURU	éé Ä	MKQ	NRTNSHRS	Q	VSKQR	TVfR	NOMQ
OP	k ~	QR	e É	ONNKSTN	éé Ä	NKS	NUUVMSKQO	OM	NVRKUQ	TVfR	NOMQ
OQ	j Ö	QR	e É	ONKVUR	éé Ä	OKT	TVVPKRV	OM	NMVKVP	TVfR	NOMQ
OT	^ ä	QR	e É	JOKSOO	éé Ä	k L^	OVPUKNP	OM	JNPKSN	TVfR	NOMQ
OU	p á	QR	e O	VVKQUU	éé Ä	NKU	QSQQSHRU	NMM	VVKQV	TVfR	NOMQ
PV	h	QR	e É	ONNKCPT	éé Ä	NKO	VQQUPKVV	OM	NVRHSO	TVfR	NOMQ
QM	` ~	QR	e O	OPKMVQ	éé Ä	NKM	VPQRRKMM	OM	NNRKQT	TVfR	NOMQ
RN	s	UV	e É	NKMMQ	éé Ä	PKP	QRQQKNQ	N	NMMKQ	TVfR	NOMQ
RO	` ê	UV	e É	NKMQR	éé Ä	NKO	SOQPKRQ	N	NMOKR	TVfR	NOMQ
RR	j å	UV	e É	MKPTP	éé Ä	PKV	NPMTKNR	MQ	VPKQR	TVfR	NOMQ
RS	c É	UV	e O	ONKQQT	éé Ä	MKT	OTPPOTHRN	OM	NVSKCP	TVfR	NOMQ
RV	` ç	UV	e É	MKOMP	éé Ä	SKR	NVTUKMM	MO	NMNHR	TVfR	NOMQ
SM	k á	UV	e É	MKQQR	éé Ä	PKP	NPQPKQO	MQ	NNNKCR	TVfR	NOMQ
SP	` ì	UV	e É	MKSSO	éé Ä	QKV	RNNSKRT	MS	NNMKPP	TVfR	NOMQ
SS	w å	UV	e É	MKSPV	éé Ä	NRKO	PQMUKOS	O	PNKVR	TVfR	NOMQ
TR	^ ë	UV	e É	MKVVO	éé Ä	QKN	VNTKQS	N	VVKO	TVfR	NOMQ
TU	p É	UV	e O	MKVVN	éé Ä	PKS	QVNKSS	N	VVKN	TVfR	NOMQ
UU	p ê	UV	e É	NKMNQ	éé Ä	OKP	PQSTKNN	N	NMNKQ	TVfR	NOMQ
VR	j ç	UV	e É	NKMRS	éé Ä	QKR	PPVNKRV	N	NVRHS	TVfR	NOMQ
NMT	^ Ö	UV	e É	MKONO	éé Ä	NKN	OPUUKMP	MO	NMS	TVfR	NOMQ
NNN	` Ç	UV	e É	MKOMS	éé Ä	QKO	PNMKTQ	MO	NMP	TVfR	NOMQ
NNU	p å	NRV	e É	MKUUT	éé Ä	RKR	PMSPKTP	N	UUKT	TVfR	NOMQ
NON	p Ä	NRV	k ç=d ~ë	MKOOR	éé Ä	NMKN	RMMOKVM	MO	NNOKR	TVfR	NOMQ
NPT	_ ~	NRV	k ç=d ~ë	MKQRT	éé Ä	NMKN	OTUVKVP	MQ	NNQKCR	TVfR	NOMQ
NUO	t	NRV	k ç=d ~ë	MKVVN	éé Ä	QKM	NORNRKUV	N	VVKN	TVfR	NOMQ
OMR	q ä	OMV	k ç=d ~ë	MKONU	éé Ä	VKT	RUTTKRR	MO	NMV	TVfR	NOMQ
OMU	m Ä	OMV	k ç=d ~ë	MKONQ	éé Ä	OKP	UNRVKSP	MO	NMT	TVfR	NOMQ
OPO	q Ü	OMV	k ç=d ~ë	MKNSU	éé Ä	QKR	SSVUKUQ	MO	UQ	TVfR	NOMQ
OPU	r	OMV	k ç=d ~ë	MKOMO	éé Ä	NKR	RTQQKMR	MO	NMN	TVfR	NOMQ

n ` =c ä~Ö
c ~ äÉÇ=a ç a =& c ~ äÉÇ=SMOMb m^

n ` = c ä - Ö
c ~ á É Ç = a ç a = & c ~ á É Ç = S M O M b m ^

n ` = f p q a = q ~ Ä á É

k ~ ã É	j ~ ë ë	q ì å É = j ç Ç É	` m p	` m p = ¤ p a	o É Ñ ≠ m p	B = ¤ É Å	B n ` ÷ ç ï	B n ` = ¤ ä Ö Ü	n ` = c ä - Ö
i á	S	k ç = d ~ ë	O M P V P O M K C P	N K V	O N C C P O P K Q O	V S H M V	R V H R	N O M Q	
p Å	Q R	k ç = d ~ ë	Q D Q V T P Q K U T	N K N	Q R N V V M M M Q	V Q K M O	R V H R	N O M Q	
p Å	Q R	e O	V V M O N S K N N	M K V	N M S V R V U K V R	V O K R U	R V H R	N O M Q	
p Å	Q R	e É	N Q S M O M K T O	M K S	N R T T P R K M O	V O K R T	R V H R	N O M Q	
d É	T O	k ç = d ~ ë	N M M Q M P N K N M	N K P	N M S C P U Q K U O	V Q K P P	R V H R	N O M Q	
d É	T O	e O	P V Q N Q R K P Q	M K T	Q D O M N T K M N	V P K Q	R V H R	N O M Q	
d É	T O	e É	N N P O U S K N N	M K R	N O O R S P K S N	V O K Q P	R V H R	N O M Q	
v	U V	e O	Q D U Q S M U K U M	M K T	Q T S O U U R K N Q	V Q K N S	R V H R	N O M Q	
v	U V	e É	T S Q U O V K M S	M K S	U O V Q M D K Q U	V O K O N	R V H R	N O M Q	
q Ä	N R V	k ç = d ~ ë	S O N R Q Q R K Q R	N K T	S R Q Q M S T K O O	V Q K V U	R V H R	N O M Q	
q Ä	N R V	e É	O S P Q V R M K P Q	N K U	O U R M T N T K V P	V O K Q P	R V H R	N O M Q	
_ á	O M V	k ç = d ~ ë	O V S Q Q R M K M N	N K Q	P O N U T O U K R U	V O K N	R V H R	N O M Q	
_ á	O M V	e É	N R P Q U T M K S O	M K P	N R V Q N V S K T N	V S K O U	R V H R	N O M Q	

p~ãéáÉ=k~ãÉ	f`p^
cäÉ=k~ãÉ	MNNf`p^KÇ
a~í~=m~íÜ=k~ãÉ	aWj^ÖäÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyi n`OQ^kÅ
^Åè=qáãÉ	PLCQLOMCP=NSMRLUMR
p~ãéáÉ=qóéÉ	f`p^
qçí~äaäãíáç å	NKMMMM
`çããÉáí	JJJ
fpqa=oÉÑcäÉk~ãÉ	MMS`^i_KÇ
p~ãéáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
léÉê~íçê	**~Çãáå**

n`=^å~äöíÉ=q~ÄäÉ

k~ãÉ	j~ëë	fpqa	qìåÉ	`çåÅK	råáë	opa	==mp==	bñés~ä	Biçï	BeäÖÜ	n`=c~Ö
_É	V	S	kç=d~ë	JMKMO	ééÄ	klᴬ	NMTKTU	JMKN	NMM	NMM	
_	NN	S	kç=d~ë	MKRNN	ééÄ	NKV	OTMNKQN	JO	NMM	NMM	
k~	OP	QR	eÉ	NMOTVTKNQS	ééÄ	NKO	SQTSQQQSKPP	NMMMMM	UM	NOM	
jÖ	QQ	QR	eÉ	NMOTSOKRUM	ééÄ	NKS	PQMUVOQTKMM	NMMMMM	UM	NOM	
^ä	OT	QR	eÉ	NMTSSMKNNT	ééÄ	MKU	NPMUTTRVMPV	NMMMMM	UM	NOM	
pá	QU	QR	eO	QKVSS	ééÄ	QKN	CRUVKTM	JRM	NMM	NMM	
h	PV	QR	eÉ	NMVRSPKSMP	ééÄ	NKP	CUSTNNVNKVN	NMMMMM	UM	NOM	
`~	QM	QR	eO	NMOURRKNSP	ééÄ	NKM	PPNQQQRRMSO	NMMMMM	UM	NOM	
s	RN	UV	eÉ	MKMOR	ééÄ	NNKV	QMTKTV	JMR	NMM	NMM	
`ê	RO	UV	eÉ	OKMTT	ééÄ	NKN	NMVRUKUR	NKR	NMM	NMM	
jå	RR	UV	eÉ	MKNVV	ééÄ	QKN	TTRKUU	MKNT	NMM	NMM	
cÉ	RS	UV	eO	VUNNNKMVQ	ééÄ	OKR	NNPSRPRCUNKVO	NMMMMM	UM	NOM	
`ç	RV	UV	eÉ	MKNNR	ééÄ	NMKT	NMUQKRO	M	NMM	NMM	
ká	SM	UV	eÉ	MKQOR	ééÄ	SKV	NNVQKRO	MKNU	NMM	NMM	
`ì	SP	UV	eÉ	MKNNM	ééÄ	RKS	NNPSKTP	JMKOO	NMM	NMM	
wå	SS	UV	eÉ	JMKVVO	ééÄ	klᴬ	NQPOKPO	MKQ	NMM	NMM	aça
^ë	TR	UV	eÉ	MKMSN	ééÄ	OVKR	SUKPQ	JMKR	NMM	NMM	
pÉ	TU	UV	eO	MKMSS	ééÄ	NPKT	PPKPP	JMKR	NMM	NMM	
pê	UU	UV	eÉ	MKUOR	ééÄ	RKS	OQRUKMQ	MKPT	NMM	NMM	
jç	VR	UV	eÉ	ONTOKNNR	ééÄ	MKO	SOSVQMTKQU	OMMM	UM	NOM	
^Ö	NMT	UV	eÉ	MKMNR	ééÄ	NUKN	NRTKTU	JMKN	NMM	NMM	
`Ç	NNN	UV	eÉ	MKPPR	ééÄ	OKO	QSRKRT	MKOU	NMM	NMM	
på	NNU	NRV	eÉ	JMKMST	ééÄ	klᴬ	OUMKMN	JMKR	NMM	NMM	
pÄ	NON	NRV	kç=d~ë	MKMTQ	ééÄ	MKV	NTTUKST	JMKMR	NMM	NMM	
_~	NPT	NRV	kç=d~ë	MKRPR	ééÄ	PKT	PNTTKMR	MKPP	NMM	NMM	
t	NUO	NRV	kç=d~ë	MKOPT	ééÄ	VKS	PQQMKTQ	JMKPP	NMM	NMM	
qä	OMR	OMV	kç=d~ë	MKMOO	ééÄ	NMKT	NMPTKUM	JMKN	NMM	NMM	
mÄ	OMU	OMV	kç=d~ë	MKMPT	ééÄ	UKV	OMURKSO	JMKMU	NMM	NMM	
qÜ	OPO	OMV	kç=d~ë	MKMON	ééÄ	NVKS	OOOOKRQ	JMKN	NMM	NMM	
r	OPU	OMV	kç=d~ë	MKMON	ééÄ	NMKU	SMPKVU	JMKMU	NMM	NMM	

n`=fpqa=q~ÄäÉ

k~ãÉ	j~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=eäÖÜ	n`=c~Ö
iá	S	kç=d~ë	NVUNOQSKVQ	MKV	ONOOPOPKQO	VPKPR	RVKR	NOMKQ	
pÅ	QR	kç=d~ë	QMSQSOMKQU	MKV	QRNVVMMKMQ	UVKVP	RVKR	NOMKQ	
pÅ	QR	eO	VNUTQQKNT	NKU	NMSVRVUKVR	URKV	RVKR	NOMKQ	
pÅ	QR	eÉ	NPTNRUKRM	NKO	NRTTPRKMO	USKVS	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	VQUVTQKUQ	MKU	NMSQPUQKUO	UVKNS	RVKR	NOMKQ	
dÉ	TO	eO	PSSQSNKNQ	MKO	QQOMNTKMN	USKUQ	RVKR	NOMKQ	
dÉ	TO	eÉ	NMSNNUKMS	MKQ	NOORSPKSN	USKRU	RVKR	NOMKQ	
v	UV	eO	QNUPRNTKRP	OKN	QTSOUURKNQ	UTKUQ	RVKR	NOMKQ	
v	UV	eÉ	TMSPMSKMO	MKU	UOVQMOKQU	URKNS	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	SMRUPRNKPQ	OKR	SRQQMSTKOO	VOKRU	RVKR	NOMKQ	
qÄ	NRV	eÉ	OQVNVTNKPP	NKM	OURMTNTKVP	UTKQO	RVKR	NOMKQ	
_á	OMV	kç=d~ë	OVSSTUSKMO	NKT	PONUTOUKRU	VOKNT	RVKR	NOMKQ	
_á	OMV	eÉ	NPSSNNVKSS	MKT	NRVQNVSKTN	URKSV	RVKR	NOMKQ	

fåíÉêÑÉêÉåÅÉ=ÜÉÅâ=pçäîÉåí=^_=Ef`pJ^_F=oÉéçêí

p~ã éáÉ=k~ã É	f`p^_
cäÉk~ã É	MVNCf`p_KÇ
a~í~=m~íÜ=k~ã É	aWj*ÖäÉáíçf`mj eyNya^q^yOMCPyMPJ ^oyi n`OQ*kÅ
^Åè=qáã É	PLCQLOMCP=NTWMPMRQ
p~ã éáÉ=qóéÉ	f`p_
qçí~äa ãäíáçå	NMMMMM
`çã ã Éåí	JJU
fpqa=oÉÑ¥cäÉk~ã É	MVS^i_KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã ãå**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeáÖÜ	n`=c ä~Ö
V	_É	S	kç=d~ë	NVKVSO	éé Ä	QKN	NNRRNNVSV	OM	TVfR	NOMQ	
NN	_	S	kç=d~ë	OMVMQR	éé Ä	PKO	TSPNPKMM	OM	TVfR	NOMQ	
OP	k~	QR	eÉ	NVOTPSKOJT	éé Ä	MfR	SSUPSSMRKMU	NMMMMM	TVfR	NOMQ	
OQ	j Ö	QR	eÉ	NVNUMSKQMS	éé Ä	NKO	PQUTPSMPKPT	NMMMMM	TVfR	NOMQ	
OT	^ä	QR	eÉ	NVITPUVKTTT	éé Ä	NKQ	NPQTVVRVKOQ	NMMMMM	TVfR	NOMQ	
OU	pá	QR	eO	SOMRTNP	éé Ä	OKU	OTQSNPKOO	RMM	TVfR	NOMQ	[=HLJ+NMB
PV	h	QR	eÉ	VVTNUKRPN	éé Ä	NVS	OVPRTONPKTP	NMMMMM	TVfR	NOMQ	
QM	`~	QR	eO	NVQUSRKRPV	éé Ä	PKM	PQUOUSPTTKMP	NMMMMM	TVfR	NOMQ	
RN	s	UV	eÉ	OMfRVS	éé Ä	NKN	UPUVPKOT	OM	TVfR	NOMQ	
RO	`ê	UV	eÉ	OOKMRT	éé Ä	NKM	NNPPMRKPQ	OO	TVfR	NOMQ	
RR	j å	UV	eÉ	NVKTVO	éé Ä	NKM	RNNONKPQ	OM	TVfR	NOMQ	
RS	cÉ	UV	eO	VVPUMKQPT	éé Ä	NKP	NNUQMNNVSOKSV	NMMMMM	TVfR	NOMQ	
RV	`ç	UV	eÉ	OMfOSS	éé Ä	NfR	NTTMNNKPN	OM	TVfR	NOMQ	
SM	ká	UV	eÉ	OMKNO	éé Ä	MKV	QVQQUKRN	OM	TVfR	NOMQ	
SP	`ì	UV	eÉ	NVKVOT	éé Ä	NKT	NPQQMSKVO	OM	TVfR	NOMQ	
SS	wå	UV	eÉ	NVKSPO	éé Ä	NKQ	OPPRVKUO	ONKQ	TVfR	NOMQ	
TR	^ë	UV	eÉ	OMKNUT	éé Ä	NKM	NTQURKTT	OM	TVfR	NOMQ	
TU	pÉ	UV	eO	OMKSUM	éé Ä	MKV	VRQQKSR	OM	TVfR	NOMQ	
UU	pê	UV	eÉ	ONKMVN	éé Ä	NKN	SQRORKNT	OMKV	TVfR	NOMQ	
VR	j ç	UV	eÉ	ONVMNKVVP	éé Ä	NKQ	SRPVVRUKUS	OMMM	TVfR	NOMQ	
NMT	^Ö	UV	eÉ	NVKONV	éé Ä	NKM	OMRVNSKSO	OM	TVfR	NOMQ	
NNN	`Ç	UV	eÉ	NVKTTR	éé Ä	OKM	OUPTTKTT	OM	TVfR	NOMQ	
NNU	på	NRV	eÉ	OMfORT	éé Ä	NKP	RTPSSKOV	OM	TVfR	NOMQ	
NON	pÄ	NRV	kç=d~ë	NVKUMV	éé Ä	NKP	QNUMTVKOV	OM	TVfR	NOMQ	
NPT	_~	NRV	kç=d~ë	OMfSTS	éé Ä	NKP	NORMMNKRR	OM	TVfR	NOMQ	
NUO	t	NRV	kç=d~ë	OOKROQ	éé Ä	NKP	OSVQQOKUN	OM	TVfR	NOMQ	
OMR	qä	OMV	kç=d~ë	NVKSMS	éé Ä	NKV	QVQVPUKQN	OM	TVfR	NOMQ	
OMU	mÄ	OMV	kç=d~ë	OMKQMP	éé Ä	MKP	TNSNNRKRQ	OM	TVfR	NOMQ	
OPO	qÜ	OMV	kç=d~ë	ONKNVS	éé Ä	NKT	SSOPNQKVR	OM	TVfR	NOMQ	
OPU	r	OMV	kç=d~ë	ONKMVN	éé Ä	NKQ	SMQVTRKMT	OM	TVfR	NOMQ	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ¥mp	B=oÉÁ	Bn`=içï	Bn`=eáÖÜ	n`=c ä~Ö
iá	S	kç=d~ë	NVUUVQQKOT	OKQ	ONOOPOPKQO	VPKTO	RVfR	NOMQ	
pÄ	QR	kç=d~ë	QNTTUTRKOM	MKT	QRNVVMMKMQ	VOKQP	RVfR	NOMQ	
pÅ	QR	eO	VQTNSOKTR	NKV	NMSVRVUKVR	UUKRR	RVfR	NOMQ	
pÅ	QR	eÉ	NQNSOOKPR	MfR	NRTTPRKMO	UVKTU	RVfR	NOMQ	
dÉ	TO	kç=d~ë	VVPVRSKPR	NKP	NMSQPUQKUO	VPKPU	RVfR	NOMQ	
dÉ	TO	eO	PTTRVSKVM	MKU	QOOMNTKMN	UVKQT	RVfR	NOMQ	
dÉ	TO	eÉ	NMVNPUKSQ	MKV	NOORSPKSN	UVKMR	RVfR	NOMQ	
v	UV	eO	QPMNOQMQQ	MKQ	QTSOUURKNQ	VMKPN	RVfR	NOMQ	
v	UV	eÉ	TPMNSVKSR	NKN	UOVQMOKQU	UUKMQ	RVfR	NOMQ	
qÄ	NRV	kç=d~ë	SOOVTMOKNV	MfS	SRQQMSTKOO	VRKO	RVfR	NOMQ	
qÄ	NRV	eÉ	ORRNVNMKQT	NKM	OURMTNTKVP	UVfRO	RVfR	NOMQ	
_á	OMV	kç=d~ë	PMONTQTKUU	NfR	PONUTOUKRU	VPKUU	RVfR	NOMQ	
_á	OMV	eÉ	NQMNTVQKVO	NKP	NRVQNVSKTN	UTKVP	RVfR	NOMQ	

i åâÉ~ê¬o~åÖÉ¬p~ã éäÉ¬Ei opF¬oÉéçã

p~ã éäÉ¬k~ã É	i opN
cäÉ¬k~ã É	MNPj i opKÇ
a~í~¬m~íÜ¬k~ã É	aWy^ÖäÉáíyf^ mj eyNya^q^yOMOPyMPJ ^o yi n` OQ^kÅ
^Åè¬qãã É	PLOQLOMOP¬NTWMOMP
p~ã éäÉ¬qóéÉ	i op
qçí~äaãã íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa¬o ÉÑ¾cäÉk~ã É	MVS^ i _KÇ
p~ã éäÉ¬n` ¬m~ëëlcá~ä	m~ëë
fpqa¬n` ¬m~ëëlc~ãä	m~ëë
l éÉê~íçê	**~Çã áã**

n` =^å~äöíÉ¬q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¾ mp==	bñés~ä	B o ÉÅ	B i çï	B eäÖÜ	n` ¬c ä~Ö
V	_É	S	k ç¬d ~ë	VPKNPO	éëÄ	MVS	RCQLJNSKUU	NMM	VPKNP	UVfR	NNMQ	
NN	_	S	k ç¬d ~ë	QVPKUSS	éëÄ	NKO	NUNQMTSKMT	RMM	VUKTT	UVfR	NNMQ	
RN	s	UV	e É	NMQOKPTN	éëÄ	NKS	QMPTMPRKVU	NMMM	NMQKCQ	UVfR	NNMQ	
RO	` ê	UV	e É	OMTCKOTU	éëÄ	NKV	NMMJSOTMéSS	OMMM	NMPKSN	UVfR	NNMQ	
RR	j å	UV	e É	OMNSKTMR	éëÄ	MKV	QVPVVPQKNQ	OMMM	NMMKUQ	UVfR	NNMQ	
RV	` ç	UV	e É	NMSVKCPT	éëÄ	NKS	UVMMQQOKSQ	NMMM	NMSKVO	UVfR	NNMQ	
SM	k á	UV	e É	NMVQKPTM	éëÄ	NKV	CRPMOCRKMT	NMMM	NMVKQQ	UVfR	NNMQ	
SP	` ì	UV	e É	ONCQKSVT	éëÄ	NKN	NPSCQPQRKON	OMMM	NMSKCP	UVfR	NNMQ	
SS	wå	UV	e É	ONRVKUPS	éëÄ	NKQ	CCQNVTQKPS	OMMM	NMTKVV	UVfR	NNMQ	
TR	^ë	UV	e É	VVRKPNP	éëÄ	MfR	UCNPVRKQR	NMMM	VVKRP	UVfR	NNMQ	
TU	pÉ	UV	e O	NMMNKTUO	éëÄ	MfR	QSQQSUKQO	NMMM	NMMKNU	UVfR	NNMQ	
UU	pê	UV	e É	NVUSKSQU	éëÄ	NKM	RTVRNCUKPN	OMMM	VVKPP	UVfR	NNMQ	
VR	j ç	UV	e É	NMVQKOUU	éëÄ	MKV	PNNPUNPRTM	NMMM	NMVKQP	UVfR	NNMQ	
NMT	^Ö	UV	e É	NMTHRVR	éëÄ	OKM	NMVVOUSKQU	NMM	NMTHS	UVfR	NNMQ	
NNN	` Ç	UV	e É	NMTSKTSU	éëÄ	OKQ	NQTPRVVKRS	NMMM	NMTHSU	UVfR	NNMQ	
NNU	på	NRV	e É	NMMVKONN	éëÄ	MKT	OUMMRQQKRN	NMMM	NMMKVO	UVfR	NNMQ	
NON	pÄ	NRV	k ç¬d ~ë	VUPKPNP	éëÄ	NKP	ONTNPROUKSM	NMMM	VUKPP	UVfR	NNMQ	
NPT	_~	NRV	k ç¬d ~ë	OMCPKPTR	éëÄ	MfR	NOUMQNUPKUQ	OMMM	NMNKNT	UVfR	NNMQ	
NUO	t	NRV	k ç¬d ~ë	NMSPKTMP	éëÄ	MKQ	NPCUTNRMKUR	NMMM	NMSKPT	UVfR	NNMQ	
OMR	qä	OMV	k ç¬d ~ë	NMOMKMMQ	éëÄ	NKS	CUQLUQQTQKPN	NMMM	NMOKV	UVfR	NNMQ	
OMU	mÄ	OMV	k ç¬d ~ë	OMNUKSPR	éëÄ	MKU	TTSUNTPQKUP	OMMM	NMMKVP	UVfR	NNMQ	
OPO	qÜ	OMV	k ç¬d ~ë	VURKTSQ	éëÄ	NKT	PPTPPVTPKOM	NMMM	VUKRU	UVfR	NNMQ	
OPU	r	OMV	k ç¬d ~ë	NMMMKNMR	éëÄ	NKP	PNSCQTNTKNQ	NMMM	NMMKMN	UVfR	NNMQ	

n` =fpqa¬q~ÄäÉ

k~ã É	j ~ëë	qì åÉ¬j çÇÉ	` mp	` mp¬o pa	oÉÑ¾ mp	B ¬o ÉÅ	B n` =¾ çï	B n` ¬c äÖÜ	n` ¬c ä~Ö
i á	S	k ç¬d ~ë	NVPTCURKNP	MKV	ONCCPCPKQO	VNKCU	RVfR	NOMQ	
pÅ	QR	k ç¬d ~ë	QNMVRVMTKUV	NKM	QRNVVMMMMQ	VMKTO	RVfR	NOMQ	
d É	TO	k ç¬d ~ë	VSRPVRNPP	MKQ	NMSCQPUCKUO	VMKT	RVfR	NOMQ	
qÄ	NRV	k ç¬d ~ë	SRCCPMRKRT	MKT	SRQQMSTKOO	VVfST	RVfR	NOMQ	
_á	OMV	k ç¬d ~ë	PPNSTRSKNS	MfS	PCNUTCUKRU	NVPKMR	RVfR	NOMQ	
pÅ	QR	e O	VMRPNOKNV	NKN	NMSVRVUKVR	UQKSQ	RVfR	NOMQ	
d É	TO	e O	PSONPPKSU	MKT	QCCMNTKMN	URKUN	RVfR	NOMQ	
v	UV	e O	QONTRVSKPQ	MKO	QTSCUURKNQ	UUKRR	RVfR	NOMQ	
pÅ	QR	e É	NPNTVTKQO	NfR	NRTTPRKMO	UPKRS	RVfR	NOMQ	
d É	TO	e É	NMCUPMKNN	MKQ	NCCRSPKSN	UPKV	RVfR	NOMQ	
v	UV	e É	SVSPCRKTU	MKT	UCVQMCKQU	UPKVS	RVfR	NOMQ	
qÄ	NRV	e É	CROMUMSKNP	MKO	CURMTNTKVP	UUKQP	RVfR	NOMQ	
_á	OMV	e É	NQUUMCMKMV	MKV	NRVQNVSKTN	VPKPQ	RVfR	NOMQ	

p~ã éäÉ=k~ã É i o p O

cãÉ=k~ã É MNQ p j m i K Ç

a~í~=m~íÜ=k~ã É a \ y ª Öäé åíyº m j e y N y a ^ q ^ y O M C P y M P J ^ o y j n ` O Q ^ k Å

^Åè=qãã É P L C Q L O M C P = N T W Ø P W Q T

p~ã éäÉ=qóéÉ p ~ ã é ä É

qçí~äa ãã íáçå N M M M M

p~ã éäÉ=n ` =m~ëëlc á~ä c ~ ã ä

fpqa=n ` =m~ëëlc~ãä m ~ ë ë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çàÅK	r åáë	o p a	═ mp ═	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MM/QQ	é é Ä	NMO	PTMM/N	NMM	
NN	_	S	k ç=d ~ë	PKQQO	é é Ä	PHR	NPRTTH/SS	NMM	
OP	k ~	QR	e É	NVQLOS/RTN	é é Ä	NK/M	NOORUOURTK/TN	OMMM/M	
OQ	j Ö	QR	e É	NVRM/TK/OV	é é Ä	MK/	SQSROSVPKQU	OMMM/M	
OT	^ ä	QR	e É	ONNSSV/OUTO	é é Ä	MKT	ORTMOPRV/M/S	OMMM/M	[i a o
OU	p á	QR	e O	NVRM/M/M/QT	é é Ä	NHP	QQRVNRRRTO	NMM/M	[i a o
PV	h	QR	e É	NVPMNPK/NUV	é é Ä	NHP	RQVQRMM/MPN	OMMM/M	
QM	` ~	QR	e O	OM/OM/K/MNQ	é é Ä	NKT	SPVPVPQROK/SV	OMMM/M	[i a o
RN	s	UV	e É	MKPMR	é é Ä	QK/N	NQNQKRQ	NMM/M	
RO	` ê	UV	e É	NK/MQV	é é Ä	PK/S	RUNUK/M/V	OMM/M	
RR	j å	UV	e É	NKQSN	é é Ä	NHR	PUSTK/NP	OMM/M	
RS	c É	UV	e O	VUOOPK/TU	é é Ä	MHP	NMUMNOM/UPK/MP	NMM/M/M	
RV	` ç	UV	e É	NHRUS	é é Ä	QKU	NPPQM/K/MR	NMM/M	
SM	k á	UV	e É	NK/PV	é é Ä	PK/N	OUPRK/M	NMM/M	
SP	` ì	UV	e É	MK/TO	é é Ä	MKO	SSSOKUM	OMM/M	
SS	w å	UV	e É	NK/QV	é é Ä	NNKU	PSQOR/TS	OMM/M	
TR	^ ë	UV	e É	MKQTS	é é Ä	NHP	QNNK/MR	NMM/M	
TU	p É	UV	e O	MRRR	é é Ä	VKQ	OQQKUO	NMM/M	
UU	p ê	UV	e É	OK/VQ	é é Ä	NK/V	UTTQK/M/S	OMM/M	
VR	j ç	UV	e É	OK/MNS	é é Ä	QK/N	RUPRKTV	NMM/M	
NMT	^ Ö	UV	e É	MK/MRR	é é Ä	UKO	RSSK/SV	NMM	
NNN	` Ç	UV	e É	MKOUM	é é Ä	QK/M	PURKRT	NMM/M	
NNU	p å	NRV	e É	MKSNR	é é Ä	QKR	OMTVK/MU	NMM/M	
NON	p Ä	NRV	k ç=d ~ë	MKQUN	é é Ä	SKQ	NMPQNKRR	NMM/M	
NPT	_ ~	NRV	k ç=d ~ë	NKOSU	é é Ä	PHP	TSQSK/R	OMM/M	
NUO	t	NRV	k ç=d ~ë	NK/UST	é é Ä	NPKU	OOUQNK/MT	NMM/M	
OMR	q ä	OM/	k ç=d ~ë	MRRRT	é é Ä	MKO	NQNRSK/NS	NMM/M	
OMU	m Ä	OM/	k ç=d ~ë	NKRPP	é é Ä	MHP	RPNMRKQN	OMM/M	
OPO	q Ü	OM/	k ç=d ~ë	NK/MRO	é é Ä	RKT	PPQSVKRU	NMM/M	
OPU	r	OM/	k ç=d ~ë	MKPVN	é é Ä	RKQ	NNMVPK/V	NMM/M	

n ` =fpqa=q~ÄäÉ

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o p a	o ÉÑ═ mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVSOTUNK/MR	NK/S	ONOOPOPQQO	VOKQU	RVHR	NOMQ	
p Å	QR	k ç=d ~ë	PVQNV/TRKTS	MK/S	QRNV/VMM/MQ	UTHON	RVHR	NOMQ	
p Å	QR	e O	VNMQONKRP	NHR	NMSVRV/UK/R	URK/NO	RVHR	NOMQ	
p Å	QR	e É	NPTMNM/PN	NHO	NRTTPRK/MO	USK/US	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VPNOQV/K/N	MK/S	NMSQPUQK/UO	UTHQV	RVHR	NOMQ	
d É	TO	e O	PRUTSUK/MM	MKU	QOOMNTK/MN	URK/MN	RVHR	NOMQ	
d É	TO	e É	NMROSQKQT	NKQ	NOORSPH/SN	URKUV	RVHR	NOMQ	
v	UV	e O	PVSVUTPK/NV	MHT	QTSOUURK/NQ	UPHPR	RVHR	NOMQ	
v	UV	e É	SVUPPM/K/M	MHO	UOVQMOKQU	UQHO	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SNVORPOKRQ	OK/S	SRQQM/STHOO	VQHSP	RVHR	NOMQ	
qÄ	NRV	e É	OQM/OPVKOS	NKQ	OURM/TNTK/P	UQHRO	RVHR	NOMQ	
_á	OM/	k ç=d ~ë	OVQNQURKRO	NK/M	PONUTOUHRU	VNHPV	RVHR	NOMQ	
_á	OM/	e É	NOUTPNNHRN	NK/N	NRVQNV/SHTN	UM/TR	RVHR	NOMQ	

p~ã éäÉ=k~ã É	ofk pb
cãÉ=k~ã É	MNRpj mi kÇ
a~í~=m~íÜ=k~ã É	aWÿ ÖäÉåíÿ mj eyNya^q^yOMCPyMPJ ^o yi n ` OQ^kA
^Åè=qãã É	PLOQLOMCP=NTMRRMQS
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãä íáçå	NKMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	c~åä
fpqa=n ` =m~ëëlc~åä	c~åä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==i mp==	i a o	n ` =cä-Ö
V	_É	S	k ç=d ~ë	PKUUO	éé Ä	PTKQ	NQMKMM	NMM	
NN	_	S	k ç=d ~ë	NMMKCOM	éé Ä	CKO	QCPNKUS	NMMM	
OP	k ~	QR	e É	NMPTQMKTRQ	éé Ä	NPKO	TRNPRKRV	OMMMMM	
OQ	j Ö	QR	e É	OQRRNKRNS	éé Ä	NPKP	VPSNKOU	OMMMMM	
OT	^ ä	QR	e É	OSVPQKTON	éé Ä	NOKU	PTSTKOR	OMMMMM	
OU	pá	QR	e O	QMPVMKMST	éé Ä	NMKS	CRQCKVO	NMMMM	
PV	h	QR	e É	NPMRSQKOVU	éé Ä	NQKT	QOTCUKSR	OMMMMM	
QM	` ~	QR	e O	OTQMPKROS	éé Ä	NMKM	NMRUTRKUO	OMMMMM	
RN	s	UV	e É	NNUCKOOP	éé Ä	TKQ	SMUKVN	NMMM	[i a o
RO	` ê	UV	e É	RSVRKTUM	éé Ä	PKO	PSUTKTU	OMMM	[i a o
RR	j å	UV	e É	NQPOKVVQ	éé Ä	UKS	QSTKOR	OMMM	
RS	cÉ	UV	e O	NQTNUMKOVM	éé Ä	NNKV	OTNUNMKTP	NMMMMM	[i a o
RV	` ç	UV	e É	OQMKUTO	éé Ä	SKN	OSSKSU	NMMM	
SM	k á	UV	e É	NNNPKMQS	éé Ä	UKQ	PQOKOP	NMMM	[i a o
SP	` ì	UV	e É	NTPSKNSQ	éé Ä	PKQ	NQUNKOO	OMMM	
SS	wå	UV	e É	OOMQNKSRV	éé Ä	QKV	PMQMKPV	OMMM	[i a o
TR	^ ë	UV	e É	VSRKRRM	éé Ä	OKP	NMSKMN	NMMM	
TU	pÉ	UV	e O	TOVKSTR	éé Ä	ONKR	RPKMM	NMMM	
UU	pê	UV	e É	OTQKTRR	éé Ä	NMKP	NMSKST	OMMM	
VR	j ç	UV	e É	SOMQKOUO	éé Ä	QKR	OPQUKMO	NMMM	[i a o
NMT	^ Ö	UV	e É	OQKSQQ	éé Ä	SOKV	PPKPP	NMM	
NNN	` Ç	UV	e É	NNRKVPR	éé Ä	NRKV	ONKMN	NMMM	
NNU	på	NRV	e É	NNOMVKOMV	éé Ä	RKV	QOPUKRP	NMMM	[i a o
NON	pÄ	NRV	k ç=d ~ë	RMVKSMP	éé Ä	VKO	NUQOKMS	NMMM	
NPT	_~	NRV	k ç=d ~ë	NQVQKQMQ	éé Ä	NSKT	NRPUKPV	OMMM	
NUO	t	NRV	k ç=d ~ë	QPOPKPVP	éé Ä	OPKT	UTTOKPN	NMMM	[i a o
OMR	qä	OMV	k ç=d ~ë	NQSKUPN	éé Ä	TKM	PMQSKVO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	VOKROR	éé Ä	SKR	OSTOKVS	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OPPKMVQ	éé Ä	VKT	SMMNKNP	NMMM	
OPU	r	OMV	k ç=d ~ë	NUKUPU	éé Ä	NOKU	QQTKNS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ=f mp	B=oÉÅ	B n ` = çï	B n ` =eáÜÜ	n ` =cä-Ö
i á	S	k ç=d ~ë	NOOUNKQM	NKU	ONOOPOPKQO	MKRU	RVKR	NOMKQ	SMOOMa ça
pÅ	QR	k ç=d ~ë	RRTUKTO	PKV	QRNVVMMKMQ	MKNO	RVKR	NOMKQ	SMOOMa ça
pÅ	QR	e O	NNMOKRM	SKT	NMSVRVUKVR	MKN	RVKR	NOMKQ	SMOOMa ça
pÅ	QR	e É	NRVMPM	NNKV	NRTTPRKMO	MKN	RVKR	NOMKQ	SMOOMa ça& eáÜÜ=fpqa=opa
d É	TO	k ç=d ~ë	TORVKNV	OKT	NMSOPUOKUO	MKSU	RVKR	NOMKQ	SMOOMa ça
d É	TO	e O	QURKVO	UKN	QOOMNTKMN	MKNO	RVKR	NOMKQ	SMOOMa ça& eáÜÜ=fpqa=opa
d É	TO	e É	NMNKVU	NMKS	NOORSPKSN	MKMU	RVKR	NOMKQ	SMOOMa ça& eáÜÜ=fpqa=opa
v	UV	e O	STPKUV	NPKS	QTSOUURKNQ	MKMN	RVKR	NOMKQ	SMOOMa ça& eáÜÜ=fpqa=opa
v	UV	e É	VOKSR	NKO	UOVOMOKQU	MKMN	RVKR	NOMKQ	SMOOMa ça
qÄ	NRV	k ç=d ~ë	NMTPKMU	NNKM	SRQOMSTKOO	MKMO	RVKR	NOMKQ	SMOOMa ça& eáÜÜ=fpqa=opa
qÄ	NRV	e É	PQQKSN	TKV	OURMTNTKVP	MKMN	RVKR	NOMKQ	SMOOMa ça
_á	OMV	k ç=d ~ë	OQVRKTU	UKR	PONUTOURKU	MKMU	RVKR	NOMKQ	SMOOMa ça& eáÜÜ=fpqa=opa
_á	OMV	e É	NOOUKQU	OKT	NRVONMSKTN	MKMV	RVKR	NOMKQ	SMOOMa ça

p~ã éäÉ=ɵÉéçã

p~ã éäÉ=k~ã É ofk pb

cãÉ=k~ã É MNSpj mi kÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyWPJ ^o yi n ` CCI^kÅ

^Åè=qáã É PLCQLOMCP=NTWQMQCO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå NKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä c~åä

fpqa=n ` =m~ëëlc~åä c~åä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==i mp==	i a o	n ` =cä~Ö
V	_É	S	k ç=d ~ë	CKCMO	éé Ä	SKN	NMUKUV	NMM	
NN	_	S	k ç=d ~ë	CMPKRST	éé Ä	PKR	PQCOSKMP	NMMM	
CP	k ~	CR	e É	NMCUUTKCCM	éé Ä	CKU	SPCCPKCM	CMMMMM	
CQ	j Ö	CR	e É	NRCRVKCRT	éé Ä	NMKQ	QVVSKSN	CMMMMM	
CT	^ ä	CR	e É	NTSSSKNCM	éé Ä	NNKV	CMVCKSQ	CMMMMM	
CU	pá	CR	e O	CCPSKNCM	éé Ä	SKT	CMSCKPN	NMMMM	
PV	h	CR	e É	NPUMCMSSS	éé Ä	CKS	PUPURKMT	CMMMMM	
CM	` ~	CR	e O	NTNSUKCPP	éé Ä	PKV	SMMVMKPQ	CMMMMM	
RN	s	UV	e É	NSRTKPTQ	éé Ä	CPKO	RPCKCQ	NMMM	[i a o
RO	` ê	UV	e É	VCMTKQMS	éé Ä	NSKO	PTQTRTV	CMMM	[i a o
RR	j å	UV	e É	CCVCKUSN	éé Ä	NMKO	QSUKRV	CMMM	[i a o
RS	cÉ	UV	e O	OTQNTCKNRQ	éé Ä	PKV	CPTSSMKVN	NMMMMM	[i a o
RV	` ç	UV	e É	CQSKNPV	éé Ä	NTKQ	NTNKNO	NMMM	
SM	k á	UV	e É	NTNSKTRQ	éé Ä	NRKU	PPPKPQ	NMMM	[i a o
SP	` ì	UV	e É	CQQQKUCM	éé Ä	NCKP	NPNSKTR	CMMM	[i a o
SS	wå	UV	e É	CCRSVKRPV	éé Ä	NTKN	NVRRKTP	CMMM	[i a o
TR	^ ë	UV	e É	NNPRKQTR	éé Ä	NCKU	TUKSU	NMMM	[i a o
TU	pÉ	UV	e O	NMCCKRMO	éé Ä	SKR	PRKNT	NMMM	[i a o
UU	pê	UV	e É	CRUKQCM	éé Ä	NPKT	SPKPP	CMMM	
VR	j ç	UV	e É	TMMMKTMS	éé Ä	NSKV	NSSQKRU	NMMM	[i a o
NMT	^ Ö	UV	e É	OTKVSS	éé Ä	PUKN	CPKPQ	NMM	
NNN	` Ç	UV	e É	NMPKTUQ	éé Ä	RUKV	NNKQU	NMMM	
NNU	på	NRV	e É	NURQVKURN	éé Ä	NMKU	PSRSKNO	NMMM	[i a o
NCN	pÄ	NRV	k ç=d ~ë	NMCUMVQU	éé Ä	NCKS	NPTNKRP	NMMM	[i a o
NPT	_~	NRV	k ç=d ~ë	TCQKUVT	éé Ä	NNKO	CUMKPM	CMMM	
NUO	t	NRV	k ç=d ~ë	TSPMKMVM	éé Ä	NRKU	RTRMKSS	NMMM	[i a o
CMR	qä	CMV	k ç=d ~ë	NQRKTNV	éé Ä	RKN	CMQVKMO	NMMM	
CMU	mÄ	CMV	k ç=d ~ë	USKCPU	éé Ä	SKU	NSUNKUP	CMMM	
CPO	qÜ	CMV	k ç=d ~ë	NUVKTUN	éé Ä	RKQ	POVPKVQ	NMMM	
CPU	r	CMV	k ç=d ~ë	NNKSVN	éé Ä	NSKV	NUSKUS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ=f mp	B n ` =ɵÉÅ	B n ` =i çï	B n ` =eäÖÜ	n ` =cä~Ö
i á	S	k ç=d ~ë	UUTRKNT	CKR	CNCCPCPKQD	MKQD	RVKR	NCMKQ	SMCMa ça
pÅ	CR	k ç=d ~ë	CITPNKCO	CKO	CRNVVMMKMQ	MKN	RVKR	NCMKQ	SMCMa ça
pÅ	CR	e O	VVUKRN	RKQ	NMSVRVUKVR	MKMV	RVKR	NCMKQ	SMCMa ça
pÅ	CR	e É	NPPKVU	PKV	NRTTPRKMO	MKMU	RVKR	NCMKQ	SMCMa ça
d É	TO	k ç=d ~ë	SUUVKMS	CKT	NMSCPUCKCO	MKSR	RVKR	NCMKQ	SMCMa ça
d É	TO	e O	PTCKSM	PKO	QCCMNTKMN	MKMV	RVKR	NCMKQ	SMCMa ça
d É	TO	e É	TNKPO	CUKS	NCCRSPKSN	MKMS	RVKR	NCMKQ	SMCMa ça& eäÖÜ=fpqa=opa
v	UV	e O	PNPKCU	CKO	CITSCUURKNQ	MKMN	RVKR	NCMKQ	SMCMa ça
v	UV	e É	RVKPO	NTKP	UCVCMCKQU	MKMN	RVKR	NCMKQ	SMCMa ça& eäÖÜ=fpqa=opa
qÄ	NRV	k ç=d ~ë	PVSKSM	TKT	SRQQMSTKCO	MKMN	RVKR	NCMKQ	SMCMa ça
qÄ	NRV	e É	NUMKSP	NCKN	CURMTNTKVP	MKMN	RVKR	NCMKQ	SMCMa ça& eäÖÜ=fpqa=opa
_á	CMV	k ç=d ~ë	NSUPKNP	PKS	PCNUTCUKRU	MKMR	RVKR	NCMKQ	SMCMa ça
_á	CMV	e É	VURKUR	MKO	NRVQNMSKTN	MKMS	RVKR	NCMKQ	SMCMa ça

`çåíaåì åaÖ=~äáÄê~íáçå=sÉêáÑáÅ~íáçå=É``sF=oÉéçêí

p~ã éáÉ=k~ã É	``s
cáäÉ=k~ã É	MVTJ``sKÇ
a~í~=m~íÜk~ã É	aWyÖáÉáíyf^mj eyNya^q^yOMOPyMPJ^oyi n`OQ^kÄ
^Åè=qáã É	PLOQLOMOP=NTWRMRS
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MVS^i_KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	m~ëë
fpqa=n`=m~ëëlc~áä	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	ORKMVV	ééÄ	MKQ	NQMTCOKCP	OR	NMMKQ	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKMOU	ééÄ	MKQ	VONQNKCO	OR	NMMKNN	UVKU	NNMO	
OP	k ~	OR	e É	RPNRKQSU	ééÄ	NKP	PQRTCOQKQT	RMMM	NMSKPN	UVKU	NNMO	
OQ	j Ö	OR	e É	RPMMRQO	ééÄ	MKQ	NTVPOMNKON	RMMM	NMSKMN	UVKU	NNMO	
OT	^ä	OR	e É	RONKUMU	ééÄ	NKT	STTVSKUU	RMM	NMQKPS	UVKU	NNMO	
OU	pá	OR	e O	RMPKOTS	ééÄ	NKN	OONUCUKTN	RMM	NMMKSS	UVKU	NNMO	
PV	h	OR	e É	ROPPKSQT	ééÄ	MKV	NRQUVRQKPQ	RMMM	NMQKST	UVKU	NNMO	
QM	` ~	OR	e O	RNVOKVNP	ééÄ	MKU	NTNUTTSPKSP	RMMM	NMPKUS	UVKU	NNMO	
RN	s	UV	e É	ORKSMS	ééÄ	MKV	NMPRUVKTQ	OR	NMOKQO	UVKU	NNMO	
RO	` ê	UV	e É	ORKRTM	ééÄ	MKR	NPMQONKSP	OR	NMOKCU	UVKU	NNMO	
RR	j å	UV	e É	ORKMTQ	ééÄ	MKU	SQQUVKNM	OR	NMMKP	UVKU	NNMO	
RS	cÉ	UV	e O	RNMTKUSR	ééÄ	NKS	SMPTOQQQKUO	RMMM	NMOKNS	UVKU	NNMO	
RV	` ç	UV	e É	OSKMUT	ééÄ	MKQ	OOSQOVKRR	OR	NMQKPR	UVKU	NNMO	
SM	k á	UV	e É	ORKVV	ééÄ	MKV	SOUQTHPV	OR	NMQ	UVKU	NNMO	
SP	` ì	UV	e É	OSKNRS	ééÄ	MKN	NTROOMPO	OR	NMQKSO	UVKU	NNMO	
SS	wå	UV	e É	ORKNQV	ééÄ	NKS	OVTNUKSP	OR	NMMKS	UVKU	NNMO	
TR	^ë	UV	e É	ORKQRQ	ééÄ	MKT	ONVMTKQS	OR	NMNKUO	UVKU	NNMO	
TU	pÉ	UV	e O	OQKTPP	ééÄ	MKP	NNSMQKNN	OR	VUKVP	UVKU	NNMO	
UU	pê	UV	e É	ORKSPM	ééÄ	MKN	TTVOSHRQ	OR	NMOKRO	UVKU	NNMO	
VR	j ç	UV	e É	OQKUOQ	ééÄ	MKV	TPSVSKVO	OR	VVHP	UVKU	NNMO	
NMT	^Ö	UV	e É	ORKSRS	ééÄ	MKS	OTPOMNKPU	OR	NMOKSO	UVKU	NNMO	
NNN	` Ç	UV	e É	ORKSTM	ééÄ	NKP	PSSNOKVP	OR	NMOKSU	UVKU	NNMO	
NNU	på	NRV	e É	OQKTUQ	ééÄ	MKQ	TMUTRKTP	OR	VVKNQ	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	ORKMTP	ééÄ	NKN	RCUMTRKNQ	OR	NMMKOV	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKUTM	ééÄ	NKU	NRSMVQKVS	OR	NMPKQU	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKNPP	ééÄ	MKR	OVVVUNKTN	OR	NMMKRP	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKPST	ééÄ	OKS	SQNSPQKUS	OR	NMNKQT	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKNVS	ééÄ	NKV	VONPPQKOR	OR	NMQKTU	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OQKUNP	ééÄ	MKU	TTTMQSKUQ	OR	VVKOR	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	ORKUTM	ééÄ	OKR	TQSTRVKMS	OR	NMPKQU	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=o pa	oÉÑ=mp	B=oÉÄ	B n`=ç ï	B n`=c äÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	NVOSPUMKRT	MKR	ONOOPOPKQO	VMKTT	RVKR	NOMQ	
pÅ	OR	k ç=d ~ë	OMSRQMMKOV	NKV	ORNVVMMMMQ	UVKVQ	RVKR	NOMQ	
pÅ	OR	e O	VQOVQVKOT	NKO	NMSVRVUKVR	UUKNS	RVKR	NOMQ	
pÅ	OR	e É	NPVURMSU	NKO	NRTTPRKMO	UUKSS	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VSTQOOKOT	MKV	NMSQPUQKUO	VMKUV	RVKR	NOMQ	
d É	TO	e O	PTNNVPKRT	MKR	QOOMNTKMN	UTKVS	RVKR	NOMQ	
d É	TO	e É	NMTSMRKRM	MKV	NOORSPKSN	UTKU	RVKR	NOMQ	
v	UV	e O	QOSTMPRKTV	NKQ	QTSOUURKNQ	UVKRV	RVKR	NOMQ	
v	UV	e É	TORSQTKVT	MKT	UOVQMOKQU	UTKQV	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SONTSTSKMN	MKS	SRQQMSTKOO	VRKMN	RVKR	NOMQ	
qÄ	NRV	e É	ORUMSVRKPS	NKT	OURMTNTKVP	VMKRP	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PMOVONMKQR	NKU	PONUTOUKRU	VQKNN	RVKR	NOMQ	
_á	OMV	e É	NQSRRUSKTM	NKS	NRVQNVSKTN	VNKVP	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=Ê`_F=oÉéçã

p~ã éáÉ=k~ã É ```_

cäÉ=k~ã É MNUJ```_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíyî mj eyNya^q^yOMOPyMPJ ^oyi n` OQ^kÅ

^Åè=qáã É PLOQLOMOP=NTVRSMU

p~ã éáÉ=qóéÉ ```_

qçí~äa äã íáç~å NKMMMM

`çã ã Éåí JJJ

fpqa=oÉÑc äÉk~ã É MVS^i_KÇ

p~ã éáÉ=n`=m~ëëlcá~ä c~ää

fpqa=n`=m~ëëlc~äã m~ëë

l éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==\ mp==	iãìá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MKMU	ééÄ	QOKP	NTNKN	MO	
NN	_	S	kç=d~ë	MKPOU	ééÄ	QKV	OMQQKQN	Q	
OP	k~	QR	eÉ	NQKMU	ééÄ	RKQ	RRRTMSV	OMM	
OQ	j Ö	QR	eÉ	SKQVM	ééÄ	TKM	OQLUMPM	OM	
OT	^ä	QR	eÉ	JONKQSM	ééÄ	kL^	QVOKOQ	OM	c~äë^ äëj ÉíÜçÇë& c~äÉÇ=a ça
OU	pá	QR	eO	MQTQ	ééÄ	OOKU	TNMRTT	NMM	
PV	h	QR	eÉ	OQKMTQ	ééÄ	NNKO	PSVOMKNS	OMM	
QM	`~	QR	eO	SKNRS	ééÄ	RKQ	PQPTMKVR	OM	
RN	s	UV	eÉ	MKNNN	ééÄ	NMMKM	OVUKVM	N	
RO	`ê	UV	eÉ	MKMOQ	ééÄ	NOKS	UVPKNV	N	
RR	j å	UV	eÉ	JMKMSN	ééÄ	kL^	NPVMPN	MQ	
RS	cÉ	UV	eO	QKNQR	ééÄ	NKM	SNPUOKQM	OM	
RV	`ç	UV	eÉ	MKMMV	ééÄ	PSKS	OMSKST	MO	
SM	ká	UV	eÉ	MKMNN	ééÄ	NPRQKU	ONQKQR	MQ	
SP	`ì	UV	eÉ	MKMNQ	ééÄ	PNKQ	RRQKOQ	MS	
SS	wå	UV	eÉ	JOKNQN	ééÄ	kL^	OQNKNO	O	c~äë^ äëj ÉíÜçÇë& c~äÉÇ=a ça
TR	^ë	UV	eÉ	MKMOU	ééÄ	TKP	QQKMM	N	
TU	pÉ	UV	eO	MKMQQ	ééÄ	RKN	OQKUP	N	
UU	pê	UV	eÉ	MKMNR	ééÄ	QVKQ	SSKST	N	
VR	j ç	UV	eÉ	MKPPQ	ééÄ	VKT	NNOUKVS	N	
NMT	^Ö	UV	eÉ	MKMNN	ééÄ	OSKR	NPNKNN	MO	
NNN	`Ç	UV	eÉ	MKMNO	ééÄ	NNKU	NUKUV	MO	
NNU	på	NRV	eÉ	MKMMD	ééÄ	NNQQKO	RNNKNP	N	
NON	pÄ	NRV	kç=d~ë	MKMPO	ééÄ	NTTKR	NMMNKMV	MO	
NPT	_~	NRV	kç=d~ë	MKMPO	ééÄ	UKU	OPSKVO	MQ	
NUO	t	NRV	kç=d~ë	MKPPM	ééÄ	OOKU	QVQSKON	N	
OMR	qä	OMV	kç=d~ë	MKMSP	ééÄ	OMKV	OOROKRV	MO	
OMU	mÄ	OMV	kç=d~ë	MKMON	ééÄ	OMKS	NSRRKNP	MO	
OPO	qÜ	OMV	kç=d~ë	MKMRT	ééÄ	NUKN	PSQNKMT	N	
OPU	r	OMV	kç=d~ë	MKMNV	ééÄ	TKN	SMTHPO	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=cëÜ	n`=c~ä~Ö
iá	S	kç=d~ë	OMMUPTVKN	NKO	ONOOPOPKQO	VQKSP	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QORVVTRKPS	NKO	ORNVVMMKMQ	VQKOR	RVKR	NOMQ	
pÅ	QR	eO	VUPORUKON	NKQ	NMSVRVUKVR	VNKVP	RVKR	NOMQ	
pÅ	QR	eÉ	NQPSTOKVO	MKS	NRTTPRKMO	VNKMU	RVKR	NOMQ	
dÉ	TO	kç=d~ë	NMONSVNKUU	OKQ	NMSQPUQKUO	VRKVV	RVKR	NOMQ	
dÉ	TO	eO	PVMOQOKNO	MKR	QOOMNTKMN	VOKQT	RVKR	NOMQ	
dÉ	TO	eÉ	NNPONOKVU	MKS	NOORSPKSN	VOKPT	RVKR	NOMQ	
v	UV	eO	QRONRVMKSR	MKT	QTSOUURKNQ	VQKVP	RVKR	NOMQ	
v	UV	eÉ	TSNSMUKQR	NKM	UOVQMOKQU	VNKUP	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SSNUNSSKNR	NKN	SRQQMSTKOO	NMNKNP	RVKR	NOMQ	
qÄ	NRV	eÉ	OTMROOPKTU	MKU	OURMTNTKVP	VQKV	RVKR	NOMQ	
_á	OMV	kç=d~ë	PORCOQSKQQ	NKP	PONUTOUKRU	NMNKMQ	RVKR	NOMQ	
_á	OMV	eÉ	NRRPUTMKPS	MKQ	NRVQNVSKTN	VTKQT	RVKR	NOMQ	

p~ã éáÉ=k~ã É	mmi
cäÉ=k~ã É	MNMf`sKÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOMOPyMPJ ^oyin`OQ^kÅ
^Åè=qãä É	PLOQLOMOP=NUMNMNQ
p~ã éáÉ=qóéÉ	iif`s
qçí~äaää íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=o ÉÑ¤cäÉk~ã É	MVS^i_KÇ
p~ã éáÉ=n` =m~ëëLcá~ä	c~ää
fpqa=n` =m~ëëLc~áä	m~ëë
l éÉê~íçê	**~Çã áä**

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çåÅK	r åáë	opa	==ì mp==	bñés~ä	BoÉÅ	Bi çï	BeäÖÜ
V	_É	S	kç=d~ë	MKMVU	éé Ä	SKV	NOPMKMT	MO	VV	TVfR	NOMQ
NN	_	S	kç=d~ë	OKMVM	éé Ä	OKN	NSMVPKSM	Q	NMQKTR	TVfR	NOMQ
OP	k~	QR	eÉ	OOMKMV	éé Ä	MKU	NUOOR PKQV	OM	NNMKQR	TVfR	NOMQ
OQ	j Ö	QR	eÉ	OSKRQT	éé Ä	PKU	UVSVKUM	OM	NPOKTQ	TVfR	NOMQ
OT	^ä	QR	eÉ	MKMVS	éé Ä	RVMKT	PMTPKTN	OM	MKRP	TVfR	NOMQ
OU	pá	QR	eO	NMMKSMV	éé Ä	MKR	QQNTSKUS	NMM	NMMKSN	TVfR	NOMQ
PV	h	QR	eÉ	OOQKPVM	éé Ä	NKP	VNTVVKMO	OM	NNOKO	TVfR	NOMQ
QM	`~	QR	eO	OTKPNV	éé Ä	OKM	NMNSVNKUU	OM	NPSKS	TVfR	NOMQ
RN	s	UV	eÉ	NKMPO	éé Ä	PKP	QPSTKQN	N	NMPKO	TVfR	NOMQ
RO	`ê	UV	eÉ	NKMQO	éé Ä	RKO	RVRVKQS	N	NMQKO	TVfR	NOMQ
RR	j å	UV	eÉ	MKPQM	éé Ä	TKM	NNQTKNS	MQ	UR	TVfR	NOMQ
RS	cÉ	UV	eO	OQKNSM	éé Ä	NKP	OVPMPRKOT	OM	NOMKU	TVfR	NOMQ
RV	` ç	UV	eÉ	MKONM	éé Ä	TKU	NVOMKOM	MO	NMR	TVfR	NOMQ
SM	k á	UV	eÉ	MKQQM	éé Ä	TKN	NORNKNV	MQ	NNM	TVfR	NOMQ
SP	` ì	UV	eÉ	MKSTN	éé Ä	NKV	QUTOKMQ	MS	NNNKUP	TVfR	NOMQ
SS	wå	UV	eÉ	JMKMMT	éé Ä	kL^	ORNQKTO	O	JMPR	TVfR	NOMQ
TR	^ë	UV	eÉ	NKMOP	éé Ä	NKR	UVMKNO	N	NMOKP	TVfR	NOMQ
TU	pÉ	UV	eO	NKMPU	éé Ä	MKU	QUTKQV	N	NMPKU	TVfR	NOMQ
UU	pê	UV	eÉ	NKMQR	éé Ä	NKU	PNSUKOM	N	NMQKR	TVfR	NOMQ
VR	j ç	UV	eÉ	NKOMT	éé Ä	PKP	PSPQKVV	N	NOMKT	TVfR	NOMQ
NMT	^Ö	UV	eÉ	MKOMP	éé Ä	SKP	ONQTKVV	MO	NMNKR	TVfR	NOMQ
NNN	` Ç	UV	eÉ	MKONQ	éé Ä	SKT	PMPKTN	MO	NMT	TVfR	NOMQ
NNU	på	NRV	eÉ	MKVPO	éé Ä	OKV	PMVOKUS	N	VPKO	TVfR	NOMQ
NON	pÄ	NRV	kç=d~ë	MKONV	éé Ä	MKU	QVPOKTV	MO	NMVKR	TVfR	NOMQ
NPT	_~	NRV	kç=d~ë	MKQRT	éé Ä	PKO	QUNSKSN	MQ	NNQKCR	TVfR	NOMQ
NUO	t	NRV	kç=d~ë	NKNUS	éé Ä	OKO	NQVVNKNR	N	NNUKS	TVfR	NOMQ
OMR	qä	OMV	kç=d~ë	MKOQU	éé Ä	OKP	SUQOKQN	MO	NOQ	TVfR	NOMQ
OMU	mÄ	OMV	kç=d~ë	MKOPR	éé Ä	TKT	VNVMKVV	MO	NNTHR	TVfR	NOMQ
OPO	qÜ	OMV	kç=d~ë	MKNVN	éé Ä	PKM	TSTPKTT	MO	VRKR	TVfR	NOMQ
OPU	r	OMV	kç=d~ë	MKOOS	éé Ä	RKT	SSPRKQN	MO	NNP	TVfR	NOMQ

n` =ç ä-Ö
c~áÉÇ=a ça =& c~áÉÇ-SMOMb m^
c~áÉÇ=a ça =& c~áÉÇ-SMOMb m^
c~áÉÇ=a ça =& c~áÉÇ-SMOMb m^
c~áÉÇ=a ça =

n ` ≈ c ä - Ö
c ~ á É Ç = a ç a = & c ~ á É Ç = S M O M b m ^
c ~ á É Ç = a ç a =
c ~ á É Ç = a ç a =

n ` ≈ f p q a = q ~ Ä á É

k ~ ã É	j ~ ë ë	q ì å É ≠ j ç Ç É	` m p	` m p ≈ ¤ p a	o É Ñ ≠ m p	B ≈ ¤ É Å	B n ` ≈ ÷ ç ï	B n ` ≈ ¤ á Ö Ü	n ` ≈ c ä - Ö
i á	S	k ç = d ~ ë	NVPMUNNKPP	NKN	ONCCPCPKQO	VMKVU	RVMR	NOMQ	
p Å	QR	k ç = d ~ ë	QMRVMVPKVO	MRR	QRNVVMMMQ	UVKU	RVMR	NOMQ	
p Å	QR	e O	VPNQRQKUQ	OKM	NMSVRVUKVR	UTKMU	RVMR	NOMQ	
p Å	QR	e É	NPSQMUKUT	NKN	NRTTPRKMO	USKQU	RVMR	NOMQ	
d É	TO	k ç = d ~ ë	VSVRUVKPV	NKO	NMSQPUQKUO	VNKMV	RVMR	NOMQ	
d É	TO	e O	PTNOUOKRN	MKP	QOOMNTKMN	UTKVU	RVMR	NOMQ	
d É	TO	e É	NMSRPMMQ	MKU	NOORSPHSN	USKVO	RVMR	NOMQ	
v	UV	e O	QOQSQMQKQN	NKU	QTSOUURKNQ	UVKNS	RVMR	NOMQ	
v	UV	e É	TNVTUSKUS	NKQ	UOVQMOKQU	USKTU	RVMR	NOMQ	
q Ä	NRV	k ç = d ~ ë	SOUPTNSKOS	NKP	SRQQMSTKOO	VSKMO	RVMR	NOMQ	
q Ä	NRV	e É	ORRPPSSKVN	MKO	OURMTNTKVP	UVKRT	RVMR	NOMQ	
_ á	OMV	k ç = d ~ ë	PMSQRPSKUV	MKU	PONUTOUKRU	VRKON	RVMR	NOMQ	
_ á	OMV	e É	NQSOORQKMM	NKN	NRVQNVSKTN	VNKTO	RVMR	NOMQ	

p~ã éáÉ=k~ã É	mmi
cäÉ=k~ã É	MOMf` sKÇ
a~í~=m~íÜ=k~ã É	aWÅ ÖäÉáíÅ mj eÝNya^q^yOMCPyMPJ ^oyi n` OQ^kÅ
^Åè=qãä É	PLCQLOMCP=NUMMSMQN
p~ã éáÉ=qóéÉ	i i f` s
qçí~äa ãäíáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑncäÉk~ã É	MMS` ^i _KÇ
p~ã éáÉ=n` =m~ëëlcá~ä	c~ää
fpqa=n` =m~ëëlc~ää	m~ëë
I éÉê~íçê	**~Çã áã**

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çåÅK	r åáë	opa	==ì mp==	bñés~ä	BoÉÅ	Bi çï	BeäÖÜ
V	_É	S	kç=d~ë	MKNUQ	ééÄ	PKP	NNQUKVR	MO	VO	TVfR	NCMQ
NN	_	S	kç=d~ë	QKMRT	ééÄ	NKU	NRRTTKQT	Q	NMNKCP	TVfR	NCMQ
OP	k~	QR	eÉ	OOMKMMR	ééÄ	NKU	NTUQQCKNU	OMM	NNM	TVfR	NCMQ
OQ	j Ö	QR	eÉ	OPKTTM	ééÄ	TKM	TVNNKPN	OM	NNUKUR	TVfR	NCMQ
OT	^ä	QR	eÉ	JNKRQM	ééÄ	kL^	OUCPKSS	OM	JTKT	TVfR	NCMQ
OU	pá	QR	eO	VVKONN	ééÄ	NKU	QOTUNKRO	NMM	VVKON	TVfR	NCMQ
PV	h	QR	eÉ	OOPKCPN	ééÄ	NKP	UVUPVKPM	OMM	NNNKSO	TVfR	NCMQ
QM	` ~	QR	eO	OPKVMR	ééÄ	MKP	UUVORKUM	OM	NNVKRP	TVfR	NCMQ
RN	s	UV	eÉ	NKMQV	ééÄ	PKV	QPTQKNM	N	NVQKV	TVfR	NCMQ
RO	` ê	UV	eÉ	NKMPQ	ééÄ	MKT	RUPUKTT	N	NVPKQ	TVfR	NCMQ
RR	j å	UV	eÉ	MKPRQ	ééÄ	QKN	NNSPKUP	MQ	UUfR	TVfR	NCMQ
RS	cÉ	UV	eO	ONKQRM	ééÄ	MKV	QRSRNSKOS	OM	NVTTKQR	TVfR	NCMQ
RV	` ç	UV	eÉ	MKOMD	ééÄ	QKU	NUQQKSO	MO	NVN	TVfR	NCMQ
SM	ká	UV	eÉ	MKQMT	ééÄ	RKU	NNRSKTQ	MQ	NVNKTR	TVfR	NCMQ
SP	` ì	UV	eÉ	MKSPM	ééÄ	NKU	QRPQKNQ	MS	NVR	TVfR	NCMQ
SS	wå	UV	eÉ	JMKMOV	ééÄ	kL^	OQRRKUN	O	JNKQR	TVfR	NCMQ
TR	^ë	UV	eÉ	MKVVP	ééÄ	PKT	URQKNO	N	VVKP	TVfR	NCMQ
TU	pÉ	UV	eO	NKMST	ééÄ	SKS	QVNKUO	N	NVSKT	TVfR	NCMQ
UU	pê	UV	eÉ	MKVUV	ééÄ	QKP	OVRQKUO	N	VUKV	TVfR	NCMQ
VR	j ç	UV	eÉ	NKNSU	ééÄ	PKP	PQSUKOT	N	NNSKU	TVfR	NCMQ
NMT	^Ö	UV	eÉ	MKONQ	ééÄ	QKU	OOPQKST	MO	NMT	TVfR	NCMQ
NNN	` Ç	UV	eÉ	MKSVV	ééÄ	RKU	OTUKRO	MO	VVfR	TVfR	NCMQ
NNU	på	NRV	eÉ	MKVCP	ééÄ	TKM	PMQUKNU	N	VOKP	TVfR	NCMQ
NON	pÄ	NRV	kç=d~ë	MKOMN	ééÄ	QKO	QRQUKUT	MO	NMMfR	TVfR	NCMQ
NPT	_~	NRV	kç=d~ë	MKQPN	ééÄ	RKT	OSQSKPV	MQ	NMTKTR	TVfR	NCMQ
NUO	t	NRV	kç=d~ë	NKNRV	ééÄ	QKQ	NQRVPKRR	N	NNRKV	TVfR	NCMQ
OVR	qä	OMV	kç=d~ë	MKOOP	ééÄ	MKT	SORUKNP	MO	NNNKR	TVfR	NCMQ
OMU	mÄ	OMV	kç=d~ë	MKONT	ééÄ	MKT	USMPKRV	MO	NMUKR	TVfR	NCMQ
OPO	qÜ	OMV	kç=d~ë	MKNTV	ééÄ	VKQ	TPOSKRP	MO	UVfR	TVfR	NCMQ
OPU	r	OMV	kç=d~ë	MKOMS	ééÄ	SKP	SMUNKOP	MO	NMP	TVfR	NCMQ

n` =c~ä-Ö
c~ãÉÇ=a ça =& c~ãÉÇ=SMOMb m^

n ` = c ä - Ö
c ~ á É Ç = a ç a = & c ~ á É Ç - S M O M b m ^

n ` ≠ f p q a = q ~ Ä á É

k ~ ã É	j ~ ë ë	q ì å É ÷ j ç Ç É	` m p	` m p = o p a	o É Ñ ≠ m p	B = o É Å	B n ` ≠ ç ï	B n ` = e ä Ö Ü	n ` = c ä - Ö
i á	S	k ç = d ~ ë	NVOTNQNKQP	OKT	ONCCPOPKQO	VMKU	RVMR	NOMQ	
p Å	QR	k ç = d ~ ë	PVTNNSTKNQ	NKO	QRNVVMMMQ	UTKUS	RVMR	NOMQ	
p Å	QR	e O	VNQSQTMMV	MKT	NMSVRVUKVR	URHRN	RVMR	NOMQ	
p Å	QR	e É	NPPVSUKNM	MKR	NRTTPRMVO	UQKVP	RVMR	NOMQ	
d É	TO	k ç = d ~ ë	VQPNOMKUR	NKO	NMSQPUQKUO	UUHSN	RVMR	NOMQ	
d É	TO	e O	PSSNRTKUS	NKO	QOOMNTMMN	USRTS	RVMR	NOMQ	
d É	TO	e É	NMQSPVRTP	MKV	NOORSPHSN	URHPU	RVMR	NOMQ	
v	UV	e O	QNTMQUUKVT	MKV	QTSOUURMNQ	UTHRS	RVMR	NOMQ	
v	UV	e É	TMVPSOMMT	NKM	UOVQMOKQU	URHRP	RVMR	NOMQ	
q Ä	NRV	k ç = d ~ ë	SOROMMPKUV	NKM	SRQQMSTKOO	VRHRQ	RVMR	NOMQ	
q Ä	NRV	e É	ORPRTPSHSQ	OKO	OURMMTNTKVP	UUKVR	RVMR	NOMQ	
_ á	OMV	k ç = d ~ ë	PMUQRPOKQT	NHS	PONUTOUHRU	VRKUP	RVMR	NOMQ	
_ á	OMV	e É	NQSVSQQKVS	OKM	NRVQNVSRTN	VOHMV	RVMR	NOMQ	

fåíÉâÑÉêÉåÅÉ= ÜÉÅâ=pçàíç=^=Ef`pJ^F=oÉéçëí

p~ã éáÉ=k~ã É	f`p^
cäÉ=k~ã É	MONf`p^KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyi n`OQ^KÅ
^Åè=qáã É	PLOQLOMOP=NUMNMQV
p~ã éáÉ=qóéÉ	f`p^
qçí~äaäã íáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVS`^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~äã
fpqa=n`=m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeäÖÜ	n`=c~Ö
_É	V	S	kç=d~ë	JMKMVS	éëÄ	kL^	USIKST	JMKN	NVMM	NVMM	
_	NN	S	kç=d~ë	MKRSP	éëÄ	QKR	OUNRKUU	JO	NVMM	NVMM	
k~	OP	QR	eÉ	NVPRQPKSMO	éëÄ	NKQ	SONTPPQRKPO	NMMMMM	UM	NOM	
j Ö	OQ	QR	eÉ	NVOUURKSMM	éëÄ	NKP	PQROVQRMKVM	NMMMMM	UM	NOM	
^ä	OT	QR	eÉ	NVUURNKRQM	éëÄ	NKR	NOSNNNPQKRV	NMMMMM	UM	NOM	
pá	OU	QR	eO	QKRCQ	éëÄ	RKP	OOUVKOU	JRM	NVMM	NVMM	
h	PV	QR	eÉ	NVMRQVKORU	éëÄ	OKO	OTPOONTTKPV	NMMMMM	UM	NOM	
`~	QM	QR	eO	NVQSNRKVON	éëÄ	OKN	PONSVTOPMKTS	NMMMMM	UM	NOM	
s	RN	UV	eÉ	MKVRN	éëÄ	NVKU	QNSKSU	JMKR	NVMM	NVMM	
`ê	RO	UV	eÉ	OKNOU	éëÄ	NKM	NMTSUKVR	NKR	NVMM	NVMM	
j å	RR	UV	eÉ	MKORM	éëÄ	NNKR	USSKRP	MKNT	NVMM	NVMM	
cÉ	RS	UV	eO	VVVMPKTRQ	éëÄ	NKR	NNMSTTNNQRKQV	NMMMMM	UM	NOM	
`ç	RV	UV	eÉ	MKMVU	éëÄ	SKP	VUOKOV	M	NVMM	NVMM	
ká	SM	UV	eÉ	MKQPV	éëÄ	TKT	NNTTKUR	MKNU	NVMM	NVMM	
`ì	SP	UV	eÉ	MKMVN	éëÄ	NOKP	VTPKPV	JMKOO	NVMM	NVMM	
wå	SS	UV	eÉ	JNKPNT	éëÄ	kL^	NMQSRTP	MKQ	NVMM	NVMM	aça
^ë	TR	UV	eÉ	MKMTV	éëÄ	VKR	UMKVN	JMKR	NVMM	NVMM	
pÉ	TU	UV	eO	MKMVO	éëÄ	NQKT	QPKNT	JMKR	NVMM	NVMM	
pê	UU	UV	eÉ	MKONV	éëÄ	UKM	OPQQKSU	MKPT	NVMM	NVMM	
j ç	VR	UV	eÉ	ONUTKTNT	éëÄ	MKT	SMSQPNTKUV	OMMM	UM	NOM	
^Ö	NMT	UV	eÉ	MKVNR	éëÄ	VKV	NSMKMM	JMKN	NVMM	NVMM	
`Ç	NNN	UV	eÉ	MKPRU	éëÄ	PKT	QTUKNS	MKOU	NVMM	NVMM	
på	NNU	NRV	eÉ	JMKVRN	éëÄ	kL^	PNPKPQ	JMKR	NVMM	NVMM	
pÄ	NON	NRV	kç=d~ë	MKVUP	éëÄ	NRKT	NVURKRT	JMKVR	NVMM	NVMM	
_~	NPT	NRV	kç=d~ë	MKRMT	éëÄ	QKT	PMQPKRR	MKPP	NVMM	NVMM	
t	NUO	NRV	kç=d~ë	MKPPT	éëÄ	TKU	QSROKQQ	JMKPP	NVMM	NVMM	
qä	OMR	OMV	kç=d~ë	MKVOO	éëÄ	UPKP	NMSTKUR	JMKN	NVMM	NVMM	
mÄ	OMU	OMV	kç=d~ë	MKVQT	éëÄ	SNKS	OQQVKPU	JMKVU	NVMM	NVMM	
qÜ	OPO	OMV	kç=d~ë	MKVRN	éëÄ	OMKM	PNSTKNM	JMKN	NVMM	NVMM	
r	OPU	OMV	kç=d~ë	MKVPM	éëÄ	PQKO	UVMKVV	JMKVU	NVMM	NVMM	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=ïçï	Bn`=eäÖÜ	n`=c~Ö
iá	S	kç=d~ë	NVOSUPVKRM	NKP	ONOOPOPKQO	VMKTV	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PUQVMQTHPV	MKU	QRNVVMMKMQ	URKNS	RVKR	NOMQ	
pÅ	QR	eO	UTSTRVKNR	NKP	NMSVRVUKVR	UNKVT	RVKR	NOMQ	
pÅ	QR	eÉ	NPMTNRKMS	MKQ	NRTTPRKMO	UOKUT	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VOQQRSKOO	MKP	NMSGPUQKUO	USKUR	RVKR	NOMQ	
dÉ	TO	eO	PRNVUMKVQ	MKQ	QOOMNTKMN	UPKQ	RVKR	NOMQ	
dÉ	TO	eÉ	NMNRROKNP	MKP	NOORSPKSN	UOKUS	RVKR	NOMQ	
v	UV	eO	PVVVRPVKON	MKS	QTSOUURKNQ	UPKVT	RVKR	NOMQ	
v	UV	eÉ	STUPQOKRR	MKO	UOVQMOKQU	UNKTV	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SNOPROUKNU	NKU	SRQQMSTKOO	VPKRT	RVKR	NOMQ	
qÄ	NRV	eÉ	OQMNPTRKQP	NKN	OURMTNTKVP	UQKOQ	RVKR	NOMQ	
_á	OMV	kç=d~ë	PMNPMNUKPQ	NKM	PONUTOUKRU	VPKSN	RVKR	NOMQ	
_á	OMV	eÉ	NPORNVNKRO	NKS	NRVQNVSKTN	UPKNP	RVKR	NOMQ	

p~ã éäÉ=k~ã É	ofkpb
cãÉ=k~ã É	MOOpj mi kÇ
a~í~=m~íÜ=k~ã É	aWyÖäÉåíyî mj eyNya^q^yOMOPyMPJ ^oyi n` OO^kA
^Åè=qãã É	PLOOLOMOP=NUMSMU
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	NMMMM
p~ã éäÉ=n` =m~ëëlc á~ä	c~åä
fpqa=n` =m~ëëlc~åä	c~åä

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çåÅK	r åáë	opa	==i mp==	i a o	n` =c ä-Ö
V	_É	S	k ç=d ~ë	OKTTP	ééÄ	OTKQ	NNRKRS	NMM	
NN	_	S	k ç=d ~ë	SUKMUN	ééÄ	OKP	NUQQKRV	NMMM	
OP	k ~	QR	e É	RRVVRKURT	ééÄ	UKS	NNVQTQKNU	OMMMMM	
OQ	j Ö	QR	e É	OSQNTKQMP	ééÄ	POKV	PNVRUKSQ	OMMMMM	
OT	^ ä	QR	e É	OUOPQKMVS	ééÄ	POKM	NORORKNR	OMMMMM	
OU	pá	QR	e O	NPMOKNOR	ééÄ	PPKR	NVQRKRN	NMMMM	
PV	h	QR	e É	SRQQNKNSV	ééÄ	NNKS	SOPMVKVU	OMMMMM	
QM	` ~	QR	e O	PNOUQKSQM	ééÄ	PVKR	PVRQVOKOP	OMMMMM	
RN	s	UV	e É	VNKRRQ	ééÄ	QPKV	QNTKTV	NMMM	
RO	` ê	UV	e É	SROKRNS	ééÄ	QTKV	PSNVKNN	OMMM	
RR	j å	UV	e É	NRSKPTP	ééÄ	QMKT	QRVKVO	OMMM	
RS	cÉ	UV	e O	USSTQKPTV	ééÄ	OKV	NRNSOONKNO	NMMMM	
RV	` ç	UV	e É	NUKMVM	ééÄ	NVKM	ONPKPR	NMMM	
SM	k á	UV	e É	NOVKOOV	ééÄ	RUKM	PONKNO	NMMM	
SP	` ì	UV	e É	NVMKRSV	ééÄ	QQKT	NQONKON	OMMM	
SS	wå	UV	e É	ORQSKVUQ	ééÄ	RNKO	OVOTKMD	OMMM	[i a o
TR	^ ë	UV	e É	QNKOTS	ééÄ	QQKM	QMPQ	NMMM	
TU	pÉ	UV	e O	PNKPNP	ééÄ	RNKN	NTKNT	NMMM	
UU	pê	UV	e É	OPKSUT	ééÄ	NPKT	NMUKUV	OMMM	
VR	j ç	UV	e É	RMMUKSQS	ééÄ	PUKN	NTOPOKST	NMMM	[i a o
NMT	^ Ö	UV	e É	NKQMU	ééÄ	QQKS	OOKOO	NMM	
NNN	` Ç	UV	e É	RKOVP	ééÄ	RMKM	NPKPP	NMMM	
NNU	på	NRV	e É	NPPSKTVS	ééÄ	ROKS	PRPQKVT	NMMM	[i a o
NON	pÄ	NRV	k ç=d ~ë	SNKQMV	ééÄ	NVKN	URTKSM	NMMM	
NPT	_~	NRV	k ç=d ~ë	OUQKVVU	ééÄ	NQKV	NNQTKVP	OMMM	
NUO	t	NRV	k ç=d ~ë	OUQKMPS	ééÄ	OMKN	OOQQKRT	NMMM	
OMR	qä	OMV	k ç=d ~ë	NQKTOR	ééÄ	UKV	NVOQKQR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NOKTNV	ééÄ	NPKS	NOOTKVV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OPKRVM	ééÄ	SKM	OMOUKVV	NMMM	
OPU	r	OMV	k ç=d ~ë	MKVRT	ééÄ	ONKM	TSKTR	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ=f mp	B n=o ÉÅ	B n` =i çï	B n` =e äÜÜ	n` =c ä-Ö
i á	S	k ç=d ~ë	NQOQVKNU	NKN	ONOOPOPKQO	MKST	RVKR	NOMKQ	SMOMa ça
pÅ	QR	k ç=d ~ë	NNRRRKVT	RKR	QRNVVMMKMQ	MKOS	RVKR	NOMKQ	SMOMa ça
pÅ	QR	e O	PPUMKRM	OSKP	NMSVRVUKVR	MKPO	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=o pa
pÅ	QR	e É	QSSKRV	PSKN	NRTTPRKMO	MKP	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=o pa
d É	TO	k ç=d ~ë	QQQTKOM	OKO	NMSOPUOKUO	MKQD	RVKR	NOMKQ	SMOMa ça
d É	TO	e O	NMUSKRN	PUKO	QOOMNTKMN	MKOS	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=o pa
d É	TO	e É	OSVKOV	ROKP	NOORSPKSN	MKOO	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=o pa
v	UV	e O	SPVVKSO	SUKM	QTSOUURKNQ	MKNP	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=o pa
v	UV	e É	NMPNKVQ	TOKR	UOVOMOKQU	MKNO	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=o pa
qÄ	NRV	k ç=d ~ë	QNVTKPR	NPKU	SRQQMSTKOO	MKMS	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=o pa
qÄ	NRV	e É	POPVKQV	TPKU	OURMTNTKVP	MKNN	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=o pa
_á	OMV	k ç=d ~ë	UPQNKOO	TKM	PONUTOUKRU	MKOS	RVKR	NOMKQ	SMOMa ça
_á	OMV	e É	RSSQKRS	OQKU	NRVQNVSKTN	MKPS	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=o pa

`çåíaåì åaÖ=~ëäÁê~íáçå=sÉêáÑ~Á~íáçå=É``sF=oÉéçê

p~ã éáÉ=k~ã É	``s
cäÉ=k~ã É	MOP|``skÇ
a~í~=m~íÜk~ã É	aWyªÖäÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n` OQ^kÁ
^Åè=qáã É	PLOQLOMOP=NUWNMO
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVS^i_Ç
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	B=oÉÁ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	OQKTVV	éëÄ	OKT	NPTNPOKOU	CR	VVKO	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OQKSPR	éëÄ	PKO	UVCRQKNU	CR	VUKRQ	UVKU	NNMO	
OP	k ~	CR	e É	RPTTKMUQ	éëÄ	MKO	PQSVURRKOP	RMMM	NMTKRQ	UVKU	NNMO	
OQ	j Ö	CR	e É	RPUUKNTP	éëÄ	MKV	NUMUSVVKPR	RMMM	NMTKTS	UVKU	NNMO	
OT	^ä	CR	e É	RRUKQMV	éëÄ	NKN	TNTTRKMN	RMM	NNNKSU	UVKU	NNMO	[=HLJ=NMB
OU	pá	CR	e O	RMSKVVM	éëÄ	NKR	ONVRQVKQO	RMM	NMNKQ	UVKU	NNMO	
PV	h	CR	e É	RORPKVVN	éëÄ	MKS	NRQOTUVKNS	RMMM	NMRKMU	UVKU	NNMO	
QM	` ~	CR	e O	RONTKPVU	éëÄ	NKT	NSVSRUNUKVO	RMMM	NMQKPR	UVKU	NNMO	
RN	s	UV	e É	ORKSVO	éëÄ	MKT	NMOTTMRS	CR	NMOKTT	UVKU	NNMO	
RO	` ê	UV	e É	ORKTSV	éëÄ	NKM	NOVVSNKUV	CR	NMPKMU	UVKU	NNMO	
RR	j å	UV	e É	ORKPUR	éëÄ	NKP	SQPRSKRR	CR	NMNKRQ	UVKU	NNMO	
RS	cÉ	UV	e O	RNQUKQQR	éëÄ	NKQ	SMRUPVRSKUO	RMMM	NMOKVT	UVKU	NNMO	
RV	` ç	UV	e É	OSKNPM	éëÄ	NKU	OOQQQOKMS	CR	NMQKRO	UVKU	NNMO	
SM	k á	UV	e É	ORKUQU	éëÄ	NKM	SNTUNKSV	CR	NMPKPV	UVKU	NNMO	
SP	` ì	UV	e É	OSKONS	éëÄ	NKM	NTPSRMKNU	CR	NMQKUS	UVKU	NNMO	
SS	wå	UV	e É	ORKOPO	éëÄ	NKN	OVQTQKTR	CR	NMMKVP	UVKU	NNMO	
TR	^ë	UV	e É	ORKPOR	éëÄ	MKS	ONRRPKRN	CR	NMNKP	UVKU	NNMO	
TU	pÉ	UV	e O	OQKSST	éëÄ	MKS	NNRONKRQ	CR	VUKST	UVKU	NNMO	
UU	pê	UV	e É	ORKNNV	éëÄ	NKN	TRROOKNM	CR	NMMKQU	UVKU	NNMO	
VR	j ç	UV	e É	OTKQQQ	éëÄ	MKS	UMRRPKUP	CR	NMVKTU	UVKU	NNMO	
NMT	^Ö	UV	e É	ORKVSR	éëÄ	MKP	OTPPVMKOM	CR	NMPKUS	UVKU	NNMO	
NNN	` Ç	UV	e É	ORKTQR	éëÄ	MKV	PSPNNKMP	CR	NMOKVU	UVKU	NNMO	
NNU	på	NRV	e É	ORKMST	éëÄ	NKP	TMTVOKMM	CR	NMMKOT	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKUQR	éëÄ	MKS	RCUQMMKTT	CR	VVKPU	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKRNT	éëÄ	OKN	NRRQTNKNN	CR	NMOKMT	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKNRS	éëÄ	MKR	PMPNTSKOP	CR	NMMKSO	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKPUQ	éëÄ	NKQ	SQSUPTKNP	CR	NMNKRQ	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKNOM	éëÄ	MKQ	VORQQQKMT	CR	NMQKQU	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OQKVPT	éëÄ	MKV	TUSSOPKRP	CR	VVKTR	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	ORKUSU	éëÄ	NKR	TROOPNKSR	CR	NMPKQT	UVKU	NNMO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=ç ïï	B n`=eäÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	NVMMOVRKPO	NKQ	ONOOPOPKQO	UVKRQ	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	QMQTORTKRQ	NKR	ORNVVMMMVQ	UVKRQ	RVKR	NOMQ	
pÅ	CR	e O	VOSRROKVV	OKN	NMSVRVUKVR	USKSP	RVKR	NOMQ	
pÅ	CR	e É	NPUTRVKTM	MKU	NRTTPRKMO	UTKVT	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VSNVUUKSS	MKU	NMSCPUQKUO	VMKPU	RVKR	NOMQ	
d É	TO	e O	PTNVSOKTN	NKM	QOOMNTKMN	UUKNQ	RVKR	NOMQ	
d É	TO	e É	NMTNRVKMM	MKQ	NOORSPKSN	UTKQP	RVKR	NOMQ	
v	UV	e O	QOQTTQVKSV	MKQ	QTSCUURKNQ	UVKNU	RVKR	NOMQ	
v	UV	e É	TNTRPTKUQ	MKT	UOVQMOKQU	USKRN	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SOTUOQQKPR	MKP	SRQQMSTKOO	VRKVQ	RVKR	NOMQ	
qÄ	NRV	e É	ORQUTVRKNR	MKT	OURMTNTKVP	UVKQN	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PMRNMSTKRS	NKN	PONUTOUKRU	VQKTV	RVKR	NOMQ	
_á	OMV	e É	NQSSQNVKUP	MKR	NRVQNVSKTN	VNKVU	RVKR	NOMQ	

`çåíáàì áàÖ=~äáÄê~íáçå=_ä~åâ=Ê`_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cáÉ=k~ã É MOOJ``_KÇ

a~í~=m~íÜ=k~ã É aWj^ÖáÉáíÝ^mj eyNya^q^yOMOPyMPJ ^oyi n`OO^kÂ

^Åè=qáã É PLOOLOMOP=NUARMOOT

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáçå NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑ¤cáÉk~ã É MMS^i_KÇ

p~ã éáÉ=n`=m~ëëlcá~ä c~ãä

fpqa=n`=m~ëëlc~ãä m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äóíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	råáë	opa	==mp==	iãáá	n`=c~Ö
V	_É	S	kç=d~ë	MKMNR	éé Ä	UKS	OMOKOR	MO	
NN	_	S	kç=d~ë	MKNQT	éé Ä	NKR	NOVSKTR	Q	
OP	k~	QR	eÉ	OPKMNM	éé Ä	NMKR	SMUNPKVV	OMM	
OQ	j Ö	QR	eÉ	NOKTVM	éé Ä	TKQ	QSNUKTN	OM	c~ãÉÇ=a ça
OT	^ä	QR	eÉ	JNPKVRM	éé Ä	kL^	NQPPKQP	OM	c~ãÉÇ=a ça
OU	pá	QR	eO	MKSMS	éé Ä	PTKN	TSTHRM	NMM	
PV	h	QR	eÉ	OVKVSV	éé Ä	NMKM	PUOTVRTV	OMM	
QM	`~	QR	eO	NQKNUU	éé Ä	OKU	SNTRRKNT	OM	c~ãÉÇ=a ça
RN	s	UV	eÉ	MKMNP	éé Ä	NMNKR	PMPKPQ	N	
RO	`ê	UV	eÉ	MKMNP	éé Ä	OVKS	UCQQKRP	N	
RR	j å	UV	eÉ	JMKVSM	éé Ä	kL^	NPVVKVU	MQ	
RS	cÉ	UV	eO	NPKRRQ	éé Ä	QKR	NTRQSMKVP	OM	c~ãÉÇ=a ça
RV	` ç	UV	eÉ	MKMMV	éé Ä	PPKR	OMOKOP	MO	
SM	k á	UV	eÉ	MKMNP	éé Ä	NVOKV	OQPKPQ	MQ	
SP	` ì	UV	eÉ	MKMNO	éé Ä	OQKS	RPMKMO	MS	
SS	wå	UV	eÉ	JOKMVT	éé Ä	kL^	NTRKRS	O	c~ãê^ äëj ÉíÜçÇë& c~ãÉÇ=a ça
TR	^ë	UV	eÉ	MKMOV	éé Ä	PNKM	QQKMN	N	
TU	pÉ	UV	eO	MKMRM	éé Ä	NOKM	OTKPP	N	
UU	pê	UV	eÉ	MKMOO	éé Ä	RVKS	UTKTU	N	
VR	j ç	UV	eÉ	MKSUO	éé Ä	PKQ	ONVQKSS	N	c~ãÉÇ=a ça
NMT	^Ö	UV	eÉ	MKMNT	éé Ä	UKQ	NVSKST	MO	
NNN	`Ç	UV	eÉ	MKMNP	éé Ä	RTKU	OMKTQ	MO	
NNU	på	NRV	eÉ	JMKVPR	éé Ä	kL^	PURKRT	N	
NON	pÄ	NRV	kç=d~ë	MKMPO	éé Ä	RKO	VVTKTR	MO	
NPT	_~	NRV	kç=d~ë	MKMOO	éé Ä	QOKV	NTSKUS	MQ	
NUO	t	NRV	kç=d~ë	MKOPU	éé Ä	OTKS	PTPTKUU	N	
OMR	qä	OMV	kç=d~ë	MKMSQ	éé Ä	RKT	OOQQKRS	MO	
OMU	mÄ	OMV	kç=d~ë	MKMNR	éé Ä	NOKU	NQMUKNV	MO	
OPO	qÜ	OMV	kç=d~ë	MKMQM	éé Ä	OOKM	PMVPKRP	N	
OPU	r	OMV	kç=d~ë	MKMOO	éé Ä	UKQ	SVQKMV	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=íçï	Bn`=eáÜÜ	n`=c~Ö
iá	S	kç=d~ë	NVOPMRTHRV	NKM	ONOOPOPKQO	VMSN	RVR	NOMQ	
pÅ	QR	kç=d~ë	QNMTONUKSP	NKV	QRNVVMMMVQ	VMKUT	RVR	NOMQ	
pÅ	QR	eO	VTUMTQRTU	MRT	NMSVRVUKVR	VNKQQ	RVR	NOMQ	
pÅ	QR	eÉ	NQOOMNST	NRT	NRTTPRMVO	VMKNR	RVR	NOMQ	
dÉ	TO	kç=d~ë	VVNPPMSO	MKV	NMSQPUQKUO	VPKNQ	RVR	NOMQ	
dÉ	TO	eO	PUUTUQKOM	NKM	QOOMNTKMN	VOKNP	RVR	NOMQ	
dÉ	TO	eÉ	NNNQOOKNQ	MKV	NOORSPKSN	VMKVP	RVR	NOMQ	
v	UV	eO	QQOSOUOKRN	MRP	QTSOUURKNQ	VOKVP	RVR	NOMQ	
v	UV	eÉ	TRRQOOKMS	MRP	UOVQMOKQU	VNKMU	RVR	NOMQ	
qÄ	NRV	kç=d~ë	SRRMURSKPS	NKQ	SRQQMSTKOO	NMMKN	RVR	NOMQ	
qÄ	NRV	eÉ	OSMUVPPKNT	NKU	OURMTNTKVP	VNKRO	RVR	NOMQ	
_á	OMV	kç=d~ë	PNUQNRSKSO	PKR	PONUTOUKRU	VUKVP	RVR	NOMQ	
_á	OMV	eÉ	NQVTNUPKON	NKP	NRVQNVSKTN	VPKVN	RVR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` ONfj t O
cáÉ=k~ã É	MOR| m_KÇ
a~í~=m~íÜ=k~ã É	a Wy^ ÖäÉáíyf` mj e yNya^q^yOMOPyMPJ ^o yi n` OQ^ kÄ
^Åè=qãã É	PLOQLOMOP=NUMRRMRQ
p~ã éäÉ=qóéÉ	m_
qçí~ä=a áä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==` mp==	i ãã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	MKMMV	ééÄ	NUOKU	NONKNN	MKR	
_	NN	S	k ç=d ~ë	NKMMQ	ééÄ	NKO	NQNMKNM	NM	
k~	OP	QR	e É	NOQKTVS	ééÄ	NOKO	RTRSMKRO	RMM	
j Ö	OQ	QR	e É	PRKNPQ	ééÄ	PKP	OQQSKVT	RM	
^ä	OT	QR	e É	JVNKMMU	ééÄ	k L^	UPOKOS	RM	m_=SMOM=c~åë=a ça
pá	OU	QR	e O	VKSUN	ééÄ	SKS	NOTQKTP	ORM	
h	PV	QR	e É	NSRKRUS	ééÄ	QKQ	PSPRRKTN	RMM	
` ~	QM	QR	e O	RUKPVU	ééÄ	OKR	QVOVOKSV	RM	m_=SMOM=c~åë=a ça
s	RN	UV	e É	MKQPU	ééÄ	NTKM	RTOKOQ	OKR	
` ê	RO	UV	e É	MKNTV	ééÄ	OTKU	UTTKOM	OKR	
j å	RR	UV	e É	MKMQO	ééÄ	VUKR	OVUKSN	N	
cÉ	RS	UV	e O	OUKNTO	ééÄ	QKP	TPQSVKPR	RM	
` ç	RV	UV	e É	JMKMMR	ééÄ	k L^	NMOKOP	MKR	
k á	SM	UV	e É	MKMUV	ééÄ	NTKQ	OPSKST	N	
` ì	SP	UV	e É	MKPPQ	ééÄ	NUKN	UQRKSM	NKR	
wå	SS	UV	e É	PKUQS	ééÄ	NMKU	PORTKNM	R	
^ë	TR	UV	e É	MKNSU	ééÄ	ONKP	QQKST	OKR	
pÉ	TU	UV	e O	MKNPQ	ééÄ	OUKS	NRKMM	OKR	
pê	UU	UV	e É	MKMTN	ééÄ	RSKQ	RUKUV	OKR	
j ç	VR	UV	e É	OKOPS	ééÄ	TKV	NPSOKPO	OKR	
^Ö	NMT	UV	e É	MKMPU	ééÄ	NPKN	URKRS	MKR	
` Ç	NNN	UV	e É	MKMOT	ééÄ	SMKU	UKRO	MKR	
på	NNU	NRV	e É	MKRQU	ééÄ	NUKO	TTNKNQ	OKR	
pÄ	NON	NRV	k ç=d ~ë	MKNOO	ééÄ	SKS	TVQKOM	MKR	
_~	NPT	NRV	k ç=d ~ë	MKOMT	ééÄ	OQKS	OUPKSP	N	
t	NUO	NRV	k ç=d ~ë	MKSTR	ééÄ	VKO	OPROKTM	OKR	
qä	OMR	OMV	k ç=d ~ë	MKNMV	ééÄ	PTKS	NNMTKUV	MKR	
mÄ	OMU	OMV	k ç=d ~ë	MKMPP	ééÄ	OUKV	NNMQKRO	MKR	
qÜ	OPO	OMV	k ç=d ~ë	MKNOR	ééÄ	TKP	ORNSKOQ	OKR	
r	OPU	OMV	k ç=d ~ë	MKMQN	ééÄ	NMKN	OTMKOV	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eäÖÜ	n`=cä-Ö
iá	S	kç=dl~ë	NUNUPMNKMN	NKU	CNCCPCPKQO	URKSU	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	PVTPMPPKVT	NKQ	QRNVVMMKMQ	UTKV	RVKR	NOMQ	
pÅ	QR	eO	VMTCNCKRT	NKS	NMSVRVUKVR	UQKUO	RVKR	NOMQ	
pÅ	QR	eÉ	NPNUPRKSS	MKN	NRTTPRKMO	UPKRU	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VQRPVCKQO	MKV	NMSCPUQKUO	UUKUO	RVKR	NOMQ	
dÉ	TO	eO	PRUCOMKSP	MKS	QCOMNTKMN	UQKUU	RVKR	NOMQ	
dÉ	TO	eÉ	NMCSMTKTV	NKM	NCCRSPKSN	UPKTO	RVKR	NOMQ	
v	UV	eO	QNRNOMCKTQ	NKP	QTSCUURKNQ	UTKNS	RVKR	NOMQ	
v	UV	eÉ	TMMPNTKQO	MKV	UCVQMCKQU	UQKQQ	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	SCUVVRMQT	NKV	SRQQMSTKCO	VSKNO	RVKR	NOMQ	
qÄ	NRV	eÉ	CRNPOVCKVM	NKN	CURMTNTKVP	UUKNS	RVKR	NOMQ	
_á	CMV	kç=dl~ë	PNVCQUTKVQ	NKP	PCNUTCUKRU	VVKNU	RVKR	NOMQ	
_á	CMV	eÉ	NQTUUTTKQP	MKN	NRVQNVSKTN	VCKTT	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i `pt n`ONfj t O
cäÉ=k~ã É	MDSi `pt kÇ
a~í~=m~íÜ=k~ã É	aWf^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJ ^oyi n` OQ^kÄ
^Åè=qã É	PLOQLOMOP=NUWQNMMO
p~ã éäÉ=qóéÉ	i `pt
qçí~äaäi íáçå	RKMMMM
` çã ã Éäí	JJJ
fpqa=oÉÑcäÉk~ã É	MMS` ^i _kÇ
p~ã éäÉ=n` =m~ëëlc á~ä	c~äi
fpqa=n` =m~ëëlc~äi	m~ëë
l éÉê~íçê	**~Çã åä**

n` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÁ	B i çï	B eáÖÜ	n` =c ä-Ö
_É	V	S	k ç=dl ~ë	RRKNUT	éëÄ	NKV	RUOVNKRV	RM	OOKMT	TVKR	NOMQ	
_	NN	S	k ç=dl ~ë	RNSKSQO	éëÄ	NKQ	PRRTNMKRN	RMM	OMKST	TVKR	NOMQ	
k~	OP	QR	e É	UQTQKQOU	éëÄ	NKU	NMSPUVPKTN	TRMM	OOKS	TVKR	NOMQ	
j Ö	OQ	QR	e É	RPNQKPOM	éëÄ	MKP	PPTTVMKPN	RMMM	ONKOS	TVKR	NOMQ	
^ä	OT	QR	e É	ONURKURM	éëÄ	MKS	RPUNRKTP	OMMM	ONKUS	TVKR	NOMQ	
pá	OU	QR	e O	NVPPKMQP	éëÄ	NKU	URSVTKMS	NMMM	OMKSS	M	OMM	
h	PV	QR	e É	NMQPNKMN	éëÄ	MKP	RVSNQRKUR	NMMMM	OMKUS	TVKR	NOMQ	
` ~	QM	QR	e O	OTNTKNSS	éëÄ	NKM	NSVUPSSKTS	ORMM	ONKTQ	TVKR	NOMQ	
s	RN	UV	e É	RSNKUNN	éëÄ	MKV	QPNPOOKQT	RMM	OOKQT	TVKR	NOMQ	
`ê	RO	UV	e É	OORKQQQ	éëÄ	NKT	ONUMUPKQP	OMM	OOKRQ	TVKR	NOMQ	
j å	RR	UV	e É	RRRKOTR	éëÄ	MKS	OSVTROKNO	RMM	OOKON	TVKR	NOMQ	
cÉ	RS	UV	e O	NNOPKQTT	éëÄ	MKT	ORUQVQPKMP	NMMM	OOKQT	TVKR	NOMQ	
` ç	RV	UV	e É	RVMKTNP	éëÄ	MKS	VTQPVOKSN	RMM	OPKSP	TVKR	NOMQ	a ça
ká	SM	UV	e É	RTTKSNP	éëÄ	MKR	OSQTVNKPP	RMM	OPKN	TVKR	NOMQ	
` ì	SP	UV	e É	OUUKPPP	éëÄ	MKT	PSSTPQKMP	ORM	OPKMT	TVKR	NOMQ	
wå	SS	UV	e É	RSSKPUM	éëÄ	MKU	NNUTTTKPT	RMM	OOKSS	TVKR	NOMQ	
^ë	TR	UV	e É	NMQKTOU	éëÄ	NKS	NTNQMKSP	NMM	OMKVR	TVKR	NOMQ	
pÉ	TU	UV	e O	NVOKNRN	éëÄ	NKM	VOVUKUP	NMM	OMKQP	TVKR	NOMQ	
pê	UU	UV	e É	ROOKPQM	éëÄ	MKS	PMNUURKSV	RMM	OMKUV	TVKR	NOMQ	
j ç	VR	UV	e É	NMVMKVQR	éëÄ	MKP	SNRRTKMT	NMM	ONKUN	TVKR	NOMQ	
^Ö	NMT	UV	e É	RPKMRR	éëÄ	MKS	NMTQMUKOV	RM	ONKOO	TVKR	NOMQ	
` Ç	NNN	UV	e É	OSUKUNM	éëÄ	MKO	TOUVPKPU	ORM	ONKR	TVKR	NOMQ	
på	NNU	NRV	e É	RMUKNQU	éëÄ	NKO	OUMOSMKUO	RMM	OMKPP	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl ~ë	VUKVRR	éëÄ	MKV	QNTTQUKPR	NMM	NVKTV	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl ~ë	OOPSKOQO	éëÄ	MKO	OTMPRTMKOT	OMMM	OOKPS	TVKR	NOMQ	
t	NUO	NRV	k ç=dl ~ë	NNMKRPS	éëÄ	NKT	OSQQUTKQQ	NMM	OOKNN	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl ~ë	NVOKNSM	éëÄ	MKQ	RQQTTSKTQ	NMM	OMKQP	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl ~ë	NVRKSRR	éëÄ	MKU	TUPPOVKUS	NMM	ONKNP	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl ~ë	NMMKVQR	éëÄ	NKN	SSSQVQKNN	NMM	OMKNV	TVKR	NOMQ	
r	OPU	OMV	k ç=dl ~ë	NMTKSMQ	éëÄ	NKO	SRQUSSKUR	NMM	ONKRO	TVKR	NOMQ	

n` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=`çåíêçä=p~ã éäÉ=Ei `pF=oÉéçêí

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÖÜ	n ` =cä~Ö
i á	S	k ç=d ~ë	NUNOTNMKUM	MKS	ONOOPOPKQO	URKQN	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVOOQMPKVP	NKO	QRNVVMMKMQ	USKTU	RVKR	NOMKQ	
pÅ	QR	e O	UUQUPPKPQ	OKT	NMSVRVUKVR	UOKTP	RVKR	NOMKQ	
pÅ	QR	e É	NPNPMVKSP	MKQ	NRTTPRKMO	UPKOR	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VQNVOOKNO	MKT	NMSOPUQKUO	UUKQV	RVKR	NOMKQ	
d É	TO	e O	PRQPNQKPP	MKT	QOOMNTKMN	UPKVS	RVKR	NOMKQ	
d É	TO	e É	NMOSNRKVP	NKN	NOORSPKSN	UPKTO	RVKR	NOMKQ	
v	UV	e O	QNPVPTQKPO	MKV	QTSOUURKNQ	USKVN	RVKR	NOMKQ	
v	UV	e É	SUVTVVKTM	MKT	UOVQMOKQU	UPKNT	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SOPMNRSKNM	MKP	SRQQMSTKOO	VRKO	RVKR	NOMKQ	
qÄ	NRV	e É	ORMNQVUKUT	NKO	OURMTNTKVP	UTKTR	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PNVNQVMKQR	MKM	PONUTOUKRU	VVKNR	RVKR	NOMKQ	
_á	OMV	e É	NQTNNVUKQP	MKV	NRVQNVSKTN	VOKOU	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NMNRJMOQ

cãÉ=k~ã É MOTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖãÉåíyf^ mj eyNya^q^yOMOPyMPJ ^oyi n ` OQ^ hÅ

^Åè=qãã É PLOQLOMOP=NUWQMNM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	MMVPS	éé Ä	RQKM	NRVMVM	NVM	
NN	_	S	k ç=d ~ë	PMVV	éé Ä	RKO	OVQNKQS	NVMM	
OP	k ~	QR	e É	UTKOSM	éé Ä	NNKQ	RPVOVKRV	OMMMM	
OQ	j Ö	QR	e É	OPKQSO	éé Ä	TKV	NTPNKCU	OMMMM	
OT	^ ä	QR	e É	JVUKRUN	éé Ä	k L^	SSSKSV	OMMMM	
OU	pá	QR	e O	NVKUUQ	éé Ä	SKO	ONCRKTO	NVMMM	
PV	h	QR	e É	NPQKMCP	éé Ä	QKP	PRCOSKSS	OMMMM	
QM	` ~	QR	e O	QQKPNP	éé Ä	NKN	PUUQRKRS	OMMMM	
RN	s	UV	e É	MRTTO	éé Ä	PKQ	UQQKQV	NVMM	
RO	` ê	UV	e É	MKPPU	éé Ä	NOKM	NVQTKUQ	OMMM	
RR	j å	UV	e É	MKMSN	éé Ä	NPOKP	PNOKSN	OMMM	
RS	cÉ	UV	e O	VKVUP	éé Ä	MKU	PNQTQKUU	NVMMMM	
RV	` ç	UV	e É	MKPPU	éé Ä	QKU	SUSKTN	NVMM	
SM	k á	UV	e É	MKPMN	éé Ä	NQKR	PQMKMN	NVMM	
SP	` ì	UV	e É	MKONV	éé Ä	OQKU	TMTKUN	OMMM	
SS	wå	UV	e É	JUKQQV	éé Ä	k L^	TMOKCR	OMMM	
TR	^ ë	UV	e É	MKNVT	éé Ä	ONKR	RMMPQ	NVMM	
TU	pÉ	UV	e O	MKOUS	éé Ä	NVKU	OUKST	NVMM	
UU	pê	UV	e É	MKPVR	éé Ä	NTKS	CRCKCP	OMMM	
VR	j ç	UV	e É	NKCPS	éé Ä	TKV	VNTKUP	NVMM	
NVT	^ Ö	UV	e É	MKMPV	éé Ä	NQKP	UUKUV	NVM	
NNN	` Ç	UV	e É	MKMSS	éé Ä	NUKP	QTKQN	NVMM	
NNU	på	NRV	e É	MKNVU	éé Ä	PQKV	RUCKCR	NVMM	
NON	pÄ	NRV	k ç=d ~ë	MKNQN	éé Ä	VKQ	VNMKVV	NVMM	
NPT	_~	NRV	k ç=d ~ë	NKVMP	éé Ä	OKS	OQPVKQV	OMMM	
NUO	t	NRV	k ç=d ~ë	MKSOV	éé Ä	NRKV	OPNVMPN	NVMM	
OVR	qä	OMV	k ç=d ~ë	MKOUN	éé Ä	OKV	OMTRKTN	NVMM	
OMU	mÄ	OMV	k ç=d ~ë	MKVUU	éé Ä	OTKQ	NRQUKPR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKTUN	éé Ä	RKT	TMVOKSV	NVMM	
OPU	r	OMV	k ç=d ~ë	MKVUP	éé Ä	UKM	RQMKRV	NVMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¨ çï	B n ` =¢ äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	NUPMQVNKNT	NKO	ONCOPOPKQO	USKCR	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVUVSTQKQP	NKQ	QRNVVMMMVQ	UUKOT	RVKR	NOMKQ	
pÅ	QR	e O	VMCCRSKQN	NKV	NMSVRVUKVR	UQKPR	RVKR	NOMKQ	
pÅ	QR	e É	NPQNCCKNM	MKV	NRTTPRMVO	URMVP	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VRTNCPKNV	MKQ	NMSQPUQKUO	UVKVO	RVKR	NOMKQ	
d É	TO	e O	PSPUPPKVP	MKO	QCCMNTMVN	USKON	RVKR	NOMKQ	
d É	TO	e É	NMRNQVKUM	MKT	NCCRSPKSN	URKTV	RVKR	NOMKQ	
v	UV	e O	QNCSVTNKUQ	MKU	QTSCUURKNQ	USKSR	RVKR	NOMKQ	
v	UV	e É	TNMSRSKNO	MKS	UCVQMCKQU	URKSU	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SRNTCNUKRN	OKM	SRQQMSTKOO	VVKRV	RVKR	NOMKQ	
qÄ	NRV	e É	CRPCVCPKNO	MKR	CURMTNTKVP	UUKUR	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	POTMNPSKVR	NKQ	PCNUTCUKRU	NMNKS	RVKR	NOMKQ	
_á	OMV	e É	NRVMPRTKRN	MKR	NRVQNVSKTN	VQKNN	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMMV

cãÉ=k~ã É MOUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OO^ hÅ

^Åè=qãã É PLOOLOMOP=NUMRQMU

p~ã éäÉ=qóéÉ p~ã éäÉ

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p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä~Ö
V	_É	S	k ç=d ~ë	JMKVOR	éé Ä	k L^	UPHPQ	NMM	
NN	_	S	k ç=d ~ë	OKOSU	éé Ä	PHS	OOQMOCN	NMMM	
OP	k ~	QR	e É	NMRHRQT	éé Ä	RHR	RRSNTHRQ	OMMMMM	
OQ	j Ö	QR	e É	NMKQPO	éé Ä	OKN	NQRRHSU	OMMMMM	
OT	^ ä	QR	e É	JVUHSOO	éé Ä	k L^	SRUKVO	OMMMMM	
OU	pá	QR	e O	VNHKOO	éé Ä	NKV	UMPTHPT	NMMMM	
PV	h	QR	e É	NPQKNNV	éé Ä	NRHS	PQUSTHSS	OMMMMM	
QM	` ~	QR	e O	UTHTRP	éé Ä	OKM	SSVMVHSM	OMMMMM	
RN	s	UV	e É	MHRMO	éé Ä	VHS	SOOKOR	NMMM	
RO	` ê	UV	e É	MHOQR	éé Ä	PNKU	VQOHRO	OMMM	
RR	j å	UV	e É	JMKMTN	éé Ä	k L^	OQPKOV	OMMM	
RS	cÉ	UV	e O	SKOVT	éé Ä	PKO	OOVSVHSP	NMMMMM	
RV	` ç	UV	e É	MHNMV	éé Ä	NMKN	OVPHPR	NMMM	
SM	k á	UV	e É	MHNMP	éé Ä	NUKO	OQPHPQ	NMMM	
SP	` ì	UV	e É	MHOOM	éé Ä	NTHS	TMMKMP	OMMM	
SS	wå	UV	e É	JTHSOO	éé Ä	k L^	USRHSM	OMMM	
TR	^ ë	UV	e É	MHMVN	éé Ä	OUKN	POHMM	NMMM	
TU	pÉ	UV	e O	MHNMP	éé Ä	OUHR	NOHMM	NMMM	
UU	pê	UV	e É	MHONP	éé Ä	NOKN	NQOKOP	OMMM	
VR	j ç	UV	e É	MHVVQ	éé Ä	OKV	SROKOR	NMMM	
NMT	^ Ö	UV	e É	MHMNS	éé Ä	QSKV	PUKUV	NMM	
NNN	` Ç	UV	e É	MHMTT	éé Ä	NUKU	OOKOO	NMMM	
NNU	på	NRV	e É	JMKMMP	éé Ä	k L^	QTOKOQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MHNOO	éé Ä	OKN	UMQKOM	NMMM	
NPT	_~	NRV	k ç=d ~ë	OHNUV	éé Ä	RKQ	OTPSHRM	OMMM	
NUO	t	NRV	k ç=d ~ë	MHPVM	éé Ä	OPHR	NSURHOO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MHMUP	éé Ä	OUHM	VVQKQO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MHMMO	éé Ä	VOSKU	UVQHPM	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MHOMV	éé Ä	NRHO	PNOTHMQ	NMMM	
OPU	r	OMV	k ç=d ~ë	MHMOS	éé Ä	OOHO	NUPHRP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¡ çï	B n ` =¢äÜÜ	n ` =¢ä~Ö
i á	S	k ç=d ~ë	NTURQUNKGS	MKU	ONOOPOPKQO	UQKNP	RVHR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVTRQVVKTT	NKV	QRNVVMMKMQ	UTKVS	RVHR	NOMKQ	
pÅ	QR	e O	UVOVNSKNT	NHR	NMSVRVUKVR	UPKQU	RVHR	NOMKQ	
pÅ	QR	e É	NPOTRPKQV	MKU	NRTTPRKMO	UQKNS	RVHR	NOMKQ	
d É	TO	k ç=d ~ë	VRNUUVKON	MKU	NMSQPUQKUO	UVKQP	RVHR	NOMKQ	
d É	TO	e O	PRRSNSKRQ	NHR	QOOMNTKMN	UQKOT	RVHR	NOMKQ	
d É	TO	e É	NMQOOQVKVS	NKU	NOORSPKSN	URKMS	RVHR	NOMKQ	
v	UV	e O	QNNPOTOKRU	MKN	QTSOUURKNQ	USHPS	RVHR	NOMKQ	
v	UV	e É	TMNPVMKTR	MKU	UOVQMOKQU	UQKRR	RVHR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SPSRMNTHRQ	MKT	SRQQMSTKOO	VTKOS	RVHR	NOMKQ	
qÄ	NRV	e É	ORQQVVQKMO	NHR	OURMTNTKVP	UVKOU	RVHR	NOMKQ	
_á	OMV	k ç=d ~ë	PORVMNVKMV	NKU	PONUTOUKRU	NMNKOR	RVHR	NOMKQ	
_á	OMV	e É	NQUPRRRKMT	NKQ	NRVQNVSKTN	VPKMS	RVHR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNM

cãÉ=k~ã É MOVpj mi hÇ

a~í~=m~íÜ=k~ã É a\yt ÖäÉåíyf^ mj eyNya^q^yOMOPyMPJ ^oyi n` OO^hÅ

^Åè=qãã É PLOQLOMOP=NUMRVWOS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMMNT	ééÄ	k L^	VOKOO	NMM	
NN	_	S	k ç=d ~ë	NKTST	ééÄ	SKM	NVMQKSM	NMMM	
OP	k ~	QR	e É	NMOKVUN	ééÄ	NKR	RQUVQKMS	OMMMMM	
OQ	j Ö	QR	e É	OSKPTM	ééÄ	TKS	NUUSKUR	OMMMMM	
OT	^ ä	QR	e É	JSOKMRO	ééÄ	k L^	NRMTKUV	OMMMMM	
OU	pá	QR	e O	OMKUOV	ééÄ	NMKT	ONTVKNQ	NMMMM	
PV	h	QR	e É	NPRKVPQ	ééÄ	NNKT	PQTNOKPS	OMMMMM	
QM	` ~	QR	e O	SMKRRP	ééÄ	OKV	QVUNRKPO	OMMMMM	
RN	s	UV	e É	MKQUP	ééÄ	NPKU	SMNKNP	NMMM	
RO	` ê	UV	e É	MKPSV	ééÄ	VKQ	NMRNKUQ	OMMM	
RR	j å	UV	e É	NKOPM	ééÄ	NKM	UTQKRP	OMMM	
RS	cÉ	UV	e O	NSRKPVO	ééÄ	NKQ	PVNNTSKPO	NMMMMM	
RV	` ç	UV	e É	MKMRM	ééÄ	RSKO	NVPKPQ	NMMM	
SM	k á	UV	e É	MKOSN	ééÄ	NUKO	PNPKPQ	NMMM	
SP	` ì	UV	e É	MKQVU	ééÄ	NNKM	NVQSKTO	OMMM	
SS	wå	UV	e É	PVKUMR	ééÄ	NKR	NMSQQKON	OMMM	
TR	^ ë	UV	e É	MKNPU	ééÄ	OSKN	PVMPP	NMMM	
TU	pÉ	UV	e O	MKMVR	ééÄ	POKO	NNKRM	NMMM	
UU	pê	UV	e É	MKNRR	ééÄ	QOKS	NMSKST	OMMM	
VR	j ç	UV	e É	NKMPV	ééÄ	UKO	STMKMP	NMMM	
NMT	^ Ö	UV	e É	MKMOM	ééÄ	STKS	QSKST	NMM	
NNN	` Ç	UV	e É	MKMSV	ééÄ	PSKS	NVKSP	NMMM	
NNU	på	NRV	e É	MKMNP	ééÄ	PRQKU	QTSKSV	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNOV	ééÄ	OKQ	UOTKRT	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKQOS	ééÄ	NMKR	RRPKVQ	OMMM	
NUO	t	NRV	k ç=d ~ë	MKQOR	ééÄ	TKT	NTRRKPN	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMTQ	ééÄ	NVKM	VQQKPT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMSN	ééÄ	PVKR	NPPQKTU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNUM	ééÄ	VKO	OVPSKTV	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMQV	ééÄ	TKN	PPMKPR	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n` =ï çï	B n` =¤ä ÜÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	NTUUSOUKUO	NKN	ONOOPOPQQO	UQKOU	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVQSTNOKOQ	OKR	QRNVVMMKMQ	UTHPO	RVKR	NOMKQ	
pÅ	QR	e O	UVOMUSKNN	NKT	NMSVRVUKVR	UPKQ	RVKR	NOMKQ	
pÅ	QR	e É	NPNTTQKOV	NKM	NRTTPRKMO	UPKRQ	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VQPOOTKMO	MKU	NMSQPUQKUO	UUKSO	RVKR	NOMKQ	
d É	TO	e O	PRQSTSKOO	MKU	QOOMNTKMN	UQKMQ	RVKR	NOMKQ	
d É	TO	e É	NMORRMKQR	NKO	NOORSPKSN	UPKST	RVKR	NOMKQ	
v	UV	e O	QNTQNQSKVV	MKU	QTSOUURKNQ	UTKSQ	RVKR	NOMKQ	
v	UV	e É	SVOVUOKSQ	MKT	UOVQMOKQU	UPKRR	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SPMUMSTKVP	MKV	SRQQMSTKOO	VSKPV	RVKR	NOMKQ	
qÄ	NRV	e É	QRNVRNOKUT	MKP	OURMTNTKVP	UUKPU	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PORUQVRKSV	OKM	PONUTOUKRU	NMNKOQ	RVKR	NOMKQ	
_á	OMV	e É	NQUMTSPKPP	NKM	NRVQNVSKTN	VOKUU	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNN

cãÉ=k~ã É MPMpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ hÅ

^Åè=qãã É PLCQLOMCP=NVMMQMRR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKMNM	éé Ä	k L^	NMMKMM	NMM	
NN	_	S	k ç=d ~ë	VKMPO	éé Ä	NHP	SVOVKRQ	NMMM	
OP	k ~	QR	e É	OVPNKMSP	éé Ä	NKM	PVVPVUHPM	OMMMMM	
OQ	j Ö	QR	e É	TPSKSCU	éé Ä	MO	QTQQSKNR	OMMMMM	
OT	^ ä	QR	e É	JURKQQT	éé Ä	k L^	VSTKUP	OMMMMM	
OU	pá	QR	e O	NTRCKVRO	éé Ä	MHP	NQTCSPKTQ	NMMMM	
PV	h	QR	e É	SRPHPQT	éé Ä	PKM	SPQVRKQV	OMMMMM	
QM	` ~	QR	e O	NPCQKRTU	éé Ä	OKT	UQSCQUKVN	OMMMMM	
RN	s	UV	e É	MQQVV	éé Ä	NNKT	SNTKUM	NMMM	
RO	` ê	UV	e É	MHPNP	éé Ä	OKV	NMVRKUR	OMMM	
RR	j å	UV	e É	NCKCSO	éé Ä	NKV	SPMQKUU	OMMM	
RS	cÉ	UV	e O	TSKVRS	éé Ä	OHP	NUQQVRKPQ	NMMMMM	
RV	` ç	UV	e É	MKNPO	éé Ä	VKU	PPNKNP	NMMM	
SM	k á	UV	e É	MKNRR	éé Ä	SVKO	CSSKST	NMMM	
SP	` ì	UV	e É	MKSRP	éé Ä	NNHR	NCRQKRO	OMMM	
SS	wå	UV	e É	JTKVTN	éé Ä	k L^	TVMKMP	OMMM	
TR	^ ë	UV	e É	MQQVS	éé Ä	NUHP	UQKMN	NMMM	
TU	pÉ	UV	e O	MKNST	éé Ä	NVHP	NTKUP	NMMM	
UU	pê	UV	e É	TKTMT	éé Ä	MO	QRCUKSN	OMMM	
VR	j ç	UV	e É	MKTQT	éé Ä	OHP	RMUKVN	NMMM	
NMT	^ Ö	UV	e É	MKMNN	éé Ä	PMHP	CUKUV	NMM	
NNN	` Ç	UV	e É	MKVCR	éé Ä	NRHP	TKTU	NMMM	
NNU	på	NRV	e É	MQSSM	éé Ä	NSKT	TCQKQU	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MQSSO	éé Ä	SKR	NPTQKUS	NMMM	
NPT	_~	NRV	k ç=d ~ë	NPKQUV	éé Ä	NHS	NSOTTKMU	OMMM	
NUO	t	NRV	k ç=d ~ë	MHPOT	éé Ä	NQHS	NQVNKST	NMMM	
OVR	qä	OMV	k ç=d ~ë	MKMPU	éé Ä	PPKQ	TPQKNQ	NMMM	
OVU	mÄ	OMV	k ç=d ~ë	MKMUM	éé Ä	PPHR	NQQUKCP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMTU	éé Ä	PMKV	ONVVKQM	NMMM	
OPU	r	OMV	k ç=d ~ë	MKVCU	éé Ä	OKN	NVPKRQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ¤ mp	B =o ÉÅ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NTVSVPRKNQ	NHP	ONCCPCPKQO	UQKST	RVHR	NOMHQ	
pÅ	QR	k ç=d ~ë	PVONCRCKMU	NKN	QRNVVMMKMQ	USKTS	RVHR	NOMHQ	
pÅ	QR	e O	UVTTVQRTQ	NHO	NMSVRVUKVR	UPKVQ	RVHR	NOMHQ	
pÅ	QR	e É	NPCRSORTU	NKQ	NRTTPRKMO	UQKMQ	RVHR	NOMHQ	
d É	TO	k ç=d ~ë	VQRTTPKUR	MKU	NMSCPUQKUO	UUKUS	RVHR	NOMHQ	
d É	TO	e O	PRSRNSKRU	MKT	QCCOMNTKMN	UQKQU	RVHR	NOMHQ	
d É	TO	e É	NMQCCCKOV	MKN	NCCRSPKSN	URKMR	RVHR	NOMHQ	
v	UV	e O	QNNVMTRKPQ	NHP	QTSCUURKNQ	USKQU	RVHR	NOMHQ	
v	UV	e É	SVUTSNKQM	MKV	UOVQMOKQU	UQKCR	RVHR	NOMHQ	
qÄ	NRV	k ç=d ~ë	SOMRQVQKSN	NKN	SRQQMSTKOO	VQKUP	RVHR	NOMHQ	
qÄ	NRV	e É	CROMQMNKMT	NKM	OURMTNTKVP	UUKQN	RVHR	NOMHQ	
_á	OMV	k ç=d ~ë	PNUTTUVKQO	NHP	PONUTOUKRU	VVKMQ	RVHR	NOMHQ	
_á	OMV	e É	NQTQPRUKUN	NKQ	NRVQNVSKTN	VOKQU	RVHR	NOMHQ	

p~ã éäÉ=k~ã É pn NOMNUMNO

cãÉ=k~ã É MPNpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ hÅ

^Åè=qãã É PLOQLOMCP=NVMMVMQP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==: mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMMCP	ééÄ	k L^	USMST	NMM	
NN	_	S	k ç=d ~ë	VKCPN	ééÄ	NHP	TMCRKNS	NMMM	
CP	k ~	CR	e É	OVCRKPRO	ééÄ	CKO	PVTPNSKRQ	CMMMMM	
CQ	j Ö	CR	e É	TPNKPNN	ééÄ	NKT	QSVCMKNM	CMMMMM	
CT	^ ä	CR	e É	JSCKSVN	ééÄ	k L^	NCRMKNM	CMMMMM	
CU	pá	CR	e O	NTRCKRPM	ééÄ	CKM	NCRUCCKCV	NMMMM	
PV	h	CR	e É	SPVKPNP	ééÄ	PKR	SCCNUKRR	CMMMMM	
QM	` ~	CR	e O	NPNSKTSM	ééÄ	CKQ	UPCCSVKMR	CMMMMM	
RN	s	UV	e É	MSCCS	ééÄ	NUKN	TCMKMP	NMMM	
RO	` ê	UV	e É	MKPUN	ééÄ	SKQ	NMTSKRM	CMMM	
RR	j å	UV	e É	NCKCNQ	ééÄ	NHP	SPMUKCO	CMMM	
RS	cÉ	UV	e O	UMMKQCS	ééÄ	MKN	NUPRMCUKUP	NMMMMM	
RV	` ç	UV	e É	MKNPU	ééÄ	CMKQ	PQCCKCQ	NMMM	
SM	k á	UV	e É	MKCPQ	ééÄ	CSKP	PMCQCR	NMMM	
SP	` ì	UV	e É	NKTTV	ééÄ	CKS	CTNCQKTS	CMMM	
SS	wå	UV	e É	JRKRRP	ééÄ	k L^	NCVUKVT	CMMM	
TR	^ ë	UV	e É	MKQTU	ééÄ	VKM	VSKPQ	NMMM	
TU	pÉ	UV	e O	MKNTO	ééÄ	UKV	NUKPP	NMMM	
UU	pê	UV	e É	TKQUO	ééÄ	PKN	QCCNSKPQ	CMMM	
VR	j ç	UV	e É	MKRVM	ééÄ	NCKR	QCCNKNP	NMMM	
NMT	^ Ö	UV	e É	MKMMQ	ééÄ	NCVKS	NQKCQ	NMM	
NNN	` Ç	UV	e É	MKMNT	ééÄ	CQCKS	RKRS	NMMM	
NNU	på	NRV	e É	JMKCNM	ééÄ	k L^	PRTKTV	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKOTP	ééÄ	CMKQ	NQCCNKRT	NMMM	
NPT	_~	NRV	k ç=d ~ë	NCKVNS	ééÄ	PKP	NRSMRKQQ	CMMM	
NUO	t	NRV	k ç=d ~ë	MKCNO	ééÄ	CQKM	NCCCNKPR	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMMS	ééÄ	k L^	QVPKUT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	CKMRV	ééÄ	PKP	NSSUNKTV	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMSN	ééÄ	QMKR	CMTRKTN	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMNU	ééÄ	PMKT	NPPKQU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUMVPPPKRR	NKN	CNCCPCPKQO	URKCR	RVKR	NCMKQ	
pÅ	CR	k ç=d ~ë	PVPPRPTKQN	NHP	CRNVVMMKVQ	UTHKP	RVKR	NCMKQ	
pÅ	CR	e O	UUUPMUKQS	NKS	NMSVRVUKVR	UPKVR	RVKR	NCMKQ	
pÅ	CR	e É	NPCNMPKUO	MKS	NRTTPRKMO	UPKTR	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	VQVUSCRRR	MKP	NMSCPUCKUO	UVKCQ	RVKR	NCMKQ	
d É	TO	e O	PRQVOVKMV	MKQ	QCCMNTKMN	UQKN	RVKR	NCMKQ	
d É	TO	e É	NMPUPRKTS	NKO	NCCRSPKSN	UQKTO	RVKR	NCMKQ	
v	UV	e O	QNNUTMNKCN	MKU	QTSCUURKNQ	USKQT	RVKR	NCMKQ	
v	UV	e É	TMNTCUKNQ	MKS	UCVQMCKQU	UQKSN	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SCNQSRPKTU	MKT	SRQQMSTKCO	VQKVT	RVKR	NCMKQ	
qÄ	NRV	e É	CRRNRMCKOM	NKQ	CURMTNTKVP	UVKR	RVKR	NCMKQ	
_á	OMV	k ç=d ~ë	PNRVUNNKVS	NKM	PCNUTCUKRU	VUKNT	RVKR	NCMKQ	
_á	OMV	e É	NRNCUTRKPN	MKP	NRVQNVSKTN	VQKV	RVKR	NCMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNO

cãÉ=k~ã É MPOpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OO^ hÅ

^Åè=qãã É PLOOLOMOP=NVMNOMRN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå ORKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKOMM	ééÄ	k L^	TOKOO	NMM	
NN	_	S	k ç=d ~ë	NMKVPS	ééÄ	PKT	OPOOQKST	NMMM	
OP	k ~	OR	e É	PMOPKVQQ	ééÄ	MKV	NNUMMPKRM	OMMMMM	
OQ	j Ö	OR	e É	TRNKNNN	ééÄ	OKQ	VVUPKTS	OMMMMM	
OT	^ ä	OR	e É	JRNTKRNU	ééÄ	k L^	RRNKNP	OMMMMM	
OU	pá	OR	e O	NUQTKUTT	ééÄ	MKT	PNTNUKNM	NMMMM	
PV	h	OR	e É	NNQTKRVR	ééÄ	PKP	OMSSNKUR	OMMMMM	
QM	` ~	OR	e O	NPSQKNTN	ééÄ	NKR	NURSMUKCN	OMMMMM	
RN	s	UV	e É	MKRUQ	ééÄ	NUKV	POTKTV	NMMM	
RO	` ê	UV	e É	MKRSN	ééÄ	VKN	UOSKRQ	OMMM	
RR	j å	UV	e É	NNKMRT	ééÄ	NKN	NPVPKNQ	OMMM	
RS	cÉ	UV	e O	TURKUVN	ééÄ	NKU	PTSTOUKOO	NMMMM	
RV	` ç	UV	e É	JMKMRN	ééÄ	k L^	VRKRS	NMMM	
SM	k á	UV	e É	JMKNOS	ééÄ	k L^	NUSKST	NMMM	
SP	` ì	UV	e É	NKVQU	ééÄ	NOKV	VPQKQV	OMMM	
SS	wå	UV	e É	JQTKUTS	ééÄ	k L^	QSRKRT	OMMM	
TR	^ ë	UV	e É	MKQTT	ééÄ	NMKS	PPKPP	NMMM	
TU	pÉ	UV	e O	MKQVS	ééÄ	NRKU	NOKMM	NMMM	
UU	pê	UV	e É	TKQTM	ééÄ	VKM	VNMKVR	OMMM	
VR	j ç	UV	e É	OKQMQ	ééÄ	RKP	PSQKQS	NMMM	
NMT	^ Ö	UV	e É	MKMOS	ééÄ	NUKM	NTKTU	NMM	
NNN	` Ç	UV	e É	MKMPS	ééÄ	UQKV	OKVS	NMMM	
NNU	på	NRV	e É	JOKRRT	ééÄ	k L^	NURKRS	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKPPV	ééÄ	NRKT	RSTKOU	NMMM	
NPT	_~	NRV	k ç=d ~ë	NPKNTT	ééÄ	RKV	POSPKUQ	OMMM	
NUO	t	NRV	k ç=d ~ë	NKOMP	ééÄ	NPKQ	NPNNKOR	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMOR	ééÄ	k L^	RMMKRQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OKMSU	ééÄ	NPKN	PVMQKPV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKNUQ	ééÄ	k L^	NQQNKSP	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMOO	ééÄ	VSKN	RMMKR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ¤ mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUVVRQUKPP	MKT	ONOOPOPKQO	UVKR	RVKR	NOMKQ	
pÅ	OR	k ç=d ~ë	PVUPTOQKMM	MKO	ORNVVMMKVQ	UUKNQ	RVKR	NOMKQ	
pÅ	OR	e O	VMSSSPKMQ	QKN	NMSVRVUKVR	UQKTT	RVKR	NOMKQ	
pÅ	OR	e É	NPQRNMKSP	NKO	NRTTPRKMO	URKOU	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VSMROKUM	MKP	NMSQPUQKUO	VMKOQ	RVKR	NOMKQ	
d É	TO	e O	PSPRRRKUV	PKS	QOOMNTKMN	USKNR	RVKR	NOMKQ	
d É	TO	e É	NMRSPPKSQ	MKR	NOORSPKSN	USKNV	RVKR	NOMKQ	
v	UV	e O	QOOQNNRKQN	NKQ	OTSOUURKNQ	UUKSV	RVKR	NOMKQ	
v	UV	e É	TNPPUVKST	MKS	UOVQMOKQU	USKMN	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SPONSQNKSP	MKV	SRQQMSTKOO	VSKS	RVKR	NOMKQ	
qÄ	NRV	e É	ORNPROTKNV	NKU	OURMTNTKVP	UUKNT	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PNTUORQKQP	NKM	PONUTOUKRU	VUKTQ	RVKR	NOMKQ	
_á	OMV	e É	NORSNNVKRO	NKV	NRVQNVSKTN	VNKPQ	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNO^

cãÉ=k~ã É MPPpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ HÅ

^Åè=qáã É PLCQLOMCP=NVMMVMRV

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==: mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	NMKMCS	ééÄ	CKQ	NMBSTKQR	NMM	
NN	_	S	k ç=d ~ë	CNQKSNT	ééÄ	CKU	NQTVQVKQQ	NMMM	
CP	k ~	QR	e É	NPTNOKSPN	ééÄ	NKN	NSTSVUTKMT	OMMMMM	
CQ	j Ö	QR	e É	NTRVMPCP	ééÄ	NKR	NNMTPQKNQ	OMMMMM	
CT	^ ä	QR	e É	VTTTKMRO	ééÄ	CKM	CRQMMSM	OMMMMM	
CU	pá	QR	e O	SSPSKMVV	ééÄ	NKS	RQPQMVKPM	NMMMM	
PV	h	QR	e É	NMBMQKTPU	ééÄ	NKQ	RVUVSQKRR	OMMMMM	
QM	` ~	QR	e O	CPVNKMVR	ééÄ	NKS	NQLQOVMNKVQ	OMMMMM	
RN	s	UV	e É	RCKMNR	ééÄ	CKM	QMMUMKRU	NMMM	
RO	` ê	UV	e É	RNKTUV	ééÄ	MKV	RMRSUKRS	OMMM	
RR	j å	UV	e É	PPKCSP	ééÄ	NKU	NSPVQKQO	OMMM	
RS	cÉ	UV	e O	NUCCKVUM	ééÄ	CKN	QNPTTUVKSO	NMMMMM	
RV	` ç	UV	e É	NMKSMT	ééÄ	NKR	NTRUMKQU	NMMM	
SM	k á	UV	e É	CNKRPP	ééÄ	NKT	NMMQCKSU	NMMM	
SP	` ì	UV	e É	PQKPMR	ééÄ	MKO	QPVPVKCO	OMMM	
SS	wå	UV	e É	NMCKTRM	ééÄ	CKN	CPQVRKSS	OMMM	
TR	^ ë	UV	e É	RCKMMU	ééÄ	NKO	URMVKNR	NMMM	
TU	pÉ	UV	e O	RMKSPO	ééÄ	NKR	QRRQKPS	NMMM	
UU	pê	UV	e É	RTKSPV	ééÄ	MKP	PPCUTKQM	OMMM	
VR	j ç	UV	e É	RCKMUP	ééÄ	CKR	OVQMQKNN	NMMM	
NMT	^ Ö	UV	e É	NMKSNS	ééÄ	CKM	CNQSUKPP	NMM	
NNN	` Ç	UV	e É	NMKQST	ééÄ	PKP	CUPRKNP	NMMM	
NNU	på	NRV	e É	RMKNQU	ééÄ	NKN	OTTQNKMM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	VKVSO	ééÄ	NKP	QONOVKTP	NMMM	
NPT	_~	NRV	k ç=d ~ë	PQKQQD	ééÄ	NKO	QNRMNKNS	OMMM	
NUO	t	NRV	k ç=d ~ë	RQKQUN	ééÄ	NKN	NPMNVSKSV	NMMM	
OMR	qä	OMV	k ç=d ~ë	VKCPP	ééÄ	MKS	RMSCOKPS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NCKNQR	ééÄ	MKS	VCQRTKQQ	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	VKUUV	ééÄ	MKV	SUMQMKPV	NMMM	
OPU	r	OMV	k ç=d ~ë	NMKOMS	ééÄ	MKV	SPCSUKNR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=ɵpa	oÉÑ= mp	B ɵ ÉÅ	B n ` =ì çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUNMTMUKUT	CKU	CNCCPCPKQO	URKPO	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVNQSNCKNN	MKU	QRNVVMMKMQ	USHSN	RVKR	NOMKQ	
pÅ	QR	e O	UTTNSMKUQ	NKT	NMSVRVUKVR	UCKMN	RVKR	NOMKQ	
pÅ	QR	e É	NOVUURKPP	NKP	NRTTPRKMO	UCKPQ	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VPNUUPKSQ	MKO	NMSCPUQKUO	UTHRR	RVKR	NOMKQ	
d É	TO	e O	PRCCUPKCM	NKQ	QCCMNTKMN	UPKVR	RVKR	NOMKQ	
d É	TO	e É	NMPNPRKMT	NKP	NCCRSPKSN	UQKNR	RVKR	NOMKQ	
v	UV	e O	QMUVNCNKVO	MKT	QTSCUURKNQ	URKUR	RVKR	NOMKQ	
v	UV	e É	SUUVQVKVR	MKV	UCVQMCKQU	UPKMT	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SCMRCPVKCR	MKV	SRQQMSTKOO	VQKUO	RVKR	NOMKQ	
qÄ	NRV	e É	CQTNQNMKPS	NKP	CURMTNTKVP	USHSV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PCQVTCMKUO	MKV	PCNUTCUKRU	NMMKVS	RVKR	NOMKQ	
_á	OMV	e É	NQTRUTVHSQ	MKQ	NRVQNVSKTN	VCKRU	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNOm

cãÉ=k~ã É MPQpj mi HÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf^ mj eyNya^q^yOMOPyMPJ ^oyi n` OQ^HÅ

^Åè=qãã É PLOQLOMOP=NMWRMT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	RMKUQR	éé Ä	NHP	RPSTNKTP	NMM	
NN	_	S	k ç=d ~ë	RPQKVVT	éé Ä	OHS	PSTVUSKQV	NMMM	
OP	k ~	QR	e É	NNQMUKTVV	éé Ä	NKT	NQOSNNQKPT	OMMMMM	
OQ	j Ö	QR	e É	SMSTHSQV	éé Ä	MKT	PUTVQNKTR	OMMMMM	
OT	^ ä	QR	e É	OMOPKMSQ	éé Ä	NKV	RMTVNKQQ	OMMMMM	
OU	pá	QR	e O	OUSNKTPQ	éé Ä	NKQ	OPTTTPVKPU	NMMMM	
PV	h	QR	e É	NNMVRKOQV	éé Ä	OKM	SPSMRVKV	OMMMMM	
QM	` ~	QR	e O	QMSOKMVM	éé Ä	NKM	ORQSQMRKRP	OMMMMM	
RN	s	UV	e É	RMVKNUN	éé Ä	MKQ	PVPMOOKMR	NMMM	
RO	` ê	UV	e É	OMRKPON	éé Ä	NKM	NVVTOUKRP	OMMM	
RR	j å	UV	e É	RNTKOTN	éé Ä	MKU	ORQSOMKTU	OMMM	
RS	cÉ	UV	e O	NTUUHSQS	éé Ä	MKP	QNSQPNNKQM	NMMMMM	
RV	` ç	UV	e É	ROTKNPQ	éé Ä	MKQ	UTQMVTKTV	NMMM	
SM	k á	UV	e É	RORKUUQ	éé Ä	MKO	OQQPSUKTM	NMMM	
SP	` ì	UV	e É	OSVKVNV	éé Ä	MKP	PQRNQRKTO	OMMM	
SS	wå	UV	e É	ROVKVPQ	éé Ä	MKR	NNNUTTKNS	OMMM	
TR	^ ë	UV	e É	NMSKMUO	éé Ä	MKU	NTQRQKMT	NMMM	
TU	pÉ	UV	e O	NMQKOMU	éé Ä	NKP	VSNNKRO	NMMM	
UU	pê	UV	e É	RPOKPRM	éé Ä	MKR	PMVPMQKTN	OMMM	
VR	j ç	UV	e É	NNMKVMV	éé Ä	NKM	SOVPRKRS	NMMM	
NMT	^ Ö	UV	e É	QVKORP	éé Ä	NKN	NMVOPQKSQ	NMM	
NNN	` Ç	UV	e É	OTQKQRT	éé Ä	NKP	TQUNTKOU	NMMM	
NNU	på	NRV	e É	ROPKUMQ	éé Ä	MKP	OUUNNQKPP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NMVKONT	éé Ä	OKN	QOTNNMKVU	NMMM	
NPT	_~	NRV	k ç=d ~ë	OMTUKPVN	éé Ä	OKP	ORPSSRUKPQ	OMMM	
NUO	t	NRV	k ç=d ~ë	NNPKOUT	éé Ä	NKO	OTPSTOKMQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	NMVKROV	éé Ä	NKQ	RPVMPVKOV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NMVKVVQ	éé Ä	MKU	UNVVTTKTR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NMOKPVU	éé Ä	MKQ	STVUMTKSN	NMMM	
OPU	r	OMV	k ç=d ~ë	NMVKTNM	éé Ä	NKP	STNPSVKVM	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ ÉÅ	B n` =¨ çï	B n` =¤ äÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	NUNNQONKPU	NKR	ONOOPOPKQO	URKPR	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVPOOPRKON	NKR	QRNVVMMKMQ	UT	RVKR	NOMKQ	
pÅ	QR	e O	UUUUUVKUQ	MKT	NMSVRVUKVR	UPKN	RVKR	NOMKQ	
pÅ	QR	e É	NPOMVTKNS	MKT	NRTTPRKMO	UPKTR	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VPQMTVKUV	MKS	NMSQPUQKUO	UTKTS	RVKR	NOMKQ	
d É	TO	e O	PRVMOPKPT	MKT	QOOMNTKMN	URKMT	RVKR	NOMKQ	
d É	TO	e É	NMOVTPKON	MKS	NOORSPKSN	UQKMO	RVKR	NOMKQ	
v	UV	e O	QNVPTOSKRP	MKQ	OTSOUURKNQ	UUKVR	RVKR	NOMKQ	
v	UV	e É	SVPQOUKRV	NKN	UOVQMOKQU	UPKSN	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SOVNQSRKMU	OKM	SRQQMSTKOO	VSKNQ	RVKR	NOMKQ	
qÄ	NRV	e É	OQVQSUNKTT	MKU	OURMTNTKVP	UTHRN	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	POMVNVRKQN	MKQ	PONUTOUKRU	VVKT	RVKR	NOMKQ	
_á	OMV	e É	NQSNRQUKNP	OKP	NRVQNVSKTN	VNKSU	RVKR	NOMKQ	

`çåíaåì åaÖ=~äáÄê~íáç=sÉêáÑÑA~íáç=Ê``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cäÉ=k~ã É	MPR\``sKÇ
a~í~=m~íÜ=k~ã É	aWyªÖäÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OQ^kA
^Åè=qáã É	PLOQLOMOP=NVMROMQ
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑ¥cäÉk~ã É	MVS`^i_KÇ
p~ã éáÉ=n`=m~ëëlcá-ä	m~ëë
fpqa=n`=m~ëëlc~äí	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	OQKUVM	ééÄ	MKU	NPSVTNKCN	CR	VVKRS	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OQKVOU	ééÄ	MKO	VMVUQKTV	CR	VVKTN	UVKU	NNMO	
OP	k ~	CR	e É	RPSNKQTU	ééÄ	OKQ	PPNUSPOKUQ	RMMM	NMTKOP	UVKU	NNMO	
OQ	j Ö	CR	e É	RQPMKPMV	ééÄ	NKN	NTQURVRKSV	RMMM	NMUKSN	UVKU	NNMO	
OT	^ä	CR	e É	RMUKTRO	ééÄ	NKM	SOVVQKNU	RMM	NMNKTR	UVKU	NNMO	
OU	pá	CR	e O	RMPKVNN	ééÄ	MKR	ONSPVNKUV	RMM	NMMKTU	UVKU	NNMO	
PV	h	CR	e É	RNSPKSPN	ééÄ	MKP	NQRQVUPKUT	RMMM	NMPKOT	UVKU	NNMO	
QM	` ~	CR	e O	RNSNKVQU	ééÄ	MKS	NSSQSPMPKPS	RMMM	NMPKOQ	UVKU	NNMO	
RN	s	UV	e É	ORKQRP	ééÄ	OKQ	VUUVMKQS	CR	NMNKUN	UVKU	NNMO	
RO	` ê	UV	e É	ORKQPO	ééÄ	NKU	NOQRUPKPM	CR	NMNKTP	UVKU	NNMO	
RR	j å	UV	e É	ORMVSR	ééÄ	NKR	SNTOOKNM	CR	NMMKOS	UVKU	NNMO	
RS	cÉ	UV	e O	RNTPKMNN	ééÄ	MKO	RUPTVMNVKUU	RMMM	NMPKQS	UVKU	NNMO	
RV	` ç	UV	e É	ORKTUS	ééÄ	MKV	ONQVQOKRR	CR	NMPKNQ	UVKU	NNMO	
SM	k á	UV	e É	ORKQVO	ééÄ	OKO	RVNTUKPR	CR	NMNKVT	UVKU	NNMO	
SP	` ì	UV	e É	ORKTRP	ééÄ	NKP	NSRSUUKUS	CR	NMPKMN	UVKU	NNMO	
SS	wå	UV	e É	OQKTSN	ééÄ	NKN	OUNPUKTR	CR	VVKMQ	UVKU	NNMO	
TR	^ë	UV	e É	ORKOMN	ééÄ	MKQ	OMUPNKPV	CR	NMMKU	UVKU	NNMO	
TU	pÉ	UV	e O	ORKOMV	ééÄ	MKS	NNOVNKMQ	CR	NMMKUQ	UVKU	NNMO	
UU	pê	UV	e É	ORKQMS	ééÄ	MKT	TQNUMKRT	CR	NMNKSO	UVKU	NNMO	
VR	j ç	UV	e É	OQKQUR	ééÄ	NKU	SVUNNKMQ	CR	VTKVQ	UVKU	NNMO	
NMT	^Ö	UV	e É	ORKSNU	ééÄ	MKU	OSNVUOKPO	CR	NMOKQT	UVKU	NNMO	
NNN	` Ç	UV	e É	ORKVRQ	ééÄ	MKS	PRRRPKUN	CR	NMPKUO	UVKU	NNMO	
NNU	på	NRV	e É	OQKVNT	ééÄ	MKS	SUPROKVQ	CR	VVKST	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKOTS	ééÄ	MKP	ROQPMOKRM	CR	VTKN	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKTOP	ééÄ	MKR	NRVNRQKRM	CR	NMOKUV	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKORQ	ééÄ	MKU	PMVMTNKTV	CR	NMNKMO	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	OQKTPT	ééÄ	NKR	SRSQTNKNM	CR	VUKVR	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	ORKTTQ	ééÄ	MKT	VRNMNSKOV	CR	NMPKN	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	ORKRQO	ééÄ	NKO	UPVMRRKQM	CR	NMOKNT	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKOVM	ééÄ	NKN	TVSQPQKQO	CR	NMRKNS	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ¥mp	B=oÉÄ	B n`=ïçï	B n`=eäÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	NUVMTVQKPU	NKM	ONOOPOPKQO	UVKMV	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVOOMTSKRM	MKQ	QRNVVMMKMQ	USKTT	RVKR	NOMQ	
pÅ	CR	e O	VNUSSTKQN	MKU	NMSVRVUKVR	URKUV	RVKR	NOMQ	
pÅ	CR	e É	NPPNMSKUU	MKS	NRTTPRKMO	UQKPV	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VQSPSTKUP	MKP	NMSQPUQKUO	UUKVN	RVKR	NOMQ	
d É	TO	e O	PSPPVTKPU	NKN	QOOMNTKMN	USKNN	RVKR	NOMQ	
d É	TO	e É	NMPTRMKRP	NKS	NOORSPKSN	UQKSR	RVKR	NOMQ	
v	UV	e O	OMTPRVSKVU	NKQ	QTSOUURKNQ	URKRP	RVKR	NOMQ	
v	UV	e É	SVSVNQKTQ	MKS	UOVQMOKQU	UQKMP	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPTRSTPKOM	MKP	SRQQMSTKOO	VTKQP	RVKR	NOMQ	
qÄ	NRV	e É	OQTRROPKVU	MKO	OURMTNTKVP	USKUQ	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PNTTPUMKOR	MKU	PONUTOUKRU	VUKTO	RVKR	NOMQ	
_á	OMV	e É	NQNVVRMKRM	NKT	NRVQNVSKTN	UVKMT	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=Ê``_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MPS|``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíyî mj eyNya^q^yOMOPyMPJ ^oyi n` OQ^kÅ

^Åè=qáã É PLOQLOMOP=NVMQOMT

p~ã éáÉ=qóéÉ ``_

qçí~äa äã íáç~å NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑc äÉk~ã É MVS^i_KÇ

p~ã éáÉ=n`=m~ëëlc á~ä c~äã

fpqa=n`=m~ëëlc~äã m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äóíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==\ mp==	iãáá	n`=c ä~Ö
V	_É	S	kç=d~ë	MKMNM	éé Ä	QVKV	NTSKST	MO	
NN	_	S	kç=d~ë	MKPQR	éé Ä	RKN	QVSRKTP	Q	
OP	k~	QR	eÉ	SKNUV	éé Ä	NNKT	QUUOVKUU	QVM	
OQ	j Ö	QR	eÉ	PKRVQ	éé Ä	NRKR	NQOVKMO	QM	
OT	^ä	QR	eÉ	JOPKTSV	éé Ä	k L^	NVOKOP	QM	c~äë^ äëj ÉÍÜçÇë& c~äÉÇ=a ça
OU	pá	QR	eO	MKSOV	éé Ä	NUKM	TPMKTV	NVM	
PV	h	QR	eÉ	NVKUQN	éé Ä	NMKN	PQRUOKNQ	QVM	
QM	`~	QR	eO	QKSSS	éé Ä	VKS	OTPORKRQ	QM	
RN	s	UV	eÉ	MKMNP	éé Ä	SUKU	OVRKRS	N	
RO	`ê	UV	eÉ	MKMOM	éé Ä	RPKN	UPTKOM	N	
RR	j å	UV	eÉ	JMKMRU	éé Ä	k L^	NQOKSQ	MQ	
RS	cÉ	UV	eO	PKRPO	éé Ä	NVKT	QVUVUKVN	QM	
RV	` ç	UV	eÉ	MKMNT	éé Ä	ORKT	OSOKOQ	MO	
SM	k á	UV	eÉ	JMKMMN	éé Ä	k L^	QVOKOP	MQ	
SP	` ì	UV	eÉ	MKMNP	éé Ä	QUKV	ROPKPR	MS	
SS	wå	UV	eÉ	JOKNST	éé Ä	k L^	QVOKOR	O	c~äë^ äëj ÉÍÜçÇë& c~äÉÇ=a ça
TR	^ë	UV	eÉ	MKMOR	éé Ä	SKN	PVKPP	N	
TU	pÉ	UV	eO	MKMQO	éé Ä	NKU	OOKMM	N	
UU	pê	UV	eÉ	MKMOT	éé Ä	PQKS	NVNKNN	N	
VR	j ç	UV	eÉ	MKNUN	éé Ä	OKR	SPNKNQ	N	
NVT	^Ö	UV	eÉ	MKMNP	éé Ä	NSKT	NRNKNO	MO	
NNN	`Ç	UV	eÉ	MKMNP	éé Ä	OSKR	QVMKM	MO	
NNU	på	NRV	eÉ	JMKMNM	éé Ä	k L^	QRRKRT	N	
NON	pÄ	NRV	kç=d~ë	MKMOT	éé Ä	OPKR	UUQKOV	MO	
NPT	_~	NRV	kç=d~ë	MKMSQ	éé Ä	PNKT	QPTKNQ	MQ	
NUO	t	NRV	kç=d~ë	MKOMP	éé Ä	ORKR	PPMMKRT	N	
OVR	qä	OVV	kç=d~ë	MKMSP	éé Ä	NPKT	OORVKOU	MO	
OVU	mÄ	OVV	kç=d~ë	MKMMU	éé Ä	SKN	NNUQKSM	MO	
OPO	qÜ	OVV	kç=d~ë	MKMUS	éé Ä	PNKV	QSMRKTO	N	
OPU	r	OVV	kç=d~ë	MKMOO	éé Ä	NVMP	SVQKMU	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ= mp	B=oÉÁ	B n`=ç ï	B n`=eåÜ	n`=c ä~Ö
iá	S	kç=d~ë	NVTMOUQKRP	NKU	ONOOPOPKQO	VOKUQ	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QMNTQOOKSP	OKR	QRNVVMMKMQ	UUKUU	RVKR	NOMQ	
pÅ	QR	eO	VNVRTTKMT	OKQ	NMSVRVUKVR	URKVT	RVKR	NOMQ	
pÅ	QR	eÉ	NPVPPUKPS	MKN	NRTTPRKMO	UUKPQ	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VUNVOPKNO	MKU	NMSQPUQKUO	VOKOR	RVKR	NOMQ	
dÉ	TO	eO	PTNMPMKOT	OKM	QOOMNTKMN	UTKVO	RVKR	NOMQ	
dÉ	TO	eÉ	NMUUQMKO	MKR	NOORSPKSN	UUKU	RVKR	NOMQ	
v	UV	eO	QOMPOQUKTR	NKP	QTSOUURKNQ	UUKOR	RVKR	NOMQ	
v	UV	eÉ	TPROVVKRQ	MKQ	UOVQMOKQU	UUKSR	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SRRSPROKVP	NKR	SRQQMSTKOO	NMVKNV	RVKR	NOMQ	
qÄ	NRV	eÉ	OSMPVMSKQV	MKU	OURMTNTKVP	VNKPQ	RVKR	NOMQ	
_á	OVV	kç=d~ë	POTMPMTKVQ	OKV	PONUTOUKRU	NMNKS	RVKR	NOMQ	
_á	OVV	eÉ	NROVUTVKNR	MKP	NRVQNVSKTN	VRKVT	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNQp

cãÉ=k~ã É MPTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OQ^ hÅ

^Åè=qãã É PLOQLOMOP=NMVQQTNMP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	RRKQST	ééÄ	MKU	RURVRKVQ	NMM	
NN	_	S	k ç=d ~ë	RRVKUPP	ééÄ	NKP	PUQUQPKQO	NMMM	
OP	k ~	QR	e É	NNSPPKNSO	ééÄ	NKV	NQQVUPUKQO	OMMMMM	
OQ	j Ö	QR	e É	SOVRKVOT	ééÄ	NKR	PVRUTOKTR	OMMMMM	
OT	^ ä	QR	e É	ONSTKMPM	ééÄ	NKT	RPRTMKPT	OMMMMM	
OU	pá	QR	e O	OUPUKUQN	ééÄ	OKN	OPSRMOKUR	NMMMM	
PV	h	QR	e É	NNPRMSRN	ééÄ	NKR	SQURSSKUQ	OMMMMM	
QM	` ~	QR	e O	ONSRKNRM	ééÄ	NKQ	OSNSSOPKNQ	OMMMMM	
RN	s	UV	e É	RRMKUSP	ééÄ	OKS	QORNSOKPS	NMMM	
RO	` ê	UV	e É	OOMKOTN	ééÄ	PKN	ONQOOUKTR	OMMM	
RR	j å	UV	e É	RSNKOQV	ééÄ	OKP	OTQNMNKMR	OMMM	
RS	cÉ	UV	e O	NVOOKMSP	ééÄ	NKQ	OPRSUURKUM	NMMMM	
RV	` ç	UV	e É	RTVKMTO	ééÄ	OKN	VSMPSRKNU	NMMM	
SM	k á	UV	e É	RSNKMVO	ééÄ	OKM	ORUSMOKPR	NMMM	
SP	` ì	UV	e É	OUQKTQN	ééÄ	OKR	PSQMTUKMO	OMMM	
SS	wå	UV	e É	RSTKMUR	ééÄ	NKV	NNVRSOKTQ	OMMM	
TR	^ ë	UV	e É	NMUKUSU	ééÄ	OKP	NTVNNKPR	NMMM	
TU	pÉ	UV	e O	NVSKVPQ	ééÄ	MKS	VRVOKNU	NMMM	
UU	pê	UV	e É	RRNKVSR	ééÄ	NKP	POMTRVKRN	OMMM	
VR	j ç	UV	e É	NNOKMSR	ééÄ	MKS	SPSMRKPR	NMMM	
NMT	^ Ö	UV	e É	ROKNTU	ééÄ	NKQ	NMSOMSKOS	NMM	
NNN	` Ç	UV	e É	OUNKSMT	ééÄ	NKQ	TSTTSKMR	NMMM	
NNU	på	NRV	e É	RPNKRSN	ééÄ	MKN	OVOPMNKSO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NMPKVRP	ééÄ	MKO	QONRUMKMT	NMMM	
NPT	_~	NRV	k ç=d ~ë	OOSPKNRV	ééÄ	MKT	OTRPOSSKNQ	OMMM	
NUO	t	NRV	k ç=d ~ë	NNSKPRO	ééÄ	NKM	OUMNMVKUO	NMMM	
OMR	qä	OMV	k ç=d ~ë	NMPKPUN	ééÄ	OKS	RRVUNVKRM	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NNOKUMV	ééÄ	NKR	UQVQQQOKUV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NMSKMUR	ééÄ	NKP	TNNPUTKPT	NMMM	
OPU	r	OMV	k ç=d ~ë	NNOKSMO	ééÄ	MKQ	SVSOMOKPP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUNVMUNKNU	MKN	ONOOPOPKQO	URKOV	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVMRVPPKQU	NKV	QRNVVMMKMQ	USKQO	RVKR	NOMKQ	
pÅ	QR	e O	UVNQPNKTO	MKS	NMSVRVUKVR	UPKPQ	RVKR	NOMKQ	
pÅ	QR	e É	NPNTVVKSS	NKU	NRTTPRKMO	UPKRS	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VPUMTUKSU	NKS	NMSQPUQKUO	UUKNP	RVKR	NOMKQ	
d É	TO	e O	PRQQONKST	MKN	QOOMNTKMN	UPKVU	RVKR	NOMKQ	
d É	TO	e É	NMOOVKOP	NKM	NOORSPKSN	UPKQT	RVKR	NOMKQ	
v	UV	e O	QMTVTTPKVV	MKU	QTSOUURKNQ	URKSS	RVKR	NOMKQ	
v	UV	e É	SVPSOPKVN	NKT	UOVQMOKQU	UPKSP	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SOSVPPPKQT	NKR	SRQQMSTKOO	VRKU	RVKR	NOMKQ	
qÄ	NRV	e É	ORNNNRTKRU	NKM	OURMTNTKVP	UUKMV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	POQOOSOKTT	OKU	PONUTOUKRU	NMVKTQ	RVKR	NOMKQ	
_á	OMV	e É	NQTSMTPKOP	NKQ	NRVQNVSKTN	VOKRV	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNP

cãÉ=k~ã É MPUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ hÅ

^Åè=qãã É PLCQLOMCP=NVARRVQR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MMVCP	ééÄ	RQKM	NPRKRS	NVM	
NN	_	S	k ç=d ~ë	NCKCNM	ééÄ	MKR	VNCRKCR	NMMM	
CP	k ~	QR	e É	PCQSKSMN	ééÄ	CHP	CPOSRSKTP	CMMMMM	
CQ	j Ö	QR	e É	UUSKMTU	ééÄ	NKR	RSPRUKUT	CMMMMM	
CT	^ ä	QR	e É	JRNKCCO	ééÄ	k L^	NTRVMKNQ	CMMMMM	
CU	pá	QR	e O	NPPTKCRN	ééÄ	NKQ	NNNNNUKTU	NMMMM	
PV	h	QR	e É	TRCKSCS	ééÄ	CKO	SUMSPKMU	CMMMMM	
QM	` ~	QR	e O	NSUNKTQV	ééÄ	NKQ	NVRUCPVKTV	CMMMMM	
RN	s	UV	e É	MKVQS	ééÄ	PKS	VSQKRM	NMMM	
RO	` ê	UV	e É	MKRMQ	ééÄ	NVKQ	NNVNKNS	CMMM	
RR	j å	UV	e É	NQKMRR	ééÄ	CHP	TNUNKNO	CMMM	
RS	cÉ	UV	e O	NMNMCRQ	ééÄ	NKV	CPMUSRTHSV	NMMMM	
RV	` ç	UV	e É	MKRUR	ééÄ	NUKO	NMUSKTR	NMMM	
SM	k á	UV	e É	MKQVU	ééÄ	PKR	QCRKRT	NMMM	
SP	` ì	UV	e É	MKRQR	ééÄ	UKM	NNNQKRN	CMMM	
SS	wå	UV	e É	JNKRUS	ééÄ	k L^	CNNSKUT	CMMM	
TR	^ ë	UV	e É	MKSSQ	ééÄ	CKQ	NCSKSU	NMMM	
TU	pÉ	UV	e O	MKCUV	ééÄ	NSKT	CUKUP	NMMM	
UU	pê	UV	e É	VKPMQ	ééÄ	NKR	RQSMKMS	CMMM	
VR	j ç	UV	e É	MKSQO	ééÄ	NNKS	QCQUKVN	NMMM	
NMT	^ Ö	UV	e É	MKMRO	ééÄ	OSKS	NNPHPQ	NMM	
NNN	` Ç	UV	e É	MKCPR	ééÄ	CPKS	SRKRS	NMMM	
NNU	på	NRV	e É	MKPNP	ééÄ	CRKU	SQMMVP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKQRO	ééÄ	PKN	CCCCKRO	NMMM	
NPT	_~	NRV	k ç=d ~ë	NQKUVR	ééÄ	NKT	NUPSUKQV	CMMM	
NUO	t	NRV	k ç=d ~ë	MKSSU	ééÄ	OQKO	CPRSKMQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKOSO	ééÄ	NRKN	NVRCKCO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	PKCPQ	ééÄ	PKQ	CRNQSKMR	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	NKNNS	ééÄ	NVKV	VNSSKQM	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNMV	ééÄ	NOKT	SVQKMU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUNSRSSKQN	MKP	CNCCPCPKQO	URKRV	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVCSNRQKSQ	MKN	QRNVVMMKMQ	USKUS	RVKR	NOMKQ	
pÅ	QR	e O	UUTNCUKSN	NKM	NMSVRVUKVR	UCKVQ	RVKR	NOMKQ	
pÅ	QR	e É	NPNMVRKVM	NKO	NRTTPRKMO	UPKVR	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VQROVQKSM	MKR	NMSCPUQKUO	UUKUN	RVKR	NOMKQ	
d É	TO	e O	PRRUSPKSV	NKO	QCCMNTKMN	UQKPO	RVKR	NOMKQ	
d É	TO	e É	NMQNNSKUQ	NKN	NCCRSPKSN	UQKVR	RVKR	NOMKQ	
v	UV	e O	QNNMQVUKRS	NKS	QTSCUURKNQ	USKP	RVKR	NOMKQ	
v	UV	e É	SVUCSSKQM	MKS	UCVQMCKQU	UQKMV	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SPQQTPQKCS	NKM	SRQQMSTKOO	VSKVR	RVKR	NOMKQ	
qÄ	NRV	e É	CRMRUUCKQN	NKO	CURMTNTKVP	UTKV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PCPQUNQKQR	MKT	PCNUTCUKRU	NMMKR	RVKR	NOMKQ	
_á	OMV	e É	NQUSSTTKRU	OKN	NRVQNVSKTN	VPKOS	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNQ

cãÉ=k~ã É MPVpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ hÅ

^Åè=qãã É PLCQLOMCP=OMMMMRO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKMMP	ééÄ	k L^	NNMKMM	NMM	
NN	_	S	k ç=d ~ë	UHPMM	ééÄ	CKT	SRCCKSU	NMMM	
CP	k ~	CR	e É	NRRRKQCS	ééÄ	NKU	COVSPNKQT	CMMMMM	
CQ	j Ö	CR	e É	CCPKMVT	ééÄ	CKQ	NQPTSHRQ	CMMMMM	
CT	^ ä	CR	e É	MKSCN	ééÄ	VQTKU	OVRVKCR	CMMMMM	
CU	pá	CR	e O	PNPVKCUV	ééÄ	CKR	CQTCQTKUV	NMMMM	
PV	h	CR	e É	NTNKSST	ééÄ	CKQ	PSRNQKCS	CMMMMM	
QM	` ~	CR	e O	PNMKQNR	ééÄ	NKO	NVCLUMNKSS	CMMMMM	
RN	s	UV	e É	NKPTP	ééÄ	NKO	NOVCKPN	NMMM	
RO	` ê	UV	e É	MKURN	ééÄ	VKM	NRCRKNP	CMMM	
RR	j å	UV	e É	NTKUTS	ééÄ	CKM	VMOTKUQ	CMMM	
RS	cÉ	UV	e O	NMMCKSTR	ééÄ	NKT	COPMCMMKTO	NMMMMM	
RV	` ç	UV	e É	MKCMS	ééÄ	RKO	CRPKPS	NMMM	
SM	k á	UV	e É	MKNRR	ééÄ	NQKP	OSRKRS	NMMM	
SP	` ì	UV	e É	MKPTN	ééÄ	NCKO	UUTKUO	CMMM	
SS	wå	UV	e É	JVKMVR	ééÄ	k L^	RTCKCR	CMMM	
TR	^ ë	UV	e É	MKRUR	ééÄ	NMKS	NNPKPQ	NMMM	
TU	pÉ	UV	e O	MKNQO	ééÄ	CUKS	NRKNT	NMMM	
UU	pê	UV	e É	CKVCP	ééÄ	TKV	NTPCKPT	CMMM	
VR	j ç	UV	e É	MKRNQ	ééÄ	NCKU	PTCKQS	NMMM	
NMT	^ Ö	UV	e É	MKMCR	ééÄ	OVKT	RSKSST	NMM	
NNN	` Ç	UV	e É	MKMRP	ééÄ	OTHR	NRKRS	NMMM	
NNU	på	NRV	e É	JMKNCV	ééÄ	k L^	PVCKCQ	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKNCP	ééÄ	NQKT	TVCKCM	NMMM	
NPT	_~	NRV	k ç=d ~ë	NMKTSQ	ééÄ	CKR	NPMRPKQP	CMMM	
NUO	t	NRV	k ç=d ~ë	MKQMN	ééÄ	CUKQ	NSTRKCO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNPM	ééÄ	CNKN	NCNQKST	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMTN	ééÄ	NMKM	NPTCKUO	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKPPV	ééÄ	CPKN	PVMCKTR	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMSU	ééÄ	NPKO	QPPKUM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e åÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUQOTQPKUU	NKU	CNCOPCPKQO	USKUP	RVKR	NOMKQ	
pÅ	CR	k ç=d ~ë	PUVUTNNKVO	NKV	QRNVVMMKMQ	USKOS	RVKR	NOMKQ	
pÅ	CR	e O	UQOTSPKNQ	NKQ	NMSVRVUKVR	TUKTV	RVKR	NOMKQ	
pÅ	CR	e É	NPNCNTKNS	MKU	NRTTPRKMO	UPKNV	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VOVQMSKCS	NKP	NMSQPUQKUO	UTKPO	RVKR	NOMKQ	
d É	TO	e O	PQRNMSKQP	NKR	QCCMNTKMN	UNKTU	RVKR	NOMKQ	
d É	TO	e É	NMNTTSKQS	MKU	NCCRSPKSN	UPKMQ	RVKR	NOMKQ	
v	UV	e O	QMMMRPVKCS	CKP	QTSCLUURKNQ	UPKVV	RVKR	NOMKQ	
v	UV	e É	SVRVPVKQR	MKT	UCVQMCKQU	UPKVN	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SCPPQRQKUV	MKT	SRQQMSTKCO	VRKCR	RVKR	NOMKQ	
qÄ	NRV	e É	CQLSSSMMKCO	NKR	CURMTNTKVP	UTKCP	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PNTSPVUKNP	MKU	PCNUTCUKRU	VUKSU	RVKR	NOMKQ	
_á	OMV	e É	NQSVNMVKRO	MKU	NRVQNVSKTN	VCKNR	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNR

cãÉ=k~ã É MQMpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` CQ^ hÅ

^Åè=qãã É PLCQLOMCP=OMMRMQN

p~ã éäÉ=qóéÉ p~ã éäÉ

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p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKMCR	éé Ä	k L^	SPHPP	NMM	
NN	_	S	k ç=d ~ë	THSPQ	éé Ä	PKT	RVOTKVV	NMMM	
CP	k ~	CR	e É	NSPVKROT	éé Ä	CKM	CQMCUUKRO	CMMMMM	
CQ	j Ö	CR	e É	NVTHRRS	éé Ä	NHS	NOTTCKTQ	CMMMMM	
CT	^ ä	CR	e É	JUPKUSO	éé Ä	k L^	VVSKTO	CMMMMM	
CU	pá	CR	e O	OSCPHRPN	éé Ä	NHS	CNUVMPKQQ	NMMMM	
PV	h	CR	e É	OSSKNTT	éé Ä	CKM	CNTRVHRT	CMMMMM	
QM	` ~	CR	e O	OTTKQSO	éé Ä	NKU	NURSUQKCR	CMMMMM	
RN	s	UV	e É	MKVUS	éé Ä	VKV	VUQHRM	NMMM	
RO	` ê	UV	e É	MKQVM	éé Ä	NMP	NNSQKQV	CMMM	
RR	j å	UV	e É	NVRKTCU	éé Ä	MKU	RNSCUKVV	CMMM	
RS	cÉ	UV	e O	PVUQKCRS	éé Ä	MKU	VNRQCPUNRRS	NMMMMM	
RV	` ç	UV	e É	MKOVS	éé Ä	NUKN	RVTKUN	NMMM	
SM	k á	UV	e É	MKMOV	éé Ä	NTMKQ	CMRKRS	NMMM	
SP	` ì	UV	e É	NKCQU	éé Ä	VKQ	NVVRKTP	CMMM	
SS	wå	UV	e É	JTKCSS	éé Ä	k L^	VCRHSM	CMMM	
TR	^ ë	UV	e É	NKCNS	éé Ä	RKN	CNRHSV	NMMM	
TU	pÉ	UV	e O	MKNMQ	éé Ä	CRKQ	NCKNT	NMMM	
UU	pê	UV	e É	CKUCP	éé Ä	CKO	NSSNKCQ	CMMM	
VR	j ç	UV	e É	MKQUS	éé Ä	RKN	PRRKRT	NMMM	
NMT	^ Ö	UV	e É	MKMMT	éé Ä	TQKP	CMKMM	NMM	
NNN	` Ç	UV	e É	MKNNU	éé Ä	PPHS	RKVP	NMMM	
NNU	på	NRV	e É	JMKCNO	éé Ä	k L^	PQUKVM	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKNMO	éé Ä	PKR	TMQKMV	NMMM	
NPT	_~	NRV	k ç=d ~ë	NMKRPO	éé Ä	CHS	NOTUSKNS	CMMM	
NUO	t	NRV	k ç=d ~ë	MKCRR	éé Ä	CUKT	NPPNKQU	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMPS	éé Ä	NVKR	TCQKNP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMST	éé Ä	NCKR	NPRUKNP	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNUS	éé Ä	CKM	CVCSKUM	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMNS	éé Ä	QTKO	NCMKNP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÁ	B n ` =i çï	B n ` =e åÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUMCNVPKCO	MKV	CNCCPCPQCO	UQKVO	RVKR	NCMKQ	
pÅ	CR	k ç=d ~ë	PUQSSUPKVN	NKO	CRNVVMMKMQ	URKSN	RVKR	NCMKQ	
pÅ	CR	e O	UVCSURKVO	NKM	NMSVRVUKVR	UPKQS	RVKR	NCMKQ	
pÅ	CR	e É	NPNRCMKVT	CKN	NRTTPRKMO	UPHPU	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	VCVTMSKTO	MKQ	NMSCPUQKUO	UTHPR	RVKR	NCMKQ	
d É	TO	e O	PRRCRPHPV	MKR	QCCMNTKMN	UQKSU	RVKR	NCMKQ	
d É	TO	e É	NMPMCMKRU	MKU	NCCRSPHSN	UQKMR	RVKR	NCMKQ	
v	UV	e O	QNQPTCCKTV	NKN	QTSCUURKNQ	UT	RVKR	NCMKQ	
v	UV	e É	SVMQNCKMO	MKQ	UCVQMCKQU	UPKCQ	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SCQCRRSKSS	CKM	SRQQMSTKCO	VRHPV	RVKR	NCMKQ	
qÄ	NRV	e É	CQVSRCVMKN	NKO	CURMTNTKVP	UTHRU	RVKR	NCMKQ	
_á	OMV	k ç=d ~ë	PCMNMMQKRV	MKO	PCNUTCUKRU	VVKQR	RVKR	NCMKQ	
_á	OMV	e É	NQTSMVNKVR	NKM	NRVQNVSKTN	VCHRV	RVKR	NCMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNS

cãÉ=k~ã É MQNpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ hÅ

^Åè=qãã É PLCQLOMCP=OMNMMRMM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	JMKMDS	ééÄ	k L^	UPHPP	NMM	
NN	_	S	k ç=d ~ë	THOTO	ééÄ	PHS	RTCRHSU	NMMM	
OP	k ~	QR	e É	NPOQHSRU	ééÄ	OHM	OMNCQTHMR	OMMMMM	
OQ	j Ö	QR	e É	OPUHMNR	ééÄ	PHU	NRCSSHQP	OMMMMM	
OT	^ ä	QR	e É	OUHCOS	ééÄ	OQHV	PRVNHSP	OMMMMM	
OU	pá	QR	e O	ONPTHRSU	ééÄ	NHV	NTUVRMCO	NMMMM	
PV	h	QR	e É	OSRHQSV	ééÄ	PHP	ONRNMRTM	OMMMMM	
QM	` ~	QR	e O	OVQHMUN	ééÄ	MHV	NVSSUMHQR	OMMMMM	
RN	s	UV	e É	MHVMU	ééÄ	PHQ	VPMMMR	NMMM	
RO	` ê	UV	e É	MHQSN	ééÄ	NOHN	NNQPHNS	OMMM	
RR	j å	UV	e É	NPHMVN	ééÄ	NHV	SSSUHVU	OMMM	
RS	cÉ	UV	e O	QRMMNTU	ééÄ	NRT	NMPSMUUHMP	NMMMMM	
RV	` ç	UV	e É	MHNSS	ééÄ	NPHM	PUQHQS	NMMM	
SM	k á	UV	e É	MHNQR	ééÄ	UHO	OSMHMN	NMMM	
SP	` ì	UV	e É	MHSRP	ééÄ	NSHQ	NCQSRTQ	OMMM	
SS	wå	UV	e É	JUHQTO	ééÄ	k L^	SUNHNQ	OMMM	
TR	^ ë	UV	e É	MHPPO	ééÄ	NVHV	TNHPQ	NMMM	
TU	pÉ	UV	e O	MHMUM	ééÄ	NHM	NVHMM	NMMM	
UU	pê	UV	e É	OHSTN	ééÄ	QHN	NRTNHCP	OMMM	
VR	j ç	UV	e É	MHPNQ	ééÄ	NUHQ	OSMHMN	NMMM	
NMT	^ Ö	UV	e É	MHMMS	ééÄ	SVHS	NUHUV	NMM	
NNN	` Ç	UV	e É	MHMNU	ééÄ	RTHU	RHVP	NMMM	
NNU	på	NRV	e É	JMPMP	ééÄ	k L^	OVQHQR	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MHNMQ	ééÄ	QHV	TMTHQQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	UHRNR	ééÄ	MHU	NVOTUHON	OMMM	
NUO	t	NRV	k ç=d ~ë	MHPNU	ééÄ	QUHT	NQSUHPO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MHMPN	ééÄ	OVHN	SUQHMT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MHPMS	ééÄ	RHN	PMTSHTP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MHNPQ	ééÄ	RNHN	CRCSHOT	NMMM	
OPU	r	OMV	k ç=d ~ë	MHMDS	ééÄ	PVHV	NTSHUR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B =¤ÉÅ	B n ` =ì çï	B n ` =¢äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	NUNTRPPHRQ	NHV	ONCCPCPHQO	URHSQ	RVHR	NOMHQ	
pÅ	QR	k ç=d ~ë	PURQQUQHPV	MHQ	QRNVVMMHMQ	URHCU	RVHR	NOMHQ	
pÅ	QR	e O	UVRPSNHQN	NHV	NMSVRVUHVR	UPHTN	RVHR	NOMHQ	
pÅ	QR	e É	NPMUQTHUT	NHP	NRTTPRHMO	UCHVR	RVHR	NOMHQ	
d É	TO	k ç=d ~ë	VCCUSPHPO	NHV	NMSCPUQHUO	USHT	RVHR	NOMHQ	
d É	TO	e O	PRTCSCHVN	MHT	QCCMNTHMN	UQHSS	RVHR	NOMHQ	
d É	TO	e É	NMCPSRHUS	MHO	NCCRSPHSN	UPHRO	RVHR	NOMHQ	
v	UV	e O	QNNVSCTHNR	MHT	QTSCUURHNQ	USHQV	RVHR	NOMHQ	
v	UV	e É	SVQPMRHMN	NHS	UCVQMCHQU	UPHTN	RVHR	NOMHQ	
qÄ	NRV	k ç=d ~ë	SCMNUVTHMQ	NHT	SRQQMSTHCO	VQHTT	RVHR	NOMHQ	
qÄ	NRV	e É	CQRVPTUHRQ	MHR	CURMTNTHVP	USHOT	RVHR	NOMHQ	
_á	OMV	k ç=d ~ë	PNPTUNQHNV	NHS	PCNUTCUHRU	VTHQV	RVHR	NOMHQ	
_á	OMV	e É	NQSTPPTHMM	NHM	NRVQNVSHTN	VCHMQ	RVHR	NOMHQ	

p~ã éäÉ=k~ã É pn NOMNUMNT

cãÉ=k~ã É MQQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ hÅ

^Åè=qãã É PLOQLOMCP=OMNNRMU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä~Ö
V	_É	S	k ç=d ~ë	JMKMNQ	éé Ä	k L^	VSKST	NMM	
NN	_	S	k ç=d ~ë	TKQTP	éé Ä	PKO	RURRKTP	NMMM	
OP	k ~	QR	e É	NOUMKUNO	éé Ä	OKM	NVTRRRKMD	OMMMMM	
OQ	j Ö	QR	e É	ORSKMTR	éé Ä	OKN	NSRQPHPV	OMMMMM	
OT	^ ä	QR	e É	NOOKVOO	éé Ä	NMQ	RUPPKRO	OMMMMM	
OU	pá	QR	e O	NQQMKNSS	éé Ä	PKS	NNVNVSKVV	NMMMM	
PV	h	QR	e É	OSPKQOV	éé Ä	NKV	QNTOVKQP	OMMMMM	
QM	` ~	QR	e O	PPSKUQM	éé Ä	NKR	QOMTQOKVR	OMMMMM	
RN	s	UV	e É	MKUQQ	éé Ä	RKT	UTPKPU	NMMM	
RO	` ê	UV	e É	MKQPN	éé Ä	NPKV	NNMRKNT	OMMM	
RR	j å	UV	e É	NNKRMN	éé Ä	NKS	RUQSKNM	OMMM	
RS	cÉ	UV	e O	QUNKSNN	éé Ä	MKN	NMVTPQPKTQ	NMMMMM	
RV	` ç	UV	e É	MKNRR	éé Ä	ORKV	PSQKQS	NMMM	
SM	k á	UV	e É	MKNSQ	éé Ä	NTKT	OSSKST	NMMM	
SP	` ì	UV	e É	MKTNM	éé Ä	QKQ	NPMUKVT	OMMM	
SS	wå	UV	e É	JTKSPP	éé Ä	k L^	UQTKUO	OMMM	
TR	^ ë	UV	e É	MKOVM	éé Ä	RKT	SQKMN	NMMM	
TU	pÉ	UV	e O	MKMUV	éé Ä	NUKS	NMKST	NMMM	
UU	pê	UV	e É	OKUQO	éé Ä	PKN	NSRSKUM	OMMM	
VR	j ç	UV	e É	MKOPV	éé Ä	OMKT	ONRKRS	NMMM	
NMT	^ Ö	UV	e É	MKMNM	éé Ä	QPKP	OSKST	NMM	
NNN	` Ç	UV	e É	MKMNM	éé Ä	OOKU	PKTM	NMMM	
NNU	på	NRV	e É	JMKMQ	éé Ä	k L^	PMNKNO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMUQ	éé Ä	QOKN	SNTKPP	NMMM	
NPT	_~	NRV	k ç=d ~ë	NMKNNR	éé Ä	PKM	NOMTNKQS	OMMM	
NUO	t	NRV	k ç=d ~ë	MKNST	éé Ä	PUKQ	NNMNKOO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMMS	éé Ä	PTUKP	RSPKVQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKORT	éé Ä	PKQ	OTSVKTO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMUN	éé Ä	OUKT	OOPOKRU	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMOV	éé Ä	NMKP	OMMKON	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =ï çï	B n ` =¢ äÜÜ	n ` =¢ä~Ö
i á	S	k ç=d ~ë	NUNPVSRKVT	NKR	ONOOPOPKQO	URKQT	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PUTNVRKKPS	MKT	QRNVVMMKMQ	URKSS	RVKR	NOMKQ	
pÅ	QR	e O	UUQNUSKPS	NKP	NMSVRVUKVR	UOKST	RVKR	NOMKQ	
pÅ	QR	e É	NPNUUSKSV	MKQ	NRTTPRKMO	UPKSN	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VONSVUKNQ	MKV	NMSQPUQKUO	USKRV	RVKR	NOMKQ	
d É	TO	e O	PRPRNPKUN	MKS	QOOMNTKMN	UPKTT	RVKR	NOMKQ	
d É	TO	e É	NMONTSKVU	MKU	NOORSPKSN	UPKPT	RVKR	NOMKQ	
v	UV	e O	QMUMUNOKTQ	MKU	OTSOUURKNQ	URKSU	RVKR	NOMKQ	
v	UV	e É	SUUTRRKOS	MKR	UOVQMOKQU	UPKMQ	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SNPRMSVKNO	MKT	SRQQMSTKOO	VPKTR	RVKR	NOMKQ	
qÄ	NRV	e É	ORQOVOSKTQ	MKP	OURMTNTKVP	UUKR	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	POMNQONKVM	NKR	PONUTOUKRU	VVKQS	RVKR	NOMKQ	
_á	OMV	e É	NQUPUMTKMN	MKT	NRVQNVSKTN	VPKMU	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNU

cãÉ=k~ã É MOPpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMOPyMPJ ^oyi n ` OO^ hÅ

^Åè=qãã É PLOOLOMOP=OMOONMMT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==: mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKMNS	ééÄ	RRHP	NPMKMM	NMM	
NN	_	S	k ç=d ~ë	UKNPQ	ééÄ	NHR	SQNTHMS	NMMM	
OP	k ~	QR	e É	NTRTHSQU	ééÄ	NHS	ORRNUTKQM	OMMMMM	
OQ	j Ö	QR	e É	OOPKOUP	ééÄ	RKQ	NQQQVKVP	OMMMMM	
OT	^ ä	QR	e É	OMRKPRP	ééÄ	PKQ	TTRSHSS	OMMMMM	
OU	pá	QR	e O	PSNTKNTM	ééÄ	OKV	OVPNPUKVR	NMMMM	
PV	h	QR	e É	NRTHPUS	ééÄ	SKV	PRVMQRTN	OMMMMM	
QM	` ~	QR	e O	OQSHRVT	ééÄ	NKQ	NSNTMMKMD	OMMMMM	
RN	s	UV	e É	NHRQT	ééÄ	NHS	NQNTKUU	NMMM	
RO	` ê	UV	e É	MRRRO	ééÄ	SHM	NOOSKQV	OMMM	
RR	j å	UV	e É	NPKQUM	ééÄ	OHP	SUPPKMD	OMMM	
RS	cÉ	UV	e O	ONMKMMM	ééÄ	OHP	QUPTPTKQR	NMMMM	
RV	` ç	UV	e É	MKMSM	ééÄ	NUKQ	PTPKPR	NMMM	
SM	k á	UV	e É	MKOMM	ééÄ	PNHR	OUQKQR	NMMM	
SP	` ì	UV	e É	NHPQP	ééÄ	NHP	ONOMKOM	OMMM	
SS	wå	UV	e É	UPKQVS	ééÄ	OKT	NVSOMKTQ	OMMM	
TR	^ ë	UV	e É	MKONP	ééÄ	UHP	RNHSU	NMMM	
TU	pÉ	UV	e O	MKMSU	ééÄ	OOHS	UKUP	NMMM	
UU	pê	UV	e É	OHSUT	ééÄ	RKQ	NRTPKQR	OMMM	
VR	j ç	UV	e É	MKPON	ééÄ	PRKU	OSPKPQ	NMMM	
NMT	^ Ö	UV	e É	MKMNQ	ééÄ	RRHN	PRKRR	NMM	
NNN	` Ç	UV	e É	MKMNU	ééÄ	SUHR	RKVP	NMMM	
NNU	på	NRV	e É	JMKMVR	ééÄ	k L^	PQUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNOR	ééÄ	PNKO	UMMKUT	NMMM	
NPT	_~	NRV	k ç=d ~ë	NNKPTO	ééÄ	PKT	NPTRQKUV	OMMM	
NUO	t	NRV	k ç=d ~ë	MKMMV	ééÄ	NTHR	VTTKTQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMNP	ééÄ	k L^	QSPKUQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKUQM	ééÄ	SKO	TNSUHPT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMRO	ééÄ	PUHP	OMRVMUN	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMPR	ééÄ	PTHR	OQMKOS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n ` =i çï	B n ` =¤ëÛÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NUQQVUNKOQ	MKS	ONOOPOPKQO	USKVP	RVHR	NOMKQ	
pÅ	QR	k ç=d ~ë	PUPTRRMKQM	MKR	ORNVVMMKMQ	UQKV	RVHR	NOMKQ	
pÅ	QR	e O	USTTRSHSN	NKV	NMSVRVUKVR	UNKNP	RVHR	NOMKQ	
pÅ	QR	e É	NPNUPRKUQ	MKT	NRTTPRKMO	UPHRU	RVHR	NOMKQ	
d É	TO	k ç=d ~ë	VONONOKOT	MKQ	NMSQPUQKUO	USHRR	RVHR	NOMKQ	
d É	TO	e O	PRNUTQKRP	MKT	QOOMNTKMN	UPHPU	RVHR	NOMKQ	
d É	TO	e É	NMNUTRKOT	MKQ	NOORSPHSN	UPHNO	RVHR	NOMKQ	
v	UV	e O	QMURQMSKOU	NHR	QTSOUURKNQ	URKTU	RVHR	NOMKQ	
v	UV	e É	SVNRUNKMO	MKU	UOVQMOKQU	UPHPU	RVHR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SONUSMQKNO	MKT	SRQQMSTKOO	VRKMP	RVHR	NOMKQ	
qÄ	NRV	e É	OQPNPPOKPU	MKT	OURMTNTKVP	URKOV	RVHR	NOMKQ	
_á	OMV	k ç=d ~ë	POPMQNNKTT	MKP	PONUTOUKRU	NMMKPS	RVHR	NOMKQ	
_á	OMV	e É	NQSOVRVKNU	NHP	NRVQNVSKTN	VNKTT	RVHR	NOMKQ	

p~ã éäÉ=k~ã É pn MUTSJMMNm

cãÉ=k~ã É MQQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl^ mj eyNya^q^yOMCPyMPJj ^oyi n` OQ^ hÅ

^Åè=qã É PLOQLOMCP=OMØSNR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãi íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãi m~ëë

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==ì mp==	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	OTKNOU	éé Ä	OKU	OVNNSKNQ	NMM	
NN	_	S	k ç=d ~ë	ONUKPVR	éé Ä	MKV	NROVQRKPN	NMMM	
OP	k ~	QR	e É	PUSOKSMP	éé Ä	OKT	RONNTTKVS	OMMMMM	
OQ	j Ö	QR	e É	VTTOKTMT	éé Ä	NKR	SPTOONKMQ	OMMMMM	
OT	^ ä	QR	e É	NOOOPNKSNU	éé Ä	MKV	OVOSVMVKMV	OMMMMM	
OU	pá	QR	e O	NNQPKPNR	éé Ä	TKP	VVPPMSM	NMMMM	
PV	h	QR	e É	NMRQRKVOM	éé Ä	MKT	SNUNRSKSN	OMMMMM	
QM	` ~	QR	e O	NPSVPKPQM	éé Ä	OKP	UVMOUTVKPN	OMMMMM	
RN	s	UV	e É	PSRKRVR	éé Ä	MKT	PMQOOQMKVT	NMMM	
RO	` ê	UV	e É	ONUKSSS	éé Ä	MKO	OOVOQMKRR	OMMM	
RR	j å	UV	e É	QOPKQNR	éé Ä	NKN	OOOVQNKQN	OMMM	
RS	cÉ	UV	e O	QRTOVKQMQ	éé Ä	MKQ	NNPNUOMNUKUS	NMMMMM	
RV	` ç	UV	e É	OQTKQSV	éé Ä	MKS	QQOPTMKUR	NMMM	
SM	k á	UV	e É	OUUKPQM	éé Ä	NKM	NQPPOSKPS	NMMM	
SP	` ì	UV	e É	NVUKSUN	éé Ä	MKT	OTPVRPKUO	OMMM	
SS	wå	UV	e É	SRNKOMO	éé Ä	NKO	NQTRTUKRO	OMMM	
TR	^ ë	UV	e É	SQKOPP	éé Ä	NKS	NNPVTKRN	NMMM	
TU	pÉ	UV	e O	QNKVOR	éé Ä	MKS	QNOMKTR	NMMM	
UU	pê	UV	e É	OUUKNST	éé Ä	NKM	NUMQSTKTN	OMMM	
VR	j ç	UV	e É	QPKPMR	éé Ä	NKM	OSRQPKTT	NMMM	
NMT	^ Ö	UV	e É	ONKTUO	éé Ä	NKQ	QTTUSKQT	NMM	
NNN	` Ç	UV	e É	NNNKVQV	éé Ä	NKO	POUVPKQR	NMMM	
NNU	på	NRV	e É	OORKRQU	éé Ä	OKN	NONUMSKTM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NOKVRV	éé Ä	MKS	RQPROKOO	NMMM	
NPT	_~	NRV	k ç=d ~ë	NQRVKQMV	éé Ä	NKR	NTQRPORKQS	OMMM	
NUO	t	NRV	k ç=d ~ë	OOKNSM	éé Ä	OKT	RPMNVKVP	NMMM	
OMR	qä	OMV	k ç=d ~ë	QRKTOT	éé Ä	OKO	OQQNVQKUT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NSUKRSO	éé Ä	MKU	NOPVPOQKPT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	RVKSMT	éé Ä	OKT	PVNNNNKOP	NMMM	
OPU	r	OMV	k ç=d ~ë	RSKOUU	éé Ä	MKV	PPVUSOKPP	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n` =ì çï	B n` =e åÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	NUPUVMSKOM	OKN	ONOOPOPKQO	USKSR	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVTSMMOKOV	NKM	QRNVVMMKMQ	UTKVT	RVKR	NOMKQ	
pÅ	QR	e O	VORUMVKNP	OKT	NMSVRVUKVR	USKRS	RVKR	NOMKQ	
pÅ	QR	e É	NPQTRVKMM	NKQ	NRTTPRKMO	URKQP	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VMVRQUKNO	MKS	NMSQPUQKUO	URKQR	RVKR	NOMKQ	
d É	TO	e O	PQSRPOKMU	MKU	QOOMNTKMN	UOKNN	RVKR	NOMKQ	
d É	TO	e É	NMVRMQKUT	NKN	NOORSPKSN	UO	RVKR	NOMKQ	
v	UV	e O	QQSTOOVKMP	MKT	QTSOUURKNQ	VPRTV	RVKR	NOMKQ	
v	UV	e É	TQTQRNKOT	MKV	UOVQMOKQU	VMKNO	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SNSPOOTKNR	NKV	SRQQMSTKOO	VQKNU	RVKR	NOMKQ	
qÄ	NRV	e É	OQQQNONKOO	MKN	OURMTNTKVP	URRTQ	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PNSSOPRKST	MKP	PONUTOUKRU	VUKPT	RVKR	NOMKQ	
_á	OMV	e É	NQNUVRQKRQ	NKM	NRVQNVSKTN	UVKMN	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MUTSJMMNp

cãÉ=k~ã É MQRpj mi hÇ

a~í~=m~íÜ=k~ã É a\yt ÖäÉåíyf^ mj eyNya^q^yOMCPyMPJ ^oyi n` CQ^ hÅ

^Åè=qáã É PLCQLOMCP=OMRPNMQO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ää m~ëë

n` =^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=¤l ~ë	OTKVMO	ééÄ	NKQ	PMNMVKPO	NMVM	
NN	_	S	k ç=¤l ~ë	OPVKQTO	ééÄ	MKT	NSURMUKPO	NMMM	
OP	k ~	QR	e É	PVTMKUPM	ééÄ	NKN	RQMVPVKNM	OMMMMM	
OQ	j Ö	QR	e É	VRRMKNTT	ééÄ	NKQ	SOVVPMKMT	OMMMMM	
OT	^ ä	QR	e É	NNSOTNKMPM	ééÄ	MKV	OUMTUURKVT	OMMMMM	
OU	pá	QR	e O	NOTQKRUR	ééÄ	NKV	NMURPTKMP	NMMMM	
PV	h	QR	e É	NMVOMKVSP	ééÄ	NKN	SQRRVPKMQ	OMMMMM	
QM	` ~	QR	e O	NPNOUKMRR	ééÄ	NKS	UPUQQTPKRS	OMMMMM	
RN	s	UV	e É	PSUKNPO	ééÄ	MKV	PMVRPSKVV	NMMM	
RO	` ê	UV	e É	ONQKPVS	ééÄ	MKQ	OOTNOSKMT	OMMM	
RR	j å	UV	e É	QMVKKVQ	ééÄ	MKU	ONTTOMKVM	OMMM	
RS	cÉ	UV	e O	QMTPUKQQR	ééÄ	MKU	NMVRMQQSVKVM	NMMMMM	
RV	` ç	UV	e É	OQVKSMT	ééÄ	MKR	QRMURSKUO	NMMM	
SM	k á	UV	e É	OVMKTQV	ééÄ	NKQ	NQSMPNKPO	NMMM	
SP	` ì	UV	e É	OMSKPUR	ééÄ	NKP	OUTROTKNM	OMMM	
SS	wå	UV	e É	RVNKSQT	ééÄ	MKU	NPRTPPKTU	OMMM	
TR	^ ë	UV	e É	SPKTPN	ééÄ	NKU	NNQOTKOM	NMMM	
TU	pÉ	UV	e O	QOKVNR	ééÄ	OKM	QOMNKTT	NMMM	
UU	pê	UV	e É	OVPKTNP	ééÄ	MKT	NURUSTKNU	OMMM	
VR	j ç	UV	e É	QOKVOM	ééÄ	NKO	OTUNRKOS	NMMM	
NMT	^ Ö	UV	e É	OOKSUR	ééÄ	OKQ	RMOUQKQQ	NMM	
NNN	` Ç	UV	e É	NNPKMTU	ééÄ	MKU	PPRTPKST	NMMM	
NNU	på	NRV	e É	OPSKRNP	ééÄ	OKQ	NPMPVTKUM	NMMM	
NON	pÄ	NRV	k ç=¤l ~ë	NPKTUO	ééÄ	OKN	RUNMTKUT	NMMM	
NPT	_~	NRV	k ç=¤l ~ë	NQTNKVPN	ééÄ	MKU	NTTMPRTKOM	OMMM	
NUO	t	NRV	k ç=¤l ~ë	ONKPSS	ééÄ	NKO	RNQPUKPT	NMMM	
OMR	qä	OMV	k ç=¤l ~ë	QUKMQD	ééÄ	NKT	ORTNVPKQO	NMMM	
OMU	mÄ	OMV	k ç=¤l ~ë	NSMKOTR	ééÄ	NKP	NNVNOOSKMO	OMMM	
OPO	qÜ	OMV	k ç=¤l ~ë	RVMSPP	ééÄ	MKV	PVRRRVKOT	NMMM	
OPU	r	OMV	k ç=¤l ~ë	RTKOVO	ééÄ	NKM	PQVSVMKQO	NMMM	

n` =fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ ÉÅ	B n` =¡ çï	B n` =¤ äÜÜ	n` =¤ä~Ö
i á	S	k ç=¤l ~ë	NUQUOUQKSP	MKT	ONOOPOPKQO	UTKMV	RVKR	NOMKQ	
pÅ	QR	k ç=¤l ~ë	QMNNUVTKTU	MKP	QRNVVMMKMQ	UUKRQ	RVKR	NOMKQ	
pÅ	QR	e O	VMVQUTKPQ	RKM	NMSVRVUKVR	URKMP	RVKR	NOMKQ	
pÅ	QR	e É	NPSNNPKOQ	MKS	NRTTPRKMO	USKOV	RVKR	NOMKQ	
d É	TO	k ç=¤l ~ë	VONUTRKNN	MKT	NMSQPUQKUO	USKSN	RVKR	NOMKQ	
d É	TO	e O	PQPNOUKMO	PKP	QOOMNTKMN	UNKPN	RVKR	NOMKQ	
d É	TO	e É	NMNRMQKQT	NKO	NOORSPKSN	UOKUO	RVKR	NOMKQ	
v	UV	e O	QQROMRUKUO	PKP	OTSOUURKNQ	VPKQT	RVKR	NOMKQ	
v	UV	e É	TRROROQKSV	MKR	UOVQMOKQU	VNKVS	RVKR	NOMKQ	
qÄ	NRV	k ç=¤l ~ë	SNVTVSUKQR	MKV	SRQQMSTKOO	VQKTN	RVKR	NOMKQ	
qÄ	NRV	e É	OQVSNOTKTP	NKO	OURMTNTKVP	UTKRS	RVKR	NOMKQ	
_á	OMV	k ç=¤l ~ë	POMMVUNKUS	NKR	PONUTOUKRU	VVKQR	RVKR	NOMKQ	
_á	OMV	e É	NOSOMONKOS	MKQ	NRVQNVSKTN	VNKTN	RVKR	NOMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` NQfj pO
cáÉ=k~ã É	MQSi` pl KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉåíyf` mj eyNya^q^yOMOPyMPJj ^oyin` OQ^kÄ
^Åè=qãã É	PLOQLOMOP=OMMPSVPM
p~ã éäÉ=qóéÉ	m_
qçí~ä=aäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iãã á	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMVR	ééÄ	kL^	NMSKST	MKR	
_	NN	S	kç=d~ë	PKVSV	ééÄ	PKO	PQSMKQT	NM	
k~	OP	QR	eÉ	QQKUSO	ééÄ	NTKN	QUPTMKTS	RMM	
jÖ	OQ	QR	eÉ	PSKSPT	ééÄ	NKV	ORSVKON	RM	
^ä	OT	QR	eÉ	NNPKMUO	ééÄ	VKO	RSRRKSU	RM	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
pá	OU	QR	eO	ONKRPO	ééÄ	NQKS	ONURKUN	ORM	
h	PV	QR	eÉ	NRPKQVQ	ééÄ	NNKR	PSMRMKMV	RMM	
`~	QM	QR	eO	VPKRQP	ééÄ	NNKU	SUTVMKPP	RM	m_=SMOM=c~âë=aça
s	RN	UV	eÉ	NKNPV	ééÄ	OKV	NNNTKUQ	OKR	
`ê	RO	UV	eÉ	NKNMU	ééÄ	PKT	NTURKNN	OKR	
jå	RR	UV	eÉ	MKUMQ	ééÄ	NTKS	STPKOO	N	
cÉ	RS	UV	eO	NQNKQVR	ééÄ	ONKO	POTUTSKVP	RM	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
`ç	RV	UV	eÉ	MKROQ	ééÄ	NQKR	VUSKTQ	MKR	m_=SMOM=c~âë=aça
ká	SM	UV	eÉ	NKMMQ	ééÄ	NOKM	SSNKNQ	N	m_=SMOM=c~âë=aça
`ì	SP	UV	eÉ	MKVSO	ééÄ	PKO	NSRQKRU	NKR	
wå	SS	UV	eÉ	JUKQTT	ééÄ	kL^	SURKRU	R	m_=SMOM=c~âë=aça
^ë	TR	UV	eÉ	MKOVT	ééÄ	OVKS	SSKPQ	OKR	
pÉ	TU	UV	eO	MKPNN	ééÄ	NNKU	PMKST	OKR	
pê	UU	UV	eÉ	MKUMR	ééÄ	NOKT	QUUKVN	OKR	
jç	VR	UV	eÉ	MKSQO	ééÄ	NMKO	QRMKMO	OKR	
^Ö	NMT	UV	eÉ	MKVRU	ééÄ	NPKR	NORKRS	MKR	
`Ç	NNN	UV	eÉ	MKOPM	ééÄ	OPKU	SQKMU	MKR	
på	NNU	NRV	eÉ	QMKUMS	ééÄ	PKQ	OOPVRKRU	OKR	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKNTS	ééÄ	NQKS	VUQKQN	MKR	
_~	NPT	NRV	kç=d~ë	PKVMU	ééÄ	NKS	QSNRKTQ	N	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
t	NUO	NRV	kç=d~ë	MKOSN	ééÄ	NNKU	NPMNKQR	OKR	
qä	OMR	OMV	kç=d~ë	MKQOO	ééÄ	UKR	OTNPKNS	MKR	
mÄ	OMU	OMV	kç=d~ë	MKSSP	ééÄ	UKN	RSPSKQR	MKR	m_=SMOM=c~âë=aça
qÜ	OPO	OMV	kç=d~ë	MKTRO	ééÄ	PKU	SQURKNU	OKR	
r	OPU	OMV	kç=d~ë	MKNQM	ééÄ	NSKN	URMKVP	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NUCCROMSO	OKM	ONCCPCPKQO	URKUT	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	PUUNSMRKQT	OKN	QRNVVMMKMQ	URKUU	RVKR	NOMQ	
pÅ	QR	eO	UTNQRUKVQ	NKU	NMSVRVUKVR	UNKQU	RVKR	NOMQ	
pÅ	QR	eÉ	NPPNUTKUU	NKT	NRTTPRKMO	UQKQQ	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VOMQPPKNO	NKM	NMSCPUQKUO	USKQU	RVKR	NOMQ	
dÉ	TO	eO	PRPQNQKSU	MKR	QCOMNTKMN	UPKTQ	RVKR	NOMQ	
dÉ	TO	eÉ	NMCOUUKTM	MKS	NOCRSPKSN	UPKQS	RVKR	NOMQ	
v	UV	eO	QMUQMMSKNN	NKV	QTSOUURKNQ	URKTR	RVKR	NOMQ	
v	UV	eÉ	TMMMNNKMM	NKM	UOVQMOKQU	UQKQ	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	SMQRUPNKUU	NKS	SRQQMSTKOO	VOKPV	RVKR	NOMQ	
qÄ	NRV	eÉ	OQQQPRRKRV	NKN	OURMTNTKVP	URKSU	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PNNRMVSKMR	OKM	PONUTOUKRU	VSKTU	RVKR	NOMQ	
_á	OMV	eÉ	NQQMTTOKRM	MKT	NRVQNVSKTN	VMKPU	RVKR	NOMQ	

`çåíaåì åaÖ=~ëäÁê~íáçå=sÉêáÑáÅ~íáçå=É``sF=oÉéçê

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MQTJ``sKÇ
a~í~=m~íÜ=k~ã É	aWy^ÖãÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n``OQ^kÁ
^Åè=qáã É	PLOQLOMOP=OMQNMPV
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑc ãÉk~ã É	MVS^i_KÇ
p~ã éáÉ=n``=m~ëëlcá~ä	m~ëë
fpqa=n``=m~ëëlc~áä	m~ëë
l éÉê~íçê	**~Çã áå**

n``=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÁ	B i çï	B eäÜÜ	n``=c ä-Ö
V	_É	S	k ç=d ~ë	OQKTRQ	éëÄ	NKU	NPVVTUHPP	CR	VVKMO	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OQKUPN	éëÄ	OKM	VOOMNKRT	CR	VVKPO	UVKU	NNMO	
OP	k ~	CR	e É	RPNUKTQT	éëÄ	MKR	PPUOVTNKQT	RMMM	NMSKPT	UVKU	NNMO	
OQ	j Ö	CR	e É	RPQSKSOS	éëÄ	NKQ	NTSUSQOKOP	RMMM	NMSKVP	UVKU	NNMO	
OT	^ä	CR	e É	RNUKOOV	éëÄ	NKP	SRUSRKUO	RMM	NMPKSR	UVKU	NNMO	
OU	pá	CR	e O	RNNKMPU	éëÄ	NKO	OOPQTOKMR	RMM	NMOKON	UVKU	NNMO	
PV	h	CR	e É	RNUPKNMQ	éëÄ	MKU	NRMMOSMKTP	RMMM	NMPKSS	UVKU	NNMO	
QM	` ~	CR	e O	RNVUKONR	éëÄ	MKV	NTMTNVORKNS	RMMM	NMPKVS	UVKU	NNMO	
RN	s	UV	e É	ORKNTQ	éëÄ	MKT	NMNOSMRN	CR	NMMKT	UVKU	NNMO	
RO	` ê	UV	e É	ORKQMU	éëÄ	MKU	NOUUSVKPM	CR	NMNKSP	UVKU	NNMO	
RR	j å	UV	e É	ORKNQQ	éëÄ	NKR	SQNMMKON	CR	NMMKRU	UVKU	NNMO	
RS	cÉ	UV	e O	RMUUKNNN	éëÄ	NKV	RVUTUUOMKR	RMMM	NMNKTS	UVKU	NNMO	
RV	` ç	UV	e É	ORKRSR	éëÄ	NKS	OOMSNVKPU	CR	NMOKOS	UVKU	NNMO	
SM	k á	UV	e É	ORKTOP	éëÄ	NKV	SNUOOKVP	CR	NMOKUV	UVKU	NNMO	
SP	` ì	UV	e É	ORKSRV	éëÄ	MKR	NTTMVNTKNN	CR	NMOKSQ	UVKU	NNMO	
SS	wå	UV	e É	ORKMOU	éëÄ	NKN	OVQNVKMT	CR	NMMKNN	UVKU	NNMO	
TR	^ë	UV	e É	ORKMTP	éëÄ	NKS	ONQRSKTM	CR	NMMKOV	UVKU	NNMO	
TU	pÉ	UV	e O	OQKSUU	éëÄ	NKM	NNRPMKTO	CR	VUKTR	UVKU	NNMO	
UU	pê	UV	e É	ORKSRP	éëÄ	NKS	TTRRQKSM	CR	NMOKSN	UVKU	NNMO	
VR	j ç	UV	e É	OQKQTV	éëÄ	MKQ	TOORUKTQ	CR	VTKVO	UVKU	NNMO	
NMT	^Ö	UV	e É	ORKOVP	éëÄ	MKQ	OSTTUSKUN	CR	NMNKNT	UVKU	NNMO	
NNN	` Ç	UV	e É	ORKQVU	éëÄ	MKU	PSNSNKMP	CR	NMNKVV	UVKU	NNMO	
NNU	på	NRV	e É	OQKUTT	éëÄ	OKM	SVOPMKSQ	CR	VVKRN	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKRTR	éëÄ	MKT	ROMTSRKTM	CR	VUKP	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKPTU	éëÄ	NKR	NRQMRUKON	CR	NMNKRN	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OQKVQV	éëÄ	MKU	OVVSNNKSU	CR	VVKU	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	OQKSSR	éëÄ	MKT	SRMPQNKTN	CR	VUKSS	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	ORKSNM	éëÄ	MKR	VPUUTQKPP	CR	NMOKQQ	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OQKVTQ	éëÄ	MKS	UNRNMNKNM	CR	VVKV	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	ORKUUQ	éëÄ	NKM	TTVNMRKQQ	CR	NMPKRQ	UVKU	NNMO	

n``=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n``=ç ïï	B n``=c äÜÜ	n``=c ä-Ö
i á	S	k ç=d ~ë	NVQPNONKVS	NKU	ONOOPOPKQO	VNKRS	RVRR	NOMQ	
pÅ	CR	k ç=d ~ë	PVQVQURKSQ	NKO	QRNVVMMMVQ	UTKPU	RVRR	NOMQ	
pÅ	CR	e O	VPRSNQKNM	NKN	NMSVRVUKVR	UTKQT	RVRR	NOMQ	
pÅ	CR	e É	NPSTQUKVQ	MKS	NRTTPRKMO	USKT	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VQVRVUKNV	MKT	NMSQPUQKUO	UVKOO	RVRR	NOMQ	
d É	TO	e O	PTMUOTKUT	NKP	QOOMNTKMN	UTKUT	RVRR	NOMQ	
d É	TO	e É	NMSSVTKPS	NKT	NOORSPKSN	UTKMR	RVRR	NOMQ	
v	UV	e O	QOQTUQSKRU	MKT	QTSOUURKNQ	UVKNV	RVRR	NOMQ	
v	UV	e É	TONRMQKSU	MKR	UOVQMOKQU	USKVV	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SORRSRNKVR	MKS	SRQQMSTKOO	VRKRV	RVRR	NOMQ	
qÄ	NRV	e É	ORNNRNSKQV	MKS	OURMTNTKVP	UUKN	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PNRSUOMKMN	NKP	PONUTOUKRU	VUKMU	RVRR	NOMQ	
_á	OMV	e É	NQSMSNRKSR	MKU	NRVQNVSKTN	VNKSO	RVRR	NOMQ	

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MOLJ``_KÇ

a~í~=m~íÜ=k~ã É aWj^ÖäÉáíÝ^mj eyNya^q^yOMOPyMPJ ^oyi n`OQ^kÅ

^Åè=qáã É PLOQLOMOP=OMRRNMMO

p~ã éáÉ=qóéÉ ``_

qçí~äa äã íáç~å NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑcäÉk~ã É MMS^i_KÇ

p~ã éáÉ=n`=m~ëëlc~äã c~äã

fpqa=n`=m~ëëlc~äã m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==\ mp==	iãáá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MKMNT	ééÄ	NMKQ	COMKMN	MO	
NN	_	S	kç=d~ë	MKPNQ	ééÄ	TKR	NVCRKTO	Q	
CP	k~	CR	eÉ	CKPUT	ééÄ	COCKU	CURNNKQM	CMM	
CQ	j Ö	CR	eÉ	RKTTN	ééÄ	UKM	COMMKCR	CM	
CT	^ä	CR	eÉ	JNVKRRV	ééÄ	kL^	TCQKQU	CM	c~äÉÇ=a ça
CU	pá	CR	eO	MKSPT	ééÄ	PCKQ	TSMKUO	NMM	
PV	h	CR	eÉ	COKSCU	ééÄ	NCKP	PSRVSKMU	CMM	
QM	`~	CR	eO	TKNVT	ééÄ	CKO	PSUMMKPU	CM	
RN	s	UV	eÉ	MKMCQ	ééÄ	NVMS	PRNKNO	N	
RO	`ê	UV	eÉ	MKMCU	ééÄ	NSKN	VMCKRO	N	
RR	j å	UV	eÉ	JMKMPN	ééÄ	kL^	CNTHPM	MQ	
RS	cÉ	UV	eO	SKMV	ééÄ	NKN	VPMRNKSO	CM	
RV	` ç	UV	eÉ	MKMCQ	ééÄ	CPKU	PPTKUM	MO	
SM	ká	UV	eÉ	JMKMU	ééÄ	kL^	NVMKMM	MQ	
SP	` ì	UV	eÉ	MKMNV	ééÄ	CQCKV	RUPHPS	MS	
SS	wå	UV	eÉ	JCKNCP	ééÄ	kL^	CPSKST	O	c~äá^ äáíj ÉÍÜçÇë& c~äÉÇ=a ça
TR	^ë	UV	eÉ	MKMOT	ééÄ	OVKT	CQCKST	N	
TU	pÉ	UV	eO	MKMRM	ééÄ	UKV	OTHKM	N	
UU	pê	UV	eÉ	MKMPS	ééÄ	CPKV	NPCKCP	N	
VR	j ç	UV	eÉ	MKNTP	ééÄ	UKM	SCCKCR	N	
NMT	^Ö	UV	eÉ	MKMCO	ééÄ	CKN	CCLUKVM	MO	
NNN	`Ç	UV	eÉ	MKMCP	ééÄ	NCKR	PCKCR	MO	
NNU	på	NRV	eÉ	JMKMNN	ééÄ	kL^	CSPHPR	N	
NCN	pÄ	NRV	kç=d~ë	MKMPQ	ééÄ	CNKQ	NVPNKNP	MO	
NPT	_~	NRV	kç=d~ë	MKMVQ	ééÄ	NCKV	SOMKST	MQ	
NUO	t	NRV	kç=d~ë	MKNRN	ééÄ	NNKM	OSNSKPU	N	
OMR	qä	OMV	kç=d~ë	MKMTP	ééÄ	SKQ	CCRCKUP	MO	
OMU	mÄ	OMV	kç=d~ë	MKMOV	ééÄ	TKV	NVNRKCP	MO	
OPO	qÜ	OMV	kç=d~ë	MKMSN	ééÄ	CKR	PSUTKUN	N	
OPU	r	OMV	kç=d~ë	MKMCU	ééÄ	SKU	URTHSM	MO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j ÇÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=íçï	Bn`=cäÜÜ	n`=c~ä~Ö
iá	S	kç=d~ë	NVSPNNMKUV	NKP	CNCCPCPKQO	VCKR	RVKR	NCMKQ	
pÅ	CR	kç=d~ë	CNOTNUUKTO	MKO	CRNVVMMKMQ	VNKPN	RVKR	NCMKQ	
pÅ	CR	eO	VRPMCSKMS	NKM	NMSVRVUKVR	UVKN	RVKR	NCMKQ	
pÅ	CR	eÉ	NQNTUCKRV	MKU	NRTTPRKMO	UVKUV	RVKR	NCMKQ	
dÉ	TO	kç=d~ë	NMMCCUUKTU	MKU	NMSCPUQKUO	VQKNT	RVKR	NCMKQ	
dÉ	TO	eO	PUTCCQKQU	MKS	QCCMNTKMN	VNKTS	RVKR	NCMKQ	
dÉ	TO	eÉ	NNCMCRKNR	CKP	NCCRSPHSN	VNKQO	RVKR	NCMKQ	
v	UV	eO	CPUCNVCKSS	MKT	CJTSCUURKNQ	VCKMN	RVKR	NCMKQ	
v	UV	eÉ	TRRTPTHSP	MKN	UCVCMCKQU	VNKNO	RVKR	NCMKQ	
qÄ	NRV	kç=d~ë	SQSNUNCKVO	NKN	SRQCMSTKOO	VUKTQ	RVKR	NCMKQ	
qÄ	NRV	eÉ	OSRCPNQKRR	NKQ	CURMTNTKVP	VPKMQ	RVKR	NCMKQ	
_á	OMV	kç=d~ë	PNTUROVKCR	CKM	PCNUTCUKRU	VUKTR	RVKR	NCMKQ	
_á	OMV	eÉ	NRMRPQCKTN	MKU	NRVCNVSKTN	VCKCP	RVKR	NCMKQ	

i ~ÄçêíçêóÈçåíêçäæp~ã éäÉÈi `pF¤oÉéçã

p~ã éäÉÈk~ã É	i ` Cl n ` NQj pO
cäÉÈk~ã É	MQMi ` pl lÇ
a~í~¤m~íÜÈk~ã É	aWi^ÖäÉáíyf` mj eyNya^q^yOMCPyMPuj ^oyi n ` CQQ^lÄ
^Åè¤qãã É	PLCQLOMCP¤OMRSWMU
p~ã éäÉ¤qóéÉ	i ` pl
qçí~äæäãi íáçå	RKMMMM
` çã ã Éãáí	JJJ
fpqa¤oÉÑcäÉk~ã É	MMS` ^i _lÇ
p~ã éäÉ¤n ` ¤m~ëëlcá~ä	m~ëë
fpqa¤n ` ¤m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åã**

n ` ¤^å~äöíÉ¤q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==¤ mp==	bñés~ä	B¤oÉÄ	B i çï	B eáÖÜ	n ` ¤cä-Ö
_É	V	S	k ç¤dl~ë	QVKRUP	éëÄ	NKT	RONOSKNU	RIM	NVKUP	TVKR	NOMQ	
_	NN	S	k ç¤dl~ë	QUQKOQU	éëÄ	NKN	PPNTVMKPU	RIMM	NVKPT	TVKR	NOMQ	
k~	OP	QR	e É	TTNMKVOT	éëÄ	NKS	VTSMRRKMU	TRIMM	OMRS	TVKR	NOMQ	
j Ö	OQ	QR	e É	QVRMKUQP	éëÄ	NKV	PNSMONKRU	RIMMM	NVKU	TVKR	NOMQ	
^ä	OT	QR	e É	NVPQKMPN	éëÄ	NKR	QUNSMKOO	OIMMM	NVKPQ	TVKR	NOMQ	
pá	OU	QR	e O	VOQKSQM	éëÄ	NKV	TUNRVKSU	NIMMM	NUKQV	TVKR	NOMQ	
h	PV	QR	e É	VSMVKQON	éëÄ	NKO	RRPSTRKQS	NIMMMM	NVKOO	TVKR	NOMQ	
` ~	QM	QR	e O	ORONKPSU	éëÄ	OKS	NSNMRQRKSP	ORMM	OMKOP	TVKR	NOMQ	
s	RN	UV	e É	QUPKSVS	éëÄ	MKV	PTRSMMKPR	RIMM	NVKPR	TVKR	NOMQ	
`ê	RO	UV	e É	NVRKSQS	éëÄ	MKS	NVNRMOKOO	OMM	NVKRS	TVKR	NOMQ	
j å	RR	UV	e É	QUUKQUR	éëÄ	MKU	OQMMNSKSS	RIMM	NVKRQ	TVKR	NOMQ	
cÉ	RS	UV	e O	NMOSKTNP	éëÄ	NKT	OPOSMNUKOM	NIMMM	OMKRP	TVKR	NOMQ	
` ç	RV	UV	e É	RMNKPRP	éëÄ	NKM	UPSPSOKSO	RIMM	OMKVR	TVKR	NOMQ	
ká	SM	UV	e É	RMPKPNO	éëÄ	NKT	OPPPSTKST	RIMM	OMKNP	TVKR	NOMQ	
` ì	SP	UV	e É	ORQKQUO	éëÄ	MKQ	POQUMMKTU	ORM	OMKO	TVKR	NOMQ	
wå	SS	UV	e É	QVUKSSM	éëÄ	NKS	NMSMPVKQV	RIMM	NVKVR	TVKR	NOMQ	
^ë	TR	UV	e É	VSKNOO	éëÄ	MKT	NRVNMKTP	NIMM	NVKOO	TVKR	NOMQ	
pÉ	TU	UV	e O	VQKTOO	éëÄ	MKV	UQUTKRN	NIMM	NUKVQ	TVKR	NOMQ	
pê	UU	UV	e É	QTRKRNQ	éëÄ	MKS	OTTVPTKTM	RIMM	NVKMO	TVKR	NOMQ	
j ç	VR	UV	e É	VUKQOO	éëÄ	MKQ	RSNVPKMU	NIMM	NVKSU	TVKR	NOMQ	
^Ö	NMT	UV	e É	QUKSVQ	éëÄ	MKU	VVSUVKOR	RIM	NVKQU	TVKR	NOMQ	
` Ç	NNN	UV	e É	OQMVKOT	éëÄ	NKT	SSMSSKNR	ORM	NVKOT	TVKR	NOMQ	
på	NNU	NRV	e É	RNNKRVP	éëÄ	MKS	OUMPSQKPP	RIMM	OMKQS	TVKR	NOMQ	
pÄ	NON	NRV	k ç¤dl~ë	VNKNNR	éëÄ	NKO	PUOMTUKUQ	NIMM	NUKOO	TVKR	NOMQ	
_~	NPT	NRV	k ç¤dl~ë	NVUVKVRV	éëÄ	NKM	OPUVRSOKON	OIMMM	NVKV	TVKR	NOMQ	
t	NUO	NRV	k ç¤dl~ë	NMPKNNM	éëÄ	NKN	OQRMVQKTN	NIMM	OMKSO	TVKR	NOMQ	
qä	OMR	OMV	k ç¤dl~ë	VRKOPU	éëÄ	MKR	RIPUMOKOU	NIMM	NVKMR	TVKR	NOMQ	
mÄ	OMU	OMV	k ç¤dl~ë	VTKURQ	éëÄ	MKO	TNVTNPKPQ	NIMM	NVKRT	TVKR	NOMQ	
qÜ	OPO	OMV	k ç¤dl~ë	VNKPVQ	éëÄ	MKT	RVUTNQKOP	NIMM	NUKOU	TVKR	NOMQ	
r	OPU	OMV	k ç¤dl~ë	VUKPOS	éëÄ	MKP	RVPRUPKOS	NIMM	NVKSS	TVKR	NOMQ	

n ` ¤fpqa¤q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä=Ö
iá	S	kç=d~ë	NUMPUQUMST	OKM	ONCOPOPKQO	UQKVV	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PUTQNPRKOR	MKS	QRNVVMMKMQ	URKTN	RVKR	NOMQ	
pÅ	QR	eO	VMNMVUKUT	OKM	NMSVRVUKVR	UQKCR	RVKR	NOMQ	
pÅ	QR	eÉ	NPNUVPKUR	OKN	NRTTPRKMO	UPKSO	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VPMVTVKTP	MKO	NMSCPUQKUO	UTKQT	RVKR	NOMQ	
dÉ	TO	eO	PRSPTMKNR	MKU	QCOMNTKMN	UQKQQ	RVKR	NOMQ	
dÉ	TO	eÉ	NMPPNPKOU	NKO	NOORSPKSN	UQKOV	RVKR	NOMQ	
v	UV	eO	QMTQNPOKQS	MKT	QTSOUURKNQ	URKRQ	RVKR	NOMQ	
v	UV	eÉ	SVTRUQKOM	NKN	UOVQMOKQU	UQKNN	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SNUUQPRKNN	NKN	SRQQMSTKOO	VQKRT	RVKR	NOMQ	
qÄ	NRV	eÉ	OQURQNMKPQ	MKU	OURMTNTKVP	UTKNV	RVKR	NOMQ	
_á	OMV	kç=d~ë	PNSRTUQKNP	MKR	PONUTOUKRU	VUKPS	RVKR	NOMQ	
_á	OMV	eÉ	NQRVUONKVR	MKQ	NRVQNVSKTN	VNKRT	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` pl n ` NQfj pO
cáÉ=k~ã É	MRMj m_KÇ
a~í~=m~íÜ=k~ã É	aWi^ÖäÉáíy^ mj eyNya^q^yOMOPyMPJj ^oyi n ` OQ^kÄ
^Åè=qáã É	PLOQLOMOP=ONMMPMRP
p~ã éäÉ=qóéÉ	i ` pl
qçí~äaäãíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑ=cäÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åä**

n ` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==i mp==	bñés~ä	B=oÉÁ	B i çï	B eáÖÜ	n ` =c ä-Ö
_É	V	S	k ç=dl~ë	QUKSQO	éëÄ	NKN	RNNSUKPM	RM	NVKQS	TVKR	NOMQ	
_	NN	S	k ç=dl~ë	QUPKRPP	éëÄ	NKM	PPNRMVKUU	RMM	NVKPQ	TVKR	NOMQ	
k~	OP	QR	e É	TTVTKMTP	éëÄ	NKM	VTTUMRKPV	TRMM	OMKTV	TVKR	NOMQ	
j Ö	OQ	QR	e É	RMOOKTQV	éëÄ	NKP	PNTTVOKTU	RMMM	OMKW	TVKR	NOMQ	
^ä	OT	QR	e É	NVSMKPTN	éëÄ	NKU	QUPQUKQR	OMMM	NVKS	TVKR	NOMQ	
pá	OU	QR	e O	VTNKMQO	éëÄ	MKU	UMMMUKPR	NMMM	NVKQO	TVKR	NOMQ	
h	PV	QR	e É	VSVOKUTV	éëÄ	MKU	RRPOVTKPQ	NMMMM	NVKPV	TVKR	NOMQ	
` ~	QM	QR	e O	ORTSKOON	éëÄ	MKR	NRVVORSKRO	ORMM	OMKSN	TVKR	NOMQ	
s	RN	UV	e É	QUTKMNV	éëÄ	MKV	PTPOTQKOT	RMM	NVKQU	TVKR	NOMQ	
`ê	RO	UV	e É	NVVKPOO	éëÄ	NKP	NVORRTKRU	OMM	NVKVP	TVKR	NOMQ	
j å	RR	UV	e É	QVRKTMM	éëÄ	NKN	OQMQMRKSM	RMM	NVKUP	TVKR	NOMQ	
cÉ	RS	UV	e O	NMNPKTPQ	éëÄ	NKU	OOVQMTRKUQ	NMMM	OMKOT	TVKR	NOMQ	
` ç	RV	UV	e É	RNOKSRO	éëÄ	MKU	UQQNPPKVT	RMM	OMKRN	TVKR	NOMQ	
ká	SM	UV	e É	RMRKVPM	éëÄ	NKO	OPNRPNKMM	RMM	OMKOQ	TVKR	NOMQ	
` ì	SP	UV	e É	ORQKUPR	éëÄ	NKP	POMMQSKTM	ORM	OMKOP	TVKR	NOMQ	
wå	SS	UV	e É	RMRKSSN	éëÄ	NKN	NMSNNSKTM	RMM	OMKOP	TVKR	NOMQ	
^ë	TR	UV	e É	VTKOUT	éëÄ	MKT	NRUVRKPT	NMM	NVKQS	TVKR	NOMQ	
pÉ	TU	UV	e O	VSKOMT	éëÄ	NKM	USNNKQO	NMM	NVKOQ	TVKR	NOMQ	
pê	UU	UV	e É	QUQKMOR	éëÄ	NKM	OTVORVKVM	RMM	NVKPS	TVKR	NOMQ	
j ç	VR	UV	e É	VUKQTU	éëÄ	MKU	RRRMSKVQ	NMM	NVKT	TVKR	NOMQ	
^Ö	NMT	UV	e É	QVKTRV	éëÄ	NKV	NMVRQVKQO	RM	NVKV	TVKR	NOMQ	
` Ç	NNN	UV	e É	OQTKRMV	éëÄ	NKP	SSVVRKSM	ORM	NVKU	TVKR	NOMQ	
på	NNU	NRV	e É	RORKSNU	éëÄ	MKQ	QUPMOUKVO	RMM	ONKMO	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl~ë	VPKNNS	éëÄ	MKR	PURQQMSR	NMM	NUKSO	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl~ë	OMPTKSRU	éëÄ	NKM	OQNRPQVKRS	OMMM	OMKPU	TVKR	NOMQ	
t	NUO	NRV	k ç=dl~ë	NMPKUUP	éëÄ	MKS	OQPTRTKQP	NMM	OMKTU	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl~ë	VRKUMN	éëÄ	NKU	RMRUUSKRN	NMM	NVKNS	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl~ë	VUKQRM	éëÄ	NKM	TOOUOQKTU	NMM	NVKSV	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl~ë	VQKSTV	éëÄ	OKM	SNVMOQKPN	NMM	NUKVQ	TVKR	NOMQ	
r	OPU	OMV	k ç=dl~ë	VVKTTO	éëÄ	NKV	SMNNVPKTT	NMM	NVKVR	TVKR	NOMQ	

n ` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=`çåíêçä=p~ã éäÉ=Ei `pF=oÉéçê

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÖÜ	n ` =cä~Ö
i á	S	k ç=d ~ë	NUMQUMMKOP	MKS	ONOOPOPKQO	URKMQ	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PURPVRMKRU	MKR	QRNVVMMKMQ	URKOT	RVKR	NOMKQ	
pÅ	QR	e O	UTUPVPKMP	NKO	NMSVRVUKVR	UOKNO	RVKR	NOMKQ	
pÅ	QR	e É	NPMTMTKQT	MKR	NRTTPRKMD	UOKUT	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VPNPSMKQM	NKR	NMSQPUQKUO	UTKR	RVKR	NOMKQ	
d É	TO	e O	PRSOMTKVP	MKO	QOOMNTKMN	UQKQN	RVKR	NOMKQ	
d É	TO	e É	NMORONKSQ	NKQ	NOORSPKSN	UPKSR	RVKR	NOMKQ	
v	UV	e O	QMSVVTQKRU	MKV	QTSOUURKNQ	URKQR	RVKR	NOMKQ	
v	UV	e É	SUUSONKMS	NKP	UOVQMOKQU	UPKMP	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SNMURRUKST	MKP	SRQQMSTKOO	VPKPQ	RVKR	NOMKQ	
qÄ	NRV	e É	OQQOOUUKNV	NKO	OURMTNTKVP	URKST	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PNSMRVPKNP	NKU	PONUTOUKRU	VUKNV	RVKR	NOMKQ	
_á	OMV	e É	NQOVOSMKSO	MKU	NRVQNVSKTN	UVKSR	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NNUUUMMN

cãÉ=k~ã É MRNpj mi lÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^kÄ

^Åè=qãã É PLCQLOMCP=ONMNNQQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKONT	ééÄ	ONKU	PQPKPQ	NMM	
NN	_	S	k ç=d ~ë	QKTQM	ééÄ	SKP	QMNSKNV	NMMM	
OP	k ~	QR	e É	SVKNMP	ééÄ	NUKU	QVUUTKSQ	OMMMMM	
OQ	j Ö	QR	e É	NMVKUVP	ééÄ	OKS	TMUQKON	OMMMMM	
OT	^ ä	QR	e É	RMVMKTTQ	ééÄ	MKO	NNVSVOKQQ	OMMMMM	
OU	pá	QR	e O	NTQVKTTM	ééÄ	MKV	NQQSRMKU	NMMMM	
PV	h	QR	e É	OQRKOUT	ééÄ	OKM	PVVUOKMT	OMMMMM	
QM	` ~	QR	e O	NSRKSPV	ééÄ	MKP	NNOUVOKPR	OMMMMM	
RN	s	UV	e É	NTKORN	ééÄ	MKU	NQOMNKUP	NMMM	
RO	` ê	UV	e É	NTKRMQ	ééÄ	NKP	NURCUKSN	OMMM	
RR	j å	UV	e É	OTKNQQ	ééÄ	MKP	NQNUNKTT	OMMM	
RS	cÉ	UV	e O	OQPMKMV	ééÄ	MKT	RUCCUUTKSU	NMMMM	
RV	` ç	UV	e É	MKTRN	ééÄ	TKR	NQCCKPR	NMMM	
SM	k á	UV	e É	NKUPT	ééÄ	VKS	NMVMKMS	NMMM	
SP	` ì	UV	e É	PKTUR	ééÄ	PKS	RRMOKPM	OMMM	
SS	wå	UV	e É	JOKUPV	ééÄ	k L^	NVPQKSN	OMMM	
TR	^ ë	UV	e É	QKOPR	ééÄ	OKP	TUOKQQ	NMMM	
TU	pÉ	UV	e O	MKRVM	ééÄ	NTKT	RUKUP	NMMM	
UU	pê	UV	e É	SKSSS	ééÄ	NKO	QMUMKSU	OMMM	
VR	j ç	UV	e É	NKQSV	ééÄ	NKN	VRUKVQ	NMMM	
NMT	^ Ö	UV	e É	MKMSS	ééÄ	VKS	NQTKTU	NMM	
NNN	` Ç	UV	e É	MKMVR	ééÄ	TKN	RSKST	NMMM	
NNU	på	NRV	e É	PUKONM	ééÄ	NKO	ONNUVKNR	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOTM	ééÄ	SKR	NQMOKUU	NMMM	
NPT	_~	NRV	k ç=d ~ë	OOKVQS	ééÄ	MKT	OTSQTKQQ	OMMM	
NUO	t	NRV	k ç=d ~ë	MKSUV	ééÄ	NQKN	OPROKTM	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKPQU	ééÄ	NQKM	OQQSKNP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OMKVPN	ééÄ	MKQ	NRNSUUKSV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NMTKTNM	ééÄ	MKR	TOOUTUKUV	NMMM	
OPU	r	OMV	k ç=d ~ë	ONKVUR	ééÄ	NKM	NPMQTQKUM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ ÉÅ	B n ` =¨ çï	B n ` =¤ äÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NUPOSNRKRQ	MKQ	ONOOPOPKQO	USKPR	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVMSMRNKVN	NKP	QRNVVMMKMQ	USKQO	RVKR	NOMKQ	
pÅ	QR	e O	UTNOOQKNS	MKS	NMSVRVUKVR	UNKQS	RVKR	NOMKQ	
pÅ	QR	e É	NOVQOQKPT	NKP	NRTTPRKMO	UOKMS	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VOUMPSKNQ	MKV	NMSQPUQKUO	UTKNV	RVKR	NOMKQ	
d É	TO	e O	PQTVNTKQN	NKO	QOOMNTKMN	UOKQQ	RVKR	NOMKQ	
d É	TO	e É	NMNVNVKTS	NKT	NOORSPKSN	UPKNS	RVKR	NOMKQ	
v	UV	e O	QPNUSMTKPM	NKM	QTSOUURKNQ	VMKST	RVKR	NOMKQ	
v	UV	e É	TOTQVOKMS	NKS	UOVQMOKQU	UTKTN	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SOMOMTTKMV	MKO	SRQQMSTKOO	VQKTT	RVKR	NOMKQ	
qÄ	NRV	e É	OQSQRPSKRP	MKU	OURMTNTKVP	USKQR	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	POQQRUOKTV	MKS	PONUTOUKRU	NMVKU	RVKR	NOMKQ	
_á	OMV	e É	NQROTPPKTV	MKU	NRVQNVSKTN	VNKNP	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NNUUUMMP

cãÉ=k~ã É MRQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf^ mj eyNya^q^yOMCPyMPJ ^oyi n` OQ^ hÅ

^Åè=qáã É PLCQLOMCP=ONMSVRS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	OMVT	éé Ä	PMS	CPCPMRS	NMM	
NN	_	S	k ç=d ~ë	TMRSO	éé Ä	RMR	RVSRMTU	NMMM	
CP	k ~	CR	e É	NRMVUCO	éé Ä	NMVO	SMCNCMM	CMMMM	
CQ	j Ö	CR	e É	NNCRMCCM	éé Ä	NVO	TNSPTMTR	CMMMM	
CT	^ ä	CR	e É	VMMTVMPNP	éé Ä	NVO	CMVTRTRMVO	CMMMM	
CU	pá	CR	e O	PTRMVMUN	éé Ä	NRMQ	PMUVPCMPT	NMMM	
PV	h	CR	e É	NOSUMOTN	éé Ä	MVQ	VSCUPMCU	CMMMM	
QM	` ~	CR	e O	CPVMVVT	éé Ä	CMN	CUOTVPMSP	CMMMM	
RN	s	UV	e É	NUNMRNV	éé Ä	MMT	NQPUCUMCR	NMMM	
RO	` ê	UV	e É	UQMCUU	éé Ä	MMS	UQRMUMVP	CMMM	
RR	j å	UV	e É	RPMQRN	éé Ä	NMP	OTMCPMPU	CMMM	
RS	cÉ	UV	e O	NSNPQMCRO	éé Ä	MMS	PTRMVOVQMSQ	NMMMM	
RV	` ç	UV	e É	PMMOV	éé Ä	RMU	RCSRMSO	NMMM	
SM	k á	UV	e É	NRMMQV	éé Ä	CMQ	TPMRMPS	NMMM	
SP	` ì	UV	e É	UTMTRT	éé Ä	MMP	NNRPSVMNT	CMMM	
SS	wå	UV	e É	QSMROT	éé Ä	PMO	NCPCRMSP	CMMM	
TR	^ ë	UV	e É	VMPVM	éé Ä	NMQ	NRVVMVP	NMMM	
TU	pÉ	UV	e O	PMPUS	éé Ä	QMS	PNRMUO	NMMM	
UU	pê	UV	e É	CNMCUO	éé Ä	CMM	NCSVUMOT	CMMM	
VR	j ç	UV	e É	TMRUN	éé Ä	NMM	QQVMMUM	NMMM	
NMT	^ Ö	UV	e É	MMUQ	éé Ä	NUMV	PVNMNO	NMM	
NNN	` Ç	UV	e É	MCSP	éé Ä	TMP	TQMCR	NMMM	
NNU	på	NRV	e É	QMSMM	éé Ä	PMO	CCPUNMVR	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MMSVP	éé Ä	RMO	OTTSMRQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	NPMMVRO	éé Ä	MMU	NRQUQTMRQ	CMMM	
NUO	t	NRV	k ç=d ~ë	MMTQQ	éé Ä	PMV	CQRSMNR	NMMM	
OMR	qä	OMV	k ç=d ~ë	MMRRS	éé Ä	TMQ	PQVMMUR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NQQMOTO	éé Ä	NMP	NMSVNRRMVM	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	CUMOVP	éé Ä	MMT	NUUMVRMOV	NMMM	
OPU	r	OMV	k ç=d ~ë	TMTRQ	éé Ä	NMR	QTOMTMUU	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B¤¤ÉÅ	B n` =¨ çï	B n` =¤ëÜÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	NUPMVDCMVO	NMV	CNCCPCPMQO	USMCP	RVMR	NOMVQ	
pÅ	CR	k ç=d ~ë	PURTOSPMQS	MMT	CRNVVMVMMVQ	URMPQ	RVMR	NOMVQ	
pÅ	CR	e O	UTUQVSMQU	PMR	NMSVRVUMVR	UOMNP	RVMR	NOMVQ	
pÅ	CR	e É	NPNCCOMMNU	NMS	NRTTPRMVO	UPMNV	RVMR	NOMVQ	
d É	TO	k ç=d ~ë	VMUNRVMPT	MMU	NMSCPUQMUO	URMPO	RVMR	NOMVQ	
d É	TO	e O	PQNQCPMSR	MMR	QCCOMNTMMN	UMMVN	RVMR	NOMVQ	
d É	TO	e É	VUVQMMNT	MMO	NCCRSPMSN	UMMTP	RVMR	NOMVQ	
v	UV	e O	QCOMRSNCMUS	NMN	QTSCUURMNQ	UUMP	RVMR	NOMVQ	
v	UV	e É	TNNNTSMPM	NMS	UCVQMCMQU	URMTR	RVMR	NOMVQ	
qÄ	NRV	k ç=d ~ë	SNPQSTTMMP	MMS	SRQQMVSTMCO	VPMTQ	RVMR	NOMVQ	
qÄ	NRV	e É	CQRPPVCMVN	NMP	CURMTNTMVP	USMVS	RVMR	NOMVQ	
_á	OMV	k ç=d ~ë	PNVNNPMMUU	MMT	PCNUTCUMRU	VVMNQ	RVMR	NOMVQ	
_á	OMV	e É	NCPRMMQMSS	NMU	NRVQNVSMTN	VMMVN	RVMR	NOMVQ	

p~ã éäÉ=k~ã É pn NNUUUMVR

cãÉ=k~ã É MRPpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf^ mj eyNya^q^yOVOPyWPJ ^oyi n ` OQ^ hÅ

^Åè=qãã É PLOQLOVOP=ONWØOVMP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMVMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä~Ö
V	_É	S	k ç=d ~ë	MRRMQ	ééÄ	NKT	SQQKQT	NVM	
NN	_	S	k ç=d ~ë	QKMVU	ééÄ	TKP	PRQMRM	NVMM	
OP	k ~	QR	e É	UNKQNS	ééÄ	UKU	RNQQNKOS	OVMMMM	
OQ	j Ö	QR	e É	PPRKMTU	ééÄ	QKM	ONOMTKRR	OVMMMM	
OT	^ ä	QR	e É	NNMRVKSQR	ééÄ	MKQ	ORSVRNKOU	OVMMMM	
OU	pá	QR	e O	OMSQKVRP	ééÄ	OKT	NSVSPOKSN	NVMMM	
PV	h	QR	e É	PRQKTRV	ééÄ	OKU	QRVOTKOS	OVMMMM	
QM	` ~	QR	e O	TSQKTUU	ééÄ	NKU	QUPMVRKOT	OVMMMM	
RN	s	UV	e É	ORKSQM	ééÄ	NKS	OMNROKQO	NVMM	
RO	` ê	UV	e É	NVKTNM	ééÄ	OKP	NVVQTKSN	OVMM	
RR	j å	UV	e É	NVUKRPQ	ééÄ	MKP	VTUPUKVU	OVMM	
RS	cÉ	UV	e O	NTNSTKSON	ééÄ	OKR	PVQPSVSQKTQ	NVMMMM	
RV	` ç	UV	e É	PKPOV	ééÄ	PKQ	RSTMKOQ	NVMM	
SM	k á	UV	e É	QKQSU	ééÄ	NKV	OOSSKVM	NVMM	
SP	` ì	UV	e É	VKTOR	ééÄ	NKO	NOVORKMR	OVMM	
SS	wå	UV	e É	OTKUVN	ééÄ	RKR	UORNKQU	OVMM	
TR	^ ë	UV	e É	TKTNM	ééÄ	PKU	NOVPKNV	NVMM	
TU	pÉ	UV	e O	NKTTN	ééÄ	OKR	NSQKNS	NVMM	
UU	pê	UV	e É	TKPVT	ééÄ	QKN	QPQSKPN	OVMM	
VR	j ç	UV	e É	NKORQ	ééÄ	NKP	VNOKOT	NVMM	
NMT	^ Ö	UV	e É	MKMTM	ééÄ	NOKU	NRMKMM	NVM	
NNN	` Ç	UV	e É	MKNTV	ééÄ	RKR	RMKMM	NVMM	
NNU	på	NRV	e É	PUKPMO	ééÄ	NKS	ONOMNKPT	NVMM	
NON	pÄ	NRV	k ç=d ~ë	MKTRT	ééÄ	PKS	PQTMKTU	NVMM	
NPT	_~	NRV	k ç=d ~ë	SPKOOU	ééÄ	NKQ	TSROTKUT	OVMM	
NUO	t	NRV	k ç=d ~ë	MKOUQ	ééÄ	NVKQ	NPVUKON	NVMM	
OMR	qä	OMV	k ç=d ~ë	MKNOT	ééÄ	TKV	NOONKPQ	NVMM	
OMU	mÄ	OMV	k ç=d ~ë	TNKSPQ	ééÄ	MKU	RPUONRKQS	OVMM	
OPO	qÜ	OMV	k ç=d ~ë	PPKOVU	ééÄ	NKN	OOPVNRKNS	NVMM	
OPU	r	OMV	k ç=d ~ë	RKNUN	ééÄ	NKQ	PNVSTKPQ	NVMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ ÉÅ	B n ` =¡ çï	B n ` =¢ äÜÜ	n ` =¢ä~Ö
i á	S	k ç=d ~ë	NUNTRQNKVM	NKQ	ONOOPOPKQO	URKSQ	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PUSTQRMKPU	MKV	QRNVVMMKMQ	URKRS	RVKR	NOMKQ	
pÅ	QR	e O	UTUQMRKPO	MKT	NMSVRVUKVR	UOKNO	RVKR	NOMKQ	
pÅ	QR	e É	NOVSNMKSM	NKO	NRTTPRKMO	UOKNT	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VNOTOPKTO	NKQ	NMSQPUQKUO	URKTR	RVKR	NOMKQ	
d É	TO	e O	PQVVMQKQN	NKS	QOOMNTKMN	UOKVN	RVKR	NOMKQ	
d É	TO	e É	NMNVVPKPR	NKT	NOORSPKSN	UPKOO	RVKR	NOMKQ	
v	UV	e O	QNQSNUMKRV	MKT	QTSOUURKNQ	UTKVR	RVKR	NOMKQ	
v	UV	e É	SVUQUPKQR	MKS	UOVQMOKQU	UQKOO	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SOPRPNQKUN	NKM	SRQQMSTKOO	VRKOU	RVKR	NOMKQ	
qÄ	NRV	e É	OQSMPSRKVN	MKV	OURMTNTKVP	USKPN	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	POPPVOPKNR	MKV	PONUTOUKRU	NMVKQT	RVKR	NOMKQ	
_á	OMV	e É	NQTMUQTKMU	MKQ	NRVQNVSKTN	VOKOS	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NNUUUMMRI

cãÉ=k~ã É MRQpj mi hÇ

a~í~=m~íÜ=k~ã É aWjtÖäÉáíyî mj eyNya^q^yOMCPyMPJ ^oyi n ` CQ^hÅ

^Åè=qãã É PLCQLOMCP=ONMØTMN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå CRKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKPQT	éé Ä	NNKS	NVCKCP	NMM	
NN	_	S	k ç=d ~ë	TKVMP	éé Ä	TKV	NUUMKNR	NMMM	
CP	k ~	CR	e É	NRKCQP	éé Ä	CMSKP	CPPUPKNO	CMMMMM	
CQ	j Ö	CR	e É	PTCKTTP	éé Ä	PKQ	RMCRKQU	CMMMMM	
CT	^ ä	CR	e É	NNNVUKCQU	éé Ä	NKS	RSMNMKUQ	CMMMMM	
CU	pá	CR	e O	CNTPKRUM	éé Ä	CKR	PTQQCKVP	NMMMM	
PV	h	CR	e É	SRVKPTN	éé Ä	NCKT	PQVRTKUS	CMMMMM	
QM	` ~	CR	e O	UQUKTPV	éé Ä	NKO	NCMTPRKTO	CMMMMM	
RN	s	UV	e É	CUKTTO	éé Ä	CKM	QTNTKRQ	NMMM	
RO	` ê	UV	e É	CNKNSO	éé Ä	NKV	QUQVKCQ	CMMM	
RR	j å	UV	e É	CNQKQSM	éé Ä	NKT	CNQCUKNP	CMMM	
RS	cÉ	UV	e O	NUPTTKCCN	éé Ä	NKQ	URNRVNTKCU	NMMMMM	
RV	` ç	UV	e É	PKURV	éé Ä	PKU	NQMQKRS	NMMM	
SM	k á	UV	e É	PKUMT	éé Ä	CSKU	RRVMKMO	NMMM	
SP	` ì	UV	e É	NMKCNO	éé Ä	MKT	PNMPKTP	CMMM	
SS	wå	UV	e É	JTKRSR	éé Ä	k L^	CNQMKCM	CMMM	
TR	^ ë	UV	e É	UKMMT	éé Ä	CKM	CUPKMP	NMMM	
TU	pÉ	UV	e O	NKUQS	éé Ä	UKU	PSKST	NMMM	
UU	pê	UV	e É	TKTTQ	éé Ä	UKP	VPMKMR	CMMM	
VR	j ç	UV	e É	CKMQS	éé Ä	PCKP	PNSKSU	NMMM	
NMT	^ Ö	UV	e É	MKMUQ	éé Ä	NMKS	CNKKN	NMM	
NNN	` Ç	UV	e É	MKOTV	éé Ä	CNKO	NSKCV	NMMM	
NNU	på	NRV	e É	PSKPNO	éé Ä	CKO	CQQCNKVN	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKVRR	éé Ä	NNKU	NMSQKRM	NMMM	
NPT	_~	NRV	k ç=d ~ë	STKPVP	éé Ä	RKM	NSMVSKSN	CMMM	
NUO	t	NRV	k ç=d ~ë	MKQQP	éé Ä	PNKM	VNTKSU	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNTP	éé Ä	TSKV	TMTKQQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	TTKMRQ	éé Ä	MKU	NNQMRPKPV	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	PMKQSM	éé Ä	NKU	QNQTQKVU	NMMM	
OPU	r	OMV	k ç=d ~ë	RKSCO	éé Ä	RKU	SUNCKQO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c ä~Ö	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUVNMDCKMN	NKV	CNCCPCPKQO	UVKN	RVKR	NCMKQ	
pÅ	CR	k ç=d ~ë	PURCUSRKVS	MKV	CRNVVMMKMQ	URKCQ	RVKR	NCMKQ	
pÅ	CR	e O	VNNRUQKUO	NKU	NMSVRVUKVR	URKCP	RVKR	NCMKQ	
pÅ	CR	e É	NPPRTCRTV	NKN	NRTTPRKMO	UQKSU	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	VNTTSTKRU	NKO	NMSQPUQKUO	USKCP	RVKR	NCMKQ	
d É	TO	e O	PRSTSSKOV	NKQ	QDCMNTKMN	UQKRQ	RVKR	NCMKQ	
d É	TO	e É	NMCPCDKSR	NKM	NCCRSPKSN	UPKR	RVKR	NCMKQ	
v	UV	e O	CNTUCCTKRV	NKP	CITSCLUURKNQ	UTKTO	RVKR	NCMKQ	
v	UV	e É	TMMVPPKPR	MKT	UCVCMCKCU	UQKRN	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SNQCVRCKUP	NKO	SRQQMSTKCO	VPKUT	RVKR	NCMKQ	
qÄ	NRV	e É	CQTTPNMKTR	NKM	CURMTNTKVP	USKV	RVKR	NCMKQ	
_á	OMV	k ç=d ~ë	PNSRRSCKRT	NKO	PCNUTCUKRU	VUKPR	RVKR	NCMKQ	
_á	OMV	e É	NQTSTMTKQN	NKP	NRVQNVSKTN	VCKSP	RVKR	NCMKQ	

p~ã éäÉ=k~ã É pn NNUUUMMR^

cãÉ=k~ã É MRRpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl^ mj eyNya^q^yOMCPyMPJj ^oyi n` OQ^ hÅ

^Åè=qãã É PLOQLOMCP=ONMROMM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	NMKNRQ	ééÄ	PKN	NNMTTKTM	NMM	
NN	_	S	k ç=d ~ë	OMMKVTM	ééÄ	NKV	NQONTRKNM	NMMM	
OP	k ~	QR	e É	NMTTTKMMP	ééÄ	MKV	NPMVQTUKOT	OMMMMM	
OQ	j Ö	QR	e É	NPTMKTRP	ééÄ	MKT	URNVNHPO	OMMMMM	
OT	^ ä	QR	e É	NNUCPKOOV	ééÄ	NHP	OTNUUUKNO	OMMMMM	
OU	pá	QR	e O	SVTUKRSU	ééÄ	MKQ	RSCUUNHPM	NMMMM	
PV	h	QR	e É	NMCPUKNMP	ééÄ	OKO	RTNRNTKNN	OMMMMM	
QM	` ~	QR	e O	NUCRKRNP	ééÄ	MKN	NNNUMNUKUP	OMMMMM	
RN	s	UV	e É	TPHKNTR	ééÄ	MKR	RSQMMKTP	NMMM	
RO	` ê	UV	e É	SUKQUQ	ééÄ	NHP	SSTRUHRM	OMMM	
RR	j å	UV	e É	ONTHKOCR	ééÄ	MKQ	NMRSUTKMV	OMMM	
RS	cÉ	UV	e O	NUNMNKTNR	ééÄ	MKS	QMUUPQRVKVQ	NMMMMM	
RV	` ç	UV	e É	NPKQTO	ééÄ	PKN	OCPPSKOT	NMMM	
SM	k á	UV	e É	CRKPMU	ééÄ	OKM	NNTUVKRU	NMMM	
SP	` ì	UV	e É	QMKQCO	ééÄ	NHS	RNTUQKUU	OMMM	
SS	wå	UV	e É	NPOKQVR	ééÄ	MKU	OVSQVKRO	OMMM	
TR	^ ë	UV	e É	RSHSUS	ééÄ	MKT	VCUUKTP	NMMM	
TU	pÉ	UV	e O	RMVKVUV	ééÄ	NKN	QRTOKMP	NMMM	
UU	pê	UV	e É	RRKPTU	ééÄ	NKR	PCMPPHKV	OMMM	
VR	j ç	UV	e É	RCKPMU	ééÄ	MKT	OVRUCKCQ	NMMM	
NMT	^ Ö	UV	e É	NMKQOT	ééÄ	MHS	ONNCOKCO	NMM	
NNN	` Ç	UV	e É	NMKPVP	ééÄ	OKU	CUCMKPN	NMMM	
NNU	på	NRV	e É	UUKUQR	ééÄ	NKO	QTRTRKNU	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NMKOUP	ééÄ	OKP	QCSRUHPT	NMMM	
NPT	_~	NRV	k ç=d ~ë	UPKTTR	ééÄ	OKT	VUVVOKCQ	OMMM	
NUO	t	NRV	k ç=d ~ë	RRHSRR	ééÄ	MHS	NPMQVOKPS	NMMM	
OMR	qä	OMV	k ç=d ~ë	VKUQS	ééÄ	OKM	RCQTQKVO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	UCHSPN	ééÄ	MKV	SMSVCQKQU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	QSKRQR	ééÄ	NKM	PMRCSNKMV	NMMM	
OPU	r	OMV	k ç=d ~ë	NRKQPT	ééÄ	MKP	VPMSQKMM	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B¤ ÉÅ	B n` =¡ çï	B n` =¤ä×Ü	n` =¤ä-Ö
i á	S	k ç=d ~ë	NURSSSRKPM	MKQ	ONCCPCPQCO	UTKQU	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PUNMRVRKUU	MHS	QRNVVMMKVQ	UQKPN	RVKR	NOMKQ	
pÅ	QR	e O	USPVSNKPQ	MKN	NMSVRVUKVR	UMKTT	RVKR	NOMKQ	
pÅ	QR	e É	NOUNSVKMU	MHS	NRTTPRKMO	UNKOS	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VMMNSSKUV	MKP	NMSCPUQKUO	UQKRT	RVKR	NOMKQ	
d É	TO	e O	PCPURUHSO	MKQ	QCCMNTKMN	UNKQU	RVKR	NOMKQ	
d É	TO	e É	VUVUCKOS	MKU	NOCRSPKSN	UMKTS	RVKR	NOMKQ	
v	UV	e O	QMTSMSNKRP	MHS	QTSCUURKNQ	URKRU	RVKR	NOMKQ	
v	UV	e É	SVMMTPKSO	MKP	UOVQMOKQU	UPKO	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SMUUTUCKVO	NKO	SRQQMSTKOO	VPKMQ	RVKR	NOMKQ	
qÄ	NRV	e É	CQMVSSSHSS	NKM	OURMTNTKVP	UQKRP	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PNSMUTTKOO	MKR	PONUTCUKRU	VUKO	RVKR	NOMKQ	
_á	OMV	e É	NQOMUUPKNP	NKR	NRVQNVSKTN	UVKNP	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NNUUUMMRm

cãÉ=k~ã É MRSpj mi hÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^hÅ

^Åè=qãã É PLCQLOMCP=ONWTWQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä~Ö
V	_É	S	k ç=d ~ë	QUKRVV	ééÄ	NMS	RNSOQKQQ	NMM	
NN	_	S	k ç=d ~ë	QSSKSUN	ééÄ	MKR	PCPNCRKPT	NMMM	
OP	k ~	QR	e É	TQTPKMPM	ééÄ	PKQ	VPTVMUKQV	OMMMMM	
OQ	j Ö	QR	e É	RCCUKUCQ	ééÄ	OKV	PPMRMMKNN	OMMMMM	
OT	^ ä	QR	e É	ONURCKQTV	ééÄ	PKM	RMUSNCKTV	OMMMMM	
OU	pá	QR	e O	CUQSKTMD	ééÄ	OKR	COVTPSKVN	NMMMM	
PV	h	QR	e É	VSTPKCQD	ééÄ	PKM	RRNSRMKUV	OMMMMM	
QM	` ~	QR	e O	PMQRKQQT	ééÄ	MKU	NURSTUTKRN	OMMMMM	
RN	s	UV	e É	QTSKUSS	ééÄ	NMS	PTRNUPKTT	NMMM	
RO	` ê	UV	e É	OMQKSPQ	ééÄ	MMS	OMOVOMKVU	OMMM	
RR	j å	UV	e É	RVOKNPT	ééÄ	NKQ	OVQTPVKUN	OMMM	
RS	cÉ	UV	e O	OPVRNKTTO	ééÄ	MKV	RRMTONNUKMV	NMMMMM	
RV	` ç	UV	e É	QUPKCPM	ééÄ	MKU	UNSTURKTV	NMMM	
SM	k á	UV	e É	QTUKOVQ	ééÄ	MKU	CCQTMVKNM	NMMM	
SP	` ì	UV	e É	CQQKVTP	ééÄ	NKN	PNVPQPKVP	OMMM	
SS	wå	UV	e É	RMQKRRT	ééÄ	MKV	NMUSVTKNT	OMMM	
TR	^ ë	UV	e É	VTKTVP	ééÄ	NKP	NSQMNKPR	NMMM	
TU	pÉ	UV	e O	UMKCRP	ééÄ	MKV	UNQRKSS	NMMM	
UU	pê	UV	e É	QSMKNTV	ééÄ	MKV	OTCRPUKCQ	OMMM	
VR	j ç	UV	e É	UMKQUN	ééÄ	MKO	RNTTQKTV	NMMM	
NMT	^ Ö	UV	e É	QSKQSU	ééÄ	OKM	VSPVUKVR	NMM	
NNN	` Ç	UV	e É	COVKPQS	ééÄ	NKO	SPTCUKPR	NMMM	
NNU	på	NRV	e É	QVRKPST	ééÄ	NKN	OSVPRCKTT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	SCKPQQ	ééÄ	NKR	CRVSPCKMD	NMMM	
NPT	_~	NRV	k ç=d ~ë	NVVQKRPM	ééÄ	MKN	CPTTUSCKCM	OMMM	
NUO	t	NRV	k ç=d ~ë	UMKMVQ	ééÄ	NKN	NUVNUCKCR	NMMM	
OMR	qä	OMV	k ç=d ~ë	VNKCNR	ééÄ	MKU	CURPSCKVV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NSUKCPP	ééÄ	MMS	NCQPVTVKOT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NRNKQUQ	ééÄ	MMS	VVTMTMKVM	NMMM	
OPU	r	OMV	k ç=d ~ë	NVRKUMM	ééÄ	NKP	SQCCQMRKRO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ÉÅ	B n ` =¡çï	B n ` =¢äÜÜ	n ` =¢ä~Ö
i á	S	k ç=d ~ë	NUCCSPPKVV	NKQ	CNCCPCPKQO	URKUU	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	PUPSRTPKNU	NKP	QRNVVMMKMQ	UQKUU	RVRR	NOMQ	
pÅ	QR	e O	USPSNVKNU	OKM	NMSVRVUKVR	UMKTQ	RVRR	NOMQ	
pÅ	QR	e É	NPMSQNKPV	OKU	NRTTPRKMO	UCKUO	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VNPVNSKPM	MKS	NMSQPUQKUO	URKUS	RVRR	NOMQ	
d É	TO	e O	PQVTQVKQM	MKS	QCCMNTKMN	UCKUU	RVRR	NOMQ	
d É	TO	e É	NMNVPRKPR	NKR	NCCRSPKSN	UPKNT	RVRR	NOMQ	
v	UV	e O	QNQVVQQKVS	NKP	QTSCUURKNQ	UTKNP	RVRR	NOMQ	
v	UV	e É	TMSUPTKTT	MKO	UCVQMCKQU	URKCO	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SNQPSTUKNM	MKU	SRQQMSTKOO	VPKUU	RVRR	NOMQ	
qÄ	NRV	e É	CQSRUTVKQN	MKR	CURMTNTKVP	USKR	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PNUQCRRKPN	MKS	PCNUTCUKRU	VUKVP	RVRR	NOMQ	
_á	OMV	e É	NQRCQQMKUR	OKP	NRVQNVSKTN	VNKN	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMMRp

cãÉ=k~ã É MRTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ hÅ

^Åè=qãã É PLCQLOMCP=ONMQRMMN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä~Ö
V	_É	S	k ç=d ~ë	QUKSUS	ééÄ	NKO	RNONRKNQ	NMM	
NN	_	S	k ç=d ~ë	QSQKUCP	ééÄ	NKS	PNUTNMSM	NMMM	
OP	k ~	QR	e É	TPRRKQUO	ééÄ	NKN	VOUUOUKQQ	OMMMMM	
OQ	j Ö	QR	e É	RPQNKNRQ	ééÄ	OKQ	PPVPUQKTN	OMMMMM	
OT	^ ä	QR	e É	OTPPRKUSO	ééÄ	NKU	SPUVPRKUS	OMMMMM	
OU	pá	QR	e O	OQUNKNUP	ééÄ	TKM	OMRSTRKQQ	NMMMM	
PV	h	QR	e É	VSVQKTQR	ééÄ	MKO	RRRURMSS	OMMMMM	
QM	` ~	QR	e O	PPPUKCPO	ééÄ	MKT	OMUTMOTKVM	OMMMMM	
RN	s	UV	e É	QUOKMSU	ééÄ	NKM	PUPQQTKRO	NMMM	
RO	` ê	UV	e É	OMVKVVN	ééÄ	NKN	ONMQVVKMQ	OMMM	
RR	j å	UV	e É	SQRKQQO	ééÄ	MKR	POQTTRKSR	OMMM	
RS	cÉ	UV	e O	OPSRPKMRQ	ééÄ	MKV	RQUSOTNOKMP	NMMMM	
RV	` ç	UV	e É	QTRKPST	ééÄ	MKV	UNCPQCKPQ	NMMM	
SM	k á	UV	e É	QTQKCOV	ééÄ	NKN	CCRCQSKSO	NMMM	
SP	` ì	UV	e É	OQPKTTN	ééÄ	NKS	PONOSTKMO	OMMM	
SS	wå	UV	e É	RNMKPQQ	ééÄ	MKV	NNNNCOKVN	OMMM	
TR	^ ë	UV	e É	VNKSUO	ééÄ	MKR	NRRQSKOT	NMMM	
TU	pÉ	UV	e O	UUKMVN	ééÄ	NKQ	UNNMKPN	NMMM	
UU	pê	UV	e É	QSPKVNR	ééÄ	MKS	OTTTSOKQV	OMMM	
VR	j ç	UV	e É	UUKSVS	ééÄ	NKT	RNUUPKUM	NMMM	
NMT	^ Ö	UV	e É	QSKNMT	ééÄ	NKM	VSSVUKTR	NMM	
NNN	` Ç	UV	e É	OCUKTMU	ééÄ	MKR	SQCQVKCR	NMMM	
NNU	på	NRV	e É	RMRKQQV	ééÄ	NKU	OTPSPMRRQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	RSKPVR	ééÄ	MKS	OPTQUCKUV	NMMM	
NPT	_~	NRV	k ç=d ~ë	OMMMUSS	ééÄ	MKP	OQNNUSPKUV	OMMM	
NUO	t	NRV	k ç=d ~ë	TQKTQU	ééÄ	MKS	NTURSNKRU	NMMM	
OMR	qä	OMV	k ç=d ~ë	VMKQMS	ééÄ	MKR	QUTVNSKNR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NVQKTVQ	ééÄ	MKU	NQSMSTMKMN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NRTHSSP	ééÄ	MKR	NMROQRUKVO	NMMM	
OPU	r	OMV	k ç=d ~ë	NMTKUNM	ééÄ	MKS	SSPVOSKTS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ ÉÅ	B n ` =í çï	B n ` =¢äÜÜ	n ` =¢ä~Ö
i á	S	k ç=d ~ë	NUMQUCUKPP	NKN	ONCOPOPKQO	URMVQ	RVMR	NOMVQ	
pÅ	QR	k ç=d ~ë	PUNNMVUKSN	MKS	QRNVVMMMVQ	UQKPO	RVMR	NOMVQ	
pÅ	QR	e O	UUSMPPKOO	NKR	NMSVRVUKVR	UOKUQ	RVMR	NOMVQ	
pÅ	QR	e É	NPNOUUKUS	NKP	NRTTPRKMO	UPKCP	RVMR	NOMVQ	
d É	TO	k ç=d ~ë	VNQNMOKSM	MKO	NMSQPUQKUO	URKUU	RVMR	NOMVQ	
d É	TO	e O	PRMRPSKUS	NKO	QOOMNTKMN	UPKMS	RVMR	NOMVQ	
d É	TO	e É	NMNRQVKMS	MKR	NOORSPKSN	UOKUR	RVMR	NOMVQ	
v	UV	e O	QNUSOVNKQU	MKS	QTSOUURKNQ	UTKUV	RVMR	NOMVQ	
v	UV	e É	TNQRVMKRS	MKQ	UOVQMOKQU	USKNS	RVMR	NOMVQ	
qÄ	NRV	k ç=d ~ë	SONNUSVKPQ	NKM	SRQQMSTKOO	VQKVO	RVMR	NOMVQ	
qÄ	NRV	e É	OQRRSPTKUT	NKS	OURMTNTKVP	USKNQ	RVMR	NOMVQ	
_á	OMV	k ç=d ~ë	POOVRUNKOM	MKS	PONUTOUKRU	NMMKPQ	RVMR	NOMVQ	
_á	OMV	e É	NQPPOMRKVQ	NKQ	NRVQNVSKTN	UVKV	RVMR	NOMVQ	

p~ã éäÉ=k~ã É	pn NNUUUMMT
cãÉ=k~ã É	MRUpj mi hÇ
a~í~=m~íÜ=k~ã É	aWjt ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^hÅ
^Åè=qãã É	PLCQLOMCP=ONMRPMQN
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RKMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	NKRMP	éé Ä	THR	NTNRHSV	NMM	
NN	_	S	k ç=d ~ë	NOHSUQ	éé Ä	MKR	VRQQHMV	NMMM	
OP	k ~	QR	e É	URHSSR	éé Ä	RKV	RQSSMKQT	OMMMMM	
OQ	j Ö	QR	e É	RPTHOPP	éé Ä	OHP	PQPSMKMQ	OMMMMM	
OT	^ ä	QR	e É	QMSTVRRQS	éé Ä	NKU	VRMQQRKMM	OMMMMM	
OU	pá	QR	e O	OSSPHQMU	éé Ä	NHR	ONVQTRKUS	NMMMM	
PV	h	QR	e É	RNSKVVO	éé Ä	NKQ	RRQPOKUQ	OMMMMM	
QM	` ~	QR	e O	SVTHRSP	éé Ä	MKP	QQPOMNKQN	OMMMMM	
RN	s	UV	e É	NRNHPVV	éé Ä	MKQ	NNTUQSKMN	NMMM	
RO	` ê	UV	e É	RNKMOR	éé Ä	MKV	RMRNSHPO	OMMM	
RR	j å	UV	e É	NNMKMPS	éé Ä	MKT	RQPPVHPO	OMMM	
RS	cÉ	UV	e O	ORUURKUNS	éé Ä	OKT	RUPPNVTNKRU	NMMMMM	
RV	` ç	UV	e É	OHPVU	éé Ä	PKM	ONNQKMV	NMMM	
SM	k á	UV	e É	UHRVS	éé Ä	RKM	ONUMKTM	NMMM	
SP	` ì	UV	e É	OQHSOM	éé Ä	OHP	POMUMKQU	OMMM	
SS	wå	UV	e É	NQKVQV	éé Ä	SKN	RRRSKTR	OMMM	
TR	^ ë	UV	e É	NPKMMU	éé Ä	OKN	ONTMKMS	NMMM	
TU	pÉ	UV	e O	PKMOT	éé Ä	RKQ	OTPHPO	NMMM	
UU	pê	UV	e É	NPKUTN	éé Ä	PKO	UNPOKRS	OMMM	
VR	j ç	UV	e É	SKOMP	éé Ä	OKN	PSOOKTT	NMMM	
NMT	^ Ö	UV	e É	MKNNO	éé Ä	SKN	OPRHRS	NMM	
NNN	` Ç	UV	e É	MKPUS	éé Ä	NPKQ	NMTKMQ	NMMM	
NNU	på	NRV	e É	PVKOON	éé Ä	NKR	ONUPRKTN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKTNR	éé Ä	OKR	POUMKRP	NMMM	
NPT	_~	NRV	k ç=d ~ë	NQMKVNR	éé Ä	NKQ	NSVTMPKUN	OMMM	
NUO	t	NRV	k ç=d ~ë	MKRSV	éé Ä	UKN	OMSVKMO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKRPV	éé Ä	OKT	PQRTKQT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	PUHSSO	éé Ä	NKT	OVNTSNKQQ	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NUKMVO	éé Ä	NHO	NOOTUOKQO	NMMM	
OPU	r	OMV	k ç=d ~ë	OKTRN	éé Ä	PKM	NTMPOKVQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ¹ mp	B =o ÉÅ	B n ` =¹ çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUPPUVNKTS	MHS	ONOOPOPQQO	USKQN	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PVNVVPMKNU	MHS	QRNVVMMKMQ	USKTP	RVHR	NOMQ	
pÅ	QR	e O	UUNRRPRTP	MHO	NMSVRVUKVR	UOKQO	RVHR	NOMQ	
pÅ	QR	e É	NPNQPVKNU	NHO	NRTTPRKMO	UPHPP	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VOTURVKVO	MHR	NMSQPUQKUO	UTHNT	RVHR	NOMQ	
d É	TO	e O	PQRTNNRTP	MKV	QOOMNTKMN	UNKVO	RVHR	NOMQ	
d É	TO	e É	NMMUSNKVQ	NHM	NOORSPHSN	UOKOV	RVHR	NOMQ	
v	UV	e O	QMSTUVQKQN	NHN	QTSOUURKNQ	URKQN	RVHR	NOMQ	
v	UV	e É	SVUPROHSU	MHO	UOVQMOKQU	UQKO	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SOMSOVPKOQ	OHR	SRQQMSTKOO	VQKUQ	RVHR	NOMQ	
qÄ	NRV	e É	OQTRUUOKRU	MKV	OURMTNTKVP	USKUR	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	POQOVTMKTN	NKV	PONUTOUKRU	NMMKTR	RVHR	NOMQ	
_á	OMV	e É	NQTMVOOHSP	NKQ	NRVQNVSKTN	VOKOT	RVHR	NOMQ	

`çåíáåìåÖ=~äÄê~íáç=sÉêÑ~íáç=E``sF=oÉéçê

p~ãéäÉ=k~ãÉ	``s
cäÉ=k~ãÉ	MRV|``skÇ
a~í~=m~íÜ=k~ãÉ	aWj^ÖäÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OQ^kÄ
^Åè=qáã É	PLOQLOMOP=ONMRUMOV
p~ãéäÉ=qóéÉ	``s
qçí~äa ãäíáç;å	NKMMMM
`çã ãÉåí	JJJ
fpqa=oÉÑ¥cäÉk~ãÉ	MVS^i_Ç
p~ãéäÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äí	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ãÉ	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=cä-Ö
V	_É	S	kç=d~ë	OQKNSM	éëÄ	PKN	NPUNQNKRV	OR	VSKSQ	UVKU	NNMO	
NN	_	S	kç=d~ë	OQKRRM	éëÄ	PKN	VONUPKQQ	OR	VUKO	UVKU	NNMO	
OP	k~	QR	eÉ	RPMOKNQT	éëÄ	NKN	PPMQPUSKMV	RMMM	NMSKMQ	UVKU	NNMO	
OQ	j Ö	QR	eÉ	RPOUKQSS	éëÄ	OKN	NTOSUUMKVS	RMMM	NMSKRT	UVKU	NNMO	
OT	^ä	QR	eÉ	RNRKQNO	éëÄ	MKS	SQOMTKNP	RMM	NMPKMU	UVKU	NNMO	
OU	pá	QR	eO	ROQKVNR	éëÄ	NKM	OOQROSKUV	RMM	NMQKVU	UVKU	NNMO	
PV	h	QR	eÉ	RNUQKMQQ	éëÄ	MKP	NQTMQNRKSU	RMMM	NMPKSU	UVKU	NNMO	
QM	`~	QR	eO	ROPMKRSV	éëÄ	MKV	NSUMOTMOKVQ	RMMM	NMQKSN	UVKU	NNMO	
RN	s	UV	eÉ	ORKPNM	éëÄ	MKV	VVNMSKRU	OR	NMNKOQ	UVKU	NNMO	
RO	`ê	UV	eÉ	ORKPTP	éëÄ	MKR	NORROTUKNT	OR	NMNKQV	UVKU	NNMO	
RR	j å	UV	eÉ	ORKVQN	éëÄ	NKN	SOPVSKQM	OR	NMMKRS	UVKU	NNMO	
RS	cÉ	UV	eO	RNNVKVMV	éëÄ	MKV	RVMVOUSOKUT	RMMM	NMOKQ	UVKU	NNMO	
RV	`ç	UV	eÉ	ORKRSP	éëÄ	NKM	ONQTSVKRP	OR	NMOKOR	UVKU	NNMO	
SM	ká	UV	eÉ	ORKQUP	éëÄ	MKR	RVSOSKRV	OR	NMNKVP	UVKU	NNMO	
SP	`ì	UV	eÉ	ORKRON	éëÄ	NKP	NSRQVOKVS	OR	NMOKMU	UVKU	NNMO	
SS	wå	UV	eÉ	OQKQUT	éëÄ	NKS	OUMTRKOO	OR	VTKVR	UVKU	NNMO	
TR	^ë	UV	eÉ	ORKNPU	éëÄ	MKU	OMVQOKRP	OR	NMMKRR	UVKU	NNMO	
TU	pÉ	UV	eO	OQKSVQ	éëÄ	MKQ	NNPNOKRR	OR	VUKTU	UVKU	NNMO	
UU	pê	UV	eÉ	ORKRQO	éëÄ	MKT	TRNTNKPT	OR	NMOKNT	UVKU	NNMO	
VR	j ç	UV	eÉ	OQKRVQ	éëÄ	MKS	TMSTQKNV	OR	VUKPU	UVKU	NNMO	
NMT	^Ö	UV	eÉ	ORKSQT	éëÄ	MKU	OSQPPPKRQ	OR	NMOKRV	UVKU	NNMO	
NNN	`Ç	UV	eÉ	ORKUTM	éëÄ	NKR	PRTNQKSR	OR	NMPKQU	UVKU	NNMO	
NNU	på	NRV	eÉ	OQKVNV	éëÄ	NKQ	SVNRPKQR	OR	VVKSU	UVKU	NNMO	
NON	pÄ	NRV	kç=d~ë	OQKOQU	éëÄ	PKO	RNPOVNKSO	OR	VSKVV	UVKU	NNMO	
NPT	_~	NRV	kç=d~ë	ORKQUM	éëÄ	PKM	NRQRNSKMM	OR	NMNKVO	UVKU	NNMO	
NUO	t	NRV	kç=d~ë	ORKOVT	éëÄ	NKO	PMPRNPKRM	OR	NMNKMV	UVKU	NNMO	
OMR	qä	OMV	kç=d~ë	OQKOSN	éëÄ	NKS	SQUPMOKQS	OR	VTKMQ	UVKU	NNMO	
OMU	mÄ	OMV	kç=d~ë	ORKQQT	éëÄ	MKV	VQRQRTKUP	OR	NMNKTV	UVKU	NNMO	
OPO	qÜ	OMV	kç=d~ë	OQKUTR	éëÄ	NKQ	UOOTTTKVS	OR	VVKR	UVKU	NNMO	
OPU	r	OMV	kç=d~ë	ORKUMV	éëÄ	NKR	TUTOOMKOT	OR	NMPKOQ	UVKU	NNMO	

n`=fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ¥mp	B=oÉÄ	B n`=çï	B n`=eäÜÜ	n`=cä-Ö
iá	S	kç=d~ë	NVSRQQPKOQ	OKR	ONOOPOPKQO	VOKSN	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PUTRVVMKTN	NKM	QRNVVMMMKQ	URKTR	RVKR	NOMQ	
pÅ	QR	eO	VNRNTUKRT	NKO	NMSVRVUKVR	URKRS	RVKR	NOMQ	
pÅ	QR	eÉ	NPQMVPKPU	OKM	NRTTPRKMO	UQKVR	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VPRRQPKTN	MKO	NMSQPUQKUO	UTKV	RVKR	NOMQ	
dÉ	TO	eO	PSQUOSKMR	MKQ	QOOMNTKMN	USKQR	RVKR	NOMQ	
dÉ	TO	eÉ	NMPOTVKUT	NKM	NOORSPKSN	UQKOT	RVKR	NOMQ	
v	UV	eO	QNSSOSMKNV	MKQ	QTSOUURKNQ	UTKQT	RVKR	NOMQ	
v	UV	eÉ	TMOPUVKPO	MKR	UOVQMOKQU	UQKSV	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SORNNVTKQT	NKV	SRQQMSTKOO	VRKRO	RVKR	NOMQ	
qÄ	NRV	eÉ	ORMQRURKTN	NKN	OURMTNTKVP	UTKUS	RVKR	NOMQ	
_á	OMV	kç=d~ë	PNVVQMUKMS	NKM	PONUTOUKRU	VVKQ	RVKR	NOMQ	
_á	OMV	eÉ	NQQNVMQKQM	MKS	NRVQNVSKTN	VMKQR	RVKR	NOMQ	

`çåíáåì åÖ=~ëÄê~íáçå=_ä~åâ=É``_F=oÉéçê

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MSM``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíÝ^mj eyNya^q^yOMOPyMPJ ^oyi n`OQ^kÂ

^Åè=qáã É PLOQLOMOP=OOMMTWVP

p~ã éáÉ=qóéÉ ``_

qçí~äa äí íáçå NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑcäÉk~ã É MVS^i_KÇ

p~ã éáÉ=n`=m~ëëlc á~ä c~äí

fpqa=n`=m~ëëlc~äí m~ëë

l éÉê~íçê **~Çã áíí**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÄK	r åáë	opa	==\ mp==	i ãä á	n`=c ä~Ö
V	_É	S	k ç=d ~ë	MKMNQ	éé Ä	SUKM	NVRKRS	MO	
NN	_	S	k ç=d ~ë	MKQQO	éé Ä	QKO	OPORKTU	Q	
OP	k~	QR	e É	JNKNRN	éé Ä	k L^	QQTMMKVN	OMM	
OQ	j Ö	QR	e É	PKVVR	éé Ä	QKR	NRUQKRV	OM	
OT	^ä	QR	e É	JONKORU	éé Ä	k L^	RMUKVN	OM	c~äë^ äëj ÉÍÜçÇë& c~äÉÇ=a ça
OU	pá	QR	e O	NKSST	éé Ä	RMO	NONMKOM	NMM	
PV	h	QR	e É	NUKNMO	éé Ä	THS	PQRNRHPU	OMM	
QM	`~	QR	e O	RKNNM	éé Ä	PKV	OVTTOKSO	OM	
RN	s	UV	e É	MKMNP	éé Ä	SQKS	PMMKMN	N	
RO	`ê	UV	e É	MKMON	éé Ä	SHP	URTHKW	N	
RR	j å	UV	e É	JMKMQT	éé Ä	k L^	NTPKVT	MQ	
RS	cÉ	UV	e O	SKNVV	éé Ä	NKQ	UPSTRKOT	OM	
RV	` ç	UV	e É	MKMNT	éé Ä	QUKV	OTPHPR	MO	
SM	k á	UV	e É	JMKMMT	éé Ä	k L^	NVNKNO	MQ	
SP	` ì	UV	e É	MKMNQ	éé Ä	QPHN	RPRKRT	MS	
SS	wå	UV	e É	JOKNRO	éé Ä	k L^	OOPHPQ	O	c~äë^ äëj ÉÍÜçÇë& c~äÉÇ=a ça
TR	^ë	UV	e É	MKMPN	éé Ä	OPKO	QRKMM	N	
TU	pÉ	UV	e O	MKMRM	éé Ä	UKM	OSKUP	N	
UU	pê	UV	e É	MKMOT	éé Ä	PMP	NMOKOP	N	
VR	j ç	UV	e É	MKNPQ	éé Ä	OKO	QVRKRT	N	
NMT	^Ö	UV	e É	MKMON	éé Ä	VKM	OPPHPQ	MO	
NNN	` Ç	UV	e É	MKMNV	éé Ä	NTHS	OUKRO	MO	
NNU	på	NRV	e É	JMKMMO	éé Ä	k L^	QURKRU	N	
NON	pÄ	NRV	k ç=d ~ë	MKMPO	éé Ä	NUKO	VTQKQM	MO	
NPT	_~	NRV	k ç=d ~ë	MKMUO	éé Ä	NSKO	RQPKVO	MQ	
NUO	t	NRV	k ç=d ~ë	MKNRM	éé Ä	THR	ORUSKPO	N	
OMR	qä	OMV	k ç=d ~ë	MKMSQ	éé Ä	NVKU	OOPOKRS	MO	
OMU	mÄ	OMV	k ç=d ~ë	MKMNU	éé Ä	RKU	NRPNHSR	MO	
OPO	qÜ	OMV	k ç=d ~ë	MKMTM	éé Ä	PKO	PVTUKNS	N	
OPU	r	OMV	k ç=d ~ë	MKMOP	éé Ä	NOKR	TNTKQR	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=ç ï	B n`=cëÜÜ	n`=c ä~Ö
i á	S	k ç=d ~ë	NVQSSMSKQU	PKN	ONOOPOPKQO	VNKTO	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QMROVOPKOQ	NKT	QRNVVMMKMQ	UVKST	RVKR	NOMQ	
pÅ	QR	e O	VRNPTPKVU	NKM	NMSVRVUKVR	UUKVR	RVKR	NOMQ	
pÅ	QR	e É	NQNNNQKUT	MKR	NRTTPRKMO	UVKQS	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VTSPVVKQM	MKQ	NMSQPUQKUO	VNKTP	RVKR	NOMQ	
d É	TO	e O	PUPSVNKQN	MKV	QOOMNTKMN	VMKVO	RVKR	NOMQ	
d É	TO	e É	NNMVVNKTO	MKR	NOORSPKSN	UVKVN	RVKR	NOMQ	
v	UV	e O	QPQPPTPKVP	MKT	QTSOUURKNQ	VNKMV	RVKR	NOMQ	
v	UV	e É	TQSNONKVP	NKN	UOVQMOKQU	UVKVS	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQOQMSTKUV	NKP	SRQQMSTKOO	VUKNT	RVKR	NOMQ	
qÄ	NRV	e É	OSPTVMSKOP	MKU	OURMTNTKVP	VOKRP	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PNTMQTQKUU	NKS	PONUTOUKRU	VUKR	RVKR	NOMQ	
_á	OMV	e É	NRMVNSNKNT	NKR	NRVQNVSKTN	VQKST	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMMV

cãÉ=k~ã É MSNpj mi HÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf^ mj eyNya^q^yOMCPyMPJj ^oyi n` OQ^HÅ

^Åè=qãã É PLOQLOMCP=OONMOMQM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RHMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=¤l ~ë	MHMVQ	éé Ä	NVKM	ONOKCP	NVM	
NN	_	S	k ç=¤l ~ë	CKUQV	éé Ä	RKO	OTMCKRO	NVMM	
CP	k ~	QR	e É	POKUNU	éé Ä	PPKV	QSVUNHSU	OMMMMM	
CQ	j Ö	QR	e É	TPKTUO	éé Ä	TKO	QVSVKVP	OMMMMM	
OT	^ ä	QR	e É	PQCQKNMT	éé Ä	NKO	UPVRRKUP	OMMMMM	
CU	pá	QR	e O	NONUKCUT	éé Ä	NKQ	NVCORRKCP	NVMMM	
PV	h	QR	e É	NUNHRSU	éé Ä	NKT	PTSTSKTN	OMMMMM	
QM	` ~	QR	e O	NVCKTMR	éé Ä	PKM	TSRMUKQM	OMMMMM	
RN	s	UV	e É	UKMCR	éé Ä	NKN	SRSCKVU	NVMM	
RO	` ê	UV	e É	NVKTCQ	éé Ä	NKN	NNPNSKPU	OMMM	
RR	j å	UV	e É	NSKTMM	éé Ä	CKN	URVPKSS	OMMM	
RS	cÉ	UV	e O	NQVCKCQV	éé Ä	NKT	PQRORRRKPO	NVMMMM	
RV	` ç	UV	e É	MKPMD	éé Ä	SKO	SCCKCS	NVMM	
SM	k á	UV	e É	NKCCO	éé Ä	CKU	TTNKHR	NVMM	
SP	` ì	UV	e É	NUHSPP	éé Ä	NKN	CQTMNHMM	OMMM	
SS	wå	UV	e É	MKTRN	éé Ä	PUKU	OSPUKMT	OMMM	
TR	^ ë	UV	e É	NKRCQ	éé Ä	UKT	OTCKTM	NVMM	
TU	pÉ	UV	e O	MKOTV	éé Ä	NNKO	CUKPP	NVMM	
UU	pê	UV	e É	PKRPT	éé Ä	PKS	ONNPKRP	OMMM	
VR	j ç	UV	e É	MKVRP	éé Ä	CKT	SPCKQT	NVMM	
NVT	^ Ö	UV	e É	MHMSV	éé Ä	CCKO	NQUKUV	NVM	
NNN	` Ç	UV	e É	MHMRM	éé Ä	NSKR	NQKUO	NVMM	
NNU	på	NRV	e É	PTKVSO	éé Ä	NKR	ONMTTKVO	NVMM	
NON	pÄ	NRV	k ç=¤l ~ë	MHMVU	éé Ä	CKO	NMVTKUT	NVMM	
NPT	_~	NRV	k ç=¤l ~ë	VKQTQ	éé Ä	CKS	NNPRMHNU	OMMM	
NUO	t	NRV	k ç=¤l ~ë	MKQUQ	éé Ä	TKV	NURCKMU	NVMM	
OVR	qä	OMV	k ç=¤l ~ë	MHNMT	éé Ä	NTHN	NMUQKRP	NVMM	
OMU	mÄ	OMV	k ç=¤l ~ë	NNHPCP	éé Ä	NKT	UPPQTKQR	OMMM	
OPO	qÜ	OMV	k ç=¤l ~ë	POKMSO	éé Ä	MKV	OMVQNMKVM	NVMM	
OPU	r	OMV	k ç=¤l ~ë	RHPSR	éé Ä	MHS	PONQQKTU	NVMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B¤pÉÅ	B n` =¡çï	B n` =¤ä ÜÜ	n` =¤ä-Ö
i á	S	k ç=¤l ~ë	NUPCRVSHSR	MKU	ONCCPCPKQO	USHPR	RVHR	NOMQ	
pÅ	QR	k ç=¤l ~ë	PUSVPCMKPU	NHN	QRNVVMMKMQ	URHSN	RVHR	NOMQ	
pÅ	QR	e O	UVRVTVKMO	CKQ	NMSVRVUKVR	UPKTT	RVHR	NOMQ	
pÅ	QR	e É	NPPQNSKPU	MKP	NRTTPRKMO	UQKRU	RVHR	NOMQ	
d É	TO	k ç=¤l ~ë	VCUPCRKTO	MHS	NMSCPUQKUO	UTHCO	RVHR	NOMQ	
d É	TO	e O	PRRSQSKUS	MHS	QCCMNTKMN	UQKOT	RVHR	NOMQ	
d É	TO	e É	NMPCNUKQV	NKM	NCCRSPHSN	UQKCO	RVHR	NOMQ	
v	UV	e O	QNSSRSPKQT	NHS	QTSCUURKNQ	UTKQU	RVHR	NOMQ	
v	UV	e É	TMTRPMKCN	MKO	UCVQMCKQU	URKPN	RVHR	NOMQ	
qÄ	NRV	k ç=¤l ~ë	SNRTCCSKCP	CKN	SRQQMSTKOO	VQKMV	RVHR	NOMQ	
qÄ	NRV	e É	CQSTPMTKCR	MKR	CURMTNTKVP	USHRR	RVHR	NOMQ	
_á	OMV	k ç=¤l ~ë	PNQMNUQKQO	NKO	PCNUTCUKRU	VTHRS	RVHR	NOMQ	
_á	OMV	e É	NQQCUSMKVR	NKU	NRVQNVSKTN	VMHRN	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMNR

cãÉ=k~ã É MSQpj mi lÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ kÅ

^Åè=qãã É PLOQLOMCP=OONMTWQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKPST	ééÄ	TKT	QVUKVM	NMM	
NN	_	S	k ç=d ~ë	OKUMQ	ééÄ	SKT	OSQSKVR	NMMM	
OP	k ~	QR	e É	RQKMMM	ééÄ	NNKV	QUVOSKVM	OMMMMM	
OQ	j Ö	QR	e É	OQQKNOM	ééÄ	NKU	NRTRPKRT	OMMMMM	
OT	^ ä	QR	e É	UPRSKSRS	ééÄ	MKO	NVTVNTKMM	OMMMMM	
OU	pá	QR	e O	OQRRKNOU	ééÄ	RKP	OMNQNOKPR	NMMMM	
PV	h	QR	e É	PMMKNST	ééÄ	QKT	QPSRRKVR	OMMMMM	
QM	` ~	QR	e O	QOVKSUT	ééÄ	NKR	OTSQOSKNS	OMMMMM	
RN	s	UV	e É	NVKQNQ	ééÄ	MKP	NRSTPKQP	NMMM	
RO	` ê	UV	e É	NRKVMN	ééÄ	NKM	NSSMSKSM	OMMM	
RR	j å	UV	e É	NNNKUTR	ééÄ	NKM	RSRQOKNQ	OMMM	
RS	cÉ	UV	e O	NPNMRKNPS	ééÄ	OKO	PMSTOSSPKOR	NMMMMM	
RV	` ç	UV	e É	OKMRS	ééÄ	QKT	PSOTKOU	NMMM	
SM	k á	UV	e É	PKNNQ	ééÄ	TKO	NSTSKUM	NMMM	
SP	` ì	UV	e É	RKSUS	ééÄ	PKR	TVMSKUO	OMMM	
SS	wå	UV	e É	NVKUCR	ééÄ	VKU	QUMUKSV	OMMM	
TR	^ ë	UV	e É	THRMM	ééÄ	NKR	NOUTKUS	NMMM	
TU	pÉ	UV	e O	NKQNT	ééÄ	QKS	NPQOQV	NMMM	
UU	pê	UV	e É	QKTPN	ééÄ	PKR	OURMRKM	OMMM	
VR	j ç	UV	e É	NKOOQ	ééÄ	NMKU	TVUVKP	NMMM	
NMT	^ Ö	UV	e É	MKMSQ	ééÄ	NPHS	NQNKNO	NMM	
NNN	` Ç	UV	e É	MKMUO	ééÄ	OOKT	OQKMT	NMMM	
NNU	på	NRV	e É	PUKQOS	ééÄ	NKQ	ONPPOKTM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKRPS	ééÄ	QKO	OQSSKNS	NMMM	
NPT	_~	NRV	k ç=d ~ë	PRKSUN	ééÄ	NKP	QNVTVKSP	OMMM	
NUO	t	NRV	k ç=d ~ë	MKPOV	ééÄ	UKQ	NQSNKSO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNPU	ééÄ	NMKU	NOQNKPV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QPKRVO	ééÄ	NKP	PNTOTOKSN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	RNKVNP	ééÄ	OKN	PPSTVMKOM	NMMM	
OPU	r	OMV	k ç=d ~ë	UKOON	ééÄ	OKU	QVMRSKTO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` = ç ï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUNRTOQKMV	MKP	ONOOPOPKQO	URKRR	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PUSQNRNKUU	NKQ	QRNVVMMKMQ	URKQV	RVKR	NOMKQ	
pÅ	QR	e O	UTUOROKPU	OKR	NMSVRVUKVR	UOKNN	RVKR	NOMKQ	
pÅ	QR	e É	NPNSQMKQR	MKU	NRTTPRKMO	UPKQS	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VNRPQVKVQ	MKT	NMSQPUQKUO	US	RVKR	NOMKQ	
d É	TO	e O	PROSTUPKM	MKR	QOOMNTKMN	UPKRT	RVKR	NOMKQ	
d É	TO	e É	NMOUTOKST	MKT	NOORSPKSN	UPKVP	RVKR	NOMKQ	
v	UV	e O	QOOQSVVKQO	NKU	QTSOUURKNQ	UUKT	RVKR	NOMKQ	
v	UV	e É	TNQUPRKOM	NKR	UOVQMOKQU	USKMV	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SMRUSOUKQN	MKT	SRQQMSTKOO	VOKRU	RVKR	NOMKQ	
qÄ	NRV	e É	OQSTSTPKQM	MKS	OURMTNTKVP	USKRS	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PNOUQVTKMV	NKR	PONUTOUKRU	VTKO	RVKR	NOMKQ	
_á	OMV	e É	NQRTOQRKPQ	MKS	NRVQNVSKTN	VNKQO	RVKR	NOMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` NSfj pN
cáÉ=k~ã É	MSP| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJj ^oyin` OQ^kÄ
^Åè=qãã É	PLOQLOMOP=OOWVOWRS
p~ã éäÉ=qóéÉ	m_
qçí~ä=aäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iãã á	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMST	ééÄ	kL^	QMKMM	MKR	
_	NN	S	kç=d~ë	NKVNR	ééÄ	NMKP	OMOOKQM	NM	
k~	OP	QR	eÉ	OPKPQP	ééÄ	PPKV	QRTPSKUQ	RMM	
j Ö	OQ	QR	eÉ	NUKTMT	ééÄ	NKR	NQNPKQS	RM	
^ä	OT	QR	eÉ	JTTKQTM	ééÄ	kL^	NNSMKMT	RM	m_=SMOM=c~âë=aça
pá	OU	QR	eO	NTKQNT	ééÄ	OKM	NUVUKUM	ORM	
h	PV	QR	eÉ	NPQKTQP	ééÄ	NTKR	PRMMSKOO	RMM	
` ~	QM	QR	eO	QVKTQO	ééÄ	NKN	QPMVTKSR	RM	
s	RN	UV	eÉ	MKPUP	ééÄ	QKM	ROQKQS	OKR	
` ê	RO	UV	eÉ	MKSRN	ééÄ	OKN	NPOTKNQ	OKR	
j å	RR	UV	eÉ	MKPNP	ééÄ	NOKP	QOUKRV	N	
cÉ	RS	UV	eO	QQKVTU	ééÄ	PKO	NNMQQSKVS	RM	
` ç	RV	UV	eÉ	MKMNT	ééÄ	VVKN	NPTKTU	MKR	
k á	SM	UV	eÉ	MKOSM	ééÄ	PQKR	PNPKPQ	N	
` ì	SP	UV	eÉ	MKPSN	ééÄ	SKT	UTPKPU	NKR	
wå	SS	UV	eÉ	JUKTNR	ééÄ	kL^	SPNKNQ	R	m_=SMOM=c~âë=aça
^ë	TR	UV	eÉ	MKNNP	ééÄ	QRKO	PRKPP	OKR	
pÉ	TU	UV	eO	MKVRP	ééÄ	OQKU	TKRM	OKR	
pê	UU	UV	eÉ	MKNTO	ééÄ	OMKV	NNSKST	OKR	
j ç	VR	UV	eÉ	MKOTN	ééÄ	OQKM	OPRKRS	OKR	
^Ö	NMT	UV	eÉ	MKMNR	ééÄ	PQKN	PTKTU	MKR	
` Ç	NNN	UV	eÉ	MKMOM	ééÄ	NOKN	SKPM	MKR	
på	NNU	NRV	eÉ	PUKSUQ	ééÄ	OKQ	ONRTOKMN	OKR	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKMSR	ééÄ	NQKP	ROTKOP	MKR	
_~	NPT	NRV	kç=d~ë	MKQQR	ééÄ	NNKM	RRMKSM	N	
t	NUO	NRV	kç=d~ë	MKNQS	ééÄ	QUKN	NMPNKNQ	OKR	
qä	OMR	OMV	kç=d~ë	MKMNR	ééÄ	VVKN	RVPKVT	MKR	
mÄ	OMU	OMV	kç=d~ë	MKOOV	ééÄ	NSKS	OQVVKQO	MKR	
qÜ	OPO	OMV	kç=d~ë	NKMOQ	ééÄ	OKS	UOQQKTM	OKR	
r	OPU	OMV	kç=d~ë	MKMQR	ééÄ	NMKO	OVMKPN	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä-Ö
iá	S	kç=dl~ë	NUMRSOVKNS	OKP	ONCOPOPKQO	URKMU	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	PUMVSNOKVR	MKV	QRNVVMMKMQ	UQKOV	RVKR	NOMQ	
pÅ	QR	eO	UVOUTMKSU	MKS	NMSVRVUKVR	UPKQU	RVKR	NOMQ	
pÅ	QR	eÉ	NPPNTMKOU	NKP	NRTTPRKMO	UQKQP	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VNNQSPKMU	MKS	NMSCPUQKUO	URKSP	RVKR	NOMQ	
dÉ	TO	eO	PRPRMTKMU	MKR	QCOMNTKMN	UPKTT	RVKR	NOMQ	
dÉ	TO	eÉ	NMPORMKVN	MKV	NOORSPKSN	UQKOQ	RVKR	NOMQ	
v	UV	eO	QMMVOTPKTP	OKN	QTSOUURKNQ	URKUU	RVKR	NOMQ	
v	UV	eÉ	SVQNSOKQM	MKN	UOVQMOKQU	UPKSV	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	SMNVRPMKRO	MKT	SRQQMSTKOO	VNKVU	RVKR	NOMQ	
qÄ	NRV	eÉ	OQTVQQMKNU	NKO	OURMTNTKVP	USKVU	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PNNUUNOKOS	MKQ	PONUTOUKRU	VSKV	RVKR	NOMQ	
_á	OMV	eÉ	NQSMNNSKVQ	NKT	NRVQNVSKTN	VNKRV	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäåp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` pl n ` NSfj pN
cáÉ=k~ã É	MSQ ` pl kÇ
a~í~=m~íÜ=k~ã É	aWf^ÖäÉáíyf` mj eyNya ^q^ yOMOPyMPuj ^o yi n ` OQ^ kÄ
^Åè=qáã É	PLOQLOMOP=OOMQUMQ
p~ã éäÉ=qóéÉ	i ` pl
qçí~äaäãíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MMS ` ^i _kÇ
p~ã éäÉ=n ` =m~ëëlcá~ä	m~ëë
fpqa=n ` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åä**

n ` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n ` =c~ä-Ö
_É	V	S	k ç=d ~ë	QUKPMP	ééÄ	OKN	RNOMVKQV	RM	NVKPO	TVKR	NOMQ	
_	NN	S	k ç=d ~ë	QSTKSVP	ééÄ	OKP	POPNROKSS	RMM	NUKTN	TVKR	NOMQ	
k~	OP	QR	e É	TSPNKNMS	ééÄ	OKM	VSSMROKUT	TRMM	OMKPR	TVKR	NOMQ	
j Ö	OQ	QR	e É	QVQTKOUP	ééÄ	NKR	PNRTNMOOO	RMMM	NVKTV	TVKR	NOMQ	
^ä	OT	QR	e É	NVQSKNPM	ééÄ	OKO	QUQOKPM	OMMM	NVKQS	TVKR	NOMQ	
pá	OU	QR	e O	UURKSUM	ééÄ	PKN	TPOQOKTO	NMMM	NTKTN	TVKR	NOMQ	
h	PV	QR	e É	VRUNKTVO	ééÄ	NKS	RRNVQMKTM	NMMMM	NVKNS	TVKR	NOMQ	
` ~	QM	QR	e O	ORQSKTVT	ééÄ	MKP	NRTPVQTKPM	ORMM	OMKON	TVKR	NOMQ	
s	RN	UV	e É	QUOKPTO	ééÄ	MKQ	PTMSVOKVQ	RMM	NVKOV	TVKR	NOMQ	
`ê	RO	UV	e É	NVTKQMQ	ééÄ	MKS	NVNOONKOP	OMM	NVKTQ	TVKR	NOMQ	
j å	RR	UV	e É	QVQKOUS	ééÄ	MKR	OQMPSNKOP	RMM	NVKTT	TVKR	NOMQ	
cÉ	RS	UV	e O	NMNNKVQR	ééÄ	NKV	OOTMQQUKMR	NMMM	OMKOQ	TVKR	NOMQ	
` ç	RV	UV	e É	RMSKMQR	ééÄ	MKQ	UPRQSSKUM	RMM	OMKOQ	TVKR	NOMQ	
ká	SM	UV	e É	RMPKUTR	ééÄ	MKT	OPNOMUKMM	RMM	OMKNS	TVKR	NOMQ	
` ì	SP	UV	e É	ORPKRRR	ééÄ	MKT	POOUNVKUT	ORM	OMKOU	TVKR	NOMQ	
wå	SS	UV	e É	RMPKVRQ	ééÄ	NKT	NMSMPVKSM	RMM	OMKNS	TVKR	NOMQ	
^ë	TR	UV	e É	VTKNPU	ééÄ	MKV	NRVNOKTP	NMM	NVKQP	TVKR	NOMQ	
pÉ	TU	UV	e O	VSKTUP	ééÄ	NKN	URUUKOQ	NMM	NVKPS	TVKR	NOMQ	
pê	UU	UV	e É	QUSKQOR	ééÄ	NKR	OUNPTMKVR	RMM	NVKQS	TVKR	NOMQ	
j ç	VR	UV	e É	VTKOPU	ééÄ	MKR	RQVQSKVT	NMM	NVKQR	TVKR	NOMQ	
^Ö	NMT	UV	e É	QVKTUT	ééÄ	NKM	NMMUUNKVS	RM	NVKVN	TVKR	NOMQ	
` Ç	NNN	UV	e É	OQUKQOV	ééÄ	MKN	STQOSKMN	ORM	NVKUT	TVKR	NOMQ	
på	NNU	NRV	e É	RMUKMRO	ééÄ	MKV	OTSMORKVV	RMM	OMKPO	TVKR	NOMQ	
pÄ	NON	NRV	k ç=d ~ë	VPKMUO	ééÄ	MKV	PTRRUSKUM	NMM	NUKSO	TVKR	NOMQ	
_~	NPT	NRV	k ç=d ~ë	OMNSKMPT	ééÄ	NKR	OPOVQVTKQV	OMMM	OMKNS	TVKR	NOMQ	
t	NUO	NRV	k ç=d ~ë	NMMKPNT	ééÄ	MKU	OOVQUNKTU	NMM	OMKVS	TVKR	NOMQ	
qä	OMR	OMV	k ç=d ~ë	VQKMUN	ééÄ	NKQ	QUQQTRKTN	NMM	NUKUO	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=d ~ë	VUKRNP	ééÄ	NKS	TMRPNUKOP	NMM	NVKT	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=d ~ë	UTKVTU	ééÄ	NKN	RSNNOMKMN	NMM	NTKS	TVKR	NOMQ	
r	OPU	OMV	k ç=d ~ë	VVKQOQ	ééÄ	NKM	RUQPMMKSM	NMM	NVKUV	TVKR	NOMQ	

n ` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä=Ö
iá	S	kç=d~ë	NUNVOMTKVP	NKV	ONCOCPOPKQO	URKTO	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PUOUUQMQQ	MKV	QRNVVMMKMQ	UQKTN	RVKR	NOMQ	
pÅ	QR	eO	UUNOSSKNN	NKP	NMSVRVUKVR	UOKPV	RVKR	NOMQ	
pÅ	QR	eÉ	NPNUPTKTM	MKV	NRTTPRKMO	UPKRU	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VNVOUNKRV	MKR	NMSOPUOKUO	USKPT	RVKR	NOMQ	
dÉ	TO	eO	PRQRUOMS	MKQ	QOOMNTKMN	UQKMO	RVKR	NOMQ	
dÉ	TO	eÉ	NMOOOTKTV	MKT	NOORSPKSN	UPKQN	RVKR	NOMQ	
v	UV	eO	QMPQVNRKNQ	MKR	QTSOUURKNQ	UQKTO	RVKR	NOMQ	
v	UV	eÉ	SVMPVVKNN	MKS	UOVQMOKQU	UPKOQ	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	RVRQUPUKTR	MKS	SRQQMSTKOO	VN	RVKR	NOMQ	
qÄ	NRV	eÉ	OQSQMPOKNV	MKU	OURMTNTKVP	USKQQ	RVKR	NOMQ	
_á	OMV	kç=d~ë	PMUONPRKVN	NKS	PONUTOUKRU	VRKTS	RVKR	NOMQ	
_á	OMV	eÉ	NQQVNSMKTP	NKU	NRVQNVSKTN	VMKV	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMNN

cãÉ=k~ã É MSRpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf^ mj eyNya^q^yOMCPyMPJj ^o yi n ` OQ^ hÅ

^Åè=qáã É PLOQLOMCP=OOMRRMS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==: mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MPMP	éé Ä	RKN	QPQQS	NMM	
NN	_	S	k ç=d ~ë	QKOQO	éé Ä	OKP	PSSTKMV	NMMM	
OP	k ~	QR	e É	SQKRCS	éé Ä	ONMS	RMVPUKUQ	OMMMMM	
OQ	j Ö	QR	e É	NSRQKOMU	éé Ä	OKQ	NMTNCUKTO	OMMMMM	
OT	^ ä	QR	e É	TVONMVRU	éé Ä	NKR	NVMRTRKRV	OMMMMM	
OU	pá	QR	e O	NNTMKMVR	éé Ä	PKV	VTSUPKVQ	NMMMM	
PV	h	QR	e É	NTCOKTTR	éé Ä	NKT	NCPOSVKTS	OMMMMM	
QM	` ~	QR	e O	NPSQKOPM	éé Ä	NKN	USQRVSKRT	OMMMMM	
RN	s	UV	e É	ONKUQV	éé Ä	OKT	NTQMSHRQ	NMMM	
RO	` ê	UV	e É	NPKQVP	éé Ä	MKV	NQMPSKVS	OMMM	
RR	j å	UV	e É	NQSKMVN	éé Ä	MKS	TOVMUHRT	OMMM	
RS	cÉ	UV	e O	NRQTPKNUO	éé Ä	NKU	PSOTNPVRKNO	NMMMMM	
RV	` ç	UV	e É	OKPSQ	éé Ä	QKR	QNMRKNV	NMMM	
SM	k á	UV	e É	OKUSR	éé Ä	RKS	NRQNKCO	NMMM	
SP	` ì	UV	e É	PKNMQ	éé Ä	MKV	QQRUKRS	OMMM	
SS	wå	UV	e É	NPKQTM	éé Ä	OKR	RPNNKMN	OMMM	
TR	^ ë	UV	e É	QKNMS	éé Ä	QKN	TMQRTS	NMMM	
TU	pÉ	UV	e O	MPMU	éé Ä	NQKQ	PNHRM	NMMM	
UU	pê	UV	e É	UKQSM	éé Ä	NKR	RMCRKQR	OMMM	
VR	j ç	UV	e É	PKUQV	éé Ä	QKV	QPMRKTV	NMMM	
NMT	^ Ö	UV	e É	MKMSP	éé Ä	NUKM	NPTKTU	NMM	
NNN	` Ç	UV	e É	MKONP	éé Ä	OPKQ	SMKMM	NMMM	
NNU	på	NRV	e É	PUKQTP	éé Ä	NKR	ONQUTKQN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOQU	éé Ä	NTKV	NOUUKNM	NMMM	
NPT	_~	NRV	k ç=d ~ë	RMKUUQ	éé Ä	NKR	SMMQVKQP	OMMM	
NUO	t	NRV	k ç=d ~ë	MKRNQ	éé Ä	VKT	NUVUKUP	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKPVQ	éé Ä	THP	OSMSKPR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	SKOTT	éé Ä	NKU	QSVOSKSV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NPKUTV	éé Ä	NKS	VOOTNHPM	NMMM	
OPU	r	OMV	k ç=d ~ë	OKORU	éé Ä	NKO	NPSQNKUR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUPNNTRKUP	MKT	ONCOPOPKQO	USKOU	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PVPQLUUNKSM	MKT	QRNVVMMKMQ	UTHKS	RVHR	NOMQ	
pÅ	QR	e O	UVMVRNKSV	MKV	NMSVRVUKVR	UPHP	RVHR	NOMQ	
pÅ	QR	e É	NPPSOVKSN	NKM	NRTTPRKMO	UQRTO	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VPPQTPKOT	MKR	NMSQPUQKUO	UTRT	RVHR	NOMQ	
d É	TO	e O	PRPMURKUV	NKU	QOOMNTKMN	UPHST	RVHR	NOMQ	
d É	TO	e É	NMOQVNKON	MKV	NOORSPHSN	UPHSO	RVHR	NOMQ	
v	UV	e O	QOPMRVUKUO	MKT	QTSOLUURKNQ	UUKUO	RVHR	NOMQ	
v	UV	e É	TMSRUTHRN	MKO	UOVQMOKQU	URKMV	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SMTUQORKSN	MKO	SRQQMSTKOO	VOKUU	RVHR	NOMQ	
qÄ	NRV	e É	OQLOURSKMR	NKR	OURMTNTKVP	UTHKN	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PNSPQONKVU	MKQ	PONUTOUKRU	VUKOU	RVHR	NOMQ	
_á	OMV	e É	NQSSPQLKNP	MKS	NRVQNVSKTN	VNKVU	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMNP

cãÉ=k~ã É MSSpj mi lÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ kÅ

^Åè=qãã É PLCQLOMCP=COAQNMP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKNQT	éé Ä	ORRT	OSTKTV	NMM	
NN	_	S	k ç=d ~ë	PKQQR	éé Ä	OKT	PMWOKSN	NMMM	
OP	k ~	QR	e É	NVRKVPU	éé Ä	VKN	RRQNVKVM	OMMMMM	
OQ	j Ö	QR	e É	ORUKOUT	éé Ä	NKN	NSTOPKSR	OMMMMM	
OT	^ ä	QR	e É	TSSVKVUS	éé Ä	NKV	NUOSPRKPR	OMMMMM	
OU	pá	QR	e O	OMSNKQUU	éé Ä	OMP	NSVTPNKCP	NMMMM	
PV	h	QR	e É	PSOKORU	éé Ä	PKV	QTOQTKNV	OMMMMM	
QM	` ~	QR	e O	PRMPPUR	éé Ä	NKQ	OOUPQOKQS	OMMMMM	
RN	s	UV	e É	VKVPV	éé Ä	OKM	NORQUKMM	NMMM	
RO	` ê	UV	e É	TKTNR	éé Ä	OKM	NOVVMKUT	OMMM	
RR	j å	UV	e É	OOKOOS	éé Ä	NKV	NTSSVKTN	OMMM	
RS	cÉ	UV	e O	RSTSKMNQ	éé Ä	PKO	NVVVSUMUKSM	NMMMMM	
RV	` ç	UV	e É	MKSOM	éé Ä	OKS	NUMVKMT	NMMM	
SM	k á	UV	e É	OKNUS	éé Ä	QKU	NVMSKUP	NMMM	
SP	` ì	UV	e É	NNKSTV	éé Ä	NKN	OQPRVKOV	OMMM	
SS	wå	UV	e É	ONPSN	éé Ä	PKR	NMUTPKPN	OMMM	
TR	^ ë	UV	e É	OKRSO	éé Ä	PKM	SVRKTS	NMMM	
TU	pÉ	UV	e O	MKNSN	éé Ä	NOKM	OSKST	NMMM	
UU	pê	UV	e É	OKNQM	éé Ä	PKN	OMVOKQN	OMMM	
VR	j ç	UV	e É	NKMTN	éé Ä	PKT	NNUQKRO	NMMM	
NMT	^ Ö	UV	e É	MKMOM	éé Ä	NTKN	TSKST	NMM	
NNN	` Ç	UV	e É	MKMRT	éé Ä	PTKU	OSKPM	NMMM	
NNU	på	NRV	e É	QMQOMR	éé Ä	NKR	OORNOKQS	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOOV	éé Ä	UKR	NOVQKTS	NMMM	
NPT	_~	NRV	k ç=d ~ë	OMKVOP	éé Ä	MKT	OQLUVOKUM	OMMM	
NUO	t	NRV	k ç=d ~ë	MKOSP	éé Ä	SKN	NPNUKNP	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNPR	éé Ä	OVKP	NOQNKPT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NQKNNT	éé Ä	NKQ	NMRMMNKVT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NNKQNN	éé Ä	NKV	TSRPTKRP	NMMM	
OPU	r	OMV	k ç=d ~ë	NKPOP	éé Ä	MKV	UMQNKMT	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤pÉÅ	B n ` =¡ çï	B n ` =¤ëÃÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NUNUTQMKP	OKS	ONOOPOPKQO	URRT	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PUSRSQOKVR	MKV	QRNVVMMKMQ	URKRO	RVKR	NOMKQ	
pÅ	QR	e O	UUNMTMKVR	MKV	NMSVRVUKVR	UOKPT	RVKR	NOMKQ	
pÅ	QR	e É	NPONUVKNU	MKV	NRTTPRKMO	UPKU	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VNTMVPKRQ	MKN	NMSQPUQKUO	USKNS	RVKR	NOMKQ	
d É	TO	e O	PRMUNUKNN	MKU	QOOMNTKMN	UPKNP	RVKR	NOMKQ	
d É	TO	e É	NMOORTKPS	MKU	NOORSPKSN	UPKQP	RVKR	NOMKQ	
v	UV	e O	SPRUMVRKUP	OKO	QTSOUURKNQ	NPPKQV	RVKR	NOMKQ	SMOMa ça
v	UV	e É	NNMOMTUKQO	MKP	UOVQMOKQU	NPOKUU	RVKR	NOMKQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	SNMNPNMKOR	NKM	SRQQMSTKOO	VPKQP	RVKR	NOMKQ	
qÄ	NRV	e É	OQTVPSMKSN	NKN	OURMTNTKVP	USKVT	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PNTUVPQKVU	MKS	PONUTOUKRU	VUKTS	RVKR	NOMKQ	
_á	OMV	e É	NQSNTQNKTR	NKM	NRVQNVSKTN	VNKSV	RVKR	NOMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` NSfj t N
cáÉ=k~ã É	MST| m_KÇ
a~í~=m~íÜ=k~ã É	a Wy^ ÖäÉáíyf` mj e yNya^q^yOMOPyMPJ ^o yi n` OQ^ kÄ
^Åè=qãã É	PLOQLOMOP=OOWQSWO
p~ã éäÉ=qóéÉ	m_
qçí~ä=a áä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==` mp==	i ãã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	JMKMQU	ééÄ	k L^	SMKMM	MKR	
_	NN	S	k ç=d ~ë	NKTPT	ééÄ	NNKR	NUTSKUO	NM	
k~	OP	QR	e É	OTKVQV	ééÄ	OOKM	QSPVVKOS	RMM	
j Ö	OQ	QR	e É	TKOPO	ééÄ	NPKS	STRKSM	RM	
^ä	OT	QR	e É	JVRKVVQ	ééÄ	k L^	TOQKQU	RM	m_=SMOM=c~ãë=a ça
pá	OU	QR	e O	ORKMUM	ééÄ	RKP	ORNSKOO	ORM	
h	PV	QR	e É	NMUKTOQ	ééÄ	PKR	PPSQUKSQ	RMM	
` ~	QM	QR	e O	PVKMUS	ééÄ	OKM	PSMVUKPQ	RM	
s	RN	UV	e É	MKPPT	ééÄ	SKN	QVMKMO	OKR	
` ê	RO	UV	e É	MKOTU	ééÄ	NQKT	VSTKNU	OKR	
j å	RR	UV	e É	MKMUT	ééÄ	UQKN	PNUKSN	N	
cÉ	RS	UV	e O	OUKPMQ	ééÄ	NKR	TOUSPKSP	RM	
` ç	RV	UV	e É	MKMST	ééÄ	OOKT	OOOKOP	MKR	
k á	SM	UV	e É	JMKMTU	ééÄ	k L^	NRTKTU	N	
` ì	SP	UV	e É	MKNNV	ééÄ	QMKR	RSQKQS	NKR	
wå	SS	UV	e É	JPKQOU	ééÄ	k L^	NTOSKUM	R	
^ë	TR	UV	e É	MKNMP	ééÄ	OPKS	PPKST	OKR	
pÉ	TU	UV	e O	MKMRP	ééÄ	NTKR	TKRM	OKR	
pê	UU	UV	e É	MKNNS	ééÄ	OTKP	UQKQR	OKR	
j ç	VR	UV	e É	MKNTO	ééÄ	PRKR	NUMKMN	OKR	
^Ö	NMT	UV	e É	MKMNQ	ééÄ	OPKT	PRKRR	MKR	
` Ç	NNN	UV	e É	MKMPT	ééÄ	PVKR	NNKNN	MKR	
på	NNU	NRV	e É	JMKNNQ	ééÄ	k L^	PVSKSU	OKR	
pÄ	NON	NRV	k ç=d ~ë	MKMTS	ééÄ	ORKN	RSTKOU	MKR	
_~	NPT	NRV	k ç=d ~ë	MKQTP	ééÄ	NSKR	RTTKOV	N	
t	NUO	NRV	k ç=d ~ë	MKNPO	ééÄ	QMKR	VVNKMV	OKR	
qä	OMR	OMV	k ç=d ~ë	MKMQT	ééÄ	RPKN	TRMKUO	MKR	
mÄ	OMU	OMV	k ç=d ~ë	MKMNO	ééÄ	VUKP	VMTKSQ	MKR	
qÜ	OPO	OMV	k ç=d ~ë	MKRTV	ééÄ	OUKU	ROVPKPV	OKR	
r	OPU	OMV	k ç=d ~ë	MKMOQ	ééÄ	RTKQ	NSMKNT	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NTUPPQMKTS	OKN	ONCCPCPKQO	UQKMP	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	PUNVURVKQR	NKV	QRNVVMMKMQ	UQKRN	RVKR	NOMQ	
pÅ	QR	eO	UURVRRKRM	OKO	NMSVRVUKVR	UOKTR	RVKR	NOMQ	
pÅ	QR	eÉ	NPPQQUKPT	MKO	NRTTPRKMO	UQKS	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	UVVUQMKNU	OKP	NMSCPUQKUO	UQKRQ	RVKR	NOMQ	
dÉ	TO	eO	PRSVPSKRR	MKT	QCOMNTKMN	UQKRU	RVKR	NOMQ	
dÉ	TO	eÉ	NMOTMMKNR	NKU	NOORSPKSN	UPKTV	RVKR	NOMQ	
v	UV	eO	QMVUUPNKNQ	NKS	QTSOUURKNQ	USKMS	RVKR	NOMQ	
v	UV	eÉ	SVRPMUKRV	MKP	UOVQMOKQU	UPKUP	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	RVSPMSVKVQ	NKO	SRQQMSTKOO	VNKNO	RVKR	NOMQ	
qÄ	NRV	eÉ	OQRVPURKRS	NKQ	OURMTNTKVP	USKOT	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PMSQSQTKOQ	NKV	PONUTOUKRU	VRKON	RVKR	NOMQ	
_á	OMV	eÉ	NQRPOUQKTR	NKM	NRVQNVSKTN	VNKNS	RVKR	NOMQ	

i ~ÄçêíçêÓ=çåíêçäp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` Ot n ` NSfj t N
cáÉ=k~ã É	MSUI ` pt kÇ
a~í~=m~íÜ=k~ã É	aWI^ÖäÉáíÿ` mj eyNya ^q^ yOMOPyMPJ ^oyi n ` OQ^ kÄ
^Åè=qáã É	PLOQLOMOP=OOVRNVQM
p~ã éäÉ=qóéÉ	i ` pt
qçí~äaãäíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MVS` ^i _kÇ
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åä**

n ` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==i mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n ` =c ä-Ö
_É	V	S	k ç=dl~ë	ROKTOV	ééÄ	NKN	RQVTRKPR	RM	ONKWV	TVKR	NOMQ	
_	NN	S	k ç=dl~ë	ROSKMVO	ééÄ	MKS	PRTRTVKNV	RMM	ONKMR	TVKR	NOMQ	
k~	OP	QR	e É	UNPOKMNS	ééÄ	NKP	NMPMVMVKNM	TRMM	ONKSV	TVKR	NOMQ	
j Ö	OQ	QR	e É	ROQOKMVT	ééÄ	MKV	PPRVMVKVQ	RMMM	OMKVT	TVKR	NOMQ	
^ä	OT	QR	e É	OVSMVKNQS	ééÄ	NKP	RNPMMKOP	OMMM	OMKS	TVKR	NOMQ	
pá	OU	QR	e O	NVOVKVON	ééÄ	NKU	USVVOKTS	NMMM	OMKS	M	OMM	
h	PV	QR	e É	NVOUOKMSQ	ééÄ	MKS	RVOTPVKMO	NMMMM	OMRKS	TVKR	NOMQ	
` ~	QM	QR	e O	OSVSKVNV	ééÄ	MKP	NTNSNOTKNN	ORMM	ONKRU	TVKR	NOMQ	
s	RN	UV	e É	ROOKNMS	ééÄ	NKO	QVSMTQKSN	RMM	OMKUU	TVKR	NOMQ	
` ê	RO	UV	e É	OVUKTNS	ééÄ	NKO	OVQRVMKUQ	OMM	OMKUT	TVKR	NOMQ	
j å	RR	UV	e É	RNVMKNNU	ééÄ	MKV	ORRQPNKPO	RMM	OMKTS	TVKR	NOMQ	
cÉ	RS	UV	e O	NVROKVNT	ééÄ	OKM	OQMOQTRKRO	NMMM	ONKWS	TVKR	NOMQ	
` ç	RV	UV	e É	RPMKVOP	ééÄ	MKV	UURSQRKQP	RMM	ONKO	TVKR	NOMQ	
ká	SM	UV	e É	ROSKOPP	ééÄ	MKT	OQQPUSKVV	RMM	ONKMR	TVKR	NOMQ	
` ì	SP	UV	e É	OSSKROR	ééÄ	NKM	PQPQPOKRQ	ORM	ONKPO	TVKR	NOMQ	
wå	SS	UV	e É	RPTKRUU	ééÄ	MKT	NNQPPMQU	RMM	ONKR	TVKR	NOMQ	
^ë	TR	UV	e É	NVNKSTU	ééÄ	NKN	NSURTKVO	NMM	OMKPQ	TVKR	NOMQ	
pÉ	TU	UV	e O	NVOKNNP	ééÄ	MKS	VONSKNN	NMM	OMKQO	TVKR	NOMQ	
pê	UU	UV	e É	RNMKMTO	ééÄ	MKP	OVUSPQKPT	RMM	OMKQ	TVKR	NOMQ	
j ç	VR	UV	e É	NVQKNPR	ééÄ	MKT	RVRROKST	NMM	OMKUP	TVKR	NOMQ	
^Ö	NMT	UV	e É	ROKPPQ	ééÄ	NKM	NMTPPMKMS	RM	OMKVP	TVKR	NOMQ	
` Ç	NNN	UV	e É	OSMKQRO	ééÄ	NKQ	TNRQRKUO	ORM	OMKUQ	TVKR	NOMQ	
på	NNU	NRV	e É	RNMKORU	ééÄ	MKO	OTTQNMKRV	RMM	OMKQN	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl~ë	VUKVUR	ééÄ	NKN	QNVPQVKON	NMM	NVKU	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl~ë	ONOVKOMN	ééÄ	MKR	ORQTVVRKPU	OMMM	ONKOV	TVKR	NOMQ	
t	NUO	NRV	k ç=dl~ë	NMUKVUO	ééÄ	MKR	ORSMVVKMN	NMM	ONKU	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl~ë	NMNKMOV	ééÄ	MKS	RONVQVKMU	NMM	OMKQN	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl~ë	NMQKOQT	ééÄ	MKR	TQUUNOKUT	NMM	OMKUR	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl~ë	VUKTTM	ééÄ	MKS	SPNUPUKSP	NMM	NVKTR	TVKR	NOMQ	
r	OPU	OMV	k ç=dl~ë	NMRKSMR	ééÄ	NKS	SOOSNMKTO	NMM	ONKNO	TVKR	NOMQ	

n ` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä=Ö
iá	S	kç=d~ë	NTUVCCCKRR	NKU	CNCCPCPKQO	UQIP	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PUVQNSCKMU	MKT	QRNVVMMKMQ	USKNS	RVKR	NOMQ	
pÅ	QR	eO	VMMSQVKSQ	NKO	NMSVRVUKVR	UQKO	RVKR	NOMQ	
pÅ	QR	eÉ	NPCPTVKRS	NKO	NRTTPRKMO	UPKVP	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VCUTVUKTP	NKT	NMSCPUQKUO	UTKCS	RVKR	NOMQ	
dÉ	TO	eO	PRPSPVKQM	CKN	QCCMNTKMN	UPKU	RVKR	NOMQ	
dÉ	TO	eÉ	NMPPNTKUU	NKO	NCCRSPKSN	UQIP	RVKR	NOMQ	
v	UV	eO	QNMQMRSKSM	NKP	QTSCUURKNQ	USKNT	RVKR	NOMQ	
v	UV	eÉ	SVUTSRKVQ	MKN	UCVQMCKQU	UQKCR	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SNNURMVKVP	NKM	SRQQMSTKCO	VPHR	RVKR	NOMQ	
qÄ	NRV	eÉ	CQSRTCSKRQ	NKP	CURMTNTKVP	USKQV	RVKR	NOMQ	
_á	CMV	kç=d~ë	PMVCMTNKMD	NKM	PCNUTCUKRU	VSKMS	RVKR	NOMQ	
_á	CMV	eÉ	NQPMCRMKVR	NKO	NRVQNVSKTN	UVKTO	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i `pt n `NSfj t N
cáÉ=k~ã É	MSVi `pt kÇ
a~í~=m~íÜ=k~ã É	aWi^ÖäÉáíy` mj eyNya^q^yOMOPyMPJ ^oyi n `OQ^kÄ
^Åè=qáã É	PLOQLOMOP=OOMRVMMS
p~ã éäÉ=qóéÉ	i `pt
qçí~äa äãíáç;å	RKMMMM
`çã ã Éáí	JJJ
fpqa=oÉÑ=cáÉk~ã É	MMS` ^i _kÇ
p~ã éäÉ=n `=m~ëëlc á~ä	c~äã
fpqa=n `=m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åã**

n `=^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÄK	r åáë	opa	==i mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n `=cä-Ö
_É	V	S	k ç=dl~ë	RPKRSS	éëÄ	NKS	RSRVPKTV	RM	ONKQP	TVKR	NOMQ	
_	NN	S	k ç=dl~ë	RONKSQS	éëÄ	OKN	PRVNURKVM	RMM	OMKUT	TVKR	NOMQ	
k~	OP	QR	e É	UPNTKQUN	éëÄ	OKV	NMRVTQTHPR	TRMM	COKNU	TVKR	NOMQ	
j Ö	OQ	QR	e É	RPUNKQQM	éëÄ	NKO	PQSUVMKTS	RMMM	ONKRP	TVKR	NOMQ	
^ä	OT	QR	e É	QMVSKPNP	éëÄ	OKP	RCQSQKCU	OMMM	OMKVS	TVKR	NOMQ	
pá	OU	QR	e O	NMSTKVVT	éëÄ	NKM	UVNSTKCP	NMMM	ONKPS	M	OMM	
h	PV	QR	e É	NMOVVKSVO	éëÄ	MKU	RVTOTRKSU	NMMMM	OMKS	TVKR	NOMQ	
`~	QM	QR	e O	OTPSKPOP	éëÄ	MKT	NTONQVTKVV	ORMM	ONKUV	TVKR	NOMQ	
s	RN	UV	e É	RPRKVTV	éëÄ	NKN	QNPUPNKRO	RMM	ONKQQ	TVKR	NOMQ	
`ê	RO	UV	e É	ONPKMVR	éëÄ	NKM	OMTQQSKUM	OMM	ONKPO	TVKR	NOMQ	
j å	RR	UV	e É	RPUKQUR	éëÄ	NKR	OSPMTNKQN	RMM	ONKRQ	TVKR	NOMQ	
cÉ	RS	UV	e O	NNTNKPUT	éëÄ	MKV	OSSOOOQKRP	NMMM	OPKQP	TVKR	NOMQ	
`ç	RV	UV	e É	RRQKORM	éëÄ	MKV	VNSMUOKQU	RMM	COKWV	TVKR	NOMQ	
ká	SM	UV	e É	RQPKTON	éëÄ	MKU	ORMSTNKUO	RMM	ONKTR	TVKR	NOMQ	
`ì	SP	UV	e É	OTPKMRS	éëÄ	MKS	PQVOUQKTV	ORM	ONKUQ	TVKR	NOMQ	
wå	SS	UV	e É	SMTKVRS	éëÄ	MKR	NOUMQMKRT	RMM	OQKPO	TVKR	NOMQ	SMOMK& a ça
^ë	TR	UV	e É	NMRKRMQ	éëÄ	MKM	NTPSRKOU	NMM	ONKN	TVKR	NOMQ	
pÉ	TU	UV	e O	NMPKQTT	éëÄ	MKQ	VPMRKUP	NMM	OMKT	TVKR	NOMQ	
pê	UU	UV	e É	RPNKQRQ	éëÄ	MKU	PMUVONKUO	RMM	ONKOS	TVKR	NOMQ	
j ç	VR	UV	e É	NMSKNQM	éëÄ	NKU	SMORPKRP	NMM	ONKOP	TVKR	NOMQ	
^Ö	NMT	UV	e É	RPKTPQ	éëÄ	MKU	NMVQMVKVO	RM	ONKQV	TVKR	NOMQ	
`Ç	NNN	UV	e É	OSTKMPO	éëÄ	MKQ	TOUCPKTR	ORM	ONKPS	TVKR	NOMQ	
på	NNU	NRV	e É	RNSKRQN	éëÄ	MKU	OUPMTMKUS	RMM	OMKSS	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl~ë	NMMKNOM	éëÄ	NKS	QMVRCUKOQ	NMM	OMMVO	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl~ë	ONVSKMVQ	éëÄ	NKO	ORTOSSSKNO	OMMM	ONKVS	TVKR	NOMQ	
t	NUO	NRV	k ç=dl~ë	NNMKTOR	éëÄ	MKT	ORSTOUKVN	NMM	COKNQ	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl~ë	NMNKUUU	éëÄ	OKN	RPOSVSKNT	NMM	OMPU	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl~ë	NMRKUPP	éëÄ	NKT	TSVPORKTT	NMM	ONKNT	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl~ë	NMNKTVO	éëÄ	NKM	SRVMMSKOU	NMM	OMKPS	TVKR	NOMQ	
r	OPU	OMV	k ç=dl~ë	NMTKONQ	éëÄ	MKQ	SPVUSTKNM	NMM	ONKQQ	TVKR	NOMQ	

n `=fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä=Ö
iá	S	kç=d~ë	NUNPPSPMPR	OMP	ONOOPOPKQO	URKQQ	RVMR	NOMQ	
pÅ	QR	kç=d~ë	PUSMONTMRU	NMS	QRNVVMMMVQ	URKQ	RVMR	NOMQ	
pÅ	QR	eO	UVMRPVMVO	NMO	NMSVRVUMVR	UPKOS	RVMR	NOMQ	
pÅ	QR	eÉ	NPPNTQKUO	MMT	NRTTPRMVO	UQKQP	RVMR	NOMQ	
dÉ	TO	kç=d~ë	VOMSSMKQO	MMV	NMSOPUQKUO	USMR	RVMR	NOMQ	
dÉ	TO	eO	PRSVOOMNT	NMP	QOOMNTMVN	UQMRU	RVMR	NOMQ	
dÉ	TO	eÉ	NMPVNUKUS	NMN	NOORSPMSN	UQRTV	RVMR	NOMQ	
v	UV	eO	QMUVNUPMVR	MMP	QTSOUURMVQ	URKUS	RVMR	NOMQ	
v	UV	eÉ	SVPTOPMRS	MMV	UOVQMOKQU	UPMSQ	RVMR	NOMQ	
qÄ	NRV	kç=d~ë	SMPTSRQMPR	NMT	SRQQMSTKOO	VOKOS	RVMR	NOMQ	
qÄ	NRV	eÉ	OQURQTQMVP	MMO	OURMTNTMVP	UTMVV	RVMR	NOMQ	
_á	OMV	kç=d~ë	PNOVTROKQR	NMU	PONUTOURU	VTMQQ	RVMR	NOMQ	
_á	OMV	eÉ	NQQVPRNMOU	NMN	NRVQNVSMTN	VMMVN	RVMR	NOMQ	

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É pn MVMTJMMT

cãÉ=k~ã É MTMpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖãÉåíyf^ mj eyNya^q^yOMCPyMPJj ^oyi n` OQ^hÅ

^Åè=qãã É PLOQLOMCP=CPAMTWQR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==\ mp==	i a o	n` =¢ä-Ö
V	_É	S	k ç=d ~ë	JMKMNT	ééÄ	k L^	VRHRS	NMM	
NN	_	S	k ç=d ~ë	QRTUN	ééÄ	PHM	QMUNRTR	NMMM	
OP	k ~	QR	e É	NUTKQTS	ééÄ	NHS	SSNOVKOU	OMMMM	
OQ	j Ö	QR	e É	PNHPPU	ééÄ	RHR	OOPUKMQ	OMMMM	
OT	^ ä	QR	e É	JUPKPUN	ééÄ	k L^	NMORHSN	OMMMM	
OU	pá	QR	e O	TORTPQ	ééÄ	QRT	SRPPRKMS	NMMM	
PV	h	QR	e É	NQMKMRV	ééÄ	PKO	PRQLUPKVQ	OMMMM	
QM	` ~	QR	e O	NPTKVNP	ééÄ	OHM	VUTQRHSN	OMMMM	
RN	s	UV	e É	MRTST	ééÄ	NQOP	UOSKTM	NMMM	
RO	` ê	UV	e É	MRRMU	ééÄ	UKV	NNVRKUP	OMMM	
RR	j å	UV	e É	MKUNO	ééÄ	NNKV	STSHRS	OMMM	
RS	cÉ	UV	e O	QQKNRO	ééÄ	MHP	NMTMTQHSS	NMMMM	
RV	` ç	UV	e É	MQRO	ééÄ	OMKM	USQHRN	NMMM	
SM	k á	UV	e É	MQQO	ééÄ	OMKV	PVMKMN	NMMM	
SP	` ì	UV	e É	MHSMO	ééÄ	OHS	NNUUKVS	OMMM	
SS	wå	UV	e É	JUKTOM	ééÄ	k L^	SPQKQT	OMMM	
TR	^ ë	UV	e É	MKNTM	ééÄ	NRHS	QRHMM	NMMM	
TU	pÉ	UV	e O	MORQ	ééÄ	VRT	ORHNT	NMMM	
UU	pê	UV	e É	NKPPM	ééÄ	NSHP	STTKUN	OMMM	
VR	j ç	UV	e É	MQQM	ééÄ	THS	PPPHPQ	NMMM	
NMT	^ Ö	UV	e É	MKMQV	ééÄ	NNHR	NMTKTU	NMM	
NNN	` Ç	UV	e É	MOPU	ééÄ	NNHO	SSHPM	NMMM	
NNU	på	NRV	e É	MPSS	ééÄ	OPHO	SSQKQT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MOMQ	ééÄ	POHP	NMVTKUT	NMMM	
NPT	_~	NRV	k ç=d ~ë	OHSVV	ééÄ	NSKU	POMMQLU	OMMM	
NUO	t	NRV	k ç=d ~ë	MHSNO	ééÄ	PNHM	ONNRRTR	NMMM	
OMR	qä	OMV	k ç=d ~ë	MPPQM	ééÄ	PHS	OOSOHSM	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMSS	ééÄ	NRHS	NPMUKMU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NHOTU	ééÄ	OMKV	VTRQKNR	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNOQ	ééÄ	NPHS	TQTKQV	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n` =i çï	B n` =¢äÜÜ	n` =¢ä-Ö
i á	S	k ç=d ~ë	NUQVPNQKNP	PHR	ONOOPOPQQO	UTHNQ	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PUPPRRVHSO	OHM	QRNVVMMMVQ	UQKUO	RVHR	NOMQ	
pÅ	QR	e O	UVSTVUKPN	NHR	NMSVRVUKVR	UPKUQ	RVHR	NOMQ	
pÅ	QR	e É	NPPUOOKOP	MHP	NRTTPRKMO	UQKUQ	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VNVUVSKUP	PKQ	NMSQPUQKUO	USKQP	RVHR	NOMQ	
d É	TO	e O	PRRUNQKPM	MKO	QOOMNTKMN	UQKPN	RVHR	NOMQ	
d É	TO	e É	NMPRTVKTP	NHM	NOORSPHSN	UQKRN	RVHR	NOMQ	
v	UV	e O	QMPONNRKOP	NHN	QTSOLURKNQ	UQHSS	RVHR	NOMQ	
v	UV	e É	SVUSPSKUS	NHM	UOVQMOKQU	UQKOP	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SMTQTQRKPV	PKQ	SRQQMSTKOO	VOKUP	RVHR	NOMQ	
qÄ	NRV	e É	OQLVPPNKVR	MKU	OURMTNTKVP	UTKPO	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PMUSTVOKRQ	PKQ	PONUTOUKRU	VRKV	RVHR	NOMQ	
_á	OMV	e É	NORNUQOKVO	MHS	NRVQNVSKTN	VNHMT	RVHR	NOMQ	

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p~ã éáÉ=k~ã É	``s
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n``=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÁ	B i çï	B eäÜÜ	n``=c ä~Ö
V	_É	S	k ç=d ~ë	OQKVPQ	ééÄ	OKM	NQMSNSKON	CR	VVKTQ	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKQMT	ééÄ	NKU	VQMSVKTQ	CR	NMNKSP	UVKU	NNMO	
OP	k ~	QR	e É	RPMNKMNO	ééÄ	NKU	PQMRNMRKMV	RMMM	NMSKMO	UVKU	NNMO	
OQ	j Ö	QR	e É	RQUQKQUQ	ééÄ	MKU	NTSRPQVKUM	RMMM	NMRKSV	UVKU	NNMO	
OT	^ä	QR	e É	RMRKUUP	ééÄ	OKS	SQVVSKNT	RMM	NMNKNU	UVKU	NNMO	
OU	pá	QR	e O	RNNKTOT	ééÄ	NKM	OORNQNKUM	RMM	NMOKPR	UVKU	NNMO	
PV	h	QR	e É	RQOPKQUV	ééÄ	NKT	NRQSRORKRM	RMMM	NMQKQT	UVKU	NNMO	
QM	`~	QR	e O	RNMSKQOS	ééÄ	NKM	NSUTNTQSKMM	RMMM	NMOKNP	UVKU	NNMO	
RN	s	UV	e É	ORKQMO	ééÄ	MKU	NMNNRPKUN	CR	NMNKSN	UVKU	NNMO	
RO	`ê	UV	e É	ORKPSV	ééÄ	MKN	NOTPTVKSN	CR	NMNKQU	UVKU	NNMO	
RR	j å	UV	e É	ORKQQM	ééÄ	MKR	SPTMQKRO	CR	NMMKVS	UVKU	NNMO	
RS	cÉ	UV	e O	RNURKQUU	ééÄ	MKV	RVUQQUVUKSO	RMMM	NMPKTN	UVKU	NNMO	
RV	`ç	UV	e É	ORKUNN	ééÄ	MKU	OOMROMPU	CR	NMPKOQ	UVKU	NNMO	
SM	ká	UV	e É	ORKQMS	ééÄ	MKV	SMQRPKRT	CR	NMNKSO	UVKU	NNMO	
SP	`ì	UV	e É	ORKSQT	ééÄ	NKR	NSVNNVKRU	CR	NMOKRV	UVKU	NNMO	
SS	wå	UV	e É	OQKUSQ	ééÄ	OKN	OUVQVKNS	CR	VVKQS	UVKU	NNMO	
TR	^ë	UV	e É	ORKRQM	ééÄ	NKO	ONSPTKMM	CR	NMOKNS	UVKU	NNMO	
TU	pÉ	UV	e O	OQKVTQ	ééÄ	MKQ	NNQQMKNQ	CR	VVKV	UVKU	NNMO	
UU	pê	UV	e É	ORKQMV	ééÄ	NKP	TSMQUKOO	CR	NMNKSQ	UVKU	NNMO	
VR	j ç	UV	e É	OQKRSS	ééÄ	NKN	TNTUSKSN	CR	VUKOS	UVKU	NNMO	
NMT	^Ö	UV	e É	ORKSPP	ééÄ	MKU	OSUSSQKQM	CR	NMOKRP	UVKU	NNMO	
NNN	`Ç	UV	e É	ORKSNU	ééÄ	MKR	PRVSUKRU	CR	NMOKQT	UVKU	NNMO	
NNU	på	NRV	e É	ORKMQP	ééÄ	MKV	TMNRQKMR	CR	NMMKNT	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKSUS	ééÄ	MKQ	RQQSVQKON	CR	VUKTQ	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKQOP	ééÄ	NKO	NRQTVQKUO	CR	NMNKSV	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKMTU	ééÄ	MKQ	PMOMQSKNS	CR	NMMKPN	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKNON	ééÄ	OKN	SQSURVKUN	CR	NMMKQU	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	ORKUUV	ééÄ	NKO	VOSURQKRV	CR	NMPKRS	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	ORKNSP	ééÄ	NKM	UMOMNUKTM	CR	NMMKSR	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	ORKVTS	ééÄ	MKU	TSPRNMKRM	CR	NMPKV	UVKU	NNMO	

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k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=o pa	oÉÑ=mp	B=oÉÁ	B n``=i çï	B n``=c äÜÜ	n``=c ä~Ö
i á	S	k ç=d ~ë	NVPTTTPKPM	MKT	ONOOPOPKQO	VNKP	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QMOTRNMKRT	NKR	QRNVVMMMVQ	UVKNN	RVKR	NOMQ	
pÅ	QR	e O	VQNPQNKTR	OKM	NMSVRVUKVR	UUKMN	RVKR	NOMQ	
pÅ	QR	e É	NPUNMMPM	NKN	NRTTPRKMO	UTHRR	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VRPOSVKTM	MKV	NMSQPUQKUO	UVKRS	RVKR	NOMQ	
d É	TO	e O	PTNQSTKVO	NKQ	QOOMNTKMN	UUKMO	RVKR	NOMQ	
d É	TO	e É	NMSOQUKNO	MKS	NOORSPKSN	USKSV	RVKR	NOMQ	
v	UV	e O	QNSRVSPKRQ	NKM	QTSOUURKNQ	UTKQT	RVKR	NOMQ	
v	UV	e É	TNQOUVKVS	MKS	UOVQMOKQU	USKNO	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SOTQQOMKNO	NKQ	SRQQMSTKOO	VRKUU	RVKR	NOMQ	
qÄ	NRV	e É	ORQUNQQKVV	NKN	QURMTNTKVP	UUKSU	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PMUOUORKVO	MKN	PONUTOUKRU	VRKTU	RVKR	NOMQ	
_á	OMV	e É	NQSOPVPKNT	MKU	NRVQNVSKTN	VNKTP	RVKR	NOMQ	

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p~ã éáÉ=k~ã É ``_

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^Åè=qáã É PLCQLOMCP=CPVQNMVT

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qçí~äa ãäíáç~å NKMMMM

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fpqa=oÉÑ=cäÉk~ã É MVS^i_KÇ

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fpqa=n`=m~ëëlc~ää m~ëë

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n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==\ mp==	iãäá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MKMNO	ééÄ	OMKT	NVPKPP	MO	
NN	_	S	kç=d~ë	MKPTU	ééÄ	TKT	CONRKTT	Q	
CP	k~	QR	eÉ	JQKVQN	ééÄ	kL^	QNVRQKOT	OMM	
CQ	j Ö	QR	eÉ	PKTOM	ééÄ	NMKP	NQLUMKNP	OM	
OT	^ä	QR	eÉ	JCPKRNM	ééÄ	kL^	OORKRS	OM	c~äë^ äëj ÉíÜçÇë& c~äÉÇ=a ça
OU	pá	QR	eO	MQVQ	ééÄ	CPKV	SUMKTP	NMM	
PV	h	QR	eÉ	NUKPST	ééÄ	OVKS	PQPRMKMU	OMM	
QM	`~	QR	eO	RKPPT	ééÄ	TKR	OVTQRKMM	OM	
RN	s	UV	eÉ	MKMVS	ééÄ	NNTKM	OTOKCP	N	
RO	`ê	UV	eÉ	MKMOU	ééÄ	OOKM	UVSKRO	N	
RR	j å	UV	eÉ	JMKMRP	ééÄ	kL^	NRRKVT	MQ	
RS	cÉ	UV	eO	QKQOS	ééÄ	VKR	SNUQMKOR	OM	
RV	` ç	UV	eÉ	MKMNS	ééÄ	OVKR	OSOKCP	MO	
SM	k á	UV	eÉ	JMKMON	ééÄ	kL^	NRRKRS	MQ	
SP	` ì	UV	eÉ	MKMNR	ééÄ	ONKV	RQPKPS	MS	
SS	wå	UV	eÉ	JOKNSN	ééÄ	kL^	ONQKQR	O	c~äë^ äëj ÉíÜçÇë& c~äÉÇ=a ça
TR	^ë	UV	eÉ	MKMOU	ééÄ	NVKS	QOKST	N	
TU	pÉ	UV	eO	MKMQQ	ééÄ	NNKU	OPKRM	N	
UU	pê	UV	eÉ	MKMOQ	ééÄ	QMO	VOKCP	N	
VR	j ç	UV	eÉ	MKNQQ	ééÄ	RKS	ROSKSV	N	
NMT	^Ö	UV	eÉ	MKMNT	ééÄ	SKS	NVSKST	MO	
NNN	` Ç	UV	eÉ	MKMOO	ééÄ	SKV	PPKTM	MO	
NNU	på	NRV	eÉ	MKMVR	ééÄ	NSQKO	QVTKUM	N	
NON	pÄ	NRV	kç=d~ë	MKMPQ	ééÄ	PKT	NMMTKTT	MO	
NPT	_~	NRV	kç=d~ë	MKMSN	ééÄ	RKT	ONPKTU	MQ	
NUO	t	NRV	kç=d~ë	MKNRU	ééÄ	NTHP	OSTVKTU	N	
OMR	qä	OMV	kç=d~ë	MKMSQ	ééÄ	NNKT	OOMVKNV	MO	
OMU	mÄ	OMV	kç=d~ë	MKMNM	ééÄ	NNKV	NOOQKSR	MO	
OPO	qÜ	OMV	kç=d~ë	MKMUN	ééÄ	MKV	QPORKPP	N	
OPU	r	OMV	kç=d~ë	MKMOT	ééÄ	OOKT	UQMKVO	MO	

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iá	S	kç=d~ë	NVVOORSKMP	MKP	ONOOPOPKQO	VPKUU	RVKR	NOMKQ	
pÅ	QR	kç=d~ë	QMSSUUOKVR	NKM	ORNVVMMKMQ	UVKVU	RVKR	NOMKQ	
pÅ	QR	eO	VOTSMRKPT	PKO	NMSVRVUKVR	USKTO	RVKR	NOMKQ	
pÅ	QR	eÉ	NQMNQUKNS	MKT	NRTTPRKMO	UUKUR	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	VTONSQKPQ	NKU	NMSQPUQKUO	VNKPQ	RVKR	NOMKQ	
dÉ	TO	eO	PTUMVMKPV	NKS	QOOMNTKMN	UVKRV	RVKR	NOMKQ	
dÉ	TO	eÉ	NNMMOPKSO	MKP	NOORSPKSN	UVKTT	RVKR	NOMKQ	
v	UV	eO	QPNRPTOKMP	PKN	QTSOUURKNQ	VMKS	RVKR	NOMKQ	
v	UV	eÉ	TQTMSMKOT	MKO	UOVQMOKQU	VMKMT	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	SQMPPUNKPO	MKS	SRQQMSTKOO	VTKUR	RVKR	NOMKQ	
qÄ	NRV	eÉ	ORVOMVUKQN	NKM	OURMTNTKVP	VMKVP	RVKR	NOMKQ	
_á	OMV	kç=d~ë	PNRVSUSKSM	NKR	PONUTOUKRU	VUKNT	RVKR	NOMKQ	
_á	OMV	eÉ	NQVNUMKOO	MKV	NRVQNVSKTN	VPKRU	RVKR	NOMKQ	

KATAHDIN ANALYTICAL SERVICES, LLC
METALS ANALYSIS RUN INFORMATION SHEET

INSTR. ID: L (Agilent 7800) **ANALYST**: KS **ANALYSIS DATE**: 03/28/23

METHOD: **ICP-MS**
- ☑ 200.8
- ☑ 6020
- ☑ DOD

FILE NAME: LQC28E

Reviewed By: EA 033023

The pHs of all samples that were tested by direct analysis in this analytical run were checked just prior to analysis and confirmed to be <2. The time of preservation of these samples was checked in the "Measured Turbidity and Preservation of Incoming Samples" logbook to verify that they had been preserved at least 16 hours prior to analysis. These verifications were performed by _____ (initials) on _____ (date).

STANDARDS USED:

Standard Name	Standard ID	Prep Date	Expiration Date	Standard Conc.
Cal Blk/ICB/CCB	MW21411	03/02/23	03/02/24	0 ug/L
Cal Std	MW21445	03/27/23	05/31/23	Varies by Element
ICV	MW21429	03/15/23	06/14/23	Varies by Element
PQL	MW21447	03/27/23	05/31/23	Varies by Element
LRS1	MW21454	03/28/23	05/31/23	Varies by Element
LRS2	MW21450	03/27/23	05/31/23	Varies by Element
ICSA	MW21441	03/24/23	03/31/23	Varies by Element
ICSAB	MW21448	03/27/23	04/03/23	Varies by Element
CCV	MW21455	03/28/23	05/31/23	Varies by Element
Internal Standard (ISTD)	N/A	N/A	N/A	0.2 mg/L (Li,Sc,Ge/Y,Tb,Bi)

Additional Comments and Notes:

Samples with ISTD RSDs > 8% were reanalyzed immediately.

ISTD was manually added to all standards and samples (0.08 mL of MS2459 to 8 mL).

Dilutions: Some samples were diluted based on history or due to interfering element concentrations.

Dilution preparations are as follows:

5x diln.: 1.6 mL of sample (pipet M30) + 6.4 mL of MW21411 (pipet M31)

10x diln.: 0.8 mL of sample (pipet M19) + 7.2 mL of MW21411 (pipet M31)

25x diln.: 0.32 mL of sample(pipet M19) + 7.68 mL of MW21411 (pipet M31)

Post Spike: 0.08 mL of MW21329 (pipet M27) into 8 mL final volume of appropriately diluted sample (pipet M31)

INSTRUMENT RUNLOG

Instrument: AGILENT 7800

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
RINSE	1	LQC28E	03/28/2023	15:39	KS
RINSE	1	LQC28E	03/28/2023	15:44	KS
RINSE	1	LQC28E	03/28/2023	15:49	KS
CalBlank	1	LQC28E	03/28/2023	15:55	KS
CalStd	1	LQC28E	03/28/2023	16:00	KS
ICV	1	LQC28E	03/28/2023	16:12	KS
ICB	1	LQC28E	03/28/2023	16:21	KS
PQL	1	LQC28E	03/28/2023	16:26	KS
ICSA	1	LQC28E	03/28/2023	16:31	KS
ICSAB	1	LQC28E	03/28/2023	16:36	KS
LRS1	1	LQC28E	03/28/2023	16:45	KS
LRS2	1	LQC28E	03/28/2023	16:57	KS
RINSE	1	LQC28E	03/28/2023	17:04	KS
RINSE	1	LQC28E	03/28/2023	17:09	KS
RINSE	1	LQC28E	03/28/2023	17:14	KS
CCV	1	LQC28E	03/28/2023	17:20	KS
CCB	1	LQC28E	03/28/2023	17:28	KS
NEWLOTTEST	1	LQC28E	03/28/2023	17:33	KS
PBSQC14IMS2	5	LQC28E	03/28/2023	17:38	KS
SQ1188-005A	5	LQC28E	03/28/2023	17:43	KS
PBSQC16IMS1	5	LQC28E	03/28/2023	17:48	KS
LCSOQC16IMS1	5	LQC28E	03/28/2023	17:54	KS
SQ1188-011	5	LQC28E	03/28/2023	18:01	KS
SQ1188-013	5	LQC28E	03/28/2023	18:07	KS
PBSQC17IMS1	5	LQC28E	03/28/2023	18:12	KS
LCSOQC17IMS1	5	LQC28E	03/28/2023	18:17	KS
SQ0941-001	5	LQC28E	03/28/2023	18:25	KS
CCV	1	LQC28E	03/28/2023	18:30	KS
CCB	1	LQC28E	03/28/2023	18:39	KS
SQ0941-003	5	LQC28E	03/28/2023	18:44	KS
SQ0941-005	5	LQC28E	03/28/2023	18:49	KS
SQ0941-007	5	LQC28E	03/28/2023	18:54	KS
SQ0941-007L	25	LQC28E	03/28/2023	18:59	KS
SQ0941-007A	5	LQC28E	03/28/2023	19:04	KS
SQ0941-007P	5	LQC28E	03/28/2023	19:09	KS
SQ0941-007S	5	LQC28E	03/28/2023	19:17	KS
SQ0941-009	5	LQC28E	03/28/2023	19:25	KS
SQ0941-011	5	LQC28E	03/28/2023	19:30	KS
SQ0961-001	5	LQC28E	03/28/2023	19:35	KS
CCV	1	LQC28E	03/28/2023	19:41	KS
CCB	1	LQC28E	03/28/2023	19:49	KS
SQ0961-003	5	LQC28E	03/28/2023	19:54	KS
SQ0961-005	5	LQC28E	03/28/2023	19:59	KS
SQ0961-009	5	LQC28E	03/28/2023	20:04	KS

US EPA Tune Check Report

Operator Name	admin
Acq/Data Batch	D:\Agilent\ICPMH\1\DATA\2023\03-MAR\LQC28[illegible].b
Acq. Date-Time	3/28/2023 14:56:18
Report Comment	---
Instrument Name	G8421A SG18503526

KS 3/30/23

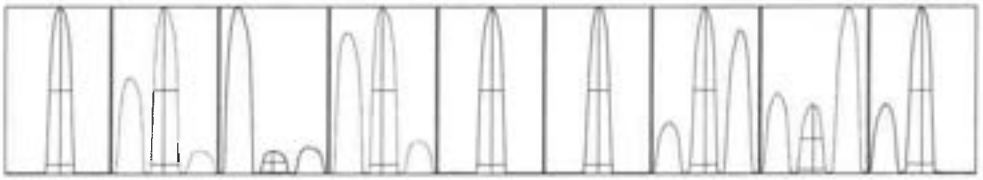
[No Gas]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
9	10.00	60507	605071.36	3.783	5.000	
24	10.00	262919	2629186.84	3.523	5.000	
25	10.00	34691	346911.08	4.416	5.000	
26	10.00	41467	414669.72	3.330	5.000	
59	10.00	560397	5603969.55	3.590	5.000	
115	10.00	651098	6510977.08	3.103	5.000	
206	10.00	105357	1053567.63	3.419	5.000	
207	10.00	89612	896122.28	3.883	5.000	
208	10.00	219298	2192981.17	4.253	5.000	

Integration Time [sec] 0.1

Resolution/Axis



Mass	Peak Height	Axis	Axis (Required)	Axis (Flag)
9	62546.00	9.10	8.90 - 9.10	
24	273281.45	24.00	23.90 - 24.10	
25	35853.87	25.00	24.90 - 25.10	
26	42339.17	26.00	25.90 - 29.10	
59	567772.85	59.05	58.90 - 59.10	
115	651456.65	115.05	114.90 - 115.10	
206	108038.95	206.00	205.90 - 206.10	
207	93169.45	207.00	206.90 - 207.10	
208	225484.57	208.00	207.90 - 208.10	

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
9	0.62	0.780	0.900	
24	0.68	0.790	0.900	
25	0.67	0.787	0.900	

US EPA Tune Check Report

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
26	0.67	0.790	0.900	
59	0.64	0.788	0.900	
115	0.59	0.775	0.900	
206	0.60	0.771	0.900	
207	0.61	0.780	0.900	
208	0.61	0.781	0.900	

Integration Time [sec] 0.1
Acquisition Time [sec] 47.0000000000001
Y Axis Linear

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.34 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	13.0 V
Extract 2	-250.0 V	Cell Entrance	-40 V	Plate Bias	-40 V
Omega Bias	-85 V	Cell Exit	-60 V		

Cell Parameters

Use Gas	No	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-8.0 V		
H2 Flow	0.0 mL/min	OctP RF	130 V		

QP Parameters

Mass Gain	121	Axis Gain	0.9980	QP Bias	-3.0 V
Mass Offset	125	Axis Offset	0.17		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.8 mm

EM

Discriminator	3.5 mV	Analog HV	2216 V	Pulse HV	1206 V

[H2]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	41752	417523.10	3.377	5.000	
89	10.00	42555	425547.15	2.803	5.000	
205	10.00	35982	359824.81	3.382	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

US EPA Tune Check Report

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.34 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-18.0 V		
H2 Flow	5.0 mL/min	OctP RF	200 V		

QP Parameters

Mass Gain	121	Axis Gain	0.9980	QP Bias	-13.0 V
Mass Offset	125	Axis Offset	0.17		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.8 mm		

EM

Discriminator	3.5 mV	Analog HV	2216 V	Pulse HV	1206 V

[He]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	132030	1320301.29	4.074	5.000	
89	10.00	8990	89895.05	3.589	5.000	
205	10.00	17898	178983.42	3.543	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.34 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	4.5 mL/min	OctP Bias	-18.0 V		
H2 Flow	0.0 mL/min	OctP RF	200 V		

QP Parameters

US EPA Tune Check Report

Mass Gain	121	Axis Gain	0.9980	QP Bias	-13.0 V
Mass Offset	125	Axis Offset	0.17		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.8 mm		

EM

Discriminator	3.5 mV	Analog HV	2216 V	Pulse HV	1206 V

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OT	^ä	QR	e É	OONKNO	NPKT
OU	pá	QR	e O	QUTKNV	NKO
PV	h	QR	e É	PQNRVKSS	NKM
QM	` ~	QR	e O	NRRSOKNN	NKQ
RN	s	UV	e É	OURKRS	NSKS
RO	` ê	UV	e É	NNNNKUP	VKR
RR	j å	UV	e É	NRNKVT	PKR
RS	cÉ	UV	e O	NPQSMKSR	OKU
RV	` ç	UV	e É	OUUKVM	NNKQ
SM	k á	UV	e É	NTRKRS	NOKS
SP	` ì	UV	e É	RSUKVN	OKV
SS	wå	UV	e É	OMTKTU	UKU
TR	^ë	UV	e É	ONKMM	QKU
TU	pÉ	UV	e O	NMKNT	NQKO
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NMT	^Ö	UV	e É	QNKNN	QMKM
NNN	` Ç	UV	e É	NMKTQ	QNKU
NNU	på	NRV	e É	PONKNO	RKT
NON	pÄ	NRV	k ç=d ~ë	UOTKRT	NOKQ
NPT	_~	NRV	k ç=d ~ë	NSSKUQ	VKO
NUO	t	NRV	k ç=d ~ë	OPUOKTO	NMKT
OMR	qä	OMV	k ç=d ~ë	SSQKMR	RKT
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pÅ	QR	e O	VURSOPKUN	OKS
pÅ	QR	e É	NSMVPNKOP	MKQ
d É	TO	k ç=d ~ë	NMTQOQSKRP	NKU
d É	TO	e O	PVPUSVKSQ	OKP
d É	TO	e É	NORORSSKVR	MKT
v	UV	e O	QPMNURSKUS	NKT
v	UV	e É	UQNPQOKNU	NKN
qÄ	NRV	k ç=d ~ë	SRVNQQQKUP	MKO
qÄ	NRV	e É	OUSSNVMKNM	MKV
_á	OMV	k ç=d ~ë	PNTPQTOKSU	NKO
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fpqa=oÉÑ=cãÉk~ãÉ	MVQ ^ i _KÇ
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n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ãÉ	fpqa	qìåÉ	==` mp==	opa
V	_É	S	k ç=d ~ë	OUSTNSKTV	MKQ
NN	_	S	k ç=d ~ë	NUTNQRKOR	MKV
OP	k~	QR	e É	TQNUTOQKQR	NKT
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OT	^ä	QR	e É	NQQQTMKSM	OKP
OU	pá	QR	e O	QTQPNTKTO	NKO
PV	h	QR	e É	PPPSRRUKNV	MKS
QM	` ~	QR	e O	PRRQVVNUKVO	NKP
RN	s	UV	e É	OPTUPRKOU	MKS
RO	` ê	UV	e É	OVURSUKMO	NKO
RR	j å	UV	e É	NQUVOVKPU	NKT
RS	cÉ	UV	e O	NORRMMNVRKTT	NKQ
RV	` ç	UV	e É	RNMMQOKUN	MKV
SM	k á	UV	e É	NQOURQKQP	NKT
SP	` ì	UV	e É	PVSTVPKMU	NKQ
SS	wå	UV	e É	STNPUKMM	NKR
TR	^ë	UV	e É	QVMRVKUS	NKS
TU	pÉ	UV	e O	OPQTOKQR	MKP
UU	pê	UV	e É	NTRVPRKNR	NKR
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NPT	_~	NRV	k ç=d ~ë	POVOMRKRT	MKR
NUO	t	NRV	k ç=d ~ë	SQSNVRKMQ	MKR
OMR	qä	OMV	k ç=d ~ë	NQOPTNOKRO	MKS
OMU	mÄ	OMV	k ç=d ~ë	NVQTRSRKOR	NKP
OPO	qÜ	OMV	k ç=d ~ë	NTNOSVQKSP	NKO
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v	UV	e O	QPUQOVVKNO	NKM	QPMNURSKUS	NMNKVO	RVKR	NOMKQ	
v	UV	e É	USMVOUKTQ	NKU	UQNPQOKNU	NMOKPP	RVKR	NOMKQ	
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QP	k~	QR	eÉ	QNUQKPPQ	ééÄ	MKQ	PNMPQPRKQN	QMMM	NMQKRS	UVKS	NNMQ	
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QT	^ä	QR	eÉ	QNTKMPO	ééÄ	NKQ	RVUNUKCU	QMM	NMQKOS	UVKS	NNMQ	
QU	pá	QR	eO	QMVKNNU	ééÄ	MKV	NVOSSUKRU	QMM	NMOKOU	UVKS	NNMQ	
PV	h	QR	eÉ	QNVNKVRO	ééÄ	MKP	NQMRVRNKQQ	QMMM	NMQKU	UVKS	NNMQ	
QM	`~	QR	eO	QNSPKQMN	ééÄ	NKR	NQSUNPUMKUV	QMMM	NMQKMU	UVKS	NNMQ	
RN	s	UV	eÉ	QMKQUO	ééÄ	MKT	VSNSMKVP	QM	NMOKQN	UVKS	NNMQ	
RO	`ê	UV	eÉ	QMKQST	ééÄ	NKQ	NONMSQKTR	QM	NMOKPQ	UVKS	NNMQ	
RR	j å	UV	eÉ	QMKRVO	ééÄ	NKM	SMRNOKQQ	QM	NMOKVS	UVKS	NNMQ	
RS	cÉ	UV	eO	PVURKQUP	ééÄ	NKP	RMQPPSNQKPQ	QMMM	VVKSQ	UVKS	NNMQ	
RV	`ç	UV	eÉ	QNKNOT	ééÄ	NKR	QNORMRKSN	QM	NMRKSQ	UVKS	NNMQ	
SM	ká	UV	eÉ	QMKVOO	ééÄ	NKM	RUVUVKVT	QM	NMQKSN	UVKS	NNMQ	
SP	`ì	UV	eÉ	QMKVOU	ééÄ	NKO	NSPVQSKVR	QM	NMQKSQ	UVKS	NNMQ	
SS	wå	UV	eÉ	QNKOTS	ééÄ	NKS	CUOSQKQS	QM	NMSKPU	UVKS	NNMQ	
TR	^ë	UV	eÉ	QMQNN	ééÄ	NKP	NVTQPKPQ	QM	NMOKMS	UVKS	NNMQ	
TU	pÉ	UV	eO	QMMMOS	ééÄ	MKQ	VQUQKTU	QM	NMMKNP	UVKS	NNMQ	
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NNU	på	NRV	eÉ	NVKVNQ	ééÄ	NKT	SRMMNKOP	QM	VVKRT	UVKS	NNMQ	
NON	pÄ	NRV	kç=cl~ë	NVKTOT	ééÄ	NKR	QSNOMUKNS	QM	VUKSQ	UVKS	NNMQ	
NPT	_~	NRV	kç=cl~ë	QMKSQT	ééÄ	NKP	NQMDVQKTP	QM	NMPKOP	UVKS	NNMQ	
NUO	t	NRV	kç=cl~ë	QNKSRS	ééÄ	NKQ	OVMMQUKRP	QM	NMUKOU	UVKS	NNMQ	
QMR	qä	QMV	kç=cl~ë	NVKQQP	ééÄ	OKO	RTQVTOKMV	QM	VTKOO	UVKS	NNMQ	
QMU	mÄ	QMV	kç=cl~ë	NVKVOO	ééÄ	NKT	UMSTORKOS	QM	VVKSN	UVKS	NNMQ	
QPO	qÜ	QMV	kç=cl~ë	NVKOVQ	ééÄ	QKS	SUTRUOKVS	QM	VSKQT	UVKS	NNMQ	
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pÅ	QR	kç=cl~ë	QUMSUVUKPU	NKU	QRTPSTVKOQ	NMRKN	RVKR	NOMQ	
pÅ	QR	eO	NMNVOTUKTU	MKQ	VURSOPKUN	NMPKQN	RVKR	NOMQ	
pÅ	QR	eÉ	NSPSUOKMT	MKS	NSMVPNKOP	NMNKTN	RVKR	NOMQ	
dÉ	TO	kç=cl~ë	NNOSTVOKVN	NKV	NMTQOQSKRP	NMQKUV	RVKR	NOMQ	
dÉ	TO	eO	PVUMMSKVR	MKQ	PVPUSVKSQ	NMNKMR	RVKR	NOMQ	
dÉ	TO	eÉ	NOTUQSKNS	NKO	NORQSSKVR	NMOKMS	RVKR	NOMQ	
v	UV	eO	QQQMPOUKQV	NKQ	QPMNURSKUS	NMOKTR	RVKR	NOMQ	
v	UV	eÉ	UQUNMPKQT	MKO	UQNPQOKNU	NMMKU	RVKR	NOMQ	
qÄ	NRV	kç=cl~ë	TNSSPTRKPO	MKV	SRVNQQQKUP	NMUKTO	RVKR	NOMQ	
qÄ	NRV	eÉ	OVSNOQQKSP	MKR	OUSSNVMKN	NMPKPO	RVKR	NOMQ	
_á	QMV	kç=cl~ë	PROSNMQKTV	NKO	PNTPQTOKSU	NNNKSN	RVKR	NOMQ	
_á	QMV	eÉ	NSVRTTQKPR	MKT	NSMVTVTKOQ	NMRKPQ	RVKR	NOMQ	

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fpqa=n`=m~ëëlc~äã	m~ëë
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NN	_	S	kç=d~ë	MKNVO	ééÄ	NPHN	NSCOKRS	Q	
CP	k~	CR	eÉ	CKSNM	ééÄ	COCU	RVSCNKNO	CMM	
CQ	j Ö	CR	eÉ	CKSVR	ééÄ	VKT	NRSCKPS	CM	
CT	^ä	CR	eÉ	JMKNVR	ééÄ	kL^	NVUKUV	CM	
CU	pá	CR	eO	MKPVN	ééÄ	UTHR	SNTHPP	NVM	
PV	h	CR	eÉ	SKRUT	ééÄ	CRHP	PQVCSKON	CMM	
QM	`~	CR	eO	PKVRT	ééÄ	THR	CRTCSKVT	CM	
RN	s	UV	eÉ	MKMVM	ééÄ	kL^	OTRKRS	N	
RO	`ê	UV	eÉ	MKMVV	ééÄ	NCSKT	NNCRKUP	N	
RR	j å	UV	eÉ	MKMVQ	ééÄ	NCNKT	NRTKVT	MQ	
RS	cÉ	UV	eO	PKOVQ	ééÄ	PKU	RPRNUKSR	CM	
RV	`ç	UV	eÉ	JMKMVR	ééÄ	kL^	CPPHPQ	MO	
SM	ká	UV	eÉ	MKMVM	ééÄ	PQSSTKU	NTMKMM	MQ	
SP	`ì	UV	eÉ	MKMVQ	ééÄ	RCHS	RUNKNP	MS	
SS	wå	UV	eÉ	MKVPN	ééÄ	NNHP	CQMKMM	O	
TR	^ë	UV	eÉ	MKVNT	ééÄ	PPKN	PSKMM	N	
TU	pÉ	UV	eO	MKVOS	ééÄ	OVHS	ONKUP	N	
UU	pê	UV	eÉ	MKMVM	ééÄ	OURSKT	RNKNN	N	
VR	j ç	UV	eÉ	MKOMT	ééÄ	CKO	VORKSM	N	
NMT	^Ö	UV	eÉ	MKVNO	ééÄ	PNKM	NUPHPQ	MO	
NNN	`Ç	UV	eÉ	MKVNQ	ééÄ	PQKV	PNKQU	MO	
NNU	på	NRV	eÉ	MKVOQ	ééÄ	OTHM	PVPHPR	N	
NON	pÄ	NRV	kç=d~ë	MKVPS	ééÄ	TKT	NSRNKUR	MO	
NPT	_~	NRV	kç=d~ë	MKMVQ	ééÄ	TMQ	NVSKUU	MQ	
NUO	t	NRV	kç=d~ë	MKNPP	ééÄ	ONKU	QNCRKVD	N	
OMR	qä	OMV	kç=d~ë	MKVRV	ééÄ	NPKN	OCPRKVM	MO	
OMU	mÄ	OMV	kç=d~ë	JMKMVT	ééÄ	kL^	NVVUKUR	MO	
OPO	qÜ	OMV	kç=d~ë	MKNNM	ééÄ	CUHP	CUOVKVU	N	
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iá	S	kç=d~ë	NVNNCPPHPP	NKU	NUVQNRTHMT	NMMKV	RVHR	NOMQ	
pÅ	CR	kç=d~ë	QQTPNURKTR	MKU	QRTPSTVKOQ	VTKU	RVHR	NOMQ	
pÅ	CR	eO	VTSCPMKRP	NKQ	VURSCPKUN	VVKMR	RVHR	NOMQ	
pÅ	CR	eÉ	NRRMOVKMS	MKV	NSMVPNKCP	VSHPP	RVHR	NOMQ	
dÉ	TO	kç=d~ë	NMUUPSNKQQ	MKV	NMTQQQSKRP	NMNHPN	RVHR	NOMQ	
dÉ	TO	eO	PUNSCNKVP	MKR	PVPUSVKSQ	VSKUV	RVHR	NOMQ	
dÉ	TO	eÉ	NOQQTVKTU	NKT	NORCSSKVR	VTKTU	RVHR	NOMQ	
v	UV	eO	QQSMTMPKOS	MKR	QPMNURSKUS	VVKMQ	RVHR	NOMQ	
v	UV	eÉ	UNQQRTKVQ	MKT	UQNPQQCKNU	VSKU	RVHR	NOMQ	
qÄ	NRV	kç=d~ë	STUONMSKSV	CKQ	SRVNQQQKUP	NMOKUV	RVHR	NOMQ	
qÄ	NRV	eÉ	OUQTONCKTP	MKS	OUSSNVMKN	VVHPQ	RVHR	NOMQ	
_á	OMV	kç=d~ë	PNUSRTVKQT	OKR	PNTPQTOKSU	NMMQN	RVHR	NOMQ	
_á	OMV	eÉ	NRVRSNVKNO	MKV	NSMVTVTKOQ	VVKNO	RVHR	NOMQ	

p~ã éáÉ=k~ã É	mmi
cäÉ=k~ã É	MVUJ f ` s kÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf ` mj e y N y a ^ q ^ y O M C P y M P J ^ o y i n ` O U b k Å
^Åè=qáã É	PLOULOMCP=NSW0SWQO
p~ã éáÉ=qóéÉ	i i f ` s
qçí~äa ãäí íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=o ÉÑ¤cäÉk~ã É	MVQ ^ i _ kÇ
p~ã éáÉ=n ` =m~ëëlcá~ä	c~ää
fpqa=n ` =m~ëëlc~áä	m~ëë
I éÉê~íçê	**~Çã áä**

n ` =^ å~äöíÉ=q~ÄáÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==¹ mp==	bñés~ä	B o ÉÅ	B i çï	B e äÜÜ	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMVN	éé Ä	OKU	NQQJUKVU	MO	VRNR	TVMR	NOMQ	
NN	_	S	k ç=d ~ë	OKMSP	éé Ä	MKR	NTPSRKNO	Q	NMNHRT	TVMR	NOMQ	
OP	k ~	QR	e É	OMMMVOR	éé Ä	NKV	OMQRVSKTR	OMM	NMMKMN	TVMR	NOMQ	
OQ	j Ö	QR	e É	OMVKQTN	éé Ä	MKT	UVMMKUP	OM	NMOHPR	TVMR	NOMQ	
OT	^ ä	QR	e É	OMKTMT	éé Ä	OKQ	PPONKRR	OM	NMPHRQ	TVMR	NOMQ	
OU	p á	QR	e O	NMMKOMR	éé Ä	OKN	QVNRNKVQ	NMM	NMMO	TVMR	NOMQ	
PV	h	QR	e É	NVTHRSQ	éé Ä	MHP	NMPSSOKVM	OMM	VUKTU	TVMR	NOMQ	
QM	` ~	QR	e O	OMPRR	éé Ä	NKR	VMTPPHMU	OM	NMNRTU	TVMR	NOMQ	
RN	s	UV	e É	NKMPV	éé Ä	OKM	RPVSKHST	N	NMPKV	TVMR	NOMQ	
RO	` ê	UV	e É	NKMQS	éé Ä	OKN	TRVNHOT	N	NMQHS	TVMR	NOMQ	
RR	j å	UV	e É	MKQMS	éé Ä	OHR	NQMUKQT	MQ	NMNHR	TVMR	NOMQ	
RS	c É	UV	e O	OMKNUP	éé Ä	NKQ	OURTMMKUQ	OM	NMMKVO	TVMR	NOMQ	
RV	` ç	UV	e É	MKMVT	éé Ä	UHR	OPTPHSO	MO	VUHR	TVMR	NOMQ	
SM	k á	UV	e É	MKQRO	éé Ä	SHP	NRNQKRR	MQ	NNP	TVMR	NOMQ	
SP	` ì	UV	e É	MHSCQ	éé Ä	PHO	RTMRKTM	MHS	NMQ	TVMR	NOMQ	
SS	wå	UV	e É	OKQQN	éé Ä	PHP	PPNPKTV	O	NNOKMR	TVMR	NOMQ	
TR	^ ë	UV	e É	NKMNU	éé Ä	RKO	NMROKQU	N	NMNKU	TVMR	NOMQ	
TU	p É	UV	e O	MKVVO	éé Ä	PHO	RMUKVV	N	VVHO	TVMR	NOMQ	
UU	p ê	UV	e É	NKMOT	éé Ä	NKV	PTUOKUN	N	NMOKT	TVMR	NOMQ	
VR	j ç	UV	e É	NKMQS	éé Ä	OHP	PVNVMRO	N	NMOHS	TVMR	NOMQ	
NMT	^ Ö	UV	e É	MKMVU	éé Ä	SKV	ORRNKQM	MO	VV	TVMR	NOMQ	
NNN	` Ç	UV	e É	MKQMS	éé Ä	THM	PSNKNO	MO	NMP	TVMR	NOMQ	
NNU	p å	NRV	e É	NKMPU	éé Ä	OKM	PUNSKNS	N	NMPKU	TVMR	NOMQ	
NON	p Ä	NRV	k ç=d ~ë	MKONR	éé Ä	SKO	SMVOKQT	MO	NMTHR	TVMR	NOMQ	
NPT	_ ~	NRV	k ç=d ~ë	MKQNV	éé Ä	UKQ	PNNTKMM	MQ	NMQRTR	TVMR	NOMQ	
NUO	t	NRV	k ç=d ~ë	MKMMM	éé Ä	OKU	NQVUQKQN	N	VM	TVMR	NOMQ	
OMR	qä	OMV	k ç=d ~ë	MKOMM	éé Ä	SKU	SRPRKOT	MO	NMM	TVMR	NOMQ	
OMU	mÄ	OMV	k ç=d ~ë	MKMTV	éé Ä	OHR	VRTUKOU	MO	UVHR	TVMR	NOMQ	
OPO	qÜ	OMV	k ç=d ~ë	MKNRU	éé Ä	SKN	UORNKQT	MO	TV	TVMR	NOMQ	c~äÉÇ=a ça =
OPU	r	OMV	k ç=d ~ë	MKOMN	éé Ä	SHR	STSRHRV	MO	NMMR	TVMR	NOMQ	

n ` =fpqa=q~ÄáÉ

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ¤ mp	B =o ÉÅ	B n ` =i çï	B n ` =e äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	ONSSUSOHRO	NKU	NUVQNRTHMT	NNQKQ	RVHR	NOMQ	
p Å	QR	k ç=d ~ë	QUVPQQMKQM	NHS	QRTPSTVKOQ	NVSKVV	RVHR	NOMQ	
p Å	QR	e O	NMRPQVUKUP	OKU	VURSOPKUN	NVSKUV	RVHR	NOMQ	
p Å	QR	e É	NTMTRTKVQ	MKU	NSMVPNKOP	NVSKNN	RVHR	NOMQ	
d É	TO	k ç=d ~ë	NNRQQSSKSN	NKQ	NMTQQQSKRP	NMTHQT	RVHR	NOMQ	
d É	TO	e O	QNOOSSKRU	NKV	PVPUSVKSQ	NVQKST	RVHR	NOMQ	
d É	TO	e É	NPNUORKST	MHR	NORQSSKVR	NVRKOR	RVHR	NOMQ	
v	UV	e O	QSVNOVPKUU	MKO	OPMNURSKUS	NVVKMR	RVHR	NOMQ	
v	UV	e É	UUUQQRKOV	NHP	UQNPQQKNU	NVRKS	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	TPUPQMUKRU	NKV	SRVNQQQKUP	NNOKMO	RVHR	NOMQ	
qÄ	NRV	e É	PMROVQTKMS	NHS	OUSSNVMKN	NVSKRO	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PQTPVPMKTO	PKO	PNTPQTOKSU	NVVKQT	RVHR	NOMQ	
_á	OMV	e É	NTTNTOOKTU	MHR	NSMVTVTKOQ	NNMKMS	RVHR	NOMQ	

fåíÉâÑÉêÉåÅÉ= ÜÉÅâ=pçàíç=^=Ef`pJ^F=oÉéçëí

p~ã éáÉ=k~ã É	f`p^
cäÉ=k~ã É	MVMf`p^KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOVOCPyWPJ ^oyjn`OUbkÅ
^Åè=qáã É	PLOULOVOCP=NSVAPNVAVM
p~ã éáÉ=qóéÉ	f`p^
qçí~äaäã íáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVOJ ^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄäÉ

k~ã É	j~ëë	fpqa	qìåÉ	`çåÅK	råáë	opa	==mp==	bñés~ä	Bíçï	BeäÖÜ	n`=ëä~Ö
_É	V	S	kç=ël~ë	JMKVNO	éëÄ	klᴬ	NVOKQR	JMKN	NVM	NVM	
_	NN	S	kç=ël~ë	MKQVR	éëÄ	PHS	OVTUKNQ	JO	NVM	NVM	
k~	OP	QR	eÉ	NVSQTMKQMN	éëÄ	NKM	TMRTMSQVKM	NVMMMM	UM	NOM	
jÖ	OQ	QR	eÉ	NVRRQRKQPV	éëÄ	MP	PSUVPMNNKST	NVMMMM	UM	NOM	
^ä	OT	QR	eÉ	NVVUNURTSU	éëÄ	MKV	NQQQMQTVKO	NVMMMM	UM	NOM	
pá	OU	QR	eO	QKUVR	éëÄ	NVRT	ORNSKOU	JRM	NVM	NVM	
h	PV	QR	eÉ	NVOOTMVQU	éëÄ	MP	PMPUTNVOKRQ	NVMMMM	UM	NOM	
`~	QM	QR	eO	NVRQROKVUO	éëÄ	NKU	PPUTQQUUNKSO	NVMMMM	UM	NOM	
s	RN	UV	eÉ	MKVPU	éëÄ	NVKO	QQOKOQ	JVKR	NVM	NVM	
`ê	RO	UV	eÉ	OKNTM	éëÄ	NKO	NORSNKOM	NKR	NVM	NVM	
jå	RR	UV	eÉ	MKQVU	éëÄ	THO	NOOQKQV	MKNT	NVM	NVM	
cÉ	RS	UV	eO	VUNVPKSQM	éëÄ	MKR	NNPVPPOVVSKNM	NVMMMM	UM	NOM	
`ç	RV	UV	eÉ	MKNVQ	éëÄ	THP	NONRKSR	M	NVM	NVM	
ká	SM	UV	eÉ	MKQOO	éëÄ	UKS	NOPSKTQ	MKNU	NVM	NVM	
`ì	SP	UV	eÉ	MKVVU	éëÄ	VKV	NONPKQN	JVKOO	NVM	NVM	
wå	SS	UV	eÉ	MKVTU	éëÄ	SKP	NPSMKVV	MKQ	NVM	NVM	
^ë	TR	UV	eÉ	MKVTP	éëÄ	NSKO	UPKVN	JVKR	NVM	NVM	
pÉ	TU	UV	eO	MKVTO	éëÄ	NOKR	QVKUP	JVKR	NVM	NVM	
pê	UU	UV	eÉ	MKUQV	éëÄ	PKT	OTNVKOM	MKPT	NVM	NVM	
jç	VR	UV	eÉ	OOPSKVVT	éëÄ	NKM	SUURUSPKOP	OMVM	UM	NOM	
^Ö	NMT	UV	eÉ	MKVNS	éëÄ	OQKN	OMUKUV	JVKN	NVM	NVM	
`Ç	NNN	UV	eÉ	MKPQP	éëÄ	OKP	RNQKQS	MKOU	NVM	NVM	
på	NNU	NRV	eÉ	MKVUT	éëÄ	NQKU	RTMKVO	JVKR	NVM	NVM	
pÄ	NON	NRV	kç=ël~ë	MKVUT	éëÄ	VHP	OUSSKSU	JVKVR	NVM	NVM	
_~	NPT	NRV	kç=ël~ë	MKQTT	éëÄ	NKS	PPQVKSM	MKPP	NVM	NVM	
t	NUO	NRV	kç=ël~ë	MKONR	éëÄ	UKM	RPOSKSU	JVKPP	NVM	NVM	
qä	OMR	OMV	kç=ël~ë	MKVMS	éëÄ	PRKV	UVTKSS	JVKN	NVM	NVM	
mÄ	OMU	OMV	kç=ël~ë	JVKVMN	éëÄ	klᴬ	OPUVKPM	JVKVU	NVM	NVM	
qÜ	OPO	OMV	kç=ël~ë	MKVNR	éëÄ	OQKV	POPPKUR	JVKN	NVM	NVM	
r	OPU	OMV	kç=ël~ë	MKVNS	éëÄ	OKM	TPTKQT	JVKVU	NVM	NVM	

n`=fpqa=q~ÄäÉ

k~ã É	j~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=íçï	Bn`=eäÖÜ	n`=ëä~Ö
iá	S	kç=ël~ë	ONNOOORKUN	MKT	NUVQNRTKMT	NNNKRO	RVKR	NOMQ	
pÅ	QR	kç=ël~ë	QQSUMTQKTU	NKM	QRTPSTVKOQ	VTKSV	RVKR	NOMQ	
pÅ	QR	eO	VOVRQPKPN	NKN	VURSOPKUN	VQKPN	RVKR	NOMQ	
pÅ	QR	eÉ	NQURQTKVM	MKS	NSMVPNKOP	VOKOV	RVKR	NOMQ	
dÉ	TO	kç=ël~ë	NMURQSTKUM	NKS	NMTQOOSKRP	NMNKMQ	RVKR	NOMQ	
dÉ	TO	eO	PRSPQRKUV	MKP	PVPUSVKSQ	VMKQT	RVKR	NOMQ	
dÉ	TO	eÉ	NNRTQRKUM	NKQ	NORQSSKVR	VOKQ	RVKR	NOMQ	
v	UV	eO	QMRPSQNKPR	MKR	QPMNURSKUS	VQKOP	RVKR	NOMQ	
v	UV	eÉ	TSVTVPKRQ	MKT	UQNPQOKNU	VNKR	RVKR	NOMQ	
qÄ	NRV	kç=ël~ë	TMMTSSUKOP	NKV	SRVNQQQKUP	NMSKPN	RVKR	NOMQ	
qÄ	NRV	eÉ	OTRPOTVKON	MKS	OUSSNVMKN	VSKMS	RVKR	NOMQ	
_á	OMV	kç=ël~ë	PQRMRSRKNM	OKN	PNTPQTOKSU	NMUKTP	RVKR	NOMQ	
_á	OMV	eÉ	NQVVSQTKNU	MKT	NSMVTVTKOQ	VPKNS	RVKR	NOMQ	

fåíÉêÑÉêÉåÅÉ=ÜÉÅâ=pçäîÉåí=^_=Ef`pJ^_F=oÉéçêí

p~ã éáÉ=k~ã É	f`p^_
cäÉk~ã É	MNMf`p_KÇ
a~í~=m~íÜ=k~ã É	aWf`ÖäÉáíf`mj eyNya^q^yOMOPyMPJ ^oyi n`OUbkÅ
^Åè=qáã É	PLOULOMOP=NSWRSMRT
p~ã éáÉ=qóéÉ	f`p_
qçí~äa ãäíáçå	NKMMMM
`çã ã Éåí	JJU
fpqa=oÉÑÉcäÉk~ã É	MVQ ^i_KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã ãå**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeáÖÜ	n`=c ä~Ö
V	_É	S	kçíd~ë	NVKTNR	éëÄ	OKS	NNSMUVKRO	OM	TVKR	NOMQ	
NN	_	S	kçíd~ë	OMKRNO	éëÄ	PKQ	TVPOMCP	OM	TVKR	NOMQ	
OP	k~	QR	eÉ	NVRSVNKRVO	éëÄ	MKU	SUCCRQTUKVN	NMMMMM	TVKR	NOMQ	
OQ	j Ö	QR	eÉ	NVRRSTKNOO	éëÄ	MKU	PRVPSSNSKQN	NMMMMM	TVKR	NOMQ	
OT	^ä	QR	eÉ	NMVMQNKRVQ	éëÄ	MKV	NPTTMTMQKOQ	NMMMMM	TVKR	NOMQ	
OU	pá	QR	eO	SCUKVN	éëÄ	OKP	OSMCPUKPM	RMM	TVKR	NOMQ	[=HLJ=NMB
PV	h	QR	eÉ	NVDSMPKVCR	éëÄ	MKO	OVSUVNQQKCR	NMMMMM	TVKR	NOMQ	
QM	`~	QR	eO	NVRMQVKVSM	éëÄ	NKQ	PCRSVMQUQKMQ	NMMMMM	TVKR	NOMQ	
RN	s	UV	eÉ	ONKMUO	éëÄ	MKP	UTMPSKTM	OM	TVKR	NOMQ	
RO	`ê	UV	eÉ	OOKSSU	éëÄ	MKT	NNTUMPKCP	OO	TVKR	NOMQ	
RR	j å	UV	eÉ	OMKUOM	éëÄ	MKR	RPUMMKTT	OM	TVKR	NOMQ	
RS	cÉ	UV	eO	VVQQQKVPO	éëÄ	MKV	NNCOSUSVQMKTP	NMMMMM	TVKR	NOMQ	
RV	`ç	UV	eÉ	ONKMUT	éëÄ	MKV	NUSRCPKCU	OM	TVKR	NOMQ	
SM	ká	UV	eÉ	ONKNOU	éëÄ	NKT	RCPUCQKTP	OM	TVKR	NOMQ	
SP	`ì	UV	eÉ	OMKSUP	éëÄ	NKN	NQQQVQKPR	OM	TVKR	NOMQ	
SS	wå	UV	eÉ	OOQKRRV	éëÄ	MKT	CUSSNKUV	ONKQ	TVKR	NOMQ	
TR	^ë	UV	eÉ	OMKVRM	éëÄ	NKT	NTUNUKVM	OM	TVKR	NOMQ	
TU	pÉ	UV	eO	OMKPMT	éëÄ	MKV	URUOKMT	OM	TVKR	NOMQ	
UU	pê	UV	eÉ	ONKSQM	éëÄ	NKS	SRVVNKQV	OMKV	TVKR	NOMQ	
VR	j ç	UV	eÉ	OPMMKSOQ	éëÄ	NKM	SUSNQOOKUU	OMMM	TVKR	NOMQ	
NMT	^Ö	UV	eÉ	OMKRTU	éëÄ	MKU	ONUVSQKTR	OM	TVKR	NOMQ	
NNN	`Ç	UV	eÉ	OMKVQV	éëÄ	MKV	OVURMKNV	OM	TVKR	NOMQ	
NNU	på	NRV	eÉ	OMKNTM	éëÄ	MKV	RVSQTHPN	OM	TVKR	NOMQ	
NON	pÄ	NRV	kçíd~ë	NVKRUP	éëÄ	MKP	QQSSUMKTU	OM	TVKR	NOMQ	
NPT	_~	NRV	kçíd~ë	OMKTQU	éëÄ	NKN	NPTROOKVM	OM	TVKR	NOMQ	
NUO	t	NRV	kçíd~ë	OPKOSU	éëÄ	OKM	PMPUPMKRM	OM	TVKR	NOMQ	
OMR	qä	OMV	kçíd~ë	NVKSOU	éëÄ	NKM	RSSVMSKRP	OM	TVKR	NOMQ	
OMU	mÄ	OMV	kçíd~ë	OMKTQO	éëÄ	NKT	UOMNPUKPM	OM	TVKR	NOMQ	
OPO	qÜ	OMV	kçíd~ë	ONKTRU	éëÄ	MKQ	TRTMMOKUR	OM	TVKR	NOMQ	
OPU	r	OMV	kçíd~ë	ONKURP	éëÄ	PKN	TMRMMNKSV	OM	TVKR	NOMQ	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eáÖÜ	n`=c ä~Ö
iá	S	kçíd~ë	OMSPRVQKRS	NKU	NUVQNRTHMT	NMUKVR	RVKR	NOMQ	
pÅ	QR	kçíd~ë	QOVNMPVKVM	NKS	QRTPSTVKOQ	VPKUO	RVKR	NOMQ	
pÅ	QR	eO	UVTNNUKPS	NKN	VURSCPKUN	VNKMO	RVKR	NOMQ	
pÅ	QR	eÉ	NQQSCQKVM	MKQ	NSMVPNKCP	UVKUU	RVKR	NOMQ	
dÉ	TO	kçíd~ë	NMPRPSTKQT	OKP	NMTQQQSKRP	VSKPU	RVKR	NOMQ	
dÉ	TO	eO	PQPRTTKMN	MKP	PVPUSVKSQ	UTKCP	RVKR	NOMQ	
dÉ	TO	eÉ	NNOSVTKCU	MKV	NCRCSSKVR	UVKVT	RVKR	NOMQ	
v	UV	eO	PVQQQOVNKNU	NKT	QPMNURSKUS	VNKSV	RVKR	NOMQ	
v	UV	eÉ	TQRUNQKSS	MKQ	UQNPQOKNU	UUKSR	RVKR	NOMQ	
qÄ	NRV	kçíd~ë	SVVNNMNKCN	MKS	SRVNQQQKUP	NVSKMS	RVKR	NOMQ	
qÄ	NRV	eÉ	OSUOVPOKNU	NKT	CUSSNVMKN	VPKSN	RVKR	NOMQ	
_á	OMV	kçíd~ë	PQQQNOUKMO	OKS	PNTPQTOKSU	NMUKRP	RVKR	NOMQ	
_á	OMV	eÉ	NQSVNRNKUM	MKV	NSMVTVTKOQ	VNKOS	RVKR	NOMQ	

i åâÉ~ê¬ø~åÖÉ¬p~ã éäÉ¬Ei opF¬øÉéçã

p~ã éäÉ¬k~ã É	i opN
cäÉ¬k~ã É	MNNj i opKÇ
a~í~¬m~íÜ¬k~ã É	aWy^ÖäÉáíyf^ mj eyNya^q^yOMOPyMPJ ^o yi n` OUbkÄ
^Åè¬qãä É	PLOULOMOP¬NSWØRWØR
p~ã éäÉ¬qóéÉ	i op
qçí~äaãä íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa¬øÉÑcäÉk~ã É	MVO ^i _KÇ
p~ã éäÉ¬n` ¬m~ëëlcá~ä	c~ää
fpqa¬n` ¬m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áã**

n` =^å~äöíÉ¬q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çåÅK	r åáë	opa	==¬ mp==	bñés~ä	BoÉÄ	Bi çï	BeäÖÜ	n` ¬ø~ä~Ö
V	_É	S	kç¬d~ë	VSKVMN	ééÄ	NKT	RSRUOMOR	NMM	VSKV	UVfR	NNMQ	
NN	_	S	kç¬d~ë	QSRKSUP	ééÄ	NKO	NTSTOTNKUR	RMM	VPKNQ	UVfR	NNMQ	
RN	s	UV	eÉ	NMNRKTRN	ééÄ	NKV	QMUMMNPKRN	NMMM	NMNKRU	UVfR	NNMQ	
RO	` ê	UV	eÉ	OMQRKQOT	ééÄ	OKQ	NMOUSTOOKPN	OMMM	NMOKOT	UVfR	NNMQ	
RR	j å	UV	eÉ	NMUPKNNN	ééÄ	NKS	QVUUMPMKNV	OMMM	VVKNS	UVfR	NNMQ	
RV	` ç	UV	eÉ	NMTUKTST	ééÄ	OKR	VOVTOUOKMV	NMMM	NMTKUU	UVfR	NNMQ	
SM	ká	UV	eÉ	NMVSKUQN	ééÄ	NKQ	OSQRURMKMN	NMMM	NMVKSU	UVfR	NNMQ	
SP	` ì	UV	eÉ	ONNOKSUU	ééÄ	NKQ	NQNRPNSUKQM	OMMM	NMRKSP	UVfR	NNMQ	
SS	wå	UV	eÉ	OMTSKVPQ	ééÄ	NKR	OPRMNVSKUS	OMMM	NMPKUR	UVfR	NNMQ	
TR	^ë	UV	eÉ	VURKRUN	ééÄ	NKQ	UNTNTUKTQ	NMMM	VUKRS	UVfR	NNMQ	
TU	pÉ	UV	eO	VTTKNPV	ééÄ	MKQ	QMTRONKUT	NMMM	VTKTN	UVfR	NNMQ	
UU	pê	UV	eÉ	NVRRKRVT	ééÄ	MKT	RUNRTVOKTS	OMMM	VTKTU	UVfR	NNMQ	
VR	j ç	UV	eÉ	NMTUKMMS	ééÄ	MKQ	PNPTRVQKUN	NMMM	NMTKU	UVfR	NNMQ	
NMT	^Ö	UV	eÉ	NNVKSUS	ééÄ	NKO	NOQQSOUKTS	NMM	NNVKSV	UVfR	NNMQ	[¬HLHNMB
NNN	` Ç	UV	eÉ	NVQVKRNQ	ééÄ	NKP	NQRUUPOKUS	NMMM	NVQKVR	UVfR	NNMQ	
NNU	på	NRV	eÉ	VQNKMVR	ééÄ	NKN	OTVVPVRKVP	NMMM	VQKN	UVfR	NNMQ	
NON	pÄ	NRV	kç¬d~ë	VPOKSMM	ééÄ	MKO	ONURURNNKQV	NMMM	VPKOS	UVfR	NNMQ	
NPT	_~	NRV	kç¬d~ë	NVSNKPQT	ééÄ	MKR	NPPSTNQMKUQ	OMMM	VUKMT	UVfR	NNMQ	
NUO	t	NRV	kç¬d~ë	NVRPKMRN	ééÄ	NKN	NQMQOONTKTT	NMMM	NMRKPN	UVfR	NNMQ	
OVR	qä	OMV	kç¬d~ë	NVOMKQNN	ééÄ	NKN	PMURTPTPKVV	NMMM	NVOKMQ	UVfR	NNMQ	
OVU	mÄ	OMV	kç¬d~ë	OVOVKROT	ééÄ	NKQ	UPUUQVTPKSU	OMMM	NMNKQU	UVfR	NNMQ	
OPO	qÜ	OMV	kç¬d~ë	NMVSKMON	ééÄ	MKV	PSRRUVSTKOS	NMMM	NMMKS	UVfR	NNMQ	
OPU	r	OMV	kç¬d~ë	NVPQKVTP	ééÄ	NKU	PQVVVUPNKMM	NMMM	NMPKR	UVfR	NNMQ	

n` =fpqa¬q~ÄäÉ

k~ã É	j ~ëë	qìåÉ¬j çÇÉ	` mp	` mp¬øpa	oÉÑ¬ mp	B¬øÉÄ	Bn` =i çï	Bn` ¬eäÖÜ	n` ¬ø~ä~Ö
iá	S	kç¬d~ë	OMQVTMTKQN	NKU	NUVQNRTKMT	NMUKON	RVfR	NOMQ	
pÅ	QR	kç¬d~ë	QPOOMMKON	NKP	QRTPSTVKOQ	VQKR	RVfR	NOMQ	
dÉ	TO	kç¬d~ë	NVROMVMKPQ	OKV	NMTQOQSKRP	VTKVR	RVfR	NOMQ	
qÄ	NRV	kç¬d~ë	TNVTSTTKUN	OKS	SRVNQQQKUP	NMVKO	RVfR	NOMQ	
_á	OMV	kç¬d~ë	PSNMQVSKSS	OKS	PNTPQTOKSU	NNPKTT	RVfR	NOMQ	
pÅ	QR	eO	UQNPNNKUU	MKS	VURSOPKUN	URKPS	RVfR	NOMQ	
dÉ	TO	eO	PPRTQUKMS	NKN	PVPUSVKSQ	URKOQ	RVfR	NOMQ	
v	UV	eO	PUVSQOPKRR	MKV	QPMNURSKUS	VMKRU	RVfR	NOMQ	
pÅ	QR	eÉ	NPSVTTKTU	MKT	NSMVPNKOP	URKNO	RVfR	NOMQ	
dÉ	TO	eÉ	NNMOUVKRP	NKP	NORCSSKVR	UUKMQ	RVfR	NOMQ	
v	UV	eÉ	TOTUSRKVR	NKU	UQNPQOKNU	USKRN	RVfR	NOMQ	
qÄ	NRV	eÉ	OTNORCROTKST	NKS	OUSSNVMKN	VQKSQ	RVfR	NOMQ	
_á	OMV	eÉ	NRUTSQUKVR	NKP	NSMVTVTKOQ	VUKSO	RVfR	NOMQ	

p~ã éäÉ=k~ã É i o p O

cãÉ=k~ã É MNQ p j m i K Ç

a~í~=m~íÜ=k~ã É a W y t Ö ä É á í y f ` m j e y N y a ^ q ^ y O M C P y M P J ^ o y j n ` O U b k Å

^Åè=qãã É P L O U L O M C P = N S W R T W N T

p~ã éäÉ=qóéÉ p ~ ã é ä É

qçí~äaãã íáçå N K M M M M

p~ã éäÉ=n` =m~ëëlc á~ä c ~ ã ä

fpqa=n` =m~ëëlc~ãä m ~ ë ë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k ~ã É	fpqa	qìåÉ	` çàÅK	r åáë	o p a	═ mp ═	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMOQ	éé Ä	QMKV	PVMKMN	NMM	
NN	_	S	k ç=d ~ë	PKRPQ	éé Ä	NKT	NQQRPKVN	NMMM	
OP	k ~	QR	e É	OMOPOQKQRV	éé Ä	MKT	NOUCRTRSUKMR	OMMMMM	[i a o
OQ	j Ö	QR	e É	NVTTPUKSTU	éé Ä	NKM	SSNCOQLVMRT	OMMMMM	
OT	^ ä	QR	e É	ONNNPTKTRN	éé Ä	MKU	OSNVOVPQKMR	OMMMMM	[i a o
OU	p á	QR	e O	NVSTQKOMM	éé Ä	NKN	QNQONSQKOS	NMMMM	[i a o
PV	h	QR	e É	NVOUTSKMTT	éé Ä	MKT	RQTVUVTMKUO	OMMMMM	
QM	` ~	QR	e O	OMMNPSKOSV	éé Ä	MKU	RUCPVVOSSKUU	OMMMMM	[i a o
RN	s	UV	e É	MKCPT	éé Ä	NOKU	NOMRKSP	NMMM	
RO	` ê	UV	e É	MKUSP	éé Ä	SKM	RPPTKPP	OMMM	
RR	j å	UV	e É	NKQUV	éé Ä	NKV	PVMPKNQ	OMMM	
RS	c É	UV	e O	VQCCQKOMU	éé Ä	MKN	VVQRCRVRVMKVO	NMMMMM	
RV	` ç	UV	e É	NKROT	éé Ä	OKO	NPRMOKRQ	NMMM	
SM	k á	UV	e É	NKMTS	éé Ä	TKO	OTSRKUU	NMMM	
SP	` ì	UV	e É	MKUCO	éé Ä	QKQ	SMPSKVS	OMMM	
SS	w å	UV	e É	PKROT	éé Ä	PKV	QNVUKQV	OMMM	
TR	^ ë	UV	e É	MKQMU	éé Ä	UKV	PRUKTN	NMMM	
TU	p É	UV	e O	MKRON	éé Ä	RKT	ONQKPO	NMMM	
UU	p ê	UV	e É	OKUSR	éé Ä	OKQ	USCNKTO	OMMM	
VR	j ç	UV	e É	NKTTM	éé Ä	OKM	RQNOKOT	NMMM	
NMT	^ Ö	UV	e É	MKMRU	éé Ä	SKM	SQQKQT	NMM	
NNN	` Ç	UV	e É	MKCRR	éé Ä	QKU	PSSKPM	NMMM	
NNU	p å	NRV	e É	MKSRM	éé Ä	TKM	ONCOKQP	NMMM	
NON	p Ä	NRV	k ç=d ~ë	MKCRS	éé Ä	SKV	NMVMOKSO	NMMM	
NPT	_ ~	NRV	k ç=d ~ë	NKCPR	éé Ä	QKN	UMVQKPO	OMMM	
NUO	t	NRV	k ç=d ~ë	NKSCO	éé Ä	NQKP	COTTTKQO	NMMM	
OMR	q ä	OMV	k ç=d ~ë	MKPTQ	éé Ä	THR	NMVRSKQT	NMMM	
OMU	m Ä	OMV	k ç=d ~ë	NKQUO	éé Ä	NHR	RTVVUKUP	OMMM	
OPO	q Ü	OMV	k ç=d ~ë	MKUUS	éé Ä	NNHS	PNURQKOS	NMMM	
OPU	r	OMV	k ç=d ~ë	MKPUR	éé Ä	SKN	NOMPUKTP	NMMM	

n` =fpqa=q~ÄäÉ

k ~ã É	j ~ëë	qìåÉ=j ÇÇÉ	` mp	` mp=o p a	o ÉÑ= mp	B =o ÉÅ	B n` =ï çï	B n` =e ä ÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	OMOSPRRKOU	NKN	NUVQNRTHMT	NMSKVU	RVHR	NOMQ	
p Å	QR	k ç=d ~ë	QMSOTTNKVQ	NKU	QRTPSTVKOQ	UUKUP	RVHR	NOMQ	
p Å	QR	e O	UQQMNMKVR	MKP	VURSCPKUN	URKQP	RVHR	NOMQ	
p Å	QR	e É	NQQMVPKUO	MKS	NSMVPNKCP	UUKOV	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VTMVSTKMQ	NKN	NMTQQQSKRP	VMPV	RVHR	NOMQ	
d É	TO	e O	PCURNQKUT	NKM	PVPUSVHSQ	UPKQN	RVHR	NOMQ	
d É	TO	e É	NNMPNUKUP	NKO	NCRCSSKVR	UUKMT	RVHR	NOMQ	
v	UV	e O	PSUTQURKNP	MKV	QPMNURSKUS	URKTO	RVHR	NOMQ	
v	UV	e É	TPCSUVKQM	MKU	UQNPQCKNU	UTHMV	RVHR	NOMQ	
q Ä	NRV	k ç=d ~ë	STTPPVQKPR	NKN	SRVNQQQKUP	NMCKTS	RVHR	NOMQ	
q Ä	NRV	e É	CRTCQVOKMT	MKQ	CUSSNVMKN	UVKTR	RVHR	NOMQ	
_ á	OMV	k ç=d ~ë	PCUCNNPHRN	MKR	PNTPQTCKSU	NMPKQO	RVHR	NOMQ	
_ á	OMV	e É	NPTNPMUKRP	MKU	NSMVTVTKOQ	URKMV	RVHR	NOMQ	

p~ã éäÉ=k~ã É ofkpb

cãÉ=k~ã É MNPpj mi lÇ

a~í~=m~íÜ=k~ã É aWÿ ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÅ

^Åè=qãã É PLOULOMCP=NTWMQMQR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå NKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä c~åä

fpqa=n` =m~ëëlc~åä c~åä

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	QKPRM	ééÄ	NNKP	OTSKST	NMM	
NN	_	S	k ç=d ~ë	NQPKPRV	ééÄ	OKP	RUTPKRN	NMMM	
OP	k ~	QR	e É	TMPSOKPRP	ééÄ	PKU	NMRNUMSQ	OMMMMM	
OQ	j Ö	QR	e É	POVRUKPOV	ééÄ	TKU	OSMNOKTU	OMMMMM	
OT	^ä	QR	e É	PQUOTKQMQ	ééÄ	RKU	NMNUUKRT	OMMMMM	
OU	pá	QR	e O	QNQUKQMV	ééÄ	MKS	PVOQKSV	NMMMM	
PV	h	QR	e É	UORVRKVVU	ééÄ	OKM	RROUUKRV	OMMMMM	
QM	` ~	QR	e O	PQSNVKVSO	ééÄ	PKS	OQRROOKVQ	OMMMMM	
RN	s	UV	e É	PUPKUUP	ééÄ	NRKR	UMRKRV	NMMM	
RO	` ê	UV	e É	NSRVKVVS	ééÄ	UKQ	QPTTTKNU	OMMM	
RR	j å	UV	e É	QQOKMPO	ééÄ	PKT	RUQKRT	OMMM	
RS	cÉ	UV	e O	VVVOOKSST	ééÄ	PKU	RQRMMUKPQ	NMMMM	
RV	` ç	UV	e É	NMMKVSN	ééÄ	NPKQ	QSMKMP	NMMM	
SM	k á	UV	e É	OPSKSQR	ééÄ	NOKN	PMMKMN	NMMM	
SP	` ì	UV	e É	RMQKOVU	ééÄ	NKV	NTTTKVO	OMMM	
SS	wå	UV	e É	RRTRKTSU	ééÄ	SKT	PPNNKRS	OMMM	[i a o
TR	^ë	UV	e É	PORKTMV	ééÄ	NNKS	NQNKPR	NMMM	
TU	pÉ	UV	e O	PNUKRMV	ééÄ	OKO	SRKMM	NMMM	
UU	pê	UV	e É	NOMKQSS	ééÄ	ONKM	NUUKUV	OMMM	
VR	j ç	UV	e É	NVUNKQVV	ééÄ	VKU	PMONKRM	NMMM	[i a o
NMT	^Ö	UV	e É	VKONO	ééÄ	NQKP	RMKMM	NMM	
NNN	` Ç	UV	e É	QOKOMT	ééÄ	NQKM	PNKSN	NMMM	
NNU	på	NRV	e É	QMSQKOOU	ééÄ	UKT	RTOPKRR	NMMM	[i a o
NON	pÄ	NRV	k ç=d ~ë	PONKQVS	ééÄ	NPKM	PRQMKUV	NMMM	
NPT	_~	NRV	k ç=d ~ë	SMNKMRS	ééÄ	VKM	NVOUKUQ	OMMM	
NUO	t	NRV	k ç=d ~ë	OONNKORV	ééÄ	NMKO	NRNOUKNP	NMMM	[i a o
OMR	qä	OMV	k ç=d ~ë	PQKVNT	ééÄ	UKQ	OPOVKPQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QSKQQR	ééÄ	UKM	QOPUKMV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NQOKOOP	ééÄ	TKU	NNPUTKON	NMMM	
OPU	r	OMV	k ç=d ~ë	NNKOSS	ééÄ	NKV	UOMKVO	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B n` =¤ÄÜ	B n` =¤ÄÜ	B n` =¤ÄÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	OONVRKRU	OKN	NUVONRTKMT	NKNT	RVKR	NOMKQ	SMOMa ça
pÅ	QR	k ç=d ~ë	NMOMUKQN	OKN	QRTPSTVKOQ	MKOO	RVKR	NOMKQ	SMOMa ça
pÅ	QR	e O	OMROKQP	QKS	VURSOPKUN	MKON	RVKR	NOMKQ	SMOMa ça
pÅ	QR	e É	PPQKSN	QKR	NSMVPNKOP	MKON	RVKR	NOMKQ	SMOMa ça
d É	TO	k ç=d ~ë	UOMSKUR	OKR	NMTQOQSKRP	MKTS	RVKR	NOMKQ	SMOMa ça
d É	TO	e O	SVRKUU	UKM	PVPUSVKSQ	MKNU	RVKR	NOMKQ	SMOMa ça& eäÖÜ=fpqa=¤pa
d É	TO	e É	OMMKSP	NVKU	NORQSSKVR	MKNS	RVKR	NOMKQ	SMOMa ça& eäÖÜ=fpqa=¤pa
v	UV	e O	NVMTKTT	RKU	QPMVNURSKUS	MKVQ	RVKR	NOMKQ	SMOMa ça
v	UV	e É	PUPKOT	UKN	UQNPQQKNU	MKVR	RVKR	NOMKQ	SMOMa ça& eäÖÜ=fpqa=¤pa
qÄ	NRV	k ç=d ~ë	PQMQKQU	TKT	SRVNQQQKUP	MKVR	RVKR	NOMKQ	SMOMa ça
qÄ	NRV	e É	NOVRKNS	VKM	OUSSNVMKN	MKVR	RVKR	NOMKQ	SMOMa ça& eäÖÜ=fpqa=¤pa
_á	OMV	k ç=d ~ë	TVSQKVU	PKV	PNTPQTOKSU	MKOR	RVKR	NOMKQ	SMOMa ça
_á	OMV	e É	PTQRKNT	NKV	NSMVTVTKOQ	MKOP	RVKR	NOMKQ	SMOMa ça

p~ã éäÉ=ɵÉéçã

p~ã éäÉ=k~ã É ofkpb

cãÉ=k~ã É MNQpj mi kÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíÿ mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÅ

^Åè=qãã É PLOULOMCP=NTMMMQN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå NMMMM

p~ã éäÉ=n` =m~ëëlc á~ä c~ãä

fpqa=n` =m~ëëlc~ãä c~ãä

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==mp==	iao	n` =cä~Ö
V	_É	S	kç=d ~ë	RMMVU	ééÄ	OMR	OOMKMM	NMM	
NN	_	S	kç=d ~ë	NRTMRVP	ééÄ	RMS	QPURMKV	NMMM	
OP	k~	QR	eÉ	TNOTTKQUU	ééÄ	SMN	TOORRMNS	OMMMMM	
OQ	j Ö	QR	eÉ	OONVRMVPV	ééÄ	TMU	NNUSPMPO	OMMMMM	
OT	^ä	QR	eÉ	OPRVTMORO	ééÄ	NNMN	QSTRMPP	OMMMMM	
OU	pá	QR	eO	PVORMPMM	ééÄ	TMU	OSTSMQM	NMMMM	
PV	h	QR	eÉ	VOUSQMNV	ééÄ	PMT	QONVVMNM	OMMMMM	
QM	` ~	QR	eO	ONRTTKUMS	ééÄ	SMU	NNMPPRMTR	OMMMMM	
RN	s	UV	eÉ	SPOMOMS	ééÄ	VMM	TSOMOR	NMMM	
RO	` ê	UV	eÉ	OUTPMPTT	ééÄ	NNMO	QPOVMNU	OMMM	[i a o
RR	j å	UV	eÉ	UMPMTQO	ééÄ	NOMO	SMRMOP	OMMM	
RS	cÉ	UV	eO	NMMRQTMTMO	ééÄ	RMN	OUQRNNMKU	NMMMM	[i a o
RV	` ç	UV	eÉ	NOUMSQP	ééÄ	OMKV	PPNMNP	NMMM	
SM	k á	UV	eÉ	QPVMURT	ééÄ	NQMN	PNTMTV	NMMM	
SP	` ì	UV	eÉ	UQOMVQQ	ééÄ	RMM	NTMMMNQ	OMMM	
SS	wå	UV	eÉ	NMMSQMNUQ	ééÄ	TMS	PQQNMRV	OMMM	[i a o
TR	^ë	UV	eÉ	PTTMTTR	ééÄ	NPMQ	VPMSU	NMMM	
TU	pÉ	UV	eO	PTSMSRV	ééÄ	OPMP	PVMST	NMMM	
UU	pê	UV	eÉ	NRPMTPS	ééÄ	OOMP	NQMKMM	OMMM	
VR	j ç	UV	eÉ	OPRUMRSS	ééÄ	VMT	OMRVMKV	NMMM	[i a o
NMT	^Ö	UV	eÉ	NRMONQ	ééÄ	OUMS	QSMST	NMM	
NNN	` Ç	UV	eÉ	SRMVVO	ééÄ	PMR	OTMTU	NMMM	
NNU	på	NRV	eÉ	TMQUMSMR	ééÄ	NMMR	RONOMON	NMMM	[i a o
NON	pÄ	NRV	kç=d ~ë	QPNMSRP	ééÄ	VMS	OQROMUN	NMMM	
NPT	_~	NRV	kç=d ~ë	NNVQMVSM	ééÄ	NTMU	NVSUMVM	OMMM	
NUO	t	NRV	kç=d ~ë	PMSSMUUV	ééÄ	NMMR	VVNQMPO	NMMM	[i a o
OMR	qä	OMV	kç=d ~ë	QQMQMV	ééÄ	SMS	NSMRMNP	NMMM	
OMU	mÄ	OMV	kç=d ~ë	SVMONT	ééÄ	OMT	PQQPMUM	OMMM	
OPO	qÜ	OMV	kç=d ~ë	NRTMOTM	ééÄ	PMO	SUPRMTS	NMMM	
OPU	r	OMV	kç=d ~ë	NRMQUQ	ééÄ	NOMR	SOTMPR	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ=mp	B=oÉÅ	Bn` =içï	Bn` =eäÜÜ	n` =cä~Ö
iá	S	kç=d ~ë	NRMOMKUN	NMS	NUVQNRTMMT	MRTV	RVMR	NOMKQ	SMOMa ça
pÅ	QR	kç=d ~ë	TTOTMPN	NMN	QRTPSTVMQQ	MMMT	RVMR	NOMKQ	SMOMa ça
pÅ	QR	eO	NQUPMNP	RMU	VURSOPMUN	MMNR	RVMR	NOMKQ	SMOMa ça
pÅ	QR	eÉ	OOTMOV	PMN	NSMVPNMOP	MMNQ	RVMR	NOMKQ	SMOMa ça
dÉ	TO	kç=d ~ë	TVRQMNN	MKV	NMTQOQSMRP	MRTQ	RVMR	NOMKQ	SMOMa ça
dÉ	TO	eO	QVNMVN	TMR	PVPUSVMSQ	MMNO	RVMR	NOMKQ	SMOMa ça
dÉ	TO	eÉ	NMUMSR	TMT	NORQSSMVR	MMMV	RVMR	NOMKQ	SMOMa ça
v	UV	eO	VUVMUR	PMV	QPMVNURSMUS	MMVO	RVMR	NOMKQ	SMOMa ça
v	UV	eÉ	ONVMVS	NNMV	UQNPQQMNU	MMVP	RVMR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=opa
qÄ	NRV	kç=d ~ë	NTQVMNO	QMU	SRVNQQQMUP	MMVP	RVMR	NOMKQ	SMOMa ça
qÄ	NRV	eÉ	STUMRS	VMM	OUSSNVMMN	MMVO	RVMR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=opa
_á	OMV	kç=d ~ë	QPNVMOR	PMU	PNTPQTOMSU	MMNQ	RVMR	NOMKQ	SMOMa ça
_á	OMV	eÉ	OOQVMTT	PMO	NSMVTVTMQQ	MMNQ	RVMR	NOMKQ	SMOMa ça

p~ã éäÉ=ɵÉéçã

p~ã éäÉ=k~ã É	ofkpb
cãÉ=k~ã É	MNRpj mi lÇ
a~í~=m~íÜ=k~ã É	aWÿ ÖäÉåíyî mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÅ
^Åè=qãã É	PLOULOMCP=NTWMQMRS
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	NKMMMM
p~ã éäÉ=n` =m~ëëlc á~ä	c~åä
fpqa=n` =m~ëëlc~åä	c~åä

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==mp==	iao	n` =cä-Ö
V	_É	S	kç=d~ë	SKSTO	éé Ä	QKN	OMUKVM	NMM	
NN	_	S	kç=d~ë	NSTKMPN	éé Ä	SKQ	PPTUKCP	NMMM	
OP	k~	QR	eÉ	URMPMKVSR	éé Ä	NRKO	SRRSVKMP	OMMMMM	
OQ	j Ö	QR	eÉ	OQUCUKTVP	éé Ä	NSKV	NMMTTKCQ	OMMMMM	
OT	^ä	QR	eÉ	OQUPSKRSP	éé Ä	NNKU	PTRUKPQ	OMMMMM	
OU	pá	QR	eO	QUPSKMDT	éé Ä	TKO	OQNVKQP	NMMMM	
PV	h	QR	eÉ	NNTRPNKUUO	éé Ä	NRKP	QMSMSKSV	OMMMMM	
QM	` ~	QR	eO	OTTSVKMDT	éé Ä	OKS	NMQMSMPU	OMMMMM	
RN	s	UV	eÉ	TRCKUSV	éé Ä	NPKV	SOMKMD	NMMM	
RO	` ê	UV	eÉ	PRTSKVOV	éé Ä	RKV	PSVUKQR	OMMM	[i a o
RR	j å	UV	eÉ	NNQRKRRO	éé Ä	RKQ	RVOKRT	OMMM	
RS	cÉ	UV	eO	NOSNMNKRPQ	éé Ä	PKS	PMSVRMKON	NMMMMM	[i a o
RV	` ç	UV	eÉ	NSPKVTS	éé Ä	QKQ	OVNKNP	NMMM	
SM	ká	UV	eÉ	RUCKVSP	éé Ä	NOKO	OUUKVM	NMMM	
SP	` ì	UV	eÉ	NNOUKOMP	éé Ä	RKV	NRRQKRS	OMMM	
SS	wå	UV	eÉ	UVRQKQNO	éé Ä	TKN	OMUCKQO	OMMM	[i a o
TR	^ë	UV	eÉ	QRTKVRU	éé Ä	UKM	TUKMN	NMMM	
TU	pÉ	UV	eO	PTOKOUN	éé Ä	OUKU	PPKST	NMMM	
UU	pê	UV	eÉ	OOPKUSO	éé Ä	NVKR	NPSKST	OMMM	
VR	j ç	UV	eÉ	OTQVKVUS	éé Ä	NQKO	NSQMKNP	NMMM	[i a o
NMT	^Ö	UV	eÉ	OQKMNS	éé Ä	NQKV	RNKNN	NMM	
NNN	` Ç	UV	eÉ	NNQKOMT	éé Ä	NMKP	POKRV	NMMM	
NNU	på	NRV	eÉ	RVVTKUCO	éé Ä	NKR	PQPPKUP	NMMM	[i a o
NON	pÄ	NRV	kç=d~ë	RQPKNTS	éé Ä	SKQ	OPSVKPU	NMMM	
NPT	_~	NRV	kç=d~ë	QMSKRUU	éé Ä	NKS	RNTKOO	OMMM	
NUO	t	NRV	kç=d~ë	PMMSKSSU	éé Ä	PMKN	TPSSKSN	NMMM	[i a o
OMR	qä	OMV	kç=d~ë	SNKNTU	éé Ä	OKO	NQTNKSQ	NMMM	
OMU	mÄ	OMV	kç=d~ë	UVKMMT	éé Ä	NNKQ	OVNPKOO	OMMM	
OPO	qÜ	OMV	kç=d~ë	NRNKSUS	éé Ä	UKS	QPVOKMS	NMMM	
OPU	r	OMV	kç=d~ë	OTKTUS	éé Ä	NQKR	TQTKQU	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=opa	oÉÑ=mp	B=ɵÉÅ	Bn` =içï	Bn` =eäÜÜ	n` =cä-Ö
iá	S	kç=d~ë	NMVNQKQQ	OKV	NUVQNRTKMT	MKRU	RVKR	NOMKQ	SMOMaça
pÅ	QR	kç=d~ë	RUPUKTT	RKQ	QRTPSTVKQQ	MKNP	RVKR	NOMKQ	SMOMaça
pÅ	QR	eO	NMUQKRN	OKN	VURSCPKUN	MKNN	RVKR	NOMKQ	SMOMaça
pÅ	QR	eÉ	NTRKPM	NQKQ	NSMVPNKCP	MKNN	RVKR	NOMKQ	SMOMaça& eäÜÜ=fpqa=opa
dÉ	TO	kç=d~ë	SRMSKOT	PKM	NMTQQQSKRP	MKSN	RVKR	NOMKQ	SMOMaça
dÉ	TO	eO	PORKOT	TKN	PVPUSVKSQ	MKVU	RVKR	NOMKQ	SMOMaça
dÉ	TO	eÉ	TTKPO	NMKU	NORCSSKVR	MKVS	RVKR	NOMKQ	SMOMaça& eäÜÜ=fpqa=opa
v	UV	eO	URNKOM	QKM	QPMVNURSKUS	MKVO	RVKR	NOMKQ	SMOMaça
v	UV	eÉ	NQVKVT	RKU	UQNPQQKNU	MKVO	RVKR	NOMKQ	SMOMaça
qÄ	NRV	kç=d~ë	NPQQKQV	VKO	SRVNQQQKUP	MKVO	RVKR	NOMKQ	SMOMaça& eäÜÜ=fpqa=opa
qÄ	NRV	eÉ	RONKVN	PKP	OUSSNVMKN	MKVO	RVKR	NOMKQ	SMOMaça
_á	OMV	kç=d~ë	OUTOKQR	TKR	PNTPQTOKSU	MKVV	RVKR	NOMKQ	SMOMaça
_á	OMV	eÉ	NQOPKUN	PKR	NSMVTVTKQQ	MKVV	RVKR	NOMKQ	SMOMaça

`çåíaåì åaÖ=~ëäÄê~íáç=sÉêëÑÑA~íáç=Ê``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cäÉ=k~ã É	MNS|``skÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf^mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ
^Åè=qáã É	PLOULOMCP=NTWMMM
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVQ ^i _kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã ää**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==\ mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	CRKCOT	éëÄ	NKM	NQSPMQKSM	CR	NMMKN	UVKU	NNMO	
NN	_	S	k ç=d ~ë	CRKTCQ	éëÄ	NKS	VTTTNKMV	CR	NMCKV	UVKU	NNMO	
CP	k ~	CR	e É	RSOVKTPP	éëÄ	NKV	PRSTCSTKTT	RMMM	NNCKRV	UVKU	NNMO	[=HLJ=NMB
CQ	j Ö	CR	e É	RTMCKNPO	éëÄ	NKN	NUUCNSNKQN	RMMM	NNQKMQ	UVKU	NNMO	[=HLJ=NMB
CT	^ä	CR	e É	RRNKSVS	éëÄ	NKQ	STTVTKMU	RMM	NNMPQ	UVKU	NNMO	[=HLJ=NMB
CU	pá	CR	e O	RPPKROV	éëÄ	MKV	CMVRMUKMM	RMM	NMSKTN	UVKU	NNMO	
PV	h	CR	e É	RPRMQMR	éëÄ	MKQ	NRPMRVRKOV	RMMM	NMTKMN	UVKU	NNMO	
QM	` ~	CR	e O	RPMTKCPN	éëÄ	MKS	NRSNCCRTKUO	RMMM	NMSKNQ	UVKU	NNMO	
RN	s	UV	e É	OSKTCQ	éëÄ	MKN	NMTRSCKTR	CR	NMSKVU	UVKU	NNMO	
RO	` ê	UV	e É	OSKSPQ	éëÄ	MKP	NPQTSQKSO	CR	NMSKRQ	UVKU	NNMO	
RR	j å	UV	e É	OSKPPS	éëÄ	MKS	SSPMTKQN	CR	NMRKPQ	UVKU	NNMO	
RS	cÉ	UV	e O	RMRUKRRS	éëÄ	NKS	RRPUNTVRKSU	RMMM	NMNKNT	UVKU	NNMO	
RV	` ç	UV	e É	OTKPQV	éëÄ	NKO	CPRTQTKSM	CR	NMVKQ	UVKU	NNMO	
SM	ká	UV	e É	OTKMP	éëÄ	NKO	SRQSQKMN	CR	NMUKQN	UVKU	NNMO	
SP	` ì	UV	e É	OTKNTT	éëÄ	NKM	NUCPSNKRS	CR	NMUKTN	UVKU	NNMO	
SS	wå	UV	e É	OTKMCP	éëÄ	NKV	PMTQTKRU	CR	NMUKNT	UVKU	NNMO	
TR	^ë	UV	e É	OSKNPS	éëÄ	NKS	CNSSRKPV	CR	NMCKRQ	UVKU	NNMO	
TU	pÉ	UV	e O	CRKMPV	éëÄ	CKP	NMCRSKTV	CR	NMMKNS	UVKU	NNMO	
UU	pê	UV	e É	CRKVUM	éëÄ	MKS	TTCCQKUT	CR	NMPKVO	UVKU	NNMO	
VR	j ç	UV	e É	OSKPSU	éëÄ	CKN	TSUTRKCS	CR	NMRKQT	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKTRT	éëÄ	NKN	CUTUUSKSR	CR	NNNKMP	UVKU	NNMO	[=HLJ=NMB
NNN	` Ç	UV	e É	OTKPVU	éëÄ	NKM	PUMRCKQS	CR	NMVKRV	UVKU	NNMO	
NNU	på	NRV	e É	CQKURT	éëÄ	NKM	TPMCQKVQ	CR	VVKQP	UVKU	NNMO	
NCN	pÄ	NRV	k ç=d ~ë	CRKCQR	éëÄ	MKQ	RSPTNQKST	CR	NMMKVU	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	OSKNUN	éëÄ	NKQ	NSVVNTKNS	CR	NMQKTO	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKSVP	éëÄ	CKO	PQNMNCKNS	CR	NMSKTT	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	CRKTCS	éëÄ	CKT	TRMTVUKNO	CR	NMCKV	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKPRO	éëÄ	NKT	NMROTUQKSQ	CR	NMRKQN	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKMRN	éëÄ	MKQ	VNRTQQKQU	CR	NMQKO	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKUQD	éëÄ	CKT	UTRRRPKRR	CR	NMTKPT	UVKU	NNMO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ï çï	B n`=eäÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	OMPOVTPKOS	NKP	NUVQNRTKMT	NMTKPP	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	QPTUQNQKQN	NKT	QRTPSTVKQQ	VRKTP	RVKR	NOMQ	
pÅ	CR	e O	URMRPNKRS	CKQ	VURSCPKUN	USKOV	RVKR	NOMQ	
pÅ	CR	e É	NQMPRVKOM	MKT	NSMVPNKCP	UTKCO	RVKR	NOMQ	
d É	TO	k ç=d ~ë	NMOTSUQKNQ	MKO	NMTQQQSKRP	VRKST	RVKR	NOMQ	
d É	TO	e O	PPTMNNKMR	MKR	PVPUSVKSQ	URKRS	RVKR	NOMQ	
d É	TO	e É	NNMQMOKNT	NKP	NCRCSSKVR	UUKNP	RVKR	NOMQ	
v	UV	e O	PUCQRCUKRR	NKQ	QPMNURSKUS	UUKV	RVKR	NOMQ	
v	UV	e É	TOTMOMKSM	MKR	UQNPQCKNU	USKQN	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUQTMRMPS	MKS	SRVNQQQKUP	NVPKUU	RVKR	NOMQ	
qÄ	NRV	e É	OSSUNMNKTT	NKO	CUSSNVMKN	VPKMV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQUNVMPKUQ	NKU	PNTPQTCKSU	NMVKTO	RVKR	NOMQ	
_á	OMV	e É	NRPSNNVKOT	NKT	NSMVTVTKOQ	VRKQO	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=É``_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MNT|``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíyf^mj eyNya^q^yOMCPyMPJ^oyi n`OUbkÅ

^Åè=qáã É PLOULOMCP=NTW0UM0T

p~ã éáÉ=qóéÉ ``_

qçí~äa äáíáç=å NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑc äÉk~ã É MMQ^i_KÇ

p~ã éáÉ=n`=m~ëëlc á~ä m~ëë

fpqa=n`=m~ëëlc~áä m~ëë

I éÉê~íçê **~Çã áä**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==\ mp==	iãáá	n`=c ä~Ö
V	_É	S	kç=d~ë	MKMU	ééÄ	NMPKV	PNNKNO	MO	
NN	_	S	kç=d~ë	MKPUU	ééÄ	RKT	ORRSKVQ	Q	
OP	k~	QR	eÉ	RKOMR	ééÄ	OOKR	QUUOVKVU	OMM	
OQ	j Ö	QR	eÉ	SKTTM	ééÄ	NPKT	OVQTKMU	OM	
OT	^ä	QR	eÉ	OKQSN	ééÄ	NSKT	ROOKOQ	OM	
OU	pá	QR	eO	MKVOO	ééÄ	TKQ	UNQKOO	NMM	
PV	h	QR	eÉ	NQKMMQ	ééÄ	OMKT	PRSNOKSP	OMM	
QM	`~	QR	eO	SKTMV	ééÄ	NKQ	PQRPPKRR	OM	
RN	s	UV	eÉ	MKMNV	ééÄ	OPKQ	PQPKPR	N	
RO	`ê	UV	eÉ	JMKMNU	ééÄ	kL^	VOQKRO	N	
RR	j å	UV	eÉ	MKMNM	ééÄ	ONKQ	NSRKPM	MKQ	
RS	cÉ	UV	eO	RKNUP	ééÄ	OKS	TNSMQKCR	OM	
RV	`ç	UV	eÉ	MKMMN	ééÄ	NPPKT	OTTKTV	MO	
SM	ká	UV	eÉ	MKMNP	ééÄ	QUKT	NVQKQR	MKQ	
SP	`ì	UV	eÉ	MKMMS	ééÄ	SMKT	RSPKPS	MKS	
SS	wå	UV	eÉ	MKMTP	ééÄ	QNKR	OTUKVM	O	
TR	^ë	UV	eÉ	MKMPQ	ééÄ	OTKT	QVKMN	N	
TU	pÉ	UV	eO	MKMRS	ééÄ	NTKU	PPKPP	N	
UU	pê	UV	eÉ	MKMNM	ééÄ	NSKR	UNKNN	N	
VR	j ç	UV	eÉ	MKPPT	ééÄ	OKV	NOUOKPM	N	
NMT	^Ö	UV	eÉ	MKMNV	ééÄ	NQKU	OQTKTV	MO	
NNN	`Ç	UV	eÉ	MKMNT	ééÄ	NPKQ	PRKNU	MO	
NNU	på	NRV	eÉ	MKNOS	ééÄ	ONKT	TMSKTM	N	
NON	pÄ	NRV	kç=d~ë	MKMOV	ééÄ	NOKV	NSNNKUM	MO	
NPT	_~	NRV	kç=d~ë	MKMNU	ééÄ	NQKS	PMSKVV	MKQ	
NUO	t	NRV	kç=d~ë	MKOUV	ééÄ	SKR	SRSRKOU	N	
OMR	qä	OMV	kç=d~ë	MKMQQ	ééÄ	TKO	OMTVKMR	MO	
OMU	mÄ	OMV	kç=d~ë	JMKMMV	ééÄ	kL^	ONTOKPU	MO	
OPO	qÜ	OMV	kç=d~ë	MKMQO	ééÄ	OVKM	QPVOKMR	N	
OPU	r	OMV	kç=d~ë	MKMON	ééÄ	VKT	VRQKPU	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=çï	B n`=cäÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	ONMTSQMPU	NKM	NUVQNRTKMT	NNNKOT	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QPVQQTRKPU	MKT	QRTPSTVKOQ	VSKMU	RVKR	NOMQ	
pÅ	QR	eO	UURUTRKUS	MKQ	VURSOPKUN	UVKUU	RVKR	NOMQ	
pÅ	QR	eÉ	NQUOQTKUR	MKT	NSMVPNKOP	VOKNO	RVKR	NOMQ	
dÉ	TO	kç=d~ë	NMSSOUQKTV	NKP	NMTQOQSKRP	VVKOS	RVKR	NOMQ	
dÉ	TO	eO	PQUMVRKOS	NKS	PVPUSVKSQ	UUKPS	RVKR	NOMQ	
dÉ	TO	eÉ	NNTUOOKPU	MKP	NORCSSKVR	VQKMS	RVKR	NOMQ	
v	UV	eO	PVURVRSKRV	MKU	QPMNURSKUS	VOKSS	RVKR	NOMQ	
v	UV	eÉ	TTPUMNKRM	MKR	UQNPQOKNU	VNKVT	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	TPNRSQRKON	NKN	SRVNQQQKUP	NNMKVV	RVKR	NOMQ	
qÄ	NRV	eÉ	OUPQNMUKUS	NKT	OUSSNVMKN	VUKUU	RVKR	NOMQ	
_á	OMV	kç=d~ë	PSORNURKTO	MKQ	PNTPQTOKSU	NNQKOP	RVKR	NOMQ	
_á	OMV	eÉ	NSRPTTRKSP	NKS	NSMVTVTKOQ	NVOKTP	RVKR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	kbt il qqbpq
cáÉ=k~ã É	MNU| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJ ^oyin` OUbKÄ
^Åè=qãã É	PLOULOMOP=NTVRPVRP
p~ã éäÉ=qóéÉ	m_
qçí~ä=aäíáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMQ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	m~ëë
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iáãáí	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMMV	ééÄ	kL^	ONPKPQ	MKR	
_	NN	S	kç=d~ë	MKOUP	ééÄ	QKV	ONVRKTS	NM	
k~	OP	QR	eÉ	SKUOO	ééÄ	NTKM	QVROVKPO	RMM	
jÖ	OQ	QR	eÉ	QKNON	ééÄ	RKQ	OMMVKNM	RM	
^ä	OT	QR	eÉ	OKSQR	ééÄ	ONKU	RQOKOQ	RM	
pá	OU	QR	eO	NKOPS	ééÄ	TKU	VPTKSV	ORM	
h	PV	QR	eÉ	NNKSNU	ééÄ	NPKM	PQSROKOS	RMM	
`~	QM	QR	eO	UKTMR	ééÄ	OKS	QMQPUKVU	RM	
s	RN	UV	eÉ	MKMNN	ééÄ	OPKM	PNMKMN	OKR	
`ê	RO	UV	eÉ	JMKMNU	ééÄ	kL^	VPNKUS	OKR	
jå	RR	UV	eÉ	MKMSS	ééÄ	SKT	PNTKVQ	N	
cÉ	RS	UV	eO	OKRNR	ééÄ	PKM	QMSMRKRQ	RM	
`ç	RV	UV	eÉ	JMKMNT	ééÄ	kL^	NMUKVM	MKR	
ká	SM	UV	eÉ	MKMRM	ééÄ	NTKV	OVNKNO	N	
`ì	SP	UV	eÉ	MKMRS	ééÄ	NVKV	VORKSM	NKR	
wå	SS	UV	eÉ	NKPMR	ééÄ	TKM	NTTMKNQ	R	
^ë	TR	UV	eÉ	MKMNR	ééÄ	ORKT	PPKMM	OKR	
pÉ	TU	UV	eO	MKMOP	ééÄ	UMKO	NUKUP	OKR	
pê	UU	UV	eÉ	MKMNS	ééÄ	NPKS	VTKTU	OKR	
jç	VR	UV	eÉ	MKONS	ééÄ	RKO	VNPKPU	OKR	
^Ö	NMT	UV	eÉ	MKMVR	ééÄ	SMKO	UUKUV	MKR	
`Ç	NNN	UV	eÉ	MKMVR	ééÄ	TUKQ	NTKMP	MKR	
på	NNU	NRV	eÉ	MKNPQ	ééÄ	NUKV	TPNKNQ	OKR	
pÄ	NON	NRV	kç=d~ë	MKMOP	ééÄ	NRKU	NQVNKSS	MKR	
_~	NPT	NRV	kç=d~ë	MKMMO	ééÄ	PVSKV	OMMKON	N	
t	NUO	NRV	kç=d~ë	MKNRQ	ééÄ	UKT	QUOSKMQ	OKR	
qä	OMR	OMV	kç=d~ë	MKMMU	ééÄ	RUKT	NMPNKNQ	MKR	
mÄ	OMU	OMV	kç=d~ë	JMKMNS	ééÄ	kL^	NVORKQP	MKR	
qÜ	OPO	OMV	kç=d~ë	JMKMNN	ééÄ	kL^	ORNSKOR	OKR	
r	OPU	OMV	kç=d~ë	MKMMT	ééÄ	NVKV	QTPKUR	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	CNRRVCQCKVO	NVR	NUVCNRTKMT	NNPKUO	RVKR	NCMCQ	
pÅ	QR	kç=dl~ë	CPVVCRVKNT	PKP	QRTPSTVKCQ	VSKNV	RVKR	NCMCQ	
pÅ	QR	eO	UUNRRQKSO	NVR	VURSCPKUN	UVKQQ	RVKR	NCMCQ	
pÅ	QR	eÉ	NQTNTCKRU	NKP	NSIVPNKCP	VNKQR	RVKR	NCMCQ	
dÉ	TO	kç=dl~ë	NMUUVNSKRS	MKV	NMTQCQSKRP	NMNKPT	RVKR	NCMCQ	
dÉ	TO	eO	PQQQPCKRM	MKT	PVPUSVKSQ	UTKQR	RVKR	NCMCQ	
dÉ	TO	eÉ	NNSVQVKNR	MKS	NCRCSSKVR	VPKPS	RVKR	NCMCQ	
v	UV	eO	PVPMRUSKCV	MKU	CPMNURSKUS	VNKPT	RVKR	NCMCQ	
v	UV	eÉ	TTTUCVKSO	MKS	UQNPQCKNU	VCKQR	RVKR	NCMCQ	
qÄ	NRV	kç=dl~ë	TQRURPVKRQ	CKM	SRVNQQQKUP	NNPKNR	RVKR	NCMCQ	
qÄ	NRV	eÉ	CUCNCRVKNR	NKQ	CUSSNVMKN	VUKQP	RVKR	NCMCQ	
_á	CMV	kç=dl~ë	PSVNTTMUKUT	CKT	PNTPQTCKSU	NNSKPP	RVKR	NCMCQ	
_á	CMV	eÉ	NSRNRUPKRT	MKU	NSIVTVTKCQ	NMCKS	RVKR	NCMCQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` NQfj pO
cáÉ=k~ã É	MNV| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJ ^oyin` OUbKÄ
^Åè=qáã É	PLOULOMOP=NTVPVUVQN
p~ã éäÉ=qóéÉ	m_
qçí~ä=aáäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMQ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iáã á	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMTV	ééÄ	kL^	NSMKMM	MKR	
_	NN	S	kç=d~ë	OKNQV	ééÄ	NMKU	ORRPKSN	NM	
k~	OP	QR	eÉ	RSKSRQ	ééÄ	NNKQ	QUONPKSO	RMM	
jÖ	OQ	QR	eÉ	ORKPNP	ééÄ	VKR	ONQQKSU	RM	
^ä	OT	QR	eÉ	RSKVMM	ééÄ	NNKU	NROVKMM	RM	m_=SMOM=c~âë=aça
pá	OU	QR	eO	NUKPNR	ééÄ	UKV	NTORKOT	ORM	
h	PV	QR	eÉ	VTKVOT	ééÄ	PKM	PPVUOKQU	RMM	
`~	QM	QR	eO	TQKTVO	ééÄ	MKR	RPPUMKQS	RM	m_=SMOM=c~âë=aça
s	RN	UV	eÉ	MKRRU	ééÄ	VKO	SUNKNQ	OKR	
`ê	RO	UV	eÉ	MKTRO	ééÄ	TKP	NSUNKTU	OKR	
jå	RR	UV	eÉ	MKSQS	ééÄ	NUKT	QQSKSM	N	
cÉ	RS	UV	eO	PRKNVS	ééÄ	NKQ	UQPQVKPQ	RM	
`ç	RV	UV	eÉ	JMKMQO	ééÄ	kL^	NTPKPQ	MKR	
ká	SM	UV	eÉ	MKSNM	ééÄ	VKS	QPSKSU	N	
`ì	SP	UV	eÉ	NKVNS	ééÄ	MKQ	OVVPKTN	NKR	m_=SMOM=c~âë=aça
wå	SS	UV	eÉ	NPKQTP	ééÄ	UKM	PNRVKPN	R	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
^ë	TR	UV	eÉ	MKNVS	ééÄ	PUKR	QVKST	OKR	
pÉ	TU	UV	eO	MKNMQ	ééÄ	PUKP	NSKST	OKR	
pê	UU	UV	eÉ	MKNRN	ééÄ	NRKN	NPOKOO	OKR	
jç	VR	UV	eÉ	MKVPU	ééÄ	VKM	TRRKRV	OKR	
^Ö	NMT	UV	eÉ	MKMMU	ééÄ	TUKO	RNKNN	MKR	
`Ç	NNN	UV	eÉ	MKMMO	ééÄ	RMQKV	VKSP	MKR	
på	NNU	NRV	eÉ	PUKPST	ééÄ	NKP	OOSSUKPM	OKR	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKOSR	ééÄ	NOKT	OMRUKVV	MKR	
_~	NPT	NRV	kç=d~ë	MKRRQ	ééÄ	SKR	VMMKVT	N	
t	NUO	NRV	kç=d~ë	MKSOQ	ééÄ	OPKM	QMVQKVS	OKR	
qä	OMR	OMV	kç=d~ë	JMKMVR	ééÄ	kL^	TPMKTV	MKR	
mÄ	OMU	OMV	kç=d~ë	MKNTS	ééÄ	NNKV	QMOQKRN	MKR	
qÜ	OPO	OMV	kç=d~ë	MKNNU	ééÄ	NQKO	PTONKNR	OKR	
r	OPU	OMV	kç=d~ë	MKMMM	ééÄ	kL^	OOSKVN	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NVUNNTQKVT	NKT	NUVQNRTKMT	NMQKRV	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	QNRMRPOKUU	OKR	QRTPSTVKQQ	VMKTR	RVKR	NOMQ	
pÅ	QR	eO	TVMVCPKCR	NKO	VURSCPKUN	UMKCR	RVKR	NOMQ	
pÅ	QR	eÉ	NPRNTOKUT	MKR	NSMVPNKCP	UPKVV	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	NMMPPTRKPT	OKO	NMTQQQSKRP	VPKQ	RVKR	NOMQ	
dÉ	TO	eO	PNRVVSKNS	NKM	PVPUSVKSQ	UMKCP	RVKR	NOMQ	
dÉ	TO	eÉ	NMSRQOKQO	MKM	NCRCSSKVR	URKMR	RVKR	NOMQ	
v	UV	eO	PSCPRPTKMV	MKS	QPMVNURSKUS	UQKCP	RVKR	NOMQ	
v	UV	eÉ	TNCCPCKRN	MKS	UQNPQCKNU	UQKSR	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	SVNNPQCKTR	NKN	SRVNQQQKUP	NMQKUR	RVKR	NOMQ	
qÄ	NRV	eÉ	OSRUNVCKRP	MKT	OUSSNVMKN	VOKTQ	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PSCSSQVKUM	NKU	PNTPQTCKSU	NNQKCU	RVKR	NOMQ	
_á	OMV	eÉ	NRSRRPMKVP	MKO	NSMVTVTKQQ	VTKCR	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMMR^

cãÉ=k~ã É MOMpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl^ mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=NTWPWQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	VKMMD	ééÄ	OKP	NNNUTKUQ	NMM	
NN	_	S	k ç=d ~ë	OMRKMMP	ééÄ	OKM	NQUCRTHRV	NMMM	
OP	k ~	QR	e É	NNNSOKVQV	ééÄ	NKN	NPPPVTUKTU	OMMMMM	
OQ	j Ö	QR	e É	NQQQKSQT	ééÄ	OKM	UUTSQKTN	OMMMMM	
OT	^ ä	QR	e É	NPOSUKVVM	ééÄ	NKT	PMNPOPKUU	OMMMMM	
OU	pá	QR	e O	UMMOKRNV	ééÄ	PKR	SPRMUUKTQ	NMMMM	
PV	h	QR	e É	NMONSKPST	ééÄ	MKV	RRUPPOKQU	OMMMMM	
QM	` ~	QR	e O	NUPTKRRS	ééÄ	NKO	VVQMNKQO	OMMMMM	
RN	s	UV	e É	TPKMVQ	ééÄ	NKM	RTNTUKOQ	NMMM	
RO	` ê	UV	e É	TNKQTM	ééÄ	NKN	TMSPRKUQ	OMMM	
RR	j å	UV	e É	OORKUNN	ééÄ	NKT	NNMOUMKVO	OMMM	
RS	cÉ	UV	e O	NTVSPKPPU	ééÄ	NKM	PTQPVPOMKRM	NMMMM	
RV	` ç	UV	e É	NPKUST	ééÄ	MKQ	OPQOOKRQ	NMMM	
SM	k á	UV	e É	OSKNQV	ééÄ	NKR	NOPUMKMV	NMMM	
SP	` ì	UV	e É	QNKRON	ééÄ	OKO	RQQNUKQU	OMMM	
SS	wå	UV	e É	NQMKVSR	ééÄ	NKN	PMVMVKMN	OMMM	
TR	^ ë	UV	e É	RTKMON	ééÄ	NKO	VNUSKMM	NMMM	
TU	pÉ	UV	e O	QVKPQS	ééÄ	NKM	PURPKRO	NMMM	
UU	pê	UV	e É	RSKSUO	ééÄ	NKS	POTPMKQT	OMMM	
VR	j ç	UV	e É	RPKRPP	ééÄ	NKV	PMQOVKSV	NMMM	
NMT	^ Ö	UV	e É	NMKSRU	ééÄ	NKU	ONQVMKRR	NMM	
NNN	` Ç	UV	e É	NMKSTT	ééÄ	MKU	OUUSKVV	NMMM	
NNU	på	NRV	e É	USKQPQ	ééÄ	NKS	QUURTKQN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NMKOSP	ééÄ	PKQ	QSOMPKQU	NMMM	
NPT	_~	NRV	k ç=d ~ë	UURTMT	ééÄ	NKO	NNQNSUKRT	OMMM	
NUO	t	NRV	k ç=d ~ë	ROKQOQ	ééÄ	OKQ	NPQOPVKQT	NMMM	
OMR	qä	OMV	k ç=d ~ë	VKOSU	ééÄ	MKS	RSNRMKVT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	URKVRP	ééÄ	OKP	TMQUMVKOO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	QSKUOM	ééÄ	NKS	PPVNQRKNO	NMMM	
OPU	r	OMV	k ç=d ~ë	NRKUMT	ééÄ	OKP	NMRMVSKVU	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B¤ ÉÅ	B n` =¨ çï	B n` =¤ëÛÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	NVQMRPNKTN	MKT	NUVQNRTHMT	NMOKQR	RVMR	NOMQ	
pÅ	QR	k ç=d ~ë	PVVNPTOKTS	NKM	QRTPSTVKOQ	UTHOT	RVMR	NOMQ	
pÅ	QR	e O	TTPTRUKST	NKO	VURSCPKUN	TUMR	RVMR	NOMQ	
pÅ	QR	e É	NOVVUQKPT	NKM	NSMVPNKCP	UMRTT	RVMR	NOMQ	
d É	TO	k ç=d ~ë	VSMPMRKQT	NMR	NMTQOQSKRP	UVMPV	RVMR	NOMQ	
d É	TO	e O	PMPTPMKPR	MKT	PVPUSVKSQ	TTHKN	RVMR	NOMQ	
d É	TO	e É	NMOPSRKOS	MKV	NORCSSKVR	UNKTO	RVMR	NOMQ	
v	UV	e O	PSPVTNTHPV	MKU	OPMNURSKUS	UQHSN	RVMR	NOMQ	
v	UV	e É	TMRSTTKOV	MKR	UQNPQOKNU	UPKUU	RVMR	NOMQ	
qÄ	NRV	k ç=d ~ë	STUSQONKOQ	NKP	SRVNQQQKUP	NMOKVS	RVMR	NOMQ	
qÄ	NRV	e É	ORSCPQOKVR	NKQ	OUSSNVMKN	UVKQ	RVMR	NOMQ	
_á	OMV	k ç=d ~ë	PRSUQTUKCP	MKT	PNTPQTOKSU	NNOKQR	RVMR	NOMQ	
_á	OMV	e É	NROTRSOKUN	OKN	NSMVTVTKOQ	VQKUV	RVMR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` NSfj pN
cáÉ=k~ã É	MON| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉåíyf` mj eyNya^q^yOMOPyMPJj ^oyin` OUbKÄ
^Åè=qãã É	PLOULOMOP=NTWQUWRR
p~ã éäÉ=qóéÉ	m_
qçí~ä=aäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMQ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iãã á	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMQS	ééÄ	kL^	NVSKST	MKR	
_	NN	S	kç=d~ë	PKQPR	ééÄ	UKP	PQVUKOS	NM	
k~	OP	QR	eÉ	TTKQPM	ééÄ	UKU	QVSTVKTU	RMM	
jÖ	OQ	QR	eÉ	OSKNVP	ééÄ	NOKQ	ONRRKUN	RM	
^ä	OT	QR	eÉ	QSKRPQ	ééÄ	NOKP	NORUKVU	RM	
pá	OU	QR	eO	POKUQT	ééÄ	OMKU	OTSTKRT	ORM	
h	PV	QR	eÉ	NOOKQRM	ééÄ	PKU	PQRVOKMS	RMM	
`~	QM	QR	eO	STKOMT	ééÄ	NKR	QUURPKMO	RM	m_=SMOM=c~åë=aça
s	RN	UV	eÉ	MKSRQ	ééÄ	SKP	TRQKQU	OKR	
`ê	RO	UV	eÉ	MKTRP	ééÄ	NPKU	NSTUKQR	OKR	
jå	RR	UV	eÉ	MKVSS	ééÄ	PKS	SMOKRT	N	
cÉ	RS	UV	eO	RTKOQP	ééÄ	NKU	NPMNOSKSR	RM	m_=SMOM=c~åë=aça
`ç	RV	UV	eÉ	JMKMST	ééÄ	kL^	NPNKNN	MKR	
ká	SM	UV	eÉ	MKRMQ	ééÄ	UKM	PURKRT	N	
`ì	SP	UV	eÉ	MKPPU	ééÄ	NKV	VOOKOT	NKR	
wå	SS	UV	eÉ	TKMQM	ééÄ	SKU	NTPMKNQ	R	m_=SMOM=c~åë=aça
^ë	TR	UV	eÉ	MKOUQ	ééÄ	OMKT	SPKSU	OKR	
pÉ	TU	UV	eO	MKOTO	ééÄ	NNKV	OVKST	OKR	
pê	UU	UV	eÉ	MKOMP	ééÄ	OPKP	NSOKOP	OKR	
jç	VR	UV	eÉ	MKURU	ééÄ	QKV	TMTKUN	OKR	
^Ö	NMT	UV	eÉ	MKMOP	ééÄ	SPKV	UNKNO	MKR	
`Ç	NNN	UV	eÉ	JMKMMO	ééÄ	kL^	UKRO	MKR	
på	NNU	NRV	eÉ	PUKQSM	ééÄ	OKP	OOPRUKUR	OKR	m_=SMOM=c~åë=aça & m_=SMOM=c~åë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKNOQ	ééÄ	NUKR	NQMNKRS	MKR	
_~	NPT	NRV	kç=d~ë	MKPMT	ééÄ	RKV	RSTKOU	N	
t	NUO	NRV	kç=d~ë	MKQSS	ééÄ	NVKQ	PSPNKMP	OKR	
qä	OMR	OMV	kç=d~ë	MKMOR	ééÄ	RVKV	UVTKSR	MKR	
mÄ	OMU	OMV	kç=d~ë	MKNTN	ééÄ	OMKO	PVONKMV	MKR	
qÜ	OPO	OMV	kç=d~ë	MKOMR	ééÄ	UKM	QOVNKVN	OKR	
r	OPU	OMV	kç=d~ë	MKMNO	ééÄ	NSKM	PMTKMM	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NVUMNTUKOU	NKQ	NUVQNRTKMT	NMQKRQ	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	QMTNOUQKUR	OKR	QRTPSTVKQQ	UVKMD	RVKR	NOMQ	
pÅ	QR	eO	TUQUSNKQT	NKO	VURSOPKUN	TVKSP	RVKR	NOMQ	
pÅ	QR	eÉ	NPOQPMKPN	NKV	NSMVPNKCP	UOKOV	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VUUPVRKVR	NKV	NMTQOQSKRP	VOKMN	RVKR	NOMQ	
dÉ	TO	eO	PMURONKVN	MKP	PVPUSVKSQ	TUKPP	RVKR	NOMQ	
dÉ	TO	eÉ	NMRSOUKSR	NKM	NORQSSKVR	UQKPO	RVKR	NOMQ	
v	UV	eO	PSOQOVSKVM	NKM	QPMNURSKUS	UQKOR	RVKR	NOMQ	
v	UV	eÉ	TNMOVTKVR	MKS	UQNPQOKNU	UQKQO	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	STVSMNSKUO	NKU	SRVNQQQKUP	NMPKN	RVKR	NOMQ	
qÄ	NRV	eÉ	OSNSQUNKMU	NKT	OUSSNMMKN	VNKOV	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PRTNOQQKNP	NKP	PNTPQTOKSU	NNOKRP	RVKR	NOMQ	
_á	OMV	eÉ	NRSSPRMKNT	MKP	NSMVTVTKOQ	VTHP	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` pl n ` NSfj pN
cáÉ=k~ã É	MDCI ` pl kÇ
a~í~=m~íÜ=k~ã É	aWf ÖáÉáíyf` mj eyNya ^q^ yOMOPyMPJ ^oyi n ` OUbkÄ
^Åè=qáã É	PLOULOMOP=NTWRQMP
p~ã éäÉ=qóéÉ	i ` pl
qçí~äaãäíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcáÉk~ã É	MMQI ^i _kÇ
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åä**

n ` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n ` =c ä-Ö
_É	V	S	k ç=d ~ë	QVKTUT	ééÄ	OKM	RQPTPKOU	RIM	NVKVN	TVKR	NOMQ	
_	NN	S	k ç=d ~ë	QVOKUUP	ééÄ	OKN	PQVNRVKNO	RIMM	NVKTO	TVKR	NOMQ	
k ~	OP	QR	e É	UPUOKVRR	ééÄ	MKR	NMNOQQSKSM	TRIMM	OOKPR	TVKR	NOMQ	
j Ö	OQ	QR	e É	ROTRKUPP	ééÄ	MKQ	POPROPKSM	RIMM	ONKN	TVKR	NOMQ	
^ ä	OT	QR	e É	ONNNKRNR	ééÄ	MKU	QUNPTKUR	OIMM	ONKNO	TVKR	NOMQ	
pá	OU	QR	e O	UVVKMOV	ééÄ	MKT	SQTNRKUM	NIMM	NTKVU	TVKR	NOMQ	
h	PV	QR	e É	VVNNKOUU	ééÄ	MKT	RQOUUQKNU	NIMMM	NVKUO	TVKR	NOMQ	
` ~	QM	QR	e O	OSOMSNM	ééÄ	NKO	NQNURURKPN	ORIMM	OMKVS	TVKR	NOMQ	
s	RN	UV	e É	QUUKTOQ	ééÄ	NKU	PTUROOKTS	RIMM	NVKRR	TVKR	NOMQ	
` ê	RO	UV	e É	OMTKMSP	ééÄ	MKR	OMNRTNKTP	OIMM	OMKTN	TVKR	NOMQ	
j å	RR	UV	e É	RMVKTTR	ééÄ	NKM	OQTOMMKMT	RIMM	OMKPV	TVKR	NOMQ	
cÉ	RS	UV	e O	NMMVKPSP	ééÄ	NKM	OMUPQTOKQS	NIMM	OMKNV	TVKR	NOMQ	
` ç	RV	UV	e É	RPSKQMT	ééÄ	MKU	UVNNQQKPN	RIMM	ONKQS	TVKR	NOMQ	
ká	SM	UV	e É	RPMKQVR	ééÄ	NKM	OQSTNSKRS	RIMM	ONKOO	TVKR	NOMQ	
` ì	SP	UV	e É	OSUKRUM	ééÄ	MKO	PQTNSQKNP	ORIM	ONKQV	TVKR	NOMQ	
wå	SS	UV	e É	RNOKVMS	ééÄ	NKS	NNOMMTKPR	RIMM	OMKRO	TVKR	NOMQ	
^ ë	TR	UV	e É	NMMKUOM	ééÄ	MKS	NSNORKMM	NIMM	OMKNS	TVKR	NOMQ	
pÉ	TU	UV	e O	VSKRTO	ééÄ	NKM	TQOPKNP	NIMM	NVKPN	TVKR	NOMQ	
pê	UU	UV	e É	QVMKNVO	ééÄ	MKV	OUMVOPKTN	RIMM	NVKSN	TVKR	NOMQ	
j ç	VR	UV	e É	NMQKPSS	ééÄ	MKQ	RUTQMKOP	NIMM	OMKUT	TVKR	NOMQ	
^ Ö	NMT	UV	e É	RQKPTT	ééÄ	MKR	NMUUMUKPS	RIM	ONKTR	TVKR	NOMQ	
` Ç	NNN	UV	e É	OSNKVOR	ééÄ	MKR	TMNSUKTV	ORIM	OMKVS	TVKR	NOMQ	
på	NNU	NRV	e É	RMSKMSU	ééÄ	NKP	OUTVTMKPM	RIMM	OMKOQ	TVKR	NOMQ	
pÄ	NON	NRV	k ç=d ~ë	VPKSUP	ééÄ	NKR	QNTQUTKMN	NIMM	NUKTQ	TVKR	NOMQ	
_~	NPT	NRV	k ç=d ~ë	OMOPKONR	ééÄ	NKU	OSQOQMSKQP	OIMM	OMKQP	TVKR	NOMQ	
t	NUO	NRV	k ç=d ~ë	NMTKNUR	ééÄ	MKR	OTPSUMKON	NIMM	ONKQQ	TVKR	NOMQ	
qä	OMR	OMV	k ç=d ~ë	VTKQTU	ééÄ	NKR	RTVSUPKNM	NIMM	NVKR	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=d ~ë	NMNKPNQ	ééÄ	MKT	UORMNNKPO	NIMM	OMKOS	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=d ~ë	VQKRSO	ééÄ	NKR	STTSSSKQO	NIMM	NUKVN	TVKR	NOMQ	
r	OPU	OMV	k ç=d ~ë	NMPKTMV	ééÄ	NKV	SUVNNTKRQ	NIMM	OMKTQ	TVKR	NOMQ	

n ` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä-Ö
iá	S	kç=d~ë	NVMVMMVKUU	MKS	NUVQNRTKMT	NMMKTU	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QMUQNNUKCR	MKU	QRTPSTVKCQ	UVKP	RVKR	NOMQ	
pÅ	QR	eO	TTSPUTKQM	MKO	VURSCPKUN	TUKTT	RVKR	NOMQ	
pÅ	QR	eÉ	NPMMTRKTM	MKP	NSMVPNKCP	UMKUP	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VUPQNCKNR	MKO	NMTQCQSKRP	VNKRQ	RVKR	NOMQ	
dÉ	TO	eO	PMVSVRKSV	MKR	PVPUSVKSQ	TUKSP	RVKR	NOMQ	
dÉ	TO	eÉ	NMCPUNKCU	NKO	NCRCSSKVR	UPKPP	RVKR	NOMQ	
v	UV	eO	PRUSQRRKCO	MKT	QPMNURSKUS	UPKPT	RVKR	NOMQ	
v	UV	eÉ	TMNNSVKMS	MKR	UQNPQCKNU	UPKPQ	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SUCVTSSKNR	NKQ	SRVNQQCKUP	NMPKSO	RVKR	NOMQ	
qÄ	NRV	eÉ	CRVNVPNKQT	NKO	CUSSNVMKN	VMKCP	RVKR	NOMQ	
_á	QW	kç=d~ë	PRQRPUUKVR	NKN	PNTPQTCKSU	NNNKTO	RVKR	NOMQ	
_á	QW	eÉ	NRPSSRTKRV	MKV	NSMVTVTKCQ	VRKQS	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMNN

cãÉ=k~ã É MOPpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMOP=NUMNMU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MOQN	éé Ä	NVKU	RMRKRT	NMM	
NN	_	S	k ç=d ~ë	OKURP	éé Ä	SKV	OQOMOKMU	NMMM	
OP	k ~	QR	e É	USKMQT	éé Ä	OKO	RNQRRKMN	OMMMMM	
OQ	j Ö	QR	e É	NTQSKOTM	éé Ä	OKO	NNMVRTHPU	OMMMMM	
OT	^ ä	QR	e É	UONMKNQU	éé Ä	NKR	NVOUMOKNM	OMMMMM	
OU	pá	QR	e O	NOSQKNRR	éé Ä	PKR	VOMRVKQT	NMMMM	
PV	h	QR	e É	NTPMPRV	éé Ä	NKM	NONQPQKOV	OMMMMM	
QM	` ~	QR	e O	NPUVKQUS	éé Ä	NKO	TSUNOMPR	OMMMMM	
RN	s	UV	e É	OOKOQS	éé Ä	OKT	NTVNOKUM	NMMM	
RO	` ê	UV	e É	NPKUPP	éé Ä	MKU	NQTMUKNU	OMMM	
RR	j å	UV	e É	NRMKUQV	éé Ä	OKQ	TRNRQKSM	OMMM	
RS	cÉ	UV	e O	NRPTUKUUV	éé Ä	OKM	PORMONUNKQR	NMMMMM	
RV	` ç	UV	e É	OKPSU	éé Ä	OKM	QOUPKUP	NMMM	
SM	k á	UV	e É	PKORQ	éé Ä	SKN	NTMOKPR	NMMM	
SP	` ì	UV	e É	PKQNU	éé Ä	TKM	RMNOKNM	OMMM	
SS	wå	UV	e É	ORKNTV	éé Ä	OKP	RUNNKPN	OMMM	
TR	^ ë	UV	e É	QKNUP	éé Ä	PKP	TMPKTS	NMMM	
TU	pÉ	UV	e O	MOQSN	éé Ä	VKT	QRKNT	NMMM	
UU	pê	UV	e É	UKUMQ	éé Ä	PKR	ROONKMV	OMMM	
VR	j ç	UV	e É	QKMVV	éé Ä	OKV	ORUOKRN	NMMM	
NMT	^ Ö	UV	e É	MKMQU	éé Ä	OQKN	NPQKQR	NMM	
NNN	` Ç	UV	e É	MKNQT	éé Ä	VKR	QVKSP	NMMM	
NNU	på	NRV	e É	PUKPUN	éé Ä	MKT	OONQUKQN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MOQT	éé Ä	PKU	NVUOKOQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	RMKMVR	éé Ä	NKS	SRVQMKRQ	OMMM	
NUO	t	NRV	k ç=d ~ë	MKPVO	éé Ä	PMKM	PRMTHKRM	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKPNV	éé Ä	TKU	OTMSKQV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	SKPOR	éé Ä	NKR	RRPQQKTT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NQKPNN	éé Ä	NKP	NMTUSSKMQ	NMMM	
OPU	r	OMV	k ç=d ~ë	OKOUQ	éé Ä	NKM	NRUOSKTN	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ¨ mp	B =o ÉÁ	B n ` =¨ çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVOPQOUKQP	NKQ	NUVQNRTKMT	NMNKRR	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QNPMQNNKPS	NKN	QRTPSTVKOQ	VMKPN	RVKR	NOMQ	
pÅ	QR	e O	TUSUMNKTU	MKS	VURSOPKUN	TVKUP	RVKR	NOMQ	
pÅ	QR	e É	NPQPRSKQR	MKV	NSMVPNKOP	UPKQV	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VVQOUPKUM	NKV	NMTQOQSKRP	VOKRS	RVKR	NOMQ	
d É	TO	e O	PMVUPQKMN	MKR	PVPUSVKSQ	TUKSS	RVKR	NOMQ	
d É	TO	e É	NMQRSQKRS	NKN	NORQSSKVR	UPKQT	RVKR	NOMQ	
v	UV	e O	PSVNRMRKOQ	OKM	QPMNURSKUS	URKUN	RVKR	NOMQ	
v	UV	e É	TNVSRNKNU	NKQ	UQNPQOKNU	URKRQ	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVNTRRSKUQ	NKO	SRVNQQQKUP	NMQKVR	RVKR	NOMQ	
qÄ	NRV	e É	QRVSRQMKST	NKM	OUSSNVMKN	VMKRV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PSQQMRSKRP	MKT	PNTPQTOKSU	NNQKUP	RVKR	NOMQ	
_á	OMV	e É	NRSQNNNKRT	NKQ	NSMVTVTKOQ	VTKNS	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMNP

cãÉ=k~ã É MOQpj mi hÇ

a~í~=m~íÜ=k~ã É aWÿ ÖãÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n` OUbkÃ

^Åè=qáã É PLOULOMOP=NUMMTMS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä¬Ö
V	_É	S	k ç=d ~ë	MKMRM	ééÄ	RQKQ	PMSKST	NMM	
NN	_	S	k ç=d ~ë	PKPQO	ééÄ	NKT	PQRMKQU	NMMM	
OP	k ~	QR	e É	QRKVSQ	ééÄ	UKM	QRPQUKMM	OMMMMM	
OQ	j Ö	QR	e É	OSRKRVR	ééÄ	NKS	NSUQSKMS	OMMMMM	
OT	^ ä	QR	e É	TTTMKPTO	ééÄ	NKM	NTTQOPKMM	OMMMMM	
OU	pá	QR	e O	NTNOKVOO	ééÄ	PKU	NOPRSOKTR	NMMMM	
PV	h	QR	e É	OURKUPT	ééÄ	PKT	QOSRNKTU	OMMMMM	
QM	` ~	QR	e O	NTNKOSV	ééÄ	MKV	NMQSVOKUV	OMMMMM	
RN	s	UV	e É	NRKUNP	ééÄ	NKO	NOQUMKNP	NMMM	
RO	` ê	UV	e É	NOKTVN	ééÄ	MKR	NPPOQKPV	OMMM	
RR	j å	UV	e É	PQKNTN	ééÄ	OKS	NSSVMKMS	OMMM	
RS	cÉ	UV	e O	UUSUKVPT	ééÄ	NKT	NUPVOQQTKQO	NMMMMM	
RV	` ç	UV	e É	MKVNM	ééÄ	NOKQ	NTRPKRN	NMMM	
SM	k á	UV	e É	PKMVU	ééÄ	OKS	NRUSKTV	NMMM	
SP	` ì	UV	e É	OKURN	ééÄ	PKO	QNRRKNQ	OMMM	
SS	wå	UV	e É	NTKOOS	ééÄ	PKU	PVOVKRN	OMMM	
TR	^ ë	UV	e É	QKNMS	ééÄ	PKV	STPKTR	NMMM	
TU	pÉ	UV	e O	MOOPS	ééÄ	NPKQ	OSKUP	NMMM	
UU	pê	UV	e É	OKVTS	ééÄ	OKT	NTQVKVP	OMMM	
VR	j ç	UV	e É	NKMVP	ééÄ	RKT	UUSKTN	NMMM	
NMT	^ Ö	UV	e É	MKMNV	ééÄ	NRKR	TPKPP	NMM	
NNN	` Ç	UV	e É	MKMSV	ééÄ	PSKS	OTKQN	NMMM	
NNU	på	NRV	e É	PUKVOT	ééÄ	NKN	OOSSQKVN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOUP	ééÄ	SKN	ONUOKQV	NMMM	
NPT	_~	NRV	k ç=d ~ë	NVKUUT	ééÄ	NKN	OSSUNKPQ	OMMM	
NUO	t	NRV	k ç=d ~ë	MKNPR	ééÄ	PQKV	OUVSKTO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMST	ééÄ	OUKV	NNSTKVS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NPKSUU	ééÄ	NKS	NNSTPMKVR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NNKURT	ééÄ	NKP	UVUOTKUR	NMMM	
OPU	r	OMV	k ç=d ~ë	NKPQR	ééÄ	UKN	VQMPKQV	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B¤¤ ÉÅ	B n` =¨ çï	B n` =¤ëÜÜ	n` =¤ä¬Ö
i á	S	k ç=d ~ë	NVVOQVVKPP	NKT	NUVQNRTKMT	NVRKNV	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QMSTVNNKOQ	MKT	QRTPSTVKOQ	UUKVQ	RVKR	NOMQ	
pÅ	QR	e O	TUMOQTKVS	MKP	VURSOPKUN	TVKNS	RVKR	NOMQ	
pÅ	QR	e É	NPMSPMSU	MKN	NSMVPNKOP	UNKNT	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VUMUPUKRN	NKO	NMTQOQSKRP	VNKP	RVKR	NOMQ	
d É	TO	e O	PMSTNMKRQ	MKQ	PVPUSVKSQ	TTKUT	RVKR	NOMQ	
d É	TO	e É	NMPVSTKMR	MKU	NORCSSKVR	UP	RVKR	NOMQ	
v	UV	e O	PSOMRTOKTT	MKS	OPMNURSKUS	UQKNS	RVKR	NOMQ	
v	UV	e É	TMNOUMKMN	MKQ	UQNPOOKNU	UPKPR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	TMPTTSOKTO	NKN	SRVNOQQKUP	NMSKTT	RVKR	NOMQ	
qÄ	NRV	e É	OSOMVRNKTS	MKU	OUSSNVMKN	VNKQN	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PSQORMOKPQ	NKN	PNTPQTOKSU	NNQKTU	RVKR	NOMQ	
_á	OMV	e É	NRUPNMUKSQ	MKT	NSMVTVTKOQ	VUKPQ	RVKR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` NTfj pN
cáÉ=k~ã É	MCR| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf` mj eyNya^q^yOMCPyMPJj ^oyin` OUbKÄ
^Åè=qãã É	PLOULOMCP=NUMOMP
p~ã éäÉ=qóéÉ	m_
qçí~ä=aäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMQ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iáã á	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMCP	ééÄ	kL^	NVUKVM	MKR	
_	NN	S	kç=d~ë	NKURO	ééÄ	PKO	OPOPKRS	NM	
k~	OP	QR	eÉ	QOKSPM	ééÄ	OQKV	QRRVRKUU	RMM	
jÖ	OQ	QR	eÉ	OQKOPO	ééÄ	NSKS	OMPRKTV	RM	
^ä	OT	QR	eÉ	QNKNRP	ééÄ	RKR	NNPQKRN	RM	
pá	OU	QR	eO	NVKQMN	ééÄ	SKN	NTTRKPN	ORM	
h	PV	QR	eÉ	NMVKORP	ééÄ	QKQ	PPVNOKRP	RMM	
`~	QM	QR	eO	SMKTPS	ééÄ	NKN	QQVPNKQM	RM	m_=SMOM=c~âë=aça
s	RN	UV	eÉ	MKRVV	ééÄ	TKN	SVPKPT	OKR	
`ê	RO	UV	eÉ	MKRST	ééÄ	RKV	NQRTKUM	OKR	
jå	RR	UV	eÉ	MKQSQ	ééÄ	PKR	PQTKOT	N	
cÉ	RS	UV	eO	QUKVUQ	ééÄ	PKP	NMVSSNKVU	RM	
`ç	RV	UV	eÉ	MKMMV	ééÄ	PRVKT	ORPKPR	MKR	
ká	SM	UV	eÉ	PKVMU	ééÄ	PKV	NVPTKVR	N	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
`ì	SP	UV	eÉ	MKQOQ	ééÄ	ORKS	NMMTKUQ	NKR	
wå	SS	UV	eÉ	QKOSU	ééÄ	RKR	NMVMKMS	R	
^ë	TR	UV	eÉ	MKNUS	ééÄ	PQKP	QSKST	OKR	
pÉ	TU	UV	eO	MKVRS	ééÄ	QRKO	NOKRM	OKR	
pê	UU	UV	eÉ	MKONO	ééÄ	OUKP	NSPKPQ	OKR	
jç	VR	UV	eÉ	MKQSQ	ééÄ	NNKR	QTOKOQ	OKR	
^Ö	NMT	UV	eÉ	MKMMU	ééÄ	PRKN	QUKUV	MKR	
`Ç	NNN	UV	eÉ	MKVPN	ééÄ	OMKU	NTKMQ	MKR	
på	NNU	NRV	eÉ	QMKQPS	ééÄ	OKS	OPQSTKTM	OKR	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKNUM	ééÄ	QKS	NSPNKUP	MKR	
_~	NPT	NRV	kç=d~ë	MKQPO	ééÄ	UKR	TOMKTV	N	
t	NUO	NRV	kç=d~ë	JMKNMN	ééÄ	kL^	ONTVKNR	OKR	
qä	OMR	OMV	kç=d~ë	MKMMQ	ééÄ	ROKO	TSTKQV	MKR	
mÄ	OMU	OMV	kç=d~ë	MKVPQ	ééÄ	QUKR	OTUVKTP	MKR	
qÜ	OPO	OMV	kç=d~ë	MKQOO	ééÄ	ORKP	RUPTKRT	OKR	
r	OPU	OMV	kç=d~ë	MKMMT	ééÄ	VQKP	OTPKSP	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NVSVQRSKTT	MKU	NUVQNRTKMT	NMPKVU	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	QMRNMUQKSN	MKQ	QRTPSTVKQQ	UUKRT	RVKR	NOMQ	
pÅ	QR	eO	TTTSUPKQQ	MKS	VURSQPKUN	TUKV	RVKR	NOMQ	
pÅ	QR	eÉ	NPQRNSKQR	NKS	NSMVPNKQP	UQKPQ	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VTSTQUKSQ	NKV	NMTQQQSKRP	VMKVO	RVKR	NOMQ	
dÉ	TO	eO	PMPRRUKMR	MKT	PVPUSVKSQ	TTKMT	RVKR	NOMQ	
dÉ	TO	eÉ	NMOTNSKSO	OKM	NQRQSSKVR	UO	RVKR	NOMQ	
v	UV	eO	PRNTSNUKNN	MKU	QPMNURSKUS	UNKTT	RVKR	NOMQ	
v	UV	eÉ	SVQOTUKQU	NKM	UQNPQQKNU	UQKQU	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	STQUMMUKVP	NKM	SRVNQQQKUP	NMQKMT	RVKR	NOMQ	
qÄ	NRV	eÉ	QSNQVVSKSR	MKV	QUSSNVMKN	VNKNT	RVKR	NOMQ	
_á	QMV	kç=dl~ë	PRSNSRVKQT	NKO	PNTPQTQKSU	NNQKQP	RVKR	NOMQ	
_á	QMV	eÉ	NRQNSUTKPM	MKV	NSMVTVTKQQ	VRKTT	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` pl n ` NTfj pN
cáÉ=k~ã É	MDSi ` pl kÇ
a~í~=m~íÜ=k~ã É	aWf ÖáÉáíÿ` mj eyNya ^q^ yOMOPyMPJ ^oyi n ` OUbkÄ
^Åè=qáã É	PLOULOMOP=NUMNTWOM
p~ã éäÉ=qóéÉ	i ` pl
qçí~äaãäíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcáÉk~ã É	MMQ ^i _kÇ
p~ã éäÉ=n ` =m~ëëlcá~ä	m~ëë
fpqa=n ` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åä**

n ` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n ` =c~ä-Ö
_É	V	S	k ç=dl ~ë	QVKUPN	éëÄ	NKN	RQPNQKPT	RM	NVKVP	TVKR	NOMQ	
_	NN	S	k ç=dl ~ë	QVPKOQS	éëÄ	NKO	PQUTNOKUM	RMM	NVKTP	TVKR	NOMQ	
k~	OP	QR	e É	UPOTKPTR	éëÄ	OKO	NMNQUMQKQV	TRMM	OOKON	TVKR	NOMQ	
j Ö	OQ	QR	e É	RPRPKMNP	éëÄ	NKU	PPNNQVKTQ	RMMM	ONKQN	TVKR	NOMQ	
^ä	OT	QR	e É	ONROKNQV	éëÄ	NKT	QVQVPKQP	OMMM	ONKRO	TVKR	NOMQ	
pá	OU	QR	e O	VUNKQTV	éëÄ	PKO	SVSUTHST	NMMM	NVKSP	TVKR	NOMQ	
h	PV	QR	e É	NMNMQKTRT	éëÄ	NKO	RRTUVRKTO	NMMMM	OMKON	TVKR	NOMQ	
` ~	QM	QR	e O	OTOOKSQQ	éëÄ	NKO	NQRPUSMKVR	ORMM	ONKTU	TVKR	NOMQ	
s	RN	UV	e É	QVOKUQQ	éëÄ	NKR	PTVVOQKQP	RMM	NVKTN	TVKR	NOMQ	
` ê	RO	UV	e É	OMTKVVP	éëÄ	NKM	OMNROUKVS	OMM	OMKU	TVKR	NOMQ	
j å	RR	UV	e É	RNQKMMR	éëÄ	NKM	OQUMURKVN	RMM	OMKRS	TVKR	NOMQ	
cÉ	RS	UV	e O	NMPOKOPP	éëÄ	MKV	OMSROQRKRQ	NMMM	OMKSQ	TVKR	NOMQ	
` ç	RV	UV	e É	RPVKVUQ	éëÄ	NKQ	UVOUVUKRP	RMM	ONKS	TVKR	NOMQ	
ká	SM	UV	e É	ROUKVPS	éëÄ	NKP	OQQUQPKNQ	RMM	ONKNS	TVKR	NOMQ	
` ì	SP	UV	e É	OSTKNMP	éëÄ	NKR	PQPSPOKSR	ORM	ONKPT	TVKR	NOMQ	
wå	SS	UV	e É	RNSKPMS	éëÄ	NKM	NNOONSKOO	RMM	OMKSR	TVKR	NOMQ	
^ë	TR	UV	e É	VUKRNR	éëÄ	NKV	NRSUPKNO	NMM	NVKT	TVKR	NOMQ	
pÉ	TU	UV	e O	VUKVPV	éëÄ	OKP	TPTMKNM	NMM	NVKTV	TVKR	NOMQ	
pê	UU	UV	e É	QVTKSSV	éëÄ	MKT	OUPUTNKRM	RMM	NVKVN	TVKR	NOMQ	
j ç	VR	UV	e É	NMRKQUO	éëÄ	NKR	RVMUTKSO	NMM	ONKN	TVKR	NOMQ	
^Ö	NMT	UV	e É	RPKVQN	éëÄ	MKR	NMTQPPKUT	RM	ONKRU	TVKR	NOMQ	
` Ç	NNN	UV	e É	OSPKUVV	éëÄ	NKR	TMPRVKMO	ORM	ONKNN	TVKR	NOMQ	
på	NNU	NRV	e É	RNMKVNN	éëÄ	NKO	OVONPQKOU	RMM	OMKQQ	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl ~ë	VQKPTO	éëÄ	MKO	QNRUUSKQQ	NMM	NUKUT	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl ~ë	OMPOKQTN	éëÄ	MKR	ORVVQQSKOU	OMMM	OMKPO	TVKR	NOMQ	
t	NUO	NRV	k ç=dl ~ë	NMUKNTS	éëÄ	MKV	OTPMTSKVN	NMM	ONKSQ	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl ~ë	VUKRUN	éëÄ	MKS	RUMTUOKVT	NMM	NVKTO	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl ~ë	NMOKOOS	éëÄ	MKT	UOQSRNKPT	NMM	OMKQQ	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl ~ë	VSKPON	éëÄ	MKP	SUPUQPKSM	NMM	NVKOS	TVKR	NOMQ	
r	OPU	OMV	k ç=dl ~ë	NMRKMSQ	éëÄ	MKU	SVNSSMKPS	NMM	ONKMN	TVKR	NOMQ	

n ` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=ÿ çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=ÿçï	Bn`=eäÜÜ	n`=ä-Ö
iá	S	kç=d~ë	NVMRNQPKUV	NKO	NUVQNRTKMT	NMMRU	RVRR	NOMQ	
pÅ	QR	kç=d~ë	PVQQMRSKUR	MKS	QRTPSTVKQQ	USKCP	RVRR	NOMQ	
pÅ	QR	eO	TSSNPUKRN	NKO	VURSCPKUN	TTKTP	RVRR	NOMQ	
pÅ	QR	eÉ	NPNCRPKUV	CKO	NSMVPNKCP	UNKRS	RVRR	NOMQ	
dÉ	TO	kç=d~ë	VSNQUMKPU	NKN	NMTQQQSKRP	UMRR	RVRR	NOMQ	
dÉ	TO	eO	PMRPNSKCN	MRR	PVPUSVKSQ	TTKRO	RVRR	NOMQ	
dÉ	TO	eÉ	NMDVSQKTN	NKM	NCRCSSKVR	UCKO	RVRR	NOMQ	
v	UV	eO	PQTTTMNUKNR	CKO	QPMNURSKUS	UMKUP	RVRR	NOMQ	
v	UV	eÉ	SVTUUVKRS	MKQ	UQNPQCKNU	UCKVR	RVRR	NOMQ	
qÄ	NRV	kç=d~ë	STRPMSQKCR	MRR	SRVNQQQKUP	NMCKQR	RVRR	NOMQ	
qÄ	NRV	eÉ	OSMQQCPKNR	MRR	OUSSNVMKN	VMKUT	RVRR	NOMQ	
_á	OW	kç=d~ë	PRNCQMRKRP	NKP	PNTPQTCKSU	NNMSU	RVRR	NOMQ	
_á	OW	eÉ	NRQQQTPKQQ	NKN	NSMVTVTKCQ	VRKVQ	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn MVQNUMMN

cãÉ=k~ã É MOTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=NUMRVQP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	NKSUQ	éé Ä	QKU	OMUPKRO	NMM	
NN	_	S	k ç=d ~ë	NOKUTV	éé Ä	QKP	NMNMSKMM	NMMM	
OP	k ~	QR	e É	RRQKRPS	éé Ä	PKR	NMTURMKMP	OMMMMM	
OQ	j Ö	QR	e É	SUOUKRTU	éé Ä	NKP	QPPQQUKOQ	OMMMMM	
OT	^ ä	QR	e É	NQPSNSKOVV	éé Ä	MKU	PPTTVPVKSM	OMMMMM	
OU	pá	QR	e O	PNPQKMPU	éé Ä	NUKT	OPMSPRKTO	NMMMM	
PV	h	QR	e É	RRPOKTVT	éé Ä	MKU	POSQSOKUS	OMMMMM	
QM	` ~	QR	e O	PQUOKMOM	éé Ä	NKS	NVPOORSKUP	OMMMMM	
RN	s	UV	e É	NSOKPVT	éé Ä	OKO	NPQPMQKVT	NMMM	
RO	` ê	UV	e É	NMSKMTT	éé Ä	NKV	NNMSNQRTU	OMMM	
RR	j å	UV	e É	NOSKUSU	éé Ä	NKU	SRTNUHPN	OMMM	
RS	cÉ	UV	e O	PPPRUKTUR	éé Ä	OKP	TONRVMVSKRR	NMMMMM	
RV	` ç	UV	e É	NQKMSS	éé Ä	MKU	ORNTQKQN	NMMM	
SM	k á	UV	e É	QNKOSP	éé Ä	NRT	OMSNOKNO	NMMM	
SP	` ì	UV	e É	NVMPUP	éé Ä	NKU	OTNVNKNU	OMMM	
SS	wå	UV	e É	UTKVNS	éé Ä	OKR	OMSPQKQP	OMMM	
TR	^ ë	UV	e É	UKPUT	éé Ä	QKM	NQQTHRS	NMMM	
TU	pÉ	UV	e O	NHPNR	éé Ä	THO	NNRHPP	NMMM	
UU	pê	UV	e É	RNKNRU	éé Ä	OKR	PNPMUKNR	OMMM	
VR	j ç	UV	e É	NKUMM	éé Ä	TKU	NPMUKVT	NMMM	
NMT	^ Ö	UV	e É	MKOTP	éé Ä	VHP	SNUKVO	NMM	
NNN	` Ç	UV	e É	MHPQM	éé Ä	RHN	NMSKST	NMMM	
NNU	på	NRV	e É	QQKUQM	éé Ä	MKN	OQSRNRTO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MHRQT	éé Ä	PHM	PPMMRRT	NMMM	
NPT	_~	NRV	k ç=d ~ë	PQNMVQQO	éé Ä	NKM	QQQUSMRRU	OMMM	
NUO	t	NRV	k ç=d ~ë	MHPOV	éé Ä	ONHR	PPNPKVO	NMMM	
OMR	qä	OMV	k ç=d ~ë	NRTUS	éé Ä	NKU	NNQPMSN	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	VNHKOCR	éé Ä	MKV	TQTRUPKVT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	QOKSMN	éé Ä	MKQ	PMVMQVRRQ	NMMM	
OPU	r	OMV	k ç=d ~ë	RKUSQ	éé Ä	PKV	PVORPKMV	NMMM	

n` =fpqa=q~ÄäÉ

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i á	S	k ç=d ~ë	NVONSRRHRR	OHM	NUVQNRTHMT	NMHKOR	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	QNOPNOPHPO	MHP	QRTPSTVKOQ	VMHNR	RVHR	NOMQ	
pÅ	QR	e O	TVTSTPHNP	MKU	VURSOPKUN	UMKVP	RVHR	NOMQ	
pÅ	QR	e É	NPQSVVKOR	NHM	NSMVPNKOP	UPHT	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VSRMSUKNO	MHS	NMTQOQSHRP	UVKUQ	RVHR	NOMQ	
d É	TO	e O	OVVROTHPV	MHR	PVPUSVHSQ	TSHMR	RVHR	NOMQ	
d É	TO	e É	NMPTMRHNP	NHM	NORCSSKVR	UOHTV	RVHR	NOMQ	
v	UV	e O	PTTURMOKNP	MKV	OPMNURSKUS	UTKUP	RVHR	NOMQ	
v	UV	e É	TQTVOOKQU	NKQ	UQNPQOKNU	UUKV	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SURQPSMHSR	MKO	SRVNQQQKUP	NMPKVV	RVHR	NOMQ	
qÄ	NRV	e É	ORVOSNVKNS	MHP	OUSSNVMKN	VMKQS	RVHR	NOMQ	
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_á	OMV	e É	NROURMMKVN	MKU	NSMVTVTKOQ	VQKVR	RVHR	NOMQ	

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NN	_	S	k ç=d ~ë	ORKOVN	éëÄ	NKM	VTTVVKOR	OR	NMNKNS	UVKU	NNMO	
OP	k ~	OR	e É	RSOPKQTM	éëÄ	NKU	PQTMQOTKPQ	RMMM	NNOKQT	UVKU	NNMO	[=HLJ=NMB
OQ	j Ö	OR	e É	RSPUKMOP	éëÄ	NKS	NUNQQPSKRO	RMMM	NNOKTS	UVKU	NNMO	[=HLJ=NMB
OT	^ä	OR	e É	RVNKOUO	éëÄ	MKS	TMTTNKOV	RMM	NNUKOS	UVKU	NNMO	[=HLJ=NMB
OU	pá	OR	e O	RROKRRV	éëÄ	NKN	OMRPSSKPT	RMM	NNMKRN	UVKU	NNMO	[=HLJ=NMB
PV	h	OR	e É	RQMPKVST	éëÄ	MKV	NRMRVOSKQS	RMMM	NMUKMU	UVKU	NNMO	
QM	` ~	OR	e O	RPPTKSMS	éëÄ	MKR	NQUSNRRRKTR	RMMM	NMSKTR	UVKU	NNMO	
RN	s	UV	e É	OSKPUT	éëÄ	MKU	NMQQPPKTP	OR	NMRKRR	UVKU	NNMO	
RO	` ê	UV	e É	OSKOPP	éëÄ	MKV	NPMSORKNP	OR	NMQKVP	UVKU	NNMO	
RR	j å	UV	e É	OSKMMM	éëÄ	NKM	SQSSPKQR	OR	NMQKQ	UVKU	NNMO	
RS	cÉ	UV	e O	RNQQKPTT	éëÄ	NKN	RQTTVPQVKVV	RMMM	NMOKUV	UVKU	NNMO	
RV	` ç	UV	e É	OSKUMM	éëÄ	MKN	OOUMVOKSU	OR	NMTHRS	UVKU	NNMO	
SM	k á	UV	e É	OSKSQT	éëÄ	NKV	SPPPQKPT	OR	NMSKRV	UVKU	NNMO	
SP	` ì	UV	e É	OSKVPS	éëÄ	NKP	NTTURRKSO	OR	NMTKTQ	UVKU	NNMO	
SS	wå	UV	e É	OSKSMN	éëÄ	MKS	OVTSQKOO	OR	NMSKQ	UVKU	NNMO	
TR	^ë	UV	e É	ORKURR	éëÄ	MKS	ONMVMKTV	OR	NMPKQO	UVKU	NNMO	
TU	pÉ	UV	e O	ORKMQU	éëÄ	MKR	VSNSKSV	OR	NMMKNV	UVKU	NNMO	
UU	pê	UV	e É	ORKUUU	éëÄ	NKS	TRTNVMKV	OR	NMPKRR	UVKU	NNMO	
VR	j ç	UV	e É	ORKVTN	éëÄ	MKU	TQRNSKUS	OR	NMPKUU	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKRPR	éëÄ	MKP	OUNVPOKMU	OR	NNMKNQ	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKVUS	éëÄ	NKQ	PSUUNKRN	OR	NMTKVQ	UVKU	NNMO	
NNU	på	NRV	e É	OQKUOV	éëÄ	NKO	TNPUVKPO	OR	VVKPO	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKQMN	éëÄ	OKM	RQVNTQKNR	OR	VTHS	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKURU	éëÄ	NKS	NSVNQRKVO	OR	NMPKQP	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKVQN	éëÄ	NKP	PPQNNTKVR	OR	NMPKTS	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	OQKTPR	éëÄ	NKP	TPTRPVKPM	OR	VUKVQ	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKNQU	éëÄ	NKP	NMSTNQSKNT	OR	NMQKRV	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKNNR	éëÄ	PKM	VPTROTKTN	OR	NMQKQS	UVKU	NNMO	
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i á	S	k ç=d ~ë	OMSUMNTKNU	OKP	NUVQNRTKMT	NMVKNU	RVKR	NOMQ	
pÅ	OR	k ç=d ~ë	QNTNQNNKRU	NKQ	QRTPSTVKOQ	VNKO	RVKR	NOMQ	
pÅ	OR	e O	UMQVRTKRV	MKO	VURSOPKUN	UNKST	RVKR	NOMQ	
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dÉ	TO	k ç=d ~ë	VVQTNQKUP	MKU	NMTQQQSKRP	VOKS	RVKR	NOMQ	
dÉ	TO	e O	POMOQRKPM	MKU	PVPUSVKSQ	UNKPN	RVKR	NOMQ	
dÉ	TO	e É	NMTQVTKTV	MKU	NORQSSKVR	URKUN	RVKR	NOMQ	
v	UV	e O	PRUPTTTKQR	MKT	QPMNURSKUS	UPKPN	RVKR	NOMQ	
v	UV	e É	TNRQNMKTT	MKR	UQNPQQKNU	URKMP	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVMNVOMKPM	NKP	SRVNQQQKUP	NVQKTN	RVKR	NOMQ	
qÄ	NRV	e É	OSNNNSSKRS	MKU	OUSSNVMKN	VNKN	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRRSPMUKNS	MKT	PNTPQTOKSU	NNOKMS	RVKR	NOMQ	
_á	OMV	e É	NQUTQSVKVU	NKU	NSMVTVTKOQ	VOKQ	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=É``_F=oÉéçã

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fpqa=n`=m~ëëlc~áä m~ëë

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NN	_	S	k ç=d ~ë	MKPMN	ééÄ	OKQ	OOORMOOO	Q	
OP	k~	OR	e É	JPKRMM	ééÄ	k L^	OONONKSM	OMM	
OQ	j Ö	OR	e É	OKRTS	ééÄ	VKP	ONPPKRT	OM	
OT	^ä	OR	e É	SKSTU	ééÄ	OKV	NVOOKRM	OM	
OU	pá	OR	e O	MKVPV	ééÄ	PRKR	UMVKUT	NVM	
PV	h	OR	e É	UKPRM	ééÄ	NRKR	PPNVOKUM	OMM	
QM	`~	OR	e O	OKTTU	ééÄ	OKM	OTVMPKPO	OM	
RN	s	UV	e É	MKMPM	ééÄ	NTKO	PUUKVM	N	
RO	`ê	UV	e É	JMKMNO	ééÄ	k L^	VQVKNV	N	
RR	j å	UV	e É	MKMOM	ééÄ	TQKP	NVNKPM	MQ	
RS	cÉ	UV	e O	RKRPM	ééÄ	PKU	TOSQSKMQ	OM	
RV	` ç	UV	e É	MKMVR	ééÄ	RVKV	PMSKSU	MO	
SM	k á	UV	e É	MKMVV	ééÄ	PNKP	NUOKOP	MQ	
SP	`ì	UV	e É	MKMVU	ééÄ	RSKR	RTTKUM	MS	
SS	wå	UV	e É	MKMUQ	ééÄ	OOKN	OVMKMN	O	
TR	^ë	UV	e É	MKMPN	ééÄ	OKQ	OSKPQ	N	
TU	pÉ	UV	e O	MKMOT	ééÄ	OMKQ	OMKMM	N	
UU	pê	UV	e É	MKMOR	ééÄ	NMKT	NORKRS	N	
VR	j ç	UV	e É	MKMRP	ééÄ	NPKQ	TMTKUN	N	
NMT	^Ö	UV	e É	MKMNR	ééÄ	NUKU	OMPKPQ	MO	
NNN	`Ç	UV	e É	MKMNR	ééÄ	ONKR	POOOO	MO	
NNU	på	NRV	e É	MKMUU	ééÄ	ORKR	RUOKOR	N	
NON	pÄ	NRV	k ç=d ~ë	MKMON	ééÄ	OSKN	NPSUKNU	MO	
NPT	_~	NRV	k ç=d ~ë	MKMRO	ééÄ	NOKM	ROTKOQ	MQ	
NUO	t	NRV	k ç=d ~ë	MKMVR	ééÄ	PNKM	PUNQKSM	N	
OMR	qä	OMV	k ç=d ~ë	MKMQU	ééÄ	OKO	OOSOKSM	MO	
OMU	mÄ	OMV	k ç=d ~ë	JMKMNQ	ééÄ	k L^	OMVRKRP	MO	
OPO	qÜ	OMV	k ç=d ~ë	MKMQQ	ééÄ	NVKR	ORPOKPM	N	
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i á	S	k ç=d ~ë	ONPVOSUKTQ	MKV	NUVQNRTKMT	NNOKVR	RVKR	NOMQ	
pÅ	OR	k ç=d ~ë	OPUMRQVKQN	MKR	ORTPSTVKOQ	VRKTU	RVKR	NOMQ	
pÅ	OR	e O	USPUPQKUV	NKU	VURSOPKUN	UTKSQ	RVKR	NOMQ	
pÅ	OR	e É	NQQVUOKRR	MKQ	NSMVPNKOP	VMKV	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NMSTQNNKTT	NKN	NMTQOQSKRP	VVKPS	RVKR	NOMQ	
dÉ	TO	e O	PPVVNQKRM	MKT	PVPUSVKSQ	USKP	RVKR	NOMQ	
dÉ	TO	e É	NNQTORKTU	MKQ	NOROSSKVR	VNKRV	RVKR	NOMQ	
v	UV	e O	PUPNURQKQO	MKS	OPMNURSKUS	UVKMT	RVKR	NOMQ	
v	UV	e É	TSTUNRKNO	NKP	UQNPOOKNU	VNKOS	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	TMVUMVPKQM	NKU	SRVNQQQKUP	NMTKSV	RVKR	NOMQ	
qÄ	NRV	e É	OTVMMMUKVN	NKN	OUSSNVMKN	VTKPQ	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PSUNMTNKPT	NKU	PNTPQTOKSU	NNS	RVKR	NOMQ	
_á	OMV	e É	NSNUSRSKTM	NKQ	NSMVTVTKOQ	NVMKRR	RVKR	NOMQ	

Logbooks and Supporting Documents

Katahdin Analytical Services, Inc. **Metals Preparation Benchsheet** **Method:** 3050H-MS

Reagents and Consumables Information:

HNO3: MB2309 HCL: MB2303 Digestion Vessels: ML00860000805 Filter Paper: 17617485

1:1 HNO3: MB3561 H2O2: MB2267 Boiling Stones: MB2304

Pipet	LCS / Spike	LCS/Spiking Information:
M33	☑ ☑	CLPP-SPK-1 (ID/Vol): MB8349 / 0.1 mL
M35	☑ ☑	CLPP-SPK-INT1 (ID/Vol): MW81891 / 1.0 mL
M95	☑ ☑	CLPP-SPK-INT2 (ID/Vol): MW81892 / 1.0 mL
-	☐ ☐	- Spike (ID/Vol): - / - mL
		LCSS: - Balance ID: 09

Heat Source ID: B
Start Time: 1110 /Temp. 98 °C
End Time: 1700 /Temp. 90 °C
Thermometer ID/Pos: IR C 85 / 5,8

Sample ID	Batch ID	Initial Wt/Vol	Initial Units	Final Vol	Final Units	MX	Meth	Anal.	Date	Bottle
LC2OQC14IMS2	QC14IMS2	1.0	g	0.1	L	SL	IM	CD	03/14/2023	N/A
LCSOQC14IMS2	QC14IMS2	1	g		L	SL	IM	CD	03/14/2023	1
PBSQC14IMS2	QC14IMS2	〃	g		L	SL	IM	CD	03/14/2023	〃
~~SQ1008-004~~	~~QC14IMS2~~	~~1.52~~	~~g~~		~~L~~	~~SL~~	~~IM~~	~~CD~~	~~03/14/2023~~	C
SQ1008-013	QC14IMS2	1.53	g		L	SL	IM	CD	03/14/2023	
SQ1008-014	QC14IMS2	1.86	g		L	SL	IM	CD	03/14/2023	
SQ1008-015R	QC14IMS2	1.07	g		L	SL	IM	CD	03/14/2023	
~~SQ1008-016~~	~~QC14IMS2~~	~~1.19~~	~~g~~		~~L~~	~~SL~~	~~IM~~	~~CD~~	~~03/14/2023~~	
SQ1008-017	QC14IMS2	1.18	g		L	SL	IM	CD	03/14/2023	
~~SQ1008-018~~	~~QC14IMS2~~	~~0.71~~	~~g~~		~~L~~	~~SL~~	~~IM~~	~~CD~~	~~03/14/2023~~	
SQ1008-019	QC14IMS2	0.71	g		L	SL	IM	CD	03/14/2023	
~~SQ1008-020~~	~~QC14IMS2~~	~~0.71~~	~~g~~		~~L~~	~~SL~~	~~IM~~	~~CD~~	~~03/14/2023~~	
SQ1008-021	QC14IMS2	0.76	g		L	SL	IM	CD	03/14/2023	
SQ1008-022	QC14IMS2	0.75	g		L	SL	IM	CD	03/14/2023	✓
SQ1188-001	QC14IMS2	1.50	g		L	SL	IM	CD	03/14/2023	A
SQ1188-003	QC14IMS2	1.91	g		L	SL	IM	CD	03/14/2023	
SQ1188-005	QC14IMS2	1.24	g		L	SL	IM	CD	03/14/2023	
SQ1188-005P	QC14IMS2	1.31	g		L	SL	IM	CD	03/14/2023	
SQ1188-005S	QC14IMS2	1.66	g		L	SL	IM	CD	03/14/2023	
SQ1188-007	QC14IMS2	1.05	g		L	SL	IM	CD	03/14/2023	
SQ1188-009	QC14IMS2	1.23	g		L	SL	IM	CD	03/14/2023	
SQ1188-015	QC14IMS2	1.04	g		L	SL	IM	CD	03/14/2023	✓

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KATAHDIN ANALYTICAL
METALS SECTION

Katahdin Analytical Services, Inc. **Metals Preparation Benchsheet** **Method:** 3050H-MS

Reagents and Consumables Information:

HNO3: MSR509 HCL: MSR303 Digestion Vessels: MLD026000205 Filter Paper: 17617435

1:1 HNO3: MR3561 H2O2: MSR267 Boiling Stones: MSR304

Pipet LCS / Spike LCS/Spiking Information:

M33 ☐ ☐ CLPP-SPK-1 (ID/Vol): MS2349 / 0.1 mL

M35 ☐ ☐ CLPP-SPK-INT1 (ID/Vol): MW21891 / 1.0 mL

M35 ☐ ☐ CLPP-SPK-INT2 (ID/Vol): MW21430 / 1.0 mL

— ☐ ☐ — Spike (ID/Vol): — / — mL

LCSS: — Balance ID: 09

Heat Source ID: B

Start Time: 1045 /Temp. 92 °C

End Time: 1750 /Temp. 95 °C

Thermometer ID/Pos: ALC25 / 1,5

Sample ID	Batch ID	Initial Wt/Vol	Initial Units	Final Vol	Final Units	MX	Meth	Anal.	Date	Bottle
LCSOQC16IMS1	QC16IMS1	1	g	0.1	L	SL	IM	KS	03/16/2023	—
PBSQC16IMS1	QC16IMS1	1	g	0.1	L	SL	IM	KS	03/16/2023	—
~~* SQ1008-018~~	~~QC16IMS1~~	~~0.31~~	~~g~~	~~0.1~~	~~L~~	~~SL~~	~~IM~~	~~KS~~	~~03/16/2023~~	~~A~~
SQ1188-011	QC16IMS1	1.13	g	0.1	L	SL	IM	KS	03/16/2023	A
SQ1188-013	QC16IMS1	1.12	g	0.1	L	SL	IM	KS	03/16/2023	C

* Sample exploded after slow H_2O_2 addition

BCF 3-17-23

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3/20/23

KATAHDIN ANALYTICAL METALS SECTION

 Digestion performed by: KS/BCF On: 3/16/23

Katahdin Analytical Services, Inc. | Metals Preparation Benchsheet | Method: 821/R-91-100

Reagents and Consumables Information:

HNO3: N/A | HCL: N/A | Digestion Vessels: N/A | Filter Paper: N/A

1:1 HNO3: ↓ | H2O2: ↓ | Boiling Stones: ↓

Pipet	LCS / Spike	LCS/Spiking Information:
W14	☑ ☑	CLPP-SPK-1 (ID/Vol): MS2349 / 0.2 mL
W00	☑ ☑	CLPP-SPK-INT1 (ID/Vol): MW21431 / 2.0 mL
W00	☑ ☑	CLPP-SPK-INT2 (ID/Vol): MW21430 / 2.0 mL
W28	☑ ☑	HgA Spike (ID/Vol): MW21426 / 1.0 mL
		LCSS: — Balance ID: wetchem

Heat Source ID: —

Start Time: — /Temp. — °C

End Time: — /Temp. — °C

Thermometer ID/Pos: — / —

Sample ID	Batch ID	Initial Wt/Vol	Initial Units	Final Vol	Final Units	MX	Meth	Anal.	Date	Bottle
LCSOQC21ICS2	QC21ICS2	10.0	g	0.2	L	SL	IC	JRS	03/21/2023	N/A
PBSQC21ICS2	QC21ICS2	10.0	g		L	SL	IC	JRS	03/21/2023	
SQ1188-002	QC21ICS2	12.575	g		L	SL	IC	JRS	03/21/2023	
SQ1188-004	QC21ICS2	10.744	g		L	SL	IC	JRS	03/21/2023	
SQ1188-006	QC21ICS2	10.314	g		L	SL	IC	JRS	03/21/2023	
SQ1188-008	QC21ICS2	10.580	g		L	SL	IC	JRS	03/21/2023	
SQ1188-008D	QC21ICS2	10.607	g		L	SL	IC	JRS	03/21/2023	
SQ1188-008S	QC21ICS2	10.780 → 10.254	g		L	SL	IC	JRS	03/21/2023	
SQ1188-010	QC21ICS2	10.496	g		L	SL	IC	JRS	03/21/2023	
SQ1188-012	QC21ICS2	10.104	g		L	SL	IC	JRS	03/21/2023	
SQ1188-014	QC21ICS2	10.698	g		L	SL	IC	JRS	03/21/2023	
SQ1188-016	QC21ICS2	10.610	g	↓	L	SL	IC	JRS	03/21/2023	↓

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KATAHDIN ANALYTICAL METALS SECTION

KATAHDIN ANALYTICAL

ACID VOLATILE SULFIDE PREPARATION

METHOD: EPA-821-R-91-100

REAGENT LOT #:	
IODINE STANDARD: W21583	STS SOLUTION - 0.0375 N: SWL 5042
Na2S SOLUTION: W21504/W21505	NaOH - 0.5 N: 3/21/23
HCl-6N: W21718	Pipet ID: W14 W00 W28
LCS PREP: 0.1mL S1, 1.0mL HgA, 2mL CLPP-SPK-Int 1+2, 0.2mL	
MS PREP: CLPP-SPK1	

STANDARDIZATION OF I2		STANDARDIZATION OF S1			STANDARDIZATION OF S2		
VOL(ml) I2	VOL(ml) Na2S2O3	VOL(ml) I2	VOL(ml) Na2S2O3	VOL(ml) Na2S	VOL(ml) I2	VOL(ml) Na2S2O3	VOL(ml) Na2S
15	9.97	30	10.76	0.1	30	11.48	0.1
↓	10.05	↓	10.67	↓	↓	11.25	↓
↓	10.01	↓	10.81	↓	↓	11.26	↓
	X:		X:			X:	

Prep Start Time	Prep End Time	Sample ID	Sample Wt. (g)	NaOH Trap Vol. (ml)
11:45	12:46	Blank	—	170
↓	↓	AVS LCS	—	↓
		SEM LCS	—	
		SQ1188-2	12.575	
		-4	10.744	
		-6	10.314	
		-8	10.580	
		-8 DUP	10.607	
		AVS -8 MS	10.780	
		-10	10.496	
		-12	10.104	
		-14	10.698	
		-16	10.610	
↓	↓	A SEM -8 MS	11.479	10.254 ↓

JRS 3/21/23

NOTES: Bal 20 WG334165

ANALYST:	DATE: 3/21/23
CHECKED BY:	DATE:

CONVENTIONAL AND PHYSICAL ANALYTICAL DATA

QC Summary Section

Katahdin
ANALYTICAL SERVICES

Quality Control Report

Blank Sample Summary Report

Acid Volatile Sulfide

QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	Units	LOQ	MDL	LOD
WG334165	EPA 821	21-MAR-23	21-MAR-23	U0.076	umole/g	0.10	0.038	0.076

Total Solids

QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	Units	LOQ	MDL	LOD
WG334193	SW846 3540C	24-MAR-23	22-MAR-23	100	%	1.0	1.0	1.0

Quality Control Report

Laboratory Control Sample Summary Report

Acid Volatile Sulfide

Laboratory Sample ID	Sample Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amount	Result	Recovery (%)	Acceptance Range	RPD
WG334165-2	LCS	WG334165	21-MAR-23	21-MAR-23	umole/g	17.355	19.	111	50-120	

Total Solids

Laboratory Sample ID	Sample Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amount	Result	Recovery (%)	Acceptance Range	RPD
WG334193-2	LCS	WG334193	24-MAR-23	22-MAR-23	%	90	90.	99	90-110	
WG334193-3	LCSD	WG334193	24-MAR-23	22-MAR-23	%	90	89.	99	90-110	0

Quality Control Report

Duplicate Sample Summary Report

Acid Volatile Sulfide

Duplicate Sample ID	Original Sample ID	QC Batch	Analysis Date	Units	Sample Result	Duplicate Result	RPD	RPD Limit
WG334165-3	SQ1188-8	WG334165	21-MAR-23	umole/g	U 0.14	U 0.14	NC	20

Quality Control Report

Matrix Spike Sample Summary Report

Acid Volatile Sulfide

Matrix Spike Sample ID	Sample Type	Original Sample ID	QC Batch	Analysis Date	Units	Spike Amount	Sample Result	MS Result	Recovery (%)	Acceptance Range	RPD
WG334165-4	MS	SQ1188-8	WG334165	21-MAR-23	umole/g	30.639	U 0.14	13.	42*	75 - 125	

Sample Data Section

KATAHDIN ANALYTICAL SERVICES – INORGANIC DATA QUALIFIERS

The sampled date indicated on the attached Report(s) of Analysis (ROA) is the date for which a grab sample was collected or the date for which a composite sample was completed. Beginning and start times for composite samples can be found on the Chain-of-Custody.

U Indicates the compound was analyzed for but not detected above the specified level. This level may be the Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client.

Note: All results reported as "U" MDL have a 50% rate for false negatives compared to those results reported as "U" PQL "U" LOQ or "U" LOD, where the rate of false negatives is <1%.

E Estimated value. This flag identifies compounds whose concentrations exceed the upper level of the calibration range of the instrument for that specific analysis.

J Estimated value. The analyte was detected in the sample at a concentration less than the laboratory Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), but above the Method Detection Limit (MDL).

I-7 The laboratory's Practical Quantitation Level (PQL) or LOQ could not be achieved for this parameter due to sample composition, matrix effects, sample volume, or quantity used for analysis.

A-4 Please refer to cover letter or narrative for further information.

H_ Please note that the regulatory holding time for _____ is "analyze immediately". Ideally, this analysis must be performed in the field at the time of sample collection. _____ for this sample was not performed at the time of sample collection. The analysis was performed as soon as possible after receipt by the laboratory.

H1 - pH H2 - DO H3 - sulfite H4 - residual chlorine

T1 The client did not provide the full volume of at least one liter for analysis of TSS. Therefore, the PQL of 2.5 mg/L could not be achieved.

T2 The client provided the required volume of at least one liter for analysis of TSS, but the laboratory could not filter the full one liter volume due to the sample matrix. Therefore, the PQL of 2.5 mg/L could not be achieved.

M1 The matrix spike and/or matrix spike duplicate recovery performed on this sample was outside of the laboratory acceptance criteria. Sample matrix is suspected. The laboratory criteria was met for the Laboratory Control Sample (LCS) analyzed concurrently with this sample.

M2 The matrix spike and/or matrix spike duplicate recovery was outside of the laboratory acceptance criteria. The native sample concentration is greater than four times the spike added concentration so the spike added could not be distinguished from the native sample concentration.

R1 The relative percent difference (RPD) between the duplicate analyses performed on this sample was outside of the laboratory acceptance criteria (when both values are greater than ten times the PQL).

MCL	Maximum Contaminant Level	NL	No limit
NFL	No Free Liquid Present	FLP	Free Liquid Present
NOD	No Odor Detected	TON	Threshold Odor Number

D-1 As required by Method 5210B, APHA Standard Methods for the Examination of Water and Wastewater (21st edition), the BOD value reported for this sample is 'qualified' because the check standard run concurrently with the sample analysis did not meet the criteria specified in the method (198 +/- 30.5 mg/L). These results may not be reportable for compliance purposes.

D-2 The measured final dissolved oxygen concentrations of all dilutions were less than the method-specified limit of 1 mg/L. The reported BOD result was calculated assuming a final oxygen concentration equal to 1 mg/L. The reported value should be considered a minimum value.

D-3 The dilution water used to prepare this sample did not meet the method and/or regulatory criteria of less than 0.2 or 0.4 mg/L dissolved oxygen (DO) uptake over the five day period of incubation. These results may not be reportable for compliance purposes.

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Report of Analytical Results

Lab Sample ID: SQ1188-1
Client ID: JACKSON-SDCC3-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 14:15	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	75. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:08	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-2
Client ID: JACKSON-SDCC3-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 14:15	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.10 umole/g	0.13	0.051	0.10	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	75. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:08	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-3
Client ID: JACKSON-SDCC2-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 10:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	23. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:09	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-4
Client ID: JACKSON-SDCC2-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 10:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.34 umole/g	0.44	0.17	0.34	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	23. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:09	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-5
Client ID: JACKSON-SDMC3-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 14:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	74. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:09	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-6
Client ID: JACKSON-SDMC3-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 14:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.10 umole/g	0.14	0.052	0.10	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	74. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:09	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-7
Client ID: JACKSON-SDMC1-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 11:50	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	52. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:09	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-8
Client ID: JACKSON-SDMC1-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 11:50	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.14 umole/g	0.19	0.072	0.14	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	M1
Total Solids	52. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:09	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-9
Client ID: JACKSON-SDCC4-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 09:40	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	80. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:10	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-10
Client ID: JACKSON-SDCC4-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 09:40	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.095 umole/g	0.12	0.047	0.095	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	80. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:10	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-11
Client ID: JACKSON-SDJC1-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 13:30	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	80. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:10	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-12
Client ID: JACKSON-SDJC1-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 13:30	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.095 umole/g	0.12	0.047	0.095	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	80. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:10	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-13
Client ID: JACKSON-SDMC2-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 11:30	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	84. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:10	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-14
Client ID: JACKSON-SDMC2-DC-01
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 11:30	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.091 umole/g	0.12	0.045	0.091	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	84. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:10	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-15
Client ID: SDDUP
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 00:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Total Solids	74. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:11	SW846 3540C	22-MAR-23	

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Report of Analytical Results

Lab Sample ID: SQ1188-16
Client ID: SDDUP
SDG: SQ1188
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
SL	08-MAR-23 00:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Acid Volatile Sulfide	U0.10 umole/g	0.14	0.052	0.10	EPA 821	WG334165	21-MAR-23 14:05	EPA 821	21-MAR-23	
Total Solids	74. %	1.0	1.0	1.0	SW846 3540C	WG334193	24-MAR-23 09:11	SW846 3540C	22-MAR-23	

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Raw Data Section

WET CHEMISTRY BATCH REPORT
Mar 24 2023, 05:00 pm
Batch: WG334165 Run ID 1: R611938 Run ID 2: NONE

Parameter: Acid Volatile Sulfide
Prep Date: 21-MAR-23

Date Analyzed: 21-MAR-23
Prep Method: EPA 821

Analyst Initials: JRS
Prep Chemist: JRS

Sample	Samp Type	Method	Initial Amt.	Final Amt.	Rpt. DF	Result	Rpt Result	TS(%)	PQL	MDL	Adj PQL	RPD	%Rec
SQ1188-2	SAMP	EPA 821	40.mL	40.mL	1	.001	U0.10 umole/g	75.	.1	0.051	0.13		
SQ1188-4	SAMP	EPA 821	40.mL	40.mL	1	.043	U0.34 umole/g	23.	.1	0.17	0.44		
SQ1188-6	SAMP	EPA 821	40.mL	40.mL	1	.005	U0.10 umole/g	74.	.1	0.052	0.14		
SQ1188-8	SAMP	EPA 821	40.mL	40.mL	1	.061	U0.14 umole/g	52.	.1	0.072	0.19		
SQ1188-10	SAMP	EPA 821	40.mL	40.mL	1	-.002	U0.095 umole/g	80.	.1	0.047	0.12		
SQ1188-12	SAMP	EPA 821	40.mL	40.mL	1	-.002	U0.095 umole/g	80.	.1	0.047	0.12		
SQ1188-14	SAMP	EPA 821	40.mL	40.mL	1	.005	U0.091 umole/g	84.	.1	0.045	0.12		
SQ1188-16	SAMP	EPA 821	40.mL	40.mL	1	.001	U0.10 umole/g	74.	.1	0.052	0.14		
WG334165-1	MBLANK	EPA 821	40.mL	40.mL	1	-.003	U0.076 umole/g	NA	.1	0.038	0.10		
WG334165-2	LCS	EPA 821	40.mL	40.mL	1	19.214	19. umole/g	NA	.1	0.038	0.10		111
WG334165-3	DUP	EPA 821	40.mL	40.mL	1	.056	U0.14 umole/g	NA	.1	0.072	0.19	NC	
WG334165-4	MS	EPA 821	40.mL	40.mL	1	12.972	13. umole/g	NA	.1	0.072	0.19		42

Comments:

SQ1188-2	Use TS from SQ1188-1.
SQ1188-4	Use TS from SQ1188-3.
SQ1188-6	MS/MSD. Use TS from SQ1188-5.
SQ1188-8	Use TS from SQ1188-7.
SQ1188-10	Use TS from SQ1188-9.
SQ1188-12	Use TS from SQ1188-11.
SQ1188-14	Use TS from SQ1188-13.
SQ1188-16	Use TS from SQ1188-15.
WG334165-1	SQ1188-10
WG334165-2	SQ1188-10
WG334165-3	SQ1188-8
WG334165-4	SQ1188-8

Entered by: JRS Date: 3/24/23 Accepted by: RAD Date: 3/27/23

Katahdin Analytical Services SQ1188 Page 649 of 654

Acid Volatile Sulfide Calculations

Standardization of Iodine

Iodine Normality = Normality $Na_2S_2O_3$ x mL $Na_2S_2O_3$ / mL I_2

Normality of $Na_2S_2O_3$:		0.0375
Vol (mL) I_2	Vol (mL) 0.0375 N $Na_2S_2O_3$	Calc. Normality I_2	Mean Normality I_2
15	9.97	0.02493	
15	10.05	0.02513	**0.02503**
15	10.01	0.02503	

Standardization of Saturated Na_2S Stock "S1"

$S^=$ (mg/L) = (mL I_2 x Normality I_2) - (mL $Na_2S_2O_3$ x Normality $Na_2S_2O_3$) x 16000 / mL Na_2S Standard

			N $Na_2S_2O_3$:	0.0375
Vol (mL) I_2	Vol (mL) 0.0375 N $Na_2S_2O_3$	Vol (mL) Na_2S	Calc. $S^=$ Conc. (mg/L)	Mean $S^=$ Conc. Of **S1** (mg/L)
30	10.76	0.1	55560	
30	10.67	0.1	56100	**55640**
30	10.81	0.1	55260	

Prep of Sulfide Working Standard "W1"

Stock "S1" Added (mL)	Final Vol (mL)	Calc. Conc. W1(mg/L)
0.1	100	**55.64**

QC Sample Preparation

QC Sample Name (CCV, LCS, MS, etc.)	Source Standard (S1, W2, etc.)	Source Standard Conc.	Source Standard Added (mL)
CCVA	W1	55.64	0.5
CCVB	W2	52.14	0.5
LCS	S1	55640.00	0.1
SQ1188-8 MS	S1	55640.00	0.1

Standardization of Saturated Na_2S Stock "S2"

$S^=$ (mg/L) = (mL I_2 x Normality I_2) - (mL $Na_2S_2O_3$ x Normality $Na_2S_2O_3$) x 16000 / mL Na_2S Standard

			N $Na_2S_2O_3$:	0.0375
Vol (mL) I_2	Vol (mL) 0.0375 N $Na_2S_2O_3$	Vol (mL) Na_2S	Calc. $S^=$ Conc. (mg/L)	Mean $S^=$ Conc. Of **S2** (mg/L)
30	11.48	0.1	51240	
30	11.25	0.1	52620	**52140**
30	11.26	0.1	52560	

Prep of Sulfide Working Standard "W2"

Stock "S2" Added (mL)	Final Vol (mL)	Calc. Conc. W2 (mg/L)
0.1	100	**52.14**

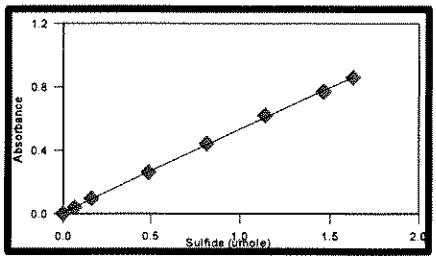
Calibration Standards

mL Working Std. "W2" Used	Abs. At 670 nm	Sulfide (ug) in Cal. Std.	Sulfide (umole) in Cal. Std.
0.00	0.002	0.00	0.000
0.04	0.040	2.09	0.065
0.10	0.098	5.21	0.163
0.30	0.263	15.64	0.488
0.50	0.444	26.07	0.813
0.70	0.620	36.50	1.138
0.90	0.772	46.93	1.464
1.00	0.861	52.14	1.626

Linear Regression, y=ax+b (Sulfide in umole)

Corr. Coeff (r) =	0.99979
Slope (a) =	0.52722
Y-Intercept (b) =	0.00812
Number of Data Points=	8

Calibration Plot



Sample Analysis (Reportable Results in Bold)

	SCRUBBER ANALYSIS											
Katahdin Sample No.	Analysis Vol (mL)	Abs. At 670 nm	Calc $S^=$ (ug)	Calc. $S^=$ (umole)	Calc. $S^=$ (mg/L)	CCV True Conc. (mg/L)	CCV Rcvy (%)	Sample Wet Weight (g)	Sample Percent Solids	Scrubber Final Vol. (mL)	Calc. $S^=$ Conc. (ug/g dry)	Calc. $S^=$ Conc. (umole/g dry)
CCVA	40.0	0.502	30.033	0.937	0.751	0.70	108.0%	10	100	170	12.76	**0.398**
CCVB	40.0	0.450	26.870	0.838	0.672	0.65	103.1%	10	100	170	11.42	**0.356**
CCB	40.0	0.002	-0.372	-0.012	-0.009			10	100	170	-0.16	**-0.005**
BLANK	40.0	0.005	-0.190	-0.006	-0.005			10	100	170	-0.08	**-0.003**
LCS	1.0	0.604	36.235	1.130	36.235			10	100	170	616.00	**19.214**
SQ1188-2	40.0	0.009	0.053	0.002	0.001			12.575	75.006	170	0.02	**0.001**
SQ1188-4	40.0	0.021	0.783	0.024	0.020			10.744	22.669	170	1.37	**0.043**
SQ1188-6	40.0	0.013	0.297	0.009	0.007			10.314	73.658	170	0.17	**0.005**
SQ1188-8	40.0	0.050	2.546	0.079	0.064			10.58	52.545	170	1.95	**0.061**
SQ1188-8 DUP	40.0	0.047	2.364	0.074	0.059			10.607	52.545	170	1.80	**0.056**
SQ1188-8 MS	1.0	0.236	13.857	0.432	13.857			10.78	52.545	170	415.88	**12.972**
SQ1188-10	40.0	0.006	-0.129	-0.004	-0.003			10.496	80.27	170	-0.07	**-0.002**
SQ1188-12	40.0	0.006	-0.129	-0.004	-0.003			10.104	80.121	170	-0.07	**-0.002**
CCVB	40.0	0.454	27.114	0.846	0.678	0.65	104.0%	10	100	170	11.52	**0.359**
CCB	40.0	0.003	-0.312	-0.010	-0.008			10	100	170	-0.13	**-0.004**
SQ1188-14	40.0	0.014	0.357	0.011	0.009			10.698	83.696	170	0.17	**0.005**
SQ1188-16	40.0	0.009	0.053	0.002	0.001			10.61	73.645	170	0.03	**0.001**
CCVB	40.0	0.458	27.357	0.853	0.684	0.65	104.9%	10	100	170	11.63	**0.363**
CCB	40.0	0.003	-0.312	-0.010	-0.008			10	100	170	-0.13	**-0.004**

Quality Control Sample Calculations

Sample or LCS or MS ID	Duplicate or MSD ID	Matrix Spike Sample ID	Dup RPD	Spk Added to LCS (umole/g dry)	LCS Rcvy (%)	Spk Added to MS (umole/g dry)	Matrix Spike Rcvy (%)
LCS				17.355	110.71%		
SQ1188-8	SQ1188-8 DUP		7.68%				
SQ1188-8		SQ1188-8 MS				30.639	42.14%

KATAHDIN ANALYTICAL
ACID VOLATILE SULFIDE PREPARATION
METHOD: EPA-821-R-91-100

REAGENT LOT #:	
IODINE STANDARD: W21583	**STS SOLUTION - 0.0375 N:** SWL 5042
Na2S SOLUTION: W21504/W21505	**NaOH - 0.5 N:** 3/21/23
HCl-6N: W21718	**Pipet ID:** V14 W00 W28
LCS PREP: 0.1mL S1, 1.0mL HgA, 2mL CLPP-SPK-Int 1+2, 0.2mL	
MS PREP: CLPP-SPK1	

STANDARDIZATION OF I2		STANDARDIZATION OF S1			STANDARDIZATION OF S2		
VOL(ml) I2	VOL(ml) Na2S2O3	VOL(ml) I2	VOL(ml) Na2S2O3	VOL(ml) Na2S	VOL(ml) I2	VOL(ml) Na2S2O3	VOL(ml) Na2S
15	9.97	30	10.76	0.1	30	11.48	0.1
〃	10.05	〃	10.67	〃	〃	11.25	〃
〃	10.01	〃	10.81	〃	〃	11.26	〃
	X:		X:			X:	

Prep Start Time	Prep End Time	Sample ID	Sample Wt. (g)	NaOH Trap Vol. (ml)
11:45	12:46	Blank	—	170
〃	〃	AVS LCS	—	〃
〃	〃	SEM LCS	—	
〃	〃	SQ1188-2	12.575	
〃	〃	-4	10.744	
〃	〃	-6	10.314	
〃	〃	-8	10.580	
〃	〃	-8 DUP	10.607	
〃	〃	AVS -8 MS	10.780	
〃	〃	-10	10.496	
〃	〃	-12	10.104	
〃	〃	-14	10.698	
〃	〃	-16	10.610	
〃	〃	A SEM -8 MS	~~11.479~~	10.254 JRS 3/21/23
				JRS 3/21/23

NOTES: Bal 20 WG334165 R611938

ANALYST: JRS **DATE:** 3/21/23

CHECKED BY: RAD **DATE:** 3/24/23

Katahdin Analytical Services, Inc.

Acid Volatile Sulfide (Colorimetric) — **EPA Draft Method 821/R-91-100**

Reagents and Standards

Stock Na2S Standard ID:	W21504 / W21505
Stock Na2S Std. Prep Date:	12/30/22
Working Na2S Standard ID:	V_{W2} = 0.1 mL S^{1}_{S2} → 100 DI
Working Na2S Std. Prep Date:	3/2/23
Mixed Diamine Reagent ID:	W21502

Cal. Std. ID	mL Working Std. Added	Cal. Std. ID	mL Working Std. Added
0.04	W2	0.9	W2
0.1	〃	1.0	〃
0.3	〃	CCV	0.9mL W2
0.5	〃	QQ0/CCB	NA
0.7	〃		

Sequence Number	Katahdin Sample Number	Site ID (optional)	Sample Vol. Analyzed (mL)	Abs. @ 670 nm	Analysis Time (optional)
	Cal 0.0		40	0.002	14:05
	0.04		〃	0.040	〃
	0.1		〃	0.098	〃
	0.3		〃	0.263	〃
	0.5		〃	0.444	〃
	0.7		〃	0.620	〃
	0.9		〃	0.772	〃
	1.0		〃	0.861	〃
	ICV		〃	0.502	〃
	CCV		〃	0.450	〃
	CCB		〃	0.002	〃
	Blank		40	0.005	〃
	LCS		1.0	0.604	〃
	~~SQ~~ SQ1188-2		40	0.009	〃
	-4		〃	0.021	〃
	-6		〃	0.013	〃
	-8		〃	0.050	〃
	-8 DUP		〃	0.047	〃
	-8 MS		1.0	0.236	〃
	-10		40	0.006	〃
	-12		〃	0.006	〃
	CCV		〃	0.454	〃
	CCB		〃	0.003	〃
	SQ1188-14		〃	0.014	〃
	-16		〃	0.009	〃
	CCV		〃	0.458	〃
	CCB		〃	0.003	〃
					JRS 3/21/23

Analysis Performed By: JRS	Analysis Date: 3/21/23
Data Reviewed By: RAD	Review Date: 3/24/23

TOTAL SOLIDS BATCH REPORT
Mar 24 2023, 02:06 pm
Batch: WG334193 Run ID: R611749

Sample	Matrix	Type	Prep Date	Tare	Initial	Finall	Final	by	Date	Raw TS	Rep TS	Recovery	RPD
SQ1015-9	N/A	SAMP	22-MAR-23	1.443956 g	22.8955 g	16.2502 g	16.2502 g	JRS	24-MAR-23	69.0220	69. %		
SQ1015-10	N/A	SAMP	22-MAR-23	1.443956 g	29.1731 g	21.7463 g	21.7463 g	JRS	24-MAR-23	73.2170	73. %		
SQ1015-11	N/A	SAMP	22-MAR-23	1.443956 g	25.3783 g	19.9191 g	19.9191 g	JRS	24-MAR-23	77.1910	77. %		
SQ1015-12	N/A	SAMP	22-MAR-23	1.443956 g	26.7323 g	21.7706 g	21.7706 g	JRS	24-MAR-23	80.3790	80. %		
SQ1015-13	N/A	SAMP	22-MAR-23	1.443956 g	22.3899 g	16.723 g	16.723 g	JRS	24-MAR-23	72.9450	73. %		
SQ1015-14	N/A	SAMP	22-MAR-23	1.443956 g	34.9285 g	25.3653 g	25.3653 g	JRS	24-MAR-23	71.4400	71. %		
SQ1188-1	N/A	SAMP	22-MAR-23	1.443956 g	25.5748 g	19.5436 g	19.5436 g	JRS	24-MAR-23	75.0060	75. %		
SQ1188-2	N/A	SAMP	22-MAR-23	1.443956 g	25.5748 g	19.5436 g	19.5436 g	JRS	24-MAR-23	75.0060	75. %		
SQ1188-3	N/A	SAMP	22-MAR-23	1.443956 g	21.33 g	5.9519 g	5.9519 g	JRS	24-MAR-23	22.6690	23. %		
SQ1188-4	N/A	SAMP	22-MAR-23	1.443956 g	21.33 g	5.9519 g	5.9519 g	JRS	24-MAR-23	22.6690	23. %		
SQ1188-5	N/A	SAMP	22-MAR-23	1.443956 g	23.0763 g	17.3778 g	17.3778 g	JRS	24-MAR-23	73.6580	74. %		
SQ1188-6	N/A	SAMP	22-MAR-23	1.443956 g	23.0763 g	17.3778 g	17.3778 g	JRS	24-MAR-23	73.6580	74. %		
SQ1188-7	N/A	SAMP	22-MAR-23	1.443956 g	23.6471 g	13.1107 g	13.1107 g	JRS	24-MAR-23	52.5450	52. %		
SQ1188-8	N/A	SAMP	22-MAR-23	1.443956 g	23.6471 g	13.1107 g	13.1107 g	JRS	24-MAR-23	52.5450	52. %		
SQ1188-9	N/A	SAMP	22-MAR-23	1.443956 g	25.1969 g	20.5104 g	20.5104 g	JRS	24-MAR-23	80.2700	80. %		
SQ1188-10	N/A	SAMP	22-MAR-23	1.443956 g	25.1969 g	20.5104 g	20.5104 g	JRS	24-MAR-23	80.2700	80. %		
SQ1188-11	N/A	SAMP	22-MAR-23	1.443956 g	34.2127 g	27.6987 g	27.6987 g	JRS	24-MAR-23	80.1210	80. %		
SQ1188-12	N/A	SAMP	22-MAR-23	1.443956 g	34.2127 g	27.6987 g	27.6987 g	JRS	24-MAR-23	80.1210	80. %		
SQ1188-13	N/A	SAMP	22-MAR-23	1.443956 g	23.7065 g	20.0768 g	20.0768 g	JRS	24-MAR-23	83.6960	84. %		
SQ1188-14	N/A	SAMP	22-MAR-23	1.443956 g	23.7065 g	20.0768 g	20.0768 g	JRS	24-MAR-23	83.6960	84. %		
SQ1188-15	N/A	SAMP	22-MAR-23	1.443956 g	31.7228 g	23.7427 g	23.7427 g	JRS	24-MAR-23	73.6450	74. %		
SQ1188-16	N/A	SAMP	22-MAR-23	1.443956 g	31.7228 g	23.7427 g	23.7427 g	JRS	24-MAR-23	73.6450	74. %		
WG334193-1	N/A	MBLANK	22-MAR-23	1.443956 g	5.7131 g	5.713 g	5.713 g	JRS	24-MAR-23	99.9980	100 %		
WG334193-2	N/A	LCS	22-MAR-23	1.443956 g	6.2522 g	5.7486 g	5.7486 g	JRS	24-MAR-23	89.5260	90. %	99	
WG334193-3	N/A	LCSD	22-MAR-23	1.443956 g	6.2132 g	5.7094 g	5.7094 g	JRS	24-MAR-23	89.4360	89. %	99	0

Comments:

SQ1188-2	Use TS from SQ1188-1.
SQ1188-4	Use TS from SQ1188-3.
SQ1188-5	MS/MSD.
SQ1188-6	MS/MSD. Use TS from SQ1188-5.
SQ1188-8	Use TS from SQ1188-7.
SQ1188-10	Use TS from SQ1188-9.
SQ1188-12	Use TS from SQ1188-11.
SQ1188-14	Use TS from SQ1188-13.
SQ1188-16	Use TS from SQ1188-15.
WG334193-1	SQ1015-10
WG334193-2	SQ1015-10
WG334193-3	SQ1015-10

Entered by: JRS Date: 3/24/23 Accepted by: RAD Date: 3/24/23

Katahdin Analytical Services SQ1188 Page 653 of 654

Katahdin
ANALYTICAL SERVICES

Analytical Balance Workgroup (ts01)
22-MAR-23 09:13 AM

Work Group: WG334193 **Run ID:** R611749 **Department:** 100 Wetlab Prep **Created:** 22-MAR-23

Dish	Sample	Volume (mL)	Sample Type	Product	Method	Matrix	PQL	Status
1	SQ1015-9		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
2	SQ1015-10		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
3	SQ1015-11		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
4	SQ1015-12		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
5	SQ1015-13		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
6	SQ1015-14		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
7	SQ1188-1		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
8	SQ1188-3		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
9	SQ1188-5		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
10	SQ1188-7		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
11	SQ1188-9		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
12	SQ1188-11		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
13	SQ1188-13		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
14	SQ1188-15		SAMPLE	TS	SW846 3540C	Solid	0.1%	WIP
15	WG334193-1		MBLANK	TS	SW846 3540C	Solid	0.1%	WIP
16	WG334193-2		LCS	TS	SW846 3540C	Solid	0.1%	WIP
17	WG334193-3		LCSD	TS	SW846 3540C	Solid	0.1%	WIP

Comments:

SQ1188-5 MS/MSD.

Workorder Notes::

SQ1015 DOD, ND to LOD w/ J flags. FDS. Include sample calculation in report or narrative for each method. Metals suppress Ca & Mg when performing hardness calc. AVS/SEM one dup per batch. SEM list is Cd, Cu, Pb, Hg, Ni, Ag, Zn.

SQ1188 FDS, DoD QSM 5.1. ND to LOD w/ "J" flags. Client needs final report on time. AVS/SEM = Cd, Cu, Pb, Ni, Ag, Zn. Add TS notes to AVS/SEM samples.

Notes:

Oven Temp (C): TS/TSS: 103-105, TDS 178-182

Sand ID/Lot #: 0935	Filter Lot #:		Pipette ID: W16		Prep Start Time: 10:22
Event:	**In 1**	**Out 1**	**In 2**	**Out 2**	**Final Weight**
Analyst Initials:	JRS	JRS			JRS
Balance Calibrated? (Y/N)	Y	Y			Y
Date:	3/22/23	3/23/23			3/24/23
Time:	11:09	12:13			**Balance ID:** 1124016031
Oven Temperature:	104°	104°			**Oven ID:** 02

SUBCONTRACTED DATA
TOC

eurofins | Environment Testing

ANALYTICAL REPORT

PREPARED FOR

Attn: Darrian Lewry
Katahdin Analytical Services
600 Technology Way
Scarborough ME 04074

Generated 3/23/2023 1:18 PM

JOB DESCRIPTION

SQ118

JOB NUMBER

410-119054-1

Eurofins Lancaster Laboratories Environment Testing, LLC
2425 New Holland Pike
Lancaster PA 17601

See page two for job notes and contact information.

myEOL

Eurofins Lancaster Laboratories Environment Testing, LLC

Job Notes

Analytical test results meet all requirements of the associated regulatory program (i.e., NELAC (TNI), DoD, and ISO 17025) unless otherwise noted under the individual analysis.

Authorization

Generated
3/23/2023 1:18 PM

Authorized for release by
Stephen J Gordon, Senior Project Manager
Stephen.Gordon@et.eurofinsus.com
412 525-0071

Eurofins Lancaster Laboratories Environment Testing, LLC

Compliance Statement

Analytical test results meet all requirements of the associated regulatory program (e.g., NELAC (TNI), DoD, and ISO 17025) unless otherwise noted under the individual analysis. Data qualifiers are applied to note exceptions. Noncompliant quality control (QC) is further explained in narrative comments.
· QC results that exceed the upper limits and are associated with non-detect samples are qualified but further narration is not required since the bias is high and does not change a non-detect result. Further narration is also not required with QC blank detection when the associated sample concentration is non-detect or more than ten times the level in the blank.
· Matrix QC may not be reported if insufficient sample or site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD is performed, unless otherwise specified in the method.
· Surrogate and/or isotope dilution analyte recoveries (if applicable) which are outside of the QC window are confirmed unless attributed to a dilution or otherwise noted in the narrative.
Regulated compliance samples (e.g. SDWA, NPDES) must comply with the associated agency requirements/permits.

Measurement uncertainty values, as applicable, are available upon request.

Test results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. Times are local to the area of activity. Parameters listed in the 40 CFR Part 136 Table II as "analyze immediately" and tested in the laboratory are not performed within 15 minutes of collection.

This report shall not be reproduced except in full, without the written approval of the laboratory.

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Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Job Narrative
410-119054-1

Receipt
The samples were received on 3/16/2023 9:38 AM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was 4.0°C

General Chemistry
No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Detection Summary

Client: Katahdin Analytical Services
Project/Site: SQ118

Job ID: 410-119054-1

Client Sample ID: JACKSON-SDCC3-DC-01 — Lab Sample ID: 410-119054-1

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	2700		378	252	126	mg/Kg	1	☼	Lloyd Kahn	Total/NA

Client Sample ID: JACKSON-SDCC2-DC-01 — Lab Sample ID: 410-119054-2

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	220000		1390	925	462	mg/Kg	1	☼	Lloyd Kahn	Total/NA

Client Sample ID: JACKSON-SDMC3-DC-01 — Lab Sample ID: 410-119054-3

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	6550		530	353	177	mg/Kg	1	☼	Lloyd Kahn	Total/NA

Client Sample ID: JACKSON-SDMC1-DC-01 — Lab Sample ID: 410-119054-4

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	41800		626	417	209	mg/Kg	1	☼	Lloyd Kahn	Total/NA

Client Sample ID: JACKSON-SDCC4-DC-01 — Lab Sample ID: 410-119054-5

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	905		367	245	122	mg/Kg	1	☼	Lloyd Kahn	Total/NA

Client Sample ID: JACKSON-SDJC1-DC-01 — Lab Sample ID: 410-119054-6

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	1120		406	271	135	mg/Kg	1	☼	Lloyd Kahn	Total/NA

Client Sample ID: JACKSON-SDMC2-DC-01 — Lab Sample ID: 410-119054-7

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	537		358	239	119	mg/Kg	1	☼	Lloyd Kahn	Total/NA

Client Sample ID: SDDUP — Lab Sample ID: 410-119054-8

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	Dil Fac	D	Method	Prep Type
Total Organic Carbon	5760		439	293	146	mg/Kg	1	☼	Lloyd Kahn	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample ID: JACKSON-SDCC3-DC-01
Lab Sample ID: 410-119054-1
Date Collected: 03/08/23 14:15
Matrix: Solid
Date Received: 03/16/23 09:38

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	20.6		1.0		1.0	%		03/17/23 10:54	1

Client Sample ID: JACKSON-SDCC3-DC-01
Lab Sample ID: 410-119054-1
Date Collected: 03/08/23 14:15
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 79.4

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Total Organic Carbon (EPA Lloyd Kahn)	2700		378	252	126	mg/Kg	☼	03/22/23 14:39	1

Client Sample ID: JACKSON-SDCC2-DC-01
Lab Sample ID: 410-119054-2
Date Collected: 03/08/23 10:00
Matrix: Solid
Date Received: 03/16/23 09:38

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	78.4		1.0		1.0	%		03/17/23 10:54	1

Client Sample ID: JACKSON-SDCC2-DC-01
Lab Sample ID: 410-119054-2
Date Collected: 03/08/23 10:00
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 21.6

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Total Organic Carbon (EPA Lloyd Kahn)	220000		1390	925	462	mg/Kg	☼	03/22/23 16:20	1

Client Sample ID: JACKSON-SDMC3-DC-01
Lab Sample ID: 410-119054-3
Date Collected: 03/08/23 14:00
Matrix: Solid
Date Received: 03/16/23 09:38

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	43.3		1.0		1.0	%		03/17/23 10:54	1

Client Sample ID: JACKSON-SDMC3-DC-01
Lab Sample ID: 410-119054-3
Date Collected: 03/08/23 14:00
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 56.7

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Total Organic Carbon (EPA Lloyd Kahn)	6550		530	353	177	mg/Kg	☼	03/22/23 13:41	1

Client Sample ID: JACKSON-SDMC1-DC-01
Lab Sample ID: 410-119054-4
Date Collected: 03/08/23 11:50
Matrix: Solid
Date Received: 03/16/23 09:38

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	52.1		1.0		1.0	%		03/17/23 10:54	1

Client Sample ID: JACKSON-SDMC1-DC-01
Lab Sample ID: 410-119054-4
Date Collected: 03/08/23 11:50
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 47.9

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Total Organic Carbon (EPA Lloyd Kahn)	41800		626	417	209	mg/Kg	☼	03/22/23 14:50	1

Client Sample ID: JACKSON-SDCC4-DC-01
Lab Sample ID: 410-119054-5
Date Collected: 03/08/23 09:40
Matrix: Solid
Date Received: 03/16/23 09:38

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	18.3		1.0		1.0	%		03/17/23 10:54	1

Client Sample ID: JACKSON-SDCC4-DC-01
Lab Sample ID: 410-119054-5
Date Collected: 03/08/23 09:40
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 81.7

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Total Organic Carbon (EPA Lloyd Kahn)	905		367	245	122	mg/Kg	☼	03/22/23 14:53	1

Client Sample ID: JACKSON-SDJC1-DC-01
Lab Sample ID: 410-119054-6
Date Collected: 03/08/23 13:30
Matrix: Solid
Date Received: 03/16/23 09:38

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	26.1		1.0		1.0	%		03/17/23 10:54	1

Client Sample ID: JACKSON-SDJC1-DC-01
Lab Sample ID: 410-119054-6
Date Collected: 03/08/23 13:30
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 73.9

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Total Organic Carbon (EPA Lloyd Kahn)	1120		406	271	135	mg/Kg	☼	03/22/23 14:57	1

Client Sample ID: JACKSON-SDMC2-DC-01
Lab Sample ID: 410-119054-7
Date Collected: 03/08/23 11:30
Matrix: Solid
Date Received: 03/16/23 09:38

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	16.3		1.0		1.0	%		03/17/23 10:54	1

Client Sample ID: JACKSON-SDMC2-DC-01
Lab Sample ID: 410-119054-7
Date Collected: 03/08/23 11:30
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 83.7

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Total Organic Carbon (EPA Lloyd Kahn)	537		358	239	119	mg/Kg	☼	03/22/23 15:01	1

Client Sample ID: SDDUP
Lab Sample ID: 410-119054-8

Date Collected: 03/08/23 00:00
Matrix: Solid
Date Received: 03/16/23 09:38

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	31.6		1.0		1.0	%		03/17/23 10:54	1

Client Sample ID: SDDUP
Lab Sample ID: 410-119054-8

Date Collected: 03/08/23 00:00
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 68.4

General Chemistry

Analyte	Result	Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Total Organic Carbon (EPA Lloyd Kahn)	5760		439	293	146	mg/Kg	☼	03/22/23 15:05	1

Default Detection Limits

Client: Katahdin Analytical Services
Job ID: 410-119054-1
Project/Site: SQ118

General Chemistry

Analyte	LOQ	DL	Units
Total Organic Carbon	300	100	mg/Kg
Percent Moisture	1.0	1.0	%

Method: Lloyd Kahn - Organic Carbon, Total (TOC)

Lab Sample ID: MB 410-356521/32
Matrix: Solid
Analysis Batch: 356521

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Total Organic Carbon	<200		300	200	100	mg/Kg		03/22/23 15:47	1

Lab Sample ID: MB 410-356521/4
Matrix: Solid
Analysis Batch: 356521

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	LOQ	LOD	DL	Unit	D	Analyzed	Dil Fac
Total Organic Carbon	<200		300	200	100	mg/Kg		03/22/23 13:28	1

Lab Sample ID: LCS 410-356521/3
Matrix: Solid
Analysis Batch: 356521

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Total Organic Carbon			4690	5430		mg/Kg		116	36 - 163		

Lab Sample ID: LCS 410-356521/31
Matrix: Solid
Analysis Batch: 356521

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Total Organic Carbon			4690	5880		mg/Kg		125	36 - 163		

Lab Sample ID: 410-119054-3 MS
Matrix: Solid
Analysis Batch: 356521

Client Sample ID: JACKSON-SDMC3-DC-01
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec Limits		
Total Organic Carbon	6550		38200	50770		mg/Kg	☼	116	36 - 163		

Lab Sample ID: 410-119054-3 MSD
Matrix: Solid
Analysis Batch: 356521

Client Sample ID: JACKSON-SDMC3-DC-01
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Total Organic Carbon	6550		39500	48930		mg/Kg	☼	107	36 - 163	4	20

QC Association Summary

Client: Katahdin Analytical Services
Project/Site: SQ118

Job ID: 410-119054-1

General Chemistry

Analysis Batch: 354727

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-119054-1	JACKSON-SDCC3-DC-01	Total/NA	Solid	Moisture	
410-119054-2	JACKSON-SDCC2-DC-01	Total/NA	Solid	Moisture	
410-119054-3	JACKSON-SDMC3-DC-01	Total/NA	Solid	Moisture	
410-119054-4	JACKSON-SDMC1-DC-01	Total/NA	Solid	Moisture	
410-119054-5	JACKSON-SDCC4-DC-01	Total/NA	Solid	Moisture	
410-119054-6	JACKSON-SDJC1-DC-01	Total/NA	Solid	Moisture	
410-119054-7	JACKSON-SDMC2-DC-01	Total/NA	Solid	Moisture	
410-119054-8	SDDUP	Total/NA	Solid	Moisture	

Analysis Batch: 356521

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-119054-1	JACKSON-SDCC3-DC-01	Total/NA	Solid	Lloyd Kahn	
410-119054-2	JACKSON-SDCC2-DC-01	Total/NA	Solid	Lloyd Kahn	
410-119054-3	JACKSON-SDMC3-DC-01	Total/NA	Solid	Lloyd Kahn	
410-119054-4	JACKSON-SDMC1-DC-01	Total/NA	Solid	Lloyd Kahn	
410-119054-5	JACKSON-SDCC4-DC-01	Total/NA	Solid	Lloyd Kahn	
410-119054-6	JACKSON-SDJC1-DC-01	Total/NA	Solid	Lloyd Kahn	
410-119054-7	JACKSON-SDMC2-DC-01	Total/NA	Solid	Lloyd Kahn	
410-119054-8	SDDUP	Total/NA	Solid	Lloyd Kahn	
MB 410-356521/32	Method Blank	Total/NA	Solid	Lloyd Kahn	
MB 410-356521/4	Method Blank	Total/NA	Solid	Lloyd Kahn	
LCS 410-356521/3	Lab Control Sample	Total/NA	Solid	Lloyd Kahn	
LCS 410-356521/31	Lab Control Sample	Total/NA	Solid	Lloyd Kahn	
410-119054-3 MS	JACKSON-SDMC3-DC-01	Total/NA	Solid	Lloyd Kahn	
410-119054-3 MSD	JACKSON-SDMC3-DC-01	Total/NA	Solid	Lloyd Kahn	

Client Sample ID: JACKSON-SDCC3-DC-01
Lab Sample ID: 410-119054-1
Date Collected: 03/08/23 14:15
Matrix: Solid
Date Received: 03/16/23 09:38

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	354727	UVJN	ELLE	03/17/23 10:54

Client Sample ID: JACKSON-SDCC3-DC-01
Lab Sample ID: 410-119054-1
Date Collected: 03/08/23 14:15
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 79.4

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Lloyd Kahn		1	356521	P684	ELLE	03/22/23 14:39

Client Sample ID: JACKSON-SDCC2-DC-01
Lab Sample ID: 410-119054-2
Date Collected: 03/08/23 10:00
Matrix: Solid
Date Received: 03/16/23 09:38

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	354727	UVJN	ELLE	03/17/23 10:54

Client Sample ID: JACKSON-SDCC2-DC-01
Lab Sample ID: 410-119054-2
Date Collected: 03/08/23 10:00
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 21.6

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Lloyd Kahn		1	356521	P684	ELLE	03/22/23 16:20

Client Sample ID: JACKSON-SDMC3-DC-01
Lab Sample ID: 410-119054-3
Date Collected: 03/08/23 14:00
Matrix: Solid
Date Received: 03/16/23 09:38

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	354727	UVJN	ELLE	03/17/23 10:54

Client Sample ID: JACKSON-SDMC3-DC-01
Lab Sample ID: 410-119054-3
Date Collected: 03/08/23 14:00
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 56.7

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Lloyd Kahn		1	356521	P684	ELLE	03/22/23 13:41

Client Sample ID: JACKSON-SDMC1-DC-01
Lab Sample ID: 410-119054-4
Date Collected: 03/08/23 11:50
Matrix: Solid
Date Received: 03/16/23 09:38

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	354727	UVJN	ELLE	03/17/23 10:54

Client Sample ID: JACKSON-SDMC1-DC-01
Lab Sample ID: 410-119054-4
Date Collected: 03/08/23 11:50
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 47.9

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Lloyd Kahn		1	356521	P684	ELLE	03/22/23 14:50

Client Sample ID: JACKSON-SDCC4-DC-01
Lab Sample ID: 410-119054-5
Date Collected: 03/08/23 09:40
Matrix: Solid
Date Received: 03/16/23 09:38

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	354727	UVJN	ELLE	03/17/23 10:54

Client Sample ID: JACKSON-SDCC4-DC-01
Lab Sample ID: 410-119054-5
Date Collected: 03/08/23 09:40
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 81.7

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Lloyd Kahn		1	356521	P684	ELLE	03/22/23 14:53

Client Sample ID: JACKSON-SDJC1-DC-01
Lab Sample ID: 410-119054-6
Date Collected: 03/08/23 13:30
Matrix: Solid
Date Received: 03/16/23 09:38

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	354727	UVJN	ELLE	03/17/23 10:54

Client Sample ID: JACKSON-SDJC1-DC-01
Lab Sample ID: 410-119054-6
Date Collected: 03/08/23 13:30
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 73.9

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Lloyd Kahn		1	356521	P684	ELLE	03/22/23 14:57

Client Sample ID: JACKSON-SDMC2-DC-01
Lab Sample ID: 410-119054-7
Date Collected: 03/08/23 11:30
Matrix: Solid
Date Received: 03/16/23 09:38

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	354727	UVJN	ELLE	03/17/23 10:54

Client Sample ID: JACKSON-SDMC2-DC-01
Lab Sample ID: 410-119054-7
Date Collected: 03/08/23 11:30
Matrix: Solid
Date Received: 03/16/23 09:38
Percent Solids: 83.7

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Lloyd Kahn		1	356521	P684	ELLE	03/22/23 15:01

Lab Chronicle

Client: Katahdin Analytical Services
Project/Site: SQ118

Job ID: 410-119054-1

Client Sample ID: SDDUP
Date Collected: 03/08/23 00:00
Date Received: 03/16/23 09:38

Lab Sample ID: 410-119054-8
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	354727	UVJN	ELLE	03/17/23 10:54

Client Sample ID: SDDUP
Date Collected: 03/08/23 00:00
Date Received: 03/16/23 09:38

Lab Sample ID: 410-119054-8
Matrix: Solid
Percent Solids: 68.4

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Lloyd Kahn		1	356521	P684	ELLE	03/22/23 15:05

Laboratory References:

ELLE = Eurofins Lancaster Laboratories Environment Testing, LLC, 2425 New Holland Pike, Lancaster, PA 17601, TEL (717)656-2300

Accreditation/Certification Summary

Client: Katahdin Analytical Services
Job ID: 410-119054-1
Project/Site: SQ118

Laboratory: Eurofins Lancaster Laboratories Environment Testing, LLC

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
A2LA	Dept. of Defense ELAP	0001.01	11-30-24

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
Lloyd Kahn		Solid	Total Organic Carbon
Moisture		Solid	Percent Moisture

Method Summary

Client: Katahdin Analytical Services
Job ID: 410-119054-1
Project/Site: SQ118

Method	Method Description	Protocol	Laboratory
Lloyd Kahn	Organic Carbon, Total (TOC)	EPA	ELLE
Moisture	Percent Moisture	EPA	ELLE

Protocol References:

EPA = US Environmental Protection Agency

Laboratory References:

ELLE = Eurofins Lancaster Laboratories Environment Testing, LLC, 2425 New Holland Pike, Lancaster, PA 17601, TEL (717)656-2300

Sample Summary

Client: Katahdin Analytical Services
Job ID: 410-119054-1
Project/Site: SQ118

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
410-119054-1	JACKSON-SDCC3-DC-01	Solid	03/08/23 14:15	03/16/23 09:38
410-119054-2	JACKSON-SDCC2-DC-01	Solid	03/08/23 10:00	03/16/23 09:38
410-119054-3	JACKSON-SDMC3-DC-01	Solid	03/08/23 14:00	03/16/23 09:38
410-119054-4	JACKSON-SDMC1-DC-01	Solid	03/08/23 11:50	03/16/23 09:38
410-119054-5	JACKSON-SDCC4-DC-01	Solid	03/08/23 09:40	03/16/23 09:38
410-119054-6	JACKSON-SDJC1-DC-01	Solid	03/08/23 13:30	03/16/23 09:38
410-119054-7	JACKSON-SDMC2-DC-01	Solid	03/08/23 11:30	03/16/23 09:38
410-119054-8	SDDUP	Solid	03/08/23 00:00	03/16/23 09:38

REAGENT TRACEABILITY SUMMARY

Lab Name: Eurofins Lancaster Laboratories Env Job No.: 410-119054-1

SDG No.:

Reagent ID	Exp Date	Prep Date	Dilutant Used	Reagent Final Volume	Parent Reagent		Analyte	Concentration
					Reagent ID	Volume Added		
WC_TOC_30%SUC_00006	02/18/24	OI Analytical, Lot 021821			(Purchased Reagent)		Total Organic Carbon	289.7 mg/mL
WC_TOC_SLCSCC_00007	10/13/24	ERA, Lot d113-542			(Purchased Reagent)		Total Organic Carbon	4690 mg/Kg

Reagent

WC_TOC_SLCSCC_00007

▪ Certificate of Analysis ▪

1. The **Certified Values** are the actual "made-to" concentrations confirmed by ERA analytical verification. The certified values are monitored and purchasers will be notified of any significant changes resulting in recertification or withdrawal of this certified reference material during the period of validity of this certificate.

2. The **Uncertainty** represents an expanded uncertainty and approximates a 95% confidence interval. The uncertainty is based on the characterization, homogeneity and stability characteristics of the product, multiplied by a coverage factor (k=2). The uncertainty applies to the product as supplied and does not take into account any required or optional dilution and/or preparations the laboratory may perform while using this product. The formula used to calculate the expanded uncertainty is:
$U_{expanded} = k * SQRT((U_{char}^2) + (U_{homogen}^2) + (U_{LTS}^2) + (U_{STS}^2) + (U_{RSS}^2))$

Where:

$U_{expanded}$ = Expanded uncertainty.
k = Coverage factor.
U_{char} = Combined standard uncertainty of the manufacturing and/or analytical verification assessment.
$U_{homogen}$ = Standard uncertainty of the homogeneity assessment.
U_{LTS} = Standard uncertainty associated with long-term stability.
U_{STS} = Standard uncertainty associated with short-term (transport) stability.
U_{RSS} = Standard uncertainty associated with repeated sampling of the product (where permitted by product use instructions).

3. The **QC Performance Acceptance Limits (QC PALs™)** are based on actual historical data collected in ERA's Proficiency Testing program. The QC PALs™ reflect any inherent biases in the methods used to establish the limits and closely approximate a 95% confidence interval of the performance that experienced laboratories should achieve using accepted environmental methods. Use the QC PALs™ to realistically evaluate your performance against your peers.

4. The **PT Performance Acceptance Limits (PT PALs™)** are calculated using the regression equations and fixed acceptance criteria specified in the NELAC proficiency testing requirements. Use the PT PALs™ when analyzing this certified reference material alongside USEPA and NELAC compliant PT study materials. Please note that many PT study acceptance limits are concentration dependent (some non-linearly) and therefore, the acceptance limits of this certified reference material and any PT study material may differ relative to their difference in concentrations.

5. The **PT Performance Data** include the mean value, percent recovery and number of data points reported by laboratories in our Proficiency Testing study compared to the Certified Values. In the event this lot was not used in a proficiency testing scheme, the data displayed was generated internally by ERA.

6. Where NIST Standard Reference Materials (SRMs) are available, each analyte has been analytically traced to the NIST SRM listed. **Analytical Traceability Recovery (%)** = [(% recovery ERA certified reference material)/(% recovery NIST SRM)]*100
The traceability data shown were compiled by analyzing this ERA certified reference material and/or it's associated stock solution(s) against the applicable NIST SRMs.

7. The **Reference Values** are equal to the mean recoveries for the parameters as determined in an interlaboratory round robin study. The **Reference Values** represent the expected performance for the analytes in this standard. ERA recommends using the **Reference Values** when assessing or evaluating your results.

8. **Metrological Traceability**. This certified reference material is metrologically traceable to NIST mass reference materials through an unbroken chain of comparisons.

9. For additional information on this product such as intended use, storage information, instructions for use, minimum sample size, and safety information, please refer to the Product Use Instructions provided.

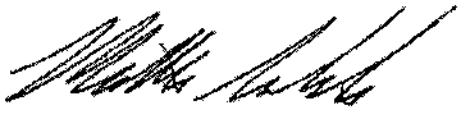
If you have any questions or need technical assistance, please call ERA technical assistance at 1-800-372-0122 or send an email to info@eraqc.com.

Certifying Officer

Brian Miller

Quality Officer

Matthew Seebeck



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ERA

A Waters Company

Certified Reference Material

▪ Certificate of Analysis ▪

Product: Nutrients in Soil
Catalog Number: 542
Lot No. D113-542
Certificate Issue Date: March 23, 2021
Expiration Date: October 13, 2024
Revision Number: Original

Product use instructions are included as part of the certification packet and are paginated separately from this Certificate of Analysis. Please reference the product use instructions for catalog #542 revision 090119.

CERTIFICATION

Parameter	Certified Value[1]	Reference Value[7]	Uncertainty[2]	QC Performance Acceptance Limits[3]	PT Performance Acceptance Limits[4]
	mg/kg	mg/kg	%	mg/kg	mg/kg
Ammonia as N	1210	1090	6.25	698 - 1470	665 - 1510
Total Kjeldahl Nitrogen	1720	1700	12.5	1100 - 2300	944 - 2460
Total Organic Carbon (TOC)	5000	4690	9.55	1690 - 7680	1610 - 7770
Total Phosphorus	1710	1570	20.5	828 - 2300	439 - 2690

ANALYTICAL VERIFICATION

Parameter	Certified Value[1]	Proficiency Testing Study			NIST Traceability	
		Mean	Recovery[5]	n	SRM Number[6]	Recovery
	mg/kg	mg/kg	%			%
Ammonia as N	1210	1090	89.7	48	-	-
Total Kjeldahl Nitrogen	1720	1700	99.0	44	-	-
Total Organic Carbon (TOC)	5000	4690	93.8	29	-	-
Total Phosphorus	1710	1570	91.6	77	-	-

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GENERAL CHEMISTRY

COVER PAGE
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories Job Number: 410-119054-1

SDG No.:

Project: SQ118

Client Sample ID	Lab Sample ID
JACKSON-SDCC3-DC-01	410-119054-1
JACKSON-SDCC2-DC-01	410-119054-2
JACKSON-SDMC3-DC-01	410-119054-3
JACKSON-SDMC1-DC-01	410-119054-4
JACKSON-SDCC4-DC-01	410-119054-5
JACKSON-SDJC1-DC-01	410-119054-6
JACKSON-SDMC2-DC-01	410-119054-7
SDDUP	410-119054-8

Comments:

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SDCC3-DC-01 Lab Sample ID: 410-119054-1

Lab Name: Eurofins Lancaster Laboratories Environment T Job No.: 410-119054-1

SDG ID.:

Matrix: Solid Date Sampled: 03/08/2023 14:15

Reporting Basis: DRY Date Received: 03/16/2023 09:38

% Solids: 79.4

Analyte	Result	LOQ	LOD	DL	Units	C	Q	DIL	Method
Total Organic Carbon	2700	378	252	126	mg/Kg			1	Lloyd Kahn

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SDCC2-DC-01 Lab Sample ID: 410-119054-2

Lab Name: Eurofins Lancaster Laboratories Environment T Job No.: 410-119054-1

SDG ID.:

Matrix: Solid Date Sampled: 03/08/2023 10:00

Reporting Basis: DRY Date Received: 03/16/2023 09:38

% Solids: 21.6

Analyte	Result	LOQ	LOD	DL	Units	C	Q	DIL	Method
Total Organic Carbon	220000	1390	925	462	mg/Kg			1	Lloyd Kahn

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SDMC3-DC-01 Lab Sample ID: 410-119054-3

Lab Name: Eurofins Lancaster Laboratories Environment T Job No.: 410-119054-1

SDG ID.:

Matrix: Solid Date Sampled: 03/08/2023 14:00

Reporting Basis: DRY Date Received: 03/16/2023 09:38

% Solids: 56.7

Analyte	Result	LOQ	LOD	DL	Units	C	Q	DIL	Method
Total Organic Carbon	6550	530	353	177	mg/Kg			1	Lloyd Kahn

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SDMC1-DC-01 Lab Sample ID: 410-119054-4

Lab Name: Eurofins Lancaster Laboratories Environment T Job No.: 410-119054-1

SDG ID.:

Matrix: Solid Date Sampled: 03/08/2023 11:50

Reporting Basis: DRY Date Received: 03/16/2023 09:38

% Solids: 47.9

Analyte	Result	LOQ	LOD	DL	Units	C	Q	DIL	Method
Total Organic Carbon	41800	626	417	209	mg/Kg			1	Lloyd Kahn

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SDCC4-DC-01 Lab Sample ID: 410-119054-5

Lab Name: Eurofins Lancaster Laboratories Environment T Job No.: 410-119054-1

SDG ID.:

Matrix: Solid Date Sampled: 03/08/2023 09:40

Reporting Basis: DRY Date Received: 03/16/2023 09:38

% Solids: 81.7

Analyte	Result	LOQ	LOD	DL	Units	C	Q	DIL	Method
Total Organic Carbon	905	367	245	122	mg/Kg			1	Lloyd Kahn

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SDJC1-DC-01 Lab Sample ID: 410-119054-6

Lab Name: Eurofins Lancaster Laboratories Environment T Job No.: 410-119054-1

SDG ID.:

Matrix: Solid Date Sampled: 03/08/2023 13:30

Reporting Basis: DRY Date Received: 03/16/2023 09:38

% Solids: 73.9

Analyte	Result	LOQ	LOD	DL	Units	C	Q	DIL	Method
Total Organic Carbon	1120	406	271	135	mg/Kg			1	Lloyd Kahn

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SDMC2-DC-01 Lab Sample ID: 410-119054-7

Lab Name: Eurofins Lancaster Laboratories Environment T Job No.: 410-119054-1

SDG ID.:

Matrix: Solid Date Sampled: 03/08/2023 11:30

Reporting Basis: DRY Date Received: 03/16/2023 09:38

% Solids: 83.7

Analyte	Result	LOQ	LOD	DL	Units	C	Q	DIL	Method
Total Organic Carbon	537	358	239	119	mg/Kg			1	Lloyd Kahn

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: SDDUP
Lab Sample ID: 410-119054-8
Lab Name: Eurofins Lancaster Laboratories Environment T
Job No.: 410-119054-1
SDG ID.:
Matrix: Solid
Date Sampled: 03/08/2023 00:00
Reporting Basis: DRY
Date Received: 03/16/2023 09:38
% Solids: 68.4

Analyte	Result	LOQ	LOD	DL	Units	C	Q	DIL	Method
Total Organic Carbon	5760	439	293	146	mg/Kg			1	Lloyd Kahn

2-IN
CALIBRATION QUALITY CONTROL
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories En Job No.: 410-119054-1

SDG No.:

Analyst: P684 Batch Start Date: 03/22/2023

Reporting Units: mg/Kg Analytical Batch No.: 356521

Sample Number	QC Type	Time	Analyte	Result	Spike Amount	(%) Recovery	Limits	Qual	Reagent
1	CCV	13:14	Total Organic Carbon	5570	4690	119	50-153		WC_TOC_SLCSCC_00007
2	CCB	13:19	Total Organic Carbon	<200					
13	CCV	14:21	Total Organic Carbon	3700	4690	79	50-153		WC_TOC_SLCSCC_00007
14	CCB	14:33	Total Organic Carbon	<200					
25	CCV	15:17	Total Organic Carbon	6270	4690	134	50-153		WC_TOC_SLCSCC_00007
26	CCB	15:23	Total Organic Carbon	<200					
37	CCV	16:09	Total Organic Carbon	6000	4690	128	50-153		WC_TOC_SLCSCC_00007
38	CCB	16:14	Total Organic Carbon	<200					
41	CCV	16:25	Total Organic Carbon	4910	4690	105	50-153		WC_TOC_SLCSCC_00007
42	CCB	16:28	Total Organic Carbon	<200					

Note! Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM II-IN

3-IN
METHOD BLANK
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories Job No.: 410-119054-1

SDG No.:

Method	Lab Sample ID	Analyte	Result	Qual	Units	LOQ	Dil
Batch ID: 356521	Date: 03/22/2023 13:28						
Lloyd Kahn	MB 410-356521/4	Total Organic Carbon	<200		mg/Kg	300	1
Batch ID: 356521	Date: 03/22/2023 15:47						
Lloyd Kahn	MB 410-356521/32	Total Organic Carbon	<200		mg/Kg	300	1

FORM III-IN

5-IN
MATRIX SPIKE SAMPLE RECOVERY
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories En Job No.: 410-119054-1

SDG No.:

Matrix: Solid

Method	Lab Sample ID	Analyte	Result	C	Unit	Spike Amount	Pct. Rec.	Limits	RPD	RPD Limit	Q
Batch ID: 356521 Date: 03/22/2023 13:47											
Lloyd Kahn	410-119054-3	Total Organic Carbon	6550		mg/Kg						
Lloyd Kahn	410-119054-3 MS	Total Organic Carbon	50770		mg/Kg	38200	116	36-163			

Calculations are performed before rounding to avoid round-off errors in calculated results.
Note - Results and Reporting Limits have been adjusted for dry weight.

FORM V-IN

5-IN
MATRIX SPIKE DUPLICATE SAMPLE RECOVERY
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories En Job No.: 410-119054-1

SDG No.:

Matrix: Solid

Method	Lab Sample ID	Analyte	Result	C	Unit	Spike Amount	Pct. Rec.	Limits	RPD	RPD Limit	Q
Batch ID: 356521 Date: 03/22/2023 13:52											
Lloyd Kahn	410-119054-3 MSD	Total Organic Carbon	48930		mg/Kg	39500	107	36-163	4	20	

Calculations are performed before rounding to avoid round-off errors in calculated results.
Note - Results and Reporting Limits have been adjusted for dry weight.

FORM V-IN

7A-IN
LAB CONTROL SAMPLE
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories En Job No.: 410-119054-1

SDG No.:

Matrix: Solid

Method	Lab Sample ID	Analyte	Result	C	Unit	Spike Amount	Pct. Rec.	Limits	RPD	RPD Limit	Q
Batch ID: 356521	Date: 03/22/2023 13:23										
						LCS Source: WC_TOC_SLCSCC_00007					
Lloyd Kahn	LCS 410-356521/3	Total Organic Carbon	5430		mg/Kg	4690	116	36-163			
Batch ID: 356521	Date: 03/22/2023 15:42										
						LCS Source: WC_TOC_SLCSCC_00007					
Lloyd Kahn	LCS 410-356521/31	Total Organic Carbon	5880		mg/Kg	4690	125	36-163			

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIIA-IN

9-IN
DETECTION LIMITS
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories Job Number: 410-119054-1

SDG Number:

Matrix: Solid Instrument ID: 11082

Method: Lloyd Kahn DL Date: 03/03/2021 12:34

Analyte	Wavelength/ Mass	LOQ (mg/Kg)	DL (mg/Kg)
Total Organic Carbon		300	100

9-IN
CALIBRATION BLANK DETECTION LIMITS
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories Job Number: 410-119054-1

SDG Number:

Matrix: Solid Instrument ID: 11082

Method: Lloyd Kahn XMDL Date: 03/03/2021 12:25

Analyte	Wavelength/ Mass	XRL (mg/Kg)	XMDL (mg/Kg)
Total Organic Carbon		300	100

9-IN
DETECTION LIMITS
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories Job Number: 410-119054-1

SDG Number:

Matrix: Solid Instrument ID: NOEQUIP

Method: Moisture DL Date: 10/16/2018 12:54

Analyte	Wavelength/ Mass	LOQ (%)	DL (%)
Percent Moisture		1	0.1

9-IN
CALIBRATION BLANK DETECTION LIMITS
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories Job Number: 410-119054-1

SDG Number:

Matrix: Solid Instrument ID: NOEQUIP

Method: Moisture XMDL Date: 10/16/2018 09:12

Analyte	Wavelength/ Mass	XRL (%)	XMDL (%)
Percent Moisture		1	0.1

13-IN
ANALYSIS RUN LOG
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories Envi Job No.: 410-119054-1

SDG No.:

Instrument ID: 11082 Analysis Method: Lloyd Kahn

Start Date: 03/22/2023 13:14 End Date: 03/22/2023 16:28

Lab Sample Id	D/F	Type	Time	Analytes																								
				TOC																								
CCV 410-356521/1	1		13:14	X																								
CCB 410-356521/2	1		13:19	X																								
LCS 410-356521/3	1	T	13:23	X																								
MB 410-356521/4	1	T	13:28	X																								
410-119054-3	1	T	13:41	X																								
410-119054-3 MS	1	T	13:47	X																								
410-119054-3 MSD	1	T	13:52	X																								
ZZZZZZ			13:57																									
ZZZZZZ			14:00																									
ZZZZZZ			14:07																									
ZZZZZZ			14:11																									
ZZZZZZ			14:14																									
CCV 410-356521/13	1		14:21	X																								
CCB 410-356521/14	1		14:33	X																								
ZZZZZZ			14:35																									
410-119054-1	1	T	14:39	X																								
ZZZZZZ			14:45																									
410-119054-4	1	T	14:50	X																								
410-119054-5	1	T	14:53	X																								
410-119054-6	1	T	14:57	X																								
410-119054-7	1	T	15:01	X																								
410-119054-8	1	T	15:05	X																								
ZZZZZZ			15:10																									
ZZZZZZ			15:14																									
CCV 410-356521/25	1		15:17	X																								
CCB 410-356521/26	1		15:23	X																								
ZZZZZZ			15:26																									
ZZZZZZ			15:29																									
ZZZZZZ			15:35																									
ZZZZZZ			15:38																									
LCS 410-356521/31	1	T	15:42	X																								
MB 410-356521/32	1	T	15:47	X																								
ZZZZZZ			15:49																									
ZZZZZZ			15:54																									
ZZZZZZ			15:59																									
ZZZZZZ			16:04																									
CCV 410-356521/37	1		16:09	X																								
CCB 410-356521/38	1		16:14	X																								
ZZZZZZ			16:16																									
410-119054-2	1	T	16:20	X																								
CCV 410-356521/41	1		16:25	X																								

FORM XIII-IN

13-IN
ANALYSIS RUN LOG
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories Envi Job No.: 410-119054-1

SDG No.:

Instrument ID: 11082 Analysis Method: Lloyd Kahn

Start Date: 03/22/2023 13:14 End Date: 03/22/2023 16:28

Lab Sample Id	D/F	Type	Time	Analytes																								
				TOC																								
CCB 410-356521/42	1		16:28	X																								

Prep Types:
T = Total/NA

FORM XIII-IN

13-IN
ANALYSIS RUN LOG
GENERAL CHEMISTRY

Lab Name: Eurofins Lancaster Laboratories Envi Job No.: 410-119054-1

SDG No.:

Instrument ID: NOEQUIP Analysis Method: Moisture

Start Date: 03/17/2023 10:54 End Date: 03/17/2023 10:54

Lab Sample Id	D/F	Type	Time	Analytes																								
				Moist																								
410-119054-1	1	T	10:54	X																								
410-119054-2	1	T	10:54	X																								
410-119054-3	1	T	10:54	X																								
410-119054-4	1	T	10:54	X																								
410-119054-5	1	T	10:54	X																								
410-119054-6	1	T	10:54	X																								
410-119054-7	1	T	10:54	X																								
410-119054-8	1	T	10:54	X																								
ZZZZZZ			10:54																									
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Prep Types:
T = Total/NA

FORM XIII-IN

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: Eurofins Lancaster Laboratorie Job No.: 410-119054-1

SDG No.:

Batch Number: 356521 Batch Start Date: 03/22/23 13:14 Batch Analyst: Cornelius, Ashlynn M

Batch Method: Lloyd Kahn Batch End Date:

Lab Sample ID	Client Sample ID	Method Chain	Basis	InitialAmount	FinalAmount	WC_TOC_30%SUC 00006	WC_TOC_SLCSCC 00007		
CCV 410-356521/1		Lloyd Kahn		111.3 mg			# mg		
CCB 410-356521/2		Lloyd Kahn		1000 mg					
LCS 410-356521/3		Lloyd Kahn		109.4 mg			# mg		
MB 410-356521/4		Lloyd Kahn		1000 mg					
410-119054-A-3	JACKSON-SDMC3-DC -01	Lloyd Kahn	T	312.1 mg					
410-119054-A-3 MS	JACKSON-SDMC3-DC -01	Lloyd Kahn	T	133.9 mg	133.9 mg	10 uL			
410-119054-A-3 MSD	JACKSON-SDMC3-DC -01	Lloyd Kahn	T	129.4 mg	129.4 mg	10 uL			
CCV 410-356521/13		Lloyd Kahn		102.6 mg			# mg		
CCB 410-356521/14		Lloyd Kahn		1000 mg					
410-119054-A-1	JACKSON-SDCC3-DC -01	Lloyd Kahn	T	326.7 mg					
410-119054-A-4	JACKSON-SDMC1-DC -01	Lloyd Kahn	T	210.8 mg					
410-119054-A-5	JACKSON-SDCC4-DC -01	Lloyd Kahn	T	273.7 mg					
410-119054-A-6	JACKSON-SDJC1-DC -01	Lloyd Kahn	T	264.4 mg					
410-119054-A-7	JACKSON-SDMC2-DC -01	Lloyd Kahn	T	352.5 mg					
410-119054-A-8	SDDUP	Lloyd Kahn	T	279.6 mg					
CCV 410-356521/25		Lloyd Kahn		101.2 mg			# mg		
CCB 410-356521/26		Lloyd Kahn		1000 mg					
LCS 410-356521/31		Lloyd Kahn		106.9 mg			# mg		
MB 410-356521/32		Lloyd Kahn		1000 mg					
CCV 410-356521/37		Lloyd Kahn		102.6 mg			# mg		
CCB 410-356521/38		Lloyd Kahn		1000 mg					
410-119054-A-2	JACKSON-SDCC2-DC -01	Lloyd Kahn	T	68.2 mg					

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: Eurofins Lancaster Laboratorie Job No.: 410-119054-1

SDG No.:

Batch Number: 356521 Batch Start Date: 03/22/23 13:14 Batch Analyst: Cornelius, Ashlynn M

Batch Method: Lloyd Kahn Batch End Date:

Lab Sample ID	Client Sample ID	Method Chain	Basis	InitialAmount	FinalAmount	WC_TOC_30%SUC 00006	WC_TOC_SLCSCC 00007		
CCV 410-356521/41		Lloyd Kahn		103.2 mg			# mg		
CCB 410-356521/42		Lloyd Kahn		1000 mg					

Batch Notes	
Acid ID	WC_TOC_1:1PA_00007
Pipette/Syringe/Dispenser ID	TOC

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: Eurofins Lancaster Laboratorie Job No.: 410-119054-1

SDG No.:

Batch Number: 354727 Batch Start Date: 03/17/23 10:54 Batch Analyst: Norton, Vincent J

Batch Method: Moisture Batch End Date:

Lab Sample ID	Client Sample ID	Method Chain	Basis	DISH#	DishWeight	SampleMassWet	SampleMassDry	%_Moisture	%_Solid
410-119054-A-1	JACKSON-SDCC3-DC-01	Moisture	T	727-01	0.81 g	6.82 g	5.58 g	20.6322795341098 %	79.3677204658902 %
410-119054-A-2	JACKSON-SDCC2-DC-01	Moisture	T	727-02	0.81 g	5.85 g	1.90 g	78.3730158730159 %	21.6269841269841 %
410-119054-A-3	JACKSON-SDMC3-DC-01	Moisture	T	727-03	0.81 g	7.50 g	4.60 g	43.3482810164425 %	56.6517189835575 %
410-119054-A-4	JACKSON-SDMC1-DC-01	Moisture	T	727-04	0.81 g	7.53 g	4.03 g	52.0833333333333 %	47.9166666666667 %
410-119054-A-5	JACKSON-SDCC4-DC-01	Moisture	T	727-05	0.80 g	6.44 g	5.41 g	18.2624113475177 %	81.7375886524823 %
410-119054-A-6	JACKSON-SDJC1-DC-01	Moisture	T	727-06	0.79 g	6.39 g	4.93 g	26.0714285714286 %	73.9285714285714 %
410-119054-A-7	JACKSON-SDMC2-DC-01	Moisture	T	727-07	0.81 g	6.22 g	5.34 g	16.2661737523105 %	83.7338262476895 %
410-119054-A-8	SDDUP	Moisture	T	727-08	0.81 g	6.15 g	4.46 g	31.6479400749064 %	68.3520599250936 %

Lab Sample ID	Client Sample ID	Method Chain	Basis	AnalysisComment					
410-119054-A-1	JACKSON-SDCC3-DC-01	Moisture	T	moist sand					
410-119054-A-2	JACKSON-SDCC2-DC-01	Moisture	T	WET soil roots					
410-119054-A-3	JACKSON-SDMC3-DC-01	Moisture	T	WET soil roots stones leaves					
410-119054-A-4	JACKSON-SDMC1-DC-01	Moisture	T	WET soil roots stones					
410-119054-A-5	JACKSON-SDCC4-DC-01	Moisture	T	moist sand					
410-119054-A-6	JACKSON-SDJC1-DC-01	Moisture	T	WET sand stones					
410-119054-A-7	JACKSON-SDMC2-DC-01	Moisture	T	moist sand					
410-119054-A-8	SDDUP	Moisture	T	WET gritty soil stones roots					

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: Eurofins Lancaster Laboratorie Job No.: 410-119054-1

SDG No.:

Batch Number: 354727 Batch Start Date: 03/17/23 10:54 Batch Analyst: Norton, Vincent J

Batch Method: Moisture Batch End Date:

Batch Notes	
Balance ID	22870
Oven ID	7493
Thermometer ID	1101
Date samples were placed in the oven	03/17/2023
Time samples were place in the oven	11:36
Oven Temp In	105 Degrees C
Date samples were removed from oven	03/17/2023
Time Samples were removed from oven	22:00
Batch Comment	cal 4-29-23

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

Manage Calibrations

eng (US)

Details

Name: Calibration [3/7/2023 11:58 AM]

Created: 3/7/2023 11:58 AM

Methods

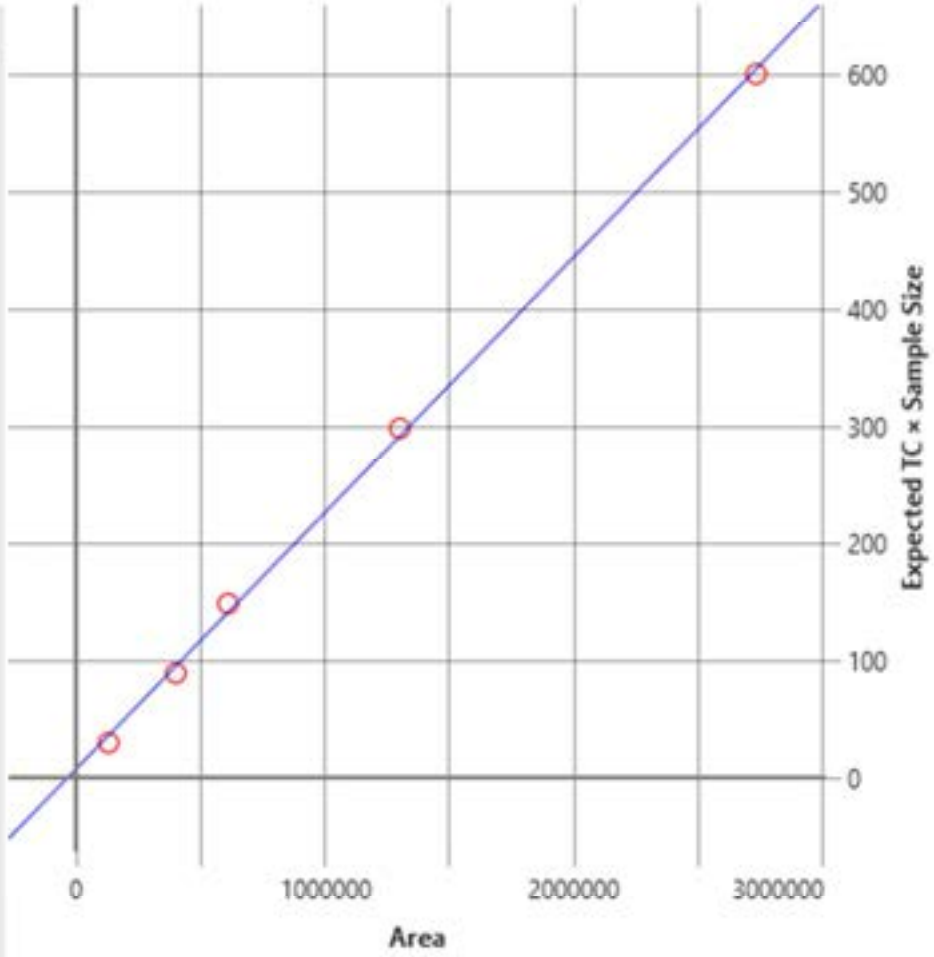
TC | TNb

Calibration | Standards

Polynomial Order: 1

Force Through Zero: ☐

y = 0.00021818004x + 8.78157766 (R^2 = 0.9988)



Save | Cancel

Manage Calibrations

eng (US)

Details

Name: Calibration [3/7/2023 11:58 AM]

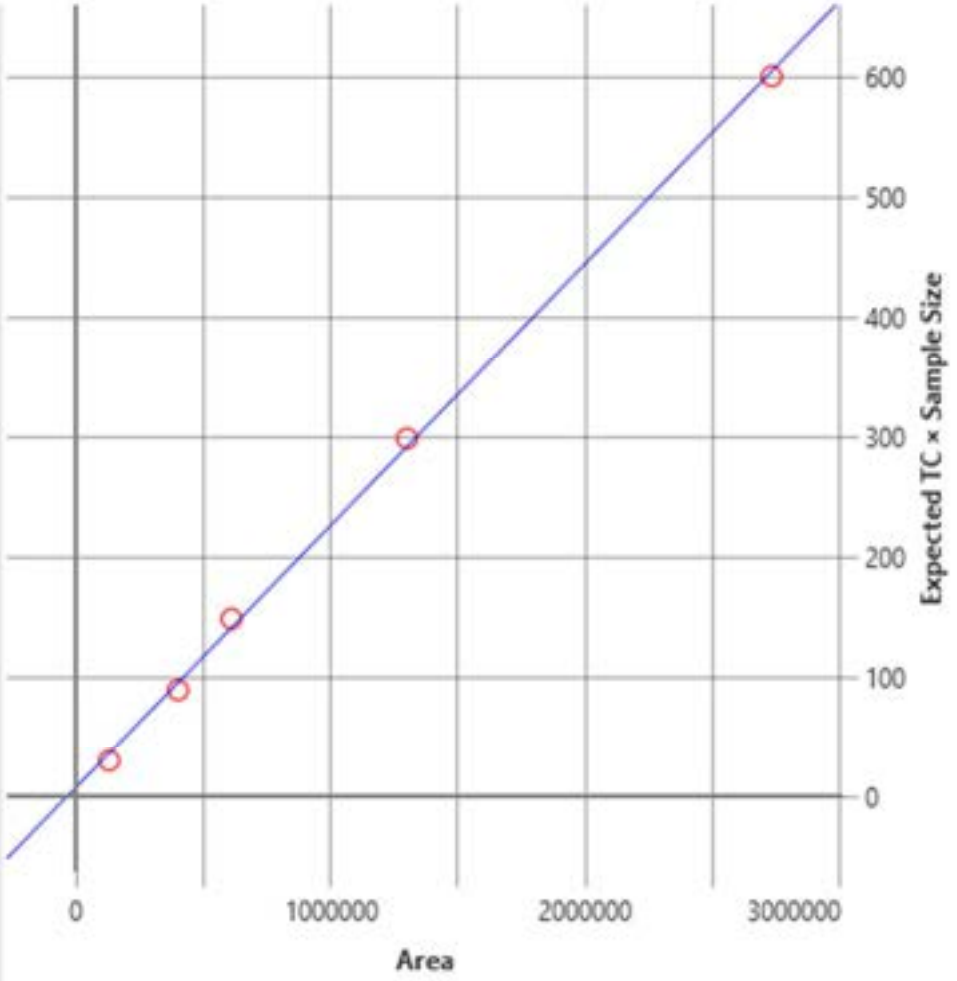
Created: 3/7/2023 11:58 AM

Methods

TC | TNb

Calibration | Standards

Id	Name	Area	Is Included	Size
1320	SOIL	129144	✓	20.8
1321	SOIL	396283	✓	62.5
1322	SOIL	605937	✓	104.2
1323	SOIL	1298676	✓	208.3
1324	SOIL	2731258	✓	416.7



Save | Cancel

Date:	3/23/2023	**Balance ID:**	12591	**Oven ID:**	974
Analyst:	AMC26520	**Sucrose:**	2053856	**Oven Temperature (°C):**	75
Run:		**CCV/LCS:**	2332813	**Time In:**	
		H3PO4:	3144436	**Time Out:**	

Tray #	Tray Position	Sample #	Sample Weight (mg)	Factor	LOQ	MDL	Comments
1	*A1*	CCV	111.3	8.98	2695	898	
	A2	CCB	1000.0	1.00	300	100	
	A3	LCS	109.4	9.14	2742	914	
	A4	MB	1000.0	1.00	300	100	
	A5	410-119054-A-3	312.1	3.20	961	320	
	A6	410-119054-A-3 MS	133.9	7.47	2240	747	
	A7	410-119054-A-3 MSD	129.4	7.73	2318	773	
	A8	410-118376-A-3	50.5	19.80	5941	1980	
	B1	410-117998-B-5	27.2	36.76	11029	3676	
	B2	680-232117-A-1	234.4	4.27	1280	427	
	B3	680-232117-A-2	244.3	4.09	1228	409	
	B4	680-232119-A-1	250.1	4.00	1200	400	
	B5	CCV	102.6	9.75	2924	975	
	B6	CCB	1000.0	1.00	300	100	
	B7	680-232119-A-2	240.1	4.16	1249	416	
	B8	410-119054-A-1	326.7	3.06	918	306	
	C1	410-119054-A-2	213.0	4.69	1408	469	
	C2	410-119054-A-4	210.8	4.74	1423	474	
	C3	410-119054-A-5	273.7	3.65	1096	365	
	C4	410-119054-A-6	264.4	3.78	1135	378	
	C5	410-119054-A-7	352.5	2.84	851	284	
	C6	410-119054-A-8	279.6	3.58	1073	358	
	C7	410-117801-A-1	186.7	5.36	1607	536	
	C8	410-117801-A-2	149.9	6.67	2001	667	

Date:	3/23/2023	**Balance ID:**	12591	**Oven ID:**	974
Analyst:	AMC26520	**Sucrose:**	2053856	**Oven Temperature (°C):**	75
Run:		**CCV/LCS:**	2332813	**Time In:**	
		H3PO4:	3144436	**Time Out:**	

Tray #	Tray Position	Sample #	Sample Weight (mg)	Factor	LOQ	MDL	Comments
2	*A1*	CCV	101.2	9.88	2964	988	
	A2	CCB	1000.0	1.00	300	100	
	A3	410-117801-A-3	147.2	6.79	2038	679	
	A4	410-117801-A-4	170.3	5.87	1762	587	
	A5	410-117801-A-5	291.4	3.43	1030	343	
	A6	410-119282-A-2	77.3	12.94	3881	1294	
	A7	LCS	106.9	9.35	2806	935	
	A8	MB	1000.0	1.00	300	100	
	B1	410-119052-A-1	280.5	3.57	1070	357	
	B2	410-119052-A-1 MS	105.6	9.47	2841	947	
	B3	410-119052-A-1 MSD	117.6	8.50	2551	850	
	B4	410-119052-A-2	132.5	7.55	2264	755	
	B5	CCV	102.6	9.75	2924	975	
	B6	CCB	1000.0	1.00	300	100	
	B7	410-117814-A-1	337.1	2.97	890	297	
	B8	410-119054-A-2	68.2	14.66	4399	1466	
	C1	CCV	103.2	9.69	2907	969	
	C2	CCB	1000.0	1.00	300	100	
	C3			#DIV/0!	#DIV/0!	#DIV/0!	
	C4			#DIV/0!	#DIV/0!	#DIV/0!	
	C5			#DIV/0!	#DIV/0!	#DIV/0!	
	C6			#DIV/0!	#DIV/0!	#DIV/0!	
	C7			#DIV/0!	#DIV/0!	#DIV/0!	
	C8			#DIV/0!	#DIV/0!	#DIV/0!	

General Chemistry Raw Data Report

Job ID: 410-119054-1

Batch: 354727 **Analyst Initials: UVJN**

Method: Moisture **Instrument: NONE**

Lab Sample ID: 410-119054-A-1 **Analysis Date: Mar 17, 2023 10:54**

Analyte	Detector	Dilution	Raw Result	Unit
Percent Moisture	None	1	20.6322795341098	%

Lab Sample ID: 410-119054-A-2 **Analysis Date: Mar 17, 2023 10:54**

Analyte	Detector	Dilution	Raw Result	Unit
Percent Moisture	None	1	78.3730158730159	%

Lab Sample ID: 410-119054-A-3 **Analysis Date: Mar 17, 2023 10:54**

Analyte	Detector	Dilution	Raw Result	Unit
Percent Moisture	None	1	43.3482810164425	%

Lab Sample ID: 410-119054-A-4 **Analysis Date: Mar 17, 2023 10:54**

Analyte	Detector	Dilution	Raw Result	Unit
Percent Moisture	None	1	52.0833333333333	%

Lab Sample ID: 410-119054-A-5 **Analysis Date: Mar 17, 2023 10:54**

Analyte	Detector	Dilution	Raw Result	Unit
Percent Moisture	None	1	18.2624113475177	%

Lab Sample ID: 410-119054-A-6 **Analysis Date: Mar 17, 2023 10:54**

Analyte	Detector	Dilution	Raw Result	Unit
Percent Moisture	None	1	26.0714285714286	%

Lab Sample ID: 410-119054-A-7 **Analysis Date: Mar 17, 2023 10:54**

Analyte	Detector	Dilution	Raw Result	Unit
Percent Moisture	None	1	16.2661737523105	%

Lab Sample ID: 410-119054-A-8 **Analysis Date: Mar 17, 2023 10:54**

Analyte	Detector	Dilution	Raw Result	Unit
Percent Moisture	None	1	31.6479400749064	%

Shipping and Receiving Documents

Eurofins Lancaster

Katahdin ANALYTICAL SERVICES

Sub-contract La

410-119054 Chain of Custody

Page: 1 of 1

Client:	Contact:	Email:	Phone #:
Katahdin Analytical Services	Heather Manz	hmanz@katahdinlab.com	(207) 874-2400
Address:	**City:**	**State:** / **Zip:**	**Project Name:**
600 Technology Way	Scarborough	Maine / 04074	Fort Jackson
KAS WO #:	**Quote #:**	**Purchase Order #:**	**TAT:** 2 week
SQ1188		SQ1188	**Verbal TAT:** N/A
RPT Level: 4	**Reporting Format:** DOD	**EDD:** EQuIS EQEDD	**Analysis:** IOC Lloyd Kahn

Sample ID:	Collect Date/Time:	Matrix:	No. of Containers	Pres.	MS/MSD Dup.	Analysis: Filtered? Y / N	~~Analysis:~~ Filtered? Y / N	~~Analysis:~~ Filtered? Y / N
JACKSON-SDCC3-DC-01	08-MAR-23 14:15	SL	1	UN PRES	NO	✓		
JACKSON-SDCC2-DC-01	08-MAR-23 10:00	SL	1	↓	↓	✓		
JACKSON-SDMC3-DC-01	08-MAR-23 14:00	SL	1		YES	✓		
JACKSON-SDMC1-DC-01	08-MAR-23 11:50	SL	1		NO	✓		
JACKSON-SDCC4-DC-01	08-MAR-23 09:40	SL	1			✓		
JACKSON-SDJC1-DC-01	08-MAR-23 13:30	SL	1			✓		
JACKSON-SDMC2-DC-01	08-MAR-23 11:30	SL	1			✓		
SDDUP	08-MAR-23 00:00	SL	1	↓	↓	✓		
[redacted]		SL						
[redacted]								

Relinquished By:	Date/Time:	Received By:	Date/Time:
	3/15/23 1000		3/16/23 0933

Comments:

same projects as 410-112772

4.0°C

Login Sample Receipt Checklist

Client: Katahdin Analytical Services

Job Number: 410-119054-1

Login Number: 119054
List Number: 1
Creator: McCaskey, Jonathan

List Source: Eurofins Lancaster Laboratories Environment Testing, LLC

Question	Answer	Comment
The cooler's custody seal is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable (</=6C, not frozen).	True	
Cooler Temperature is recorded.	True	
WV: Container Temperature is acceptable (</=6C, not frozen).	N/A	
WV: Container Temperature is recorded.	N/A	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the containers received and the COC.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses.	True	
Is the Field Sampler's name present on COC?	False	Received project as a subcontract.
Sample custody seals are intact.	N/A	
VOA sample vials do not have headspace >6mm in diameter (none, if from WV)?	N/A	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

ORA - MULTIPLE SITES FY18-22 - FORT JACKSON

SQ1201

Ms. Leslie Dimond
207-874-2400

KATAHDIN ANALYTICAL SERVICES
600 TECHNOLOGY WAY
SCARBOROUGH, ME 04074

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SAMPLE DATA PACKAGE

NARRATIVE
KATAHDIN ANALYTICAL SERVICES
EA ENGINEERING, SCIENCE, AND TECHNOLOGY
ORA – MUTIPLE SITES FY18-22- FORT JACKSON
SQ1201

Sample Receipt

The following samples were received on March 10 and 13, 2023 and were logged in under Katahdin Analytical Services work order number SQ1201 for a hardcopy due date of March 24, 2023.

KATAHDIN Sample No.	EA ENGINEERING Sample Identification
SQ1201-1	SWDUP
SQ1201-2	JACKSON-SWMC3-DC-01
SQ1201-3	JACKSON-SWMC2-DC-01
SQ1201-4	JACKSON-SWJC1-DC-01
SQ1201-5	JACKSON-SWMC1-DC-01
SQ1201-6	JACKSON-SWCC3-DC-01
SQ1201-7	JACKSON-SWCC4-DC-01
SQ1201-8	JACKSON-SWCC2-DC-01
SQ1201-9	JACKSON-EB-01
SQ1201-10	JACKSON-CB-01
SQ1201-11	SWDUP
SQ1201-12	JACKSON-SWMC3-DC-01
SQ1201-13	JACKSON-SWMC2-DC-01
SQ1201-14	JACKSON-SWJC1-DC-01
SQ1201-15	JACKSON-SWMC1-DC-01
SQ1201-16	JACKSON-SWCC3-DC-01
SQ1201-17	JACKSON-SWCC4-DC-01
SQ1201-18	JACKSON-SWCC2-DC-01

The samples were logged in for the analyses specified on the chain of custody form. All problems encountered and resolved during sample receipt have been documented on the applicable chain of custody forms.

We certify that the test results provided in this report meet all the requirements of the NELAP standards unless otherwise noted in this narrative or in the Report of Analysis.

We certify that the test results provided in this report are accredited under the laboratory's ISO/IEC 17025:2017 and DoD-ELAP accreditation issued by the ANSI-ASQ National Accreditation Board. Refer to certificate and scope of accreditation L2223.

Analytes which are reported but not listed on our ANAB scope of accreditation will be "^" flagged and the following language will be included in the case narrative for all DoD compliant work: "^"

Indicates this analyte is not included on Katahdin Analytical Services DoD-ELAP Scope of Accreditation.

Sample analyses have been performed by the methods as noted herein.

Should you have any questions or comments concerning this Report of Analysis, please do not hesitate to contact your Katahdin Analytical Services Project Manager, **Heather Manz**. This narrative is an integral part of the Report of Analysis.

Organics Analysis

The samples of SQ1201 were analyzed in accordance with Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), V (2015) and VI (2019), and/or for the specific methods listed below or on the Report of Analysis.

Sample SQ1201-2 was used for the Matrix Spike (MS) and Matrix Spike Duplicate (MSD), as requested by the client.

8330B Analysis

Sample SQ1201-4 had a low recovery for the extraction surrogate 1,2-dinitrobenzene which was outside the DoD QSM acceptance limits. Based on the laboratory reporting difficulties during the extraction process, the deviation is likely attributable to a matrix effect. Therefore, no further action was taken.

All samples were initially analyzed on the primary Phenomenex column. If a sample has a peak that is within the retention time window of a target analyte and the concentration is above the PQL, the sample is reanalyzed for confirmation on the confirmation Acclaim E2 column. An analyte is considered confirmed if the mentioned criteria are achieved with both columns. The results from the primary column are reported.

The reported percent recovery acceptance limits for the Laboratory Control Samples (LCSs) are based on the DoD QSM acceptance limits for the full list of spiked compounds. The recoveries of the spiked analytes in the LCS, Matrix Spike (MS) and Matrix Spike Duplicate (MSD) are compared to these acceptance limits. Katahdin standard operating procedure is to take corrective action only if the number of spiked analytes in the LCS that are outside of the QC limits is greater than the DoD QSM allowable number of exceedances, which is one. If the associated MS/MSD has greater than the allowable number of exceedances, no corrective action is taken, as long as the LCS is acceptable.

There were no other protocol deviations or observations noted by the organics laboratory staff.

Metals Analysis

The samples of Katahdin Work Order SQ1201 were prepared and analyzed for metals in accordance with Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA

publication SW-846, Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), V (2015), and VI (2019). Office of Solid Waste and Emergency Response, U.S. EPA.

Inductively-Coupled Plasma Atomic Emission Spectroscopic Analysis (ICP)

Aqueous-matrix Katahdin Sample Numbers SQ1201-(1-8) were digested for ICP analysis on 03/16/2023 (QC Batch QC16ICW1) in accordance with USEPA Method 3010A. Per client request, Katahdin Sample Number SQ1201-2 was prepared with duplicate matrix-spiked aliquots.

ICP analyses of Katahdin Work Order SQ1201 sample digestates were performed using a Thermo iCAP 6500 ICP spectrometer in accordance with USEPA Method 6010C. All samples were analyzed within holding times and all analytical run QC criteria were met with the following exception:

The ICSA standard analyzed on ICP run IQC20A was outside project acceptance criteria for potassium. Accepted results were either less than ½ LOQ or greater than 10x the failing value of the standard.

Inductively-Coupled Plasma Mass Spectrometric Analysis (ICP-MS)

Aqueous-matrix Katahdin Sample Numbers SQ1201-(9-18) were digested for ICP-MS analysis on 03/21/2023 (QC Batch QC21IMW2) in accordance with USEPA Method 3010A. Per client request, Katahdin Sample Number SQ1201-12 was prepared with duplicate matrix-spiked aliquots.

ICP-MS analyses of Katahdin Work Order SQ1201 sample digestates were performed using an Agilent 7800 ICP-MS spectrometer in accordance with USEPA Method 6020A. Results for all standards and samples are reported using the mean of 3 replicate measurements. All sample digestates were diluted by a factor of 5 during analysis to reduce mass interferences from chlorine, which is present in the digestates from the hydrochloric acid used in digesting the samples. All samples were analyzed within holding times and all analytical run QC criteria were met with the following exceptions:

The CCB standard analyzed at 18:30 on ICP-MS run LQC24A was outside the project acceptance criteria for calcium and magnesium. All accepted results were greater than 10 times the failing value or less than ½ LOQ, except the magnesium result for the serial dilution aliquot of Katahdin Sample Number SQ1201-12.

The CCV standard analyzed at 23:46 on ICP-MS run LQC30A was outside the project acceptance criteria for magnesium. Katahdin sample number SQ1201-10 was accepted without corrective action, as the result was less than ½ LOQ. Katahdin sample number SQ1201-9 was accepted without corrective action per client request.

Internal standard recoveries for ICP-MS analyses can be found in the raw data section of the accompanying data package. The following table indicates which analytes are associated with each internal standard element.

Internal Standard Element	Associated Analytes
Lithium	Beryllium, Boron
Scandium	Sodium, Magnesium, Aluminum, Potassium, Calcium
Germanium or Yttrium	Vanadium, Chromium, Manganese, Iron, Cobalt, Nickel, Copper, Zinc, Arsenic, Selenium, Silver, Cadmium, Strontium, Molybdenum
Terbium	Antimony, Barium, Tin, Tungsten
Bismuth	Lead, Thallium, Thorium, Uranium

Instrument tuning information can also be found in the raw data section in the reports labeled "USEPA Method Tune Report". For Method 6020A, the relative standard deviation was determined from 5 replicate measurements and the peak width was measured at 10% of the peak height.

Matrix QC Summary

All matrix QC results are within project acceptance limits.

Reporting of Metals Results

Per client request, analytical results for client samples on Form I and preparation blanks on Form IIIP have been reported using the laboratory's limits of detection (LOD). All results were evaluated down to the laboratory's method detection limits (MDLs). Results that fall between the MDL and the LOQ are flagged with "J" in the C-qualifier column, and the measured concentration appears in the concentration column. Results that are less than the MDL are flagged with "U" in the C-qualifier column, and the LOD is listed in the concentration column. These LOQs, MDLs and LODs have been adjusted for each sample based on the sample amounts used in preparation and analysis.

Analytical results on Forms VA, VD, VII, and IX for client samples, matrix QC samples (duplicates and matrix spikes), and laboratory control samples have been reported down to the laboratory's method detection limits (MDLs). Analytical results that are below the MDLs are flagged with "U" in the C-qualifier column, and the adjusted LOD is listed in the concentration column.

Analytical results for instrument run QC samples (ICVs, ICBs, etc.) have been reported down to the laboratory's instrument detection limits (IDLs).

IDLs, LODs, MDLs, and LOQs are listed on Form 10 of the accompanying data package.

Wet Chemistry Analysis

The samples of Katahdin Work Order SQ1201 were analyzed in accordance with the specific methods listed on the Report of Analysis.

Analyses for sulfate and chloride were performed according to “Methods for the Determination of Inorganic Substances in Environmental Samples”, EPA 600/R-93/100, August 1993.

Analyses for alkalinity were performed according to "Standard Methods for the Examination of Water and Wastewater", 15th, 16th, 17th, 18th, 19th, and 20th editions, 1980, 1985, 1989, 1992, 1995, 1999. APHA-AWWA-WPCF.

All Wet Chemistry results were evaluated to Katahdin Analytical Services’ Method Detection Limits (MDL). Measured concentrations that fall between the MDL and Katahdin’s Limit of Quantitation (LOQ) are flagged “J”. Measured concentrations that are below the MDL are flagged “U” and reported as “U LOD”, where “LOD” is the numerical value of the Limit of Detection.

All quality control criteria were met. All analyses were performed within analytical holding time with the following exception:

The sub lab contacted us to let us know that they did not receive a bottle for the alkalinity analysis of SQ1201-8, so we analyzed the sample in house. By this time the sample was already out of hold. The alkalinity analysis for SQ1201-8 was performed on day 16 of the 14-day analytical holding time. The client was contacted.

Subcontracted Data

Analyses for Perchlorate by Method SW6850, DOC by method SW9060 and Alkalinity by method SM2320B were performed by subcontract laboratories. Please refer to the sections of the data package titled Subcontracted Data.

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Quality Assurance Officer, or their designee, as verified by the following signature.

04/11/2023

for
Leslie Dimond
Quality Assurance Officer

Katahdin Analytical Services, Inc.

Manual Integration Codes For GC/MS, GC, HPLC and/or IC

M1	Peak splitting.
M2	Well defined peaks on the shoulders of the other peaks.
M3	There is additional area due to a coeluting interferant.
M4	There are negative spikes in the baseline.
M5	There are rising or falling baselines.
M6	The software has failed to detect a peak or misidentified a peak.
M7	Excessive peak tailing.
M8	Analysis such as GRO, DRO and TPH require a baseline hold.
M9	Peak was not completely integrated as in GC/MS.
M10	Primary ion was correctly integrated, but secondary or tertiary ion needed manual integration as in GC/MS.
M11	For GC analysis, when a sample is diluted by 1:10 or more, the surrogate is set to undetected and then the area under the surrogate is manually integrated.
M12	Manual integration saved in method due to TurboChrom floating point error.

Katahdin Analytical Services, LLC. **Sample Receipt Condition Report**

Client: EA Engineering	KAS PM: HHM	Sampled By: Client
Project:	KIMS Entry By: MLV	Delivered By: FedEx
KAS Work Order#: SQ 1185 1201	KIMS Review By: HHM	Received By: GP
	Labeled By: GP	
SDG #:	Cooler: 1 of 2	Date/Time Rec.: 3/10/23 0940

Receipt Criteria	Y	N	EX*	NA	Comments and/or Resolution
1. Custody seals present / intact?	✓				
2. Chain of Custody present in cooler?	✓				
3. Chain of Custody signed by client?	✓				
4. Chain of Custody matches samples?	✓				
5. Temperature Blanks present? If not, take temperature of any sample w/ IR gun.	✓				Temp (°C): 5.2° Thermometer ID: IR-1
Samples received at <6 °C w/o freezing?	✓				Note: Not required for metals (except Hg soil) analysis.
Ice packs or ice present?	✓				The lack of ice or ice packs (i.e. no attempt to begin cooling process) or insufficient ice may not meet certain regulatory requirements and may invalidate certain data.
If yes, was there sufficient ice to meet temperature requirements?	✓				
If temp. out, has the cooling process begun (i.e. ice or packs present) and sample collection times <6hrs., but samples are not yet cool?				✓	Note: No cooling process required for metals (except Hg soil) analysis.
6. Volatiles:					
Aqueous: No bubble larger than a pea?				✓	
Soil/Sediment:					
Received in airtight container?				✓	
Received in methanol?				✓	
Methanol covering soil?				✓	
D.I. Water - Received within 48 hour HT?				✓	
7. Trip Blank present in cooler?				✓	
8. Proper sample containers and volume?	✓				
9. Samples within hold time upon receipt?	✓				
10. Aqueous samples properly preserved?					
Metals, COD, NH3, TKN, O/G, phenol, TPO4, N+N, TOC, DRO, TPH – pH <2				✓	
Sulfide - >9				✓	
Cyanide – pH >12				✓	
11. Bottleware Prepped on:					

* Log-In Notes to Exceptions: document any problems with samples or discrepancies or pH adjustments.

Katahdin Analytical Services, LLC. — Sample Receipt Condition Report

Client:	GA Engineering	KAS PM:	HHM	Sampled By:	Client
Project:		KIMS Entry By:	MLV	Delivered By:	FedEx
KAS Work Order#:	SQ HBS 1201	KIMS Review By:	HHM	Received By:	EP
		Labeled By:	EP		
SDG #:		Cooler: 2 of 2		Date/Time Rec.:	3/10/23 0940

Receipt Criteria	Y	N	EX*	NA	Comments and/or Resolution
1. Custody seals present / intact?	/				
2. Chain of Custody present in cooler?	/				
3. Chain of Custody signed by client?	/				
4. Chain of Custody matches samples?					
5. Temperature Blanks present? If not, take temperature of any sample w/ IR gun.	/				Temp (°C): 5.0 — Thermometer ID: IR-1
Samples received at <6 °C w/o freezing?	/				Note: Not required for metals (except Hg soil) analysis.
Ice packs or ice present?	/				The lack of ice or ice packs (i.e. no attempt to begin cooling process) or insufficient ice may not meet certain regulatory requirements and may invalidate certain data.
If yes, was there sufficient ice to meet temperature requirements?	/				
If temp. out, has the cooling process begun (i.e. ice or packs present) and sample collection times <6hrs., but samples are not yet cool?				/	Note: No cooling process required for metals (except Hg soil) analysis.
6. Volatiles:					
Aqueous: No bubble larger than a pea?				/	
Soil/Sediment:					
Received in airtight container?				/	
Received in methanol?				/	
Methanol covering soil?				/	
D.I. Water - Received within 48 hour HT?				/	
7. Trip Blank present in cooler?				/	
8. Proper sample containers and volume?	/				
9. Samples within hold time upon receipt?	/				
10. Aqueous samples properly preserved?					
Metals, COD, NH3, TKN, O/G, phenol, TPO4, N+N, TOC, DRO, TPH – pH <2				/	
Sulfide - >9				/	
Cyanide – pH >12				/	
11. Bottleware Prepped on:					

* Log-In Notes to Exceptions: document any problems with samples or discrepancies or pH adjustments.

Katahdin Analytical Services, LLC. — Sample Receipt Condition Report

Client: EA Engineering	KAS PM: HHM	Sampled By: Client
Project:	KIMS Entry By: MLV	Delivered By: Fedex
KAS Work Order#: SQ 1201	KIMS Review By: HHM	Received By: DB
	Labeled By: EF	
SDG #:	Cooler: X1 of X1	Date/Time Rec.: 3/13/23 0835

Receipt Criteria	Y	N	EX*	NA	Comments and/or Resolution
1. Custody seals present / intact?	/				
2. Chain of Custody present in cooler?		/			In other cooler
3. Chain of Custody signed by client?	/				
4. Chain of Custody matches samples?	/				
5. Temperature Blanks present? If not, take temperature of any sample w/ IR gun.	/				Temp (°C): 2.9 — Thermometer ID: IR-1
Samples received at <6 °C w/o freezing?	/				Note: Not required for metals (except Hg soil) analysis.
Ice packs or ice present?	/				The lack of ice or ice packs (i.e. no attempt to begin cooling process) or insufficient ice may not meet certain regulatory requirements and may invalidate certain data.
If yes, was there sufficient ice to meet temperature requirements?	/				
If temp. out, has the cooling process begun (i.e. ice or packs present) and sample collection times <6hrs., but samples are not yet cool?				/	Note: No cooling process required for metals (except Hg soil) analysis.
6. Volatiles: **Aqueous:** No bubble larger than a pea?				/	
Soil/Sediment: Received in airtight container?				/	
Received in methanol?				/	
Methanol covering soil?				/	
D.I. Water - Received within 48 hour HT?				/	
7. Trip Blank present in cooler?				/	
8. Proper sample containers and volume?	/				
9. Samples within hold time upon receipt?	/				
10. Aqueous samples properly preserved? Metals, COD, NH3, TKN, O/G, phenol, TPO4, N+N, TOC, DRO, TPH – pH <2				/	
Sulfide - >9				/	
Cyanide – pH >12				/	
11. Bottleware Prepped on:					

* Log-In Notes to Exceptions: document any problems with samples or discrepancies or pH adjustments.

Missing cooler form 3/10

Katahdin ANALYTICAL SERVICES
600 Technology Way
Scarborough, ME 04074
Tel: (207) 874-2400
Fax: (207) 775-4029

CHAIN of CUSTODY

PLEASE BEAR DOWN AND PRINT LEGIBLY IN PEN

Client: EA Engineering, Science, and Technology | Contact: Tara Lamond | Phone #: (410) 584-7000 | Fax #: ( )

Address: 225 Schilling Circle | City: Hunt Valley | State: MD | Zip Code: 21031

Purchase Order # | Proj. Name / No. | Katahdin Quote #

Bill (if different than above): 62686I6.005AF.0003 | Address

Sampler (Print / Sign) | Copies To:

LAB USE ONLY | WORK ORDER #: SQ 1485 | KATAHDIN PROJECT NUMBER: 1201

REMARKS:

SHIPPING INFO: ☐ FED EX ☐ UPS ☐ CLIENT

AIRBILL NO:

TEMP°C ____ ☐ TEMP BLANK ☐ INTACT ☐ NOT INTACT

*	Sample Description	Date / Time coll'd	Matrix	No. of Cntrs.	Explosives / L Amber Filt. Y N	Metals/Hardness 250 ml HDPE/HNO3 Filt. Y N	Perchlorate 250 ml HDPE Filt. Y N	DOC 40 ml Vials/H2SO4 Filt. Y N	Alkalinity, SO4, Cl 250 ml HDPE Filt. Y N	Ca, Mg, K, Na 250 ml HDPE/HNO3 Filt. Y N	Filt. Y N	Filt. Y N	Filt. Y N	Filt. Y N
	SWDUP	3/8/23/ —	SW	8	✓	✓	✓	✓	✓	✓				
	RM ~~SWDUP~~	3/8/23/	SW	1						✓				
	JACKSON-SWMC3-DC-01	3/8/23/1400	SW	8	✓	✓	✓	✓	✓	✓				
	JACKSON-SWMC3-DC-01MS	3/8/23/1400	SW	8	✓	✓	✓	✓	✓	✓				
	JACKSON-SWMC3-DC-01MSD	3/8/23/1400	SW	8	✓	✓	✓	✓	✓	✓				
	Jackson-SWMC2-DC-01	3/8/23/1130	SW	8	✓	✓	✓	✓	✓	✓				
	JACKSON-SWJC1-DC-01	3/8/23/1330	SW	8	✓	✓	✓	✓	✓	✓				
	JACKSON-SWMC1-DC-01	3/8/23/1150	SW	8	✓	✓	✓	✓	✓	✓				
	JACKSON-SWCC3-DC-01	3/8/23/1415	SW	8	✓	✓	✓	✓	✓	✓				
	JACKSON-SWCC4-DC-01	3/8/23/0940	SW	8	✓	✓	✓	✓	✓	✓				
	JACKSON-SWCC2-DC-01	3/8/23/1000	SW	6		✓	✓	✓	✓	✓				
	JACKSON-EB-01	3/8/23/1530	SW	4	✓	✓	✓							
	JACKSON-CB-01	3/8/23/1600	SW	4	✓	✓	✓							
		/												
		/												
		/												

COMMENTS

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)
Robin Mahoney	3/9/23 4:20 PM	3/10/23 0840			
Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)

THE TERMS AND CONDITIONS ON THE REVERSE SIDE HEREOF SHALL GOVERN SERVICES, EXCEPT WHEN A SIGNED CONTRACTUAL AGREEMENT EXISTS.

Mar. 22, 2023
05:13 PM

Login Number: SQ1201

Account: EAENGI002
EA Engineering, Science, and Technolog

Project: EAENG-ORAP-FY18-22

Primary Report Address:

Tara Lamond
EA Engineering, Science, and Technology
225 Schilling Circle

Hunt Valley, MD 21031

tlamond@eaest.com

Primary Invoice Address:

Accounts Payable
EA Engineering, Science, and Technology
225 Schilling Circle

Hunt Valley,MD 21031

midatlancitcap@eaest.com

Report CC Addresses:
Invoice CC Addresses:

Quote/Incoming: EAENG-ORAP-FY18-22

Login Information

ANALYSIS INSTRUCTIONS	:	FDS, DoD QSM 5.1. ND to LOD w/ "J" flags. Client needs final report on time. Anions = Cl, SO4. Do not supress Ca & Mg results when hardness is required.
CHECK NO.	:	
CLIENT PO#	:	17796; Proj #6268616
CLIENT PROJECT MANAGE	:	Katherine Wertz
CONTRACT	:	W91ZLK-13-D-0004
COOLER TEMPERATURE	:	5.2, 5.0, 2.9
DELIVERY SERVICES	:	FedEx
EDD FORMAT	:	KAS073QC-CSV
ISM INSTRUCTIONS	:	
LOGIN INITIALS	:	MLV
PM	:	HHM
PROJECT NAME	:	ORA - Multiple Sites FY18-22 - Fort Jackson
QC LEVEL	:	IV
REPORT INSTRUCTIONS	:	2 sample receipt dates March 10 & 13. SDS needs all forms. Email final PDF & EDD to Katherine (KWertz@eaest.com) and Tara (tlamond@eaest.com) no HC. Email invoice to midatlanticap@eaest.com.
SDG ID	:	
SDG STATUS	:	
VERBAL TAT	:	

6:20 pm, Mar 22, 2023

Run Reports: Logindetail

Login Number: SQ1201

Account: EAENGI002
EA Engineering, Science, and Technolog

Project: EAENG-ORAP-FY18-22

Quote/Incoming: EAENG-ORAP-FY18-22

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1201-1	SWDUP	08-MAR-23 00:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: 1 amber received 03132023.

Matrix		Product	Hold Date (shortest)		Notes	Bottle Type
Aqueous	S	ALKALINITY-SUB	22-MAR-23			
Aqueous	S	E300.0-ANIONS	07-APR-23	SHORT	Rec. on Holddate	250mL Plastic
Aqueous	S	SM5310-DOC-SUB	05-APR-23			40 mL Vial+H2SO4
Aqueous	S	SW3010-PREP	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-CALCIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-MAGNESIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-POTASSIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-SODIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6850PERC-SUB	05-APR-23			250mL Plastic
Aqueous	S	SW8330-S	15-MAR-23			1L N-Amber Glass

SQ1201-2	JACKSON-SWMC3-DC-01	08-MAR-23 14:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: MS/MSD

Matrix		Product	Hold Date (shortest)		Notes	Bottle Type
Aqueous	S	ALKALINITY-SUB	22-MAR-23			
Aqueous	S	E300.0-ANIONS	07-APR-23	SHORT	Rec. on Holddate	250mL Plastic
Aqueous	S	SM5310-DOC-SUB	05-APR-23			40 mL Vial+H2SO4
Aqueous	S	SW3010-PREP	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-CALCIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-MAGNESIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-POTASSIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-SODIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6850PERC-SUB	05-APR-23			250mL Plastic
Aqueous	S	SW8330-S	15-MAR-23			1L N-Amber Glass

SQ1201-3	JACKSON-SWMC2-DC-01	08-MAR-23 11:30	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)		Notes	Bottle Type
Aqueous	S	ALKALINITY-SUB	22-MAR-23			
Aqueous	S	E300.0-ANIONS	07-APR-23	SHORT	Rec. on Holddate	250mL Plastic
Aqueous	S	SM5310-DOC-SUB	05-APR-23			40 mL Vial+H2SO4
Aqueous	S	SW3010-PREP	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-CALCIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-MAGNESIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-POTASSIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-SODIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6850PERC-SUB	05-APR-23			250mL Plastic
Aqueous	S	SW8330-S	15-MAR-23			1L N-Amber Glass

6:20 pm, Mar 22, 2023

Run Reports: Logindetail

Login Number: SQ1201

Account: EAENGI002

EA Engineering, Science, and Technolog

Project: EAENG-ORAP-FY18-22

Quote/Incoming: EAENG-ORAP-FY18-22

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1201-4	JACKSON-SWJC1-DC-01	08-MAR-23 13:30	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)		Notes	Bottle Type
Aqueous	S	ALKALINITY-SUB	22-MAR-23			
Aqueous	S	E300.0-ANIONS	07-APR-23	SHORT	Rec. on Holddate	250mL Plastic
Aqueous	S	SM5310-DOC-SUB	05-APR-23			40 mL Vial+H2SO4
Aqueous	S	SW3010-PREP	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-CALCIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-MAGNESIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-POTASSIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-SODIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6850PERC-SUB	05-APR-23			250mL Plastic
Aqueous	S	SW8330-S	15-MAR-23			1L N-Amber Glass

SQ1201-5	JACKSON-SWMC1-DC-01	08-MAR-23 11:50	10-MAR-23		24-MAR-23	**24-MAR-23**	

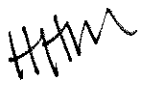
Sample Comments: 2 ambers received 03132023.

Matrix		Product	Hold Date (shortest)		Notes	Bottle Type
Aqueous	S	ALKALINITY-SUB	22-MAR-23			
Aqueous	S	E300.0-ANIONS	07-APR-23	SHORT	Rec. on Holddate	250mL Plastic
Aqueous	S	SM5310-DOC-SUB	05-APR-23			40 mL Vial+H2SO4
Aqueous	S	SW3010-PREP	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-CALCIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-MAGNESIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-POTASSIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-SODIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6850PERC-SUB	05-APR-23			250mL Plastic
Aqueous	S	SW8330-S	15-MAR-23			1L N-Amber Glass

SQ1201-6	JACKSON-SWCC3-DC-01	08-MAR-23 14:15	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: 2 ambers received 03132023.

Matrix		Product	Hold Date (shortest)		Notes	Bottle Type
Aqueous	S	ALKALINITY-SUB	22-MAR-23			125mL Plastic
Aqueous	S	E300.0-ANIONS	07-APR-23	SHORT	Rec. on Holddate	250mL Plastic
Aqueous	S	SM5310-DOC-SUB	05-APR-23			40 mL Vial+H2SO4
Aqueous	S	SW3010-PREP	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-CALCIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-MAGNESIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-POTASSIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-SODIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6850PERC-SUB	05-APR-23			250mL Plastic
Aqueous	S	SW8330-S	15-MAR-23			1L N-Amber Glass



6:20 pm, Mar 22, 2023

Run Reports: Logindetail

Login Number: SQ1201

Account: EAENGI002
EA Engineering, Science, and Technolog

Project: EAENG-ORAP-FY18-22

Quote/Incoming: EAENG-ORAP-FY18-22

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1201-7	JACKSON-SWCC4-DC-01	08-MAR-23 09:40	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: 2 ambers received 03132023.

Matrix		Product	Hold Date (shortest)		Notes	Bottle Type
Aqueous	S	ALKALINITY-SUB	22-MAR-23			125mL Plastic
Aqueous	S	E300.0-ANIONS	07-APR-23	SHORT	Rec. on Holddate	250mL Plastic
Aqueous	S	SM5310-DOC-SUB	05-APR-23			40 mL Vial+H2SO4
Aqueous	S	SW3010-PREP	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-CALCIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-MAGNESIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-POTASSIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-SODIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6850PERC-SUB	05-APR-23			250mL Plastic
Aqueous	S	SW8330-S	15-MAR-23			1L N-Amber Glass

SQ1201-8	JACKSON-SWCC2-DC-01	08-MAR-23 10:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)		Notes	Bottle Type
Aqueous	S	E300.0-ANIONS	07-APR-23	SHORT	Rec. on Holddate	250mL Plastic
Aqueous	S	SM2320B-ALKALINITY	22-MAR-23			250mL Plastic
Aqueous	S	SM5310-DOC-SUB	05-APR-23			40 mL Vial+H2SO4
Aqueous	S	SW3010-PREP	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-CALCIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-MAGNESIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-POTASSIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6010-SODIUM	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6850PERC-SUB	05-APR-23			250mL Plastic

SQ1201-9	JACKSON-EB-01	08-MAR-23 15:30	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: 2 ambers received 03132023.

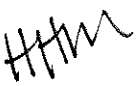
Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Aqueous	S	SM2340B-HARDCALC-DIS	04-SEP-23		125mL Plastic+HNO3
Aqueous	S	SW3010MS-PREP	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ANTIMONY-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-CALCIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-COPPER-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-LEAD-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-MAGNESIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ZINC-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6850PERC-SUB	05-APR-23		250mL Plastic
Aqueous	S	SW8330-S	15-MAR-23		1L N-Amber Glass

SQ1201-10	JACKSON-CB-01	08-MAR-23 16:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: 2 ambers received 03132023.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Aqueous	S	SM2340B-HARDCALC-DIS	04-SEP-23		125mL Plastic+HNO3
Aqueous	S	SW3010MS-PREP	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ANTIMONY-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-CALCIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-COPPER-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-LEAD-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-MAGNESIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ZINC-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6850PERC-SUB	05-APR-23		250mL Plastic
Aqueous	S	SW8330-S	15-MAR-23		1L N-Amber Glass

Run Reports: Logindetail



6:20 pm, Mar 22, 2023

Login Number: SQ1201

Account: EAENGI002

EA Engineering, Science, and Technolog

Project: EAENG-ORAP-FY18-22

Quote/Incoming: EAENG-ORAP-FY18-22

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1201-11	SWDUP	08-MAR-23 00:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Aqueous	S	SM2340B-HARDCALC-DIS	04-SEP-23		125mL Plastic+HNO3
Aqueous	S	SW3010MS-PREP	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ANTIMONY-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-CALCIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-COPPER-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-LEAD-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-MAGNESIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ZINC-DIS	04-SEP-23		250mL Plastic+HNO3

SQ1201-12	JACKSON-SWMC3-DC-01	08-MAR-23 14:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: MS/MSD

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Aqueous	S	SM2340B-HARDCALC-DIS	04-SEP-23		125mL Plastic+HNO3
Aqueous	S	SW3010MS-PREP	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ANTIMONY-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-CALCIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-COPPER-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-LEAD-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-MAGNESIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ZINC-DIS	04-SEP-23		250mL Plastic+HNO3

SQ1201-13	JACKSON-SWMC2-DC-01	08-MAR-23 11:30	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Aqueous	S	SM2340B-HARDCALC-DIS	04-SEP-23		125mL Plastic+HNO3
Aqueous	S	SW3010MS-PREP	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ANTIMONY-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-CALCIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-COPPER-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-LEAD-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-MAGNESIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ZINC-DIS	04-SEP-23		250mL Plastic+HNO3

SQ1201-14	JACKSON-SWJC1-DC-01	08-MAR-23 13:30	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Aqueous	S	SM2340B-HARDCALC-DIS	04-SEP-23		125mL Plastic+HNO3
Aqueous	S	SW3010MS-PREP	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ANTIMONY-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-CALCIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-COPPER-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-LEAD-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-MAGNESIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ZINC-DIS	04-SEP-23		250mL Plastic+HNO3

6:20 pm, Mar 22, 2023

Run Reports: Logindetail

Login Number: SQ1201

Account: EAENGI002

EA Engineering, Science, and Technolog

Project: EAENG-ORAP-FY18-22

Quote/Incoming: EAENG-ORAP-FY18-22

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1201-15	JACKSON-SWMC1-DC-01	08-MAR-23 11:50	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Aqueous	S	SM2340B-HARDCALC-DIS	04-SEP-23		125mL Plastic+HNO3
Aqueous	S	SW3010MS-PREP	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ANTIMONY-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-CALCIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-COPPER-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-LEAD-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-MAGNESIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ZINC-DIS	04-SEP-23		250mL Plastic+HNO3

SQ1201-16	JACKSON-SWCC3-DC-01	08-MAR-23 14:15	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Aqueous	S	SM2340B-HARDCALC-DIS	04-SEP-23		125mL Plastic+HNO3
Aqueous	S	SW3010MS-PREP	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ANTIMONY-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-CALCIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-COPPER-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-LEAD-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-MAGNESIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ZINC-DIS	04-SEP-23		250mL Plastic+HNO3

SQ1201-17	JACKSON-SWCC4-DC-01	08-MAR-23 09:40	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Aqueous	S	SM2340B-HARDCALC-DIS	04-SEP-23		125mL Plastic+HNO3
Aqueous	S	SW3010MS-PREP	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ANTIMONY-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-CALCIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-COPPER-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-LEAD-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-MAGNESIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ZINC-DIS	04-SEP-23		250mL Plastic+HNO3

SQ1201-18	JACKSON-SWCC2-DC-01	08-MAR-23 10:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments:

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Aqueous	S	SM2340B-HARDCALC-DIS	04-SEP-23		125mL Plastic+HNO3
Aqueous	S	SW3010MS-PREP	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ANTIMONY-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-CALCIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-COPPER-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-LEAD-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-MAGNESIUM-DIS	04-SEP-23		250mL Plastic+HNO3
Aqueous	S	SW6020-ZINC-DIS	04-SEP-23		250mL Plastic+HNO3

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Run Reports: Logindetail

Login Number: SQ1201

Account: EAENGI002

EA Engineering, Science, and Technolog

Project: EAENG-ORAP-FY18-22

Quote/Incoming: EAENG-ORAP-FY18-22

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Due Date	Verbal Due Date	Mailed
SQ1201-19	MS CHARGE JACKSON-SWMC3-DC-01	08-MAR-23 14:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Not a sample, MS charge for SQ1201-2.

Matrix		Product	Hold Date (shortest)		Notes	Bottle Type
Aqueous	S	E300.0-ANIONS	07-APR-23	SHORT	Rec. on Holddate	250mL Plastic
Aqueous	S	SM2320B-ALKALINITY	22-MAR-23			
Aqueous	S	SM5310-DOC-SUB	05-APR-23			40 mL Vial+H2SO4
Aqueous	S	SW3010-PREP	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6850PERC-SUB	05-APR-23			250mL Plastic
Aqueous	S	SW8330-S	15-MAR-23			1L N-Amber Glass

SQ1201-20	MSD CHARGE JACKSON-SWMC3-DC-01	08-MAR-23 14:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Not a sample, MSD charge for SQ1201-2.

Matrix		Product	Hold Date (shortest)		Notes	Bottle Type
Aqueous	S	E300.0-ANIONS	07-APR-23	SHORT	Rec. on Holddate	250mL Plastic
Aqueous	S	SM2320B-ALKALINITY	22-MAR-23			
Aqueous	S	SM5310-DOC-SUB	05-APR-23			40 mL Vial+H2SO4
Aqueous	S	SW3010-PREP	04-SEP-23			250mL Plastic+HNO3
Aqueous	S	SW6850PERC-SUB	05-APR-23			250mL Plastic
Aqueous	S	SW8330-S	15-MAR-23			1L N-Amber Glass

SQ1201-21	MS CHARGE JACKSON-SWMC3-DC-01	08-MAR-23 14:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Not a sample, MS charge for SQ1201-12.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Aqueous	S	SW3010MS-PREP	04-SEP-23		250mL Plastic+HNO3

SQ1201-22	MSD CHARGE JACKSON-SWMC3-DC-01	08-MAR-23 14:00	10-MAR-23		24-MAR-23	**24-MAR-23**	

Sample Comments: Not a sample, MSD charge for SQ1201-12.

Matrix		Product	Hold Date (shortest)	Notes	Bottle Type
Aqueous	S	SW3010MS-PREP	04-SEP-23		250mL Plastic+HNO3

Total Samples: 22 ***Total Analyses: 177***

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Run Reports: Logindetail

SAMPLE DATA SUMMARY PACKAGE

KATAHDIN ANALYTICAL SERVICES - ORGANIC DATA QUALIFIERS

U Indicates the compound was analyzed for but not detected above the specified level. This level may be the Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client.

Note: All results reported as "U" MDL have a 50% rate for false negatives compared to those results reported as "U" PQL, "U" LOQ or "U" LOD, where the rate of false negatives is <1%.

* Compound recovery or percent RPD (relative percent difference) was outside of quality control limits.

D Indicates the result was obtained from analysis of a diluted sample. Surrogate recoveries may not be calculable.

E Estimated value. This flag identifies compounds whose concentrations exceed the upper level of the calibration range of the instrument for that specific analysis.

J Estimated value. The analyte was detected in the sample at a concentration less than the laboratory Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), but above the Method Detection Limit (MDL).

And/or

J Used for Dual Column analytes when there is a greater than 40% difference for detected concentrations between the two GC/HPLC columns.

B Indicates the analyte was detected in the laboratory method blank analyzed concurrently with the sample.

I Indicates that the flagged compound did not meet DoD criteria in the corresponding Initial Calibration (ICAL).

D Indicates that the flagged compound did not meet DoD criteria in the corresponding Initial Calibration Verification (ICV).

C Indicates that the flagged compound did not meet DoD criteria in the corresponding opening Calibration Verification (CV).

V Indicates that the flagged compound did not meet DoD criteria in the corresponding closing Calibration Verification (CV).

L/LL Indicates that the flagged compound did not meet DoD criteria in the corresponding Laboratory Control Sample (LCS) and/or Laboratory Control Sample Duplicate (LCSD) prepared and/or analyzed concurrently with the sample.

M/MM Indicates that the flagged compound did not meet DoD criteria in the Matrix Spike (MS) and/or Matrix Spike Duplicate MSD) prepared and/or analyzed concurrently with the native sample.

H Indicates the flagged compound was detected on the primary column but was not detected on the confirmation column therefore the compound is not reported as a positive detection. (SW846 8330A/B only)

METALS SAMPLE FLAGGING

FLAG	SPECIFIED MEANING
E	The reported value is estimated because of the presence of interference (as indicated by serial dilution).
N	The pre-digestion spiked sample recovery is not within control limits.
*	The duplicate sample analysis relative percent difference (RPD) is not within control limits.
B	Indicates the analyte was detected in the laboratory method blank analyzed concurrently with the sample.
A	The post-digestion spiked sample recovery is not within control limits.
•	Analytical run QC sample (e.g. ICV, CCV, ICB, CCB, ICSA, ICSAB) not within control limits.
U	The analyte was not detected above the specified level. This level may be the Limit of Quantitation (LOQ) (previously called Practical Quantitation Level (PQL)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client. Note: All results reported as “U” MDL have a 50% rate for false negatives compared to those results reported as “U” PQL/LOQ or “U” LOD, where the rate of false negatives is <1%.
J	The analyte was detected in the sample at a concentration less than the laboratory Limit of Quantitation (LOQ) (previously called Practical Quantitation Limit (PQL)), but above the Method Detection Limit (MDL).
Q	One or more quality control criteria failed (e.g., LCS recovery, surrogate spike recovery or CCV).

KATAHDIN ANALYTICAL SERVICES – INORGANIC DATA QUALIFIERS

The sampled date indicated on the attached Report(s) of Analysis (ROA) is the date for which a grab sample was collected or the date for which a composite sample was completed. Beginning and start times for composite samples can be found on the Chain-of-Custody.

U Indicates the compound was analyzed for but not detected above the specified level. This level may be the Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client.

Note: All results reported as "U" MDL have a 50% rate for false negatives compared to those results reported as "U" PQL "U" LOQ or "U" LOD, where the rate of false negatives is <1%.

E Estimated value. This flag identifies compounds whose concentrations exceed the upper level of the calibration range of the instrument for that specific analysis.

J Estimated value. The analyte was detected in the sample at a concentration less than the laboratory Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), but above the Method Detection Limit (MDL).

I-7 The laboratory's Practical Quantitation Level (PQL) or LOQ could not be achieved for this parameter due to sample composition, matrix effects, sample volume, or quantity used for analysis.

A-4 Please refer to cover letter or narrative for further information.

H_ Please note that the regulatory holding time for _____ is "analyze immediately". Ideally, this analysis must be performed in the field at the time of sample collection. _____ for this sample was not performed at the time of sample collection. The analysis was performed as soon as possible after receipt by the laboratory.

H1 - pH H2 - DO H3 - sulfite H4 - residual chlorine

T1 The client did not provide the full volume of at least one liter for analysis of TSS. Therefore, the PQL of 2.5 mg/L could not be achieved.

T2 The client provided the required volume of at least one liter for analysis of TSS, but the laboratory could not filter the full one liter volume due to the sample matrix. Therefore, the PQL of 2.5 mg/L could not be achieved.

M1 The matrix spike and/or matrix spike duplicate recovery performed on this sample was outside of the laboratory acceptance criteria. Sample matrix is suspected. The laboratory criteria was met for the Laboratory Control Sample (LCS) analyzed concurrently with this sample.

M2 The matrix spike and/or matrix spike duplicate recovery was outside of the laboratory acceptance criteria. The native sample concentration is greater than four times the spike added concentration so the spike added could not be distinguished from the native sample concentration.

R1 The relative percent difference (RPD) between the duplicate analyses performed on this sample was outside of the laboratory acceptance criteria (when both values are greater than ten times the PQL).

MCL	Maximum Contaminant Level	NL	No limit
NFL	No Free Liquid Present	FLP	Free Liquid Present
NOD	No Odor Detected	TON	Threshold Odor Number

D-1 As required by Method 5210B, APHA Standard Methods for the Examination of Water and Wastewater (21st edition), the BOD value reported for this sample is 'qualified' because the check standard run concurrently with the sample analysis did not meet the criteria specified in the method (198 +/- 30.5 mg/L). These results may not be reportable for compliance purposes.

D-2 The measured final dissolved oxygen concentrations of all dilutions were less than the method-specified limit of 1 mg/L. The reported BOD result was calculated assuming a final oxygen concentration equal to 1 mg/L. The reported value should be considered a minimum value.

D-3 The dilution water used to prepare this sample did not meet the method and/or regulatory criteria of less than 0.2 or 0.4 mg/L dissolved oxygen (DO) uptake over the five day period of incubation. These results may not be reportable for compliance purposes.

Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-1
Client ID: SWDUP
Matrix: AQ
Lab File ID: HQC00093.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		103.	%					

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ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-2
Client ID: JACKSON-SWMC3-DC-01
Matrix: AQ
Lab File ID: HQC00094.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	ULMM	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		111.	%					

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Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-3
Client ID: JACKSON-SWMC2-DC-01
Matrix: AQ
Lab File ID: HQC00097.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		105.	%					

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ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-4
Client ID: JACKSON-SWJC1-DC-01
Matrix: AQ
Lab File ID: HQC00098.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene	*	52.2	%					

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Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-5
Client ID: JACKSON-SWMC1-DC-01
Matrix: AQ
Lab File ID: HQC00099.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	UH	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		104.	%					

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Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-6
Client ID: JACKSON-SWCC3-DC-01
Matrix: AQ
Lab File ID: HQC00100.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		102.	%					

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Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-7
Client ID: JACKSON-SWCC4-DC-01
Matrix: AQ
Lab File ID: HQC00101.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		106.	%					

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Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-9
Client ID: JACKSON-EB-01
Matrix: AQ
Lab File ID: HQC00102.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		104.	%					

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Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-10
Client ID: JACKSON-CB-01
Matrix: AQ
Lab File ID: HQC00104.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	UH	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		96.5	%					

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Report of Analytical Results

SDG: SQ1201
Lab ID: WG333823-1
Client ID: Method Blank
Matrix: AQ
Lab File ID: HQC00088.D

Sample Date: N/A
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	U	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		104.	%					

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Form 2
System Monitoring Compound Recovery

Lab Name: Katahdin Analytical Services **SDG:** SQ1201 **Matrix:** AQ

Client Sample ID	Lab Sample ID	Col. ID	DNB	#
SWDUP	SQ1201-1	P	103.	
JACKSON-SWMC3-DC-01	SQ1201-2	P	111.	
JACKSON-SWMC2-DC-01	SQ1201-3	P	105.	
JACKSON-SWJC1-DC-01	SQ1201-4	P	52.2	*
JACKSON-SWMC1-DC-01	SQ1201-5	P	104.	
JACKSON-SWCC3-DC-01	SQ1201-6	P	102.	
JACKSON-SWCC4-DC-01	SQ1201-7	P	106.	
JACKSON-EB-01	SQ1201-9	P	104.	
JACKSON-CB-01	SQ1201-10	P	96.5	
Method Blank	WG333823-1	P	104.	
Laboratory Control S	WG333823-2	P	103.	
Matrix Spike	WG333823-3	P	112.	
Matrix Spike Duplica	WG333823-4	P	104.	

Abbr.	Surrogate Compound	QC Limits
DNB	1,2-Dinitrobenzene	83-119

= Column to be used to flag recovery limits.
* = Values outside of contract required QC limits.
D= System Monitoring Compound diluted out.

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ANALYTICAL SERVICES

LCS Recovery Report

Lab ID: WG333823-2
Client ID: LCS
SDG: SQ1201
LCS File ID: HQC00090.D
Report Date: 31-MAR-23

Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
Matrix: AQ

Compound	Recovery (%)	Conc Added	Conc Recovered	Conc Units	Limits
HMX	106.	5.00	5.30	ug/L	65-135
RDX	105.	5.00	5.26	ug/L	68-130
1,3,5-Trinitrobenzene	103.	5.00	5.16	ug/L	73-125
1,3-Dinitrobenzene	102.	5.00	5.10	ug/L	78-120
Tetryl	* 144.	5.00	7.22	ug/L	64-128
Nitrobenzene	91.4	5.00	4.57	ug/L	65-134
2,4,6-Trinitrotoluene	114.	5.00	5.68	ug/L	71-123
4-Am-DNT	113.	5.00	5.66	ug/L	76-125
2-Am-DNT	102.	5.00	5.11	ug/L	79-120
2,6-Dinitrotoluene	104.	5.00	5.19	ug/L	77-127
2,4-Dinitrotoluene	94.6	5.00	4.73	ug/L	78-120
2-Nitrotoluene	108.	5.00	5.41	ug/L	70-127
4-Nitrotoluene	98.0	5.00	4.90	ug/L	71-127
3-Nitrotoluene	97.2	5.00	4.86	ug/L	73-125
Nitroglycerin	108.	20.0	21.7	ug/L	74-127
1,2-Dinitrobenzene	103.				83-119

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MS/MSD Recovery Report

MS ID: WG333823-3
MSD ID: WG333823-4
Sample ID: SQ1201-2
Client ID: JACKSON-SWMC3-DC-01
SDG: SQ1201
MS File ID: HQC00095.D

Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823
Report Date: 31-MAR-23
MSD File ID: HQC00096.D

Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
Matrix: AQ
% Solids: N/A
Sample File ID: HQC00094.D

Compound	MS Spike	MSD Spike	Conc Units	Samp Conc	MS Conc	MSD Conc	MS Rec (%)	MSD Rec (%)	RPD (%)	RPD Limit	Limits
HMX	5.00	5.00	ug/L	U0.12	5.4	5.1	107.	101.	6	20	65-135
RDX	5.00	5.00	ug/L	U0.12	5.3	4.9	106.	98.4	7	20	68-130
1,3,5-Trinitrobenzene	5.00	5.00	ug/L	U0.12	5.1	4.9	103.	97.6	5	20	73-125
1,3-Dinitrobenzene	5.00	5.00	ug/L	U0.12	5.2	4.8	104.	96.8	7	20	78-120
Tetryl	5.00	5.00	ug/L	ULMM0.12	7.0	6.7	140.*	134.*	4	20	64-128
Nitrobenzene	5.00	5.00	ug/L	U0.12	5.0	4.4	99.8	87.0	14	20	65-134
2,4,6-Trinitrotoluene	5.00	5.00	ug/L	U0.12	5.6	5.4	112.	108.	3	20	71-123
4-Am-DNT	5.00	5.00	ug/L	U0.12	5.8	5.3	116.	106.	9	20	76-125
2-Am-DNT	5.00	5.00	ug/L	U0.12	5.1	4.8	102.	96.0	6	20	79-120
2,6-Dinitrotoluene	5.00	5.00	ug/L	U0.12	5.2	5.0	105.	101.	4	20	77-127
2,4-Dinitrotoluene	5.00	5.00	ug/L	U0.12	4.8	4.5	95.6	90.8	5	20	78-120
2-Nitrotoluene	5.00	5.00	ug/L	U0.12	5.6	5.3	113.	106.	6	20	70-127
4-Nitrotoluene	5.00	5.00	ug/L	U0.12	5.1	4.8	102.	96.4	6	20	71-127
3-Nitrotoluene	5.00	5.00	ug/L	U0.12	5.1	4.8	101.	96.2	5	20	73-125
Nitroglycerin	20.0	20.0	ug/L	U2.0	22.	21.	110.	106.	4	20	74-127
1,2-Dinitrobenzene							112.	104.			83-119

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Method Blank Summary

Lab Name : Katahdin Analytical Services
SDG : SQ1201
Lab File ID : HQC00088.D
Lab Sample ID : WG333823-1
Instrument ID : HPLC02
Date Extracted : 14-MAR-23
Matrix : AQ
Date Analyzed : 17-MAR-23
Extraction method : SW846 8330B
Time Analyzed : 09:57

This Method Blank applies to the following samples and QC samples:

Client Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
Laboratory Control S	WG333823-2	HQC00090.D	03/17/23	11:06
SWDUP	SQ1201-1	HQC00093.D	03/17/23	12:50
JACKSON-SWMC3-DC-01	SQ1201-2	HQC00094.D	03/17/23	13:25
Matrix Spike	WG333823-3	HQC00095.D	03/17/23	14:00
Matrix Spike Duplica	WG333823-4	HQC00096.D	03/17/23	14:34
JACKSON-SWMC2-DC-01	SQ1201-3	HQC00097.D	03/17/23	15:09
JACKSON-SWJC1-DC-01	SQ1201-4	HQC00098.D	03/17/23	15:44
JACKSON-SWMC1-DC-01	SQ1201-5	HQC00099.D	03/17/23	16:18
JACKSON-SWCC3-DC-01	SQ1201-6	HQC00100.D	03/17/23	16:53
JACKSON-SWCC4-DC-01	SQ1201-7	HQC00101.D	03/17/23	17:28
JACKSON-EB-01	SQ1201-9	HQC00102.D	03/17/23	18:02
JACKSON-CB-01	SQ1201-10	HQC00104.D	03/17/23	19:12

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Method Blank Summary

Lab Name : Katahdin Analytical Services
Lab File ID : HQC00126.D
Instrument ID : HPLC02
Matrix : AQ
Extraction method : SW846 8330B

SDG : SQ1201
Lab Sample ID : WG333823-1C
Date Extracted : 14-MAR-23
Date Analyzed : 21-MAR-23
Time Analyzed : 20:06

This Method Blank applies to the following samples and QC samples:

Client Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
Laboratory Control S	WG333823-2C	HQC00130.D	03/21/23	23:27
JACKSON-SWMC1-DC-01	SQ1201-5C	HQC00131.D	03/22/23	00:17
JACKSON-CB-01	SQ1201-10C	HQC00132.D	03/22/23	01:08

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Form 6
Initial Calibration Summary

Lab Name : Katahdin Analytical Services
SDG: SQ1201
Instrument ID: HPLC02
Calibration Date(s): 15-MAR-23 09:32
15-MAR-23 13:00
Lab File IDs : HQC00038.I,HQC00039.I,HQC00040.I
HQC00041.I,HQC00042.I,HQC00043.I
HQC00044.I

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7		Curve				%RSD or R^2		
	0.0250000	0.0500000	0.1000000	0.2500000	0.5000000	1.0000	2.0000		Type	b	m1	m2	Result	Limit	
NITROGLYCERIN	6230	6420	6913	6952	7130	7000	7155		AVG		6828		5.26	20	O

Legend: O = Acceptable; W = Failed %RSD Value; X = Failed R^2 Value; Y = Failed Minimum RF

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Form 6
Initial Calibration Summary

Lab Name : Katahdin Analytical Services
SDG: SQ1201
Instrument ID: HPLC02
Calibration Date(s): 15-MAR-23 09:32
15-MAR-23 13:00
Lab File IDs : HQC00038.I,HQC00039.I,HQC00040.I
HQC00041.I,HQC00042.I,HQC00043.I
HQC00044.I

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7		Curve				%RSD or R^2		
	0.0250000	0.0500000	0.1000000	0.2500000	0.5000000	1.0000	2.0000		Type	b	m1	m2	Result	Limit	
HMX	7480	7760	7990	8004	8094	7940	8125		AVG		7913		2.842	15	O
RDX	8160	8240	8680	8624	8782	8611	8834		AVG		8562		3.044	15	O
1,3,5-trinitrobenzene	4800	4660	4600	5148	5210	5069	5161		AVG		4950		5.18	15	O
1,3-dinitrobenzene	10480	10720	11420	11344	11552	11296	11631		AVG		11210		3.883	15	O
nitrobenzene	15200	11500	10840	10600	10834	10558	10858		AVG		11480		14.52	15	O
TETRYL	2320	2300	2400	2276	2294	2324	+++++		AVG		2319		1.872	15	O
2,4,6-trinitrotoluene	2760	2920	3190	3164	3162	3128	3125		AVG		3064		5.269	15	O
4-AM-DNT	5760	5840	6140	6212	6326	6207	6372		AVG		6122		3.832	15	O
2-AM-DNT	8160	8200	8810	8800	8964	8778	9062		AVG		8682		4.122	15	O
2,6-dinitrotoluene	4200	3960	3990	4084	4104	4038	4042		AVG		4060		1.956	15	O
2,4-dinitrotoluene	6160	6220	9060	6664	6756	6626	6812		AVG		6900		14.29	15	O
2-nitrotoluene	3920	3800	3930	3932	4008	3912	4016		AVG		3931		1.82	15	O
4-nitrotoluene	3240	3440	3510	3552	3610	3522	3636		AVG		3501		3.779	15	O
3-nitrotoluene	4080	4320	4550	4572	4650	4535	4671		AVG		4483		4.707	15	O
1,2-dinitrobenzene	6280	7780	7390	6236	6330	6427	6304		AVG		6678		9.47	15	

Legend: O = Acceptable; W = Failed %RSD Value; X = Failed R^2 Value; Y = Failed Minimum RF

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Form 6
Initial Calibration Summary

Lab Name : Katahdin Analytical Services
SDG: SQ1201
Instrument ID: HPLC02
Calibration Date(s): 21-MAR-23 13:24
21-MAR-23 18:25
Lab File IDs : HQC00119.I,HQC00120.I,HQC00121.I
HQC00122.I,HQC00118.I,HQC00123.I
HQC00124.I

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7		Curve				%RSD or R^2		
	0.1000000	0.2000000	0.4000000	1.0000	2.0000	4.0000	8.0000		Type	b	m1	m2	Result	Limit	
NITROGLYCERIN	2130	1405	1518	1609	1621	1582	1604		AVG		1638		14.02	20	O

Legend: O = Acceptable; W = Failed %RSD Value; X = Failed R^2 Value; Y = Failed Minimum RF

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Form 6
Initial Calibration Summary

Lab Name : Katahdin Analytical Services
SDG: SQ1201
Instrument ID: HPLC02
Calibration Date(s): 21-MAR-23 13:24
21-MAR-23 18:25
Lab File IDs : HQC00119.I HQC00120.I HQC00121.I HQC00122.I HQC00118.I HQC00123.I HQC00124.I

	Level 1 0.0250000	Level 2 0.0500000	Level 3 0.1000000	Level 4 0.2500000	Level 5 0.5000000	Level 6 1.0000	Level 7 2.0000		Curve Type	b	m1	m2	%RSD or R^2 Result	Limit	
HMX	2360	2120	2310	2248	2274	2213	2249		AVG		2253		3.363	20	O
RDX	2080	2340	2420	2420	2380	2360	2383		AVG		2340		5.062	20	O
1,3,5-trinitrobenzene	4880	5520	5560	5820	5730	5682	5751		AVG		5563		5.74	20	O
1,3-dinitrobenzene	5920	5680	5940	6236	6250	6094	6175		AVG		6042		3.429	20	O
nitrobenzene	3680	3360	3300	3476	3512	3400	3448		AVG		3454		3.555	20	O
TETRYL	1800	1800	1670	1752	1760	1698	1733		AVG		1745		2.8	20	O
2,4,6-trinitrotoluene	2680	2640	2710	2928	2898	2819	2858		AVG		2790		4.064	20	O
4-AM-DNT	880	1040	970	1004	1022	992	1026		AVG		991		5.45	20	O
2-AM-DNT	1360	1180	1450	1448	1574	1486	1526		AVG		1432		9.068	20	O
2,6-dinitrotoluene	2000	1900	2010	1848	1864	1815	1831		AVG		1895		4.199	20	O
2,4-dinitrotoluene	3120	3220	3410	3464	3434	3385	3420		AVG		3350		3.844	20	O
2-nitrotoluene	1440	1320	1100	1168	1176	1143	1137		AVG		1212		10.09	20	O
4-nitrotoluene	1240	1160	1210	1180	1228	1176	1215		AVG		1201		2.465	20	O
3-nitrotoluene	920	1140	990	1000	1022	988	1025		AVG		1012		6.543	20	O
1,2-dinitrobenzene	2320	2400	2230	2344	2342	2257	2275		AVG		2310		2.55	20	

Legend: O = Acceptable; W = Failed %RSD Value; X = Failed R^2 Value; Y = Failed Minimum RF

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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG333979-1
Analytical Date: 03/17/23 09:08
Lab File ID: HQC00087.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 210 um

Compound	$\overline{\text{RRF}}$/Amount	RF0.500	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
NITROGLYCERIN	6828	7138	0.010	4.53329	20.00000	Averaged

*** = Compound out of QC criteria**

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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG333979-1
Analytical Date: 03/17/23 09:08
Lab File ID: HQC00087.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 254 um

Compound	$\overline{RRF}$/Amount	RF0.500	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
HMX	7913	8110	0.010	2.48587	20.00000	Averaged
RDX	8562	8842	0.010	3.27630	20.00000	Averaged
1,3,5-trinitrobenzene	4950	5218	0.010	5.42175	20.00000	Averaged
1,3-dinitrobenzene	11206	11452	0.010	2.19460	20.00000	Averaged
nitrobenzene	11484	10816	0.010	-5.81913	20.00000	Averaged
TETRYL	2319	2776	0.010	19.70677	20.00000	Averaged
2,4,6-trinitrotoluene	3064	3242	0.010	5.80693	20.00000	Averaged
4-AM-DNT	6122	6282	0.010	2.60634	20.00000	Averaged
2-AM-DNT	8682	8898	0.010	2.48791	20.00000	Averaged
2,6-dinitrotoluene	4060	4174	0.010	2.81693	20.00000	Averaged
2,4-dinitrotoluene	6900	6774	0.010	-1.82101	20.00000	Averaged
2-nitrotoluene	3931	4036	0.010	2.66921	20.00000	Averaged
4-nitrotoluene	3501	3578	0.010	2.18686	20.00000	Averaged
3-nitrotoluene	4483	4642	0.010	3.55828	20.00000	Averaged
1,2-dinitrobenzene	6678	6202	0.010	-7.12888	20.00000	Averaged

*** = Compound out of QC criteria**

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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG333979-2
Analytical Date: 03/17/23 18:37
Lab File ID: HQC00103.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 210 um

Compound	$\overline{\text{RRF}}$/Amount	RF0.250	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
NITROGLYCERIN	6828	6980	0.010	2.21944	20.00000	Averaged

*** = Compound out of QC criteria**

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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG333979-2
Analytical Date: 03/17/23 18:37
Lab File ID: HQC00103.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 254 um

Compound	$\overline{RRF}$/Amount	RF0.250	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
HMX	7913	7980	0.010	0.84307	20.00000	Averaged
RDX	8562	8652	0.010	1.05706	20.00000	Averaged
1,3,5-trinitrobenzene	4950	5180	0.010	4.65402	20.00000	Averaged
1,3-dinitrobenzene	11206	11388	0.010	1.62348	20.00000	Averaged
nitrobenzene	11484	10568	0.010	-7.97860	20.00000	Averaged
TETRYL	2319	2740	0.010	18.15438	20.00000	Averaged
2,4,6-trinitrotoluene	3064	3152	0.010	2.86966	20.00000	Averaged
4-AM-DNT	6122	6180	0.010	0.94034	20.00000	Averaged
2-AM-DNT	8682	8808	0.010	1.45128	20.00000	Averaged
2,6-dinitrotoluene	4060	4116	0.010	1.38823	20.00000	Averaged
2,4-dinitrotoluene	6900	6700	0.010	-2.89352	20.00000	Averaged
2-nitrotoluene	3931	3992	0.010	1.54992	20.00000	Averaged
4-nitrotoluene	3501	3536	0.010	0.98735	20.00000	Averaged
3-nitrotoluene	4483	4572	0.010	1.99665	20.00000	Averaged
1,2-dinitrobenzene	6678	6128	0.010	-8.23698	20.00000	Averaged

*** = Compound out of QC criteria**

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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG333979-3
Analytical Date: 03/18/23 00:59
Lab File ID: HQC00114.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 210 um

Compound	$\overline{\text{RRF}}$/Amount	RF0.500	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
NITROGLYCERIN	6828	7043	0.010	3.14206	20.00000	Averaged

*** = Compound out of QC criteria**

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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG333979-3
Analytical Date: 03/18/23 00:59
Lab File ID: HQC00114.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 254 um

Compound	$\overline{RRF}$/Amount	RF0.500	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
HMX	7913	7972	0.010	0.74197	20.00000	Averaged
RDX	8562	8716	0.010	1.80459	20.00000	Averaged
1,3,5-trinitrobenzene	4950	5168	0.010	4.41157	20.00000	Averaged
1,3-dinitrobenzene	11206	11324	0.010	1.05236	20.00000	Averaged
nitrobenzene	11484	10784	0.010	-6.09777	20.00000	Averaged
TETRYL	2319	2746	0.010	18.41311	20.00000	Averaged
2,4,6-trinitrotoluene	3064	3176	0.010	3.65294	20.00000	Averaged
4-AM-DNT	6122	6272	0.010	2.44301	20.00000	Averaged
2-AM-DNT	8682	8860	0.010	2.05022	20.00000	Averaged
2,6-dinitrotoluene	4060	4190	0.010	3.21105	20.00000	Averaged
2,4-dinitrotoluene	6900	6666	0.010	-3.38630	20.00000	Averaged
2-nitrotoluene	3931	3970	0.010	0.99028	20.00000	Averaged
4-nitrotoluene	3501	3560	0.010	1.67279	20.00000	Averaged
3-nitrotoluene	4483	4582	0.010	2.21974	20.00000	Averaged
1,2-dinitrobenzene	6678	6174	0.010	-7.54816	20.00000	Averaged

*** = Compound out of QC criteria**

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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG334216-9
Analytical Date: 03/22/23 08:40
Lab File ID: HQC00141.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/21/23 13:24 03/21/23 18:25
Wavelength: 210 um

Compound	$\overline{\text{RRF}}$/Amount	RF1	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
NITROGLYCERIN	1638	1580	0.010	-3.55352	20.00000	Averaged

*** = Compound out of QC criteria**

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Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG334216-9
Analytical Date: 03/22/23 08:40
Lab File ID: HQC00141.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/21/23 13:24 03/21/23 18:25
Wavelength: 254 um

Compound	$\overline{RRF}$/Amount	RF0.250	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
HMX	2253	2224	0.010	-1.30595	20.00000	Averaged
RDX	2340	2384	0.010	1.86479	20.00000	Averaged
1,3,5-trinitrobenzene	5563	5740	0.010	3.17644	20.00000	Averaged
1,3-dinitrobenzene	6042	6124	0.010	1.35597	20.00000	Averaged
nitrobenzene	3454	3276	0.010	-5.14364	20.00000	Averaged
TETRYL	1745	1740	0.010	-0.26612	20.00000	Averaged
2,4,6-trinitrotoluene	2790	2836	0.010	1.63313	20.00000	Averaged
4-AM-DNT	991	1016	0.010	2.57446	20.00000	Averaged
2-AM-DNT	1432	1520	0.010	6.14525	20.00000	Averaged
2,6-dinitrotoluene	1895	1860	0.010	-1.86546	20.00000	Averaged
2,4-dinitrotoluene	3350	3428	0.010	2.31745	20.00000	Averaged
2-nitrotoluene	1212	1104	0.010	-8.91089	20.00000	Averaged
4-nitrotoluene	1201	1168	0.010	-2.76506	20.00000	Averaged
3-nitrotoluene	1012	1008	0.010	-0.40229	20.00000	Averaged
1,2-dinitrobenzene	2310	2280	0.010	-1.28649	20.00000	Averaged

*** = Compound out of QC criteria**

Form 8
Analytical Sequence

Lab Name: Katahdin Analytical Services **SDG:** SQ1201
Instrument ID: HPLC02 **Wavelength:** 210 um

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed	DNB	
Initial Calibration	WG333590-1	03/15/23	09:32		
Initial Calibration	WG333590-2	03/15/23	10:06		
Initial Calibration	WG333590-3	03/15/23	10:41		
Initial Calibration	WG333590-4	03/15/23	11:16		
Initial Calibration	WG333590-5	03/15/23	11:50		
Initial Calibration	WG333590-6	03/15/23	12:25		
Initial Calibration	WG333590-7	03/15/23	13:00		
Independent Source	WG333590-8	03/15/23	13:35		
Continuing Calibrati	WG333979-1	03/17/23	09:08		
Method Blank	WG333823-1	03/17/23	09:57		
Laboratory Control S	WG333823-2	03/17/23	11:06		
SWDUP	SQ1201-1	03/17/23	12:50		
JACKSON-SWMC3-DC-01	SQ1201-2	03/17/23	13:25		
Matrix Spike	WG333823-3	03/17/23	14:00		
Matrix Spike Duplica	WG333823-4	03/17/23	14:34		
JACKSON-SWMC2-DC-01	SQ1201-3	03/17/23	15:09		
JACKSON-SWJC1-DC-01	SQ1201-4	03/17/23	15:44		
JACKSON-SWMC1-DC-01	SQ1201-5	03/17/23	16:18		
JACKSON-SWCC3-DC-01	SQ1201-6	03/17/23	16:53		
JACKSON-SWCC4-DC-01	SQ1201-7	03/17/23	17:28		
JACKSON-EB-01	SQ1201-9	03/17/23	18:02		
Continuing Calibrati	WG333979-2	03/17/23	18:37		
JACKSON-CB-01	SQ1201-10	03/17/23	19:12		
Continuing Calibrati	WG333979-3	03/18/23	00:59		

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Form 8
Analytical Sequence

Lab Name: Katahdin Analytical Services **SDG:** SQ1201
Instrument ID: HPLC02 **Wavelength:** 254 um

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed	DNB	
Initial Calibration	WG333590-1	03/15/23	09:32	8.791	
Initial Calibration	WG333590-2	03/15/23	10:06	8.786	
Initial Calibration	WG333590-3	03/15/23	10:41	8.82	
Initial Calibration	WG333590-4	03/15/23	11:16	8.771	
Initial Calibration	WG333590-5	03/15/23	11:50	8.758	
Initial Calibration	WG333590-6	03/15/23	12:25	8.738	
Initial Calibration	WG333590-7	03/15/23	13:00	8.722	
Independent Source	WG333590-8	03/15/23	13:35		
Continuing Calibrati	WG333979-1	03/17/23	09:08	8.828	
Method Blank	WG333823-1	03/17/23	09:57	8.835	
Laboratory Control S	WG333823-2	03/17/23	11:06	8.828	
SWDUP	SQ1201-1	03/17/23	12:50	8.76	
JACKSON-SWMC3-DC-01	SQ1201-2	03/17/23	13:25	8.773	
Matrix Spike	WG333823-3	03/17/23	14:00	8.765	
Matrix Spike Duplica	WG333823-4	03/17/23	14:34	8.779	
JACKSON-SWMC2-DC-01	SQ1201-3	03/17/23	15:09	8.8	
JACKSON-SWJC1-DC-01	SQ1201-4	03/17/23	15:44	8.82	
JACKSON-SWMC1-DC-01	SQ1201-5	03/17/23	16:18	8.803	
JACKSON-SWCC3-DC-01	SQ1201-6	03/17/23	16:53	8.884	
JACKSON-SWCC4-DC-01	SQ1201-7	03/17/23	17:28	8.832	
JACKSON-EB-01	SQ1201-9	03/17/23	18:02	8.874	
Continuing Calibrati	WG333979-2	03/17/23	18:37	8.787	
JACKSON-CB-01	SQ1201-10	03/17/23	19:12	8.835	
Continuing Calibrati	WG333979-3	03/18/23	00:59	8.816	

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Form 8
Analytical Sequence

Lab Name: Katahdin Analytical Services **SDG:** SQ1201
Instrument ID: HPLC02 **Wavelength:** 210 um

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed	DNB	
Initial Calibration	WG334216-5	03/21/23	13:24		
Initial Calibration	WG334216-1	03/21/23	14:14		
Initial Calibration	WG334216-2	03/21/23	15:04		
Initial Calibration	WG334216-3	03/21/23	15:55		
Initial Calibration	WG334216-4	03/21/23	16:45		
Initial Calibration	WG334216-6	03/21/23	17:35		
Initial Calibration	WG334216-7	03/21/23	18:25		
Independent Source	WG334216-8	03/21/23	19:16		
Method Blank	WG333823-1C	03/21/23	20:06		
Laboratory Control S	WG333823-2C	03/21/23	23:27		
JACKSON-SWMC1-DC-01	SQ1201-5C	03/22/23	00:17		
JACKSON-CB-01	SQ1201-10C	03/22/23	01:08		
Continuing Calibrati	WG334216-9	03/22/23	08:40		

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Form 8
Analytical Sequence

Lab Name: Katahdin Analytical Services **SDG:** SQ1201
Instrument ID: HPLC02 **Wavelength:** 254 um

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed	DNB	
Initial Calibration	WG334216-5	03/21/23	13:24	13.75	
Initial Calibration	WG334216-1	03/21/23	14:14	13.72	
Initial Calibration	WG334216-2	03/21/23	15:04	13.79	
Initial Calibration	WG334216-3	03/21/23	15:55	13.81	
Initial Calibration	WG334216-4	03/21/23	16:45	13.79	
Initial Calibration	WG334216-6	03/21/23	17:35	13.78	
Initial Calibration	WG334216-7	03/21/23	18:25	13.80	
Independent Source	WG334216-8	03/21/23	19:16		
Method Blank	WG333823-1C	03/21/23	20:06	13.80	
Laboratory Control S	WG333823-2C	03/21/23	23:27	13.77	
JACKSON-SWMC1-DC-01	SQ1201-5C	03/22/23	00:17	13.77	
JACKSON-CB-01	SQ1201-10C	03/22/23	01:08	13.77	
Continuing Calibrati	WG334216-9	03/22/23	08:40	13.77	

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INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** SWDUP

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-001

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-70-2	CALCIUM, TOTAL	1290			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	700			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	529	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	2980			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-002

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-70-2	CALCIUM, TOTAL	1280			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	693			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	457	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	2970			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC2-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-003

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-70-2	CALCIUM, TOTAL	1560			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	792			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	621	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	3150			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWJC1-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-004

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-70-2	CALCIUM, TOTAL	769			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	224			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	48	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	1550			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC1-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-005

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-70-2	CALCIUM, TOTAL	219			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	175			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	56	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	1590			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWCC3-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-006

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-70-2	CALCIUM, TOTAL	272			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	214			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	50	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	1290			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWCC4-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-007

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-70-2	CALCIUM, TOTAL	319			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	236			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	100	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	1290			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWCC2-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-008

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-70-2	CALCIUM, TOTAL	220			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	204			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	500	U		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	1780			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-EB-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-009

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-36-0	ANTIMONY, DISSOLVED	0.12	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	83	J		MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.20	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	260	J		MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.50	U		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	12	J		MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	5.7	J		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-CB-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-010

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, DISSOLVED	0.095	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	52	J		MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.43	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	170	J		MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.50	U		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	8.8	J		MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	8.0	U		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** SWDUP

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-011

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, DISSOLVED	0.27	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	1340			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.69	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	6390			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.50	U		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	737			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	8.0	U		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-012

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	LOQ	ADJUSTED MDL	LOD
7440-36-0	ANTIMONY, DISSOLVED	0.34	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	1320			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	1.8	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	6310			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	2.18			MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	731			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	7.0	J		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC2-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-013

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	LOQ	ADJUSTED MDL	LOD
7440-36-0	ANTIMONY, DISSOLVED	0.50	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	1650			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.49	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	7770			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	3.25			MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	886			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	8.0	U		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWJC1-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-014

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, DISSOLVED	0.16	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	299			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.35	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	1660			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.50	U		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	223			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	8.0	U		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC1-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-015

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, DISSOLVED	0.12	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	605			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	1.2	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	2320			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.50	U		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	198			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	4.2	J		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWCC3-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-016

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-36-0	ANTIMONY, DISSOLVED	0.14	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	304			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.66	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	1740			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.34	J		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	238			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	4.7	J		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWCC4-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-017

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-36-0	ANTIMONY, DISSOLVED	0.12	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	367			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.70	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	1970			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.26	J		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	256			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	7.0	J		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWCC2-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-018

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-36-0	ANTIMONY, DISSOLVED	0.15	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	313			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	1.4	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	1700			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.853	J		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	223			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	9.5	J		MS	5	10	3.9	8.0

Comments:

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: IQC17A Mar 17, 2023 16:17

Analyte	True	Found	%R (1)
ALUMINUM	10000.0	10360.00	103.6
CALCIUM	10000.0	10460.00	104.6
IRON	10000.0	10340.00	103.4
MAGNESIUM	10000.0	10530.00	105.3
SODIUM	10000.0	10230.00	102.3

SAMPLE: CCV

File: IQC17A Mar 17, 2023 16:38

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13080.00	104.6
CALCIUM	12500.0	12380.00	99.0
IRON	12500.0	12500.00	100.0
MAGNESIUM	12500.0	12740.00	101.9
SODIUM	12500.0	13130.00	105.0

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC17A Mar 17, 2023 16:56

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13110.00	104.9
CALCIUM	12500.0	12460.00	99.7
IRON	12500.0	12610.00	100.9
MAGNESIUM	12500.0	12960.00	103.7
SODIUM	12500.0	13290.00	106.3

SAMPLE: CCV

File: IQC17A Mar 17, 2023 17:46

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13030.00	104.2
CALCIUM	12500.0	12130.00	97.0
IRON	12500.0	12270.00	98.2
MAGNESIUM	12500.0	12780.00	102.2
SODIUM	12500.0	12970.00	103.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC17A Mar 17, 2023 18:38

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12920.00	103.4
CALCIUM	12500.0	11740.00	93.9
IRON	12500.0	11800.00	94.4
MAGNESIUM	12500.0	12350.00	98.8
SODIUM	12500.0	12860.00	102.9

SAMPLE: CCV

File: IQC17A Mar 17, 2023 19:29

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13200.00	105.6
CALCIUM	12500.0	11290.00	90.3
IRON	12500.0	11400.00	91.2
MAGNESIUM	12500.0	11820.00	94.6
SODIUM	12500.0	13230.00	105.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC17A Mar 17, 2023 20:21

Analyte	True	Found	%R (1)	
ALUMINUM	12500.0	13340.00	106.7	
CALCIUM	12500.0	10910.00	87.3	•
IRON	12500.0	11050.00	88.4	•
MAGNESIUM	12500.0	11500.00	92.0	
SODIUM	12500.0	13240.00	105.9	

SAMPLE: CCV

File: IQC17A Mar 17, 2023 21:13

Analyte	True	Found	%R (1)	
ALUMINUM	12500.0	13270.00	106.2	
CALCIUM	12500.0	10750.00	86.0	•
IRON	12500.0	10910.00	87.3	•
MAGNESIUM	12500.0	11560.00	92.5	
SODIUM	12500.0	12950.00	103.6	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC17A Mar 17, 2023 22:03

Analyte	True	Found	%R (1)	
ALUMINUM	12500.0	13350.00	106.8	
CALCIUM	12500.0	10800.00	86.4	•
IRON	12500.0	10870.00	87.0	•
MAGNESIUM	12500.0	11450.00	91.6	
SODIUM	12500.0	12910.00	103.3	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: IQC20A Mar 20, 2023 16:37

Analyte	True	Found	%R (1)
ALUMINUM	10000.0	10450.00	104.5
CALCIUM	10000.0	10540.00	105.4
IRON	10000.0	10460.00	104.6
MAGNESIUM	10000.0	10440.00	104.4
POTASSIUM	13600.0	13800.00	101.5

SAMPLE: CCV

File: IQC20A Mar 20, 2023 16:59

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12540.00	100.3
CALCIUM	12500.0	12560.00	100.5
IRON	12500.0	12570.00	100.6
MAGNESIUM	12500.0	12800.00	102.4
POTASSIUM	12500.0	12780.00	102.2

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC20A Mar 20, 2023 17:17

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12340.00	98.7
CALCIUM	12500.0	12330.00	98.6
IRON	12500.0	12380.00	99.0
MAGNESIUM	12500.0	12620.00	101.0
POTASSIUM	12500.0	12730.00	101.8

SAMPLE: CCV

File: IQC20A Mar 20, 2023 18:09

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12870.00	103.0
CALCIUM	12500.0	12940.00	103.5
IRON	12500.0	12900.00	103.2
MAGNESIUM	12500.0	12670.00	101.4
POTASSIUM	12500.0	12780.00	102.2

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC20A Mar 20, 2023 19:01

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12170.00	97.4
CALCIUM	12500.0	12140.00	97.1
IRON	12500.0	12250.00	98.0
MAGNESIUM	12500.0	12400.00	99.2
POTASSIUM	12500.0	12480.00	99.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: IQC21A Mar 21, 2023 16:35

Analyte	True	Found	%R (1)
ALUMINUM	10000.0	10400.00	104.0
CALCIUM	10000.0	10590.00	105.9
IRON	10000.0	10210.00	102.1
MAGNESIUM	10000.0	10440.00	104.4
POTASSIUM	13600.0	13710.00	100.8

SAMPLE: CCV

File: IQC21A Mar 21, 2023 16:56

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12830.00	102.6
CALCIUM	12500.0	12940.00	103.5
IRON	12500.0	12610.00	100.9
MAGNESIUM	12500.0	12830.00	102.6
POTASSIUM	12500.0	12640.00	101.1

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC21A Mar 21, 2023 17:14

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13040.00	104.3
CALCIUM	12500.0	13160.00	105.3
IRON	12500.0	13010.00	104.1
MAGNESIUM	12500.0	12770.00	102.2
POTASSIUM	12500.0	13320.00	106.6

SAMPLE: CCV

File: IQC21A Mar 21, 2023 18:06

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13060.00	104.5
CALCIUM	12500.0	13220.00	105.8
IRON	12500.0	12770.00	102.2
MAGNESIUM	12500.0	13030.00	104.2
POTASSIUM	12500.0	12830.00	102.6

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: LQC23C Mar 23, 2023 18:35

Analyte	True	Found	%R (1)
ALUMINUM	400.0	419.40	104.8
ANTIMONY	20.0	19.56	97.8
CALCIUM	4000.0	4122.23	103.1
COPPER	20.0	20.44	102.2
IRON	4000.0	4040.42	101.0
LEAD	20.0	20.08	100.4
MAGNESIUM	4000.0	4213.46	105.3
MOLYBDENUM	40.0	39.17	97.9
POTASSIUM	4000.0	4078.66	102.0
SODIUM	4000.0	4166.03	104.2

SAMPLE: CCV

File: LQC23C Mar 23, 2023 19:40

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	558.34	111.7	•
ANTIMONY	25.0	25.61	102.4	
CALCIUM	5000.0	5367.32	107.3	
COPPER	25.0	27.02	108.1	
IRON	5000.0	5107.83	102.2	
LEAD	25.0	26.47	105.9	
MAGNESIUM	5000.0	5541.47	110.8	•
MOLYBDENUM	25.0	26.09	104.4	
POTASSIUM	5000.0	5313.48	106.3	
SODIUM	5000.0	5544.01	110.9	•

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC23C Mar 23, 2023 19:54

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	534.61	106.9	
ANTIMONY	25.0	25.21	100.8	
CALCIUM	5000.0	5241.28	104.8	
COPPER	25.0	26.84	107.4	
IRON	5000.0	5129.21	102.6	
LEAD	25.0	26.11	104.4	
MAGNESIUM	5000.0	5484.46	109.7	
MOLYBDENUM	25.0	26.02	104.1	
POTASSIUM	5000.0	5297.82	106.0	
SODIUM	5000.0	5411.29	108.2	

SAMPLE: CCV

File: LQC23C Mar 23, 2023 20:14

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	710.14	142.0	•
ANTIMONY	25.0	25.28	101.1	
CALCIUM	5000.0	5556.38	111.1	•
COPPER	25.0	26.57	106.3	
IRON	5000.0	5330.08	106.6	
LEAD	25.0	26.40	105.6	
MAGNESIUM	5000.0	5704.29	114.1	•
MOLYBDENUM	25.0	33.35	133.4	•
POTASSIUM	5000.0	5503.92	110.1	
SODIUM	5000.0	5680.51	113.6	•

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC23C Mar 23, 2023 21:26

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	536.13	107.2	
ANTIMONY	25.0	24.86	99.4	
CALCIUM	5000.0	5283.18	105.7	
COPPER	25.0	26.76	107.0	
IRON	5000.0	5145.75	102.9	
LEAD	25.0	26.25	105.0	
MAGNESIUM	5000.0	5614.67	112.3	•
MOLYBDENUM	25.0	26.10	104.4	
POTASSIUM	5000.0	5308.01	106.2	
SODIUM	5000.0	5556.72	111.1	•

SAMPLE: CCV

File: LQC23C Mar 23, 2023 22:35

Analyte	True	Found	%R (1)
ALUMINUM	500.0	534.64	106.9
ANTIMONY	25.0	24.58	98.3
CALCIUM	5000.0	5350.41	107.0
COPPER	25.0	27.13	108.5
IRON	5000.0	5125.94	102.5
LEAD	25.0	26.53	106.1
MAGNESIUM	5000.0	5463.31	109.3
MOLYBDENUM	25.0	25.86	103.4
POTASSIUM	5000.0	5394.04	107.9
SODIUM	5000.0	5487.75	109.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: LQC24A Mar 24, 2023 16:38

Analyte	True	Found	%R (1)
ALUMINUM	400.0	398.74	99.7
CALCIUM	4000.0	4087.04	102.2
IRON	4000.0	3966.65	99.2
MAGNESIUM	4000.0	4141.96	103.5
MOLYBDENUM	40.0	39.01	97.5
POTASSIUM	4000.0	4104.51	102.6
SODIUM	4000.0	4132.93	103.3

SAMPLE: CCV

File: LQC24A Mar 24, 2023 17:45

Analyte	True	Found	%R (1)
ALUMINUM	500.0	521.81	104.4
CALCIUM	5000.0	5192.91	103.9
IRON	5000.0	5107.87	102.2
MAGNESIUM	5000.0	5300.54	106.0
MOLYBDENUM	25.0	24.82	99.3
POTASSIUM	5000.0	5233.65	104.7
SODIUM	5000.0	5315.47	106.3

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC24A Mar 24, 2023 18:21

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	558.41	111.7	•
CALCIUM	5000.0	5217.40	104.3	
IRON	5000.0	5148.44	103.0	
MAGNESIUM	5000.0	5388.17	107.8	
MOLYBDENUM	25.0	27.44	109.8	
POTASSIUM	5000.0	5253.99	105.1	
SODIUM	5000.0	5377.08	107.5	

SAMPLE: CCV

File: LQC24A Mar 24, 2023 19:32

Analyte	True	Found	%R (1)
ALUMINUM	500.0	508.75	101.8
CALCIUM	5000.0	5161.95	103.2
IRON	5000.0	5173.01	103.5
MAGNESIUM	5000.0	5430.31	108.6
MOLYBDENUM	25.0	24.48	97.9
POTASSIUM	5000.0	5163.63	103.3
SODIUM	5000.0	5361.48	107.2

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC24A Mar 24, 2023 20:41

Analyte	True	Found	%R (1)
ALUMINUM	500.0	518.23	103.6
CALCIUM	5000.0	5198.22	104.0
IRON	5000.0	5088.11	101.8
MAGNESIUM	5000.0	5346.63	106.9
MOLYBDENUM	25.0	24.48	97.9
POTASSIUM	5000.0	5183.10	103.7
SODIUM	5000.0	5318.75	106.4

(1) Control Limits: Mercury 80-120; Other Metals 90-110

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: LQC28E Mar 28, 2023 16:12

Analyte	True	Found	%R (1)
ALUMINUM	400.0	417.03	104.3
CALCIUM	4000.0	4163.20	104.1
IRON	4000.0	3985.48	99.6
MAGNESIUM	4000.0	4215.47	105.4
MOLYBDENUM	40.0	40.47	101.2
POTASSIUM	4000.0	4191.95	104.8
SODIUM	4000.0	4182.33	104.6
ZINC	20.0	21.28	106.4

SAMPLE: CCV

File: LQC28E Mar 28, 2023 17:20

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	551.70	110.3	
CALCIUM	5000.0	5307.23	106.1	
IRON	5000.0	5058.56	101.2	
MAGNESIUM	5000.0	5702.13	114.0	•
MOLYBDENUM	25.0	26.37	105.5	
POTASSIUM	5000.0	5350.41	107.0	
SODIUM	5000.0	5629.73	112.6	•
ZINC	25.0	27.04	108.2	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC28E Mar 28, 2023 18:30

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	591.28	118.3	•
CALCIUM	5000.0	5337.61	106.8	
IRON	5000.0	5144.38	102.9	
MAGNESIUM	5000.0	5638.02	112.8	•
MOLYBDENUM	25.0	25.97	103.9	
POTASSIUM	5000.0	5403.97	108.1	
SODIUM	5000.0	5623.47	112.5	•
ZINC	25.0	26.60	106.4	

SAMPLE: CCV

File: LQC28E Mar 28, 2023 19:41

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	603.82	120.8	•
CALCIUM	5000.0	5318.21	106.4	
IRON	5000.0	5113.64	102.3	
MAGNESIUM	5000.0	5656.78	113.1	•
MOLYBDENUM	25.0	25.43	101.7	
POTASSIUM	5000.0	5361.75	107.2	
SODIUM	5000.0	5542.90	110.9	•
ZINC	25.0	26.65	106.6	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC28E Mar 28, 2023 20:52

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	556.82	111.4	•
CALCIUM	5000.0	5590.68	111.8	•
IRON	5000.0	5134.17	102.7	
MAGNESIUM	5000.0	5644.55	112.9	•
MOLYBDENUM	25.0	25.78	103.1	
POTASSIUM	5000.0	5376.16	107.5	
SODIUM	5000.0	6384.73	127.7	•
ZINC	25.0	26.63	106.5	

SAMPLE: CCV

File: LQC28E Mar 28, 2023 22:00

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	549.22	109.8	
CALCIUM	5000.0	5348.60	107.0	
IRON	5000.0	5138.26	102.8	
MAGNESIUM	5000.0	5606.95	112.1	•
MOLYBDENUM	25.0	25.53	102.1	
POTASSIUM	5000.0	5403.06	108.1	
SODIUM	5000.0	5631.98	112.6	•
ZINC	25.0	26.32	105.3	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC28E Mar 28, 2023 23:07

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	560.37	112.1	•
CALCIUM	5000.0	5355.72	107.1	
IRON	5000.0	5145.55	102.9	
MAGNESIUM	5000.0	5707.07	114.1	•
MOLYBDENUM	25.0	25.56	102.2	
POTASSIUM	5000.0	5443.69	108.9	
SODIUM	5000.0	5625.08	112.5	•
ZINC	25.0	26.68	106.7	

SAMPLE: CCV

File: LQC28E Mar 29, 2023 00:12

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	715.00	143.0	•
CALCIUM	5000.0	5609.49	112.2	•
IRON	5000.0	5264.70	105.3	
MAGNESIUM	5000.0	5816.67	116.3	•
MOLYBDENUM	25.0	33.02	132.1	•
POTASSIUM	5000.0	5593.55	111.9	•
SODIUM	5000.0	5795.34	115.9	•
ZINC	25.0	26.24	105.0	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: LQC29A Mar 29, 2023 19:02

Analyte	True	Found	%R (1)
ALUMINUM	400.0	418.42	104.6
CALCIUM	4000.0	4147.24	103.7
IRON	4000.0	4112.48	102.8
MAGNESIUM	4000.0	4220.44	105.5
MOLYBDENUM	40.0	40.72	101.8
POTASSIUM	4000.0	4147.80	103.7
SODIUM	4000.0	4158.04	104.0
ZINC	20.0	21.08	105.4

SAMPLE: CCV

File: LQC29A Mar 29, 2023 20:00

Analyte	True	Found	%R (1)
ALUMINUM	500.0	609.48	121.9 •
CALCIUM	5000.0	5334.09	106.7
IRON	5000.0	5285.07	105.7
MAGNESIUM	5000.0	5601.04	112.0 •
MOLYBDENUM	25.0	27.03	108.1
POTASSIUM	5000.0	5385.76	107.7
SODIUM	5000.0	5499.04	110.0
ZINC	25.0	26.71	106.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC29A Mar 29, 2023 20:21

Analyte	True	Found	%R (1)
ALUMINUM	500.0	533.99	106.8
CALCIUM	5000.0	5245.47	104.9
IRON	5000.0	5239.21	104.8
MAGNESIUM	5000.0	5464.21	109.3
MOLYBDENUM	25.0	26.81	107.2
POTASSIUM	5000.0	5221.05	104.4
SODIUM	5000.0	5410.11	108.2
ZINC	25.0	26.72	106.9

SAMPLE: CCV

File: LQC29A Mar 29, 2023 21:41

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	539.19	107.8	
CALCIUM	5000.0	5195.91	103.9	
IRON	5000.0	5232.05	104.6	
MAGNESIUM	5000.0	5608.51	112.2	•
MOLYBDENUM	25.0	26.78	107.1	
POTASSIUM	5000.0	5212.20	104.2	
SODIUM	5000.0	5488.49	109.8	
ZINC	25.0	26.83	107.3	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC29A Mar 29, 2023 22:47

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	537.85	107.6	
CALCIUM	5000.0	5205.08	104.1	
IRON	5000.0	5184.85	103.7	
MAGNESIUM	5000.0	5603.35	112.1	•
MOLYBDENUM	25.0	26.78	107.1	
POTASSIUM	5000.0	5239.44	104.8	
SODIUM	5000.0	5491.18	109.8	
ZINC	25.0	27.07	108.3	

SAMPLE: CCV

File: LQC29A Mar 29, 2023 23:55

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	540.49	108.1	
CALCIUM	5000.0	5202.04	104.0	
IRON	5000.0	5164.09	103.3	
MAGNESIUM	5000.0	5645.20	112.9	•
MOLYBDENUM	25.0	26.91	107.6	
POTASSIUM	5000.0	5165.69	103.3	
SODIUM	5000.0	5531.68	110.6	•
ZINC	25.0	26.61	106.4	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC29A Mar 30, 2023 00:45

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	544.18	108.8	
CALCIUM	5000.0	5264.47	105.3	
IRON	5000.0	5183.08	103.7	
MAGNESIUM	5000.0	5676.19	113.5	•
MOLYBDENUM	25.0	26.52	106.1	
POTASSIUM	5000.0	5193.22	103.9	
SODIUM	5000.0	5631.59	112.6	•
ZINC	25.0	27.18	108.7	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: LQC30A Mar 30, 2023 16:58

Analyte	True	Found	%R (1)
ALUMINUM	400.0	420.51	105.1
CALCIUM	4000.0	4124.11	103.1
IRON	4000.0	4056.96	101.4
MAGNESIUM	4000.0	4139.76	103.5
MOLYBDENUM	40.0	40.78	102.0
POTASSIUM	4000.0	4143.68	103.6
SODIUM	4000.0	4175.35	104.4
ZINC	20.0	21.26	106.3

SAMPLE: CCV

File: LQC30A Mar 30, 2023 17:46

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	612.15	122.4	•
CALCIUM	5000.0	5229.62	104.6	
IRON	5000.0	5363.81	107.3	
MAGNESIUM	5000.0	5555.32	111.1	•
MOLYBDENUM	25.0	27.16	108.6	
POTASSIUM	5000.0	5373.99	107.5	
SODIUM	5000.0	5538.98	110.8	•
ZINC	25.0	26.84	107.4	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC30A Mar 30, 2023 18:04

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	542.25	108.5	
CALCIUM	5000.0	5190.80	103.8	
IRON	5000.0	5197.56	104.0	
MAGNESIUM	5000.0	5497.42	109.9	
MOLYBDENUM	25.0	27.15	108.6	
POTASSIUM	5000.0	5287.83	105.8	
SODIUM	5000.0	5536.07	110.7	•
ZINC	25.0	26.85	107.4	

SAMPLE: CCV

File: LQC30A Mar 30, 2023 18:17

Analyte	True	Found	%R (1)
ALUMINUM	500.0	532.51	106.5
CALCIUM	5000.0	5247.37	104.9
IRON	5000.0	5220.03	104.4
MAGNESIUM	5000.0	5526.02	110.5
MOLYBDENUM	25.0	26.69	106.8
POTASSIUM	5000.0	5224.81	104.5
SODIUM	5000.0	5424.54	108.5
ZINC	25.0	27.21	108.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC30A Mar 30, 2023 19:23

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	545.74	109.1	
CALCIUM	5000.0	5216.33	104.3	
IRON	5000.0	5147.18	102.9	
MAGNESIUM	5000.0	5569.29	111.4	•
MOLYBDENUM	25.0	26.82	107.3	
POTASSIUM	5000.0	5211.71	104.2	
SODIUM	5000.0	5564.65	111.3	•
ZINC	25.0	27.06	108.2	

SAMPLE: CCV

File: LQC30A Mar 30, 2023 20:27

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	707.53	141.5	•
CALCIUM	5000.0	5429.01	108.6	
IRON	5000.0	5600.99	112.0	•
MAGNESIUM	5000.0	5545.42	110.9	•
MOLYBDENUM	25.0	26.51	106.0	
POTASSIUM	5000.0	5309.00	106.2	
SODIUM	5000.0	5409.74	108.2	
ZINC	25.0	27.60	110.4	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC30A Mar 30, 2023 21:33

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	609.51	121.9	•
CALCIUM	5000.0	5238.27	104.8	
IRON	5000.0	5307.22	106.1	
MAGNESIUM	5000.0	5412.89	108.3	
MOLYBDENUM	25.0	26.02	104.1	
POTASSIUM	5000.0	5295.13	105.9	
SODIUM	5000.0	5249.88	105.0	
ZINC	25.0	27.39	109.6	

SAMPLE: CCV

File: LQC30A Mar 30, 2023 22:39

Analyte	True	Found	%R (1)
ALUMINUM	500.0	547.79	109.6
CALCIUM	5000.0	5252.46	105.0
IRON	5000.0	5283.91	105.7
MAGNESIUM	5000.0	5484.73	109.7
MOLYBDENUM	25.0	26.41	105.6
POTASSIUM	5000.0	5277.85	105.6
SODIUM	5000.0	5390.99	107.8
ZINC	25.0	26.75	107.0

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC30A Mar 30, 2023 23:46

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	578.06	115.6	•
CALCIUM	5000.0	5334.34	106.7	
IRON	5000.0	5274.35	105.5	
MAGNESIUM	5000.0	5601.75	112.0	•
MOLYBDENUM	25.0	26.23	104.9	
POTASSIUM	5000.0	5303.26	106.1	
SODIUM	5000.0	5504.11	110.1	
ZINC	25.0	27.01	108.0	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

2C

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: IQC17A Mar 17, 2023 16:25

Analyte	TRUE	FOUND	% R
ALUMINUM	300.0	294.40	98.1
CALCIUM	100.0	100.10	100.1
IRON	100.0	101.40	101.4
MAGNESIUM	100.0	107.20	107.2
SODIUM	1000.0	1033.00	103.3

2C

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: IQC20A Mar 20, 2023 16:46

Analyte	TRUE	FOUND	% R
ALUMINUM	300.0	281.70	93.9
CALCIUM	100.0	96.35	96.3
IRON	100.0	102.50	102.5
MAGNESIUM	100.0	109.70	109.7
POTASSIUM	1000.0	942.70	94.3

2C

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: IQC21A Mar 21, 2023 16:43

Analyte	TRUE	FOUND	% R
ALUMINUM	300.0	315.10	105.0
CALCIUM	100.0	102.10	102.1
IRON	100.0	93.20	93.2
MAGNESIUM	100.0	109.60	109.6
POTASSIUM	1000.0	915.60	91.6

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: LQC23C Mar 23, 2023 18:49

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	20.95	104.7
ANTIMONY	0.2	0.19	95.0
CALCIUM	20.0	20.87	104.4
COPPER	0.6	0.63	105.0
IRON	20.0	20.17	100.9
LEAD	0.2	0.20	100.0
MAGNESIUM	20.0	21.03	105.2
MOLYBDENUM	1.0	0.95	95.0
POTASSIUM	200.0	200.12	100.1
SODIUM	200.0	200.80	100.4

2C

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: LQC24A Mar 24, 2023 18:06

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	-1.54	-7.7•
CALCIUM	20.0	23.90	119.5
IRON	20.0	21.45	107.3
MAGNESIUM	20.0	23.77	118.8
MOLYBDENUM	1.0	1.17	117.0
POTASSIUM	200.0	223.23	111.6
SODIUM	200.0	220.01	110.0

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: LQC28E Mar 28, 2023 16:26

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	20.71	103.6
CALCIUM	20.0	20.36	101.8
IRON	20.0	20.18	100.9
MAGNESIUM	20.0	20.47	102.3
MOLYBDENUM	1.0	1.03	103.0
POTASSIUM	200.0	197.56	98.8
SODIUM	200.0	200.03	100.0
ZINC	2.0	2.24	112.0

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: LQC29A Mar 29, 2023 19:16

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	21.70	108.5
CALCIUM	20.0	21.90	109.5
IRON	20.0	21.57	107.8
MAGNESIUM	20.0	22.85	114.3
MOLYBDENUM	1.0	1.08	108.0
POTASSIUM	200.0	207.78	103.9
SODIUM	200.0	200.08	100.0
ZINC	2.0	2.10	105.0

2C

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: LQC30A Mar 30, 2023 17:09

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	21.09	105.5
CALCIUM	20.0	20.66	103.3
IRON	20.0	21.21	106.1
MAGNESIUM	20.0	21.32	106.6
MOLYBDENUM	1.0	1.01	101.0
POTASSIUM	200.0	201.13	100.6
SODIUM	200.0	207.82	103.9
ZINC	2.0	2.10	105.0

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: IQC17A Mar 17, 2023 16:21

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	2.900	U
SODIUM	-21.760	U

SAMPLE: CCB

File: IQC17A Mar 17, 2023 16:42

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.759	J
MAGNESIUM	5.930	J
SODIUM	52.130	J

SAMPLE: CCB

File: IQC17A Mar 17, 2023 17:00

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	3.146	J
SODIUM	64.140	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB
File: IQC17A Mar 17, 2023 17:51

Analyte	Result	C
ALUMINUM	-11.060	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	3.351	J
SODIUM	12.000	U

SAMPLE: CCB
File: IQC17A Mar 17, 2023 18:42

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	2.900	U
SODIUM	60.850	J

SAMPLE: CCB
File: IQC17A Mar 17, 2023 19:34

Analyte	Result	C
ALUMINUM	-10.610	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	2.900	U
SODIUM	137.700	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB
File: IQC17A Mar 17, 2023 20:25

Analyte	Result	C
ALUMINUM	-16.850	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	3.176	J
SODIUM	137.300	J

SAMPLE: CCB
File: IQC17A Mar 17, 2023 21:17

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	3.981	J
SODIUM	24.450	J

SAMPLE: CCB
File: IQC17A Mar 17, 2023 22:08

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	4.505	J
MAGNESIUM	5.099	J
SODIUM	-22.760	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: IQC20A Mar 20, 2023 16:42

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	4.060	J
MAGNESIUM	2.900	U
POTASSIUM	-90.220	U

SAMPLE: CCB

File: IQC20A Mar 20, 2023 17:03

Analyte	Result	C
ALUMINUM	25.830	J
CALCIUM	17.780	J
IRON	8.568	J
MAGNESIUM	11.350	J
POTASSIUM	73.000	U

SAMPLE: CCB

File: IQC20A Mar 20, 2023 17:21

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	4.535	J
MAGNESIUM	4.638	J
POTASSIUM	102.400	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: IQC20A Mar 20, 2023 18:13

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	3.965	J
POTASSIUM	73.000	U

SAMPLE: CCB

File: IQC20A Mar 20, 2023 19:05

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	2.900	U
POTASSIUM	73.000	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: IQC21A Mar 21, 2023 16:39

Analyte	Result	C
ALUMINUM	14.040	J
CALCIUM	11.000	U
IRON	-6.168	U
MAGNESIUM	2.900	U
POTASSIUM	73.000	U

SAMPLE: CCB

File: IQC21A Mar 21, 2023 17:01

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	24.300	J
IRON	3.600	U
MAGNESIUM	11.260	J
POTASSIUM	73.000	U

SAMPLE: CCB

File: IQC21A Mar 21, 2023 17:19

Analyte	Result	C
ALUMINUM	43.840	J
CALCIUM	42.310	J
IRON	8.931	J
MAGNESIUM	2.900	U
POTASSIUM	73.000	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: IQC21A Mar 21, 2023 18:10

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	2.900	U
POTASSIUM	73.000	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: LQC23C Mar 23, 2023 18:44

Analyte	Result	C
ALUMINUM	0.337	J
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.011	J
MAGNESIUM	2.371	J
MOLYBDENUM	0.162	J
POTASSIUM	12.000	U
SODIUM	6.600	U

SAMPLE: CCB

File: LQC23C Mar 23, 2023 19:49

Analyte	Result	C
ALUMINUM	3.477	J
ANTIMONY	0.061	U
CALCIUM	6.880	J
COPPER	0.087	U
IRON	6.400	U
LEAD	0.017	J
MAGNESIUM	6.872	J
MOLYBDENUM	0.298	J
POTASSIUM	12.000	U
SODIUM	11.398	J

SAMPLE: CCB

File: LQC23C Mar 23, 2023 20:04

Analyte	Result	C
ALUMINUM	1.252	J
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.015	J
MAGNESIUM	4.222	J
MOLYBDENUM	0.203	J
POTASSIUM	12.000	U
SODIUM	8.305	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: LQC23C Mar 23, 2023 20:23

Analyte	Result	C
ALUMINUM	23.352	B
ANTIMONY	0.061	U
CALCIUM	30.149	B
COPPER	0.087	U
IRON	26.796	B
LEAD	0.014	J
MAGNESIUM	27.854	B
MOLYBDENUM	1.257	B
POTASSIUM	36.518	J
SODIUM	36.825	J

SAMPLE: CCB

File: LQC23C Mar 23, 2023 21:35

Analyte	Result	C
ALUMINUM	0.386	J
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.011	J
MAGNESIUM	2.745	J
MOLYBDENUM	0.138	J
POTASSIUM	12.405	J
SODIUM	6.600	U

SAMPLE: CCB

File: LQC23C Mar 23, 2023 22:46

Analyte	Result	C
ALUMINUM	0.455	J
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.005	U
MAGNESIUM	1.613	J
MOLYBDENUM	0.067	J
POTASSIUM	123.795	B
SODIUM	67.310	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: LQC24A Mar 24, 2023 16:47

Analyte	Result	C
ALUMINUM	0.871	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	2.632	J
MOLYBDENUM	0.201	J
POTASSIUM	12.000	U
SODIUM	6.600	U

SAMPLE: CCB

File: LQC24A Mar 24, 2023 17:56

Analyte	Result	C
ALUMINUM	-21.460	B
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	6.490	J
MOLYBDENUM	0.334	J
POTASSIUM	24.074	J
SODIUM	14.108	J

SAMPLE: CCB

File: LQC24A Mar 24, 2023 18:30

Analyte	Result	C
ALUMINUM	-13.950	B
CALCIUM	14.188	B
IRON	13.554	B
MAGNESIUM	12.790	B
MOLYBDENUM	0.682	B
POTASSIUM	29.969	J
SODIUM	23.010	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: LQC24A Mar 24, 2023 19:42

Analyte	Result	C
ALUMINUM	-23.769	B
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.594	J
MOLYBDENUM	0.181	J
POTASSIUM	19.841	J
SODIUM	6.600	U

SAMPLE: CCB

File: LQC24A Mar 24, 2023 20:51

Analyte	Result	C
ALUMINUM	-19.559	B
CALCIUM	7.197	J
IRON	6.909	J
MAGNESIUM	5.771	J
MOLYBDENUM	0.173	J
POTASSIUM	24.628	J
SODIUM	6.600	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: LQC28E Mar 28, 2023 16:21

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	2.605	J
MOLYBDENUM	0.207	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC28E Mar 28, 2023 17:28

Analyte	Result	C
ALUMINUM	2.461	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	6.770	J
MOLYBDENUM	0.337	J
POTASSIUM	14.004	J
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC28E Mar 28, 2023 18:39

Analyte	Result	C
ALUMINUM	6.678	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	4.576	J
MOLYBDENUM	0.153	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: LQC28E Mar 28, 2023 19:49

Analyte	Result	C
ALUMINUM	10.452	B
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.382	J
MOLYBDENUM	0.098	J
POTASSIUM	12.000	U
SODIUM	-10.584	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC28E Mar 28, 2023 21:00

Analyte	Result	C
ALUMINUM	0.949	J
CALCIUM	23.121	B
IRON	6.400	U
MAGNESIUM	7.590	J
MOLYBDENUM	0.130	J
POTASSIUM	12.000	U
SODIUM	137.740	B
ZINC	0.220	U

SAMPLE: CCB

File: LQC28E Mar 28, 2023 22:08

Analyte	Result	C
ALUMINUM	0.936	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.406	J
MOLYBDENUM	0.101	J
POTASSIUM	12.000	U
SODIUM	19.289	J
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: LQC28E Mar 28, 2023 23:15

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.001	J
MOLYBDENUM	0.088	J
POTASSIUM	12.000	U
SODIUM	6.875	J
ZINC	0.220	U

SAMPLE: CCB

File: LQC28E Mar 29, 2023 00:20

Analyte	Result	C
ALUMINUM	25.955	B
CALCIUM	32.856	B
IRON	30.409	B
MAGNESIUM	29.999	B
MOLYBDENUM	1.259	B
POTASSIUM	25.441	J
SODIUM	36.581	J
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: LQC29A Mar 29, 2023 19:11

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.570	J
MOLYBDENUM	0.214	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC29A Mar 29, 2023 20:10

Analyte	Result	C
ALUMINUM	10.325	B
CALCIUM	14.863	B
IRON	9.282	J
MAGNESIUM	14.526	B
MOLYBDENUM	0.459	J
POTASSIUM	20.238	J
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC29A Mar 29, 2023 20:31

Analyte	Result	C
ALUMINUM	4.576	J
CALCIUM	9.238	J
IRON	6.486	J
MAGNESIUM	8.982	J
MOLYBDENUM	0.311	J
POTASSIUM	16.177	J
SODIUM	6.600	U
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: LQC29A Mar 29, 2023 21:50

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.247	J
MOLYBDENUM	0.166	J
POTASSIUM	12.000	U
SODIUM	-11.556	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC29A Mar 29, 2023 22:56

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.654	J
MOLYBDENUM	0.153	J
POTASSIUM	12.000	U
SODIUM	-14.322	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC29A Mar 30, 2023 00:04

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.167	J
MOLYBDENUM	0.147	J
POTASSIUM	12.000	U
SODIUM	-18.315	U
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: LQC29A Mar 30, 2023 00:55

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.089	J
MOLYBDENUM	0.158	J
POTASSIUM	12.000	U
SODIUM	-19.579	U
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: LQC30A Mar 30, 2023 17:04

Analyte	Result	C
ALUMINUM	0.711	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	5.319	J
MOLYBDENUM	0.274	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC30A Mar 30, 2023 17:54

Analyte	Result	C
ALUMINUM	10.792	B
CALCIUM	15.504	B
IRON	8.542	J
MAGNESIUM	15.222	B
MOLYBDENUM	0.336	J
POTASSIUM	21.028	J
SODIUM	12.976	J
ZINC	0.330	J

SAMPLE: CCB

File: LQC30A Mar 30, 2023 18:12

Analyte	Result	C
ALUMINUM	0.484	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.875	J
MOLYBDENUM	0.150	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB
File: LQC30A Mar 30, 2023 18:25

Analyte	Result	C
ALUMINUM	0.456	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.240	J
MOLYBDENUM	0.130	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB
File: LQC30A Mar 30, 2023 19:31

Analyte	Result	C
ALUMINUM	0.643	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	4.944	J
MOLYBDENUM	0.046	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB
File: LQC30A Mar 30, 2023 20:35

Analyte	Result	C
ALUMINUM	36.476	B
CALCIUM	48.491	B
IRON	62.462	B
MAGNESIUM	14.162	B
MOLYBDENUM	0.036	J
POTASSIUM	12.000	U
SODIUM	-13.984	U
ZINC	0.261	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: LQC30A Mar 30, 2023 21:41

Analyte	Result	C
ALUMINUM	16.911	B
CALCIUM	8.942	J
IRON	15.380	B
MAGNESIUM	5.597	J
MOLYBDENUM	0.033	J
POTASSIUM	12.000	U
SODIUM	-21.863	U
ZINC	0.439	J

SAMPLE: CCB

File: LQC30A Mar 30, 2023 22:46

Analyte	Result	C
ALUMINUM	1.295	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	4.715	J
MOLYBDENUM	0.024	J
POTASSIUM	12.000	U
SODIUM	-21.247	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC30A Mar 30, 2023 23:54

Analyte	Result	C
ALUMINUM	7.700	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	5.545	J
MOLYBDENUM	0.023	J
POTASSIUM	12.000	U
SODIUM	-20.307	U
ZINC	0.220	U

3P

PREPARATION BLANKS

Lab Name: Katahdin Analytical Services **Sample ID:** PBWQC16ICW1

Matrix: WATER **SDG Name:** SQ1201

QC Batch ID: QC16ICW1

Concentration Units : ug/L

Analyte	RESULT	C
CALCIUM	80	U
MAGNESIUM	80	U
POTASSIUM	500	U
SODIUM	110	J

3P

PREPARATION BLANKS

Lab Name: Katahdin Analytical Services **Sample ID:** PBWQC21IMW2

Matrix: WATER **SDG Name:** SQ1201

QC Batch ID: QC21IMW2

Concentration Units : ug/L

Analyte	RESULT	C
ANTIMONY	0.11	J
CALCIUM	41	J
COPPER	1.4	J
LEAD	0.50	U
MAGNESIUM	35	J
ZINC	4.2	J

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSA

File: IQC17A Mar 17, 2023 16:29

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	556800.00	111.4
CALCIUM	500000.00	509800.00	102.0
IRON	200000.00	201800.00	100.9
MAGNESIUM	500000.00	441300.00	88.3
SODIUM	0	265.10	

SAMPLE: ICSAB

File: IQC17A Mar 17, 2023 16:34

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	549900.00	110.0
CALCIUM	500000.00	497500.00	99.5
IRON	200000.00	198700.00	99.4
MAGNESIUM	500000.00	435900.00	87.2
SODIUM	20000.00	22070.00	110.3

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSA

File: IQC20A Mar 20, 2023 16:50

Analyte	TRUE	FOUND	% R	
ALUMINUM	500000.00	531700.00	106.3	
CALCIUM	500000.00	508500.00	101.7	
IRON	200000.00	199000.00	99.5	
MAGNESIUM	500000.00	427900.00	85.6	
POTASSIUM	0	836.20		•

SAMPLE: ICSAB

File: IQC20A Mar 20, 2023 16:55

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	534200.00	106.8
CALCIUM	500000.00	508400.00	101.7
IRON	200000.00	199900.00	100.0
MAGNESIUM	500000.00	426100.00	85.2
POTASSIUM	20000.00	21910.00	109.6

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSA

File: IQC21A Mar 21, 2023 16:48

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	547800.00	109.6
CALCIUM	500000.00	516800.00	103.4
IRON	200000.00	205900.00	103.0
MAGNESIUM	500000.00	429600.00	85.9
POTASSIUM	0	388.60	

SAMPLE: ICSAB

File: IQC21A Mar 21, 2023 16:52

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	543500.00	108.7
CALCIUM	500000.00	523800.00	104.8
IRON	200000.00	203500.00	101.8
MAGNESIUM	500000.00	428000.00	85.6
POTASSIUM	20000.00	21110.00	105.6

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSAB

File: LQC23C Mar 23, 2023 18:59

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	106669.80	106.7
ANTIMONY	20.05	19.73	100.0
CALCIUM	100000.00	105478.97	105.5
COPPER	20.08	20.24	100.0
IRON	100000.00	99063.47	99.1
LEAD	20.02	20.70	105.0
MAGNESIUM	100000.00	103354.09	103.4
MOLYBDENUM	2000.00	2229.30	111.5
POTASSIUM	100000.00	99870.57	99.9
SODIUM	100000.00	103388.24	103.4

SAMPLE: ICSA

File: LQC23C Mar 23, 2023 20:09

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	107372.96	107.4
ANTIMONY	0.05	0.08	
CALCIUM	100000.00	104397.23	104.4
COPPER	0.08	0.10	
IRON	100000.00	98767.35	98.8
LEAD	0.02	0.03	
MAGNESIUM	100000.00	104346.96	104.3
MOLYBDENUM	2000.00	2239.96	112.0
POTASSIUM	100000.00	99670.18	99.7
SODIUM	100000.00	103644.03	103.6

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSAB

File: LQC24A Mar 24, 2023 17:03

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	107389.78	107.4
CALCIUM	100000.00	104865.54	104.9
IRON	100000.00	99380.44	99.4
MAGNESIUM	100000.00	101806.41	101.8
MOLYBDENUM	2000.00	2191.99	109.6
POTASSIUM	100000.00	99718.53	99.7
SODIUM	100000.00	102736.29	102.7

SAMPLE: ICSA

File: LQC24A Mar 24, 2023 18:11

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	108851.54	108.9
CALCIUM	100000.00	104615.12	104.6
IRON	100000.00	99903.75	99.9
MAGNESIUM	100000.00	102885.10	102.9
MOLYBDENUM	2000.00	2187.72	109.4
POTASSIUM	100000.00	100549.26	100.5
SODIUM	100000.00	103543.60	103.5

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSA

File: LQC28E Mar 28, 2023 16:31

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	109818.77	109.8
CALCIUM	100000.00	105452.98	105.5
IRON	100000.00	98193.64	98.2
MAGNESIUM	100000.00	105545.44	105.5
MOLYBDENUM	2000.00	2237.00	111.9
POTASSIUM	100000.00	102270.05	102.3
SODIUM	100000.00	106470.40	106.5
ZINC	1.40	0.98	

SAMPLE: ICSAB

File: LQC28E Mar 28, 2023 16:36

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	109041.59	109.0
CALCIUM	100000.00	105049.96	105.1
IRON	100000.00	99444.93	99.4
MAGNESIUM	100000.00	105567.12	105.6
MOLYBDENUM	2000.00	2300.62	115.1
POTASSIUM	100000.00	102603.93	102.6
SODIUM	100000.00	105691.59	105.7
ZINC	21.40	24.56	119.0

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSA

File: LQC29A Mar 29, 2023 19:21

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	107941.04	107.9
CALCIUM	100000.00	104542.16	104.5
IRON	100000.00	102858.10	102.9
MAGNESIUM	100000.00	103551.32	103.6
MOLYBDENUM	2000.00	2275.88	113.8
POTASSIUM	100000.00	101794.84	101.8
SODIUM	100000.00	103487.13	103.5
ZINC	1.40	1.24	

SAMPLE: ICSAB

File: LQC29A Mar 29, 2023 19:27

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	108483.46	108.5
CALCIUM	100000.00	104691.66	104.7
IRON	100000.00	103781.40	103.8
MAGNESIUM	100000.00	104440.02	104.4
MOLYBDENUM	2000.00	2300.50	115.0
POTASSIUM	100000.00	100724.06	100.7
SODIUM	100000.00	103296.24	103.3
ZINC	21.40	21.47	100.0

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSA

File: LQC30A Mar 30, 2023 17:14

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	109267.15	109.3
CALCIUM	100000.00	104469.10	104.5
IRON	100000.00	103885.09	103.9
MAGNESIUM	100000.00	103853.82	103.9
MOLYBDENUM	2000.00	2269.40	113.5
POTASSIUM	100000.00	101667.19	101.7
SODIUM	100000.00	103236.91	103.2
ZINC	1.40	1.39	

SAMPLE: ICSAB

File: LQC30A Mar 30, 2023 17:19

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	108884.33	108.9
CALCIUM	100000.00	104561.68	104.6
IRON	100000.00	104009.37	104.0
MAGNESIUM	100000.00	105185.21	105.2
MOLYBDENUM	2000.00	2322.46	116.1
POTASSIUM	100000.00	100519.04	100.5
SODIUM	100000.00	105582.88	105.6
ZINC	21.40	21.93	104.8

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01P

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-002P

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
CALCIUM, TOTAL	3930		1280		2500	106.2		87	113	P
MAGNESIUM, TOTAL	5580		693		5000	97.8		85	113	P
POTASSIUM, TOTAL	11100		457	J	10000	106.1		86	114	P
SODIUM, TOTAL	11200		2970		7500	109.1		87	115	P

Comments:

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01S

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-002S

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
CALCIUM, TOTAL	4080		1280		2500	112.2		87	113	P
MAGNESIUM, TOTAL	5700		693		5000	100.1		85	113	P
POTASSIUM, TOTAL	11000		457	J	10000	105.5		86	114	P
SODIUM, TOTAL	11400		2970		7500	111.9		87	115	P

Comments:

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01P

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-012P

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
ANTIMONY, DISSOLVED	101		0.34	J	100	100.8		85	117	MS
CALCIUM, DISSOLVED	4090		1320		2500	110.9		87	118	MS
COPPER, DISSOLVED	271		1.8	J	250	107.6		85	118	MS
LEAD, DISSOLVED	110		2.18		100	107.6		88	115	MS
MAGNESIUM, DISSOLVED	6070		731		5000	106.7		83	118	MS
ZINC, DISSOLVED	515		7.0	J	500	101.5		83	119	MS

Comments:

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01S

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-012S

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
ANTIMONY, DISSOLVED	102		0.34	J	100	102.1		85	117	MS
CALCIUM, DISSOLVED	4150		1320		2500	113.1		87	118	MS
COPPER, DISSOLVED	296		1.8	J	250	117.9		85	118	MS
LEAD, DISSOLVED	113		2.18		100	110.6		88	115	MS
MAGNESIUM, DISSOLVED	6200		731		5000	109.5		83	118	MS
ZINC, DISSOLVED	557		7.0	J	500	110.0		83	119	MS

Comments:

5B

POST DIGEST SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01A

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-002A

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
CALCIUM, TOTAL	7180		1280		5500	107.2		80	120	P
MAGNESIUM, TOTAL	6340		693		5500	102.6		80	120	P
POTASSIUM, TOTAL	11200		457	J	10000	107.4		80	120	P
SODIUM, TOTAL	9120		2970		5500	111.8		80	120	P

Comments:

FORM V (Part 2) - IN

5B

POST DIGEST SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01A

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-012A

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
ANTIMONY, DISSOLVED	1.98		0.068	J	2	95.6		80	120	MS
CALCIUM, DISSOLVED	490		264		200	112.9		80	120	MS
COPPER, DISSOLVED	6.86		0.35	J	6	108.5		80	120	MS
LEAD, DISSOLVED	2.47		0.437		2	101.6		80	120	MS
MAGNESIUM, DISSOLVED	352		146		200	102.9		80	120	MS
ZINC, DISSOLVED	20.2		1.4	J	20	93.8		80	120	MS

Comments:

5D

SPIKE DUPLICATES

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-002

Concentration Units : ug/L

Analyte	Control Limits	Spike Result	C	Spike Dup. Result	C	RPD	Q	M
CALCIUM, TOTAL		4080		3930		3.8		P
MAGNESIUM, TOTAL		5700		5580		2.0		P
POTASSIUM, TOTAL		11000		11100		0.5		P
SODIUM, TOTAL		11400		11200		1.9		P

Comments:

5D

SPIKE DUPLICATES

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-012

Concentration Units : ug/L

Analyte	Control Limits	Spike Result	C	Spike Dup. Result	C	RPD	Q	M
ANTIMONY, DISSOLVED		102		101		1.3		MS
CALCIUM, DISSOLVED		4150		4090		1.3		MS
COPPER, DISSOLVED		296		271		9.1		MS
LEAD, DISSOLVED		113		110		2.7		MS
MAGNESIUM, DISSOLVED		6200		6070		2.3		MS
ZINC, DISSOLVED		557		515		7.9		MS

Comments:

LABORATORY CONTROL SAMPLES

Lab Name: Katahdin Analytical Services **Sample ID:** LCSWQC16ICW1

Matrix: WATER **SDG Name:** SQ1201

QC Batch ID: QC16ICW1

Concentration Units : ug/L

Analyte	TRUE	FOUND	% R	LIMITS (%)	
CALCIUM	2500	2560	102.5	87	113
MAGNESIUM	5000	5030	100.6	85	113
POTASSIUM	10000	10200	102.3	86	114
SODIUM	7500	8440	112.5	87	115

LABORATORY CONTROL SAMPLES

Lab Name: Katahdin Analytical Services **Sample ID:** LCSWQC21IMW2

Matrix: WATER **SDG Name:** SQ1201

QC Batch ID: QC21IMW2

Concentration Units : ug/L

Analyte	TRUE	FOUND	% R	LIMITS (%)	
ANTIMONY	100	98.6	98.6	85	117
CALCIUM	2500	2720	108.7	87	118
COPPER	250	295	118.0	85	118
LEAD	100	106	105.9	88	115
MAGNESIUM	5000	5310	106.3	83	118
ZINC	500	566	113.2	83	119

ICP SERIAL DILUTION

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01L

Matrix: WATER **SDG Name:** SQ1201

Lab Sample ID: SQ1201-002L

Concentration Units: ug/L

Analyte	Sample Result	C	Dilution Result	C	% Difference	Q	M
CALCIUM, TOTAL	1280		1390		8.6		P
MAGNESIUM, TOTAL	693		728		5.1		P
POTASSIUM, TOTAL	457	J	210	J	54.0		P
SODIUM, TOTAL	2970		3140	J	5.7		P

ICP SERIAL DILUTION

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01L

Matrix: WATER **SDG Name:** SQ1201

Lab Sample ID: SQ1201-012L

Concentration Units: ug/L

Analyte	Sample Result	C	Dilution Result	C	% Difference	Q	M
ANTIMONY, DISSOLVED	0.068	J	0.092	J	35.3		MS
CALCIUM, DISSOLVED	264		281		6.4		MS
COPPER, DISSOLVED	0.35	J	0.36	J	2.9		MS
LEAD, DISSOLVED	0.437		0.38	J	13.0		MS
MAGNESIUM, DISSOLVED	146		150		2.7		MS
ZINC, DISSOLVED	1.4	J	3.9	U	100.0		MS

INSTRUMENT DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 01/23/2019

Concentration Units: ug/L

Analyte	PQL/LOQ	IDL	M
ALUMINUM	300	10	P
CALCIUM	100	11	P
IRON	100	3.6	P
MAGNESIUM	100	2.9	P
MOLYBDENUM	10	0.41	P
POTASSIUM	1000	73	P
SODIUM	1000	12	P

FORM X - IN

INSTRUMENT DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 06/11/2018

Concentration Units: ug/L

Analyte	PQL/LOQ	IDL	M
ALUMINUM	20	0.33	MS
ANTIMONY	0.20	0.061	MS
CALCIUM	20	6.8	MS
COPPER	0.60	0.087	MS
IRON	20	6.4	MS
LEAD	0.20	0.0049	MS
MAGNESIUM	20	0.35	MS
MOLYBDENUM	1.0	0.020	MS
POTASSIUM	200	12	MS
SODIUM	200	6.6	MS
ZINC	2.0	0.22	MS

LIMITS of DETECTION

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 06/11/2010

Analyte	LOD	Units	M	EPA Prep./Anal. Method
CALCIUM	80	ug/L	P	SW846 3010A / SW846 6010C
MAGNESIUM	80	ug/L	P	SW846 3010A / SW846 6010C
POTASSIUM	500	ug/L	P	SW846 3010A / SW846 6010C
SODIUM	500	ug/L	P	SW846 3010A / SW846 6010C

LIMITS of DETECTION

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 06/11/2010

Analyte	LOD	Units	M	EPA Prep./Anal. Method
ANTIMONY	0.10	ug/L	MS	SW846 3010A / SW846 6020A
CALCIUM	16	ug/L	MS	SW846 3010A / SW846 6020A
COPPER	0.40	ug/L	MS	SW846 3010A / SW846 6020A
HARDNESS	106	ug/L	MS	SW846 3010A / STDM 2340B Hardness
LEAD	0.10	ug/L	MS	SW846 3010A / SW846 6020A
MAGNESIUM	16	ug/L	MS	SW846 3010A / SW846 6020A
ZINC	1.6	ug/L	MS	SW846 3010A / SW846 6020A

METHOD DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 01/19/2011

Analyte	MDL	Units	M	EPA Prep./Anal. Method
CALCIUM	11	ug/L	P	SW846 3010A / SW846 6010C
MAGNESIUM	7.8	ug/L	P	SW846 3010A / SW846 6010C
POTASSIUM	41	ug/L	P	SW846 3010A / SW846 6010C
SODIUM	24	ug/L	P	SW846 3010A / SW846 6010C

METHOD DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 01/25/2011

Analyte	MDL	Units	M	EPA Prep./Anal. Method
ANTIMONY	0.011	ug/L	MS	SW846 3010A / SW846 6020A
CALCIUM	4.1	ug/L	MS	SW846 3010A / SW846 6020A
COPPER	0.037	ug/L	MS	SW846 3010A / SW846 6020A
HARDNESS	17	ug/L	MS	SW846 3010A / STDM 2340B Hardness
LEAD	0.015	ug/L	MS	SW846 3010A / SW846 6020A
MAGNESIUM	1.6	ug/L	MS	SW846 3010A / SW846 6020A
ZINC	0.78	ug/L	MS	SW846 3010A / SW846 6020A

ICP INTERELEMENT CORRECTION FACTORS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument Name: THERMO ICAP 6500 **Instrument ID:** I **Date:** 03/10/2021

	Wavelength	Interelement Correction Factors for:												
Analyte	**(nm)**	**Al**	**Ca**	**Fe**	**Mg**	**As**	**Cr**	**Co**	**Cu**	**Mn**	**Mo**	**Ni**	**Ti**	**V**
ALUMINUM	396.15	0.0	0.0006250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0293740	0.0	0.0	0.0
ANTIMONY	206.83	0.0000130	0.0	0.0000150	0.0	0.0000731	0.0160080	0.0	0.0	0.0	-0.0046490	-0.0008980	0.0	-0.0005030
ARSENIC	189.04	-0.0000090	0.0	-0.0001780	0.0	0.0	0.0001984	0.0	0.0	0.0	0.0015170	0.0	0.0	0.0
BARIUM	455.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERYLLIUM	313.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0006836	0.0001220
BORON	208.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0501700	0.0	0.0	0.0
CADMIUM	226.50	0.0	0.0	0.0000850	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0001140	0.0000801	0.0
CALCIUM	315.89	0.0	0.0	0.0	0.0	0.0	0.0026700	0.0008487	0.0	0.0	0.0	0.0	0.0	0.0
CHROMIUM	267.72	0.0	0.0	-0.0000010	0.0	0.0	0.0	0.0	0.0	0.0003640	0.0	0.0	0.0	-0.0000100
COBALT	228.62	0.0	0.0	0.0000050	0.0	0.0	0.0001670	0.0	0.0	0.0	0.0	0.0001562	0.0017840	0.0
COPPER	327.40	0.0000079	0.0	-0.0000147	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0006988	0.0004860
GOLD	242.79	0.0	0.0	0.0001110	0.0	0.0	0.0	0.0	0.0	0.0058700	0.0	0.0	0.0	0.0
IRON	259.94	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LEAD	220.35	-0.0001590	0.0	0.0000440	0.0	0.0001480	-0.0000772	-0.0000860	0.0004910	0.0	-0.0010840	0.0003270	-0.0000220	0.0
LITHIUM	670.78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAGNESIUM	202.58	0.0	0.0	0.0000300	0.0	0.0	0.0	0.1395100	0.0	0.0	0.0145280	0.0	0.0003530	0.0
MANGANESE	257.61	-0.0000050	0.0	0.0000100	0.0000391	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOLYBDENUM	202.03	0.0	0.0	0.0	0.0	0.0	0.0000270	0.0	0.0	-0.0000204	0.0	0.0	0.0	-0.0001163
NICKEL	231.60	0.0	0.0	-0.0000490	0.0	0.0	0.0	0.0000390	0.0	0.0	0.0034490	0.0	0.0	0.0
POTASSIUM	766.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SELENIUM	196.09	0.0000090	0.0	0.0000320	0.0	0.0003180	0.0	0.0002310	0.0	0.0006280	0.0	0.0	0.0	0.0003040
SILICON	251.61	0.0	0.0	-0.0000150	0.0	0.0	0.0	0.0	0.0	0.0	0.0132630	0.0	0.0105540	0.0
SILVER	328.07	0.0	0.0	-0.0002820	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0008413	0.0
SODIUM	589.59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STRONTIUM	421.55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THALLIUM	190.86	0.0000030	0.0	0.0000001	0.0	0.0	0.0	0.0023030	-0.0000680	-0.0024730	-0.0000880	0.0	-0.0009840	-0.0078940
TIN	189.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TITANIUM	334.90	0.0	0.0	0.0	0.0	0.0	0.0001510	0.0	0.0	0.0	0.0002130	0.0	0.0	0.0
VANADIUM	292.40	0.0	0.0	0.0000120	0.0	0.0	-0.0053650	0.0	0.0	-0.0001670	-0.0037960	0.0	0.0006990	0.0
ZINC	206.20	0.0	0.0	0.0	0.0	0.0	-0.0010444	0.0	0.0	0.0	0.0	0.0	0.0	0.0

FORM XI - IN

ICP LINEAR RANGES

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 08/11/2022

Concentration Units: ug/L

Analyte	Integration Time (sec)	Linear Range	M
ALUMINUM	5.00	500000	P
ANTIMONY	45.00	20000	P
CALCIUM	5.00	500000	P
COPPER	10.00	20000	P
IRON	5.00	250000	P
LEAD	45.00	20000	P
MAGNESIUM	45.00	200000	P
MOLYBDENUM	45.00	5000	P
POTASSIUM	5.00	300000	P
SODIUM	5.00	200000	P
ZINC	45.00	20000	P

ICP LINEAR RANGES

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 10/06/2022

Concentration Units: ug/L

Analyte	Integration Time (sec)	Linear Range	M
ALUMINUM	0.30	200000	MS
ANTIMONY	0.10	1000	MS
CALCIUM	0.30	200000	MS
COPPER	0.30	2000	MS
IRON	0.10	100000	MS
LEAD	0.10	2000	MS
MAGNESIUM	0.15	200000	MS
MOLYBDENUM	0.30	1000	MS
POTASSIUM	0.20	200000	MS
SODIUM	0.10	200000	MS
ZINC	0.30	2000	MS

PREPARATION LOG

Lab Name: Katahdin Analytical Services **QC Batch ID:** QC16ICW1

Matrix: WATER **SDG Name:** SQ1201

Method: P **Prep Date:** 03/16/2023

Client ID	Lab Sample ID	Initial (L)	Final (L)	Bottle ID
LCSWQC16ICW1	LCSWQC16ICW1	0.05	0.05	
PBWQC16ICW1	PBWQC16ICW1	0.05	0.05	
SWDUP	SQ1201-001	0.05	0.05	C
JACKSON-SWMC3-DC-01	SQ1201-002	0.05	0.05	I
JACKSON-SWMC3-DC-01P	SQ1201-002P	0.05	0.05	I
JACKSON-SWMC3-DC-01S	SQ1201-002S	0.05	0.05	I
JACKSON-SWMC2-DC-01	SQ1201-003	0.05	0.05	C
JACKSON-SWJC1-DC-01	SQ1201-004	0.05	0.05	C
JACKSON-SWMC1-DC-01	SQ1201-005	0.05	0.05	C
JACKSON-SWCC3-DC-01	SQ1201-006	0.05	0.05	C
JACKSON-SWCC4-DC-01	SQ1201-007	0.05	0.05	C
JACKSON-SWCC2-DC-01	SQ1201-008	0.05	0.05	E

FORM XIII - IN

PREPARATION LOG

Lab Name: Katahdin Analytical Services **QC Batch ID:** QC21IMW2

Matrix: WATER **SDG Name:** SQ1201

Method: MS **Prep Date:** 03/21/2023

Client ID	Lab Sample ID	Initial (L)	Final (L)	Bottle ID
LCSWQC21IMW2	LCSWQC21IMW2	0.05	0.05	
PBWQC21IMW2	PBWQC21IMW2	0.05	0.05	
JACKSON-EB-01	SQ1201-009	0.05	0.05	A
JACKSON-CB-01	SQ1201-010	0.05	0.05	A
SWDUP	SQ1201-011	0.05	0.05	A
JACKSON-SWMC3-DC-01	SQ1201-012	0.05	0.05	A
JACKSON-SWMC3-DC-01P	SQ1201-012P	0.05	0.05	A
JACKSON-SWMC3-DC-01S	SQ1201-012S	0.05	0.05	A
JACKSON-SWMC2-DC-01	SQ1201-013	0.05	0.05	A
JACKSON-SWJC1-DC-01	SQ1201-014	0.05	0.05	A
JACKSON-SWMC1-DC-01	SQ1201-015	0.05	0.05	A
JACKSON-SWCC3-DC-01	SQ1201-016	0.05	0.05	A
JACKSON-SWCC4-DC-01	SQ1201-017	0.05	0.05	A
JACKSON-SWCC2-DC-01	SQ1201-018	0.05	0.05	A

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC17A

Date: 03/17/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
Blank		1	16:08	AL	CA	FE	MG	NA
Std 1		1	16:13	AL	CA	FE	MG	NA
ICV		1	16:17	AL	CA	FE	MG	NA
ICB		1	16:21	AL	CA	FE	MG	NA
PQL		1	16:25	AL	CA	FE	MG	NA
ICSA		1	16:29	AL	CA	FE	MG	NA
ICSAB		1	16:34	AL	CA	FE	MG	NA
CCV		1	16:38	AL	CA	FE	MG	NA
CCB		1	16:42	AL	CA	FE	MG	NA
ZZZZZZ		1	16:47					
ZZZZZZ		1	16:51					
CCV		1	16:56	AL	CA	FE	MG	NA
CCB		1	17:00	AL	CA	FE	MG	NA
ZZZZZZ		1	17:04					
ZZZZZZ		1	17:08					
ZZZZZZ		1	17:13					
ZZZZZZ		1	17:17					
ZZZZZZ		1	17:21					
ZZZZZZ		2	17:25					
ZZZZZZ		5	17:29					
ZZZZZZ		5	17:34					
ZZZZZZ		1	17:38					
ZZZZZZ		1	17:42					
CCV		1	17:46	AL	CA	FE	MG	NA
CCB		1	17:51	AL	CA	FE	MG	NA
ZZZZZZ		1	17:55					
ZZZZZZ		2	17:59					

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC17A

Date: 03/17/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
ZZZZZZ		1	18:04					
ZZZZZZ		1	18:08					
ZZZZZZ		2	18:12					
ZZZZZZ		1	18:16					
ZZZZZZ		1	18:20					
ZZZZZZ		1	18:25					
ZZZZZZ		1	18:29					
ZZZZZZ		1	18:34					
CCV		1	18:38	AL	CA	FE	MG	NA
CCB		1	18:42	AL	CA	FE	MG	NA
ZZZZZZ		1	18:46					
ZZZZZZ		1	18:51					
ZZZZZZ		1	18:55					
ZZZZZZ		1	18:59					
ZZZZZZ		1	19:04					
ZZZZZZ		1	19:08					
ZZZZZZ		1	19:12					
ZZZZZZ		1	19:16					
ZZZZZZ		1	19:21					
ZZZZZZ		1	19:25					
CCV		1	19:29	AL	CA	FE	MG	NA
CCB		1	19:34	AL	CA	FE	MG	NA
ZZZZZZ		1	19:38					
ZZZZZZ		1	19:42					
ZZZZZZ		5	19:47					
ZZZZZZ		1	19:51					
ZZZZZZ		1	19:55					

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC17A

Date: 03/17/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
ZZZZZZ		1	19:59					
ZZZZZZ		1	20:04					
ZZZZZZ		1	20:08					
ZZZZZZ		1	20:13					
ZZZZZZ		5	20:17					
CCV		1	20:21	AL	CA	FE	MG	NA
CCB		1	20:25	AL	CA	FE	MG	NA
ZZZZZZ		1	20:30					
ZZZZZZ		50	20:34					
ZZZZZZ		50	20:38					
ZZZZZZ		100	20:43					
LCSWQC16ICW1		1	20:47				MG	NA
PBWQC16ICW1		1	20:51				MG	NA
SQ1201-001	SWDUP	1	20:55				MG	NA
SQ1201-002	JACKSON-SWMC3-DC-01	1	21:00				MG	NA
SQ1201-002A	JACKSON-SWMC3-DC-01A	1	21:04				MG	NA
SQ1201-002L	JACKSON-SWMC3-DC-01L	5	21:08				MG	NA
CCV		1	21:13	AL	CA	FE	MG	NA
CCB		1	21:17	AL	CA	FE	MG	NA
SQ1201-002P	JACKSON-SWMC3-DC-01P	1	21:21				MG	NA
SQ1201-002S	JACKSON-SWMC3-DC-01S	1	21:25				MG	NA
SQ1201-003	JACKSON-SWMC2-DC-01	1	21:29				MG	NA
SQ1201-004	JACKSON-SWJC1-DC-01	1	21:34				MG	NA
SQ1201-005	JACKSON-SWMC1-DC-01	1	21:38				MG	NA
SQ1201-006	JACKSON-SWCC3-DC-01	1	21:42				MG	NA
SQ1201-007	JACKSON-SWCC4-DC-01	1	21:47				MG	NA
SQ1201-008	JACKSON-SWCC2-DC-01	1	21:51				MG	NA

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC17A

Date: 03/17/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
ZZZZZZ		1	21:55					
ZZZZZZ		1	21:59					
CCV		1	22:03	AL	CA	FE	MG	NA
CCB		1	22:08	AL	CA	FE	MG	NA

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC20A

Date: 03/20/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
Blank		1	16:29	AL	CA	FE	MG	K
Std 1		1	16:33	AL	CA	FE	MG	K
ICV		1	16:37	AL	CA	FE	MG	K
ICB		1	16:42	AL	CA	FE	MG	K
PQL		1	16:46	AL	CA	FE	MG	K
ICSA		1	16:50	AL	CA	FE	MG	K
ICSAB		1	16:55	AL	CA	FE	MG	K
CCV		1	16:59	AL	CA	FE	MG	K
CCB		1	17:03	AL	CA	FE	MG	K
ZZZZZZ		1	17:08					
ZZZZZZ		1	17:13					
CCV		1	17:17	AL	CA	FE	MG	K
CCB		1	17:21	AL	CA	FE	MG	K
ZZZZZZ		1	17:26					
ZZZZZZ		1	17:30					
ZZZZZZ		1	17:34					
LCSWQC16ICW1		1	17:39		CA			K
PBWQC16ICW1		1	17:43		CA			K
SQ1201-001	SWDUP	1	17:47		CA			
SQ1201-002	JACKSON-SWMC3-DC-01	1	17:52		CA			K
SQ1201-002A	JACKSON-SWMC3-DC-01A	1	17:56		CA			K
SQ1201-002L	JACKSON-SWMC3-DC-01L	5	18:00		CA			K
SQ1201-002P	JACKSON-SWMC3-DC-01P	1	18:05		CA			K
CCV		1	18:09	AL	CA	FE	MG	K
CCB		1	18:13	AL	CA	FE	MG	K
SQ1201-002S	JACKSON-SWMC3-DC-01S	1	18:18		CA			K
SQ1201-003	JACKSON-SWMC2-DC-01	1	18:22		CA			

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC20A

Date: 03/20/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
SQ1201-004	JACKSON-SWJC1-DC-01	1	18:26		CA			K
SQ1201-005	JACKSON-SWMC1-DC-01	1	18:31		CA			K
SQ1201-006	JACKSON-SWCC3-DC-01	1	18:35		CA			K
SQ1201-007	JACKSON-SWCC4-DC-01	1	18:39		CA			K
SQ1201-008	JACKSON-SWCC2-DC-01	1	18:44		CA			K
ZZZZZZ		1	18:48					
ZZZZZZ		1	18:52					
ZZZZZZ		1	18:57					
CCV		1	19:01	AL	CA	FE	MG	K
CCB		1	19:05	AL	CA	FE	MG	K

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC21A

Date: 03/21/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
Blank		1	16:26	AL	CA	FE	MG	K
Std 1		1	16:30	AL	CA	FE	MG	K
ICV		1	16:35	AL	CA	FE	MG	K
ICB		1	16:39	AL	CA	FE	MG	K
PQL		1	16:43	AL	CA	FE	MG	K
ICSA		1	16:48	AL	CA	FE	MG	K
ICSAB		1	16:52	AL	CA	FE	MG	K
CCV		1	16:56	AL	CA	FE	MG	K
CCB		1	17:01	AL	CA	FE	MG	K
ZZZZZZ		1	17:05					
ZZZZZZ		1	17:10					
CCV		1	17:14	AL	CA	FE	MG	K
CCB		1	17:19	AL	CA	FE	MG	K
SQ1201-001	SWDUP	1	17:23					K
SQ1201-003	JACKSON-SWMC2-DC-01	1	17:27					K
ZZZZZZ		1	17:32					
ZZZZZZ		1	17:36					
ZZZZZZ		1	17:40					
ZZZZZZ		1	17:44					
ZZZZZZ		2	17:49					
ZZZZZZ		5	17:53					
ZZZZZZ		1	17:58					
ZZZZZZ		1	18:02					
CCV		1	18:06	AL	CA	FE	MG	K
CCB		1	18:10	AL	CA	FE	MG	K

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC23C

Date: 03/23/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements								
CalBlank		1	18:20	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CalStd		1	18:25	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
ICV		1	18:35	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
ICB		1	18:44	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
PQL		1	18:49	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
ZZZZZZ		1	18:54										
ICSAB		1	18:59	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
ZZZZZZ		1	19:07										
ZZZZZZ		1	19:19										
ZZZZZZ		1	19:29										
ZZZZZZ		1	19:35										
CCV		1	19:40	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCB		1	19:49	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCV		1	19:54	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCB		1	20:04	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
ICSA		1	20:09	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCV		1	20:14	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCB		1	20:23	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
PBWQC21IMW2		5	20:28		Sb		Cu		Pb				
LCSWQC21IMW2		5	20:34		Sb		Cu		Pb				
ZZZZZZ		5	20:42										
SQ1201-009	JACKSON-EB-01	5	20:47		Sb		Cu		Pb				
SQ1201-010	JACKSON-CB-01	5	20:52		Sb		Cu		Pb				
SQ1201-011	SWDUP	5	20:57		Sb		Cu		Pb				
SQ1201-012	JACKSON-SWMC3-DC-01	5	21:02		Sb		Cu		Pb				
SQ1201-012L	JACKSON-SWMC3-DC-01L	25	21:08		Sb		Cu		Pb				
SQ1201-012A	JACKSON-SWMC3-DC-01A	5	21:13		Sb		Cu		Pb				

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC23C

Date: 03/23/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements										
SQ1201-012P	JACKSON-SWMC3-DC-01P	5	21:18		Sb			Cu		Pb				
CCV		1	21:26	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCB		1	21:35	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na
SQ1201-012S	JACKSON-SWMC3-DC-01S	5	21:40		Sb			Cu		Pb				
SQ1201-013	JACKSON-SWMC2-DC-01	5	21:49		Sb			Cu		Pb				
SQ1201-014	JACKSON-SWJC1-DC-01	5	21:54		Sb			Cu		Pb				
SQ1201-015	JACKSON-SWMC1-DC-01	5	21:59		Sb			Cu		Pb				
SQ1201-016	JACKSON-SWCC3-DC-01	5	22:04		Sb			Cu		Pb				
SQ1201-017	JACKSON-SWCC4-DC-01	5	22:09		Sb			Cu		Pb				
SQ1201-018	JACKSON-SWCC2-DC-01	5	22:14		Sb			Cu		Pb				
ZZZZZZ		5	22:19											
ZZZZZZ		5	22:25											
ZZZZZZ		5	22:30											
CCV		1	22:35	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCB		1	22:46	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC24A

Date: 03/24/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
CalBlank		1	16:21	Al	Ca	Fe	Mg	Mo	K	Na
CalStd		1	16:27	Al	Ca	Fe	Mg	Mo	K	Na
ICV		1	16:38	Al	Ca	Fe	Mg	Mo	K	Na
ICB		1	16:47	Al	Ca	Fe	Mg	Mo	K	Na
ZZZZZZ		1	16:52							
ZZZZZZ		1	16:58							
ICSAB		1	17:03	Al	Ca	Fe	Mg	Mo	K	Na
ZZZZZZ		1	17:12							
ZZZZZZ		1	17:23							
ZZZZZZ		1	17:35							
ZZZZZZ		1	17:40							
CCV		1	17:45	Al	Ca	Fe	Mg	Mo	K	Na
CCB		1	17:56	Al	Ca	Fe	Mg	Mo	K	Na
ZZZZZZ		1	18:01							
PQL		1	18:06	Al	Ca	Fe	Mg	Mo	K	Na
ICSA		1	18:11	Al	Ca	Fe	Mg	Mo	K	Na
ZZZZZZ		1	18:16							
CCV		1	18:21	Al	Ca	Fe	Mg	Mo	K	Na
CCB		1	18:30	Al	Ca	Fe	Mg	Mo	K	Na
PBWQC21IMW2		5	18:35				Mg			
LCSWQC21IMW2		5	18:41		Ca		Mg			
ZZZZZZ		5	18:49							
ZZZZZZ		5	18:54							
ZZZZZZ		5	18:59							
SQ1201-011	SWDUP	5	19:04				Mg			
SQ1201-012	JACKSON-SWMC3-DC-01	5	19:09				Mg			
SQ1201-012L	JACKSON-SWMC3-DC-01L	25	19:14				Mg			

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC24A

Date: 03/24/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
SQ1201-012A	JACKSON-SWMC3-DC-01A	5	19:19				Mg			
SQ1201-012P	JACKSON-SWMC3-DC-01P	5	19:25				Mg			
CCV		1	19:32	Al	Ca	Fe	Mg	Mo	K	Na
CCB		1	19:42	Al	Ca	Fe	Mg	Mo	K	Na
SQ1201-012S	JACKSON-SWMC3-DC-01S	5	19:47				Mg			
SQ1201-013	JACKSON-SWMC2-DC-01	5	19:55				Mg			
SQ1201-014	JACKSON-SWJC1-DC-01	5	20:00				Mg			
SQ1201-015	JACKSON-SWMC1-DC-01	5	20:05				Mg			
SQ1201-016	JACKSON-SWCC3-DC-01	5	20:10				Mg			
SQ1201-017	JACKSON-SWCC4-DC-01	5	20:15				Mg			
SQ1201-018	JACKSON-SWCC2-DC-01	5	20:21				Mg			
ZZZZZZ		5	20:26							
ZZZZZZ		5	20:31							
ZZZZZZ		5	20:36							
CCV		1	20:41	Al	Ca	Fe	Mg	Mo	K	Na
CCB		1	20:51	Al	Ca	Fe	Mg	Mo	K	Na

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC28E

Date: 03/28/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
CalBlank		1	15:55	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CalStd		1	16:00	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICV		1	16:12	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICB		1	16:21	Al	Ca	Fe	Mg	Mo	K	Na	Zn
PQL		1	16:26	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSA		1	16:31	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSAB		1	16:36	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	16:45								
ZZZZZZ		1	16:57								
ZZZZZZ		1	17:04								
ZZZZZZ		1	17:09								
ZZZZZZ		1	17:14								
CCV		1	17:20	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	17:28	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	17:33								
ZZZZZZ		5	17:38								
ZZZZZZ		5	17:43								
ZZZZZZ		5	17:48								
ZZZZZZ		5	17:54								
ZZZZZZ		5	18:01								
ZZZZZZ		5	18:07								
ZZZZZZ		5	18:12								
ZZZZZZ		5	18:17								
ZZZZZZ		5	18:25								
CCV		1	18:30	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	18:39	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	18:44								

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC28E

Date: 03/28/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
ZZZZZZ		5	18:49								
ZZZZZZ		5	18:54								
ZZZZZZ		25	18:59								
ZZZZZZ		5	19:04								
ZZZZZZ		5	19:09								
ZZZZZZ		5	19:17								
ZZZZZZ		5	19:25								
ZZZZZZ		5	19:30								
ZZZZZZ		5	19:35								
CCV		1	19:41	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	19:49	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	19:54								
ZZZZZZ		5	19:59								
ZZZZZZ		5	20:04								
ZZZZZZ		5	20:09								
ZZZZZZ		5	20:14								
ZZZZZZ		5	20:19								
ZZZZZZ		5	20:28								
ZZZZZZ		1	20:36								
ZZZZZZ		1	20:41								
ZZZZZZ		1	20:47								
CCV		1	20:52	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	21:00	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	21:05								
ZZZZZZ		5	21:10								
ZZZZZZ		5	21:19								
ZZZZZZ		5	21:24								

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC28E

Date: 03/28/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
ZZZZZZ		5	21:29								
ZZZZZZ		5	21:34								
ZZZZZZ		5	21:39								
ZZZZZZ		5	21:44								
ZZZZZZ		5	21:49								
ZZZZZZ		5	21:55								
CCV		1	22:00	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	22:08	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	22:13								
ZZZZZZ		5	22:18								
ZZZZZZ		5	22:23								
ZZZZZZ		5	22:28								
PBWQC21IMW2		5	22:33		Ca						Zn
LCSWQC21IMW2		5	22:38								Zn
ZZZZZZ		5	22:46								
SQ1201-009	JACKSON-EB-01	5	22:51		Ca						Zn
SQ1201-010	JACKSON-CB-01	5	22:57		Ca						
SQ1201-011	SWDUP	5	23:02		Ca						Zn
CCV		1	23:07	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	23:15	Al	Ca	Fe	Mg	Mo	K	Na	Zn
SQ1201-012	JACKSON-SWMC3-DC-01	5	23:20								Zn
SQ1201-012L	JACKSON-SWMC3-DC-01L	25	23:25								Zn
SQ1201-012A	JACKSON-SWMC3-DC-01A	5	23:31								Zn
SQ1201-013	JACKSON-SWMC2-DC-01	5	23:36								Zn
SQ1201-014	JACKSON-SWJC1-DC-01	5	23:41								Zn
SQ1201-015	JACKSON-SWMC1-DC-01	5	23:46								Zn
SQ1201-016	JACKSON-SWCC3-DC-01	5	23:51								Zn

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC28E

Date: 03/28/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
SQ1201-017	JACKSON-SWCC4-DC-01	5	23:56								Zn
ZZZZZZ		5	00:01								
ZZZZZZ		1	00:07								
CCV		1	00:12	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	00:20	Al	Ca	Fe	Mg	Mo	K	Na	Zn

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC29A

Date: 03/29/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
CalBlank		1	18:45	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CalStd		1	18:50	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICV		1	19:02	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICB		1	19:11	Al	Ca	Fe	Mg	Mo	K	Na	Zn
PQL		1	19:16	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSA		1	19:21	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSAB		1	19:27	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	19:35								
ZZZZZZ		1	19:47								
ZZZZZZ		1	19:55								
CCV		1	20:00	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	20:10	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	20:15								
CCV		1	20:21	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	20:31	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	20:36								
ZZZZZZ		5	20:41								
ZZZZZZ		5	20:49								
ZZZZZZ		5	20:54								
ZZZZZZ		5	21:00								
ZZZZZZ		5	21:05								
ZZZZZZ		5	21:13								
ZZZZZZ		1	21:22								
ZZZZZZ		5	21:27								
ZZZZZZ		5	21:32								
CCV		1	21:41	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	21:50	Al	Ca	Fe	Mg	Mo	K	Na	Zn

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC29A

Date: 03/29/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
ZZZZZZ		5	21:56								
ZZZZZZ		5	22:01								
ZZZZZZ		5	22:06								
ZZZZZZ		5	22:11								
ZZZZZZ		5	22:16								
ZZZZZZ		5	22:21								
ZZZZZZ		5	22:26								
ZZZZZZ		5	22:31								
ZZZZZZ		5	22:37								
ZZZZZZ		5	22:42								
CCV		1	22:47	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	22:56	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	23:01								
ZZZZZZ		5	23:06								
ZZZZZZ		5	23:11								
ZZZZZZ		5	23:16								
ZZZZZZ		5	23:24								
ZZZZZZ		5	23:29								
ZZZZZZ		5	23:35								
ZZZZZZ		5	23:40								
SQ1201-012	JACKSON-SWMC3-DC-01	5	23:45		Ca						
SQ1201-012L	JACKSON-SWMC3-DC-01L	25	23:50		Ca						
CCV		1	23:55	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	00:04	Al	Ca	Fe	Mg	Mo	K	Na	Zn
SQ1201-012A	JACKSON-SWMC3-DC-01A	5	00:09		Ca						
SQ1201-013	JACKSON-SWMC2-DC-01	5	00:14		Ca						
SQ1201-014	JACKSON-SWJC1-DC-01	5	00:20		Ca						

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC29A

Date: 03/30/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
SQ1201-015	JACKSON-SWMC1-DC-01	5	00:25		Ca					
SQ1201-016	JACKSON-SWCC3-DC-01	5	00:30		Ca					
SQ1201-017	JACKSON-SWCC4-DC-01	5	00:35		Ca					
SQ1201-018	JACKSON-SWCC2-DC-01	5	00:40		Ca					Zn
CCV		1	00:45	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	00:55	Al	Ca	Fe	Mg	Mo	K	Na	Zn

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC30A

Date: 03/30/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
CalBlank		1	16:44	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CalStd		1	16:50	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICV		1	16:58	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICB		1	17:04	Al	Ca	Fe	Mg	Mo	K	Na	Zn
PQL		1	17:09	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSA		1	17:14	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSAB		1	17:19	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	17:24								
ZZZZZZ		1	17:36								
ZZZZZZ		1	17:41								
CCV		1	17:46	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	17:54	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	17:59								
CCV		1	18:04	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	18:12	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCV		1	18:17	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	18:25	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	18:30								
ZZZZZZ		5	18:35								
ZZZZZZ		5	18:42								
ZZZZZZ		5	18:48								
ZZZZZZ		5	18:53								
ZZZZZZ		5	18:58								
ZZZZZZ		5	19:03								
ZZZZZZ		5	19:08								
ZZZZZZ		5	19:13								
ZZZZZZ		5	19:18								

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC30A

Date: 03/30/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
CCV		1	19:23	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	19:31	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	19:36								
ZZZZZZ		5	19:41								
ZZZZZZ		5	19:46								
ZZZZZZ		5	19:51								
ZZZZZZ		5	19:56								
ZZZZZZ		5	20:02								
ZZZZZZ		5	20:07								
ZZZZZZ		5	20:12								
ZZZZZZ		5	20:17								
ZZZZZZ		5	20:22								
CCV		1	20:27	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	20:35	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	20:40								
ZZZZZZ		5	20:45								
ZZZZZZ		25	20:50								
ZZZZZZ		5	20:55								
ZZZZZZ		5	21:00								
ZZZZZZ		5	21:05								
ZZZZZZ		5	21:13								
ZZZZZZ		5	21:18								
ZZZZZZ		5	21:23								
ZZZZZZ		5	21:28								
CCV		1	21:33	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	21:41	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	21:46								

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC30A

Date: 03/30/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
ZZZZZZ		5	21:51								
ZZZZZZ		5	21:56								
ZZZZZZ		5	22:01								
ZZZZZZ		5	22:06								
ZZZZZZ		5	22:11								
ZZZZZZ		5	22:18								
ZZZZZZ		5	22:23								
ZZZZZZ		5	22:29								
ZZZZZZ		5	22:34								
CCV		1	22:39	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	22:46	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	22:51								
ZZZZZZ		5	22:57								
ZZZZZZ		5	23:03								
SQ1201-009	JACKSON-EB-01	5	23:09				Mg				
SQ1201-010	JACKSON-CB-01	5	23:14				Mg				Zn
SQ1201-012S	JACKSON-SWMC3-DC-01S	5	23:19		Ca						Zn
SQ1201-012P	JACKSON-SWMC3-DC-01P	5	23:26		Ca						Zn
ZZZZZZ		5	23:31								
ZZZZZZ		5	23:36								
ZZZZZZ		5	23:41								
CCV		1	23:46	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	23:54	Al	Ca	Fe	Mg	Mo	K	Na	Zn

Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

Lab Sample ID: SQ1201-1
Client ID: SWDUP
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 00:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	3.6 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 17:28	N/A	N/A	
Sulfate	J0.64 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 17:28	N/A	N/A	

600 Technology Way
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http://www.katahdinlab.com

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Report of Analytical Results

Lab Sample ID: SQ1201-2
Client ID: JACKSON-SWMC3-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 14:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	3.6 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 17:46	N/A	N/A	
Sulfate	J0.67 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 17:46	N/A	N/A	

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Report of Analytical Results

Lab Sample ID: SQ1201-3
Client ID: JACKSON-SWMC2-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 11:30	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	4.3 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 18:37	N/A	N/A	
Sulfate	J0.78 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 18:37	N/A	N/A	

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Report of Analytical Results

Lab Sample ID: SQ1201-4
Client ID: JACKSON-SWJC1-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 13:30	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	2.3 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 18:55	N/A	N/A	
Sulfate	J0.15 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 18:55	N/A	N/A	

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Report of Analytical Results

Lab Sample ID: SQ1201-5
Client ID: JACKSON-SWMC1-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 11:50	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	2.2 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 19:12	N/A	N/A	
Sulfate	J0.64 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 19:12	N/A	N/A	

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Report of Analytical Results

Lab Sample ID: SQ1201-6
Client ID: JACKSON-SWCC3-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 14:15	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	2.0 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 19:29	N/A	N/A	
Sulfate	J0.60 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 19:29	N/A	N/A	

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Report of Analytical Results

Lab Sample ID: SQ1201-7
Client ID: JACKSON-SWCC4-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 09:40	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	J2.0 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 19:46	N/A	N/A	
Sulfate	J0.94 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 19:46	N/A	N/A	

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Report of Analytical Results

Lab Sample ID: SQ1201-8
Client ID: JACKSON-SWCC2-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 10:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Alkalinity	U4.0 mg/L	5.0	0.23	4.0	STDM 2320B	WG334311	24-MAR-23 11:28	N/A	N/A	
Chloride	2.7 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 20:38	N/A	N/A	
Sulfate	1.5 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 20:38	N/A	N/A	

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Quality Control Report

Blank Sample Summary Report

Alkalinity

QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	Units	LOQ	MDL	LOD
WG334311	STDM 2320B	24-MAR-23	N/A	J2.4	mg/L	5.0	0.23	4.0

Chloride

QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	Units	LOQ	MDL	LOD
WG334130	EPA 300.0	20-MAR-23	N/A	U1.0	mg/L	2.0	0.099	1.0

Sulfate

QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	Units	LOQ	MDL	LOD
WG334130	EPA 300.0	20-MAR-23	N/A	U0.50	mg/L	1.0	0.064	0.50

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Cert No E87604

Quality Control Report

Laboratory Control Sample Summary Report

Alkalinity

Laboratory Sample ID	Sample Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amount	Result	Recovery (%)	Acceptance Range	RPD
WG334311-2	LCS	WG334311	24-MAR-23	N/A	mg/L	120	130	106	85-115	
WG334311-3	LCSD	WG334311	24-MAR-23	N/A	mg/L	120	130	106	85-115	0

Chloride

Laboratory Sample ID	Sample Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amount	Result	Recovery (%)	Acceptance Range	RPD
WG334130-2	LCS	WG334130	20-MAR-23	N/A	mg/L	3.75	3.74	99.7	90-110	

Sulfate

Laboratory Sample ID	Sample Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amount	Result	Recovery (%)	Acceptance Range	RPD
WG334130-2	LCS	WG334130	20-MAR-23	N/A	mg/L	3.75	3.68	98.1	90-110	

Quality Control Report

Matrix Spike Sample Summary Report

Chloride

Matrix Spike Sample ID	Sample Type	Original Sample ID	QC Batch	Analysis Date	Units	Spike Amount	Sample Result	MS Result	Recovery (%)	Acceptance Range	RPD
WG334130-3	MS	SQ1201-2	WG334130	20-MAR-23	mg/L	3.947368421	3.6	7.7	102	90 - 110	
WG334130-4	MSD	SQ1201-2	WG334130	20-MAR-23	mg/L	3.947368421	3.6	7.8	105	90 - 110	1

Sulfate

Matrix Spike Sample ID	Sample Type	Original Sample ID	QC Batch	Analysis Date	Units	Spike Amount	Sample Result	MS Result	Recovery (%)	Acceptance Range	RPD
WG334130-3	MS	SQ1201-2	WG334130	20-MAR-23	mg/L	3.947368421	J 0.67	4.6	100	90 - 110	
WG334130-4	MSD	SQ1201-2	WG334130	20-MAR-23	mg/L	3.947368421	J 0.67	4.7	102	90 - 110	2

EXPLOSIVES DATA

QC Summary Section

Form 2
System Monitoring Compound Recovery

Lab Name: Katahdin Analytical Services **SDG:** SQ1201 **Matrix:** AQ

Client Sample ID	Lab Sample ID	Col. ID	DNB	#
SWDUP	SQ1201-1	P	103.	
JACKSON-SWMC3-DC-01	SQ1201-2	P	111.	
JACKSON-SWMC2-DC-01	SQ1201-3	P	105.	
JACKSON-SWJC1-DC-01	SQ1201-4	P	52.2	*
JACKSON-SWMC1-DC-01	SQ1201-5	P	104.	
JACKSON-SWCC3-DC-01	SQ1201-6	P	102.	
JACKSON-SWCC4-DC-01	SQ1201-7	P	106.	
JACKSON-EB-01	SQ1201-9	P	104.	
JACKSON-CB-01	SQ1201-10	P	96.5	
Method Blank	WG333823-1	P	104.	
Laboratory Control S	WG333823-2	P	103.	
Matrix Spike	WG333823-3	P	112.	
Matrix Spike Duplica	WG333823-4	P	104.	

Abbr.	Surrogate Compound	QC Limits
DNB	1,2-Dinitrobenzene	83-119

= Column to be used to flag recovery limits.
* = Values outside of contract required QC limits.
D= System Monitoring Compound diluted out.

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Method Blank Summary

Lab Name : Katahdin Analytical Services
SDG : SQ1201
Lab File ID : HQC00088.D
Lab Sample ID : WG333823-1
Instrument ID : HPLC02
Date Extracted : 14-MAR-23
Matrix : AQ
Date Analyzed : 17-MAR-23
Extraction method : SW846 8330B
Time Analyzed : 09:57

This Method Blank applies to the following samples and QC samples:

Client Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
Laboratory Control S	WG333823-2	HQC00090.D	03/17/23	11:06
SWDUP	SQ1201-1	HQC00093.D	03/17/23	12:50
JACKSON-SWMC3-DC-01	SQ1201-2	HQC00094.D	03/17/23	13:25
Matrix Spike	WG333823-3	HQC00095.D	03/17/23	14:00
Matrix Spike Duplica	WG333823-4	HQC00096.D	03/17/23	14:34
JACKSON-SWMC2-DC-01	SQ1201-3	HQC00097.D	03/17/23	15:09
JACKSON-SWJC1-DC-01	SQ1201-4	HQC00098.D	03/17/23	15:44
JACKSON-SWMC1-DC-01	SQ1201-5	HQC00099.D	03/17/23	16:18
JACKSON-SWCC3-DC-01	SQ1201-6	HQC00100.D	03/17/23	16:53
JACKSON-SWCC4-DC-01	SQ1201-7	HQC00101.D	03/17/23	17:28
JACKSON-EB-01	SQ1201-9	HQC00102.D	03/17/23	18:02
JACKSON-CB-01	SQ1201-10	HQC00104.D	03/17/23	19:12

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Method Blank Summary

Lab Name : Katahdin Analytical Services
Lab File ID : HQC00126.D
Instrument ID : HPLC02
Matrix : AQ
Extraction method : SW846 8330B

SDG : SQ1201
Lab Sample ID : WG333823-1C
Date Extracted : 14-MAR-23
Date Analyzed : 21-MAR-23
Time Analyzed : 20:06

This Method Blank applies to the following samples and QC samples:

Client Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
Laboratory Control S	WG333823-2C	HQC00130.D	03/21/23	23:27
JACKSON-SWMC1-DC-01	SQ1201-5C	HQC00131.D	03/22/23	00:17
JACKSON-CB-01	SQ1201-10C	HQC00132.D	03/22/23	01:08

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Form 8
Analytical Sequence

Lab Name: Katahdin Analytical Services **SDG:** SQ1201
Instrument ID: HPLC02 **Wavelength:** 210 um

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed	DNB	
Initial Calibration	WG333590-1	03/15/23	09:32		
Initial Calibration	WG333590-2	03/15/23	10:06		
Initial Calibration	WG333590-3	03/15/23	10:41		
Initial Calibration	WG333590-4	03/15/23	11:16		
Initial Calibration	WG333590-5	03/15/23	11:50		
Initial Calibration	WG333590-6	03/15/23	12:25		
Initial Calibration	WG333590-7	03/15/23	13:00		
Independent Source	WG333590-8	03/15/23	13:35		
Continuing Calibrati	WG333979-1	03/17/23	09:08		
Method Blank	WG333823-1	03/17/23	09:57		
Laboratory Control S	WG333823-2	03/17/23	11:06		
SWDUP	SQ1201-1	03/17/23	12:50		
JACKSON-SWMC3-DC-01	SQ1201-2	03/17/23	13:25		
Matrix Spike	WG333823-3	03/17/23	14:00		
Matrix Spike Duplica	WG333823-4	03/17/23	14:34		
JACKSON-SWMC2-DC-01	SQ1201-3	03/17/23	15:09		
JACKSON-SWJC1-DC-01	SQ1201-4	03/17/23	15:44		
JACKSON-SWMC1-DC-01	SQ1201-5	03/17/23	16:18		
JACKSON-SWCC3-DC-01	SQ1201-6	03/17/23	16:53		
JACKSON-SWCC4-DC-01	SQ1201-7	03/17/23	17:28		
JACKSON-EB-01	SQ1201-9	03/17/23	18:02		
Continuing Calibrati	WG333979-2	03/17/23	18:37		
JACKSON-CB-01	SQ1201-10	03/17/23	19:12		
Continuing Calibrati	WG333979-3	03/18/23	00:59		

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Form 8
Analytical Sequence

Lab Name: Katahdin Analytical Services **SDG:** SQ1201
Instrument ID: HPLC02 **Wavelength:** 254 um

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed	DNB	
Initial Calibration	WG333590-1	03/15/23	09:32	8.791	
Initial Calibration	WG333590-2	03/15/23	10:06	8.786	
Initial Calibration	WG333590-3	03/15/23	10:41	8.82	
Initial Calibration	WG333590-4	03/15/23	11:16	8.771	
Initial Calibration	WG333590-5	03/15/23	11:50	8.758	
Initial Calibration	WG333590-6	03/15/23	12:25	8.738	
Initial Calibration	WG333590-7	03/15/23	13:00	8.722	
Independent Source	WG333590-8	03/15/23	13:35		
Continuing Calibrati	WG333979-1	03/17/23	09:08	8.828	
Method Blank	WG333823-1	03/17/23	09:57	8.835	
Laboratory Control S	WG333823-2	03/17/23	11:06	8.828	
SWDUP	SQ1201-1	03/17/23	12:50	8.76	
JACKSON-SWMC3-DC-01	SQ1201-2	03/17/23	13:25	8.773	
Matrix Spike	WG333823-3	03/17/23	14:00	8.765	
Matrix Spike Duplica	WG333823-4	03/17/23	14:34	8.779	
JACKSON-SWMC2-DC-01	SQ1201-3	03/17/23	15:09	8.8	
JACKSON-SWJC1-DC-01	SQ1201-4	03/17/23	15:44	8.82	
JACKSON-SWMC1-DC-01	SQ1201-5	03/17/23	16:18	8.803	
JACKSON-SWCC3-DC-01	SQ1201-6	03/17/23	16:53	8.884	
JACKSON-SWCC4-DC-01	SQ1201-7	03/17/23	17:28	8.832	
JACKSON-EB-01	SQ1201-9	03/17/23	18:02	8.874	
Continuing Calibrati	WG333979-2	03/17/23	18:37	8.787	
JACKSON-CB-01	SQ1201-10	03/17/23	19:12	8.835	
Continuing Calibrati	WG333979-3	03/18/23	00:59	8.816	

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Form 8
Analytical Sequence

Lab Name: Katahdin Analytical Services **SDG:** SQ1201
Instrument ID: HPLC02 **Wavelength:** 210 um

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed	DNB	
Initial Calibration	WG334216-5	03/21/23	13:24		
Initial Calibration	WG334216-1	03/21/23	14:14		
Initial Calibration	WG334216-2	03/21/23	15:04		
Initial Calibration	WG334216-3	03/21/23	15:55		
Initial Calibration	WG334216-4	03/21/23	16:45		
Initial Calibration	WG334216-6	03/21/23	17:35		
Initial Calibration	WG334216-7	03/21/23	18:25		
Independent Source	WG334216-8	03/21/23	19:16		
Method Blank	WG333823-1C	03/21/23	20:06		
Laboratory Control S	WG333823-2C	03/21/23	23:27		
JACKSON-SWMC1-DC-01	SQ1201-5C	03/22/23	00:17		
JACKSON-CB-01	SQ1201-10C	03/22/23	01:08		
Continuing Calibrati	WG334216-9	03/22/23	08:40		

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Form 8
Analytical Sequence

Lab Name: Katahdin Analytical Services **SDG:** SQ1201
Instrument ID: HPLC02 **Wavelength:** 254 um

Client Sample ID	Lab Sample ID	Date Analyzed	Time Analyzed	DNB	
Initial Calibration	WG334216-5	03/21/23	13:24	13.75	
Initial Calibration	WG334216-1	03/21/23	14:14	13.72	
Initial Calibration	WG334216-2	03/21/23	15:04	13.79	
Initial Calibration	WG334216-3	03/21/23	15:55	13.81	
Initial Calibration	WG334216-4	03/21/23	16:45	13.79	
Initial Calibration	WG334216-6	03/21/23	17:35	13.78	
Initial Calibration	WG334216-7	03/21/23	18:25	13.80	
Independent Source	WG334216-8	03/21/23	19:16		
Method Blank	WG333823-1C	03/21/23	20:06	13.80	
Laboratory Control S	WG333823-2C	03/21/23	23:27	13.77	
JACKSON-SWMC1-DC-01	SQ1201-5C	03/22/23	00:17	13.77	
JACKSON-CB-01	SQ1201-10C	03/22/23	01:08	13.77	
Continuing Calibrati	WG334216-9	03/22/23	08:40	13.77	

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Sample Data Section

KATAHDIN ANALYTICAL SERVICES - ORGANIC DATA QUALIFIERS

U Indicates the compound was analyzed for but not detected above the specified level. This level may be the Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client.

Note: All results reported as "U" MDL have a 50% rate for false negatives compared to those results reported as "U" PQL, "U" LOQ or "U" LOD, where the rate of false negatives is <1%.

* Compound recovery or percent RPD (relative percent difference) was outside of quality control limits.

D Indicates the result was obtained from analysis of a diluted sample. Surrogate recoveries may not be calculable.

E Estimated value. This flag identifies compounds whose concentrations exceed the upper level of the calibration range of the instrument for that specific analysis.

J Estimated value. The analyte was detected in the sample at a concentration less than the laboratory Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), but above the Method Detection Limit (MDL).

And/or

J Used for Dual Column analytes when there is a greater than 40% difference for detected concentrations between the two GC/HPLC columns.

B Indicates the analyte was detected in the laboratory method blank analyzed concurrently with the sample.

I Indicates that the flagged compound did not meet DoD criteria in the corresponding Initial Calibration (ICAL).

D Indicates that the flagged compound did not meet DoD criteria in the corresponding Initial Calibration Verification (ICV).

C Indicates that the flagged compound did not meet DoD criteria in the corresponding opening Calibration Verification (CV).

V Indicates that the flagged compound did not meet DoD criteria in the corresponding closing Calibration Verification (CV).

L/LL Indicates that the flagged compound did not meet DoD criteria in the corresponding Laboratory Control Sample (LCS) and/or Laboratory Control Sample Duplicate (LCSD) prepared and/or analyzed concurrently with the sample.

M/MM Indicates that the flagged compound did not meet DoD criteria in the Matrix Spike (MS) and/or Matrix Spike Duplicate MSD) prepared and/or analyzed concurrently with the native sample.

H Indicates the flagged compound was detected on the primary column but was not detected on the confirmation column therefore the compound is not reported as a positive detection. (SW846 8330A/B only)

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Manual Integration Codes For GC/MS, GC, HPLC and/or IC

M1	Peak splitting.
M2	Well defined peaks on the shoulders of the other peaks.
M3	There is additional area due to a coeluting interferant.
M4	There are negative spikes in the baseline.
M5	There are rising or falling baselines.
M6	The software has failed to detect a peak or misidentified a peak.
M7	Excessive peak tailing.
M8	Analysis such as GRO, DRO and TPH require a baseline hold.
M9	Peak was not completely integrated as in GC/MS.
M10	Primary ion was correctly integrated, but secondary or tertiary ion needed manual integration as in GC/MS.
M11	For GC analysis, when a sample is diluted by 1:10 or more, the surrogate is set to undetected and then the area under the surrogate is manually integrated.
M12	Manual integration saved in method due to TurboChrom floating point error.

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ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-1
Client ID: SWDUP
Matrix: AQ
Lab File ID: HQC00093.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		103.	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00093.D
Report Date: 23-Mar-2023 10:32

Katahdin Analytical Services

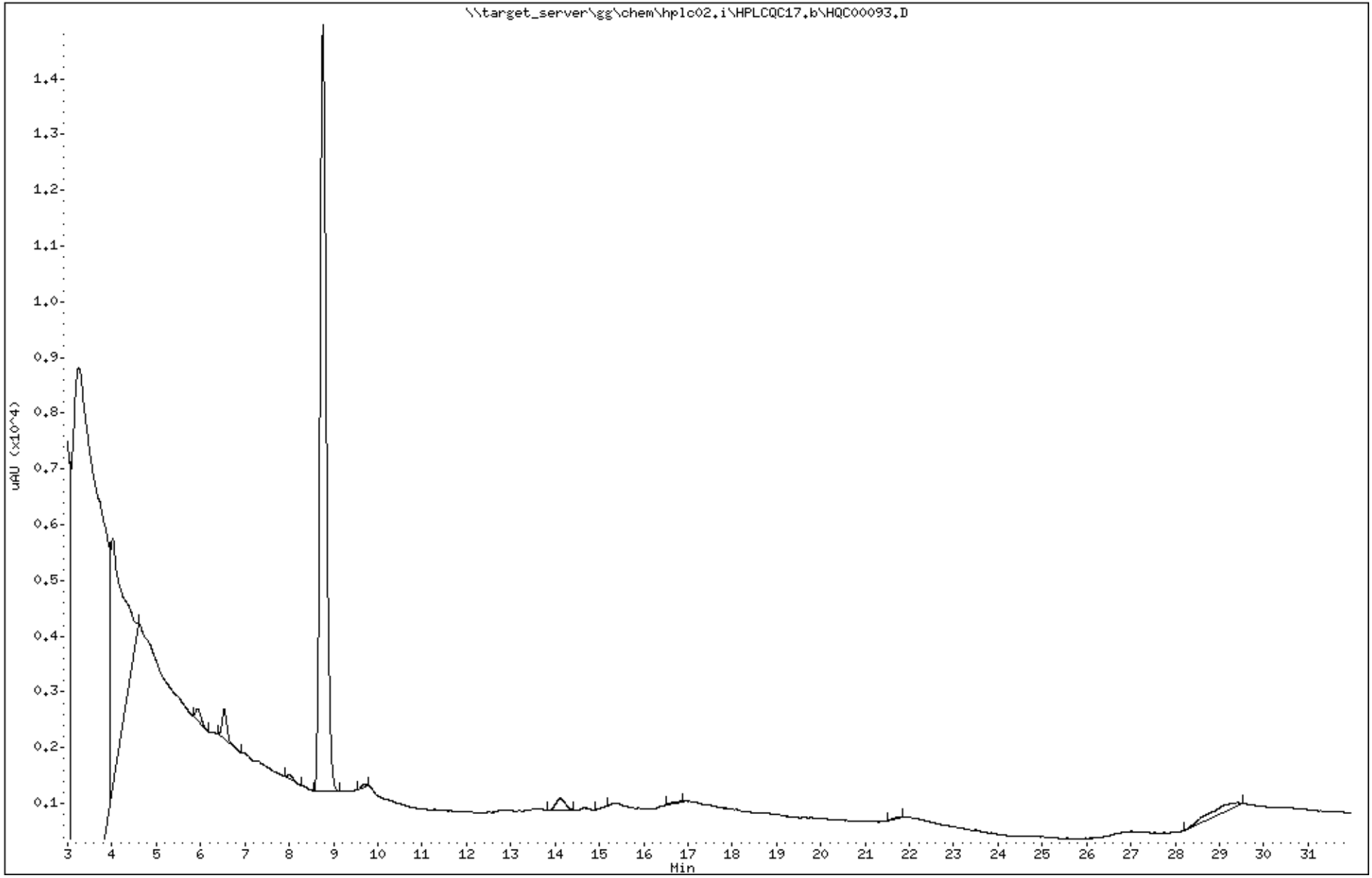
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00093.D
Lab Smp Id: SQ1201-1 Client Smp ID: SWDUP
Inj Date : 17-MAR-2023 12:50
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-1
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00093.D
Date : 17-MAR-2023 12:50
Client ID: SWDUP
Instrument: hplc02.i
Sample Info: SQ1201-1
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 208 of 1130

Data File: HQC00093.D
Report Date: 23-Mar-2023 10:26

Katahdin Analytical Services

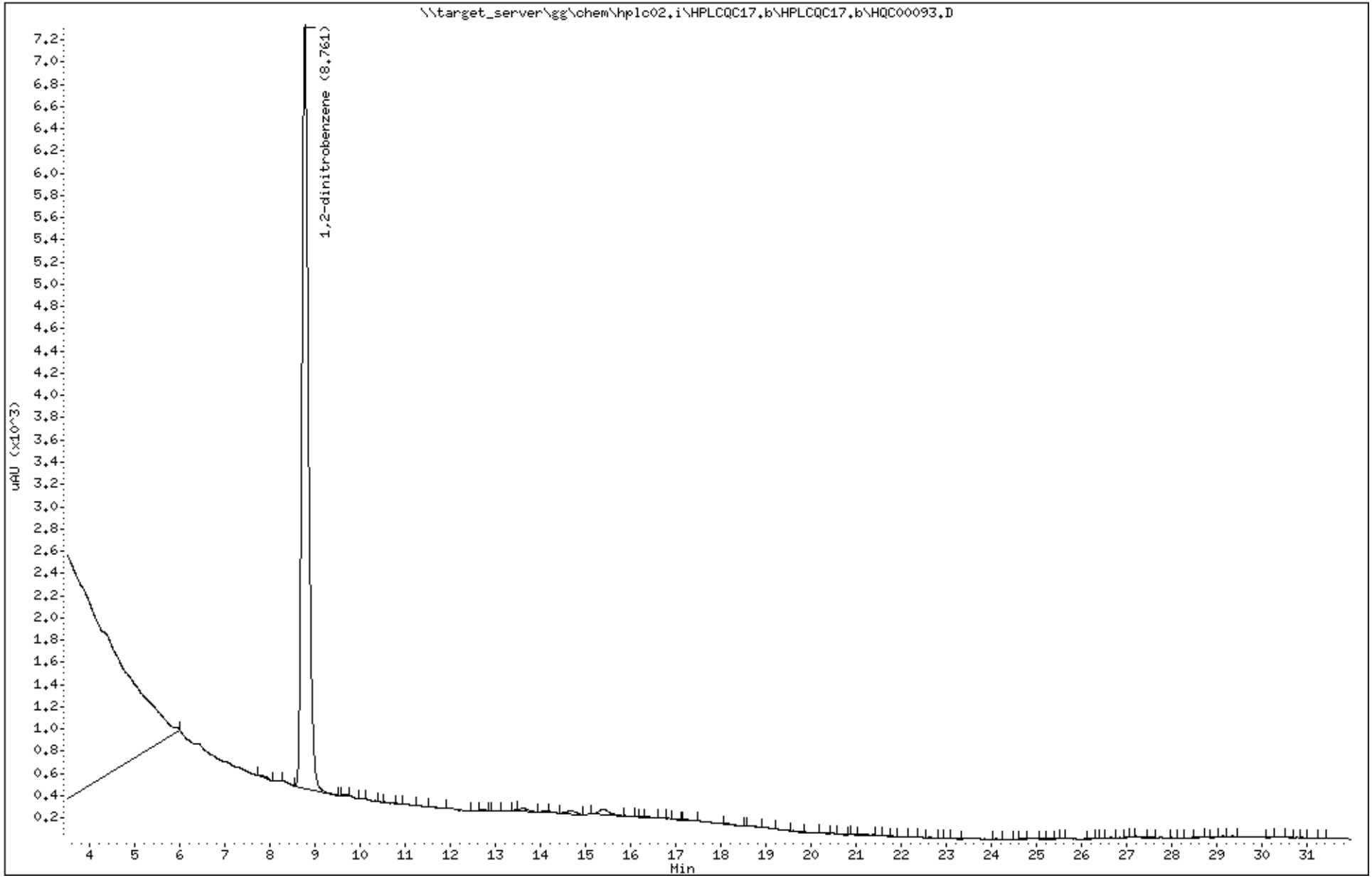
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00093.D
Lab Smp Id: SQ1201-1 Client Smp ID: SWDUP
Inj Date : 17-MAR-2023 12:50
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-1
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.760	8.828	-0.068	6872	1.02904	10.3	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00093.D
Date : 17-MAR-2023 12:50
Client ID: SWDUP
Instrument: hplc02.i
Sample Info: SQ1201-1
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-2
Client ID: JACKSON-SWMC3-DC-01
Matrix: AQ
Lab File ID: HQC00094.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	ULMM	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		111.	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00094.D
Report Date: 23-Mar-2023 10:32

Katahdin Analytical Services

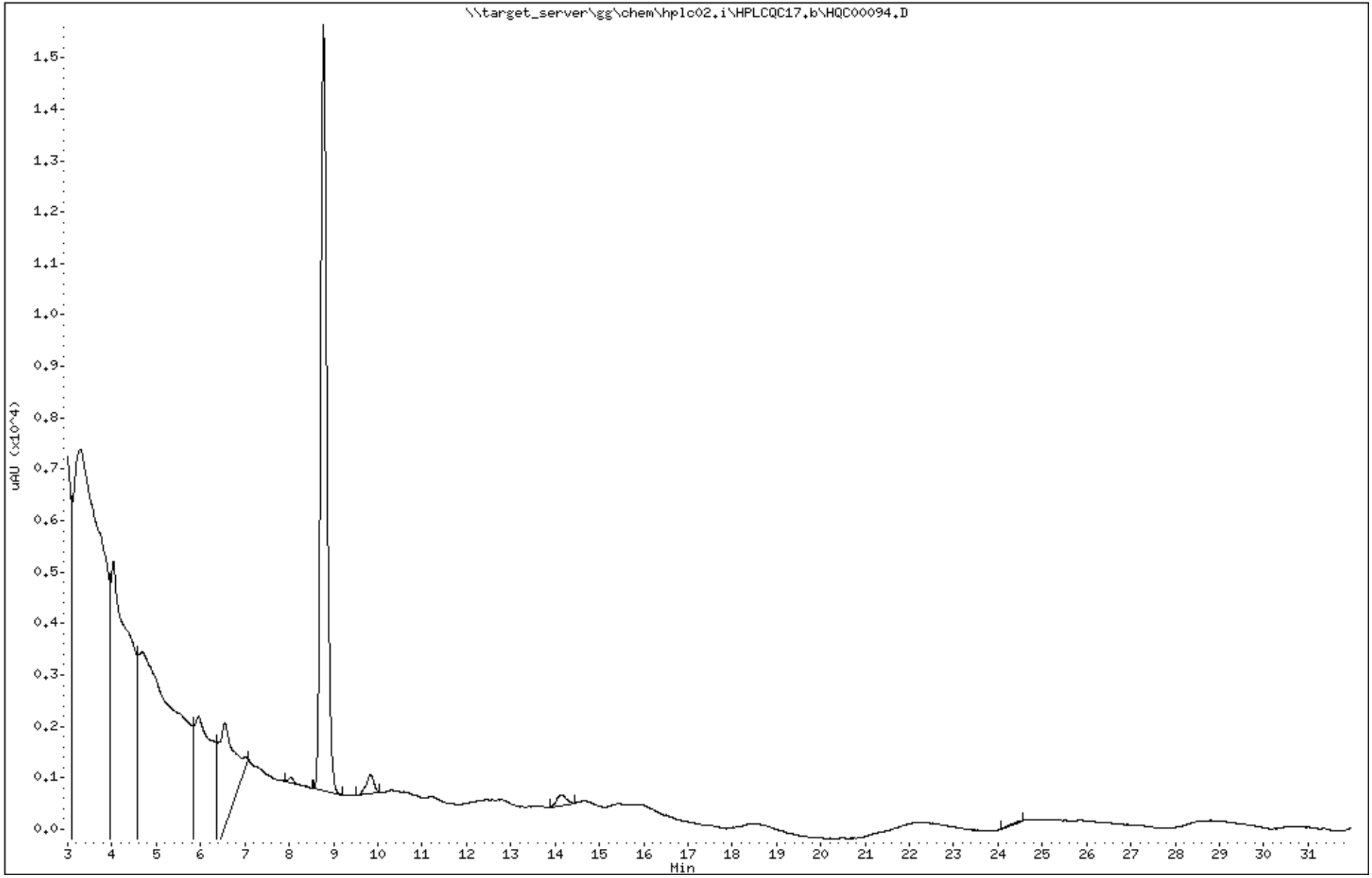
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00094.D
Lab Smp Id: SQ1201-2 Client Smp ID: JACKSON-SWMC3-DC-01
Inj Date : 17-MAR-2023 13:25
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-2
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00094.D
Date : 17-MAR-2023 13:25
Client ID: JACKSON-SWMC3-DC-01
Instrument: hplc02.i
Sample Info: SQ1201-2
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: HQC00094.D
Report Date: 23-Mar-2023 10:26

Katahdin Analytical Services

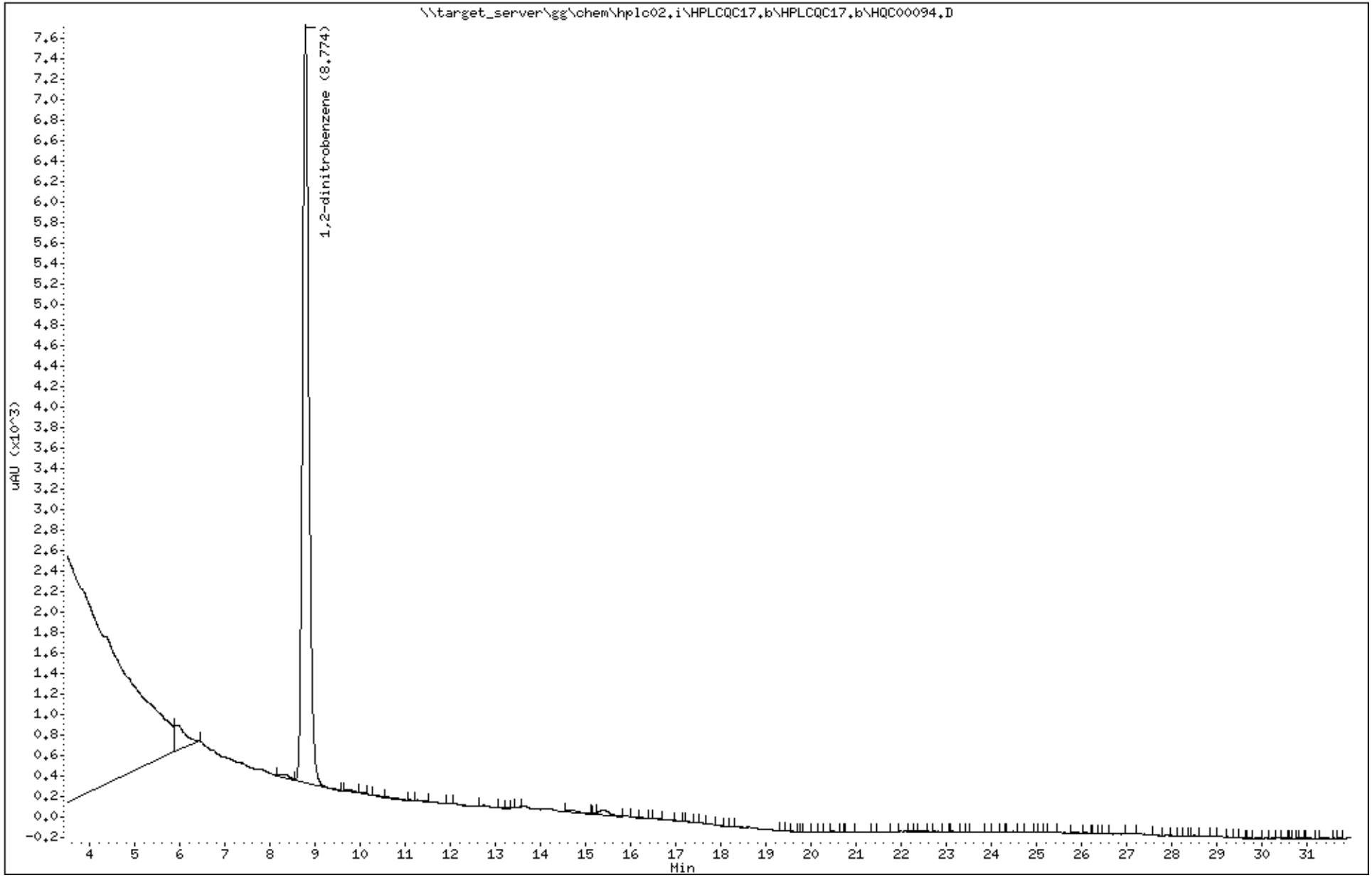
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00094.D
Lab Smp Id: SQ1201-2 Client Smp ID: JACKSON-SWMC3-DC-01
Inj Date : 17-MAR-2023 13:25
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-2
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.773	8.828	-0.055	7392	1.10691	11.1	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00094.D
Date : 17-MAR-2023 13:25
Client ID: JACKSON-SWMC3-DC-01 Instrument: hplc02.i
Sample Info: SQ1201-2
Purge Volume: 0.5 Operator: EP
Column phase: Phenomenex Kinetex Column diameter: 4.60



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Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-3
Client ID: JACKSON-SWMC2-DC-01
Matrix: AQ
Lab File ID: HQC00097.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		105.	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00097.D
Report Date: 23-Mar-2023 10:33

Katahdin Analytical Services

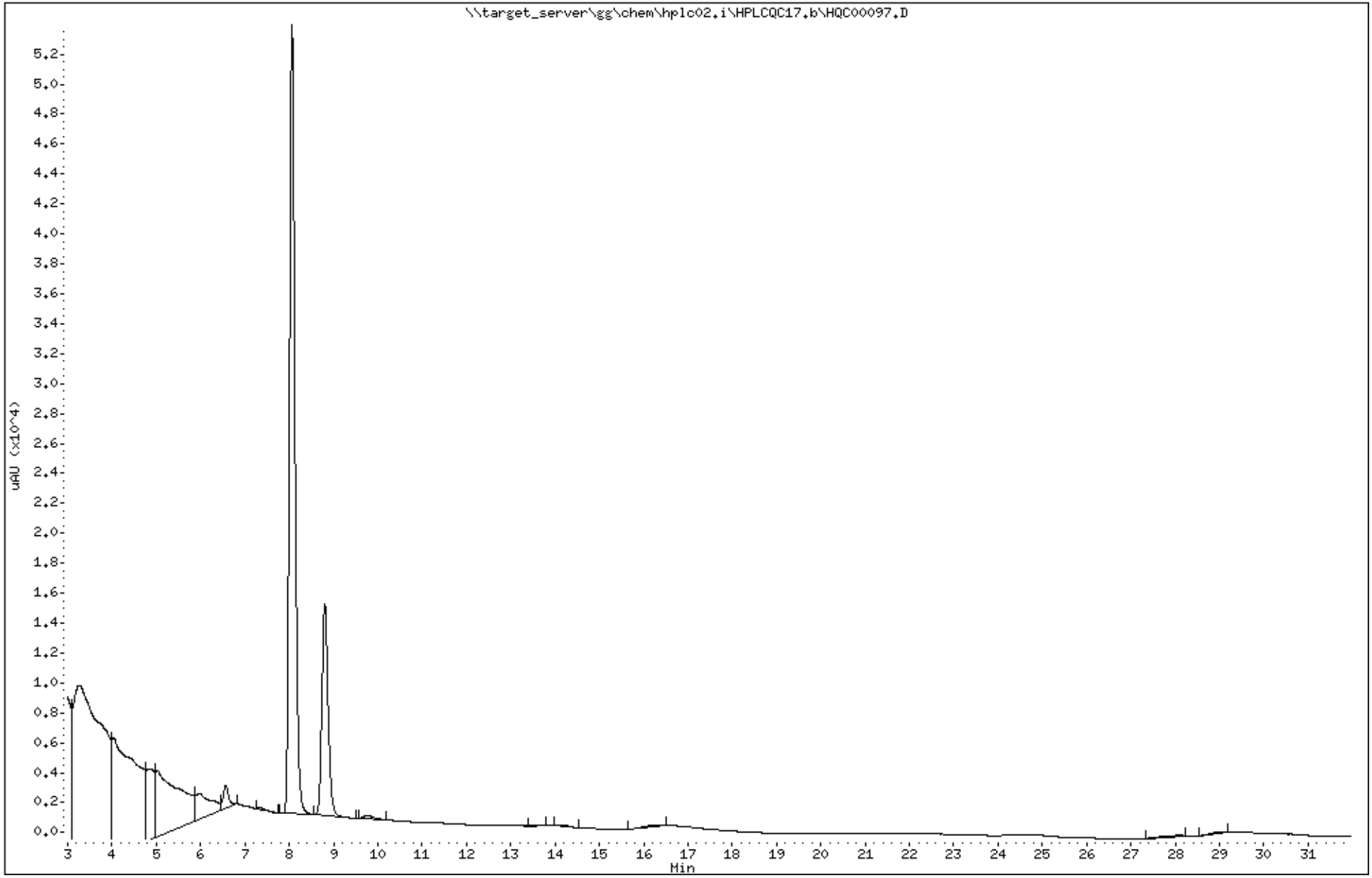
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00097.D
Lab Smp Id: SQ1201-3 Client Smp ID: JACKSON-SWMC2-DC-01
Inj Date : 17-MAR-2023 15:09
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-3
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00097.D
Date : 17-MAR-2023 15:09
Client ID: JACKSON-SWMC2-DC-01 Instrument: hplc02.i
Sample Info: SQ1201-3
Purge Volume: 0.5 Operator: EP
Column phase: Phenomenex Kinetex Column diameter: 4.60



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Data File: HQC00097.D
Report Date: 23-Mar-2023 10:26

Katahdin Analytical Services

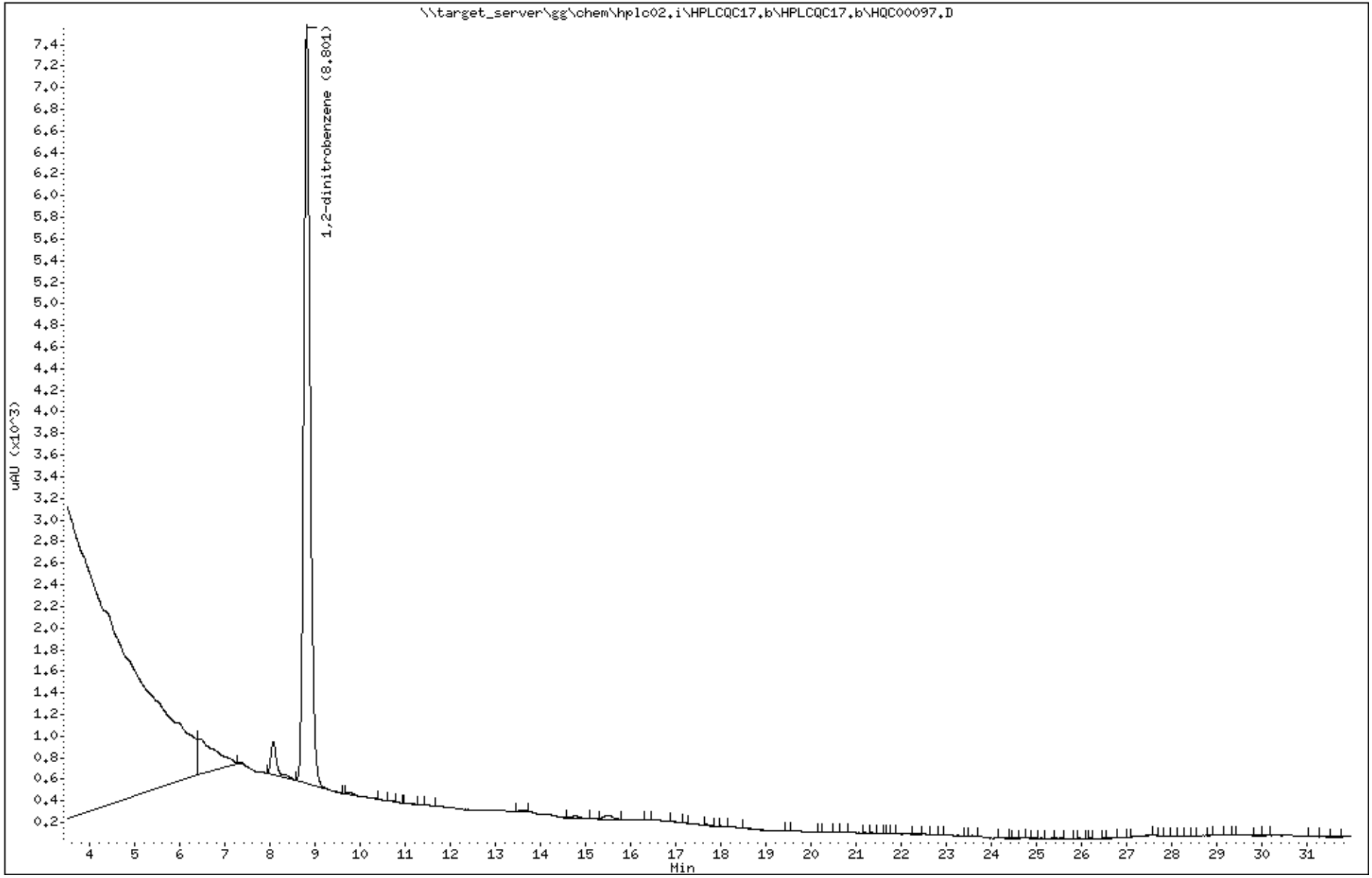
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00097.D
Lab Smp Id: SQ1201-3 Client Smp ID: JACKSON-SWMC2-DC-01
Inj Date : 17-MAR-2023 15:09
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-3
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.800	8.828	-0.028	7026	1.05210	10.5	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00097.D
Date : 17-MAR-2023 15:09
Client ID: JACKSON-SWMC2-DC-01 Instrument: hplc02.i
Sample Info: SQ1201-3
Purge Volume: 0.5 Operator: EP
Column phase: Phenomenex Kinetex Column diameter: 4.60



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Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-4
Client ID: JACKSON-SWJC1-DC-01
Matrix: AQ
Lab File ID: HQC00098.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene	*	52.2	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00098.D
Report Date: 23-Mar-2023 10:33

Katahdin Analytical Services

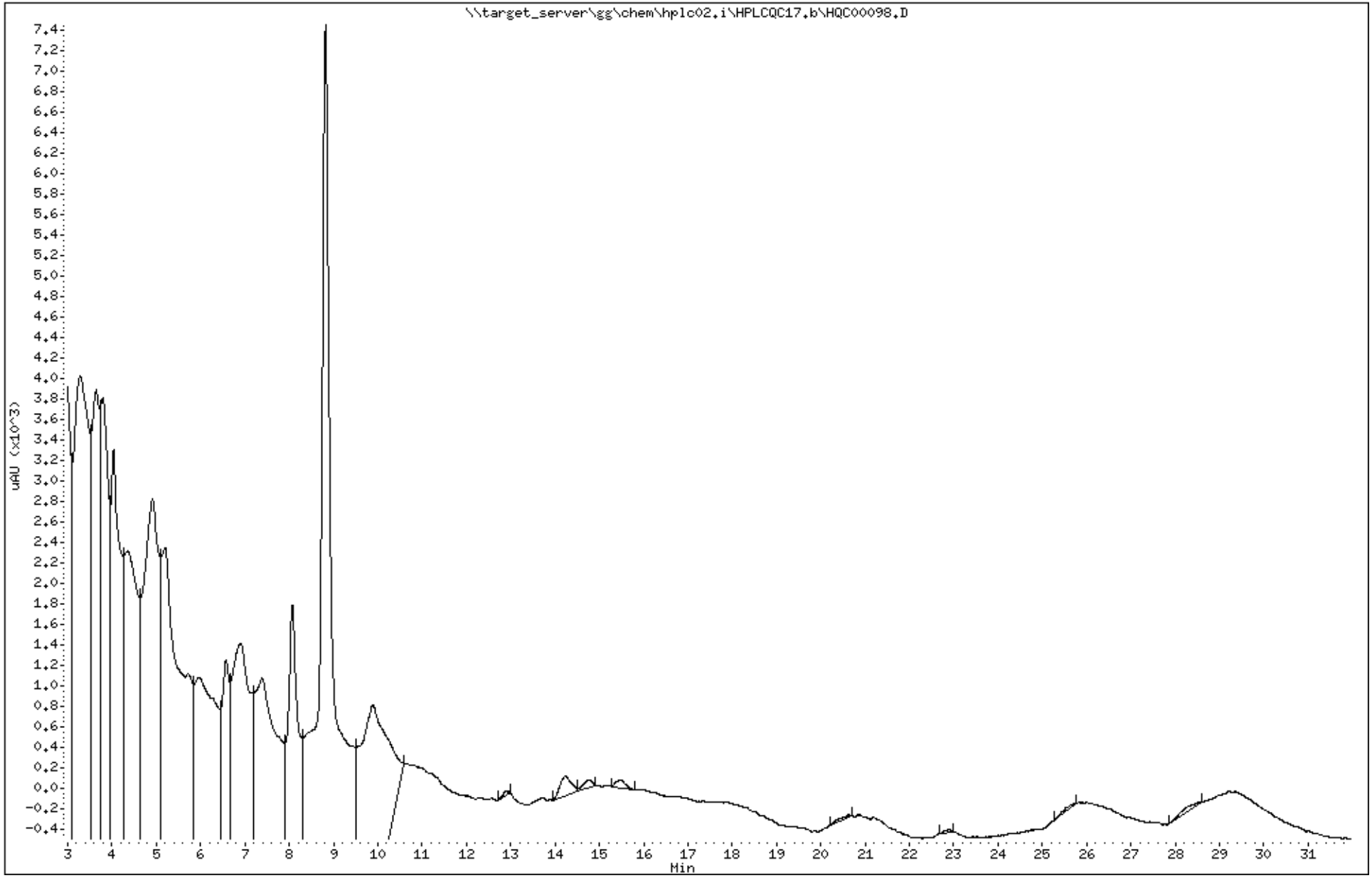
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00098.D
Lab Smp Id: SQ1201-4 Client Smp ID: JACKSON-SWJC1-DC-01
Inj Date : 17-MAR-2023 15:44
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-4
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00098.D
Date : 17-MAR-2023 15:44
Client ID: JACKSON-SWJC1-DC-01
Instrument: hplc02.i
Sample Info: SQ1201-4
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: HQC00098.D
Report Date: 23-Mar-2023 10:26

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00098.D
Lab Smp Id: SQ1201-4 Client Smp ID: JACKSON-SWJC1-DC-01
Inj Date : 17-MAR-2023 15:44
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-4
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

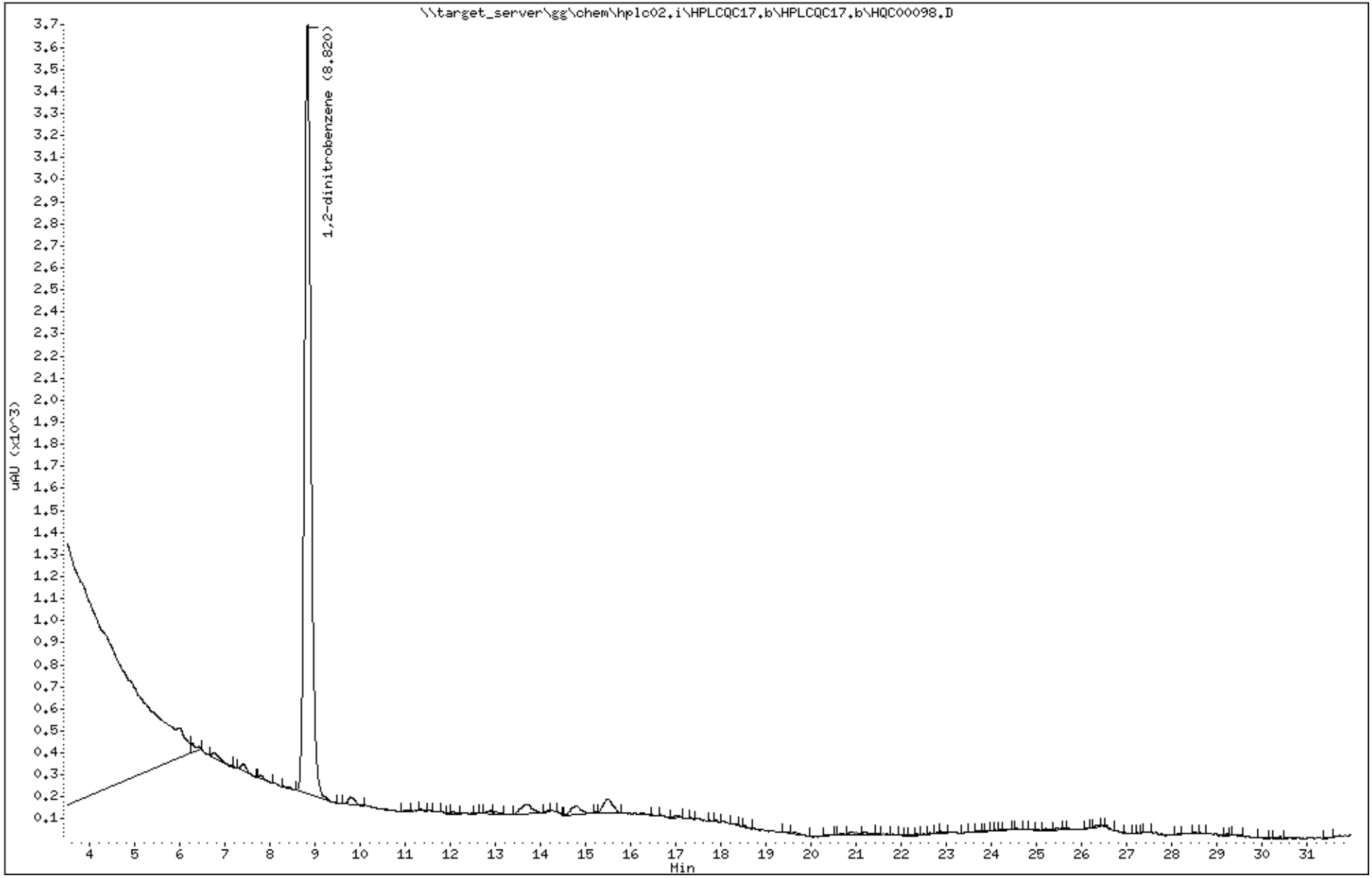
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.820	8.828	-0.008	3489	0.52246	5.22(R)	

QC Flag Legend

R - Spike/Surrogate failed recovery limits.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00098.D
Date : 17-MAR-2023 15:44
Client ID: JACKSON-SWJC1-DC-01 Instrument: hplc02.i
Sample Info: SQ1201-4
Purge Volume: 0.5 Operator: EP
Column phase: Phenomenex Kinetex Column diameter: 4.60



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Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-5
Client ID: JACKSON-SWMC1-DC-01
Matrix: AQ
Lab File ID: HQC00099.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	UH	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		104.	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00099.D
Report Date: 23-Mar-2023 10:33

Katahdin Analytical Services

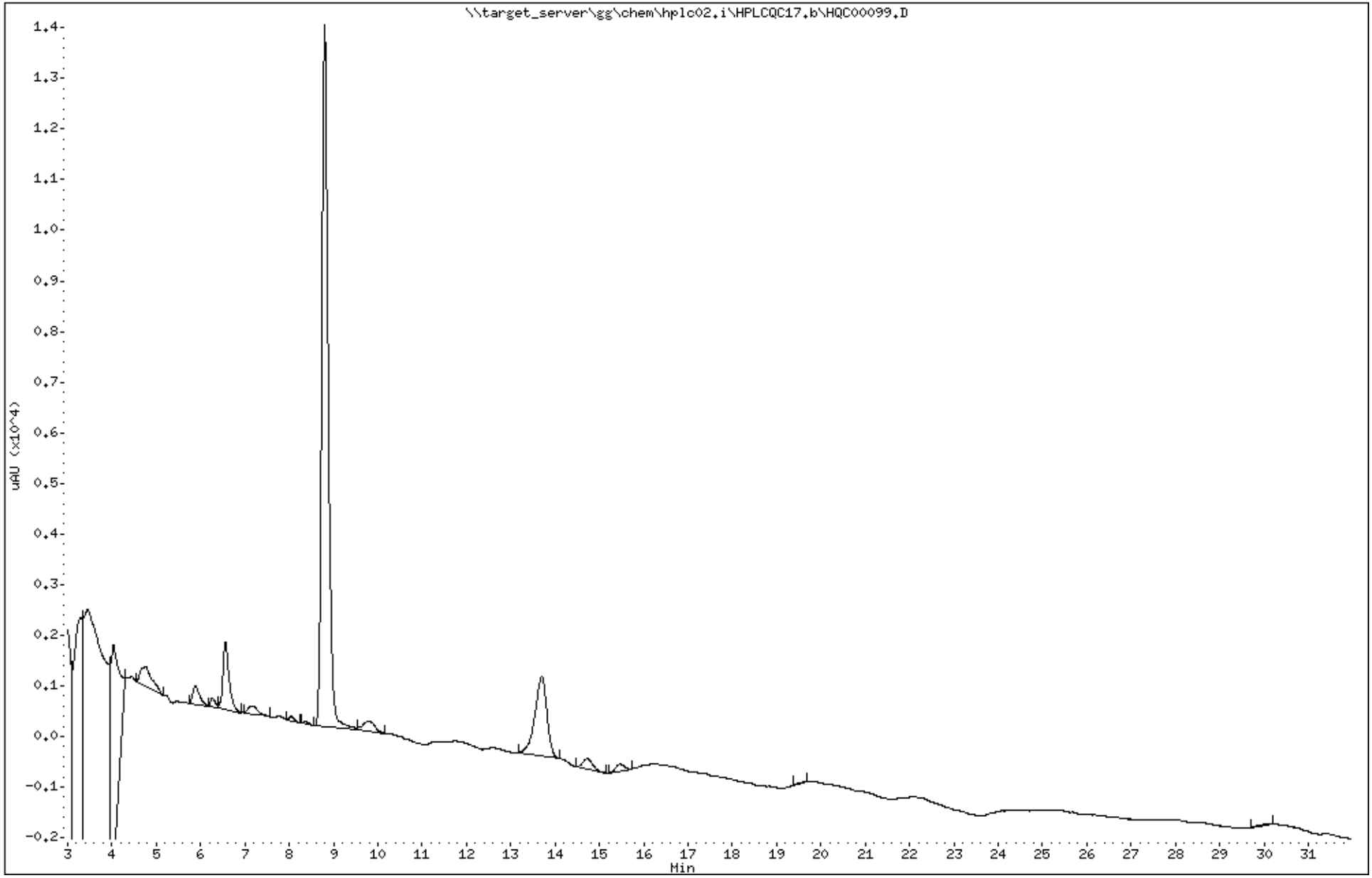
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00099.D
Lab Smp Id: SQ1201-5 Client Smp ID: JACKSON-SWMC1-DC-01
Inj Date : 17-MAR-2023 16:18
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-5
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00099.D
Date : 17-MAR-2023 16:18
Client ID: JACKSON-SWMC1-DC-01 Instrument: hplc02.i
Sample Info: SQ1201-5
Purge Volume: 0.5 Operator: EP
Column phase: Phenomenex Kinetex Column diameter: 4.60



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Data File: HQC00099.D
Report Date: 23-Mar-2023 10:26

Katahdin Analytical Services

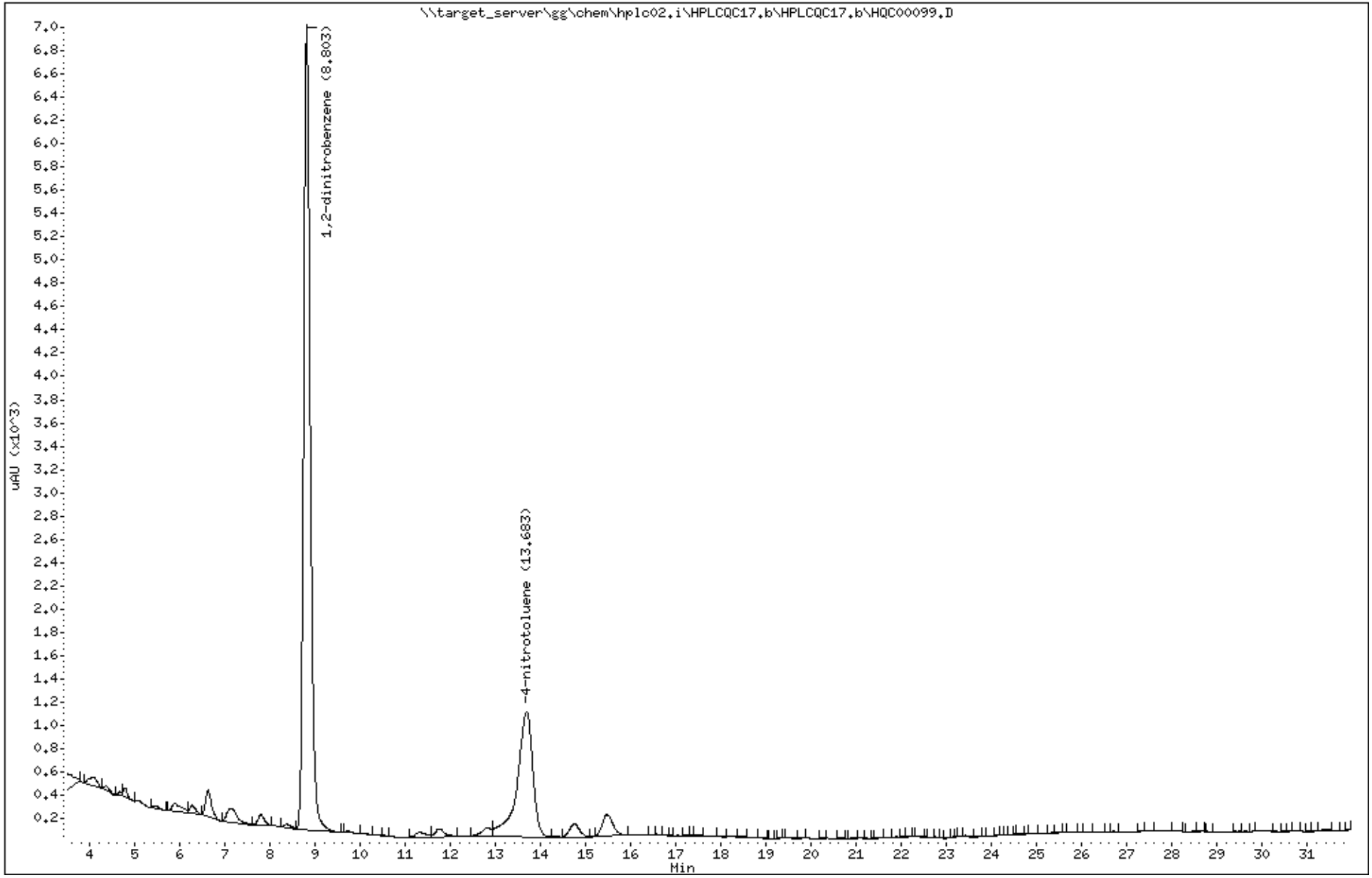
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00099.D
Lab Smp Id: SQ1201-5 Client Smp ID: JACKSON-SWMC1-DC-01
Inj Date : 17-MAR-2023 16:18
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-5
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

						CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	
Compounds	RT	EXP RT	DLT RT	RESPONSE				REVIEW CODE
$ 2 1,2-dinitrobenzene	8.803	8.828	-0.025	6925		1.03698	10.4	
16 4-nitrotoluene	13.683	13.648	0.035	1078		0.30787	3.08	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00099.D
Date : 17-MAR-2023 16:18
Client ID: JACKSON-SWMC1-DC-01 Instrument: hplc02.i
Sample Info: SQ1201-5
Purge Volume: 0.5 Operator: EP
Column phase: Phenomenex Kinetex Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00131.D
Report Date: 23-Mar-2023 12:58

Katahdin Analytical Services

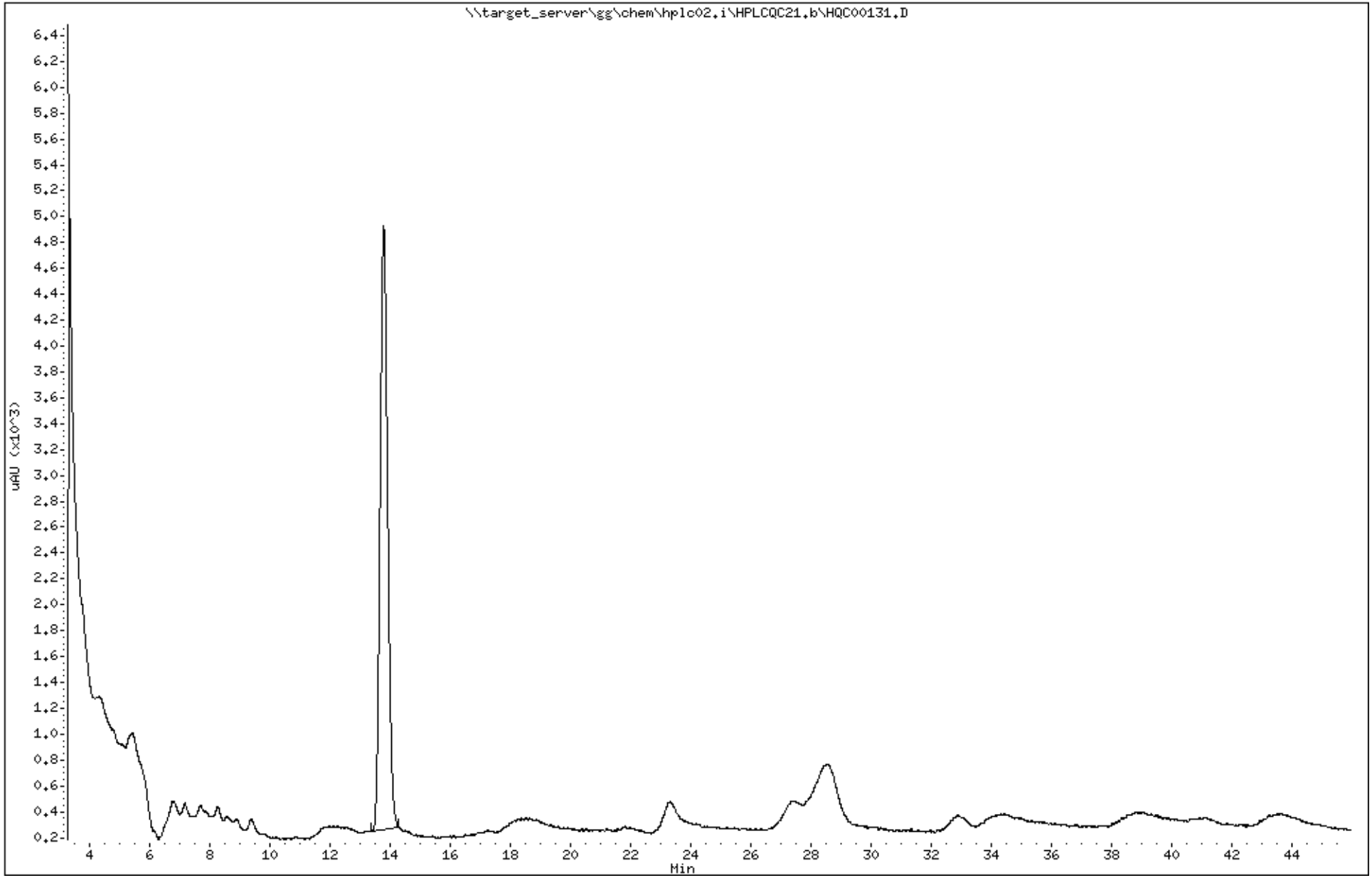
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00131.D
Lab Smp Id: SQ1201-5C
Inj Date : 22-MAR-2023 00:17
Operator : EP   Inst ID: hplc02.i
Smp Info : SQ1201-5C
Misc Info : WG334216,WG333823,WG334216-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 10:46 hplc02.i   Quant Type: ESTD
Cal Date : 21-MAR-2023 16:45   Cal File: HQC00122.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: NGPETN.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00131.D
Date : 22-MAR-2023 00:17
Client ID:
Instrument: hplc02.i
Sample Info: SQ1201-5C
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



Data File: HQC00131.D
Report Date: 23-Mar-2023 12:58

Katahdin Analytical Services

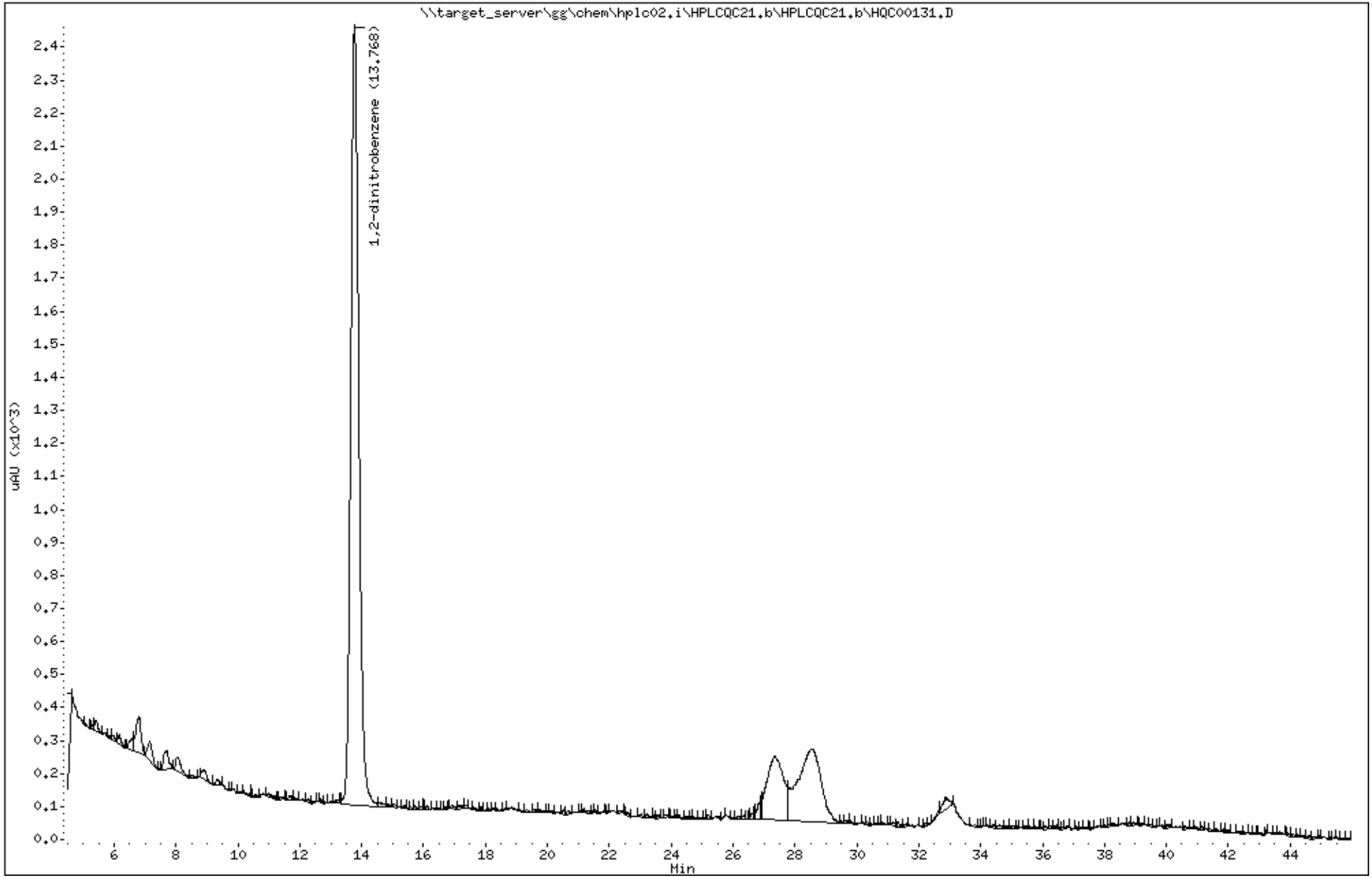
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00131.D
Lab Smp Id: SQ1201-5C
Inj Date : 22-MAR-2023 00:17
Operator : EP   Inst ID: hplc02.i
Smp Info : SQ1201-5C
Misc Info : WG334216,WG333823,WG334216-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 10:43 hplc02.i   Quant Type: ESTD
Cal Date : 21-MAR-2023 18:25   Cal File: HQC00124.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
$ 2 1,2-dinitrobenzene	13.768	13.796	-0.028	2362	1.02264	10.2	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00131.D
Date : 22-MAR-2023 00:17
Client ID:
Instrument: hplc02.i
Sample Info: SQ1201-5C
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



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Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-6
Client ID: JACKSON-SWCC3-DC-01
Matrix: AQ
Lab File ID: HQC00100.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		102.	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00100.D
Report Date: 23-Mar-2023 10:33

Katahdin Analytical Services

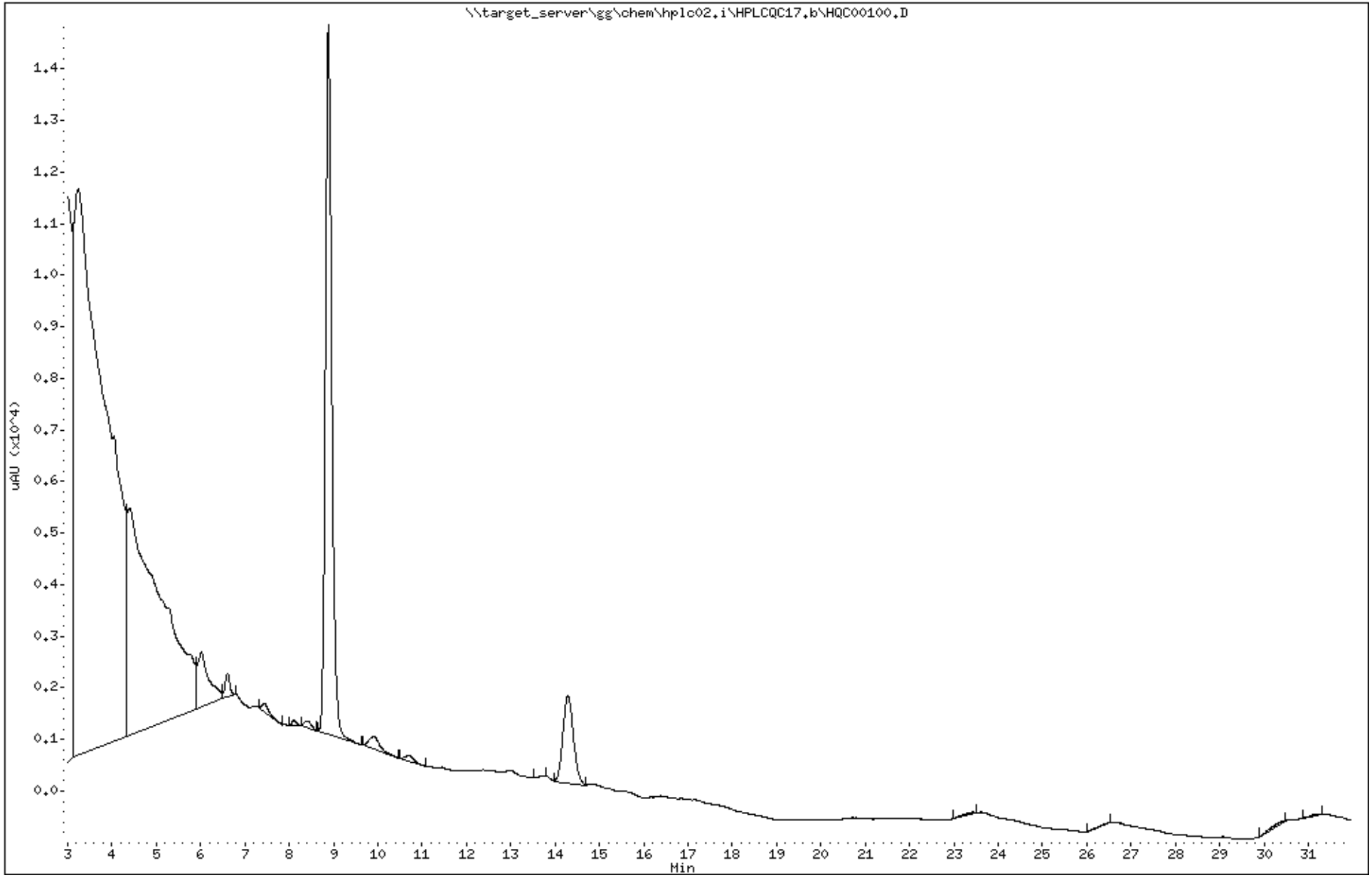
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00100.D
Lab Smp Id: SQ1201-6 Client Smp ID: JACKSON-SWCC3-DC-01
Inj Date : 17-MAR-2023 16:53
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-6
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00100.D
Date : 17-MAR-2023 16:53
Client ID: JACKSON-SWCC3-DC-01
Instrument: hplc02.i
Sample Info: SQ1201-6
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: HQC00100.D
Report Date: 23-Mar-2023 10:26

Katahdin Analytical Services

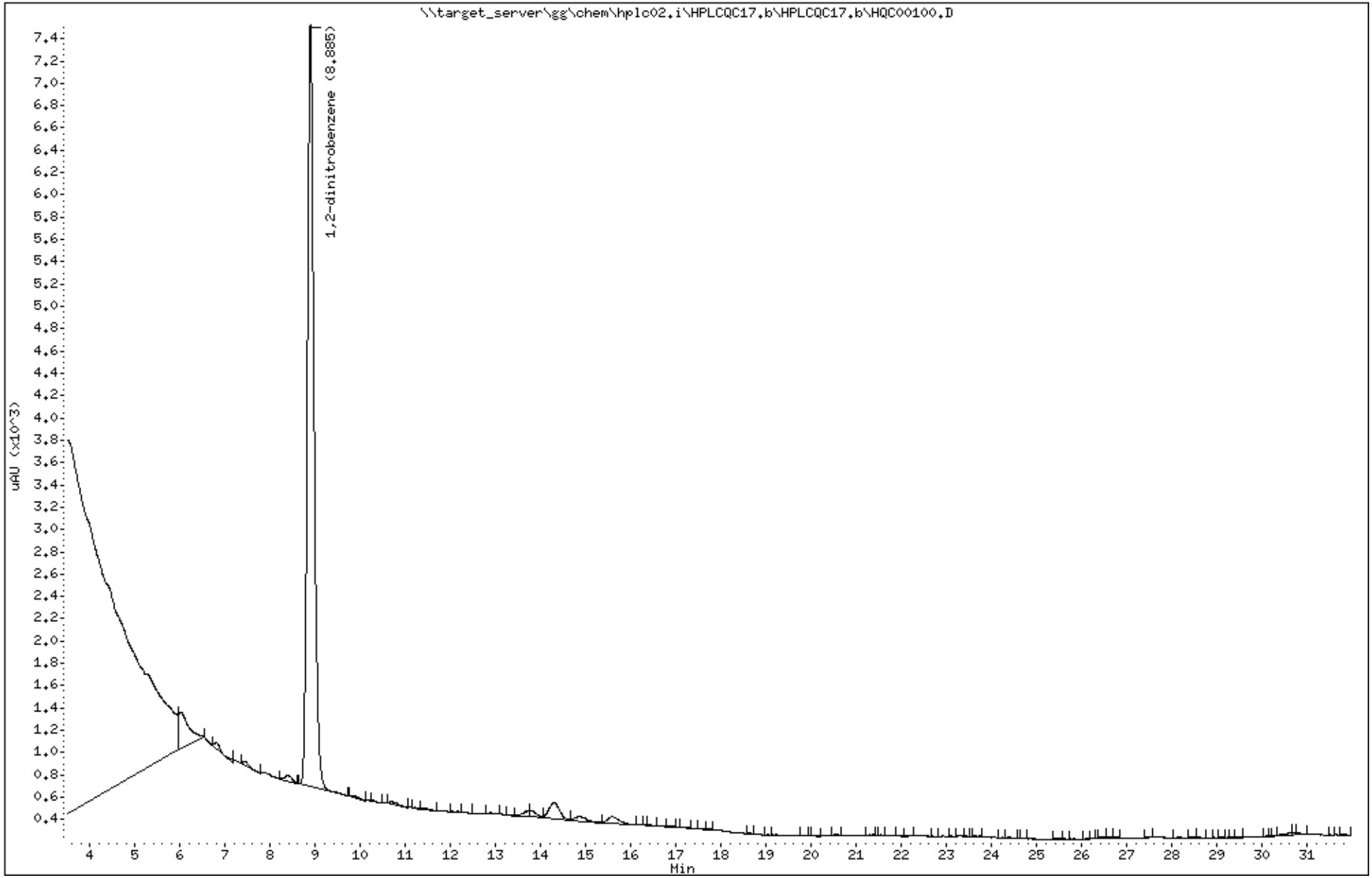
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00100.D
Lab Smp Id: SQ1201-6 Client Smp ID: JACKSON-SWCC3-DC-01
Inj Date : 17-MAR-2023 16:53
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-6
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.884	8.828	0.056	6831	1.02290	10.2	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00100.D
Date : 17-MAR-2023 16:53
Client ID: JACKSON-SWCC3-DC-01 Instrument: hplc02.i
Sample Info: SQ1201-6
Purge Volume: 0.5 Operator: EP
Column phase: Phenomenex Kinetex Column diameter: 4.60



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Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-7
Client ID: JACKSON-SWCC4-DC-01
Matrix: AQ
Lab File ID: HQC00101.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		106.	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00101.D
Report Date: 23-Mar-2023 10:33

Katahdin Analytical Services

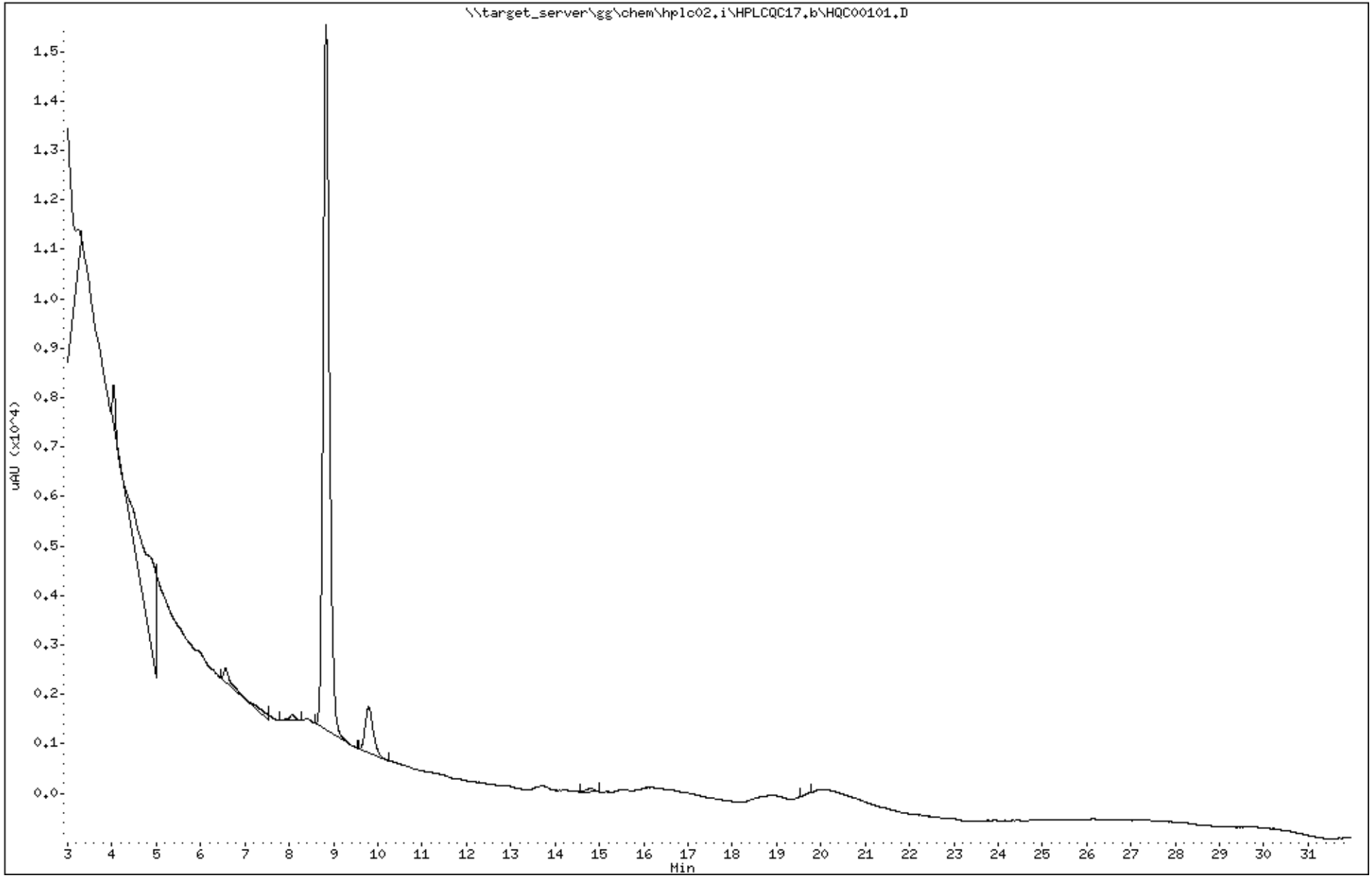
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00101.D
Lab Smp Id: SQ1201-7 Client Smp ID: JACKSON-SWCC4-DC-01
Inj Date : 17-MAR-2023 17:28
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-7
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00101.D
Date : 17-MAR-2023 17:28
Client ID: JACKSON-SWCC4-DC-01
Instrument: hplc02.i
Sample Info: SQ1201-7
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 242 of 1130

Data File: HQC00101.D
Report Date: 23-Mar-2023 10:26

Katahdin Analytical Services

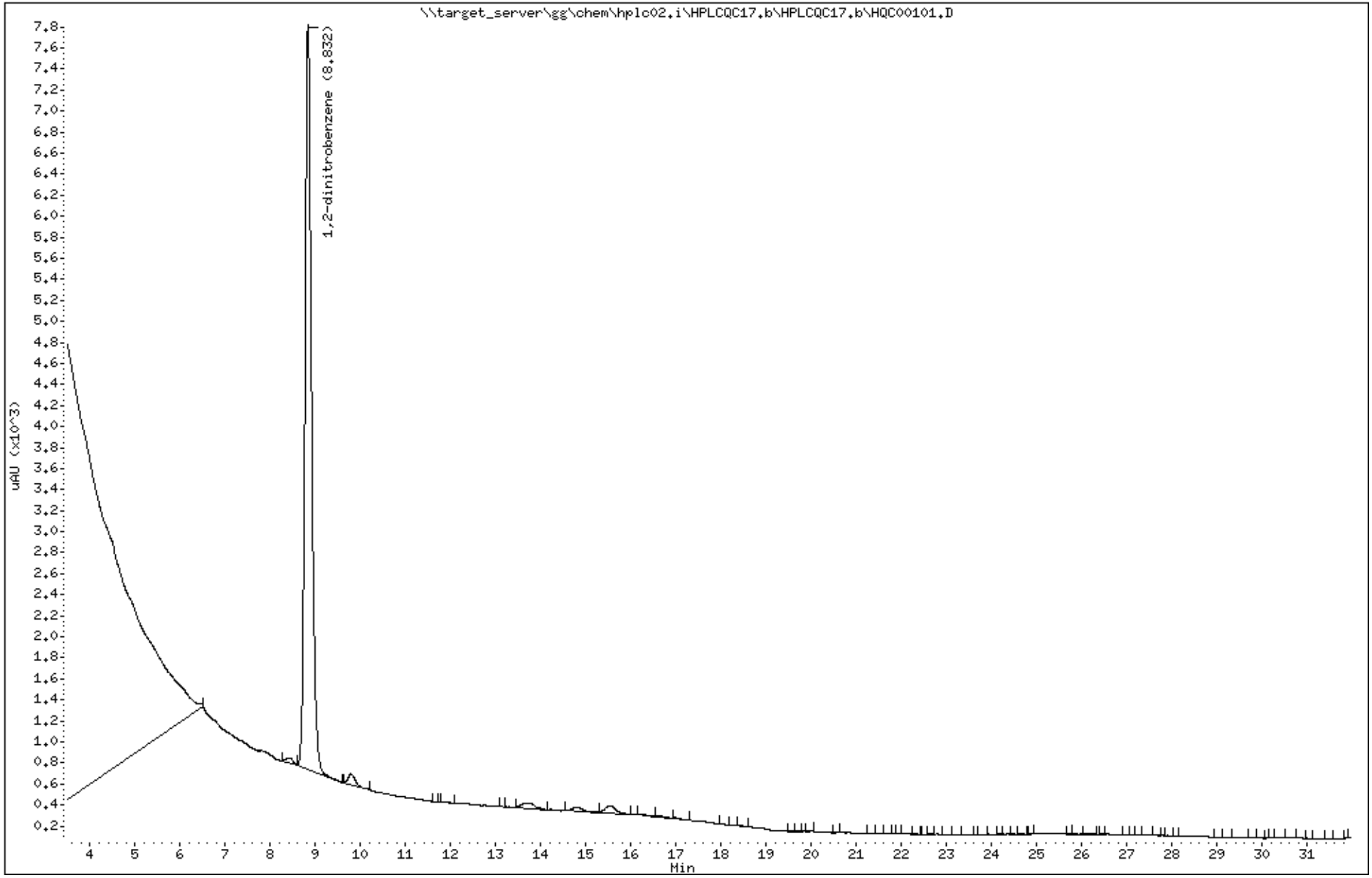
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00101.D
Lab Smp Id: SQ1201-7 Client Smp ID: JACKSON-SWCC4-DC-01
Inj Date : 17-MAR-2023 17:28
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-7
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.832	8.828	0.004	7087	1.06123	10.6	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00101.D
Date : 17-MAR-2023 17:28
Client ID: JACKSON-SWCC4-DC-01 Instrument: hplc02.i
Sample Info: SQ1201-7
Purge Volume: 0.5 Operator: EP
Column phase: Phenomenex Kinetex Column diameter: 4.60



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Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-9
Client ID: JACKSON-EB-01
Matrix: AQ
Lab File ID: HQC00102.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		104.	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00102.D
Report Date: 23-Mar-2023 10:33

Katahdin Analytical Services

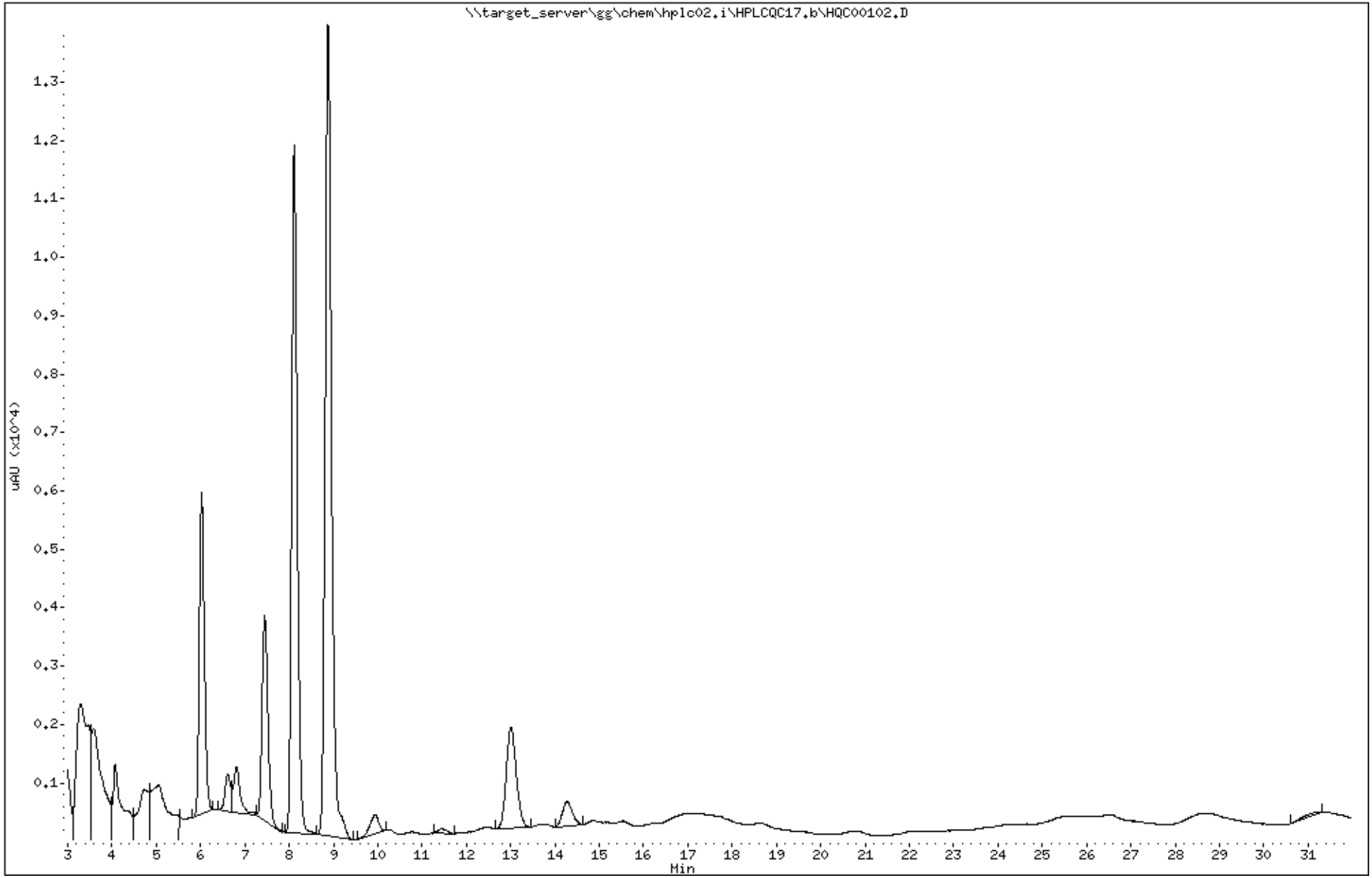
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00102.D
Lab Smp Id: SQ1201-9 Client Smp ID: JACKSON-EB-01
Inj Date : 17-MAR-2023 18:02
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-9
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00102.D
Date : 17-MAR-2023 18:02
Client ID: JACKSON-EB-01
Instrument: hplc02.i
Sample Info: SQ1201-9
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: HQC00102.D
Report Date: 23-Mar-2023 10:27

Katahdin Analytical Services

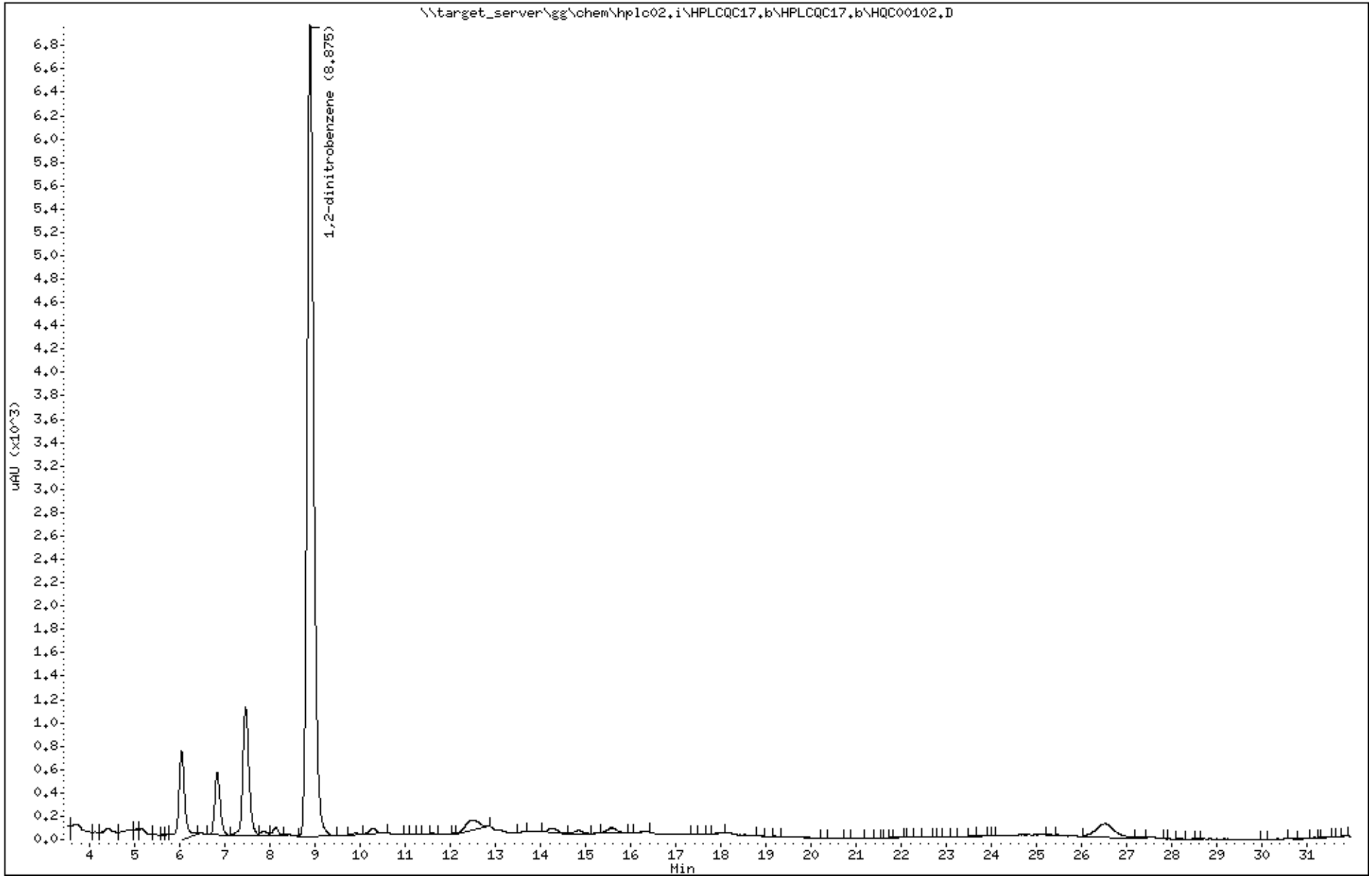
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00102.D
Lab Smp Id: SQ1201-9 Client Smp ID: JACKSON-EB-01
Inj Date : 17-MAR-2023 18:02
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-9
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.874	8.828	0.046	6950	1.04072	10.4	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00102.D
Date : 17-MAR-2023 18:02
Client ID: JACKSON-EB-01
Instrument: hplc02.i
Sample Info: SQ1201-9
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: SQ1201-10
Client ID: JACKSON-CB-01
Matrix: AQ
Lab File ID: HQC00104.D

Sample Date: 08-MAR-23
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	UL	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	UH	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		96.5	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00104.D
Report Date: 23-Mar-2023 10:33

Katahdin Analytical Services

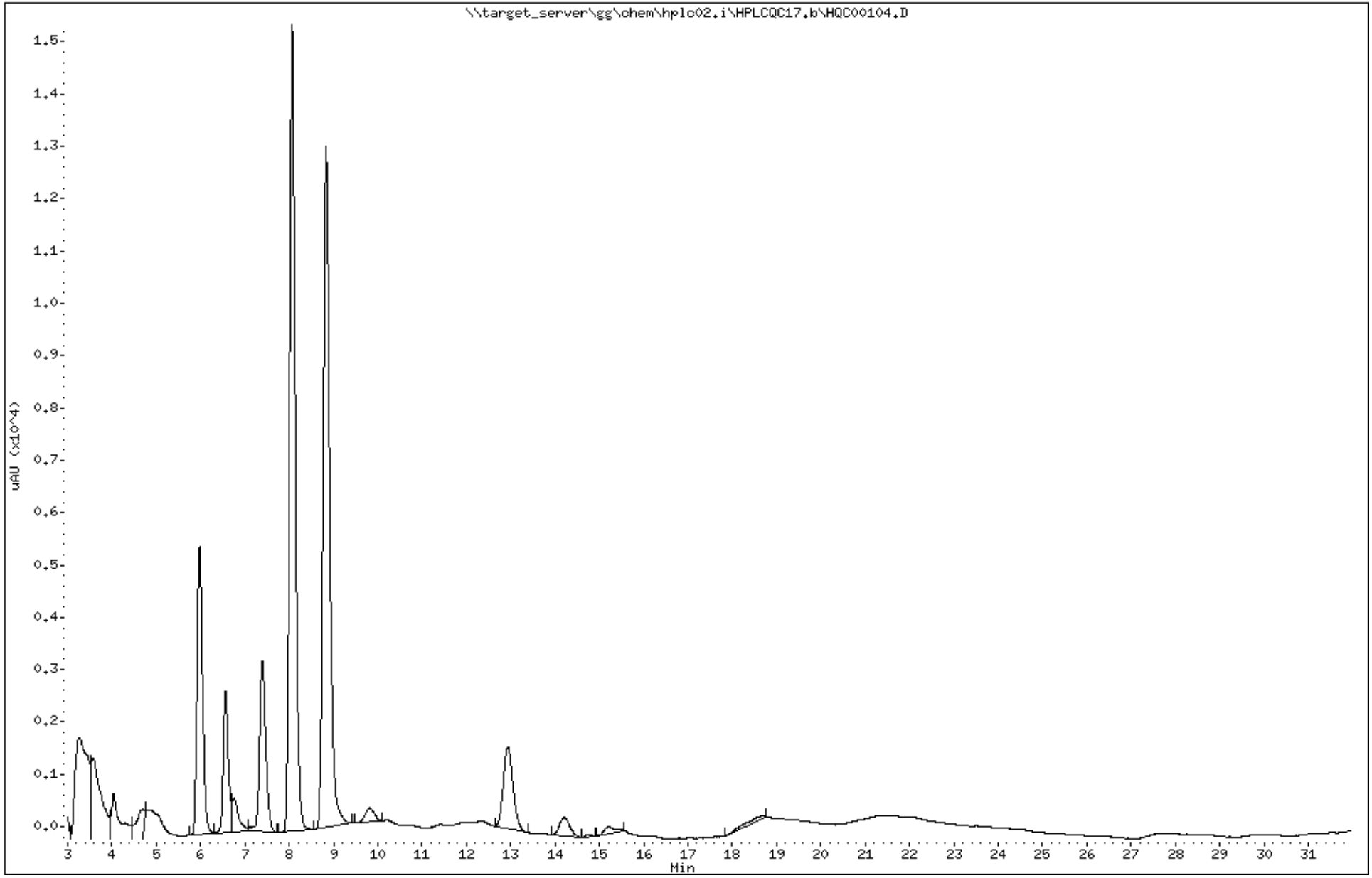
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00104.D
Lab Smp Id: SQ1201-10 Client Smp ID: JACKSON-CB-01
Inj Date : 17-MAR-2023 19:12
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-10
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00104.D
Date : 17-MAR-2023 19:12
Client ID: JACKSON-CB-01
Instrument: hplc02.i
Sample Info: SQ1201-10
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: HQC00104.D
Report Date: 23-Mar-2023 10:27

Katahdin Analytical Services

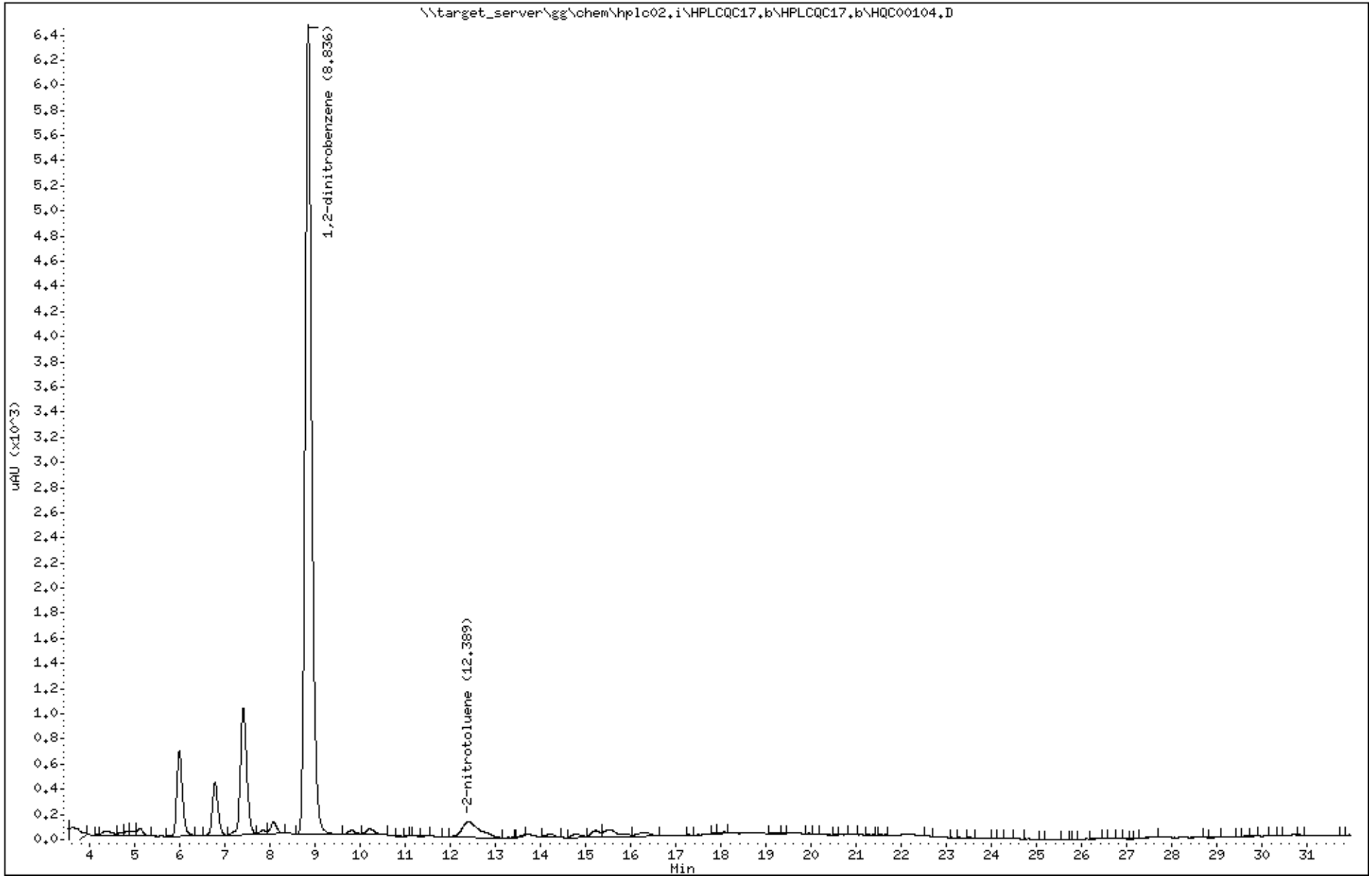
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00104.D
Lab Smp Id: SQ1201-10 Client Smp ID: JACKSON-CB-01
Inj Date : 17-MAR-2023 19:12
Operator : EP Inst ID: hplc02.i
Smp Info : SQ1201-10
Misc Info : WG333979,WG333823,WG333590-5
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.835	8.828	0.007	6443	0.96480	9.65	
15 2-nitrotoluene	12.389	12.328	0.061	127	0.03231	0.323	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00104.D
Date : 17-MAR-2023 19:12
Client ID: JACKSON-CB-01 Instrument: hplc02.i
Sample Info: SQ1201-10
Purge Volume: 0.5 Operator: EP
Column phase: Phenomenex Kinetex Column diameter: 4.60



Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00132.D
Report Date: 23-Mar-2023 12:58

Katahdin Analytical Services

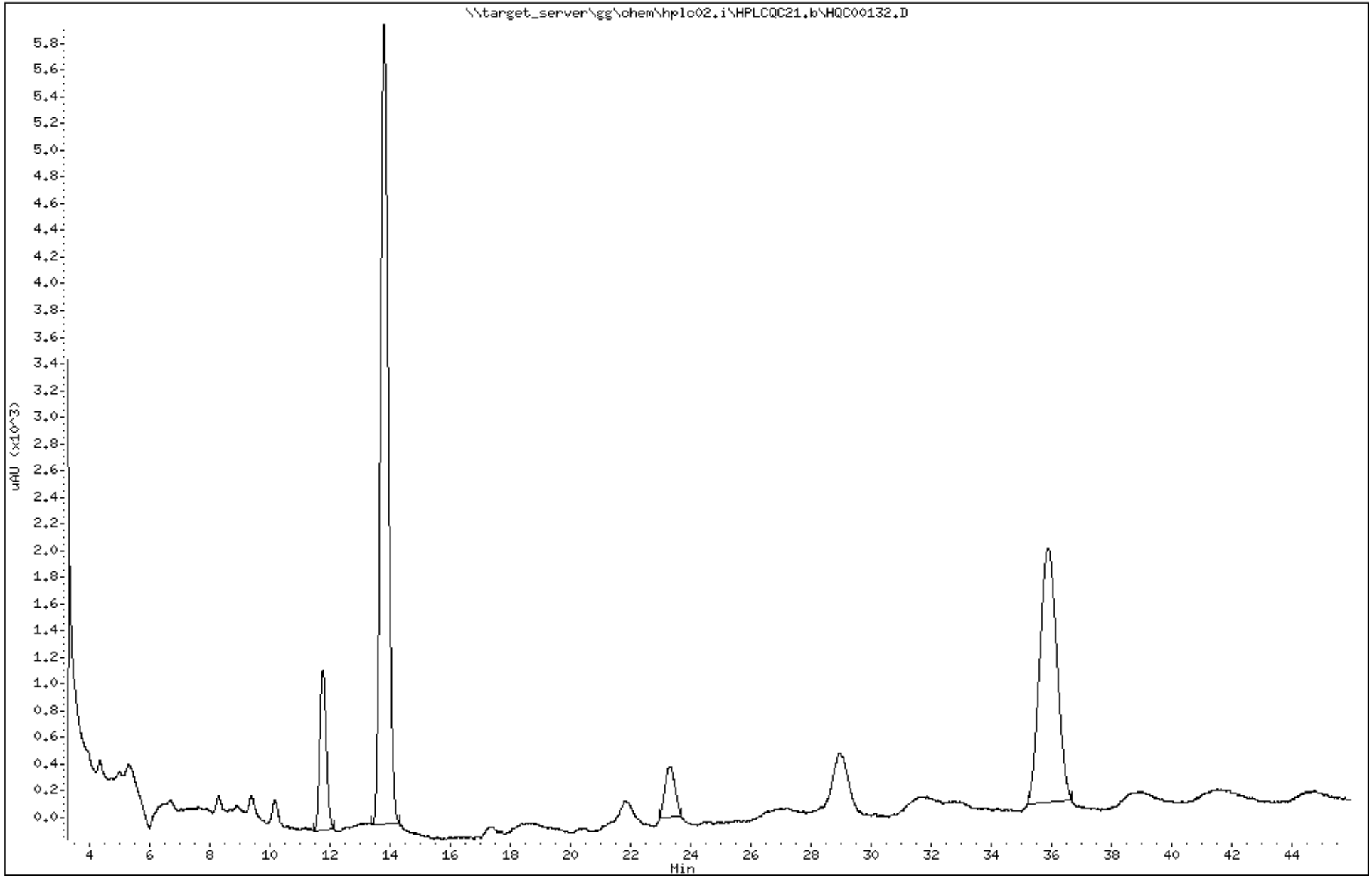
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00132.D
Lab Smp Id: SQ1201-10C
Inj Date : 22-MAR-2023 01:08
Operator : EP   Inst ID: hplc02.i
Smp Info : SQ1201-10C
Misc Info : WG334216,WG333823,WG334216-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 10:46 hplc02.i Quant Type: ESTD
Cal Date : 21-MAR-2023 16:45   Cal File: HQC00122.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: NGPETN.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00132.D
Date : 22-MAR-2023 01:08
Client ID:
Instrument: hplc02.i
Sample Info: SQ1201-10C
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



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Data File: HQC00132.D
Report Date: 23-Mar-2023 12:58

Katahdin Analytical Services

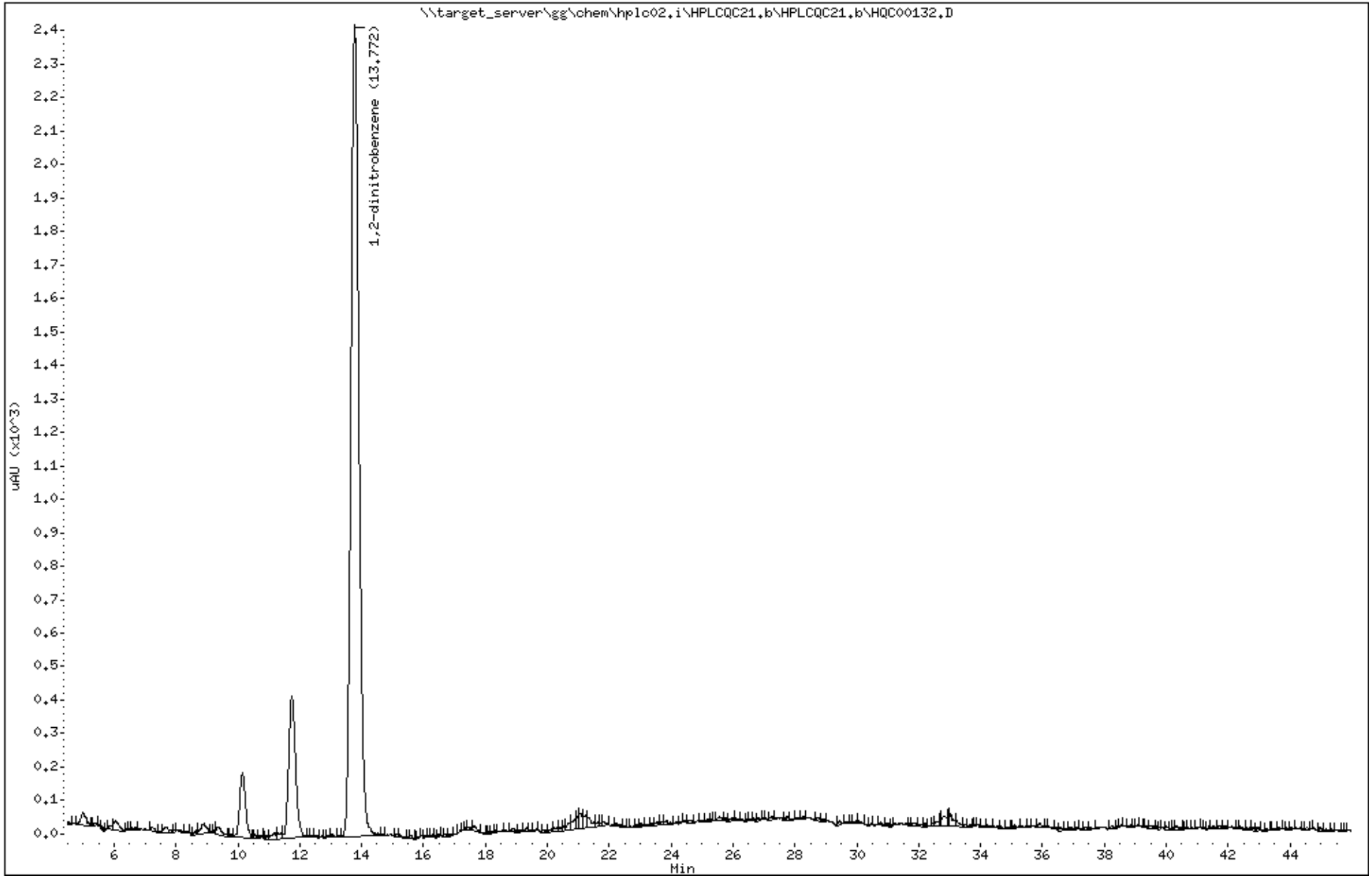
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00132.D
Lab Smp Id: SQ1201-10C
Inj Date : 22-MAR-2023 01:08
Operator : EP   Inst ID: hplc02.i
Smp Info : SQ1201-10C
Misc Info : WG334216,WG333823,WG334216-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 10:43 hplc02.i   Quant Type: ESTD
Cal Date : 21-MAR-2023 18:25   Cal File: HQC00124.D
Als bottle: 1
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
$ 2 1,2-dinitrobenzene	13.771	13.796	-0.025	2424	1.04948	10.5	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00132.D
Date : 22-MAR-2023 01:08
Client ID:
Instrument: hplc02.i
Sample Info: SQ1201-10C
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



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Standards Data Section

Form 6
Initial Calibration Summary

Lab Name : Katahdin Analytical Services
SDG: SQ1201
Instrument ID: HPLC02
Calibration Date(s): 15-MAR-23 09:32
15-MAR-23 13:00
Lab File IDs : HQC00038.I,HQC00039.I,HQC00040.I
HQC00041.I,HQC00042.I,HQC00043.I
HQC00044.I

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7		Curve				%RSD or R^2		
	0.0250000	0.0500000	0.1000000	0.2500000	0.5000000	1.0000	2.0000		Type	b	m1	m2	Result	Limit	
NITROGLYCERIN	6230	6420	6913	6952	7130	7000	7155		AVG		6828		5.26	20	O

Legend: O = Acceptable; W = Failed %RSD Value; X = Failed R^2 Value; Y = Failed Minimum RF

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http://katahdinlab.com
sales@katahdinlab.com

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00045.D
Report Date: 23-Mar-2023 10:18

Katahdin Analytical Services

RECOVERY REPORT

Client Name: Client SDG: SDGa00508
Sample Matrix: LIQUID Fraction: Explosives
Lab Smp Id: WG333590-8
Level: LOW Operator: EP
Data Type: LC DATA SampleType: INDSOURCE
SpikeList File: IND.spk Quant Type: ESTD
Sublist File: ngpetn.sub
Method File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Misc Info: WG333590,WG333590,WG333590-5

SPIKE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
3 Ethylene Glycol D	20.0	0.000	*	30-150
8 NITROGLYCERIN	20.0	19.6	98.29	80-120
18 PETN	20.0	20.2	101.06	80-120

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00038.D
Report Date: 23-Mar-2023 10:17

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00038.D
Lab Smp Id: WG333590-1
Inj Date : 15-MAR-2023 09:32
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-1
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:50   Cal File: HQC00042.D
Als bottle: 1   Calibration Sample, Level: 1
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

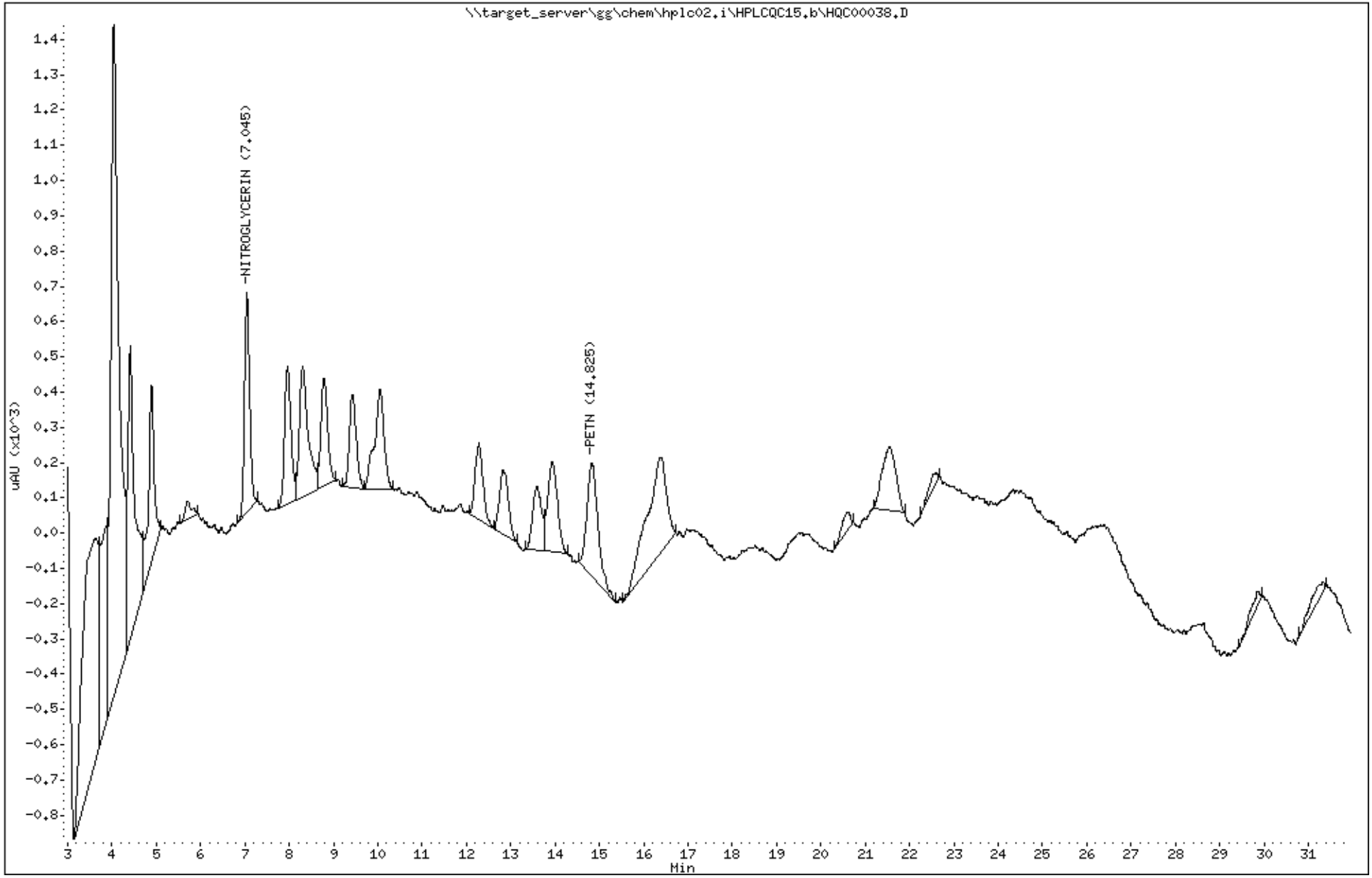
EP
11:19 am, Mar 23, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	ON-COL (ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.044	7.031	0.013	623	0.10000	0.0920(aM)	M6
18 PETN	14.824	14.751	0.073	319	0.10000	0.0916(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00038.D
Date : 15-MAR-2023 09:32
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-1
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00039.D
Report Date: 23-Mar-2023 10:17

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00039.D
Lab Smp Id: WG333590-2
Inj Date : 15-MAR-2023 10:06
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-2
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:50   Cal File: HQC00042.D
Als bottle: 1   Calibration Sample, Level: 2
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

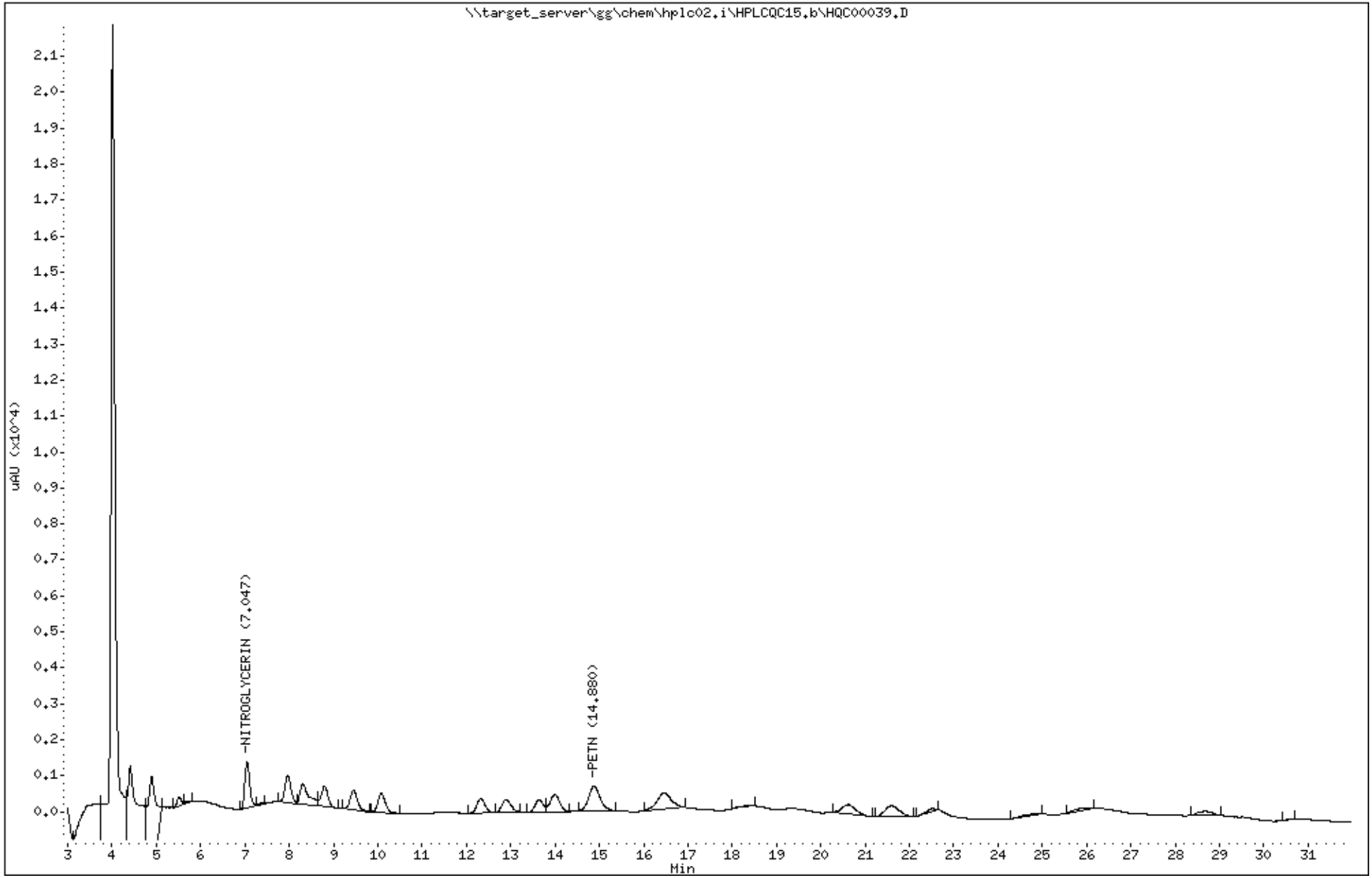
EP
11:19 am, Mar 23, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.046	7.031	0.015	1284	0.20000	0.192(aM)	M6
18 PETN	14.879	14.751	0.128	680	0.20000	0.196(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00039.D
Date : 15-MAR-2023 10:06
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-2
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00040.D
Report Date: 23-Mar-2023 10:17

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00040.D
Lab Smp Id: WG333590-3
Inj Date : 15-MAR-2023 10:41
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-3
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:50   Cal File: HQC00042.D
Als bottle: 1   Calibration Sample, Level: 3
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

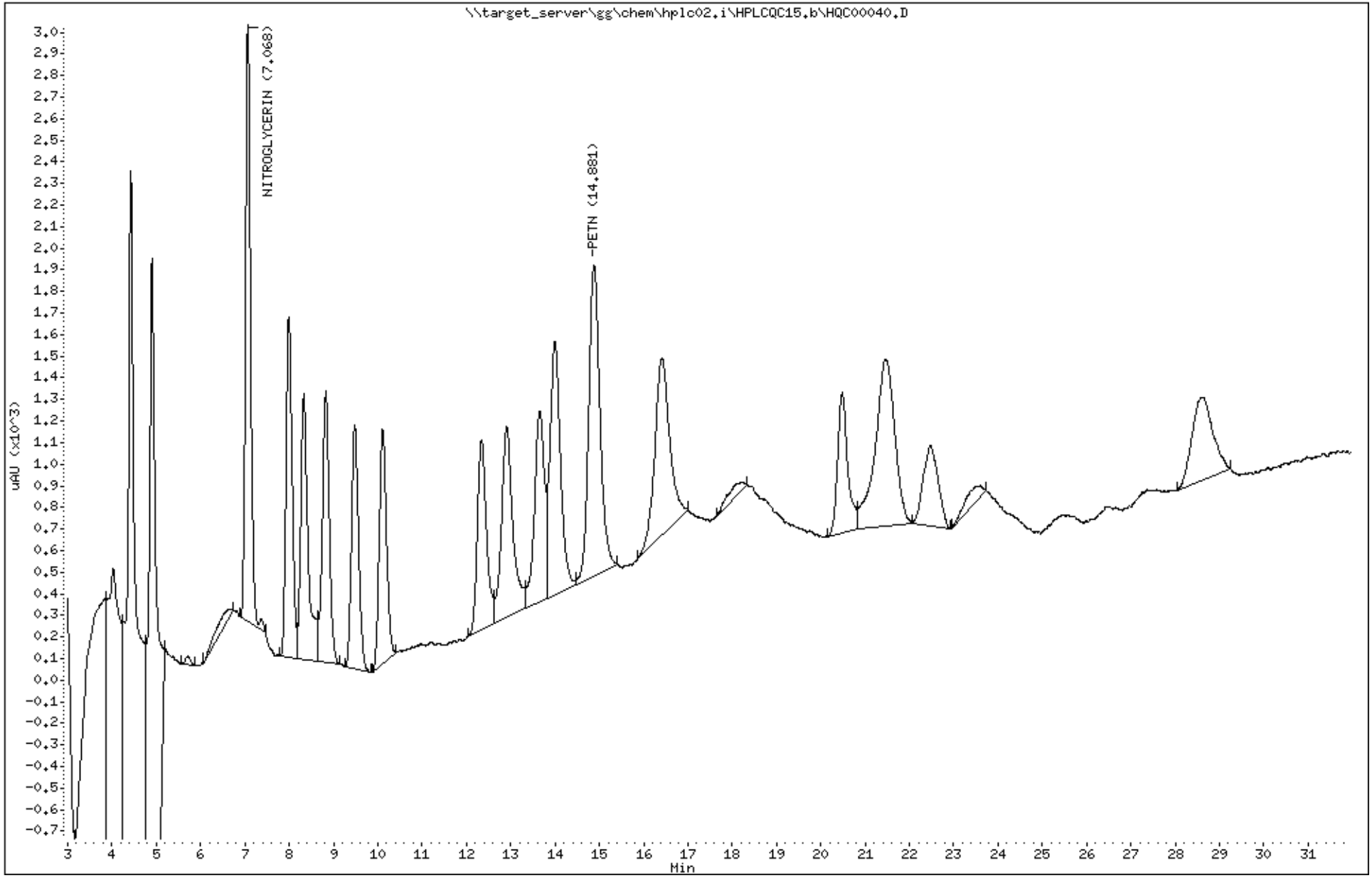
EP
11:19 am, Mar 23, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.067	7.031	0.036	2765	0.40000	0.411(aM)	M6
18 PETN	14.880	14.751	0.129	1439	0.40000	0.413(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00040.D
Date : 15-MAR-2023 10:41
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-3
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00041.D
Report Date: 23-Mar-2023 10:18

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00041.D
Lab Smp Id: WG333590-4
Inj Date : 15-MAR-2023 11:16
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-4
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:16   Cal File: HQC00041.D
Als bottle: 1   Calibration Sample, Level: 4
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

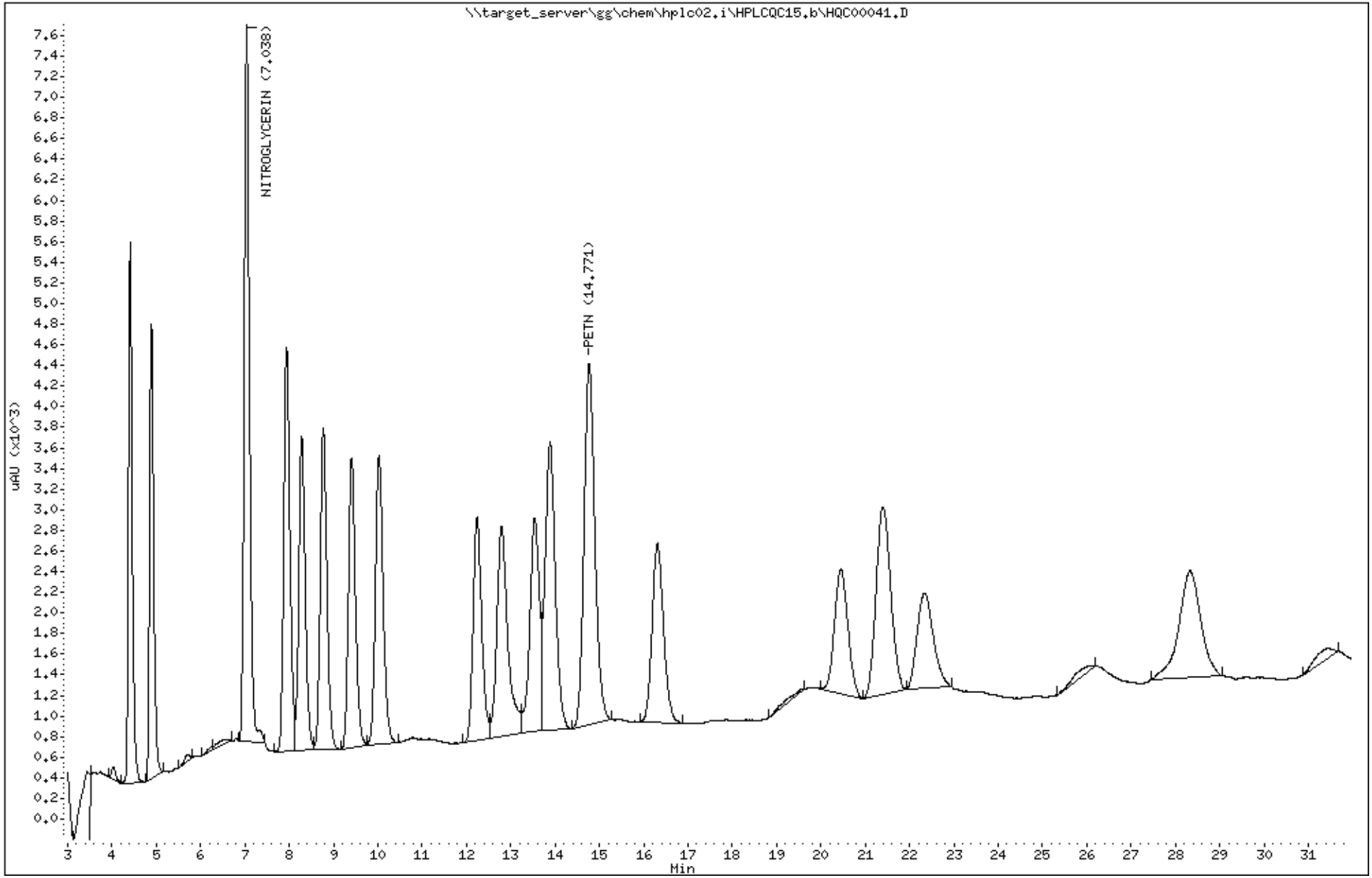
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.037	7.031	0.006	6952	1.00000	0.987(a)	
18 PETN	14.771	14.751	0.020	3498	1.00000	0.991(a)	

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00041.D
Date : 15-MAR-2023 11:16
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-4
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00042.D
Report Date: 23-Mar-2023 10:18

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00042.D
Lab Smp Id: WG333590-5
Inj Date : 15-MAR-2023 11:50
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-5
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:50   Cal File: HQC00042.D
Als bottle: 1   Calibration Sample, Level: 5
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

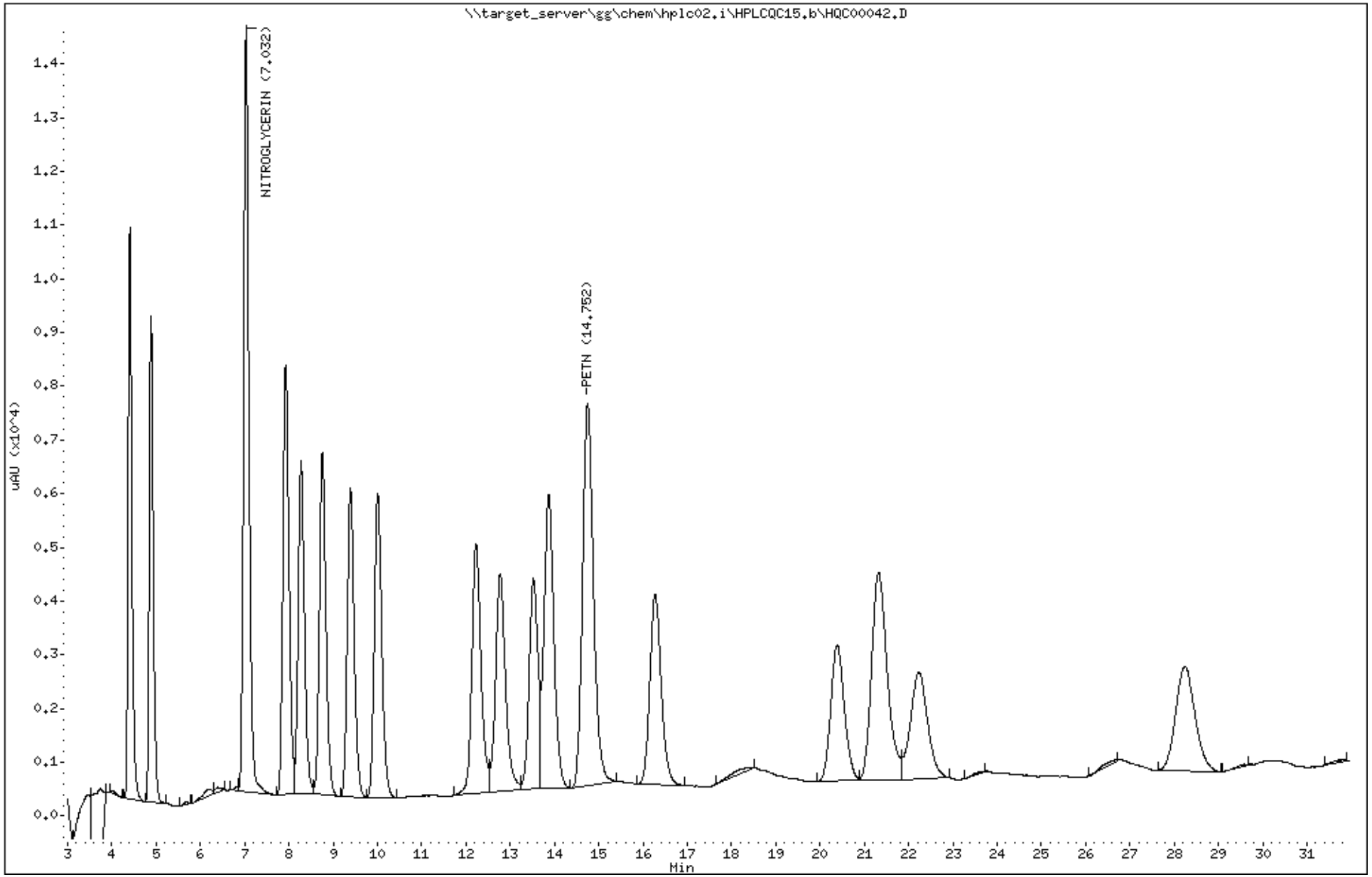
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.031	7.031	0.000	14259	2.00000	2.00(a)	
18 PETN	14.751	14.751	0.000	7120	2.00000	2.00(a)	

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00042.D
Date : 15-MAR-2023 11:50
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-5
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00043.D
Report Date: 23-Mar-2023 10:18

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00043.D
Lab Smp Id: WG333590-6
Inj Date : 15-MAR-2023 12:25
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-6
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 12:25   Cal File: HQC00043.D
Als bottle: 1   Calibration Sample, Level: 6
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

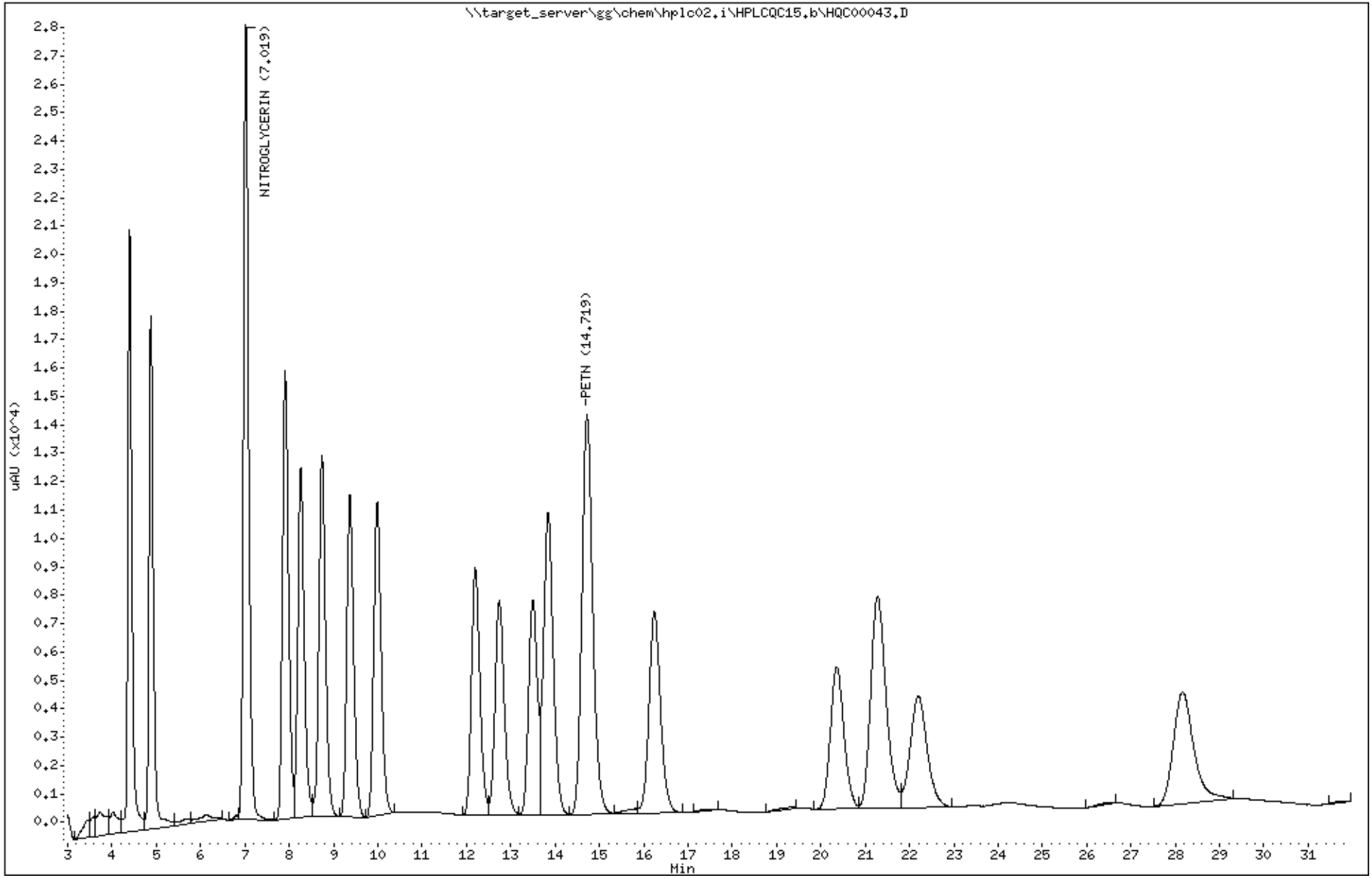
EP
11:19 am, Mar 23, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.018	7.031	-0.013	28000	4.00000	4.13(M)	M6
18 PETN	14.718	14.751	-0.033	14081	4.00000	4.04	

QC Flag Legend

M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00043.D
Date : 15-MAR-2023 12:25
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-6
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00044.D
Report Date: 23-Mar-2023 10:18

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00044.D
Lab Smp Id: WG333590-7
Inj Date : 15-MAR-2023 13:00
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-7
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Calibration Sample, Level: 7
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

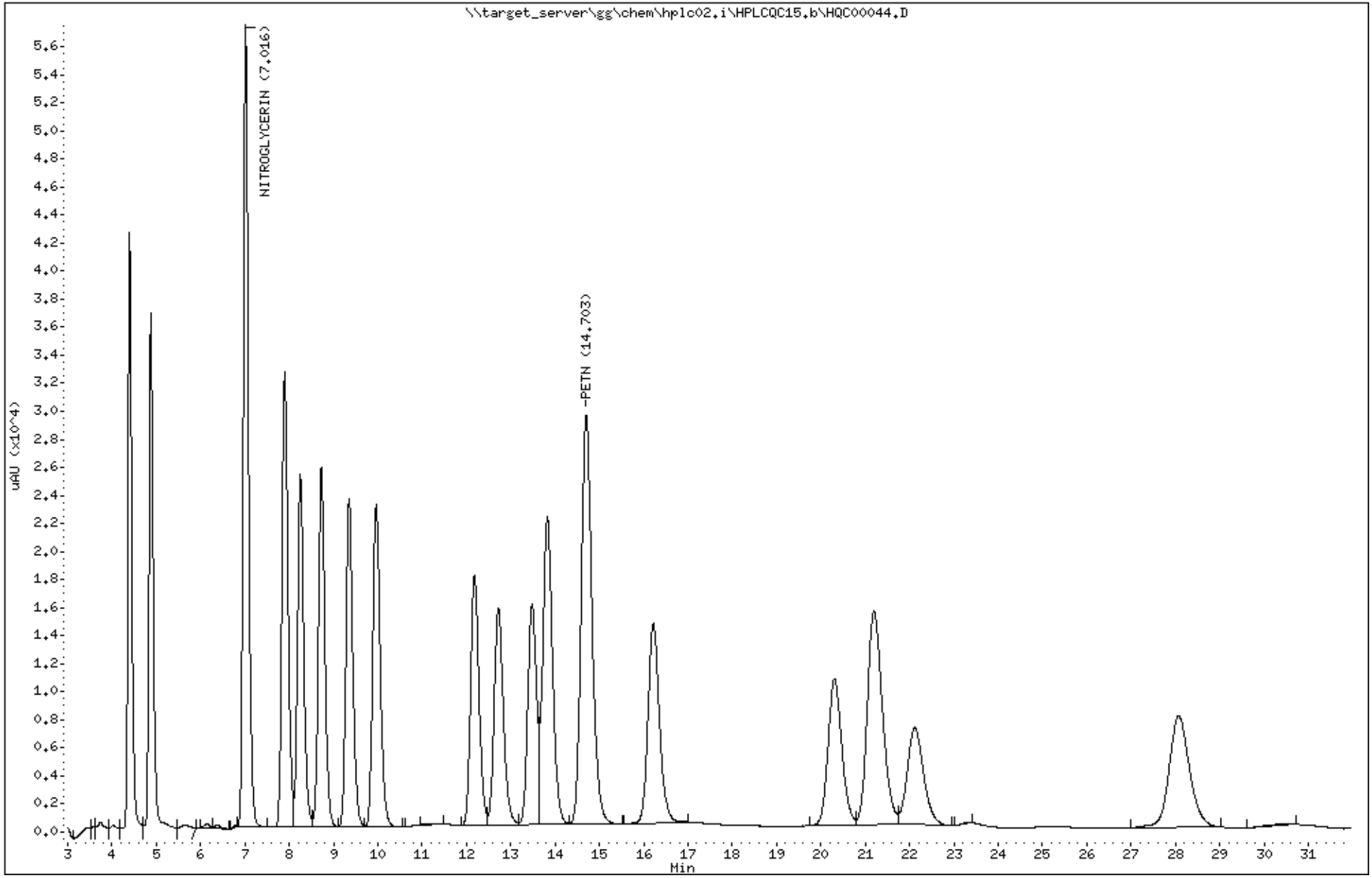
EP
11:19 am, Mar 23, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.016	7.031	-0.015	57241	8.00000	8.38(AM)	M6
18 PETN	14.702	14.751	-0.049	29150	8.00000	8.36(A)	

QC Flag Legend

A - Target compound detected but, quantitated amount
    exceeded maximum amount.
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00044.D
Date : 15-MAR-2023 13:00
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-7
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00045.D
Report Date: 23-Mar-2023 10:18

Katahdin Analytical Services

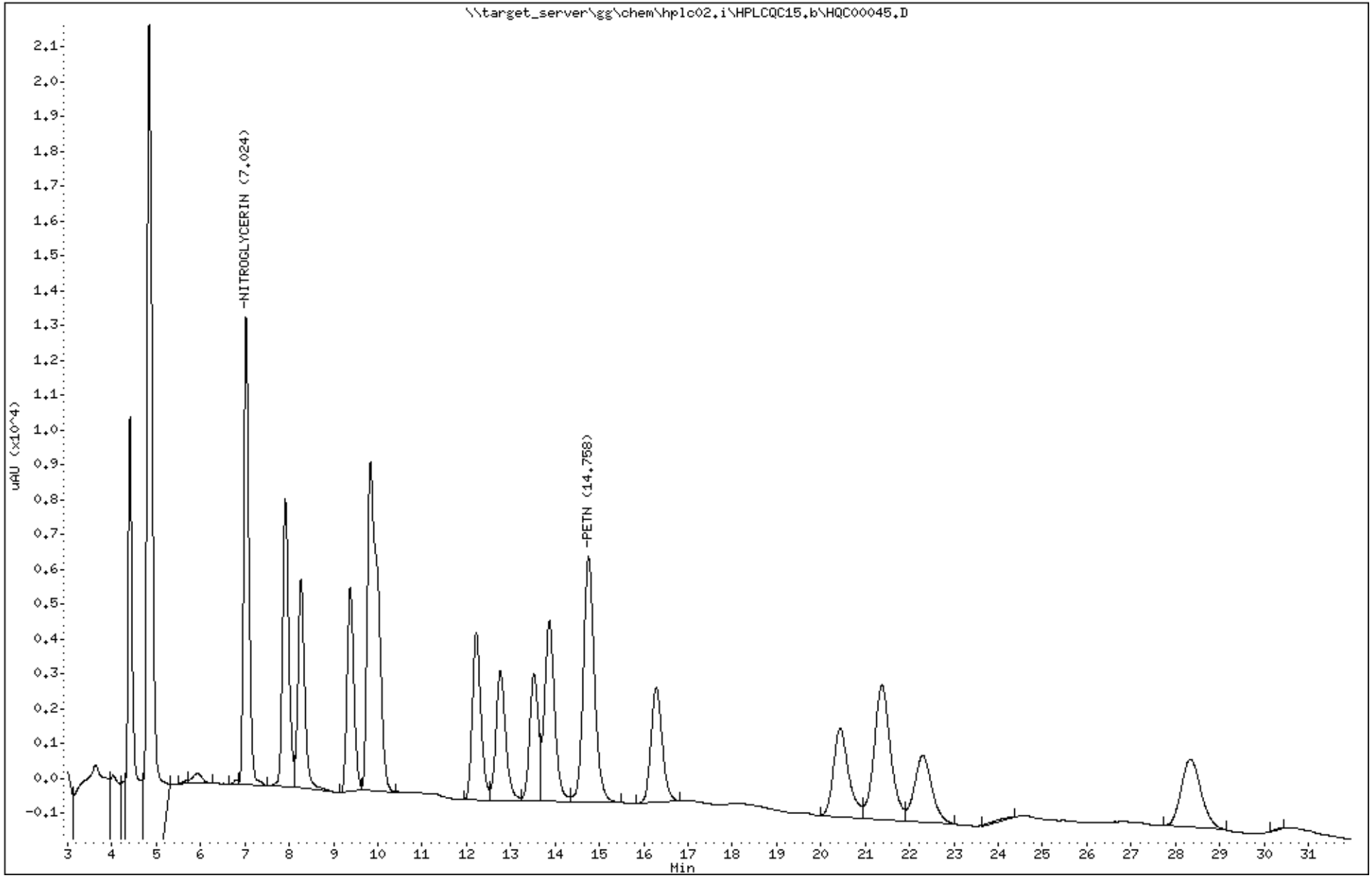
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00045.D
Lab Smp Id: WG333590-8
Inj Date : 15-MAR-2023 13:35
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-8
Misc Info : WG333590,WG333590,WG333590-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m
Meth Date : 17-Mar-2023 06:18 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   QC Sample: INDSOURCE
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
8 NITROGLYCERIN	7.024	7.031	-0.007	13423	1.96575	19.6	
18 PETN	14.757	14.751	0.006	7048	2.02118	20.2	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00045.D
Date : 15-MAR-2023 13:35
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-8
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Form 6
Initial Calibration Summary

Lab Name : Katahdin Analytical Services
SDG: SQ1201
Instrument ID: HPLC02
Calibration Date(s): 15-MAR-23 09:32
15-MAR-23 13:00
Lab File IDs : HQC00038.I,HQC00039.I,HQC00040.I
HQC00041.I,HQC00042.I,HQC00043.I
HQC00044.I

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7		Curve				%RSD or R^2		
	0.0250000	0.0500000	0.1000000	0.2500000	0.5000000	1.0000	2.0000		Type	b	m1	m2	Result	Limit	
HMX	7480	7760	7990	8004	8094	7940	8125		AVG		7913		2.842	15	O
RDX	8160	8240	8680	8624	8782	8611	8834		AVG		8562		3.044	15	O
1,3,5-trinitrobenzene	4800	4660	4600	5148	5210	5069	5161		AVG		4950		5.18	15	O
1,3-dinitrobenzene	10480	10720	11420	11344	11552	11296	11631		AVG		11210		3.883	15	O
nitrobenzene	15200	11500	10840	10600	10834	10558	10858		AVG		11480		14.52	15	O
TETRYL	2320	2300	2400	2276	2294	2324	+++++		AVG		2319		1.872	15	O
2,4,6-trinitrotoluene	2760	2920	3190	3164	3162	3128	3125		AVG		3064		5.269	15	O
4-AM-DNT	5760	5840	6140	6212	6326	6207	6372		AVG		6122		3.832	15	O
2-AM-DNT	8160	8200	8810	8800	8964	8778	9062		AVG		8682		4.122	15	O
2,6-dinitrotoluene	4200	3960	3990	4084	4104	4038	4042		AVG		4060		1.956	15	O
2,4-dinitrotoluene	6160	6220	9060	6664	6756	6626	6812		AVG		6900		14.29	15	O
2-nitrotoluene	3920	3800	3930	3932	4008	3912	4016		AVG		3931		1.82	15	O
4-nitrotoluene	3240	3440	3510	3552	3610	3522	3636		AVG		3501		3.779	15	O
3-nitrotoluene	4080	4320	4550	4572	4650	4535	4671		AVG		4483		4.707	15	O
1,2-dinitrobenzene	6280	7780	7390	6236	6330	6427	6304		AVG		6678		9.47	15	

Legend: O = Acceptable; W = Failed %RSD Value; X = Failed R^2 Value; Y = Failed Minimum RF

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P.O. Box 540, Scarborough, ME 04070
Tel:(207) 874-2400 Fax:(207) 775-4029
http://katahdinlab.com
sales@katahdinlab.com

Data File: HQC00045.D
Report Date: 23-Mar-2023 10:10

Katahdin Analytical Services

RECOVERY REPORT

Client Name: Client SDG: SDGa00508
Sample Matrix: LIQUID Fraction: Explosives
Lab Smp Id: WG333590-8
Level: LOW Operator: EP
Data Type: LC DATA SampleType: INDSOURCE
SpikeList File: IND.spk Quant Type: ESTD
Sublist File: SW8330A.sub
Method File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Misc Info: WG333590,WG333590,WG333590-5

SPIKE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
1 HMX	5.00	5.18	103.52	80-120
4 RDX	5.00	5.00	99.96	80-120
5 1,3,5-trinitrobenz	5.00	4.92	98.43	80-120
6 1,3-dinitrobenzene	5.00	4.80	96.09	80-120
7 nitrobenzene	5.00	4.34	86.78	80-120
9 TETRYL	5.00	4.92	98.32	80-120
10 2,4,6-trinitrotolu	5.00	5.20	104.11	80-120
11 4-AM-DNT	5.00	5.29	105.78	80-120
12 2-AM-DNT	5.00	4.79	95.85	80-120
13 2,6-dinitrotoluene	5.00	4.77	95.48	80-120
14 2,4-dinitrotoluene	5.00	4.55	90.96	80-120
15 2-nitrotoluene	5.00	5.41	108.21	80-120
16 4-nitrotoluene	5.00	4.76	95.10	80-120
17 3-nitrotoluene	5.00	4.86	97.22	80-120
51 3,5-Dinitroaniline	5.00	5.16	103.27	80-120

SURROGATE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
$ 2 1,2-dinitrobenzene	10.0	0.000	*	83-119

Data File: HQC00038.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00038.D
Lab Smp Id: WG333590-1
Inj Date : 15-MAR-2023 09:32
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-1
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 09:32   Cal File: HQC00038.D
Als bottle: 1   Calibration Sample, Level: 1
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

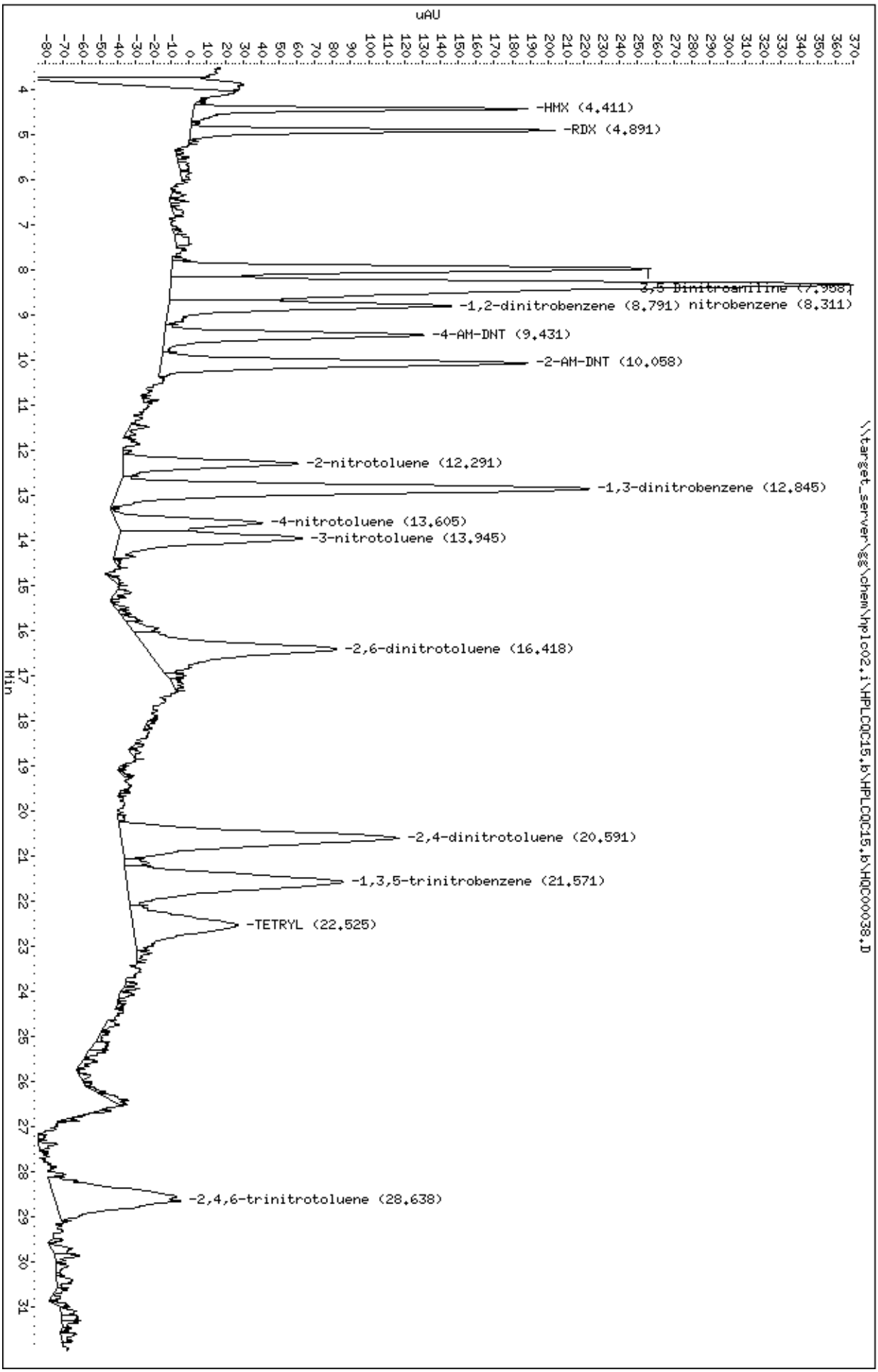
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.411	4.396	0.015	187	0.02500	0.0238(a)	
4	RDX	4.891	4.876	0.015	204	0.02500	0.0240(a)	
51	3,5-Dinitroaniline	7.958	7.896	0.062	266	0.02500	0.0235(aM)	M6
7	nitrobenzene	8.311	8.250	0.061	380	0.02500	0.0311(aM)	M6
$ 2	1,2-dinitrobenzene	8.791	8.723	0.068	157	0.02500	0.0192(a)	
11	4-AM-DNT	9.431	9.350	0.081	144	0.02500	0.0236(aM)	M6
12	2-AM-DNT	10.058	9.963	0.095	204	0.02500	0.0236(aM)	M6
15	2-nitrotoluene	12.291	12.183	0.108	98	0.02500	0.0250(a)	
6	1,3-dinitrobenzene	12.844	12.723	0.121	262	0.02500	0.0235(aM)	M6
16	4-nitrotoluene	13.604	13.483	0.121	81	0.02500	0.0234(aM)	M6
17	3-nitrotoluene	13.944	13.830	0.114	102	0.02500	0.0232(a)	
13	2,6-dinitrotoluene	16.418	16.216	0.202	105	0.02500	0.0254(aM)	M6
14	2,4-dinitrotoluene	20.591	20.310	0.281	154	0.02500	0.0215(aM)	M6
5	1,3,5-trinitrobenzene	21.571	21.196	0.375	120	0.02500	0.0237(aM)	M6
9	TETRYL	22.524	22.123	0.401	58	0.02500	0.0357(aM)	M6
10	2,4,6-trinitrotoluene	28.638	28.076	0.562	69	0.02500	0.0440(aM)	M9

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC000038.D
Date : 15-MAR-2023 09:32
Client ID:
Sample Info: WG333590-1
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC000038.D
uAU
Min
-HMX (4.411)
-RDX (4.891)
-1,2-dinitrobenzene (8.791) nitrobenzene (8.311)
-4-AM-DNT (9.431)
-2-AM-DNT (10.058)
-2-nitrotoluene (12.291)
-1,3-dinitrobenzene (12.845)
-4-nitrotoluene (13.605)
-3-nitrotoluene (13.945)
-2,6-dinitrotoluene (16.418)
-2,4-dinitrotoluene (20.591)
-1,3,5-trinitrobenzene (21.571)
-TETRYL (22.525)
-2,4,6-trinitrotoluene (28.638)

Data File: HQC00039.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00039.D
Lab Smp Id: WG333590-2
Inj Date : 15-MAR-2023 10:06
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-2
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 10:06   Cal File: HQC00039.D
Als bottle: 1   Calibration Sample, Level: 2
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

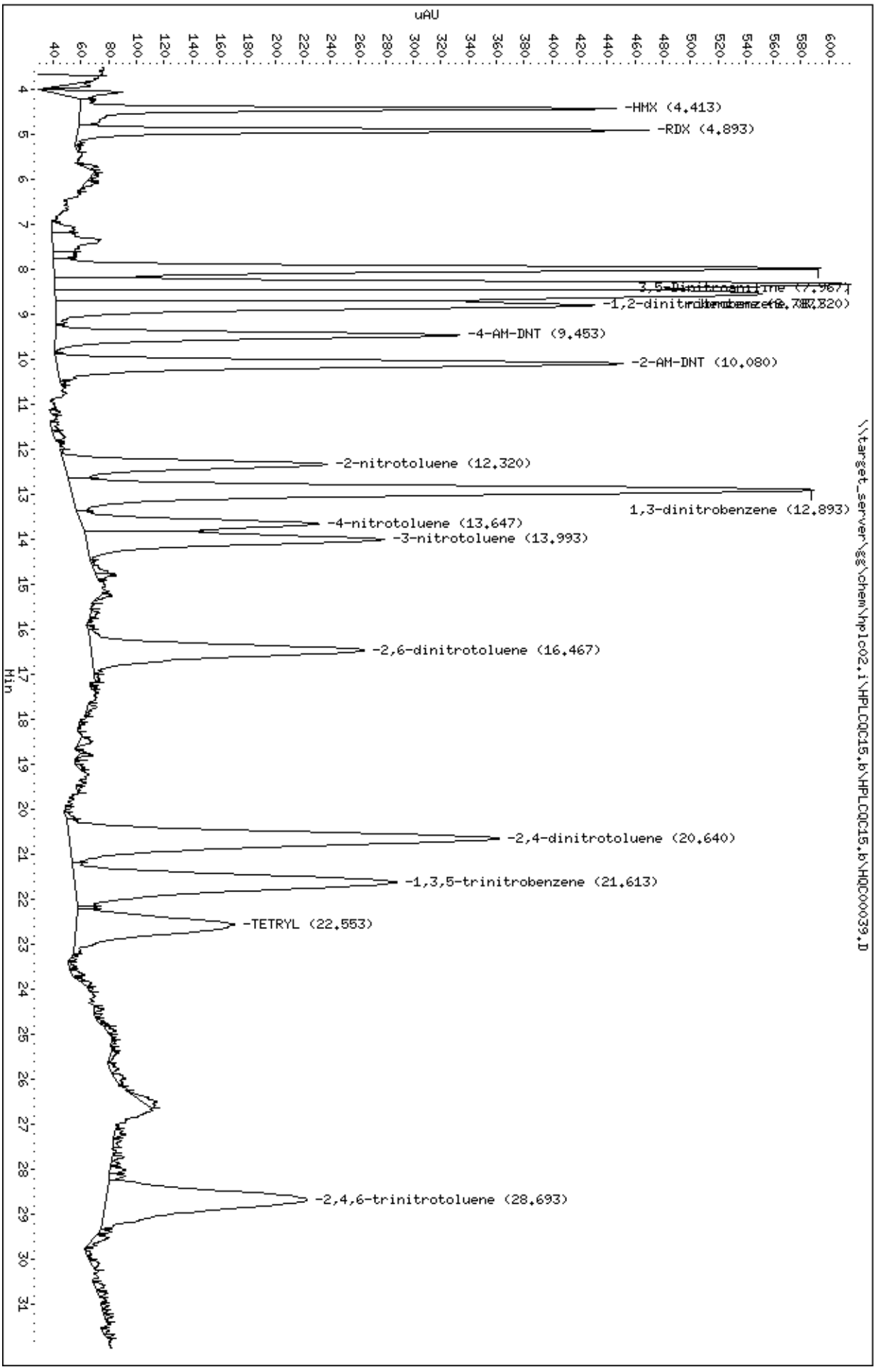
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.413	4.396	0.017	388	0.05000	0.0493(a)	
4	RDX	4.893	4.876	0.017	412	0.05000	0.0485(a)	
51	3,5-Dinitroaniline	7.966	7.896	0.070	554	0.05000	0.0493(aM)	M6
7	nitrobenzene	8.319	8.250	0.069	575	0.05000	0.0478(aM)	M6
$ 2	1,2-dinitrobenzene	8.786	8.723	0.063	389	0.05000	0.0563(a)	
11	4-AM-DNT	9.453	9.350	0.103	292	0.05000	0.0484(aM)	M6
12	2-AM-DNT	10.079	9.963	0.116	410	0.05000	0.0481(aM)	M6
15	2-nitrotoluene	12.319	12.183	0.136	190	0.05000	0.0485(a)	
6	1,3-dinitrobenzene	12.893	12.723	0.170	536	0.05000	0.0486(aM)	M6
16	4-nitrotoluene	13.646	13.483	0.163	172	0.05000	0.0497(aM)	M6
17	3-nitrotoluene	13.993	13.830	0.163	216	0.05000	0.0491(a)	
13	2,6-dinitrotoluene	16.466	16.216	0.250	198	0.05000	0.0484(aM)	M6
14	2,4-dinitrotoluene	20.639	20.310	0.329	311	0.05000	0.0446(aM)	M6
5	1,3,5-trinitrobenzene	21.613	21.196	0.417	233	0.05000	0.0470(aM)	M6
9	TETRYL	22.553	22.123	0.430	115	0.05000	0.0499(aM)	M6
10	2,4,6-trinitrotoluene	28.693	28.076	0.617	146	0.05000	0.0652(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00039.D
Date : 15-MAR-2023 10:06
Client ID:
Sample Info: WG333590-2
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00039.D
uAU
Min
-HMX (4.413)
-RDX (4.893)
3,5-Dinitroaniline (7.967)
-1,2-dinitrobenzene (8.780)
-4-AM-DNT (9.453)
-2-AM-DNT (10.080)
-2-nitrotoluene (12.320)
1,3-dinitrobenzene (12.893)
-4-nitrotoluene (13.647)
-3-nitrotoluene (13.993)
-2,6-dinitrotoluene (16.467)
-2,4-dinitrotoluene (20.640)
-1,3,5-trinitrobenzene (21.613)
-TETRYL (22.553)
-2,4,6-trinitrotoluene (28.693)

Data File: HQC00040.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00040.D
Lab Smp Id: WG333590-3
Inj Date : 15-MAR-2023 10:41
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-3
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 10:41   Cal File: HQC00040.D
Als bottle: 1   Calibration Sample, Level: 3
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

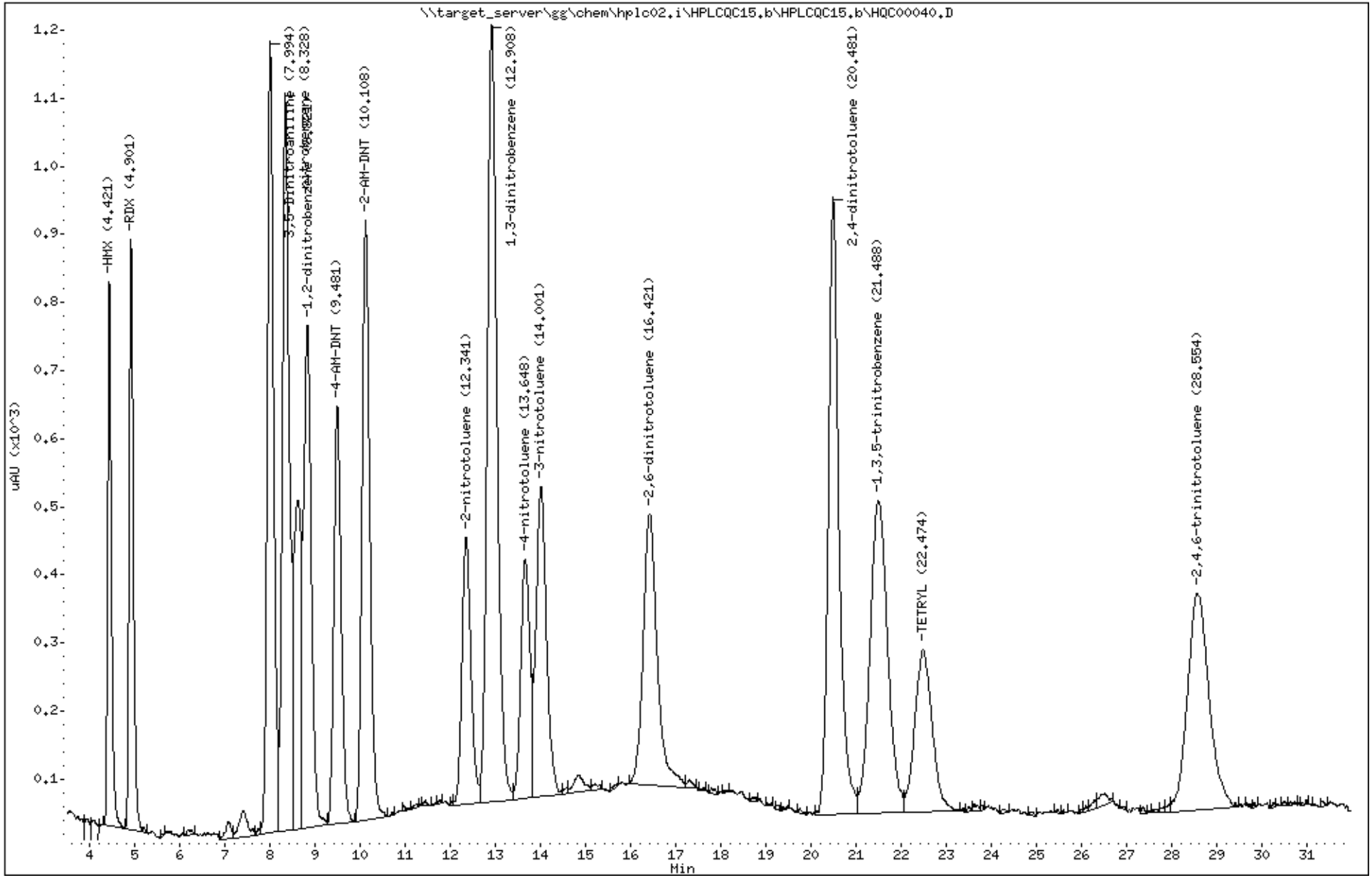
EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.420	4.396	0.024	799	0.10000	0.102(a)	
4	RDX	4.900	4.876	0.024	868	0.10000	0.102(a)	
51	3,5-Dinitroaniline	7.994	7.896	0.098	1162	0.10000	0.103(aM)	M6
7	nitrobenzene	8.327	8.250	0.077	1084	0.10000	0.0919(aM)	M6
$ 2	1,2-dinitrobenzene	8.820	8.723	0.097	739	0.10000	0.112(a)	
11	4-AM-DNT	9.480	9.350	0.130	614	0.10000	0.101(aM)	M6
12	2-AM-DNT	10.107	9.963	0.144	881	0.10000	0.102(aM)	M6
15	2-nitrotoluene	12.340	12.183	0.157	393	0.10000	0.100(a)	
6	1,3-dinitrobenzene	12.907	12.723	0.184	1142	0.10000	0.103(aM)	M6
16	4-nitrotoluene	13.647	13.483	0.164	351	0.10000	0.101(aM)	M6
17	3-nitrotoluene	14.000	13.830	0.170	455	0.10000	0.103(a)	
13	2,6-dinitrotoluene	16.420	16.216	0.204	399	0.10000	0.0981(aM)	M6
14	2,4-dinitrotoluene	20.480	20.310	0.170	906	0.10000	0.130(a)	
5	1,3,5-trinitrobenzene	21.487	21.196	0.291	460	0.10000	0.0942(aM)	M6
9	TETRYL	22.474	22.123	0.351	240	0.10000	0.103(aM)	M6
10	2,4,6-trinitrotoluene	28.554	28.076	0.478	319	0.10000	0.106(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00040.D
Date : 15-MAR-2023 10:41
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-3
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 285 of 1130

Data File: HQC00041.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00041.D
Lab Smp Id: WG333590-4
Inj Date : 15-MAR-2023 11:16
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-4
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:16   Cal File: HQC00041.D
Als bottle: 1   Calibration Sample, Level: 4
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

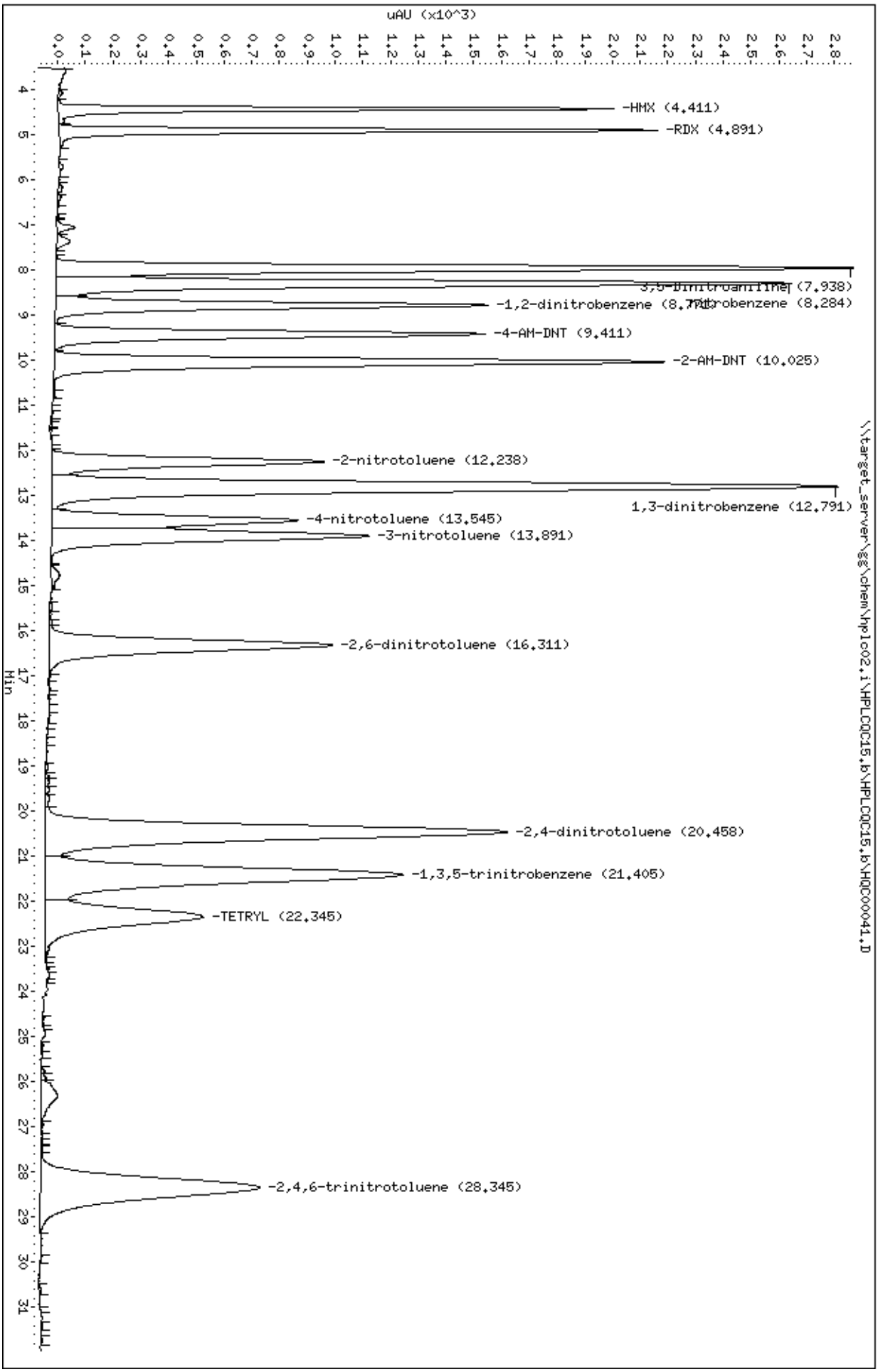
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.411	4.396	0.015	2001	0.25000	0.254	
4	RDX	4.891	4.876	0.015	2156	0.25000	0.254	
51	3,5-Dinitroaniline	7.937	7.896	0.041	2874	0.25000	0.254	
7	nitrobenzene	8.284	8.250	0.034	2650	0.25000	0.225(a)	
$ 2	1,2-dinitrobenzene	8.771	8.723	0.048	1559	0.25000	0.243(a)	
11	4-AM-DNT	9.411	9.350	0.061	1553	0.25000	0.256	
12	2-AM-DNT	10.024	9.963	0.061	2200	0.25000	0.256	
15	2-nitrotoluene	12.237	12.183	0.054	983	0.25000	0.251(M)	M6
6	1,3-dinitrobenzene	12.791	12.723	0.068	2836	0.25000	0.255	
16	4-nitrotoluene	13.544	13.483	0.061	888	0.25000	0.256	
17	3-nitrotoluene	13.891	13.830	0.061	1143	0.25000	0.258(M)	M6
13	2,6-dinitrotoluene	16.311	16.216	0.095	1021	0.25000	0.251	
14	2,4-dinitrotoluene	20.457	20.310	0.147	1666	0.25000	0.239(a)	
5	1,3,5-trinitrobenzene	21.404	21.196	0.208	1287	0.25000	0.264	
9	TETRYL	22.344	22.123	0.221	569	0.25000	0.245(aM)	M6
10	2,4,6-trinitrotoluene	28.344	28.076	0.268	791	0.25000	0.260(M)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00041.D
Date : 15-MAR-2023 11:16
Client ID:
Sample Info: WG333590-4
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00041.D
uAU (x10^3)
Min
-HMX (4.411)
-RDX (4.891)
3,5-Dinitroaniline (7.938)
-1,2-dinitrobenzene (8.284)
-4-AM-DNT (9.411)
-2-AM-DNT (10.025)
-2-nitrotoluene (12.238)
1,3-dinitrobenzene (12.791)
-4-nitrotoluene (13.545)
-3-nitrotoluene (13.891)
-2,6-dinitrotoluene (16.311)
-2,4-dinitrotoluene (20.458)
-1,3,5-trinitrobenzene (21.405)
-TETRYL (22.345)
-2,4,6-trinitrotoluene (28.345)

Data File: HQC00042.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00042.D
Lab Smp Id: WG333590-5
Inj Date : 15-MAR-2023 11:50
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-5
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 11:50   Cal File: HQC00042.D
Als bottle: 1   Calibration Sample, Level: 5
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

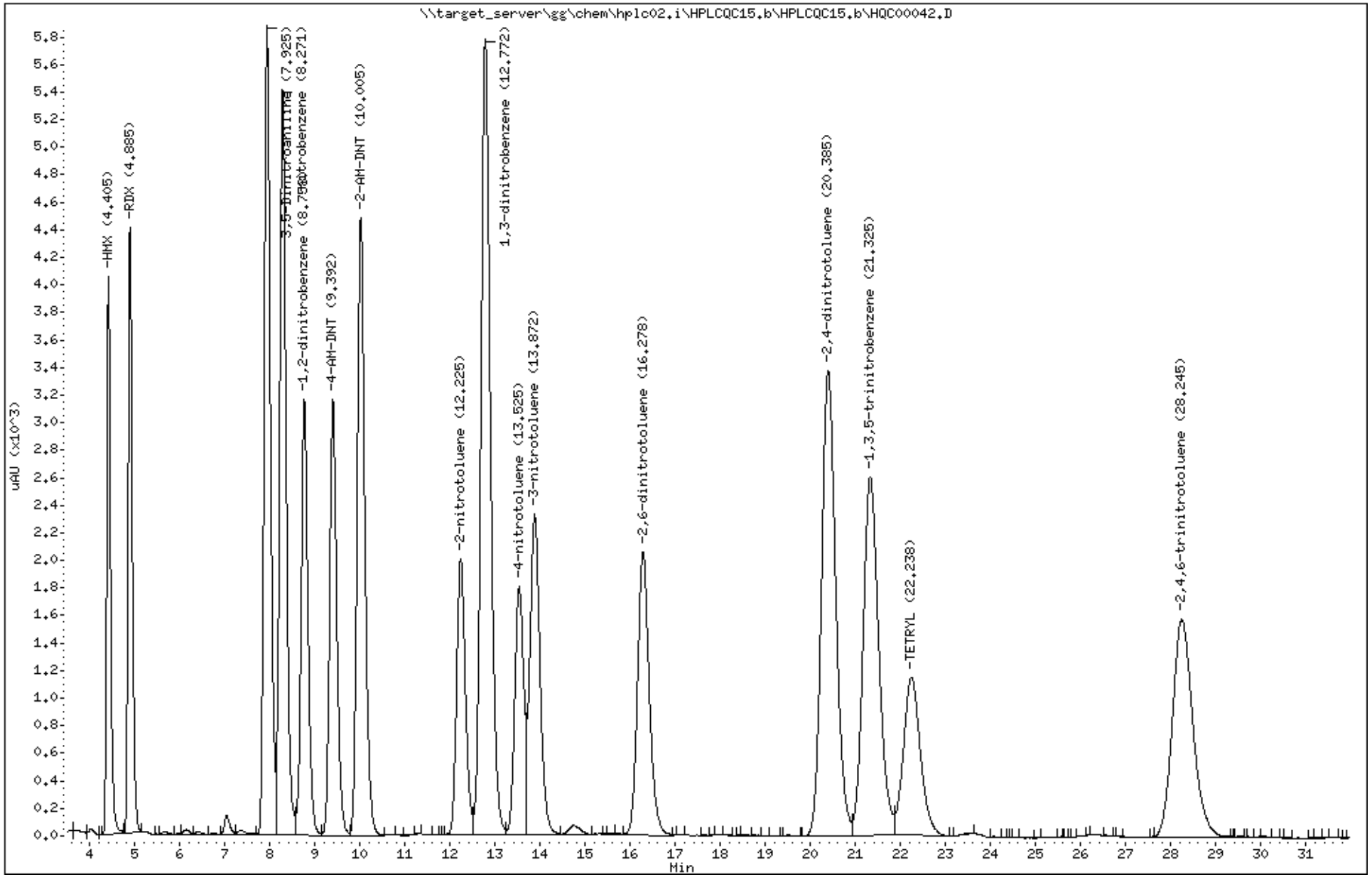
EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	ON-COL (ug/mL)	REVIEW CODE
	1 HMX	4.404	4.396	0.008	4047	0.50000	0.500(M)	M2
	4 RDX	4.884	4.876	0.008	4391	0.50000	0.500(M)	M2
	51 3,5-Dinitroaniline	7.924	7.896	0.028	5881	0.50000	0.500	
	7 nitrobenzene	8.271	8.250	0.021	5417	0.50000	0.500	
$	2 1,2-dinitrobenzene	8.758	8.723	0.035	3165	0.50000	0.500	
	11 4-AM-DNT	9.391	9.350	0.041	3163	0.50000	0.500	
	12 2-AM-DNT	10.004	9.963	0.041	4482	0.50000	0.500	
	15 2-nitrotoluene	12.224	12.183	0.041	2004	0.50000	0.500	
	6 1,3-dinitrobenzene	12.771	12.723	0.048	5776	0.50000	0.500	
	16 4-nitrotoluene	13.524	13.483	0.041	1805	0.50000	0.500	
	17 3-nitrotoluene	13.871	13.830	0.041	2325	0.50000	0.500	
	13 2,6-dinitrotoluene	16.278	16.216	0.062	2052	0.50000	0.500	
	14 2,4-dinitrotoluene	20.384	20.310	0.074	3378	0.50000	0.500	
	5 1,3,5-trinitrobenzene	21.324	21.196	0.128	2605	0.50000	0.500	
	9 TETRYL	22.238	22.123	0.115	1147	0.50000	0.500	
	10 2,4,6-trinitrotoluene	28.244	28.076	0.168	1581	0.50000	0.500	

QC Flag Legend

M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00042.D
Date : 15-MAR-2023 11:50
Client ID:
Instrument: hplc02.i
Sample Info: WG333590-5
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Data File: HQC00043.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00043.D
Lab Smp Id: WG333590-6
Inj Date : 15-MAR-2023 12:25
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-6
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 12:25   Cal File: HQC00043.D
Als bottle: 1   Calibration Sample, Level: 6
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

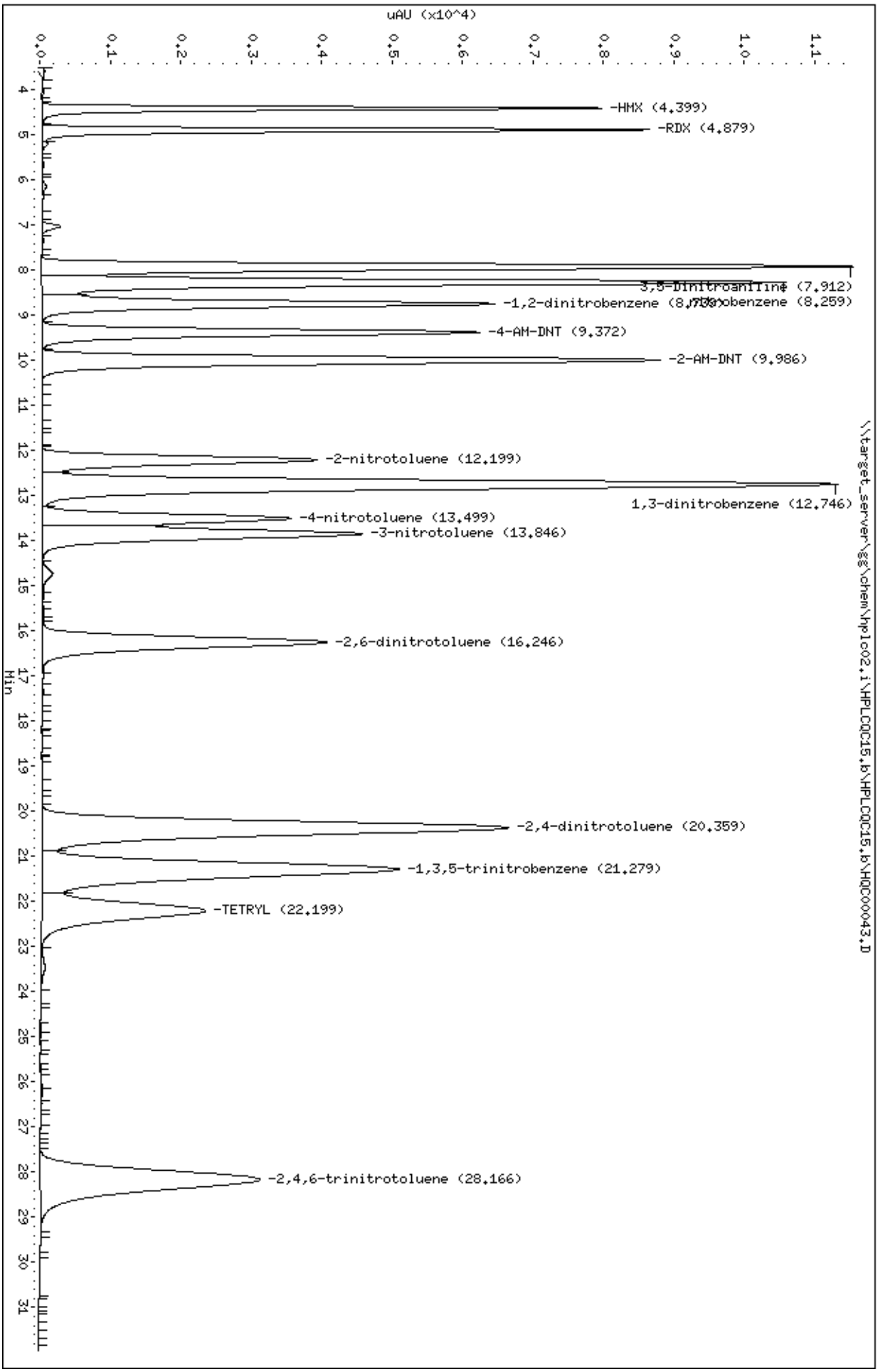
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.398	4.396	0.002	7940	1.00000	1.01(M)	M6
4	RDX	4.878	4.876	0.002	8611	1.00000	1.01(M)	M6
51	3,5-Dinitroaniline	7.912	7.896	0.016	11517	1.00000	1.01(M)	M6
7	nitrobenzene	8.258	8.250	0.008	10558	1.00000	0.911	
$ 2	1,2-dinitrobenzene	8.738	8.723	0.015	6427	1.00000	0.953	
11	4-AM-DNT	9.372	9.350	0.022	6207	1.00000	1.02(M)	M6
12	2-AM-DNT	9.985	9.963	0.022	8778	1.00000	1.02	
15	2-nitrotoluene	12.198	12.183	0.015	3912	1.00000	0.999	
6	1,3-dinitrobenzene	12.745	12.723	0.022	11296	1.00000	1.01	
16	4-nitrotoluene	13.498	13.483	0.015	3522	1.00000	1.01	
17	3-nitrotoluene	13.845	13.830	0.015	4535	1.00000	1.02	
13	2,6-dinitrotoluene	16.245	16.216	0.029	4038	1.00000	0.994	
14	2,4-dinitrotoluene	20.358	20.310	0.048	6626	1.00000	0.958	
5	1,3,5-trinitrobenzene	21.278	21.196	0.082	5069	1.00000	1.03	
9	TETRYL	22.198	22.123	0.075	2324	1.00000	1.00(M)	M6
10	2,4,6-trinitrotoluene	28.165	28.076	0.089	3128	1.00000	1.02	

QC Flag Legend

M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00043.D
Date : 15-MAR-2023 12:25
Client ID:
Sample Info: WG333590-6
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
uAU (x10^4)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
Min
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
-HMX (4.399)
-RDX (4.879)
3,5-Dinitroaniline (7.912)
-1,2-dinitrobenzene (8.259)
-4-AM-DNT (9.372)
-2-AM-DNT (9.986)
-2-nitrotoluene (12.199)
1,3-dinitrobenzene (12.746)
-4-nitrotoluene (13.499)
-3-nitrotoluene (13.846)
-2,6-dinitrotoluene (16.246)
-2,4-dinitrotoluene (20.359)
-1,3,5-trinitrobenzene (21.279)
-TETRYL (22.199)
-2,4,6-trinitrotoluene (28.166)
\\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00043.D

Data File: HQC00044.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00044.D
Lab Smp Id: WG333590-7
Inj Date : 15-MAR-2023 13:00
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-7
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Calibration Sample, Level: 7
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

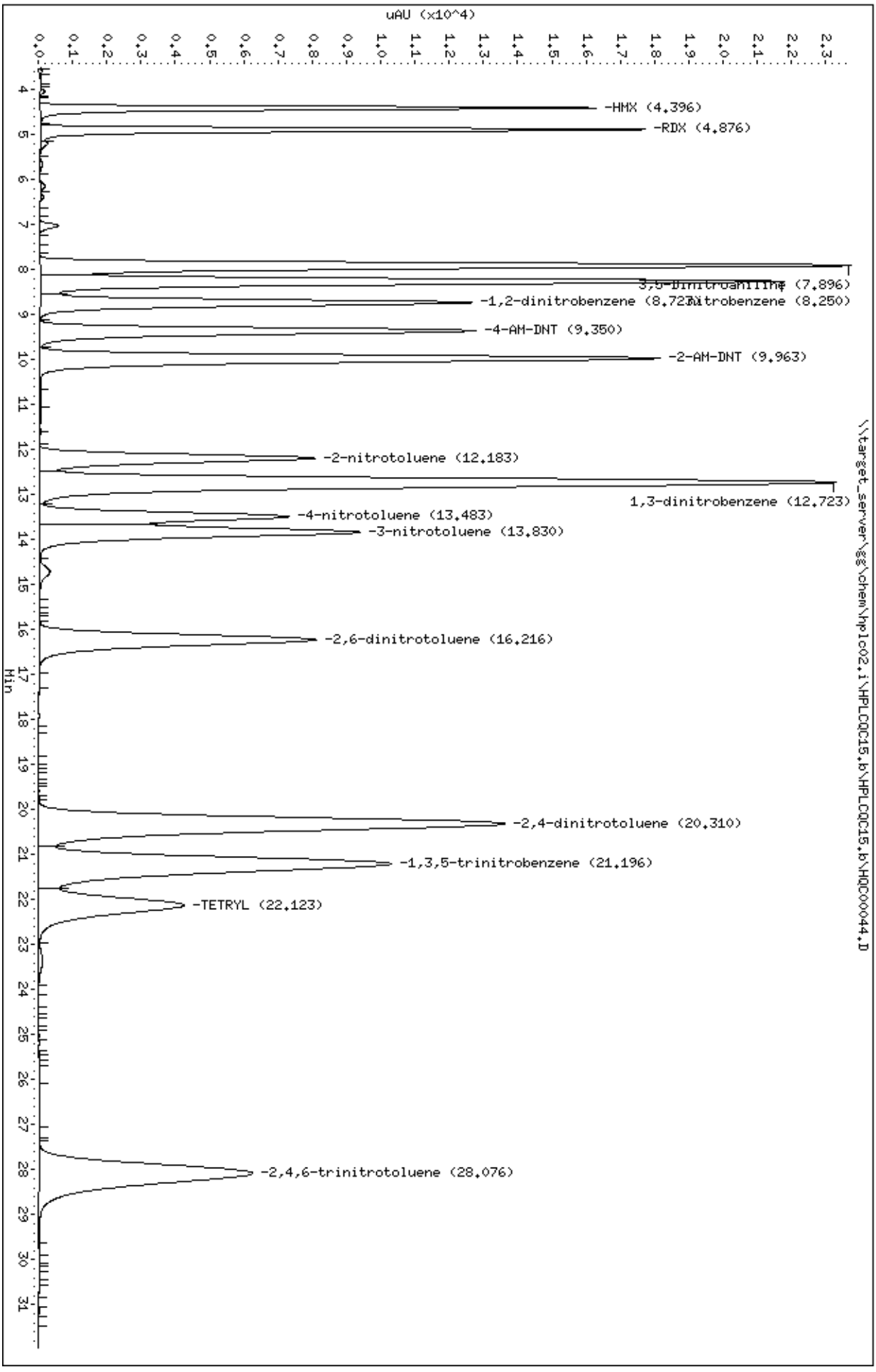
Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.396	4.396	0.000	16250	2.00000	2.05(A)	
4	RDX	4.876	4.876	0.000	17667	2.00000	2.06(A)	
51	3,5-Dinitroaniline	7.896	7.896	0.000	23689	2.00000	2.07(A)	
7	nitrobenzene	8.249	8.250	-0.001	21716	2.00000	1.89	
$ 2	1,2-dinitrobenzene	8.722	8.723	-0.001	12607	2.00000	1.89	
11	4-AM-DNT	9.349	9.350	-0.001	12744	2.00000	2.08(A)	
12	2-AM-DNT	9.962	9.963	-0.001	18124	2.00000	2.09(A)	
15	2-nitrotoluene	12.182	12.183	-0.001	8031	2.00000	2.04(A)	
6	1,3-dinitrobenzene	12.722	12.723	-0.001	23261	2.00000	2.08(A)	
16	4-nitrotoluene	13.482	13.483	-0.001	7272	2.00000	2.08(A)	
17	3-nitrotoluene	13.829	13.830	-0.001	9341	2.00000	2.08(A)	
13	2,6-dinitrotoluene	16.216	16.216	0.000	8083	2.00000	1.99	
14	2,4-dinitrotoluene	20.309	20.310	-0.001	13623	2.00000	1.97	
5	1,3,5-trinitrobenzene	21.196	21.196	0.000	10321	2.00000	2.08(A)	
9	TETRYL	22.122	22.123	-0.001	4257	2.00000	1.84	
10	2,4,6-trinitrotoluene	28.076	28.076	0.000	6249	2.00000	2.04(A)	

QC Flag Legend

A - Target compound detected but, quantitated amount
    exceeded maximum amount.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HQC00044.D
Date : 15-MAR-2023 13:00
Client ID:
Sample Info: WG333590-7
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
uAU (x10^4)
Min
-HMX (4.396)
-RDX (4.876)
3,5-Dinitroaniline (7.896)
-1,2-dinitrobenzene (8.723)
Nitrobenzene (8.250)
-4-AM-DNT (9.350)
-2-AM-DNT (9.963)
-2-nitrotoluene (12.183)
1,3-dinitrobenzene (12.723)
-4-nitrotoluene (13.483)
-3-nitrotoluene (13.830)
-2,6-dinitrotoluene (16.216)
-2,4-dinitrotoluene (20.310)
-1,3,5-trinitrobenzene (21.196)
-TETRYL (22.123)
-2,4,6-trinitrotoluene (28.076)
\\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00044.D

Data File: HQC00045.D
Report Date: 23-Mar-2023 10:09

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00045.D
Lab Smp Id: WG333590-8
Inj Date : 15-MAR-2023 13:35
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333590-8
Misc Info : WG333590,WG333590,WG333590-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC15.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   QC Sample: INDSOURCE
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

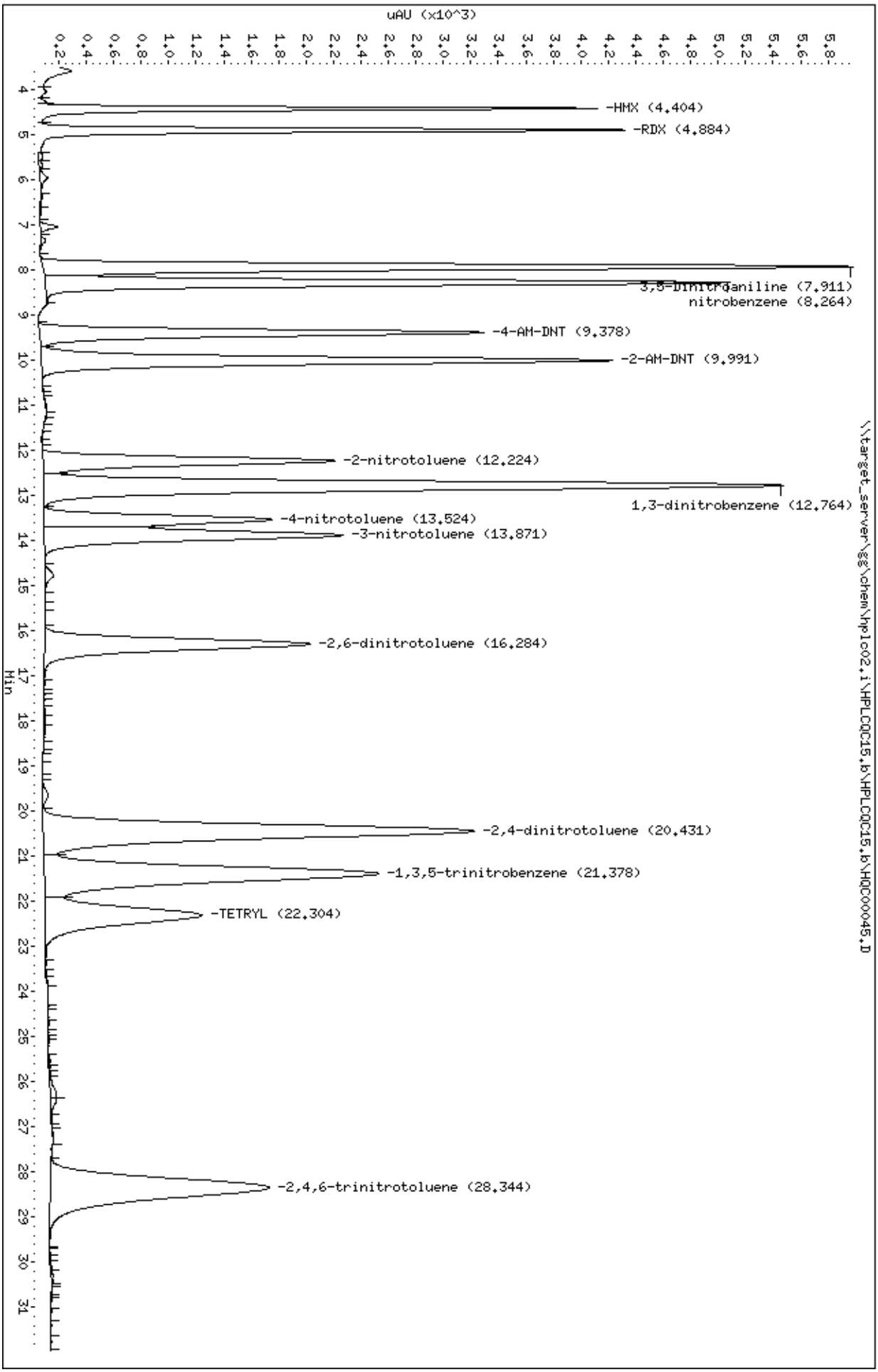
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:11 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE
1	HMX	4.404	4.396	0.008	4096	0.51761	5.18	
4	RDX	4.884	4.876	0.008	4279	0.49980	5.00	
51	3,5-Dinitroaniline	7.910	7.896	0.014	5898	0.51634	5.16	
7	nitrobenzene	8.264	8.250	0.014	4983	0.43390	4.34	
11	4-AM-DNT	9.377	9.350	0.027	3238	0.52888	5.29	
12	2-AM-DNT	9.990	9.963	0.027	4161	0.47927	4.79	
15	2-nitrotoluene	12.224	12.183	0.041	2127	0.54107	5.41	
6	1,3-dinitrobenzene	12.764	12.723	0.041	5384	0.48045	4.80	
16	4-nitrotoluene	13.524	13.483	0.041	1665	0.47552	4.76	
17	3-nitrotoluene	13.870	13.830	0.040	2179	0.48611	4.86	
13	2,6-dinitrotoluene	16.284	16.216	0.068	1938	0.47738	4.77	
14	2,4-dinitrotoluene	20.430	20.310	0.120	3138	0.45481	4.55	
5	1,3,5-trinitrobenzene	21.377	21.196	0.181	2436	0.49216	4.92(M)	M6
9	TETRYL	22.304	22.123	0.181	1140	0.49159	4.92(M)	M6
10	2,4,6-trinitrotoluene	28.344	28.076	0.268	1595	0.52055	5.20(M)	M6

QC Flag Legend

M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00045.D
Date : 15-MAR-2023 13:35
Client ID:
Sample Info: WG333590-8
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC15.b\HPLCQC15.b\HQC00045.D
uAU (x10^3)
Min
-HMX (4.404)
-RDX (4.884)
3,5-Dinitroaniline (7.911)
nitrobenzene (8.264)
-4-AM-DNT (9.378)
-2-AM-DNT (9.991)
-2-nitrotoluene (12.224)
1,3-dinitrobenzene (12.764)
-4-nitrotoluene (13.524)
-3-nitrotoluene (13.871)
-2,6-dinitrotoluene (16.284)
-2,4-dinitrotoluene (20.431)
-1,3,5-trinitrobenzene (21.378)
-TETRYL (22.304)
-2,4,6-trinitrotoluene (28.344)

Form 6
Initial Calibration Summary

Lab Name : Katahdin Analytical Services
SDG: SQ1201
Instrument ID: HPLC02
Calibration Date(s): 21-MAR-23 13:24
21-MAR-23 18:25
Lab File IDs : HQC00119.I,HQC00120.I,HQC00121.I
HQC00122.I,HQC00118.I,HQC00123.I
HQC00124.I

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7		Curve				%RSD or R^2		
	0.1000000	0.2000000	0.4000000	1.0000	2.0000	4.0000	8.0000		Type	b	m1	m2	Result	Limit	
NITROGLYCERIN	2130	1405	1518	1609	1621	1582	1604		AVG		1638		14.02	20	O

Legend: O = Acceptable; W = Failed %RSD Value; X = Failed R^2 Value; Y = Failed Minimum RF

600 Technology Way
P.O. Box 540, Scarborough, ME 04070
Tel:(207) 874-2400 Fax:(207) 775-4029
http://katahdinlab.com
sales@katahdinlab.com

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00125.D
Report Date: 23-Mar-2023 10:43

Katahdin Analytical Services

RECOVERY REPORT

Client Name: Client SDG: SDGa00508
Sample Matrix: LIQUID Fraction: Explosives
Lab Smp Id: WG334216-8
Level: LOW Operator: EP
Data Type: LC DATA SampleType: INDSOURCE
SpikeList File: IND.spk Quant Type: ESTD
Sublist File: NGPETN.sub
Method File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Misc Info: WG334216,WG334216,WG334216-5

SPIKE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
3 Ethylene Glycol D	20.0	0.000	*	80-120
8 NITROGLYCERIN	20.0	18.4	92.30	80-120
18 PETN	20.0	17.4	87.17	80-120

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00118.D
Report Date: 23-Mar-2023 10:43

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00118.D
Lab Smp Id: WG334216-5
Inj Date : 21-MAR-2023 13:24
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-5
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 05:45 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 13:24   Cal File: HQC00118.D
Als bottle: 1   Calibration Sample, Level: 5
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: NGPETN.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00100	Final Volume (L)
Vo	1.000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

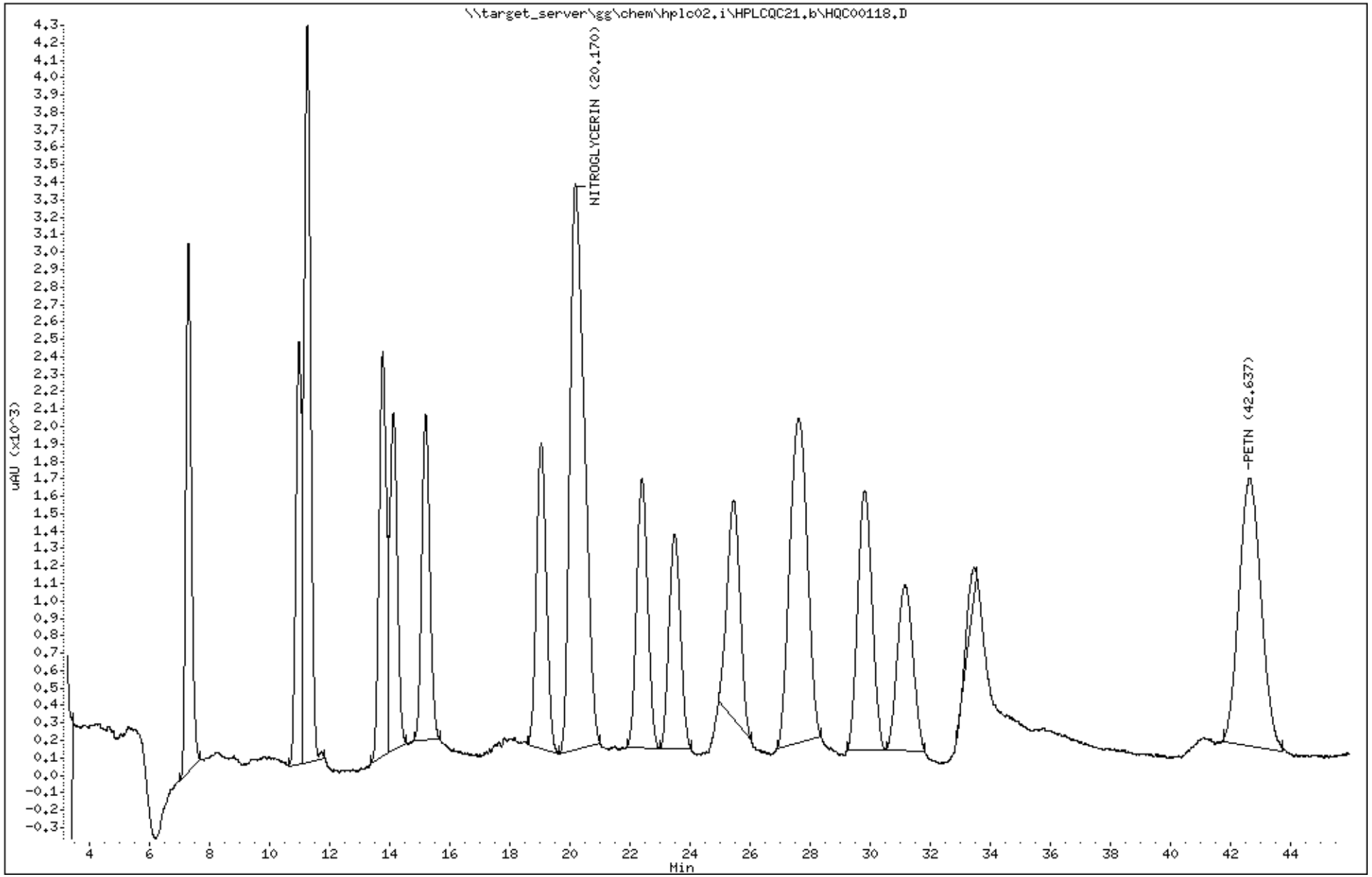
EP
11:45 am, Mar 23, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	20.170	20.170	0.000	3241	2.00000	2.00(a)	
18 PETN	42.636	42.636	0.000	1533	2.00000	2.00(aM)	M9

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00118.D
Date : 21-MAR-2023 13:24
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-5
Purge Volume: 1.0
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00119.D
Report Date: 23-Mar-2023 10:43

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00119.D
Lab Smp Id: WG334216-1
Inj Date : 21-MAR-2023 14:14
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-1
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 05:45 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 13:24   Cal File: HQC00118.D
Als bottle: 1   Calibration Sample, Level: 1
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: NGPETN.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

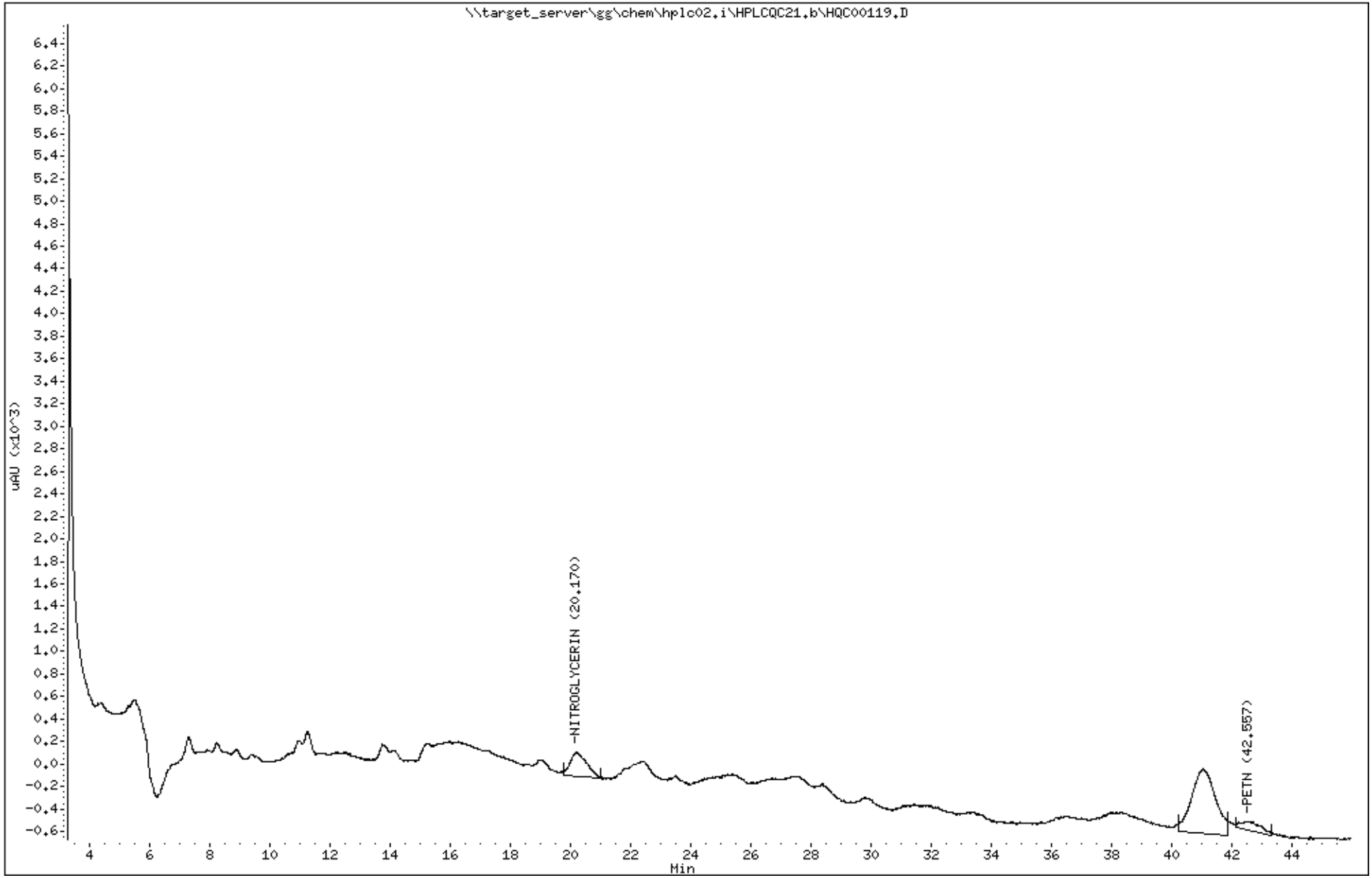
EP
11:45 am, Mar 23, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	20.170	20.170	0.000	213	0.10000	0.127(aM)	M6
18 PETN	42.556	42.636	-0.080	76	0.10000	0.100(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00119.D
Date : 21-MAR-2023 14:14
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-1
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00120.D
Report Date: 23-Mar-2023 10:43

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00120.D
Lab Smp Id: WG334216-2
Inj Date : 21-MAR-2023 15:04
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-2
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 05:45 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 13:24   Cal File: HQC00118.D
Als bottle: 1   Calibration Sample, Level: 2
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: NGPETN.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

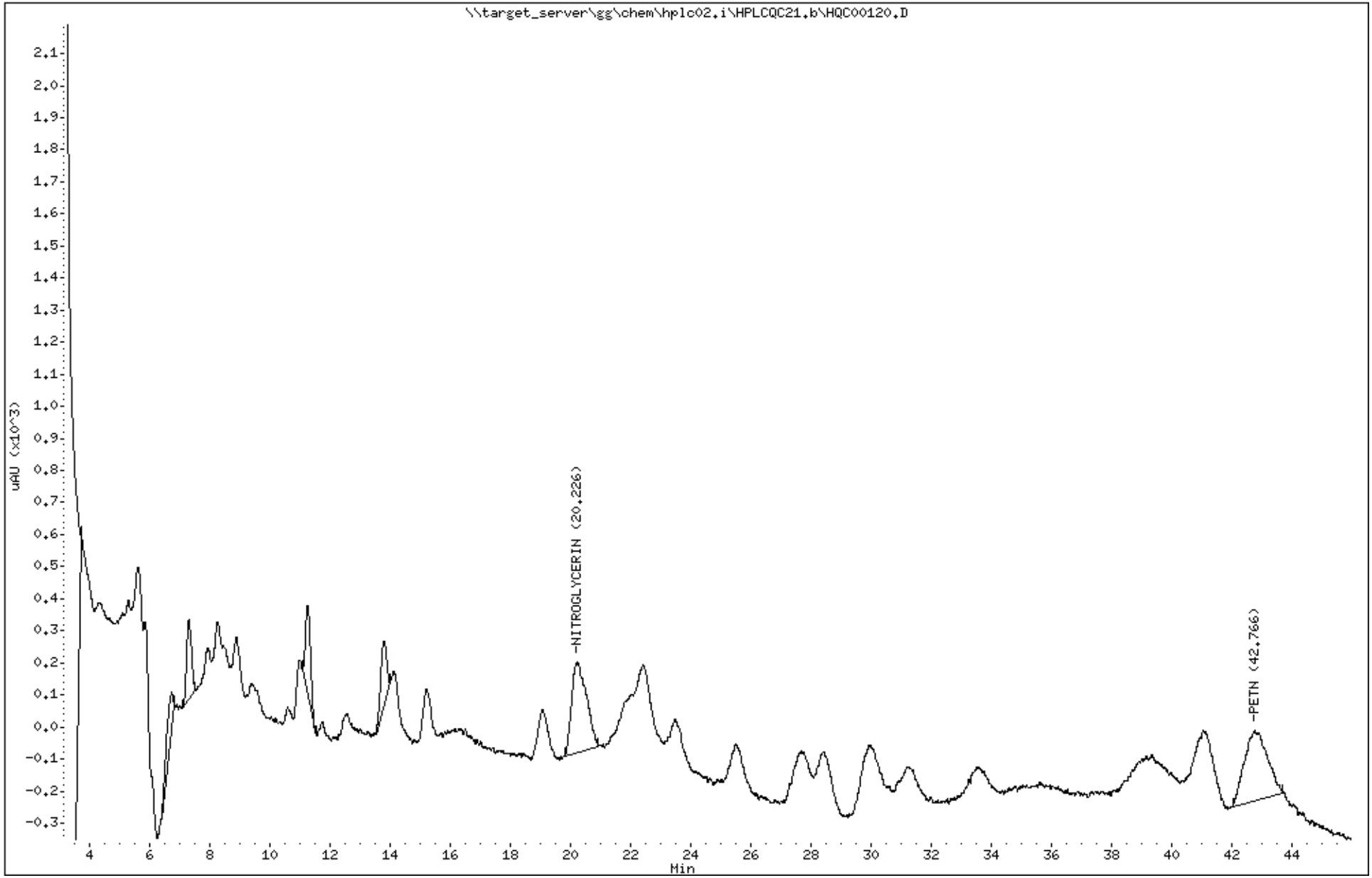
EP
11:45 am, Mar 23, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	20.226	20.170	0.056	281	0.20000	0.172(aM)	M6
18 PETN	42.766	42.636	0.130	216	0.20000	0.262(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00120.D
Date : 21-MAR-2023 15:04
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-2
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00121.D
Report Date: 23-Mar-2023 10:43

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00121.D
Lab Smp Id: WG334216-3
Inj Date : 21-MAR-2023 15:55
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-3
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 05:45 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 15:55   Cal File: HQC00121.D
Als bottle: 1   Calibration Sample, Level: 3
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: NGPETN.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

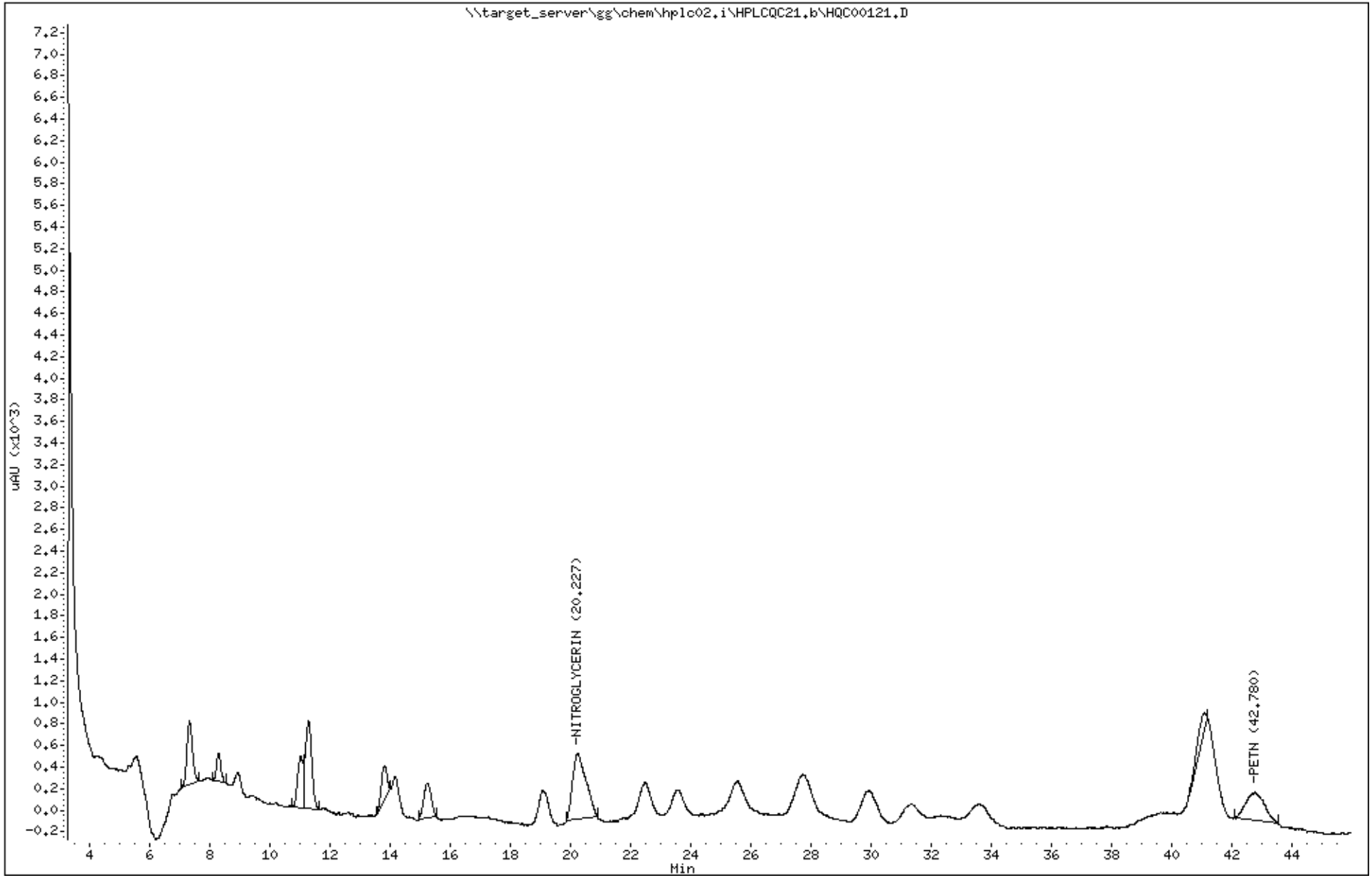
EP
11:45 am, Mar 23, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	20.226	20.170	0.056	607	0.40000	0.370(a)	
18 PETN	42.779	42.636	0.143	262	0.40000	0.329(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00121.D
Date : 21-MAR-2023 15:55
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-3
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00122.D
Report Date: 23-Mar-2023 10:43

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00122.D
Lab Smp Id: WG334216-4
Inj Date : 21-MAR-2023 16:45
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-4
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 05:45 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 16:45   Cal File: HQC00122.D
Als bottle: 1   Calibration Sample, Level: 4
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: NGPETN.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

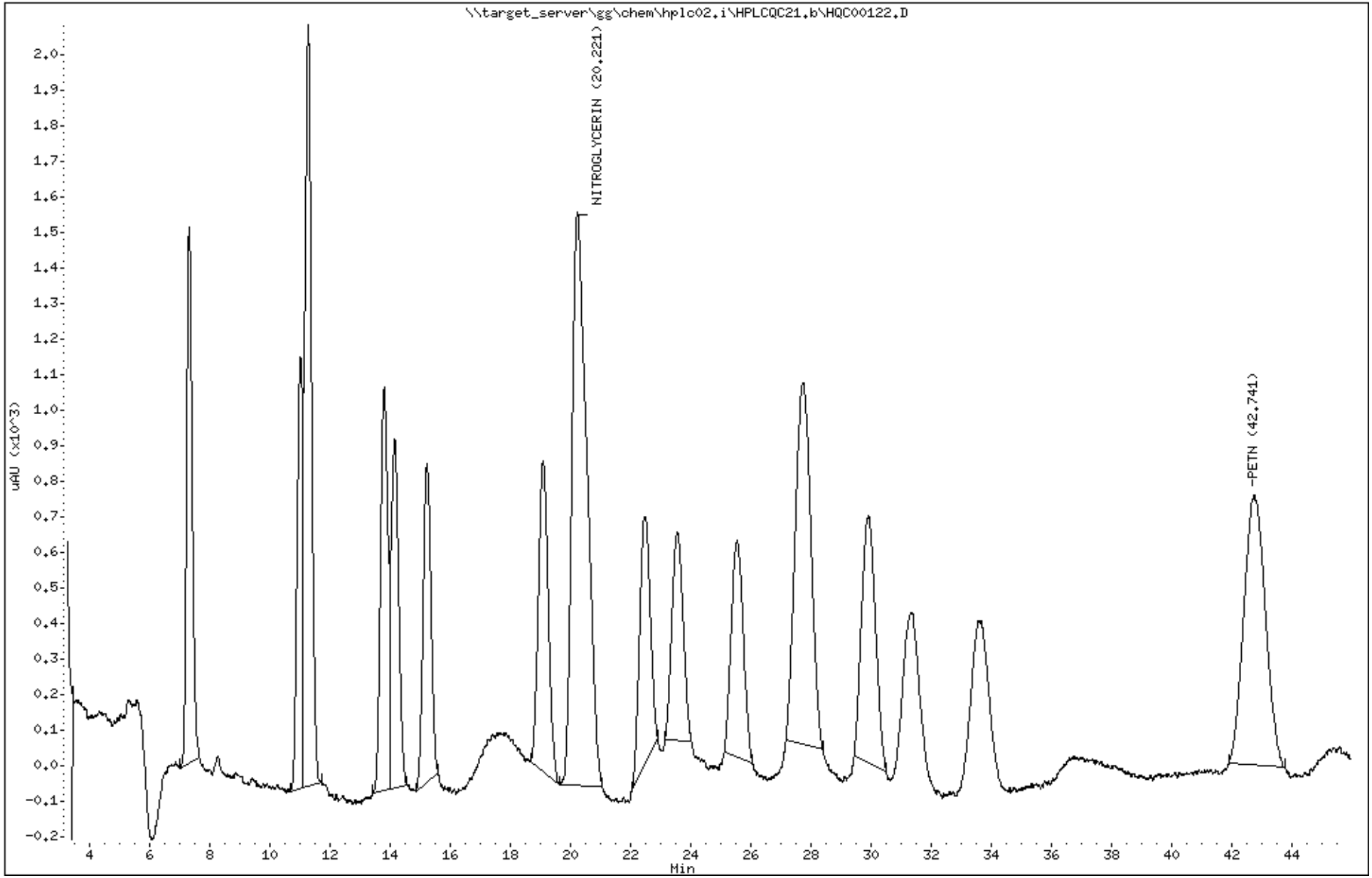
EP
11:45 am, Mar 23, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
8 NITROGLYCERIN	20.221	20.170	0.051	1609	1.00000	0.982(a)	
18 PETN	42.741	42.636	0.105	757	1.00000	0.958(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00122.D
Date : 21-MAR-2023 16:45
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-4
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00123.D
Report Date: 23-Mar-2023 10:43

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00123.D
Lab Smp Id: WG334216-6
Inj Date : 21-MAR-2023 17:35
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-6
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 05:45 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 17:35   Cal File: HQC00123.D
Als bottle: 1   Calibration Sample, Level: 6
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: NGPETN.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

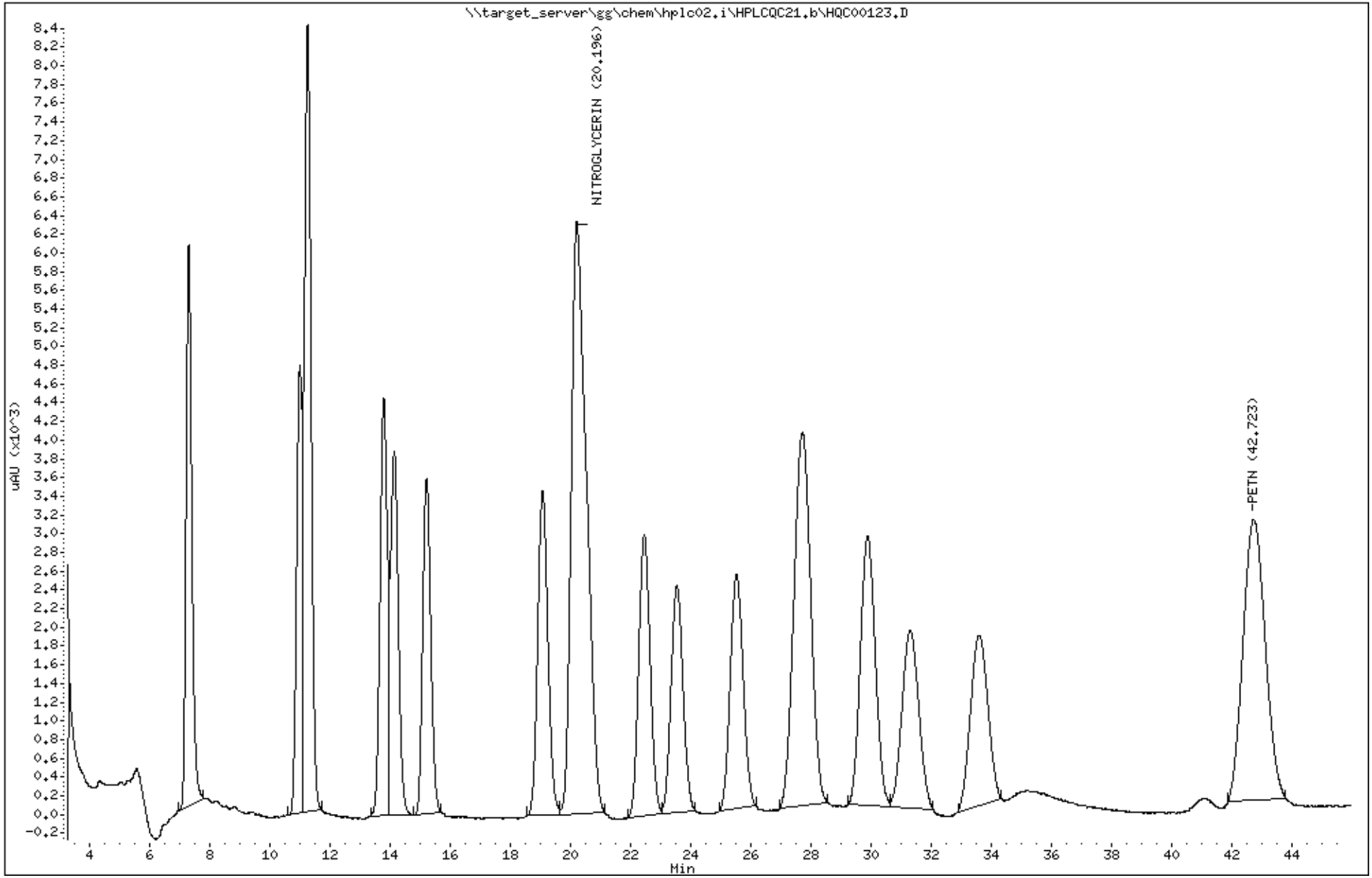
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	20.196	20.170	0.026	6326	4.00000	4.00	
18 PETN	42.723	42.636	0.087	3003	4.00000	3.96(a)	

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00123.D
Date : 21-MAR-2023 17:35
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-6
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00124.D
Report Date: 23-Mar-2023 10:43

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00124.D
Lab Smp Id: WG334216-7
Inj Date : 21-MAR-2023 18:25
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-7
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 05:45 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 18:25   Cal File: HQC00124.D
Als bottle: 1   Calibration Sample, Level: 7
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: NGPETN.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

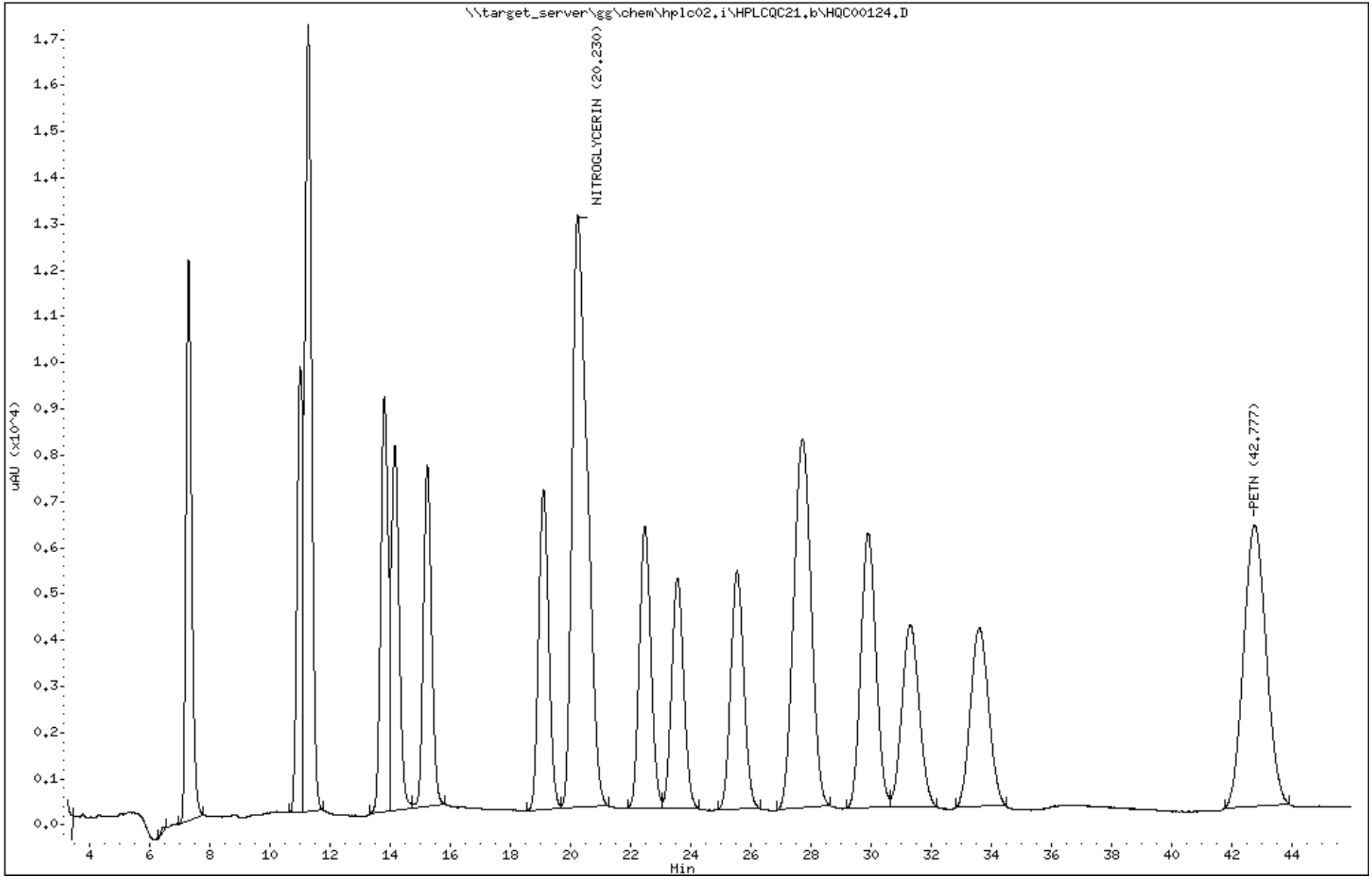
					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	20.230	20.170	0.060	12832	8.00000	8.09(A)	
18 PETN	42.776	42.636	0.140	6077	8.00000	8.01(A)	

QC Flag Legend

A - Target compound detected but, quantitated amount
    exceeded maximum amount.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00124.D
Date : 21-MAR-2023 18:25
Client ID:
Sample Info: WG334216-7
Purge Volume: 0.5
Column phase: Acclaim E2

Instrument: hplc02.i
Operator: EP
Column diameter: 4.60



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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00125.D
Report Date: 23-Mar-2023 10:43

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00125.D
Lab Smp Id: WG334216-8
Inj Date : 21-MAR-2023 19:16
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-8
Misc Info : WG334216,WG334216,WG334216-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 05:45 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 16:45   Cal File: HQC00122.D
Als bottle: 1   QC Sample: INDSOURCE
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: NGPETN.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

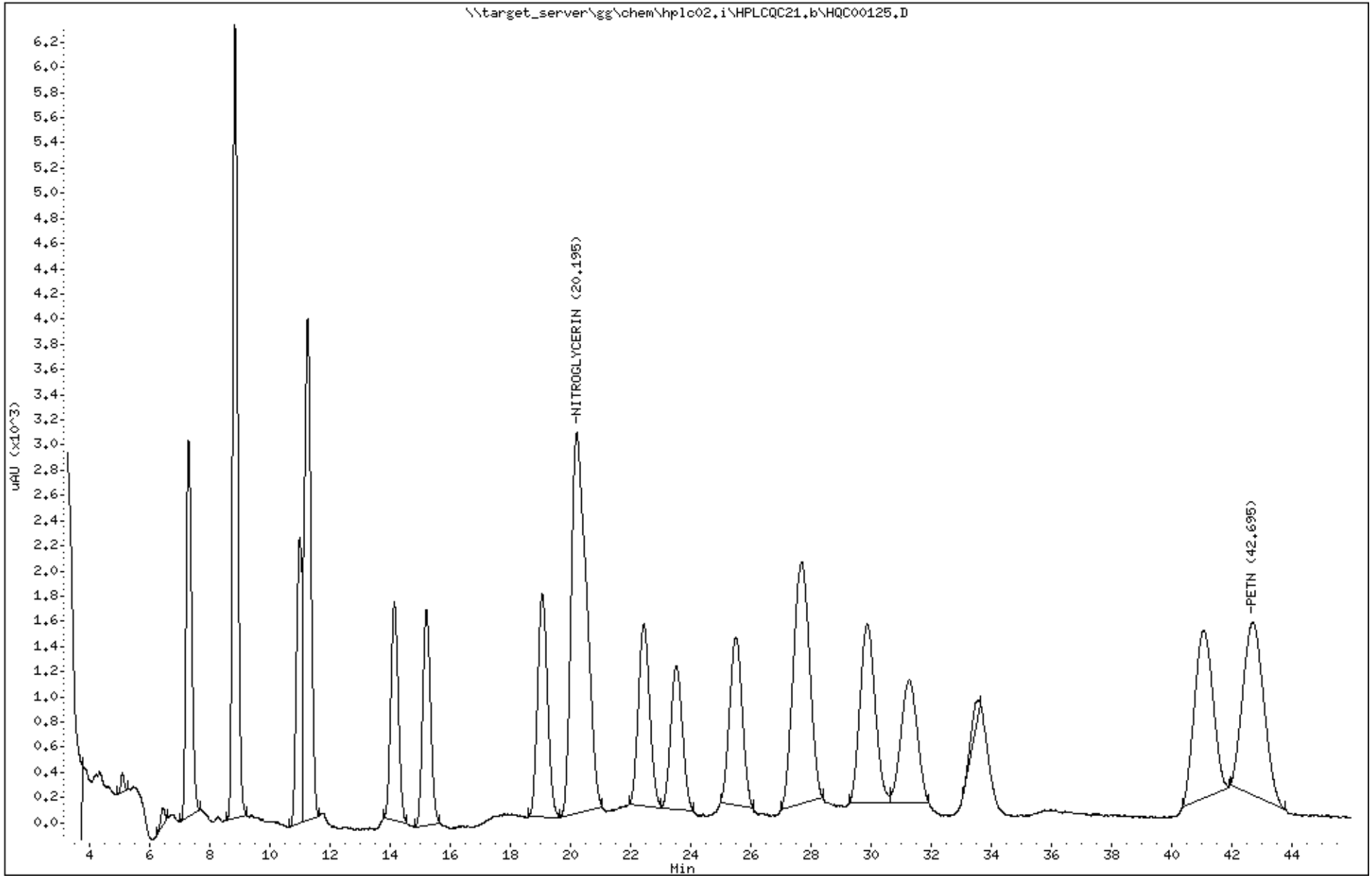
EP
11:45 am, Mar 23, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE
8 NITROGLYCERIN	20.195	20.170	0.025	3024	1.84591	18.4	
18 PETN	42.695	42.636	0.059	1377	1.74339	17.4(M)	M9

QC Flag Legend

M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00125.D
Date : 21-MAR-2023 19:16
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-8
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



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Form 6
Initial Calibration Summary

Lab Name : Katahdin Analytical Services
SDG: SQ1201
Instrument ID: HPLC02
Calibration Date(s): 21-MAR-23 13:24
21-MAR-23 18:25
Lab File IDs : HQC00119.I,HQC00120.I,HQC00121.I
HQC00122.I,HQC00118.I,HQC00123.I
HQC00124.I

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7		Curve				%RSD or R^2		
	0.0250000	0.0500000	0.1000000	0.2500000	0.5000000	1.0000	2.0000		Type	b	m1	m2	Result	Limit	
HMX	2360	2120	2310	2248	2274	2213	2249		AVG		2253		3.363	20	O
RDX	2080	2340	2420	2420	2380	2360	2383		AVG		2340		5.062	20	O
1,3,5-trinitrobenzene	4880	5520	5560	5820	5730	5682	5751		AVG		5563		5.74	20	O
1,3-dinitrobenzene	5920	5680	5940	6236	6250	6094	6175		AVG		6042		3.429	20	O
nitrobenzene	3680	3360	3300	3476	3512	3400	3448		AVG		3454		3.555	20	O
TETRYL	1800	1800	1670	1752	1760	1698	1733		AVG		1745		2.8	20	O
2,4,6-trinitrotoluene	2680	2640	2710	2928	2898	2819	2858		AVG		2790		4.064	20	O
4-AM-DNT	880	1040	970	1004	1022	992	1026		AVG		991		5.45	20	O
2-AM-DNT	1360	1180	1450	1448	1574	1486	1526		AVG		1432		9.068	20	O
2,6-dinitrotoluene	2000	1900	2010	1848	1864	1815	1831		AVG		1895		4.199	20	O
2,4-dinitrotoluene	3120	3220	3410	3464	3434	3385	3420		AVG		3350		3.844	20	O
2-nitrotoluene	1440	1320	1100	1168	1176	1143	1137		AVG		1212		10.09	20	O
4-nitrotoluene	1240	1160	1210	1180	1228	1176	1215		AVG		1201		2.465	20	O
3-nitrotoluene	920	1140	990	1000	1022	988	1025		AVG		1012		6.543	20	O
1,2-dinitrobenzene	2320	2400	2230	2344	2342	2257	2275		AVG		2310		2.55	20	

Legend: O = Acceptable; W = Failed %RSD Value; X = Failed R^2 Value; Y = Failed Minimum RF

600 Technology Way
P.O. Box 540, Scarborough, ME 04070
Tel:(207) 874-2400 Fax:(207) 775-4029
http://katahdinlab.com
sales@katahdinlab.com

Data File: HQC00125.D
Report Date: 23-Mar-2023 10:36

Katahdin Analytical Services

RECOVERY REPORT

Client Name: Client SDG: SDGa00508
Sample Matrix: LIQUID Fraction: Explosives
Lab Smp Id: WG334216-8
Level: LOW Operator: EP
Data Type: LC DATA SampleType: INDSOURCE
SpikeList File: IND.spk Quant Type: ESTD
Sublist File: SW8330A.sub
Method File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Misc Info: WG334216,WG334216,WG334216-5

SPIKE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
1 HMX	5.00	4.99	99.85	80-120
4 RDX	5.00	4.77	95.37	80-120
5 1,3,5-trinitrobenz	5.00	4.87	97.35	80-120
6 1,3-dinitrobenzene	5.00	4.74	94.80	80-120
7 nitrobenzene	5.00	4.67	93.41	80-120
9 TETRYL	5.00	5.07	101.34	80-120
10 2,4,6-trinitrotolu	5.00	5.24	104.86	80-120
11 4-AM-DNT	5.00	5.40	108.03	80-120
12 2-AM-DNT	5.00	4.95	99.02	80-120
13 2,6-dinitrotoluene	5.00	4.65	92.96	80-120
14 2,4-dinitrotoluene	5.00	4.81	96.17	80-120
15 2-nitrotoluene	5.00	4.98	99.50	80-120
16 4-nitrotoluene	5.00	4.79	95.74	80-120
17 3-nitrotoluene	5.00	5.28	105.53	80-120
52 3,5-dinitroaniline	5.00	5.38	107.51	80-120

SURROGATE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
$ 2 1,2-dinitrobenzene	10.0	0.000	*	82-150

Data File: HQC00118.D
Report Date: 23-Mar-2023 10:35

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00118.D
Lab Smp Id: WG334216-5
Inj Date : 21-MAR-2023 13:24
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-5
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 13:24   Cal File: HQC00118.D
Als bottle: 1   Calibration Sample, Level: 5
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00100	Final Volume (L)
Vo	1.000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

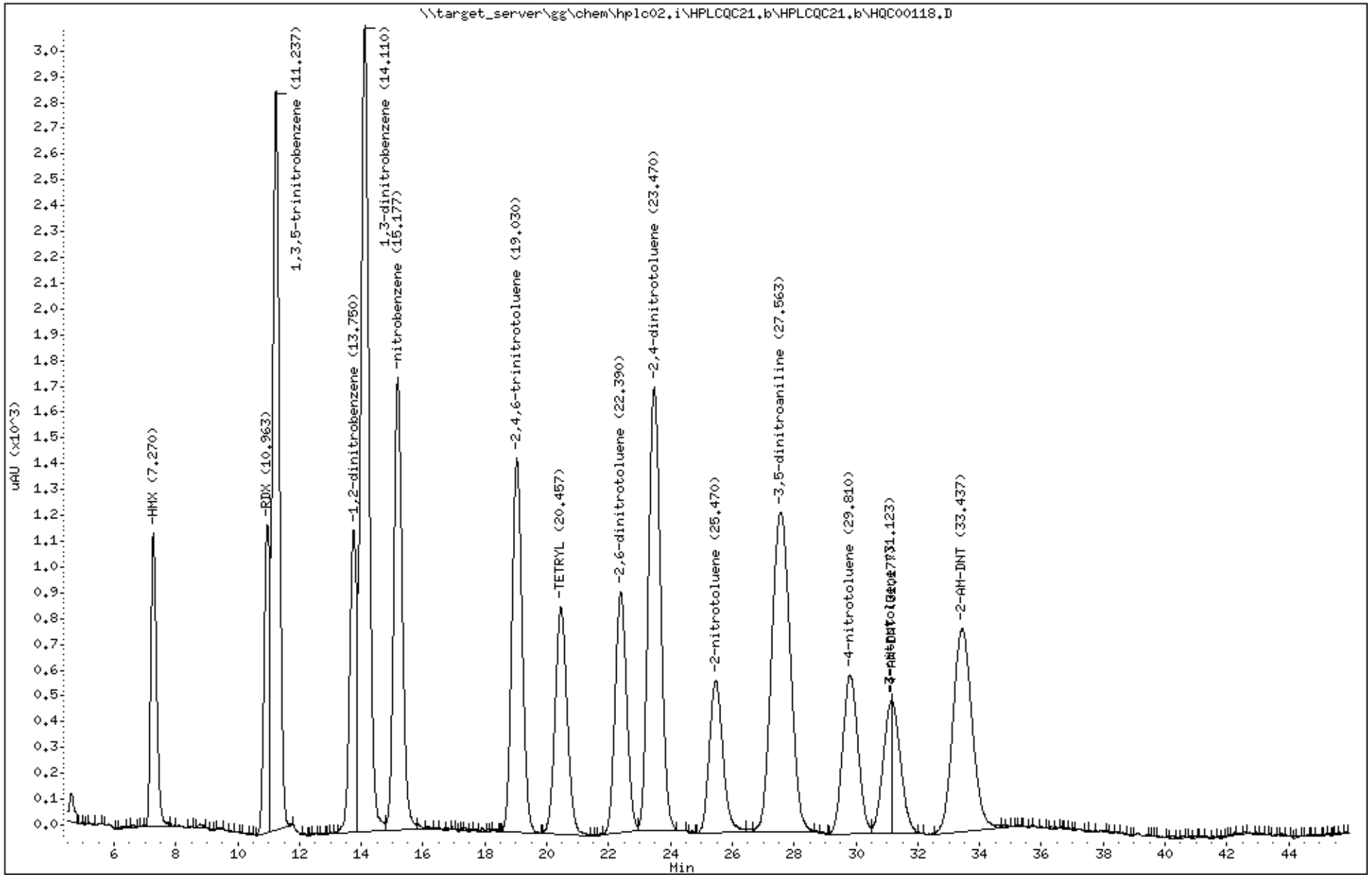
EP
11:38 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	ON-COL (ug/mL)	REVIEW CODE
1	HMX	7.270	7.270	0.000	1137	0.50000	0.500	
4	RDX	10.963	10.996	-0.033	1190	0.50000	0.500	
5	1,3,5-trinitrobenzene	11.236	11.256	-0.020	2865	0.50000	0.500	
$ 2	1,2-dinitrobenzene	13.750	13.796	-0.046	1171	0.50000	0.500	
6	1,3-dinitrobenzene	14.110	14.150	-0.040	3125	0.50000	0.500	
7	nitrobenzene	15.176	15.223	-0.047	1756	0.50000	0.500	
10	2,4,6-trinitrotoluene	19.030	19.090	-0.060	1449	0.50000	0.500	
9	TETRYL	20.456	20.536	-0.080	880	0.50000	0.500	
13	2,6-dinitrotoluene	22.390	22.463	-0.073	932	0.50000	0.500	
14	2,4-dinitrotoluene	23.470	23.550	-0.080	1717	0.50000	0.500	
15	2-nitrotoluene	25.470	25.536	-0.066	588	0.50000	0.500	
52	3,5-dinitroaniline	27.563	27.676	-0.113	1239	0.50000	0.500	
16	4-nitrotoluene	29.810	29.903	-0.093	614	0.50000	0.500	
17	3-nitrotoluene	31.123	31.283	-0.160	511	0.50000	0.500(M)	M1
11	4-AM-DNT	31.176	31.290	-0.114	511	0.50000	0.500(M)	M1
12	2-AM-DNT	33.436	33.596	-0.160	787	0.50000	0.500	

QC Flag Legend

M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00118.D
Date : 21-MAR-2023 13:24
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-5
Purge Volume: 1.0
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



Data File: HQC00119.D
Report Date: 23-Mar-2023 10:35

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00119.D
Lab Smp Id: WG334216-1
Inj Date : 21-MAR-2023 14:14
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-1
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 14:14   Cal File: HQC00119.D
Als bottle: 1   Calibration Sample, Level: 1
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:38 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	7.270	7.270	0.000	59	0.02500	0.0262(a)	
4	RDX	10.930	10.996	-0.066	52	0.02500	0.0222(a)	
5	1,3,5-trinitrobenzene	11.236	11.256	-0.020	122	0.02500	0.0219(a)	
$ 2	1,2-dinitrobenzene	13.723	13.796	-0.073	58	0.02500	0.0251(a)	
6	1,3-dinitrobenzene	14.130	14.150	-0.020	148	0.02500	0.0245(a)	
7	nitrobenzene	15.190	15.223	-0.033	92	0.02500	0.0266(a)	
10	2,4,6-trinitrotoluene	18.983	19.090	-0.107	67	0.02500	0.0240(a)	
9	TETRYL	20.423	20.536	-0.113	45	0.02500	0.0276(aM)	M9
13	2,6-dinitrotoluene	22.443	22.463	-0.020	50	0.02500	0.0264(aM)	M9
14	2,4-dinitrotoluene	23.490	23.550	-0.060	78	0.02500	0.0233(aH)	
15	2-nitrotoluene	25.410	25.536	-0.126	36	0.02500	0.0341(aM)	M9
52	3,5-dinitroaniline	27.563	27.676	-0.113	52	0.02500	0.0265(aM)	M9
16	4-nitrotoluene	29.863	29.903	-0.040	31	0.02500	0.0334(aM)	M9
17	3-nitrotoluene	31.103	31.283	-0.180	23	0.02500	0.0293(aM)	M9
11	4-AM-DNT	31.210	31.290	-0.080	22	0.02500	0.0494(aM)	M9
12	2-AM-DNT	33.550	33.596	-0.046	34	0.02500	0.0752(aM)	M9

QC Flag Legend

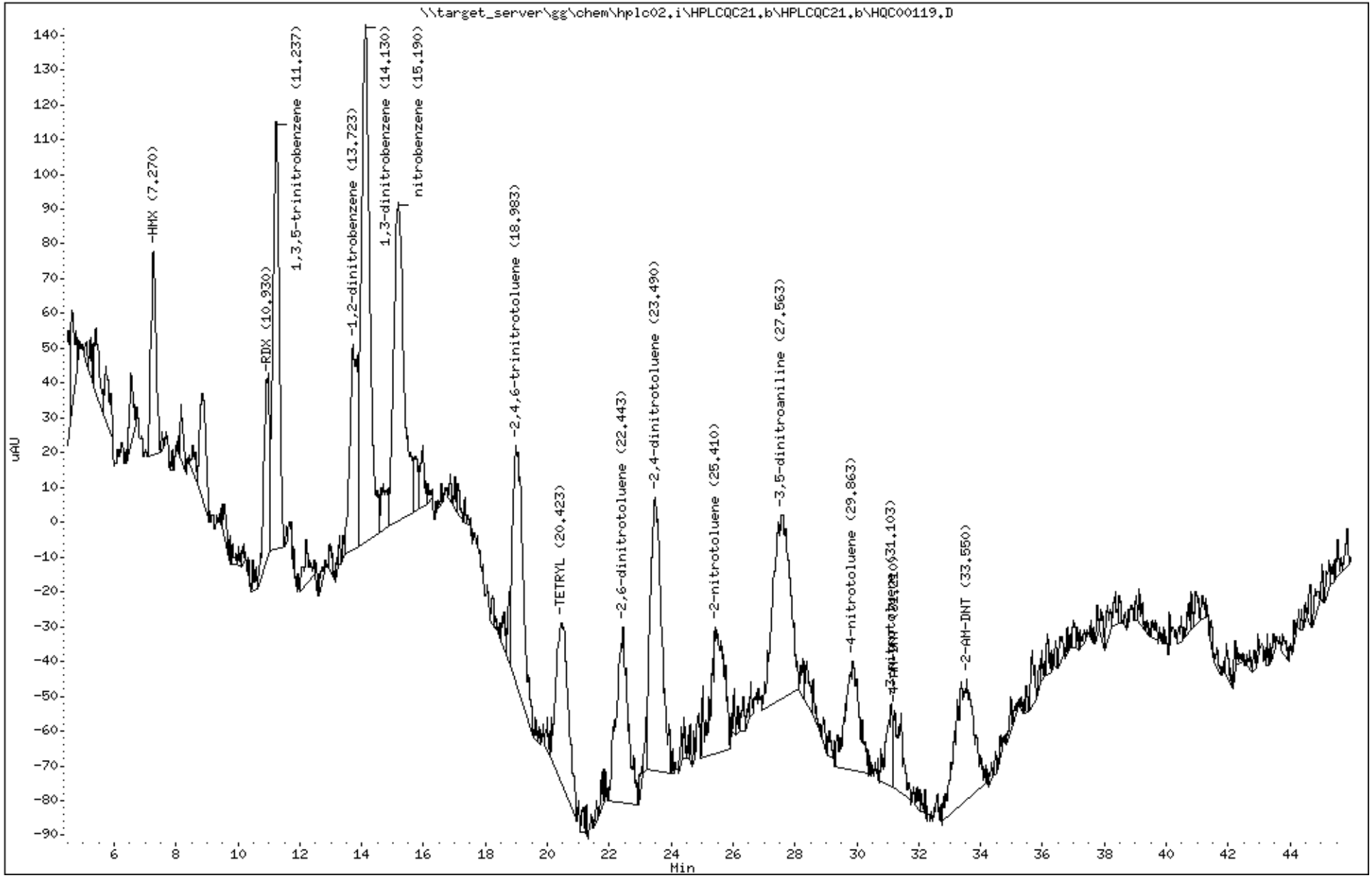
a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: HQC00119.D
Report Date: 23-Mar-2023 10:35

QC Flag Legend

H - Operator selected an alternate compound hit.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00119.D
Date : 21-MAR-2023 14:14
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-1
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



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Data File: HQC00120.D
Report Date: 23-Mar-2023 10:35

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00120.D
Lab Smp Id: WG334216-2
Inj Date : 21-MAR-2023 15:04
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-2
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 15:04   Cal File: HQC00120.D
Als bottle: 1   Calibration Sample, Level: 2
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

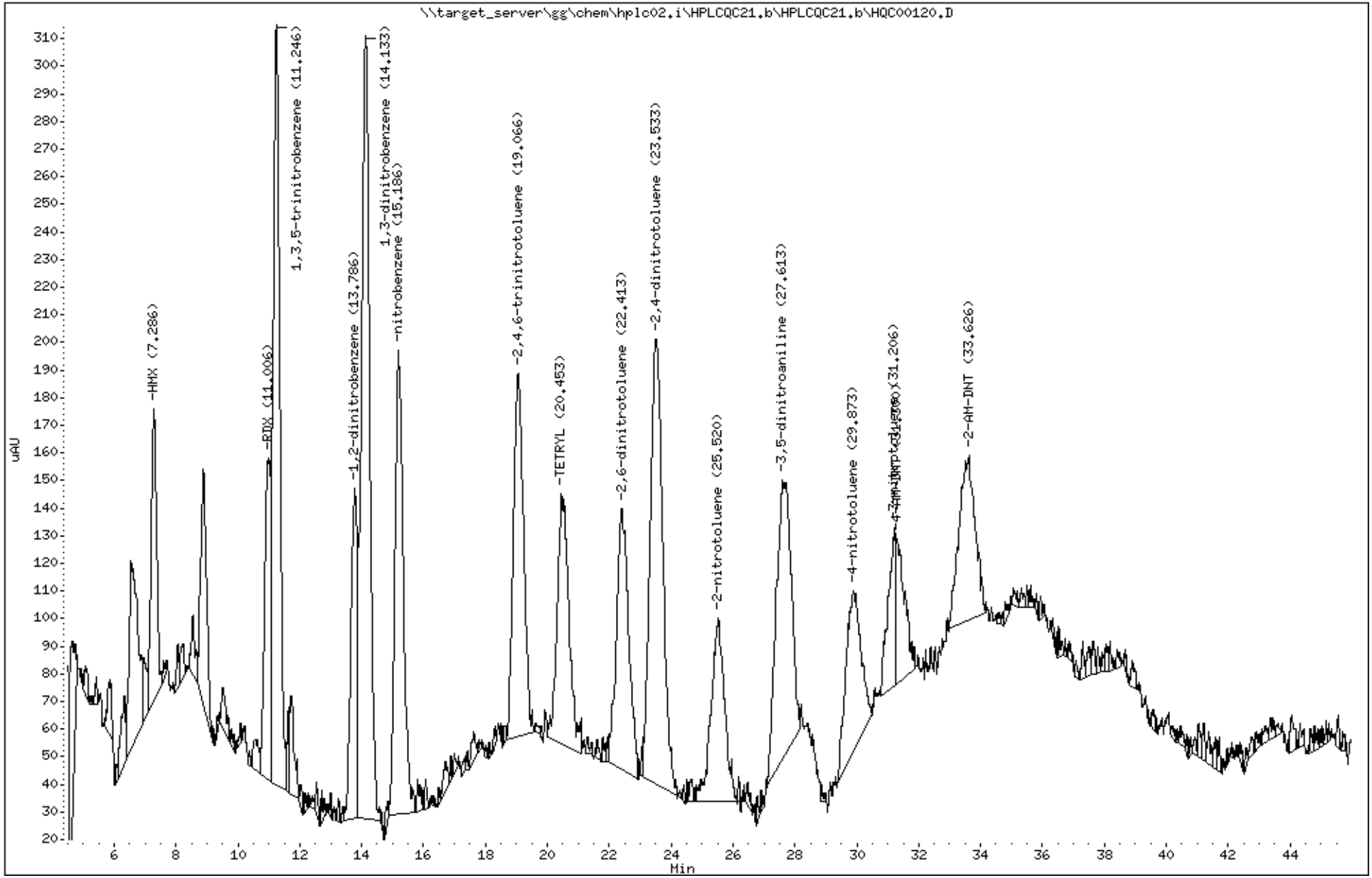
EP
11:38 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	7.286	7.270	0.016	106	0.05000	0.0470(a)	
4	RDX	11.006	10.996	0.010	117	0.05000	0.0500(a)	
5	1,3,5-trinitrobenzene	11.246	11.256	-0.010	276	0.05000	0.0496(a)	
$ 2	1,2-dinitrobenzene	13.786	13.796	-0.010	120	0.05000	0.0520	
6	1,3-dinitrobenzene	14.133	14.150	-0.017	284	0.05000	0.0470(a)	
7	nitrobenzene	15.186	15.223	-0.037	168	0.05000	0.0486(a)	
10	2,4,6-trinitrotoluene	19.066	19.090	-0.024	132	0.05000	0.0473(a)	
9	TETRYL	20.453	20.536	-0.083	90	0.05000	0.0507(aM)	M9
13	2,6-dinitrotoluene	22.413	22.463	-0.050	95	0.05000	0.0501(a)	
14	2,4-dinitrotoluene	23.533	23.550	-0.017	161	0.05000	0.0480(a)	
15	2-nitrotoluene	25.519	25.536	-0.017	66	0.05000	0.0548(aM)	M9
52	3,5-dinitroaniline	27.613	27.676	-0.063	100	0.05000	0.0465(aM)	M9
16	4-nitrotoluene	29.873	29.903	-0.030	58	0.05000	0.0562(aM)	M9
17	3-nitrotoluene	31.206	31.283	-0.077	57	0.05000	0.0647(aM)	M9
11	4-AM-DNT	31.299	31.290	0.009	52	0.05000	0.0853(aM)	M9
12	2-AM-DNT	33.626	33.596	0.030	59	0.05000	0.0973(aM)	M9

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00120.D
Date : 21-MAR-2023 15:04
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-2
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



Data File: HQC00121.D
Report Date: 23-Mar-2023 10:35

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00121.D
Lab Smp Id: WG334216-3
Inj Date : 21-MAR-2023 15:55
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-3
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 15:55   Cal File: HQC00121.D
Als bottle: 1   Calibration Sample, Level: 3
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

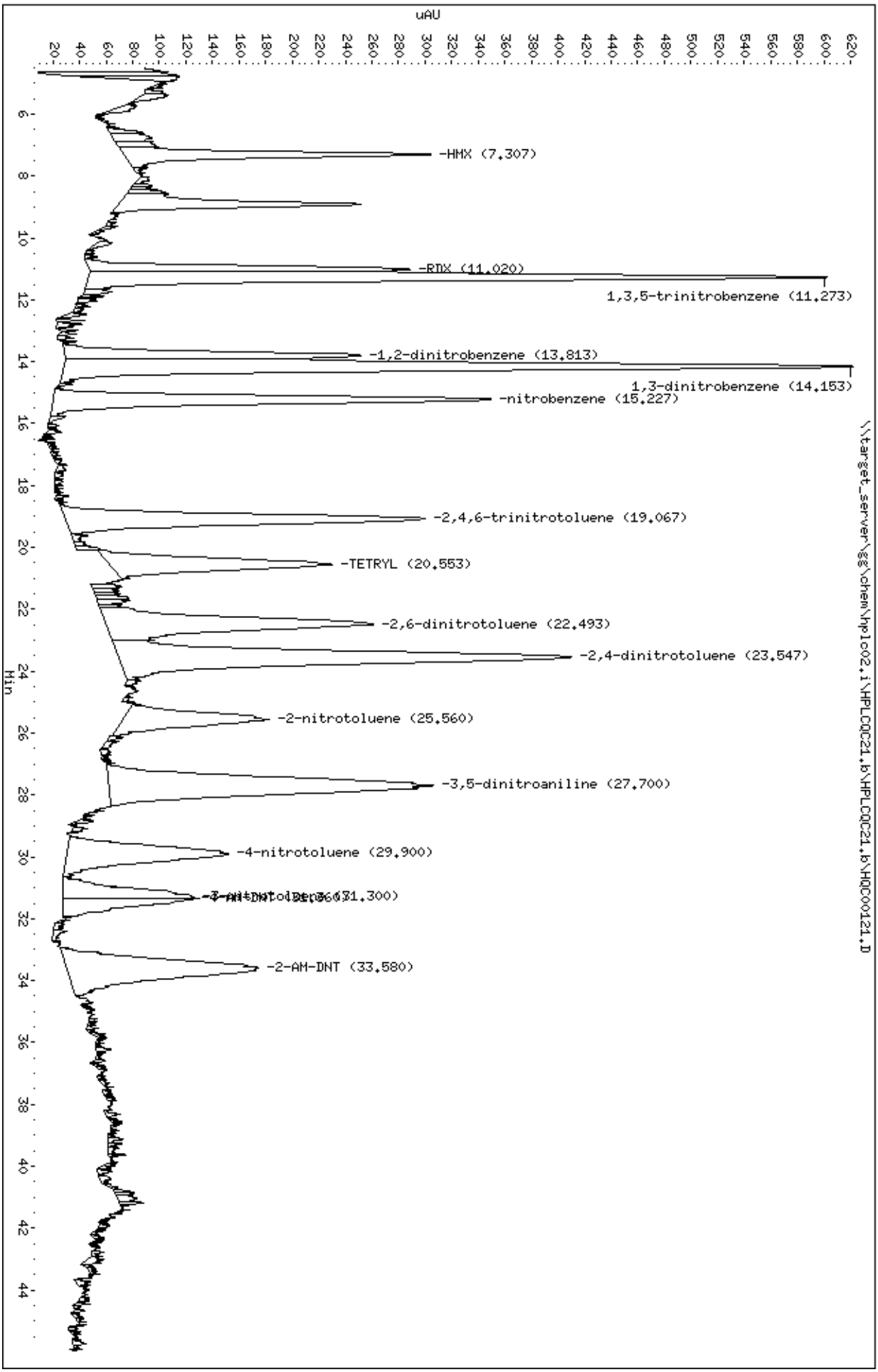
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:38 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	7.306	7.270	0.036	231	0.10000	0.102(a)	
4	RDX	11.019	10.996	0.023	242	0.10000	0.103(a)	
5	1,3,5-trinitrobenzene	11.273	11.256	0.017	556	0.10000	0.0999(a)	
$ 2	1,2-dinitrobenzene	13.813	13.796	0.017	223	0.10000	0.0965	
6	1,3-dinitrobenzene	14.153	14.150	0.003	594	0.10000	0.0983(a)	
7	nitrobenzene	15.226	15.223	0.003	330	0.10000	0.0956(a)	
10	2,4,6-trinitrotoluene	19.066	19.090	-0.024	271	0.10000	0.0971(a)	
9	TETRYL	20.553	20.536	0.017	167	0.10000	0.0957(aM)	M2
13	2,6-dinitrotoluene	22.493	22.463	0.030	201	0.10000	0.106(a)	
14	2,4-dinitrotoluene	23.546	23.550	-0.004	341	0.10000	0.102(a)	
15	2-nitrotoluene	25.559	25.536	0.023	110	0.10000	0.0908(aM)	M9
52	3,5-dinitroaniline	27.699	27.676	0.023	243	0.10000	0.101(aM)	M9
16	4-nitrotoluene	29.899	29.903	-0.004	121	0.10000	0.113(aM)	M9
17	3-nitrotoluene	31.299	31.283	0.016	99	0.10000	0.0976(aM)	M9
11	4-AM-DNT	31.359	31.290	0.069	97	0.10000	0.123(aM)	M9
12	2-AM-DNT	33.579	33.596	-0.017	145	0.10000	0.181(aM)	M9

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00121.D
Date : 21-MAR-2023 15:55
Client ID:
Sample Info: WG334216-3
Purge Volume: 0.5
Column phase: Acclaim E2
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00121.D
uAU
Min
-HMX (7.307)
-RDX (11.020)
1,3,5-trinitrobenzene (11.273)
-1,2-dinitrobenzene (13.813)
1,3-dinitrobenzene (14.153)
-nitrobenzene (15.227)
-2,4,6-trinitrotoluene (19.067)
-TETRYL (20.553)
-2,6-dinitrotoluene (22.493)
-2,4-dinitrotoluene (23.547)
-2-nitrotoluene (25.560)
-3,5-dinitroaniline (27.700)
-4-nitrotoluene (29.900)
-2-AM-DNT (33.580)

Data File: HQC00122.D
Report Date: 23-Mar-2023 10:35

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00122.D
Lab Smp Id: WG334216-4
Inj Date : 21-MAR-2023 16:45
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-4
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 16:45   Cal File: HQC00122.D
Als bottle: 1   Calibration Sample, Level: 4
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

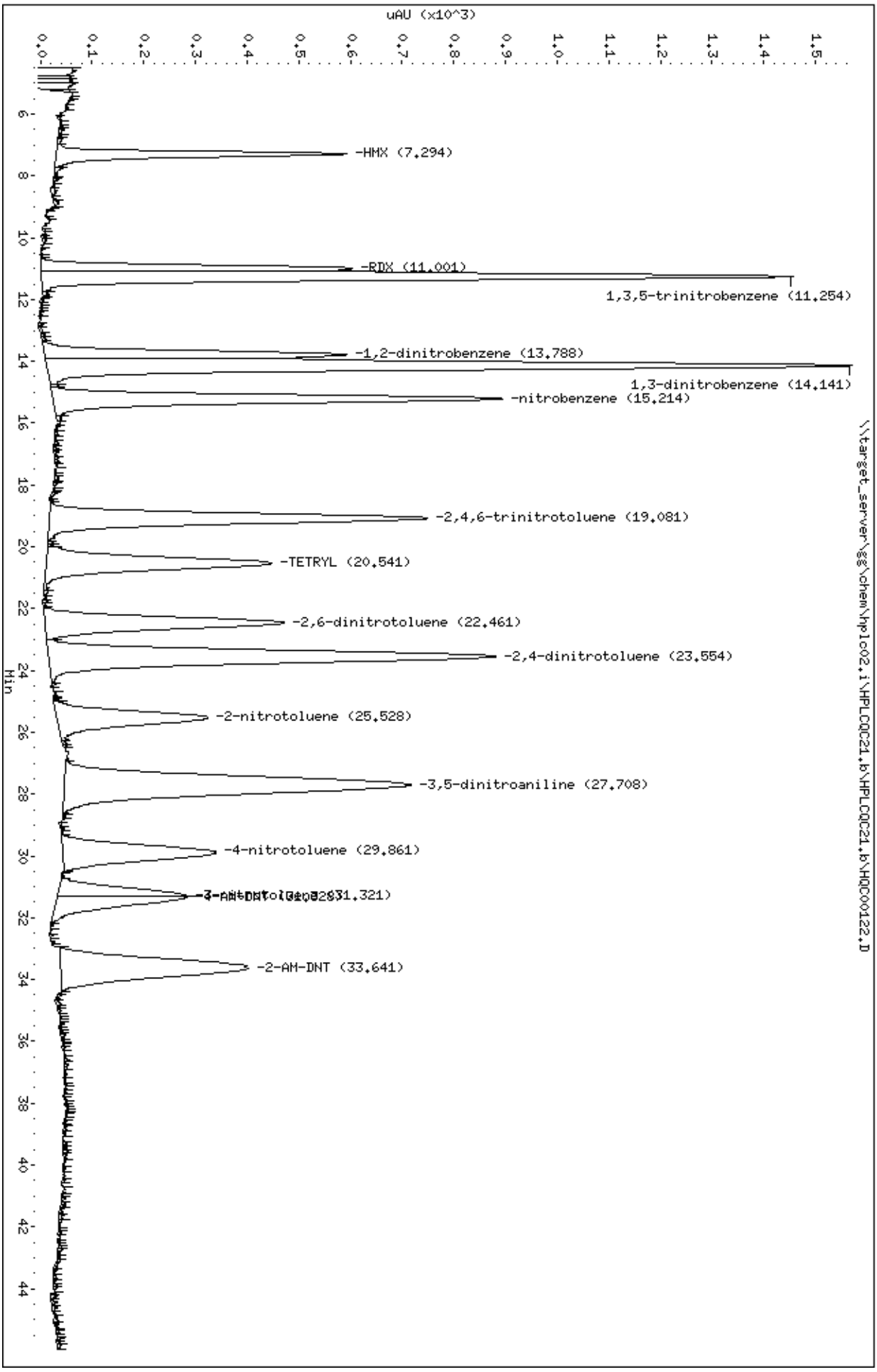
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:38 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	7.294	7.270	0.024	562	0.25000	0.249(a)	
4	RDX	11.001	10.996	0.005	605	0.25000	0.258	
5	1,3,5-trinitrobenzene	11.254	11.256	-0.002	1455	0.25000	0.262	
$ 2	1,2-dinitrobenzene	13.787	13.796	-0.009	586	0.25000	0.254	
6	1,3-dinitrobenzene	14.141	14.150	-0.009	1559	0.25000	0.258	
7	nitrobenzene	15.214	15.223	-0.009	869	0.25000	0.252	
10	2,4,6-trinitrotoluene	19.081	19.090	-0.009	732	0.25000	0.262	
9	TETRYL	20.541	20.536	0.005	438	0.25000	0.251	
13	2,6-dinitrotoluene	22.461	22.463	-0.002	462	0.25000	0.244(a)	
14	2,4-dinitrotoluene	23.554	23.550	0.004	866	0.25000	0.258	
15	2-nitrotoluene	25.527	25.536	-0.009	292	0.25000	0.241(a)	
52	3,5-dinitroaniline	27.707	27.676	0.031	671	0.25000	0.280	
16	4-nitrotoluene	29.861	29.903	-0.042	295	0.25000	0.246(aM)	
17	3-nitrotoluene	31.321	31.283	0.038	250	0.25000	0.247(aM)	
11	4-AM-DNT	31.327	31.290	0.037	251	0.25000	0.255(M)	
12	2-AM-DNT	33.641	33.596	0.045	362	0.25000	0.360(M)	M9

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00122.D
Date : 21-MAR-2023 16:45
Client ID:
Sample Info: WG334216-4
Purge Volume: 0.5
Column phase: Acclaim E2
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00122.D
uAU (x10^3)
Min
-HMX (7.294)
-RDX (11.001)
1,3,5-trinitrobenzene (11.254)
-1,2-dinitrobenzene (13.788)
1,3-dinitrobenzene (14.141)
-nitrobenzene (15.214)
-2,4,6-trinitrotoluene (19.081)
-TETRYL (20.541)
-2,6-dinitrotoluene (22.461)
-2,4-dinitrotoluene (23.554)
-2-nitrotoluene (25.528)
-3,5-dinitroaniline (27.708)
-4-nitrotoluene (29.861)
-2-AM-DNT (33.641)

Data File: HQC00123.D
Report Date: 23-Mar-2023 10:35

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00123.D
Lab Smp Id: WG334216-6
Inj Date : 21-MAR-2023 17:35
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-6
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 17:35   Cal File: HQC00123.D
Als bottle: 1   Calibration Sample, Level: 6
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

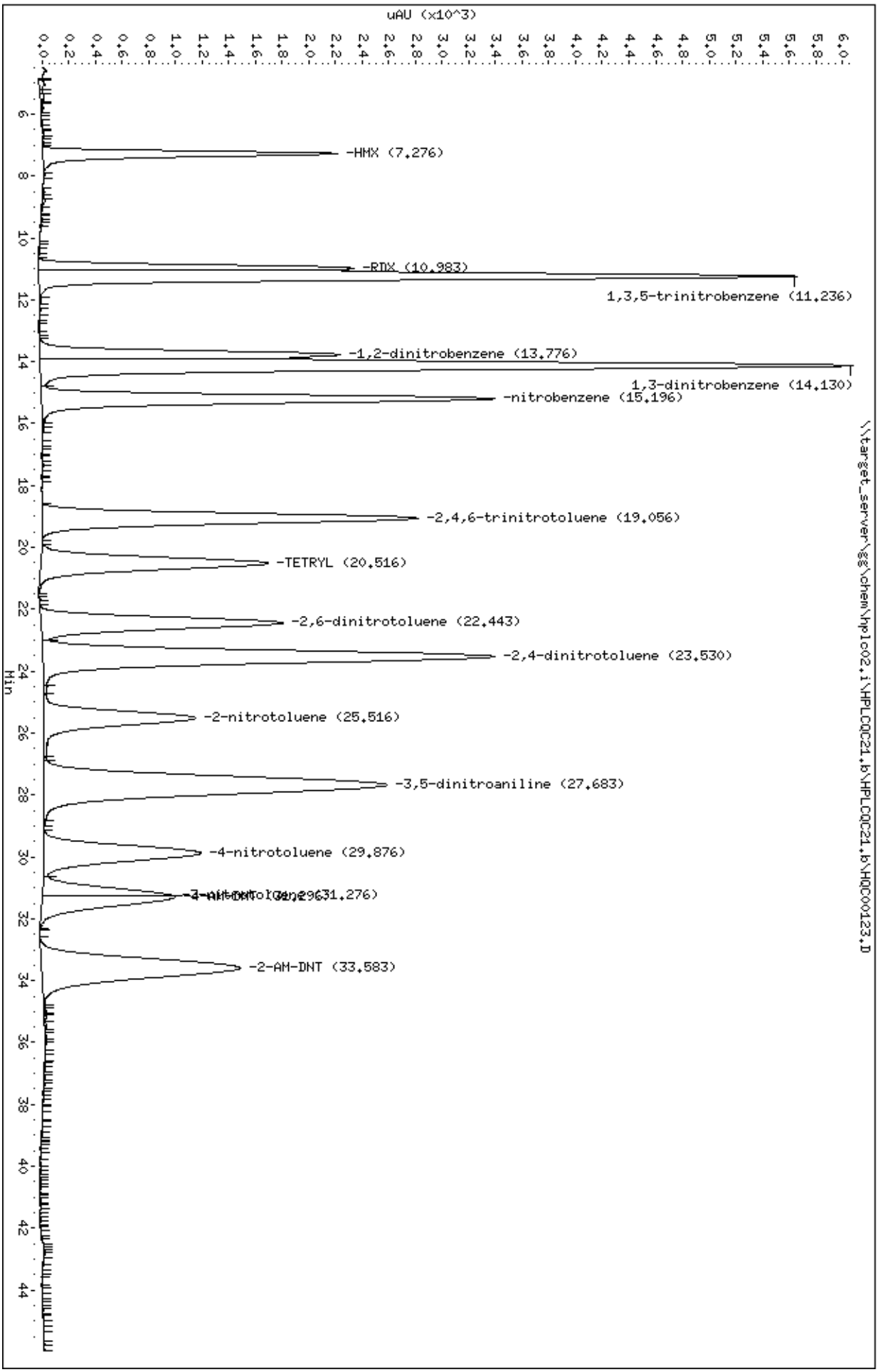
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:38 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	7.276	7.270	0.006	2213	1.00000	0.982	
4	RDX	10.983	10.996	-0.013	2360	1.00000	1.01	
5	1,3,5-trinitrobenzene	11.236	11.256	-0.020	5682	1.00000	1.02	
$ 2	1,2-dinitrobenzene	13.776	13.796	-0.020	2257	1.00000	0.977	
6	1,3-dinitrobenzene	14.129	14.150	-0.021	6094	1.00000	1.01	
7	nitrobenzene	15.196	15.223	-0.027	3400	1.00000	0.984	
10	2,4,6-trinitrotoluene	19.056	19.090	-0.034	2819	1.00000	1.01	
9	TETRYL	20.516	20.536	-0.020	1698	1.00000	0.973	
13	2,6-dinitrotoluene	22.443	22.463	-0.020	1815	1.00000	0.958	
14	2,4-dinitrotoluene	23.529	23.550	-0.021	3385	1.00000	1.01	
15	2-nitrotoluene	25.516	25.536	-0.020	1143	1.00000	0.943	
52	3,5-dinitroaniline	27.683	27.676	0.007	2574	1.00000	1.07	
16	4-nitrotoluene	29.876	29.903	-0.027	1176	1.00000	0.979	
17	3-nitrotoluene	31.276	31.283	-0.007	988	1.00000	0.976(M)	M1
11	4-AM-DNT	31.296	31.290	0.006	992	1.00000	1.01(M)	M1
12	2-AM-DNT	33.583	33.596	-0.013	1486	1.00000	1.22(M)	M6

QC Flag Legend

M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00123.D
Date : 21-MAR-2023 17:35
Client ID:
Sample Info: WG334216-6
Purge Volume: 0.5
Column phase: Acclaim E2
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00123.D
uAU (x10^3)
Min
-HMX (7.276)
-RDX (10.983)
1,3,5-trinitrobenzene (11.236)
-1,2-dinitrobenzene (13.776)
1,3-dinitrobenzene (14.130)
-nitrobenzene (15.196)
-2,4,6-trinitrotoluene (19.056)
-TETRYL (20.516)
-2,6-dinitrotoluene (22.443)
-2,4-dinitrotoluene (23.530)
-2-nitrotoluene (25.516)
-3,5-dinitroaniline (27.683)
-4-nitrotoluene (29.876)
-2-AM-DNT (33.583)

Data File: HQC00124.D
Report Date: 23-Mar-2023 10:35

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00124.D
Lab Smp Id: WG334216-7
Inj Date : 21-MAR-2023 18:25
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-7
Misc Info :
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 18:25   Cal File: HQC00124.D
Als bottle: 1   Calibration Sample, Level: 7
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

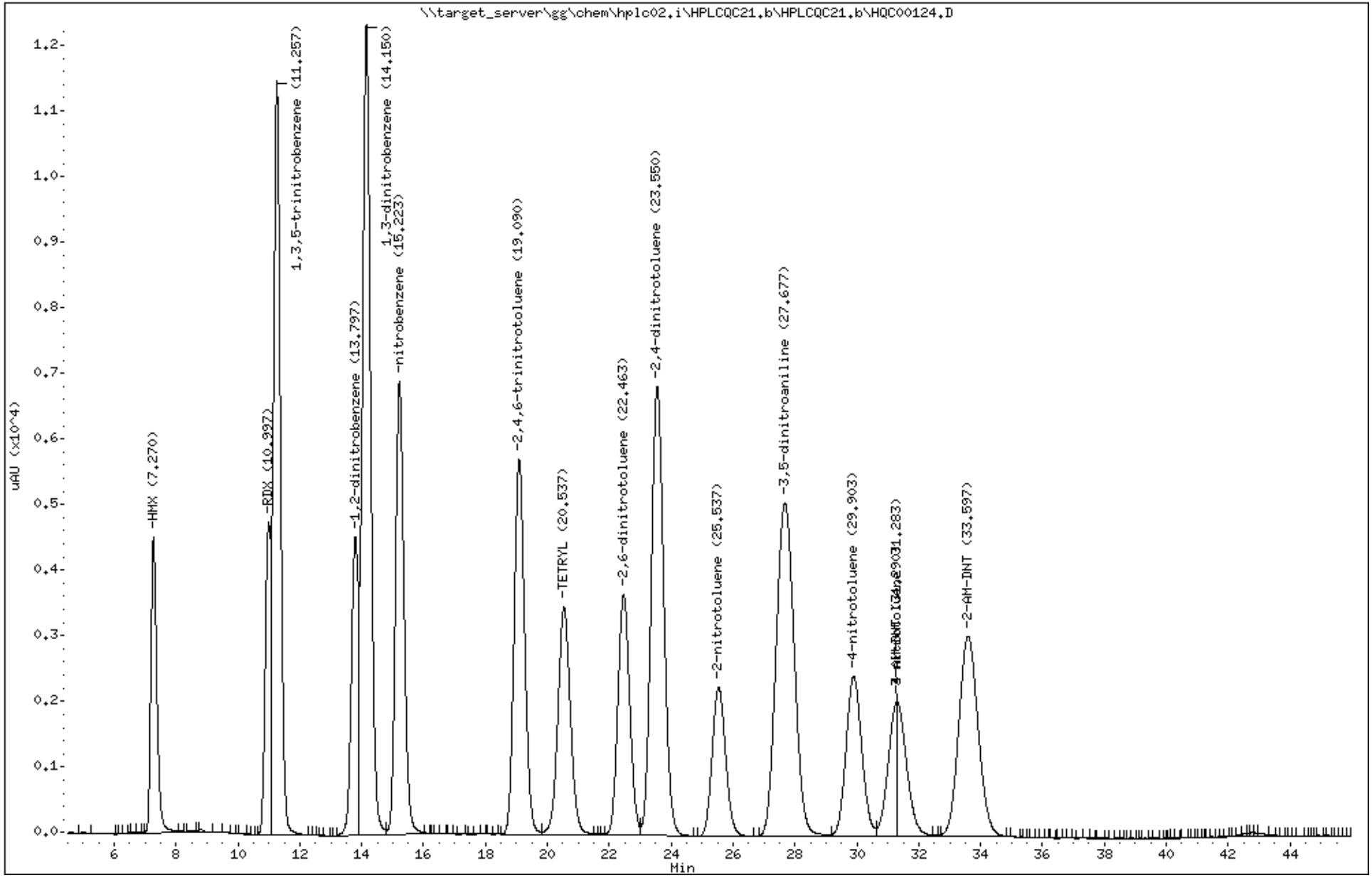
EP
11:38 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	7.270	7.270	0.000	4498	2.00000	2.00	
4	RDX	10.996	10.996	0.000	4765	2.00000	2.04(A)	
5	1,3,5-trinitrobenzene	11.256	11.256	0.000	11502	2.00000	2.07(A)	
$ 2	1,2-dinitrobenzene	13.796	13.796	0.000	4550	2.00000	1.97	
6	1,3-dinitrobenzene	14.150	14.150	0.000	12349	2.00000	2.04(A)	
7	nitrobenzene	15.223	15.223	0.000	6895	2.00000	2.00	
10	2,4,6-trinitrotoluene	19.090	19.090	0.000	5716	2.00000	2.05(A)	
9	TETRYL	20.536	20.536	0.000	3465	2.00000	1.99	
13	2,6-dinitrotoluene	22.463	22.463	0.000	3661	2.00000	1.93	
14	2,4-dinitrotoluene	23.550	23.550	0.000	6839	2.00000	2.04(A)	
15	2-nitrotoluene	25.536	25.536	0.000	2274	2.00000	1.88	
52	3,5-dinitroaniline	27.676	27.676	0.000	5079	2.00000	2.12(A)	
16	4-nitrotoluene	29.903	29.903	0.000	2429	2.00000	2.02(A)	
17	3-nitrotoluene	31.283	31.283	0.000	2049	2.00000	2.02(AM)	M1
11	4-AM-DNT	31.290	31.290	0.000	2051	2.00000	2.07(AM)	M1
12	2-AM-DNT	33.596	33.596	0.000	3052	2.00000	2.13(AM)	M6

QC Flag Legend

A - Target compound detected but, quantitated amount
    exceeded maximum amount.
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00124.D
Date : 21-MAR-2023 18:25
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-7
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 330 of 1130

Data File: HQC00125.D
Report Date: 23-Mar-2023 10:36

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00125.D
Lab Smp Id: WG334216-8
Inj Date : 21-MAR-2023 19:16
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-8
Misc Info : WG334216,WG334216,WG334216-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 06:53 epelletier Quant Type: ESTD
Cal Date : 21-MAR-2023 18:25   Cal File: HQC00124.D
Als bottle: 1   QC Sample: INDSOURCE
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

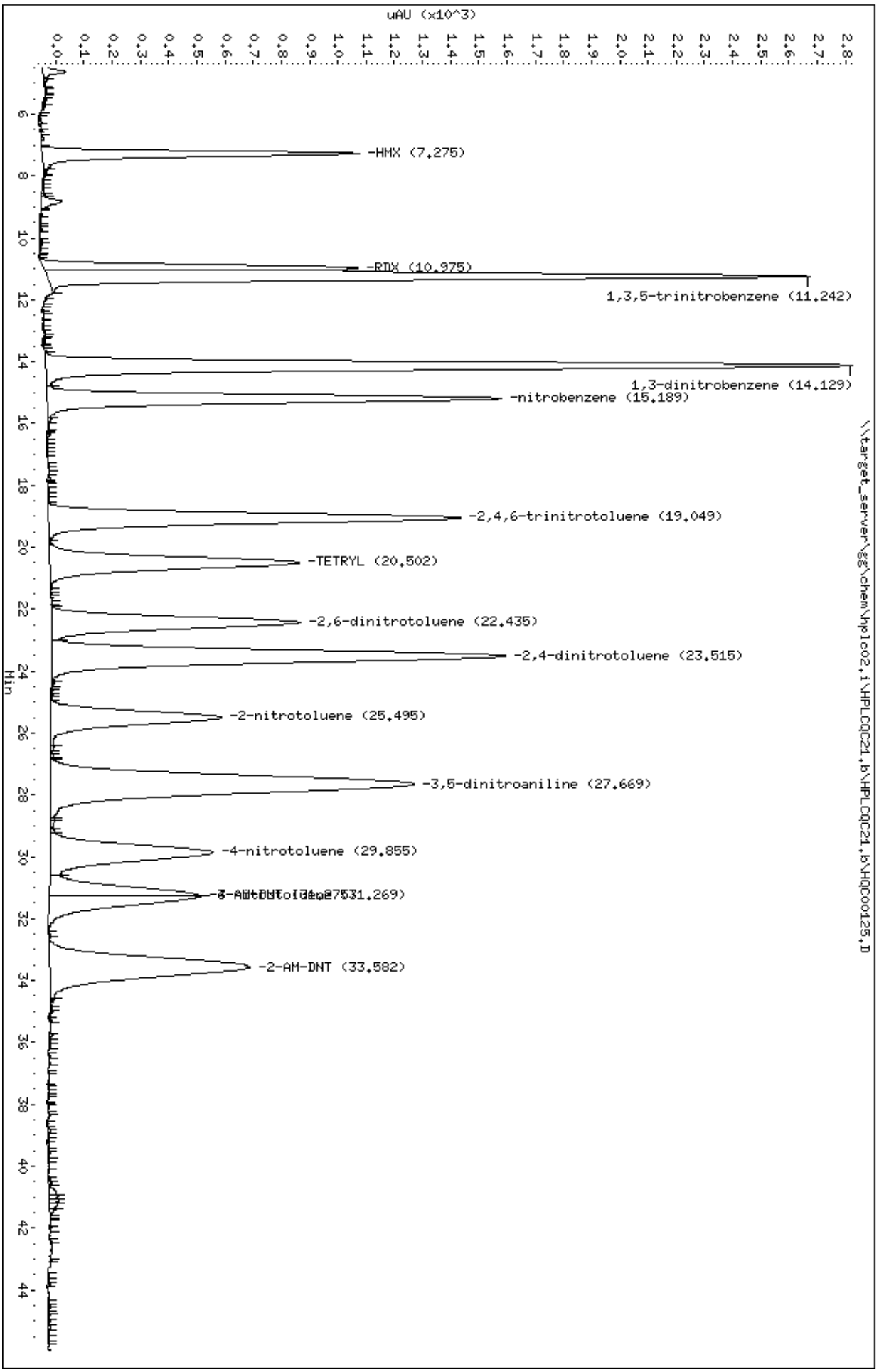
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
11:38 am, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE
1	HMX	7.275	7.270	0.005	1125	0.49924	4.99	
4	RDX	10.975	10.996	-0.021	1116	0.47685	4.77	
5	1,3,5-trinitrobenzene	11.241	11.256	-0.015	2708	0.48676	4.87	
6	1,3-dinitrobenzene	14.128	14.150	-0.022	2864	0.47401	4.74	
7	nitrobenzene	15.188	15.223	-0.035	1613	0.46704	4.67	
10	2,4,6-trinitrotoluene	19.048	19.090	-0.042	1463	0.52429	5.24	
9	TETRYL	20.501	20.536	-0.035	884	0.50669	5.07	
13	2,6-dinitrotoluene	22.435	22.463	-0.028	881	0.46482	4.65	
14	2,4-dinitrotoluene	23.515	23.550	-0.035	1611	0.48084	4.81	
15	2-nitrotoluene	25.495	25.536	-0.041	603	0.49752	4.98	
52	3,5-dinitroaniline	27.668	27.676	-0.008	1289	0.53755	5.38	
16	4-nitrotoluene	29.855	29.903	-0.048	575	0.47868	4.79	
17	3-nitrotoluene	31.268	31.283	-0.015	534	0.52763	5.28(M)	M1
11	4-AM-DNT	31.275	31.290	-0.015	535	0.54013	5.40(M)	M1
12	2-AM-DNT	33.581	33.596	-0.015	709	0.49511	4.95	

QC Flag Legend

M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00125.D
Date : 21-MAR-2023 19:16
Client ID:
Sample Info: WG334216-8
Purge Volume: 0.5
Column phase: Acclaim E2
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00125.D
uAU (x10^3)
Min
-HMX (7.275)
-RDX (10.975)
1,3,5-trinitrobenzene (11.242)
1,3-dinitrobenzene (14.129)
-nitrobenzene (15.189)
-2,4,6-trinitrotoluene (19.049)
-TETRYL (20.502)
-2,6-dinitrotoluene (22.435)
-2,4-dinitrotoluene (23.515)
-2-nitrotoluene (25.495)
-3,5-dinitroaniline (27.669)
-4-nitrotoluene (29.855)
-2-AM-DNT (33.582)

Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG333979-1
Analytical Date: 03/17/23 09:08
Lab File ID: HQC00087.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 210 um

Compound	$\overline{\text{RRF}}$/Amount	RF0.500	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
NITROGLYCERIN	6828	7138	0.010	4.53329	20.00000	Averaged

*** = Compound out of QC criteria**

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00087.D
Report Date: 23-Mar-2023 13:58

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00087.D
Lab Smp Id: WG333979-1
Inj Date : 17-MAR-2023 09:08
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333979-1,SQ1201
Misc Info : WG333979,WG333979,WG333590-5,SQ1201-1
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 13:58 hplc02.i   Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

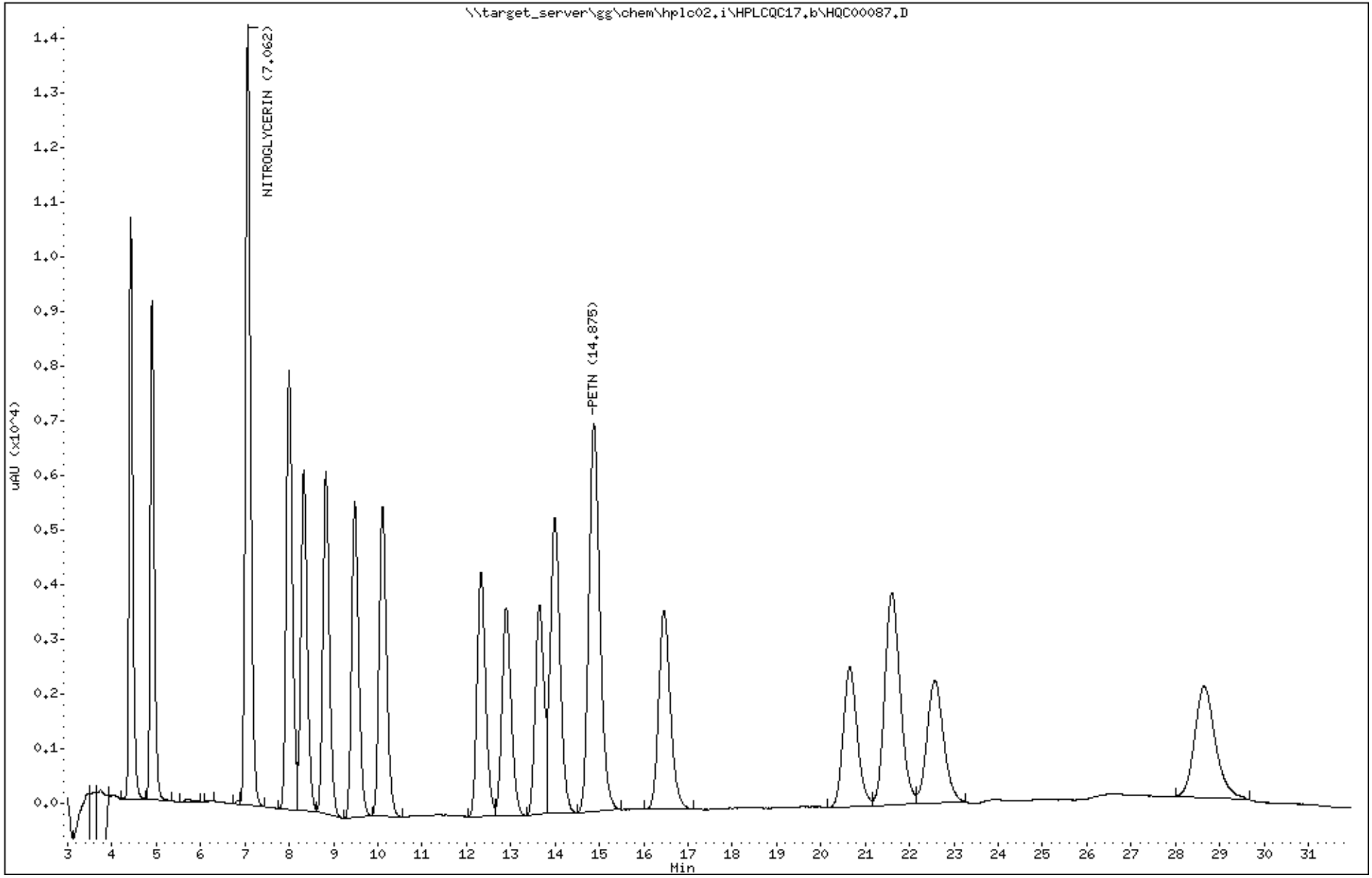
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.061	7.061	0.000	14276	2.00000	2.09(a)	
18 PETN	14.875	14.875	0.000	7087	2.00000	2.03(a)	

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00087.D
Date : 17-MAR-2023 09:08
Client ID:
Instrument: hplc02.i
Sample Info: WG333979-1,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 335 of 1130

Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG333979-1
Analytical Date: 03/17/23 09:08
Lab File ID: HQC00087.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 254 um

Compound	$\overline{\text{RRF}}$/Amount	RF0.500	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
HMX	7913	8110	0.010	2.48587	20.00000	Averaged
RDX	8562	8842	0.010	3.27630	20.00000	Averaged
1,3,5-trinitrobenzene	4950	5218	0.010	5.42175	20.00000	Averaged
1,3-dinitrobenzene	11206	11452	0.010	2.19460	20.00000	Averaged
nitrobenzene	11484	10816	0.010	-5.81913	20.00000	Averaged
TETRYL	2319	2776	0.010	19.70677	20.00000	Averaged
2,4,6-trinitrotoluene	3064	3242	0.010	5.80693	20.00000	Averaged
4-AM-DNT	6122	6282	0.010	2.60634	20.00000	Averaged
2-AM-DNT	8682	8898	0.010	2.48791	20.00000	Averaged
2,6-dinitrotoluene	4060	4174	0.010	2.81693	20.00000	Averaged
2,4-dinitrotoluene	6900	6774	0.010	-1.82101	20.00000	Averaged
2-nitrotoluene	3931	4036	0.010	2.66921	20.00000	Averaged
4-nitrotoluene	3501	3578	0.010	2.18686	20.00000	Averaged
3-nitrotoluene	4483	4642	0.010	3.55828	20.00000	Averaged
1,2-dinitrobenzene	6678	6202	0.010	-7.12888	20.00000	Averaged

*** = Compound out of QC criteria**

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Data File: HQC00087.D
Report Date: 23-Mar-2023 10:26

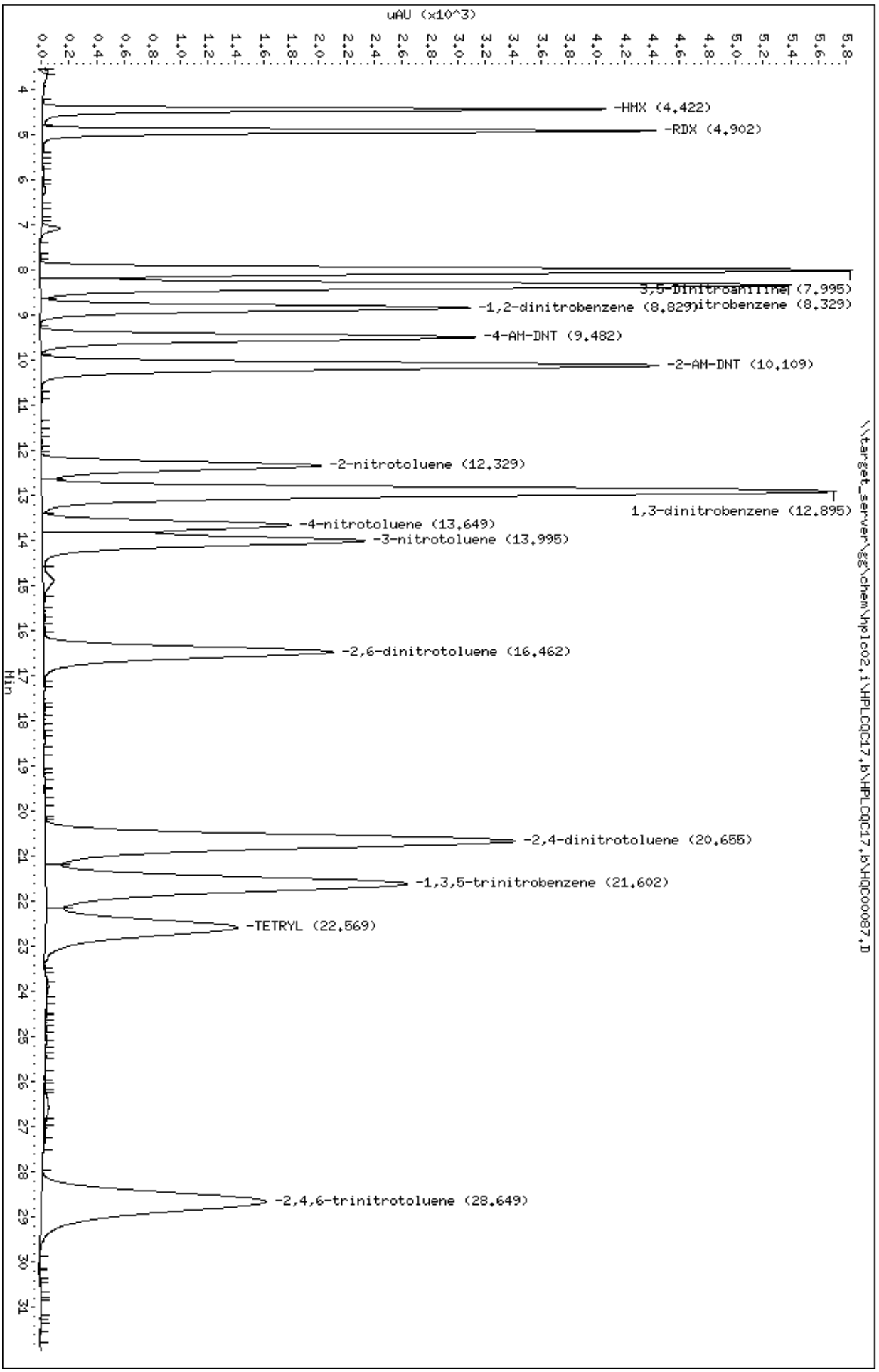
Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00087.D
Lab Smp Id: WG333979-1
Inj Date : 17-MAR-2023 09:08
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333979-1,SQ1201
Misc Info : WG333979,WG333979,WG333590-5,SQ1201-1
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.421	4.421	0.000	4055	0.50000	0.512	
4	RDX	4.901	4.901	0.000	4421	0.50000	0.516	
51	3,5-Dinitroaniline	7.995	7.995	0.000	5854	0.50000	0.512	
7	nitrobenzene	8.328	8.328	0.000	5408	0.50000	0.471	
$ 2	1,2-dinitrobenzene	8.828	8.828	0.000	3101	0.50000	0.464	
11	4-AM-DNT	9.481	9.481	0.000	3141	0.50000	0.513	
12	2-AM-DNT	10.108	10.108	0.000	4449	0.50000	0.512	
15	2-nitrotoluene	12.328	12.328	0.000	2018	0.50000	0.513	
6	1,3-dinitrobenzene	12.895	12.895	0.000	5726	0.50000	0.511	
16	4-nitrotoluene	13.648	13.648	0.000	1789	0.50000	0.511	
17	3-nitrotoluene	13.995	13.995	0.000	2321	0.50000	0.518	
13	2,6-dinitrotoluene	16.461	16.461	0.000	2087	0.50000	0.514	
14	2,4-dinitrotoluene	20.655	20.655	0.000	3387	0.50000	0.491	
5	1,3,5-trinitrobenzene	21.601	21.601	0.000	2609	0.50000	0.527	
9	TETRYL	22.568	22.568	0.000	1388	0.50000	0.598	
10	2,4,6-trinitrotoluene	28.648	28.648	0.000	1621	0.50000	0.529	


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00087.D
Date : 17-MAR-2023 09:08
Client ID:
Sample Info: WG333979-1,SQ1201
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
uAU (x10^3)
Min
-HMX (4.422)
-RDX (4.902)
3,5-Dinitroaniline (7.995)
-1,2-dinitrobenzene (8.829)
nitrobenzene (8.329)
-4-AM-DNT (9.482)
-2-AM-DNT (10.109)
-2-nitrotoluene (12.329)
1,3-dinitrobenzene (12.895)
-4-nitrotoluene (13.649)
-3-nitrotoluene (13.995)
-2,6-dinitrotoluene (16.462)
-2,4-dinitrotoluene (20.655)
-1,3,5-trinitrobenzene (21.602)
-TETRYL (22.569)
-2,4,6-trinitrotoluene (28.649)
\\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00087.D

Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG333979-2
Analytical Date: 03/17/23 18:37
Lab File ID: HQC00103.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 210 um

Compound	$\overline{\text{RRF}}$/Amount	RF0.250	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
NITROGLYCERIN	6828	6980	0.010	2.21944	20.00000	Averaged

*** = Compound out of QC criteria**

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00103.D
Report Date: 23-Mar-2023 10:33

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00103.D
Lab Smp Id: WG333979-2
Inj Date : 17-MAR-2023 18:37
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333979-2,SQ1201
Misc Info : WG333979,WG333979,WG333590-5,SQ1201-1
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i   Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

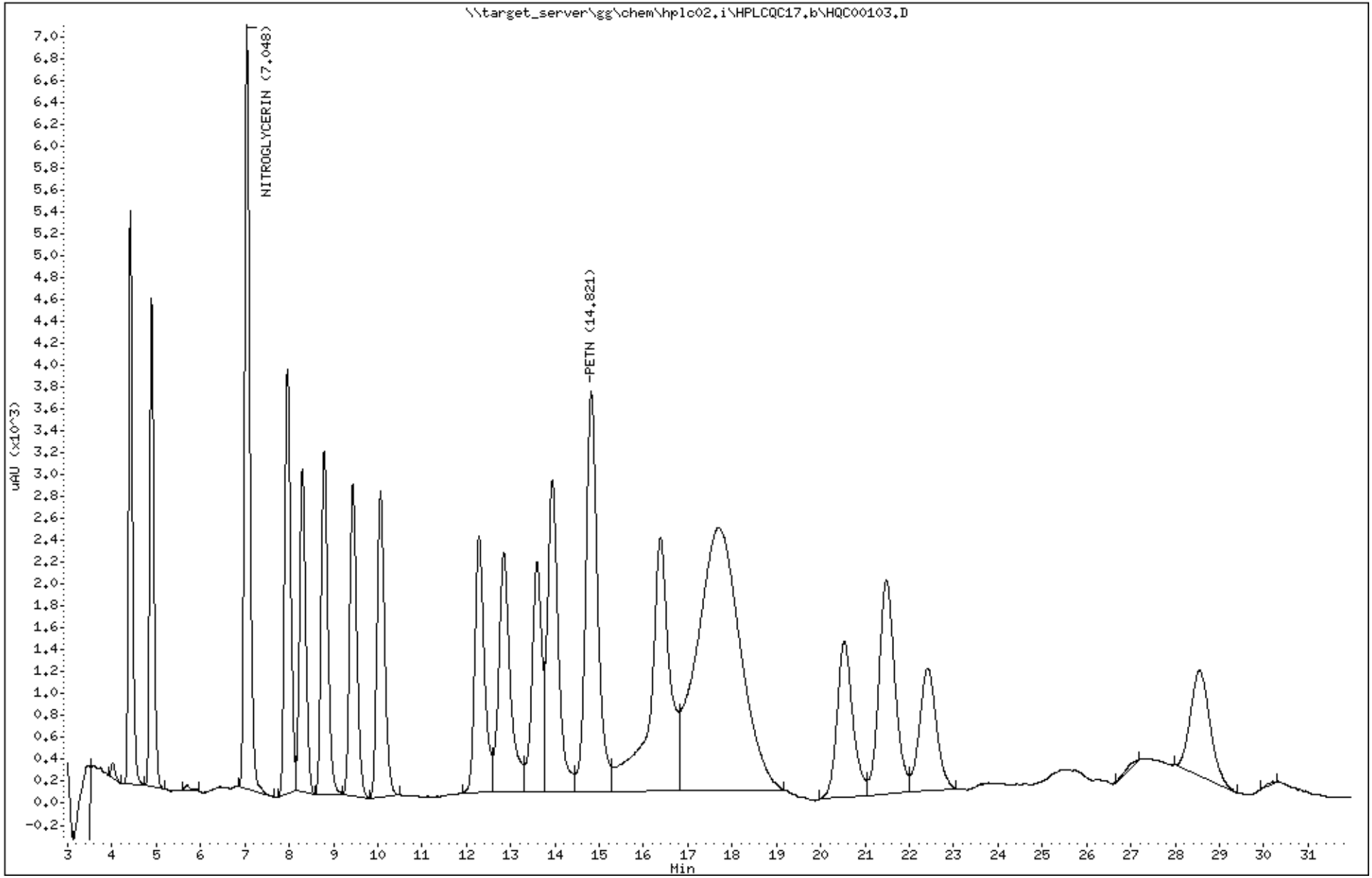
EP
2:34 pm, Mar 23, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	ON-COL (ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.047	7.061	-0.014	6980	1.00000	1.02(aM)	M6
18 PETN	14.821	14.875	-0.054	3655	1.00000	1.05(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00103.D
Date : 17-MAR-2023 18:37
Client ID:
Instrument: hplc02.i
Sample Info: WG333979-2,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 341 of 1130

Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG333979-2
Analytical Date: 03/17/23 18:37
Lab File ID: HQC00103.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 254 um

Compound	$\overline{\text{RRF}}$/Amount	RF0.250	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
HMX	7913	7980	0.010	0.84307	20.00000	Averaged
RDX	8562	8652	0.010	1.05706	20.00000	Averaged
1,3,5-trinitrobenzene	4950	5180	0.010	4.65402	20.00000	Averaged
1,3-dinitrobenzene	11206	11388	0.010	1.62348	20.00000	Averaged
nitrobenzene	11484	10568	0.010	-7.97860	20.00000	Averaged
TETRYL	2319	2740	0.010	18.15438	20.00000	Averaged
2,4,6-trinitrotoluene	3064	3152	0.010	2.86966	20.00000	Averaged
4-AM-DNT	6122	6180	0.010	0.94034	20.00000	Averaged
2-AM-DNT	8682	8808	0.010	1.45128	20.00000	Averaged
2,6-dinitrotoluene	4060	4116	0.010	1.38823	20.00000	Averaged
2,4-dinitrotoluene	6900	6700	0.010	-2.89352	20.00000	Averaged
2-nitrotoluene	3931	3992	0.010	1.54992	20.00000	Averaged
4-nitrotoluene	3501	3536	0.010	0.98735	20.00000	Averaged
3-nitrotoluene	4483	4572	0.010	1.99665	20.00000	Averaged
1,2-dinitrobenzene	6678	6128	0.010	-8.23698	20.00000	Averaged

*** = Compound out of QC criteria**

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Data File: HQC00103.D
Report Date: 23-Mar-2023 10:28

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00103.D
Lab Smp Id: WG333979-2
Inj Date : 17-MAR-2023 18:37
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333979-2,SQ1201
Misc Info : WG333979,WG333979,WG333590-5,SQ1201-1
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 23-Mar-2023 10:28 hplc02.i   Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

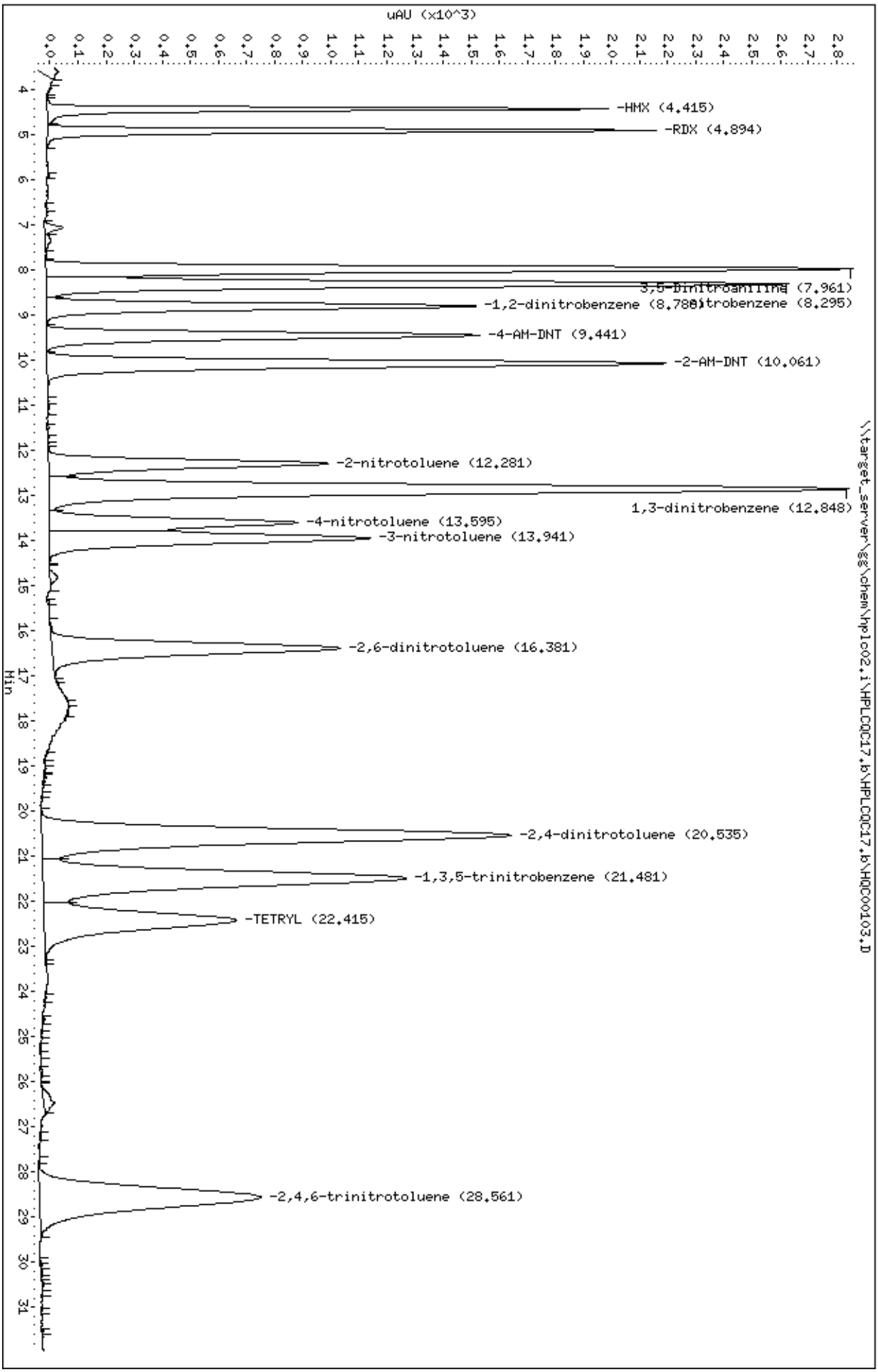
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
2:34 pm, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.414	4.421	-0.007	1995	0.25000	0.252	
4	RDX	4.894	4.901	-0.007	2163	0.25000	0.253	
51	3,5-Dinitroaniline	7.961	7.995	-0.034	2874	0.25000	0.252(M)	M6
7	nitrobenzene	8.294	8.328	-0.034	2642	0.25000	0.230(aM)	M6
$ 2	1,2-dinitrobenzene	8.787	8.828	-0.041	1532	0.25000	0.229(a)	
11	4-AM-DNT	9.441	9.481	-0.040	1545	0.25000	0.252(M)	M6
12	2-AM-DNT	10.061	10.108	-0.047	2202	0.25000	0.254(M)	M6
15	2-nitrotoluene	12.281	12.328	-0.047	998	0.25000	0.254	
6	1,3-dinitrobenzene	12.847	12.895	-0.048	2847	0.25000	0.254	
16	4-nitrotoluene	13.594	13.648	-0.054	884	0.25000	0.252	
17	3-nitrotoluene	13.941	13.995	-0.054	1143	0.25000	0.255	
13	2,6-dinitrotoluene	16.381	16.461	-0.080	1029	0.25000	0.253	
14	2,4-dinitrotoluene	20.534	20.655	-0.121	1675	0.25000	0.243(a)	
5	1,3,5-trinitrobenzene	21.481	21.601	-0.120	1295	0.25000	0.262	
9	TETRYL	22.414	22.568	-0.154	685	0.25000	0.295(M)	M6
10	2,4,6-trinitrotoluene	28.561	28.648	-0.087	788	0.25000	0.257	

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00103.D
Date : 17-MAR-2023 18:37
Client ID:
Sample Info: WG333979-2,SQ1201
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
uAU (x10^3)
Min
-HMX (4.415)
-RDX (4.894)
3,5-Dinitroaniline (7.961)
-1,2-dinitrobenzene (8.788)
itrobenzene (8.295)
-4-AM-DNT (9.441)
-2-AM-DNT (10.061)
-2-nitrotoluene (12.281)
1,3-dinitrobenzene (12.848)
-4-nitrotoluene (13.595)
-3-nitrotoluene (13.941)
-2,6-dinitrotoluene (16.381)
-2,4-dinitrotoluene (20.535)
-1,3,5-trinitrobenzene (21.481)
-TETRYL (22.415)
-2,4,6-trinitrotoluene (28.561)
\\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00103.D

Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG333979-3
Analytical Date: 03/18/23 00:59
Lab File ID: HQC00114.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 210 um

Compound	$\overline{\text{RRF}}$/Amount	RF0.500	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
NITROGLYCERIN	6828	7043	0.010	3.14206	20.00000	Averaged

*** = Compound out of QC criteria**

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sales@katahdinlab.com

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00114.D
Report Date: 23-Mar-2023 13:58

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00114.D
Lab Smp Id: WG333979-3
Inj Date : 18-MAR-2023 00:59
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333979-3,SQ1201
Misc Info : WG333979,WG333979,WG333590-5,SQ1201-1
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 13:58 hplc02.i   Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: ngpetn.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

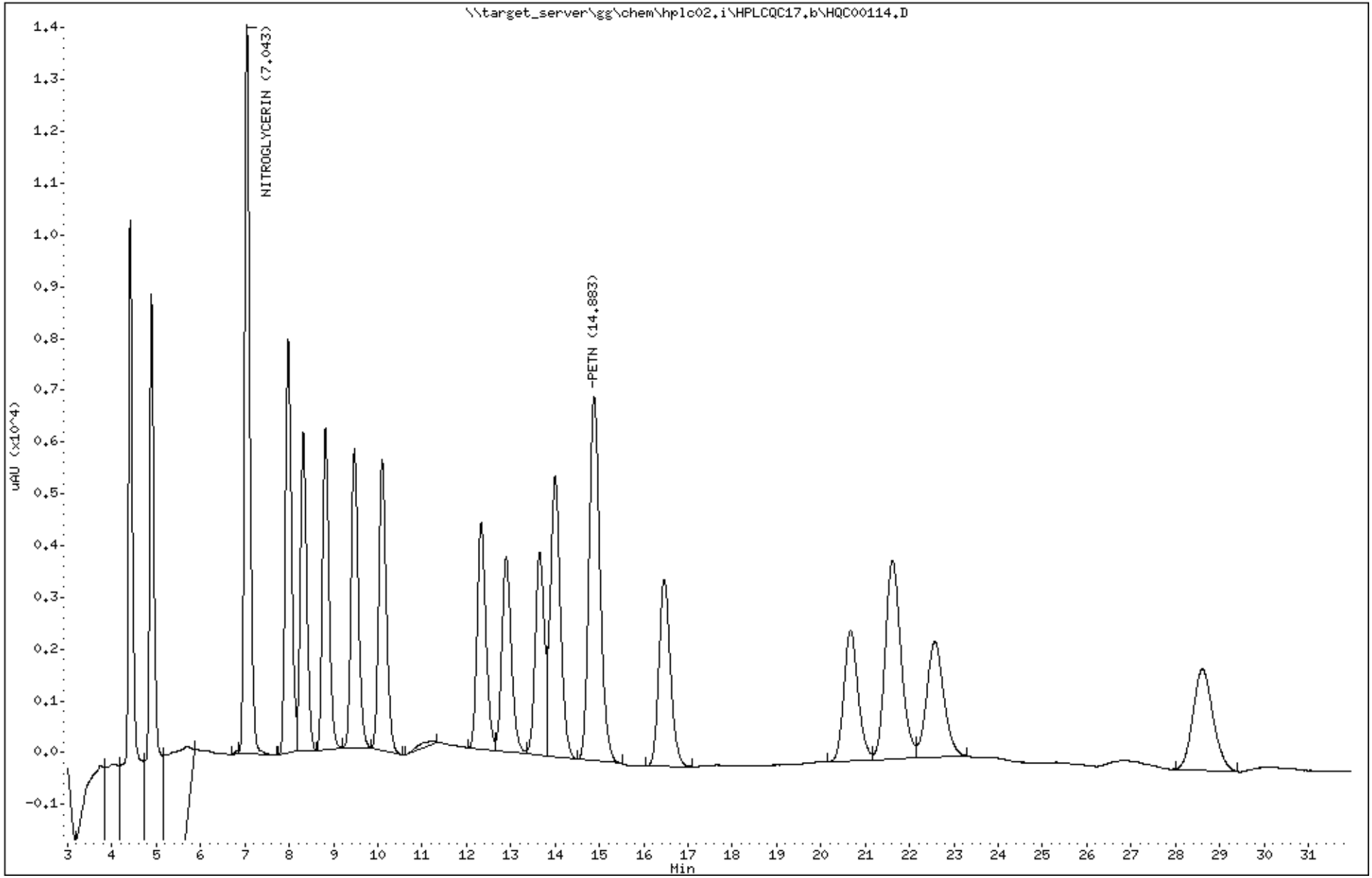
EP
3:00 pm, Mar 23, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
8 NITROGLYCERIN	7.042	7.061	-0.019	14086	2.00000	2.06(aM)	M6
18 PETN	14.882	14.875	0.007	7032	2.00000	2.02(a)	

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00114.D
Date : 18-MAR-2023 00:59
Client ID:
Instrument: hplc02.i
Sample Info: WG333979-3,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 347 of 1130

Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG333979-3
Analytical Date: 03/18/23 00:59
Lab File ID: HQC00114.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/15/23 09:32 03/15/23 13:00
Wavelength: 254 um

Compound	$\overline{RRF}$/Amount	RF0.500	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
HMX	7913	7972	0.010	0.74197	20.00000	Averaged
RDX	8562	8716	0.010	1.80459	20.00000	Averaged
1,3,5-trinitrobenzene	4950	5168	0.010	4.41157	20.00000	Averaged
1,3-dinitrobenzene	11206	11324	0.010	1.05236	20.00000	Averaged
nitrobenzene	11484	10784	0.010	-6.09777	20.00000	Averaged
TETRYL	2319	2746	0.010	18.41311	20.00000	Averaged
2,4,6-trinitrotoluene	3064	3176	0.010	3.65294	20.00000	Averaged
4-AM-DNT	6122	6272	0.010	2.44301	20.00000	Averaged
2-AM-DNT	8682	8860	0.010	2.05022	20.00000	Averaged
2,6-dinitrotoluene	4060	4190	0.010	3.21105	20.00000	Averaged
2,4-dinitrotoluene	6900	6666	0.010	-3.38630	20.00000	Averaged
2-nitrotoluene	3931	3970	0.010	0.99028	20.00000	Averaged
4-nitrotoluene	3501	3560	0.010	1.67279	20.00000	Averaged
3-nitrotoluene	4483	4582	0.010	2.21974	20.00000	Averaged
1,2-dinitrobenzene	6678	6174	0.010	-7.54816	20.00000	Averaged

*** = Compound out of QC criteria**

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Data File: HQC00114.D
Report Date: 23-Mar-2023 10:27

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00114.D
Lab Smp Id: WG333979-3
Inj Date : 18-MAR-2023 00:59
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333979-3,SQ1201
Misc Info : WG333979,WG333979,WG333590-5,SQ1201-1
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00   Cal File: HQC00044.D
Als bottle: 1   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

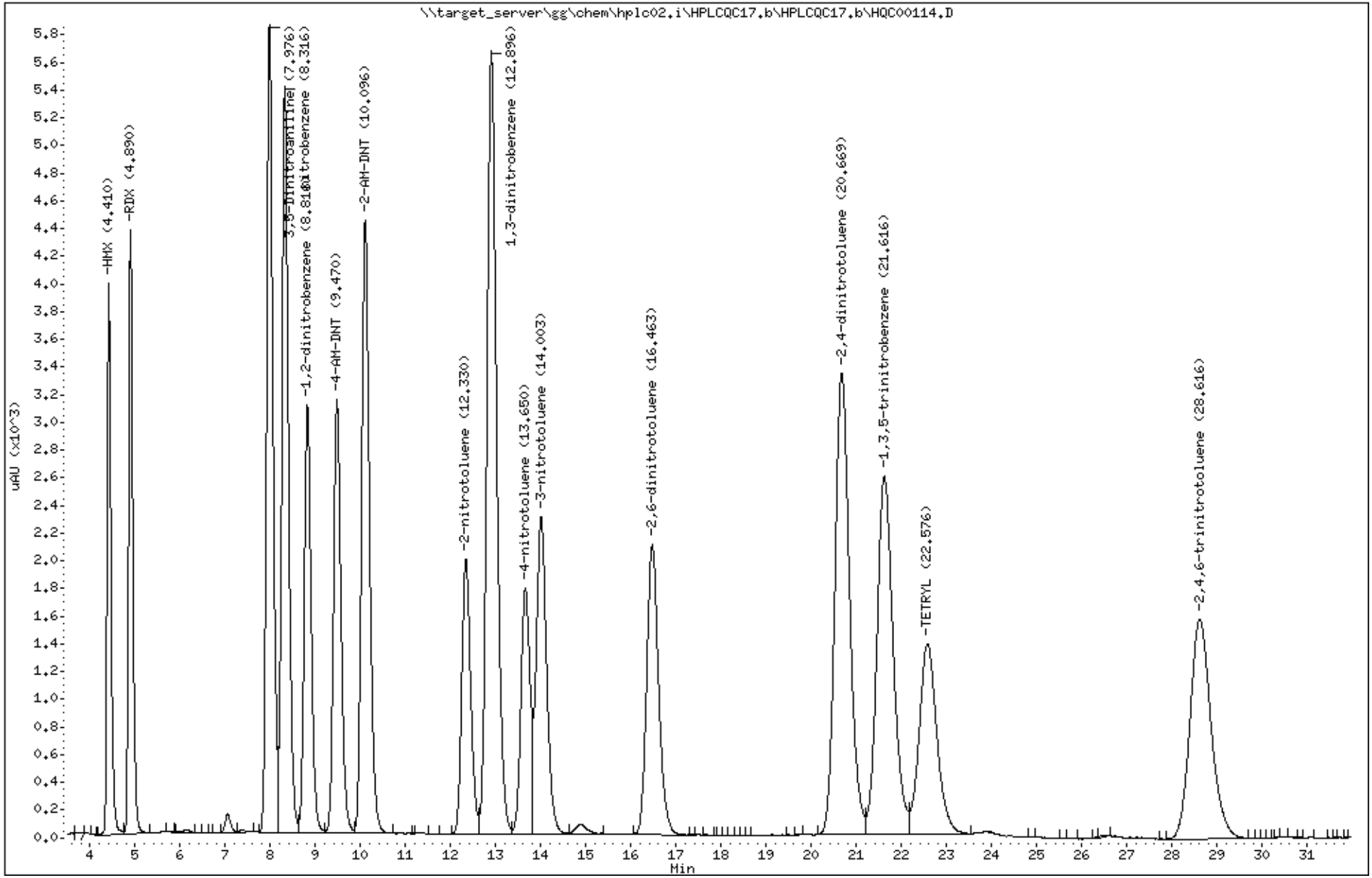
EP
2:34 pm, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	4.409	4.421	-0.012	3986	0.50000	0.504(M)	M6
4	RDX	4.889	4.901	-0.012	4358	0.50000	0.509(M)	M6
51	3,5-Dinitroaniline	7.976	7.995	-0.019	5834	0.50000	0.511	
7	nitrobenzene	8.316	8.328	-0.012	5392	0.50000	0.470	
$ 2	1,2-dinitrobenzene	8.816	8.828	-0.012	3087	0.50000	0.462	
11	4-AM-DNT	9.469	9.481	-0.012	3136	0.50000	0.512	
12	2-AM-DNT	10.096	10.108	-0.012	4430	0.50000	0.510	
15	2-nitrotoluene	12.329	12.328	0.001	1985	0.50000	0.505	
6	1,3-dinitrobenzene	12.896	12.895	0.001	5662	0.50000	0.505	
16	4-nitrotoluene	13.649	13.648	0.001	1780	0.50000	0.508	
17	3-nitrotoluene	14.002	13.995	0.007	2291	0.50000	0.511	
13	2,6-dinitrotoluene	16.462	16.461	0.001	2095	0.50000	0.516	
14	2,4-dinitrotoluene	20.669	20.655	0.014	3333	0.50000	0.483	
5	1,3,5-trinitrobenzene	21.616	21.601	0.015	2584	0.50000	0.522	
9	TETRYL	22.576	22.568	0.008	1373	0.50000	0.592	
10	2,4,6-trinitrotoluene	28.616	28.648	-0.032	1588	0.50000	0.518	

QC Flag Legend

M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00114.D
Date : 18-MAR-2023 00:59
Client ID:
Instrument: hplc02.i
Sample Info: WG333979-3,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 350 of 1130

Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG334216-9
Analytical Date: 03/22/23 08:40
Lab File ID: HQC00141.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/21/23 13:24 03/21/23 18:25
Wavelength: 210 um

Compound	$\overline{\text{RRF}}$/Amount	RF1	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
NITROGLYCERIN	1638	1580	0.010	-3.55352	20.00000	Averaged

*** = Compound out of QC criteria**

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00141.D
Report Date: 23-Mar-2023 12:58

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00141.D
Lab Smp Id: WG334216-9
Inj Date : 22-MAR-2023 08:40
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-9,SQ1201
Misc Info : WG334216,WG334216,WG334216-5,SQ1201-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 10:46 hplc02.i   Quant Type: ESTD
Cal Date : 21-MAR-2023 16:45   Cal File: HQC00122.D
Als bottle: 1   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: NGPETN.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

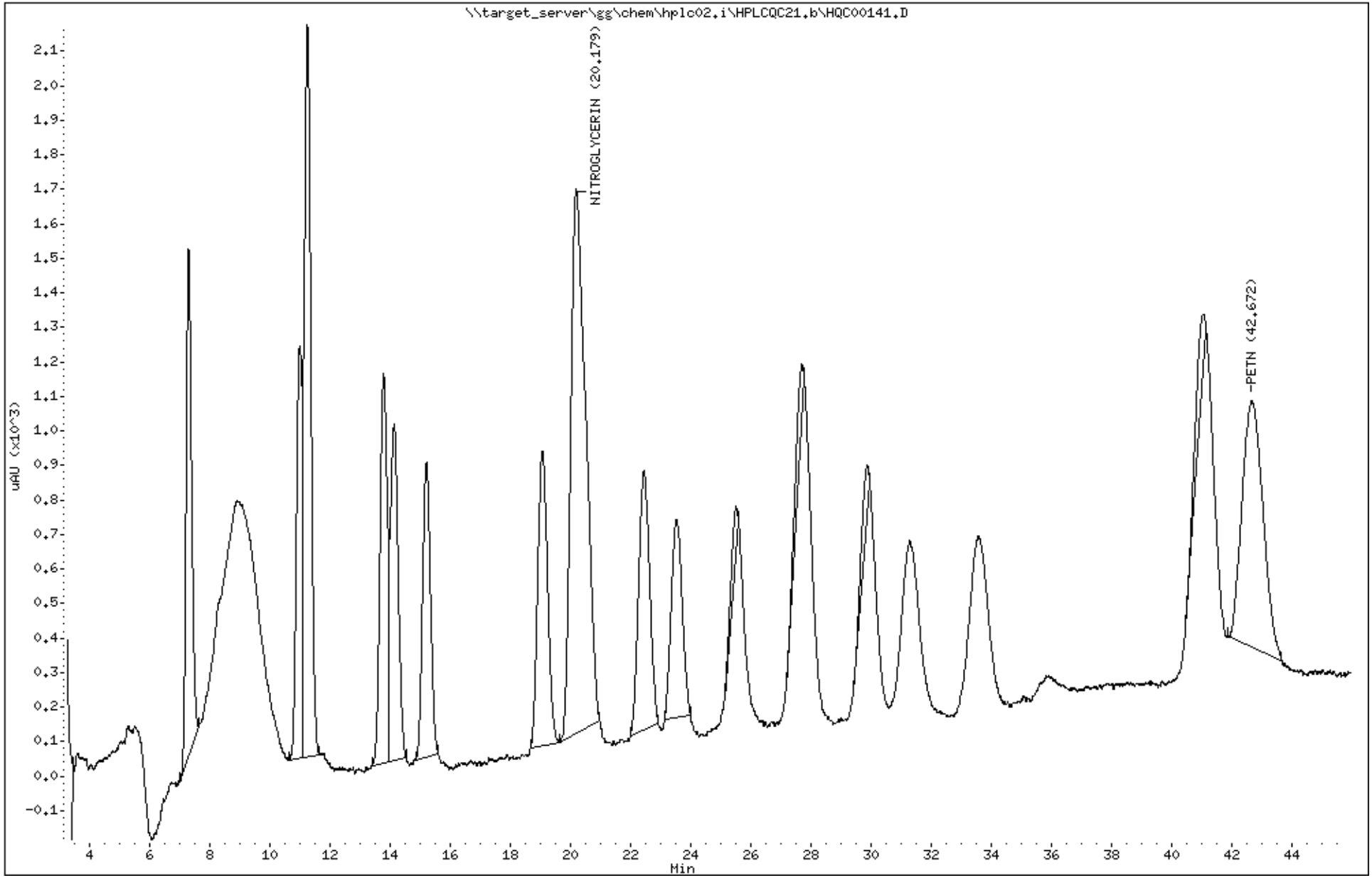
EP
2:34 pm, Mar 23, 2023

					AMOUNTS		
					CAL-AMT	ON-COL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/mL)	REVIEW CODE
8 NITROGLYCERIN	20.178	20.170	0.008	1580	1.00000	0.964(a)	
18 PETN	42.672	42.636	0.036	715	1.00000	0.905(aM)	M6

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00141.D
Date : 22-MAR-2023 08:40
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-9,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 353 of 1130

Form 7
Calibration Verification Summary

Lab Name: Katahdin Analytical Services
SDG: SQ1201
Lab ID: WG334216-9
Analytical Date: 03/22/23 08:40
Lab File ID: HQC00141.D
Instrument ID: HPLC02
Initial Calibration Date(s): 03/21/23 13:24 03/21/23 18:25
Wavelength: 254 um

Compound	$\overline{RRF}$/Amount	RF0.250	Min RRF	%D/ %Drift	Max %D/ %Drift	Curve Type
HMX	2253	2224	0.010	-1.30595	20.00000	Averaged
RDX	2340	2384	0.010	1.86479	20.00000	Averaged
1,3,5-trinitrobenzene	5563	5740	0.010	3.17644	20.00000	Averaged
1,3-dinitrobenzene	6042	6124	0.010	1.35597	20.00000	Averaged
nitrobenzene	3454	3276	0.010	-5.14364	20.00000	Averaged
TETRYL	1745	1740	0.010	-0.26612	20.00000	Averaged
2,4,6-trinitrotoluene	2790	2836	0.010	1.63313	20.00000	Averaged
4-AM-DNT	991	1016	0.010	2.57446	20.00000	Averaged
2-AM-DNT	1432	1520	0.010	6.14525	20.00000	Averaged
2,6-dinitrotoluene	1895	1860	0.010	-1.86546	20.00000	Averaged
2,4-dinitrotoluene	3350	3428	0.010	2.31745	20.00000	Averaged
2-nitrotoluene	1212	1104	0.010	-8.91089	20.00000	Averaged
4-nitrotoluene	1201	1168	0.010	-2.76506	20.00000	Averaged
3-nitrotoluene	1012	1008	0.010	-0.40229	20.00000	Averaged
1,2-dinitrobenzene	2310	2280	0.010	-1.28649	20.00000	Averaged

*** = Compound out of QC criteria**

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Data File: HQC00141.D
Report Date: 23-Mar-2023 12:58

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00141.D
Lab Smp Id: WG334216-9
Inj Date : 22-MAR-2023 08:40
Operator : EP   Inst ID: hplc02.i
Smp Info : WG334216-9,SQ1201
Misc Info : WG334216,WG334216,WG334216-5,SQ1201-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 10:43 hplc02.i   Quant Type: ESTD
Cal Date : 21-MAR-2023 18:25   Cal File: HQC00124.D
Als bottle: 1   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

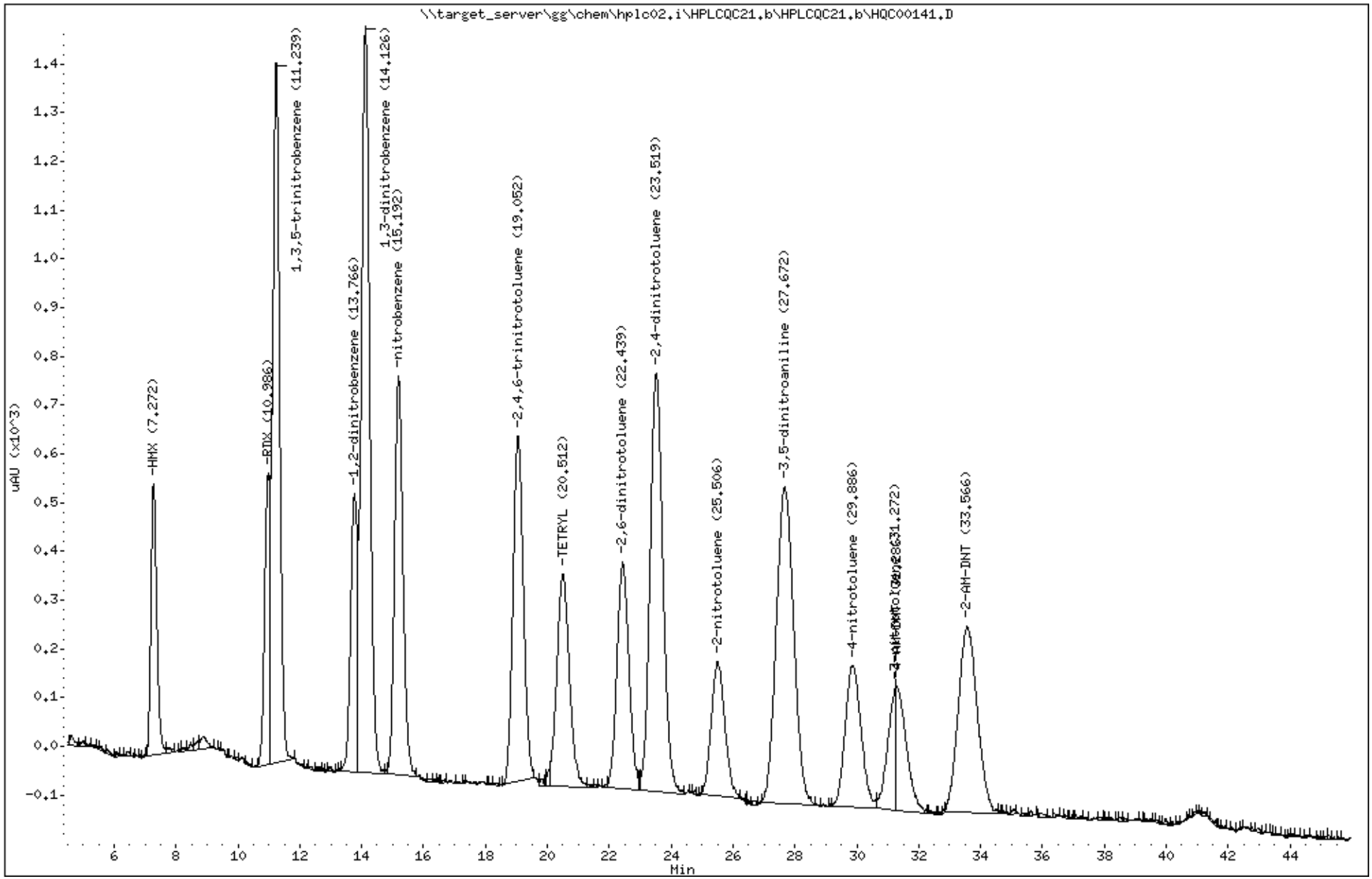
EP
2:34 pm, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	AMOUNTS CAL-AMT (ug/mL)	AMOUNTS ON-COL (ug/mL)	REVIEW CODE
1	HMX	7.272	7.270	0.002	556	0.25000	0.247(a)	
4	RDX	10.985	10.996	-0.011	596	0.25000	0.255	
5	1,3,5-trinitrobenzene	11.238	11.256	-0.018	1435	0.25000	0.258	
$ 2	1,2-dinitrobenzene	13.765	13.796	-0.031	570	0.25000	0.247	
6	1,3-dinitrobenzene	14.125	14.150	-0.025	1531	0.25000	0.253	
7	nitrobenzene	15.192	15.223	-0.031	819	0.25000	0.237(a)	
10	2,4,6-trinitrotoluene	19.052	19.090	-0.038	709	0.25000	0.254(M)	M9
9	TETRYL	20.512	20.536	-0.024	435	0.25000	0.249(a)	
13	2,6-dinitrotoluene	22.438	22.463	-0.025	465	0.25000	0.245(a)	
14	2,4-dinitrotoluene	23.518	23.550	-0.032	857	0.25000	0.256	
15	2-nitrotoluene	25.505	25.536	-0.031	276	0.25000	0.228(a)	
52	3,5-dinitroaniline	27.672	27.676	-0.004	649	0.25000	0.271	
16	4-nitrotoluene	29.885	29.903	-0.018	292	0.25000	0.243(a)	
17	3-nitrotoluene	31.272	31.283	-0.011	252	0.25000	0.249(aM)	M6
11	4-AM-DNT	31.285	31.290	-0.005	254	0.25000	0.256(M)	M6
12	2-AM-DNT	33.565	33.596	-0.031	380	0.25000	0.265	

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00141.D
Date : 22-MAR-2023 08:40
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-9,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 356 of 1130

Raw QC Data Section

Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

SDG: SQ1201
Lab ID: WG333823-1
Client ID: Method Blank
Matrix: AQ
Lab File ID: HQC00088.D

Sample Date: N/A
Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Report Date: 31-MAR-23
Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
% Solids: N/A

Compound	Qualifier	Result	Units	Dilution	LOQ	ADJ LOQ	ADJ MDL	ADJ LOD
HMX	U	0.12	ug/L	1	.25	0.25	0.052	0.12
RDX	U	0.12	ug/L	1	.25	0.25	0.055	0.12
1,3,5-Trinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.056	0.12
1,3-Dinitrobenzene	U	0.12	ug/L	1	.25	0.25	0.024	0.12
Tetryl	U	0.12	ug/L	1	.25	0.25	0.067	0.12
Nitrobenzene	U	0.12	ug/L	1	.25	0.25	0.029	0.12
2,4,6-Trinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.053	0.12
4-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.075	0.12
2-Am-DNT	U	0.12	ug/L	1	.25	0.25	0.044	0.12
2,6-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.078	0.12
2,4-Dinitrotoluene	U	0.12	ug/L	1	.25	0.25	0.040	0.12
2-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.041	0.12
4-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.081	0.12
3-Nitrotoluene	U	0.12	ug/L	1	.25	0.25	0.057	0.12
Nitroglycerin	U	2.0	ug/L	1	4	4.0	0.77	2.0
1,2-Dinitrobenzene		104.	%					

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00088.D
Report Date: 23-Mar-2023 10:32

Katahdin Analytical Services

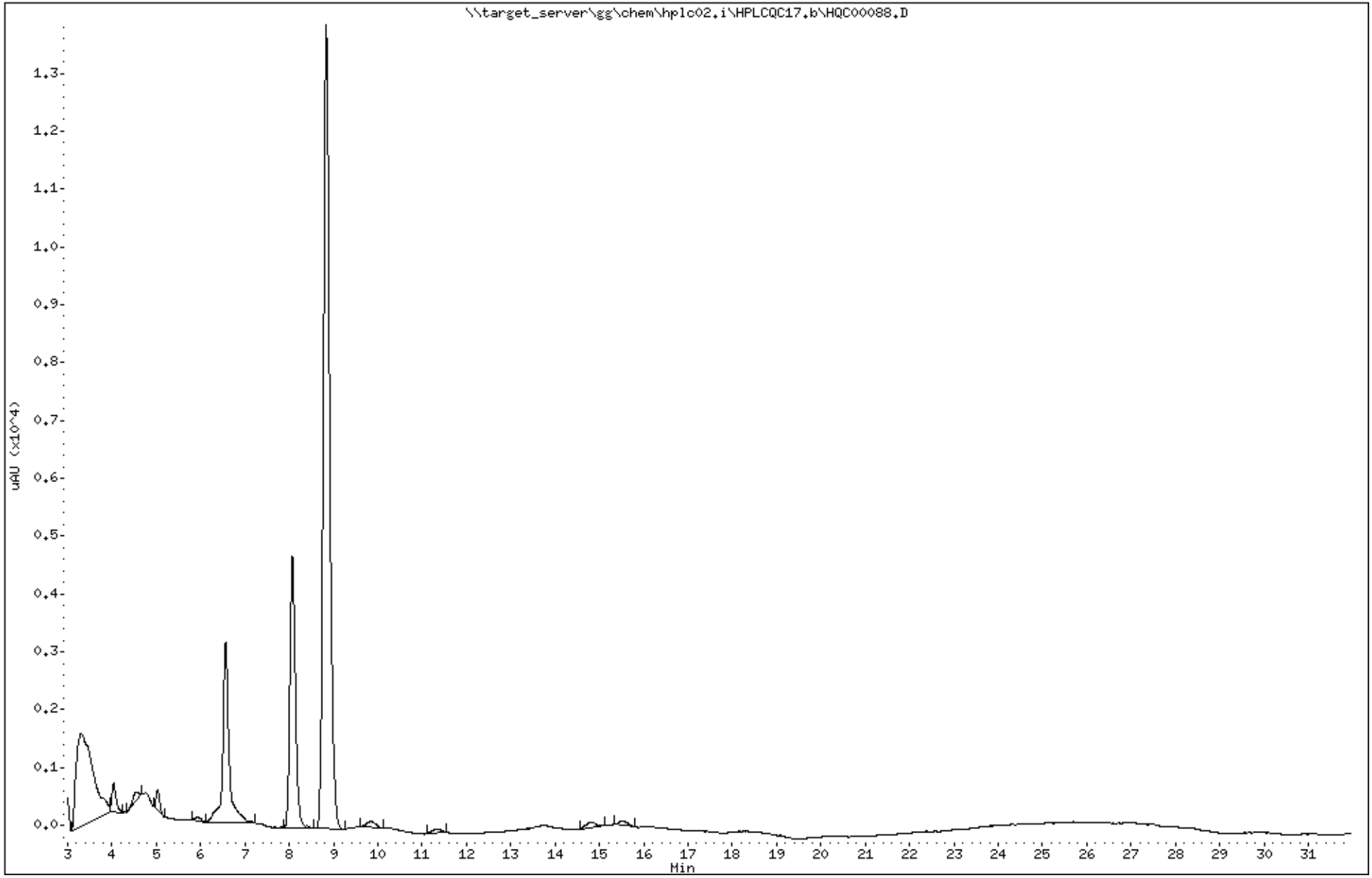
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00088.D
Lab Smp Id: WG333823-1 Client Smp ID: WG333823-Blank
Inj Date : 17-MAR-2023 09:57
Operator : EP Inst ID: hplc02.i
Smp Info : WG333823-1,SQ1201
Misc Info : WG333979,WG333823,WG333590-5,SQ1201-1
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: BLANK
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00088.D
Date : 17-MAR-2023 09:57
Client ID: WG333823-Blank
Instrument: hplc02.i
Sample Info: WG333823-1,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



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Data File: HQC00088.D
Report Date: 23-Mar-2023 10:26

Katahdin Analytical Services

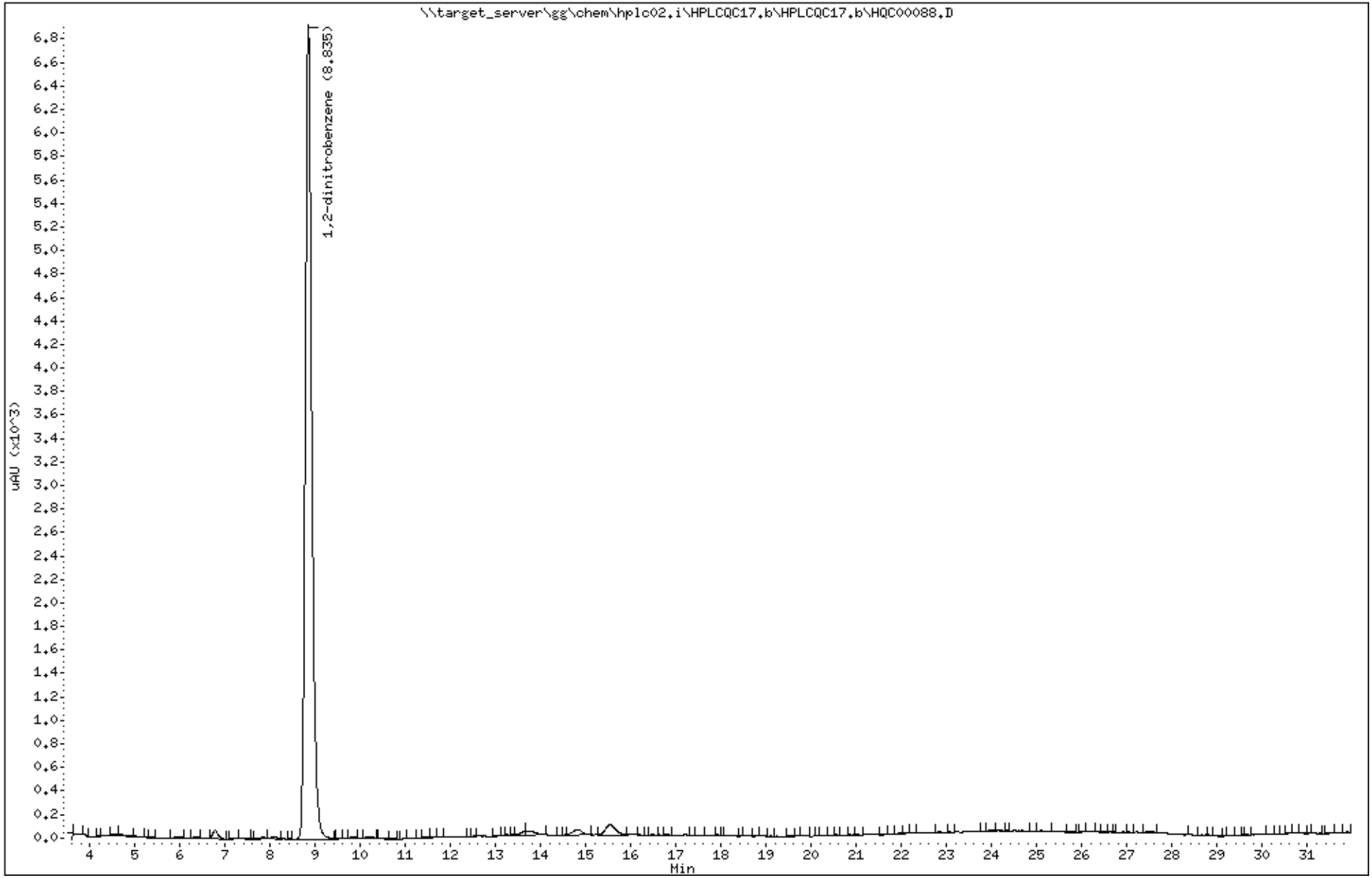
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00088.D
Lab Smp Id: WG333823-1 Client Smp ID: WG333823-Blank
Inj Date : 17-MAR-2023 09:57
Operator : EP Inst ID: hplc02.i
Smp Info : WG333823-1,SQ1201
Misc Info : WG333979,WG333823,WG333590-5,SQ1201-1
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: BLANK
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
$ 2 1,2-dinitrobenzene	8.835	8.828	0.007	6934	1.03832	10.4	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00088.D
Date : 17-MAR-2023 09:57
Client ID: WG333823-Blank
Instrument: hplc02.i
Sample Info: WG333823-1,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 362 of 1130

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00126.D
Report Date: 23-Mar-2023 12:58

Katahdin Analytical Services

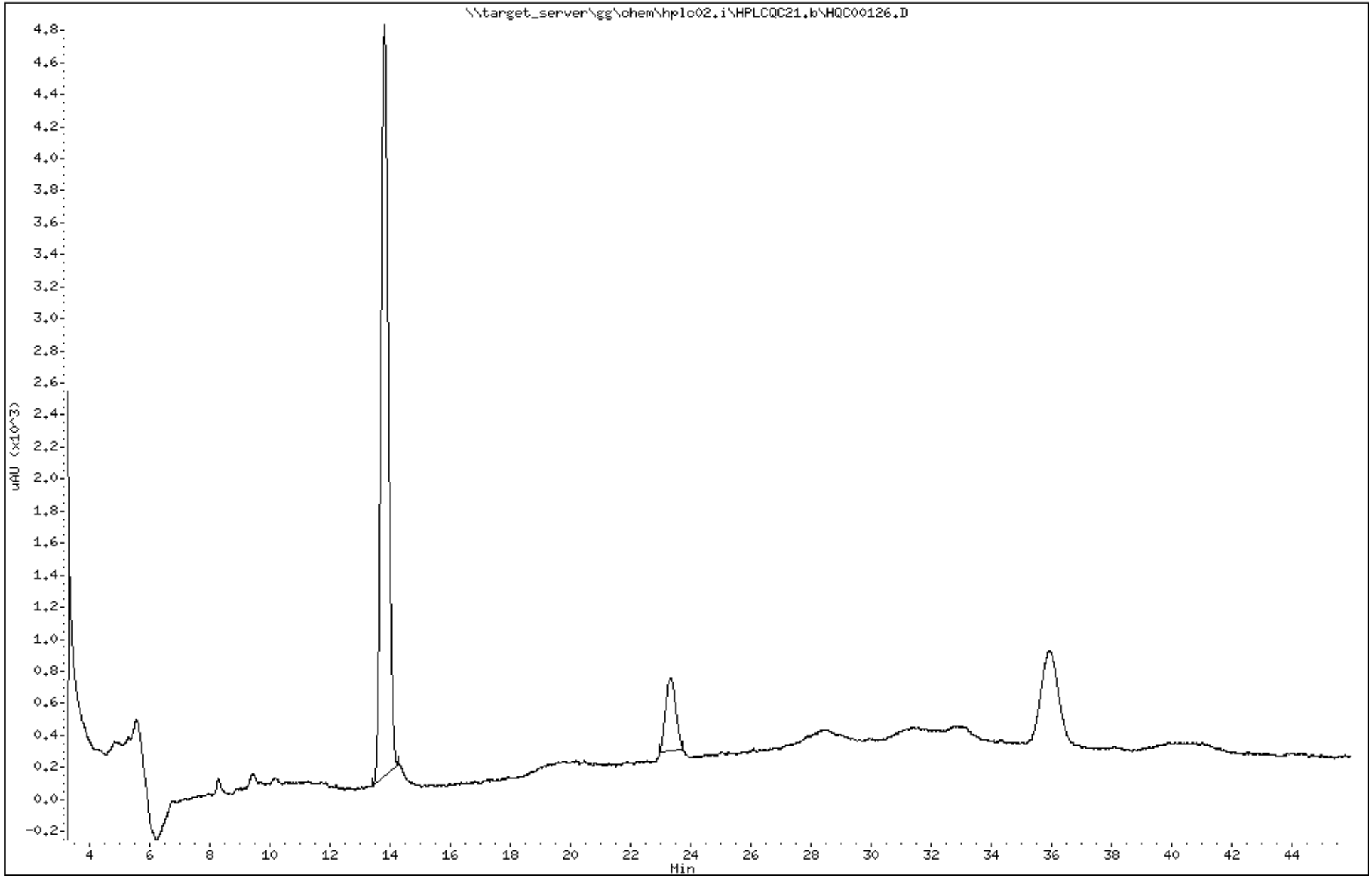
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00126.D
Lab Smp Id: WG333823-1C
Inj Date : 21-MAR-2023 20:06
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333823-1C,SQ1201
Misc Info : WG334216,WG333823,WG334216-5,SQ1201-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 10:46 hplc02.i   Quant Type: ESTD
Cal Date : 21-MAR-2023 16:45   Cal File: HQC00122.D
Als bottle: 1   QC Sample: BLANK
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: NGPETN.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00126.D
Date : 21-MAR-2023 20:06
Client ID:
Instrument: hplc02.i
Sample Info: WG333823-1C,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



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Data File: HQC00126.D
Report Date: 23-Mar-2023 12:58

Katahdin Analytical Services

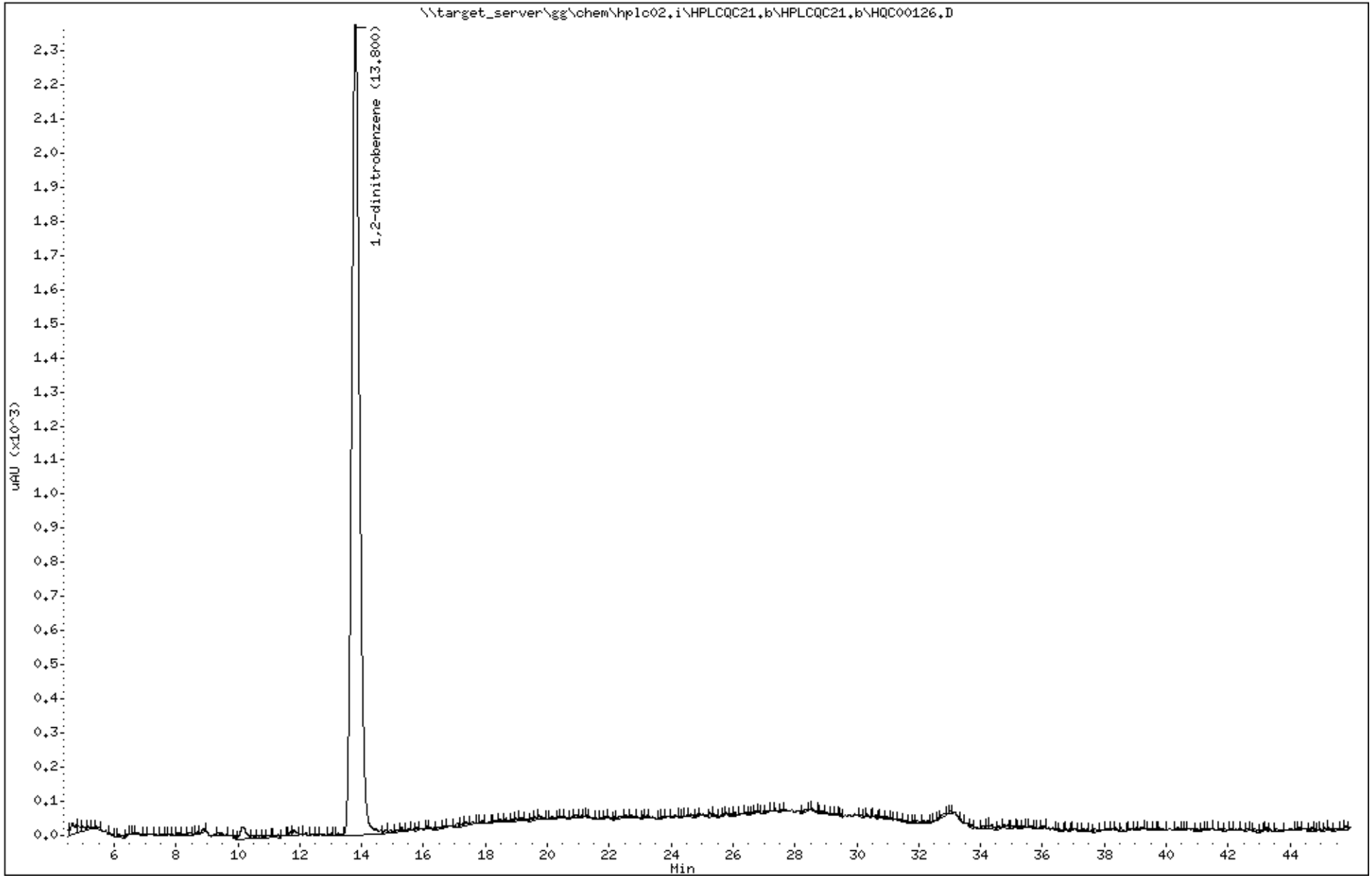
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00126.D
Lab Smp Id: WG333823-1C
Inj Date : 21-MAR-2023 20:06
Operator : EP   Inst ID: hplc02.i
Smp Info : WG333823-1C,SQ1201
Misc Info : WG334216,WG333823,WG334216-5,SQ1201-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 10:43 hplc02.i   Quant Type: ESTD
Cal Date : 21-MAR-2023 18:25   Cal File: HQC00124.D
Als bottle: 1   QC Sample: BLANK
Dil Factor: 1.00000
Integrator: Falcon   Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
$ 2 1,2-dinitrobenzene	13.799	13.796	0.003	2375	1.02827	10.3	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00126.D
Date : 21-MAR-2023 20:06
Client ID:
Instrument: hplc02.i
Sample Info: WG333823-1C,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 366 of 1130

Katahdin
ANALYTICAL SERVICES

LCS Recovery Report

Lab ID: WG333823-2
Client ID: LCS
SDG: SQ1201
LCS File ID: HQC00090.D
Report Date: 31-MAR-23

Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823

Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
Matrix: AQ

Compound	Recovery (%)	Conc Added	Conc Recovered	Conc Units	Limits
HMX	106.	5.00	5.30	ug/L	65-135
RDX	105.	5.00	5.26	ug/L	68-130
1,3,5-Trinitrobenzene	103.	5.00	5.16	ug/L	73-125
1,3-Dinitrobenzene	102.	5.00	5.10	ug/L	78-120
Tetryl	* 144.	5.00	7.22	ug/L	64-128
Nitrobenzene	91.4	5.00	4.57	ug/L	65-134
2,4,6-Trinitrotoluene	114.	5.00	5.68	ug/L	71-123
4-Am-DNT	113.	5.00	5.66	ug/L	76-125
2-Am-DNT	102.	5.00	5.11	ug/L	79-120
2,6-Dinitrotoluene	104.	5.00	5.19	ug/L	77-127
2,4-Dinitrotoluene	94.6	5.00	4.73	ug/L	78-120
2-Nitrotoluene	108.	5.00	5.41	ug/L	70-127
4-Nitrotoluene	98.0	5.00	4.90	ug/L	71-127
3-Nitrotoluene	97.2	5.00	4.86	ug/L	73-125
Nitroglycerin	108.	20.0	21.7	ug/L	74-127
1,2-Dinitrobenzene	103.				83-119

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00090.D
Report Date: 23-Mar-2023 10:32

Katahdin Analytical Services

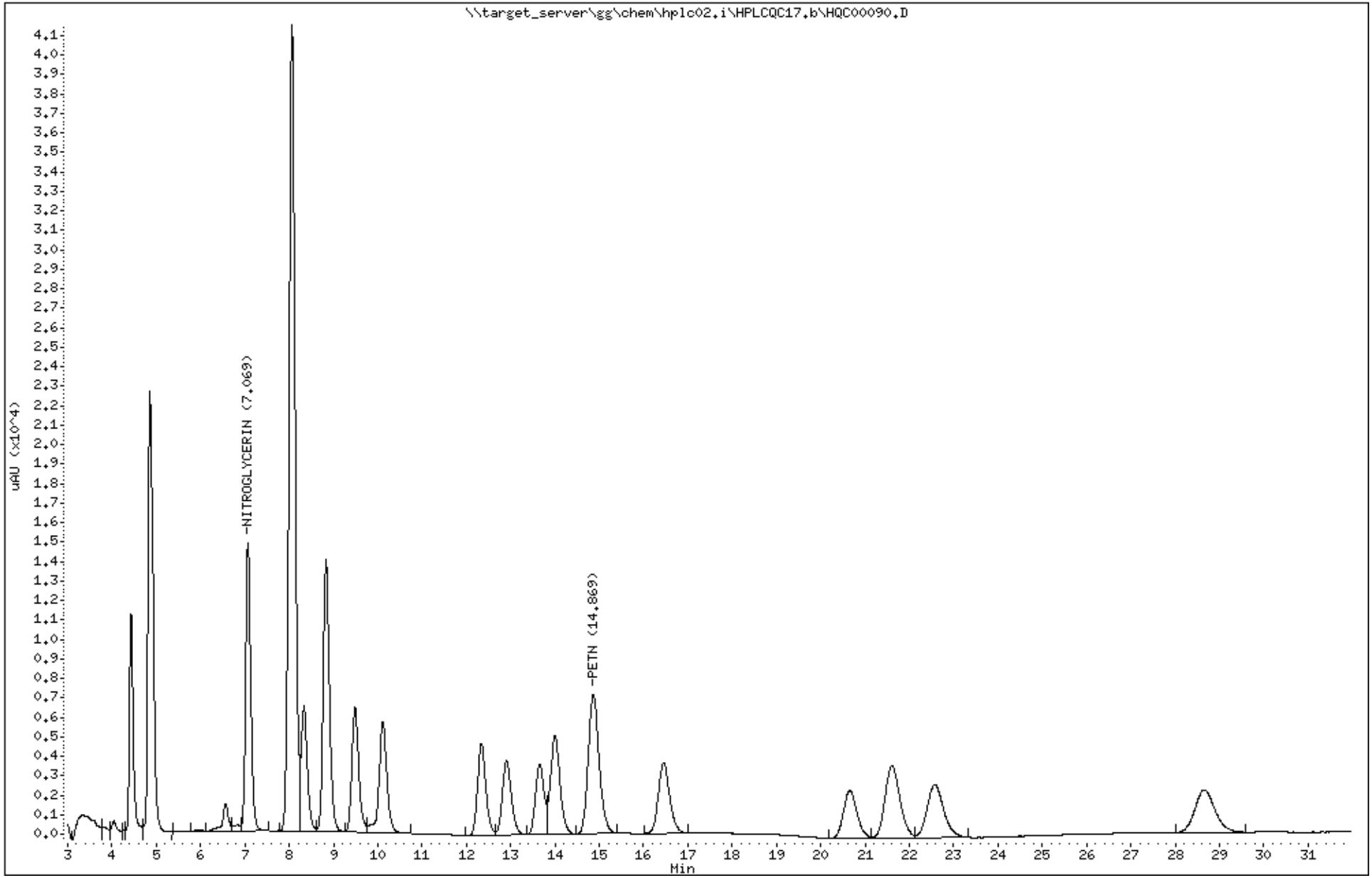
Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00090.D
Lab Smp Id: WG333823-2 Client Smp ID: WG333823-LCS
Inj Date : 17-MAR-2023 11:06
Operator : EP Inst ID: hplc02.i
Smp Info : WG333823-2,SQ1201
Misc Info : WG333979,WG333823,WG333590-5,SQ1201-1
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: LCS
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

					CONCENTRATIONS		
					ON-COLUMN	FINAL	
Compounds	RT	EXP RT	DLT RT	RESPONSE	(ug/mL)	(ug/L)	REVIEW CODE
8 NITROGLYCERIN	7.068	7.061	0.007	14801	2.16755	21.7	
18 PETN	14.868	14.875	-0.007	7161	2.05359	20.5	

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00090.D
Date : 17-MAR-2023 11:06
Client ID: WG333823-LCS
Instrument: hplc02.i
Sample Info: WG333823-2,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 369 of 1130

Data File: HQC00090.D
Report Date: 23-Mar-2023 10:26

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00090.D
Lab Smp Id: WG333823-2 Client Smp ID: WG333823-LCS
Inj Date : 17-MAR-2023 11:06
Operator : EP Inst ID: hplc02.i
Smp Info : WG333823-2,SQ1201
Misc Info : WG333979,WG333823,WG333590-5,SQ1201-1
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: LCS
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

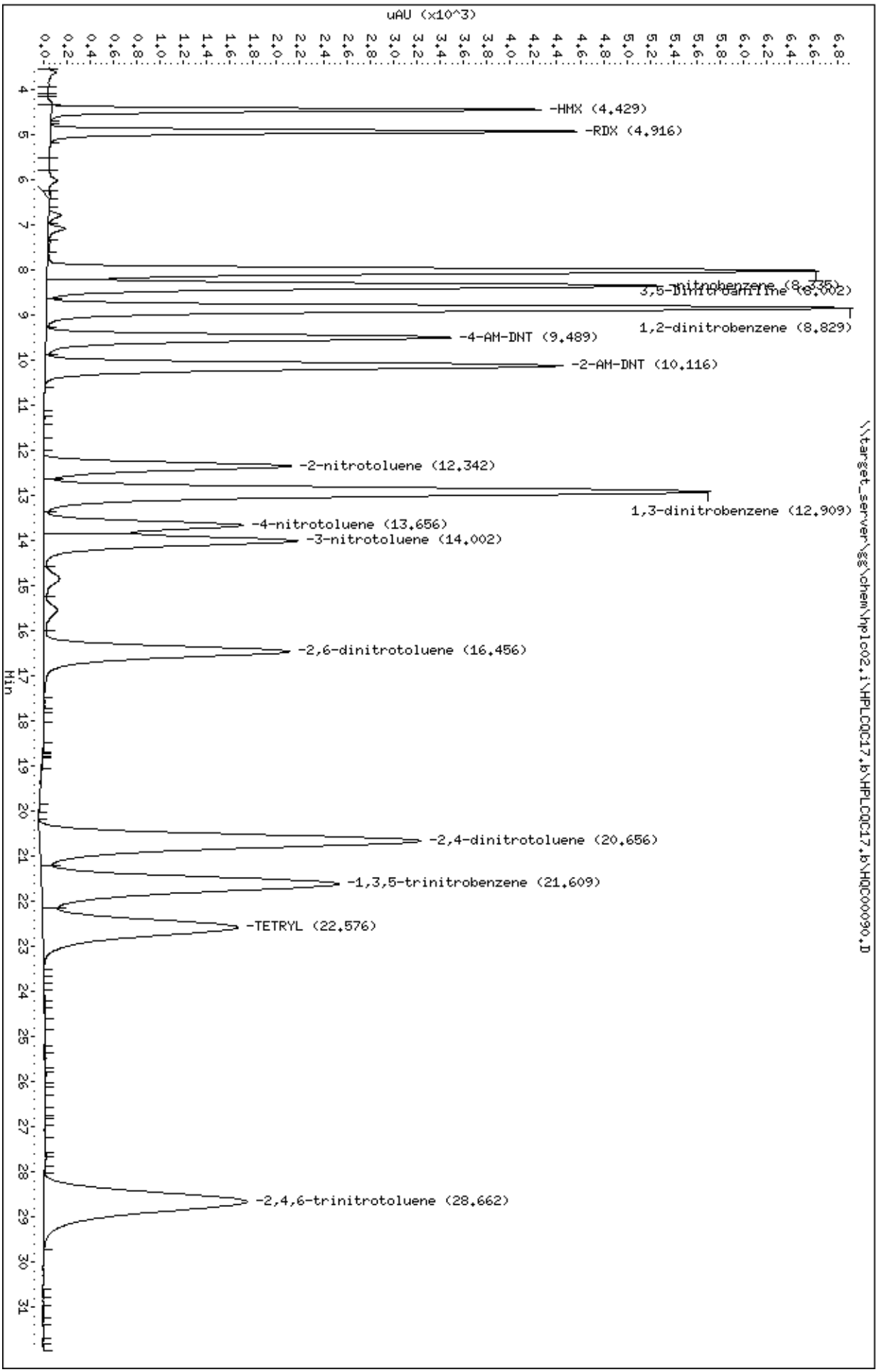
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
2:34 pm, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE
1	HMX	4.428	4.421	0.007	4196	0.53025	5.30(M)	M2
4	RDX	4.915	4.901	0.014	4503	0.52596	5.26(M)	M6
51	3,5-Dinitroaniline	8.002	7.995	0.007	6602	0.57797	5.78	
7	nitrobenzene	8.335	8.328	0.007	5249	0.45706	4.57	
$ 2	1,2-dinitrobenzene	8.828	8.828	0.000	6907	1.03428	10.3	
11	4-AM-DNT	9.488	9.481	0.007	3467	0.56628	5.66	
12	2-AM-DNT	10.115	10.108	0.007	4438	0.51117	5.11	
15	2-nitrotoluene	12.342	12.328	0.014	2126	0.54082	5.41	
6	1,3-dinitrobenzene	12.908	12.895	0.013	5714	0.50990	5.10	
16	4-nitrotoluene	13.655	13.648	0.007	1717	0.49037	4.90	
17	3-nitrotoluene	14.002	13.995	0.007	2177	0.48567	4.86	
13	2,6-dinitrotoluene	16.455	16.461	-0.006	2106	0.51876	5.19	
14	2,4-dinitrotoluene	20.655	20.655	0.000	3264	0.47307	4.73	
5	1,3,5-trinitrobenzene	21.608	21.601	0.007	2552	0.51559	5.16	
9	TETRYL	22.575	22.568	0.007	1675	0.72229	7.22(R)	
10	2,4,6-trinitrotoluene	28.662	28.648	0.014	1740	0.56787	5.68	

QC Flag Legend

R - Spike/Surrogate failed recovery limits.
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00090.D
Date : 17-MAR-2023 11:06
Client ID: WG333823-LCS
Sample Info: WG333823-2,SQ1201
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
uAU (x10^3)
Min
-HMX (4.429)
-RDX (4.916)
-nitrobenzene (8.335)
3,5-Dinitroaniline (8.802)
1,2-dinitrobenzene (8.829)
-4-AM-DNT (9.489)
-2-AM-DNT (10.116)
-2-nitrotoluene (12.342)
1,3-dinitrobenzene (12.909)
-4-nitrotoluene (13.656)
-3-nitrotoluene (14.002)
-2,6-dinitrotoluene (16.456)
-2,4-dinitrotoluene (20.656)
-1,3,5-trinitrobenzene (21.609)
-TETRYL (22.576)
-2,4,6-trinitrotoluene (28.662)
\\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00090.D

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00130.D
Report Date: 23-Mar-2023 12:58

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00130.D
Lab Smp Id: WG333823-2C Client Smp ID: WG333823-LCS
Inj Date : 21-MAR-2023 23:27
Operator : EP Inst ID: hplc02.i
Smp Info : WG333823-2C,SQ1201
Misc Info : WG334216,WG333823,WG334216-5,SQ1201-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m
Meth Date : 23-Mar-2023 10:46 hplc02.i Quant Type: ESTD
Cal Date : 21-MAR-2023 16:45 Cal File: HQC00122.D
Als bottle: 1 QC Sample: LCS
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: NGPETN.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

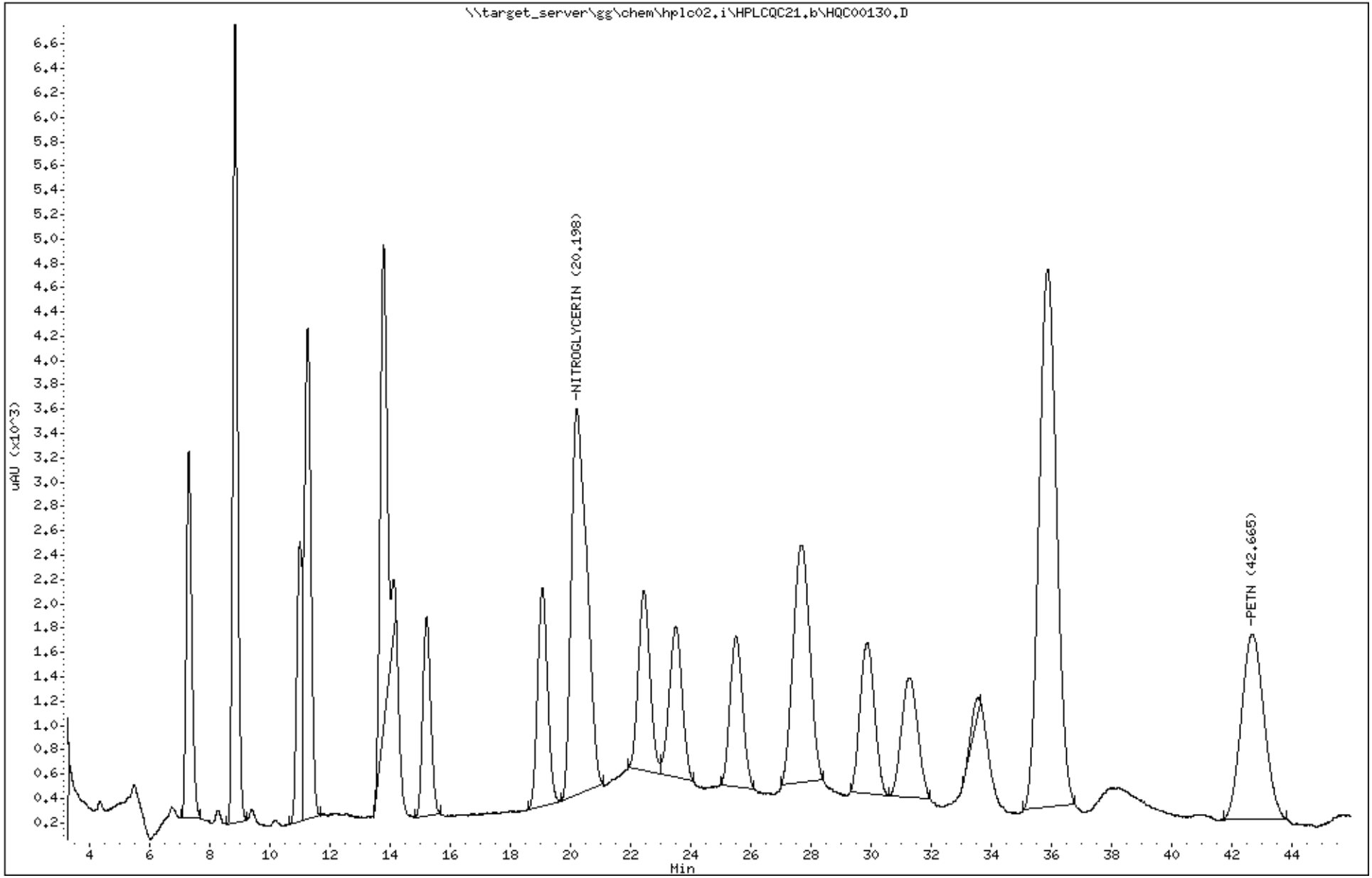
EP
2:34 pm, Mar 23, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE
8 NITROGLYCERIN	20.197	20.170	0.027	3169	1.93442	19.3	
18 PETN	42.664	42.636	0.028	1516	1.91938	19.2(M)	M9

QC Flag Legend

M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00130.D
Date : 21-MAR-2023 23:27
Client ID: WG333823-LCS
Instrument: hplc02.i
Sample Info: WG333823-2C,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



Data File: HQC00130.D
Report Date: 23-Mar-2023 12:58

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HPLCQC21.b\HQC00130.D
Lab Smp Id: WG333823-2C Client Smp ID: WG333823-LCS
Inj Date : 21-MAR-2023 23:27
Operator : EP Inst ID: hplc02.i
Smp Info : WG333823-2C,SQ1201
Misc Info : WG334216,WG333823,WG334216-5,SQ1201-5
Comment   :
Method   : \\target_server\gg\chem\hplc02.i\HPLCQC21.b\E2B23.m\E2B23.m
Meth Date : 23-Mar-2023 10:43 hplc02.i Quant Type: ESTD
Cal Date : 21-MAR-2023 18:25 Cal File: HQC00124.D
Als bottle: 1 QC Sample: LCS
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

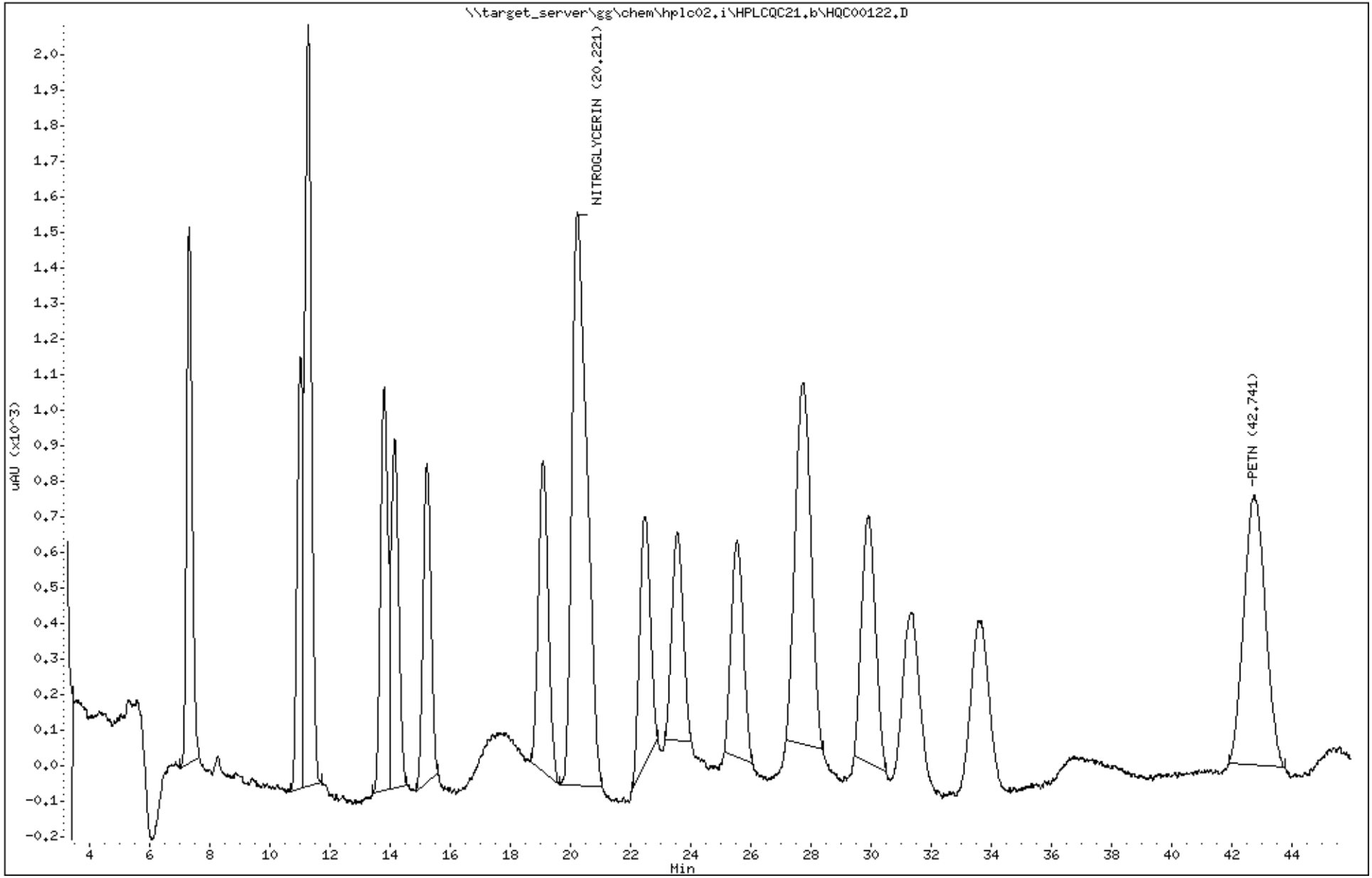
EP
2:34 pm, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE
1	HMX	7.277	7.270	0.007	1124	0.49880	4.99	
4	RDX	10.991	10.996	-0.005	1147	0.49010	4.90	
5	1,3,5-trinitrobenzene	11.237	11.256	-0.019	2751	0.49449	4.94	
$ 2	1,2-dinitrobenzene	13.771	13.796	-0.025	2369	1.02567	10.2	
6	1,3-dinitrobenzene	14.124	14.150	-0.026	2953	0.48874	4.89	
7	nitrobenzene	15.197	15.223	-0.026	1557	0.45083	4.51	
10	2,4,6-trinitrotoluene	19.051	19.090	-0.039	1500	0.53755	5.38	
9	TETRYL	20.504	20.536	-0.032	1029	0.58981	5.90	
13	2,6-dinitrotoluene	22.424	22.463	-0.039	900	0.47484	4.75	
14	2,4-dinitrotoluene	23.517	23.550	-0.033	1608	0.47995	4.80	
15	2-nitrotoluene	25.504	25.536	-0.032	571	0.47112	4.71	
52	3,5-dinitroaniline	27.657	27.676	-0.019	1284	0.53546	5.35	
16	4-nitrotoluene	29.851	29.903	-0.052	523	0.43539	4.35	
17	3-nitrotoluene	31.237	31.283	-0.046	523	0.51676	5.17(M)	M1
11	4-AM-DNT	31.244	31.290	-0.046	524	0.52903	5.29(M)	M1
12	2-AM-DNT	33.571	33.596	-0.025	713	0.49791	4.98	

QC Flag Legend

M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC21.b\HQC00122.D
Date : 21-MAR-2023 16:45
Client ID:
Instrument: hplc02.i
Sample Info: WG334216-4
Purge Volume: 0.5
Operator: EP
Column phase: Acclaim E2
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 375 of 1130

Katahdin
ANALYTICAL SERVICES

MS/MSD Recovery Report

MS ID: WG333823-3
MSD ID: WG333823-4
Sample ID: SQ1201-2
Client ID: JACKSON-SWMC3-DC-01
SDG: SQ1201
MS File ID: HQC00095.D

Extract Date: 14-MAR-23
Extracted By: AP
Extraction Method: SW846 8330B
Lab Prep Batch: WG333823
Report Date: 31-MAR-23
MSD File ID: HQC00096.D

Analysis Date: 17-MAR-23
Analyst: EP
Analysis Method: SW846 8330B
Matrix: AQ
% Solids: N/A
Sample File ID: HQC00094.D

Compound	MS Spike	MSD Spike	Conc Units	Samp Conc	MS Conc	MSD Conc	MS Rec (%)	MSD Rec (%)	RPD (%)	RPD Limit	Limits
HMX	5.00	5.00	ug/L	U0.12	5.4	5.1	107.	101.	6	20	65-135
RDX	5.00	5.00	ug/L	U0.12	5.3	4.9	106.	98.4	7	20	68-130
1,3,5-Trinitrobenzene	5.00	5.00	ug/L	U0.12	5.1	4.9	103.	97.6	5	20	73-125
1,3-Dinitrobenzene	5.00	5.00	ug/L	U0.12	5.2	4.8	104.	96.8	7	20	78-120
Tetryl	5.00	5.00	ug/L	ULMM0.12	7.0	6.7	140.*	134.*	4	20	64-128
Nitrobenzene	5.00	5.00	ug/L	U0.12	5.0	4.4	99.8	87.0	14	20	65-134
2,4,6-Trinitrotoluene	5.00	5.00	ug/L	U0.12	5.6	5.4	112.	108.	3	20	71-123
4-Am-DNT	5.00	5.00	ug/L	U0.12	5.8	5.3	116.	106.	9	20	76-125
2-Am-DNT	5.00	5.00	ug/L	U0.12	5.1	4.8	102.	96.0	6	20	79-120
2,6-Dinitrotoluene	5.00	5.00	ug/L	U0.12	5.2	5.0	105.	101.	4	20	77-127
2,4-Dinitrotoluene	5.00	5.00	ug/L	U0.12	4.8	4.5	95.6	90.8	5	20	78-120
2-Nitrotoluene	5.00	5.00	ug/L	U0.12	5.6	5.3	113.	106.	6	20	70-127
4-Nitrotoluene	5.00	5.00	ug/L	U0.12	5.1	4.8	102.	96.4	6	20	71-127
3-Nitrotoluene	5.00	5.00	ug/L	U0.12	5.1	4.8	101.	96.2	5	20	73-125
Nitroglycerin	20.0	20.0	ug/L	U2.0	22.	21.	110.	106.	4	20	74-127
1,2-Dinitrobenzene							112.	104.			83-119

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Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00095.D
Report Date: 23-Mar-2023 10:33

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00095.D
Lab Smp Id: WG333823-3 Client Smp ID: JACKSON-SWMC3-DC-01
Inj Date : 17-MAR-2023 14:00
Operator : EP Inst ID: hplc02.i
Smp Info : WG333823-3,SQ1201
Misc Info : WG333979,WG333823,WG333590-5,SQ1201-2
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: MS
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

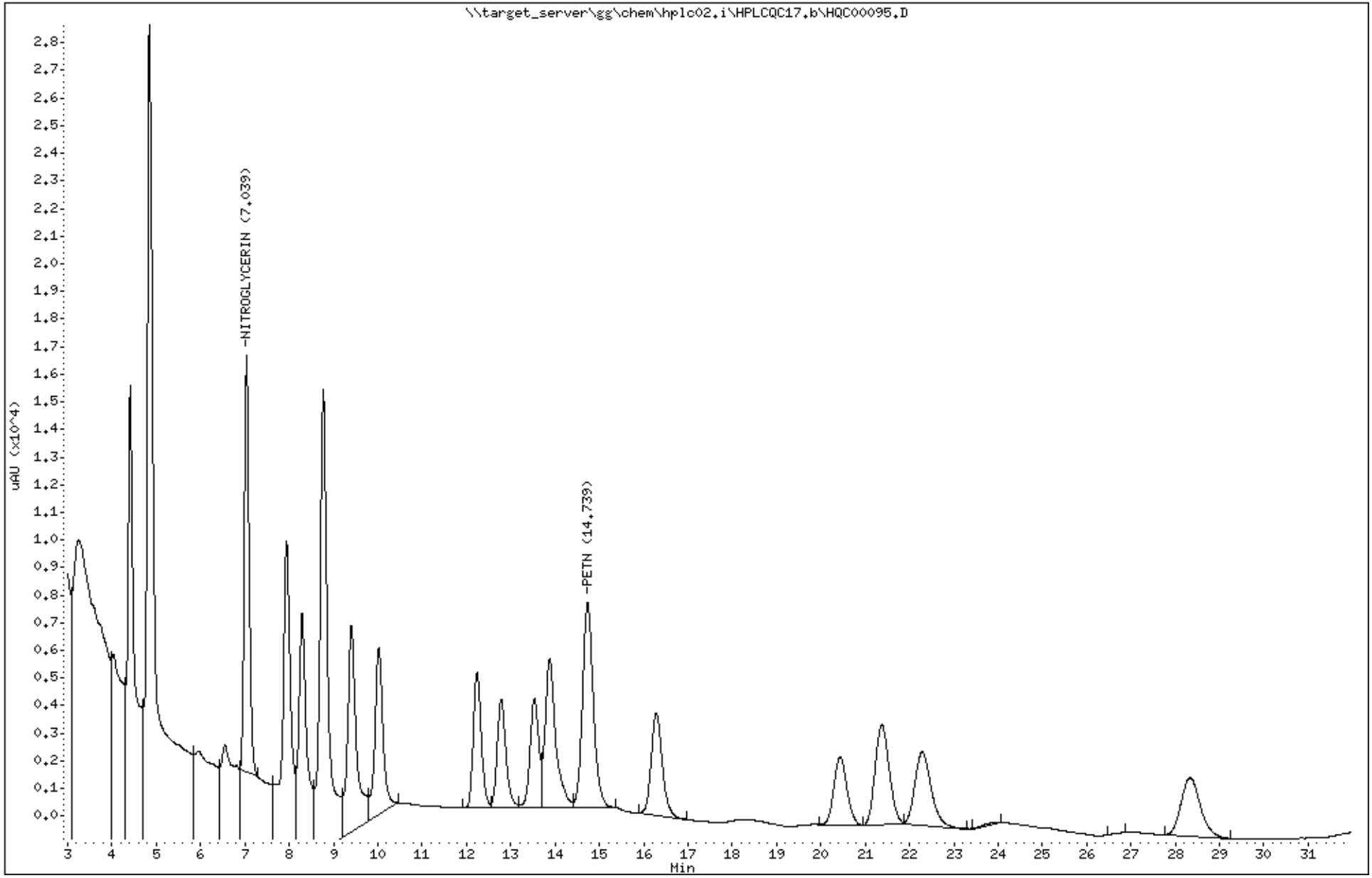
EP
2:34 pm, Mar 23, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE
8 NITROGLYCERIN	7.038	7.061	-0.023	15075	2.20768	22.1(M)	M6
18 PETN	14.738	14.875	-0.137	7418	2.12729	21.3(M)	M6

QC Flag Legend

M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00095.D
Date : 17-MAR-2023 14:00
Client ID: JACKSON-SWMC3-DC-01
Instrument: hplc02.i
Sample Info: WG333823-3,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 378 of 1130

Data File: HQC00095.D
Report Date: 23-Mar-2023 10:26

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00095.D
Lab Smp Id: WG333823-3 Client Smp ID: JACKSON-SWMC3-DC-01
Inj Date : 17-MAR-2023 14:00
Operator : EP Inst ID: hplc02.i
Smp Info : WG333823-3,SQ1201
Misc Info : WG333979,WG333823,WG333590-5,SQ1201-2
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: MS
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

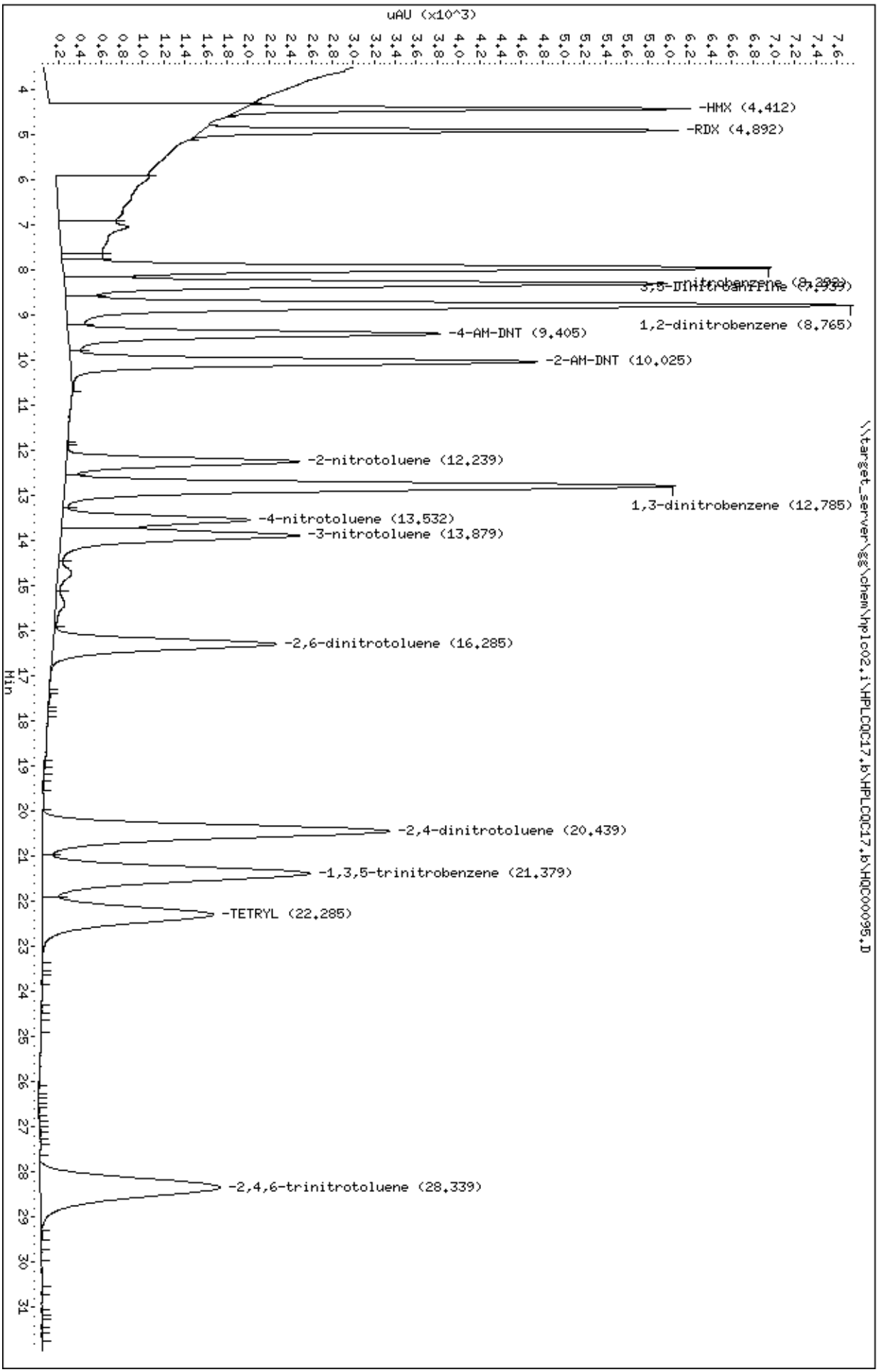
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
2:34 pm, Mar 23, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE
1 HMX	4.411	4.421	-0.010	4252	0.53732	5.37(M)	M2
4 RDX	4.891	4.901	-0.010	4535	0.52970	5.30(M)	M2
51 3,5-Dinitroaniline	7.938	7.995	-0.057	6736	0.58970	5.90(RM)	M6
7 nitrobenzene	8.291	8.328	-0.037	5730	0.49894	4.99(M)	M6
$ 2 1,2-dinitrobenzene	8.765	8.828	-0.063	7486	1.12098	11.2	
11 4-AM-DNT	9.405	9.481	-0.076	3539	0.57804	5.78(M)	M6
12 2-AM-DNT	10.025	10.108	-0.083	4445	0.51198	5.12(M)	M6
15 2-nitrotoluene	12.238	12.328	-0.090	2216	0.56371	5.64(M)	M6
6 1,3-dinitrobenzene	12.785	12.895	-0.110	5811	0.51856	5.18(M)	M6
16 4-nitrotoluene	13.531	13.648	-0.117	1788	0.51065	5.11(M)	M6
17 3-nitrotoluene	13.878	13.995	-0.117	2271	0.50664	5.07(M)	M6
13 2,6-dinitrotoluene	16.285	16.461	-0.176	2132	0.52517	5.25(M)	M6
14 2,4-dinitrotoluene	20.438	20.655	-0.217	3299	0.47814	4.78(M)	M6
5 1,3,5-trinitrobenzene	21.378	21.601	-0.223	2542	0.51357	5.14(M)	M6
9 TETRYL	22.285	22.568	-0.283	1629	0.70246	7.02(RM)	M6
10 2,4,6-trinitrotoluene	28.338	28.648	-0.310	1709	0.55775	5.58(M)	M6

QC Flag Legend

R - Spike/Surrogate failed recovery limits.
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00095.D
Date : 17-MAR-2023 14:00
Client ID: JACKSON-SWMC3-DC-01
Sample Info: WG333823-3,SQ1201
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00095.D
uAU (x10^3)
Min
-HMX (4.412)
-RDX (4.892)
-nitrobenzene (8.292)
3,5-Dinitroaniline (7.939)
1,2-dinitrobenzene (8.765)
-4-AM-DNT (9.405)
-2-AM-DNT (10.025)
-2-nitrotoluene (12.239)
1,3-dinitrobenzene (12.785)
-4-nitrotoluene (13.532)
-3-nitrotoluene (13.879)
-2,6-dinitrotoluene (16.285)
-2,4-dinitrotoluene (20.439)
-1,3,5-trinitrobenzene (21.379)
-TETRYL (22.285)
-2,4,6-trinitrotoluene (28.339)

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00096.D
Report Date: 23-Mar-2023 10:33

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00096.D
Lab Smp Id: WG333823-4 Client Smp ID: JACKSON-SWMC3-DC-01
Inj Date : 17-MAR-2023 14:34
Operator : EP Inst ID: hplc02.i
Smp Info : WG333823-4,SQ1201
Misc Info : WG333979,WG333823,WG333590-5,SQ1201-2
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m
Meth Date : 23-Mar-2023 10:29 hplc02.i Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: MSD
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: ngpetn.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

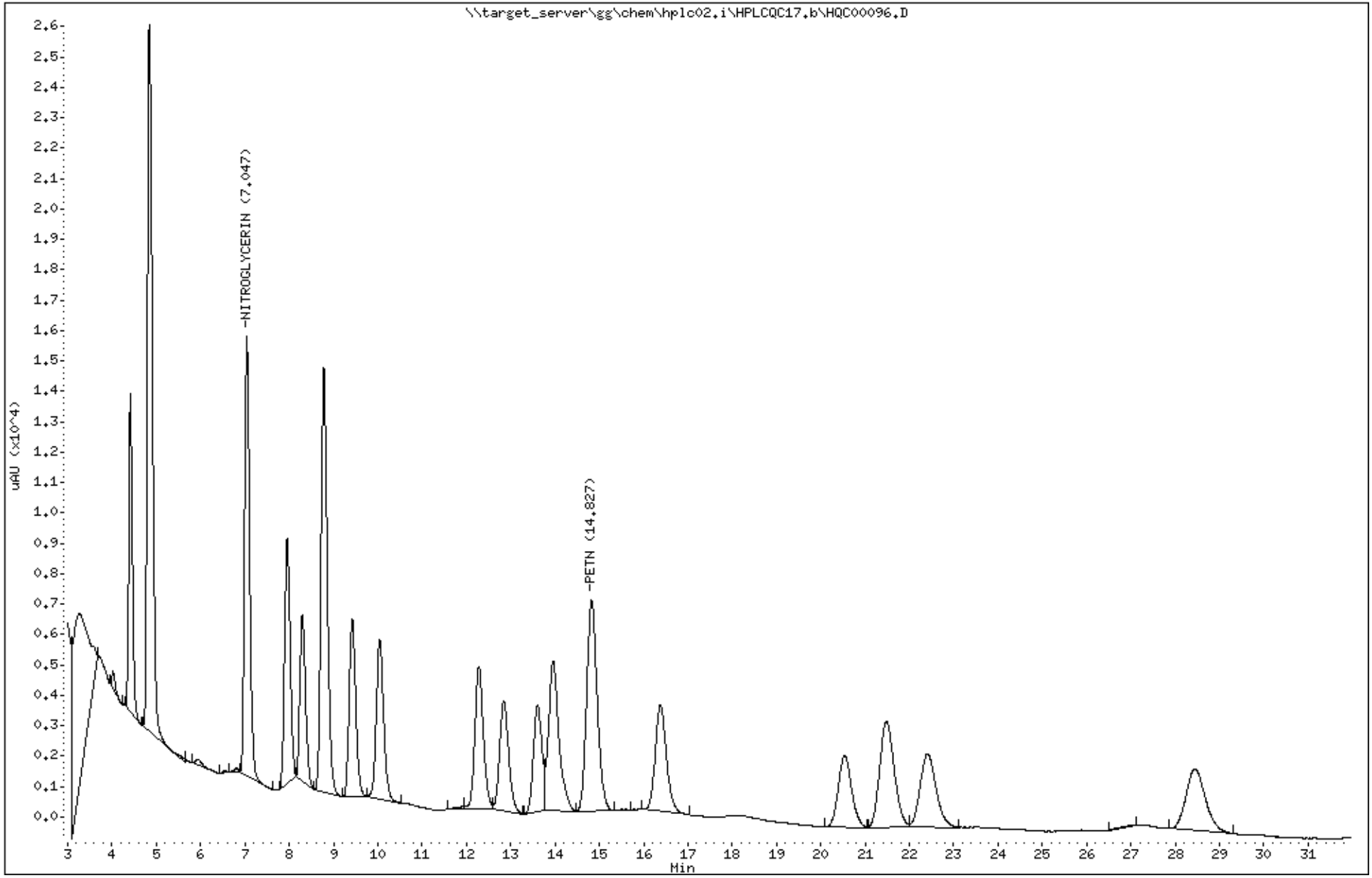
EP
2:34 pm, Mar 23, 2023

Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE
8 NITROGLYCERIN	7.046	7.061	-0.015	14452	2.11644	21.2(M)	M6
18 PETN	14.826	14.875	-0.049	6939	1.98992	19.9	

QC Flag Legend

M - Compound response manually integrated.

Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HQC00096.D
Date : 17-MAR-2023 14:34
Client ID: JACKSON-SWMC3-DC-01
Instrument: hplc02.i
Sample Info: WG333823-4,SQ1201
Purge Volume: 0.5
Operator: EP
Column phase: Phenomenex Kinetex
Column diameter: 4.60



Katahdin Analytical Services SQ1201 Page 382 of 1130

Data File: HQC00096.D
Report Date: 23-Mar-2023 10:26

Katahdin Analytical Services

Data file : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00096.D
Lab Smp Id: WG333823-4 Client Smp ID: JACKSON-SWMC3-DC-01
Inj Date : 17-MAR-2023 14:34
Operator : EP Inst ID: hplc02.i
Smp Info : WG333823-4,SQ1201
Misc Info : WG333979,WG333823,WG333590-5,SQ1201-2
Comment :
Method : \\target_server\gg\chem\hplc02.i\HPLCQC17.b\EXPB23A.m\EXPB23A.m
Meth Date : 20-Mar-2023 06:13 epelletier Quant Type: ESTD
Cal Date : 15-MAR-2023 13:00 Cal File: HQC00044.D
Als bottle: 1 QC Sample: MSD
Dil Factor: 1.00000
Integrator: Falcon Compound Sublist: SW8330A.sub
Target Version: 4.12
Processing Host: INSPIRON1

Concentration Formula: Amt * DF * 1000*(Vt/Vo) * CpndVariable

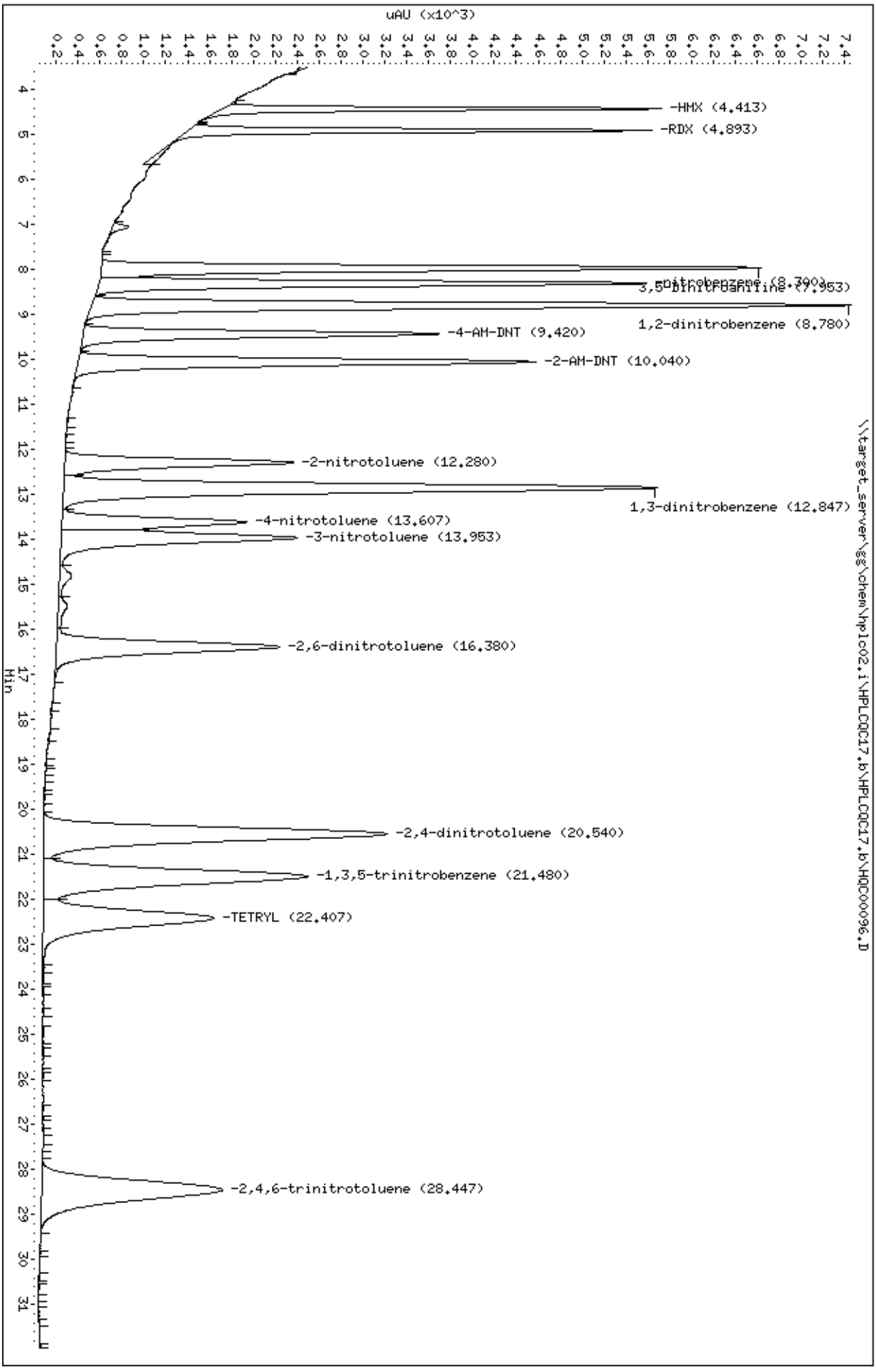
Name	Value	Description
DF	1.000	Dilution Factor
Vt	0.00500	Final Volume (L)
Vo	0.50000	Sample Volume (L)
Cpnd Variable		Local Compound Variable

EP
2:34 pm, Mar 23, 2023

	Compounds	RT	EXP RT	DLT RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/mL)	CONCENTRATIONS FINAL (ug/L)	REVIEW CODE
1	HMX	4.413	4.421	-0.008	4009	0.50662	5.07	
4	RDX	4.893	4.901	-0.008	4214	0.49220	4.92	
51	3,5-Dinitroaniline	7.953	7.995	-0.042	6022	0.52719	5.27(M)	M6
7	nitrobenzene	8.299	8.328	-0.029	5001	0.43546	4.35	
$ 2	1,2-dinitrobenzene	8.779	8.828	-0.049	6926	1.03713	10.4	
11	4-AM-DNT	9.419	9.481	-0.062	3242	0.52953	5.30(M)	M6
12	2-AM-DNT	10.039	10.108	-0.069	4172	0.48053	4.80(M)	M6
15	2-nitrotoluene	12.279	12.328	-0.049	2091	0.53192	5.32	
6	1,3-dinitrobenzene	12.846	12.895	-0.049	5420	0.48367	4.84	
16	4-nitrotoluene	13.606	13.648	-0.042	1687	0.48180	4.82	
17	3-nitrotoluene	13.953	13.995	-0.042	2155	0.48076	4.81	
13	2,6-dinitrotoluene	16.379	16.461	-0.082	2041	0.50275	5.03	
14	2,4-dinitrotoluene	20.539	20.655	-0.116	3134	0.45423	4.54	
5	1,3,5-trinitrobenzene	21.479	21.601	-0.122	2413	0.48751	4.88	
9	TETRYL	22.406	22.568	-0.162	1556	0.67098	6.71(RM)	M6
10	2,4,6-trinitrotoluene	28.446	28.648	-0.202	1652	0.53915	5.39(M)	M6

QC Flag Legend

R - Spike/Surrogate failed recovery limits.
M - Compound response manually integrated.


Data File: \\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00096.D
Date : 17-MAR-2023 14:34
Client ID: JACKSON-SWMC3-DC-01
Sample Info: WG333823-4,SQ1201
Purge Volume: 0.5
Column phase: Phenomenex Kinetex
Instrument: hplc02.i
Operator: EP
Column diameter: 4.60
\\target_server\gg\chem\hplc02.i\HPLCQC17.b\HPLCQC17.b\HQC00096.D
uAU (x10^3)
Min
-HMX (4.413)
-RDX (4.893)
-nitrobenzene (8.700)
3,5-dinitroaniline (7.953)
1,2-dinitrobenzene (8.780)
-4-AM-DNT (9.420)
-2-AM-DNT (10.040)
-2-nitrotoluene (12.280)
1,3-dinitrobenzene (12.847)
-4-nitrotoluene (13.607)
-3-nitrotoluene (13.953)
-2,6-dinitrotoluene (16.380)
-2,4-dinitrotoluene (20.540)
-1,3,5-trinitrobenzene (21.480)
-TETRYL (22.407)
-2,4,6-trinitrotoluene (28.447)

Logbooks and Supporting Documents

KATAHDIN ANALYTICAL SERVICES
ORGANIC EXTRACTIONS LOGBOOK - AQUEOUS EXPLOSIVES
METHOD: SW846 8330 B Mod.

Surrogate Lot # GC2437
Spike Lot # GC2436
Acetonitrile (ACN) Lot # 220799
Cartidrge Lot # CX0105

Other Lot # GC2435 - PENG spike
Other Lot # —

Extraction Start Time: 12:30
Extraction Finish Time: 15:30

Extract Date	Extract Time	Analyst	Sample ID	Bottle ID.	Initial Vol. (500 mL)	Surr.: Add 500 uL of 10 ug/mL Add to all samples	SPIKE: Add 25 uL of 100 ug/mL to MS/D & LCS/D	Elute 15 mL ACN (at gravity flow rate) thru cartridge and discard	Elute 30 mL water thru cartridge and discard	Elute sample through cartidge and discard	Elute 5 mL ACN through cartidge and collect	Add 10 mL water to ACN extract	Store sample in labeled vial	Tray Location	Comments
3/14/23	12:30	AP	WG333823-1	1	✓	0.5	NR	✓	✓	✓	✓	✓	✓	A8	Exp 340 R611273
			-2	2			0.1							9	+40 ul PENG SPIKE LCS
			-3	3										10	MS-SQ1201-2
			-4	4										11	MSD

AP 3/14/23

HP-001 - Revision 1 - 02/11/2010

QAEX465 - 000356

000013

Extract Date	Extract Time	Analyst	Sample ID	Bottle ID.	Initial Vol. (500 mL)	Surr.: Add 500 uL of 10 ug/mL Add to all samples	SPIKE: Add 25 uL of 100 ug/mL to MS/D & LCS/D	Elute 15 mL ACN (at gravity flow rate) thru cartridge and discard	Elute 30 mL water thru cartridge and discard	Elute sample through cartidge and discard	Elute 5 mL ACN through cartidge and collect	Add 10 mL water to ACN extract	Store sample in labeled amber vial	Tray Location	Comments
3/14/23	12:30	AP	SQ1201-1	5	✓	✓	NR	✓	✓	✓	✓	✓	✓	A12	
			-2	6										B1	
			-3	7										2	
			-4	8										3	lots of debri, too much sediment sample wouldn't el
			-5	9										4	
			-6	10										5	
	14:00		-7	11										6	
			-9	12										7	
			-10	13										8	

AP 3/14/23

HP-001 - Revision 1 - 02/11/2010

QAEX465 - 000356

0000139

Katahdin Analytical Services

HPLC Runlog
Instrument: HPLC02

Method (circle): 8330B MOD. 8330B

Column: Phenomenex #559	Injection Volume: 100mL	Standard	Standard ID
Flow Rate: 1.0mL/min	Methanol lot #: ED852-US ED601-US	C5	P0786
Detector Wavelengths: 210/254nm/ACN lot #: 211110		C4	P0787

Date	Init.	Result File	Sample ID	Y/N	Analyical Workgroup	Method	Comments
15Mar23	EP	HQC00038	C1 0.025/0.1 -1	Y	WG333590	EXPB23A	P0787 100→1000
		39	C2 0.05/0.2 -2	Y			P0787 200→1000
		40	C3 0.1/0.4 -3	Y			P0786 200→1000
		41	C4 0.25/1.0 -4	Y			P0787
		42	C5 0.5/2.0 -5	Y			P0786
		43	C6 1.0/4.0 -6	Y			P0785 500→1000
		44	C7 2.0/8.0 -7	Y			P0785
		45	IND -8	Y			P0670 Passed
		46	WG333425-1	Y			None
		47	WG333426-1	Y			None
		48	WG333429-1	Y			None
		49	WG333425-2	Y			LCS tetryl↑
		50	WG333425-3	Y			LCSD tetryl↑
		51	WG333426-2	Y			LCS tetryl↑
		52	WG333429-2	Y			LCS tetryl↑
		53	SQ0938-16RA	Y			None
		54	SQ0938-17RA	Y			None
		55	SQ0938-18RA	Y			None
		56	SQ0951-1	Y			HMX
		57	WG333429-5	Y			SQ0951-1 MS Passed
		58	WG333429-6	Y			SQ0951-1 MSD tetryl↑
		59	SQ0951-2	Y			RDX 4AM 26DNT NB 2AM 246TNT
		60	SQ0951-3	Y			RDX 4AM 26DNT NB 2AM 246TNT
		61	SQ0951-4	Y			None
		62	SQ0951-5	Y			4AM 2AM
		63	C4 -9	Y			Passed
		64	SQ0951-6	Y			4AM 2AM
		65	SQ0951-7	Y			None

Reviewed by/Date:

HP-003 - Revision 2 - 09/01/2016

Katahdin Analytical Services

HPLC Runlog
Instrument: HPLC02

Method (circle): 8330B MOD. 8330B

Column: Phenomenex #559	Injection Volume: 100mL	Standard	Standard ID
Flow Rate: 1.0mL/min	Methanol lot #: ED852-US ED601-US	C5	P0786
Detector Wavelengths: 210/254 nm	ACN lot #: 211110	C4	P0787

Date	Init.	Result File	Sample ID	Y/N	Analyical Workgroup	Method	Comments
15Mar23	EP	HQC00066	SQ0951-8	Y	WG333590	EXPB23A	None
		67	SQ0951-9	Y			HMx
		68	SQ0951-10	Y			None EP17Mar23 ~~surr (26.2%)~~
		69	SQ0951-11	Y			HMx
		70	SQ0951-12	Y			4AM 2AM
		71	SQ0951-13				RDX 4AM 4NT (212.40%) NB 13DNB 26DNT surr↑
		72	SQ0951-14	Y			4AM 2AM
		73	SQ0951-15	Y			None
		74	C5 -10	Y			Passed
		75	SQ0951-16	Y			None
		76	SQ0951-17	Y			None
		77	SQ0951-18	Y			4AM 2AM
		78	SQ0951-19	Y			None
		79	SQ1009-1	Y			None
		80	SQ1033-1	Y			2AM
		81	SQ1033-2	Y			4AM 2AM
		82	SQ1033-3	Y			None
		83	SQ0991-1	Y			13DNB surr↑ (140.34%)
		84	SQ0991-2	Y			NB 4AM
		85	C4 -11	Y			~~Passed~~ surr 12DNB↑ tetryl↑
		86	SQ0991-3	~~Y~~ N			Inst shutdown not using
17Mar23	EP	HQC00087	C5 -1	Y	WG333979	EXPB23A	Passed
		88	WG333823-1	Y			None
		89	WG333767-1	Y			None
		90	WG333823-2	Y			LCS tetryl↑
		91	WG333767-2	Y			LCS tetryl↑
		92	WG333767-3	Y			LCSD tetryl↑
		93	SQ1201-1	Y			None

EP 17Mar23

Reviewed by/Date:

HP-003 - Revision 2 - 09/01/2016

Katahdin Analytical Services

HPLC Runlog
Instrument: HPLC02

Method (circle): (8330B MOD.) (8330B)

Column: Phenomenex #559	Injection Volume: 100uL	Standard	Standard ID
Flow Rate: 1.0 mL/min	Methanol lot #: EQ852-US EQ421-US	C5	P0786
Detector Wavelengths: 210/254 nm	ACN lot #: 211110	C4	P0787

Date	Init.	Result File	Sample ID	Y/N	Analyical Workgroup	Method	Comments
17Mar23	EP	HQC00094	SQ1201-2	Y	WG333979	EXPB23A	None
		95	WG333823-3	Y			SQ1201-2 3SDNA MS HMX
		96	WG333823-4	Y			SQ1201-2 MSD HMX
		97	SQ1201-3	Y			None
		98	SQ1201-4	Y			None Surr 1 (52.25%)
		99	SQ1201-5	Y			4NT
		HQC00100	SQ1201-6	Y			None
		01	SQ1201-7	Y			None
		02	SQ1201-9	Y			None
		03	C4 -2	Y			Passed
		04	SQ1201-10	Y			2NT
		05	SQ1107-1	Y			2NT 3SDNA ocal Surr 1 (67.59%)
		~~10~~	SQ1107-2	Y			2NT 3SDNA ocal
		07	SQ1132-1	Y			HMX 2NT 3SDNA ocal
		08	SQ1132-2	Y			~~2NT~~ ~~3SDNA ocal~~ NG PETN
		09	SQ1132-3	Y			2NT 3SDNA ocal Surr 1 (43.44%)
		10	SQ1132-4	Y			2NT 3SDNA ocal Surr 1 (66.29%)
		11	SQ1132-5	Y			NG
		12	SQ1154-1	Y			3SDNA NG
		13	SQ1154-2	Y			NG
		14	C5 -3	Y			Passed
		15	SQ1154-4	Y			3SDNA NB
		16	SQ1154-5	Y			RDX NB
		17	C4 / -4	Y			Passed
							EP 20Mar23

EP 20Mar23

Reviewed by/Date:

Katahdin Analytical Services

HPLC Runlog
Instrument: HPLC02

Method (circle): ~~8330B MOD.~~ 8330B

Column: Acclaim E2 #577	Injection Volume: 150 µL	Standard	Standard ID
Flow Rate: 1.0 mL/min	Methanol lot #: EDB57-US EDL01-US	C5	P0786
Detector Wavelengths: 210/254nm	ACN lot #: 211110	C4	P0787

Date	Init.	Result File	Sample ID	Y/N	Analyical Workgroup	Method	Comments
Acclaim E2			Confirmation on Column installed		20 March 23		
21Mar23	EP	HQC0011B	C5 0.5/2.0 -5	Y	W6334216	EB23	P0786
		19	C1 0.025/0.1 -1	Y			P0787 100→1000
		20	C2 0.05/0.2 -2	Y			P0787 200→1000
		21	C3 0.1/0.4 -3	Y			P0786 200→1000
		22	C4 0.25/1.0 -4	Y			P0787
		23	C6 1.0/4.0 -6	Y			P0785 500→1000
		24	C7 2.0/8.0 -7	Y			P0785
		25	IND -8	Y			P0670 Passed
		26	W6333823-1C	Y			None
		27	W6333141-1C	Y			None
		28	W6333425-1C	Y			None
		29	W6333767-1C	Y			None
		30	W6333823-2C	Y			LCS Passed
		31	SQ1201-5C	Y			None
		32	SQ1201-10C	Y			None
		33	SQ0906-3C	Y			None
		34	SQ0906-4C	Y			None
		35	SQ0946-5C	Y			None
		36	SQ1033-1C	Y			None
		37	SQ1033-2C	Y			4AM
		38	SQ1107-1C	Y			Surr ok None
		39	SQ1107-2C	Y			None
		40	SQ1132-1C	Y			None
		41	C4 -9	Y			Passed
		42	SQ1132-2C	Y			None
		43	SQ1132-3C	Y			Surr ok none
		44	SQ1132-4C	Y			Surr ok None

Reviewed by/Date: _____

FORM 10
PESTICIDE IDENTIFICATION SUMMARY
FOR SINGLE COMPONENT ANALYTES

CLIENT SAMPLE ID

WG333823-LCS

Lab Name: Project:

Lab Code: PO No.: SDG No.: SDGA00508

Lab Sample ID: WG333823-2 Date(s) Analyzed: 03/17/23 03/21/23

Instrument ID (1): HPLC02 Instrument ID (2): HPLC02

GC Column(1): PHENOMENEX KINETEX ID: 4.60(mm) GC Column(2): ACCLAIM E2 ID: 4.60(mm)

ANALYTE	COL	RT	RT WINDOW FROM	RT WINDOW TO	CONCENTRATION	RPD
NITROGLYCERIN	1	7.07	7.05	7.07	21.7	
	2	20.20	19.76	20.58	19.3	11.7
PETN	1	14.87	14.83	14.93	20.5	
	2	42.66	41.31	43.97	19.2	6.5
	1					
	2					
	1					
	2					
	1					
	2					
	1					
	2					
	1					
	2					
	1					
	2					

FORM X PEST-1

FORM 10
PESTICIDE IDENTIFICATION SUMMARY
FOR SINGLE COMPONENT ANALYTES

CLIENT SAMPLE ID: WG333823-LCS

Lab Name: Project:

Lab Code: PO No.: SDG No.: SDGA00508

Lab Sample ID: WG333823-2 Date(s) Analyzed: 03/17/23 03/21/23

Instrument ID (1): HPLC02 Instrument ID (2): HPLC02

GC Column(1): PHENOMENEX KINETEX ID: 4.60(mm) GC Column(2): ACCLAIM E2 ID: 4.60(mm)

ANALYTE	COL	RT	RT WINDOW FROM	RT WINDOW TO	CONCENTRATION	RPD
HMX	1	4.43	4.41	4.43	5.30	
	2	7.28	7.01	7.53	4.99	6.0
RDX	1	4.92	4.89	4.91	5.26	
	2	10.99	10.64	11.36	4.90	7.1
TETRYL	1	22.58	22.43	22.71	7.22	
	2	20.50	19.86	21.22	5.90	20.1
nitrobenzene	1	8.34	8.30	8.36	4.57	
	2	15.20	14.94	15.50	4.51	1.3
1,3,5-trinitrobenzene	1	21.61	21.46	21.74	5.16	
	2	11.24	11.07	11.45	4.94	4.4
4-AM-DNT	1	9.49	9.45	9.51	5.66	
	2	31.24	29.88	32.70	5.29	6.8
2-AM-DNT	1	10.12	10.07	10.15	5.11	
	2	33.57	32.07	35.13	4.98	2.6
2-nitrotoluene	1	12.34	12.26	12.40	5.41	
	2	25.50	24.98	26.10	4.71	13.8

FORM 10
PESTICIDE IDENTIFICATION SUMMARY
FOR SINGLE COMPONENT ANALYTES

CLIENT SAMPLE ID: WG333823-LCS

Lab Name: Project:

Lab Code: PO No.: SDG No.: SDGA00508

Lab Sample ID: WG333823-2 Date(s) Analyzed: 03/17/23 03/21/23

Instrument ID (1): HPLC02 Instrument ID (2): HPLC02

GC Column(1): PHENOMENEX KINETEX ID: 4.60(mm) GC Column(2): ACCLAIM E2 ID: 4.60(mm)

ANALYTE	COL	RT	RT WINDOW FROM	RT WINDOW TO	CONCENTRATION	RPD
1,3-dinitrobenzene	1	12.91	12.83	12.97	5.10	
	2	14.12	13.87	14.43	4.89	4.2
4-nitrotoluene	1	13.66	13.58	13.72	4.90	
	2	29.85	29.26	30.54	4.35	11.9
3-nitrotoluene	1	14.00	13.92	14.08	4.86	
	2	31.24	30.58	31.98	5.17	6.2
2,6-dinitrotoluene	1	16.46	16.36	16.56	5.19	
	2	22.42	21.93	22.99	4.75	8.8
2,4-dinitrotoluene	1	20.66	20.53	20.79	4.73	
	2	23.52	22.98	24.12	4.80	1.5
2,4,6-trinitrotoluene	1	28.66	28.45	28.85	5.68	
	2	19.05	18.68	19.50	5.38	5.4
3,5-Dinitroaniline	1	8.00	7.98	8.02	5.78	
	2	27.66	26.28	29.08	5.35	7.7
	1					
	2					

FORM X PEST-1

ExPB73A

FORM 8
EXPLOSIVES ANALYTICAL SEQUENCE

Lab Name: Lab Code:

Project: SDG No.: SDGA00508

GC Column: PHENOMENEX KINETEX ID: 4.60 (mm) Init. Calib. Date(s): 03/15/23 03/15/23

Instrument ID: HPLC02

THE ANALYTICAL SEQUENCE OF PERFORMANCE EVALUATION MIXTURES, BLANKS, SAMPLES, AND STANDARDS IS GIVEN BELOW:

MEAN SURROGATE RT FROM INITIAL CALIBRATION
S1 : 8.72

	CLIENT SAMPLE ID	LAB SAMPLE ID	DATE ANALYZED	TIME ANALYZED	S1 RT	#	RT	#
01		WG333590-1	03/15/23	0932	8.79			
02		WG333590-2	03/15/23	1006	8.79			
03		WG333590-3	03/15/23	1041	8.82			
04		WG333590-4	03/15/23	1116	8.77			
05		WG333590-5	03/15/23	1150	8.76			
06		WG333590-6	03/15/23	1225	8.74			
07		WG333590-7	03/15/23	1300	8.72			
08		WG333590-8	03/15/23	1335				
09								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

QC LIMITS
S1 = 1,2-dinitrobenzene (+/- 0.15 MINUTES)

Column used to flag retention time values with an asterisk.
* Values outside of QC limits.

FORM 8
EXPLOSIVES ANALYTICAL SEQUENCE

Lab Name: Lab Code:

Project: SDG No.: SQ1201

GC Column: PHENOMENEX KINETEX ID: 4.60 (mm) Init. Calib. Date(s): 03/15/23 03/15/23

Instrument ID: HPLC02

THE ANALYTICAL SEQUENCE OF PERFORMANCE EVALUATION MIXTURES, BLANKS, SAMPLES, AND STANDARDS IS GIVEN BELOW:

MEAN SURROGATE RT FROM INITIAL CALIBRATION
S1 : 8.83

	CLIENT SAMPLE ID	LAB SAMPLE ID	DATE ANALYZED	TIME ANALYZED	S1 RT #	RT #
01		WG333979-1	03/17/23	0908	8.83	
02	WG333823-BLA	WG333823-1	03/17/23	0957	8.84	
03	WG333823-LCS	WG333823-2	03/17/23	1106	8.83	
04	SWDUP	SQ1201-1	03/17/23	1250	8.76	
05	JACKSON-SWMC	SQ1201-2	03/17/23	1325	8.77	
06	JACKSON-SWMC	WG333823-3	03/17/23	1400	8.77	
07	JACKSON-SWMC	WG333823-4	03/17/23	1434	8.78	
08	JACKSON-SWMC	SQ1201-3	03/17/23	1509	8.80	
09	JACKSON-SWJC	SQ1201-4	03/17/23	1544	8.82	
10	JACKSON-SWMC	SQ1201-5	03/17/23	1618	8.80	
11	JACKSON-SWCC	SQ1201-6	03/17/23	1653	8.88	
12	JACKSON-SWCC	SQ1201-7	03/17/23	1728	8.83	
13	JACKSON-EB-0	SQ1201-9	03/17/23	1802	8.87	
14		WG333979-2	03/17/23	1837	8.79	
15	JACKSON-CB-0	SQ1201-10	03/17/23	1912	8.84	
16		WG333979-3	03/18/23	0059	8.82	
17						
18						
19						
20						

QC LIMITS
S1 = 1,2-dinitrobenzene (+/- 0.15 MINUTES)

Column used to flag retention time values with an asterisk.
* Values outside of QC limits.

FORM VIII EXPLOSIVES

E2B23

FORM 8
EXPLOSIVES ANALYTICAL SEQUENCE

Lab Name: Lab Code:

Project: SDG No.: 021497

GC Column: ACCLAIM E2 ID: 4.60 (mm) Init. Calib. Date(s): 03/21/23 03/21/23

Instrument ID: HPLC02

THE ANALYTICAL SEQUENCE OF PERFORMANCE EVALUATION MIXTURES, BLANKS, SAMPLES, AND STANDARDS IS GIVEN BELOW:

MEAN SURROGATE RT FROM INITIAL CALIBRATION
S1 : 13.80

	CLIENT SAMPLE ID	LAB SAMPLE ID	DATE ANALYZED	TIME ANALYZED	S1 RT #	RT #
01		WG334216-5	03/21/23	1324	13.75	
02		WG334216-1	03/21/23	1414	13.72	
03		WG334216-2	03/21/23	1504	13.79	
04		WG334216-3	03/21/23	1555	13.81	
05		WG334216-4	03/21/23	1645	13.79	
06		WG334216-6	03/21/23	1735	13.78	
07		WG334216-7	03/21/23	1825	13.80	
08		WG334216-8	03/21/23	1916		
09						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

QC LIMITS

S1 = 1,2-dinitrobenzene (+/- 0.36 MINUTES)

Column used to flag retention time values with an asterisk.
* Values outside of QC limits.

FORM 8
EXPLOSIVES ANALYTICAL SEQUENCE

Lab Name: Lab Code:

Project: SDG No.: SDGA00508

GC Column: ACCLAIM E2 ID: 4.60 (mm) Init. Calib. Date(s): 03/21/23 03/21/23

Instrument ID: HPLC02

THE ANALYTICAL SEQUENCE OF PERFORMANCE EVALUATION MIXTURES, BLANKS, SAMPLES, AND STANDARDS IS GIVEN BELOW:

MEAN SURROGATE RT FROM INITIAL CALIBRATION
S1 : 13.80

	CLIENT SAMPLE ID	LAB SAMPLE ID	DATE ANALYZED	TIME ANALYZED	S1 RT	#	RT	#
01		WG333823-1C	03/21/23	2006	13.80			
02		WG333823-2C	03/21/23	2327	13.77			
03		SQ1201-5C	03/22/23	0017	13.77			
04		SQ1201-10C	03/22/23	0108	13.77			
05		WG334216-9	03/22/23	0840	13.77			
06								
07								
08								
09								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

QC LIMITS
S1 = 1,2-dinitrobenzene (+/- 0.36 MINUTES)

Column used to flag retention time values with an asterisk.
* Values outside of QC limits.

FORM VIII EXPLOSIVES

GC EXTRACTION SPIKE STANDARD PREPARATION

Prep Info	Stock #	Stock Name	Amt Added	Stock Conc. ug/mL
GC2388	EPH spike			
AP	STD 9965, STD 9967, STD 9968	Aromatic	2.25 mL	1000 ug/mL
9/13/22	STD 9923, STD 9922, STD 9970	Aliphatic	2.25 mL	↓
x 3/13/22	Diluted to 25 mL in Acetone #solv 0156			
~~GC 2389~~	~~Exp PHE + NG Spike~~			
~~CMW~~	~~STD 9871~~	~~PEN TN~~	~~1.2~~	
~~9/21/22~~	~~STD 9874~~	~~EGDN~~	~~1.0~~	
~~x 3/21/22~~	STD 9876	Nitroglycerin	1.2	
	~~Diluted to 4.8 mL in Ac~~			
GC2389	Exp LCS			
CMW	STD 9790 ↑	3.5 Dinitroaniline	0.5	1000 ug/mL
9/21/22	STD 9786 ↓	8330 Calibration	0.5	
x 3/21/23	Diluted to 5 mL in ACN # 216634			
GC2390	Herb spike			
CMW	STD 9908 - 9907	M-8151A	1.25 mL	Various
9/22/22	Diluted to 25 mL in MeOH Solv 0173			
x 3/22/23	F.C 9.0 ug/mL			
GC 2391	Diazald			
9/26/22	STD 9910 9811	N-Nitro-N-methynol	13.2g	
CMW	STD 9927	Carbitol	50 mL	
3/26/23	222207 ~~F.C~~	ether	50 mL	
GC2392	EPH Surr			
9/26/22	STD 9863 - 9862 - 9864	Oterphenyl	2.25	1000 ug/mL
CMW	STD 9602 9603	5 Alpha Androstane	↓	
x 3/26/23	Diluted to 250 mL in Acetone / F.C 9.0 ug/mL			

EX-020 – Revision 1 – 07/25/2012

GC EXTRACTION SPIKE STANDARD PREPARATION

PREP INFO	STOCK NAME	AMT ADDED	STOCK CONC.	STOCK#
ID#: GC2434				
Prep Date: 2/28/23				
Initials: AP				STD0017, STD0018
Exp. Date: 8/28/23				
ID#: GC2435	Explosive	P+E+NG spike		
Prep Date: 2/28/23	PETN	1.0 mL	1000 ug/mL	STD 9098
Initials: AP	EGDN	↓	↓	STD 9096
Exp. Date: 8/28/23	Nitroglycerin	↓	↓	STD 9100
	Diluted to	4 mL in ACN	solvo 268	
ID#: GC2436	Explosive	LCS		
Prep Date: 2/28/23	3,5 Dinitroaniline	0.5 mL	1000 ug/mL	STD 9926
Initials: AP	#330 calibration	↓	↓	STD 8832
Exp. Date: 8/28/23	Diluted to	5 mL in ACN	# solvo268	

HERB SPIKE		
M-8151A	1.25 mL	Varied
Diluted to 25mL in MeOH#	Solvo ~~268~~ 275	F.C.: 5.0 ug/mL

#2/28/23 AP

Wrong

EX-020 - Revision 2 - 09/12/2022

QAEX484 - 000681

0000009

*AP 2/28/23 GC EXTRACTION SPIKE STANDARD PREPARATION

PREP INFO	STOCK NAME	AMT ADDED	STOCK CONC.	STOCK#
ID#: GC2437	* ~~Exp Surr~~	1,2 DNB		
Prep Date: 2/28/23	1,2-Dinitrobenzene	1.0 mL	1000 ug/mL	STD00150, STD00151
Initials: AP	Diluted to 100 mL in ACN	SDN02168		
Exp. Date: 8/28/23				
ID#: GC2438				
Prep Date: 3/17/23				
Initials: AP				STD00018, STD00019
Exp. Date: 9/17/23				
ID#: GC2439				
Prep Date: 3/17/23				
Initials: AP				STD00234, STD00243
Exp. Date: 9/17/23				

HERB SURR		
M-8151B-SS-10X	1.25 mL	1000 ug/mL
Diluted to 250mL in MeOH# ED-601-US		

HERB SPIKE		
M-8151A	1.25 mL	Varied
Diluted to 25mL in MeOH# ED 601-US		**F.C.: 5.0 ug/mL**

KATAHDIN ANALYTICAL SERVICES

GC PESTICIDES/PCB/HERBICIDES

STANDARD PREPARATION LOG

GC LABORATORY
REVIEWED BY/DATE:

P0664 | AR 1660 1.0 ppm — hexlot 0182 — 10/27/22 — X: 1/13/23 MG
1.0 ml P0652 → 10 ml hexane

P0665 | AR 1660 1.0 ppm — hexlot 0182 — 10/28/22 — X 1/9/23 MG
1.0 ml P0652 → 10 ml hexane

P0666 | AR 1254 1.0 ppm — 10/2/22 — X: 3/13/30 MG
10 ml P0660 → 10 ml hexane

P0667 | Explosives C7 2.0/8.0 — P: 04Nov22 — X: 04Apr23 — EP
+40uL M-8330-R-0.5x (STK6721)
+200uL M-8330-ADD-4 (STK6358)
+8uL M-8330-ADD-1 (STK6223)
+80uL M-8330-ADD-2-10X (STK6220) → into 10mL ACN lot #: 216631
+800uL M-8330-ADD-5 (STD9797) and 20mL DiH_2O
+20uL M-8330-SS (STK6195)
+200uL M-8330-ADD-13 (STK6353)
+200uL M-8330-ADD-12 (STK6354)

P0668 | Explosives C5 0.5/2.0
10mL P0667 into 10mL ACN lot # 216631
and 20mL DiH_2O

P0669 | Explosives C4 0.75/1.0
10mL P0668 into 10mL 1:2 v/v ACN lot 216631 : diH_2O
(10mL : 20mL)

P0670 | Explosives Independent Std (IND 0.5/2.0) — P: 04Nov22 — X: 21Mar23 — EP
+20mL each of STD9099 (NG STOCK), STD9097 (PETN STOCK) and STD9095 (EDGN STOCK)
and 50mL of LCS STOCK (6238 9) into 10mL ACN lot #: 216631
and 20mL DiH_2O

KATAHDIN ANALYTICAL SERVICES

GC PESTICIDES/PCB/HERBICIDES

STANDARD PREPARATION LOG

GC LABORATORY
REVIEWED BY/DATE:

P0780 | AR 1268 10.0 ppm — MG 2/22/23 — X: 8/22/23
100 ul STK6261 → 10 ml hexane #222209

P0781 | AR 1016 1.0 IND — MG 2/27/23 — MG 2/27/23 — X: 8/27/23
290 ul STK6210 → 10 ml hexane
145 5 #222209

P0782 | AR 1260 1.0 IND
290 ul STK6211 → 10 ml hexane
145 5 #222209

P0783 | AR 1242 0.25 ppm — MG — 3/3/23 — 2/9/23 ~~X 9/3/23~~ MG 3/3/23
250 ul P01607 → 10 ml hexane
#222209

P0784 | AR 1660 1.0 ppm — MG — 3/9/23 — X 7/16/23
1 ml P0731 → 10 ml hexane
#222209

P0785 | Explosives C7 2.0/8.0 — EP P: 030923 X: 060423
+40 mL M8330-R-0.5x (STK6221)
+200 mL M-8330-ADD-4 (STK6358)
+80 mL M8330-ADD-1-10x (STK6223) → into 10mL ACN lot #211110 and 20 mL di H2O
+80 mL M-8330-ADD-2-10x (STK6220)
+20 mL M-8330-SS (STK6145)

P0786 | Explosives C5 0.5/2.0
10mL P0785 into 10mL ACN lot #211110
and 20mL di H2O

P0787 | Explosives C4 0.25/1.0
10mL P0786 into 10mL 1:2 v/v 10mL ACN lot #211110
and 20mL di H2O

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

Extractions Laboratory

STD8832 — MP 5/5/20

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
33905 Danger 1 mL
Lot# A0157375
Expire: 09/2023 Store: 10°C or colder
8330 Calibration Standard
1000 µg/mL each in Acetonitrile
Full label information for the chemical is provided on the outside package

STD8833 — MP 5/5/20

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
32005 Danger 1 mL
Lot# A0155324
Expire: 02/2024 Store: 10°C or colder
Toxaphene Standard
1000 µg/mL each in Hexane
Full label information for the chemical is provided on the outside package

STD8834
8835
N-methyl-N-nitroso-p-toluenesulfonamide — MK — 5-20-20
Lot# 1D0353
$C_8H_{10}N_2O_3S$ 25g
MZ272
CAS# 80-11-5

STD8836
8837

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com
GRH-IS-10X 1 mL
5-alpha Androstane
10.0 mg/mL in CH2Cl2
Lot: 217091116 1 comp(s)
Exp: Sep 11, 2027 Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H315 H335
H332 H302
H351 H360
P338 P360
P331 P233
P262 P202
Refer to SDS
Signal Word Warning

MK

STD8838
8839
8840

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31459 Danger 1 mL
Lot# A0151405
Expire: 08/2026 Store: 25°C nominal
MA EPH Aliphatic Hydrocarbon Standard
1000 µg/mL each in Hexane
Full label information for the chemical is provided on the outside package

STD8841
8842
8843

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31458 Danger 1 mL
Lot# A0159443
Expire: 02/2026 Store: 25°C nominal
MA EPH Aromatic Hydrocarbon Standard
Sonication required. Mix is photosensitive.
1000 µg/mL each in Methylene chloride
Full label information for the chemical is provided on the outside package

STD8844
8845
8846
8847

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31097 Warning 1 mL
Lot# A0158517
Expire: 10/2023 Store: 10°C or colder
o-Terphenyl Standard
Sonicate prior to use.
10000 µg/mL each in Methylene Chloride
Full label information for the chemical is provided on the outside package.

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

Extractions Laboratory

STD9075
9076
9077
9078
9079

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

Z-014F 1 mL
Benzidine & 3,3'-Dichlorobenzidine
2.0 mg/mL in MeOH
Lot: 221091180 2 comp(s)
Exp: Sep 09, 2025 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H225 H370 H336 H320 H315 H311 H332 H301 H350 H360, H350 P338 Refer to SDS
Signal Word Danger

SR 9/27/22

STD9080
9081
9082
9083
9084

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

APP-9-096-20X 1 mL
p-Dioxane Standard
2.0 mg/mL in MeOH
Lot: 219011122 1 comp(s)
Exp: Jan 10, 2029 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H225 H336 H370 H320 H315 H311 H332 H301 H351 H360, H350 P338 Refer to SDS
Signal Word Danger

STD9085
9086
9087
9088
9089

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

CLP-HC-A-R 1 mL
Acid Composite Mixture
2.0 mg/mL in CH2Cl2
Lot: 222041590 19 comp(s)
Exp: May 03, 2025 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H315 H335 H332 H302 H350 H350 P338 P360 P331 P233 P262 P202 Refer to SDS
Signal Word Danger

STD9090
9091
9092
9093

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

APP-9-191-10X 1 mL
1,2,4,5-Tetrachlorobenzene
1000 µg/mL in MeOH
Lot: 219041253 1 comp(s)
Exp: Apr 09, 2029 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H336 H225 H370 H320 H315 H311 H332 H301 H360 P338 P360 P331 Refer to SDS
Signal Word Danger

STD9094

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

P-233S-10X 1 mL
bis(2-Ethylhexyl)adipate
1000 µg/mL in MeOH
Lot: 222011504 *1 comp(s)
Exp: Jan 25, 2032 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H335 H225 H370 H320 H315 H311 H332 H301 H360 P338 P360 P331 Refer to SDS
Signal Word Danger

SR 9/28/22

STD9095
9096

RESTEK 31601 Danger 1 mL
Lot# A0189256
Expire: 09/2027 Store: 10°C or colder
EGDN Standard
1000 µg/mL each in Methanol
Full label information for the chemical is provided on the outside package

STD9097
9098

RESTEK 31600 Danger 1 mL
Lot# A0187142
Expire: 07/2027 Store: 10°C or colder
PETN Standard
Sonicate prior to use.
1000 µg/mL each in Methanol
Full label information for the chemical is provided on the outside package

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

Extractions Laboratory

STD9099
9100

RESTEK
31498 Danger 1 mL
Lot# A0187280
Expire: 07/2027 Store: 10°C or colder
Nitroglycerin Standard
1000 µg/mL each in Methanol
Full label information for the chemical is provided on the outside package

SR 9/23/22

STD9101
9102
9103
9104
9105

RESTEK
33912 Warning 1 mL
Lot# AC160139
Expire: 12/2024 Store: 10°C or colder
alpha-Terpineol Standard
2000 µg/mL each in Methylene Chloride
Full label information for the chemical is provided on the outside package

STD9106
9107
9108

RESTEK
31480 Danger 1 mL
Lot# A0187668
Expire: 06/2028 Store: 10°C or colder
MA Fractionation Surrogate Spike Mix
Sonication required. Mix is photosensitive.
4000 µg/mL each in Hexane
Full label information for the chemical is provided on the outside package

STD9109

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com
M-8151A 1 mL
Underivatized Chlorinated Herbicides
Varied conc. in Acetone
Lot: 221121297-01 18 comp(s)
Exp: Sep 11, 2023 Storage: Freeze (<-10 °C)
FOR LABORATORY USE ONLY
H226 H336 H335 H319 H315 P338 P360 P331 P233 P260 P262 P202
Refer to SDS
Signal Word Danger

AP 9/29/22

STD9110
-11
-12

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com
GRH-IS-10X 1 mL
5-alpha Androstane
10.0 mg/mL in CH2Cl2
Lot: 220111195 1 comp(s)
Exp: Nov 19, 2030 Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H315 H335 H332 H302 H351 H350 P338 P360 P331 P233 P262 P202
Refer to SDS
Signal Word Warning

STD9113
-14
-15

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com
P-233S-10X 1 mL
bis(2-Ethylhexyl)adipate
1000 µg/mL in MeOH
Lot: 222011504 1 comp(s)
Exp: Jan 25, 2032 Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H336 H225 H370 H320 H315 H311 H332 H301 H360 P338 P360 P331
Refer to SDS
Signal Word Danger

STD 9/# 0070
-71
-72

RESTEK
31097 Warning 1 mL
Lot# A0188827
Expire: 03/2026 Store: 10°C or colder
o-Terphenyl Standard
Sonicate prior to use.
10000 µg/mL each in Methylene Chloride
Full label information for the chemical is provided on the outside package

CMW 10/4/22

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

Extractions Laboratory

STD9914
9915
9916
9917
9918

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

DRH-FTRPH 1 mL
FTRPH Calibration/ Window Defining Standard
500 µg/mL in Hexane
Lot: 221121036 17 comp(s)
Exp: Dec 21, 2031 Storage: Ambient (>5 °C)/Sonicate

FOR LABORATORY USE ONLY
H304 H225
H336 H361
H315 H335
H332 H302
H360 P338
P352 P331
Refer to SDS
Signal Word Danger

SR 5/17/22

STD9919
9920

Silicic Acid ~80 Mesh
Lot#: MKCJ8025

SR 5/18/22

STD9921
9922
9923
9924
9925

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31459 Danger 1 mL
Lot# A0180427
Expire: 02/2029 Store: 25°C nominal
MA EPH Aliphatic Hydrocarbon Standard
1000 µg/mL each in Hexane
Full label information for the chemical is provided on the outside package

SR 5/24/22

STD9926

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31661 Danger 1 mL
Lot# A0178657
Expire: 06/2026 Store: 10°C or colder
3,5-Dinitroaniline Standard
1000 µg/mL each in Acetonitrile
Full label information for the chemical is provided on the outside package

SR 5/24/22

STD9927

Diethylene glycol (Carbitol) 99% Lot# MKCQ2376

SR 6/3/22

STD9928
9929
9930

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31097 Warning 1 mL
Lot# A0183688
Expire: 11/2025 Store: 10°C or colder
o-Terphenyl Standard
Sonicate prior to use.
10000 µg/mL each in Methylene Chloride
Full label information for the chemical is provided on the outside package

SR 6/3/22

STD9931

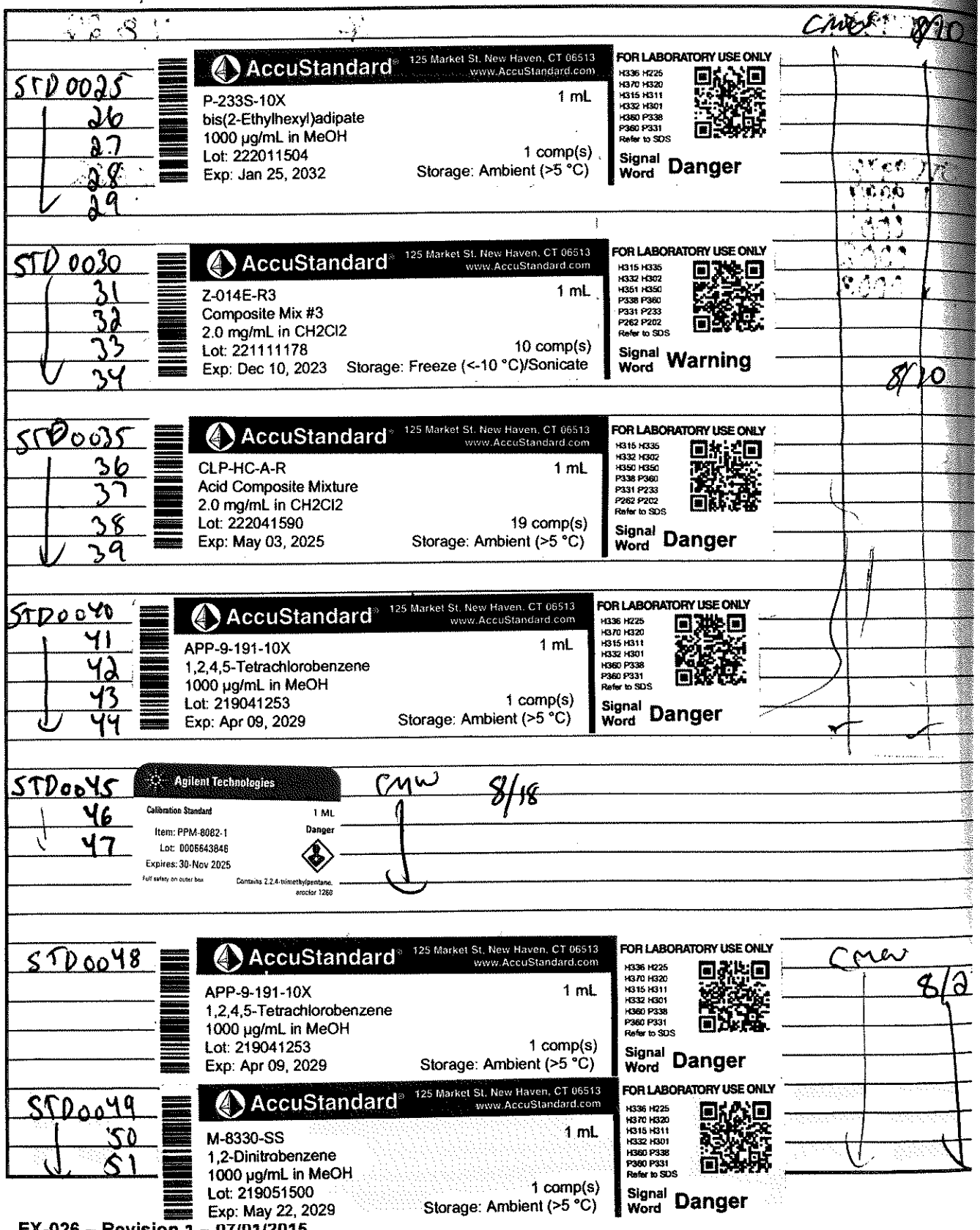
Silicic Acid Powder, ~80 Mesh
Lot# MKCJ8025

SR 6/3/22

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

Extractions Laboratory



KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

GC and Semivolatile Extractables Laboratory

STK 6190

32251 US/EN
Dinoseb Standard
Lot# A0165987
Expire: 05/2022 Store: 10°C or colder 1 mL
1000 µg/mL each in Methanol
RESTEK

JLK 10/19/21

STK6191

31835 US/EN
3,3'- Dichlorobenzidine Standard
Lot# A0174073
Expire: 02/2026 Store: 10°C or colder 1 mL
2000 µg/mL each in Methylene Chloride
RESTEK
Contains carcinogen/mutagen/reproductive toxin

JLK 10/19/21

STK6192

33913 US/EN
SOM01.0 SIM Analysis Standard
Lot# A0175442
Expire: 07/2027 Store: 10°C or colder 1 mL
2000 µg/mL each in Methylene Chloride
RESTEK
Sonication required. Mix is photosensitive.

JLK 10/19/21

STK6193

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
APP-9-191-10X 1 mL
1,2,4,5-Tetrachlorobenzene
1000 µg/mL in MeOH
Lot: 219041253 1 comp(s)
Exp: Apr 09, 2029 Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

JLK 10/25/21

STK6194

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
M-8330-SS 1 mL
1,2-Dinitrobenzene
1000 µg/mL in MeOH
Lot: 219051500 1 comp(s)
Exp: May 22, 2029 Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

MK 102521

STK6195

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com
M-8330-SS 1 mL
1,2-Dinitrobenzene
1000 µg/mL in MeOH
Lot: 219051500 1 comp(s)
Exp: May 22, 2029 Storage: Ambient (>5 °C)
FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

MK 102521

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

GC and Semivolatile Extractables Laboratory

STK6211

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

C-260S 1 mL
Aroclor 1260
35 µg/mL in Isooctane
Lot: 221041549 1 comp(s)
Exp: Apr 27, 2031 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H305 H225
H336 H315
H302 H319
P338 P352
P331 P233
P260 P262
Refer to SDS
Signal Word Danger

11/2/21 DT

STK6212

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

C-248S-H 1 mL
Aroclor 1248
100 µg/mL in Hexane
Lot: 219111357 1 comp(s)
Exp: Dec 02, 2029 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H304 H225
H336 H361
H315 H335
H332 H302
H360 P338
P352 P331
Refer to SDS
Signal Word Danger

11/2/21 DT

STK6213

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

C-248S-H 1 mL
Aroclor 1248
100 µg/mL in Hexane
Lot: 219111357 1 comp(s)
Exp: Dec 02, 2029 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H304 H225
H336 H361
H315 H335
H332 H302
H360 P338
P352 P331
Refer to SDS
Signal Word Danger

11/4/21 DT

STK6214

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

M-8270-SS 1 mL
Method 8270 - Surrogate Standard
4.0 mg/mL in CH2Cl2
Lot: 221081696 6 comp(s)
Exp: Sep 03, 2031 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H315 H336
H332 H302
H351 H350
P338 P360
P331 P233
P262 P202
Refer to SDS
Signal Word Warning

STK6215

32460 US/EN
Methapyrilene Standard
Lot# A0170165
Expire: 09/2022 Store: 0°C or colder 1 mL
2000 µg/mL each in Methylene Chloride
RESTEK
This product is photosensitive

STK6216

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
32008 Danger 1 mL
Lot# A0170315
Expire: 08/2027 Store: 25°C nominal
Aroclor® 1232 Standard
This product contains PCBs.
1000 µg/mL each in Hexane
Full label information for the chemical is provided on the outside package.

11/8/21 SR

STK6217
6218

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

M-8330-ADD-5 1 mL
EGDN
100 µg/mL in Acetonitrile:Methanol (95:5)
Lot: 220031214-01 1 comp(s)
Exp: Apr 01, 2023 Storage: Freeze (<-10 °C)

FOR LABORATORY USE ONLY
H225 H370
H336 H315
H332 H319
H360 P338
P352 P340
P233 P260
Refer to SDS
Signal Word Danger

11/8/21 SR

STK6219
6220

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

M-8330-ADD-2-10X 1 mL
PETN
1000 µg/mL in Methanol
Lot: 221051166 1 comp(s)
Exp: Jun 10, 2023 Storage: Refrig (0-5 °C)

FOR LABORATORY USE ONLY
H225 H370
H336 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

11/8/21 SR

EX-012 – Revision 1 – 06/28/2010

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

GC and Semivolatile Extractables Laboratory

STK6221
6222

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

M-8330-R-0.5X 1 mL
Method 8330 - Explosives by HPLC
0.5 mg/mL in Methanol:Acetonitrile (50:50)
Lot: 221071166 14 comp(s)
Exp: Aug 15, 2023 Storage: Freeze (<-10 °C)

FOR LABORATORY USE ONLY
H225 H370
H336 H315
H332 H319
H350 H360
P338 P352
P340 P233
Refer to SDS
Signal Word Danger

11/8/21 SR

STK6223
6224

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

M-8330-ADD-1-10X 1 mL
Nitroglycerin
1000 µg/mL in Ethanol:Methanol (97:3)
Lot: 220041110-01 1 comp(s)
Exp: Jun 04, 2023 Storage: Refrig (0-5 °C)

FOR LABORATORY USE ONLY
H225 H320
H315 H312
H336 H332
H302 H360
P338 P360
P340 P233
Refer to SDS
Signal Word Danger

11/9/21 SR

STK6225

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

S-279-5X 1 mL
Tetrachloro-m-xylene
1000 µg/mL in MeOH
Lot: 221051625 1 comp(s)
Exp: May 28, 2031 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

11/10/21 DT

STK6226

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

M-504.1-CSS 1 mL
Method 504.1 - Calibration Stock Solution
0.2 mg/mL in MeOH
Lot: 220081432 3 comp(s)
Exp: Aug 31, 2025 Storage: Ambient (>5 °C)

FOR LABORATORY USE ONLY
H336 H225
H370 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

STK6227

AccuStandard® 125 Market St, New Haven, CT 06513 www.AccuStandard.com

P-398S-10X 1 mL
Chloropicrin
1000 µg/mL in Methanol
Lot: 221091631 1 comp(s)
Exp: Sep 29, 2026 Storage: Refrig (0-5 °C)

FOR LABORATORY USE ONLY
H225 H370
H336 H320
H315 H311
H332 H301
H360 P338
P360 P331
Refer to SDS
Signal Word Danger

STK6228

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31441 Danger 1 mL
Lot# A0176146
Expire: 04/2026 Store: 10°C or colder
Benzidine Standard
1000 µg/mL each in Methanol
Full label information for the chemical is provided on the outside package

11/12/21 MK

STK6229
6230

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31480 Danger 1 mL
Lot# A0175042
Expire: 07/2027 Store: 10°C or colder
MA Fractionation Surrogate Spike Mix
Sonication required. Mix is photosensitive.
4000 µg/mL each in Hexane
Full label information for the chemical is provided on the outside package

11/22/21 SR

STK6231
6232

RESTEK 110 Benner Circle Bellefonte, PA 16823 814-353-1300 Made in USA For Laboratory Use Only
31458 Danger 1 mL
Lot# A0176586
Expire 08/2027 Store: 25°C nominal
MA EPH Aromatic Hydrocarbon Standard
Sonication required. Mix is photosensitive.
1000 µg/mL each in Methylene chloride
Full label information for the chemical is provided on the outside package

11/22/21 SR

KATAHDIN ANALYTICAL SERVICES

STOCK STANDARDS RECEIVED

GC and Semivolatile Extractables Laboratory

STK6357

SPEX CertiPrep
Calibrate with Confidence™

Part # : S-911
Lot # : MP220919008
Date Opened: 10/13/22

10/13/22 DT

Chloropicrin

Contains the following in **Methanol**

Concentration	Compound
1000 µg/mL	Chloropicrin

S-911
MP220919008

*** END LIST ***

Danger

Storage: **Freezer**

Highly flammable liquid and vapour. Toxic if inhaled. Causes damage to the central nervous system and the visual organs.
If medical advice is needed, have product container or label at hand. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use explosion-proof electrical/ventilating/lighting/ equipment. Do not breathe dust/ fume/ gas/ mist/ vapours/ spray. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. Dispose of contents/container in accordance with local/regional/national/international regulations.

Phone: 732-549-7144

For Laboratory Use Only

STK6358
59
60
61

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

M-8330-ADD-4 1 mL
3,5-Dinitroaniline
0.1 mg/mL in Acetonitrile:Methanol
Lot: 222011692-01
Exp: Oct 06, 2023 1 comp(s)
Storage: Ambient (>5 °C)
PRODUCT OF THE USA **FOR LABORATORY USE ONLY**

H225 H370
H336 H315
H332 H319
H360 P338
P352 P340
P233 P260
Refer to SDS

Signal Word: Danger

R: 10/14/22 EP

STK6362
63

31806 US/EN
Appendix IX Mix #2
Lot# A0187840
Expire: 01/2024 Store: 0°C or colder 1 mL
1000 µg/mL each in Methylene chloride

RESTEK

STK6364

AccuStandard® 125 Market St. New Haven, CT 06513 www.AccuStandard.com

M-8330-ADD-3-50X 1 mL
Picric acid
5.0 mg/mL in AcCN:MeOH
Lot: 222021531
Exp: Mar 25, 2024 1 comp(s)
Storage: Ambient (>5 °C)
PRODUCT OF THE USA **FOR LABORATORY USE ONLY**

H225 H370
H336 H315
H332 H319
H360 P338
P352 P340
P233 P260
Refer to SDS

Signal Word: Danger

EP R: 10/17/22

METALS DATA

Sample Data Section

METALS SAMPLE FLAGGING

FLAG	SPECIFIED MEANING
E	The reported value is estimated because of the presence of interference (as indicated by serial dilution).
N	The pre-digestion spiked sample recovery is not within control limits.
*	The duplicate sample analysis relative percent difference (RPD) is not within control limits.
B	Indicates the analyte was detected in the laboratory method blank analyzed concurrently with the sample.
A	The post-digestion spiked sample recovery is not within control limits.
•	Analytical run QC sample (e.g. ICV, CCV, ICB, CCB, ICSA, ICSAB) not within control limits.
U	The analyte was not detected above the specified level. This level may be the Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client. Note: All results reported as "U" MDL have a 50% rate for false negatives compared to those results reported as "U" PQL, "U" LOQ or "U" LOD, where the rate of false negatives is <1%.
J	Estimated value. The analyte was detected in the sample at a concentration less than the laboratory Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), but above the Method Detection Limit (MDL).
Q	One or more quality control criteria failed (e.g., LCS recovery, surrogate spike recovery or CCV).

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: Katahdin Analytical Services

SDG Name: SQ1201 **SOW No.** SW846

Client Field ID	Lab Sample ID
JACKSON-CB-01	SQ1201-010
JACKSON-EB-01	SQ1201-009
JACKSON-SWCC2-DC-01	SQ1201-008
JACKSON-SWCC2-DC-01	SQ1201-018
JACKSON-SWCC3-DC-01	SQ1201-006
JACKSON-SWCC3-DC-01	SQ1201-016
JACKSON-SWCC4-DC-01	SQ1201-007
JACKSON-SWCC4-DC-01	SQ1201-017
JACKSON-SWJC1-DC-01	SQ1201-004
JACKSON-SWJC1-DC-01	SQ1201-014
JACKSON-SWMC1-DC-01	SQ1201-005
JACKSON-SWMC1-DC-01	SQ1201-015
JACKSON-SWMC2-DC-01	SQ1201-003
JACKSON-SWMC2-DC-01	SQ1201-013
JACKSON-SWMC3-DC-01	SQ1201-002
JACKSON-SWMC3-DC-01	SQ1201-012
JACKSON-SWMC3-DC-01P	SQ1201-002P
JACKSON-SWMC3-DC-01P	SQ1201-012P
JACKSON-SWMC3-DC-01S	SQ1201-002S
JACKSON-SWMC3-DC-01S	SQ1201-012S
SWDUP	SQ1201-001
SWDUP	SQ1201-011

Were ICP interelement corrections applied ?	Yes
Were ICP background corrections applied ?	Yes
If yes - were raw data generated before application of background corrections ?	No

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed in the case narrative. Release of the data contained in this hardcopy data package and in the computer-readable data submitted has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Edward A. Morgan Name: Edward A. Morgan

Date: April 11, 2023 Title: Data Management

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** SWDUP

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-001

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	LOQ	ADJUSTED MDL	LOD
7440-70-2	CALCIUM, TOTAL	1290			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	700			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	529	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	2980			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-002

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-70-2	CALCIUM, TOTAL	1280			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	693			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	457	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	2970			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC2-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-003

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-70-2	CALCIUM, TOTAL	1560			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	792			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	621	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	3150			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWJC1-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-004

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-70-2	CALCIUM, TOTAL	769			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	224			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	48	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	1550			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC1-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-005

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-70-2	CALCIUM, TOTAL	219			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	175			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	56	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	1590			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWCC3-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-006

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-70-2	CALCIUM, TOTAL	272			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	214			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	50	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	1290			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWCC4-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-007

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-70-2	CALCIUM, TOTAL	319			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	236			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	100	J		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	1290			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWCC2-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-008

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-70-2	CALCIUM, TOTAL	220			P	1	100	11	80
7439-95-4	MAGNESIUM, TOTAL	204			P	1	100	7.8	80
7440-09-7	POTASSIUM, TOTAL	500	U		P	1	1000	41	500
7440-23-5	SODIUM, TOTAL	1780			P	1	1000	24	500

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-EB-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-009

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, DISSOLVED	0.12	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	83	J		MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.20	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	260	J		MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.50	U		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	12	J		MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	5.7	J		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-CB-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-010

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, DISSOLVED	0.095	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	52	J		MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.43	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	170	J		MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.50	U		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	8.8	J		MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	8.0	U		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** SWDUP

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-011

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-36-0	ANTIMONY, DISSOLVED	0.27	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	1340			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.69	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	6390			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.50	U		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	737			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	8.0	U		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-012

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	LOQ	ADJUSTED MDL	LOD
7440-36-0	ANTIMONY, DISSOLVED	0.34	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	1320			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	1.8	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	6310			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	2.18			MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	731			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	7.0	J		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC2-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-013

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-36-0	ANTIMONY, DISSOLVED	0.50	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	1650			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.49	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	7770			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	3.25			MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	886			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	8.0	U		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWJC1-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-014

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, DISSOLVED	0.16	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	299			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.35	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	1660			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.50	U		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	223			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	8.0	U		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC1-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-015

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, DISSOLVED	0.12	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	605			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	1.2	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	2320			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.50	U		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	198			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	4.2	J		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWCC3-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-016

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	LOQ	ADJUSTED MDL	LOD
7440-36-0	ANTIMONY, DISSOLVED	0.14	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	304			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.66	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	1740			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.34	J		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	238			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	4.7	J		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWCC4-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-017

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	MDL	LOD
7440-36-0	ANTIMONY, DISSOLVED	0.12	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	367			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	0.70	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	1970			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.26	J		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	256			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	7.0	J		MS	5	10	3.9	8.0

Comments:

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWCC2-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-018

Concentration Units : ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF	ADJUSTED LOQ	ADJUSTED MDL	ADJUSTED LOD
7440-36-0	ANTIMONY, DISSOLVED	0.15	J		MS	5	1.0	0.055	0.50
7440-70-2	CALCIUM, DISSOLVED	313			MS	5	100	21	80
7440-50-8	COPPER, DISSOLVED	1.4	J		MS	5	3.0	0.19	2.0
000-03-5	HARDNESS, DISSOLVED	1700			MS	5	650	85	530
7439-92-1	LEAD, DISSOLVED	0.853	J		MS	5	1.0	0.075	0.50
7439-95-4	MAGNESIUM, DISSOLVED	223			MS	5	100	8.0	80
7440-66-6	ZINC, DISSOLVED	9.5	J		MS	5	10	3.9	8.0

Comments:

QC Summary Section

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: IQC17A Mar 17, 2023 16:17

Analyte	True	Found	%R (1)
ALUMINUM	10000.0	10360.00	103.6
CALCIUM	10000.0	10460.00	104.6
IRON	10000.0	10340.00	103.4
MAGNESIUM	10000.0	10530.00	105.3
SODIUM	10000.0	10230.00	102.3

SAMPLE: CCV

File: IQC17A Mar 17, 2023 16:38

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13080.00	104.6
CALCIUM	12500.0	12380.00	99.0
IRON	12500.0	12500.00	100.0
MAGNESIUM	12500.0	12740.00	101.9
SODIUM	12500.0	13130.00	105.0

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC17A Mar 17, 2023 16:56

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13110.00	104.9
CALCIUM	12500.0	12460.00	99.7
IRON	12500.0	12610.00	100.9
MAGNESIUM	12500.0	12960.00	103.7
SODIUM	12500.0	13290.00	106.3

SAMPLE: CCV

File: IQC17A Mar 17, 2023 17:46

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13030.00	104.2
CALCIUM	12500.0	12130.00	97.0
IRON	12500.0	12270.00	98.2
MAGNESIUM	12500.0	12780.00	102.2
SODIUM	12500.0	12970.00	103.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC17A Mar 17, 2023 18:38

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12920.00	103.4
CALCIUM	12500.0	11740.00	93.9
IRON	12500.0	11800.00	94.4
MAGNESIUM	12500.0	12350.00	98.8
SODIUM	12500.0	12860.00	102.9

SAMPLE: CCV

File: IQC17A Mar 17, 2023 19:29

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13200.00	105.6
CALCIUM	12500.0	11290.00	90.3
IRON	12500.0	11400.00	91.2
MAGNESIUM	12500.0	11820.00	94.6
SODIUM	12500.0	13230.00	105.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC17A Mar 17, 2023 20:21

Analyte	True	Found	%R (1)	
ALUMINUM	12500.0	13340.00	106.7	
CALCIUM	12500.0	10910.00	87.3	•
IRON	12500.0	11050.00	88.4	•
MAGNESIUM	12500.0	11500.00	92.0	
SODIUM	12500.0	13240.00	105.9	

SAMPLE: CCV

File: IQC17A Mar 17, 2023 21:13

Analyte	True	Found	%R (1)	
ALUMINUM	12500.0	13270.00	106.2	
CALCIUM	12500.0	10750.00	86.0	•
IRON	12500.0	10910.00	87.3	•
MAGNESIUM	12500.0	11560.00	92.5	
SODIUM	12500.0	12950.00	103.6	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC17A Mar 17, 2023 22:03

Analyte	True	Found	%R (1)	
ALUMINUM	12500.0	13350.00	106.8	
CALCIUM	12500.0	10800.00	86.4	•
IRON	12500.0	10870.00	87.0	•
MAGNESIUM	12500.0	11450.00	91.6	
SODIUM	12500.0	12910.00	103.3	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: IQC20A Mar 20, 2023 16:37

Analyte	True	Found	%R (1)
ALUMINUM	10000.0	10450.00	104.5
CALCIUM	10000.0	10540.00	105.4
IRON	10000.0	10460.00	104.6
MAGNESIUM	10000.0	10440.00	104.4
POTASSIUM	13600.0	13800.00	101.5

SAMPLE: CCV

File: IQC20A Mar 20, 2023 16:59

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12540.00	100.3
CALCIUM	12500.0	12560.00	100.5
IRON	12500.0	12570.00	100.6
MAGNESIUM	12500.0	12800.00	102.4
POTASSIUM	12500.0	12780.00	102.2

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC20A Mar 20, 2023 17:17

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12340.00	98.7
CALCIUM	12500.0	12330.00	98.6
IRON	12500.0	12380.00	99.0
MAGNESIUM	12500.0	12620.00	101.0
POTASSIUM	12500.0	12730.00	101.8

SAMPLE: CCV

File: IQC20A Mar 20, 2023 18:09

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12870.00	103.0
CALCIUM	12500.0	12940.00	103.5
IRON	12500.0	12900.00	103.2
MAGNESIUM	12500.0	12670.00	101.4
POTASSIUM	12500.0	12780.00	102.2

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC20A Mar 20, 2023 19:01

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12170.00	97.4
CALCIUM	12500.0	12140.00	97.1
IRON	12500.0	12250.00	98.0
MAGNESIUM	12500.0	12400.00	99.2
POTASSIUM	12500.0	12480.00	99.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: IQC21A Mar 21, 2023 16:35

Analyte	True	Found	%R (1)
ALUMINUM	10000.0	10400.00	104.0
CALCIUM	10000.0	10590.00	105.9
IRON	10000.0	10210.00	102.1
MAGNESIUM	10000.0	10440.00	104.4
POTASSIUM	13600.0	13710.00	100.8

SAMPLE: CCV

File: IQC21A Mar 21, 2023 16:56

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	12830.00	102.6
CALCIUM	12500.0	12940.00	103.5
IRON	12500.0	12610.00	100.9
MAGNESIUM	12500.0	12830.00	102.6
POTASSIUM	12500.0	12640.00	101.1

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: IQC21A Mar 21, 2023 17:14

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13040.00	104.3
CALCIUM	12500.0	13160.00	105.3
IRON	12500.0	13010.00	104.1
MAGNESIUM	12500.0	12770.00	102.2
POTASSIUM	12500.0	13320.00	106.6

SAMPLE: CCV

File: IQC21A Mar 21, 2023 18:06

Analyte	True	Found	%R (1)
ALUMINUM	12500.0	13060.00	104.5
CALCIUM	12500.0	13220.00	105.8
IRON	12500.0	12770.00	102.2
MAGNESIUM	12500.0	13030.00	104.2
POTASSIUM	12500.0	12830.00	102.6

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: LQC23C Mar 23, 2023 18:35

Analyte	True	Found	%R (1)
ALUMINUM	400.0	419.40	104.8
ANTIMONY	20.0	19.56	97.8
CALCIUM	4000.0	4122.23	103.1
COPPER	20.0	20.44	102.2
IRON	4000.0	4040.42	101.0
LEAD	20.0	20.08	100.4
MAGNESIUM	4000.0	4213.46	105.3
MOLYBDENUM	40.0	39.17	97.9
POTASSIUM	4000.0	4078.66	102.0
SODIUM	4000.0	4166.03	104.2

SAMPLE: CCV

File: LQC23C Mar 23, 2023 19:40

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	558.34	111.7	•
ANTIMONY	25.0	25.61	102.4	
CALCIUM	5000.0	5367.32	107.3	
COPPER	25.0	27.02	108.1	
IRON	5000.0	5107.83	102.2	
LEAD	25.0	26.47	105.9	
MAGNESIUM	5000.0	5541.47	110.8	•
MOLYBDENUM	25.0	26.09	104.4	
POTASSIUM	5000.0	5313.48	106.3	
SODIUM	5000.0	5544.01	110.9	•

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC23C Mar 23, 2023 19:54

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	534.61	106.9	
ANTIMONY	25.0	25.21	100.8	
CALCIUM	5000.0	5241.28	104.8	
COPPER	25.0	26.84	107.4	
IRON	5000.0	5129.21	102.6	
LEAD	25.0	26.11	104.4	
MAGNESIUM	5000.0	5484.46	109.7	
MOLYBDENUM	25.0	26.02	104.1	
POTASSIUM	5000.0	5297.82	106.0	
SODIUM	5000.0	5411.29	108.2	

SAMPLE: CCV

File: LQC23C Mar 23, 2023 20:14

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	710.14	142.0	•
ANTIMONY	25.0	25.28	101.1	
CALCIUM	5000.0	5556.38	111.1	•
COPPER	25.0	26.57	106.3	
IRON	5000.0	5330.08	106.6	
LEAD	25.0	26.40	105.6	
MAGNESIUM	5000.0	5704.29	114.1	•
MOLYBDENUM	25.0	33.35	133.4	•
POTASSIUM	5000.0	5503.92	110.1	
SODIUM	5000.0	5680.51	113.6	•

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC23C Mar 23, 2023 21:26

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	536.13	107.2	
ANTIMONY	25.0	24.86	99.4	
CALCIUM	5000.0	5283.18	105.7	
COPPER	25.0	26.76	107.0	
IRON	5000.0	5145.75	102.9	
LEAD	25.0	26.25	105.0	
MAGNESIUM	5000.0	5614.67	112.3	•
MOLYBDENUM	25.0	26.10	104.4	
POTASSIUM	5000.0	5308.01	106.2	
SODIUM	5000.0	5556.72	111.1	•

SAMPLE: CCV

File: LQC23C Mar 23, 2023 22:35

Analyte	True	Found	%R (1)
ALUMINUM	500.0	534.64	106.9
ANTIMONY	25.0	24.58	98.3
CALCIUM	5000.0	5350.41	107.0
COPPER	25.0	27.13	108.5
IRON	5000.0	5125.94	102.5
LEAD	25.0	26.53	106.1
MAGNESIUM	5000.0	5463.31	109.3
MOLYBDENUM	25.0	25.86	103.4
POTASSIUM	5000.0	5394.04	107.9
SODIUM	5000.0	5487.75	109.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: LQC24A Mar 24, 2023 16:38

Analyte	True	Found	%R (1)
ALUMINUM	400.0	398.74	99.7
CALCIUM	4000.0	4087.04	102.2
IRON	4000.0	3966.65	99.2
MAGNESIUM	4000.0	4141.96	103.5
MOLYBDENUM	40.0	39.01	97.5
POTASSIUM	4000.0	4104.51	102.6
SODIUM	4000.0	4132.93	103.3

SAMPLE: CCV

File: LQC24A Mar 24, 2023 17:45

Analyte	True	Found	%R (1)
ALUMINUM	500.0	521.81	104.4
CALCIUM	5000.0	5192.91	103.9
IRON	5000.0	5107.87	102.2
MAGNESIUM	5000.0	5300.54	106.0
MOLYBDENUM	25.0	24.82	99.3
POTASSIUM	5000.0	5233.65	104.7
SODIUM	5000.0	5315.47	106.3

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC24A Mar 24, 2023 18:21

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	558.41	111.7	•
CALCIUM	5000.0	5217.40	104.3	
IRON	5000.0	5148.44	103.0	
MAGNESIUM	5000.0	5388.17	107.8	
MOLYBDENUM	25.0	27.44	109.8	
POTASSIUM	5000.0	5253.99	105.1	
SODIUM	5000.0	5377.08	107.5	

SAMPLE: CCV

File: LQC24A Mar 24, 2023 19:32

Analyte	True	Found	%R (1)
ALUMINUM	500.0	508.75	101.8
CALCIUM	5000.0	5161.95	103.2
IRON	5000.0	5173.01	103.5
MAGNESIUM	5000.0	5430.31	108.6
MOLYBDENUM	25.0	24.48	97.9
POTASSIUM	5000.0	5163.63	103.3
SODIUM	5000.0	5361.48	107.2

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC24A Mar 24, 2023 20:41

Analyte	True	Found	%R (1)
ALUMINUM	500.0	518.23	103.6
CALCIUM	5000.0	5198.22	104.0
IRON	5000.0	5088.11	101.8
MAGNESIUM	5000.0	5346.63	106.9
MOLYBDENUM	25.0	24.48	97.9
POTASSIUM	5000.0	5183.10	103.7
SODIUM	5000.0	5318.75	106.4

(1) Control Limits: Mercury 80-120; Other Metals 90-110

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: LQC28E Mar 28, 2023 16:12

Analyte	True	Found	%R (1)
ALUMINUM	400.0	417.03	104.3
CALCIUM	4000.0	4163.20	104.1
IRON	4000.0	3985.48	99.6
MAGNESIUM	4000.0	4215.47	105.4
MOLYBDENUM	40.0	40.47	101.2
POTASSIUM	4000.0	4191.95	104.8
SODIUM	4000.0	4182.33	104.6
ZINC	20.0	21.28	106.4

SAMPLE: CCV

File: LQC28E Mar 28, 2023 17:20

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	551.70	110.3	
CALCIUM	5000.0	5307.23	106.1	
IRON	5000.0	5058.56	101.2	
MAGNESIUM	5000.0	5702.13	114.0	•
MOLYBDENUM	25.0	26.37	105.5	
POTASSIUM	5000.0	5350.41	107.0	
SODIUM	5000.0	5629.73	112.6	•
ZINC	25.0	27.04	108.2	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC28E Mar 28, 2023 18:30

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	591.28	118.3	•
CALCIUM	5000.0	5337.61	106.8	
IRON	5000.0	5144.38	102.9	
MAGNESIUM	5000.0	5638.02	112.8	•
MOLYBDENUM	25.0	25.97	103.9	
POTASSIUM	5000.0	5403.97	108.1	
SODIUM	5000.0	5623.47	112.5	•
ZINC	25.0	26.60	106.4	

SAMPLE: CCV

File: LQC28E Mar 28, 2023 19:41

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	603.82	120.8	•
CALCIUM	5000.0	5318.21	106.4	
IRON	5000.0	5113.64	102.3	
MAGNESIUM	5000.0	5656.78	113.1	•
MOLYBDENUM	25.0	25.43	101.7	
POTASSIUM	5000.0	5361.75	107.2	
SODIUM	5000.0	5542.90	110.9	•
ZINC	25.0	26.65	106.6	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC28E Mar 28, 2023 20:52

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	556.82	111.4	•
CALCIUM	5000.0	5590.68	111.8	•
IRON	5000.0	5134.17	102.7	
MAGNESIUM	5000.0	5644.55	112.9	•
MOLYBDENUM	25.0	25.78	103.1	
POTASSIUM	5000.0	5376.16	107.5	
SODIUM	5000.0	6384.73	127.7	•
ZINC	25.0	26.63	106.5	

SAMPLE: CCV

File: LQC28E Mar 28, 2023 22:00

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	549.22	109.8	
CALCIUM	5000.0	5348.60	107.0	
IRON	5000.0	5138.26	102.8	
MAGNESIUM	5000.0	5606.95	112.1	•
MOLYBDENUM	25.0	25.53	102.1	
POTASSIUM	5000.0	5403.06	108.1	
SODIUM	5000.0	5631.98	112.6	•
ZINC	25.0	26.32	105.3	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC28E Mar 28, 2023 23:07

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	560.37	112.1	•
CALCIUM	5000.0	5355.72	107.1	
IRON	5000.0	5145.55	102.9	
MAGNESIUM	5000.0	5707.07	114.1	•
MOLYBDENUM	25.0	25.56	102.2	
POTASSIUM	5000.0	5443.69	108.9	
SODIUM	5000.0	5625.08	112.5	•
ZINC	25.0	26.68	106.7	

SAMPLE: CCV

File: LQC28E Mar 29, 2023 00:12

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	715.00	143.0	•
CALCIUM	5000.0	5609.49	112.2	•
IRON	5000.0	5264.70	105.3	
MAGNESIUM	5000.0	5816.67	116.3	•
MOLYBDENUM	25.0	33.02	132.1	•
POTASSIUM	5000.0	5593.55	111.9	•
SODIUM	5000.0	5795.34	115.9	•
ZINC	25.0	26.24	105.0	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: LQC29A Mar 29, 2023 19:02

Analyte	True	Found	%R (1)
ALUMINUM	400.0	418.42	104.6
CALCIUM	4000.0	4147.24	103.7
IRON	4000.0	4112.48	102.8
MAGNESIUM	4000.0	4220.44	105.5
MOLYBDENUM	40.0	40.72	101.8
POTASSIUM	4000.0	4147.80	103.7
SODIUM	4000.0	4158.04	104.0
ZINC	20.0	21.08	105.4

SAMPLE: CCV

File: LQC29A Mar 29, 2023 20:00

Analyte	True	Found	%R (1)
ALUMINUM	500.0	609.48	121.9 •
CALCIUM	5000.0	5334.09	106.7
IRON	5000.0	5285.07	105.7
MAGNESIUM	5000.0	5601.04	112.0 •
MOLYBDENUM	25.0	27.03	108.1
POTASSIUM	5000.0	5385.76	107.7
SODIUM	5000.0	5499.04	110.0
ZINC	25.0	26.71	106.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC29A Mar 29, 2023 20:21

Analyte	True	Found	%R (1)
ALUMINUM	500.0	533.99	106.8
CALCIUM	5000.0	5245.47	104.9
IRON	5000.0	5239.21	104.8
MAGNESIUM	5000.0	5464.21	109.3
MOLYBDENUM	25.0	26.81	107.2
POTASSIUM	5000.0	5221.05	104.4
SODIUM	5000.0	5410.11	108.2
ZINC	25.0	26.72	106.9

SAMPLE: CCV

File: LQC29A Mar 29, 2023 21:41

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	539.19	107.8	
CALCIUM	5000.0	5195.91	103.9	
IRON	5000.0	5232.05	104.6	
MAGNESIUM	5000.0	5608.51	112.2	•
MOLYBDENUM	25.0	26.78	107.1	
POTASSIUM	5000.0	5212.20	104.2	
SODIUM	5000.0	5488.49	109.8	
ZINC	25.0	26.83	107.3	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC29A Mar 29, 2023 22:47

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	537.85	107.6	
CALCIUM	5000.0	5205.08	104.1	
IRON	5000.0	5184.85	103.7	
MAGNESIUM	5000.0	5603.35	112.1	•
MOLYBDENUM	25.0	26.78	107.1	
POTASSIUM	5000.0	5239.44	104.8	
SODIUM	5000.0	5491.18	109.8	
ZINC	25.0	27.07	108.3	

SAMPLE: CCV

File: LQC29A Mar 29, 2023 23:55

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	540.49	108.1	
CALCIUM	5000.0	5202.04	104.0	
IRON	5000.0	5164.09	103.3	
MAGNESIUM	5000.0	5645.20	112.9	•
MOLYBDENUM	25.0	26.91	107.6	
POTASSIUM	5000.0	5165.69	103.3	
SODIUM	5000.0	5531.68	110.6	•
ZINC	25.0	26.61	106.4	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC29A Mar 30, 2023 00:45

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	544.18	108.8	
CALCIUM	5000.0	5264.47	105.3	
IRON	5000.0	5183.08	103.7	
MAGNESIUM	5000.0	5676.19	113.5	•
MOLYBDENUM	25.0	26.52	106.1	
POTASSIUM	5000.0	5193.22	103.9	
SODIUM	5000.0	5631.59	112.6	•
ZINC	25.0	27.18	108.7	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICV

File: LQC30A Mar 30, 2023 16:58

Analyte	True	Found	%R (1)
ALUMINUM	400.0	420.51	105.1
CALCIUM	4000.0	4124.11	103.1
IRON	4000.0	4056.96	101.4
MAGNESIUM	4000.0	4139.76	103.5
MOLYBDENUM	40.0	40.78	102.0
POTASSIUM	4000.0	4143.68	103.6
SODIUM	4000.0	4175.35	104.4
ZINC	20.0	21.26	106.3

SAMPLE: CCV

File: LQC30A Mar 30, 2023 17:46

Analyte	True	Found	%R (1)
ALUMINUM	500.0	612.15	122.4 •
CALCIUM	5000.0	5229.62	104.6
IRON	5000.0	5363.81	107.3
MAGNESIUM	5000.0	5555.32	111.1 •
MOLYBDENUM	25.0	27.16	108.6
POTASSIUM	5000.0	5373.99	107.5
SODIUM	5000.0	5538.98	110.8 •
ZINC	25.0	26.84	107.4

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC30A Mar 30, 2023 18:04

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	542.25	108.5	
CALCIUM	5000.0	5190.80	103.8	
IRON	5000.0	5197.56	104.0	
MAGNESIUM	5000.0	5497.42	109.9	
MOLYBDENUM	25.0	27.15	108.6	
POTASSIUM	5000.0	5287.83	105.8	
SODIUM	5000.0	5536.07	110.7	•
ZINC	25.0	26.85	107.4	

SAMPLE: CCV

File: LQC30A Mar 30, 2023 18:17

Analyte	True	Found	%R (1)
ALUMINUM	500.0	532.51	106.5
CALCIUM	5000.0	5247.37	104.9
IRON	5000.0	5220.03	104.4
MAGNESIUM	5000.0	5526.02	110.5
MOLYBDENUM	25.0	26.69	106.8
POTASSIUM	5000.0	5224.81	104.5
SODIUM	5000.0	5424.54	108.5
ZINC	25.0	27.21	108.8

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC30A Mar 30, 2023 19:23

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	545.74	109.1	
CALCIUM	5000.0	5216.33	104.3	
IRON	5000.0	5147.18	102.9	
MAGNESIUM	5000.0	5569.29	111.4	•
MOLYBDENUM	25.0	26.82	107.3	
POTASSIUM	5000.0	5211.71	104.2	
SODIUM	5000.0	5564.65	111.3	•
ZINC	25.0	27.06	108.2	

SAMPLE: CCV

File: LQC30A Mar 30, 2023 20:27

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	707.53	141.5	•
CALCIUM	5000.0	5429.01	108.6	
IRON	5000.0	5600.99	112.0	•
MAGNESIUM	5000.0	5545.42	110.9	•
MOLYBDENUM	25.0	26.51	106.0	
POTASSIUM	5000.0	5309.00	106.2	
SODIUM	5000.0	5409.74	108.2	
ZINC	25.0	27.60	110.4	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC30A Mar 30, 2023 21:33

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	609.51	121.9	•
CALCIUM	5000.0	5238.27	104.8	
IRON	5000.0	5307.22	106.1	
MAGNESIUM	5000.0	5412.89	108.3	
MOLYBDENUM	25.0	26.02	104.1	
POTASSIUM	5000.0	5295.13	105.9	
SODIUM	5000.0	5249.88	105.0	
ZINC	25.0	27.39	109.6	

SAMPLE: CCV

File: LQC30A Mar 30, 2023 22:39

Analyte	True	Found	%R (1)
ALUMINUM	500.0	547.79	109.6
CALCIUM	5000.0	5252.46	105.0
IRON	5000.0	5283.91	105.7
MAGNESIUM	5000.0	5484.73	109.7
MOLYBDENUM	25.0	26.41	105.6
POTASSIUM	5000.0	5277.85	105.6
SODIUM	5000.0	5390.99	107.8
ZINC	25.0	26.75	107.0

(1) Control Limits: Mercury 80-120; Other Metals 90-110

FORM II (Part 1) - IN

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCV

File: LQC30A Mar 30, 2023 23:46

Analyte	True	Found	%R (1)	
ALUMINUM	500.0	578.06	115.6	•
CALCIUM	5000.0	5334.34	106.7	
IRON	5000.0	5274.35	105.5	
MAGNESIUM	5000.0	5601.75	112.0	•
MOLYBDENUM	25.0	26.23	104.9	
POTASSIUM	5000.0	5303.26	106.1	
SODIUM	5000.0	5504.11	110.1	
ZINC	25.0	27.01	108.0	

(1) Control Limits: Mercury 80-120; Other Metals 90-110

2C

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: IQC17A Mar 17, 2023 16:25

Analyte	TRUE	FOUND	% R
ALUMINUM	300.0	294.40	98.1
CALCIUM	100.0	100.10	100.1
IRON	100.0	101.40	101.4
MAGNESIUM	100.0	107.20	107.2
SODIUM	1000.0	1033.00	103.3

2C

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: IQC20A Mar 20, 2023 16:46

Analyte	TRUE	FOUND	% R
ALUMINUM	300.0	281.70	93.9
CALCIUM	100.0	96.35	96.3
IRON	100.0	102.50	102.5
MAGNESIUM	100.0	109.70	109.7
POTASSIUM	1000.0	942.70	94.3

2C

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: IQC21A Mar 21, 2023 16:43

Analyte	TRUE	FOUND	% R
ALUMINUM	300.0	315.10	105.0
CALCIUM	100.0	102.10	102.1
IRON	100.0	93.20	93.2
MAGNESIUM	100.0	109.60	109.6
POTASSIUM	1000.0	915.60	91.6

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: LQC23C Mar 23, 2023 18:49

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	20.95	104.7
ANTIMONY	0.2	0.19	95.0
CALCIUM	20.0	20.87	104.4
COPPER	0.6	0.63	105.0
IRON	20.0	20.17	100.9
LEAD	0.2	0.20	100.0
MAGNESIUM	20.0	21.03	105.2
MOLYBDENUM	1.0	0.95	95.0
POTASSIUM	200.0	200.12	100.1
SODIUM	200.0	200.80	100.4

2C

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: LQC24A Mar 24, 2023 18:06

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	-1.54	-7.7•
CALCIUM	20.0	23.90	119.5
IRON	20.0	21.45	107.3
MAGNESIUM	20.0	23.77	118.8
MOLYBDENUM	1.0	1.17	117.0
POTASSIUM	200.0	223.23	111.6
SODIUM	200.0	220.01	110.0

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: LQC28E Mar 28, 2023 16:26

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	20.71	103.6
CALCIUM	20.0	20.36	101.8
IRON	20.0	20.18	100.9
MAGNESIUM	20.0	20.47	102.3
MOLYBDENUM	1.0	1.03	103.0
POTASSIUM	200.0	197.56	98.8
SODIUM	200.0	200.03	100.0
ZINC	2.0	2.24	112.0

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: LQC29A Mar 29, 2023 19:16

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	21.70	108.5
CALCIUM	20.0	21.90	109.5
IRON	20.0	21.57	107.8
MAGNESIUM	20.0	22.85	114.3
MOLYBDENUM	1.0	1.08	108.0
POTASSIUM	200.0	207.78	103.9
SODIUM	200.0	200.08	100.0
ZINC	2.0	2.10	105.0

PQL STANDARD FOR AA AND ICP

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: PQL

File: LQC30A Mar 30, 2023 17:09

Analyte	TRUE	FOUND	% R
ALUMINUM	20.0	21.09	105.5
CALCIUM	20.0	20.66	103.3
IRON	20.0	21.21	106.1
MAGNESIUM	20.0	21.32	106.6
MOLYBDENUM	1.0	1.01	101.0
POTASSIUM	200.0	201.13	100.6
SODIUM	200.0	207.82	103.9
ZINC	2.0	2.10	105.0

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: IQC17A Mar 17, 2023 16:21

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	2.900	U
SODIUM	-21.760	U

SAMPLE: CCB

File: IQC17A Mar 17, 2023 16:42

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.759	J
MAGNESIUM	5.930	J
SODIUM	52.130	J

SAMPLE: CCB

File: IQC17A Mar 17, 2023 17:00

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	3.146	J
SODIUM	64.140	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB
File: IQC17A Mar 17, 2023 17:51

Analyte	Result	C
ALUMINUM	-11.060	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	3.351	J
SODIUM	12.000	U

SAMPLE: CCB
File: IQC17A Mar 17, 2023 18:42

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	2.900	U
SODIUM	60.850	J

SAMPLE: CCB
File: IQC17A Mar 17, 2023 19:34

Analyte	Result	C
ALUMINUM	-10.610	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	2.900	U
SODIUM	137.700	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB
File: IQC17A Mar 17, 2023 20:25

Analyte	Result	C
ALUMINUM	-16.850	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	3.176	J
SODIUM	137.300	J

SAMPLE: CCB
File: IQC17A Mar 17, 2023 21:17

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	3.981	J
SODIUM	24.450	J

SAMPLE: CCB
File: IQC17A Mar 17, 2023 22:08

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	4.505	J
MAGNESIUM	5.099	J
SODIUM	-22.760	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB
File: IQC20A Mar 20, 2023 16:42

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	4.060	J
MAGNESIUM	2.900	U
POTASSIUM	-90.220	U

SAMPLE: CCB
File: IQC20A Mar 20, 2023 17:03

Analyte	Result	C
ALUMINUM	25.830	J
CALCIUM	17.780	J
IRON	8.568	J
MAGNESIUM	11.350	J
POTASSIUM	73.000	U

SAMPLE: CCB
File: IQC20A Mar 20, 2023 17:21

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	4.535	J
MAGNESIUM	4.638	J
POTASSIUM	102.400	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: IQC20A Mar 20, 2023 18:13

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	3.965	J
POTASSIUM	73.000	U

SAMPLE: CCB

File: IQC20A Mar 20, 2023 19:05

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	2.900	U
POTASSIUM	73.000	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB
File: IQC21A Mar 21, 2023 16:39

Analyte	Result	C
ALUMINUM	14.040	J
CALCIUM	11.000	U
IRON	-6.168	U
MAGNESIUM	2.900	U
POTASSIUM	73.000	U

SAMPLE: CCB
File: IQC21A Mar 21, 2023 17:01

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	24.300	J
IRON	3.600	U
MAGNESIUM	11.260	J
POTASSIUM	73.000	U

SAMPLE: CCB
File: IQC21A Mar 21, 2023 17:19

Analyte	Result	C
ALUMINUM	43.840	J
CALCIUM	42.310	J
IRON	8.931	J
MAGNESIUM	2.900	U
POTASSIUM	73.000	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: IQC21A Mar 21, 2023 18:10

Analyte	Result	C
ALUMINUM	10.000	U
CALCIUM	11.000	U
IRON	3.600	U
MAGNESIUM	2.900	U
POTASSIUM	73.000	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: LQC23C Mar 23, 2023 18:44

Analyte	Result	C
ALUMINUM	0.337	J
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.011	J
MAGNESIUM	2.371	J
MOLYBDENUM	0.162	J
POTASSIUM	12.000	U
SODIUM	6.600	U

SAMPLE: CCB

File: LQC23C Mar 23, 2023 19:49

Analyte	Result	C
ALUMINUM	3.477	J
ANTIMONY	0.061	U
CALCIUM	6.880	J
COPPER	0.087	U
IRON	6.400	U
LEAD	0.017	J
MAGNESIUM	6.872	J
MOLYBDENUM	0.298	J
POTASSIUM	12.000	U
SODIUM	11.398	J

SAMPLE: CCB

File: LQC23C Mar 23, 2023 20:04

Analyte	Result	C
ALUMINUM	1.252	J
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.015	J
MAGNESIUM	4.222	J
MOLYBDENUM	0.203	J
POTASSIUM	12.000	U
SODIUM	8.305	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB
File: LQC23C Mar 23, 2023 20:23

Analyte	Result	C
ALUMINUM	23.352	B
ANTIMONY	0.061	U
CALCIUM	30.149	B
COPPER	0.087	U
IRON	26.796	B
LEAD	0.014	J
MAGNESIUM	27.854	B
MOLYBDENUM	1.257	B
POTASSIUM	36.518	J
SODIUM	36.825	J

SAMPLE: CCB
File: LQC23C Mar 23, 2023 21:35

Analyte	Result	C
ALUMINUM	0.386	J
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.011	J
MAGNESIUM	2.745	J
MOLYBDENUM	0.138	J
POTASSIUM	12.405	J
SODIUM	6.600	U

SAMPLE: CCB
File: LQC23C Mar 23, 2023 22:46

Analyte	Result	C
ALUMINUM	0.455	J
ANTIMONY	0.061	U
CALCIUM	6.800	U
COPPER	0.087	U
IRON	6.400	U
LEAD	0.005	U
MAGNESIUM	1.613	J
MOLYBDENUM	0.067	J
POTASSIUM	123.795	B
SODIUM	67.310	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: LQC24A Mar 24, 2023 16:47

Analyte	Result	C
ALUMINUM	0.871	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	2.632	J
MOLYBDENUM	0.201	J
POTASSIUM	12.000	U
SODIUM	6.600	U

SAMPLE: CCB

File: LQC24A Mar 24, 2023 17:56

Analyte	Result	C
ALUMINUM	-21.460	B
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	6.490	J
MOLYBDENUM	0.334	J
POTASSIUM	24.074	J
SODIUM	14.108	J

SAMPLE: CCB

File: LQC24A Mar 24, 2023 18:30

Analyte	Result	C
ALUMINUM	-13.950	B
CALCIUM	14.188	B
IRON	13.554	B
MAGNESIUM	12.790	B
MOLYBDENUM	0.682	B
POTASSIUM	29.969	J
SODIUM	23.010	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: LQC24A Mar 24, 2023 19:42

Analyte	Result	C
ALUMINUM	-23.769	B
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.594	J
MOLYBDENUM	0.181	J
POTASSIUM	19.841	J
SODIUM	6.600	U

SAMPLE: CCB

File: LQC24A Mar 24, 2023 20:51

Analyte	Result	C
ALUMINUM	-19.559	B
CALCIUM	7.197	J
IRON	6.909	J
MAGNESIUM	5.771	J
MOLYBDENUM	0.173	J
POTASSIUM	24.628	J
SODIUM	6.600	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: LQC28E Mar 28, 2023 16:21

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	2.605	J
MOLYBDENUM	0.207	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC28E Mar 28, 2023 17:28

Analyte	Result	C
ALUMINUM	2.461	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	6.770	J
MOLYBDENUM	0.337	J
POTASSIUM	14.004	J
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC28E Mar 28, 2023 18:39

Analyte	Result	C
ALUMINUM	6.678	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	4.576	J
MOLYBDENUM	0.153	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB
File: LQC28E Mar 28, 2023 19:49

Analyte	Result	C
ALUMINUM	10.452	B
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.382	J
MOLYBDENUM	0.098	J
POTASSIUM	12.000	U
SODIUM	-10.584	U
ZINC	0.220	U

SAMPLE: CCB
File: LQC28E Mar 28, 2023 21:00

Analyte	Result	C
ALUMINUM	0.949	J
CALCIUM	23.121	B
IRON	6.400	U
MAGNESIUM	7.590	J
MOLYBDENUM	0.130	J
POTASSIUM	12.000	U
SODIUM	137.740	B
ZINC	0.220	U

SAMPLE: CCB
File: LQC28E Mar 28, 2023 22:08

Analyte	Result	C
ALUMINUM	0.936	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.406	J
MOLYBDENUM	0.101	J
POTASSIUM	12.000	U
SODIUM	19.289	J
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: LQC28E Mar 28, 2023 23:15

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.001	J
MOLYBDENUM	0.088	J
POTASSIUM	12.000	U
SODIUM	6.875	J
ZINC	0.220	U

SAMPLE: CCB

File: LQC28E Mar 29, 2023 00:20

Analyte	Result	C
ALUMINUM	25.955	B
CALCIUM	32.856	B
IRON	30.409	B
MAGNESIUM	29.999	B
MOLYBDENUM	1.259	B
POTASSIUM	25.441	J
SODIUM	36.581	J
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: LQC29A Mar 29, 2023 19:11

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.570	J
MOLYBDENUM	0.214	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC29A Mar 29, 2023 20:10

Analyte	Result	C
ALUMINUM	10.325	B
CALCIUM	14.863	B
IRON	9.282	J
MAGNESIUM	14.526	B
MOLYBDENUM	0.459	J
POTASSIUM	20.238	J
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC29A Mar 29, 2023 20:31

Analyte	Result	C
ALUMINUM	4.576	J
CALCIUM	9.238	J
IRON	6.486	J
MAGNESIUM	8.982	J
MOLYBDENUM	0.311	J
POTASSIUM	16.177	J
SODIUM	6.600	U
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB
File: LQC29A Mar 29, 2023 21:50

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.247	J
MOLYBDENUM	0.166	J
POTASSIUM	12.000	U
SODIUM	-11.556	U
ZINC	0.220	U

SAMPLE: CCB
File: LQC29A Mar 29, 2023 22:56

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.654	J
MOLYBDENUM	0.153	J
POTASSIUM	12.000	U
SODIUM	-14.322	U
ZINC	0.220	U

SAMPLE: CCB
File: LQC29A Mar 30, 2023 00:04

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.167	J
MOLYBDENUM	0.147	J
POTASSIUM	12.000	U
SODIUM	-18.315	U
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: LQC29A Mar 30, 2023 00:55

Analyte	Result	C
ALUMINUM	0.330	U
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.089	J
MOLYBDENUM	0.158	J
POTASSIUM	12.000	U
SODIUM	-19.579	U
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICB

File: LQC30A Mar 30, 2023 17:04

Analyte	Result	C
ALUMINUM	0.711	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	5.319	J
MOLYBDENUM	0.274	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC30A Mar 30, 2023 17:54

Analyte	Result	C
ALUMINUM	10.792	B
CALCIUM	15.504	B
IRON	8.542	J
MAGNESIUM	15.222	B
MOLYBDENUM	0.336	J
POTASSIUM	21.028	J
SODIUM	12.976	J
ZINC	0.330	J

SAMPLE: CCB

File: LQC30A Mar 30, 2023 18:12

Analyte	Result	C
ALUMINUM	0.484	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.875	J
MOLYBDENUM	0.150	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: LQC30A Mar 30, 2023 18:25

Analyte	Result	C
ALUMINUM	0.456	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	3.240	J
MOLYBDENUM	0.130	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC30A Mar 30, 2023 19:31

Analyte	Result	C
ALUMINUM	0.643	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	4.944	J
MOLYBDENUM	0.046	J
POTASSIUM	12.000	U
SODIUM	6.600	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC30A Mar 30, 2023 20:35

Analyte	Result	C
ALUMINUM	36.476	B
CALCIUM	48.491	B
IRON	62.462	B
MAGNESIUM	14.162	B
MOLYBDENUM	0.036	J
POTASSIUM	12.000	U
SODIUM	-13.984	U
ZINC	0.261	J

INITIAL AND CONTINUING CALIBRATION BLANKS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: CCB

File: LQC30A Mar 30, 2023 21:41

Analyte	Result	C
ALUMINUM	16.911	B
CALCIUM	8.942	J
IRON	15.380	B
MAGNESIUM	5.597	J
MOLYBDENUM	0.033	J
POTASSIUM	12.000	U
SODIUM	-21.863	U
ZINC	0.439	J

SAMPLE: CCB

File: LQC30A Mar 30, 2023 22:46

Analyte	Result	C
ALUMINUM	1.295	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	4.715	J
MOLYBDENUM	0.024	J
POTASSIUM	12.000	U
SODIUM	-21.247	U
ZINC	0.220	U

SAMPLE: CCB

File: LQC30A Mar 30, 2023 23:54

Analyte	Result	C
ALUMINUM	7.700	J
CALCIUM	6.800	U
IRON	6.400	U
MAGNESIUM	5.545	J
MOLYBDENUM	0.023	J
POTASSIUM	12.000	U
SODIUM	-20.307	U
ZINC	0.220	U

PREPARATION BLANKS

Lab Name: Katahdin Analytical Services **Sample ID:** PBWQC16ICW1

Matrix: WATER **SDG Name:** SQ1201

QC Batch ID: QC16ICW1

Concentration Units : ug/L

Analyte	RESULT	C
CALCIUM	80	U
MAGNESIUM	80	U
POTASSIUM	500	U
SODIUM	110	J

3P

PREPARATION BLANKS

Lab Name: Katahdin Analytical Services **Sample ID:** PBWQC21IMW2

Matrix: WATER **SDG Name:** SQ1201

QC Batch ID: QC21IMW2

Concentration Units : ug/L

Analyte	RESULT	C
ANTIMONY	0.11	J
CALCIUM	41	J
COPPER	1.4	J
LEAD	0.50	U
MAGNESIUM	35	J
ZINC	4.2	J

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSA

File: IQC17A Mar 17, 2023 16:29

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	556800.00	111.4
CALCIUM	500000.00	509800.00	102.0
IRON	200000.00	201800.00	100.9
MAGNESIUM	500000.00	441300.00	88.3
SODIUM	0	265.10	

SAMPLE: ICSAB

File: IQC17A Mar 17, 2023 16:34

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	549900.00	110.0
CALCIUM	500000.00	497500.00	99.5
IRON	200000.00	198700.00	99.4
MAGNESIUM	500000.00	435900.00	87.2
SODIUM	20000.00	22070.00	110.3

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSA

File: IQC20A Mar 20, 2023 16:50

Analyte	TRUE	FOUND	% R	
ALUMINUM	500000.00	531700.00	106.3	
CALCIUM	500000.00	508500.00	101.7	
IRON	200000.00	199000.00	99.5	
MAGNESIUM	500000.00	427900.00	85.6	
POTASSIUM	0	836.20		•

SAMPLE: ICSAB

File: IQC20A Mar 20, 2023 16:55

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	534200.00	106.8
CALCIUM	500000.00	508400.00	101.7
IRON	200000.00	199900.00	100.0
MAGNESIUM	500000.00	426100.00	85.2
POTASSIUM	20000.00	21910.00	109.6

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSA

File: IQC21A Mar 21, 2023 16:48

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	547800.00	109.6
CALCIUM	500000.00	516800.00	103.4
IRON	200000.00	205900.00	103.0
MAGNESIUM	500000.00	429600.00	85.9
POTASSIUM	0	388.60	

SAMPLE: ICSAB

File: IQC21A Mar 21, 2023 16:52

Analyte	TRUE	FOUND	% R
ALUMINUM	500000.00	543500.00	108.7
CALCIUM	500000.00	523800.00	104.8
IRON	200000.00	203500.00	101.8
MAGNESIUM	500000.00	428000.00	85.6
POTASSIUM	20000.00	21110.00	105.6

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSAB

File: LQC23C Mar 23, 2023 18:59

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	106669.80	106.7
ANTIMONY	20.05	19.73	100.0
CALCIUM	100000.00	105478.97	105.5
COPPER	20.08	20.24	100.0
IRON	100000.00	99063.47	99.1
LEAD	20.02	20.70	105.0
MAGNESIUM	100000.00	103354.09	103.4
MOLYBDENUM	2000.00	2229.30	111.5
POTASSIUM	100000.00	99870.57	99.9
SODIUM	100000.00	103388.24	103.4

SAMPLE: ICSA

File: LQC23C Mar 23, 2023 20:09

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	107372.96	107.4
ANTIMONY	0.05	0.08	
CALCIUM	100000.00	104397.23	104.4
COPPER	0.08	0.10	
IRON	100000.00	98767.35	98.8
LEAD	0.02	0.03	
MAGNESIUM	100000.00	104346.96	104.3
MOLYBDENUM	2000.00	2239.96	112.0
POTASSIUM	100000.00	99670.18	99.7
SODIUM	100000.00	103644.03	103.6

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSAB

File: LQC24A Mar 24, 2023 17:03

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	107389.78	107.4
CALCIUM	100000.00	104865.54	104.9
IRON	100000.00	99380.44	99.4
MAGNESIUM	100000.00	101806.41	101.8
MOLYBDENUM	2000.00	2191.99	109.6
POTASSIUM	100000.00	99718.53	99.7
SODIUM	100000.00	102736.29	102.7

SAMPLE: ICSA

File: LQC24A Mar 24, 2023 18:11

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	108851.54	108.9
CALCIUM	100000.00	104615.12	104.6
IRON	100000.00	99903.75	99.9
MAGNESIUM	100000.00	102885.10	102.9
MOLYBDENUM	2000.00	2187.72	109.4
POTASSIUM	100000.00	100549.26	100.5
SODIUM	100000.00	103543.60	103.5

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSA

File: LQC28E Mar 28, 2023 16:31

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	109818.77	109.8
CALCIUM	100000.00	105452.98	105.5
IRON	100000.00	98193.64	98.2
MAGNESIUM	100000.00	105545.44	105.5
MOLYBDENUM	2000.00	2237.00	111.9
POTASSIUM	100000.00	102270.05	102.3
SODIUM	100000.00	106470.40	106.5
ZINC	1.40	0.98	

SAMPLE: ICSAB

File: LQC28E Mar 28, 2023 16:36

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	109041.59	109.0
CALCIUM	100000.00	105049.96	105.1
IRON	100000.00	99444.93	99.4
MAGNESIUM	100000.00	105567.12	105.6
MOLYBDENUM	2000.00	2300.62	115.1
POTASSIUM	100000.00	102603.93	102.6
SODIUM	100000.00	105691.59	105.7
ZINC	21.40	24.56	119.0

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSA

File: LQC29A Mar 29, 2023 19:21

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	107941.04	107.9
CALCIUM	100000.00	104542.16	104.5
IRON	100000.00	102858.10	102.9
MAGNESIUM	100000.00	103551.32	103.6
MOLYBDENUM	2000.00	2275.88	113.8
POTASSIUM	100000.00	101794.84	101.8
SODIUM	100000.00	103487.13	103.5
ZINC	1.40	1.24	

SAMPLE: ICSAB

File: LQC29A Mar 29, 2023 19:27

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	108483.46	108.5
CALCIUM	100000.00	104691.66	104.7
IRON	100000.00	103781.40	103.8
MAGNESIUM	100000.00	104440.02	104.4
MOLYBDENUM	2000.00	2300.50	115.0
POTASSIUM	100000.00	100724.06	100.7
SODIUM	100000.00	103296.24	103.3
ZINC	21.40	21.47	100.0

ICP INTERFERENCE CHECK SAMPLE

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Concentration Units: ug/L

SAMPLE: ICSA

File: LQC30A Mar 30, 2023 17:14

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	109267.15	109.3
CALCIUM	100000.00	104469.10	104.5
IRON	100000.00	103885.09	103.9
MAGNESIUM	100000.00	103853.82	103.9
MOLYBDENUM	2000.00	2269.40	113.5
POTASSIUM	100000.00	101667.19	101.7
SODIUM	100000.00	103236.91	103.2
ZINC	1.40	1.39	

SAMPLE: ICSAB

File: LQC30A Mar 30, 2023 17:19

Analyte	TRUE	FOUND	% R
ALUMINUM	100000.00	108884.33	108.9
CALCIUM	100000.00	104561.68	104.6
IRON	100000.00	104009.37	104.0
MAGNESIUM	100000.00	105185.21	105.2
MOLYBDENUM	2000.00	2322.46	116.1
POTASSIUM	100000.00	100519.04	100.5
SODIUM	100000.00	105582.88	105.6
ZINC	21.40	21.93	104.8

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01P

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-002P

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
CALCIUM, TOTAL	3930		1280		2500	106.2		87	113	P
MAGNESIUM, TOTAL	5580		693		5000	97.8		85	113	P
POTASSIUM, TOTAL	11100		457	J	10000	106.1		86	114	P
SODIUM, TOTAL	11200		2970		7500	109.1		87	115	P

Comments:

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01S

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-002S

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
CALCIUM, TOTAL	4080		1280		2500	112.2		87	113	P
MAGNESIUM, TOTAL	5700		693		5000	100.1		85	113	P
POTASSIUM, TOTAL	11000		457	J	10000	105.5		86	114	P
SODIUM, TOTAL	11400		2970		7500	111.9		87	115	P

Comments:

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01P

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-012P

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
ANTIMONY, DISSOLVED	101		0.34	J	100	100.8		85	117	MS
CALCIUM, DISSOLVED	4090		1320		2500	110.9		87	118	MS
COPPER, DISSOLVED	271		1.8	J	250	107.6		85	118	MS
LEAD, DISSOLVED	110		2.18		100	107.6		88	115	MS
MAGNESIUM, DISSOLVED	6070		731		5000	106.7		83	118	MS
ZINC, DISSOLVED	515		7.0	J	500	101.5		83	119	MS

Comments:

5A

SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01S

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-012S

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
ANTIMONY, DISSOLVED	102		0.34	J	100	102.1		85	117	MS
CALCIUM, DISSOLVED	4150		1320		2500	113.1		87	118	MS
COPPER, DISSOLVED	296		1.8	J	250	117.9		85	118	MS
LEAD, DISSOLVED	113		2.18		100	110.6		88	115	MS
MAGNESIUM, DISSOLVED	6200		731		5000	109.5		83	118	MS
ZINC, DISSOLVED	557		7.0	J	500	110.0		83	119	MS

Comments:

5B

POST DIGEST SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01A

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-002A

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
CALCIUM, TOTAL	7180		1280		5500	107.2		80	120	P
MAGNESIUM, TOTAL	6340		693		5500	102.6		80	120	P
POTASSIUM, TOTAL	11200		457	J	10000	107.4		80	120	P
SODIUM, TOTAL	9120		2970		5500	111.8		80	120	P

Comments:

FORM V (Part 2) - IN

5B

POST DIGEST SPIKE SAMPLE RECOVERY

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01A

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-012A

Concentration Units : ug/L

Analyte	Spiked Sample Result	C	Sample Result	C	Spike Added	%R	Q	Control Limits (%R) Low	High	M
ANTIMONY, DISSOLVED	1.98		0.068	J	2	95.6		80	120	MS
CALCIUM, DISSOLVED	490		264		200	112.9		80	120	MS
COPPER, DISSOLVED	6.86		0.35	J	6	108.5		80	120	MS
LEAD, DISSOLVED	2.47		0.437		2	101.6		80	120	MS
MAGNESIUM, DISSOLVED	352		146		200	102.9		80	120	MS
ZINC, DISSOLVED	20.2		1.4	J	20	93.8		80	120	MS

Comments:

5D

SPIKE DUPLICATES

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-002

Concentration Units : ug/L

Analyte	Control Limits	Spike Result	C	Spike Dup. Result	C	RPD	Q	M
CALCIUM, TOTAL		4080		3930		3.8		P
MAGNESIUM, TOTAL		5700		5580		2.0		P
POTASSIUM, TOTAL		11000		11100		0.5		P
SODIUM, TOTAL		11400		11200		1.9		P

Comments:

5D

SPIKE DUPLICATES

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01

Matrix: WATER **SDG Name:** SQ1201

Percent Solids: 0.00 **Lab Sample ID:** SQ1201-012

Concentration Units : ug/L

Analyte	Control Limits	Spike Result	C	Spike Dup. Result	C	RPD	Q	M
ANTIMONY, DISSOLVED		102		101		1.3		MS
CALCIUM, DISSOLVED		4150		4090		1.3		MS
COPPER, DISSOLVED		296		271		9.1		MS
LEAD, DISSOLVED		113		110		2.7		MS
MAGNESIUM, DISSOLVED		6200		6070		2.3		MS
ZINC, DISSOLVED		557		515		7.9		MS

Comments:

LABORATORY CONTROL SAMPLES

Lab Name: Katahdin Analytical Services **Sample ID:** LCSWQC16ICW1

Matrix: WATER **SDG Name:** SQ1201

QC Batch ID: QC16ICW1

Concentration Units : ug/L

Analyte	TRUE	FOUND	% R	LIMITS (%)	
CALCIUM	2500	2560	102.5	87	113
MAGNESIUM	5000	5030	100.6	85	113
POTASSIUM	10000	10200	102.3	86	114
SODIUM	7500	8440	112.5	87	115

LABORATORY CONTROL SAMPLES

Lab Name: Katahdin Analytical Services **Sample ID:** LCSWQC21IMW2

Matrix: WATER **SDG Name:** SQ1201

QC Batch ID: QC21IMW2

Concentration Units : ug/L

Analyte	TRUE	FOUND	% R	LIMITS (%)	
ANTIMONY	100	98.6	98.6	85	117
CALCIUM	2500	2720	108.7	87	118
COPPER	250	295	118.0	85	118
LEAD	100	106	105.9	88	115
MAGNESIUM	5000	5310	106.3	83	118
ZINC	500	566	113.2	83	119

ICP SERIAL DILUTION

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01L

Matrix: WATER **SDG Name:** SQ1201

Lab Sample ID: SQ1201-002L

Concentration Units: ug/L

Analyte	Sample Result	C	Dilution Result	C	% Difference	Q	M
CALCIUM, TOTAL	1280		1390		8.6		P
MAGNESIUM, TOTAL	693		728		5.1		P
POTASSIUM, TOTAL	457	J	210	J	54.0		P
SODIUM, TOTAL	2970		3140	J	5.7		P

FORM IX - IN

ICP SERIAL DILUTION

Lab Name: Katahdin Analytical Services **Client Field ID:** JACKSON-SWMC3-DC-01L

Matrix: WATER **SDG Name:** SQ1201

Lab Sample ID: SQ1201-012L

Concentration Units: ug/L

Analyte	Sample Result	C	Dilution Result	C	% Difference	Q	M
ANTIMONY, DISSOLVED	0.068	J	0.092	J	35.3		MS
CALCIUM, DISSOLVED	264		281		6.4		MS
COPPER, DISSOLVED	0.35	J	0.36	J	2.9		MS
LEAD, DISSOLVED	0.437		0.38	J	13.0		MS
MAGNESIUM, DISSOLVED	146		150		2.7		MS
ZINC, DISSOLVED	1.4	J	3.9	U	100.0		MS

INSTRUMENT DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 01/23/2019

Concentration Units: ug/L

Analyte	PQL/LOQ	IDL	M
ALUMINUM	300	10	P
CALCIUM	100	11	P
IRON	100	3.6	P
MAGNESIUM	100	2.9	P
MOLYBDENUM	10	0.41	P
POTASSIUM	1000	73	P
SODIUM	1000	12	P

INSTRUMENT DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 06/11/2018

Concentration Units: ug/L

Analyte	PQL/LOQ	IDL	M
ALUMINUM	20	0.33	MS
ANTIMONY	0.20	0.061	MS
CALCIUM	20	6.8	MS
COPPER	0.60	0.087	MS
IRON	20	6.4	MS
LEAD	0.20	0.0049	MS
MAGNESIUM	20	0.35	MS
MOLYBDENUM	1.0	0.020	MS
POTASSIUM	200	12	MS
SODIUM	200	6.6	MS
ZINC	2.0	0.22	MS

LIMITS of DETECTION

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 06/11/2010

Analyte	LOD	Units	M	EPA Prep./Anal. Method
CALCIUM	80	ug/L	P	SW846 3010A / SW846 6010C
MAGNESIUM	80	ug/L	P	SW846 3010A / SW846 6010C
POTASSIUM	500	ug/L	P	SW846 3010A / SW846 6010C
SODIUM	500	ug/L	P	SW846 3010A / SW846 6010C

LIMITS of DETECTION

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 06/11/2010

Analyte	LOD	Units	M	EPA Prep./Anal. Method
ANTIMONY	0.10	ug/L	MS	SW846 3010A / SW846 6020A
CALCIUM	16	ug/L	MS	SW846 3010A / SW846 6020A
COPPER	0.40	ug/L	MS	SW846 3010A / SW846 6020A
HARDNESS	106	ug/L	MS	SW846 3010A / STDM 2340B Hardness
LEAD	0.10	ug/L	MS	SW846 3010A / SW846 6020A
MAGNESIUM	16	ug/L	MS	SW846 3010A / SW846 6020A
ZINC	1.6	ug/L	MS	SW846 3010A / SW846 6020A

METHOD DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 01/19/2011

Analyte	MDL	Units	M	EPA Prep./Anal. Method
CALCIUM	11	ug/L	P	SW846 3010A / SW846 6010C
MAGNESIUM	7.8	ug/L	P	SW846 3010A / SW846 6010C
POTASSIUM	41	ug/L	P	SW846 3010A / SW846 6010C
SODIUM	24	ug/L	P	SW846 3010A / SW846 6010C

METHOD DETECTION LIMITS

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 01/25/2011

Analyte	MDL	Units	M	EPA Prep./Anal. Method
ANTIMONY	0.011	ug/L	MS	SW846 3010A / SW846 6020A
CALCIUM	4.1	ug/L	MS	SW846 3010A / SW846 6020A
COPPER	0.037	ug/L	MS	SW846 3010A / SW846 6020A
HARDNESS	17	ug/L	MS	SW846 3010A / STDM 2340B Hardness
LEAD	0.015	ug/L	MS	SW846 3010A / SW846 6020A
MAGNESIUM	1.6	ug/L	MS	SW846 3010A / SW846 6020A
ZINC	0.78	ug/L	MS	SW846 3010A / SW846 6020A

ICP INTERELEMENT CORRECTION FACTORS

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument Name: THERMO ICAP 6500 **Instrument ID:** I **Date:** 03/10/2021

	Wavelength	Interelement Correction Factors for:												
Analyte	**(nm)**	**Al**	**Ca**	**Fe**	**Mg**	**As**	**Cr**	**Co**	**Cu**	**Mn**	**Mo**	**Ni**	**Ti**	**V**
ALUMINUM	396.15	0.0	0.0006250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0293740	0.0	0.0	0.0
ANTIMONY	206.83	0.0000130	0.0	0.0000150	0.0	0.0000731	0.0160080	0.0	0.0	0.0	-0.0046490	-0.0008980	0.0	-0.0005030
ARSENIC	189.04	-0.0000090	0.0	-0.0001780	0.0	0.0	0.0001984	0.0	0.0	0.0	0.0015170	0.0	0.0	0.0
BARIUM	455.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERYLLIUM	313.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0006836	0.0001220
BORON	208.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0501700	0.0	0.0	0.0
CADMIUM	226.50	0.0	0.0	0.0000850	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0001140	0.0000801	0.0
CALCIUM	315.89	0.0	0.0	0.0	0.0	0.0	0.0026700	0.0008487	0.0	0.0	0.0	0.0	0.0	0.0
CHROMIUM	267.72	0.0	0.0	-0.0000010	0.0	0.0	0.0	0.0	0.0	0.0003640	0.0	0.0	0.0	-0.0000100
COBALT	228.62	0.0	0.0	0.0000050	0.0	0.0	0.0001670	0.0	0.0	0.0	0.0	0.0001562	0.0017840	0.0
COPPER	327.40	0.0000079	0.0	-0.0000147	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0006988	0.0004860
GOLD	242.79	0.0	0.0	0.0001110	0.0	0.0	0.0	0.0	0.0	0.0058700	0.0	0.0	0.0	0.0
IRON	259.94	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LEAD	220.35	-0.0001590	0.0	0.0000440	0.0	0.0001480	-0.0000772	-0.0000860	0.0004910	0.0	-0.0010840	0.0003270	-0.0000220	0.0
LITHIUM	670.78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAGNESIUM	202.58	0.0	0.0	0.0000300	0.0	0.0	0.0	0.1395100	0.0	0.0	0.0145280	0.0	0.0003530	0.0
MANGANESE	257.61	-0.0000050	0.0	0.0000100	0.0000391	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOLYBDENUM	202.03	0.0	0.0	0.0	0.0	0.0	0.0000270	0.0	0.0	-0.0000204	0.0	0.0	0.0	-0.0001163
NICKEL	231.60	0.0	0.0	-0.0000490	0.0	0.0	0.0	0.0000390	0.0	0.0	0.0034490	0.0	0.0	0.0
POTASSIUM	766.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SELENIUM	196.09	0.0000090	0.0	0.0000320	0.0	0.0003180	0.0	0.0002310	0.0	0.0006280	0.0	0.0	0.0	0.0003040
SILICON	251.61	0.0	0.0	-0.0000150	0.0	0.0	0.0	0.0	0.0	0.0	0.0132630	0.0	0.0105540	0.0
SILVER	328.07	0.0	0.0	-0.0002820	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0008413	0.0
SODIUM	589.59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STRONTIUM	421.55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THALLIUM	190.86	0.0000030	0.0	0.0000001	0.0	0.0	0.0	0.0023030	-0.0000680	-0.0024730	-0.0000880	0.0	-0.0009840	-0.0078940
TIN	189.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TITANIUM	334.90	0.0	0.0	0.0	0.0	0.0	0.0001510	0.0	0.0	0.0	0.0002130	0.0	0.0	0.0
VANADIUM	292.40	0.0	0.0	0.0000120	0.0	0.0	-0.0053650	0.0	0.0	-0.0001670	-0.0037960	0.0	0.0006990	0.0
ZINC	206.20	0.0	0.0	0.0	0.0	0.0	-0.0010444	0.0	0.0	0.0	0.0	0.0	0.0	0.0

FORM XI - IN

ICP LINEAR RANGES

Lab Name: Katahdin Analytical Services **Instrument Code:** I

Instrument Name: THERMO ICAP 6500 **Date:** 08/11/2022

Concentration Units: ug/L

Analyte	Integration Time (sec)	Linear Range	M
ALUMINUM	5.00	500000	P
ANTIMONY	45.00	20000	P
CALCIUM	5.00	500000	P
COPPER	10.00	20000	P
IRON	5.00	250000	P
LEAD	45.00	20000	P
MAGNESIUM	45.00	200000	P
MOLYBDENUM	45.00	5000	P
POTASSIUM	5.00	300000	P
SODIUM	5.00	200000	P
ZINC	45.00	20000	P

ICP LINEAR RANGES

Lab Name: Katahdin Analytical Services **Instrument Code:** L

Instrument Name: AGILENT 7800 ICP-MS **Date:** 10/06/2022

Concentration Units: ug/L

Analyte	Integration Time (sec)	Linear Range	M
ALUMINUM	0.30	200000	MS
ANTIMONY	0.10	1000	MS
CALCIUM	0.30	200000	MS
COPPER	0.30	2000	MS
IRON	0.10	100000	MS
LEAD	0.10	2000	MS
MAGNESIUM	0.15	200000	MS
MOLYBDENUM	0.30	1000	MS
POTASSIUM	0.20	200000	MS
SODIUM	0.10	200000	MS
ZINC	0.30	2000	MS

PREPARATION LOG

Lab Name: Katahdin Analytical Services **QC Batch ID:** QC16ICW1

Matrix: WATER **SDG Name:** SQ1201

Method: P **Prep Date:** 03/16/2023

Client ID	Lab Sample ID	Initial (L)	Final (L)	Bottle ID
LCSWQC16ICW1	LCSWQC16ICW1	0.05	0.05	
PBWQC16ICW1	PBWQC16ICW1	0.05	0.05	
SWDUP	SQ1201-001	0.05	0.05	C
JACKSON-SWMC3-DC-01	SQ1201-002	0.05	0.05	I
JACKSON-SWMC3-DC-01P	SQ1201-002P	0.05	0.05	I
JACKSON-SWMC3-DC-01S	SQ1201-002S	0.05	0.05	I
JACKSON-SWMC2-DC-01	SQ1201-003	0.05	0.05	C
JACKSON-SWJC1-DC-01	SQ1201-004	0.05	0.05	C
JACKSON-SWMC1-DC-01	SQ1201-005	0.05	0.05	C
JACKSON-SWCC3-DC-01	SQ1201-006	0.05	0.05	C
JACKSON-SWCC4-DC-01	SQ1201-007	0.05	0.05	C
JACKSON-SWCC2-DC-01	SQ1201-008	0.05	0.05	E

PREPARATION LOG

Lab Name: Katahdin Analytical Services **QC Batch ID:** QC21IMW2

Matrix: WATER **SDG Name:** SQ1201

Method: MS **Prep Date:** 03/21/2023

Client ID	Lab Sample ID	Initial (L)	Final (L)	Bottle ID
LCSWQC21IMW2	LCSWQC21IMW2	0.05	0.05	
PBWQC21IMW2	PBWQC21IMW2	0.05	0.05	
JACKSON-EB-01	SQ1201-009	0.05	0.05	A
JACKSON-CB-01	SQ1201-010	0.05	0.05	A
SWDUP	SQ1201-011	0.05	0.05	A
JACKSON-SWMC3-DC-01	SQ1201-012	0.05	0.05	A
JACKSON-SWMC3-DC-01P	SQ1201-012P	0.05	0.05	A
JACKSON-SWMC3-DC-01S	SQ1201-012S	0.05	0.05	A
JACKSON-SWMC2-DC-01	SQ1201-013	0.05	0.05	A
JACKSON-SWJC1-DC-01	SQ1201-014	0.05	0.05	A
JACKSON-SWMC1-DC-01	SQ1201-015	0.05	0.05	A
JACKSON-SWCC3-DC-01	SQ1201-016	0.05	0.05	A
JACKSON-SWCC4-DC-01	SQ1201-017	0.05	0.05	A
JACKSON-SWCC2-DC-01	SQ1201-018	0.05	0.05	A

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC17A

Date: 03/17/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
Blank		1	16:08	AL	CA	FE	MG	NA
Std 1		1	16:13	AL	CA	FE	MG	NA
ICV		1	16:17	AL	CA	FE	MG	NA
ICB		1	16:21	AL	CA	FE	MG	NA
PQL		1	16:25	AL	CA	FE	MG	NA
ICSA		1	16:29	AL	CA	FE	MG	NA
ICSAB		1	16:34	AL	CA	FE	MG	NA
CCV		1	16:38	AL	CA	FE	MG	NA
CCB		1	16:42	AL	CA	FE	MG	NA
ZZZZZZ		1	16:47					
ZZZZZZ		1	16:51					
CCV		1	16:56	AL	CA	FE	MG	NA
CCB		1	17:00	AL	CA	FE	MG	NA
ZZZZZZ		1	17:04					
ZZZZZZ		1	17:08					
ZZZZZZ		1	17:13					
ZZZZZZ		1	17:17					
ZZZZZZ		1	17:21					
ZZZZZZ		2	17:25					
ZZZZZZ		5	17:29					
ZZZZZZ		5	17:34					
ZZZZZZ		1	17:38					
ZZZZZZ		1	17:42					
CCV		1	17:46	AL	CA	FE	MG	NA
CCB		1	17:51	AL	CA	FE	MG	NA
ZZZZZZ		1	17:55					
ZZZZZZ		2	17:59					

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC17A

Date: 03/17/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
ZZZZZZ		1	18:04					
ZZZZZZ		1	18:08					
ZZZZZZ		2	18:12					
ZZZZZZ		1	18:16					
ZZZZZZ		1	18:20					
ZZZZZZ		1	18:25					
ZZZZZZ		1	18:29					
ZZZZZZ		1	18:34					
CCV		1	18:38	AL	CA	FE	MG	NA
CCB		1	18:42	AL	CA	FE	MG	NA
ZZZZZZ		1	18:46					
ZZZZZZ		1	18:51					
ZZZZZZ		1	18:55					
ZZZZZZ		1	18:59					
ZZZZZZ		1	19:04					
ZZZZZZ		1	19:08					
ZZZZZZ		1	19:12					
ZZZZZZ		1	19:16					
ZZZZZZ		1	19:21					
ZZZZZZ		1	19:25					
CCV		1	19:29	AL	CA	FE	MG	NA
CCB		1	19:34	AL	CA	FE	MG	NA
ZZZZZZ		1	19:38					
ZZZZZZ		1	19:42					
ZZZZZZ		5	19:47					
ZZZZZZ		1	19:51					
ZZZZZZ		1	19:55					

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC17A

Date: 03/17/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
ZZZZZZ		1	19:59					
ZZZZZZ		1	20:04					
ZZZZZZ		1	20:08					
ZZZZZZ		1	20:13					
ZZZZZZ		5	20:17					
CCV		1	20:21	AL	CA	FE	MG	NA
CCB		1	20:25	AL	CA	FE	MG	NA
ZZZZZZ		1	20:30					
ZZZZZZ		50	20:34					
ZZZZZZ		50	20:38					
ZZZZZZ		100	20:43					
LCSWQC16ICW1		1	20:47				MG	NA
PBWQC16ICW1		1	20:51				MG	NA
SQ1201-001	SWDUP	1	20:55				MG	NA
SQ1201-002	JACKSON-SWMC3-DC-01	1	21:00				MG	NA
SQ1201-002A	JACKSON-SWMC3-DC-01A	1	21:04				MG	NA
SQ1201-002L	JACKSON-SWMC3-DC-01L	5	21:08				MG	NA
CCV		1	21:13	AL	CA	FE	MG	NA
CCB		1	21:17	AL	CA	FE	MG	NA
SQ1201-002P	JACKSON-SWMC3-DC-01P	1	21:21				MG	NA
SQ1201-002S	JACKSON-SWMC3-DC-01S	1	21:25				MG	NA
SQ1201-003	JACKSON-SWMC2-DC-01	1	21:29				MG	NA
SQ1201-004	JACKSON-SWJC1-DC-01	1	21:34				MG	NA
SQ1201-005	JACKSON-SWMC1-DC-01	1	21:38				MG	NA
SQ1201-006	JACKSON-SWCC3-DC-01	1	21:42				MG	NA
SQ1201-007	JACKSON-SWCC4-DC-01	1	21:47				MG	NA
SQ1201-008	JACKSON-SWCC2-DC-01	1	21:51				MG	NA

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC17A

Date: 03/17/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
ZZZZZZ		1	21:55					
ZZZZZZ		1	21:59					
CCV		1	22:03	AL	CA	FE	MG	NA
CCB		1	22:08	AL	CA	FE	MG	NA

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC20A

Date: 03/20/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
Blank		1	16:29	AL	CA	FE	MG	K
Std 1		1	16:33	AL	CA	FE	MG	K
ICV		1	16:37	AL	CA	FE	MG	K
ICB		1	16:42	AL	CA	FE	MG	K
PQL		1	16:46	AL	CA	FE	MG	K
ICSA		1	16:50	AL	CA	FE	MG	K
ICSAB		1	16:55	AL	CA	FE	MG	K
CCV		1	16:59	AL	CA	FE	MG	K
CCB		1	17:03	AL	CA	FE	MG	K
ZZZZZZ		1	17:08					
ZZZZZZ		1	17:13					
CCV		1	17:17	AL	CA	FE	MG	K
CCB		1	17:21	AL	CA	FE	MG	K
ZZZZZZ		1	17:26					
ZZZZZZ		1	17:30					
ZZZZZZ		1	17:34					
LCSWQC16ICW1		1	17:39		CA			K
PBWQC16ICW1		1	17:43		CA			K
SQ1201-001	SWDUP	1	17:47		CA			
SQ1201-002	JACKSON-SWMC3-DC-01	1	17:52		CA			K
SQ1201-002A	JACKSON-SWMC3-DC-01A	1	17:56		CA			K
SQ1201-002L	JACKSON-SWMC3-DC-01L	5	18:00		CA			K
SQ1201-002P	JACKSON-SWMC3-DC-01P	1	18:05		CA			K
CCV		1	18:09	AL	CA	FE	MG	K
CCB		1	18:13	AL	CA	FE	MG	K
SQ1201-002S	JACKSON-SWMC3-DC-01S	1	18:18		CA			K
SQ1201-003	JACKSON-SWMC2-DC-01	1	18:22		CA			

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC20A

Date: 03/20/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
SQ1201-004	JACKSON-SWJC1-DC-01	1	18:26		CA			K
SQ1201-005	JACKSON-SWMC1-DC-01	1	18:31		CA			K
SQ1201-006	JACKSON-SWCC3-DC-01	1	18:35		CA			K
SQ1201-007	JACKSON-SWCC4-DC-01	1	18:39		CA			K
SQ1201-008	JACKSON-SWCC2-DC-01	1	18:44		CA			K
ZZZZZZ		1	18:48					
ZZZZZZ		1	18:52					
ZZZZZZ		1	18:57					
CCV		1	19:01	AL	CA	FE	MG	K
CCB		1	19:05	AL	CA	FE	MG	K

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: THERMO ICAP 6500 **File Name:** IQC21A

Date: 03/21/2023 **Method:** P

Lab Sample ID	Client ID	D.F.	Time	Elements				
Blank		1	16:26	AL	CA	FE	MG	K
Std 1		1	16:30	AL	CA	FE	MG	K
ICV		1	16:35	AL	CA	FE	MG	K
ICB		1	16:39	AL	CA	FE	MG	K
PQL		1	16:43	AL	CA	FE	MG	K
ICSA		1	16:48	AL	CA	FE	MG	K
ICSAB		1	16:52	AL	CA	FE	MG	K
CCV		1	16:56	AL	CA	FE	MG	K
CCB		1	17:01	AL	CA	FE	MG	K
ZZZZZZ		1	17:05					
ZZZZZZ		1	17:10					
CCV		1	17:14	AL	CA	FE	MG	K
CCB		1	17:19	AL	CA	FE	MG	K
SQ1201-001	SWDUP	1	17:23					K
SQ1201-003	JACKSON-SWMC2-DC-01	1	17:27					K
ZZZZZZ		1	17:32					
ZZZZZZ		1	17:36					
ZZZZZZ		1	17:40					
ZZZZZZ		1	17:44					
ZZZZZZ		2	17:49					
ZZZZZZ		5	17:53					
ZZZZZZ		1	17:58					
ZZZZZZ		1	18:02					
CCV		1	18:06	AL	CA	FE	MG	K
CCB		1	18:10	AL	CA	FE	MG	K

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC23C

Date: 03/23/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements								
CalBlank		1	18:20	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CalStd		1	18:25	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
ICV		1	18:35	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
ICB		1	18:44	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
PQL		1	18:49	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
ZZZZZZ		1	18:54										
ICSAB		1	18:59	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
ZZZZZZ		1	19:07										
ZZZZZZ		1	19:19										
ZZZZZZ		1	19:29										
ZZZZZZ		1	19:35										
CCV		1	19:40	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCB		1	19:49	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCV		1	19:54	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCB		1	20:04	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
ICSA		1	20:09	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCV		1	20:14	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCB		1	20:23	Al	Sb	Ca	Cu	Fe	Pb	Mg	Mo	K	Na
PBWQC21IMW2		5	20:28		Sb		Cu		Pb				
LCSWQC21IMW2		5	20:34		Sb		Cu		Pb				
ZZZZZZ		5	20:42										
SQ1201-009	JACKSON-EB-01	5	20:47		Sb		Cu		Pb				
SQ1201-010	JACKSON-CB-01	5	20:52		Sb		Cu		Pb				
SQ1201-011	SWDUP	5	20:57		Sb		Cu		Pb				
SQ1201-012	JACKSON-SWMC3-DC-01	5	21:02		Sb		Cu		Pb				
SQ1201-012L	JACKSON-SWMC3-DC-01L	25	21:08		Sb		Cu		Pb				
SQ1201-012A	JACKSON-SWMC3-DC-01A	5	21:13		Sb		Cu		Pb				

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC23C

Date: 03/23/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements										
SQ1201-012P	JACKSON-SWMC3-DC-01P	5	21:18		Sb			Cu		Pb				
CCV		1	21:26	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCB		1	21:35	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na
SQ1201-012S	JACKSON-SWMC3-DC-01S	5	21:40		Sb			Cu		Pb				
SQ1201-013	JACKSON-SWMC2-DC-01	5	21:49		Sb			Cu		Pb				
SQ1201-014	JACKSON-SWJC1-DC-01	5	21:54		Sb			Cu		Pb				
SQ1201-015	JACKSON-SWMC1-DC-01	5	21:59		Sb			Cu		Pb				
SQ1201-016	JACKSON-SWCC3-DC-01	5	22:04		Sb			Cu		Pb				
SQ1201-017	JACKSON-SWCC4-DC-01	5	22:09		Sb			Cu		Pb				
SQ1201-018	JACKSON-SWCC2-DC-01	5	22:14		Sb			Cu		Pb				
ZZZZZZ		5	22:19											
ZZZZZZ		5	22:25											
ZZZZZZ		5	22:30											
CCV		1	22:35	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na
CCB		1	22:46	Al	Sb		Ca	Cu	Fe	Pb	Mg	Mo	K	Na

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC24A

Date: 03/24/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
CalBlank		1	16:21	Al	Ca	Fe	Mg	Mo	K	Na
CalStd		1	16:27	Al	Ca	Fe	Mg	Mo	K	Na
ICV		1	16:38	Al	Ca	Fe	Mg	Mo	K	Na
ICB		1	16:47	Al	Ca	Fe	Mg	Mo	K	Na
ZZZZZZ		1	16:52							
ZZZZZZ		1	16:58							
ICSAB		1	17:03	Al	Ca	Fe	Mg	Mo	K	Na
ZZZZZZ		1	17:12							
ZZZZZZ		1	17:23							
ZZZZZZ		1	17:35							
ZZZZZZ		1	17:40							
CCV		1	17:45	Al	Ca	Fe	Mg	Mo	K	Na
CCB		1	17:56	Al	Ca	Fe	Mg	Mo	K	Na
ZZZZZZ		1	18:01							
PQL		1	18:06	Al	Ca	Fe	Mg	Mo	K	Na
ICSA		1	18:11	Al	Ca	Fe	Mg	Mo	K	Na
ZZZZZZ		1	18:16							
CCV		1	18:21	Al	Ca	Fe	Mg	Mo	K	Na
CCB		1	18:30	Al	Ca	Fe	Mg	Mo	K	Na
PBWQC21IMW2		5	18:35				Mg			
LCSWQC21IMW2		5	18:41		Ca		Mg			
ZZZZZZ		5	18:49							
ZZZZZZ		5	18:54							
ZZZZZZ		5	18:59							
SQ1201-011	SWDUP	5	19:04				Mg			
SQ1201-012	JACKSON-SWMC3-DC-01	5	19:09				Mg			
SQ1201-012L	JACKSON-SWMC3-DC-01L	25	19:14				Mg			

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC24A

Date: 03/24/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
SQ1201-012A	JACKSON-SWMC3-DC-01A	5	19:19				Mg			
SQ1201-012P	JACKSON-SWMC3-DC-01P	5	19:25				Mg			
CCV		1	19:32	Al	Ca	Fe	Mg	Mo	K	Na
CCB		1	19:42	Al	Ca	Fe	Mg	Mo	K	Na
SQ1201-012S	JACKSON-SWMC3-DC-01S	5	19:47				Mg			
SQ1201-013	JACKSON-SWMC2-DC-01	5	19:55				Mg			
SQ1201-014	JACKSON-SWJC1-DC-01	5	20:00				Mg			
SQ1201-015	JACKSON-SWMC1-DC-01	5	20:05				Mg			
SQ1201-016	JACKSON-SWCC3-DC-01	5	20:10				Mg			
SQ1201-017	JACKSON-SWCC4-DC-01	5	20:15				Mg			
SQ1201-018	JACKSON-SWCC2-DC-01	5	20:21				Mg			
ZZZZZZ		5	20:26							
ZZZZZZ		5	20:31							
ZZZZZZ		5	20:36							
CCV		1	20:41	Al	Ca	Fe	Mg	Mo	K	Na
CCB		1	20:51	Al	Ca	Fe	Mg	Mo	K	Na

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC28E

Date: 03/28/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
CalBlank		1	15:55	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CalStd		1	16:00	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICV		1	16:12	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICB		1	16:21	Al	Ca	Fe	Mg	Mo	K	Na	Zn
PQL		1	16:26	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSA		1	16:31	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSAB		1	16:36	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	16:45								
ZZZZZZ		1	16:57								
ZZZZZZ		1	17:04								
ZZZZZZ		1	17:09								
ZZZZZZ		1	17:14								
CCV		1	17:20	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	17:28	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	17:33								
ZZZZZZ		5	17:38								
ZZZZZZ		5	17:43								
ZZZZZZ		5	17:48								
ZZZZZZ		5	17:54								
ZZZZZZ		5	18:01								
ZZZZZZ		5	18:07								
ZZZZZZ		5	18:12								
ZZZZZZ		5	18:17								
ZZZZZZ		5	18:25								
CCV		1	18:30	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	18:39	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	18:44								

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC28E

Date: 03/28/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
ZZZZZZ		5	18:49								
ZZZZZZ		5	18:54								
ZZZZZZ		25	18:59								
ZZZZZZ		5	19:04								
ZZZZZZ		5	19:09								
ZZZZZZ		5	19:17								
ZZZZZZ		5	19:25								
ZZZZZZ		5	19:30								
ZZZZZZ		5	19:35								
CCV		1	19:41	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	19:49	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	19:54								
ZZZZZZ		5	19:59								
ZZZZZZ		5	20:04								
ZZZZZZ		5	20:09								
ZZZZZZ		5	20:14								
ZZZZZZ		5	20:19								
ZZZZZZ		5	20:28								
ZZZZZZ		1	20:36								
ZZZZZZ		1	20:41								
ZZZZZZ		1	20:47								
CCV		1	20:52	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	21:00	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	21:05								
ZZZZZZ		5	21:10								
ZZZZZZ		5	21:19								
ZZZZZZ		5	21:24								

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC28E

Date: 03/28/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
ZZZZZZ		5	21:29								
ZZZZZZ		5	21:34								
ZZZZZZ		5	21:39								
ZZZZZZ		5	21:44								
ZZZZZZ		5	21:49								
ZZZZZZ		5	21:55								
CCV		1	22:00	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	22:08	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	22:13								
ZZZZZZ		5	22:18								
ZZZZZZ		5	22:23								
ZZZZZZ		5	22:28								
PBWQC21IMW2		5	22:33		Ca						Zn
LCSWQC21IMW2		5	22:38								Zn
ZZZZZZ		5	22:46								
SQ1201-009	JACKSON-EB-01	5	22:51		Ca						Zn
SQ1201-010	JACKSON-CB-01	5	22:57		Ca						
SQ1201-011	SWDUP	5	23:02		Ca						Zn
CCV		1	23:07	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	23:15	Al	Ca	Fe	Mg	Mo	K	Na	Zn
SQ1201-012	JACKSON-SWMC3-DC-01	5	23:20								Zn
SQ1201-012L	JACKSON-SWMC3-DC-01L	25	23:25								Zn
SQ1201-012A	JACKSON-SWMC3-DC-01A	5	23:31								Zn
SQ1201-013	JACKSON-SWMC2-DC-01	5	23:36								Zn
SQ1201-014	JACKSON-SWJC1-DC-01	5	23:41								Zn
SQ1201-015	JACKSON-SWMC1-DC-01	5	23:46								Zn
SQ1201-016	JACKSON-SWCC3-DC-01	5	23:51								Zn

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC28E

Date: 03/28/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
SQ1201-017	JACKSON-SWCC4-DC-01	5	23:56								Zn
ZZZZZZ		5	00:01								
ZZZZZZ		1	00:07								
CCV		1	00:12	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	00:20	Al	Ca	Fe	Mg	Mo	K	Na	Zn

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC29A

Date: 03/29/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
CalBlank		1	18:45	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CalStd		1	18:50	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICV		1	19:02	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICB		1	19:11	Al	Ca	Fe	Mg	Mo	K	Na	Zn
PQL		1	19:16	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSA		1	19:21	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSAB		1	19:27	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	19:35								
ZZZZZZ		1	19:47								
ZZZZZZ		1	19:55								
CCV		1	20:00	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	20:10	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	20:15								
CCV		1	20:21	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	20:31	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	20:36								
ZZZZZZ		5	20:41								
ZZZZZZ		5	20:49								
ZZZZZZ		5	20:54								
ZZZZZZ		5	21:00								
ZZZZZZ		5	21:05								
ZZZZZZ		5	21:13								
ZZZZZZ		1	21:22								
ZZZZZZ		5	21:27								
ZZZZZZ		5	21:32								
CCV		1	21:41	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	21:50	Al	Ca	Fe	Mg	Mo	K	Na	Zn

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC29A

Date: 03/29/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
ZZZZZZ		5	21:56								
ZZZZZZ		5	22:01								
ZZZZZZ		5	22:06								
ZZZZZZ		5	22:11								
ZZZZZZ		5	22:16								
ZZZZZZ		5	22:21								
ZZZZZZ		5	22:26								
ZZZZZZ		5	22:31								
ZZZZZZ		5	22:37								
ZZZZZZ		5	22:42								
CCV		1	22:47	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	22:56	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	23:01								
ZZZZZZ		5	23:06								
ZZZZZZ		5	23:11								
ZZZZZZ		5	23:16								
ZZZZZZ		5	23:24								
ZZZZZZ		5	23:29								
ZZZZZZ		5	23:35								
ZZZZZZ		5	23:40								
SQ1201-012	JACKSON-SWMC3-DC-01	5	23:45		Ca						
SQ1201-012L	JACKSON-SWMC3-DC-01L	25	23:50		Ca						
CCV		1	23:55	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	00:04	Al	Ca	Fe	Mg	Mo	K	Na	Zn
SQ1201-012A	JACKSON-SWMC3-DC-01A	5	00:09		Ca						
SQ1201-013	JACKSON-SWMC2-DC-01	5	00:14		Ca						
SQ1201-014	JACKSON-SWJC1-DC-01	5	00:20		Ca						

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC29A

Date: 03/30/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
SQ1201-015	JACKSON-SWMC1-DC-01	5	00:25		Ca					
SQ1201-016	JACKSON-SWCC3-DC-01	5	00:30		Ca					
SQ1201-017	JACKSON-SWCC4-DC-01	5	00:35		Ca					
SQ1201-018	JACKSON-SWCC2-DC-01	5	00:40		Ca					Zn
CCV		1	00:45	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	00:55	Al	Ca	Fe	Mg	Mo	K	Na	Zn

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC30A

Date: 03/30/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
CalBlank		1	16:44	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CalStd		1	16:50	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICV		1	16:58	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICB		1	17:04	Al	Ca	Fe	Mg	Mo	K	Na	Zn
PQL		1	17:09	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSA		1	17:14	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ICSAB		1	17:19	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	17:24								
ZZZZZZ		1	17:36								
ZZZZZZ		1	17:41								
CCV		1	17:46	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	17:54	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		1	17:59								
CCV		1	18:04	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	18:12	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCV		1	18:17	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	18:25	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	18:30								
ZZZZZZ		5	18:35								
ZZZZZZ		5	18:42								
ZZZZZZ		5	18:48								
ZZZZZZ		5	18:53								
ZZZZZZ		5	18:58								
ZZZZZZ		5	19:03								
ZZZZZZ		5	19:08								
ZZZZZZ		5	19:13								
ZZZZZZ		5	19:18								

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC30A

Date: 03/30/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements						
CCV		1	19:23	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	19:31	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	19:36								
ZZZZZZ		5	19:41								
ZZZZZZ		5	19:46								
ZZZZZZ		5	19:51								
ZZZZZZ		5	19:56								
ZZZZZZ		5	20:02								
ZZZZZZ		5	20:07								
ZZZZZZ		5	20:12								
ZZZZZZ		5	20:17								
ZZZZZZ		5	20:22								
CCV		1	20:27	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	20:35	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	20:40								
ZZZZZZ		5	20:45								
ZZZZZZ		25	20:50								
ZZZZZZ		5	20:55								
ZZZZZZ		5	21:00								
ZZZZZZ		5	21:05								
ZZZZZZ		5	21:13								
ZZZZZZ		5	21:18								
ZZZZZZ		5	21:23								
ZZZZZZ		5	21:28								
CCV		1	21:33	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	21:41	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	21:46								

ANALYSIS RUN LOG

Lab Name: Katahdin Analytical Services **SDG Name:** SQ1201

Instrument ID: AGILENT 7800 ICP-MS **File Name:** LQC30A

Date: 03/30/2023 **Method:** MS

Lab Sample ID	Client ID	D.F.	Time	Elements							
ZZZZZZ		5	21:51								
ZZZZZZ		5	21:56								
ZZZZZZ		5	22:01								
ZZZZZZ		5	22:06								
ZZZZZZ		5	22:11								
ZZZZZZ		5	22:18								
ZZZZZZ		5	22:23								
ZZZZZZ		5	22:29								
ZZZZZZ		5	22:34								
CCV		1	22:39	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	22:46	Al	Ca	Fe	Mg	Mo	K	Na	Zn
ZZZZZZ		5	22:51								
ZZZZZZ		5	22:57								
ZZZZZZ		5	23:03								
SQ1201-009	JACKSON-EB-01	5	23:09				Mg				
SQ1201-010	JACKSON-CB-01	5	23:14				Mg				Zn
SQ1201-012S	JACKSON-SWMC3-DC-01S	5	23:19		Ca						Zn
SQ1201-012P	JACKSON-SWMC3-DC-01P	5	23:26		Ca						Zn
ZZZZZZ		5	23:31								
ZZZZZZ		5	23:36								
ZZZZZZ		5	23:41								
CCV		1	23:46	Al	Ca	Fe	Mg	Mo	K	Na	Zn
CCB		1	23:54	Al	Ca	Fe	Mg	Mo	K	Na	Zn

Raw Data Section

KATAHDIN ANALYTICAL SERVICES, LLC
METALS ANALYSIS RUN INFORMATION SHEET

INSTR. ID: I (Thermo iCAP 6500) **ANALYST**: BCF **ANALYSIS DATE**: 03/17/2023

METHOD: ICP
- ☑ 200.7
- ☑ 6010
- ☑ DOD
- ☐ _____

FILE NAME: IQC17A

Reviewed By: Ean 032023

The pHs of all samples that were tested by direct analysis in this analytical run were checked just prior to analysis and confirmed to be <2. The time of preservation of these samples was checked in the "Measured Turbidity and Preservation of Incoming Samples" logbook to verify that they had been preserved at least 16 hours prior to analysis. These verifications were performed by ____ (initials) on ____ (date).

STANDARDS USED:

Standard Name	Standard ID	Prep Date	Expiration Date	Standard Conc.
Cal. Blk/ICB/CCB	MW21420	03/03/2023	06/03/2023	0 ug/L
Standard 1	MW21417	03/02/2023	06/02/2023	Varies by Element
ICV	MW21424	03/08/2023	03/31/2023	Varies by Element
PQL	MW21396409	3/1 02/24/2023	5/31 05/24/2023	Varies by Element
LRS1	MW21390	02/20/2023	05/20/2023	Varies by Element
LRS2	MW21393410	3/1 02/22/2023	5/31 05/22/2023	Varies by Element
ICSA	MW21384	02/16/2023	05/16/2023	Varies by Element
ICSAB	MW21317	01/11/2023	04/11/2023	Varies by Element
CCV	MW21433	03/17/2023	06/17/2023	Varies by Element
Internal Standard	MW21375	02/09/2023	05/09/2023	5.0 mg/L Yttrium

Ean 032023

Additional Comments and Notes:

3x diln.: 3.0 mL of sample (pipet M30) + 6.0 mL of MW21420 (pipet M31)

2x diln.: 4.0 mL of sample (pipet M30) + 4.0 mL of MW21420 (pipet M31)

10x diln.: 0.8 mL of sample (pipet M19) + 7.2 mL of MW21420 (pipet M31)

5x diln.: 1.6 mL of sample (pipet M30) + 6.4 mL of MW21420 (pipet M31)

25x diln.: 0.4mL of (pipet M19) + 9.6 mL of MW21420 (pipet M31)

Post Spike: 4ul MS2399 (pipet M17), 80ul MS2411 (pipet M27), 40ul MS2444 (pipet M27), 40ul MS2401 (pipet M27) to 8.0mL of sample (pipet M31)

INSTRUMENT RUNLOG

Instrument: ICAP 6500

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
Blank	1.000	IQC17A	03/17/2023	16:08	BCF
Std 1	1.000	IQC17A	03/17/2023	16:13	BCF
ICV	1.000	IQC17A	03/17/2023	16:17	BCF
ICB	1.000	IQC17A	03/17/2023	16:21	BCF
PQL	1.000	IQC17A	03/17/2023	16:25	BCF
ICSA	1.000	IQC17A	03/17/2023	16:29	BCF
ICSAB	1.000	IQC17A	03/17/2023	16:34	BCF
CCV	1.000	IQC17A	03/17/2023	16:38	BCF
CCB	1.000	IQC17A	03/17/2023	16:42	BCF
LRS1	1.000	IQC17A	03/17/2023	16:47	BCF
LRS2	1.000	IQC17A	03/17/2023	16:51	BCF
CCV	1.000	IQC17A	03/17/2023	16:56	BCF
CCB	1.000	IQC17A	03/17/2023	17:00	BCF
LCSWQC08ICW1	1.000	IQC17A	03/17/2023	17:04	BCF
SQ1070-001	1.000	IQC17A	03/17/2023	17:08	BCF
LC2OQC13ICS1	1.000	IQC17A	03/17/2023	17:13	BCF
LCSOQC13ICS1	1.000	IQC17A	03/17/2023	17:17	BCF
PBSQC13ICS1	1.000	IQC17A	03/17/2023	17:21	BCF
SQ1129-001	2.000	IQC17A	03/17/2023	17:25	BCF
SQ1129-003	5.000	IQC17A	03/17/2023	17:29	BCF
SQ1129-005	5.000	IQC17A	03/17/2023	17:34	BCF
LCSWQC13ICW1	1.000	IQC17A	03/17/2023	17:38	BCF
PBWQC13ICW1	1.000	IQC17A	03/17/2023	17:42	BCF
CCV	1.000	IQC17A	03/17/2023	17:46	BCF
CCB	1.000	IQC17A	03/17/2023	17:51	BCF
SQ1089-001	1.000	IQC17A	03/17/2023	17:55	BCF
SQ1174-002	2.000	IQC17A	03/17/2023	17:59	BCF
LCSWQC14ICW1	1.000	IQC17A	03/17/2023	18:04	BCF
PBWQC14ICW1	1.000	IQC17A	03/17/2023	18:08	BCF
SQ1119-001	2.000	IQC17A	03/17/2023	18:12	BCF
LCSWQC15ICW2	1.000	IQC17A	03/17/2023	18:16	BCF
PBWQC15ICW2	1.000	IQC17A	03/17/2023	18:20	BCF
PBT1792AR	1.000	IQC17A	03/17/2023	18:25	BCF
SQ1106-001	1.000	IQC17A	03/17/2023	18:29	BCF
SQ1106-003	1.000	IQC17A	03/17/2023	18:34	BCF
CCV	1.000	IQC17A	03/17/2023	18:38	BCF
CCB	1.000	IQC17A	03/17/2023	18:42	BCF
SQ1106-004	1.000	IQC17A	03/17/2023	18:46	BCF
SQ1106-005	1.000	IQC17A	03/17/2023	18:51	BCF
SQ1111-001R	1.000	IQC17A	03/17/2023	18:55	BCF
SQ1111-002R	1.000	IQC17A	03/17/2023	18:59	BCF
SQ1111-003R	1.000	IQC17A	03/17/2023	19:04	BCF
LCSWQC15ICW1	1.000	IQC17A	03/17/2023	19:08	BCF
PBWQC15ICW1	1.000	IQC17A	03/17/2023	19:12	BCF

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
PBT1793AR	1.000	IQC17A	03/17/2023	19:16	BCF
SQ1104-002R	1.000	IQC17A	03/17/2023	19:21	BCF
SQ1104-006R	1.000	IQC17A	03/17/2023	19:25	BCF
CCV	1.000	IQC17A	03/17/2023	19:29	BCF
CCB	1.000	IQC17A	03/17/2023	19:34	BCF
SQ1104-008R	1.000	IQC17A	03/17/2023	19:38	BCF
SQ1104-008RA	1.000	IQC17A	03/17/2023	19:42	BCF
SQ1104-008RL	5.000	IQC17A	03/17/2023	19:47	BCF
SQ1104-008RN	1.000	IQC17A	03/17/2023	19:51	BCF
SQ1104-008RO	1.000	IQC17A	03/17/2023	19:55	BCF
SQ1104-010R	1.000	IQC17A	03/17/2023	19:59	BCF
SQ1104-012R	1.000	IQC17A	03/17/2023	20:04	BCF
SQ1104-014R	1.000	IQC17A	03/17/2023	20:08	BCF
SQ1129-002	1.000	IQC17A	03/17/2023	20:13	BCF
SQ1129-004	5.000	IQC17A	03/17/2023	20:17	BCF
CCV	1.000	IQC17A	03/17/2023	20:21	BCF
CCB	1.000	IQC17A	03/17/2023	20:25	BCF
SQ1169-001	1.000	IQC17A	03/17/2023	20:30	BCF
SQ1167-003R	50.00	IQC17A	03/17/2023	20:34	BCF
SQ1167-004R	50.00	IQC17A	03/17/2023	20:38	BCF
SQ1167-005L	100.0	IQC17A	03/17/2023	20:43	BCF
LCSWQC16ICW1	1.000	IQC17A	03/17/2023	20:47	BCF
PBWQC16ICW1	1.000	IQC17A	03/17/2023	20:51	BCF
SQ1201-001	1.000	IQC17A	03/17/2023	20:55	BCF
SQ1201-002	1.000	IQC17A	03/17/2023	21:00	BCF
SQ1201-002A	1.000	IQC17A	03/17/2023	21:04	BCF
SQ1201-002L	5.000	IQC17A	03/17/2023	21:08	BCF
CCV	1.000	IQC17A	03/17/2023	21:13	BCF
CCB	1.000	IQC17A	03/17/2023	21:17	BCF
SQ1201-002P	1.000	IQC17A	03/17/2023	21:21	BCF
SQ1201-002S	1.000	IQC17A	03/17/2023	21:25	BCF
SQ1201-003	1.000	IQC17A	03/17/2023	21:29	BCF
SQ1201-004	1.000	IQC17A	03/17/2023	21:34	BCF
SQ1201-005	1.000	IQC17A	03/17/2023	21:38	BCF
SQ1201-006	1.000	IQC17A	03/17/2023	21:42	BCF
SQ1201-007	1.000	IQC17A	03/17/2023	21:47	BCF
SQ1201-008	1.000	IQC17A	03/17/2023	21:51	BCF
LC2WQC16ICW2	1.000	IQC17A	03/17/2023	21:55	BCF
LCSWQC16ICW2	1.000	IQC17A	03/17/2023	21:59	BCF
CCV	1.000	IQC17A	03/17/2023	22:03	BCF
CCB	1.000	IQC17A	03/17/2023	22:08	BCF
PBWQC16ICW2	1.000	IQC17A	03/17/2023	22:12	BCF
SQ1044-001	1.000	IQC17A	03/17/2023	22:16	BCF
LCSOQC15ICS1	1.000	IQC17A	03/17/2023	22:21	BCF
PBSQC15ICS1	1.000	IQC17A	03/17/2023	22:25	BCF
SQ1129-007R	10.00	IQC17A	03/17/2023	22:29	BCF
SQ1165-032R	2.000	IQC17A	03/17/2023	22:33	BCF

Intensity Report

Author:

Published: 3/20/2023 9:53:08AM

Notes:

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Method Name: FAST-2022_POP Method Revision: 169

Analyst Name: BCF

Acquire Date: 3/17/2023 4:08:41PM Sample Type: Standard

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.00001100	Cts/S	0.00002900	267.5	-1.988
Al3961_R		-0.0004220	Cts/S	0.0003000	70.93	-4.283
As1891_A		-0.0005110	Cts/S	0.00002300	4.515	-3.629
B_2089_A		0.0003890	Cts/S	0.00002800	7.157	2.764
Ba4554_R		0.002559	Cts/S	0.0007390	28.86	25.93
Be3130_R		-0.0009980	Cts/S	0.0002520	25.29	-10.10
Ca3158_R		-0.003607	Cts/S	0.00005700	1.577	-36.53
Cd2265_A		-0.0003900	Cts/S	0.00004600	11.66	-2.771
Co2286_A		-0.0001240	Cts/S	0.00003800	30.96	-0.8796
Cr2677_A		-0.00001300	Cts/S	0.00002600	205.0	-2.311
Cu3273_A		-0.00007600	Cts/S	0.000006000	8.251	-13.97
Fe2599_R		0.0002640	Cts/S	0.0003570	135.1	2.680
K_7664_R		0.03136	Cts/S	0.0001830	0.5835	317.6
Li6707_R		0.001134	Cts/S	0.001287	113.5	11.51
Mg2795		0.002095	Cts/S	0.0002820	13.46	21.21
Mg2025_A		-0.0009810	Cts/S	0.00008000	8.140	-6.965
Mn2576_R		0.0002460	Cts/S	0.0001230	49.96	2.493
Mo2020_A		0.00002600	Cts/S	0.000009000	32.65	0.1860
Na5895_R		0.008211	Cts/S	0.001332	16.23	83.12
Ni2316_A		0.00003500	Cts/S	0.00002600	75.29	0.2468
Pb2203_A		-0.0003260	Cts/S	0.00008600	26.23	-2.315
Sb2068_A		0.0002660	Cts/S	0.00004700	17.65	1.887
Se1960_A		0.0002490	Cts/S	0.00002300	9.133	1.771
Si2516_R		0.001516	Cts/S	0.0001530	10.09	15.36
Sn1899_A		0.0002880	Cts/S	0.00003300	11.50	2.048
Sr4215_R		-0.0002470	Cts/S	0.0001020	41.39	-2.507
Ti3349_A		0.00001400	Cts/S	0.000007000	48.31	2.541
Tl1908_A		-0.0004250	Cts/S	0.00003600	8.381	-3.017
V_2924_A		-0.00001200	Cts/S	0.00001100	94.93	-2.120
Zn2062_A		0.0008490	Cts/S	0.0001080	12.71	6.025
Y_3600_R		10,127	Cts/S	38.790	0.38303	10,127
Y_2243_A		7,098.2	Cts/S	1.5628	0.022017	7,098.2
Y_3600_A		183,250	Cts/S	50.131	0.027357	183,250

Std 1

Method Name: FAST-2022_POP Method Revision: 169

Analyst Name: BCF

Acquire Date: 3/17/2023 4:13:01PM Sample Type: Standard

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1381	Cts/S	0.0003300	0.2389	24,540
Al3961_R		1.598	Cts/S	0.006773	0.4238	16,250
As1891_A		0.04600	Cts/S	0.0002270	0.4934	319.4
B_2089_A		0.1698	Cts/S	0.0004130	0.2431	1,179
Ba4554_R		2.556	Cts/S	0.01390	0.5439	25,990
Be3130_R		5.763	Cts/S	0.03947	0.6848	58,610
Ca3158_R		1.436	Cts/S	0.009860	0.6864	14,610
Cd2265_A		2.497	Cts/S	0.003007	0.1204	17,340
Co2286_A		0.6071	Cts/S	0.001147	0.1890	4,216
Cr2677_A		0.06464	Cts/S	0.0000	0.0002370	11,490
Cu3273_A		0.09715	Cts/S	0.00008200	0.08427	17,260
Fe2599_R		2.850	Cts/S	0.02350	0.8246	28,980
K_7664_R		0.8308	Cts/S	0.004246	0.5111	8,449

Std 1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:13:01PM
Sample Type: Standard

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Li6707_R		0.7422	Cts/S	0.007968	1.074	7,548
Mg2795		106.4	Cts/S	1.169	1.099	1,082,000
Mg2025_A		1.251	Cts/S	0.006538	0.5226	8,687
Mn2576_R		0.6362	Cts/S	0.004378	0.6881	6,470
Mo2020_A		0.4512	Cts/S	0.0009670	0.2143	3,134
Na5895_R		2.006	Cts/S	0.01137	0.5667	20,400
Ni2316_A		0.2678	Cts/S	0.0003400	0.1268	1,859
Pb2203_A		0.1866	Cts/S	0.0003830	0.2054	1,296
Sb2068_A		0.08616	Cts/S	0.0001810	0.2100	598.4
Se1960_A		0.03553	Cts/S	0.00003000	0.08445	246.8
Si2516_R		0.9707	Cts/S	0.007399	0.7623	9,871
Sn1899_A		0.08443	Cts/S	0.00009100	0.1074	586.3
Sr4215_R		3.349	Cts/S	0.02072	0.6187	34,060
Ti3349_A		0.2059	Cts/S	0.0004840	0.2350	36,580
Tl1908_A		0.08613	Cts/S	0.0003130	0.3639	598.1
V_2924_A		0.09630	Cts/S	0.00002600	0.02722	17,110
Zn2062_A		0.5491	Cts/S	0.001329	0.2420	3,813
Y_3600_R		10,169	Cts/S	72.019	0.70821	10,169
Y_2243_A		6,944.4	Cts/S	0.73215	0.010543	6,944.4
Y_3600_A		177,680	Cts/S	38.626	0.021739	177,680

ICV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:17:10PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		390.2	ug/L	4.303	1.103	9,770
Al3961_R		10,360	ug/L	7.649	0.07382	6,802
As1891_A		382.4	ug/L	3.118	0.8152	121.8
B_2089_A		392.5	ug/L	2.190	0.5578	472.2
Ba4554_R		389.8	ug/L	1.169	0.2999	10,250
Be3130_R		397.3	ug/L	1.520	0.3826	23,520
Ca3158_R		10,460	ug/L	126.1	1.206	6,151
Cd2265_A		396.1	ug/L	2.270	0.5732	6,972
Co2286_A		398.7	ug/L	1.761	0.4417	1,706
Cr2677_A		390.1	ug/L	0.1107	0.02839	4,571
Cu3273_A		390.5	ug/L	2.570	0.6581	6,869
Fe2599_R		10,340	ug/L	90.16	0.8721	12,110
K_7664_R		13,750	ug/L	131.8	0.9588	4,840
Li6707_R		416.4	ug/L	4.488	1.078	3,182
Mg2795	W	10,630	ug/L	113.7	1.069	464,800
Mg2025_A		10,530	ug/L	44.40	0.4215	3,711
Mn2576_R		391.6	ug/L	2.028	0.5179	2,561
Mo2020_A		402.0	ug/L	2.625	0.6528	1,279
Na5895_R		10,230	ug/L	27.75	0.2714	8,479
Ni2316_A		399.2	ug/L	2.416	0.6054	753.6
Pb2203_A		402.2	ug/L	1.824	0.4535	527.7
Sb2068_A		393.0	ug/L	2.166	0.5511	239.7
Se1960_A		392.3	ug/L	2.438	0.6216	99.34
Si2516_R		10,220	ug/L	53.03	0.5188	4,006
Sn1899_A	W	427.0	ug/L	2.965	0.6942	255.4
Sr4215_R		411.2	ug/L	1.295	0.3150	14,150
Ti3349_A		391.0	ug/L	1.229	0.3143	14,600
Tl1908_A		409.5	ug/L	2.024	0.4943	246.9
V_2924_A		394.1	ug/L	3.685	0.9351	6,879
Zn2062_A		393.8	ug/L	2.095	0.5319	1,528
Y_3600_R		10,274	Cts/S	74.657	0.72666	10,274

ICV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:17:10PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Y_2243_A		7,050.2	Cts/S	25.010	0.35474	7,050.2
Y_3600_A		181,300	Cts/S	826.11	0.45566	181,300

ICB

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:21:19PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.07041	ug/L	0.2901	411.9	-3.787
Al3961_R		8.220	ug/L	15.53	188.9	1.021
As1891_A		-0.4513	ug/L	0.3035	67.24	-3.797
B_2089_A		0.06552	ug/L	0.8394	1,281	2.885
Ba4554_R		0.1623	ug/L	0.2983	183.8	30.44
Be3130_R		0.04230	ug/L	0.003536	8.358	-7.732
Ca3158_R		0.2310	ug/L	6.377	2,761	-36.81
Cd2265_A		0.05224	ug/L	0.02115	40.47	-1.851
Co2286_A		0.1737	ug/L	0.03705	21.33	-0.1325
Cr2677_A		-0.07078	ug/L	0.2483	350.8	-3.160
Cu3273_A		0.2633	ug/L	0.05840	22.18	-9.308
Fe2599_R		2.785	ug/L	1.519	54.55	5.950
K_7664_R		22.27	ug/L	1.979	8.888	328.7
Li6707_R		0.1011	ug/L	3.415	3,379	12.28
Mg2795		1.657	ug/L	0.1740	10.50	93.73
Mg2025_A		-0.1732	ug/L	0.3113	179.7	-7.050
Mn2576_R		-0.4217	ug/L	0.1693	40.16	-0.2173
Mo2020_A		0.5853	ug/L	0.03430	5.861	2.071
Na5895_R		-21.76	ug/L	7.144	32.83	66.34
Ni2316_A		-0.2720	ug/L	0.2210	81.27	-0.2717
Pb2203_A		0.2780	ug/L	0.3470	124.8	-1.956
Sb2068_A		0.2134	ug/L	0.1582	74.14	2.028
Se1960_A		-0.08418	ug/L	0.4814	571.8	1.758
Si2516_R		20.62	ug/L	11.02	53.42	23.59
Sn1899_A		-0.1685	ug/L	0.1991	118.2	1.957
Sr4215_R		0.2302	ug/L	0.1703	74.00	5.389
Ti3349_A		0.09003	ug/L	0.08120	90.20	5.967
Tl1908_A		0.7958	ug/L	0.8019	100.8	-2.539
V_2924_A		0.03426	ug/L	0.02517	73.47	-1.574
Zn2062_A		-1.257	ug/L	0.0008440	0.06715	1.133
Y_3600_R		10,247	Cts/S	83.206	0.81203	10,247
Y_2243_A		7,132.8	Cts/S	14.296	0.20042	7,132.8
Y_3600_A		183,820	Cts/S	173.14	0.094193	183,820

PQL

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:25:37PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		9.449	ug/L	0.2272	2.405	240.4
Al3961_R		294.4	ug/L	3.546	1.205	189.3
As1891_A		6.759	ug/L	1.506	22.28	-1.396
B_2089_A		46.92	ug/L	0.2433	0.5186	57.85
Ba4554_R		5.038	ug/L	0.1957	3.885	158.8
Be3130_R		5.011	ug/L	0.01995	0.3982	286.7
Ca3158_R		100.1	ug/L	3.984	3.982	22.20
Cd2265_A		4.860	ug/L	0.03134	0.6449	84.17
Co2286_A		10.01	ug/L	0.06504	0.6498	42.71
Cr2677_A		9.897	ug/L	0.03872	0.3912	116.5

PQL

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:25:37PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Cu3273_A		24.91	ug/L	0.07849	0.3151	435.3
Fe2599_R		101.4	ug/L	2.140	2.110	121.7
K_7664_R		1,171	ug/L	11.02	0.9413	708.3
Li6707_R		103.4	ug/L	2.228	2.155	800.5
Mg2795		105.9	ug/L	0.09400	0.08875	4,661
Mg2025_A		107.2	ug/L	2.116	1.974	31.76
Mn2576_R		4.703	ug/L	0.2918	6.204	33.32
Mo2020_A		9.865	ug/L	0.1142	1.158	32.10
Na5895_R		1,033	ug/L	18.46	1.787	933.8
Ni2316_A		9.731	ug/L	0.2061	2.118	18.93
Pb2203_A		4.957	ug/L	0.2488	5.020	4.284
Sb2068_A		6.431	ug/L	0.3851	5.989	5.403
Se1960_A		9.274	ug/L	2.640	28.47	4.133
Si2516_R		199.1	ug/L	9.789	4.917	93.47
Sn1899_A		97.67	ug/L	0.2431	0.2489	60.98
Sr4215_R		10.16	ug/L	0.1063	1.046	347.7
Ti3349_A		14.12	ug/L	0.09596	0.6797	542.5
Tl1908_A		16.93	ug/L	1.319	7.793	7.453
V_2924_A		9.383	ug/L	0.08623	0.9189	165.7
Zn2062_A		18.14	ug/L	0.04122	0.2271	77.43
Y_3600_R		10,293	Cts/S	32.301	0.31382	10,293
Y_2243_A		7,168.9	Cts/S	15.451	0.21553	7,168.9
Y_3600_A		185,780	Cts/S	1,264.4	0.68059	185,780

ICSA

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:29:53PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.5347	ug/L	0.2203	41.20	-14.51
Al3961_R		556,800	ug/L	6,914	1.242	341,100
As1891_A		-1.101	ug/L	0.06291	5.715	-14.64
B_2089_A		-0.6781	ug/L	0.5203	76.73	1.638
Ba4554_R		2.536	ug/L	0.1371	5.404	86.76
Be3130_R		-0.03402	ug/L	0.02401	70.55	-12.08
Ca3158_R		509,800	ug/L	10,200	2.001	281,800
Cd2265_A		0.2422	ug/L	0.1514	62.52	300.0
Co2286_A		-0.05852	ug/L	0.04393	75.06	1.937
Cr2677_A		5.677	ug/L	0.2022	3.563	42.23
Cu3273_A		-1.929	ug/L	0.5446	28.24	-12.44
Fe2599_R		201,800	ug/L	350.8	0.1738	220,800
K_7664_R	F	2,906	ug/L	304.2	10.47	1,192
Li6707_R		12.45	ug/L	4.028	32.36	99.23
Mg2795	^F	0.0000	ug/L	0.0000	0.0000	1,763,000
Mg2025_A		441,300	ug/L	961.3	0.2178	137,300
Mn2576_R		-2.053	ug/L	0.1700	8.281	7.052
Mo2020_A		-2.398	ug/L	0.1618	6.748	-6.599
Na5895_R		265.1	ug/L	11.37	4.287	282.1
Ni2316_A		-0.3802	ug/L	0.7121	187.3	-5.761
Pb2203_A		-0.5755	ug/L	1.041	180.8	-55.53
Sb2068_A		-2.390	ug/L	1.196	50.02	5.452
Se1960_A		-2.526	ug/L	2.019	79.95	3.348
Si2516_R		-0.1267	ug/L	4.908	3,873	12.57
Sn1899_A		3.661	ug/L	0.4622	12.63	3.729
Sr4215_R		5.094	ug/L	0.09474	1.860	161.4
Ti3349_A	W	12.73	ug/L	0.04979	0.3910	421.2
Tl1908_A		0.1298	ug/L	2.577	1,986	-1.311

ICSA

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:29:53PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
V_2924_A		0.08352	ug/L	0.02880	34.48	18.07
Zn2062_A		-0.2263	ug/L	0.2172	95.98	4.508
Y_3600_R		9,598.0	Cts/S	118.14	1.2309	9,598.0
Y_2243_A		6,250.3	Cts/S	7.8844	0.12614	6,250.3
Y_3600_A		159,950	Cts/S	69.100	0.043202	159,950

ICSAB

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:34:19PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		214.7	ug/L	0.5337	0.2486	4,763
Al3961_R		549,900	ug/L	7,149	1.300	338,700
As1891_A		97.60	ug/L	1.886	1.933	14.56
B_2089_A		471.4	ug/L	1.104	0.2342	501.6
Ba4554_R		534.0	ug/L	2.322	0.4348	13,180
Be3130_R		519.6	ug/L	2.118	0.4076	28,890
Ca3158_R		497,500	ug/L	271.9	0.05466	276,400
Cd2265_A		954.0	ug/L	3.686	0.3863	15,160
Co2286_A		476.5	ug/L	0.8319	0.1746	1,813
Cr2677_A		499.1	ug/L	3.515	0.7043	5,170
Cu3273_A		538.4	ug/L	0.3079	0.05719	8,421
Fe2599_R		198,700	ug/L	357.7	0.1800	218,500
K_7664_R	F	27,510	ug/L	25.30	0.09198	8,791
Li6707_R		551.2	ug/L	1.993	0.3616	3,952
Mg2795	^F	0.0000	ug/L	0.0000	0.0000	1,783,000
Mg2025_A		435,900	ug/L	609.8	0.1399	135,800
Mn2576_R		499.2	ug/L	3.473	0.6957	3,081
Mo2020_A		458.0	ug/L	0.9675	0.2112	1,293
Na5895_R		22,070	ug/L	55.95	0.2535	17,090
Ni2316_A		936.9	ug/L	2.136	0.2280	1,565
Pb2203_A		43.71	ug/L	0.3528	0.8072	-3.235
Sb2068_A		612.9	ug/L	0.3362	0.05485	336.0
Se1960_A		44.66	ug/L	0.9476	2.122	13.81
Si2516_R		2,034	ug/L	7.551	0.3713	757.5
Sn1899_A		473.7	ug/L	3.427	0.7233	251.2
Sr4215_R		530.3	ug/L	1.694	0.3194	17,130
Ti3349_A		479.2	ug/L	2.986	0.6232	15,860
Tl1908_A		89.53	ug/L	0.7849	0.8768	47.21
V_2924_A		510.0	ug/L	0.3058	0.05995	7,915
Zn2062_A		943.2	ug/L	5.770	0.6117	3,242
Y_3600_R		9,647.9	Cts/S	30.061	0.31158	9,647.9
Y_2243_A		6,257.1	Cts/S	6.2333	0.099620	6,257.1
Y_3600_A		160,720	Cts/S	21.280	0.013240	160,720

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:38:38PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		498.0	ug/L	3.642	0.7313	12,600
Al3961_R		13,080	ug/L	14.31	0.1095	8,623
As1891_A		520.4	ug/L	1.480	0.2844	166.9
B_2089_A		521.9	ug/L	0.8062	0.1545	625.1
Ba4554_R		520.6	ug/L	3.219	0.6183	13,750
Be3130_R		515.2	ug/L	1.161	0.2253	30,640
Ca3158_R		12,380	ug/L	3.916	0.03162	7,324

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:38:38PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Cd2265_A		518.8	ug/L	0.7127	0.1374	9,121
Co2286_A	W	530.2	ug/L	0.6629	0.1250	2,266
Cr2677_A		521.4	ug/L	0.4735	0.09080	6,176
Cu3273_A		514.7	ug/L	0.1409	0.02737	9,157
Fe2599_R		12,500	ug/L	8.933	0.07144	14,710
K_7664_R	F	14,650	ug/L	41.47	0.2830	5,159
Li6707_R		512.0	ug/L	2.596	0.5070	3,927
Mg2795		13,020	ug/L	1.392	0.01069	571,600
Mg2025_A		12,740	ug/L	4.204	0.03300	4,488
Mn2576_R		522.6	ug/L	1.798	0.3441	3,432
Mo2020_A		511.8	ug/L	0.04550	0.008891	1,627
Na5895_R		13,130	ug/L	67.00	0.5103	10,910
Ni2316_A		523.3	ug/L	0.06984	0.01335	987.0
Pb2203_A		522.4	ug/L	0.9722	0.1861	685.6
Sb2068_A		518.6	ug/L	0.5987	0.1155	315.6
Se1960_A		518.2	ug/L	0.9762	0.1884	130.5
Si2516_R		13,040	ug/L	43.00	0.3298	5,129
Sn1899_A		525.3	ug/L	0.3069	0.05842	313.4
Sr4215_R		516.7	ug/L	2.103	0.4070	17,860
Ti3349_A		498.3	ug/L	3.374	0.6770	18,800
Tl1908_A	F	554.0	ug/L	3.142	0.5672	334.8
V_2924_A		514.4	ug/L	0.2201	0.04279	9,076
Zn2062_A		515.8	ug/L	1.486	0.2881	1,998
Y_3600_R		10,320	Cts/S	28.533	0.27649	10,320
Y_2243_A		7,043.3	Cts/S	4.3852	0.062261	7,043.3
Y_3600_A		183,250	Cts/S	306.63	0.16732	183,250

CCB

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:42:48PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.1113	ug/L	0.1528	137.3	-4.909
Al3961_R		-7.201	ug/L	4.314	59.91	-9.038
As1891_A		-0.8906	ug/L	1.077	121.0	-3.947
B_2089_A		0.3366	ug/L	0.03125	9.285	3.198
Ba4554_R		-0.06322	ug/L	0.09067	143.4	24.62
Be3130_R		0.04438	ug/L	0.08632	194.5	-7.637
Ca3158_R		5.060	ug/L	11.87	234.7	-34.04
Cd2265_A		0.02825	ug/L	0.03160	111.9	-2.277
Co2286_A		0.1861	ug/L	0.07093	38.12	-0.08000
Cr2677_A		0.3271	ug/L	0.04626	14.14	1.592
Cu3273_A		-0.1426	ug/L	0.02509	17.60	-16.80
Fe2599_R		3.759	ug/L	1.921	51.10	7.107
K_7664_R	F	1,342	ug/L	38.30	2.854	762.7
Li6707_R		-0.7336	ug/L	3.383	461.1	6.102
Mg2795		9.684	ug/L	0.04127	0.4261	444.6
Mg2025_A		5.930	ug/L	1.339	22.58	-4.888
Mn2576_R		-0.4670	ug/L	0.6006	128.6	-0.5238
Mo2020_A		0.5451	ug/L	0.1697	31.13	1.942
Na5895_R		52.13	ug/L	2.446	4.692	127.1
Ni2316_A		-0.3716	ug/L	0.09644	25.95	-0.4623
Pb2203_A		0.5307	ug/L	0.4120	77.63	-1.617
Sb2068_A		-0.9452	ug/L	1.321	139.7	1.319
Se1960_A		-2.082	ug/L	1.406	67.52	1.258
Si2516_R		7.690	ug/L	7.840	101.9	18.58
Sn1899_A		-0.4670	ug/L	0.2894	61.98	1.779

CCB

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:42:48PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Sr4215_R		0.1345	ug/L	0.1087	80.83	2.079
Ti3349_A		0.08807	ug/L	0.04397	49.92	5.978
Tl1908_A		-0.1425	ug/L	0.1153	80.90	-3.122
V_2924_A		-0.01420	ug/L	0.01898	133.7	-2.503
Zn2062_A		-1.390	ug/L	0.01865	1.342	0.6120
Y_3600_R		10,269	Cts/S	30.383	0.29587	10,269
Y_2243_A		7,138.9	Cts/S	26.829	0.37581	7,138.9
Y_3600_A		186,600	Cts/S	1,465.9	0.78561	186,600

LRS1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:47:04PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		1,901	ug/L	15.06	0.7923	47,010
Al3961_R		-63.26	ug/L	3.653	5.775	80.26
As1891_A		20,200	ug/L	41.33	0.2046	6,358
B_2089_A		20,430	ug/L	53.44	0.2616	22,610
Ba4554_R		19,340	ug/L	40.70	0.2104	515,300
Be3130_R		18,940	ug/L	452.2	2.388	1,139,000
Ca3158_R		24.45	ug/L	1.679	6.870	-15.85
Cd2265_A		19,130	ug/L	39.75	0.2077	321,700
Co2286_A		20,040	ug/L	56.79	0.2834	82,100
Cr2677_A		19,540	ug/L	98.84	0.5058	226,600
Cu3273_A		19,400	ug/L	99.89	0.5149	337,900
Fe2599_R		2.217	ug/L	1.853	83.57	4.723
K_7664_R		792.6	ug/L	11.57	1.459	591.6
Li6707_R		19,940	ug/L	542.3	2.720	154,100
Mg2795		6.445	ug/L	0.2406	3.732	307.9
Mg2025_A		2,902	ug/L	12.17	0.4194	1,945
Mn2576_R		19,270	ug/L	504.7	2.620	127,800
Mo2020_A		4,917	ug/L	8.897	0.1809	14,970
Na5895_R		28.21	ug/L	1.693	6.001	109.2
Ni2316_A		19,740	ug/L	39.59	0.2005	35,680
Pb2203_A		20,620	ug/L	50.43	0.2446	26,070
Sb2068_A		20,200	ug/L	58.42	0.2892	11,710
Se1960_A		20,340	ug/L	63.79	0.3136	4,843
Si2516_R		323.9	ug/L	6.441	1.989	86.21
Sn1899_A		20,850	ug/L	40.28	0.1932	11,840
Sr4215_R		19,840	ug/L	415.2	2.093	693,100
Ti3349_A	F	17,700	ug/L	151.1	0.8539	653,100
Tl1908_A		20,760	ug/L	52.82	0.2544	12,130
V_2924_A		19,440	ug/L	83.31	0.4286	337,300
Zn2062_A		19,490	ug/L	26.02	0.1334	72,140
Y_3600_R		10,432	Cts/S	113.10	1.0842	10,432
Y_2243_A		6,749.9	Cts/S	7.5451	0.11178	6,749.9
Y_3600_A		179,320	Cts/S	934.33	0.52105	179,320

LRS2

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:51:45PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2003	ug/L	0.2779	138.7	-7.396
Al3961_R		515,200	ug/L	2,087	0.4050	328,200
As1891_A		-1.401	ug/L	1.337	95.41	-16.31
B_2089_A		6.924	ug/L	1.177	17.00	9.807

LRS2

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:51:45PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ba4554_R		2.747	ug/L	0.01312	0.4774	95.55
Be3130_R		1.894	ug/L	0.2641	13.95	98.39
Ca3158_R		465,200	ug/L	9,160	1.969	267,400
Cd2265_A		0.5202	ug/L	0.2992	57.51	356.7
Co2286_A		1.416	ug/L	0.3364	23.76	8.190
Cr2677_A		2.518	ug/L	0.7296	28.98	7.754
Cu3273_A		-3.683	ug/L	0.6144	16.68	1.289
Fe2599_R		229,100	ug/L	436.1	0.1903	260,600
K_7664_R		299,300	ug/L	673.8	0.2252	95,810
Li6707_R		13.36	ug/L	1.288	9.645	110.1
Mg2795	^F	0.0000	ug/L	0.0000	0.0000	4,317,000
Mg2025_A	F	169,300	ug/L	921.1	0.5441	54,510
Mn2576_R		0.6719	ug/L	1.377	204.9	23.76
Mo2020_A		0.5522	ug/L	0.6465	117.1	1.776
Na5895_R		207,100	ug/L	1,067	0.5155	165,200
Ni2316_A		-1.265	ug/L	0.1875	14.83	-8.242
Pb2203_A		-0.9691	ug/L	0.2786	28.75	-51.72
Sb2068_A		-1.234	ug/L	0.1553	12.58	6.174
Se1960_A		5.634	ug/L	2.119	37.61	5.226
Si2516_R		49,960	ug/L	17.61	0.03526	18,970
Sn1899_A		5.283	ug/L	1.099	20.80	4.741
Sr4215_R		8.168	ug/L	0.06907	0.8456	270.6
Ti3349_A		14.34	ug/L	0.3353	2.338	484.1
Tl1908_A		1.367	ug/L	0.7104	51.95	-0.8253
V_2924_A		1.421	ug/L	0.01009	0.7099	42.13
Zn2062_A		2.952	ug/L	0.5033	17.05	15.96
Y_3600_R		9,979.5	Cts/S	64.054	0.64185	9,979.5
Y_2243_A		6,470.0	Cts/S	35.551	0.54947	6,470.0
Y_3600_A		163,270	Cts/S	328.82	0.20139	163,270

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:56:18PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		499.7	ug/L	2.165	0.4333	12,640
Al3961_R		13,110	ug/L	63.12	0.4815	8,619
As1891_A		520.3	ug/L	1.407	0.2704	167.7
B_2089_A		523.5	ug/L	0.4023	0.07684	630.4
Ba4554_R		526.2	ug/L	1.081	0.2054	13,850
Be3130_R		518.8	ug/L	1.171	0.2257	30,760
Ca3158_R		12,460	ug/L	23.00	0.1845	7,351
Cd2265_A		518.4	ug/L	1.275	0.2461	9,163
Co2286_A	W	530.4	ug/L	0.1870	0.03527	2,279
Cr2677_A		523.1	ug/L	0.5076	0.09705	6,191
Cu3273_A		517.2	ug/L	0.2400	0.04641	9,194
Fe2599_R		12,610	ug/L	14.95	0.1186	14,800
K_7664_R	F	13,820	ug/L	107.6	0.7782	4,872
Li6707_R		517.7	ug/L	0.2725	0.05264	3,959
Mg2795	W	13,280	ug/L	196.0	1.476	581,600
Mg2025_A		12,960	ug/L	20.30	0.1566	4,589
Mn2576_R		525.4	ug/L	0.8656	0.1647	3,441
Mo2020_A		512.7	ug/L	1.025	0.1999	1,638
Na5895_R	W	13,290	ug/L	0.2711	0.002040	11,010
Ni2316_A		522.5	ug/L	0.4462	0.08540	990.7
Pb2203_A		522.2	ug/L	2.920	0.5593	688.9
Sb2068_A		518.2	ug/L	0.2260	0.04362	317.1

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 4:56:18PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Se1960_A		522.8	ug/L	2.916	0.5577	132.4
Si2516_R		13,150	ug/L	11.99	0.09116	5,158
Sn1899_A		523.8	ug/L	0.9923	0.1894	314.1
Sr4215_R		521.3	ug/L	1.548	0.2970	17,970
Ti3349_A		502.2	ug/L	1.613	0.3213	18,940
Tl1908_A	F	556.5	ug/L	0.5022	0.09024	338.0
V_2924_A		516.0	ug/L	0.4622	0.08956	9,098
Zn2062_A		513.8	ug/L	2.137	0.4159	2,001
Y_3600_R		10,290	Cts/S	11.061	0.10750	10,290
Y_2243_A		7,080.9	Cts/S	9.2951	0.13127	7,080.9
Y_3600_A		183,120	Cts/S	748.82	0.40891	183,120

CCB

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:00:27PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1757	ug/L	0.04461	25.39	2.510
Al3961_R		-9.227	ug/L	0.6735	7.299	-10.45
As1891_A		-0.4105	ug/L	1.015	247.2	-3.796
B_2089_A		2.031	ug/L	0.5076	24.99	5.194
Ba4554_R		0.07331	ug/L	0.1425	194.4	28.49
Be3130_R		0.4876	ug/L	0.03135	6.430	18.77
Ca3158_R		6.140	ug/L	5.601	91.23	-33.74
Cd2265_A		0.2063	ug/L	0.02236	10.84	0.8876
Co2286_A		0.4840	ug/L	0.05531	11.43	1.214
Cr2677_A		0.2483	ug/L	0.03644	14.68	0.6448
Cu3273_A		1.001	ug/L	0.3179	31.76	3.945
Fe2599_R		2.455	ug/L	2.445	99.62	5.652
K_7664_R	W	636.3	ug/L	48.65	7.646	536.0
Li6707_R		2.098	ug/L	0.04796	2.286	27.86
Mg2795		3.900	ug/L	0.3613	9.265	193.8
Mg2025_A		3.146	ug/L	0.7225	22.97	-5.874
Mn2576_R		-0.08365	ug/L	0.1643	196.4	1.997
Mo2020_A		0.9333	ug/L	0.3496	37.46	3.202
Na5895_R		64.14	ug/L	10.37	16.17	138.2
Ni2316_A		0.03019	ug/L	0.01088	36.06	0.3069
Pb2203_A		0.2792	ug/L	0.06343	22.72	-1.959
Sb2068_A		0.1288	ug/L	0.3813	296.1	1.982
Se1960_A		-1.427	ug/L	0.6436	45.09	1.426
Si2516_R		14.24	ug/L	4.504	31.62	21.34
Sn1899_A		0.07132	ug/L	0.4058	569.0	2.108
Sr4215_R		0.3979	ug/L	0.05713	14.36	11.26
Ti3349_A		0.2909	ug/L	0.03469	11.93	13.82
Tl1908_A		0.9901	ug/L	0.3481	35.16	-2.428
V_2924_A		0.1449	ug/L	0.1296	89.42	0.3450
Zn2062_A		-1.176	ug/L	0.002155	0.1833	1.456
Y_3600_R		10,364	Cts/S	119.93	1.1572	10,364
Y_2243_A		7,156.9	Cts/S	4.3635	0.060969	7,156.9
Y_3600_A		187,160	Cts/S	378.94	0.20247	187,160

LCSWQC08ICW1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:04:44PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		50.56	ug/L	0.2243	0.4437	1,306

LCSWQC08ICW1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:04:44PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Al3961_R		2,188	ug/L	16.24	0.7424	1,477
As1891_A		105.6	ug/L	0.3260	0.3087	32.10
B_2089_A		532.4	ug/L	1.801	0.3382	635.0
Ba4554_R		2,050	ug/L	21.94	1.070	55,450
Be3130_R		51.75	ug/L	0.4473	0.8643	3,141
Ca3158_R		2,534	ug/L	36.68	1.447	1,507
Cd2265_A		258.3	ug/L	0.9287	0.3596	4,670
Co2286_A		532.9	ug/L	1.889	0.3545	2,348
Cr2677_A		211.5	ug/L	1.597	0.7551	2,563
Cu3273_A		257.5	ug/L	0.5902	0.2292	4,674
Fe2599_R		1,026	ug/L	20.37	1.985	1,241
K_7664_R		10,780	ug/L	111.0	1.030	3,982
Li6707_R		528.3	ug/L	4.731	0.8955	4,158
Mg2795		5,543	ug/L	61.08	1.102	249,700
Mg2025_A	F	5,779	ug/L	16.49	0.2853	2,109
Mn2576_R		515.8	ug/L	0.6237	0.1209	3,475
Mo2020_A		99.67	ug/L	0.7419	0.7443	326.6
Na5895_R		8,146	ug/L	70.64	0.8672	6,978
Ni2316_A		530.0	ug/L	0.9765	0.1843	1,031
Pb2203_A		108.0	ug/L	0.2865	0.2651	144.4
Sb2068_A		105.0	ug/L	0.1947	0.1854	65.31
Se1960_A		105.7	ug/L	2.558	2.420	28.96
Si2516_R		1,048	ug/L	13.10	1.251	436.0
Sn1899_A		549.2	ug/L	2.255	0.4107	337.6
Sr4215_R		526.8	ug/L	5.725	1.087	18,680
Ti3349_A		496.3	ug/L	1.866	0.3760	19,150
Tl1908_A		113.8	ug/L	0.4163	0.3660	68.62
V_2924_A		516.4	ug/L	2.713	0.5254	9,398
Zn2062_A		520.4	ug/L	0.7970	0.1531	2,079
Y_3600_R		10,588	Cts/S	117.55	1.1102	10,588
Y_2243_A		7,261.0	Cts/S	27.812	0.38304	7,261.0
Y_3600_A		187,560	Cts/S	926.81	0.49414	187,560

SQ1070-001

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:08:52PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1726	ug/L	0.3641	211.0	2.394
Al3961_R		182.4	ug/L	20.32	11.14	120.1
As1891_A		0.1454	ug/L	1.043	717.7	-3.774
B_2089_A		4.250	ug/L	0.1920	4.517	7.976
Ba4554_R		1.718	ug/L	0.6152	35.80	74.06
Be3130_R		0.1849	ug/L	0.01691	9.148	-0.03761
Ca3158_R		3,211	ug/L	9.792	0.3049	1,934
Cd2265_A		0.07423	ug/L	0.01181	15.92	-0.04862
Co2286_A		0.4047	ug/L	0.007423	1.834	1.047
Cr2677_A		1.439	ug/L	0.02438	1.694	15.43
Cu3273_A		30.24	ug/L	0.01094	0.03617	551.9
Fe2599_R		838.8	ug/L	3.897	0.4646	1,023
K_7664_R		1,114	ug/L	37.67	3.383	714.3
Li6707_R		1.623	ug/L	2.582	159.1	24.97
Mg2795		898.9	ug/L	1.480	0.1646	40,810
Mg2025_A		960.1	ug/L	6.644	0.6921	348.1
Mn2576_R		7.221	ug/L	0.1887	2.613	51.65
Mo2020_A		0.01736	ug/L	0.1838	1,059	0.2529
Na5895_R		4,740	ug/L	45.71	0.9645	4,127

SQ1070-001

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:08:52PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ni2316_A		0.1446	ug/L	0.06445	44.56	0.5168
Pb2203_A		0.7755	ug/L	0.5817	75.00	-1.305
Sb2068_A		-0.9091	ug/L	0.4368	48.05	1.491
Se1960_A		0.01615	ug/L	2.351	14,550	1.851
Si2516_R		8,079	ug/L	7.281	0.09012	3,292
Sn1899_A		0.3343	ug/L	0.1387	41.50	2.341
Sr4215_R		29.45	ug/L	0.03852	0.1308	1,050
Ti3349_A		14.76	ug/L	0.4553	3.085	587.3
Tl1908_A		1.953	ug/L	0.4655	23.84	-1.914
V_2924_A		0.4555	ug/L	0.03829	8.405	6.505
Zn2062_A	W	4,034	ug/L	15.21	0.3770	16,380
Y_3600_R		10,666	Cts/S	48.828	0.45780	10,666
Y_2243_A		7,394.3	Cts/S	40.278	0.54473	7,394.3
Y_3600_A		192,540	Cts/S	923.70	0.47973	192,540

LC2OQC13ICS1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:13:07PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		46.11	ug/L	0.05288	0.1147	1,172
Al3961_R		2,094	ug/L	2.384	0.1139	1,387
As1891_A		95.58	ug/L	0.1566	0.1638	27.85
B_2089_A		488.6	ug/L	1.332	0.2727	565.9
Ba4554_R		1,980	ug/L	7.929	0.4004	52,590
Be3130_R		49.96	ug/L	0.04077	0.08161	2,977
Ca3158_R		2,446	ug/L	0.9188	0.03756	1,427
Cd2265_A		244.7	ug/L	0.2103	0.08594	4,292
Co2286_A		511.2	ug/L	1.461	0.2859	2,185
Cr2677_A		198.6	ug/L	1.532	0.7716	2,370
Cu3273_A		246.9	ug/L	1.068	0.4326	4,413
Fe2599_R		998.1	ug/L	1.486	0.1489	1,185
K_7664_R		10,340	ug/L	59.16	0.5719	3,764
Li6707_R		512.9	ug/L	0.9048	0.1764	3,962
Mg2795		5,304	ug/L	19.26	0.3631	234,600
Mg2025_A		5,233	ug/L	14.29	0.2731	1,853
Mn2576_R		497.6	ug/L	2.466	0.4956	3,291
Mo2020_A		97.70	ug/L	0.2660	0.2723	310.5
Na5895_R		7,783	ug/L	19.43	0.2496	6,549
Ni2316_A		506.3	ug/L	1.059	0.2092	955.2
Pb2203_A		101.1	ug/L	0.07121	0.07046	130.9
Sb2068_A		97.37	ug/L	0.2719	0.2792	58.55
Se1960_A		94.76	ug/L	0.05809	0.06131	25.37
Si2516_R		946.2	ug/L	1.089	0.1151	388.1
Sn1899_A		572.2	ug/L	0.9712	0.1697	341.1
Sr4215_R		509.2	ug/L	1.604	0.3151	17,730
Ti3349_A		470.1	ug/L	1.717	0.3653	17,870
Tl1908_A		104.1	ug/L	0.3596	0.3456	60.64
V_2924_A		487.5	ug/L	1.082	0.2219	8,739
Zn2062_A		492.0	ug/L	1.216	0.2472	1,907
Y_3600_R		10,394	Cts/S	75.344	0.72490	10,394
Y_2243_A		7,043.7	Cts/S	5.9728	0.084797	7,043.7
Y_3600_A		184,750	Cts/S	102.39	0.055421	184,750

LCSOQC13ICS1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF

LCSOQC13ICS1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:17:14PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		44.92	ug/L	0.1379	0.3071	1,124
Al3961_R		2,067	ug/L	14.79	0.7155	1,357
As1891_A		93.42	ug/L	0.6916	0.7403	26.94
B_2089_A		477.2	ug/L	0.7624	0.1598	548.6
Ba4554_R		1,943	ug/L	8.258	0.4250	51,130
Be3130_R		49.47	ug/L	0.4109	0.8307	2,920
Ca3158_R		2,440	ug/L	34.21	1.402	1,410
Cd2265_A		241.2	ug/L	0.4313	0.1788	4,198
Co2286_A		504.7	ug/L	0.8693	0.1722	2,141
Cr2677_A		198.0	ug/L	1.501	0.7582	2,326
Cu3273_A		244.3	ug/L	0.3538	0.1448	4,298
Fe2599_R		1,005	ug/L	9.463	0.9418	1,182
K_7664_R		10,210	ug/L	20.20	0.1979	3,684
Li6707_R		508.9	ug/L	0.9545	0.1876	3,895
Mg2795		5,252	ug/L	26.20	0.4988	230,100
Mg2025_A		5,085	ug/L	14.08	0.2769	1,787
Mn2576_R		490.7	ug/L	1.545	0.3148	3,216
Mo2020_A		97.50	ug/L	0.07839	0.08039	307.5
Na5895_R		7,619	ug/L	19.01	0.2495	6,354
Ni2316_A		498.9	ug/L	0.5334	0.1069	934.0
Pb2203_A		99.26	ug/L	0.4182	0.4213	127.5
Sb2068_A		95.97	ug/L	1.401	1.460	57.30
Se1960_A		94.23	ug/L	0.8082	0.8577	25.05
Si2516_R		989.2	ug/L	2.236	0.2261	401.4
Sn1899_A		563.0	ug/L	1.393	0.2474	333.1
Sr4215_R		500.8	ug/L	2.491	0.4973	17,270
Ti3349_A		471.1	ug/L	3.432	0.7285	17,620
Tl1908_A		100.4	ug/L	0.4590	0.4572	57.95
V_2924_A		486.9	ug/L	2.494	0.5122	8,588
Zn2062_A		485.0	ug/L	1.244	0.2564	1,865
Y_3600_R		10,298	Cts/S	31.560	0.30646	10,298
Y_2243_A		6,989.7	Cts/S	11.895	0.17018	6,989.7
Y_3600_A		181,790	Cts/S	816.35	0.44905	181,790

PBSQC13ICS1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:21:22PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2404	ug/L	0.06221	25.88	-8.249
Al3961_R		-1.026	ug/L	5.341	520.6	-4.983
As1891_A		1.092	ug/L	0.8818	80.76	-3.300
B_2089_A		1.827	ug/L	0.2803	15.34	4.946
Ba4554_R		0.5738	ug/L	0.1110	19.35	41.44
Be3130_R		0.03004	ug/L	0.007519	25.03	-8.514
Ca3158_R		35.69	ug/L	4.761	13.34	-15.98
Cd2265_A		0.001036	ug/L	0.002179	210.4	-2.718
Co2286_A		0.01304	ug/L	0.1875	1,438	-0.8285
Cr2677_A		0.3054	ug/L	0.07981	26.13	1.335
Cu3273_A		0.6077	ug/L	0.02450	4.032	-3.170
Fe2599_R		39.39	ug/L	1.981	5.028	48.95
K_7664_R		91.74	ug/L	15.87	17.30	353.0
Li6707_R		1.414	ug/L	1.073	75.86	22.41
Mg2795		16.35	ug/L	0.07837	0.4793	737.6
Mg2025_A		10.64	ug/L	0.2828	2.659	-3.240
Mn2576_R		0.9883	ug/L	0.2328	23.55	9.015
Mo2020_A		0.4672	ug/L	0.08932	19.12	1.701

PBSQC13ICS1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:21:22PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		18.05	ug/L	20.88	115.7	99.45
Ni2316_A		0.4996	ug/L	0.4479	89.64	1.208
Pb2203_A		-0.07323	ug/L	0.6728	918.7	-2.437
Sb2068_A		0.4673	ug/L	1.214	259.8	1.951
Se1960_A		0.6289	ug/L	0.1482	23.57	1.950
Si2516_R		5.452	ug/L	4.525	83.00	17.75
Sn1899_A		47.32	ug/L	0.7273	1.537	30.64
Sr4215_R		-0.03656	ug/L	0.02020	55.26	-3.811
Ti3349_A		0.3473	ug/L	0.008329	2.398	15.98
Tl1908_A		-0.6452	ug/L	0.9712	150.5	-3.452
V_2924_A		-0.1650	ug/L	0.03555	21.55	-5.243
Zn2062_A		-0.7359	ug/L	0.03199	4.347	3.192
Y_3600_R		10,293	Cts/S	120.87	1.1743	10,293
Y_2243_A		7,176.9	Cts/S	3.6077	0.050269	7,176.9
Y_3600_A		187,090	Cts/S	666.54	0.35627	187,090

SQ1129-001

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:25:40PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.4623	ug/L	0.02490	5.385	-12.50
Al3961_R	W	182,800	ug/L	299.2	0.1636	60,360
As1891_A		96.71	ug/L	1.299	1.343	5.149
B_2089_A		58.09	ug/L	0.09684	0.1667	35.52
Ba4554_R		984.2	ug/L	16.65	1.692	13,020
Be3130_R		13.69	ug/L	0.1422	1.039	359.5
Ca3158_R	W	427,200	ug/L	1,562	0.3657	127,200
Cd2265_A		3.267	ug/L	0.1980	6.061	242.9
Co2286_A		117.5	ug/L	0.4839	0.4118	253.9
Cr2677_A		242.2	ug/L	0.08914	0.03681	1,378
Cu3273_A	W	4,588	ug/L	0.1537	0.003350	39,560
Fe2599_R	W	266,900	ug/L	506.1	0.1896	157,300
K_7664_R		18,580	ug/L	135.9	0.7316	3,395
Li6707_R		254.0	ug/L	5.279	2.079	984.8
Mg2795	W	56,980	ug/L	315.5	0.5537	1,253,000
Mg2025_A	W	54,960	ug/L	123.0	0.2237	9,414
Mn2576_R	W	10,750	ug/L	72.56	0.6749	35,350
Mo2020_A		16.12	ug/L	0.04010	0.2488	24.83
Na5895_R		3,342	ug/L	47.66	1.426	1,465
Ni2316_A		152.6	ug/L	0.5859	0.3839	137.1
Pb2203_A	W	34,970	ug/L	7.872	0.02251	22,540
Sb2068_A		106.4	ug/L	0.01708	0.01605	35.34
Se1960_A		3.574	ug/L	3.208	89.75	3.730
Si2516_R		2,839	ug/L	38.32	1.350	569.4
Sn1899_A		90.82	ug/L	1.561	1.718	28.29
Sr4215_R		728.0	ug/L	7.692	1.057	12,600
Ti3349_A		1,743	ug/L	9.113	0.5229	31,740
Tl1908_A		-5.003	ug/L	3.504	70.04	-9.384
V_2924_A		352.1	ug/L	0.2963	0.08416	3,016
Zn2062_A		1,637	ug/L	0.9690	0.05920	3,097
Y_3600_R		10,339	Cts/S	31.538	0.30503	10,339
Y_2243_A		6,885.0	Cts/S	5.7546	0.083582	6,885.0
Y_3600_A		177,040	Cts/S	3.9173	0.0022130	177,040

SQ1129-003

Method Name: FAST-2022_POP
Method Revision: 169

SQ1129-003

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:29:54PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.3894	ug/L	2.165	556.0	-1.851
Al3961_R	W	158,500	ug/L	364.2	0.2298	21,060
As1891_A		88.27	ug/L	5.530	6.264	-1.092
B_2089_A		51.19	ug/L	2.273	4.440	14.52
Ba4554_R		824.5	ug/L	3.637	0.4411	4,410
Be3130_R		10.99	ug/L	0.3724	3.390	108.1
Ca3158_R	W	325,900	ug/L	1,089	0.3343	39,040
Cd2265_A		5.322	ug/L	0.6169	11.59	121.6
Co2286_A		122.7	ug/L	0.1673	0.1364	107.1
Cr2677_A		229.0	ug/L	1.503	0.6563	534.2
Cu3273_A	W	5,566	ug/L	18.99	0.3412	19,760
Fe2599_R	W	318,300	ug/L	1,074	0.3374	75,530
K_7664_R		18,200	ug/L	456.2	2.507	1,538
Li6707_R		208.7	ug/L	2.833	1.358	333.7
Mg2795		43,970	ug/L	193.4	0.4398	389,500
Mg2025_A		42,320	ug/L	389.2	0.9197	2,952
Mn2576_R	W	9,582	ug/L	49.04	0.5118	12,690
Mo2020_A		13.58	ug/L	0.3642	2.682	8.639
Na5895_R		2,685	ug/L	18.10	0.6743	532.0
Ni2316_A		138.0	ug/L	0.7745	0.5611	50.23
Pb2203_A	W	63,590	ug/L	574.8	0.9039	16,710
Sb2068_A		250.8	ug/L	2.906	1.159	32.94
Se1960_A		-3.333	ug/L	7.989	239.7	2.189
Si2516_R		4,041	ug/L	0.9098	0.02252	333.9
Sn1899_A		161.6	ug/L	1.615	0.9992	21.11
Sr4215_R		577.1	ug/L	0.5383	0.09327	4,022
Ti3349_A		1,522	ug/L	11.65	0.7652	11,420
Tl1908_A		-2.419	ug/L	0.07874	3.255	-5.107
V_2924_A		316.4	ug/L	2.442	0.7716	1,116
Zn2062_A		1,765	ug/L	11.36	0.6434	1,365
Y_3600_R		10,408	Cts/S	5.8036	0.055760	10,408
Y_2243_A		7,017.4	Cts/S	37.604	0.53587	7,017.4
Y_3600_A		182,270	Cts/S	793.20	0.43518	182,270

SQ1129-005

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:34:10PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.7112	ug/L	0.7990	112.3	-0.9711
Al3961_R	W	214,900	ug/L	287.8	0.1340	28,320
As1891_A		115.8	ug/L	1.701	1.468	0.1195
B_2089_A		63.17	ug/L	1.611	2.551	17.21
Ba4554_R		1,067	ug/L	2.817	0.2640	5,652
Be3130_R		7.437	ug/L	0.04177	0.5617	59.14
Ca3158_R	W	518,100	ug/L	12,370	2.387	61,570
Cd2265_A		4.959	ug/L	0.3137	6.325	137.9
Co2286_A		127.2	ug/L	1.678	1.319	111.8
Cr2677_A		267.2	ug/L	1.254	0.4693	616.4
Cu3273_A	W	5,837	ug/L	2.714	0.04650	20,500
Fe2599_R	W	373,000	ug/L	5,623	1.508	87,760
K_7664_R		24,240	ug/L	114.2	0.4711	1,924
Li6707_R		285.6	ug/L	4.320	1.513	448.6
Mg2795		36,970	ug/L	180.9	0.4893	324,800
Mg2025_A		33,940	ug/L	34.86	0.1027	2,357
Mn2576_R	W	9,238	ug/L	9.828	0.1064	12,130
Mo2020_A		16.97	ug/L	0.1713	1.009	10.74

SQ1129-005

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:34:10PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		3,726	ug/L	24.38	0.6542	699.3
Ni2316_A		224.1	ug/L	0.5563	0.2483	81.88
Pb2203_A	W	46,160	ug/L	243.6	0.5278	12,080
Sb2068_A		192.6	ug/L	2.928	1.520	26.03
Se1960_A		-9.989	ug/L	3.050	30.54	1.908
Si2516_R		3,526	ug/L	3.430	0.09727	290.1
Sn1899_A		119.0	ug/L	1.393	1.171	16.01
Sr4215_R		832.9	ug/L	3.818	0.4584	5,757
Ti3349_A		2,182	ug/L	11.48	0.5262	16,180
Tl1908_A		-2.301	ug/L	2.926	127.2	-5.090
V_2924_A		452.8	ug/L	0.1206	0.02664	1,586
Zn2062_A		2,146	ug/L	15.08	0.7027	1,652
Y_3600_R		10,322	Cts/S	157.22	1.5232	10,322
Y_2243_A		6,987.5	Cts/S	17.401	0.24903	6,987.5
Y_3600_A		180,270	Cts/S	682.20	0.37843	180,270

LCSWQC13ICW1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:38:21PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		50.68	ug/L	0.6382	1.259	1,319
Al3961_R		2,236	ug/L	26.25	1.174	1,500
As1891_A		107.6	ug/L	0.2301	0.2138	32.70
B_2089_A		541.1	ug/L	0.09600	0.01774	643.6
Ba4554_R		2,082	ug/L	2.653	0.1274	55,960
Be3130_R		52.46	ug/L	0.2001	0.3815	3,164
Ca3158_R		2,566	ug/L	21.54	0.8394	1,517
Cd2265_A		261.3	ug/L	0.08998	0.03443	4,713
Co2286_A		546.9	ug/L	0.4822	0.08817	2,403
Cr2677_A		211.7	ug/L	0.2583	0.1220	2,586
Cu3273_A		260.6	ug/L	0.1943	0.07455	4,769
Fe2599_R		1,058	ug/L	3.764	0.3557	1,271
K_7664_R		10,650	ug/L	1.931	0.01813	3,912
Li6707_R		534.7	ug/L	0.8415	0.1574	4,180
Mg2795		5,592	ug/L	16.78	0.3000	250,300
Mg2025_A		5,767	ug/L	8.392	0.1455	2,099
Mn2576_R		526.6	ug/L	3.441	0.6534	3,524
Mo2020_A		100.1	ug/L	0.2804	0.2801	327.1
Na5895_R		8,188	ug/L	23.10	0.2822	6,967
Ni2316_A		541.2	ug/L	0.4712	0.08708	1,050
Pb2203_A		109.6	ug/L	0.2211	0.2017	146.1
Sb2068_A		106.5	ug/L	0.7546	0.7084	66.02
Se1960_A		107.7	ug/L	1.087	1.009	29.40
Si2516_R		1,061	ug/L	8.559	0.8068	438.5
Sn1899_A		557.8	ug/L	1.170	0.2097	342.0
Sr4215_R		532.6	ug/L	0.03703	0.006952	18,760
Ti3349_A		491.4	ug/L	0.1994	0.04057	19,120
Tl1908_A	F	115.9	ug/L	1.720	1.484	69.77
V_2924_A		518.5	ug/L	0.8902	0.1717	9,512
Zn2062_A		530.0	ug/L	0.2001	0.03775	2,112
Y_3600_R		10,518	Cts/S	185.01	1.7589	10,518
Y_2243_A		7,241.3	Cts/S	8.1602	0.11269	7,241.3
Y_3600_A		189,060	Cts/S	31.974	0.016912	189,060

PBWQC13ICW1

Method Name: FAST-2022_POP
Method Revision: 169

PBWQC13ICW1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:42:29PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.02880	ug/L	0.1444	501.4	-1.288
Al3961_R		-1.597	ug/L	2.132	133.5	-5.581
As1891_A		3.061	ug/L	0.6256	20.44	-2.728
B_2089_A		-0.2810	ug/L	0.2055	73.11	2.568
Ba4554_R		0.5449	ug/L	0.6582	120.8	41.93
Be3130_R		-0.004051	ug/L	0.05367	1,325	-10.85
Ca3158_R		18.60	ug/L	2.002	10.77	-27.00
Cd2265_A		0.05514	ug/L	0.02796	50.70	-1.868
Co2286_A		0.4646	ug/L	0.03133	6.744	1.166
Cr2677_A		0.2315	ug/L	0.1020	44.06	0.4434
Cu3273_A		0.2520	ug/L	0.1290	51.21	-9.882
Fe2599_R		2.425	ug/L	2.536	104.6	5.729
K_7664_R		142.1	ug/L	40.44	28.45	382.5
Li6707_R		-0.9916	ug/L	2.296	231.6	4.398
Mg2795		6.178	ug/L	0.07831	1.268	302.2
Mg2025_A		11.34	ug/L	1.222	10.77	-3.059
Mn2576_R		0.2230	ug/L	0.2967	133.1	4.118
Mo2020_A		0.4242	ug/L	0.02266	5.341	1.611
Na5895_R		11.16	ug/L	5.295	47.45	96.90
Ni2316_A		-0.1328	ug/L	0.01192	8.978	-0.005834
Pb2203_A		0.7714	ug/L	0.2834	36.74	-1.345
Sb2068_A		-0.7542	ug/L	0.04788	6.348	1.492
Se1960_A		-1.966	ug/L	0.7362	37.44	1.334
Si2516_R		-9.921	ug/L	0.9221	9.295	12.13
Sn1899_A		-0.7038	ug/L	0.002947	0.4187	1.697
Sr4215_R		0.2433	ug/L	0.1788	73.47	6.098
Ti3349_A		0.004071	ug/L	0.07888	1,937	2.851
Tl1908_A		2.026	ug/L	0.7038	34.75	-1.847
V_2924_A		0.1578	ug/L	0.08856	56.13	0.6404
Zn2062_A		-0.9794	ug/L	0.01792	1.829	2.303
Y_3600_R		10,650	Cts/S	172.17	1.6167	10,650
Y_2243_A		7,401.1	Cts/S	24.858	0.33587	7,401.1
Y_3600_A		191,450	Cts/S	2,821.2	1.4736	191,450

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:46:50PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		491.0	ug/L	4.087	0.8324	12,380
Al3961_R		13,030	ug/L	20.88	0.1603	8,564
As1891_A		517.3	ug/L	0.5155	0.09965	165.8
B_2089_A		521.4	ug/L	0.9619	0.1845	623.9
Ba4554_R		514.8	ug/L	2.018	0.3919	13,550
Be3130_R		512.6	ug/L	0.5291	0.1032	30,380
Ca3158_R		12,130	ug/L	30.30	0.2498	7,152
Cd2265_A		518.5	ug/L	0.1163	0.02244	9,109
Co2286_A	W	531.5	ug/L	0.3642	0.06852	2,270
Cr2677_A		525.2	ug/L	2.898	0.5517	6,197
Cu3273_A		509.8	ug/L	0.8457	0.1659	9,035
Fe2599_R		12,270	ug/L	4.362	0.03556	14,390
K_7664_R		12,930	ug/L	75.38	0.5829	4,577
Li6707_R		508.5	ug/L	2.831	0.5568	3,888
Mg2795		13,000	ug/L	282.1	2.170	568,900
Mg2025_A		12,780	ug/L	11.01	0.08612	4,499
Mn2576_R		522.8	ug/L	1.501	0.2870	3,423
Mo2020_A		507.4	ug/L	0.00006700	0.00001300	1,611

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:46:50PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		12,970	ug/L	1.141	0.008801	10,740
Ni2316_A		522.9	ug/L	0.4837	0.09251	985.5
Pb2203_A		522.2	ug/L	0.09635	0.01845	684.8
Sb2068_A		517.9	ug/L	0.5518	0.1066	315.0
Se1960_A		517.2	ug/L	1.726	0.3336	130.2
Si2516_R		12,950	ug/L	9.470	0.07312	5,079
Sn1899_A		524.8	ug/L	1.914	0.3648	312.8
Sr4215_R		511.5	ug/L	2.576	0.5037	17,620
Ti3349_A		497.2	ug/L	4.175	0.8396	18,690
Tl1908_A	F	555.3	ug/L	3.586	0.6457	335.3
V_2924_A		511.7	ug/L	2.064	0.4035	8,993
Zn2062_A		512.9	ug/L	0.9558	0.1864	1,985
Y_3600_R		10,287	Cts/S	109.31	1.0627	10,287
Y_2243_A		7,038.4	Cts/S	4.1483	0.058939	7,038.4
Y_3600_A		182,550	Cts/S	1,441.2	0.78951	182,550

CCB

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:51:00PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.01462	ug/L	0.008729	59.72	-2.410
Al3961_R		-11.06	ug/L	7.237	65.45	-11.79
As1891_A		-0.9521	ug/L	0.02735	2.873	-3.964
B_2089_A		0.4431	ug/L	0.004076	0.9198	3.320
Ba4554_R		0.1087	ug/L	0.3010	276.9	29.70
Be3130_R		0.06996	ug/L	0.01229	17.57	-6.240
Ca3158_R		1.973	ug/L	13.23	670.5	-36.59
Cd2265_A		0.01393	ug/L	0.04078	292.6	-2.532
Co2286_A		0.1431	ug/L	0.001186	0.8289	-0.2649
Cr2677_A		0.1185	ug/L	0.1006	84.88	-0.9273
Cu3273_A		0.5199	ug/L	0.2201	42.34	-4.807
Fe2599_R		3.039	ug/L	0.5592	18.40	6.392
K_7664_R		143.7	ug/L	51.60	35.91	376.5
Li6707_R		1.434	ug/L	0.3660	25.53	23.01
Mg2795		2.019	ug/L	0.1478	7.319	111.9
Mg2025_A		3.351	ug/L	0.3487	10.40	-5.800
Mn2576_R		-0.4196	ug/L	0.3903	93.02	-0.2163
Mo2020_A		0.5624	ug/L	0.2000	35.57	1.997
Na5895_R		1.613	ug/L	6.348	393.5	87.32
Ni2316_A		-0.3142	ug/L	0.07974	25.38	-0.3521
Pb2203_A		0.2753	ug/L	0.2282	82.91	-1.957
Sb2068_A		0.2855	ug/L	0.5127	179.6	2.076
Se1960_A		-0.8038	ug/L	1.851	230.3	1.577
Si2516_R		5.435	ug/L	4.273	78.61	18.04
Sn1899_A		-0.7632	ug/L	0.6220	81.50	1.599
Sr4215_R		-0.05751	ug/L	0.2530	439.9	-4.597
Ti3349_A		0.07274	ug/L	0.2288	314.6	5.404
Tl1908_A		-0.3875	ug/L	0.06838	17.65	-3.270
V_2924_A		-0.1997	ug/L	0.09317	46.65	-5.876
Zn2062_A		-1.320	ug/L	0.07527	5.700	0.8853
Y_3600_R		10,472	Cts/S	26.867	0.25656	10,472
Y_2243_A		7,132.5	Cts/S	8.2621	0.11584	7,132.5
Y_3600_A		187,160	Cts/S	350.98	0.18753	187,160

SQ1089-001

Method Name: FAST-2022_POP
Method Revision: 169

SQ1089-001

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:55:18PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.03180	ug/L	0.5321	1,673	-2.871
Al3961_R		5.403	ug/L	5.674	105.0	2.334
As1891_A		1.694	ug/L	0.08052	4.753	-3.118
B_2089_A		3.831	ug/L	0.06698	1.748	7.413
Ba4554_R		63.85	ug/L	0.2252	0.3527	1,766
Be3130_R		0.05417	ug/L	0.06779	125.1	-7.474
Ca3158_R		19,000	ug/L	20.11	0.1058	11,630
Cd2265_A		0.03903	ug/L	0.03701	94.81	-1.881
Co2286_A		0.3205	ug/L	0.01670	5.211	0.5335
Cr2677_A		0.6368	ug/L	0.1222	19.19	5.390
Cu3273_A		0.3868	ug/L	0.1728	44.66	-7.117
Fe2599_R		133.6	ug/L	1.132	0.8470	165.2
K_7664_R		2,286	ug/L	21.79	0.9531	1,114
Li6707_R		3.268	ug/L	0.07528	2.304	37.91
Mg2795		7,846	ug/L	62.56	0.7973	356,000
Mg2025_A		8,122	ug/L	35.06	0.4317	2,902
Mn2576_R		47.13	ug/L	0.1613	0.3422	322.2
Mo2020_A		2.651	ug/L	0.1000	3.773	8.795
Na5895_R		14,080	ug/L	57.16	0.4060	12,080
Ni2316_A		-0.4861	ug/L	0.1505	30.96	-0.6897
Pb2203_A		0.5234	ug/L	0.2073	39.62	-1.637
Sb2068_A		-1.147	ug/L	0.9552	83.25	1.209
Se1960_A		-2.333	ug/L	1.171	50.20	1.213
Si2516_R		5,602	ug/L	13.43	0.2398	2,287
Sn1899_A		-0.7653	ug/L	0.4802	62.75	1.613
Sr4215_R		253.7	ug/L	0.6016	0.2372	9,058
Ti3349_A		2.885	ug/L	0.07311	2.534	113.9
Tl1908_A		2.153	ug/L	0.3624	16.83	-1.762
V_2924_A		-0.1959	ug/L	0.1212	61.85	-6.341
Zn2062_A		-0.7220	ug/L	0.07240	10.03	3.255
Y_3600_R		10,663	Cts/S	1.7362	0.016283	10,663
Y_2243_A		7,197.3	Cts/S	2.4699	0.034318	7,197.3
Y_3600_A		187,380	Cts/S	57.940	0.030922	187,380

SQ1174-002

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:59:41PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.03495	ug/L	0.03152	90.19	-2.248
Al3961_R		1,187	ug/L	25.14	2.118	501.8
As1891_A		2.723	ug/L	4.618	169.6	-2.206
B_2089_A	W	19,240	ug/L	3.714	0.01930	9,889
Ba4554_R		161.6	ug/L	0.1262	0.07812	2,101
Be3130_R		-0.1637	ug/L	0.1374	83.92	-15.32
Ca3158_R	W	758,100	ug/L	1,726	0.2276	219,600
Cd2265_A		0.02365	ug/L	0.05906	249.7	5.365
Co2286_A		13.98	ug/L	0.06343	0.4537	25.92
Cr2677_A		10.12	ug/L	0.7569	7.480	51.34
Cu3273_A		17.08	ug/L	0.3480	2.038	129.0
Fe2599_R		10,460	ug/L	109.3	1.044	5,999
K_7664_R	W	144,100	ug/L	37.86	0.02628	23,490
Li6707_R		183.2	ug/L	2.015	1.099	694.4
Mg2795		5,124	ug/L	21.30	0.4157	109,700
Mg2025_A		4,405	ug/L	2.076	0.04714	692.4
Mn2576_R		51.52	ug/L	1.359	2.639	167.5
Mo2020_A	W	5,386	ug/L	12.81	0.2379	7,605

SQ1174-002

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 5:59:41PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R	F	790,800	ug/L	6,043	0.7641	317,900
Ni2316_A		142.1	ug/L	0.01845	0.01298	120.1
Pb2203_A		-1.273	ug/L	1.264	99.33	-5.074
Sb2068_A		82.20	ug/L	0.4300	0.5231	21.44
Se1960_A		9.527	ug/L	1.525	16.01	2.628
Si2516_R		6,147	ug/L	106.5	1.732	1,192
Sn1899_A		12.65	ug/L	1.977	15.62	5.137
Sr4215_R	W	2,563	ug/L	2.214	0.08639	43,170
Ti3349_A		19.36	ug/L	0.2943	1.521	395.1
Tl1908_A		-2.182	ug/L	0.9630	44.12	-3.273
V_2924_A		-1.524	ug/L	0.2305	15.12	-302.6
Zn2062_A		28.34	ug/L	0.1339	0.4727	53.96
Y_3600_R		10,059	Cts/S	116.22	1.1553	10,059
Y_2243_A		6,258.3	Cts/S	15.226	0.24329	6,258.3
Y_3600_A		164,380	Cts/S	492.46	0.29959	164,380

LCSWQC14ICW1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:04:06PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		49.66	ug/L	0.3725	0.7501	1,261
Al3961_R		2,242	ug/L	2.472	0.1102	1,480
As1891_A		103.3	ug/L	1.201	1.163	30.33
B_2089_A		531.2	ug/L	3.509	0.6606	614.0
Ba4554_R		2,121	ug/L	8.407	0.3963	56,110
Be3130_R		54.14	ug/L	0.3263	0.6027	3,214
Ca3158_R		2,657	ug/L	21.39	0.8047	1,548
Cd2265_A		261.7	ug/L	1.666	0.6367	4,583
Co2286_A		549.1	ug/L	3.388	0.6170	2,344
Cr2677_A		214.8	ug/L	0.6059	0.2821	2,560
Cu3273_A		265.5	ug/L	0.4172	0.1571	4,740
Fe2599_R		1,076	ug/L	3.336	0.3099	1,273
K_7664_R		10,680	ug/L	23.08	0.2162	3,859
Li6707_R		556.5	ug/L	0.1408	0.02529	4,281
Mg2795		5,701	ug/L	11.13	0.1953	251,100
Mg2025_A		5,604	ug/L	40.54	0.7234	1,982
Mn2576_R		531.8	ug/L	0.7341	0.1380	3,503
Mo2020_A		106.7	ug/L	1.137	1.066	338.5
Na5895_R		8,399	ug/L	14.45	0.1721	7,032
Ni2316_A		544.0	ug/L	3.515	0.6462	1,025
Pb2203_A		107.7	ug/L	0.7527	0.6986	139.4
Sb2068_A		106.2	ug/L	1.799	1.695	63.94
Se1960_A		100.2	ug/L	1.764	1.761	26.68
Si2516_R		1,118	ug/L	1.439	0.1286	454.2
Sn1899_A		550.4	ug/L	5.436	0.9877	327.7
Sr4215_R		544.4	ug/L	2.281	0.4189	18,880
Ti3349_A		508.4	ug/L	0.1632	0.03210	19,290
Tl1908_A		106.9	ug/L	0.8909	0.8331	62.31
V_2924_A		527.4	ug/L	3.056	0.5794	9,438
Zn2062_A		522.8	ug/L	2.638	0.5047	2,023
Y_3600_R		10,352	Cts/S	39.344	0.38006	10,352
Y_2243_A		7,032.5	Cts/S	23.116	0.32870	7,032.5
Y_3600_A		184,440	Cts/S	436.78	0.23681	184,440

PBWQC14ICW1

Method Name: FAST-2022_POP
Method Revision: 169

PBWQC14ICW1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:08:14PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.08653	ug/L	0.2198	254.0	-4.242
Al3961_R		-1.044	ug/L	3.721	356.4	-5.097
As1891_A		0.2947	ug/L	0.1056	35.83	-3.565
B_2089_A		2.113	ug/L	0.08224	3.891	5.284
Ba4554_R		0.08064	ug/L	0.4411	547.0	28.83
Be3130_R		-0.01882	ug/L	0.01568	83.34	-11.57
Ca3158_R		35.14	ug/L	13.59	38.67	-16.50
Cd2265_A		-0.009545	ug/L	0.02220	232.6	-2.969
Co2286_A		0.004552	ug/L	0.1907	4,190	-0.8661
Cr2677_A		-0.1339	ug/L	0.1955	146.0	-3.952
Cu3273_A		0.3832	ug/L	0.4050	105.7	-7.249
Fe2599_R		-0.6817	ug/L	0.6110	89.63	1.949
K_7664_R		-22.02	ug/L	20.28	92.09	320.3
Li6707_R		1.413	ug/L	0.9488	67.15	22.83
Mg2795		7.377	ug/L	0.1936	2.624	349.8
Mg2025_A		5.178	ug/L	2.424	46.82	-5.182
Mn2576_R		-0.1010	ug/L	0.1021	101.0	1.900
Mo2020_A		0.7219	ug/L	0.1829	25.34	2.521
Na5895_R		33.05	ug/L	8.509	25.74	113.4
Ni2316_A		-0.06313	ug/L	0.2566	406.5	0.1287
Pb2203_A		0.04848	ug/L	0.01892	39.03	-2.272
Sb2068_A		0.7725	ug/L	0.2005	25.95	2.379
Se1960_A		0.09820	ug/L	1.022	1,041	1.812
Si2516_R		6.523	ug/L	7.127	109.3	18.45
Sn1899_A		0.2009	ug/L	0.03929	19.55	2.188
Sr4215_R		0.08050	ug/L	0.3705	460.3	0.2999
Ti3349_A		0.1417	ug/L	0.1243	87.76	8.005
Tl1908_A		0.2651	ug/L	0.03349	12.63	-2.881
V_2924_A		-0.05198	ug/L	0.02267	43.60	-3.163
Zn2062_A		-1.011	ug/L	0.05727	5.666	2.109
Y_3600_R		10,447	Cts/S	108.72	1.0407	10,447
Y_2243_A		7,165.2	Cts/S	13.771	0.19220	7,165.2
Y_3600_A		185,790	Cts/S	256.61	0.13812	185,790

SQ1119-001

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:12:32PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.9416	ug/L	0.1016	10.78	-13.40
Al3961_R		1,358	ug/L	3.796	0.2795	441.0
As1891_A		-0.6544	ug/L	0.03827	5.848	-3.621
B_2089_A		5.870	ug/L	0.4893	8.337	5.978
Ba4554_R		134.1	ug/L	0.4981	0.3714	1,783
Be3130_R		0.3956	ug/L	0.04535	11.46	1.339
Ca3158_R		9,852	ug/L	107.2	1.088	2,873
Cd2265_A		0.2423	ug/L	0.06171	25.47	-0.5812
Co2286_A		3.229	ug/L	0.2489	7.707	5.890
Cr2677_A		0.9882	ug/L	0.1699	17.20	3.512
Cu3273_A		1.441	ug/L	0.05953	4.132	-1.336
Fe2599_R		40.92	ug/L	5.393	13.18	26.65
K_7664_R		2,142	ug/L	34.39	1.606	673.0
Li6707_R		-1.337	ug/L	1.442	107.8	6.588
Mg2795		1,574	ug/L	14.96	0.9507	34,360
Mg2025_A		1,437	ug/L	11.52	0.8014	239.0
Mn2576_R		215.3	ug/L	0.5990	0.2783	704.5
Mo2020_A		1.304	ug/L	0.4388	33.66	2.193

SQ1119-001

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:12:32PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R	W	226,000	ug/L	1,414	0.6253	92,710
Ni2316_A		6.356	ug/L	0.4591	7.224	6.084
Pb2203_A		1.024	ug/L	1.418	138.5	-1.664
Sb2068_A		1.457	ug/L	0.1251	8.582	2.262
Se1960_A		0.7975	ug/L	2.727	342.0	1.832
Si2516_R		1,065	ug/L	13.40	1.258	223.2
Sn1899_A		0.6955	ug/L	0.1781	25.61	2.183
Sr4215_R		48.25	ug/L	0.5696	1.180	826.4
Ti3349_A		4.410	ug/L	0.01960	0.4445	82.46
Tl1908_A		-0.1654	ug/L	0.4461	269.6	-3.055
V_2924_A		0.08573	ug/L	0.1038	121.1	-2.014
Zn2062_A		12.68	ug/L	0.2441	1.926	29.72
Y_3600_R		10,258	Cts/S	139.63	1.3612	10,258
Y_2243_A		6,869.8	Cts/S	9.7878	0.14248	6,869.8
Y_3600_A		176,340	Cts/S	267.61	0.15176	176,340

LCSWQC15ICW2

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:16:47PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		49.82	ug/L	0.1033	0.2073	1,262
Al3961_R		2,295	ug/L	9.391	0.4092	1,490
As1891_A		104.0	ug/L	0.4697	0.4516	30.62
B_2089_A		529.2	ug/L	3.345	0.6321	612.6
Ba4554_R		2,171	ug/L	8.475	0.3905	56,460
Be3130_R		55.03	ug/L	0.04407	0.08010	3,213
Ca3158_R		2,707	ug/L	5.875	0.2170	1,551
Cd2265_A		264.9	ug/L	1.562	0.5898	4,647
Co2286_A		558.0	ug/L	2.317	0.4153	2,385
Cr2677_A		218.9	ug/L	0.9312	0.4254	2,602
Cu3273_A		265.6	ug/L	1.371	0.5161	4,730
Fe2599_R		1,102	ug/L	0.09621	0.008727	1,282
K_7664_R		10,800	ug/L	75.82	0.7018	3,837
Li6707_R		570.8	ug/L	0.6542	0.1146	4,318
Mg2795	F	5,844	ug/L	2.087	0.03572	253,200
Mg2025_A		5,616	ug/L	27.91	0.4969	1,990
Mn2576_R		543.9	ug/L	2.082	0.3828	3,524
Mo2020_A		105.2	ug/L	0.8971	0.8525	334.4
Na5895_R		8,514	ug/L	39.39	0.4627	7,009
Ni2316_A		550.9	ug/L	2.389	0.4337	1,039
Pb2203_A		109.3	ug/L	0.1449	0.1325	141.7
Sb2068_A		106.1	ug/L	0.8380	0.7900	63.97
Se1960_A		102.1	ug/L	0.002986	0.002925	27.20
Si2516_R		1,132	ug/L	3.223	0.2847	451.9
Sn1899_A		556.8	ug/L	2.659	0.4776	332.0
Sr4215_R		556.2	ug/L	1.850	0.3327	18,970
Ti3349_A		515.4	ug/L	1.108	0.2150	19,510
Tl1908_A		107.8	ug/L	0.4044	0.3752	62.93
V_2924_A		532.7	ug/L	0.7365	0.1383	9,509
Zn2062_A		529.8	ug/L	1.599	0.3018	2,053
Y_3600_R		10,181	Cts/S	8.3170	0.081688	10,181
Y_2243_A		7,042.9	Cts/S	32.580	0.46259	7,042.9
Y_3600_A		183,990	Cts/S	460.55	0.25031	183,990

PBWQC15ICW2

Method Name: FAST-2022_POP
Method Revision: 169

PBWQC15ICW2

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:20:56PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.08317	ug/L	0.1717	206.4	-4.174
Al3961_R		-8.910	ug/L	13.65	153.2	-10.28
As1891_A		1.628	ug/L	0.6077	37.33	-3.111
B_2089_A		1.279	ug/L	0.2819	22.04	4.276
Ba4554_R		0.4136	ug/L	0.01038	2.511	37.57
Be3130_R		0.02362	ug/L	0.01088	46.05	-8.973
Ca3158_R		8.921	ug/L	2.411	27.03	-32.14
Cd2265_A		-0.05933	ug/L	0.02987	50.36	-3.845
Co2286_A		0.04184	ug/L	0.09028	215.8	-0.7023
Cr2677_A		-0.04830	ug/L	0.03531	73.11	-2.944
Cu3273_A		0.3920	ug/L	0.3090	78.83	-7.122
Fe2599_R		1.314	ug/L	0.8601	65.48	4.299
K_7664_R		-146.0	ug/L	7.478	5.121	277.4
Li6707_R		-0.9087	ug/L	1.986	218.5	4.799
Mg2795		5.861	ug/L	0.01732	0.2955	280.9
Mg2025_A		1.885	ug/L	0.1336	7.087	-6.339
Mn2576_R		0.09910	ug/L	0.4083	412.0	3.214
Mo2020_A		0.1928	ug/L	0.05107	26.49	0.8092
Na5895_R		14.09	ug/L	5.805	41.20	97.01
Ni2316_A		0.08574	ug/L	0.1676	195.4	0.4130
Pb2203_A		0.2160	ug/L	0.6058	280.4	-2.039
Sb2068_A		1.353	ug/L	0.7988	59.02	2.733
Se1960_A		1.287	ug/L	0.8614	66.94	2.107
Si2516_R		-5.608	ug/L	3.861	68.85	13.54
Sn1899_A		-0.2220	ug/L	0.09485	42.73	1.928
Sr4215_R		-0.01737	ug/L	0.04187	241.0	-3.176
Ti3349_A		0.2924	ug/L	0.06532	22.34	13.87
Tl1908_A		-0.3753	ug/L	0.3429	91.39	-3.270
V_2924_A		0.02958	ug/L	0.4217	1,426	-1.662
Zn2062_A		-1.069	ug/L	0.06545	6.125	1.875
Y_3600_R		10,391	Cts/S	15.605	0.15017	10,391
Y_2243_A		7,146.1	Cts/S	22.577	0.31594	7,146.1
Y_3600_A		187,240	Cts/S	981.18	0.52401	187,240

PBT1792AR

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:25:15PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.1778	ug/L	0.2565	144.2	-6.033
Al3961_R		7.538	ug/L	6.066	80.47	0.6220
As1891_A		1.186	ug/L	1.279	107.9	-3.026
B_2089_A		6.062	ug/L	0.2728	4.500	9.119
Ba4554_R		0.5474	ug/L	0.02669	4.875	40.32
Be3130_R		0.07341	ug/L	0.02082	28.36	-5.876
Ca3158_R		40.65	ug/L	7.801	19.19	-12.91
Cd2265_A		-0.03196	ug/L	0.05602	175.3	-3.119
Co2286_A		-0.3028	ug/L	0.03208	10.60	-2.038
Cr2677_A		0.2330	ug/L	0.2253	96.72	0.4139
Cu3273_A		0.2145	ug/L	0.1549	72.19	-9.458
Fe2599_R		1.167	ug/L	3.850	330.0	4.030
K_7664_R		503.3	ug/L	54.47	10.82	483.5
Li6707_R		0.6928	ug/L	1.227	177.2	16.76
Mg2795		15.53	ug/L	0.07755	0.4993	694.6
Mg2025_A		8.040	ug/L	1.188	14.78	-3.869
Mn2576_R		-0.1169	ug/L	0.2199	188.1	1.750
Mo2020_A		0.2249	ug/L	0.06866	30.54	0.8472

PBT1792AR

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:25:15PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R	F	363,000	ug/L	5,212	1.436	295,600
Ni2316_A		0.9347	ug/L	0.09669	10.34	1.892
Pb2203_A		0.1545	ug/L	0.2699	174.6	-1.972
Sb2068_A		0.8717	ug/L	0.3120	35.80	2.262
Se1960_A		0.8321	ug/L	0.2229	26.79	1.850
Si2516_R		-1.679	ug/L	9.810	584.1	14.81
Sn1899_A		0.3153	ug/L	0.1627	51.60	2.090
Sr4215_R		0.1483	ug/L	0.2738	184.7	2.567
Ti3349_A		0.1578	ug/L	0.04235	26.83	7.917
Tl1908_A		-0.3619	ug/L	0.3086	85.26	-3.029
V_2924_A		-0.1728	ug/L	0.2693	155.9	-4.870
Zn2062_A		-0.2916	ug/L	0.04818	16.52	4.570
Y_3600_R		10,188	Cts/S	60.863	0.59740	10,188
Y_2243_A		6,636.3	Cts/S	12.450	0.18760	6,636.3
Y_3600_A		170,650	Cts/S	731.73	0.42879	170,650

SQ1106-001

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:29:38PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.1855	ug/L	0.1548	83.48	-6.347
Al3961_R		315.3	ug/L	18.20	5.772	214.8
As1891_A		0.1117	ug/L	0.1409	126.2	-3.349
B_2089_A		4.139	ug/L	0.5217	12.61	7.008
Ba4554_R		238.2	ug/L	1.359	0.5704	6,315
Be3130_R		0.09196	ug/L	0.04733	51.46	-5.711
Ca3158_R	W	71,150	ug/L	242.0	0.3401	42,330
Cd2265_A		0.2414	ug/L	0.01643	6.807	1.560
Co2286_A		7.480	ug/L	0.03095	0.4138	29.26
Cr2677_A		1.722	ug/L	0.2207	12.81	17.90
Cu3273_A		1.508	ug/L	0.3681	24.41	11.84
Fe2599_R		106.0	ug/L	2.800	2.641	127.6
K_7664_R		892.5	ug/L	102.4	11.47	619.2
Li6707_R		0.8183	ug/L	0.1586	19.38	17.99
Mg2795		4,073	ug/L	21.48	0.5273	179,200
Mg2025_A		3,502	ug/L	6.351	0.1814	1,145
Mn2576_R	W	1,081	ug/L	9.083	0.8403	7,106
Mo2020_A		0.01702	ug/L	0.07029	413.1	0.1581
Na5895_R	F	369,000	ug/L	4,055	1.099	304,800
Ni2316_A		1.888	ug/L	0.09170	4.858	3.566
Pb2203_A		1.799	ug/L	0.1343	7.463	0.03976
Sb2068_A		1.465	ug/L	0.6078	41.48	2.600
Se1960_A		1.633	ug/L	1.460	89.43	2.213
Si2516_R		801.8	ug/L	7.689	0.9589	330.7
Sn1899_A		0.08730	ug/L	0.5433	622.4	1.954
Sr4215_R		155.6	ug/L	0.2913	0.1872	5,385
Ti3349_A		17.17	ug/L	0.1281	0.7459	607.8
Tl1908_A		-1.749	ug/L	0.09701	5.547	-4.666
V_2924_A		0.3040	ug/L	0.05144	16.92	-2.971
Zn2062_A		12.00	ug/L	0.03429	0.2857	49.12
Y_3600_R		10,336	Cts/S	26.342	0.25485	10,336
Y_2243_A		6,605.9	Cts/S	6.7513	0.10220	6,605.9
Y_3600_A		171,370	Cts/S	1,316.7	0.76832	171,370

SQ1106-003

Method Name: FAST-2022_POP
Method Revision: 169

SQ1106-003

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:34:01PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.1427	ug/L	0.1545	108.3	-5.706
Al3961_R		15.73	ug/L	0.7068	4.494	8.691
As1891_A		1.192	ug/L	1.339	112.3	-3.224
B_2089_A		24.63	ug/L	0.1118	0.4537	31.06
Ba4554_R		46.72	ug/L	0.2221	0.4753	1,263
Be3130_R		-0.01719	ug/L	0.07841	456.1	-11.52
Ca3158_R		16,730	ug/L	74.17	0.4434	9,943
Cd2265_A		-0.07924	ug/L	0.05298	66.87	-4.156
Co2286_A		0.02383	ug/L	0.1228	515.5	-0.7496
Cr2677_A		0.2139	ug/L	0.1147	53.61	0.3469
Cu3273_A		0.6721	ug/L	0.4427	65.87	-2.077
Fe2599_R		0.7585	ug/L	2.157	284.4	3.629
K_7664_R		134.4	ug/L	50.02	37.21	369.4
Li6707_R		0.6761	ug/L	0.06158	9.107	16.94
Mg2795		1,756	ug/L	5.860	0.3337	77,430
Mg2025_A		1,726	ug/L	8.079	0.4680	600.7
Mn2576_R		118.0	ug/L	1.021	0.8658	779.5
Mo2020_A		0.9720	ug/L	0.03077	3.165	3.280
Na5895_R		2,877	ug/L	8.654	0.3008	2,467
Ni2316_A		-0.1219	ug/L	0.2022	165.8	0.01502
Pb2203_A		0.7683	ug/L	0.8273	107.7	-1.293
Sb2068_A		0.006568	ug/L	0.005701	86.81	1.887
Se1960_A		-0.9154	ug/L	1.845	201.6	1.558
Si2516_R		846.9	ug/L	4.955	0.5851	349.3
Sn1899_A		-0.1783	ug/L	0.8073	452.7	1.934
Sr4215_R		47.61	ug/L	0.1526	0.3206	1,649
Ti3349_A		2.858	ug/L	0.1618	5.660	112.1
Tl1908_A		0.1730	ug/L	0.5054	292.2	-3.003
V_2924_A		-0.1931	ug/L	0.03081	15.95	-6.477
Zn2062_A		30.38	ug/L	0.04687	0.1543	123.9
Y_3600_R		10,360	Cts/S	3.6680	0.035407	10,360
Y_2243_A		7,073.9	Cts/S	11.283	0.15950	7,073.9
Y_3600_A		186,270	Cts/S	212.58	0.11413	186,270

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:38:17PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A	W	471.9	ug/L	1.114	0.2360	12,090
Al3961_R		12,920	ug/L	16.44	0.1272	8,639
As1891_A		495.3	ug/L	0.1439	0.02905	159.7
B_2089_A		512.7	ug/L	0.9571	0.1867	617.2
Ba4554_R		501.8	ug/L	0.1532	0.03052	13,430
Be3130_R		501.8	ug/L	1.452	0.2893	30,250
Ca3158_R	W	11,740	ug/L	22.40	0.1908	7,036
Cd2265_A		511.2	ug/L	0.3638	0.07116	9,045
Co2286_A	W	528.2	ug/L	0.5695	0.1078	2,272
Cr2677_A		516.3	ug/L	2.615	0.5066	6,189
Cu3273_A		495.6	ug/L	2.721	0.5490	8,922
Fe2599_R	W	11,800	ug/L	6.335	0.05370	14,070
K_7664_R		12,430	ug/L	89.33	0.7188	4,486
Li6707_R		496.1	ug/L	2.329	0.4695	3,858
Mg2795		12,600	ug/L	130.6	1.036	561,000
Mg2025_A		12,350	ug/L	19.58	0.1585	4,379
Mn2576_R		513.8	ug/L	1.601	0.3117	3,421
Mo2020_A		486.6	ug/L	0.005162	0.001061	1,556

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:38:17PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		12,860	ug/L	27.85	0.2166	10,830
Ni2316_A		516.2	ug/L	0.5549	0.1075	979.8
Pb2203_A		512.2	ug/L	1.127	0.2199	676.3
Sb2068_A		510.6	ug/L	0.8546	0.1674	312.8
Se1960_A		492.2	ug/L	2.813	0.5714	124.9
Si2516_R		12,700	ug/L	0.7500	0.005904	5,066
Sn1899_A		502.2	ug/L	0.3982	0.07929	301.6
Sr4215_R		498.8	ug/L	1.231	0.2468	17,470
Ti3349_A		479.7	ug/L	0.7381	0.1539	18,320
Tl1908_A	W	529.4	ug/L	0.3910	0.07387	321.8
V_2924_A		498.2	ug/L	0.4716	0.09466	8,896
Zn2062_A		501.8	ug/L	1.191	0.2372	1,956
Y_3600_R		10,461	Cts/S	39.173	0.37447	10,461
Y_2243_A		7,087.7	Cts/S	13.685	0.19309	7,087.7
Y_3600_A		185,480	Cts/S	866.88	0.46737	185,480

CCB

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:42:26PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.1660	ug/L	0.1131	68.16	-6.380
Al3961_R		-1.966	ug/L	3.556	180.9	-5.701
As1891_A		1.232	ug/L	0.3545	28.78	-3.237
B_2089_A		0.6229	ug/L	0.04727	7.590	3.517
Ba4554_R		0.05425	ug/L	0.2608	480.7	28.12
Be3130_R		0.1365	ug/L	0.009540	6.989	-2.197
Ca3158_R		3.672	ug/L	2.602	70.85	-35.38
Cd2265_A		0.04586	ug/L	0.03038	66.25	-1.964
Co2286_A		0.02883	ug/L	0.1117	387.5	-0.7585
Cr2677_A		0.1338	ug/L	0.002959	2.211	-0.7458
Cu3273_A		0.4951	ug/L	0.2034	41.07	-5.307
Fe2599_R		2.790	ug/L	1.621	58.10	6.066
K_7664_R		-72.94	ug/L	2.711	3.717	302.5
Li6707_R		-0.0008590	ug/L	0.2016	23,480	11.81
Mg2795		2.991	ug/L	0.3398	11.36	154.4
Mg2025_A		0.7133	ug/L	0.01823	2.555	-6.741
Mn2576_R		-0.1525	ug/L	0.09317	61.10	1.557
Mo2020_A		0.3740	ug/L	0.1779	47.57	1.390
Na5895_R		60.85	ug/L	15.12	24.85	136.2
Ni2316_A		-0.3143	ug/L	0.08631	27.46	-0.3522
Pb2203_A		0.4770	ug/L	0.2369	49.67	-1.688
Sb2068_A		1.593	ug/L	0.5979	37.52	2.878
Se1960_A		-1.391	ug/L	1.758	126.3	1.429
Si2516_R		9.113	ug/L	9.910	108.8	19.41
Sn1899_A		-0.5963	ug/L	0.3471	58.20	1.699
Sr4215_R		-0.07595	ug/L	0.05403	71.15	-5.231
Ti3349_A		0.09052	ug/L	0.01156	12.77	6.139
Tl1908_A		-0.4366	ug/L	0.2504	57.34	-3.300
V_2924_A		0.2064	ug/L	0.09791	47.43	1.548
Zn2062_A		-1.345	ug/L	0.01284	0.9547	0.7902
Y_3600_R		10,421	Cts/S	24.563	0.23571	10,421
Y_2243_A		7,130.7	Cts/S	0.21508	0.0030160	7,130.7
Y_3600_A		188,600	Cts/S	1,043.9	0.55351	188,600

SQ1106-004

Method Name: FAST-2022_POP
Method Revision: 169

SQ1106-004

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:46:43PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2402	ug/L	0.1998	83.21	-7.748
Al3961_R		443.1	ug/L	4.740	1.070	291.3
As1891_A		1.068	ug/L	0.4854	45.43	-3.084
B_2089_A		5.040	ug/L	0.4387	8.706	8.045
Ba4554_R		61.55	ug/L	0.5577	0.9061	1,650
Be3130_R		0.01404	ug/L	0.02930	208.7	-10.66
Ca3158_R		22,640	ug/L	228.7	1.010	13,430
Cd2265_A		0.1282	ug/L	0.01821	14.20	-0.1922
Co2286_A		-0.1038	ug/L	0.1287	124.0	-1.044
Cr2677_A		0.8594	ug/L	0.01479	1.721	7.440
Cu3273_A		1.368	ug/L	0.6426	46.96	9.610
Fe2599_R		176.6	ug/L	0.2232	0.1264	210.6
K_7664_R		604.9	ug/L	8.101	1.339	523.7
Li6707_R		1.134	ug/L	0.1490	13.13	20.39
Mg2795		1,263	ug/L	2.960	0.2345	55,500
Mg2025_A		1,051	ug/L	2.177	0.2071	342.0
Mn2576_R		12.17	ug/L	0.1419	1.166	82.47
Mo2020_A		0.1479	ug/L	0.05613	37.94	0.6185
Na5895_R	F	354,600	ug/L	6,805	1.919	292,700
Ni2316_A		1.120	ug/L	0.1572	14.03	2.225
Pb2203_A		0.7855	ug/L	0.9083	115.6	-1.237
Sb2068_A		1.626	ug/L	0.4684	28.82	2.709
Se1960_A		-0.9411	ug/L	0.3544	37.65	1.445
Si2516_R		1,264	ug/L	7.785	0.6160	511.8
Sn1899_A		0.3679	ug/L	0.9053	246.0	2.128
Sr4215_R		68.87	ug/L	0.4374	0.6352	2,380
Ti3349_A		23.58	ug/L	0.8333	3.534	842.6
Tl1908_A		0.1198	ug/L	0.7850	655.1	-2.789
V_2924_A		0.6423	ug/L	0.1052	16.37	9.072
Zn2062_A		9.647	ug/L	0.05634	0.5840	40.92
Y_3600_R		10,328	Cts/S	12.023	0.11641	10,328
Y_2243_A		6,661.3	Cts/S	10.777	0.16178	6,661.3
Y_3600_A		173,230	Cts/S	472.61	0.27283	173,230

SQ1106-005

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:51:05PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2432	ug/L	0.07798	32.06	-8.279
Al3961_R		10.43	ug/L	2.527	24.23	4.069
As1891_A		2.195	ug/L	1.275	58.09	-2.900
B_2089_A		23.97	ug/L	0.1100	0.4590	30.35
Ba4554_R		36.21	ug/L	0.2250	0.6214	985.3
Be3130_R		0.04702	ug/L	0.02022	43.01	-7.642
Ca3158_R		9,765	ug/L	78.12	0.8000	5,794
Cd2265_A		-0.06581	ug/L	0.004654	7.073	-3.926
Co2286_A		0.06335	ug/L	0.2292	361.8	-0.5897
Cr2677_A		0.4789	ug/L	0.1769	36.93	3.467
Cu3273_A		0.3142	ug/L	0.5335	169.8	-8.552
Fe2599_R		2.834	ug/L	0.08516	3.005	6.085
K_7664_R		-38.05	ug/L	3.635	9.554	312.5
Li6707_R		-0.01391	ug/L	0.7045	5,066	11.62
Mg2795		660.9	ug/L	0.5981	0.09049	29,180
Mg2025_A		634.6	ug/L	2.024	0.3189	217.0
Mn2576_R		44.02	ug/L	0.9327	2.119	292.7
Mo2020_A		0.3702	ug/L	0.1491	40.28	1.368

SQ1106-005

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:51:05PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		1,550	ug/L	11.64	0.7509	1,369
Ni2316_A		0.07042	ug/L	0.2277	323.4	0.3801
Pb2203_A		0.6507	ug/L	0.5234	80.44	-1.449
Sb2068_A		2.093	ug/L	0.3227	15.42	3.162
Se1960_A		0.1069	ug/L	2.122	1,986	1.804
Si2516_R		783.2	ug/L	17.91	2.286	324.4
Sn1899_A		0.7395	ug/L	0.5242	70.89	2.487
Sr4215_R		22.03	ug/L	0.3418	1.552	762.5
Ti3349_A		1.933	ug/L	0.1210	6.261	76.61
Tl1908_A		-0.7975	ug/L	0.05552	6.963	-3.541
V_2924_A		-0.2678	ug/L	0.02248	8.394	-7.322
Zn2062_A		28.73	ug/L	0.08533	0.2971	117.8
Y_3600_R		10,368	Cts/S	111.94	1.0797	10,368
Y_2243_A		7,090.3	Cts/S	4.1649	0.058741	7,090.3
Y_3600_A		186,100	Cts/S	952.17	0.51164	186,100

SQ1111-001R

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:55:22PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.3383	ug/L	0.2732	80.78	-9.999
Al3961_R		130.5	ug/L	12.16	9.314	85.38
As1891_A		-0.6665	ug/L	0.3688	55.34	-3.608
B_2089_A		31.41	ug/L	0.1515	0.4823	42.54
Ba4554_R		40.07	ug/L	0.3894	0.9718	1,079
Be3130_R		0.1155	ug/L	0.07812	67.64	-3.540
Ca3158_R		6,437	ug/L	84.46	1.312	3,777
Cd2265_A		0.2591	ug/L	0.01651	6.373	1.738
Co2286_A		6.015	ug/L	0.06794	1.130	23.67
Cr2677_A		0.5911	ug/L	0.2962	50.11	4.859
Cu3273_A		14.21	ug/L	0.4531	3.189	226.1
Fe2599_R		25.96	ug/L	1.295	4.988	33.13
K_7664_R		1,806	ug/L	17.43	0.9649	916.6
Li6707_R		3.994	ug/L	1.049	26.26	42.07
Mg2795		412.7	ug/L	0.3576	0.08665	18,080
Mg2025_A		332.0	ug/L	0.5295	0.1595	105.3
Mn2576_R		451.5	ug/L	1.811	0.4012	2,955
Mo2020_A		116.5	ug/L	0.01083	0.009296	353.3
Na5895_R	F	373,700	ug/L	9,965	2.667	307,100
Ni2316_A		9.076	ug/L	0.005830	0.06424	16.60
Pb2203_A		2.181	ug/L	0.5943	27.25	0.4272
Sb2068_A		2.110	ug/L	0.7286	34.53	2.902
Se1960_A		-1.221	ug/L	0.8967	73.43	1.466
Si2516_R		368.2	ug/L	8.523	2.315	159.6
Sn1899_A		-0.4448	ug/L	0.5158	116.0	1.687
Sr4215_R		22.52	ug/L	0.1246	0.5533	773.4
Ti3349_A		1.890	ug/L	0.08318	4.400	72.84
Tl1908_A		-1.072	ug/L	0.06654	6.207	-3.835
V_2924_A		0.05844	ug/L	0.1874	320.6	-16.83
Zn2062_A		109.0	ug/L	0.05351	0.04910	407.6
Y_3600_R		10,287	Cts/S	113.58	1.1041	10,287
Y_2243_A		6,719.1	Cts/S	21.245	0.31619	6,719.1
Y_3600_A		173,430	Cts/S	98.405	0.056740	173,430

SQ1111-002R

Method Name: FAST-2022_POP
Method Revision: 169

SQ1111-002R

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 6:59:42PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.09378	ug/L	0.009230	9.842	-4.060
Al3961_R		78.85	ug/L	0.7425	0.9417	73.41
As1891_A		-0.7384	ug/L	0.2142	29.01	-3.535
B_2089_A		25.99	ug/L	0.3972	1.528	30.09
Ba4554_R		167.1	ug/L	0.8613	0.5154	4,369
Be3130_R		-0.04053	ug/L	0.03254	80.29	-13.00
Ca3158_R	W	169,600	ug/L	906.8	0.5346	99,410
Cd2265_A		0.3885	ug/L	0.005915	1.523	3.754
Co2286_A		15.37	ug/L	0.1165	0.7580	59.63
Cr2677_A		2.876	ug/L	0.03189	1.109	34.71
Cu3273_A		8.327	ug/L	0.2473	2.969	123.7
Fe2599_R		22.23	ug/L	0.8104	3.646	28.48
K_7664_R		1,438	ug/L	70.42	4.896	787.4
Li6707_R		9.300	ug/L	2.462	26.47	81.67
Mg2795		983.7	ug/L	1.010	0.1027	42,620
Mg2025_A		805.8	ug/L	6.966	0.8645	254.5
Mn2576_R	W	6,022	ug/L	16.31	0.2708	38,970
Mo2020_A		5.594	ug/L	0.07733	1.382	16.17
Na5895_R	F	392,300	ug/L	4,674	1.192	319,100
Ni2316_A		12.92	ug/L	0.3098	2.398	22.64
Pb2203_A		3.066	ug/L	0.4800	15.65	1.598
Sb2068_A		2.801	ug/L	0.03900	1.392	3.301
Se1960_A		-2.414	ug/L	0.7235	29.97	2.066
Si2516_R		1,797	ug/L	15.60	0.8679	710.8
Sn1899_A		0.3090	ug/L	0.4443	143.8	2.038
Sr4215_R		550.9	ug/L	3.697	0.6712	18,780
Ti3349_A		8.482	ug/L	0.04070	0.4798	297.1
Tl1908_A		-2.118	ug/L	0.2268	10.71	-8.619
V_2924_A		-0.9243	ug/L	0.01069	1.157	-51.97
Zn2062_A		687.1	ug/L	1.301	0.1893	2,448
Y_3600_R		10,179	Cts/S	29.642	0.29122	10,179
Y_2243_A		6,479.0	Cts/S	11.637	0.17961	6,479.0
Y_3600_A		168,840	Cts/S	673.70	0.39902	168,840

SQ1111-003R

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:04:03PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.2187	ug/L	0.08591	39.29	3.248
Al3961_R		53.41	ug/L	9.730	18.22	48.55
As1891_A		-0.6378	ug/L	1.451	227.5	-3.503
B_2089_A		15.44	ug/L	0.06405	0.4148	18.77
Ba4554_R		115.2	ug/L	0.4278	0.3713	3,055
Be3130_R		0.002272	ug/L	0.01169	514.4	-10.53
Ca3158_R	W	113,200	ug/L	484.5	0.4281	67,080
Cd2265_A		0.2949	ug/L	0.08799	29.83	2.238
Co2286_A		11.36	ug/L	0.1334	1.174	43.81
Cr2677_A		2.610	ug/L	0.1979	7.581	30.80
Cu3273_A		5.641	ug/L	0.1224	2.170	79.91
Fe2599_R		18.53	ug/L	0.9578	5.170	24.46
K_7664_R		1,225	ug/L	3.748	0.3059	726.3
Li6707_R		5.845	ug/L	0.4388	7.508	56.27
Mg2795		715.3	ug/L	0.4743	0.06631	31,350
Mg2025_A		593.2	ug/L	0.08257	0.01392	185.5
Mn2576_R	W	4,766	ug/L	7.677	0.1611	31,200
Mo2020_A		0.8853	ug/L	0.08911	10.07	2.472

SQ1111-003R

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:04:03PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R	F	385,200	ug/L	152.9	0.03970	317,000
Ni2316_A		9.717	ug/L	0.1084	1.115	17.06
Pb2203_A		3.558	ug/L	0.2365	6.646	2.198
Sb2068_A		1.503	ug/L	0.08223	5.470	2.572
Se1960_A		0.07112	ug/L	3.184	4,477	2.420
Si2516_R		1,175	ug/L	18.22	1.550	475.5
Sn1899_A		1.091	ug/L	0.1521	13.95	2.461
Sr4215_R		362.1	ug/L	1.552	0.4286	12,480
Ti3349_A		7.213	ug/L	0.2592	3.594	253.9
Tl1908_A		-3.057	ug/L	1.432	46.84	-8.160
V_2924_A		-0.4710	ug/L	0.2507	53.22	-37.03
Zn2062_A		537.2	ug/L	2.548	0.4743	1,913
Y_3600_R		10,295	Cts/S	11.198	0.10877	10,295
Y_2243_A		6,471.9	Cts/S	23.648	0.36540	6,471.9
Y_3600_A		169,510	Cts/S	86.748	0.051176	169,510

LCSWQC15ICW1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:08:23PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		46.73	ug/L	0.2276	0.4871	1,193
Al3961_R		2,277	ug/L	20.70	0.9092	1,493
As1891_A		101.3	ug/L	0.2290	0.2261	29.76
B_2089_A		523.0	ug/L	0.7069	0.1352	606.2
Ba4554_R		2,080	ug/L	0.3596	0.01729	54,630
Be3130_R		52.65	ug/L	0.3590	0.6818	3,104
Ca3158_R		2,498	ug/L	21.05	0.8427	1,442
Cd2265_A		262.8	ug/L	0.2582	0.09828	4,616
Co2286_A		559.5	ug/L	0.9212	0.1646	2,395
Cr2677_A		217.9	ug/L	1.104	0.5066	2,612
Cu3273_A		258.5	ug/L	0.2882	0.1115	4,641
Fe2599_R		1,008	ug/L	5.091	0.5049	1,184
K_7664_R		10,540	ug/L	14.93	0.1416	3,788
Li6707_R		532.8	ug/L	9.625	1.806	4,071
Mg2795		5,590	ug/L	15.74	0.2816	244,500
Mg2025_A		5,263	ug/L	2.919	0.05547	1,869
Mn2576_R		534.3	ug/L	2.533	0.4741	3,495
Mo2020_A		99.43	ug/L	0.6291	0.6327	316.5
Na5895_R		8,658	ug/L	37.11	0.4286	7,195
Ni2316_A		544.3	ug/L	0.07624	0.01401	1,028
Pb2203_A		107.6	ug/L	0.8301	0.7713	139.7
Sb2068_A		106.4	ug/L	0.1614	0.1516	64.32
Se1960_A		100.5	ug/L	1.361	1.354	26.85
Si2516_R		1,061	ug/L	1.248	0.1176	428.6
Sn1899_A		547.2	ug/L	1.360	0.2484	326.8
Sr4215_R		536.2	ug/L	0.4876	0.09093	18,460
Ti3349_A		484.5	ug/L	3.022	0.6238	18,490
Tl1908_A		108.3	ug/L	0.09364	0.08648	63.36
V_2924_A		520.8	ug/L	0.1411	0.02709	9,372
Zn2062_A		522.7	ug/L	0.2733	0.05228	2,029
Y_3600_R		10,279	Cts/S	80.091	0.77914	10,279
Y_2243_A		7,053.9	Cts/S	7.7373	0.10969	7,053.9
Y_3600_A		185,480	Cts/S	22.757	0.012269	185,480

PBWQC15ICW1

Method Name: FAST-2022_POP
Method Revision: 169

PBWQC15ICW1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:12:33PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.02861	ug/L	0.06659	232.8	-1.324
Al3961_R		-8.166	ug/L	9.333	114.3	-9.823
As1891_A		1.332	ug/L	0.1685	12.65	-3.235
B_2089_A		0.8582	ug/L	0.01253	1.460	3.823
Ba4554_R		0.1487	ug/L	0.5330	358.4	30.63
Be3130_R		-0.09118	ug/L	0.01945	21.33	-15.88
Ca3158_R		4.952	ug/L	7.971	161.0	-34.60
Cd2265_A		-0.06575	ug/L	0.004539	6.904	-3.945
Co2286_A		-0.05991	ug/L	0.06305	105.2	-1.153
Cr2677_A		0.02814	ug/L	0.1277	453.6	-2.052
Cu3273_A		12.45	ug/L	0.2867	2.302	216.2
Fe2599_R		25.65	ug/L	0.1514	0.5903	33.20
K_7664_R		-92.31	ug/L	55.56	60.19	295.9
Li6707_R		-1.120	ug/L	0.2309	20.61	3.166
Mg2795		5.273	ug/L	0.05613	1.064	255.5
Mg2025_A		3.569	ug/L	2.300	64.45	-5.787
Mn2576_R		0.3290	ug/L	0.1743	52.99	4.746
Mo2020_A		0.3445	ug/L	0.1398	40.58	1.308
Na5895_R		170.3	ug/L	16.78	9.849	227.3
Ni2316_A		-0.3123	ug/L	0.1133	36.26	-0.3523
Pb2203_A		0.8926	ug/L	0.01564	1.752	-1.138
Sb2068_A		1.681	ug/L	0.06324	3.761	2.953
Se1960_A		-0.3440	ug/L	0.3604	104.8	1.709
Si2516_R		-5.744	ug/L	7.426	129.3	13.52
Sn1899_A		0.5755	ug/L	0.4748	82.49	2.425
Sr4215_R		-0.2225	ug/L	0.005715	2.568	-10.34
Ti3349_A		-0.02760	ug/L	0.03780	136.9	1.578
Tl1908_A		-0.4839	ug/L	0.4117	85.10	-3.361
V_2924_A		-0.1637	ug/L	0.1217	74.30	-5.279
Zn2062_A		-1.144	ug/L	0.02282	1.994	1.589
Y_3600_R		10,416	Cts/S	17.817	0.17105	10,416
Y_2243_A		7,198.3	Cts/S	9.0062	0.12512	7,198.3
Y_3600_A		190,740	Cts/S	1,738.2	0.91129	190,740

PBT1793AR

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:16:54PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2913	ug/L	0.05850	20.08	-8.978
Al3961_R		-6.775	ug/L	15.72	232.1	-8.754
As1891_A		0.06178	ug/L	0.1326	214.7	-3.421
B_2089_A		5.239	ug/L	0.3461	6.606	8.354
Ba4554_R		0.3814	ug/L	0.6724	176.3	36.36
Be3130_R		-0.05230	ug/L	0.1086	207.7	-13.38
Ca3158_R		25.06	ug/L	0.5877	2.345	-22.32
Cd2265_A		-0.1080	ug/L	0.001703	1.576	-4.437
Co2286_A		-0.2635	ug/L	0.04015	15.24	-1.907
Cr2677_A		0.1876	ug/L	0.2291	122.1	-0.07876
Cu3273_A		0.4055	ug/L	0.1640	40.45	-6.467
Fe2599_R		1.351	ug/L	1.575	116.5	4.302
K_7664_R		333.7	ug/L	6.050	1.813	433.6
Li6707_R		1.468	ug/L	0.2318	15.78	22.91
Mg2795		14.63	ug/L	0.1614	1.103	663.8
Mg2025_A		8.886	ug/L	0.7444	8.377	-3.639
Mn2576_R		-0.4222	ug/L	0.2489	58.95	-0.2186
Mo2020_A		0.3215	ug/L	0.06727	20.92	1.152

PBT1793AR

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:16:54PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R	F	289,400	ug/L	2,082	0.7193	238,600
Ni2316_A		0.6337	ug/L	0.07572	11.95	1.376
Pb2203_A		-0.0003900	ug/L	0.3400	87,240	-2.195
Sb2068_A		2.112	ug/L	1.502	71.11	3.012
Se1960_A		0.1244	ug/L	0.8168	656.7	1.708
Si2516_R		1.116	ug/L	2.679	240.0	16.07
Sn1899_A		0.1065	ug/L	0.6222	584.3	2.002
Sr4215_R		0.1082	ug/L	0.04690	43.34	1.179
Ti3349_A		0.07710	ug/L	0.009538	12.37	5.229
Tl1908_A		-0.2345	ug/L	0.1415	60.32	-2.997
V_2924_A		-0.1525	ug/L	0.06677	43.78	-4.685
Zn2062_A		-0.7570	ug/L	0.1208	15.96	2.916
Y_3600_R		10,315	Cts/S	101.58	0.98484	10,315
Y_2243_A		6,729.2	Cts/S	16.049	0.23849	6,729.2
Y_3600_A		175,610	Cts/S	700.98	0.39917	175,610

SQ1104-002R

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:21:19PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.1304	ug/L	0.1356	103.9	-5.330
Al3961_R		26.93	ug/L	16.20	60.17	13.85
As1891_A		1.618	ug/L	0.7414	45.83	-3.076
B_2089_A		3.669	ug/L	0.3637	9.915	6.945
Ba4554_R		2.777	ug/L	0.04894	1.762	102.4
Be3130_R		-0.1270	ug/L	0.01932	15.21	-18.37
Ca3158_R		65.24	ug/L	1.628	2.495	1.611
Cd2265_A		-0.002256	ug/L	0.004452	197.3	-2.795
Co2286_A		0.1882	ug/L	0.07493	39.82	-0.07245
Cr2677_A		0.1131	ug/L	0.07265	64.22	-0.9721
Cu3273_A		0.8472	ug/L	0.009949	1.174	1.123
Fe2599_R		0.5462	ug/L	0.3839	70.28	3.465
K_7664_R		64.22	ug/L	11.84	18.44	354.5
Li6707_R		0.2915	ug/L	1.643	563.7	14.43
Mg2795		23.69	ug/L	0.0001020	0.0004290	1,092
Mg2025_A		23.68	ug/L	0.2379	1.005	1.402
Mn2576_R		7.242	ug/L	0.5029	6.943	51.50
Mo2020_A		-0.05257	ug/L	0.1277	242.8	0.01814
Na5895_R	W	78,140	ug/L	100.1	0.1281	66,330
Ni2316_A		0.1787	ug/L	0.06829	38.22	0.5827
Pb2203_A		11.44	ug/L	0.4156	3.634	12.81
Sb2068_A		-0.07117	ug/L	0.8316	1,168	1.832
Se1960_A		-2.751	ug/L	1.734	63.01	1.079
Si2516_R		9.425	ug/L	1.494	15.85	19.90
Sn1899_A		0.1490	ug/L	0.4609	309.4	2.125
Sr4215_R		0.3211	ug/L	0.09280	28.90	8.760
Ti3349_A		-0.1960	ug/L	0.08352	42.61	-4.885
Tl1908_A		1.385	ug/L	0.5092	36.76	-2.161
V_2924_A		-0.07818	ug/L	0.08466	108.3	-3.591
Zn2062_A		0.5975	ug/L	0.01145	1.916	8.305
Y_3600_R		10,611	Cts/S	173.96	1.6395	10,611
Y_2243_A		7,058.4	Cts/S	34.624	0.49053	7,058.4
Y_3600_A		184,820	Cts/S	587.67	0.31798	184,820

SQ1104-006R

Method Name: FAST-2022_POP
Method Revision: 169

SQ1104-006R

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:25:37PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2776	ug/L	0.1882	67.81	-8.563
Al3961_R		287.5	ug/L	2.834	0.9856	184.8
As1891_A		-0.3819	ug/L	0.2803	73.39	-3.532
B_2089_A		16.85	ug/L	0.004766	0.02828	20.84
Ba4554_R		9.994	ug/L	0.08696	0.8701	289.5
Be3130_R		0.02774	ug/L	0.04313	155.5	-8.655
Ca3158_R		85.48	ug/L	11.00	12.87	13.56
Cd2265_A		-0.1005	ug/L	0.02513	25.01	-4.262
Co2286_A		0.1801	ug/L	0.1662	92.28	-0.09366
Cr2677_A		0.3233	ug/L	0.03656	11.31	1.468
Cu3273_A		12.12	ug/L	0.1235	1.019	191.6
Fe2599_R		10.20	ug/L	0.6646	6.516	14.70
K_7664_R		612.2	ug/L	60.55	9.891	525.0
Li6707_R		2.668	ug/L	0.1161	4.351	32.07
Mg2795		54.39	ug/L	0.6317	1.161	2,407
Mg2025_A		40.79	ug/L	2.264	5.552	7.006
Mn2576_R		26.12	ug/L	1.348	5.162	173.7
Mo2020_A		0.1740	ug/L	0.05011	28.79	0.6973
Na5895_R	F	351,100	ug/L	281.8	0.08027	289,200
Ni2316_A		1.558	ug/L	0.2489	15.97	3.016
Pb2203_A		430.3	ug/L	1.322	0.3072	535.6
Sb2068_A		1.603	ug/L	0.4147	25.86	2.693
Se1960_A		-1.734	ug/L	0.7190	41.47	1.263
Si2516_R		130.6	ug/L	2.468	1.890	66.79
Sn1899_A		1.189	ug/L	0.4534	38.13	2.593
Sr4215_R		1.034	ug/L	0.01568	1.517	33.14
Ti3349_A		0.3959	ug/L	0.2203	55.64	16.60
Tl1908_A		-0.9124	ug/L	0.4803	52.64	-3.383
V_2924_A		-0.02129	ug/L	0.04182	196.4	-2.562
Zn2062_A		1.044	ug/L	0.002863	0.2742	9.487
Y_3600_R		10,308	Cts/S	60.541	0.58730	10,308
Y_2243_A		6,672.9	Cts/S	14.760	0.22119	6,672.9
Y_3600_A		174,070	Cts/S	310.60	0.17844	174,070

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:29:59PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A	W	449.7	ug/L	1.088	0.2419	11,590
Al3961_R	W	13,200	ug/L	27.28	0.2067	8,827
As1891_A		497.8	ug/L	0.2894	0.05814	160.4
B_2089_A		519.0	ug/L	0.4960	0.09558	623.0
Ba4554_R		507.3	ug/L	2.442	0.4813	13,590
Be3130_R		499.0	ug/L	4.141	0.8300	30,100
Ca3158_R	W	11,290	ug/L	144.9	1.283	6,771
Cd2265_A		515.8	ug/L	1.000	0.1939	9,116
Co2286_A	W	540.2	ug/L	0.7219	0.1336	2,321
Cr2677_A	W	527.8	ug/L	1.052	0.1994	6,368
Cu3273_A		490.4	ug/L	1.063	0.2168	8,885
Fe2599_R	W	11,400	ug/L	77.87	0.6831	13,610
K_7664_R		12,400	ug/L	4.513	0.03640	4,479
Li6707_R		490.8	ug/L	3.915	0.7978	3,820
Mg2795		12,530	ug/L	205.8	1.642	558,300
Mg2025_A	W	11,820	ug/L	24.17	0.2045	4,187
Mn2576_R		517.7	ug/L	0.6161	0.1190	3,449
Mo2020_A	W	471.6	ug/L	0.9157	0.1942	1,507

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:29:59PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R	W	13,230	ug/L	60.10	0.4544	11,150
Ni2316_A		522.8	ug/L	0.9692	0.1854	991.4
Pb2203_A		512.3	ug/L	1.086	0.2120	675.8
Sb2068_A		515.9	ug/L	0.04436	0.008597	315.9
Se1960_A		495.9	ug/L	5.057	1.020	125.7
Si2516_R		12,740	ug/L	5.423	0.04257	5,085
Sn1899_A		504.0	ug/L	0.5994	0.1189	302.3
Sr4215_R		503.5	ug/L	2.176	0.4322	17,660
Ti3349_A	W	464.9	ug/L	1.229	0.2643	17,870
Tl1908_A	W	538.3	ug/L	4.182	0.7769	327.0
V_2924_A		495.4	ug/L	0.6667	0.1346	8,903
Zn2062_A		504.9	ug/L	1.111	0.2200	1,966
Y_3600_R		10,469	Cts/S	98.038	0.93648	10,469
Y_2243_A		7,081.1	Cts/S	8.7827	0.12403	7,081.1
Y_3600_A		186,660	Cts/S	47.769	0.025592	186,660

CCB

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:34:08PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.3805	ug/L	0.3385	88.96	-12.02
Al3961_R		-10.61	ug/L	0.8334	7.858	-11.50
As1891_A		0.8128	ug/L	0.1157	14.23	-3.380
B_2089_A		0.5555	ug/L	0.5358	96.45	3.451
Ba4554_R		0.04859	ug/L	0.05320	109.5	28.10
Be3130_R		0.002584	ug/L	0.04109	1,590	-10.30
Ca3158_R		6.849	ug/L	5.915	86.37	-33.64
Cd2265_A		-0.02708	ug/L	0.06521	240.9	-3.264
Co2286_A		0.005394	ug/L	0.1895	3,514	-0.8635
Cr2677_A		0.07352	ug/L	0.07920	107.7	-1.489
Cu3273_A		0.8734	ug/L	0.5244	60.04	1.684
Fe2599_R		1.125	ug/L	3.187	283.2	4.113
K_7664_R		-225.9	ug/L	39.67	17.56	252.8
Li6707_R		0.8549	ug/L	1.324	154.9	18.53
Mg2795		3.097	ug/L	0.1124	3.629	159.9
Mg2025_A		1.993	ug/L	0.2217	11.12	-6.296
Mn2576_R		-0.4395	ug/L	0.1792	40.78	-0.3437
Mo2020_A		0.5069	ug/L	0.08166	16.11	1.820
Na5895_R		137.7	ug/L	3.301	2.398	201.2
Ni2316_A		-0.5273	ug/L	0.01112	2.108	-0.7597
Pb2203_A		0.9611	ug/L	0.4313	44.88	-1.043
Sb2068_A		2.236	ug/L	0.3159	14.13	3.274
Se1960_A		-0.01247	ug/L	1.396	11,190	1.779
Si2516_R		7.951	ug/L	3.611	45.42	19.05
Sn1899_A		-0.1983	ug/L	0.08398	42.35	1.941
Sr4215_R		0.2233	ug/L	0.1453	65.04	5.237
Ti3349_A		-0.03564	ug/L	0.1079	302.7	1.242
Tl1908_A		-0.07486	ug/L	0.4404	588.3	-3.081
V_2924_A		-0.02786	ug/L	0.008386	30.10	-2.778
Zn2062_A		-1.244	ug/L	0.01399	1.124	1.187
Y_3600_R		10,473	Cts/S	31.083	0.29680	10,473
Y_2243_A		7,139.7	Cts/S	24.463	0.34263	7,139.7
Y_3600_A		190,020	Cts/S	1,290.2	0.67899	190,020

SQ1104-008R

Method Name: FAST-2022_POP
Method Revision: 169

SQ1104-008R

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:38:26PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2282	ug/L	0.1566	68.62	-7.613
Al3961_R		159.0	ug/L	2.848	1.791	101.2
As1891_A		0.5515	ug/L	0.6633	120.3	-3.306
B_2089_A		32.40	ug/L	0.02998	0.09252	38.44
Ba4554_R		5.700	ug/L	0.2665	4.675	178.0
Be3130_R		0.007956	ug/L	0.04748	596.8	-9.914
Ca3158_R		144.4	ug/L	0.3215	0.2227	48.96
Cd2265_A		-0.08632	ug/L	0.03667	42.48	-4.098
Co2286_A		-0.05658	ug/L	0.1452	256.6	-1.075
Cr2677_A		0.1486	ug/L	0.008401	5.654	-0.5321
Cu3273_A		37.98	ug/L	0.3557	0.9366	648.3
Fe2599_R		16.23	ug/L	0.1746	1.076	21.98
K_7664_R		152.7	ug/L	54.94	35.99	376.9
Li6707_R		2.344	ug/L	0.3956	16.87	29.86
Mg2795		71.76	ug/L	0.08309	0.1158	3,197
Mg2025_A		57.74	ug/L	0.6115	1.059	12.88
Mn2576_R		7.038	ug/L	0.2675	3.801	49.10
Mo2020_A		0.3972	ug/L	0.1547	38.94	1.398
Na5895_R	W	190,100	ug/L	1,934	1.017	158,000
Ni2316_A		1.513	ug/L	0.04545	3.005	2.993
Pb2203_A		437.4	ug/L	0.2890	0.06608	555.3
Sb2068_A		2.551	ug/L	0.09372	3.673	3.304
Se1960_A		-0.2676	ug/L	0.9978	372.9	1.636
Si2516_R		84.47	ug/L	2.017	2.388	49.16
Sn1899_A		0.3877	ug/L	0.2860	73.78	2.186
Sr4215_R		1.943	ug/L	0.01705	0.8777	65.11
Ti3349_A		0.1010	ug/L	0.1418	140.4	6.240
Tl1908_A		-0.1670	ug/L	0.2469	147.8	-2.997
V_2924_A		-0.1361	ug/L	0.1421	104.4	-4.552
Zn2062_A		1.756	ug/L	0.02510	1.429	12.34
Y_3600_R		10,400	Cts/S	7.8373	0.075362	10,400
Y_2243_A		6,806.2	Cts/S	0.37904	0.0055690	6,806.2
Y_3600_A		179,390	Cts/S	887.26	0.49459	179,390

SQ1104-008RA

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:42:49PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		447.9	ug/L	2.052	0.4581	11,070
Al3961_R		699.4	ug/L	9.731	1.391	475.0
As1891_A		501.2	ug/L	0.9562	0.1908	155.1
B_2089_A		552.0	ug/L	0.5445	0.09864	634.4
Ba4554_R		507.2	ug/L	2.393	0.4718	13,550
Be3130_R		508.3	ug/L	0.5268	0.1036	30,580
Ca3158_R		5,265	ug/L	2.529	0.04803	3,129
Cd2265_A		519.4	ug/L	1.445	0.2781	8,792
Co2286_A		539.7	ug/L	1.302	0.2413	2,224
Cr2677_A		534.2	ug/L	0.2924	0.05474	6,178
Cu3273_A		525.4	ug/L	2.073	0.3945	9,123
Fe2599_R		5,159	ug/L	0.1591	0.003085	6,142
K_7664_R		10,400	ug/L	59.49	0.5720	3,800
Li6707_R		501.2	ug/L	4.609	0.9196	3,890
Mg2795		5,842	ug/L	16.07	0.2750	259,500
Mg2025_A		4,988	ug/L	10.75	0.2155	1,707
Mn2576_R		518.8	ug/L	3.219	0.6206	3,447
Mo2020_A		483.6	ug/L	2.561	0.5297	1,482

SQ1104-008RA

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:42:49PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R	W	190,200	ug/L	6,446	3.390	158,700
Ni2316_A		524.2	ug/L	1.343	0.2562	953.4
Pb2203_A		931.0	ug/L	1.267	0.1361	1,182
Sb2068_A		518.6	ug/L	1.053	0.2031	306.8
Se1960_A		506.0	ug/L	3.822	0.7553	122.9
Si2516_R		355.4	ug/L	3.794	1.068	155.5
Sn1899_A		0.8347	ug/L	0.1422	17.04	2.436
Sr4215_R		528.3	ug/L	1.443	0.2731	18,470
Ti3349_A		471.0	ug/L	1.357	0.2881	17,350
Tl1908_A		518.0	ug/L	1.551	0.2994	301.6
V_2924_A		510.6	ug/L	1.059	0.2074	8,798
Zn2062_A		515.1	ug/L	1.985	0.3853	1,923
Y_3600_R		10,441	Cts/S	112.09	1.0736	10,441
Y_2243_A		6,789.9	Cts/S	4.4266	0.065193	6,789.9
Y_3600_A		178,940	Cts/S	403.55	0.22552	178,940

SQ1104-008RL

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:47:01PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-1.128	ug/L	1.787	158.4	-7.824
Al3961_R		155.1	ug/L	35.10	22.63	16.46
As1891_A		2.911	ug/L	0.6007	20.64	-3.400
B_2089_A		34.97	ug/L	0.4099	1.172	10.72
Ba4554_R		8.000	ug/L	0.9231	11.54	70.13
Be3130_R		0.3943	ug/L	0.1346	34.14	-5.740
Ca3158_R		192.7	ug/L	12.72	6.602	-14.64
Cd2265_A		-0.3533	ug/L	0.03150	8.916	-3.971
Co2286_A		0.8707	ug/L	0.7756	89.08	-0.1287
Cr2677_A		0.1417	ug/L	0.8976	633.6	-2.005
Cu3273_A		41.20	ug/L	1.045	2.536	134.9
Fe2599_R		21.20	ug/L	2.514	11.86	7.885
K_7664_R		-662.0	ug/L	70.54	10.66	286.3
Li6707_R		-5.784	ug/L	10.01	173.0	2.907
Mg2795		88.33	ug/L	2.142	2.425	815.4
Mg2025_A		68.67	ug/L	2.760	4.019	-2.080
Mn2576_R		7.137	ug/L	0.1226	1.717	12.18
Mo2020_A		2.575	ug/L	1.142	44.36	1.815
Na5895_R	W	197,200	ug/L	1,363	0.6910	33,350
Ni2316_A		0.1670	ug/L	1.487	890.6	0.3076
Pb2203_A		464.6	ug/L	1.676	0.3607	119.9
Sb2068_A		11.67	ug/L	3.010	25.80	3.279
Se1960_A		-10.03	ug/L	0.5866	5.850	1.256
Si2516_R		42.34	ug/L	33.49	79.08	19.40
Sn1899_A		-1.898	ug/L	1.013	53.41	1.802
Sr4215_R		2.579	ug/L	0.5911	22.92	15.63
Ti3349_A		0.6898	ug/L	0.5000	72.48	7.881
Tl1908_A		-0.7200	ug/L	5.514	765.8	-3.072
V_2924_A		0.3819	ug/L	0.4496	117.7	-0.8420
Zn2062_A		-2.352	ug/L	0.1486	6.319	4.148
Y_3600_R		10,554	Cts/S	20.410	0.19338	10,554
Y_2243_A		7,021.7	Cts/S	15.969	0.22743	7,021.7
Y_3600_A		186,260	Cts/S	173.85	0.093339	186,260

SQ1104-008RN

Method Name: FAST-2022_POP
Method Revision: 169

SQ1104-008RN

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:51:20PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		9.028	ug/L	0.1836	2.034	215.3
Al3961_R		1,022	ug/L	8.177	0.7998	677.2
As1891_A		33.74	ug/L	1.051	3.114	7.127
B_2089_A		214.1	ug/L	0.2590	0.1210	236.6
Ba4554_R		686.8	ug/L	0.3190	0.04645	18,320
Be3130_R		17.04	ug/L	0.09045	0.5306	1,013
Ca3158_R		947.1	ug/L	14.16	1.495	531.5
Cd2265_A		86.44	ug/L	0.2064	0.2388	1,439
Co2286_A		182.6	ug/L	0.3815	0.2089	741.2
Cr2677_A		72.56	ug/L	0.9217	1.270	817.7
Cu3273_A		150.1	ug/L	0.5583	0.3718	2,535
Fe2599_R		325.2	ug/L	0.3424	0.1053	389.4
K_7664_R		3,766	ug/L	17.34	0.4604	1,583
Li6707_R		169.1	ug/L	1.012	0.5987	1,319
Mg2795		1,837	ug/L	2.705	0.1472	81,570
Mg2025_A		1,497	ug/L	6.079	0.4060	500.9
Mn2576_R		183.8	ug/L	0.02368	0.01289	1,221
Mo2020_A		32.00	ug/L	0.1443	0.4511	96.76
Na5895_R	F	324,800	ug/L	110.0	0.03385	270,800
Ni2316_A		179.4	ug/L	0.07669	0.04276	321.7
Pb2203_A		773.7	ug/L	2.777	0.3590	967.6
Sb2068_A		37.64	ug/L	0.2026	0.5383	22.82
Se1960_A		33.22	ug/L	1.244	3.744	9.540
Si2516_R		482.8	ug/L	9.672	2.003	206.8
Sn1899_A		176.1	ug/L	0.7292	0.4140	101.1
Sr4215_R		176.8	ug/L	0.1522	0.08610	6,174
Ti3349_A		152.2	ug/L	0.1869	0.1228	5,475
Tl1908_A		32.13	ug/L	0.6051	1.883	15.85
V_2924_A		172.4	ug/L	0.03886	0.02254	2,921
Zn2062_A		177.8	ug/L	0.5795	0.3260	658.4
Y_3600_R		10,431	Cts/S	13.357	0.12805	10,431
Y_2243_A		6,693.4	Cts/S	5.6629	0.084604	6,693.4
Y_3600_A		174,730	Cts/S	216.84	0.12410	174,730

SQ1104-008RO

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:55:39PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		8.773	ug/L	0.04641	0.5290	208.9
Al3961_R		990.3	ug/L	3.175	0.3206	653.6
As1891_A		31.84	ug/L	0.9803	3.079	6.520
B_2089_A		207.5	ug/L	0.01437	0.006921	229.0
Ba4554_R		675.4	ug/L	1.083	0.1603	17,960
Be3130_R		16.52	ug/L	0.1247	0.7547	978.5
Ca3158_R		928.5	ug/L	5.494	0.5917	518.6
Cd2265_A		84.36	ug/L	0.1159	0.1374	1,402
Co2286_A		178.1	ug/L	0.2253	0.1265	721.4
Cr2677_A		71.34	ug/L	0.2419	0.3390	802.9
Cu3273_A		146.4	ug/L	0.4617	0.3154	2,468
Fe2599_R		322.8	ug/L	2.674	0.8284	385.3
K_7664_R		3,746	ug/L	2.045	0.05459	1,572
Li6707_R		160.4	ug/L	1.192	0.7429	1,247
Mg2795		1,806	ug/L	9.611	0.5323	79,900
Mg2025_A		1,465	ug/L	1.995	0.1361	489.2
Mn2576_R		181.7	ug/L	0.9445	0.5199	1,204
Mo2020_A		30.98	ug/L	0.04664	0.1506	93.50

SQ1104-008RO

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:55:39PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R	F	324,200	ug/L	1,225	0.3779	269,400
Ni2316_A		174.6	ug/L	0.2905	0.1664	312.7
Pb2203_A		757.4	ug/L	2.424	0.3201	945.4
Sb2068_A		36.47	ug/L	0.2933	0.8041	22.13
Se1960_A		32.03	ug/L	2.861	8.931	9.243
Si2516_R		460.9	ug/L	4.447	0.9649	197.4
Sn1899_A		171.0	ug/L	0.4338	0.2537	98.06
Sr4215_R		173.1	ug/L	1.007	0.5816	6,025
Ti3349_A		149.4	ug/L	0.1177	0.07881	5,367
Tl1908_A		31.24	ug/L	0.2159	0.6911	15.30
V_2924_A		168.4	ug/L	0.3856	0.2289	2,851
Zn2062_A		174.1	ug/L	0.2805	0.1611	643.6
Y_3600_R		10,396	Cts/S	9.7349	0.093637	10,396
Y_2243_A		6,681.2	Cts/S	9.8801	0.14788	6,681.2
Y_3600_A		174,520	Cts/S	478.37	0.27411	174,520

SQ1104-010R

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 7:59:57PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.09077	ug/L	0.2770	305.2	-4.154
Al3961_R		204.5	ug/L	5.479	2.680	132.5
As1891_A		0.1537	ug/L	0.8156	530.8	-3.395
B_2089_A		28.48	ug/L	0.2162	0.7590	33.72
Ba4554_R		11.58	ug/L	0.1487	1.284	337.1
Be3130_R		-0.03265	ug/L	0.02257	69.11	-12.45
Ca3158_R		124.3	ug/L	6.266	5.042	37.25
Cd2265_A		-0.1326	ug/L	0.06265	47.26	-4.850
Co2286_A		0.1510	ug/L	0.2150	142.4	-0.2175
Cr2677_A		0.07658	ug/L	0.01982	25.88	-1.347
Cu3273_A		0.8016	ug/L	0.2357	29.40	0.2257
Fe2599_R		2.348	ug/L	1.308	55.69	5.572
K_7664_R		343.5	ug/L	20.77	6.048	444.3
Li6707_R		2.137	ug/L	1.010	47.24	28.54
Mg2795		64.14	ug/L	0.2363	0.3684	2,885
Mg2025_A		49.77	ug/L	2.258	4.536	10.07
Mn2576_R		11.64	ug/L	0.2630	2.260	80.22
Mo2020_A		0.1231	ug/L	0.04591	37.29	0.5496
Na5895_R	F	212,600	ug/L	585.7	0.2755	178,300
Ni2316_A		0.6133	ug/L	0.06133	9.999	1.340
Pb2203_A		1.514	ug/L	0.2926	19.32	-0.3107
Sb2068_A		2.427	ug/L	1.180	48.59	3.174
Se1960_A		-0.7365	ug/L	0.7046	95.67	1.508
Si2516_R		89.54	ug/L	10.97	12.26	51.64
Sn1899_A		4.957	ug/L	0.6362	12.83	4.750
Sr4215_R		0.4661	ug/L	0.02801	6.009	13.78
Ti3349_A		0.1158	ug/L	0.08407	72.58	6.686
Tl1908_A		-0.003480	ug/L	0.5693	16,360	-2.872
V_2924_A		0.1839	ug/L	0.08698	47.29	1.037
Zn2062_A		0.6618	ug/L	0.007721	1.167	8.159
Y_3600_R		10,492	Cts/S	65.486	0.62418	10,492
Y_2243_A		6,732.2	Cts/S	7.4013	0.10994	6,732.2
Y_3600_A		177,360	Cts/S	242.96	0.13699	177,360

SQ1104-012R

Method Name: FAST-2022_POP
Method Revision: 169

SQ1104-012R

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:04:21PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.3043	ug/L	0.09575	31.47	-9.405
Al3961_R		204.6	ug/L	2.413	1.179	131.1
As1891_A		-0.1690	ug/L	1.725	1,021	-3.515
B_2089_A		40.19	ug/L	0.2975	0.7403	46.75
Ba4554_R		10.42	ug/L	0.2581	2.476	302.4
Be3130_R		0.003582	ug/L	0.03200	893.2	-10.15
Ca3158_R		180.3	ug/L	1.684	0.9338	70.29
Cd2265_A		-0.08246	ug/L	0.01731	21.00	-4.028
Co2286_A		-0.002156	ug/L	0.2499	11,590	-0.8473
Cr2677_A		0.2478	ug/L	0.2565	103.5	0.6176
Cu3273_A		0.9279	ug/L	0.1792	19.31	2.411
Fe2599_R		3.514	ug/L	0.7909	22.50	6.884
K_7664_R		275.7	ug/L	11.63	4.217	416.5
Li6707_R		-0.004613	ug/L	0.3320	7,198	11.71
Mg2795		83.33	ug/L	0.5873	0.7047	3,698
Mg2025_A		64.66	ug/L	3.277	5.068	15.14
Mn2576_R		11.02	ug/L	0.7757	7.037	75.19
Mo2020_A		0.1969	ug/L	0.01709	8.683	0.7780
Na5895_R	F	221,600	ug/L	445.8	0.2012	183,600
Ni2316_A		0.6298	ug/L	0.1246	19.78	1.376
Pb2203_A		1.094	ug/L	0.7750	70.86	-0.8443
Sb2068_A		2.435	ug/L	0.4529	18.60	3.186
Se1960_A		-0.08512	ug/L	1.606	1,887	1.671
Si2516_R		101.1	ug/L	8.496	8.405	55.54
Sn1899_A		7.080	ug/L	0.8175	11.55	5.984
Sr4215_R		0.3011	ug/L	0.06277	20.85	7.902
Ti3349_A		0.1172	ug/L	0.2046	174.6	6.757
Tl1908_A		-1.118	ug/L	0.4660	41.68	-3.540
V_2924_A		0.003245	ug/L	0.02888	889.8	-2.104
Zn2062_A		1.461	ug/L	0.04828	3.304	11.17
Y_3600_R		10,367	Cts/S	108.38	1.0454	10,367
Y_2243_A		6,767.8	Cts/S	14.943	0.22079	6,767.8
Y_3600_A		177,830	Cts/S	89.551	0.050358	177,830

SQ1104-014R

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:08:45PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.01666	ug/L	0.04001	240.1	-2.386
Al3961_R		197.0	ug/L	10.60	5.382	129.1
As1891_A		-0.2713	ug/L	0.7585	279.5	-3.605
B_2089_A		27.26	ug/L	0.2039	0.7479	33.10
Ba4554_R		9.661	ug/L	0.2115	2.190	289.4
Be3130_R		-0.009947	ug/L	0.07265	730.4	-11.23
Ca3158_R		151.0	ug/L	3.207	2.124	54.11
Cd2265_A		-0.1131	ug/L	0.007276	6.433	-4.612
Co2286_A		0.008932	ug/L	0.03194	357.6	-0.8133
Cr2677_A		0.2369	ug/L	0.3726	157.3	0.5042
Cu3273_A		7.534	ug/L	0.1830	2.429	118.8
Fe2599_R		7.997	ug/L	3.231	40.40	12.49
K_7664_R		189.3	ug/L	39.01	20.60	397.6
Li6707_R		-1.070	ug/L	1.170	109.4	3.629
Mg2795		65.43	ug/L	0.6591	1.007	2,980
Mg2025_A		49.87	ug/L	1.196	2.398	10.32
Mn2576_R		6.981	ug/L	0.1557	2.231	49.79
Mo2020_A		0.2963	ug/L	0.1559	52.61	1.099

SQ1104-014R

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:08:45PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R	F	201,200	ug/L	3,184	1.583	170,900
Ni2316_A		0.6073	ug/L	0.1567	25.81	1.357
Pb2203_A		66.25	ug/L	0.01336	0.02017	83.07
Sb2068_A		3.439	ug/L	0.6572	19.11	3.855
Se1960_A		-1.363	ug/L	1.151	84.43	1.387
Si2516_R		65.11	ug/L	5.014	7.700	42.42
Sn1899_A		2.447	ug/L	1.010	41.27	3.400
Sr4215_R		0.4677	ug/L	0.01434	3.065	14.02
Ti3349_A		0.1708	ug/L	0.1192	69.79	8.882
Tl1908_A		-0.2657	ug/L	0.2817	106.0	-3.087
V_2924_A		0.03820	ug/L	0.06847	179.3	-1.515
Zn2062_A		3.114	ug/L	0.03437	1.104	17.59
Y_3600_R		10,626	Cts/S	5.8047	0.054627	10,626
Y_2243_A		6,878.0	Cts/S	12.743	0.18527	6,878.0
Y_3600_A		181,210	Cts/S	547.82	0.30231	181,210

SQ1129-002

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:13:09PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.1525	ug/L	0.2239	146.8	-5.553
Al3961_R		55.80	ug/L	22.30	39.96	50.08
As1891_A		0.1247	ug/L	1.632	1,309	-3.299
B_2089_A		40.74	ug/L	0.5384	1.321	45.68
Ba4554_R		138.1	ug/L	0.9610	0.6957	3,672
Be3130_R		-0.05068	ug/L	0.01484	29.29	-13.72
Ca3158_R	W	112,300	ug/L	636.6	0.5671	66,790
Cd2265_A		0.4255	ug/L	0.008456	1.988	4.390
Co2286_A		3.868	ug/L	0.01844	0.4766	14.55
Cr2677_A		1.575	ug/L	0.2016	12.80	16.12
Cu3273_A		31.26	ug/L	0.4163	1.332	512.1
Fe2599_R		21.84	ug/L	1.740	7.970	28.46
K_7664_R		2,107	ug/L	80.79	3.833	1,021
Li6707_R		8.960	ug/L	0.4300	4.799	80.33
Mg2795		8,720	ug/L	105.1	1.206	383,400
Mg2025_A		7,081	ug/L	9.166	0.1294	2,293
Mn2576_R		741.9	ug/L	3.888	0.5240	4,878
Mo2020_A		0.3992	ug/L	0.1075	26.94	1.302
Na5895_R	F	354,200	ug/L	143.8	0.04060	292,500
Ni2316_A		7.894	ug/L	0.07620	0.9652	14.02
Pb2203_A	W	3,900	ug/L	6.394	0.1639	4,764
Sb2068_A		22.88	ug/L	0.4046	1.768	14.59
Se1960_A		-0.3207	ug/L	1.524	475.1	1.678
Si2516_R		12,070	ug/L	1.067	0.008840	4,757
Sn1899_A		0.06656	ug/L	0.7833	1,177	1.919
Sr4215_R		198.1	ug/L	1.744	0.8807	6,854
Ti3349_A		7.143	ug/L	0.2120	2.968	256.6
Tl1908_A		-0.5218	ug/L	1.245	238.6	-3.650
V_2924_A		-0.2058	ug/L	0.02049	9.957	-9.812
Zn2062_A		77.75	ug/L	0.3665	0.4714	283.9
Y_3600_R		10,335	Cts/S	107.08	1.0361	10,335
Y_2243_A		6,525.1	Cts/S	3.3677	0.051611	6,525.1
Y_3600_A		172,970	Cts/S	198.68	0.11487	172,970

SQ1129-004

Method Name: FAST-2022_POP
Method Revision: 169

SQ1129-004

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:17:35PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.7126	ug/L	0.7717	108.3	-5.793
Al3961_R		1,833	ug/L	52.06	2.841	252.5
As1891_A		9.542	ug/L	3.647	38.21	-2.992
B_2089_A		68.46	ug/L	1.398	2.042	18.48
Ba4554_R		344.7	ug/L	7.743	2.246	1,906
Be3130_R		1.391	ug/L	0.5325	38.29	6.182
Ca3158_R	W	228,100	ug/L	3,154	1.383	28,010
Cd2265_A		2.723	ug/L	0.03768	1.384	6.886
Co2286_A		23.39	ug/L	1.301	5.563	19.24
Cr2677_A		13.75	ug/L	0.8821	6.417	31.74
Cu3273_A		406.8	ug/L	2.578	0.6338	1,476
Fe2599_R		147.1	ug/L	2.636	1.791	38.61
K_7664_R		3,652	ug/L	144.7	3.961	583.9
Li6707_R		22.62	ug/L	5.430	24.00	47.83
Mg2795		22,200	ug/L	168.5	0.7592	201,600
Mg2025_A		19,940	ug/L	64.29	0.3224	1,398
Mn2576_R		2,959	ug/L	26.06	0.8808	4,018
Mo2020_A		0.5132	ug/L	0.08234	16.04	0.4751
Na5895_R		6,454	ug/L	115.0	1.781	1,188
Ni2316_A		12.29	ug/L	0.6546	5.326	4.904
Pb2203_A	W	58,420	ug/L	122.5	0.2097	15,480
Sb2068_A		95.82	ug/L	2.757	2.877	13.58
Se1960_A		-9.900	ug/L	7.217	72.90	1.381
Si2516_R		36,680	ug/L	460.3	1.255	2,992
Sn1899_A		-1.432	ug/L	2.108	147.2	1.871
Sr4215_R		409.9	ug/L	7.252	1.769	2,928
Ti3349_A		30.06	ug/L	0.2260	0.7518	235.8
Tl1908_A		-0.3576	ug/L	3.622	1,013	-3.553
V_2924_A		-0.1736	ug/L	0.1573	90.61	-6.678
Zn2062_A		323.2	ug/L	1.746	0.5401	257.1
Y_3600_R		10,672	Cts/S	133.29	1.2490	10,672
Y_2243_A		7,076.6	Cts/S	18.709	0.26438	7,076.6
Y_3600_A		188,560	Cts/S	177.81	0.094304	188,560

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:21:49PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A	F	438.3	ug/L	1.489	0.3398	11,330
Al3961_R	W	13,340	ug/L	14.40	0.1080	8,996
As1891_A		497.2	ug/L	0.04340	0.008728	159.8
B_2089_A		522.5	ug/L	0.7276	0.1393	625.3
Ba4554_R		509.5	ug/L	6.418	1.260	13,760
Be3130_R		495.4	ug/L	0.2257	0.04556	30,130
Ca3158_R	F	10,910	ug/L	98.97	0.9071	6,595
Cd2265_A		514.9	ug/L	0.4069	0.07903	9,080
Co2286_A	W	545.4	ug/L	2.110	0.3869	2,338
Cr2677_A	W	536.8	ug/L	0.04491	0.008366	6,495
Cu3273_A		487.9	ug/L	1.840	0.3772	8,864
Fe2599_R	F	11,050	ug/L	3.568	0.03229	13,290
K_7664_R		12,230	ug/L	61.49	0.5027	4,460
Li6707_R		483.2	ug/L	1.361	0.2817	3,791
Mg2795		12,460	ug/L	168.2	1.350	559,500
Mg2025_A	W	11,500	ug/L	29.39	0.2556	4,065
Mn2576_R		522.5	ug/L	1.014	0.1940	3,510
Mo2020_A	W	464.7	ug/L	0.1024	0.02205	1,482

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:21:49PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R	W	13,240	ug/L	194.1	1.467	11,250
Ni2316_A		524.4	ug/L	0.05813	0.01109	992.2
Pb2203_A		511.3	ug/L	0.4257	0.08325	672.9
Sb2068_A		517.0	ug/L	1.016	0.1965	315.8
Se1960_A		496.9	ug/L	0.4836	0.09733	125.6
Si2516_R		12,700	ug/L	14.20	0.1119	5,109
Sn1899_A		505.7	ug/L	1.828	0.3615	302.6
Sr4215_R		504.7	ug/L	5.006	0.9919	17,840
Ti3349_A	W	460.2	ug/L	0.08212	0.01785	17,740
Tl1908_A	W	547.3	ug/L	1.027	0.1877	331.8
V_2924_A		496.5	ug/L	0.7500	0.1511	8,948
Zn2062_A		501.0	ug/L	0.1136	0.02266	1,947
Y_3600_R		10,554	Cts/S	68.927	0.65308	10,554
Y_2243_A		7,065.2	Cts/S	3.2315	0.045739	7,065.2
Y_3600_A		187,200	Cts/S	119.61	0.063898	187,200

CCB

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:25:58PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1945	ug/L	0.3158	162.4	3.063
Al3961_R		-16.85	ug/L	5.457	32.38	-15.85
As1891_A		1.330	ug/L	0.7870	59.19	-3.202
B_2089_A		0.7512	ug/L	0.1776	23.65	3.674
Ba4554_R		0.3535	ug/L	0.1945	55.03	36.67
Be3130_R		0.09416	ug/L	0.09439	100.2	-4.824
Ca3158_R		4.874	ug/L	3.195	65.54	-35.23
Cd2265_A		-0.05936	ug/L	0.009350	15.75	-3.833
Co2286_A		0.3484	ug/L	0.1207	34.65	0.6210
Cr2677_A		0.02848	ug/L	0.01415	49.69	-2.052
Cu3273_A		0.6230	ug/L	0.4108	65.93	-2.988
Fe2599_R		1.771	ug/L	1.331	75.12	4.935
K_7664_R		-324.0	ug/L	30.38	9.377	222.4
Li6707_R		0.2528	ug/L	0.1237	48.95	14.00
Mg2795		3.489	ug/L	0.04309	1.235	179.4
Mg2025_A		3.176	ug/L	0.2642	8.320	-5.848
Mn2576_R		-0.3363	ug/L	0.6235	185.4	0.3438
Mo2020_A		0.5789	ug/L	0.06224	10.75	2.049
Na5895_R		137.3	ug/L	6.586	4.796	203.2
Ni2316_A		-0.6233	ug/L	0.02469	3.961	-0.9415
Pb2203_A		0.9664	ug/L	0.02588	2.678	-1.032
Sb2068_A		2.077	ug/L	2.045	98.47	3.169
Se1960_A		-1.539	ug/L	0.07967	5.177	1.392
Si2516_R		11.80	ug/L	1.926	16.33	20.81
Sn1899_A		-0.1786	ug/L	0.3406	190.8	1.949
Sr4215_R		0.1991	ug/L	0.07215	36.24	4.443
Ti3349_A		-0.02897	ug/L	0.1485	512.7	1.530
Tl1908_A		-0.4709	ug/L	0.1884	40.00	-3.318
V_2924_A		0.02432	ug/L	0.003848	15.82	-1.826
Zn2062_A		-1.279	ug/L	0.02064	1.614	1.048
Y_3600_R		10,592	Cts/S	9.8647	0.093132	10,592
Y_2243_A		7,127.2	Cts/S	14.359	0.20147	7,127.2
Y_3600_A		190,650	Cts/S	399.47	0.20954	190,650

SQ1169-001

Method Name: FAST-2022_POP
Method Revision: 169

SQ1169-001

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:30:16PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2979	ug/L	0.2581	86.64	-9.107
Al3961_R		215.4	ug/L	2.092	0.9715	140.2
As1891_A		-0.5375	ug/L	0.9267	172.4	-3.612
B_2089_A		38.61	ug/L	0.09297	0.2408	44.46
Ba4554_R		18.23	ug/L	0.2272	1.246	514.2
Be3130_R		-0.03329	ug/L	0.004163	12.51	-12.51
Ca3158_R		4,341	ug/L	19.31	0.4449	2,581
Cd2265_A		-0.05642	ug/L	0.02671	47.34	-2.575
Co2286_A		1.687	ug/L	0.1459	8.647	6.026
Cr2677_A		1.495	ug/L	0.1104	7.384	14.75
Cu3273_A		14.29	ug/L	0.3848	2.693	230.5
Fe2599_R		635.5	ug/L	4.908	0.7723	761.4
K_7664_R		396.0	ug/L	31.04	7.839	461.0
Li6707_R		2.074	ug/L	0.8117	39.13	27.99
Mg2795		639.2	ug/L	1.121	0.1754	28,500
Mg2025_A		503.9	ug/L	0.9603	0.1906	161.0
Mn2576_R		85.90	ug/L	0.2793	0.3251	574.6
Mo2020_A		0.8641	ug/L	0.01695	1.961	2.774
Na5895_R	F	378,200	ug/L	2,505	0.6624	316,500
Ni2316_A		17.79	ug/L	0.1905	1.071	32.02
Pb2203_A		1.628	ug/L	0.1923	11.81	-0.1268
Sb2068_A		3.409	ug/L	0.6981	20.47	3.740
Se1960_A		1.317	ug/L	2.523	191.6	1.992
Si2516_R		643.8	ug/L	11.58	1.799	272.2
Sn1899_A		0.8260	ug/L	1.097	132.8	2.391
Sr4215_R		41.41	ug/L	0.1497	0.3615	1,450
Ti3349_A		0.9860	ug/L	0.1645	16.68	38.00
Tl1908_A		-0.5816	ug/L	0.6347	109.1	-3.241
V_2924_A		0.2433	ug/L	0.1013	41.64	1.496
Zn2062_A		155.3	ug/L	0.4924	0.3170	574.8
Y_3600_R		10,472	Cts/S	52.074	0.49725	10,472
Y_2243_A		6,677.4	Cts/S	0.72490	0.010856	6,677.4
Y_3600_A		175,160	Cts/S	700.44	0.39990	175,160

SQ1167-003 R 2nd 032123

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:34:37PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		6.550	ug/L	7.546	115.2	1.275
Al3961_R		-53.96	ug/L	314.2	582.4	-5.184
As1891_A	F	-1,989	ug/L	18.81	0.9455	-3.136
B_2089_A		1,606	ug/L	9.776	0.6087	37.87
Ba4554_R		58.41	ug/L	18.05	30.90	58.78
Be3130_R		0.6915	ug/L	1.589	229.7	-9.757
Ca3158_R		993.9	ug/L	383.8	38.61	-26.11
Cd2265_A		6.299	ug/L	1.710	27.15	-1.476
Co2286_A		45.34	ug/L	0.9453	2.085	3.217
Cr2677_A		12.59	ug/L	5.965	47.37	0.6607
Cu3273_A		37.42	ug/L	27.51	73.52	-0.5770
Fe2599_R		1,681	ug/L	116.4	6.926	43.44
K_7664_R	F	19,290,000	ug/L	72,130	0.3738	131,200
Li6707_R		115.3	ug/L	40.32	34.96	30.16
Mg2795		360.3	ug/L	0.8594	0.2385	347.3
Mg2025_A		3.849	ug/L	29.36	762.9	-6.557
Mn2576_R		695.4	ug/L	14.93	2.147	96.37
Mo2020_A		24.16	ug/L	5.158	21.35	1.650

SQ1167-003 R EA 032323

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:34:37PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R	W	4,142,000	ug/L	22,490	0.5429	70,260
Ni2316_A		26,480	ug/L	14.30	0.05400	958.8
Pb2203_A		32,810	ug/L	39.28	0.1197	828.6
Sb2068_A	F	-2,715	ug/L	30.41	1.120	-554.7
Se1960_A		-116.4	ug/L	58.56	50.30	1.848
Si2516_R		-266.9	ug/L	604.0	226.3	13.93
Sn1899_A	F	5,332,000	ug/L	22,890	0.4293	60,650
Sr4215_R		1.514	ug/L	10.23	675.8	-1.533
Ti3349_A		11.51	ug/L	16.38	142.4	10.81
Tl1908_A		-119.5	ug/L	25.07	20.97	-4.281
V_2924_A		-4.143	ug/L	9.610	232.0	-3.612
Zn2062_A		472.7	ug/L	10.93	2.311	40.81
Y_3600_R		10,602	Cts/S	42.217	0.39821	10,602
Y_2243_A		6,759.2	Cts/S	12.694	0.18780	6,759.2
Y_3600_A		176,420	Cts/S	166.90	0.094605	176,420

SQ1167-004 R EA 032323

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:38:53PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		1.823	ug/L	11.02	604.7	-1.023
Al3961_R		-161.4	ug/L	455.2	282.0	-6.665
As1891_A	F	-2,476	ug/L	26.47	1.069	-3.331
B_2089_A		527.9	ug/L	5.268	0.9980	14.06
Ba4554_R		95.39	ug/L	10.78	11.30	78.86
Be3130_R		-6.251	ug/L	1.472	23.54	-18.24
Ca3158_R		2,018	ug/L	2.529	0.1253	-13.60
Cd2265_A		9.237	ug/L	1.044	11.30	0.4421
Co2286_A		41.82	ug/L	5.065	12.11	2.578
Cr2677_A		18.29	ug/L	9.075	49.62	1.939
Cu3273_A		29.26	ug/L	12.81	43.80	-3.360
Fe2599_R		1,394	ug/L	152.0	10.91	36.55
K_7664_R	F	23,800,000	ug/L	90,960	0.3823	161,900
Li6707_R		104.7	ug/L	102.2	97.67	28.44
Mg2795		330.4	ug/L	9.743	2.949	320.7
Mg2025_A		54.00	ug/L	24.83	45.98	-6.142
Mn2576_R		274.8	ug/L	4.580	1.667	39.71
Mo2020_A		40.64	ug/L	11.25	27.68	2.621
Na5895_R	W	5,048,000	ug/L	31,410	0.6221	85,720
Ni2316_A		1,785	ug/L	18.94	1.062	64.00
Pb2203_A	W	103,900	ug/L	401.3	0.3863	2,594
Sb2068_A	F	-3,694	ug/L	457.5	12.38	-672.6
Se1960_A		-125.5	ug/L	40.45	32.22	1.935
Si2516_R		249.4	ug/L	596.2	239.0	18.09
Sn1899_A	F	6,506,000	ug/L	3,156	0.04851	73,050
Sr4215_R		8.223	ug/L	9.512	115.7	3.196
Ti3349_A		-0.5456	ug/L	9.957	1,825	2.064
Tl1908_A		-131.8	ug/L	0.1191	0.09033	-4.360
V_2924_A		-4.439	ug/L	0.6313	14.22	-3.686
Zn2062_A		410.4	ug/L	6.283	1.531	35.72
Y_3600_R		10,615	Cts/S	79.013	0.74438	10,615
Y_2243_A		6,672.4	Cts/S	20.673	0.30983	6,672.4
Y_3600_A		175,120	Cts/S	281.35	0.16067	175,120

SQ1167-005 R EA 032323

Method Name: FAST-2022_POP
Method Revision: 169

SQ1167-005 R 5a 032123

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:43:09PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-5.604	ug/L	17.63	314.6	-3.371
Al3961_R		-144.7	ug/L	1,079	745.3	-5.432
As1891_A	F	-1,615	ug/L	85.21	5.277	-3.174
B_2089_A		81.86	ug/L	9.209	11.25	3.613
Ba4554_R		59.59	ug/L	11.60	19.46	43.16
Be3130_R		-9.315	ug/L	4.132	44.36	-16.24
Ca3158_R		1,553	ug/L	212.2	13.66	-28.68
Cd2265_A		-5.364	ug/L	5.032	93.81	-3.629
Co2286_A		284.7	ug/L	9.728	3.418	10.96
Cr2677_A		13.21	ug/L	20.99	158.9	-0.7327
Cu3273_A		19.34	ug/L	9.723	50.27	-10.42
Fe2599_R		586.2	ug/L	156.6	26.72	9.856
K_7664_R	W	19,000,000	ug/L	6,128	0.03225	64,600
Li6707_R		-57.03	ug/L	187.8	329.4	7.548
Mg2795		428.9	ug/L	0.5549	0.1294	215.1
Mg2025_A		300.1	ug/L	107.7	35.91	-5.549
Mn2576_R		180.5	ug/L	19.21	10.64	14.74
Mo2020_A		83.66	ug/L	5.236	6.258	2.760
Na5895_R	W	3,973,000	ug/L	2,746	0.06911	33,660
Ni2316_A		2,653	ug/L	18.14	0.6838	48.82
Pb2203_A	W	258,000	ug/L	1,177	0.4560	3,302
Sb2068_A		3,982	ug/L	105.3	2.643	-197.9
Se1960_A		-268.7	ug/L	0.5059	0.1883	1.363
Si2516_R		-1,508	ug/L	304.7	20.20	9.975
Sn1899_A	F	4,483,000	ug/L	8,719	0.1945	25,800
Sr4215_R		-14.66	ug/L	8.647	58.97	-7.816
Ti3349_A		2.389	ug/L	4.246	177.7	3.436
Tl1908_A		-76.81	ug/L	3.230	4.205	-3.357
V_2924_A		-0.009724	ug/L	9.838	101,200	-2.223
Zn2062_A		-30.46	ug/L	1.735	5.695	4.661
Y_3600_R		10,577	Cts/S	33.974	0.32122	10,577
Y_2243_A		6,838.5	Cts/S	46.101	0.67414	6,838.5
Y_3600_A	/	181,600	Cts/S	509.33	0.28047	181,600

LCSWQC16ICW1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:47:26PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		43.49	ug/L	0.04252	0.09778	1,123
Al3961_R		2,267	ug/L	21.71	0.9574	1,513
As1891_A		99.51	ug/L	0.9580	0.9627	29.24
B_2089_A		519.8	ug/L	2.134	0.4106	603.3
Ba4554_R		2,081	ug/L	11.63	0.5587	55,660
Be3130_R		51.42	ug/L	0.3889	0.7563	3,087
Ca3158_R		2,294	ug/L	26.53	1.157	1,346
Cd2265_A		257.8	ug/L	0.8892	0.3450	4,536
Co2286_A		558.9	ug/L	2.430	0.4348	2,396
Cr2677_A		217.3	ug/L	0.5770	0.2656	2,633
Cu3273_A		250.7	ug/L	1.340	0.5346	4,552
Fe2599_R		940.9	ug/L	9.767	1.038	1,125
K_7664_R		10,440	ug/L	21.80	0.2087	3,824
Li6707_R		519.0	ug/L	1.560	0.3005	4,038
Mg2795		5,413	ug/L	1.105	0.02041	241,100
Mg2025_A		5,029	ug/L	3.403	0.06767	1,790
Mn2576_R		533.3	ug/L	0.6941	0.1301	3,552
Mo2020_A		94.69	ug/L	0.5105	0.5392	301.9

LCSWQC16ICW1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:47:26PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		8,436	ug/L	92.89	1.101	7,142
Ni2316_A		538.8	ug/L	1.159	0.2151	1,020
Pb2203_A		104.9	ug/L	0.1006	0.09590	136.3
Sb2068_A		105.0	ug/L	0.1205	0.1147	63.46
Se1960_A		98.03	ug/L	3.982	4.062	26.28
Si2516_R		1,042	ug/L	0.6284	0.06032	428.9
Sn1899_A		575.9	ug/L	5.769	1.002	344.5
Sr4215_R		532.4	ug/L	2.810	0.5277	18,670
Ti3349_A		465.5	ug/L	1.709	0.3671	17,970
Tl1908_A		108.1	ug/L	0.3872	0.3582	63.37
V_2924_A		508.4	ug/L	2.009	0.3952	9,254
Zn2062_A		508.2	ug/L	2.326	0.4577	1,976
Y_3600_R		10,468	Cts/S	52.865	0.50502	10,468
Y_2243_A		7,066.5	Cts/S	23.067	0.32642	7,066.5
Y_3600_A		187,600	Cts/S	932.03	0.49682	187,600

PBWQC16ICW1

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:51:37PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.04887	ug/L	0.004507	9.223	-3.349
Al3961_R		-2.459	ug/L	8.845	359.7	-6.082
As1891_A		-0.5277	ug/L	0.5173	98.03	-3.826
B_2089_A		0.6929	ug/L	0.1224	17.66	3.602
Ba4554_R		0.3502	ug/L	0.1660	47.40	36.30
Be3130_R		-0.04609	ug/L	0.08602	186.6	-13.30
Ca3158_R		11.41	ug/L	5.321	46.65	-31.01
Cd2265_A		-0.1171	ug/L	0.0006040	0.5162	-4.871
Co2286_A		0.01248	ug/L	0.1192	955.0	-0.8308
Cr2677_A		-0.05769	ug/L	0.05189	89.94	-3.106
Cu3273_A		0.1616	ug/L	0.3231	199.9	-11.52
Fe2599_R		0.2846	ug/L	2.126	747.3	3.116
K_7664_R		-62.75	ug/L	15.99	25.48	308.6
Li6707_R		-0.1300	ug/L	2.822	2,171	10.89
Mg2795		6.618	ug/L	0.1473	2.225	318.0
Mg2025_A		3.863	ug/L	0.5172	13.39	-5.635
Mn2576_R		-0.05126	ug/L	0.5551	1,083	2.250
Mo2020_A		0.3190	ug/L	0.03282	10.29	1.216
Na5895_R		107.0	ug/L	12.43	11.63	176.1
Ni2316_A		-0.6062	ug/L	0.1058	17.45	-0.9110
Pb2203_A		0.5494	ug/L	0.1454	26.47	-1.595
Sb2068_A		1.834	ug/L	0.5966	32.52	2.945
Se1960_A		-2.975	ug/L	1.024	34.42	1.034
Si2516_R		0.2316	ug/L	4.265	1,842	16.03
Sn1899_A		15.77	ug/L	1.276	8.093	11.54
Sr4215_R		0.009007	ug/L	0.3442	3,822	-2.276
Ti3349_A		0.1243	ug/L	0.1011	81.37	7.503
Tl1908_A		-1.104	ug/L	0.2373	21.50	-3.718
V_2924_A		-0.1474	ug/L	0.2112	143.3	-4.968
Zn2062_A		-0.7840	ug/L	0.04200	5.357	2.991
Y_3600_R		10,511	Cts/S	12.404	0.11801	10,511
Y_2243_A		7,144.0	Cts/S	8.7975	0.12315	7,144.0
Y_3600_A		190,230	Cts/S	747.60	0.39300	190,230

SQ1201-001

Method Name: FAST-2022_POP
Method Revision: 169

SQ1201-001

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 8:55:56PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1034	ug/L	0.3118	301.5	0.6476
Al3961_R		77.98	ug/L	4.225	5.419	48.11
As1891_A		0.7031	ug/L	0.4846	68.93	-3.506
B_2089_A		8.399	ug/L	0.2100	2.500	12.59
Ba4554_R		13.48	ug/L	0.4300	3.191	389.1
Be3130_R		-0.07197	ug/L	0.02446	33.99	-14.90
Ca3158_R		1,158	ug/L	6.775	0.5852	663.8
Cd2265_A		-0.1012	ug/L	0.006030	5.956	-2.225
Co2286_A		0.2854	ug/L	0.1127	39.50	0.3824
Cr2677_A		0.5353	ug/L	0.2160	40.36	4.118
Cu3273_A		1.357	ug/L	0.4519	33.30	12.36
Fe2599_R		1,405	ug/L	5.632	0.4009	1,688
K_7664_R		377.4	ug/L	47.70	12.64	457.0
Li6707_R		1.284	ug/L	0.5212	40.59	21.96
Mg2795		746.4	ug/L	2.622	0.3512	33,440
Mg2025_A		700.5	ug/L	2.332	0.3329	243.2
Mn2576_R		14.78	ug/L	0.3727	2.521	101.6
Mo2020_A		0.3581	ug/L	0.01390	3.882	1.347
Na5895_R		2,985	ug/L	15.71	0.5264	2,596
Ni2316_A		-0.5150	ug/L	0.09359	18.17	-0.7831
Pb2203_A		4.097	ug/L	0.1855	4.528	3.237
Sb2068_A		2.303	ug/L	0.2165	9.398	3.296
Se1960_A		-0.3663	ug/L	3.691	1,008	1.704
Si2516_R		1,765	ug/L	26.50	1.502	722.0
Sn1899_A		9.668	ug/L	0.4130	4.272	7.911
Sr4215_R		7.934	ug/L	0.1432	1.805	277.0
Ti3349_A		0.8951	ug/L	0.03904	4.362	38.01
Tl1908_A		-0.5837	ug/L	0.1632	27.95	-3.428
V_2924_A		0.3905	ug/L	0.1008	25.81	5.060
Zn2062_A		1.360	ug/L	0.03731	2.743	11.45
Y_3600_R		10,523	Cts/S	46.568	0.44255	10,523
Y_2243_A		7,178.9	Cts/S	13.679	0.19054	7,178.9
Y_3600_A		191,920	Cts/S	24.448	0.012739	191,920

SQ1201-002

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:00:13PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.1115	ug/L	0.2000	179.4	-5.032
Al3961_R		69.37	ug/L	2.624	3.782	42.71
As1891_A		0.3559	ug/L	0.1360	38.21	-3.613
B_2089_A		8.189	ug/L	0.1509	1.843	12.31
Ba4554_R		14.65	ug/L	0.2960	2.021	424.2
Be3130_R		-0.09515	ug/L	0.01596	16.77	-16.47
Ca3158_R		1,142	ug/L	9.024	0.7904	659.8
Cd2265_A		-0.1356	ug/L	0.004411	3.254	-2.787
Co2286_A		0.05374	ug/L	0.2043	380.3	-0.6236
Cr2677_A		0.4171	ug/L	0.04794	11.49	2.642
Cu3273_A		1.097	ug/L	0.08825	8.047	7.519
Fe2599_R		1,431	ug/L	2.520	0.1761	1,734
K_7664_R		318.4	ug/L	35.18	11.05	441.0
Li6707_R		-1.115	ug/L	1.127	101.0	3.273
Mg2795		743.1	ug/L	3.852	0.5184	33,580
Mg2025_A		692.7	ug/L	1.987	0.2868	239.8
Mn2576_R		14.18	ug/L	0.05574	0.3931	98.42
Mo2020_A		0.2571	ug/L	0.1336	51.96	1.017

SQ1201-002

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:00:13PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		2,970	ug/L	26.87	0.9045	2,607
Ni2316_A		-0.5579	ug/L	0.1712	30.68	-0.8638
Pb2203_A		4.036	ug/L	0.1853	4.591	3.149
Sb2068_A		1.612	ug/L	0.5789	35.90	2.877
Se1960_A		-2.577	ug/L	0.1112	4.316	1.142
Si2516_R		1,756	ug/L	19.58	1.115	724.7
Sn1899_A		6.647	ug/L	0.4024	6.054	6.069
Sr4215_R		7.834	ug/L	0.09590	1.224	276.0
Ti3349_A		0.9014	ug/L	0.09907	10.99	38.15
Tl1908_A		-1.102	ug/L	0.7771	70.54	-3.740
V_2924_A		0.06871	ug/L	0.1498	218.1	-0.9130
Zn2062_A		1.332	ug/L	0.05700	4.278	11.31
Y_3600_R		10,616	Cts/S	20.150	0.18982	10,616
Y_2243_A		7,158.6	Cts/S	2.2457	0.031370	7,158.6
Y_3600_A		191,420	Cts/S	466.35	0.24362	191,420

SQ1201-002A

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:04:30PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		435.3	ug/L	1.002	0.2302	11,320
Al3961_R		636.2	ug/L	11.85	1.863	438.1
As1891_A		487.3	ug/L	2.168	0.4449	156.5
B_2089_A		527.0	ug/L	1.440	0.2733	630.3
Ba4554_R		526.2	ug/L	0.5577	0.1060	14,220
Be3130_R		510.9	ug/L	1.464	0.2865	31,100
Ca3158_R		6,411	ug/L	26.58	0.4146	3,864
Cd2265_A		519.9	ug/L	1.157	0.2225	9,144
Co2286_A		553.4	ug/L	1.472	0.2659	2,368
Cr2677_A		534.4	ug/L	0.8943	0.1673	6,505
Cu3273_A		491.4	ug/L	0.3931	0.07999	8,981
Fe2599_R		6,734	ug/L	27.77	0.4124	8,113
K_7664_R		10,870	ug/L	15.58	0.1433	4,005
Li6707_R		519.8	ug/L	0.5334	0.1026	4,082
Mg2795		6,786	ug/L	49.89	0.7352	305,100
Mg2025_A		6,335	ug/L	6.440	0.1017	2,247
Mn2576_R		538.1	ug/L	2.041	0.3794	3,618
Mo2020_A		480.8	ug/L	0.9735	0.2025	1,530
Na5895_R		9,117	ug/L	3.743	0.04106	7,783
Ni2316_A		532.4	ug/L	1.442	0.2709	1,006
Pb2203_A		523.8	ug/L	0.6327	0.1208	689.7
Sb2068_A		520.0	ug/L	0.2130	0.04097	319.5
Se1960_A		491.7	ug/L	1.439	0.2926	124.1
Si2516_R		2,055	ug/L	18.39	0.8949	840.2
Sn1899_A		4.880	ug/L	0.7837	16.06	4.932
Sr4215_R		545.0	ug/L	0.1520	0.02788	19,280
Ti3349_A		467.5	ug/L	0.3927	0.08399	18,130
Tl1908_A		556.6	ug/L	4.761	0.8554	336.8
V_2924_A		504.8	ug/L	1.866	0.3696	9,152
Zn2062_A		503.7	ug/L	1.186	0.2356	1,954
Y_3600_R		10,566	Cts/S	64.460	0.61008	10,566
Y_2243_A		7,053.5	Cts/S	28.887	0.40954	7,053.5
Y_3600_A		188,310	Cts/S	113.96	0.060514	188,310

SQ1201-002L

Method Name: FAST-2022_POP
Method Revision: 169

SQ1201-002L

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:08:43PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.05501	ug/L	0.2558	465.0	-2.387
Al3961_R		59.88	ug/L	20.74	34.64	3.698
As1891_A		1.279	ug/L	0.6440	50.35	-3.621
B_2089_A		9.953	ug/L	0.6965	6.998	5.166
Ba4554_R		15.81	ug/L	0.7956	5.031	113.1
Be3130_R		-0.1706	ug/L	0.2132	125.0	-12.71
Ca3158_R		1,173	ug/L	27.52	2.347	105.3
Cd2265_A		-0.5137	ug/L	0.004277	0.8326	-4.156
Co2286_A		0.9411	ug/L	0.1922	20.42	-0.06372
Cr2677_A		0.1299	ug/L	0.09829	75.68	-2.127
Cu3273_A		3.749	ug/L	3.519	93.86	-0.2841
Fe2599_R		1,491	ug/L	29.56	1.983	364.2
K_7664_R		-943.6	ug/L	40.73	4.317	269.3
Li6707_R		-1.463	ug/L	11.61	793.4	9.668
Mg2795		773.4	ug/L	3.109	0.4020	7,020
Mg2025_A		727.8	ug/L	2.358	0.3240	45.24
Mn2576_R		12.07	ug/L	0.7516	6.224	18.97
Mo2020_A		2.213	ug/L	0.6331	28.62	1.631
Na5895_R		3,142	ug/L	23.18	0.7376	621.2
Ni2316_A		-3.550	ug/L	2.527	71.19	-1.130
Pb2203_A		5.656	ug/L	3.547	62.71	-0.8094
Sb2068_A		10.09	ug/L	1.606	15.92	3.162
Se1960_A		-8.697	ug/L	7.478	85.98	1.360
Si2516_R		1,749	ug/L	45.55	2.605	157.5
Sn1899_A		14.01	ug/L	2.970	21.20	3.786
Sr4215_R		8.648	ug/L	0.5499	6.359	58.95
Ti3349_A		1.794	ug/L	0.2574	14.34	16.90
Tl1908_A		-4.068	ug/L	4.370	107.4	-3.580
V_2924_A		0.5065	ug/L	0.1064	21.00	-0.3633
Zn2062_A		-1.856	ug/L	0.4199	22.63	4.659
Y_3600_R		10,632	Cts/S	97.540	0.91743	10,632
Y_2243_A		7,220.7	Cts/S	6.0938	0.084394	7,220.7
Y_3600_A		192,570	Cts/S	68.049	0.035338	192,570

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:13:01PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A	F	432.4	ug/L	0.8343	0.1930	11,220
Al3961_R	W	13,270	ug/L	8.597	0.06478	8,995
As1891_A		495.6	ug/L	1.690	0.3411	159.6
B_2089_A		521.8	ug/L	0.8911	0.1708	625.6
Ba4554_R		506.4	ug/L	2.753	0.5436	13,740
Be3130_R		491.7	ug/L	0.4260	0.08665	30,050
Ca3158_R	F	10,750	ug/L	40.02	0.3725	6,527
Cd2265_A		511.2	ug/L	0.4658	0.09112	9,032
Co2286_A	W	543.4	ug/L	0.8480	0.1560	2,335
Cr2677_A	W	534.7	ug/L	1.113	0.2082	6,494
Cu3273_A		481.4	ug/L	0.9118	0.1894	8,779
Fe2599_R	F	10,910	ug/L	39.36	0.3609	13,190
K_7664_R		12,190	ug/L	1.088	0.008928	4,468
Li6707_R		481.6	ug/L	1.819	0.3777	3,798
Mg2795		12,430	ug/L	9.913	0.07976	561,000
Mg2025_A	W	11,560	ug/L	63.65	0.5505	4,097
Mn2576_R		517.7	ug/L	0.4300	0.08305	3,495
Mo2020_A	W	460.9	ug/L	0.3288	0.07135	1,473

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:13:01PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		12,950	ug/L	86.34	0.6666	11,060
Ni2316_A		520.6	ug/L	0.1812	0.03480	987.2
Pb2203_A		506.9	ug/L	1.148	0.2265	668.6
Sb2068_A		515.2	ug/L	0.5770	0.1120	315.4
Se1960_A		490.1	ug/L	0.2000	0.04080	124.2
Si2516_R		12,560	ug/L	50.35	0.4008	5,080
Sn1899_A		503.0	ug/L	0.05372	0.01068	301.7
Sr4215_R		502.5	ug/L	1.647	0.3276	17,850
Ti3349_A	W	458.0	ug/L	1.620	0.3538	17,720
Tl1908_A	W	544.6	ug/L	0.5461	0.1003	330.8
V_2924_A		492.7	ug/L	0.3886	0.07887	8,915
Zn2062_A		495.6	ug/L	0.8450	0.1705	1,929
Y_3600_R		10,608	Cts/S	40.176	0.37874	10,608
Y_2243_A		7,080.3	Cts/S	26.275	0.37110	7,080.3
Y_3600_A		187,920	Cts/S	277.50	0.14767	187,920

CCB

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:17:11PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2761	ug/L	0.2143	77.61	-9.437
Al3961_R		-6.060	ug/L	2.592	42.77	-8.639
As1891_A		0.9017	ug/L	1.320	146.4	-3.365
B_2089_A		0.6596	ug/L	0.3213	48.70	3.589
Ba4554_R		0.3071	ug/L	0.2686	87.48	35.78
Be3130_R		0.01823	ug/L	0.02293	125.8	-9.568
Ca3158_R		3.003	ug/L	6.642	221.2	-36.74
Cd2265_A		0.02657	ug/L	0.03700	139.3	-2.318
Co2286_A		0.2173	ug/L	0.2201	101.3	0.05748
Cr2677_A		-0.003084	ug/L	0.04626	1,500	-2.465
Cu3273_A		0.8735	ug/L	0.07709	8.826	1.672
Fe2599_R		3.350	ug/L	0.6489	19.37	6.909
K_7664_R		-307.6	ug/L	4.643	1.509	230.3
Li6707_R		-0.4632	ug/L	0.4838	104.4	8.457
Mg2795		4.490	ug/L	0.5101	11.36	226.8
Mg2025_A		3.981	ug/L	0.8304	20.86	-5.601
Mn2576_R		-0.06094	ug/L	0.5788	949.9	2.219
Mo2020_A		0.5859	ug/L	0.08131	13.88	2.084
Na5895_R		24.45	ug/L	3.982	16.29	108.7
Ni2316_A		-0.7020	ug/L	0.01171	1.667	-1.098
Pb2203_A		0.6916	ug/L	0.6495	93.92	-1.408
Sb2068_A		2.787	ug/L	0.2502	8.977	3.619
Se1960_A		-0.9905	ug/L	0.2326	23.48	1.538
Si2516_R		10.89	ug/L	8.930	81.97	20.66
Sn1899_A		1.519	ug/L	0.2991	19.69	2.985
Sr4215_R		0.2406	ug/L	0.2136	88.80	5.969
Ti3349_A		0.1580	ug/L	0.1512	95.74	8.936
Tl1908_A		-0.4527	ug/L	0.5340	118.0	-3.327
V_2924_A		-0.07388	ug/L	0.03352	45.38	-3.679
Zn2062_A		-1.279	ug/L	0.1106	8.649	1.054
Y_3600_R		10,698	Cts/S	18.937	0.17700	10,698
Y_2243_A		7,169.2	Cts/S	12.426	0.17333	7,169.2
Y_3600_A		192,470	Cts/S	245.36	0.12748	192,470

SQ1201-002P

Method Name: FAST-2022_POP
Method Revision: 169

SQ1201-002P

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:21:30PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		42.90	ug/L	0.1833	0.4273	1,116
Al3961_R		2,439	ug/L	22.81	0.9352	1,656
As1891_A		100.1	ug/L	1.046	1.045	29.42
B_2089_A		530.2	ug/L	0.3994	0.07533	616.7
Ba4554_R	W	2,101	ug/L	1.570	0.07472	57,140
Be3130_R		51.47	ug/L	0.07715	0.1499	3,143
Ca3158_R		3,368	ug/L	6.821	0.2025	2,027
Cd2265_A		256.4	ug/L	0.06751	0.02632	4,526
Co2286_A		561.1	ug/L	0.5242	0.09342	2,411
Cr2677_A		217.0	ug/L	0.7775	0.3583	2,649
Cu3273_A		251.6	ug/L	0.2514	0.09989	4,604
Fe2599_R		2,463	ug/L	6.159	0.2500	2,992
K_7664_R		10,430	ug/L	55.86	0.5356	3,885
Li6707_R		516.5	ug/L	1.893	0.3665	4,088
Mg2795		6,079	ug/L	3.218	0.05294	275,400
Mg2025_A		5,585	ug/L	20.89	0.3740	1,990
Mn2576_R		542.4	ug/L	1.686	0.3108	3,674
Mo2020_A		94.82	ug/L	0.001565	0.001650	303.0
Na5895_R		11,150	ug/L	30.49	0.2736	9,570
Ni2316_A		539.5	ug/L	1.063	0.1970	1,023
Pb2203_A		108.1	ug/L	0.4217	0.3900	141.0
Sb2068_A		105.8	ug/L	0.9433	0.8914	64.29
Se1960_A		96.06	ug/L	2.429	2.528	25.86
Si2516_R		2,887	ug/L	32.09	1.112	1,183
Sn1899_A		539.2	ug/L	1.920	0.3562	323.4
Sr4215_R		541.3	ug/L	0.1571	0.02902	19,300
Ti3349_A		464.5	ug/L	1.635	0.3520	18,060
Tl1908_A		107.0	ug/L	0.5814	0.5432	62.86
V_2924_A		506.3	ug/L	0.6356	0.1255	9,282
Zn2062_A		508.9	ug/L	0.5253	0.1032	1,984
Y_3600_R		10,646	Cts/S	52.502	0.49315	10,646
Y_2243_A		7,083.1	Cts/S	3.7176	0.052485	7,083.1
Y_3600_A		188,960	Cts/S	5.9292	0.0031380	188,960

SQ1201-002S

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:25:38PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		44.27	ug/L	0.1545	0.3489	1,149
Al3961_R		2,487	ug/L	1.489	0.05985	1,671
As1891_A		103.1	ug/L	1.668	1.619	30.44
B_2089_A		539.8	ug/L	0.8609	0.1595	628.6
Ba4554_R	W	2,142	ug/L	12.92	0.6033	57,650
Be3130_R		52.65	ug/L	0.4848	0.9207	3,182
Ca3158_R		3,496	ug/L	45.03	1.288	2,084
Cd2265_A		261.5	ug/L	0.2653	0.1015	4,621
Co2286_A		571.4	ug/L	0.3997	0.06995	2,459
Cr2677_A		222.4	ug/L	0.9426	0.4238	2,710
Cu3273_A		256.6	ug/L	0.1151	0.04485	4,685
Fe2599_R		2,573	ug/L	20.84	0.8100	3,092
K_7664_R		10,750	ug/L	54.41	0.5061	3,952
Li6707_R		525.1	ug/L	2.049	0.3903	4,111
Mg2795		6,252	ug/L	13.05	0.2088	280,200
Mg2025_A		5,697	ug/L	0.6175	0.01084	2,033
Mn2576_R		558.5	ug/L	2.156	0.3860	3,743
Mo2020_A		96.50	ug/L	0.4227	0.4381	308.8

SQ1201-002S

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:25:38PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		11,360	ug/L	100.7	0.8870	9,646
Ni2316_A		549.5	ug/L	0.4058	0.07386	1,044
Pb2203_A		109.0	ug/L	0.6137	0.5633	142.3
Sb2068_A		107.8	ug/L	1.421	1.319	65.55
Se1960_A		98.95	ug/L	0.6421	0.6489	26.61
Si2516_R		2,990	ug/L	1.150	0.03847	1,212
Sn1899_A		549.5	ug/L	2.633	0.4792	329.9
Sr4215_R		552.7	ug/L	3.057	0.5532	19,500
Ti3349_A		477.1	ug/L	1.310	0.2747	18,520
Tl1908_A		109.1	ug/L	0.3668	0.3362	64.21
V_2924_A		519.3	ug/L	0.03068	0.005907	9,503
Zn2062_A		518.8	ug/L	1.213	0.2337	2,025
Y_3600_R		10,534	Cts/S	2.0066	0.019050	10,534
Y_2243_A		7,092.3	Cts/S	27.731	0.39100	7,092.3
Y_3600_A		188,610	Cts/S	126.04	0.066826	188,610

SQ1201-003

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:29:47PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2258	ug/L	0.08755	38.78	-8.003
Al3961_R		33.22	ug/L	1.943	5.848	18.13
As1891_A		-0.5896	ug/L	0.3111	52.77	-3.943
B_2089_A		8.297	ug/L	0.1299	1.566	12.44
Ba4554_R		13.48	ug/L	0.6033	4.476	389.7
Be3130_R		0.001304	ug/L	0.01133	869.2	-10.46
Ca3158_R		1,359	ug/L	0.5483	0.04033	787.1
Cd2265_A		-0.1350	ug/L	0.05017	37.16	-2.300
Co2286_A		0.1712	ug/L	0.1353	79.03	-0.1124
Cr2677_A		0.3281	ug/L	0.3498	106.6	1.506
Cu3273_A		0.9666	ug/L	0.3524	36.46	5.423
Fe2599_R		1,712	ug/L	1.478	0.08636	2,059
K_7664_R		233.2	ug/L	5.780	2.478	409.0
Li6707_R		0.1803	ug/L	0.04679	25.95	13.36
Mg2795		851.6	ug/L	1.239	0.1455	38,200
Mg2025_A		792.5	ug/L	2.867	0.3618	275.3
Mn2576_R		16.40	ug/L	0.1078	0.6575	112.6
Mo2020_A		0.4651	ug/L	0.04933	10.61	1.689
Na5895_R		3,152	ug/L	50.11	1.590	2,740
Ni2316_A		-0.6509	ug/L	0.09777	15.02	-1.051
Pb2203_A		5.918	ug/L	0.2412	4.076	5.691
Sb2068_A		3.108	ug/L	1.563	50.29	3.825
Se1960_A		-2.003	ug/L	0.6767	33.79	1.287
Si2516_R		1,271	ug/L	0.7451	0.05864	524.9
Sn1899_A		1.598	ug/L	0.4461	27.91	3.028
Sr4215_R		9.012	ug/L	0.1690	1.876	315.4
Ti3349_A		0.6134	ug/L	0.01013	1.651	26.63
Tl1908_A		-0.01525	ug/L	0.2030	1,331	-3.069
V_2924_A		0.3604	ug/L	0.1176	32.63	4.475
Zn2062_A		1.100	ug/L	0.1027	9.334	10.40
Y_3600_R		10,537	Cts/S	109.57	1.0399	10,537
Y_2243_A		7,158.1	Cts/S	2.6360	0.036825	7,158.1
Y_3600_A		190,030	Cts/S	123.00	0.064723	190,030

SQ1201-004

Method Name: FAST-2022_POP
Method Revision: 169

SQ1201-004

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:34:05PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2644	ug/L	0.1266	47.90	-9.192
Al3961_R		304.8	ug/L	5.507	1.807	202.6
As1891_A		1.484	ug/L	0.8169	55.04	-3.344
B_2089_A		6.453	ug/L	0.1991	3.085	10.34
Ba4554_R		13.61	ug/L	0.1916	1.408	397.1
Be3130_R		-0.06298	ug/L	0.09735	154.6	-14.79
Ca3158_R		302.8	ug/L	7.644	2.524	147.2
Cd2265_A		-0.1144	ug/L	0.03968	34.70	0.6558
Co2286_A		0.1407	ug/L	0.2538	180.4	-0.1588
Cr2677_A		1.022	ug/L	0.1152	11.28	10.06
Cu3273_A		0.5113	ug/L	0.03547	6.937	-1.337
Fe2599_R		3,237	ug/L	21.38	0.6606	3,929
K_7664_R		-283.4	ug/L	54.34	19.17	237.3
Li6707_R		0.2632	ug/L	0.7035	267.3	14.15
Mg2795		240.8	ug/L	1.637	0.6796	10,930
Mg2025_A		223.8	ug/L	2.639	1.179	73.09
Mn2576_R		26.61	ug/L	0.4069	1.529	182.9
Mo2020_A		0.2971	ug/L	0.02050	6.902	1.150
Na5895_R		1,547	ug/L	9.243	0.5974	1,403
Ni2316_A		-0.6099	ug/L	0.007928	1.300	-1.023
Pb2203_A		0.3552	ug/L	0.5223	147.0	-1.722
Sb2068_A		1.838	ug/L	0.09109	4.956	3.075
Se1960_A		-2.037	ug/L	0.7416	36.40	1.291
Si2516_R		3,113	ug/L	25.19	0.8091	1,276
Sn1899_A		1.348	ug/L	0.4662	34.58	2.890
Sr4215_R		3.170	ug/L	0.2496	7.875	110.4
Ti3349_A		7.565	ug/L	0.1926	2.546	302.8
Tl1908_A		-0.7689	ug/L	0.007550	0.9820	-3.566
V_2924_A		2.838	ug/L	0.07295	2.570	51.22
Zn2062_A		1.013	ug/L	0.1483	14.64	10.10
Y_3600_R		10,641	Cts/S	37.609	0.35343	10,641
Y_2243_A		7,190.1	Cts/S	7.4922	0.10420	7,190.1
Y_3600_A		192,810	Cts/S	172.29	0.089355	192,810

SQ1201-005

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:38:22PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2086	ug/L	0.04101	19.66	-7.559
Al3961_R		56.28	ug/L	0.3444	0.6120	33.56
As1891_A		0.9565	ug/L	0.6942	72.58	-3.501
B_2089_A		6.021	ug/L	0.2072	3.441	9.708
Ba4554_R		9.878	ug/L	0.1936	1.960	293.8
Be3130_R		-0.06177	ug/L	0.006619	10.72	-14.36
Ca3158_R		203.7	ug/L	5.138	2.523	85.92
Cd2265_A		-0.1840	ug/L	0.05045	27.42	0.4066
Co2286_A		-0.1192	ug/L	0.1927	161.7	-1.320
Cr2677_A		0.3734	ug/L	0.02423	6.488	1.973
Cu3273_A		0.7784	ug/L	0.2367	30.41	4.499
Fe2599_R		3,827	ug/L	8.766	0.2291	4,616
K_7664_R		-265.7	ug/L	23.05	8.674	241.8
Li6707_R		-0.8372	ug/L	2.204	263.2	5.384
Mg2795		198.1	ug/L	0.4788	0.2417	8,938
Mg2025_A		175.1	ug/L	0.3404	0.1944	54.91
Mn2576_R		105.9	ug/L	0.2649	0.2503	714.5
Mo2020_A		0.4043	ug/L	0.08011	19.82	1.472

SQ1201-005

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:38:22PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		1,586	ug/L	16.34	1.031	1,427
Ni2316_A		-1.076	ug/L	0.03797	3.528	-1.912
Pb2203_A		0.4900	ug/L	0.05437	11.10	-1.455
Sb2068_A		2.560	ug/L	0.07197	2.812	3.466
Se1960_A		-1.471	ug/L	0.8201	55.76	1.430
Si2516_R		2,648	ug/L	2.618	0.09886	1,081
Sn1899_A		2.818	ug/L	0.1463	5.192	3.728
Sr4215_R		2.675	ug/L	0.07420	2.774	92.14
Ti3349_A		1.165	ug/L	0.1871	16.06	48.14
Tl1908_A		-1.535	ug/L	0.1253	8.163	-4.053
V_2924_A		0.5963	ug/L	0.1036	17.37	8.502
Zn2062_A		-0.6196	ug/L	0.002194	0.3541	3.607
Y_3600_R		10,575	Cts/S	59.330	0.56105	10,575
Y_2243_A		7,092.2	Cts/S	11.952	0.16852	7,092.2
Y_3600_A		189,850	Cts/S	168.37	0.088686	189,850

SQ1201-006

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:42:42PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.3672	ug/L	0.3098	84.38	-11.92
Al3961_R		199.0	ug/L	1.910	0.9597	130.9
As1891_A		0.2158	ug/L	0.04547	21.07	-3.645
B_2089_A		6.278	ug/L	0.1340	2.135	10.17
Ba4554_R		8.291	ug/L	0.2250	2.714	253.0
Be3130_R		-0.02407	ug/L	0.06629	275.5	-12.19
Ca3158_R		247.0	ug/L	2.362	0.9563	113.2
Cd2265_A		-0.1227	ug/L	0.003165	2.580	-4.034
Co2286_A		0.1934	ug/L	0.1416	73.23	-0.02368
Cr2677_A		0.3460	ug/L	0.03921	11.33	1.854
Cu3273_A		1.410	ug/L	0.05917	4.196	12.37
Fe2599_R		577.5	ug/L	7.156	1.239	704.4
K_7664_R		-252.7	ug/L	31.05	12.29	248.2
Li6707_R		-1.948	ug/L	1.280	65.69	-3.277
Mg2795		230.0	ug/L	0.006880	0.002992	10,450
Mg2025_A		213.8	ug/L	2.071	0.9688	69.67
Mn2576_R		15.29	ug/L	0.4538	2.968	106.3
Mo2020_A		0.3037	ug/L	0.03286	10.82	1.176
Na5895_R		1,292	ug/L	22.73	1.760	1,188
Ni2316_A		-0.2563	ug/L	0.1738	67.80	-0.2618
Pb2203_A		1.344	ug/L	0.1083	8.063	-0.5301
Sb2068_A		1.872	ug/L	0.09564	5.108	3.083
Se1960_A		-1.148	ug/L	0.1070	9.320	1.512
Si2516_R		2,093	ug/L	11.07	0.5290	864.3
Sn1899_A		0.8728	ug/L	0.5753	65.92	2.610
Sr4215_R		2.750	ug/L	0.1103	4.010	95.55
Ti3349_A		1.756	ug/L	0.1930	10.99	72.50
Tl1908_A		-0.9225	ug/L	0.6304	68.33	-3.655
V_2924_A		0.8555	ug/L	0.1295	15.14	13.79
Zn2062_A		0.6882	ug/L	0.05777	8.393	8.845
Y_3600_R		10,660	Cts/S	46.427	0.43555	10,660
Y_2243_A		7,212.4	Cts/S	4.2524	0.058959	7,212.4
Y_3600_A		193,330	Cts/S	169.03	0.087434	193,330

SQ1201-007

Method Name: FAST-2022_POP
Method Revision: 169

SQ1201-007

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:47:01PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2035	ug/L	0.3063	150.5	-7.478
Al3961_R		204.2	ug/L	5.119	2.507	134.3
As1891_A		1.209	ug/L	0.7630	63.11	-3.310
B_2089_A		6.183	ug/L	0.04852	0.7847	10.03
Ba4554_R		9.848	ug/L	0.05938	0.6030	295.0
Be3130_R		-0.02935	ug/L	0.006849	23.33	-12.48
Ca3158_R		284.5	ug/L	8.835	3.105	136.1
Cd2265_A		-0.1101	ug/L	0.008866	8.055	-3.607
Co2286_A		0.06123	ug/L	0.1569	256.3	-0.6023
Cr2677_A		0.5199	ug/L	0.2135	41.08	3.990
Cu3273_A		1.146	ug/L	0.3740	32.63	7.491
Fe2599_R		689.9	ug/L	1.699	0.2463	840.2
K_7664_R		-235.1	ug/L	39.12	16.64	253.9
Li6707_R		-0.7794	ug/L	2.726	349.7	5.911
Mg2795		253.6	ug/L	0.5538	0.2184	11,510
Mg2025_A		236.5	ug/L	0.1831	0.07741	77.67
Mn2576_R		11.65	ug/L	0.1677	1.439	81.54
Mo2020_A		0.1121	ug/L	0.01148	10.24	0.5517
Na5895_R		1,292	ug/L	2.360	0.1826	1,187
Ni2316_A		-0.3406	ug/L	0.1055	30.98	-0.4273
Pb2203_A		0.9605	ug/L	0.2143	22.31	-1.039
Sb2068_A		1.811	ug/L	0.1047	5.783	3.043
Se1960_A		-2.598	ug/L	0.7521	28.95	1.141
Si2516_R		1,519	ug/L	8.587	0.5654	630.9
Sn1899_A		0.5892	ug/L	0.8879	150.7	2.433
Sr4215_R		3.027	ug/L	0.03785	1.250	105.3
Ti3349_A		1.284	ug/L	0.2009	15.65	53.35
Tl1908_A		-0.3102	ug/L	0.3956	127.5	-3.263
V_2924_A		0.6532	ug/L	0.01959	2.999	9.948
Zn2062_A		0.5698	ug/L	0.04177	7.331	8.358
Y_3600_R		10,648	Cts/S	14.776	0.13877	10,648
Y_2243_A		7,197.2	Cts/S	5.5690	0.077377	7,197.2
Y_3600_A		191,970	Cts/S	632.03	0.32923	191,970

SQ1201-008

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:51:20PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.4664	ug/L	0.3003	64.38	-14.59
Al3961_R		326.1	ug/L	1.066	0.3268	217.5
As1891_A		0.09361	ug/L	0.8433	900.9	-3.652
B_2089_A		7.625	ug/L	0.1425	1.869	11.69
Ba4554_R		11.21	ug/L	0.1481	1.321	332.7
Be3130_R		-0.09426	ug/L	0.01471	15.61	-16.42
Ca3158_R		206.1	ug/L	3.710	1.800	88.15
Cd2265_A		-0.1134	ug/L	0.01773	15.64	-4.571
Co2286_A		-0.04571	ug/L	0.1119	244.9	-1.083
Cr2677_A		0.3692	ug/L	0.05129	13.89	2.180
Cu3273_A		1.704	ug/L	0.1206	7.080	17.31
Fe2599_R		154.6	ug/L	0.7298	0.4721	190.7
K_7664_R		-349.2	ug/L	19.93	5.707	215.4
Li6707_R		-0.4679	ug/L	1.096	234.3	8.426
Mg2795		222.0	ug/L	0.3345	0.1507	10,100
Mg2025_A		203.7	ug/L	0.05735	0.02815	65.79
Mn2576_R		12.65	ug/L	0.5383	4.255	88.44
Mo2020_A		0.2304	ug/L	0.08903	38.64	0.9345

SQ1201-008

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:51:20PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		1,779	ug/L	20.24	1.138	1,604
Ni2316_A		-0.3125	ug/L	0.08240	26.36	-0.3563
Pb2203_A		1.182	ug/L	0.9162	77.48	-0.7835
Sb2068_A		1.570	ug/L	0.7737	49.27	2.886
Se1960_A		-1.390	ug/L	0.4842	34.83	1.444
Si2516_R		3,577	ug/L	13.65	0.3816	1,467
Sn1899_A		0.3217	ug/L	0.5005	155.6	2.267
Sr4215_R		2.780	ug/L	0.08531	3.069	96.70
Ti3349_A		0.3477	ug/L	0.1728	49.69	16.47
Tl1908_A		-0.6624	ug/L	0.4210	63.55	-3.475
V_2924_A		1.155	ug/L	0.2264	19.60	19.39
Zn2062_A		0.8881	ug/L	0.08753	9.855	9.598
Y_3600_R		10,667	Cts/S	68.122	0.63865	10,667
Y_2243_A		7,184.1	Cts/S	19.153	0.26660	7,184.1
Y_3600_A		193,220	Cts/S	2,053.8	1.0630	193,220

LC2WQC16ICW2

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:55:38PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		42.98	ug/L	0.00008200	0.0001910	1,121
Al3961_R		2,285	ug/L	8.323	0.3643	1,556
As1891_A		100.2	ug/L	0.9269	0.9250	29.55
B_2089_A		525.7	ug/L	0.8066	0.1534	611.8
Ba4554_R		2,075	ug/L	2.423	0.1167	56,640
Be3130_R		51.45	ug/L	0.02961	0.05756	3,152
Ca3158_R		2,304	ug/L	25.58	1.110	1,380
Cd2265_A		258.7	ug/L	0.4453	0.1721	4,566
Co2286_A		565.0	ug/L	2.099	0.3715	2,430
Cr2677_A		217.8	ug/L	1.240	0.5692	2,666
Cu3273_A		251.8	ug/L	0.1980	0.07864	4,617
Fe2599_R		937.7	ug/L	8.634	0.9208	1,145
K_7664_R		9,882	ug/L	33.81	0.3421	3,711
Li6707_R		522.9	ug/L	1.803	0.3447	4,152
Mg2795		5,390	ug/L	11.76	0.2182	245,000
Mg2025_A		4,970	ug/L	12.41	0.2497	1,775
Mn2576_R		532.4	ug/L	1.599	0.3003	3,619
Mo2020_A		95.12	ug/L	0.3213	0.3378	304.2
Na5895_R		8,236	ug/L	3.854	0.04680	7,117
Ni2316_A		543.8	ug/L	1.935	0.3558	1,032
Pb2203_A		104.3	ug/L	0.4885	0.4684	135.9
Sb2068_A		105.9	ug/L	1.382	1.305	64.35
Se1960_A		95.10	ug/L	1.164	1.224	25.62
Si2516_R		1,044	ug/L	1.617	0.1549	438.5
Sn1899_A		542.4	ug/L	1.436	0.2647	325.5
Sr4215_R		532.7	ug/L	0.2514	0.04720	19,060
Ti3349_A		464.1	ug/L	2.438	0.5253	18,100
Tl1908_A		109.0	ug/L	0.7259	0.6657	64.15
V_2924_A		509.0	ug/L	1.427	0.2804	9,357
Zn2062_A		510.2	ug/L	1.472	0.2886	1,989
Y_3600_R		10,683	Cts/S	33.734	0.31578	10,683
Y_2243_A		7,087.0	Cts/S	2.6271	0.037068	7,087.0
Y_3600_A		189,470	Cts/S	401.28	0.21179	189,470

LCSWQC16ICW2

Method Name: FAST-2022_POP
Method Revision: 169

LCSWQC16ICW2

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 9:59:49PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		43.05	ug/L	0.1919	0.4459	1,118
Al3961_R	F	2,331	ug/L	2.414	0.1036	1,564
As1891_A		102.5	ug/L	2.221	2.168	30.10
B_2089_A		534.5	ug/L	1.343	0.2514	617.8
Ba4554_R		2,113	ug/L	8.000	0.3787	56,790
Be3130_R		52.17	ug/L	0.09609	0.1842	3,148
Ca3158_R		2,318	ug/L	2.139	0.09232	1,367
Cd2265_A		263.0	ug/L	0.7599	0.2889	4,612
Co2286_A	F	574.1	ug/L	0.9541	0.1662	2,452
Cr2677_A		223.3	ug/L	1.284	0.5751	2,724
Cu3273_A		254.0	ug/L	0.03061	0.01205	4,640
Fe2599_R		950.2	ug/L	2.849	0.2999	1,142
K_7664_R		10,050	ug/L	63.11	0.6280	3,712
Li6707_R		527.5	ug/L	0.1674	0.03173	4,125
Mg2795		5,494	ug/L	3.506	0.06383	246,000
Mg2025_A		5,019	ug/L	26.29	0.5238	1,781
Mn2576_R		542.3	ug/L	0.3682	0.06788	3,631
Mo2020_A		96.05	ug/L	0.4307	0.4484	305.1
Na5895_R		8,427	ug/L	16.88	0.2003	7,171
Ni2316_A		551.2	ug/L	0.03322	0.006027	1,039
Pb2203_A		106.6	ug/L	0.1387	0.1301	138.1
Sb2068_A		108.1	ug/L	0.5516	0.5102	65.24
Se1960_A		98.45	ug/L	0.3241	0.3292	26.29
Si2516_R		1,063	ug/L	3.159	0.2972	439.6
Sn1899_A		550.9	ug/L	0.2785	0.05055	328.4
Sr4215_R		543.3	ug/L	2.268	0.4175	19,150
Ti3349_A		471.3	ug/L	2.720	0.5772	18,310
Tl1908_A		111.8	ug/L	0.02104	0.01882	65.39
V_2924_A		516.6	ug/L	1.292	0.2501	9,460
Zn2062_A		516.8	ug/L	2.964	0.5735	2,002
Y_3600_R		10,522	Cts/S	13.150	0.12498	10,522
Y_2243_A		7,039.9	Cts/S	8.9532	0.12718	7,039.9
Y_3600_A		188,750	Cts/S	102.15	0.054118	188,750

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 10:03:59PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A	F	433.4	ug/L	1.456	0.3360	11,250
Al3961_R	W	13,350	ug/L	128.5	0.9625	9,052
As1891_A		494.9	ug/L	0.3257	0.06581	159.2
B_2089_A		523.0	ug/L	0.6691	0.1279	626.1
Ba4554_R		504.4	ug/L	0.6288	0.1247	13,700
Be3130_R		494.4	ug/L	0.2623	0.05306	30,240
Ca3158_R	F	10,800	ug/L	68.68	0.6360	6,566
Cd2265_A		512.3	ug/L	1.600	0.3123	9,040
Co2286_A	W	544.3	ug/L	0.5677	0.1043	2,335
Cr2677_A	W	534.1	ug/L	1.902	0.3561	6,488
Cu3273_A		486.4	ug/L	2.403	0.4940	8,873
Fe2599_R	F	10,870	ug/L	54.89	0.5050	13,150
K_7664_R		12,010	ug/L	46.93	0.3909	4,409
Li6707_R		484.7	ug/L	1.060	0.2186	3,825
Mg2795		12,430	ug/L	102.6	0.8250	561,600
Mg2025_A	W	11,450	ug/L	48.18	0.4209	4,051
Mn2576_R		519.3	ug/L	0.6280	0.1209	3,508
Mo2020_A	W	459.9	ug/L	1.081	0.2350	1,467

CCV

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 10:03:59PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		12,910	ug/L	57.25	0.4435	11,030
Ni2316_A		523.0	ug/L	0.8782	0.1679	990.4
Pb2203_A		505.3	ug/L	2.958	0.5853	665.5
Sb2068_A		514.0	ug/L	1.891	0.3679	314.2
Se1960_A		491.8	ug/L	2.009	0.4085	124.5
Si2516_R		12,590	ug/L	14.21	0.1129	5,094
Sn1899_A		503.5	ug/L	0.9487	0.1884	301.6
Sr4215_R		500.4	ug/L	1.012	0.2022	17,790
Ti3349_A	W	456.3	ug/L	0.07838	0.01718	17,660
Tl1908_A	W	548.8	ug/L	0.2802	0.05106	332.9
V_2924_A		493.9	ug/L	0.6996	0.1416	8,938
Zn2062_A		496.7	ug/L	1.849	0.3723	1,931
Y_3600_R		10,615	Cts/S	63.106	0.59448	10,615
Y_2243_A		7,070.7	Cts/S	5.1603	0.072982	7,070.7
Y_3600_A		187,940	Cts/S	47.701	0.025380	187,940

CCB

Method Name: FAST-2022_POP
Method Revision: 169
Analyst Name: BCF
Acquire Date: 3/17/2023 10:08:09PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.03465	ug/L	0.1289	372.2	-1.162
Al3961_R		1.590	ug/L	5.507	346.3	-3.406
As1891_A		1.412	ug/L	0.5796	41.04	-3.180
B_2089_A		0.8697	ug/L	0.3185	36.62	3.817
Ba4554_R		0.05050	ug/L	0.4811	952.7	28.60
Be3130_R		0.08904	ug/L	0.1059	118.9	-5.122
Ca3158_R		2.524	ug/L	5.964	236.3	-36.75
Cd2265_A		0.05934	ug/L	0.007655	12.90	-1.723
Co2286_A		0.3652	ug/L	0.1803	49.38	0.6948
Cr2677_A		0.2470	ug/L	0.1530	61.94	0.6443
Cu3273_A		0.4610	ug/L	0.3052	66.21	-6.012
Fe2599_R		4.505	ug/L	2.232	49.54	8.266
K_7664_R		-485.1	ug/L	5.565	1.147	168.3
Li6707_R		0.6772	ug/L	0.6649	98.18	17.36
Mg2795		4.420	ug/L	0.1922	4.349	221.9
Mg2025_A		5.099	ug/L	0.9030	17.71	-5.174
Mn2576_R		-0.1838	ug/L	0.09306	50.62	1.374
Mo2020_A		0.5583	ug/L	0.04818	8.630	1.986
Na5895_R		-22.76	ug/L	4.192	18.42	67.88
Ni2316_A		-0.6396	ug/L	0.3213	50.22	-0.9746
Pb2203_A		0.6452	ug/L	0.4595	71.23	-1.466
Sb2068_A		2.883	ug/L	0.3202	11.11	3.667
Se1960_A		-0.9949	ug/L	0.6478	65.11	1.531
Si2516_R		4.895	ug/L	0.6557	13.40	18.08
Sn1899_A		0.8984	ug/L	0.2819	31.38	2.599
Sr4215_R		0.3960	ug/L	0.008409	2.124	11.46
Ti3349_A		0.03718	ug/L	0.1374	369.7	4.137
Tl1908_A		-0.07652	ug/L	0.06663	87.08	-3.081
V_2924_A		0.1911	ug/L	0.2511	131.4	1.260
Zn2062_A		-1.195	ug/L	0.02084	1.743	1.376
Y_3600_R		10,621	Cts/S	73.698	0.69391	10,621
Y_2243_A		7,139.4	Cts/S	0.93592	0.013109	7,139.4
Y_3600_A		191,510	Cts/S	45.208	0.023606	191,510

PBWQC16ICW2

Method Name: FAST-2022_POP
Method Revision: 169

KATAHDIN ANALYTICAL SERVICES, LLC
METALS ANALYSIS RUN INFORMATION SHEET

INSTR. ID: I (Thermo iCAP 6500) **ANALYST**: BCF **ANALYSIS DATE**: 03/20/2023

METHOD: ICP
- ☑ 200.7
- ☑ 6010
- ☑ DOD
- ☐ _____

FILE NAME: iQC20A

Reviewed By: BCF 032123

The pHs of all samples that were tested by direct analysis in this analytical run were checked just prior to analysis and confirmed to be <2. The time of preservation of these samples was checked in the "Measured Turbidity and Preservation of Incoming Samples" logbook to verify that they had been preserved at least 16 hours prior to analysis. These verifications were performed by _____ (initials) on _____ (date).

STANDARDS USED:

Standard Name	Standard ID	Prep Date	Expiration Date	Standard Conc.
Cal. Blk/ICB/CCB	MW21420	03/03/2023	06/03/2023	0 ug/L
Standard 1	MW21417	03/02/2023	06/02/2023	Varies by Element
ICV	MW21424	03/08/2023	03/31/2023	Varies by Element
PQL	MW21396 403	02/24/2023	05/24/2023	Varies by Element
LRS1	MW21390	02/20/2023	05/20/2023	Varies by Element
LRS2	MW21434	03/20/2023	05/31/2023	Varies by Element
ICSA	MW21384	02/16/2023	05/16/2023	Varies by Element
ICSAB	MW21317	01/11/2023	04/11/2023	Varies by Element
CCV	MW21433	03/17/2023	06/17/2023	Varies by Element
Internal Standard	MW21375	02/09/2023	05/09/2023	5.0 mg/L Yttrium

BCF 033023

Additional Comments and Notes:

- Accepted < ½ PQL for Sn
- Accepted < ½ PQL and 10x FV (8.362mg/L) for K due to ICSA failure
- Used 2nd CCV as main CCV for 200.7 data

BCF 3-21-23

3x diln.: 3.0 mL of sample (pipet M30) + 6.0 mL of MW21420 (pipet M31)

2x diln.: 4.0 mL of sample (pipet M30) + 4.0 mL of MW21420 (pipet M31)

10x diln.: 0.8 mL of sample (pipet M19) + 7.2 mL of MW21420 (pipet M31)

5x diln.: 1.6 mL of sample (pipet M30) + 6.4 mL of MW21420 (pipet M31)

25x diln.: 0.4mL of (pipet M19) + 9.6 mL of MW21420 (pipet M31)

Post Spike: 4ul MS2399 (pipet M17), 80ul MS2411 (pipet M27), 40ul MS2444 (pipet M27), 40ul MS2401 (pipet M27) to 8.0mL of sample (pipet M31)

INSTRUMENT RUNLOG

Instrument: ICAP 6500

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
Blank	1.000	IQC20A	03/20/2023	16:29	BCF
Std 1	1.000	IQC20A	03/20/2023	16:33	BCF
ICV	1.000	IQC20A	03/20/2023	16:37	BCF
ICB	1.000	IQC20A	03/20/2023	16:42	BCF
PQL	1.000	IQC20A	03/20/2023	16:46	BCF
ICSA	1.000	IQC20A	03/20/2023	16:50	BCF
ICSAB	1.000	IQC20A	03/20/2023	16:55	BCF
CCV	1.000	IQC20A	03/20/2023	16:59	BCF
CCB	1.000	IQC20A	03/20/2023	17:03	BCF
LRS1	1.000	IQC20A	03/20/2023	17:08	BCF
LRS2	1.000	IQC20A	03/20/2023	17:13	BCF
CCV	1.000	IQC20A	03/20/2023	17:17	BCF
CCB	1.000	IQC20A	03/20/2023	17:21	BCF
LCSWQC15ICW2	1.000	IQC20A	03/20/2023	17:26	BCF
PBWQC15ICW2	1.000	IQC20A	03/20/2023	17:30	BCF
PBT1792AR	1.000	IQC20A	03/20/2023	17:34	BCF
LCSWQC16ICW1	1.000	IQC20A	03/20/2023	17:39	BCF
PBWQC16ICW1	1.000	IQC20A	03/20/2023	17:43	BCF
SQ1201-001	1.000	IQC20A	03/20/2023	17:47	BCF
SQ1201-002	1.000	IQC20A	03/20/2023	17:52	BCF
SQ1201-002A	1.000	IQC20A	03/20/2023	17:56	BCF
SQ1201-002L	5.000	IQC20A	03/20/2023	18:00	BCF
SQ1201-002P	1.000	IQC20A	03/20/2023	18:05	BCF
CCV	1.000	IQC20A	03/20/2023	18:09	BCF
CCB	1.000	IQC20A	03/20/2023	18:13	BCF
SQ1201-002S	1.000	IQC20A	03/20/2023	18:18	BCF
SQ1201-003	1.000	IQC20A	03/20/2023	18:22	BCF
SQ1201-004	1.000	IQC20A	03/20/2023	18:26	BCF
SQ1201-005	1.000	IQC20A	03/20/2023	18:31	BCF
SQ1201-006	1.000	IQC20A	03/20/2023	18:35	BCF
SQ1201-007	1.000	IQC20A	03/20/2023	18:39	BCF
SQ1201-008	1.000	IQC20A	03/20/2023	18:44	BCF
LC2WQC16ICW2	1.000	IQC20A	03/20/2023	18:48	BCF
LCSWQC16ICW2	1.000	IQC20A	03/20/2023	18:52	BCF
PBWQC16ICW2	1.000	IQC20A	03/20/2023	18:57	BCF
CCV	1.000	IQC20A	03/20/2023	19:01	BCF
CCB	1.000	IQC20A	03/20/2023	19:05	BCF
SQ1044-001	1.000	IQC20A	03/20/2023	19:10	BCF
LCSOQC15ICS1	1.000	IQC20A	03/20/2023	19:14	BCF
PBSQC15ICS1	1.000	IQC20A	03/20/2023	19:18	BCF
SQ1129-007R	10.00	IQC20A	03/20/2023	19:22	BCF
SQ1167-001R	100.0	IQC20A	03/20/2023	19:27	BCF
SQ1167-002R	200.0	IQC20A	03/20/2023	19:31	BCF
RINSE1	1.000	IQC20A	03/20/2023	19:35	BCF

Intensity Report

Author:

Published: 3/21/2023 10:34:19AM

Notes:

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Method Name: FAST-2022_POP Method Revision: 171

Analyst Name: BCF

Acquire Date: 3/20/2023 4:29:25PM Sample Type: Standard

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.000008000	Cts/S	0.00005100	612.0	-1.512
Al3961_R		-0.00004500	Cts/S	0.0005010	1,115	-0.4068
As1891_A		-0.0004080	Cts/S	0.00007100	17.44	-2.954
B_2089_A		0.0005040	Cts/S	0.00001900	3.864	3.651
Ba4554_R		0.002718	Cts/S	0.0006870	25.29	26.44
Be3130_R		-0.0006480	Cts/S	0.00009400	14.53	-6.292
Ca3158_R		-0.003277	Cts/S	0.0004780	14.58	-31.86
Cd2265_A		-0.0001650	Cts/S	0.00003100	18.74	-1.197
Co2286_A		-0.0003570	Cts/S	0.00007500	20.93	-2.587
Cr2677_A		0.000002000	Cts/S	0.00002500	1,153	-0.3647
Cu3273_A		-0.0003680	Cts/S	0.00006300	17.07	-64.73
Fe2599_R		0.0001940	Cts/S	0.0002350	120.9	1.902
K_7664_R		0.005487	Cts/S	0.0005060	9.226	53.33
Li6707_R		0.001007	Cts/S	0.0006060	60.19	9.743
Mg2795		0.002152	Cts/S	0.0002040	9.469	20.91
Mg2025_A		-0.001200	Cts/S	0.00002800	2.313	-8.695
Mn2576_R		0.00004800	Cts/S	0.00004000	84.18	0.4676
Mo2020_A		-0.00001900	Cts/S	0.00005400	282.0	-0.1397
Na5895_R		0.002079	Cts/S	0.001706	82.07	20.29
Ni2316_A		0.0001920	Cts/S	0.000001000	0.4835	1.392
Pb2203_A		-0.0002190	Cts/S	0.00003300	14.97	-1.588
Sb2068_A		0.0003810	Cts/S	0.00002600	6.774	2.760
Se1960_A		0.0002430	Cts/S	0.00002400	9.756	1.761
Si2516_R		0.001907	Cts/S	0.0003470	18.22	18.54
Sn1899_A		0.0002990	Cts/S	0.00004500	14.96	2.165
Sr4215_R		-0.0006910	Cts/S	0.0001010	14.60	-6.714
Ti3349_A		-0.0002030	Cts/S	0.00001300	6.408	-35.68
Tl1908_A		-0.0003260	Cts/S	0.00002800	8.610	-2.362
V_2924_A		-0.00003100	Cts/S	0.000002000	7.350	-5.484
Zn2062_A		0.0001940	Cts/S	0.00003000	15.20	1.408
Y_3600_R		9,712.9	Cts/S	117.57	1.2104	9,712.9
Y_2243_A		7,247.4	Cts/S	0.61185	0.0084420	7,247.4
Y_3600_A		175,960	Cts/S	1,745.7	0.99210	175,960

Std 1

Method Name: FAST-2022_POP Method Revision: 171

Analyst Name: BCF

Acquire Date: 3/20/2023 4:33:47PM Sample Type: Standard

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1509	Cts/S	0.0001230	0.08128	25,650
Al3961_R		1.784	Cts/S	0.009388	0.5262	17,140
As1891_A		0.04352	Cts/S	0.0005070	1.166	304.5
B_2089_A		0.1676	Cts/S	0.001622	0.9683	1,173
Ba4554_R		2.649	Cts/S	0.009873	0.3727	25,460
Be3130_R		5.776	Cts/S	0.01854	0.3209	55,500
Ca3158_R		1.521	Cts/S	0.01591	1.046	14,610
Cd2265_A		2.437	Cts/S	0.02566	1.053	17,050
Co2286_A		0.5901	Cts/S	0.004458	0.7555	4,130
Cr2677_A		0.08566	Cts/S	0.0001950	0.2278	14,560
Cu3273_A		0.09978	Cts/S	0.0004390	0.4404	16,970
Fe2599_R		3.081	Cts/S	0.02379	0.7722	29,600
K_7664_R		0.8339	Cts/S	0.002177	0.2611	8,013

Std 1

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 4:33:47PM
Sample Type: Standard

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Li6707_R		0.7325	Cts/S	0.008866	1.210	7,038
Mg2795		109.4	Cts/S	0.5798	0.5300	1,051,000
Mg2025_A		1.308	Cts/S	0.009830	0.7514	9,155
Mn2576_R		0.5858	Cts/S	0.002899	0.4949	5,629
Mo2020_A		0.4550	Cts/S	0.005149	1.132	3,184
Na5895_R		2.100	Cts/S	0.004959	0.2361	20,180
Ni2316_A		0.2577	Cts/S	0.002768	1.074	1,803
Pb2203_A		0.1838	Cts/S	0.001817	0.9885	1,286
Sb2068_A		0.08084	Cts/S	0.001069	1.323	565.7
Se1960_A		0.03326	Cts/S	0.0002980	0.8965	232.8
Si2516_R		0.9799	Cts/S	0.006931	0.7073	9,416
Sn1899_A		0.07887	Cts/S	0.001080	1.370	551.9
Sr4215_R		3.448	Cts/S	0.008380	0.2430	33,130
Ti3349_A		0.1384	Cts/S	0.0001090	0.07864	23,530
Tl1908_A		0.07483	Cts/S	0.0006860	0.9171	523.7
V_2924_A		0.09561	Cts/S	0.00009200	0.09601	16,260
Zn2062_A		0.5484	Cts/S	0.005457	0.9951	3,838
Y_3600_R		9,609.0	Cts/S	89.700	0.93350	9,609.0
Y_2243_A		6,998.7	Cts/S	58.139	0.83071	6,998.7
Y_3600_A		170,030	Cts/S	100.36	0.059022	170,030

ICV

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 4:37:56PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		394.1	ug/L	3.505	0.8894	10,210
Al3961_R		10,450	ug/L	10.30	0.09856	7,154
As1891_A		382.2	ug/L	1.321	0.3457	117.3
B_2089_A		387.4	ug/L	1.040	0.2685	468.0
Ba4554_R		392.5	ug/L	2.941	0.7492	9,988
Be3130_R		402.3	ug/L	0.2408	0.05985	22,280
Ca3158_R	W	10,540	ug/L	45.34	0.4300	6,134
Cd2265_A		392.3	ug/L	0.7938	0.2023	6,851
Co2286_A		393.2	ug/L	1.154	0.2935	1,661
Cr2677_A		391.9	ug/L	3.493	0.8913	5,767
Cu3273_A		392.8	ug/L	3.621	0.9220	6,695
Fe2599_R		10,460	ug/L	0.9838	0.009402	12,370
K_7664_R		13,800	ug/L	57.79	0.4189	4,436
Li6707_R		420.5	ug/L	0.9875	0.2348	2,960
Mg2795	W	10,720	ug/L	46.94	0.4380	449,700
Mg2025_A		10,440	ug/L	24.35	0.2332	3,910
Mn2576_R		393.5	ug/L	0.1187	0.03016	2,211
Mo2020_A		399.7	ug/L	1.154	0.2887	1,303
Na5895_R		10,350	ug/L	34.21	0.3307	8,346
Ni2316_A		396.2	ug/L	0.2951	0.07447	732.5
Pb2203_A		398.3	ug/L	0.8457	0.2123	523.7
Sb2068_A		391.8	ug/L	0.5939	0.1516	228.5
Se1960_A		389.6	ug/L	2.994	0.7683	93.93
Si2516_R		10,320	ug/L	21.23	0.2056	3,815
Sn1899_A	W	425.4	ug/L	1.060	0.2492	241.7
Sr4215_R		413.9	ug/L	0.6226	0.1504	13,680
Ti3349_A		397.5	ug/L	1.471	0.3701	9,431
Tl1908_A		411.8	ug/L	0.7840	0.1904	219.5
V_2924_A		399.4	ug/L	2.629	0.6581	6,559
Zn2062_A		391.3	ug/L	0.3778	0.09655	1,539
Y_3600_R		9,590.1	Cts/S	34.670	0.36152	9,590.1

ICV

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 4:37:56PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Y_2243_A		7,166.4	Cts/S	3.0553	0.042634	7,166.4
Y_3600_A		171,800	Cts/S	1,062.9	0.61870	171,800

ICB

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 4:42:13PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.004452	ug/L	0.2074	4,657	-1.362
Al3961_R		3.812	ug/L	6.670	175.0	2.187
As1891_A		-0.3370	ug/L	0.7215	214.1	-3.042
B_2089_A		-0.08404	ug/L	0.05345	63.60	3.571
Ba4554_R		-0.003236	ug/L	0.2873	8,877	26.27
Be3130_R		0.09229	ug/L	0.1222	132.4	-1.162
Ca3158_R		-0.2137	ug/L	10.11	4,730	-31.88
Cd2265_A		0.006698	ug/L	0.02647	395.1	-1.063
Co2286_A		0.07674	ug/L	0.02265	29.52	-2.244
Cr2677_A		0.1941	ug/L	0.1223	63.01	2.521
Cu3273_A		0.09146	ug/L	0.3131	342.3	-62.43
Fe2599_R		4.060	ug/L	0.1796	4.424	6.726
K_7664_R		-90.22	ug/L	52.27	57.94	24.28
Li6707_R		-1.531	ug/L	1.450	94.73	-1.153
Mg2795		2.512	ug/L	0.9970	39.69	127.0
Mg2025_A		2.676	ug/L	1.261	47.11	-7.629
Mn2576_R		0.1247	ug/L	0.5393	432.6	1.152
Mo2020_A		0.7679	ug/L	0.1595	20.78	2.377
Na5895_R		-3.913	ug/L	10.65	272.3	17.00
Ni2316_A		-0.1289	ug/L	0.03414	26.49	1.144
Pb2203_A		-0.4958	ug/L	0.1395	28.13	-2.237
Sb2068_A		-1.391	ug/L	0.5435	39.08	1.935
Se1960_A		0.3194	ug/L	1.121	350.8	1.826
Si2516_R		28.65	ug/L	8.802	30.72	29.12
Sn1899_A		0.08148	ug/L	0.2571	315.6	2.198
Sr4215_R		0.1644	ug/L	0.2965	180.3	-1.137
Ti3349_A		0.09081	ug/L	0.03938	43.37	-33.10
Tl1908_A		0.9929	ug/L	0.5533	55.72	-1.810
V_2924_A		-0.08790	ug/L	0.05668	64.49	-6.997
Zn2062_A		-0.04335	ug/L	0.03187	73.51	1.227
Y_3600_R		9,679.4	Cts/S	115.26	1.1908	9,679.4
Y_2243_A		7,201.9	Cts/S	6.3301	0.087894	7,201.9
Y_3600_A		174,120	Cts/S	1,687.8	0.96930	174,120

PQL

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 4:46:36PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		9.744	ug/L	0.2200	2.257	260.1
Al3961_R		281.7	ug/L	16.95	6.019	193.8
As1891_A		7.664	ug/L	0.5513	7.194	-0.4994
B_2089_A		45.40	ug/L	0.3088	0.6803	56.80
Ba4554_R		4.526	ug/L	0.03705	0.8185	142.1
Be3130_R		4.983	ug/L	0.04622	0.9276	271.7
Ca3158_R		96.35	ug/L	8.276	8.590	25.11
Cd2265_A		4.760	ug/L	0.02722	0.5720	82.90
Co2286_A		9.538	ug/L	0.2493	2.614	38.30
Cr2677_A		9.841	ug/L	0.03320	0.3374	149.6

PQL

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 4:46:36PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Cu3273_A		24.06	ug/L	0.7378	3.067	362.7
Fe2599_R		102.5	ug/L	1.404	1.370	124.0
K_7664_R		942.7	ug/L	29.60	3.140	355.0
Li6707_R		103.4	ug/L	1.659	1.605	740.7
Mg2795		105.5	ug/L	0.7865	0.7458	4,481
Mg2025_A		109.7	ug/L	1.463	1.333	33.29
Mn2576_R		4.954	ug/L	0.2608	5.264	28.51
Mo2020_A		9.629	ug/L	0.04553	0.4728	31.64
Na5895_R		983.7	ug/L	2.500	0.2541	818.2
Ni2316_A		9.694	ug/L	0.08497	0.8765	19.50
Pb2203_A		4.756	ug/L	0.06355	1.336	4.738
Sb2068_A	W	6.299	ug/L	0.2403	3.815	6.008
Se1960_A		9.254	ug/L	1.483	16.02	3.978
Si2516_R		199.0	ug/L	1.977	0.9934	92.19
Sn1899_A		95.81	ug/L	0.4541	0.4740	56.77
Sr4215_R		10.10	ug/L	0.07256	0.7185	330.0
Ti3349_A		14.09	ug/L	0.2869	2.036	311.2
Tl1908_A		16.45	ug/L	1.049	6.375	6.605
V_2924_A		9.485	ug/L	0.1513	1.595	155.9
Zn2062_A		19.08	ug/L	0.03429	0.1797	77.34
Y_3600_R		9,667.3	Cts/S	8.1000	0.083787	9,667.3
Y_2243_A		7,253.5	Cts/S	19.351	0.26678	7,253.5
Y_3600_A		177,880	Cts/S	2,561.5	1.4400	177,880

ICSA

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 4:50:59PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.4560	ug/L	0.007189	1.576	-12.84
Al3961_R		531,700	ug/L	1,656	0.3114	350,600
As1891_A		-0.5916	ug/L	2.218	374.9	-12.84
B_2089_A		1.727	ug/L	0.4753	27.53	4.840
Ba4554_R		2.132	ug/L	0.1250	5.861	77.35
Be3130_R		0.05503	ug/L	0.01609	29.24	-3.175
Ca3158_R		508,500	ug/L	4,938	0.9710	286,900
Cd2265_A		0.02499	ug/L	0.2718	1,088	343.8
Co2286_A		-0.4513	ug/L	0.4089	90.60	-1.182
Cr2677_A		4.850	ug/L	0.2606	5.373	45.48
Cu3273_A		-0.6618	ug/L	0.5513	83.30	-32.21
Fe2599_R		199,000	ug/L	2,370	1.191	227,000
K_7664_R	W	836.2	ug/L	7.778	0.9301	307.2
Li6707_R		13.81	ug/L	0.05395	0.3907	102.8
Mg2795	^F	0.0000	ug/L	0.0000	0.0000	1,757,000
Mg2025_A		427,900	ug/L	694.1	0.1622	141,800
Mn2576_R		-1.254	ug/L	0.3133	24.98	8.541
Mo2020_A		-2.745	ug/L	0.2394	8.724	-8.075
Na5895_R		157.2	ug/L	28.38	18.05	141.2
Ni2316_A		-1.666	ug/L	0.02731	1.639	-6.672
Pb2203_A		-0.4511	ug/L	0.3978	88.17	-50.69
Sb2068_A		3.301	ug/L	0.6811	20.63	8.773
Se1960_A		0.4475	ug/L	0.8165	182.5	4.357
Si2516_R		-1.240	ug/L	1.372	110.6	9.350
Sn1899_A		6.305	ug/L	0.8278	13.13	5.057
Sr4215_R		4.791	ug/L	0.2579	5.384	146.5
Ti3349_A		2.353	ug/L	0.2803	11.91	18.96
Tl1908_A		1.719	ug/L	0.8396	48.85	-0.1789

ICSA

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 4:50:59PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
V_2924_A		-0.1201	ug/L	0.2473	205.9	10.92
Zn2062_A		1.535	ug/L	0.1250	8.144	6.585
Y_3600_R		9,254.8	Cts/S	112.54	1.2160	9,254.8
Y_2243_A		6,367.7	Cts/S	12.400	0.19473	6,367.7
Y_3600_A		154,130	Cts/S	557.61	0.36178	154,130

ICSAB

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 4:55:24PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		216.1	ug/L	1.776	0.8217	5,017
Al3961_R		534,200	ug/L	7,379	1.381	353,200
As1891_A		99.97	ug/L	2.674	2.675	15.46
B_2089_A		461.4	ug/L	1.724	0.3736	491.3
Ba4554_R		527.2	ug/L	0.2871	0.05446	12,970
Be3130_R		517.6	ug/L	2.167	0.4187	27,740
Ca3158_R		508,400	ug/L	10,710	2.107	287,600
Cd2265_A		941.6	ug/L	5.329	0.5660	14,840
Co2286_A		457.5	ug/L	2.155	0.4712	1,712
Cr2677_A		488.6	ug/L	4.564	0.9341	6,426
Cu3273_A		536.6	ug/L	1.507	0.2809	8,243
Fe2599_R		199,900	ug/L	1,005	0.5027	228,600
K_7664_R		21,910	ug/L	27.45	0.1253	6,788
Li6707_R		552.0	ug/L	1.649	0.2988	3,756
Mg2795	^F	0.0000	ug/L	0.0000	0.0000	1,733,000
Mg2025_A		426,100	ug/L	1,384	0.3250	140,500
Mn2576_R		482.4	ug/L	2.587	0.5364	2,637
Mo2020_A		456.9	ug/L	1.008	0.2206	1,317
Na5895_R		21,400	ug/L	106.6	0.4983	16,680
Ni2316_A		930.3	ug/L	3.717	0.3996	1,514
Pb2203_A		44.14	ug/L	1.821	4.126	1.255
Sb2068_A		618.0	ug/L	1.086	0.1757	321.9
Se1960_A		54.96	ug/L	1.738	3.161	15.80
Si2516_R		2,000	ug/L	10.95	0.5476	720.4
Sn1899_A		469.4	ug/L	0.5611	0.1195	235.5
Sr4215_R		524.0	ug/L	0.5398	0.1030	16,760
Ti3349_A		475.8	ug/L	1.445	0.3036	10,120
Tl1908_A		89.61	ug/L	1.946	2.171	41.76
V_2924_A		508.2	ug/L	0.07662	0.01508	7,502
Zn2062_A		928.8	ug/L	6.261	0.6741	3,229
Y_3600_R		9,279.7	Cts/S	134.46	1.4490	9,279.7
Y_2243_A		6,334.4	Cts/S	3.2101	0.050678	6,334.4
Y_3600_A		153,970	Cts/S	670.07	0.43520	153,970

CCV

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 4:59:44PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		507.5	ug/L	4.866	0.9588	13,310
Al3961_R		12,540	ug/L	34.89	0.2782	8,820
As1891_A		512.1	ug/L	0.5709	0.1115	157.0
B_2089_A		507.5	ug/L	2.141	0.4219	606.7
Ba4554_R		510.5	ug/L	1.234	0.2416	13,340
Be3130_R		511.1	ug/L	1.534	0.3001	29,090
Ca3158_R		12,560	ug/L	5.313	0.04231	7,514

CCV

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 4:59:44PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Cd2265_A		515.1	ug/L	1.500	0.2912	8,924
Co2286_A		509.7	ug/L	0.5100	0.1001	2,137
Cr2677_A		509.1	ug/L	5.437	1.068	7,580
Cu3273_A		514.7	ug/L	4.490	0.8723	8,896
Fe2599_R		12,570	ug/L	31.58	0.2513	15,260
K_7664_R		12,780	ug/L	26.95	0.2109	4,228
Li6707_R		510.9	ug/L	3.313	0.6485	3,693
Mg2795		12,930	ug/L	64.94	0.5022	557,600
Mg2025_A		12,800	ug/L	63.80	0.4986	4,757
Mn2576_R		495.9	ug/L	1.999	0.4032	2,863
Mo2020_A		513.6	ug/L	1.895	0.3690	1,661
Na5895_R		12,620	ug/L	4.130	0.03274	10,460
Ni2316_A		517.5	ug/L	1.609	0.3110	948.8
Pb2203_A		519.1	ug/L	2.287	0.4405	677.8
Sb2068_A		514.2	ug/L	4.459	0.8672	296.8
Se1960_A		511.2	ug/L	3.217	0.6293	121.7
Si2516_R		12,810	ug/L	16.17	0.1263	4,859
Sn1899_A		516.4	ug/L	3.458	0.6697	290.6
Sr4215_R		507.0	ug/L	1.488	0.2934	17,230
Ti3349_A		508.2	ug/L	5.149	1.013	12,210
Tl1908_A	W	533.5	ug/L	0.07057	0.01323	282.8
V_2924_A		515.2	ug/L	6.115	1.187	8,559
Zn2062_A		512.1	ug/L	2.277	0.4447	1,998
Y_3600_R		9,855.2	Cts/S	14.295	0.14505	9,855.2
Y_2243_A		7,109.9	Cts/S	11.010	0.15485	7,109.9
Y_3600_A		173,810	Cts/S	1,376.4	0.79188	173,810

CCB

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:03:58PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2144	ug/L	0.06080	28.36	-7.224
Al3961_R		25.83	ug/L	10.25	39.68	17.56
As1891_A		-0.8075	ug/L	0.6632	82.13	-3.197
B_2089_A		-0.1240	ug/L	0.2062	166.3	3.520
Ba4554_R		-0.02013	ug/L	0.05925	294.3	26.04
Be3130_R		0.1528	ug/L	0.005024	3.287	2.288
Ca3158_R		17.78	ug/L	0.6949	3.909	-21.44
Cd2265_A		0.005594	ug/L	0.05800	1,037	-1.076
Co2286_A		0.1053	ug/L	0.05864	55.71	-2.128
Cr2677_A		0.3631	ug/L	0.1881	51.80	5.139
Cu3273_A		-0.2959	ug/L	0.1392	47.04	-70.44
Fe2599_R		8.568	ug/L	3.372	39.36	12.22
K_7664_R		-11.45	ug/L	36.54	319.0	49.94
Li6707_R		1.205	ug/L	1.159	96.15	18.47
Mg2795		21.06	ug/L	6.528	31.00	921.3
Mg2025_A		11.35	ug/L	1.677	14.77	-4.384
Mn2576_R		0.4689	ug/L	0.6253	133.4	3.149
Mo2020_A		0.5512	ug/L	0.2737	49.66	1.670
Na5895_R		8.894	ug/L	1.078	12.12	27.62
Ni2316_A		-0.02428	ug/L	0.1787	735.8	1.341
Pb2203_A		0.3308	ug/L	0.2288	69.17	-1.144
Sb2068_A		-1.316	ug/L	0.5331	40.52	1.982
Se1960_A		-0.3675	ug/L	0.7834	213.2	1.666
Si2516_R		-7.473	ug/L	8.600	115.1	15.83
Sn1899_A		0.4026	ug/L	0.3821	94.90	2.384

CCB

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:03:58PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Sr4215_R		0.2292	ug/L	0.1864	81.31	0.9822
Ti3349_A		-0.01784	ug/L	0.1521	853.0	-36.35
Tl1908_A		0.3058	ug/L	0.6968	227.9	-2.186
V_2924_A		-0.2260	ug/L	0.06595	29.18	-9.482
Zn2062_A		0.3380	ug/L	0.1190	35.21	2.739
Y_3600_R		9,774.2	Cts/S	18.402	0.18828	9,774.2
Y_2243_A		7,214.8	Cts/S	8.8118	0.12213	7,214.8
Y_3600_A		177,330	Cts/S	1,696.7	0.95684	177,330

LRS1

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:08:21PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		1,907	ug/L	2.467	0.1294	49,310
Al3961_R		32.12	ug/L	75.95	236.5	156.1
As1891_A		19,700	ug/L	27.41	0.1391	5,953
B_2089_A		19,580	ug/L	37.24	0.1901	21,720
Ba4554_R		18,930	ug/L	191.0	1.009	497,300
Be3130_R		18,900	ug/L	158.5	0.8388	1,084,000
Ca3158_R		767.1	ug/L	1,074	140.0	438.0
Cd2265_A		18,800	ug/L	178.8	0.9510	313,500
Co2286_A		19,080	ug/L	31.32	0.1641	77,290
Cr2677_A		18,630	ug/L	5.311	0.02851	274,000
Cu3273_A		19,110	ug/L	319.2	1.670	328,100
Fe2599_R		2.310	ug/L	1.175	50.86	4.064
K_7664_R		-186.3	ug/L	19.90	10.68	-6.787
Li6707_R		19,940	ug/L	12.19	0.06113	144,800
Mg2795		7.748	ug/L	0.03080	0.3975	357.9
Mg2025_A		1,485	ug/L	15.86	1.068	1,512
Mn2576_R		18,200	ug/L	58.84	0.3233	105,800
Mo2020_A		4,883	ug/L	10.71	0.2194	15,240
Na5895_R		-8.250	ug/L	6.316	76.55	13.76
Ni2316_A		19,490	ug/L	4.057	0.02081	34,450
Pb2203_A		20,320	ug/L	19.54	0.09620	25,690
Sb2068_A		20,010	ug/L	15.35	0.07669	11,050
Se1960_A		19,830	ug/L	42.49	0.2143	4,489
Si2516_R		371.4	ug/L	29.09	7.832	100.6
Sn1899_A		20,330	ug/L	0.2533	0.001246	10,960
Sr4215_R		19,550	ug/L	45.94	0.2349	669,500
Ti3349_A		18,910	ug/L	195.6	1.034	449,600
Tl1908_A		19,540	ug/L	103.0	0.5269	10,070
V_2924_A		19,180	ug/L	63.13	0.3291	316,600
Zn2062_A		19,100	ug/L	13.66	0.07150	71,840
Y_3600_R		9,927.8	Cts/S	19.025	0.19164	9,927.8
Y_2243_A		6,860.3	Cts/S	4.7603	0.069389	6,860.3
Y_3600_A		171,680	Cts/S	181.76	0.10587	171,680

LRS2

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:13:13PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.3467	ug/L	0.2077	59.90	-10.76
Al3961_R		484,200	ug/L	2,851	0.5889	329,300
As1891_A		5.198	ug/L	1.722	33.13	-12.63
B_2089_A		9.872	ug/L	0.9729	9.855	13.63

LRS2

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:13:13PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ba4554_R		2.850	ug/L	0.3438	12.06	97.95
Be3130_R		2.595	ug/L	0.2094	8.072	136.8
Ca3158_R		460,200	ug/L	2,056	0.4468	267,800
Cd2265_A		-0.1121	ug/L	0.3169	282.7	405.0
Co2286_A		1.090	ug/L	0.5702	52.30	5.169
Cr2677_A		2.088	ug/L	0.3045	14.58	6.286
Cu3273_A		-2.459	ug/L	0.7735	31.45	-13.06
Fe2599_R		230,900	ug/L	326.3	0.1413	271,600
K_7664_R		297,000	ug/L	935.9	0.3151	93,980
Li6707_R		15.11	ug/L	0.2937	1.944	115.1
Mg2795	F	139,900	ug/L	251.7	0.1800	5,840,000
Mg2025_A	F	166,900	ug/L	450.3	0.2698	56,450
Mn2576_R		2.151	ug/L	0.1346	6.257	27.27
Mo2020_A		2.081	ug/L	0.5670	27.24	6.029
Na5895_R		205,200	ug/L	1,722	0.8389	164,400
Ni2316_A		-1.838	ug/L	1.048	57.03	-7.938
Pb2203_A		-1.275	ug/L	2.463	193.1	-44.71
Sb2068_A		6.164	ug/L	0.008253	0.1339	10.33
Se1960_A		5.455	ug/L	0.6792	12.45	5.507
Si2516_R		48,850	ug/L	28.56	0.05848	17,900
Sn1899_A		9.060	ug/L	1.091	12.04	6.567
Sr4215_R		8.717	ug/L	0.3411	3.913	280.4
Ti3349_A		4.560	ug/L	0.3938	8.636	67.97
Tl1908_A		4.023	ug/L	0.6032	14.99	0.7791
V_2924_A		1.431	ug/L	0.08911	6.228	37.53
Zn2062_A		4.437	ug/L	0.2725	6.142	17.08
Y_3600_R		9,544.3	Cts/S	42.555	0.44587	9,544.3
Y_2243_A		6,498.0	Cts/S	3.0778	0.047366	6,498.0
Y_3600_A		158,460	Cts/S	549.47	0.34676	158,460

CCV

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:17:39PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		502.7	ug/L	0.6165	0.1226	13,260
Al3961_R		12,340	ug/L	247.0	2.002	8,823
As1891_A		507.1	ug/L	1.040	0.2051	156.1
B_2089_A		508.0	ug/L	0.5342	0.1052	609.3
Ba4554_R		505.2	ug/L	8.751	1.732	13,430
Be3130_R		504.7	ug/L	7.643	1.514	29,220
Ca3158_R		12,330	ug/L	218.0	1.768	7,503
Cd2265_A		512.3	ug/L	0.008292	0.001618	8,909
Co2286_A		505.4	ug/L	0.1003	0.01984	2,127
Cr2677_A		506.4	ug/L	1.992	0.3933	7,586
Cu3273_A		515.0	ug/L	1.773	0.3442	8,957
Fe2599_R		12,380	ug/L	247.1	1.997	15,290
K_7664_R		12,730	ug/L	165.8	1.302	4,283
Li6707_R		505.8	ug/L	9.723	1.922	3,719
Mg2795		12,820	ug/L	289.5	2.259	562,100
Mg2025_A		12,620	ug/L	41.73	0.3306	4,710
Mn2576_R		493.1	ug/L	9.550	1.937	2,895
Mo2020_A		509.0	ug/L	0.5543	0.1089	1,653
Na5895_R		12,560	ug/L	240.2	1.912	10,590
Ni2316_A		516.9	ug/L	0.6048	0.1170	951.2
Pb2203_A		516.7	ug/L	0.5488	0.1062	677.1
Sb2068_A		515.0	ug/L	1.852	0.3597	298.4

CCV

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:17:39PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Se1960_A		507.5	ug/L	3.492	0.6880	121.3
Si2516_R		12,690	ug/L	229.8	1.812	4,895
Sn1899_A		510.1	ug/L	0.1027	0.02013	288.2
Sr4215_R		501.8	ug/L	9.765	1.946	17,340
Ti3349_A		502.3	ug/L	1.685	0.3355	12,140
Tl1908_A		510.4	ug/L	9.304	1.823	271.4
V_2924_A		512.2	ug/L	0.5078	0.09915	8,563
Zn2062_A		508.6	ug/L	0.3324	0.06535	1,992
Y_3600_R		10,025	Cts/S	171.84	1.7142	10,025
Y_2243_A		7,136.7	Cts/S	4.6369	0.064973	7,136.7
Y_3600_A		174,900	Cts/S	509.31	0.29120	174,900

CCB

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:21:55PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1903	ug/L	0.1614	84.82	3.625
Al3961_R		2.625	ug/L	15.92	606.4	1.450
As1891_A		1.608	ug/L	0.7754	48.22	-2.453
B_2089_A		2.288	ug/L	0.2413	10.55	6.389
Ba4554_R		-0.007375	ug/L	0.01134	153.7	26.80
Be3130_R		0.3961	ug/L	0.02277	5.749	16.29
Ca3158_R		2.395	ug/L	2.795	116.7	-31.09
Cd2265_A		0.2443	ug/L	0.1092	44.69	3.133
Co2286_A		0.2331	ug/L	0.1706	73.18	-1.598
Cr2677_A		0.1019	ug/L	0.1430	140.4	1.195
Cu3273_A		0.1914	ug/L	0.008501	4.443	-62.68
Fe2599_R		4.535	ug/L	1.786	39.37	7.479
K_7664_R		102.4	ug/L	18.34	17.91	88.18
Li6707_R		-1.335	ug/L	0.6229	46.65	0.2957
Mg2795		3.237	ug/L	0.3524	10.89	162.0
Mg2025_A		4.638	ug/L	2.158	46.53	-6.961
Mn2576_R		-0.02287	ug/L	0.03780	165.3	0.3431
Mo2020_A		1.063	ug/L	0.2040	19.19	3.381
Na5895_R		22.99	ug/L	21.67	94.25	39.79
Ni2316_A		-0.03616	ug/L	0.1739	481.1	1.332
Pb2203_A		0.09021	ug/L	1.066	1,182	-1.474
Sb2068_A		-1.092	ug/L	0.2583	23.66	2.128
Se1960_A		1.194	ug/L	0.2125	17.80	2.057
Si2516_R		5.069	ug/L	10.89	214.7	20.87
Sn1899_A		0.7781	ug/L	0.3063	39.36	2.622
Sr4215_R		0.3870	ug/L	0.04547	11.75	6.395
Ti3349_A		0.03718	ug/L	0.09848	264.9	-35.50
Tl1908_A		0.6186	ug/L	0.1703	27.53	-2.035
V_2924_A		0.05838	ug/L	0.1527	261.5	-4.694
Zn2062_A		0.4387	ug/L	0.1212	27.62	3.169
Y_3600_R		9,930.8	Cts/S	16.896	0.17014	9,930.8
Y_2243_A		7,283.9	Cts/S	13.729	0.18849	7,283.9
Y_3600_A		179,910	Cts/S	3,487.9	1.9386	179,910

LCSWQC15ICW2

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:26:19PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		50.81	ug/L	0.4304	0.8472	1,359

LCSWQC15ICW2

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:26:19PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Al3961_R		2,166	ug/L	48.00	2.216	1,542
As1891_A		105.4	ug/L	1.061	1.007	30.57
B_2089_A		509.4	ug/L	2.681	0.5264	596.1
Ba4554_R		2,127	ug/L	6.647	0.3125	56,190
Be3130_R		53.71	ug/L	0.5141	0.9573	3,083
Ca3158_R		2,671	ug/L	66.42	2.487	1,592
Cd2265_A		261.7	ug/L	1.104	0.4219	4,585
Co2286_A		529.9	ug/L	2.514	0.4745	2,252
Cr2677_A		210.0	ug/L	0.5135	0.2445	3,199
Cu3273_A		270.3	ug/L	0.8656	0.3202	4,741
Fe2599_R		1,091	ug/L	9.758	0.8947	1,343
K_7664_R		10,670	ug/L	8.121	0.07611	3,583
Li6707_R		553.5	ug/L	8.624	1.558	4,049
Mg2795		5,678	ug/L	40.13	0.7069	247,900
Mg2025_A		5,471	ug/L	30.91	0.5650	2,072
Mn2576_R		517.7	ug/L	6.658	1.286	3,025
Mo2020_A		106.1	ug/L	0.6341	0.5976	347.7
Na5895_R		8,207	ug/L	31.47	0.3835	6,893
Ni2316_A		542.3	ug/L	3.711	0.6842	1,008
Pb2203_A		107.2	ug/L	0.3552	0.3314	140.6
Sb2068_A		104.4	ug/L	1.326	1.269	61.26
Se1960_A		102.9	ug/L	0.1111	0.1080	26.31
Si2516_R		1,074	ug/L	15.65	1.457	428.4
Sn1899_A		556.5	ug/L	1.282	0.2304	317.3
Sr4215_R		544.2	ug/L	2.475	0.4547	18,720
Ti3349_A		518.0	ug/L	0.3365	0.06496	12,720
Tl1908_A		108.8	ug/L	0.01957	0.01799	56.74
V_2924_A		537.8	ug/L	1.034	0.1922	9,211
Zn2062_A		528.8	ug/L	2.618	0.4951	2,092
Y_3600_R		9,978.0	Cts/S	99.835	1.0006	9,978.0
Y_2243_A		7,207.6	Cts/S	28.427	0.39441	7,207.6
Y_3600_A		177,800	Cts/S	306.06	0.17213	177,800

PBWQC15ICW2

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:30:31PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2690	ug/L	0.04854	18.04	-8.862
Al3961_R		-7.724	ug/L	7.656	99.13	-5.921
As1891_A		0.4991	ug/L	0.3885	77.84	-2.809
B_2089_A		1.313	ug/L	0.1482	11.29	5.229
Ba4554_R		0.3073	ug/L	0.2204	71.72	35.28
Be3130_R		0.2838	ug/L	0.07019	24.73	9.888
Ca3158_R		4.946	ug/L	5.783	116.9	-29.74
Cd2265_A		0.04487	ug/L	0.06231	138.8	-0.3991
Co2286_A		0.1251	ug/L	0.1638	130.9	-2.058
Cr2677_A		0.2608	ug/L	0.01687	6.469	3.643
Cu3273_A		0.3029	ug/L	0.01882	6.213	-61.01
Fe2599_R		3.694	ug/L	1.074	29.06	6.490
K_7664_R		-57.53	ug/L	27.58	47.94	35.80
Li6707_R		-1.468	ug/L	2.529	172.3	-0.6988
Mg2795		7.795	ug/L	0.4225	5.420	362.3
Mg2025_A		6.545	ug/L	0.1197	1.829	-6.246
Mn2576_R		0.3935	ug/L	0.4473	113.7	2.778
Mo2020_A		0.5943	ug/L	0.01638	2.757	1.829
Na5895_R		19.71	ug/L	12.22	62.00	37.29

PBWQC15ICW2

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:30:31PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ni2316_A		0.1157	ug/L	0.1575	136.1	1.615
Pb2203_A		-0.03893	ug/L	1.386	3,560	-1.644
Sb2068_A		-1.032	ug/L	0.5768	55.90	2.166
Se1960_A		0.7455	ug/L	0.1533	20.56	1.949
Si2516_R		-1.338	ug/L	4.417	330.2	18.54
Sn1899_A		0.4871	ug/L	0.5089	104.5	2.454
Sr4215_R		0.4885	ug/L	0.2316	47.42	9.944
Ti3349_A		0.3537	ug/L	0.1191	33.69	-27.81
Tl1908_A		0.5890	ug/L	0.1406	23.87	-2.052
V_2924_A		0.1541	ug/L	0.01802	11.70	-3.026
Zn2062_A		0.4298	ug/L	0.03451	8.029	3.132
Y_3600_R		9,992.5	Cts/S	29.667	0.29690	9,992.5
Y_2243_A		7,283.1	Cts/S	25.199	0.34600	7,283.1
Y_3600_A		180,900	Cts/S	1,469.9	0.81254	180,900

PBT1792AR

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:34:54PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.3137	ug/L	0.06865	21.89	-9.192
Al3961_R		-9.754	ug/L	7.451	76.39	-7.201
As1891_A		-0.1397	ug/L	1.516	1,085	-2.801
B_2089_A		5.568	ug/L	0.1498	2.691	9.453
Ba4554_R		0.5378	ug/L	0.6081	113.1	40.47
Be3130_R		0.1901	ug/L	0.06130	32.25	4.444
Ca3158_R		39.21	ug/L	0.8463	2.158	-8.691
Cd2265_A		0.05893	ug/L	0.008106	13.76	-0.1435
Co2286_A		-0.2122	ug/L	0.1828	86.13	-3.268
Cr2677_A		0.3767	ug/L	0.06277	16.66	4.965
Cu3273_A		0.06605	ug/L	0.2816	426.3	-59.53
Fe2599_R		3.060	ug/L	0.7337	23.98	5.606
K_7664_R		241.2	ug/L	70.97	29.42	132.3
Li6707_R		0.1282	ug/L	1.377	1,074	10.72
Mg2795		16.16	ug/L	0.05533	0.3423	714.2
Mg2025_A		13.66	ug/L	1.487	10.88	-3.322
Mn2576_R		0.3570	ug/L	0.2486	69.64	2.528
Mo2020_A		0.2189	ug/L	0.08134	37.17	0.5431
Na5895_R	F	348,900	ug/L	5,057	1.450	286,900
Ni2316_A		0.7398	ug/L	0.4646	62.80	2.594
Pb2203_A		-0.002787	ug/L	0.3807	13,660	-1.484
Sb2068_A		-0.6984	ug/L	1.011	144.8	2.199
Se1960_A		2.043	ug/L	2.285	111.9	2.100
Si2516_R		-4.801	ug/L	2.981	62.10	16.87
Sn1899_A		0.3625	ug/L	0.6584	181.6	2.218
Sr4215_R		0.1284	ug/L	0.2160	168.2	-2.478
Ti3349_A		-0.1179	ug/L	0.3271	277.4	-36.11
Tl1908_A		0.1605	ug/L	0.9349	582.4	-2.124
V_2924_A		0.1310	ug/L	0.05061	38.63	-3.100
Zn2062_A		1.054	ug/L	0.1127	10.70	5.233
Y_3600_R		9,799.9	Cts/S	136.69	1.3949	9,799.9
Y_2243_A		6,773.2	Cts/S	48.233	0.71211	6,773.2
Y_3600_A		164,990	Cts/S	1,116.0	0.67642	164,990

LCSWQC16ICW1

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF

LCSWQC16ICW1

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:39:18PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		49.85	ug/L	0.02426	0.04867	1,328
Al3961_R		2,084	ug/L	15.75	0.7556	1,483
As1891_A		99.58	ug/L	0.001740	0.001748	28.78
B_2089_A		489.6	ug/L	0.6458	0.1319	574.2
Ba4554_R		2,034	ug/L	7.674	0.3773	53,690
Be3130_R		51.46	ug/L	0.3621	0.7036	2,951
Ca3158_R		2,563	ug/L	16.48	0.6431	1,525
Cd2265_A		252.2	ug/L	0.9756	0.3868	4,427
Co2286_A		510.7	ug/L	1.431	0.2801	2,175
Cr2677_A		203.4	ug/L	0.1141	0.05609	3,086
Cu3273_A		260.4	ug/L	0.05664	0.02175	4,547
Fe2599_R		1,036	ug/L	4.735	0.4572	1,274
K_7664_R		10,230	ug/L	42.36	0.4140	3,434
Li6707_R		531.7	ug/L	4.762	0.8955	3,887
Mg2795		5,420	ug/L	22.85	0.4216	236,400
Mg2025_A		5,268	ug/L	17.15	0.3256	1,999
Mn2576_R		492.2	ug/L	6.216	1.263	2,874
Mo2020_A		101.5	ug/L	0.3055	0.3009	333.3
Na5895_R		7,981	ug/L	48.90	0.6127	6,697
Ni2316_A		521.5	ug/L	1.497	0.2871	971.3
Pb2203_A		104.1	ug/L	0.02279	0.02189	136.8
Sb2068_A		100.6	ug/L	0.6442	0.6401	59.26
Se1960_A		98.59	ug/L	1.059	1.074	25.32
Si2516_R		1,027	ug/L	2.698	0.2627	410.0
Sn1899_A		536.7	ug/L	0.2210	0.04118	306.6
Sr4215_R		521.2	ug/L	0.9859	0.1892	17,910
Ti3349_A		499.2	ug/L	0.9529	0.1909	12,210
Tl1908_A		105.1	ug/L	0.2365	0.2250	54.88
V_2924_A		517.5	ug/L	1.450	0.2802	8,830
Zn2062_A		509.8	ug/L	1.998	0.3919	2,021
Y_3600_R		9,968.2	Cts/S	31.150	0.31250	9,968.2
Y_2243_A		7,221.5	Cts/S	1.7438	0.024148	7,221.5
Y_3600_A		177,140	Cts/S	815.02	0.46010	177,140

PBWQC16ICW1

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:43:30PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.2333	ug/L	0.01012	4.338	-7.837
Al3961_R		4.178	ug/L	11.06	264.8	2.559
As1891_A		-0.6847	ug/L	0.8195	119.7	-3.201
B_2089_A		0.9028	ug/L	0.3785	41.93	4.760
Ba4554_R		0.08559	ug/L	0.1495	174.6	29.43
Be3130_R		0.08461	ug/L	0.006897	8.151	-1.597
Ca3158_R		1.132	ug/L	0.8282	73.19	-32.08
Cd2265_A		0.02170	ug/L	0.01279	58.93	-0.8196
Co2286_A		-0.03456	ug/L	0.04952	143.3	-2.759
Cr2677_A		0.1137	ug/L	0.2221	195.4	1.351
Cu3273_A		0.2910	ug/L	0.6595	226.7	-60.91
Fe2599_R		1.410	ug/L	0.7492	53.14	3.684
K_7664_R		-33.50	ug/L	1.025	3.059	43.77
Li6707_R		-0.3080	ug/L	1.295	420.4	7.789
Mg2795		7.486	ug/L	0.05141	0.6867	349.0
Mg2025_A		6.912	ug/L	0.5913	8.556	-6.144
Mn2576_R		0.1641	ug/L	0.3479	211.9	1.435
Mo2020_A		0.3588	ug/L	0.08982	25.03	1.053

PBWQC16ICW1

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:43:30PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		74.58	ug/L	23.13	31.01	83.44
Ni2316_A		0.3905	ug/L	0.1855	47.51	2.141
Pb2203_A		-0.1811	ug/L	0.6243	344.8	-1.848
Sb2068_A		-0.9133	ug/L	0.8019	87.81	2.249
Se1960_A		0.7520	ug/L	0.8522	113.3	1.959
Si2516_R		-5.207	ug/L	3.567	68.50	17.06
Sn1899_A		-0.4130	ug/L	0.1826	44.21	1.948
Sr4215_R		0.07896	ug/L	0.1951	247.1	-4.202
Ti3349_A		0.05080	ug/L	0.02423	47.69	-35.20
Tl1908_A		-0.1353	ug/L	0.04269	31.55	-2.458
V_2924_A		0.05051	ug/L	0.1438	284.8	-4.772
Zn2062_A		0.5424	ug/L	0.05724	10.55	3.599
Y_3600_R		9,999.9	Cts/S	55.898	0.55898	9,999.9
Y_2243_A		7,314.4	Cts/S	14.413	0.19706	7,314.4
Y_3600_A		179,900	Cts/S	593.05	0.32965	179,900

SQ1201-001

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:47:55PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.01281	ug/L	0.1543	1,204	-1.900
Al3961_R		63.57	ug/L	1.829	2.877	45.49
As1891_A		-0.8098	ug/L	0.8859	109.4	-3.297
B_2089_A		8.072	ug/L	0.1991	2.467	13.06
Ba4554_R		12.87	ug/L	0.3064	2.380	371.3
Be3130_R		0.1416	ug/L	0.007925	5.598	1.682
Ca3158_R		1,290	ug/L	4.227	0.3276	761.0
Cd2265_A		0.01724	ug/L	0.002135	12.39	2.187
Co2286_A		0.3015	ug/L	0.2451	81.30	-1.276
Cr2677_A		0.7024	ug/L	0.1427	20.32	10.35
Cu3273_A		0.8832	ug/L	0.3858	43.68	-48.82
Fe2599_R		1,561	ug/L	2.899	0.1857	1,943
K_7664_R		535.6	ug/L	38.47	7.183	234.6
Li6707_R		-1.062	ug/L	2.649	249.4	2.377
Mg2795		756.3	ug/L	5.402	0.7142	33,430
Mg2025_A		758.0	ug/L	11.33	1.494	278.1
Mn2576_R		14.50	ug/L	0.4538	3.130	86.29
Mo2020_A		0.2928	ug/L	0.1136	38.80	0.8285
Na5895_R		2,847	ug/L	29.86	1.049	2,433
Ni2316_A		0.3142	ug/L	0.1686	53.66	1.937
Pb2203_A		4.468	ug/L	0.2542	5.689	4.512
Sb2068_A		-0.6681	ug/L	0.3671	54.94	2.395
Se1960_A		-0.5168	ug/L	0.5806	112.3	1.654
Si2516_R		1,752	ug/L	3.462	0.1977	697.6
Sn1899_A		-0.7221	ug/L	0.1746	24.17	1.759
Sr4215_R		7.908	ug/L	0.01359	0.1719	268.3
Ti3349_A		0.6979	ug/L	0.03670	5.259	-19.21
Tl1908_A		-0.1562	ug/L	0.1177	75.34	-2.467
V_2924_A		0.1758	ug/L	0.04869	27.69	-2.563
Zn2062_A		2.734	ug/L	0.03919	1.433	12.32
Y_3600_R		10,095	Cts/S	58.106	0.57561	10,095
Y_2243_A		7,269.4	Cts/S	44.910	0.61779	7,269.4
Y_3600_A		181,290	Cts/S	2,108.9	1.1633	181,290

SQ1201-002

Method Name: FAST-2022_POP
Method Revision: 171

SQ1201-002

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:52:18PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.1392	ug/L	0.2349	168.7	-5.262
Al3961_R		81.25	ug/L	7.153	8.804	57.18
As1891_A		1.436	ug/L	0.9298	64.73	-2.562
B_2089_A		7.631	ug/L	0.2559	3.354	12.45
Ba4554_R		14.07	ug/L	0.06622	0.4708	396.3
Be3130_R		0.1341	ug/L	0.03993	29.78	1.211
Ca3158_R		1,282	ug/L	3.193	0.2490	743.3
Cd2265_A		-0.007595	ug/L	0.05415	712.9	1.837
Co2286_A		0.06229	ug/L	0.1440	231.1	-2.280
Cr2677_A		0.4234	ug/L	0.06744	15.93	5.922
Cu3273_A		0.2648	ug/L	0.08411	31.76	-58.93
Fe2599_R		1,611	ug/L	1.118	0.06940	1,972
K_7664_R		457.0	ug/L	23.74	5.195	204.7
Li6707_R		1.454	ug/L	1.684	115.8	20.50
Mg2795		762.3	ug/L	3.179	0.4170	33,110
Mg2025_A		757.0	ug/L	3.437	0.4540	275.8
Mn2576_R		13.82	ug/L	0.4978	3.603	80.84
Mo2020_A		0.1511	ug/L	0.03173	21.00	0.3562
Na5895_R		2,842	ug/L	30.43	1.071	2,387
Ni2316_A		-0.03721	ug/L	0.1092	293.4	1.270
Pb2203_A		4.321	ug/L	0.6052	14.00	4.285
Sb2068_A		-0.4641	ug/L	0.2580	55.59	2.495
Se1960_A		-0.2482	ug/L	0.06016	24.24	1.707
Si2516_R		1,775	ug/L	11.79	0.6643	694.6
Sn1899_A		-0.2257	ug/L	0.06694	29.66	2.029
Sr4215_R		7.997	ug/L	0.1579	1.974	266.8
Ti3349_A		0.7774	ug/L	0.08149	10.48	-16.93
Tl1908_A		-0.8023	ug/L	0.1009	12.58	-2.801
V_2924_A		0.09871	ug/L	0.1324	134.1	-3.800
Zn2062_A		2.695	ug/L	0.009937	0.3687	12.08
Y_3600_R		9,921.5	Cts/S	67.263	0.67795	9,921.5
Y_2243_A		7,219.6	Cts/S	15.169	0.21011	7,219.6
Y_3600_A		178,230	Cts/S	950.01	0.53303	178,230

SQ1201-002A

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:56:41PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		504.9	ug/L	3.156	0.6249	13,470
Al3961_R		608.0	ug/L	1.503	0.2473	446.0
As1891_A		515.1	ug/L	0.3091	0.06000	157.8
B_2089_A		523.0	ug/L	1.499	0.2866	624.2
Ba4554_R		535.0	ug/L	3.874	0.7242	14,090
Be3130_R		526.7	ug/L	1.950	0.3702	30,230
Ca3158_R		7,175	ug/L	52.04	0.7253	4,314
Cd2265_A		536.3	ug/L	0.8968	0.1672	9,256
Co2286_A		528.3	ug/L	2.066	0.3909	2,210
Cr2677_A		517.4	ug/L	4.576	0.8844	7,838
Cu3273_A		525.4	ug/L	3.049	0.5804	9,239
Fe2599_R		7,430	ug/L	59.37	0.7991	9,098
K_7664_R		11,200	ug/L	112.3	1.003	3,742
Li6707_R		550.0	ug/L	2.396	0.4357	4,007
Mg2795		6,921	ug/L	47.25	0.6827	300,800
Mg2025_A		6,810	ug/L	25.79	0.3787	2,536
Mn2576_R		519.2	ug/L	3.975	0.7656	3,021
Mo2020_A		542.3	ug/L	0.5438	0.1003	1,750

SQ1201-002A

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 5:56:41PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		8,704	ug/L	87.36	1.004	7,277
Ni2316_A		542.7	ug/L	0.4768	0.08787	992.5
Pb2203_A		549.6	ug/L	1.803	0.3281	717.0
Sb2068_A		531.6	ug/L	0.1707	0.03211	308.4
Se1960_A		522.7	ug/L	3.025	0.5787	124.0
Si2516_R		2,052	ug/L	30.53	1.488	799.3
Sn1899_A		0.4105	ug/L	0.4453	108.5	2.348
Sr4215_R		555.3	ug/L	3.810	0.6861	19,020
Ti3349_A		519.3	ug/L	3.654	0.7036	12,690
Tl1908_A		555.8	ug/L	0.4298	0.07734	293.9
V_2924_A		532.1	ug/L	4.591	0.8629	8,993
Zn2062_A		533.6	ug/L	1.791	0.3356	2,076
Y_3600_R		9,935.0	Cts/S	49.580	0.49904	9,935.0
Y_2243_A		7,091.9	Cts/S	15.073	0.21254	7,091.9
Y_3600_A		176,860	Cts/S	1,399.5	0.79133	176,860

SQ1201-002L

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:00:50PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.4889	ug/L	0.3003	61.43	1.137
Al3961_R		75.18	ug/L	26.09	34.70	10.12
As1891_A		13.60	ug/L	1.072	7.879	-2.111
B_2089_A		7.976	ug/L	1.734	21.74	5.549
Ba4554_R		15.09	ug/L	0.7908	5.239	105.1
Be3130_R		0.8961	ug/L	0.3746	41.80	3.802
Ca3158_R		1,392	ug/L	0.8512	0.06117	134.4
Cd2265_A		0.1397	ug/L	0.04723	33.81	-0.03466
Co2286_A		-0.09870	ug/L	1.070	1,084	-2.679
Cr2677_A		1.741	ug/L	0.002957	0.1699	4.880
Cu3273_A		-0.08915	ug/L	2.802	3,143	-65.27
Fe2599_R		1,700	ug/L	13.31	0.7828	413.2
K_7664_R		206.1	ug/L	97.09	47.12	67.26
Li6707_R		-0.3805	ug/L	10.07	2,646	9.357
Mg2795		822.2	ug/L	2.948	0.3585	7,082
Mg2025_A		766.3	ug/L	2.711	0.3538	49.35
Mn2576_R		17.33	ug/L	0.5484	3.165	20.40
Mo2020_A		2.379	ug/L	0.02895	1.217	1.436
Na5895_R		3,004	ug/L	34.12	1.136	515.2
Ni2316_A		-0.5684	ug/L	0.1932	33.98	1.175
Pb2203_A		5.788	ug/L	0.7155	12.36	-0.01626
Sb2068_A		-1.317	ug/L	0.2481	18.84	2.619
Se1960_A		-0.8891	ug/L	6.221	699.7	1.730
Si2516_R		1,845	ug/L	31.24	1.693	157.6
Sn1899_A		3.101	ug/L	1.050	33.88	2.530
Sr4215_R		9.645	ug/L	0.06554	0.6796	58.51
Ti3349_A		0.002891	ug/L	1.389	48,050	-36.01
Tl1908_A		2.162	ug/L	2.551	118.0	-2.140
V_2924_A		-0.7506	ug/L	0.3659	48.75	-8.180
Zn2062_A		4.221	ug/L	0.002538	0.06013	4.787
Y_3600_R		9,813.7	Cts/S	31.197	0.31790	9,813.7
Y_2243_A		7,280.7	Cts/S	16.660	0.22882	7,280.7
Y_3600_A		177,760	Cts/S	214.40	0.12061	177,760

SQ1201-002P

Method Name: FAST-2022_POP
Method Revision: 171

SQ1201-002P

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:05:12PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		52.01	ug/L	1.432	2.754	1,353
Al3961_R		2,315	ug/L	23.52	1.016	1,618
As1891_A		101.9	ug/L	0.4111	0.4033	29.00
B_2089_A		514.7	ug/L	0.3186	0.06190	594.2
Ba4554_R	W	2,148	ug/L	10.95	0.5097	55,690
Be3130_R		53.06	ug/L	0.1447	0.2727	2,990
Ca3158_R		3,934	ug/L	38.93	0.9895	2,317
Cd2265_A		258.4	ug/L	1.021	0.3951	4,471
Co2286_A		530.7	ug/L	0.5387	0.1015	2,226
Cr2677_A		213.8	ug/L	2.796	1.308	3,168
Cu3273_A		271.6	ug/L	5.390	1.985	4,636
Fe2599_R		2,868	ug/L	21.50	0.7498	3,463
K_7664_R		11,070	ug/L	24.66	0.2227	3,648
Li6707_R		542.6	ug/L	0.2644	0.04872	3,897
Mg2795		6,371	ug/L	10.76	0.1689	273,100
Mg2025_A		6,117	ug/L	0.9481	0.01550	2,284
Mn2576_R		535.5	ug/L	7.999	1.494	3,072
Mo2020_A		104.9	ug/L	0.09177	0.08745	339.2
Na5895_R		10,960	ug/L	131.9	1.203	9,031
Ni2316_A		536.3	ug/L	1.110	0.2069	983.7
Pb2203_A		109.7	ug/L	0.2035	0.1856	142.2
Sb2068_A		102.5	ug/L	0.1385	0.1351	59.42
Se1960_A		101.8	ug/L	0.5409	0.5316	25.70
Si2516_R		2,956	ug/L	5.644	0.1909	1,128
Sn1899_A		545.0	ug/L	1.558	0.2859	306.6
Sr4215_R		553.1	ug/L	1.765	0.3190	18,680
Ti3349_A		524.1	ug/L	10.85	2.070	12,520
Tl1908_A		104.0	ug/L	0.1959	0.1884	53.40
V_2924_A		537.2	ug/L	10.57	1.967	8,951
Zn2062_A		527.3	ug/L	2.318	0.4397	2,058
Y_3600_R		9,794.6	Cts/S	143.56	1.4657	9,794.6
Y_2243_A		7,111.8	Cts/S	14.107	0.19836	7,111.8
Y_3600_A		173,000	Cts/S	3,326.0	1.9226	173,000

CCV

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:09:25PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		511.9	ug/L	8.001	1.563	13,350
Al3961_R		12,870	ug/L	61.49	0.4779	8,906
As1891_A		500.4	ug/L	2.344	0.4685	154.2
B_2089_A		505.8	ug/L	1.928	0.3811	607.9
Ba4554_R		515.0	ug/L	0.8439	0.1639	13,240
Be3130_R		515.6	ug/L	1.677	0.3253	28,880
Ca3158_R		12,940	ug/L	101.4	0.7834	7,622
Cd2265_A		509.0	ug/L	0.9719	0.1909	8,868
Co2286_A		511.2	ug/L	2.004	0.3921	2,156
Cr2677_A		515.5	ug/L	8.577	1.664	7,631
Cu3273_A		513.9	ug/L	8.519	1.658	8,830
Fe2599_R		12,900	ug/L	39.62	0.3071	15,420
K_7664_R		12,780	ug/L	48.45	0.3791	4,159
Li6707_R		517.1	ug/L	0.2705	0.05230	3,679
Mg2795		12,930	ug/L	46.70	0.3613	548,500
Mg2025_A		12,670	ug/L	59.48	0.4696	4,735
Mn2576_R		518.0	ug/L	3.923	0.7573	2,943
Mo2020_A		507.9	ug/L	1.898	0.3736	1,652

CCV

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:09:25PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		12,850	ug/L	18.20	0.1416	10,480
Ni2316_A		513.1	ug/L	1.025	0.1998	946.0
Pb2203_A		514.3	ug/L	1.029	0.2001	675.2
Sb2068_A		506.0	ug/L	0.8395	0.1659	293.9
Se1960_A		495.7	ug/L	1.526	0.3078	118.8
Si2516_R		12,910	ug/L	15.22	0.1179	4,822
Sn1899_A		503.7	ug/L	2.029	0.4028	285.1
Sr4215_R		512.4	ug/L	0.1004	0.01959	17,130
Ti3349_A		510.6	ug/L	7.166	1.403	12,200
Tl1908_A		504.3	ug/L	4.124	0.8177	268.6
V_2924_A		514.0	ug/L	5.348	1.040	8,491
Zn2062_A		508.8	ug/L	1.508	0.2964	1,996
Y_3600_R		9,698.8	Cts/S	76.199	0.78565	9,698.8
Y_2243_A		7,150.0	Cts/S	16.001	0.22378	7,150.0
Y_3600_A		172,820	Cts/S	1,892.6	1.0952	172,820

CCB

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:13:40PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.004546	ug/L	0.05618	1,236	-1.575
Al3961_R		-4.977	ug/L	2.501	50.26	-3.917
As1891_A		1.535	ug/L	0.3838	25.00	-2.462
B_2089_A		0.6034	ug/L	0.3110	51.53	4.377
Ba4554_R		-0.1412	ug/L	0.1443	102.2	23.08
Be3130_R		0.09281	ug/L	0.02932	31.59	-1.108
Ca3158_R		1.916	ug/L	8.989	469.2	-31.12
Cd2265_A		0.03315	ug/L	0.03011	90.83	-0.6079
Co2286_A		0.1574	ug/L	0.08501	54.00	-1.912
Cr2677_A		0.1007	ug/L	0.1134	112.7	1.164
Cu3273_A		0.1971	ug/L	0.08553	43.40	-61.51
Fe2599_R		2.733	ug/L	2.030	74.27	5.231
K_7664_R		-65.34	ug/L	64.24	98.32	32.71
Li6707_R		-0.3446	ug/L	0.8590	249.3	7.434
Mg2795		1.803	ug/L	0.3769	20.90	98.88
Mg2025_A		3.965	ug/L	1.513	38.16	-7.182
Mn2576_R		0.2373	ug/L	0.03935	16.58	1.840
Mo2020_A		0.5825	ug/L	0.1485	25.50	1.779
Na5895_R		-23.53	ug/L	1.009	4.290	1.028
Ni2316_A		0.1503	ug/L	0.2570	171.0	1.671
Pb2203_A		0.5866	ug/L	0.2040	34.78	-0.8026
Sb2068_A		-0.5427	ug/L	0.2006	36.97	2.439
Se1960_A		1.360	ug/L	1.695	124.7	2.084
Si2516_R		7.489	ug/L	5.054	67.49	21.60
Sn1899_A		0.2877	ug/L	0.2134	74.17	2.328
Sr4215_R		0.1919	ug/L	0.1815	94.62	-0.2864
Ti3349_A		0.2232	ug/L	0.1020	45.71	-30.34
Tl1908_A		1.134	ug/L	0.7412	65.34	-1.744
V_2924_A		0.1879	ug/L	0.01127	5.998	-2.367
Zn2062_A		0.3562	ug/L	0.1309	36.74	2.824
Y_3600_R		9,847.7	Cts/S	2.5572	0.025967	9,847.7
Y_2243_A		7,242.5	Cts/S	20.351	0.28099	7,242.5
Y_3600_A		176,900	Cts/S	5,514.8	3.1175	176,900

SQ1201-002S

Method Name: FAST-2022_POP
Method Revision: 171

SQ1201-002S

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:18:04PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		51.64	ug/L	0.3019	0.5846	1,354
Al3961_R		2,337	ug/L	20.65	0.8834	1,633
As1891_A		102.3	ug/L	0.6456	0.6310	29.33
B_2089_A		512.6	ug/L	1.604	0.3129	596.3
Ba4554_R	W	2,113	ug/L	12.03	0.5693	54,760
Be3130_R		54.49	ug/L	0.09240	0.1696	3,068
Ca3158_R		4,085	ug/L	14.32	0.3506	2,406
Cd2265_A		258.7	ug/L	0.9455	0.3655	4,509
Co2286_A		527.7	ug/L	1.619	0.3068	2,230
Cr2677_A		210.5	ug/L	0.03602	0.01711	3,142
Cu3273_A		266.9	ug/L	0.3492	0.1308	4,588
Fe2599_R		2,950	ug/L	11.32	0.3838	3,560
K_7664_R		11,010	ug/L	78.98	0.7171	3,626
Li6707_R		562.7	ug/L	1.576	0.2802	4,038
Mg2795		6,472	ug/L	16.80	0.2596	277,200
Mg2025_A		6,096	ug/L	36.72	0.6024	2,294
Mn2576_R		537.2	ug/L	0.2009	0.03741	3,079
Mo2020_A		104.4	ug/L	0.6837	0.6549	340.0
Na5895_R		10,850	ug/L	59.33	0.5467	8,935
Ni2316_A		538.6	ug/L	2.051	0.3808	995.4
Pb2203_A		110.3	ug/L	0.8773	0.7956	144.1
Sb2068_A		103.5	ug/L	1.614	1.559	60.44
Se1960_A		100.5	ug/L	1.016	1.011	25.59
Si2516_R		3,035	ug/L	24.48	0.8064	1,157
Sn1899_A		545.6	ug/L	3.644	0.6679	309.3
Sr4215_R		546.7	ug/L	2.989	0.5468	18,440
Ti3349_A		528.0	ug/L	1.407	0.2666	12,710
Tl1908_A		103.3	ug/L	1.073	1.039	53.42
V_2924_A		537.2	ug/L	0.7114	0.1324	9,017
Zn2062_A		528.4	ug/L	2.604	0.4928	2,079
Y_3600_R		9,786.9	Cts/S	24.561	0.25095	9,786.9
Y_2243_A		7,166.4	Cts/S	13.875	0.19361	7,166.4
Y_3600_A		174,240	Cts/S	500.59	0.28730	174,240

SQ1201-003

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:22:18PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1676	ug/L	0.01950	11.64	3.037
Al3961_R		24.51	ug/L	14.50	59.16	16.84
As1891_A		1.047	ug/L	0.8785	83.91	-2.726
B_2089_A		7.690	ug/L	0.2008	2.612	12.64
Ba4554_R		12.74	ug/L	0.1088	0.8541	355.8
Be3130_R		-0.002620	ug/L	0.001891	72.19	-6.480
Ca3158_R		1,560	ug/L	15.13	0.9700	896.6
Cd2265_A		-0.01643	ug/L	0.04757	289.6	2.354
Co2286_A		0.01599	ug/L	0.2974	1,860	-2.501
Cr2677_A		0.2296	ug/L	0.1666	72.59	2.936
Cu3273_A		0.1957	ug/L	0.1606	82.07	-60.36
Fe2599_R		1,944	ug/L	12.53	0.6448	2,341
K_7664_R		523.1	ug/L	24.30	4.645	222.8
Li6707_R		0.9171	ug/L	2.179	237.5	16.32
Mg2795		869.9	ug/L	9.022	1.037	37,180
Mg2025_A		850.8	ug/L	3.936	0.4627	313.9
Mn2576_R		16.11	ug/L	0.1042	0.6468	92.69
Mo2020_A		0.1424	ug/L	0.09603	67.44	0.3307

SQ1201-003

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:22:18PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		3,012	ug/L	12.47	0.4141	2,489
Ni2316_A		0.1649	ug/L	0.1678	101.8	1.651
Pb2203_A		5.747	ug/L	0.2429	4.228	6.273
Sb2068_A		-0.7027	ug/L	0.5729	81.53	2.377
Se1960_A		0.7745	ug/L	1.125	145.3	1.970
Si2516_R		1,271	ug/L	23.88	1.879	494.7
Sn1899_A		0.1077	ug/L	0.7968	739.6	2.238
Sr4215_R		8.970	ug/L	0.3637	4.054	295.3
Ti3349_A		0.04067	ug/L	0.2863	704.0	-35.43
Tl1908_A		0.3844	ug/L	0.7816	203.3	-2.179
V_2924_A		0.004479	ug/L	0.1005	2,243	-5.478
Zn2062_A		2.376	ug/L	0.04006	1.686	10.92
Y_3600_R		9,764.2	Cts/S	70.412	0.72113	9,764.2
Y_2243_A		7,285.3	Cts/S	6.2037	0.085154	7,285.3
Y_3600_A		180,120	Cts/S	3,223.9	1.7899	180,120

SQ1201-004

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:26:42PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.09116	ug/L	0.3334	365.8	0.8374
Al3961_R		795.2	ug/L	67.66	8.509	554.8
As1891_A		0.1887	ug/L	3.256	1,726	-3.090
B_2089_A		5.982	ug/L	0.2010	3.360	10.64
Ba4554_R		13.17	ug/L	0.4060	3.082	368.4
Be3130_R		0.07119	ug/L	0.006291	8.837	-2.646
Ca3158_R		769.0	ug/L	3.034	0.3946	427.5
Cd2265_A		0.01875	ug/L	0.06616	352.8	6.504
Co2286_A		0.2988	ug/L	0.2280	76.30	-1.171
Cr2677_A		1.667	ug/L	0.1352	8.106	24.81
Cu3273_A		7.345	ug/L	2.452	33.39	69.52
Fe2599_R		3,740	ug/L	35.55	0.9506	4,519
K_7664_R		47.68	ug/L	43.21	90.62	69.24
Li6707_R		-0.3562	ug/L	1.601	449.4	7.346
Mg2795		273.9	ug/L	1.910	0.6975	11,770
Mg2025_A		294.0	ug/L	7.704	2.620	102.9
Mn2576_R		29.22	ug/L	1.148	3.928	168.4
Mo2020_A		-0.04462	ug/L	0.01227	27.49	-0.2913
Na5895_R		1,558	ug/L	28.03	1.798	1,302
Ni2316_A		15.64	ug/L	2.736	17.49	30.64
Pb2203_A		6.287	ug/L	0.2235	3.555	7.045
Sb2068_A		-0.1500	ug/L	0.6419	428.0	2.717
Se1960_A		1.366	ug/L	0.04936	3.612	2.127
Si2516_R		3,162	ug/L	9.824	0.3107	1,208
Sn1899_A		1.711	ug/L	0.01444	0.8436	3.157
Sr4215_R		3.444	ug/L	0.1999	5.805	109.6
Ti3349_A		8.646	ug/L	0.08011	0.9265	178.1
Tl1908_A		0.5487	ug/L	0.3875	70.63	-2.104
V_2924_A		2.842	ug/L	0.2410	8.478	43.86
Zn2062_A		232.6	ug/L	36.17	15.55	931.5
Y_3600_R		9,802.6	Cts/S	52.245	0.53297	9,802.6
Y_2243_A		7,285.7	Cts/S	11.561	0.15868	7,285.7
Y_3600_A		179,060	Cts/S	2,596.1	1.4498	179,060

SQ1201-005

Method Name: FAST-2022_POP
Method Revision: 171

SQ1201-005

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:31:04PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.1998	ug/L	0.07721	38.63	-6.974
Al3961_R		55.47	ug/L	10.37	18.69	38.11
As1891_A		1.510	ug/L	0.4784	31.69	-2.702
B_2089_A		5.524	ug/L	0.4242	7.679	10.15
Ba4554_R		9.940	ug/L	0.03652	0.3674	283.2
Be3130_R		-0.003816	ug/L	0.05599	1,467	-6.534
Ca3158_R		218.9	ug/L	2.075	0.9478	98.23
Cd2265_A		-0.04762	ug/L	0.02115	44.42	6.579
Co2286_A		-0.01518	ug/L	0.1437	946.7	-2.600
Cr2677_A		0.5616	ug/L	0.06209	11.06	7.949
Cu3273_A		0.09836	ug/L	0.08340	84.79	-59.43
Fe2599_R		4,343	ug/L	3.820	0.08795	5,223
K_7664_R		55.58	ug/L	39.41	70.89	71.58
Li6707_R		-1.482	ug/L	0.4462	30.11	-0.7359
Mg2795		205.4	ug/L	0.7845	0.3819	8,791
Mg2025_A		193.6	ug/L	1.891	0.9769	64.98
Mn2576_R		100.9	ug/L	0.6080	0.6025	577.2
Mo2020_A		0.05455	ug/L	0.1720	315.3	0.03335
Na5895_R		1,521	ug/L	0.9071	0.05962	1,266
Ni2316_A		0.1992	ug/L	0.007234	3.632	1.651
Pb2203_A		-0.2095	ug/L	0.5882	280.8	-1.540
Sb2068_A		0.01000	ug/L	0.2937	2,937	2.826
Se1960_A		1.915	ug/L	0.1529	7.987	2.280
Si2516_R		2,683	ug/L	7.376	0.2749	1,023
Sn1899_A		0.2718	ug/L	0.1184	43.57	2.342
Sr4215_R		2.902	ug/L	0.1425	4.909	90.88
Ti3349_A		0.7197	ug/L	0.01233	1.713	-18.59
Tl1908_A		-0.5187	ug/L	0.7279	140.3	-2.752
V_2924_A		0.7164	ug/L	0.2675	37.34	6.680
Zn2062_A		0.9060	ug/L	0.05749	6.346	5.056
Y_3600_R		9,756.3	Cts/S	110.40	1.1316	9,756.3
Y_2243_A		7,314.2	Cts/S	3.9512	0.054021	7,314.2
Y_3600_A		180,490	Cts/S	445.78	0.24699	180,490

SQ1201-006

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:35:27PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1851	ug/L	0.02095	11.32	3.512
Al3961_R		187.9	ug/L	3.228	1.718	132.0
As1891_A		0.9258	ug/L	0.5512	59.53	-2.732
B_2089_A		5.156	ug/L	0.03833	0.7433	9.782
Ba4554_R		7.741	ug/L	0.1515	1.957	229.5
Be3130_R		0.07379	ug/L	0.05087	68.93	-2.290
Ca3158_R		272.3	ug/L	3.413	1.254	131.8
Cd2265_A		-0.02382	ug/L	0.01575	66.13	-0.3377
Co2286_A		0.1710	ug/L	0.003713	2.172	-1.858
Cr2677_A		0.3630	ug/L	0.05288	14.57	5.149
Cu3273_A		0.4730	ug/L	0.3349	70.81	-56.99
Fe2599_R		651.6	ug/L	1.896	0.2910	796.4
K_7664_R		50.29	ug/L	2.998	5.962	70.77
Li6707_R		-0.2108	ug/L	0.2993	142.0	8.424
Mg2795		239.0	ug/L	0.1448	0.06057	10,370
Mg2025_A		235.8	ug/L	1.053	0.4465	81.53
Mn2576_R		14.80	ug/L	0.7626	5.154	86.21
Mo2020_A		0.09548	ug/L	0.1129	118.3	0.1766

SQ1201-006

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:35:27PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		1,236	ug/L	4.452	0.3601	1,047
Ni2316_A		0.1410	ug/L	0.02066	14.64	1.662
Pb2203_A		0.9958	ug/L	0.7476	75.08	-0.2338
Sb2068_A		-0.6936	ug/L	1.630	235.0	2.398
Se1960_A		0.4563	ug/L	1.230	269.6	1.907
Si2516_R		2,131	ug/L	8.028	0.3767	827.8
Sn1899_A		0.1757	ug/L	0.2413	137.4	2.301
Sr4215_R		2.642	ug/L	0.1613	6.104	83.35
Ti3349_A		1.976	ug/L	0.1755	8.879	12.80
Tl1908_A		0.05598	ug/L	0.1497	267.4	-2.381
V_2924_A		0.5657	ug/L	0.2409	42.59	4.191
Zn2062_A		2.065	ug/L	0.04230	2.049	9.772
Y_3600_R		9,893.9	Cts/S	107.54	1.0869	9,893.9
Y_2243_A		7,361.8	Cts/S	5.7762	0.078462	7,361.8
Y_3600_A		180,050	Cts/S	1,141.8	0.63417	180,050

SQ1201-007

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:39:50PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1401	ug/L	0.3523	251.4	2.312
Al3961_R		196.6	ug/L	13.43	6.833	138.3
As1891_A		-0.3269	ug/L	1.047	320.2	-3.156
B_2089_A		5.420	ug/L	0.2207	4.071	10.14
Ba4554_R		9.238	ug/L	0.1767	1.913	269.1
Be3130_R		0.009828	ug/L	0.04645	472.6	-5.927
Ca3158_R		319.2	ug/L	4.180	1.310	160.3
Cd2265_A		-0.04540	ug/L	0.02195	48.35	-0.5029
Co2286_A		0.05309	ug/L	0.06411	120.7	-2.379
Cr2677_A		0.6989	ug/L	0.1168	16.71	10.42
Cu3273_A		0.6886	ug/L	0.5435	78.93	-53.49
Fe2599_R		763.1	ug/L	2.925	0.3833	933.5
K_7664_R		104.5	ug/L	8.675	8.303	88.64
Li6707_R		0.4062	ug/L	2.629	647.3	12.87
Mg2795		258.5	ug/L	2.904	1.124	11,220
Mg2025_A		257.9	ug/L	0.2374	0.09206	90.37
Mn2576_R		11.48	ug/L	0.2734	2.381	67.13
Mo2020_A		0.1632	ug/L	0.1982	121.5	0.4058
Na5895_R		1,190	ug/L	2.451	0.2060	1,010
Ni2316_A		0.2747	ug/L	0.01429	5.203	1.920
Pb2203_A		0.4709	ug/L	0.4982	105.8	-0.9420
Sb2068_A		-0.8865	ug/L	1.514	170.8	2.298
Se1960_A		0.2003	ug/L	2.111	1,054	1.852
Si2516_R		1,530	ug/L	1.833	0.1198	600.5
Sn1899_A		-0.3932	ug/L	0.3424	87.08	1.980
Sr4215_R		2.803	ug/L	0.2306	8.229	88.93
Ti3349_A		1.764	ug/L	0.01882	1.067	7.562
Tl1908_A		0.2941	ug/L	0.8761	297.9	-2.257
V_2924_A		0.7629	ug/L	0.05495	7.202	7.708
Zn2062_A		2.096	ug/L	0.03557	1.698	9.935
Y_3600_R		9,905.9	Cts/S	46.763	0.47208	9,905.9
Y_2243_A		7,392.2	Cts/S	10.364	0.14020	7,392.2
Y_3600_A		181,860	Cts/S	109.30	0.060098	181,860

SQ1201-008

Method Name: FAST-2022_POP
Method Revision: 171

SQ1201-008

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:44:14PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.007018	ug/L	0.06338	903.1	-1.737
Al3961_R		300.5	ug/L	13.68	4.552	213.8
As1891_A		0.8125	ug/L	0.6308	77.64	-2.746
B_2089_A		5.985	ug/L	0.01936	0.3234	10.75
Ba4554_R		10.39	ug/L	0.2597	2.500	302.4
Be3130_R		0.08240	ug/L	0.03997	48.51	-1.696
Ca3158_R		219.5	ug/L	2.188	0.9970	101.1
Cd2265_A		-0.01879	ug/L	0.01600	85.17	-1.207
Co2286_A		0.1755	ug/L	0.1008	57.45	-1.859
Cr2677_A		0.5580	ug/L	0.07560	13.55	8.286
Cu3273_A		1.611	ug/L	0.2892	17.96	-37.55
Fe2599_R		172.5	ug/L	0.5519	0.3199	214.8
K_7664_R		-33.74	ug/L	24.05	71.27	43.68
Li6707_R		0.8654	ug/L	1.239	143.1	16.48
Mg2795		225.9	ug/L	0.7660	0.3391	9,915
Mg2025_A		224.2	ug/L	0.06254	0.02790	77.08
Mn2576_R		12.58	ug/L	0.2489	1.979	74.22
Mo2020_A		-0.001474	ug/L	0.02423	1,644	-0.1480
Na5895_R		1,678	ug/L	8.327	0.4962	1,431
Ni2316_A		0.1628	ug/L	0.1061	65.16	1.718
Pb2203_A		1.314	ug/L	0.8733	66.45	0.1434
Sb2068_A		0.3133	ug/L	0.3659	116.8	2.994
Se1960_A		0.2604	ug/L	0.4800	184.4	1.857
Si2516_R		3,542	ug/L	3.549	0.1002	1,379
Sn1899_A		0.3078	ug/L	0.8495	276.0	2.378
Sr4215_R		2.888	ug/L	0.03340	1.157	92.79
Ti3349_A		0.4851	ug/L	0.03918	8.076	-24.66
Tl1908_A		0.5229	ug/L	0.2982	57.03	-2.119
V_2924_A		1.073	ug/L	0.2664	24.84	13.04
Zn2062_A		2.359	ug/L	0.04574	1.939	10.96
Y_3600_R		10,010	Cts/S	135.17	1.3503	10,010
Y_2243_A		7,361.8	Cts/S	6.4139	0.087124	7,361.8
Y_3600_A		182,060	Cts/S	4,637.9	2.5474	182,060

LC2WQC16ICW2

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:48:39PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		49.59	ug/L	0.9226	1.861	1,330
Al3961_R		2,115	ug/L	13.66	0.6460	1,482
As1891_A		98.71	ug/L	1.332	1.349	28.55
B_2089_A		491.5	ug/L	1.775	0.3611	577.5
Ba4554_R		2,082	ug/L	0.6083	0.02921	54,140
Be3130_R		52.46	ug/L	0.05398	0.1029	2,964
Ca3158_R		2,590	ug/L	14.79	0.5711	1,519
Cd2265_A		255.6	ug/L	0.3634	0.1422	4,495
Co2286_A		510.6	ug/L	1.942	0.3803	2,179
Cr2677_A		202.8	ug/L	2.965	1.462	3,096
Cu3273_A		258.0	ug/L	1.095	0.4246	4,533
Fe2599_R		1,057	ug/L	7.344	0.6945	1,281
K_7664_R		10,440	ug/L	12.53	0.1200	3,451
Li6707_R		536.3	ug/L	2.001	0.3731	3,862
Mg2795		5,590	ug/L	7.481	0.1338	240,200
Mg2025_A		5,346	ug/L	16.11	0.3014	2,032
Mn2576_R		504.1	ug/L	3.038	0.6028	2,899
Mo2020_A		101.8	ug/L	0.4631	0.4549	334.8

LC2WQC16ICW2

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:48:39PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		8,025	ug/L	3.941	0.04911	6,634
Ni2316_A		527.5	ug/L	0.7065	0.1339	984.4
Pb2203_A		105.3	ug/L	0.01502	0.01426	138.7
Sb2068_A		101.8	ug/L	0.1574	0.1547	60.02
Se1960_A		97.62	ug/L	0.9589	0.9823	25.14
Si2516_R		1,047	ug/L	6.572	0.6275	411.8
Sn1899_A		539.5	ug/L	2.143	0.3973	308.9
Sr4215_R		534.7	ug/L	0.7038	0.1316	18,100
Ti3349_A		500.0	ug/L	4.563	0.9126	12,310
Tl1908_A		102.9	ug/L	0.7523	0.7314	53.73
V_2924_A		519.3	ug/L	3.280	0.6316	8,915
Zn2062_A		518.3	ug/L	1.222	0.2358	2,058
Y_3600_R		9,819.9	Cts/S	95.973	0.97733	9,819.9
Y_2243_A		7,235.3	Cts/S	23.856	0.32972	7,235.3
Y_3600_A		178,240	Cts/S	2,151.6	1.2071	178,240

LCSWQC16ICW2

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:52:51PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		49.88	ug/L	0.5354	1.073	1,328
Al3961_R		2,109	ug/L	1.485	0.07039	1,490
As1891_A		100.0	ug/L	0.1712	0.1712	28.83
B_2089_A		497.7	ug/L	1.205	0.2420	581.8
Ba4554_R		2,085	ug/L	10.42	0.4996	54,640
Be3130_R		52.55	ug/L	0.5498	1.046	2,992
Ca3158_R		2,579	ug/L	43.83	1.699	1,524
Cd2265_A		259.5	ug/L	0.7286	0.2808	4,541
Co2286_A		518.1	ug/L	1.411	0.2724	2,200
Cr2677_A		206.2	ug/L	1.038	0.5031	3,127
Cu3273_A		264.0	ug/L	1.555	0.5892	4,606
Fe2599_R		1,060	ug/L	10.04	0.9475	1,295
K_7664_R		10,410	ug/L	32.46	0.3118	3,468
Li6707_R		538.3	ug/L	0.07505	0.01394	3,907
Mg2795		5,621	ug/L	9.029	0.1606	243,400
Mg2025_A		5,410	ug/L	16.51	0.3052	2,047
Mn2576_R		503.6	ug/L	1.335	0.2652	2,919
Mo2020_A		102.9	ug/L	0.1048	0.1019	336.8
Na5895_R		8,050	ug/L	45.85	0.5695	6,707
Ni2316_A		533.9	ug/L	1.796	0.3364	991.4
Pb2203_A		106.9	ug/L	1.086	1.016	140.2
Sb2068_A		104.5	ug/L	0.009154	0.008762	61.26
Se1960_A		99.39	ug/L	0.4653	0.4682	25.43
Si2516_R		1,056	ug/L	2.521	0.2388	418.2
Sn1899_A		547.8	ug/L	2.471	0.4511	312.0
Sr4215_R		534.8	ug/L	3.090	0.5779	18,240
Ti3349_A		505.8	ug/L	4.166	0.8237	12,360
Tl1908_A		103.9	ug/L	0.6697	0.6444	54.05
V_2924_A		525.3	ug/L	2.395	0.4559	8,955
Zn2062_A		524.3	ug/L	1.902	0.3627	2,072
Y_3600_R		9,896.7	Cts/S	48.573	0.49080	9,896.7
Y_2243_A		7,199.5	Cts/S	24.344	0.33813	7,199.5
Y_3600_A		176,990	Cts/S	1,011.1	0.57131	176,990

PBWQC16ICW2

Method Name: FAST-2022_POP
Method Revision: 171

PBWQC16ICW2

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 6:57:07PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.01921	ug/L	0.1973	1,027	-2.050
Al3961_R		-5.942	ug/L	6.449	108.5	-4.645
As1891_A		0.4442	ug/L	0.2880	64.83	-2.842
B_2089_A		0.5828	ug/L	0.4452	76.39	4.373
Ba4554_R		0.1237	ug/L	0.0006130	0.4957	30.29
Be3130_R		0.03110	ug/L	0.04164	133.9	-4.646
Ca3158_R		-7.190	ug/L	0.04001	0.5565	-36.96
Cd2265_A		-0.07395	ug/L	0.02257	30.52	-2.521
Co2286_A		-0.1558	ug/L	0.06380	40.94	-3.288
Cr2677_A		0.2332	ug/L	0.3163	135.6	3.217
Cu3273_A		0.4687	ug/L	0.07854	16.76	-58.17
Fe2599_R		2.565	ug/L	2.954	115.1	5.067
K_7664_R		-67.87	ug/L	19.07	28.10	32.23
Li6707_R		0.1802	ug/L	1.094	607.2	11.30
Mg2795		6.453	ug/L	0.3616	5.603	302.3
Mg2025_A		6.530	ug/L	0.3409	5.221	-6.306
Mn2576_R		0.3462	ug/L	0.06245	18.04	2.492
Mo2020_A		0.004281	ug/L	0.07131	1,666	-0.1271
Na5895_R		-16.05	ug/L	4.095	25.52	7.273
Ni2316_A		-0.003695	ug/L	0.08142	2,203	1.400
Pb2203_A		-0.4273	ug/L	0.4473	104.7	-2.181
Sb2068_A		0.06511	ug/L	0.3824	587.3	2.829
Se1960_A		-0.5936	ug/L	1.702	286.7	1.637
Si2516_R		-2.810	ug/L	8.990	319.9	17.88
Sn1899_A		0.1119	ug/L	0.3215	287.1	2.253
Sr4215_R		0.1797	ug/L	0.006944	3.865	-0.7060
Ti3349_A		-0.06590	ug/L	0.1533	232.6	-38.44
Tl1908_A		0.1192	ug/L	1.511	1,267	-2.321
V_2924_A		0.1466	ug/L	0.09660	65.88	-3.099
Zn2062_A		0.4453	ug/L	0.06835	15.35	3.213
Y_3600_R		9,946.8	Cts/S	59.369	0.59686	9,946.8
Y_2243_A		7,324.8	Cts/S	11.114	0.15174	7,324.8
Y_3600_A		181,420	Cts/S	722.69	0.39835	181,420

CCV

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 7:01:31PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		490.3	ug/L	1.878	0.3830	13,080
Al3961_R		12,170	ug/L	11.55	0.09488	8,537
As1891_A		495.2	ug/L	0.1976	0.03990	154.1
B_2089_A		489.6	ug/L	1.471	0.3005	594.4
Ba4554_R		503.5	ug/L	2.189	0.4347	13,120
Be3130_R		500.3	ug/L	4.361	0.8718	28,400
Ca3158_R		12,140	ug/L	153.2	1.262	7,241
Cd2265_A		507.8	ug/L	2.702	0.5322	8,930
Co2286_A		492.7	ug/L	0.1038	0.02108	2,097
Cr2677_A		498.1	ug/L	0.5098	0.1023	7,546
Cu3273_A		500.9	ug/L	0.9958	0.1988	8,807
Fe2599_R		12,250	ug/L	78.12	0.6379	14,830
K_7664_R		12,480	ug/L	15.92	0.1275	4,119
Li6707_R		496.3	ug/L	3.808	0.7673	3,578
Mg2795		12,920	ug/L	19.76	0.1529	555,600
Mg2025_A		12,400	ug/L	34.52	0.2784	4,679
Mn2576_R		489.3	ug/L	0.7551	0.1543	2,817
Mo2020_A		495.3	ug/L	1.062	0.2144	1,627

CCV

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 7:01:31PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		12,500	ug/L	63.98	0.5117	10,330
Ni2316_A		509.3	ug/L	2.393	0.4698	948.2
Pb2203_A		510.3	ug/L	1.019	0.1998	676.4
Sb2068_A		503.1	ug/L	1.568	0.3116	294.9
Se1960_A		492.1	ug/L	5.179	1.052	119.1
Si2516_R		12,660	ug/L	109.7	0.8667	4,791
Sn1899_A		503.3	ug/L	1.854	0.3684	287.6
Sr4215_R		500.0	ug/L	0.1638	0.03276	16,940
Ti3349_A		487.4	ug/L	1.632	0.3348	11,910
Tl1908_A		490.9	ug/L	0.8009	0.1632	264.0
V_2924_A		501.5	ug/L	0.1909	0.03806	8,479
Zn2062_A		508.7	ug/L	3.356	0.6597	2,015
Y_3600_R		9,827.3	Cts/S	26.592	0.27060	9,827.3
Y_2243_A		7,218.7	Cts/S	23.094	0.31991	7,218.7
Y_3600_A		176,860	Cts/S	912.11	0.51573	176,860

CCB

Method Name: FAST-2022_POP
Method Revision: 171
Analyst Name: BCF
Acquire Date: 3/20/2023 7:05:44PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.3833	ug/L	0.3289	85.79	8.937
Al3961_R		-3.167	ug/L	0.5897	18.62	-2.657
As1891_A		0.7052	ug/L	0.4099	58.13	-2.759
B_2089_A		0.06254	ug/L	0.1786	285.6	3.785
Ba4554_R		-0.1903	ug/L	0.007286	3.829	21.86
Be3130_R		0.1656	ug/L	0.01430	8.639	3.046
Ca3158_R		6.410	ug/L	2.312	36.07	-28.50
Cd2265_A		-0.01493	ug/L	0.04611	308.8	-1.473
Co2286_A		0.1825	ug/L	0.005166	2.831	-1.827
Cr2677_A		0.05290	ug/L	0.1566	296.0	0.4204
Cu3273_A		0.1218	ug/L	0.6059	497.4	-64.13
Fe2599_R		1.094	ug/L	1.597	145.9	3.259
K_7664_R		-65.54	ug/L	43.04	65.66	32.79
Li6707_R		-0.1398	ug/L	0.6292	450.2	8.949
Mg2795		2.070	ug/L	0.02497	1.206	110.7
Mg2025_A		2.882	ug/L	1.877	65.13	-7.679
Mn2576_R		0.04246	ug/L	0.1151	271.1	0.7157
Mo2020_A		0.3920	ug/L	0.3209	81.87	1.165
Na5895_R		-31.60	ug/L	1.395	4.416	-5.662
Ni2316_A		-0.3418	ug/L	0.4912	143.7	0.7627
Pb2203_A		0.7792	ug/L	0.3259	41.82	-0.5529
Sb2068_A		0.9695	ug/L	0.4763	49.13	3.363
Se1960_A		0.5608	ug/L	2.058	367.0	1.916
Si2516_R		3.730	ug/L	0.7849	21.04	20.24
Sn1899_A		0.01099	ug/L	0.09927	903.6	2.196
Sr4215_R		0.1461	ug/L	0.02258	15.46	-1.842
Ti3349_A		0.07445	ug/L	0.05658	76.00	-34.71
Tl1908_A		0.2336	ug/L	0.4090	175.1	-2.259
V_2924_A		0.07091	ug/L	0.06264	88.33	-4.434
Zn2062_A		0.3823	ug/L	0.07283	19.05	2.961
Y_3600_R		9,872.7	Cts/S	80.220	0.81254	9,872.7
Y_2243_A		7,327.3	Cts/S	3.7946	0.051787	7,327.3
Y_3600_A		180,460	Cts/S	89.425	0.049554	180,460

SQ1044-001

Method Name: FAST-2022_POP
Method Revision: 171

KATAHDIN ANALYTICAL SERVICES, LLC
METALS ANALYSIS RUN INFORMATION SHEET

INSTR. ID: I (Thermo iCAP 6500) **ANALYST**: BCF **ANALYSIS DATE**: 03/21/2023

METHOD: ICP
- ☑ 200.7
- ☑ 6010
- ☑ DOD
- ☐ _____

FILE NAME: IQC21A

Reviewed By: 3/22/23

The pHs of all samples that were tested by direct analysis in this analytical run were checked just prior to analysis and confirmed to be <2. The time of preservation of these samples was checked in the "Measured Turbidity and Preservation of Incoming Samples" logbook to verify that they had been preserved at least 16 hours prior to analysis. These verifications were performed by _____ (initials) on _____ (date).

STANDARDS USED:

Standard Name	Standard ID	Prep Date	Expiration Date	Standard Conc.
Cal. Blk/ICB/CCB	MW21420	03/03/2023	06/03/2023	0 ug/L
Standard 1	MW21417	03/02/2023	06/02/2023	Varies by Element
ICV	MW21424	03/08/2023	03/31/2023	Varies by Element
PQL	MW21396 409	3/ 02/24/2023	5/3 05/24/2023	Varies by Element
LRS1	MW21390	02/20/2023	05/20/2023	Varies by Element
LRS2	MW21434	03/20/2023	05/31/2023	Varies by Element
ICSA	MW21384	02/16/2023	05/16/2023	Varies by Element
ICSAB	MW21317	01/11/2023	04/11/2023	Varies by Element
CCV	MW21433	03/17/2023	06/17/2023	Varies by Element
Internal Standard	MW21375	02/09/2023	05/09/2023	5.0 mg/L Yttrium

3/30/23

Additional Comments and Notes:

3x diln.: 3.0 mL of sample (pipet M30) + 6.0 mL of MW21420 (pipet M31)

2x diln.: 4.0 mL of sample (pipet M30) + 4.0 mL of MW21420 (pipet M31)

10x diln.: 0.8 mL of sample (pipet M19) + 7.2 mL of MW21420 (pipet M31)

5x diln.: 1.6 mL of sample (pipet M30) + 6.4 mL of MW21420 (pipet M31)

25x diln.: 0.4mL of (pipet M19) + 9.6 mL of MW21420 (pipet M31)

Post Spike: 4ul MS2399 (pipet M17), 80ul MS2411 (pipet M27), 40ul MS2444 (pipet M27), 40ul MS2401 (pipet M27) to 8.0mL of sample (pipet M31)

INSTRUMENT RUNLOG

Instrument: ICAP 6500

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
Blank	1.000	IQC21A	03/21/2023	16:26	BCF
Std 1	1.000	IQC21A	03/21/2023	16:30	BCF
ICV	1.000	IQC21A	03/21/2023	16:35	BCF
ICB	1.000	IQC21A	03/21/2023	16:39	BCF
PQL	1.000	IQC21A	03/21/2023	16:43	BCF
ICSA	1.000	IQC21A	03/21/2023	16:48	BCF
ICSAB	1.000	IQC21A	03/21/2023	16:52	BCF
CCV	1.000	IQC21A	03/21/2023	16:56	BCF
CCB	1.000	IQC21A	03/21/2023	17:01	BCF
LRS1	1.000	IQC21A	03/21/2023	17:05	BCF
LRS2	1.000	IQC21A	03/21/2023	17:10	BCF
CCV	1.000	IQC21A	03/21/2023	17:14	BCF
CCB	1.000	IQC21A	03/21/2023	17:19	BCF
SQ1201-001	1.000	IQC21A	03/21/2023	17:23	BCF
SQ1201-003	1.000	IQC21A	03/21/2023	17:27	BCF
LC2WQC17ICW1	1.000	IQC21A	03/21/2023	17:32	BCF
LCSWQC17ICW1	1.000	IQC21A	03/21/2023	17:36	BCF
PBWQC17ICW1	1.000	IQC21A	03/21/2023	17:40	BCF
SQ1218-001	1.000	IQC21A	03/21/2023	17:44	BCF
SQ1242-001	2.000	IQC21A	03/21/2023	17:49	BCF
SQ1266-004	5.000	IQC21A	03/21/2023	17:53	BCF
SQ1281-001	1.000	IQC21A	03/21/2023	17:58	BCF
LCSOQC16ICS2	1.000	IQC21A	03/21/2023	18:02	BCF
CCV	1.000	IQC21A	03/21/2023	18:06	BCF
CCB	1.000	IQC21A	03/21/2023	18:10	BCF
PBSQC16ICS2	1.000	IQC21A	03/21/2023	18:15	BCF
SQ0851-001	5.000	IQC21A	03/21/2023	18:19	BCF
SQ0851-002	5.000	IQC21A	03/21/2023	18:24	BCF
SQ0851-004	5.000	IQC21A	03/21/2023	18:28	BCF
SQ0851-005	5.000	IQC21A	03/21/2023	18:33	BCF
SQ0851-006	5.000	IQC21A	03/21/2023	18:37	BCF
SQ0851-007	5.000	IQC21A	03/21/2023	18:42	BCF
SQ0851-008	5.000	IQC21A	03/21/2023	18:46	BCF
SQ0851-009	5.000	IQC21A	03/21/2023	18:51	BCF
SQ0851-010	5.000	IQC21A	03/21/2023	18:55	BCF
CCV	1.000	IQC21A	03/21/2023	18:59	BCF
CCB	1.000	IQC21A	03/21/2023	19:04	BCF
CCV	1.000	IQC21A	03/21/2023	19:08	BCF
CCB	1.000	IQC21A	03/21/2023	19:12	BCF

Intensity Report

Author:

Published: 3/22/2023 10:53:48AM

Notes:

Blank

Method Name: FAST-2022_POP Method Revision: 173

Analyst Name: BCF

Acquire Date: 3/21/2023 4:26:22PM Sample Type: Standard

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		-0.00006300	Cts/S	0.00002200	35.55	-9.649
Al3961_R		-0.0007770	Cts/S	0.0008170	105.1	-6.344
As1891_A		-0.0004450	Cts/S	0.00004000	9.041	-3.275
B_2089_A		0.0004450	Cts/S	0.00002400	5.481	3.275
Ba4554_R		0.001319	Cts/S	0.0007980	60.51	10.74
Be3130_R		-0.0007010	Cts/S	0.0007080	100.9	-5.708
Ca3158_R		-0.003951	Cts/S	0.0003280	8.304	-32.20
Cd2265_A		-0.0001250	Cts/S	0.00002400	19.17	-0.9178
Co2286_A		-0.0003930	Cts/S	0.00007700	19.57	-2.894
Cr2677_A		0.00001600	Cts/S	0.000007000	40.82	2.452
Cu3273_A		-0.0003620	Cts/S	0.00003500	9.628	-55.38
Fe2599_R		0.001127	Cts/S	0.0007270	64.51	9.192
K_7664_R		0.0005870	Cts/S	0.002089	355.8	4.811
Li6707_R		0.001594	Cts/S	0.0001050	6.610	12.99
Mg2795		0.002620	Cts/S	0.0001170	4.454	21.36
Mg2025_A		-0.001180	Cts/S	0.00005500	4.702	-8.688
Mn2576_R		0.0002260	Cts/S	0.0008810	388.9	1.835
Mo2020_A		-0.00001700	Cts/S	0.00002700	161.6	-0.1249
Na5895_R		0.005181	Cts/S	0.0009680	18.68	42.24
Ni2316_A		0.0002650	Cts/S	0.00006000	22.52	1.950
Pb2203_A		-0.0001540	Cts/S	0.00004800	31.29	-1.131
Sb2068_A		0.0002440	Cts/S	0.00007000	28.53	1.796
Se1960_A		0.0002240	Cts/S	0.00002400	10.56	1.647
Si2516_R		0.001844	Cts/S	0.00009700	5.244	15.03
Sn1899_A		0.0002820	Cts/S	0.000008000	2.864	2.078
Sr4215_R		-0.0007140	Cts/S	0.0007550	105.7	-5.813
Ti3349_A		-0.0002430	Cts/S	0.00003000	12.20	-37.16
Tl1908_A		-0.0003230	Cts/S	0.00009100	28.23	-2.377
V_2924_A		-0.00005500	Cts/S	0.000008000	14.86	-8.403
Zn2062_A		0.0002920	Cts/S	0.00004100	14.08	2.152
Y_3600_R		8,151.7	Cts/S	24.580	0.30153	8,151.7
Y_2243_A		7,361.1	Cts/S	20.940	0.28447	7,361.1
Y_3600_A		152,880	Cts/S	1,208.5	0.79053	152,880

Std 1

Method Name: FAST-2022_POP Method Revision: 173

Analyst Name: BCF

Acquire Date: 3/21/2023 4:30:45PM Sample Type: Standard

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1737	Cts/S	0.0009450	0.5440	25,680
Al3961_R		2.093	Cts/S	0.0004340	0.02076	17,040
As1891_A		0.04179	Cts/S	0.0001870	0.4472	300.1
B_2089_A		0.1619	Cts/S	0.0008880	0.5485	1,163
Ba4554_R		3.118	Cts/S	0.03433	1.101	25,390
Be3130_R		6.634	Cts/S	0.04537	0.6839	54,020
Ca3158_R		1.753	Cts/S	0.004769	0.2720	14,270
Cd2265_A		2.321	Cts/S	0.01568	0.6756	16,670
Co2286_A		0.5745	Cts/S	0.003453	0.6011	4,126
Cr2677_A		0.09914	Cts/S	0.0003870	0.3899	14,660
Cu3273_A		0.1130	Cts/S	0.0006440	0.5696	16,710
Fe2599_R		2.541	Cts/S	0.01046	0.4117	20,690
K_7664_R		0.9715	Cts/S	0.006218	0.6400	7,910

Std 1

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 4:30:45PM
Sample Type: Standard

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Li6707_R		0.8348	Cts/S	0.002102	0.2518	6,796
Mg2795		128.2	Cts/S	0.4472	0.3487	1,044,000
Mg2025_A		1.282	Cts/S	0.005613	0.4379	9,205
Mn2576_R		0.6998	Cts/S	0.001742	0.2489	5,698
Mo2020_A		0.4415	Cts/S	0.002167	0.4909	3,171
Na5895_R		2.515	Cts/S	0.02595	1.032	20,480
Ni2316_A		0.2449	Cts/S	0.001544	0.6307	1,759
Pb2203_A		0.1759	Cts/S	0.001063	0.6044	1,263
Sb2068_A		0.07645	Cts/S	0.0002470	0.3234	549.1
Se1960_A		0.03192	Cts/S	0.00002300	0.07228	229.3
Si2516_R		1.122	Cts/S	0.008118	0.7236	9,134
Sn1899_A		0.07501	Cts/S	0.0003740	0.4980	538.7
Sr4215_R		4.038	Cts/S	0.02911	0.7209	32,880
Ti3349_A		0.1562	Cts/S	0.001368	0.8759	23,090
Tl1908_A		0.07515	Cts/S	0.0005100	0.6786	539.8
V_2924_A		0.1074	Cts/S	0.0009390	0.8739	15,880
Zn2062_A		0.5252	Cts/S	0.003620	0.6892	3,772
Y_3600_R		8,141.8	Cts/S	54.529	0.66974	8,141.8
Y_2243_A		7,182.1	Cts/S	11.016	0.15339	7,182.1
Y_3600_A		147,880	Cts/S	1,221.1	0.82573	147,880

ICV

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 4:35:00PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		397.5	ug/L	3.602	0.9061	10,210
Al3961_R		10,400	ug/L	37.35	0.3592	7,156
As1891_A		379.8	ug/L	2.650	0.6978	114.2
B_2089_A		387.8	ug/L	1.253	0.3231	462.4
Ba4554_R		388.4	ug/L	0.5960	0.1534	9,967
Be3130_R		402.5	ug/L	2.986	0.7418	21,960
Ca3158_R	W	10,590	ug/L	69.08	0.6523	6,090
Cd2265_A		392.6	ug/L	0.2651	0.06753	6,673
Co2286_A		393.5	ug/L	0.1714	0.04355	1,654
Cr2677_A		395.4	ug/L	4.826	1.220	5,799
Cu3273_A		398.6	ug/L	4.753	1.193	6,627
Fe2599_R		10,210	ug/L	49.12	0.4813	8,539
K_7664_R		13,710	ug/L	68.32	0.4984	4,383
Li6707_R	W	421.7	ug/L	2.329	0.5523	2,903
Mg2795		10,370	ug/L	42.91	0.4139	437,400
Mg2025_A		10,440	ug/L	39.68	0.3802	3,912
Mn2576_R		393.4	ug/L	1.559	0.3962	2,266
Mo2020_A		399.5	ug/L	0.5896	0.1476	1,291
Na5895_R		10,180	ug/L	105.8	1.039	8,452
Ni2316_A		396.9	ug/L	0.4304	0.1084	712.9
Pb2203_A		397.1	ug/L	0.008628	0.002173	510.7
Sb2068_A		390.4	ug/L	1.449	0.3713	219.5
Se1960_A		389.1	ug/L	1.499	0.3852	91.97
Si2516_R		10,290	ug/L	64.99	0.6313	3,734
Sn1899_A	W	426.1	ug/L	0.3814	0.08952	235.2
Sr4215_R		408.6	ug/L	0.9634	0.2358	13,570
Ti3349_A		395.6	ug/L	2.031	0.5134	9,115
Tl1908_A		406.7	ug/L	3.364	0.8271	222.4
V_2924_A		399.1	ug/L	2.852	0.7146	6,334
Zn2062_A		391.4	ug/L	1.230	0.3142	1,507
Y_3600_R		8,225.4	Cts/S	84.909	1.0323	8,225.4

ICV

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 4:35:00PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Y_2243_A		7,323.0	Cts/S	24.218	0.33072	7,323.0
Y_3600_A		147,890	Cts/S	990.56	0.66980	147,890

ICB

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 4:39:18PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.3597	ug/L	0.1070	29.75	-0.1125
Al3961_R		14.04	ug/L	1.295	9.222	3.206
As1891_A		0.6054	ug/L	0.9344	154.3	-3.081
B_2089_A		0.5622	ug/L	0.2911	51.78	3.944
Ba4554_R		0.4887	ug/L	0.3854	78.86	22.84
Be3130_R		0.1138	ug/L	0.01730	15.21	0.4349
Ca3158_R		2.201	ug/L	1.546	70.22	-30.56
Cd2265_A		0.03058	ug/L	0.003330	10.89	-0.4079
Co2286_A		0.2759	ug/L	0.03809	13.81	-1.727
Cr2677_A		-0.1504	ug/L	0.2801	186.3	0.1591
Cu3273_A		0.04148	ug/L	0.003530	8.511	-54.08
Fe2599_R		-6.168	ug/L	0.4446	7.207	4.025
K_7664_R		-48.15	ug/L	46.15	95.85	-10.37
Li6707_R		-1.674	ug/L	0.1106	6.608	1.604
Mg2795		1.976	ug/L	0.4871	24.64	102.6
Mg2025_A		0.7104	ug/L	1.092	153.8	-8.388
Mn2576_R		-0.2129	ug/L	0.04645	21.82	0.6246
Mo2020_A		0.7013	ug/L	0.1939	27.65	2.151
Na5895_R		-8.514	ug/L	13.59	159.6	34.86
Ni2316_A		-0.1411	ug/L	0.1590	112.7	1.694
Pb2203_A		-0.1812	ug/L	0.4881	269.3	-1.367
Sb2068_A		-0.3749	ug/L	1.127	300.7	1.579
Se1960_A		1.330	ug/L	2.315	174.0	1.953
Si2516_R		26.60	ug/L	7.995	30.06	24.26
Sn1899_A		0.2674	ug/L	1.095	409.4	2.221
Sr4215_R		-0.1266	ug/L	0.004698	3.711	-9.865
Ti3349_A		0.09495	ug/L	0.1884	198.5	-34.52
Tl1908_A		0.2764	ug/L	0.8991	325.2	-2.220
V_2924_A		0.08210	ug/L	0.03423	41.69	-7.032
Zn2062_A		0.1857	ug/L	0.06456	34.76	2.866
Y_3600_R		8,049.4	Cts/S	54.861	0.68156	8,049.4
Y_2243_A		7,348.5	Cts/S	1.8305	0.024910	7,348.5
Y_3600_A		151,160	Cts/S	616.96	0.40816	151,160

PQL

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 4:43:41PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		9.981	ug/L	0.08322	0.8337	253.1
Al3961_R		315.1	ug/L	10.55	3.348	206.5
As1891_A		8.044	ug/L	0.9039	11.24	-0.7609
B_2089_A		46.07	ug/L	0.08868	0.1925	56.38
Ba4554_R		5.127	ug/L	0.1142	2.228	139.5
Be3130_R		5.014	ug/L	0.1339	2.670	262.5
Ca3158_R		102.1	ug/L	15.27	14.96	26.08
Cd2265_A		4.788	ug/L	0.01529	0.3193	81.12
Co2286_A		9.986	ug/L	0.1150	1.152	39.54
Cr2677_A		10.14	ug/L	0.3013	2.972	154.7

PQL

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 4:43:41PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Cu3273_A		24.75	ug/L	0.2129	0.8602	369.7
Fe2599_R		93.20	ug/L	5.454	5.851	85.46
K_7664_R		915.6	ug/L	24.50	2.676	291.7
Li6707_R		105.6	ug/L	1.128	1.067	723.0
Mg2795		106.5	ug/L	0.9346	0.8774	4,429
Mg2025_A		109.6	ug/L	0.2880	0.2627	33.16
Mn2576_R		5.386	ug/L	0.6549	12.16	32.26
Mo2020_A		9.662	ug/L	0.01784	0.1846	31.39
Na5895_R		1,010	ug/L	3.933	0.3893	860.2
Ni2316_A		9.614	ug/L	0.3461	3.600	19.33
Pb2203_A		5.022	ug/L	0.6121	12.19	5.374
Sb2068_A		7.739	ug/L	0.5750	7.430	5.744
Se1960_A	W	12.07	ug/L	0.2336	1.934	4.478
Si2516_R		208.4	ug/L	3.886	1.865	88.69
Sn1899_A		96.36	ug/L	0.4031	0.4183	55.28
Sr4215_R		9.986	ug/L	0.2227	2.230	319.6
Ti3349_A		14.55	ug/L	0.2590	1.780	307.9
Tl1908_A		16.08	ug/L	1.366	8.494	6.578
V_2924_A		9.553	ug/L	0.1309	1.370	147.3
Zn2062_A		19.35	ug/L	0.1123	0.5803	77.24
Y_3600_R		8,069.0	Cts/S	123.81	1.5344	8,069.0
Y_2243_A		7,386.8	Cts/S	3.1916	0.043206	7,386.8
Y_3600_A		151,510	Cts/S	2,844.5	1.8774	151,510

ICSA

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 4:48:03PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.5498	ug/L	0.02792	5.079	3.373
Al3961_R		547,800	ug/L	3,041	0.5551	352,900
As1891_A		3.751	ug/L	2.528	67.39	-12.59
B_2089_A		1.512	ug/L	0.6875	45.48	4.298
Ba4554_R		2.540	ug/L	0.2314	9.112	71.12
Be3130_R		-0.08353	ug/L	0.1100	131.6	-9.785
Ca3158_R		516,800	ug/L	10,680	2.068	279,800
Cd2265_A		-0.09781	ug/L	0.007601	7.771	351.4
Co2286_A		-0.5720	ug/L	0.4043	70.68	-1.832
Cr2677_A		4.764	ug/L	0.08871	1.862	46.77
Cu3273_A		-1.083	ug/L	0.2642	24.41	-29.28
Fe2599_R		205,900	ug/L	536.3	0.2605	161,200
K_7664_R		388.6	ug/L	19.89	5.117	120.8
Li6707_R		10.45	ug/L	1.182	11.32	79.39
Mg2795	^F	0.0000	ug/L	0.0000	0.0000	1,692,000
Mg2025_A		429,600	ug/L	188.0	0.04378	143,000
Mn2576_R		-2.203	ug/L	0.05109	2.319	5.111
Mo2020_A		-2.934	ug/L	0.2276	7.757	-8.570
Na5895_R		196.1	ug/L	7.864	4.009	191.6
Ni2316_A		-1.521	ug/L	0.2795	18.37	-5.901
Pb2203_A		-0.2410	ug/L	1.545	640.9	-50.81
Sb2068_A		0.8480	ug/L	0.1944	22.93	10.27
Se1960_A		0.9101	ug/L	0.6514	71.58	5.052
Si2516_R		-10.26	ug/L	0.005656	0.05513	7.916
Sn1899_A		6.891	ug/L	1.113	16.15	5.206
Sr4215_R		4.809	ug/L	0.03782	0.7863	144.2
Ti3349_A		2.683	ug/L	0.3951	14.72	23.70
Tl1908_A		-1.298	ug/L	0.1566	12.06	0.4034

ICSA

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 4:48:03PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
V_2924_A		-0.5370	ug/L	0.1454	27.08	2.554
Zn2062_A		1.574	ug/L	0.05973	3.795	7.292
Y_3600_R		7,705.4	Cts/S	67.980	0.88225	7,705.4
Y_2243_A		6,529.8	Cts/S	4.6709	0.071532	6,529.8
Y_3600_A		134,830	Cts/S	644.89	0.47829	134,830

ICSAB

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 4:52:28PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		215.6	ug/L	0.2020	0.09366	5,010
Al3961_R		543,500	ug/L	6,515	1.199	353,800
As1891_A		100.2	ug/L	5.943	5.929	14.45
B_2089_A		463.6	ug/L	0.1511	0.03259	492.0
Ba4554_R		512.7	ug/L	1.403	0.2736	12,450
Be3130_R		513.0	ug/L	0.8779	0.1711	26,510
Ca3158_R		523,800	ug/L	6,806	1.299	286,700
Cd2265_A		939.4	ug/L	2.270	0.2416	14,560
Co2286_A		464.4	ug/L	1.555	0.3348	1,745
Cr2677_A		485.6	ug/L	0.02577	0.005306	6,435
Cu3273_A		525.7	ug/L	1.238	0.2356	7,961
Fe2599_R		203,500	ug/L	47.07	0.02313	161,100
K_7664_R		21,110	ug/L	0.01765	0.00008400	6,388
Li6707_R		552.9	ug/L	1.264	0.2285	3,600
Mg2795	^F	0.0000	ug/L	0.0000	0.0000	1,650,000
Mg2025_A		428,000	ug/L	1,999	0.4670	142,700
Mn2576_R		487.4	ug/L	3.028	0.6211	2,672
Mo2020_A		457.8	ug/L	3.104	0.6780	1,321
Na5895_R		20,960	ug/L	90.59	0.4321	16,430
Ni2316_A		926.8	ug/L	1.897	0.2047	1,479
Pb2203_A		42.15	ug/L	0.8507	2.018	-1.775
Sb2068_A		601.5	ug/L	0.3562	0.05921	309.2
Se1960_A		45.31	ug/L	0.08089	0.1785	14.28
Si2516_R		1,963	ug/L	24.80	1.263	682.2
Sn1899_A		464.2	ug/L	3.975	0.8564	228.6
Sr4215_R		511.0	ug/L	1.843	0.3607	16,070
Ti3349_A		471.4	ug/L	0.4619	0.09797	9,847
Tl1908_A		84.07	ug/L	2.005	2.385	42.58
V_2924_A		497.9	ug/L	0.1836	0.03688	7,181
Zn2062_A		934.1	ug/L	0.01940	0.002077	3,208
Y_3600_R		7,788.1	Cts/S	93.910	1.2058	7,788.1
Y_2243_A		6,536.1	Cts/S	11.549	0.17670	6,536.1
Y_3600_A		133,990	Cts/S	159.34	0.11892	133,990

CCV

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 4:56:48PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		501.8	ug/L	1.637	0.3262	13,330
Al3961_R		12,830	ug/L	72.51	0.5650	8,885
As1891_A		507.2	ug/L	0.4872	0.09605	153.2
B_2089_A		507.4	ug/L	1.416	0.2790	602.2
Ba4554_R		503.7	ug/L	2.511	0.4985	13,000
Be3130_R		512.7	ug/L	0.8782	0.1713	28,150
Ca3158_R		12,940	ug/L	62.59	0.4836	7,494

CCV

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 4:56:48PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Cd2265_A		511.5	ug/L	0.9932	0.1942	8,673
Co2286_A		513.9	ug/L	1.634	0.3179	2,156
Cr2677_A		502.7	ug/L	2.732	0.5435	7,624
Cu3273_A		506.9	ug/L	1.673	0.3299	8,732
Fe2599_R		12,610	ug/L	50.31	0.3989	10,610
K_7664_R		12,640	ug/L	84.82	0.6713	4,066
Li6707_R		514.9	ug/L	1.231	0.2390	3,564
Mg2795		12,780	ug/L	229.6	1.796	542,400
Mg2025_A		12,830	ug/L	40.12	0.3126	4,802
Mn2576_R		511.1	ug/L	3.802	0.7438	2,961
Mo2020_A		512.5	ug/L	0.4800	0.09366	1,653
Na5895_R		12,600	ug/L	43.30	0.3436	10,510
Ni2316_A		515.7	ug/L	0.6540	0.1268	923.4
Pb2203_A		516.1	ug/L	0.6931	0.1343	662.7
Sb2068_A		509.2	ug/L	0.4988	0.09795	285.3
Se1960_A		506.3	ug/L	0.3869	0.07641	118.9
Si2516_R		12,750	ug/L	58.77	0.4610	4,649
Sn1899_A		509.8	ug/L	1.206	0.2365	280.4
Sr4215_R		501.8	ug/L	2.488	0.4957	16,770
Ti3349_A		499.0	ug/L	2.941	0.5895	11,900
Tl1908_A		523.0	ug/L	1.428	0.2730	286.1
V_2924_A		502.6	ug/L	2.511	0.4995	8,251
Zn2062_A		509.9	ug/L	0.9200	0.1804	1,958
Y_3600_R		8,275.6	Cts/S	90.311	1.0913	8,275.6
Y_2243_A		7,305.9	Cts/S	16.397	0.22443	7,305.9
Y_3600_A		152,950	Cts/S	275.61	0.18020	152,950

CCB

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:01:01PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.5938	ug/L	0.1538	25.90	6.149
Al3961_R		5.177	ug/L	15.46	298.6	-2.738
As1891_A		2.061	ug/L	1.123	54.47	-2.639
B_2089_A		0.5389	ug/L	0.09788	18.16	3.937
Ba4554_R		0.4382	ug/L	0.3841	87.64	22.06
Be3130_R		0.1241	ug/L	0.02053	16.54	1.007
Ca3158_R		24.30	ug/L	2.617	10.77	-18.47
Cd2265_A		0.04908	ug/L	0.006572	13.39	-0.08010
Co2286_A		0.2678	ug/L	0.01432	5.349	-1.766
Cr2677_A		-0.01217	ug/L	0.02805	230.4	2.270
Cu3273_A		0.2488	ug/L	0.1865	74.97	-51.18
Fe2599_R		1.052	ug/L	1.145	108.8	10.17
K_7664_R		-31.89	ug/L	28.54	89.49	-5.432
Li6707_R		-0.2318	ug/L	0.8317	358.8	11.58
Mg2795		18.31	ug/L	2.174	11.88	794.9
Mg2025_A		11.26	ug/L	4.118	36.56	-4.445
Mn2576_R		-0.4541	ug/L	1.064	234.3	-0.7097
Mo2020_A		0.8119	ug/L	0.1321	16.27	2.520
Na5895_R		-4.596	ug/L	6.258	136.2	38.86
Ni2316_A		0.01793	ug/L	0.1806	1,008	1.987
Pb2203_A		-0.2016	ug/L	0.6391	317.0	-1.394
Sb2068_A		0.1765	ug/L	0.2016	114.2	1.894
Se1960_A		1.534	ug/L	0.2451	15.98	2.007
Si2516_R		12.90	ug/L	6.681	51.78	19.88
Sn1899_A		0.6334	ug/L	0.5790	91.42	2.432

CCB

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:01:01PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Sr4215_R		0.07751	ug/L	0.2079	268.2	-3.259
Ti3349_A		0.1931	ug/L	0.01527	7.909	-32.62
Tl1908_A		1.384	ug/L	0.1697	12.27	-1.613
V_2924_A		-0.002198	ug/L	0.03476	1,582	-8.542
Zn2062_A		0.07003	ug/L	0.07422	106.0	2.428
Y_3600_R		8,241.1	Cts/S	112.29	1.3625	8,241.1
Y_2243_A		7,374.6	Cts/S	40.026	0.54276	7,374.6
Y_3600_A		153,190	Cts/S	1,922.1	1.2547	153,190

LRS1

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:05:24PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		2,000	ug/L	29.21	1.460	51,260
Al3961_R		5.873	ug/L	7.517	128.0	129.5
As1891_A		20,100	ug/L	14.80	0.07363	5,953
B_2089_A		20,410	ug/L	77.49	0.3797	22,290
Ba4554_R		20,040	ug/L	382.3	1.908	503,200
Be3130_R		20,330	ug/L	81.16	0.3993	1,087,000
Ca3158_R		15.02	ug/L	1.415	9.422	-16.64
Cd2265_A		19,280	ug/L	65.87	0.3417	311,900
Co2286_A		20,050	ug/L	140.4	0.7005	80,540
Cr2677_A		19,570	ug/L	38.60	0.1972	286,800
Cu3273_A		19,810	ug/L	165.3	0.8344	331,400
Fe2599_R		2.036	ug/L	1.265	62.11	10.27
K_7664_R		-124.1	ug/L	4.498	3.626	-34.10
Li6707_R		21,170	ug/L	333.1	1.573	142,200
Mg2795		8.605	ug/L	4.734	55.01	377.5
Mg2025_A		984.3	ug/L	42.47	4.315	1,380
Mn2576_R		19,630	ug/L	101.3	0.5161	110,600
Mo2020_A		5,053	ug/L	22.92	0.4537	15,590
Na5895_R		-19.23	ug/L	25.00	130.0	26.25
Ni2316_A		20,130	ug/L	25.72	0.1278	34,420
Pb2203_A		20,940	ug/L	62.66	0.2992	25,820
Sb2068_A		20,550	ug/L	22.71	0.1105	10,950
Se1960_A		20,190	ug/L	35.70	0.1768	4,471
Si2516_R		379.6	ug/L	12.63	3.327	91.79
Sn1899_A		20,730	ug/L	21.43	0.1034	10,830
Sr4215_R		20,990	ug/L	10.43	0.04968	683,400
Ti3349_A		19,560	ug/L	228.5	1.168	451,900
Tl1908_A		19,200	ug/L	147.8	0.7696	10,120
V_2924_A		19,560	ug/L	105.7	0.5403	312,200
Zn2062_A		19,740	ug/L	91.22	0.4620	72,440
Y_3600_R		8,059.3	Cts/S	51.305	0.63659	8,059.3
Y_2243_A		6,989.0	Cts/S	24.798	0.35481	6,989.0
Y_3600_A		147,820	Cts/S	1,832.1	1.2395	147,820

LRS2

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:10:22PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.5148	ug/L	0.02022	3.928	2.311
Al3961_R		521,200	ug/L	927.0	0.1779	342,100
As1891_A		6.243	ug/L	1.240	19.87	-14.13
B_2089_A		11.57	ug/L	1.490	12.88	14.81

LRS2

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:10:22PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ba4554_R		5.021	ug/L	0.6645	13.24	133.2
Be3130_R		4.051	ug/L	0.8382	20.69	205.4
Ca3158_R		503,900	ug/L	7,948	1.577	278,000
Cd2265_A		0.4311	ug/L	0.5685	131.9	440.4
Co2286_A		2.249	ug/L	0.06498	2.889	9.470
Cr2677_A		2.749	ug/L	0.3558	12.94	15.60
Cu3273_A		-1.610	ug/L	0.2923	18.15	15.98
Fe2599_R		250,800	ug/L	575.0	0.2293	200,100
K_7664_R		311,800	ug/L	98.89	0.03172	95,060
Li6707_R		12.91	ug/L	0.5662	4.387	96.93
Mg2795	^F	0.0000	ug/L	0.0000	0.0000	4,111,000
Mg2025_A	F	175,000	ug/L	240.8	0.1377	58,760
Mn2576_R		2.837	ug/L	1.509	53.18	33.10
Mo2020_A		2.192	ug/L	0.9763	44.54	6.265
Na5895_R		213,900	ug/L	45.12	0.02109	168,700
Ni2316_A		-1.272	ug/L	0.3399	26.72	-6.695
Pb2203_A		-0.2742	ug/L	1.321	481.9	-46.65
Sb2068_A		2.310	ug/L	0.003780	0.1636	11.02
Se1960_A		0.7025	ug/L	1.661	236.4	5.141
Si2516_R		51,530	ug/L	327.1	0.6348	17,780
Sn1899_A		10.04	ug/L	0.02337	0.2326	6.804
Sr4215_R		10.23	ug/L	0.6640	6.488	318.9
Ti3349_A		6.056	ug/L	0.5506	9.092	94.37
Tl1908_A		0.8334	ug/L	0.8936	107.2	1.411
V_2924_A		2.528	ug/L	0.1340	5.301	50.66
Zn2062_A		7.274	ug/L	0.3413	4.691	27.10
Y_3600_R		7,850.8	Cts/S	6.4585	0.082265	7,850.8
Y_2243_A		6,587.3	Cts/S	10.292	0.15624	6,587.3
Y_3600_A		134,130	Cts/S	216.72	0.16158	134,130

CCV

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:14:46PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		512.4	ug/L	1.546	0.3018	13,350
Al3961_R		13,040	ug/L	123.6	0.9475	8,837
As1891_A		511.9	ug/L	0.1573	0.03073	155.3
B_2089_A		512.9	ug/L	0.6265	0.1222	610.9
Ba4554_R		525.3	ug/L	4.539	0.8641	13,270
Be3130_R	W	535.0	ug/L	7.204	1.346	28,740
Ca3158_R		13,160	ug/L	228.3	1.735	7,457
Cd2265_A		517.9	ug/L	0.3462	0.06685	8,817
Co2286_A		514.2	ug/L	0.02060	0.004006	2,165
Cr2677_A		516.1	ug/L	0.7350	0.1424	7,680
Cu3273_A		523.2	ug/L	0.9632	0.1841	8,846
Fe2599_R		13,010	ug/L	131.5	1.011	10,710
K_7664_R	W	13,320	ug/L	93.34	0.7006	4,194
Li6707_R	W	535.0	ug/L	7.603	1.421	3,622
Mg2795	W	13,250	ug/L	254.9	1.923	550,300
Mg2025_A		12,770	ug/L	26.08	0.2043	4,796
Mn2576_R		522.0	ug/L	7.346	1.407	2,959
Mo2020_A		516.2	ug/L	1.392	0.2697	1,671
Na5895_R		13,080	ug/L	82.07	0.6272	10,680
Ni2316_A		521.2	ug/L	0.1472	0.02825	937.0
Pb2203_A		520.6	ug/L	0.5255	0.1009	671.1
Sb2068_A		517.6	ug/L	0.3091	0.05971	291.1

CCV

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:14:46PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Se1960_A		516.1	ug/L	0.4732	0.09169	121.6
Si2516_R		13,410	ug/L	215.1	1.604	4,785
Sn1899_A		516.9	ug/L	1.181	0.2285	285.4
Sr4215_R		523.2	ug/L	4.807	0.9188	17,100
Ti3349_A		509.2	ug/L	0.7024	0.1379	11,920
Tl1908_A		519.0	ug/L	1.397	0.2691	284.9
V_2924_A		517.1	ug/L	0.9251	0.1789	8,331
Zn2062_A		515.2	ug/L	0.1996	0.03873	1,986
Y_3600_R		8,097.7	Cts/S	157.68	1.9472	8,097.7
Y_2243_A		7,334.8	Cts/S	10.767	0.14679	7,334.8
Y_3600_A		150,090	Cts/S	584.65	0.38955	150,090

CCB

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:19:01PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.3760	ug/L	0.1100	29.26	0.3125
Al3961_R		43.84	ug/L	21.21	48.39	23.71
As1891_A		2.026	ug/L	0.1734	8.557	-2.664
B_2089_A		2.909	ug/L	0.4432	15.24	6.688
Ba4554_R	W	3.438	ug/L	1.218	35.43	98.57
Be3130_R	W	3.409	ug/L	0.9447	27.71	179.6
Ca3158_R		42.31	ug/L	19.37	45.79	-7.957
Cd2265_A		0.01521	ug/L	0.04340	285.3	-0.6451
Co2286_A		-0.01470	ug/L	0.08791	597.9	-2.971
Cr2677_A		0.6603	ug/L	0.3315	50.20	12.44
Cu3273_A		0.6358	ug/L	0.1489	23.42	-44.41
Fe2599_R		8.931	ug/L	8.178	91.56	16.67
K_7664_R		63.27	ug/L	48.72	77.00	24.86
Li6707_R		2.657	ug/L	1.556	58.55	31.19
Mg2795		18.06	ug/L	6.137	33.99	780.3
Mg2025_A		0.7119	ug/L	0.4438	62.34	-8.475
Mn2576_R	W	2.801	ug/L	0.4719	16.85	17.90
Mo2020_A		1.092	ug/L	0.1437	13.16	3.449
Na5895_R		6.956	ug/L	7.174	103.1	48.13
Ni2316_A		-0.1337	ug/L	0.2648	198.1	1.721
Pb2203_A		-0.1535	ug/L	0.09772	63.66	-1.346
Sb2068_A		1.487	ug/L	0.4834	32.51	2.647
Se1960_A		2.037	ug/L	1.706	83.75	2.137
Si2516_R		17.85	ug/L	7.207	40.38	21.51
Sn1899_A		1.146	ug/L	0.1653	14.42	2.728
Sr4215_R		3.025	ug/L	1.033	34.15	94.25
Ti3349_A		0.9045	ug/L	0.6845	75.68	-15.60
Tl1908_A		1.720	ug/L	0.5290	30.75	-1.436
V_2924_A		0.6451	ug/L	0.3933	60.96	2.110
Zn2062_A		0.08072	ug/L	0.01128	13.98	2.479
Y_3600_R		8,183.4	Cts/S	57.904	0.70758	8,183.4
Y_2243_A		7,414.2	Cts/S	13.402	0.18076	7,414.2
Y_3600_A		152,850	Cts/S	940.42	0.61526	152,850

SQ1201-001

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:23:25PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.1521	ug/L	0.1551	101.9	-5.587

SQ1201-001

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:23:25PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Al3961_R		76.13	ug/L	10.21	13.42	46.79
As1891_A		2.304	ug/L	0.2757	11.96	-2.663
B_2089_A		9.519	ug/L	0.2643	2.776	14.24
Ba4554_R		13.22	ug/L	0.1908	1.443	354.6
Be3130_R		0.1702	ug/L	0.009558	5.617	3.537
Ca3158_R		1,374	ug/L	1.728	0.1257	772.2
Cd2265_A		0.07372	ug/L	0.02719	36.88	3.463
Co2286_A		0.2761	ug/L	0.05030	18.22	-1.708
Cr2677_A		0.2848	ug/L	0.3199	112.3	6.597
Cu3273_A		1.246	ug/L	0.1171	9.402	-31.86
Fe2599_R		1,601	ug/L	4.729	0.2955	1,365
K_7664_R		528.7	ug/L	47.51	8.985	176.1
Li6707_R		-0.2260	ug/L	0.3349	148.2	11.72
Mg2795		770.0	ug/L	0.3643	0.04731	32,950
Mg2025_A		776.6	ug/L	2.263	0.2914	284.9
Mn2576_R		13.94	ug/L	0.07009	0.5026	83.27
Mo2020_A		0.5362	ug/L	0.1068	19.92	1.629
Na5895_R		2,848	ug/L	6.492	0.2280	2,427
Ni2316_A		0.3534	ug/L	0.2543	71.97	2.560
Pb2203_A		4.312	ug/L	0.4618	10.71	4.563
Sb2068_A		0.9058	ug/L	0.09469	10.45	2.332
Se1960_A		0.4748	ug/L	0.4483	94.42	1.781
Si2516_R		1,819	ug/L	14.50	0.7975	681.5
Sn1899_A		0.4526	ug/L	0.06958	15.38	2.344
Sr4215_R		7.855	ug/L	0.3987	5.075	258.6
Ti3349_A		0.9629	ug/L	0.4326	44.92	-14.04
Tl1908_A		0.7869	ug/L	0.6259	79.54	-1.963
V_2924_A		0.3919	ug/L	0.1708	43.57	-1.893
Zn2062_A		2.681	ug/L	0.1016	3.788	12.61
Y_3600_R		8,336.4	Cts/S	56.156	0.67362	8,336.4
Y_2243_A		7,414.9	Cts/S	1.6654	0.022460	7,414.9
Y_3600_A		152,020	Cts/S	1,254.9	0.82549	152,020

SQ1201-003

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:27:46PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.4270	ug/L	0.1949	45.64	1.650
Al3961_R		48.08	ug/L	3.084	6.413	26.85
As1891_A		1.899	ug/L	0.3666	19.30	-2.815
B_2089_A		9.440	ug/L	0.3736	3.957	14.16
Ba4554_R		12.86	ug/L	0.3086	2.399	339.4
Be3130_R		0.1766	ug/L	0.07902	44.74	3.861
Ca3158_R		1,641	ug/L	2.021	0.1232	912.8
Cd2265_A		-0.03314	ug/L	0.01726	52.10	2.368
Co2286_A		0.1328	ug/L	0.1387	104.5	-2.322
Cr2677_A		0.1142	ug/L	0.02442	21.39	3.987
Cu3273_A		0.07648	ug/L	0.1706	223.0	-51.81
Fe2599_R		1,978	ug/L	17.50	0.8847	1,656
K_7664_R		620.8	ug/L	57.41	9.246	202.4
Li6707_R		0.6173	ug/L	0.1458	23.61	17.28
Mg2795		887.0	ug/L	0.2750	0.03100	37,310
Mg2025_A		875.5	ug/L	6.570	0.7504	322.7
Mn2576_R		17.19	ug/L	0.4502	2.619	100.5
Mo2020_A		0.4027	ug/L	0.02738	6.798	1.193
Na5895_R		3,093	ug/L	12.12	0.3918	2,588

SQ1201-003

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:27:46PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ni2316_A		-0.2184	ug/L	0.2742	125.6	1.513
Pb2203_A		5.633	ug/L	0.2387	4.238	6.319
Sb2068_A		1.412	ug/L	0.3996	28.29	2.624
Se1960_A		1.827	ug/L	3.484	190.7	2.103
Si2516_R		1,302	ug/L	1.297	0.09956	484.0
Sn1899_A		0.5965	ug/L	0.6242	104.6	2.427
Sr4215_R		9.188	ug/L	0.01000	0.1089	298.3
Ti3349_A		0.2497	ug/L	0.07444	29.81	-31.17
Tl1908_A		0.03074	ug/L	0.7866	2,559	-2.391
V_2924_A		0.3976	ug/L	0.05165	12.99	-1.760
Zn2062_A		2.324	ug/L	0.2051	8.827	11.24
Y_3600_R		8,196.3	Cts/S	1.5756	0.019223	8,196.3
Y_2243_A		7,424.3	Cts/S	11.819	0.15920	7,424.3
Y_3600_A		152,730	Cts/S	1,085.9	0.71100	152,730

LC2WQC17ICW1

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:32:08PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		53.04	ug/L	0.2901	0.5468	1,412
Al3961_R		2,235	ug/L	2.041	0.09132	1,517
As1891_A		108.0	ug/L	1.312	1.215	30.99
B_2089_A		520.8	ug/L	0.2680	0.05146	611.8
Ba4554_R		2,097	ug/L	4.945	0.2358	53,180
Be3130_R		53.90	ug/L	0.04529	0.08402	2,898
Ca3158_R		2,798	ug/L	14.67	0.5245	1,568
Cd2265_A		265.3	ug/L	0.1491	0.05621	4,603
Co2286_A		529.3	ug/L	0.06725	0.01271	2,277
Cr2677_A		206.9	ug/L	2.178	1.053	3,173
Cu3273_A		262.7	ug/L	1.364	0.5192	4,539
Fe2599_R		1,070	ug/L	3.965	0.3704	894.0
K_7664_R		10,880	ug/L	37.04	0.3404	3,442
Li6707_R		558.6	ug/L	3.319	0.5942	3,800
Mg2795		5,665	ug/L	21.94	0.3872	236,400
Mg2025_A		5,689	ug/L	0.2962	0.005206	2,194
Mn2576_R		526.4	ug/L	0.1727	0.03282	2,998
Mo2020_A		101.5	ug/L	0.4304	0.4241	335.4
Na5895_R		8,231	ug/L	21.20	0.2576	6,766
Ni2316_A		538.5	ug/L	0.2456	0.04561	989.0
Pb2203_A		108.5	ug/L	0.1867	0.1720	142.1
Sb2068_A		106.1	ug/L	0.5614	0.5290	60.44
Se1960_A		106.5	ug/L	0.4581	0.4303	27.02
Si2516_R		1,089	ug/L	1.026	0.09428	402.7
Sn1899_A		551.8	ug/L	1.037	0.1880	311.1
Sr4215_R		544.2	ug/L	1.607	0.2953	17,880
Ti3349_A		508.0	ug/L	3.608	0.7102	12,240
Tl1908_A		112.2	ug/L	1.306	1.165	61.17
V_2924_A		522.1	ug/L	4.586	0.8783	8,729
Zn2062_A		533.3	ug/L	0.7250	0.1359	2,101
Y_3600_R		8,136.7	Cts/S	56.461	0.69391	8,136.7
Y_2243_A		7,493.2	Cts/S	6.2962	0.084026	7,493.2
Y_3600_A		154,560	Cts/S	1,599.4	1.0348	154,560

LCSWQC17ICW1

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF

LCSWQC17ICW1

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:36:22PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		52.87	ug/L	0.7962	1.506	1,413
Al3961_R		2,186	ug/L	11.56	0.5290	1,504
As1891_A		106.4	ug/L	0.6135	0.5769	30.45
B_2089_A		513.8	ug/L	3.117	0.6067	603.0
Ba4554_R		2,072	ug/L	12.45	0.6009	53,290
Be3130_R		53.60	ug/L	0.2368	0.4419	2,922
Ca3158_R		2,738	ug/L	20.71	0.7563	1,555
Cd2265_A		261.4	ug/L	2.475	0.9468	4,530
Co2286_A		523.4	ug/L	4.237	0.8094	2,250
Cr2677_A		205.7	ug/L	2.141	1.040	3,168
Cu3273_A		261.8	ug/L	2.844	1.086	4,542
Fe2599_R		1,057	ug/L	12.66	1.197	895.1
K_7664_R		10,670	ug/L	61.76	0.5789	3,423
Li6707_R		552.9	ug/L	2.531	0.4578	3,814
Mg2795		5,555	ug/L	4.040	0.07272	235,100
Mg2025_A		5,581	ug/L	2.235	0.04004	2,151
Mn2576_R		520.1	ug/L	2.504	0.4814	3,003
Mo2020_A		100.6	ug/L	1.085	1.078	332.3
Na5895_R		8,103	ug/L	62.41	0.7702	6,754
Ni2316_A		534.1	ug/L	3.418	0.6400	980.2
Pb2203_A		107.6	ug/L	0.7253	0.6739	140.8
Sb2068_A		105.9	ug/L	0.8831	0.8339	60.30
Se1960_A		105.1	ug/L	2.235	2.126	26.67
Si2516_R		1,080	ug/L	12.69	1.175	405.1
Sn1899_A		542.2	ug/L	2.821	0.5203	305.5
Sr4215_R		534.6	ug/L	1.835	0.3432	17,810
Ti3349_A		504.8	ug/L	9.786	1.939	12,210
Tl1908_A		108.1	ug/L	0.07075	0.06546	58.81
V_2924_A		522.0	ug/L	6.926	1.327	8,763
Zn2062_A		528.4	ug/L	5.621	1.064	2,080
Y_3600_R		8,249.7	Cts/S	20.655	0.25038	8,249.7
Y_2243_A		7,486.5	Cts/S	40.797	0.54494	7,486.5
Y_3600_A		155,170	Cts/S	906.21	0.58401	155,170

PBWQC17ICW1

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:40:36PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.3569	ug/L	0.03484	9.760	-0.1875
Al3961_R		-1.619	ug/L	6.871	424.4	-7.543
As1891_A		3.680	ug/L	0.1556	4.227	-2.172
B_2089_A		0.7046	ug/L	0.3867	54.89	4.188
Ba4554_R		0.8525	ug/L	0.3149	36.93	32.96
Be3130_R		0.1406	ug/L	0.01750	12.44	1.912
Ca3158_R		4.481	ug/L	4.082	91.09	-30.15
Cd2265_A		0.009970	ug/L	0.01491	149.6	-0.7779
Co2286_A		0.3956	ug/L	0.1327	33.56	-1.248
Cr2677_A		-0.09136	ug/L	0.1641	179.6	1.089
Cu3273_A		0.04130	ug/L	0.02032	49.19	-55.32
Fe2599_R		-7.513	ug/L	0.9834	13.09	3.014
K_7664_R		-43.02	ug/L	33.64	78.20	-8.967
Li6707_R		-1.832	ug/L	1.568	85.59	0.5789
Mg2795		7.611	ug/L	0.3170	4.166	345.5
Mg2025_A		11.34	ug/L	2.718	23.97	-4.500
Mn2576_R		0.09440	ug/L	0.4693	497.1	2.430
Mo2020_A		0.5161	ug/L	0.1390	26.94	1.586

PBWQC17ICW1

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:40:36PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		-20.16	ug/L	5.892	29.23	26.19
Ni2316_A		-0.4615	ug/L	0.09332	20.22	1.143
Pb2203_A		0.09136	ug/L	0.1548	169.4	-1.034
Sb2068_A		0.8484	ug/L	0.01014	1.195	2.316
Se1960_A		0.1294	ug/L	0.3000	231.7	1.711
Si2516_R		4.795	ug/L	7.904	164.8	17.05
Sn1899_A		0.4190	ug/L	0.03022	7.214	2.356
Sr4215_R		0.2816	ug/L	0.3699	131.3	3.487
Ti3349_A		0.1737	ug/L	0.1749	100.7	-33.42
Tl1908_A		1.866	ug/L	0.7427	39.80	-1.370
V_2924_A		-0.1687	ug/L	0.1813	107.5	-11.40
Zn2062_A		0.1099	ug/L	0.09565	87.07	2.631
Y_3600_R		8,294.0	Cts/S	32.147	0.38759	8,294.0
Y_2243_A		7,513.2	Cts/S	20.439	0.27204	7,513.2
Y_3600_A		154,610	Cts/S	1,476.7	0.95513	154,610

SQ1218-001

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:44:58PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.4041	ug/L	0.2759	68.29	1.087
Al3961_R		7.478	ug/L	3.526	47.16	6.685
As1891_A		5.426	ug/L	0.5768	10.63	-1.631
B_2089_A		12.04	ug/L	0.5042	4.187	16.84
Ba4554_R		17.51	ug/L	1.277	7.294	437.5
Be3130_R		0.07749	ug/L	0.04469	57.68	-1.354
Ca3158_R	W	49,780	ug/L	5,025	10.10	27,320
Cd2265_A		-0.02836	ug/L	0.01202	42.37	0.7903
Co2286_A		0.4267	ug/L	0.09718	22.77	-1.071
Cr2677_A		0.1273	ug/L	0.09053	71.14	4.398
Cu3273_A		-0.01594	ug/L	0.1549	972.2	-53.81
Fe2599_R		1,135	ug/L	102.5	9.029	910.7
K_7664_R		2,856	ug/L	228.3	7.993	872.3
Li6707_R		4.886	ug/L	0.3403	6.965	44.54
Mg2795		22,070	ug/L	1,215	5.505	886,700
Mg2025_A		21,780	ug/L	26.21	0.1203	8,094
Mn2576_R		153.6	ug/L	14.09	9.173	841.9
Mo2020_A		0.4335	ug/L	0.01548	3.570	1.263
Na5895_R		17,450	ug/L	1,547	8.864	13,740
Ni2316_A		-0.4494	ug/L	0.03476	7.735	1.099
Pb2203_A		0.1231	ug/L	0.7745	628.9	-0.9130
Sb2068_A		0.3041	ug/L	0.08519	28.01	1.959
Se1960_A		1.190	ug/L	0.06973	5.857	1.938
Si2516_R		8,211	ug/L	828.6	10.09	2,835
Sn1899_A		-0.5276	ug/L	0.3927	74.43	1.772
Sr4215_R		403.6	ug/L	37.20	9.217	12,740
Ti3349_A		-0.5304	ug/L	0.1528	28.80	-49.34
Tl1908_A		2.417	ug/L	0.4714	19.50	-1.141
V_2924_A		0.01482	ug/L	0.1390	937.8	-8.912
Zn2062_A		0.6955	ug/L	0.1711	24.60	4.798
Y_3600_R		7,847.7	Cts/S	601.02	7.6585	7,847.7
Y_2243_A		7,294.6	Cts/S	6.6811	0.091590	7,294.6
Y_3600_A		151,290	Cts/S	1,226.0	0.81037	151,290

SQ1242-001

Method Name: FAST-2022_POP
Method Revision: 173

SQ1242-001

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:49:25PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		1.617	ug/L	0.3901	24.13	11.11
Al3961_R		101.9	ug/L	1.920	1.884	33.47
As1891_A		413.2	ug/L	2.072	0.5016	55.75
B_2089_A		94.57	ug/L	0.8410	0.8894	56.68
Ba4554_R		202.0	ug/L	0.3375	0.1671	2,591
Be3130_R		0.4335	ug/L	0.1104	25.47	6.157
Ca3158_R	W	58,840	ug/L	294.4	0.5004	16,920
Cd2265_A		0.9384	ug/L	0.01087	1.158	177.8
Co2286_A		32.62	ug/L	0.4606	1.412	66.58
Cr2677_A		422.0	ug/L	2.936	0.6957	3,155
Cu3273_A		2.305	ug/L	0.2472	10.72	64.94
Fe2599_R	W	178,300	ug/L	77.90	0.04369	74,280
K_7664_R		3,976	ug/L	50.59	1.272	637.7
Li6707_R		3.393	ug/L	4.394	129.5	24.73
Mg2795		11,820	ug/L	8.102	0.06857	248,500
Mg2025_A		11,540	ug/L	33.43	0.2897	2,136
Mn2576_R	W	28,690	ug/L	99.72	0.3476	82,260
Mo2020_A		7.898	ug/L	0.1371	1.736	11.66
Na5895_R		31,830	ug/L	137.5	0.4321	13,140
Ni2316_A		50.71	ug/L	0.5916	1.167	44.60
Pb2203_A		3.532	ug/L	0.02487	0.7040	5.136
Sb2068_A		9.272	ug/L	1.218	13.14	5.973
Se1960_A		-6.816	ug/L	2.288	33.57	3.711
Si2516_R		17,570	ug/L	43.11	0.2454	3,178
Sn1899_A		1.465	ug/L	0.6896	47.07	2.455
Sr4215_R		500.1	ug/L	0.2590	0.05179	8,274
Ti3349_A		0.7595	ug/L	0.2676	35.24	-26.81
Tl1908_A		11.66	ug/L	0.5326	4.570	-9.911
V_2924_A		8.858	ug/L	0.4841	5.465	-22.73
Zn2062_A		55.50	ug/L	0.2302	0.4147	107.5
Y_3600_R		8,198.4	Cts/S	85.504	1.0429	8,198.4
Y_2243_A		7,284.8	Cts/S	4.2406	0.058212	7,284.8
Y_3600_A		150,320	Cts/S	1,744.5	1.1605	150,320

SQ1266-004

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:53:43PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.8295	ug/L	0.5661	68.25	-4.207
Al3961_R		121.8	ug/L	79.98	65.64	22.32
As1891_A		9.492	ug/L	4.447	46.85	-2.195
B_2089_A		4,467	ug/L	6.021	0.1348	833.9
Ba4554_R		9.151	ug/L	1.059	11.57	54.26
Be3130_R		0.3598	ug/L	0.5373	149.3	-1.754
Ca3158_R	W	407,200	ug/L	5,485	1.347	44,200
Cd2265_A		-0.2031	ug/L	0.01895	9.328	-1.301
Co2286_A		0.8964	ug/L	0.9096	101.5	-1.748
Cr2677_A		1.899	ug/L	0.9932	52.30	6.567
Cu3273_A		-4.142	ug/L	1.047	25.28	-55.81
Fe2599_R		52.29	ug/L	23.88	45.67	16.90
K_7664_R	W	417,900	ug/L	2,851	0.6823	25,090
Li6707_R		196.9	ug/L	9.307	4.726	265.9
Mg2795	^	0.0000	ug/L	0.0000	0.0000	0.0000
Mg2025_A	F	1,082,000	ug/L	2,232	0.2064	66,410
Mn2576_R		6.527	ug/L	0.9685	14.84	10.09
Mo2020_A		6.889	ug/L	1.885	27.36	3.560

SQ1266-004

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:53:43PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R	F	9,909,000	ug/L	70,460	0.7111	1,538,000
Ni2316_A		1.429	ug/L	0.1991	13.94	2.016
Pb2203_A		-4.194	ug/L	7.119	169.7	-1.819
Sb2068_A		6.969	ug/L	7.416	106.4	2.105
Se1960_A		24.69	ug/L	5.876	23.80	2.287
Si2516_R		413.3	ug/L	22.56	5.460	42.31
Sn1899_A		5.639	ug/L	6.450	114.4	2.207
Sr4215_R	W	7,801	ug/L	50.54	0.6479	48,700
Ti3349_A		0.08593	ug/L	0.2227	259.2	-29.40
Tl1908_A		9.167	ug/L	0.3724	4.063	-1.113
V_2924_A		-1.380	ug/L	0.6328	45.87	-10.54
Zn2062_A		7.311	ug/L	0.4920	6.729	6.384
Y_3600_R		7,728.0	Cts/S	45.957	0.59468	7,728.0
Y_2243_A		6,020.0	Cts/S	0.67209	0.011164	6,020.0
Y_3600_A		122,310	Cts/S	211.06	0.17256	122,310

SQ1281-001

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 5:58:07PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.2564	ug/L	0.1067	41.60	-2.787
Al3961_R		0.3066	ug/L	2.004	653.7	-5.151
As1891_A		9.567	ug/L	0.09379	0.9804	-0.2928
B_2089_A		33.00	ug/L	0.4129	1.251	40.66
Ba4554_R		0.6327	ug/L	0.3723	58.84	27.08
Be3130_R		0.07370	ug/L	0.01512	20.51	-1.734
Ca3158_R		6,069	ug/L	150.3	2.477	3,468
Cd2265_A		0.03074	ug/L	0.02646	86.10	-0.3858
Co2286_A		0.1755	ug/L	0.04249	24.21	-2.146
Cr2677_A		-0.1259	ug/L	0.1226	97.38	0.5306
Cu3273_A		1.450	ug/L	0.4073	28.09	-29.63
Fe2599_R		3.088	ug/L	0.5671	18.37	11.83
K_7664_R		2,535	ug/L	61.62	2.431	812.9
Li6707_R		2.894	ug/L	2.392	82.65	32.75
Mg2795		796.0	ug/L	31.47	3.954	33,530
Mg2025_A		737.3	ug/L	8.464	1.148	266.9
Mn2576_R		1.797	ug/L	0.3756	20.90	12.17
Mo2020_A		0.4263	ug/L	0.004624	1.085	1.256
Na5895_R	W	55,590	ug/L	779.9	1.403	45,860
Ni2316_A		-0.5724	ug/L	0.1319	23.04	0.9158
Pb2203_A		0.5741	ug/L	0.2212	38.53	-0.3831
Sb2068_A		0.4787	ug/L	1.295	270.4	2.056
Se1960_A		1.469	ug/L	1.456	99.09	1.981
Si2516_R		6,442	ug/L	160.2	2.486	2,338
Sn1899_A		-0.2105	ug/L	0.1969	93.55	1.954
Sr4215_R		8.762	ug/L	0.07443	0.8495	284.6
Ti3349_A		-0.1331	ug/L	0.3536	265.6	-39.48
Tl1908_A		2.436	ug/L	0.4427	18.17	-1.023
V_2924_A		-0.1389	ug/L	0.05225	37.63	-10.53
Zn2062_A		0.5723	ug/L	0.1299	22.69	4.348
Y_3600_R		8,208.8	Cts/S	120.20	1.4642	8,208.8
Y_2243_A		7,329.9	Cts/S	6.4020	0.087341	7,329.9
Y_3600_A		149,550	Cts/S	35.982	0.024061	149,550

LCSOQC16ICS2

Method Name: FAST-2022_POP
Method Revision: 173

LCSOQC16ICS2

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 6:02:30PM
Sample Type: Unknown

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		52.07	ug/L	0.7817	1.501	1,333
Al3961_R		2,236	ug/L	15.07	0.6742	1,530
As1891_A		108.7	ug/L	0.7284	0.6699	30.46
B_2089_A		546.9	ug/L	6.551	1.198	628.6
Ba4554_R		2,051	ug/L	4.852	0.2366	52,410
Be3130_R		53.10	ug/L	0.3193	0.6013	2,876
Ca3158_R		2,872	ug/L	1.021	0.03554	1,623
Cd2265_A		259.9	ug/L	1.653	0.6358	4,399
Co2286_A		530.2	ug/L	6.574	1.240	2,225
Cr2677_A		212.6	ug/L	1.671	0.7859	3,136
Cu3273_A		266.2	ug/L	2.227	0.8364	4,424
Fe2599_R	F	1,271	ug/L	2.407	0.1894	1,068
K_7664_R		10,620	ug/L	30.96	0.2916	3,385
Li6707_R		558.1	ug/L	4.631	0.8298	3,825
Mg2795		5,616	ug/L	5.827	0.1037	236,200
Mg2025_A		5,647	ug/L	45.88	0.8125	2,124
Mn2576_R		519.4	ug/L	4.756	0.9158	2,980
Mo2020_A	F	150.7	ug/L	1.269	0.8419	485.9
Na5895_R	F	11,140	ug/L	71.02	0.6373	9,216
Ni2316_A		534.5	ug/L	3.649	0.6827	957.7
Pb2203_A		107.5	ug/L	1.525	1.419	137.2
Sb2068_A		105.4	ug/L	1.553	1.474	58.54
Se1960_A		107.4	ug/L	4.097	3.815	26.57
Si2516_R		1,104	ug/L	0.06546	0.005931	411.1
Sn1899_A		544.3	ug/L	2.303	0.4231	299.3
Sr4215_R		541.7	ug/L	0.9773	0.1804	17,930
Ti3349_A		518.2	ug/L	6.102	1.178	12,010
Tl1908_A		103.4	ug/L	2.538	2.455	54.84
V_2924_A		518.9	ug/L	5.427	1.046	8,340
Zn2062_A		544.5	ug/L	5.566	1.022	2,092
Y_3600_R		8,198.9	Cts/S	22.818	0.27831	8,198.9
Y_2243_A		7,308.6	Cts/S	50.216	0.68708	7,308.6
Y_3600_A		148,670	Cts/S	1,552.6	1.0443	148,670

CCV

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 6:06:44PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		521.7	ug/L	1.421	0.2724	13,420
Al3961_R		13,060	ug/L	7.746	0.05931	8,927
As1891_A		507.3	ug/L	1.271	0.2506	149.6
B_2089_A		523.3	ug/L	1.413	0.2700	605.5
Ba4554_R		514.8	ug/L	2.258	0.4387	13,110
Be3130_R		522.3	ug/L	4.086	0.7823	28,300
Ca3158_R	W	13,220	ug/L	21.86	0.1654	7,555
Cd2265_A		517.1	ug/L	1.200	0.2321	8,561
Co2286_A	W	535.3	ug/L	2.301	0.4298	2,192
Cr2677_A		522.0	ug/L	1.560	0.2989	7,670
Cu3273_A		518.0	ug/L	3.427	0.6616	8,646
Fe2599_R		12,770	ug/L	53.23	0.4169	10,600
K_7664_R		12,830	ug/L	124.9	0.9737	4,075
Li6707_R	W	527.5	ug/L	8.440	1.600	3,603
Mg2795		12,880	ug/L	134.3	1.043	539,600
Mg2025_A		13,030	ug/L	23.01	0.1766	4,760
Mn2576_R		524.2	ug/L	1.986	0.3789	2,998
Mo2020_A		516.1	ug/L	3.593	0.6961	1,625

CCV

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 6:06:44PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Na5895_R		13,000	ug/L	54.84	0.4219	10,700
Ni2316_A		525.6	ug/L	0.5429	0.1033	918.8
Pb2203_A		525.0	ug/L	1.956	0.3726	658.0
Sb2068_A		513.9	ug/L	1.152	0.2242	281.1
Se1960_A		496.8	ug/L	5.215	1.050	113.9
Si2516_R		12,990	ug/L	127.5	0.9819	4,674
Sn1899_A		502.5	ug/L	3.217	0.6402	269.8
Sr4215_R		511.3	ug/L	2.098	0.4103	16,860
Ti3349_A		516.3	ug/L	1.777	0.3441	11,930
Tl1908_A	W	448.3	ug/L	24.28	5.416	239.1
V_2924_A		512.5	ug/L	1.804	0.3519	8,152
Zn2062_A		521.2	ug/L	1.023	0.1963	1,953
Y_3600_R		8,168.1	Cts/S	21.215	0.25973	8,168.1
Y_2243_A		7,132.0	Cts/S	4.3883	0.061530	7,132.0
Y_3600_A		148,190	Cts/S	989.71	0.66785	148,190

CCB

Method Name: FAST-2022_POP
Method Revision: 173
Analyst Name: BCF
Acquire Date: 3/21/2023 6:10:59PM
Sample Type: QC

Elem	Flags	Avg	Units	Stddev	%RSD	Intensity Ratio
Ag3280_A		0.5701	ug/L	0.08808	15.45	5.549
Al3961_R		2.610	ug/L	3.577	137.0	-4.515
As1891_A		2.931	ug/L	0.6879	23.47	-2.351
B_2089_A		1.317	ug/L	0.1469	11.15	4.777
Ba4554_R		0.2674	ug/L	0.1042	38.94	17.43
Be3130_R		0.2092	ug/L	0.01491	7.127	5.570
Ca3158_R		10.46	ug/L	12.70	121.5	-26.06
Cd2265_A		0.04779	ug/L	0.02401	50.23	-0.1088
Co2286_A		0.1655	ug/L	0.01228	7.418	-2.185
Cr2677_A		-0.1019	ug/L	0.2372	232.7	0.9135
Cu3273_A		0.2240	ug/L	0.4960	221.4	-52.14
Fe2599_R		-2.107	ug/L	0.03314	1.573	7.391
K_7664_R		-9.075	ug/L	4.632	51.04	1.898
Li6707_R		0.7757	ug/L	1.628	209.9	18.16
Mg2795		4.014	ug/L	0.1431	3.564	188.0
Mg2025_A		0.6632	ug/L	1.186	178.9	-8.388
Mn2576_R		-0.6382	ug/L	0.3362	52.68	-1.779
Mo2020_A		0.4955	ug/L	0.05591	11.28	1.479
Na5895_R		163.2	ug/L	12.70	7.780	174.7
Ni2316_A		0.4918	ug/L	0.2999	60.98	2.822
Pb2203_A		0.003760	ug/L	0.6159	16,380	-1.123
Sb2068_A		0.5531	ug/L	1.061	191.9	2.089
Se1960_A		2.437	ug/L	0.1746	7.165	2.204
Si2516_R		12.96	ug/L	1.141	8.806	19.55
Sn1899_A		1.009	ug/L	0.3089	30.63	2.621
Sr4215_R		0.3046	ug/L	0.2245	73.72	4.170
Ti3349_A		0.1031	ug/L	0.01086	10.53	-35.13
Tl1908_A		1.679	ug/L	0.4660	27.76	-1.439
V_2924_A		0.3220	ug/L	0.2251	69.91	-3.146
Zn2062_A		0.2158	ug/L	0.1052	48.76	2.973
Y_3600_R		8,100.6	Cts/S	21.825	0.26942	8,100.6
Y_2243_A		7,327.6	Cts/S	20.960	0.28604	7,327.6
Y_3600_A		154,710	Cts/S	11.189	0.0072330	154,710

PBSQC16ICS2

Method Name: FAST-2022_POP
Method Revision: 173

KATAHDIN ANALYTICAL SERVICES, LLC
METALS ANALYSIS RUN INFORMATION SHEET

INSTR. ID: L (Agilent 7800) **ANALYST:** KS **ANALYSIS DATE:** 03/23/23

METHOD: ICP-MS
- ☐ 200.8
- ☑ 6020
- ☑ DOD

FILE NAME: LQC23C

Reviewed By: EE 032423

The pHs of all samples that were tested by direct analysis in this analytical run were checked just prior to analysis and confirmed to be <2. The time of preservation of these samples was checked in the "Measured Turbidity and Preservation of Incoming Samples" logbook to verify that they had been preserved at least 16 hours prior to analysis. These verifications were performed by ——— (initials) on ——— (date).

STANDARDS USED:

Standard Name	Standard ID	Prep Date	Expiration Date	Standard Conc.
Cal Blk/ICB/CCB	MW21411	03/02/23	03/02/24	0 ug/L
Cal Std	MW21414	03/02/23	03/25/23	Varies by Element
ICV	MW21429	03/15/23	06/14/23	Varies by Element
PQL	MW21436	03/23/23	03/25/23	Varies by Element
LRS1	MW21330	01/17/23	03/25/23	Varies by Element
LRS2	MW21331	01/17/23	04/17/23	Varies by Element
ICSA	MW21437	03/23/23	03/30/23	Varies by Element
ICSAB	MW21438	03/23/23	03/25/23	Varies by Element
CCV	MW21439	03/23/23	03/25/23	Varies by Element
Internal Standard (ISTD)	N/A	N/A	N/A	0.2 mg/L (Li,Sc,Ge/Y,Tb,Bi)

Additional Comments and Notes:

Samples with ISTD RSDs > 8% were reanalyzed immediately.

ISTD was manually added to all standards and samples (0.08 mL of MS2459 to 8 mL).

Dilutions: Some samples were diluted based on history or due to interfering element concentrations.

Dilution preparations are as follows:

5x diln.: 1.6 mL of sample (pipet M30) + 6.4 mL of MW21411 (pipet M31)

10x diln.: 0.8 mL of sample (pipet M19) + 7.2 mL of MW21411 (pipet M31)

25x diln.: 0.32 mL of sample(pipet M19) + 7.68 mL of MW21411 (pipet M31)

Post Spike: 0.08 mL of MW21329 (pipet M27) into 8 mL final volume of appropriately diluted sample (pipet M31)

INSTRUMENT RUNLOG

Instrument: AGILENT 7800

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
CalBlank	1	LQC23C	03/23/2023	18:20	KS
CalStd	1	LQC23C	03/23/2023	18:25	KS
ICV	1	LQC23C	03/23/2023	18:35	KS
ICB	1	LQC23C	03/23/2023	18:44	KS
PQL	1	LQC23C	03/23/2023	18:49	KS
ICSA	1	LQC23C	03/23/2023	18:54	KS
ICSAB	1	LQC23C	03/23/2023	18:59	KS
LRS1	1	LQC23C	03/23/2023	19:07	KS
LRS2	1	LQC23C	03/23/2023	19:19	KS
RINSE	1	LQC23C	03/23/2023	19:29	KS
RINSE	1	LQC23C	03/23/2023	19:35	KS
CCV	1	LQC23C	03/23/2023	19:40	KS
CCB	1	LQC23C	03/23/2023	19:49	KS
CCV	1	LQC23C	03/23/2023	19:54	KS
CCB	1	LQC23C	03/23/2023	20:04	KS
ICSA	1	LQC23C	03/23/2023	20:09	KS
CCV	1	LQC23C	03/23/2023	20:14	KS
CCB	1	LQC23C	03/23/2023	20:23	KS
PBWQC21IMW2	5	LQC23C	03/23/2023	20:28	KS
LCSWQC21IMW2	5	LQC23C	03/23/2023	20:34	KS
SQ1015-024	5	LQC23C	03/23/2023	20:42	KS
SQ1201-009	5	LQC23C	03/23/2023	20:47	KS
SQ1201-010	5	LQC23C	03/23/2023	20:52	KS
SQ1201-011	5	LQC23C	03/23/2023	20:57	KS
SQ1201-012	5	LQC23C	03/23/2023	21:02	KS
SQ1201-012L	25	LQC23C	03/23/2023	21:08	KS
SQ1201-012A	5	LQC23C	03/23/2023	21:13	KS
SQ1201-012P	5	LQC23C	03/23/2023	21:18	KS
CCV	1	LQC23C	03/23/2023	21:26	KS
CCB	1	LQC23C	03/23/2023	21:35	KS
SQ1201-012S	5	LQC23C	03/23/2023	21:40	KS
SQ1201-013	5	LQC23C	03/23/2023	21:49	KS
SQ1201-014	5	LQC23C	03/23/2023	21:54	KS
SQ1201-015	5	LQC23C	03/23/2023	21:59	KS
SQ1201-016	5	LQC23C	03/23/2023	22:04	KS
SQ1201-017	5	LQC23C	03/23/2023	22:09	KS
SQ1201-018	5	LQC23C	03/23/2023	22:14	KS
SQ1312-001	5	LQC23C	03/23/2023	22:19	KS
SQ1312-002	5	LQC23C	03/23/2023	22:25	KS
SQ1312-003	5	LQC23C	03/23/2023	22:30	KS
CCV	1	LQC23C	03/23/2023	22:35	KS
CCB	1	LQC23C	03/23/2023	22:46	KS
SQ1312-004	5	LQC23C	03/23/2023	22:52	KS
SQ1312-005	5	LQC23C	03/23/2023	22:57	KS

US EPA Tune Check Report

Operator Name	admin
Acq/Data Batch	D:\Agilent\ICPMH\1\DATA\2023\03-MAR\LQC23[illegible].b
Acq. Date-Time	3/23/2023 13:09:03
Report Comment	---
Instrument Name	G8421A SG18503526

C KS 3/24/23

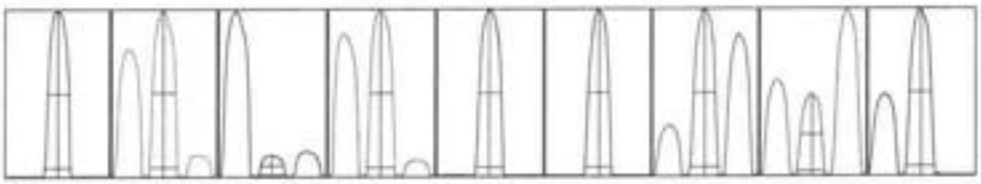
[No Gas]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
9	10.00	60670	606702.97	3.038	5.000	
24	10.00	264064	2640638.64	2.646	5.000	
25	10.00	33249	332488.80	2.705	5.000	
26	10.00	39162	391617.62	3.568	5.000	
59	10.00	487342	4873425.00	3.032	5.000	
115	10.00	536205	5362047.41	2.975	5.000	
206	10.00	94676	946761.56	3.668	5.000	
207	10.00	80810	808101.62	3.675	5.000	
208	10.00	160331	1603314.59	3.354	5.000	

Integration Time [sec] 0.1

Resolution/Axis



Mass	Peak Height	Axis	Axis (Required)	Axis (Flag)
9	60296.47	9.05	8.90 - 9.10	
24	266775.83	24.00	23.90 - 24.10	
25	33408.63	25.00	24.90 - 25.10	
26	39122.42	26.00	25.90 - 29.10	
59	500167.92	59.00	58.90 - 59.10	
115	538715.10	115.05	114.90 - 115.10	
206	95122.27	206.00	205.90 - 206.10	
207	80905.21	207.00	206.90 - 207.10	
208	164968.82	208.00	207.90 - 208.10	

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
9	0.59	0.731	0.900	
24	0.66	0.785	0.900	
25	0.64	0.743	0.900	

US EPA Tune Check Report

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
26	0.65	0.784	0.900	
59	0.63	0.780	0.900	
115	0.59	0.739	0.900	
206	0.61	0.798	0.900	
207	0.61	0.783	0.900	
208	0.61	0.816	0.900	

Integration Time [sec] 0.1
Acquisition Time (sec) 47.0000000000001
Y Axis Linear

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	13.0 V
Extract 2	-250.0 V	Cell Entrance	-40 V	Plate Bias	-40 V
Omega Bias	-85 V	Cell Exit	-60 V		

Cell Parameters

Use Gas	No	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-8.0 V		
H2 Flow	0.0 mL/min	OctP RF	130 V		

QP Parameters

Mass Gain	120	Axis Gain	0.9982	QP Bias	-3.0 V
Mass Offset	126	Axis Offset	0.12		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.7 mm

EM

Discriminator	3.7 mV	Analog HV	2214 V	Pulse HV	1205 V

[H2]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	52461	524613.77	3.298	5.000	
89	10.00	51521	515211.64	2.650	5.000	
205	10.00	38896	388955.05	2.819	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

US EPA Tune Check Report

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-18.0 V		
H2 Flow	5.0 mL/min	OctP RF	200 V		

QP Parameters

Mass Gain	120	Axis Gain	0.9982	QP Bias	-13.0 V
Mass Offset	126	Axis Offset	0.12		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.7 mm

EM

Discriminator	3.7 mV	Analog HV	2214 V	Pulse HV	1205 V

[He]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	118515	1185145.29	3.528	5.000	
89	10.00	9395	93945.00	2.999	5.000	
205	10.00	17286	172855.57	2.873	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	4.5 mL/min	OctP Bias	-18.0 V		
H2 Flow	0.0 mL/min	OctP RF	200 V		

QP Parameters

US EPA Tune Check Report

Mass Gain	120	Axis Gain	0.9982	QP Bias	-13.0 V
Mass Offset	126	Axis Offset	0.12		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.7 mm		

EM

Discriminator	3.7 mV	Analog HV	2214 V	Pulse HV	1205 V

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d É	TO	e O	QNUTVMKQQ	NKO
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v	UV	e O	QSPMSRQKUM	NKN
v	UV	e É	UMTOTPKVP	NKM
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QM	` ~	QR	e O	PTOTQQVUKSN	NKV
RN	s	UV	e É	OOOTTOKVT	NKM
RO	` ê	UV	e É	OUOMMQKUT	NKS
RR	j å	UV	e É	NQOVMMKUR	MKU
RS	cÉ	UV	e O	NOTTPQTPOKTP	MKU
RV	` ç	UV	e É	QTTOQTKOV	MKV
SM	k á	UV	e É	NPPSMOKVO	NKU
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PV	h	QR	eÉ	QMTUKSSM	éé Ä	NKU	NPVRPMPKQT	QMMM	NMNKVT	UVKS	NNMQ	
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RV	`ç	UV	eÉ	QMKNMV	éé Ä	NKQ	NVSPRPKSN	QM	NMMKRR	UVKS	NNMQ	
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SP	`ì	UV	eÉ	QMQPS	éé Ä	MKT	NRPTNNKQR	QM	NMOKNU	UVKS	NNMQ	
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TR	^ë	UV	eÉ	QMKNNU	éé Ä	NKP	NVPPNKTN	QM	NMMKNV	UVKS	NNMQ	
TU	pÉ	UV	eO	NVKTQQ	éé Ä	NKM	NMOVUKSR	QM	VUKTO	UVKS	NNMQ	
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NUO	t	NRV	kç=cl~ë	QMKRSS	éé Ä	NKV	ORUUOVKNM	QM	NMOKUP	UVKS	NNMQ	
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pÅ	QR	eO	NMVVQTUKOT	MKU	NMOSVRMKNV	NMRKMO	RVKR	NOMQ	
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dÉ	TO	eO	QPPPTSKMM	MKQ	QNUTVMKQQ	NMPKQU	RVKR	NOMQ	
dÉ	TO	eÉ	NCOUVMKTN	NKM	NNVPVMKOU	NMOKVP	RVKR	NOMQ	
v	UV	eO	QTPTRPSKPU	NKN	QSPMSRQKU	NMOKPN	RVKR	NOMQ	
v	UV	eÉ	UCRRMUKOP	NKM	UMTOTPKVP	NMOKOS	RVKR	NOMQ	
qÄ	NRV	kç=cl~ë	SRNNVQTKPN	NKV	SORQMMSKN	NMQKNS	RVKR	NOMQ	
qÄ	NRV	eÉ	OTUUMMMKRS	MKU	OTPRTRQKPS	NMNKVN	RVKR	NOMQ	
_á	QMV	kç=cl~ë	PNMVMOSKRV	NKN	OVRURQRMT	NMRKMV	RVKR	NOMQ	
_á	QMV	eÉ	NRVNVTUKVR	MKR	NRQQSOOMVP	NMPKMT	RVKR	NOMQ	

p~ã éáÉ=k~ã É	f`_
cãÉ=k~ã É	MNT]f`_ÍÇ
a~í~=m~íÜ=k~ã É	aWj^ÖãÉáíf`mj eyNya^q^yOMCPyMPJ ^oyi n`CP`kÂ
^Åè=qãã É	PLCPLCMCP=NUXQCQMM
p~ã éáÉ=qóéÉ	f`_
qçí~äa ãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑncãÉk~ã É	MNQ^i_ÍÇ
p~ã éáÉ=n`=m~ëëlc á~ä	m~ëë
fpqa=n`=m~ëëlc~ãä	m~ëë
I éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	r åáë	opa	==\ mp==	iãäá	n`=c ä~Ö
V	_É	S	kç=d~ë	MKMNV	éé Ä	CQCKV	CMUKVM	MO	
NN	_	S	kç=d~ë	MKNNP	éé Ä	CSKS	NQQTKUU	Q	
CP	k~	QR	eÉ	PKRSN	éé Ä	PCKV	QVUPPKSS	CMM	
CQ	j Ö	QR	eÉ	CKPTN	éé Ä	UKR	NRCMKNQ	CM	
CT	^ä	QR	eÉ	MKPPT	éé Ä	SPKP	NVSKST	CM	
CU	pá	QR	eO	MKMUU	éé Ä	CTNKT	UPQKCQ	NM	
PV	h	QR	eÉ	PKVUQ	éé Ä	PMKR	PPMPCKRP	CMM	
QM	`~	QR	eO	CKRQP	éé Ä	SKU	CSVNTKMM	CM	
RN	s	UV	eÉ	MKMMT	éé Ä	NNRKM	CCMKMN	N	
RO	`ê	UV	eÉ	MKMNN	éé Ä	SUMKV	USVKCM	N	
RR	j å	UV	eÉ	JMKMMT	éé Ä	k L^	NTNKPM	MQ	
RS	cÉ	UV	eO	CKSMP	éé Ä	NKR	SPTTUKTU	CM	
RV	`ç	UV	eÉ	MKMMQ	éé Ä	NCRKN	NVNKNO	MO	
SM	k á	UV	eÉ	MKMMU	éé Ä	PQNKO	NPMUKVT	MQ	
SP	`ì	UV	eÉ	MKMMU	éé Ä	NTHR	SMUKVN	MS	
SS	wå	UV	eÉ	MKMMR	éé Ä	PSVKR	NVPKPQ	O	
TR	^ë	UV	eÉ	MKMCR	éé Ä	PQKS	QSKST	N	
TU	pÉ	UV	eO	MKMPO	éé Ä	PCKS	CUKRM	N	
UU	pê	UV	eÉ	MKMNO	éé Ä	CMRT	TUKUV	N	
VR	j ç	UV	eÉ	MKMSO	éé Ä	NMKU	UNQKQU	N	
NMT	^Ö	UV	eÉ	MKMNN	éé Ä	UKO	CNTKTU	MO	
NNN	`Ç	UV	eÉ	MKMMT	éé Ä	CUKR	CPKPP	MO	
NNU	på	NRV	eÉ	MKMPT	éé Ä	NVKU	CVMKMN	N	
NCN	pÄ	NRV	kç=d~ë	MKMNU	éé Ä	RKM	SUTKQN	MO	
NPT	_~	NRV	kç=d~ë	MKMCR	éé Ä	NQKN	CCPKRT	MQ	
NUO	t	NRV	kç=d~ë	MKNRT	éé Ä	SKO	PTSQKRQ	N	
OMR	qä	OMV	kç=d~ë	MKMQT	éé Ä	VKQ	CPMVKPO	MO	
OMU	mÄ	OMV	kç=d~ë	MKMNN	éé Ä	NSKQ	NNSNKCR	MO	
OPO	qÜ	OMV	kç=d~ë	MKMMU	éé Ä	URKN	OSQSKQO	N	
OPU	r	OMV	kç=d~ë	MKMNT	éé Ä	OTKU	SVQKMV	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=çï	B n`=cëÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	CNOTCPUKVN	MKQ	CNNUNUQKUQ	NMVKQQ	RVKR	NOMKQ	
pÅ	QR	kç=d~ë	QCPRPCQKUQ	NKO	CPCQMMUKRR	VTKVR	RVKR	NOMKQ	
pÅ	QR	eO	NMQSPMTKQS	MKQ	NMQSVRMKNV	VVKVQ	RVKR	NOMKQ	
pÅ	QR	eÉ	NRRRPMKNR	MKR	NRSVCPKTQ	VVKN	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	NMNRSPMSM	NKP	NMMTQVCKRQ	NMMKUN	RVKR	NOMKQ	
dÉ	TO	eO	QCMTPTKTP	MKN	QNUTVMKQQ	NMMKQS	RVKR	NOMKQ	
dÉ	TO	eÉ	NNUVPPKMP	MKS	NNVPVMKCU	VVKSO	RVKR	NOMKQ	
v	UV	eO	QSOTCRCKQM	MKR	QSPMSRQKU	VVKVP	RVKR	NOMKQ	
v	UV	eÉ	UMVOVTKUQ	MKR	UMTOTPKVP	NMMKCR	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	SNUSOMKOO	MKU	SCRCMMSKN	VUKVR	RVKR	NOMKQ	
qÄ	NRV	eÉ	OTQOTQRKMV	NKN	OTPRTRCKPS	NMMKOS	RVKR	NOMKQ	
_á	OMV	kç=d~ë	PMNCPPSKRU	MKU	OVRURQRKMT	NMNKUO	RVKR	NOMKQ	
_á	OMV	eÉ	NRTOTRCKOQ	NKM	NRQQSOCKMP	NMNKUO	RVKR	NOMKQ	

p~ã éáÉ=k~ã É	mmi
cäÉ=k~ã É	MNUJf`sKÇ
a~í~=m~íÜ=k~ã É	aWª ÖäÉáíyf`mj eyNya^q^yOMOPyMPJ ^oyin`OP"kÅ
^Åè=qáã É	PLOPLOMOP=NUXQMMT
p~ã éáÉ=qóéÉ	iif`s
qçí~äaäã íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=o ÉÑ¢cäÉk~ã É	MNQ^i_KÇ
p~ã éáÉ=n` =m~ëëlcá~ä	c~ää
fpqa=n` =m~ëëlc~áä	m~ëë
I éÉê~íçê	**~Çã áã**

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çåÅK	r åáë	opa	==ì mp==	bñés~ä	BoÉÅ	Bi çï	BeäÖÜ
V	_É	S	kç=d~ë	MKMVV	éé Ä	NKV	NPCRKSQ	MO	VVKR	TVKR	NCMKQ
NN	_	S	kç=d~ë	PKUSV	éé Ä	NKT	NSQQNKTV	Q	VSKTO	TVKR	NCMKQ
OP	k~	QR	eÉ	OMMKTVV	éé Ä	MKP	NVQNPVKST	OMM	NMMKQ	TVKR	NCMKQ
OQ	j Ö	QR	eÉ	ONKMPQ	éé Ä	NKS	UTOVKSP	OM	NMRKNT	TVKR	NCMKQ
OT	^ä	QR	eÉ	OMKVRQ	éé Ä	SKO	PNUQKUS	OM	NMQKTT	TVKR	NCMKQ
OU	pá	QR	eO	NMNKPTT	éé Ä	NKU	RNVMTKTO	NMM	NMNKPU	TVKR	NCMKQ
PV	h	QR	eÉ	OMMKNNU	éé Ä	MKO	VVSTQKRO	OMM	NMMKVS	TVKR	NCMKQ
QM	`~	QR	eO	OMKUSV	éé Ä	NKO	VTONTKSU	OM	NMQKPQ	TVKR	NCMKQ
RN	s	UV	eÉ	NKMPV	éé Ä	QKU	QVMUKTO	N	NMPKV	TVKR	NCMKQ
RO	`ê	UV	eÉ	NKMCR	éé Ä	QKQ	STSPKST	N	NMOKR	TVKR	NCMKQ
RR	j å	UV	eÉ	MKQNN	éé Ä	OKO	NPVNKUN	MKQ	NMOKTR	TVKR	NCMKQ
RS	cÉ	UV	eO	OMKNTM	éé Ä	OKO	OVUOPPKOM	OM	NMMKUR	TVKR	NCMKQ
RV	` ç	UV	eÉ	MKMVV	éé Ä	QKP	OMVPKRT	MO	VVKR	TVKR	NCMKQ
SM	k á	UV	eÉ	MKPSU	éé Ä	NNKV	OPMRKTV	MKQ	VO	TVKR	NCMKQ
SP	` ì	UV	eÉ	MKSOT	éé Ä	OKT	RCQVKVS	MKS	NMOKR	TVKR	NCMKQ
SS	wå	UV	eÉ	OKMRQ	éé Ä	NKS	OTMVKOM	O	NMOKT	TVKR	NCMKQ
TR	^ë	UV	eÉ	NKMPV	éé Ä	MKS	NMOPKQU	N	NMPKV	TVKR	NCMKQ
TU	pÉ	UV	eO	NKMOS	éé Ä	QKU	RQPKUN	N	NMOKS	TVKR	NCMKQ
UU	pê	UV	eÉ	MKVVT	éé Ä	OKS	PQSNKSN	N	VVKT	TVKR	NCMKQ
VR	j ç	UV	eÉ	MKVQS	éé Ä	PKV	PPSVKPT	N	VQKS	TVKR	NCMKQ
NMT	^Ö	UV	eÉ	MKOMV	éé Ä	RKR	ORNVKNT	MO	NMQKR	TVKR	NCMKQ
NNN	`Ç	UV	eÉ	MKOMV	éé Ä	VKP	PQRKVP	MO	NMQKR	TVKR	NCMKQ
NNU	på	NRV	eÉ	NKMMQ	éé Ä	OKS	PPMPKUM	N	NMMKQ	TVKR	NCMKQ
NON	pÄ	NRV	kç=d~ë	MKMVO	éé Ä	QKQ	QQRUKTU	MO	VS	TVKR	NCMKQ
NPT	_~	NRV	kç=d~ë	MKQNV	éé Ä	PKS	OTNSKQU	MKQ	NMQKTR	TVKR	NCMKQ
NUO	t	NRV	kç=d~ë	MKVSQ	éé Ä	TKN	NPUNRKWV	N	VSKQ	TVKR	NCMKQ
OMR	qä	OMV	kç=d~ë	MKOMR	éé Ä	RKV	SPUNKSU	MO	NMOKR	TVKR	NCMKQ
OMU	mÄ	OMV	kç=d~ë	MKMVS	éé Ä	PKS	TTSRKUM	MO	VU	TVKR	NCMKQ
OPO	qÜ	OMV	kç=d~ë	MKMPQ	éé Ä	RKR	SSPRKQQ	MO	ST	TVKR	NCMKQ
OPU	r	OMV	kç=d~ë	MKMVV	éé Ä	RKO	RVSQKPV	MO	VVKR	TVKR	NCMKQ

n` =ç~Ö

n`=cä~Ö
c~âÉÇ=aça=& c~âÉÇ=SMOMb m^

n`=fpqa=q~ÄäÉ

k~ãÉ	j~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÅ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=d~ë	OOMPSONKUO	NKS	ONNUNUQKUQ	NMQKMP	RVKR	NOMKQ	
pÅ	QR	kç=d~ë	QPUUVUTKNQ	OKN	QPOQMMUKRR	NMNKR	RVKR	NOMKQ	
pÅ	QR	eO	NMTVNMPKMM	MKQ	NMQSVRMKNV	NMPKMT	RVKR	NOMKQ	
pÅ	QR	eÉ	NSNOMSKRV	MKV	NRSVQPKTQ	NMOKTO	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	NMOTVSUKRP	NKR	NMMTQVOKRQ	NMOKMP	RVKR	NOMKQ	
dÉ	TO	eO	QPNTTSKUN	MKP	QNUTVMKQQ	NMPKN	RVKR	NOMKQ	
dÉ	TO	eÉ	NOOUQMKQU	MKO	NNVPVMKOU	NMOKUV	RVKR	NOMKQ	
v	UV	eO	QTNOVNPKMN	MKQ	QSPMSRQKU	NMNKTU	RVKR	NOMKQ	
v	UV	eÉ	UOPUTMKQU	MKS	UMTOTPKVP	NMOKMS	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	SQMURPOKON	NKR	SORONMSKN	NMOKR	RVKR	NOMKQ	
qÄ	NRV	eÉ	OTUSNPQKMN	MKV	OTPRTROKPS	NMNKUQ	RVKR	NOMKQ	
_á	OMV	kç=d~ë	PNMUQTNKTQ	NKR	OVRURQRKMT	NMRKMT	RVKR	NOMKQ	
_á	OMV	eÉ	NSMTSMSKQO	NKU	NRQQSOOKMP	NMQKMU	RVKR	NOMKQ	

fåíÉâÑÉêÉåÅÉ= ÜÉÅâ=pçàíç=^=Ef`pJ^F=oÉéçê

p~ã éáÉ=k~ã É	f`p^
cäÉ=k~ã É	MNVf`p^KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOVCPyVPJ ^oyi n`OP`kÅ
^Åè=qáã É	PLCPLOVCP=NUVRQVNP
p~ã éáÉ=qóéÉ	f`p^
qçí~äaäã íáçå	NKVMVMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MNQ^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~ãä	c~ãä
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeäÖÜ	n`=c~ä-Ö
_É	V	S	kç=d~ë	JVKVMN	éé¿Ä	kL^	NVUKUV	JVKN	NVVM	NVVM	
_	NN	S	kç=d~ë	MQTQ	éé¿Ä	PHN	PQQQKVN	JO	NVVM	NVVM	
k~	OP	QR	eÉ	NVOURTKOUR	éé¿Ä	NHR	USTNVVSSKNU	NVVVVVM	UM	NOM	
j Ö	OQ	QR	eÉ	NVOORPKVMT	éé¿Ä	MKQ	QRTNTUPPKTS	NVVVVVM	UM	NOM	
^ä	OT	QR	eÉ	NVSSOUHSRT	éé¿Ä	NKU	NTVUOUTTKVP	NVVVVVM	UM	NOM	
pá	OU	QR	eO	QKVMU	éé¿Ä	VHN	PPNVHRQ	JRM	NVVM	NVVM	
h	PV	QR	eÉ	NVVRPNHRQU	éé¿Ä	MHR	PVNRRPTQKTP	NVVVVVM	UM	NOM	
`~	QM	QR	eO	NVSTUPKQTT	éé¿Ä	NKN	QTORVQOSUHRN	NVVVVVM	UM	NOM	
s	RN	UV	eÉ	MKVOO	éé¿Ä	NNRT	QOSHSU	JVHR	NVVM	NVVM	
`ê	RO	UV	eÉ	OKVPQ	éé¿Ä	OKP	NQTRVHRS	NHR	NVVM	NVVM	
j å	RR	UV	eÉ	MKOPQ	éé¿Ä	NNKV	NVPVHRN	MKNT	NVVM	NVVM	
cÉ	RS	UV	eO	VVNPVKVMTU	éé¿Ä	MRT	NRRVRNNVUOKUO	NVVVVVM	UM	NOM	
`ç	RV	UV	eÉ	MKNVS	éé¿Ä	THV	NPVRHSU	M	NVVM	NVVM	
ká	SM	UV	eÉ	MKNUS	éé¿Ä	SHN	ONPVKOM	MKNU	NVVM	NVVM	
`ì	SP	UV	eÉ	MKNVN	éé¿Ä	SHP	NRQVKVM	JVKOO	NVVM	NVVM	
wå	SS	UV	eÉ	NHRNM	éé¿Ä	PKV	OPTOKQT	MKQ	NVVM	NVVM	
^ë	TR	UV	eÉ	MKVMTM	éé¿Ä	NOKP	NVSHSU	JVHR	NVVM	NVVM	
pÉ	TU	UV	eO	MKVQQ	éé¿Ä	VHO	QNHPP	JVHR	NVVM	NVVM	
pê	UU	UV	eÉ	MKONU	éé¿Ä	QKM	PPRVKQT	MKPT	NVVM	NVVM	
j ç	VR	UV	eÉ	OOOOKONS	éé¿Ä	OKQ	UQSQRPRKOV	OVMVM	UM	NOM	
^Ö	NVMT	UV	eÉ	MKVMV	éé¿Ä	OHR	OOSHST	JVHN	NVVM	NVVM	
`Ç	NNN	UV	eÉ	MKPPP	éé¿Ä	NPHS	SPTKUM	MKOU	NVVM	NVVM	
på	NNU	NRV	eÉ	MKOOO	éé¿Ä	UKV	NVQSHTP	JVHR	NVVM	NVVM	
pÄ	NON	NRV	kç=d~ë	MKVSS	éé¿Ä	OKV	ONUVKNT	JVKVR	NVVM	NVVM	
_~	NPT	NRV	kç=d~ë	MKQTU	éé¿Ä	THM	PUQQHSP	MKPP	NVVM	NVVM	
t	NUO	NRV	kç=d~ë	MKNSO	éé¿Ä	SHM	QVPVKQV	JVKPP	NVVM	NVVM	
qä	OVR	OVV	kç=d~ë	JVKVNR	éé¿Ä	kL^	NVONKNO	JVHN	NVVM	NVVM	
mÄ	OVU	OVV	kç=d~ë	MKVOR	éé¿Ä	RHQ	ONOUKVU	JVKVU	NVVM	NVVM	
qÜ	OPO	OVV	kç=d~ë	JVKVMU	éé¿Ä	kL^	OTSVKVO	JVHN	NVVM	NVVM	
r	OPU	OVV	kç=d~ë	MKVNT	éé¿Ä	OOKN	UUMKVT	JVKVU	NVVM	NVVM	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=eäÖÜ	n`=c~ä-Ö
iá	S	kç=d~ë	ORURVVTKOR	NHT	ONNUNUOKUQ	NOOHVV	RVHR	NOMQ	SMOMa ça
pÅ	QR	kç=d~ë	RPMUPVUHNM	MRR	QPOQMMUHRR	NOOKTT	RVHR	NOMQ	SMOMa ça
pÅ	QR	eO	NORVUPMHNR	MRT	NMOSVRMHNV	NOMPPP	RVHR	NOMQ	
pÅ	QR	eÉ	NUUMMUKQQ	MRR	NRSVOPKTQ	NNVKTV	RVHR	NOMQ	
dÉ	TO	kç=d~ë	NORSOSUHRV	NKU	NMMTQVOHRQ	NOOKTN	RVHR	NOMQ	SMOMa ça
dÉ	TO	eO	QVNSOOKNP	MKQ	QNUTVMKQQ	NNTKQ	RVHR	NOMQ	
dÉ	TO	eÉ	NQNRMVMHN	NKN	NNVPVMKOU	NNUHRP	RVHR	NOMQ	
v	UV	eO	RRUOPNRKPV	MKN	QSPMSRQKU	NOMRRR	RVHR	NOMQ	SMOMa ça
v	UV	eÉ	VSUVNUHNP	NHT	UMTOTPKVP	NOMMO	RVHR	NOMQ	
qÄ	NRV	kç=d~ë	TVTQURMSU	NHT	SORONMSKN	NOTHRS	RVHR	NOMQ	SMOMa ça
qÄ	NRV	eÉ	PPQUQSUKQR	NKM	OTPRTROHPS	NOOKQ	RVHR	NOMQ	SMOMa ça
_á	OVV	kç=d~ë	PUTUQUMKOP	NKO	OVRURQRKMT	NPNKVV	RVHR	NOMQ	SMOMa ça
_á	OVV	eÉ	NUORMTUKOS	NKN	NRQQSOOKMP	NNUKNS	RVHR	NOMQ	

fåíÉêÑÉêÉåÅÉ=ÜÉÅâ=pçäîáåí=^_=Ef`pJ^_F=oÉéçêí

p~ã éáÉ=k~ã É	f`p^_
cäÉ=k~ã É	MOM`p_KÇ
a~í~=m~íÜ=k~ã É	aWj*ÖäÉáíç`mj eyNya^q^yOMOPyWPJ ^oyi n`OP*kÅ
^Åè=qáã É	PLOPLOMOP=NUARVMQN
p~ã éáÉ=qóéÉ	f`p_
qçí~äaäã íáçå	NMMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑÉcäÉk~ã É	MNQ ^i_KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã ää**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeäÖÜ	n`=c ä~Ö
V	_É	S	kç=d~ë	OMKMRR	éé Ä	NKT	NNSCPMKMQ	OM	TVMR	NOMQ	
NN	_	S	kç=d~ë	OMKCQS	éé Ä	MKV	TSUCSKTM	OM	TVMR	NOMQ	
CP	k~	CR	eÉ	NVPPUUKCPR	éé Ä	NMN	SUSRUSCCKMQ	NMMMMM	TVMR	NOMQ	
CQ	j Ö	CR	eÉ	NVPPRQKMUS	éé Ä	MKV	PSQMMTRQKNU	NMMMMM	TVMR	NOMQ	
CT	^ä	CR	eÉ	NVSSSVKUMQ	éé Ä	MMS	NQNTNVPQKPT	NMMMMM	TVMR	NOMQ	
CU	pá	CR	eO	SPCKNTT	éé Ä	PMP	OVQUUPKPV	RMM	TVMR	NOMQ	[=HLJ=NMB
PV	h	CR	eÉ	VVUTMKRSR	éé Ä	MKU	PMSQMTRRKTT	NMMMMM	TVMR	NOMQ	
QM	`~	CR	eO	NVRQTUKVST	éé Ä	CMS	PSVMUTNVMMVS	NMMMMM	TVMR	NOMQ	
RN	s	UV	eÉ	OMKCPM	éé Ä	MKV	URSCPKPU	OM	TVMR	NOMQ	
RO	`ê	UV	eÉ	ONKUTV	éé Ä	MMS	NNSQCMKVP	CO	TVMR	NOMQ	
RR	j å	UV	eÉ	OMKMMQ	éé Ä	NKM	RPUPQKUM	OM	TVMR	NOMQ	
RS	cÉ	UV	eO	VVMSPKQTR	éé Ä	NKP	NCPVMTPMQCKTP	NMMMMM	TVMR	NOMQ	
RV	`ç	UV	eÉ	OMKQNU	éé Ä	NKR	NUPCQTKTN	OM	TVMR	NOMQ	
SM	ká	UV	eÉ	OMKCCS	éé Ä	NKN	RNRMVKKN	OM	TVMR	NOMQ	
SP	`ì	UV	eÉ	OMKCQP	éé Ä	NKQ	NPVVRCKOT	OM	TVMR	NOMQ	
SS	wå	UV	eÉ	OMKSTQ	éé Ä	CKR	CQCUQKTN	ONKQ	TVMR	NOMQ	
TR	^ë	UV	eÉ	OMKNVV	éé Ä	MKQ	NTVOVKTN	OM	TVMR	NOMQ	
TU	pÉ	UV	eO	OMKNCS	éé Ä	MKQ	VUPRKUQ	OM	TVMR	NOMQ	
UU	pê	UV	eÉ	ONKQSP	éé Ä	MKU	STUSCKRP	OMKV	TVMR	NOMQ	
VR	j ç	UV	eÉ	OCOVKPMO	éé Ä	MKQ	SSRNNUTKUV	OMMM	TVMR	NOMQ	
NMT	^Ö	UV	eÉ	NVKSTQ	éé Ä	MKP	ONNCNUKQT	OM	TVMR	NOMQ	
NNN	`Ç	UV	eÉ	OMKOVR	éé Ä	NKU	OVTSNKNM	OM	TVMR	NOMQ	
NNU	på	NRV	eÉ	OMKMSM	éé Ä	MKV	RVUTPKSV	OM	TVMR	NOMQ	
NON	pÄ	NRV	kç=d~ë	NVKTOT	éé Ä	MKT	QPPQNUKST	OM	TVMR	NOMQ	
NPT	_~	NRV	kç=d~ë	OMKMPP	éé Ä	MMS	NOVCQMKPP	OM	TVMR	NOMQ	
NUO	t	NRV	kç=d~ë	OCKRQP	éé Ä	MKU	CURONCKPO	OM	TVMR	NOMQ	
OMR	qä	OMV	kç=d~ë	OMKNST	éé Ä	CKN	RCRMVQKUN	OM	TVMR	NOMQ	
OMU	mÄ	OMV	kç=d~ë	OMKTMM	éé Ä	CKP	TRRSNNKUS	OM	TVMR	NOMQ	
OPO	qÜ	OMV	kç=d~ë	ONKUPQ	éé Ä	NKQ	SVVPVVKMP	OM	TVMR	NOMQ	
OPU	r	OMV	kç=d~ë	ONKVMP	éé Ä	CKR	SQUPCNKUU	OM	TVMR	NOMQ	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eäÖÜ	n`=c ä~Ö
iá	S	kç=d~ë	OMTRCQCKTO	MMS	CNNUNUCKUQ	VTKVT	RVMR	NOMQ	
pÅ	CR	kç=d~ë	QNPVSNQKQU	NKP	CPCQMMUKRR	VRKTQ	RVMR	NOMQ	
pÅ	CR	eO	VVSPUUKCS	NKN	NMCSVRMKNV	VRKNT	RVMR	NOMQ	
pÅ	CR	eÉ	NQUNMMKVN	MKQ	NRSVCPKTQ	VQKPT	RVMR	NOMQ	
dÉ	TO	kç=d~ë	NMMMTMRKRO	CKN	NMMTCQVCKRQ	VVKPP	RVMR	NOMQ	
dÉ	TO	eO	PVUMOMKCR	MKT	QNUTVMKQQ	VRKMQ	RVMR	NOMQ	
dÉ	TO	eÉ	NNCPTCKPV	NKO	NNVPVMKCU	VQKNO	RVMR	NOMQ	
v	UV	eO	QCPUUTSKUP	MKT	QSPMSRQKU	VRKUS	RVMR	NOMQ	
v	UV	eÉ	TRUTOTKRU	MKP	UMTOTPKVP	VPKVV	RVMR	NOMQ	
qÄ	NRV	kç=d~ë	SRQVSRSKTT	NMS	SCRCMMSKN	NVCKTS	RVMR	NOMQ	
qÄ	NRV	eÉ	OSSRVVPKTV	MKO	OTPRTRCKPS	VTKQR	RVMR	NOMQ	
_á	OMV	kç=d~ë	PNVRUPVKMM	CKQ	OVRURQRKMT	NVUKMD	RVMR	NOMQ	
_á	OMV	eÉ	NQRUPTNKTS	MKR	NRQQSCCKMP	VQKQO	RVMR	NOMQ	

ïæåÉ~ê=ø~åÖÉ=p~ã éäÉ=Ei opF=øÉéçã

p~ã éäÉ=k~ã É	i opN
cäÉ=k~ã É	MON i opKÇ
a~í~=m~íÜ=k~ã É	aWÝ^ÖäÉáíÝ^ mj eyNya^q^yOMOPyMPJ ^o y i n ` OP^ kÅ
^Åè=qáã É	PLOPLOMOP=NVMMTWOO
p~ã éäÉ=qóéÉ	i op
qçí~äa ãäíáç;å	NKMMMM
` çã ã Éåí	JJJ
fpqa=ø ÉÑ%cäÉk~ã É	MNQ ^i _KÇ
p~ã éäÉ=n ` =m~ëëlcá~ä	c~ää
fpqa=n ` =m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áã**

n ` =^ å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==ì mp==	bñés~ä	B o ÉÅ	B i çï	B eäÖÜ	n ` =ø ä~Ö
V	_É	S	k ç=ø ~ë	VQKUOP	ééÄ	OKR	RSMOSOKOM	NMM	VQKUO	UVfR	NNMQ	
NN	_	S	k ç=ø ~ë	RMVKVNP	ééÄ	OKN	NVOSTORMN	RMM	NMNKVU	UVfR	NNMQ	
RN	s	UV	e É	NMQNKPU	ééÄ	MKQ	QNVUOSMKQO	NMMM	NMQKKQ	UVfR	NNMQ	
RO	` ê	UV	e É	OMUUMSTV	ééÄ	MKP	NMSPRPNRKTR	OMMM	NMQKQP	UVfR	NNMQ	
RR	j å	UV	e É	OMQRKTPM	ééÄ	MKQ	RQUTNOTKRT	OMMM	NMOKOV	UVfR	NNMQ	
RV	` ç	UV	e É	NMUMKMOM	ééÄ	MKV	VPPNTPNKVQ	NMMM	NMU	UVfR	NNMQ	
SM	k á	UV	e É	NNOOKUPN	ééÄ	MKV	OSVNTNUKMR	NMMM	NNOKOU	UVfR	NNMQ	[=HLJ=NMB
SP	` ì	UV	e É	ONURKQLP	ééÄ	MKT	NQRMOSQPKST	OMMM	NMVKOT	UVfR	NNMQ	
SS	wå	UV	e É	ONMUKVVU	ééÄ	MKP	OPTUOMRKOS	OMMM	NMRKQR	UVfR	NNMQ	
TR	^ë	UV	e É	NMNOKMOU	ééÄ	MKM	USQRQQKVO	NMMM	NMNNO	UVfR	NNMQ	
TU	pÉ	UV	e O	NMNPKRNU	ééÄ	MKV	QVMPVVKTN	NMMM	NMNKPR	UVfR	NNMQ	
UU	pê	UV	e É	OMQTKVMM	ééÄ	MKO	SOPRTMRKST	OMMM	NMOKQ	UVfR	NNMQ	
VR	j ç	UV	e É	NNOUKMVM	ééÄ	MKN	POQPPQQKVM	NMMM	NNOKUO	UVfR	NNMQ	[=HLJ=NMB
NMT	^Ö	UV	e É	NNMKRTU	ééÄ	MKN	NNQPRMMKOM	NMM	NNMKRU	UVfR	NNMQ	[=HLJ=NMB
NNN	` Ç	UV	e É	NMUMKRQP	ééÄ	MKP	NRPUUVUKST	NMMM	NMUKVR	UVfR	NNMQ	
NNU	på	NRV	e É	VVOKPQO	ééÄ	MKP	OVOUNOVKVS	NMMM	VVKOP	UVfR	NNMQ	
NON	pÄ	NRV	k ç=ø ~ë	VTTKPPU	ééÄ	MKR	OONONUVOKMR	NMMM	VTKTP	UVfR	NNMQ	
NPT	_~	NRV	k ç=ø ~ë	NVVMQVP	ééÄ	MKU	NPOPOPMRKUM	OMMM	VVKRO	UVfR	NNMQ	
NUO	t	NRV	k ç=ø ~ë	NMSOKVNQ	ééÄ	MKU	NPTTMOVOKRO	NMMM	NMSKOV	UVfR	NNMQ	
OMR	qä	OMV	k ç=ø ~ë	NMQQKNUP	ééÄ	MKO	OVUTPRPKMM	NMMM	NMQKQO	UVfR	NNMQ	
OMU	mÄ	OMV	k ç=ø ~ë	OMQTKVMS	ééÄ	MKN	UOOPQQSOKSN	OMMM	NMOKQ	UVfR	NNMQ	
OPO	qÜ	OMV	k ç=ø ~ë	NMPRKUTU	ééÄ	MKS	PSQMVNOMPQ	NMMM	NMPKRV	UVfR	NNMQ	
OPU	r	OMV	k ç=ø ~ë	NMSSKTNR	ééÄ	MKV	PQTSPMPQKTP	NMMM	NMSKST	UVfR	NNMQ	

n ` =fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=ø pa	oÉÑ= mp	B ø ÉÅ	B n ` =ì çï	B n ` =ø äÖÜ	n ` =ø ä~Ö
i á	S	k ç=ø ~ë	ONNQMOPKPM	OKO	ONNUNUQKUQ	VVKU	RVfR	NOMQ	
pÅ	QR	k ç=ø ~ë	QNRQOQRUKMP	NKO	QPOQMMUKRR	VSKMT	RVfR	NOMQ	
d É	TO	k ç=ø ~ë	VVORNOKVV	NKN	NMMTQVOKRQ	VUKRN	RVfR	NOMQ	
qÄ	NRV	k ç=ø ~ë	STRPMSNKTR	MKV	SOROMMSKN	NMUKMN	RVfR	NOMQ	
_á	OMV	k ç=ø ~ë	PRNUOQMSV	MKT	OVRURQRKMT	NNUKVO	RVfR	NOMQ	
pÅ	QR	e O	VTNMOVKMO	MKV	NMQSVRMKMV	VOKTR	RVfR	NOMQ	
d É	TO	e O	PUTSSRKUR	MKV	QNUTVMKQQ	VOKRT	RVfR	NOMQ	
v	UV	e O	QQMMMOTKOS	MKU	QSPMSRQKU	VRKMO	RVfR	NOMQ	
pÅ	QR	e É	NPTSTQKVM	MKU	NRSVQPKTQ	UTKTO	RVfR	NOMQ	
d É	TO	e É	NMTNPTKUO	MKP	NNVPVMKOU	UVKTQ	RVfR	NOMQ	
v	UV	e É	TPNMSNKQM	MKU	UMTOTPKVP	VMKRS	RVfR	NOMQ	
qÄ	NRV	e É	OSQPPPVKMU	NKQ	OTPRTROKPS	VSKSO	RVfR	NOMQ	
_á	OMV	e É	NRQRVVOKRS	MKV	NRQQSOOKMP	NMMKMV	RVfR	NOMQ	

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É iopO

cãÉ=k~ã É MOOpj mi kÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n` OP' kÅ

^Åè=qãã É PLOPLOMOP=NVMMVMNQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãäíáçå NMMMM

p~ã éäÉ=n` =m~ëëlc á~ä c~ãä

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==¹ mp==	iao	n` =cä~Ö
V	_É	S	kç=d ~ë	MMVOS	ééÄ	NVMN	PSMMVN	NMVM	
NN	_	S	kç=d ~ë	PMONT	ééÄ	MMV	NOVTOMSV	NMMVM	
OP	k~	OR	eÉ	NVUURUMMV	ééÄ	OMT	NOUSPVSQVMOU	OMMMMVM	
OQ	j Ö	OR	eÉ	NVTQSUMQPT	ééÄ	NMT	STTTNPORMSS	OMMMMVM	
OT	^ä	OR	eÉ	ONMSPUMTUS	ééÄ	NMVM	OTOTNVSTHPT	OMMMMVM	[iao
OU	pá	OR	eO	NVTSQMQSP	ééÄ	NMR	QUSMRNRMVP	NMMMVM	[iao
PV	h	OR	eÉ	NVPNUUMONN	ééÄ	NMO	RTTPPRUOMQN	OMMMMVM	
QM	` ~	OR	eO	OMOOPPMTMP	ééÄ	OMR	SUSRUUQOMVOU	OMMMMVM	[iao
RN	s	UV	eÉ	MMPPV	ééÄ	NOMM	NRSTMOV	NMMM	
RO	` ê	UV	eÉ	NMVMM	ééÄ	PMV	SQSMMVO	OMMM	
RR	j å	UV	eÉ	NMRTV	ééÄ	NMR	QPONMVU	OMMM	
RS	cÉ	UV	eO	VSNMNMOSV	ééÄ	NMM	NNPRVMMSTPMVV	NMMMMM	
RV	` ç	UV	eÉ	NMRQS	ééÄ	OMM	NPTSQMVV	NMMM	
SM	k á	UV	eÉ	MOUTU	ééÄ	PMU	PPPNMRS	NMMM	
SP	` ì	UV	eÉ	NMVNR	ééÄ	PMT	TPTUMTQ	OMMM	
SS	wå	UV	eÉ	PMPTN	ééÄ	PMR	PVSTMPM	OMMM	
TR	^ë	UV	eÉ	MQUS	ééÄ	MOU	QQQMTO	NMMM	
TU	pÉ	UV	eO	MRUN	ééÄ	RMQ	OTUMSS	NMMM	
UU	pê	UV	eÉ	PMVRS	ééÄ	OMN	VROVMVQ	OMMM	
VR	j ç	UV	eÉ	NMUTT	ééÄ	OMO	RTTVMVU	NMMM	
NMT	^Ö	UV	eÉ	MMVRU	ééÄ	OMP	SVOMOR	NMVM	
NNN	` Ç	UV	eÉ	MOVQ	ééÄ	RMQ	QPRMNV	NMMM	
NNU	på	NRV	eÉ	MSVN	ééÄ	OMU	ONPPMRR	NMMM	
NON	pÄ	NRV	kç=d ~ë	MQVV	ééÄ	QMM	NNONVMVP	NMMM	
NPT	_~	NRV	kç=d ~ë	NMQVN	ééÄ	QMQ	VMPVMPM	OMMM	
NUO	t	NRV	kç=d ~ë	NMSVO	ééÄ	NMP	OPMVUMVV	NMMM	
OMR	qä	OMV	kç=d ~ë	MRRR	ééÄ	RMQ	NRQNOMPT	NMMM	
OMU	mÄ	OMV	kç=d ~ë	NMSTR	ééÄ	OMP	SNMMMMVO	OMMM	
OPO	qÜ	OMV	kç=d ~ë	MMVOO	ééÄ	NMU	PNQVUMVM	NMMM	
OPU	r	OMV	kç=d ~ë	MQSQ	ééÄ	QMQ	NPTSRMRT	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B¤ÉÅ	Bn` =¡çï	Bn` =¤ãÜÜ	n` =cä~Ö
iá	S	kç=d ~ë	OMSQNTVMNO	NMQ	ONNUNUQMUQ	VTMQR	RVMR	NOMVQ	
pÅ	OR	kç=d ~ë	PVVOPSTMNQ	NMR	QPOQMMUMRR	VOMPP	RVMR	NOMVQ	
pÅ	OR	eO	VSSSSUMOM	MMT	NVQSVRVMNV	VOMPP	RVMR	NOMVQ	
pÅ	OR	eÉ	NQQPPTMPR	NMO	NRSVOPMTQ	VNMVT	RVMR	NOMVQ	
dÉ	TO	kç=d ~ë	VRMMVOMRU	MMU	NMMTQVOMRQ	VQMP	RVMR	NOMVQ	
dÉ	TO	eO	PTVOOPMOV	MMR	ONUTVMMQQ	VMMS	RVMR	NOMVQ	
dÉ	TO	eÉ	NNMSSMMVR	MMR	NNVPVMMOU	VOMSV	RVMR	NOMVQ	
v	UV	eO	ONVQVNVMON	NMQ	QSPMSRQMU	VMMRV	RVMR	NOMVQ	
v	UV	eÉ	TQRUPNMRS	MMP	UMTOTPMVP	VOMPV	RVMR	NOMVQ	
qÄ	NRV	kç=d ~ë	SRMNNTOMTO	MMU	SORONMVSMN	NMPMVV	RVMR	NOMVQ	
qÄ	NRV	eÉ	ORROVVSMUM	NMP	OTPRTRONPS	VPMPO	RVMR	NOMVQ	
_á	OMV	kç=d ~ë	PNQUOVQMSR	NMM	OVRURQRMMT	NMSMQN	RVMR	NOMVQ	
_á	OMV	eÉ	NPRTPUTMRN	MMN	NRQQSOOMMP	UTMUU	RVMR	NOMVQ	

p~ã éäÉ=k~ã É ofkpb

cãÉ=k~ã É MOPpj mi kÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n` OP' kÅ

^Åè=qãã É PLOPLOMOP=NVMØMQR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå NMMMM

p~ã éäÉ=n` =m~ëëlc á~ä c~åä

fpqa=n` =m~ëëlc~åä c~åä

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==mp==	iao	n` =cä~Ö
V	_É	S	kç=d~ë	RMVSR	éé Ä	OOKQ	NPNMKN	NMM	
NN	_	S	kç=d~ë	OONMRPV	éé Ä	OKR	PTMMRQ	NMMM	
OP	k~	QR	eÉ	NONSUUKOOS	éé Ä	NOKT	NMMTOSKOP	OMMMMM	
OQ	j Ö	QR	eÉ	RTNQVMKMR	éé Ä	VKQ	ORNSRKSP	OMMMMM	
OT	^ä	QR	eÉ	SNPVRKOQV	éé Ä	VKS	NMNVTKOP	OMMMMM	
OU	pá	QR	eO	QVNVMQVV	éé Ä	TKV	PMVSKVS	NMMMM	
PV	h	QR	eÉ	NPUMNNKSSN	éé Ä	NOKN	ROUMOKUR	OMMMMM	
QM	` ~	QR	eO	RPUTPKUQQ	éé Ä	PKP	ORQSSOKUN	OMMMMM	
RN	s	UV	eÉ	PQVMQSV	éé Ä	QKM	RVSKSV	NMMM	
RO	` ê	UV	eÉ	NQRQKMMT	éé Ä	RKT	PNPQKQO	OMMM	
RR	j å	UV	eÉ	QSUKUSS	éé Ä	PKV	RNPKOQ	OMMM	
RS	cÉ	UV	eO	VRRUNKONR	éé Ä	OKV	QVOMSPKRU	NMMMM	
RV	` ç	UV	eÉ	NNQKMVS	éé Ä	NKT	QNTKUM	NMMM	
SM	k á	UV	eÉ	UOUKQSM	éé Ä	RKN	UQNKVR	NMMM	
SP	` ì	UV	eÉ	QVPKROS	éé Ä	RKR	NPUSKTS	OMMM	
SS	wå	UV	eÉ	RQOVKRON	éé Ä	OKS	ORVPKSO	OMMM	[i a o
TR	^ë	UV	eÉ	OUMKVSP	éé Ä	QKU	NMNKSU	NMMM	
TU	pÉ	UV	eO	OUMKNNQ	éé Ä	PKM	RSKPP	NMMM	
UU	pê	UV	eÉ	NPUKSNS	éé Ä	NMKU	NTUKUV	OMMM	
VR	j ç	UV	eÉ	NVNTKQOS	éé Ä	QKQ	OPPQKTM	NMMM	[i a o
NMT	^Ö	UV	eÉ	NRKNRN	éé Ä	NMKO	SSKST	NMM	
NNN	` Ç	UV	eÉ	TNKNNQ	éé Ä	NPKV	QOKRV	NMMM	
NNU	på	NRV	eÉ	OMMKVMQ	éé Ä	PKV	OPPMKOR	NMMM	[i a o
NON	pÄ	NRV	kç=d~ë	NSOKUSS	éé Ä	NQKO	NPPQKUM	NMMM	
NPT	_~	NRV	kç=d~ë	UROKTOP	éé Ä	QKM	OMRUKVV	OMMM	
NUO	t	NRV	kç=d~ë	NVVPKQVP	éé Ä	OKV	VPTSKRO	NMMM	[i a o
OMR	qä	OMV	kç=d~ë	NOPKMQV	éé Ä	NMKV	OUMPKOR	NMMM	
OMU	mÄ	OMV	kç=d~ë	UUKPMR	éé Ä	NNKU	OUNSKQR	OMMM	
OPO	qÜ	OMV	kç=d~ë	NRPKOPV	éé Ä	RKS	QOUNKVS	NMMM	
OPU	r	OMV	kç=d~ë	POKPPR	éé Ä	NMKS	UPTKRU	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=opa	oÉÑ=mp	B=oÉÅ	Bn` =içï	Bn` =eáÜÜ	n` =cä~Ö
iá	S	kç=d~ë	VOQOKQT	NKR	ONNUNUQKUQ	MKQQ	RVKR	NOMKQ	SMOMa ça
pÅ	QR	kç=d~ë	SOOUKNU	NKO	QPOOMVUKRR	MKNQ	RVKR	NOMKQ	SMOMa ça
pÅ	QR	eO	NPQTKNQ	QKU	NVQSVRMKNV	MKNP	RVKR	NOMKQ	SMOMa ça
pÅ	QR	eÉ	NUSKSP	NOKS	NRSVOPKTQ	MKNO	RVKR	NOMKQ	SMOMa ça & eáÜÜfpqa=opa
dÉ	TO	kç=d~ë	SOURKRS	OKS	NVMTQVOKRQ	MKSO	RVKR	NOMKQ	SMOMa ça
dÉ	TO	eO	QTPKVO	PKM	QNUTVMKQQ	MKNN	RVKR	NOMKQ	SMOMa ça
dÉ	TO	eÉ	NORKPN	NVKM	NNVPVMKOU	MKNO	RVKR	NOMKQ	SMOMa ça & eáÜÜfpqa=opa
v	UV	eO	NUOTKTU	OKT	QSPMSRQKU	MKVQ	RVKR	NOMKQ	SMOMa ça
v	UV	eÉ	PMVKVR	QKV	UMTOTPKVP	MKVQ	RVKR	NOMKQ	SMOMa ça
qÄ	NRV	kç=d~ë	OQRNKSM	OKT	SORQMVSKN	MKVQ	RVKR	NOMKQ	SMOMa ça
qÄ	NRV	eÉ	NVQPKNU	QKN	OTPRTROKPS	MKVQ	RVKR	NOMKQ	SMOMa ça
_á	OMV	kç=d~ë	OTVTKTU	OKN	OVRURQRKMT	MKVV	RVKR	NOMKQ	SMOMa ça
_á	OMV	eÉ	NQVVKNQ	NKV	NRQQSOOKMP	MKN	RVKR	NOMKQ	SMOMa ça

p~ã éäÉ=k~ã É ofkpb

cãÉ=k~ã É MOOpj mi kÇ

a~í~=m~íÜ=k~ã É aWµ ÖäÉåíµ mj eyNya^q^yOMOPyMPJ ^oyi n` OP' kÅ

^Åè=qãã É PLOPLOMOP=NVMRRMMM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå NMMMM

p~ã éäÉ=n` =m~ëëlc á~ä c~ãä

fpqa=n` =m~ëëlc~ãä c~ãä

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =cä-Ö
V	_É	S	k ç=d ~ë	QKQNO	éé Ä	VKQ	TTKTU	NMM	
NN	_	S	k ç=d ~ë	OQMKOOO	éé Ä	NKO	OTOVKMV	NMMM	
OP	k ~	QR	e É	NNSNUUKTMS	éé Ä	NUKO	TOUQUKSO	OMMMMM	
OQ	j Ö	QR	e É	PTOQSKOQM	éé Ä	NQKU	NOQPMKPS	OMMMMM	
OT	^ ä	QR	e É	PVTNTKNUT	éé Ä	NNKV	RMNSKRQ	OMMMMM	
OU	pá	QR	e O	QNSNKROR	éé Ä	TKR	OOQOKRQ	NMMMM	
PV	h	QR	e É	NQNVUQKRUM	éé Ä	NRKN	QNOSNKTN	OMMMMM	
QM	` ~	QR	e O	PRMOTKSVP	éé Ä	RKM	NQNVSRKST	OMMMMM	
RN	s	UV	e É	SQUKRUQ	éé Ä	NQKM	QUSKSU	NMMM	
RO	` ê	UV	e É	POMPKSRQ	éé Ä	NOKU	PMPNKTR	OMMM	[i a o
RR	j å	UV	e É	VPVKRPR	éé Ä	UKR	QRPKOS	OMMM	
RS	cÉ	UV	e O	NPUPMVKRTS	éé Ä	NKV	PRTRRSKPM	NMMMMM	[i a o
RV	` ç	UV	e É	NQVKPSM	éé Ä	ONKS	OQMKUN	NMMM	
SM	k á	UV	e É	NTUNKTVO	éé Ä	NTKQ	TVNKNQ	NMMM	[i a o
SP	` ì	UV	e É	VURKOUO	éé Ä	OMKR	NOMTKUR	OMMM	
SS	wå	UV	e É	RSRQKORS	éé Ä	NRKO	NNUOKOV	OMMM	[i a o
TR	^ ë	UV	e É	RQNKTPV	éé Ä	UKR	USKPQ	NMMM	
TU	pÉ	UV	e O	QMRKPNN	éé Ä	VKU	QMKUP	NMMM	
UU	pê	UV	e É	ONQKRSN	éé Ä	OTKO	NOMKMM	OMMM	
VR	j ç	UV	e É	PMUMKUTS	éé Ä	TKS	NSRTKVN	NMMM	[i a o
NMT	^ Ö	UV	e É	NUKRPT	éé Ä	OTKU	PSKST	NMM	
NNN	` Ç	UV	e É	UMKVOQ	éé Ä	OQKN	ONKQU	NMMM	
NNU	på	NRV	e É	PQTOKTRM	éé Ä	SKT	NVSPKRN	NMMM	[i a o
NON	pÄ	NRV	k ç=d ~ë	NVUKNTN	éé Ä	NNKP	VQNKMP	NMMM	
NPT	_~	NRV	k ç=d ~ë	OPTKQMM	éé Ä	SKU	PPMKPR	OMMM	
NUO	t	NRV	k ç=d ~ë	ORPOKMUO	éé Ä	NMKP	SUQVKMU	NMMM	[i a o
OMR	qä	OMV	k ç=d ~ë	NNVKRRR	éé Ä	NSKO	NVORKRP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	VUKNQP	éé Ä	RKT	OONRKTR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NRNKRPM	éé Ä	VKV	OVVMKNU	NMMM	
OPU	r	OMV	k ç=d ~ë	POKNPR	éé Ä	NRKU	RUTKPM	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B=¤ÉÅ	B n` =ç ï	B n` =¤äÜÜ	n` =cä-Ö
i á	S	k ç=d ~ë	SOURKMM	MKU	ONNUNUQKUQ	MKP	RVKR	NOMKQ	SMOMa ça
pÅ	QR	k ç=d ~ë	RONQKSP	PKR	QPOQMVUKRR	MKNO	RVKR	NOMKQ	SMOMa ça
pÅ	QR	e O	NNRQKRM	OKN	NVQSVRMKNV	MKNN	RVKR	NOMKQ	SMOMa ça
pÅ	QR	e É	NQOKSQ	NSKQ	NRSVOPKTQ	MKW	RVKR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=¤pa
dÉ	TO	k ç=d ~ë	RQQUKMP	MKU	NVMTQVOKRQ	MKRQ	RVKR	NOMKQ	SMOMa ça
dÉ	TO	e O	POPKVQ	TKS	QNUTVMKQQ	MKWU	RVKR	NOMKQ	SMOMa ça
dÉ	TO	e É	UVKVU	NMKO	NNVPVMKOU	MKWU	RVKR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=¤pa
v	UV	e O	VNTKUS	PKU	QSPMSRQKU	MKWO	RVKR	NOMKQ	SMOMa ça
v	UV	e É	NPTKPN	NOKS	UMTOTPKVP	MKWO	RVKR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=¤pa
qÄ	NRV	k ç=d ~ë	NQNPKNQ	PKP	SCROMVSKN	MKWO	RVKR	NOMKQ	SMOMa ça
qÄ	NRV	e É	RMTKVN	SKR	OTPRTROKPS	MKWO	RVKR	NOMKQ	SMOMa ça
_á	OMV	k ç=d ~ë	NVUOKQR	SKP	OVRURQRKMT	MKWT	RVKR	NOMKQ	SMOMa ça
_á	OMV	e É	VUOKRO	PKN	NRQQSOOKMP	MKWS	RVKR	NOMKQ	SMOMa ça

`çåíaåìaåÖ=~äåÄê~íáçå=sÉêáÑáÅ~íáçå=É``sF=oÉéçê

p~ã éáÉ=k~ã É	``s
cáÉ=k~ã É	MOR``skÇ
a~í~=m~íÜk~ã É	aWy^ÖáÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OP^hÅ
^Åè=qáã É	PLOPLOMOP=NVKQMNQ
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MNQ ^i _kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	ORKMVP	ééÄ	NKM	NQVNQUKQO	CR	NMMPT	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OQKVPP	ééÄ	NKU	VSSVPKVN	CR	VVKTP	UVKU	NNMO	
OP	k ~	QR	e É	RRQQKMNN	ééÄ	NKV	PSPVQPSKOS	RMMM	NNMKUU	UVKU	NNMO	[=HLJ=NMB
OQ	j Ö	QR	e É	RRQNKQTN	ééÄ	MKQ	NVMTUNNKSQ	RMMM	NNMKUP	UVKU	NNMO	[=HLJ=NMB
OT	^ä	QR	e É	RRUKPQO	ééÄ	NKQ	TOSOTKVV	RMM	NNNKST	UVKU	NNMO	[=HLJ=NMB
OU	pá	QR	e O	RPVKSRP	ééÄ	NKR	ORONMVKQV	RMM	NMTKVP	UVKU	NNMO	
PV	h	QR	e É	RPNPKQUP	ééÄ	MKO	NSONMUTRTM	RMMM	NMSKOT	UVKU	NNMO	
QM	` ~	QR	e O	RPSTHPNS	ééÄ	MKP	NUUNTNPSKPV	RMMM	NMTHPR	UVKU	NNMO	
RN	s	UV	e É	OSKPRP	ééÄ	MKQ	NMVNNPKMQ	CR	NMRKQN	UVKU	NNMO	
RO	` ê	UV	e É	OSKMMU	ééÄ	MKT	NPSSMOKMO	CR	NMQKMP	UVKU	NNMO	
RR	j å	UV	e É	ORKTVQ	ééÄ	MKU	SURQQRTN	CR	NMPKNU	UVKU	NNMO	
RS	cÉ	UV	e O	RNMTKUPM	ééÄ	NKR	SPUVUQQQRRP	RMMM	NMOKNS	UVKU	NNMO	
RV	` ç	UV	e É	OSKSMM	ééÄ	MKQ	OPRUQVRTV	CR	NMSKQ	UVKU	NNMO	
SM	ká	UV	e É	OSKRON	ééÄ	MKU	SSPSTKNQ	CR	NMSKMU	UVKU	NNMO	
SP	` ì	UV	e É	OTKMNV	ééÄ	NKQ	NUQQNRKUN	CR	NMUKMU	UVKU	NNMO	
SS	wå	UV	e É	OSKQPT	ééÄ	NKU	PMQPMKNR	CR	NMQKVR	UVKU	NNMO	
TR	^ë	UV	e É	ORKPUM	ééÄ	NKS	QQQRRRTN	CR	NMNKRO	UVKU	NNMO	
TU	pÉ	UV	e O	ORKQPT	ééÄ	NKN	NOQQQKQP	CR	NMNKTR	UVKU	NNMO	
UU	pê	UV	e É	OSKMVT	ééÄ	MKO	UNRQUKCR	CR	NMQKPV	UVKU	NNMO	
VR	j ç	UV	e É	OSKMVR	ééÄ	NKN	TTQMNKOV	CR	NMQKPU	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKMNS	ééÄ	NKR	QUSRSPKQS	CR	NMUKMS	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKROV	ééÄ	MKS	PUQPTKVP	CR	NMSKNO	UVKU	NNMO	
NNU	på	NRV	e É	ORKMQM	ééÄ	OKN	TQQQSHRO	CR	NMMKNS	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	ORKSNP	ééÄ	MKV	RQSSQUVKNV	CR	NMOKQR	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKSPR	ééÄ	OKR	NSMRUNKQS	CR	NMOKRQ	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKROT	ééÄ	PKQ	PNPSRUHPM	CR	NMOKNN	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKQVM	ééÄ	NKU	SUTQQQKQN	CR	NMNKVS	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKQTQ	ééÄ	OKO	NMMNMPRKPQ	CR	NMRKV	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKMTQ	ééÄ	NKS	USRMUQKNV	CR	NMQKP	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OTKCCR	ééÄ	OKR	UPRNNSKUO	CR	NMUKV	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=o pa	oÉÑ=mp	B=oÉÄ	B n`=ï çï	B n`=eäÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	ONQQSTRKNQ	PKM	ONNUNUQKUQ	NMMPN	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QMURRNPKMM	QKR	QPQQMMUKRR	VQKQU	RVKR	NOMQ	
pÅ	QR	e O	VVTPQRKPT	NKR	NMQSVRMKNV	VRKOS	RVKR	NOMQ	
pÅ	QR	e É	NQQTQUKSO	MKR	NRSVQPKTQ	VOKCO	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	VRVQPPKSO	RKR	NMMTQVOKRQ	VRKCP	RVKR	NOMQ	
dÉ	TO	e O	PVSPVUKQM	NKN	QNUTVMKQQ	VQKSR	RVKR	NOMQ	
dÉ	TO	e É	NMVRQQKRT	MKO	NNVPVMKOU	VNKTR	RVKR	NOMQ	
v	UV	e O	QQPTSVQKPN	MKV	QSPMSRQKU	VRKUP	RVKR	NOMQ	
v	UV	e É	TQVTPQKTS	MKQ	UMTOTPKVP	VOKUT	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPSCQQMKNQ	PKT	SCROMVSKN	NMNKTT	RVKR	NOMQ	
qÄ	NRV	e É	OSRSTPSKVQ	NKM	OTPRTROKPS	VTKNN	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PPNOTVNKMS	RKP	OVRURQRKMT	NNNKVT	RVKR	NOMQ	
_á	OMV	e É	NRPNMVRKMN	NKT	NRQQSOOKMP	VVKNO	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=É``_F=oÉéçã

p~ã éáÉ=k~ã É	``_
cäÉ=k~ã É	MOS\``_KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíÝ^mj eyNya^q^yOMOPyMPJ ^oyi n`OP^kÅ
^Åè=qáã É	PLOPLOMOP=NVKQMVRS
p~ã éáÉ=qóéÉ	``_
qçí~äa äi íáç~å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑncäÉk~ã É	MNQ ^i_KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	m~ëë
fpqa=n`=m~ëëlc~äi	m~ëë
l éÉê~íçê	**~Çã áä**

n`=^å~äöíÉ=q~ÄæÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÅK	r åáë	opa	==\ mp==	i äi á	n`=c ä~Ö
V	_É	S	k ç=d ~ë	MKMNP	éé Ä	OOKO	NUNKNO	MO	
NN	_	S	k ç=d ~ë	MKOUQ	éé Ä	OKM	ONSSKUT	Q	
OP	k~	QR	e É	NNKPVU	éé Ä	NSKP	RONUUKMV	OMM	
OQ	j Ö	QR	e É	SKUTO	éé Ä	NMKN	PMMOKUU	OM	
OT	^ä	QR	e É	PKQTT	éé Ä	NOKS	RVUKVN	OM	
OU	pá	QR	e O	MKSOM	éé Ä	TTKU	NMRNKOV	NMM	
PV	h	QR	e É	NNKMVT	éé Ä	OMKO	PPPSVKVO	OMM	
QM	`~	QR	e O	SKUUM	éé Ä	NKS	QNOTPKTP	OM	
RN	s	UV	e É	MKMPO	éé Ä	OPKV	PNPKPQ	N	
RO	`ê	UV	e É	JMKMMP	éé Ä	k L^	UMPKQN	N	
RR	j å	UV	e É	JMKMMQ	éé Ä	k L^	NTTMSQ	MQ	
RS	cÉ	UV	e O	PKTPT	éé Ä	PKQ	TTNMNKQM	OM	
RV	` ç	UV	e É	MKMNR	éé Ä	TKN	QUQKQS	MO	
SM	k á	UV	e É	JMKMUR	éé Ä	k L^	TRRKRV	MQ	
SP	` ì	UV	e É	MKMMR	éé Ä	NRSKP	RRUKVN	MS	
SS	wå	UV	e É	MKMMO	éé Ä	OKR	QNPKPQ	O	
TR	^ë	UV	e É	MKMPU	éé Ä	NUKQ	RSKPQ	N	
TU	pÉ	UV	e O	MKMQN	éé Ä	NNKV	POKPP	N	
UU	pê	UV	e É	MKMNR	éé Ä	TMKQ	URKRS	N	
VR	j ç	UV	e É	MKOVU	éé Ä	OKM	NNUPKQM	N	
NMT	^Ö	UV	e É	MKMMV	éé Ä	VKQ	NUSKST	MO	
NNN	`Ç	UV	e É	MKMNR	éé Ä	OUKU	PQKMT	MO	
NNU	på	NRV	e É	MKMVT	éé Ä	QKS	QSRKRU	N	
NON	pÄ	NRV	k ç=d ~ë	MKMOV	éé Ä	NNKR	NMMNKMV	MO	
NPT	_~	NRV	k ç=d ~ë	MKMNT	éé Ä	QOKN	NUSKUT	MQ	
NUO	t	NRV	k ç=d ~ë	MKOVS	éé Ä	QKU	RVMMKUV	N	
OMR	qä	OMV	k ç=d ~ë	MKMPP	éé Ä	OTKM	OOPOKRR	MO	
OMU	mÄ	OMV	k ç=d ~ë	MKMNT	éé Ä	SKO	NRTUKPT	MO	
OPO	qÜ	OMV	k ç=d ~ë	MKMON	éé Ä	PMKR	PQTTKQV	N	
OPU	r	OMV	k ç=d ~ë	MKMNO	éé Ä	NPKP	SQQKMQ	MO	

n`=fpqa=q~ÄæÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=çï	B n`=cÖÜ	n`=c ä~Ö
i á	S	k ç=d ~ë	ONVONVOKTV	NKT	ONNUNUQKUQ	NMPKQV	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QNOSRNSKPV	MKU	QPOQMMUKRR	VRKQP	RVKR	NOMQ	
pÅ	QR	e O	NMMTUNVKMD	OKO	NMQSVRMKW	VSKOS	RVKR	NOMQ	
pÅ	QR	e É	NQSUMVKVR	NKP	NRSVOPKTQ	VPKRQ	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VVUVSNKPS	NKP	NMMTQVOKRQ	VVKNR	RVKR	NOMQ	
d É	TO	e O	QMRRSNKRQ	MKS	QNUTVMKQQ	VSKUQ	RVKR	NOMQ	
d É	TO	e É	NNNVSVKQV	MKU	NNVPVMKOU	VPKTU	RVKR	NOMQ	
v	UV	e O	QRQMVRMKTQ	MKT	QSPMSRQKU	VUKMS	RVKR	NOMQ	
v	UV	e É	TSUMVNKVT	NKQ	UMTOTPKVP	VRKNR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	STPNQRRKQM	MKR	SORQMVSKN	NMTHST	RVKR	NOMQ	
qÄ	NRV	e É	OSVURVSKUV	NKV	OTPRTROKPS	VUKSQ	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQPOOVNKPV	MKP	OVRURQRKMT	NNSKUN	RVKR	NOMQ	
_á	OMV	e É	NRQQOTRKMQ	OKM	NRQQSOOKMP	VVKVU	RVKR	NOMQ	

`çåíaåì aåÖ=~äåÄê~íáçå=sÉêáÑáÅ~íáçå=E``sF=oÉéçêí

p~ã éáÉ=k~ã É	``s
cáÉ=k~ã É	MOT|``skÇ
a~í~=m~íÜk~ã É	aWyªÖáÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OP"kÅ
^Åè=qáã É	PLOPLOMOP=NVMRQXQP
p~ã éáÉ=qóéÉ	``s
qçí~äa ãi íáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MNQ ^i _kÇ
p~ã éáÉ=n`=m~ëëlc á~ä	m~ëë
fpqa=n`=m~ëëlc~åí	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	ORKSON	ééÄ	NKP	NRNRTNKTU	OR	NVOKQU	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKVMV	ééÄ	MKS	VVVRMKNN	OR	NVPKSQ	UVKU	NNMO	
OP	k ~	OR	e É	RQNNKOVO	ééÄ	OKO	PRMORRRKVT	RMMM	NVUKOP	UVKU	NNMO	
OQ	j Ö	OR	e É	RQUQKQSO	ééÄ	OKM	NUSOOOTKUS	RMMM	NVMSV	UVKU	NNMO	
OT	^ä	OR	e É	RPQKSNO	ééÄ	MKT	SURVSKPV	RMM	NVSKVO	UVKU	NNMO	
OU	pá	OR	e O	ROVKUQQ	ééÄ	NKP	OQVSSOKUV	RMM	NVRKVT	UVKU	NNMO	
PV	h	OR	e É	ROVTKUOP	ééÄ	MKU	NRVQOPOKNN	RMMM	NVRKVS	UVKU	NNMO	
QM	` ~	OR	e O	RQQNKOTU	ééÄ	MKO	NUROVNVRKOU	RMMM	NVQKUP	UVKU	NNMO	
RN	s	UV	e É	ORKTMS	ééÄ	MKR	NVRUORKMT	OR	NVOKUO	UVKU	NNMO	
RO	` ê	UV	e É	ORKTSP	ééÄ	MKS	NPQRPSKRP	OR	NVPKMR	UVKU	NNMO	
RR	j å	UV	e É	ORKROO	ééÄ	NKO	STQORKRO	OR	NVOKMV	UVKU	NNMO	
RS	cÉ	UV	e O	RNOVKOMT	ééÄ	NKO	SPSTMOPUKSN	RMMM	NVOKRU	UVKU	NNMO	
RV	` ç	UV	e É	OSKQPN	ééÄ	MKP	OPOVVPKRP	OR	NVRKTO	UVKU	NNMO	
SM	ká	UV	e É	OSKPNQ	ééÄ	MKT	SRQTUKOS	OR	NVRKOS	UVKU	NNMO	
SP	` ì	UV	e É	OSKUPU	ééÄ	MKS	NUONNUKRT	OR	NVTKPR	UVKU	NNMO	
SS	wå	UV	e É	OSKQSN	ééÄ	NKS	PMRNOKRR	OR	NVRKUQ	UVKU	NNMO	
TR	^ë	UV	e É	ORKTQQ	ééÄ	NKO	OOQQOKVV	OR	NVOKVU	UVKU	NNMO	
TU	pÉ	UV	e O	ORKMVQ	ééÄ	MKR	NOONNKTS	OR	NVMKTU	UVKU	NNMO	
UU	pê	UV	e É	OSKPQT	ééÄ	NKO	UNUOVKMQ	OR	NVRKPV	UVKU	NNMO	
VR	j ç	UV	e É	OSKMOQ	ééÄ	MKV	TSRQTKQO	OR	NVQKN	UVKU	NNMO	
NVT	^Ö	UV	e É	OSKUOM	ééÄ	MKP	OUOUPVKPR	OR	NVTKOU	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKQNM	ééÄ	MKU	PUMOSKMS	OR	NVRKSQ	UVKU	NNMO	
NNU	på	NRV	e É	OQKTQS	ééÄ	NKP	TPQSQKUS	OR	VUKVU	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	ORKOVR	ééÄ	NKM	RROQQOKNS	OR	NVMKUO	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKOSS	ééÄ	MKT	NSOSOMKUT	OR	NVNKMS	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKSNP	ééÄ	MKV	POPMQTKON	OR	NVOKQR	UVKU	NNMO	
OVR	qä	OMV	k ç=d ~ë	ORKVMN	ééÄ	NKP	TNOOOQKPU	OR	NVPKS	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKNMU	ééÄ	MKO	NMVSTUPKMP	OR	NVQKQP	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKRSU	ééÄ	NKQ	UVURTPKTN	OR	NVSKOT	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OTKOVR	ééÄ	MKQ	URMVMQKVO	OR	NVUKUO	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ïçï	B n`=eäÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	ONNRMQUKNM	MKS	ONNUNUQKUQ	VVKUR	RVKR	NOMQ	
pÅ	OR	k ç=d ~ë	QNORVPNKMV	MKR	QPOQMMUKRR	VRKQO	RVKR	NOMQ	
pÅ	OR	e O	NMVRSQSKRT	NKU	NMQSVRMKNV	VSKMR	RVKR	NOMQ	
pÅ	OR	e É	NQOTROKTM	NKN	NRSVQPKTQ	VMKVS	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	VUOUVMKSM	MKV	NMMTQVOKRQ	VTHRS	RVKR	NOMQ	
dÉ	TO	e O	PVMTOQKOO	NKT	QNUTVMKQQ	VPHP	RVKR	NOMQ	
dÉ	TO	e É	NMVPOPKPT	MKQ	NNVPVMKOU	VNHRT	RVKR	NOMQ	
v	UV	e O	QQMPPSUKUR	NKM	QSPMSRQKU	VRHMV	RVKR	NOMQ	
v	UV	e É	TQRPUVKOS	MKR	UMTOTPKVP	VOHPP	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SRPQVMUKTO	MKV	SORONMSKN	NVQKRO	RVKR	NOMQ	
qÄ	NRV	e É	OSRPNTVKUM	MKT	OTPRTROKPS	VSKVU	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PPTRUURKVS	MKS	OVRURQRKMT	NNQKNN	RVKR	NOMQ	
_á	OMV	e É	NRNNRUVKUS	MKR	NRQQSOOKMP	VTKUS	RVKR	NOMQ	

`çåíáåì åáÖ=~äáÄê~íáçå=_ä~åâ=É``_F=oÉéçê

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MOUJ``_KÇ

a~í~=m~íÜ=k~ã É aWj^ÖäÉáíÝ^mj eyNya^q^yOMOPyMPJ ^oyi n`OP^kÅ

^Åè=qáã É PLOPLOMOP=OMMOQQOO

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáç~å NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑc äÉk~ã É MNQ^i_KÇ

p~ã éáÉ=n`=m~ëëlc á~ä m~ëë

fpqa=n`=m~ëëlc~äí m~ëë

l éÉê~íçê **~Çã áíí**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	r åáë	opa	==\ mp==	iãäá	n`=c ä~Ö
V	_É	S	kç=d~ë	MKMNO	éé Ä	NVKO	NTRKRS	MO	
NN	_	S	kç=d~ë	MKMVS	éé Ä	NRKN	NUNPKQU	Q	
OP	k~	QR	eÉ	UKPMR	éé Ä	NKO	QVQVOKQR	OMM	
OQ	j Ö	QR	eÉ	QKQCCO	éé Ä	RKQ	OMRPKRS	OM	
OT	^ä	QR	eÉ	NKCRO	éé Ä	OVKO	PMOKCP	OM	
OU	pá	QR	eO	JMKMVS	éé Ä	k L^	TMMKTS	NMM	
PV	h	QR	eÉ	NMKQVP	éé Ä	OUKS	POTNSKVM	OMM	
QM	`~	QR	eO	QKOSN	éé Ä	MKU	PNPMTKNP	OM	
RN	s	UV	eÉ	MKMOS	éé Ä	QNKR	OUPKPQ	N	
RO	`ê	UV	eÉ	JMKMMT	éé Ä	k L^	TTTKON	N	
RR	j å	UV	eÉ	JMKMNN	éé Ä	k L^	NRNKPM	MQ	
RS	cÉ	UV	eO	OKROT	éé Ä	SKO	SMUUMKVT	OM	
RV	` ç	UV	eÉ	MKMMV	éé Ä	QKP	CCCKCP	MO	
SM	k á	UV	eÉ	JMKNSP	éé Ä	k L^	UMPKPT	MQ	
SP	` ì	UV	eÉ	MKMMP	éé Ä	NPMKP	RQCKCQ	MS	
SS	wå	UV	eÉ	MKNNR	éé Ä	RKO	OORKRS	O	
TR	^ë	UV	eÉ	MKMCQ	éé Ä	SKN	QCOKST	N	
TU	pÉ	UV	eO	MKMPS	éé Ä	QKT	OVKPP	N	
UU	pê	UV	eÉ	MKNNP	éé Ä	COKS	TSKST	N	
VR	j ç	UV	eÉ	MKOMP	éé Ä	QKV	UURKSM	N	
NMT	^Ö	UV	eÉ	MKNNM	éé Ä	NUKQ	NUUKUV	MO	
NNN	` Ç	UV	eÉ	MKMMT	éé Ä	CCKO	COOKVT	MO	
NNU	på	NRV	eÉ	MKMSO	éé Ä	TKN	PSPKPQ	N	
NON	pÄ	NRV	kç=d~ë	MKMPN	éé Ä	NNKR	NMPTKUN	MO	
NPT	_~	NRV	kç=d~ë	MKNNV	éé Ä	NSKP	NVSKUU	MQ	
NUO	t	NRV	kç=d~ë	MKORT	éé Ä	NVKN	RPNMKMD	N	
OMR	qä	OMV	kç=d~ë	MKMPO	éé Ä	PUKM	ONRVKNQ	MO	
OMU	mÄ	OMV	kç=d~ë	MKNNR	éé Ä	NNKQ	NQSNKRU	MO	
OPO	qÜ	OMV	kç=d~ë	MKMQP	éé Ä	QUKN	QNMNKSU	N	
OPU	r	OMV	kç=d~ë	MKNNU	éé Ä	NNKQ	TVQKON	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ= mp	B=oÉÁ	B n`=çï	B n`=cåÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	ONURPRPKNP	NKM	ONNUNUQKUQ	NVPKNT	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QMVTRRRKPV	NKR	QPCQMMUKRR	VQKTS	RVKR	NOMQ	
pÅ	QR	eO	VURTRTKNQ	MKT	NMQSVRMKW	VQKNS	RVKR	NOMQ	
pÅ	QR	eÉ	NQQUQTKNQ	MKP	NRSVCPKTQ	VOKOV	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VUQVPMKVS	NKS	NMMTQVOKRQ	VTKTS	RVKR	NOMQ	
dÉ	TO	eO	PVSRNOKCU	MKQ	QNUTVMKQQ	VQKSU	RVKR	NOMQ	
dÉ	TO	eÉ	NNMVVSKPU	NKP	NNVPVMKCU	VOKVT	RVKR	NOMQ	
v	UV	eO	QQUSVVSKMP	MKV	QSPMSRQKU	VSKV	RVKR	NOMQ	
v	UV	eÉ	TSMNNUKMU	MKP	UMTOTPKVP	VQKNS	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SSPQPMSKPP	OKS	SCROMMSKN	NMSKNN	RVKR	NOMQ	
qÄ	NRV	eÉ	OTORRRTKMN	MKQ	OTPRTROKPS	VVKSP	RVKR	NOMQ	
_á	OMV	kç=d~ë	PPRUVMQKPO	OKV	OVRURQRKMT	NNPKRP	RVKR	NOMQ	
_á	OMV	eÉ	NRRCQQRKRP	NKN	NRQQSOOKMP	NVMKQV	RVKR	NOMQ	

fåíÉâÑÉêÉåÅÉ= ÜÉÅâ=pçàíç=^=Ef`pJ^F=oÉéçëí

p~ã éáÉ=k~ã É	f`p^
cäÉ=k~ã É	MOVf`p^KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOVCPyWPJ ^oyi n`CP`kÅ
^Åè=qáã É	PLCPLCVCP=CVMVVQU
p~ã éáÉ=qóéÉ	f`p^
qçí~äaäã íáçå	NKVMVM
`çã ã Éåí	JJJ
fpqa=oÉÑ=cäÉk~ã É	MNQ ^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äõíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeäÖÜ	n`=c ä~Ö
_É	V	S	k ç=d ~ë	MKVMO	éé Ä	TRKV	NNVKVM	JVKN	NVM	NVM	
_	NN	S	k ç=d ~ë	MKRTS	éé Ä	QKQ	PNUCKSO	JO	NVM	NVM	
k~	CP	CR	e É	NVPSQCKVPM	éé Ä	NKN	SPUUUVMTKQO	NVMVMVM	UM	NCM	
j Ö	CQ	CR	e É	NVCPCSKVRV	éé Ä	NKN	PQNNCPNVKTT	NVMVMVM	UM	NCM	
^ä	CT	CR	e É	NVITPTCKVRS	éé Ä	NKM	NPCQMVNRKTT	NVMVMVM	UM	NCM	
pá	CU	CR	e O	CKMCN	éé Ä	RHR	CQUSKCM	JRM	NVM	NVM	
h	PV	CR	e É	VVSTMKNUO	éé Ä	MKQ	CUPUCMUCKSO	NVMVMVM	UM	NCM	
`~	QM	CR	e O	NVCPVTKCPP	éé Ä	NKM	PQQVSMVNVKPN	NVMVMVM	UM	NCM	
s	RN	UV	e É	MKMTR	éé Ä	NCKN	QSMKMO	JVKR	NVM	NVM	
`ê	RO	UV	e É	CKMUT	éé Ä	NKN	NNNSVKSN	NHR	NVM	NVM	
j å	RR	UV	e É	MCCCQ	éé Ä	QKN	TPRKUU	MKNT	NVM	NVM	
cÉ	RS	UV	e O	VUTSTHPRO	éé Ä	NKO	NNTCPPUNSPKQS	NVMVMVM	UM	NCM	
`ç	RV	UV	e É	MKNNP	éé Ä	NVKN	NVUUKVT	M	NVM	NVM	
ká	SM	UV	e É	MCCMS	éé Ä	CMO	NSCNKCP	MKNU	NVM	NVM	
`ì	SP	UV	e É	MKMVR	éé Ä	VHP	NNVPKQM	JVKCO	NVM	NVM	
wå	SS	UV	e É	NKNCO	éé Ä	QHP	NPCQKRP	MKQ	NVM	NVM	
^ë	TR	UV	e É	MKMTV	éé Ä	NCKP	USKSU	JVKR	NVM	NVM	
pÉ	TU	UV	e O	MKUUN	éé Ä	PKS	QUKRM	JVKR	NVM	NVM	
pê	UU	UV	e É	MKUPM	éé Ä	QKS	CRMUKMR	MKPT	NVM	NVM	
j ç	VR	UV	e É	CCPVKVRV	éé Ä	MKQ	SPMPTQSKPM	CMVM	UM	NCM	
^Ö	NMT	UV	e É	MKUNO	éé Ä	NMKP	CMPKPQ	JVKN	NVM	NVM	
`Ç	NNN	UV	e É	MKQMR	éé Ä	NMKN	RTMKTR	MKCU	NVM	NVM	
på	NNU	NRV	e É	MKMTO	éé Ä	NCKQ	PTQKQS	JVKR	NVM	NVM	
pÄ	NCN	NRV	k ç=d ~ë	MKMTT	éé Ä	NKM	CMNUKVQ	JVKMR	NVM	NVM	
_~	NPT	NRV	k ç=d ~ë	MKRPO	éé Ä	RKQ	PQMVKUM	MKPP	NVM	NVM	
t	NUO	NRV	k ç=d ~ë	MKOTV	éé Ä	QKS	RRNPKST	JVKPP	NVM	NVM	
qä	OMR	OMV	k ç=d ~ë	MKMMN	éé Ä	PVQKP	NPMUKNN	JVKN	NVM	NVM	
mÄ	OMU	OMV	k ç=d ~ë	MKMPQ	éé Ä	ONHR	ONRVHMP	JVKMU	NVM	NVM	
qÜ	OPO	OMV	k ç=d ~ë	MKMOS	éé Ä	NTHR	PRCMVKN	JVKN	NVM	NVM	
r	OPU	OMV	k ç=d ~ë	MKMCM	éé Ä	RHM	USQKCU	JVKMU	NVM	NVM	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=ïçï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	k ç=d ~ë	CMVTVTMKMP	NKM	ONNUNUQKUQ	VVHMR	RVHR	NCMQ	
pÅ	CR	k ç=d ~ë	PVUTQCNKNT	MKQ	QPCQMMUHRR	VCKCO	RVHR	NCMQ	
pÅ	CR	e O	VQMTTUKCQ	MKU	NMQSVRMKMV	UVKUS	RVHR	NCMQ	
pÅ	CR	e É	NPTQSTKNN	MHR	NRSVCPKTQ	UTHRV	RVHR	NCMQ	
dÉ	TO	k ç=d ~ë	VSVTSUHRS	NKN	NMMTQVCHRQ	VSKCS	RVHR	NCMQ	
dÉ	TO	e O	PTCRPSKVT	MKN	QNUTVMKQQ	UUKVS	RVHR	NCMQ	
dÉ	TO	e É	NMTRMSKUU	MKP	NNVPVMKCU	VMKMR	RVHR	NCMQ	
v	UV	e O	QCNVQUUKMV	MKO	QSPMSRQKU	VNKNO	RVHR	NCMQ	
v	UV	e É	TNRSUQKCO	MKV	UMTCTPKVP	UUHSR	RVHR	NCMQ	
qÄ	NRV	k ç=d ~ë	SRPNPPMKMM	MKT	SCRCMVSKN	NVCKQT	RVHR	NCMQ	
qÄ	NRV	e É	CRUMVQVHSO	MKQ	CTPRTRCHPS	VQKPQ	RVHR	NCMQ	
_á	CMV	k ç=d ~ë	PPPCRVVKTV	MHR	CVRURQRKMT	NNCKSQ	RVHR	NCMQ	
_á	CMV	e É	NQNURCMKNN	MKT	NRQQSCCKMP	VNKUQ	RVHR	NCMQ	

`çåíaåì åaÖ=~äáÄê~íáçå=sÉêáÑáÅ~íáçå=E``sF=oÉéçêí

p~ã éáÉ=k~ã É	``s
cáäÉ=k~ã É	MPMj``skÇ
a~í~=m~íÜk~ã É	aWyªÖáÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OP°kÄ
^Åè=qáã É	PLOPLOMOP=OMNMQUPS
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MNQ ^i _kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã ää**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	kç=d~ë	ORKRUR	ééÄ	OKM	NRNTMSKQV	CR	NVOKPQ	UVKU	NNMO	
NN	_	S	kç=d~ë	ORKQCU	ééÄ	NKQ	VUPQNKNT	CR	NMNKTN	UVKU	NNMO	
OP	k~	QR	eÉ	RSUMRNQ	ééÄ	NKV	PTMUTVPKRN	RMMM	NNPKSN	UVKU	NNMO	[=HLJ-NMB
OQ	j Ö	QR	eÉ	RTMQKOVQ	ééÄ	NKP	NVRPRVPKUS	RMMM	NNQKMV	UVKU	NNMO	[=HLJ-NMB
OT	^ä	QR	eÉ	TNMMKNQM	ééÄ	MKP	VNUQTRTM	RMM	NQOKMP	UVKU	NNMO	[=HLJ-NMB
OU	pá	QR	eO	RPQKNSO	ééÄ	NKR	OQRUMRKOT	RMM	NMSKUP	UVKU	NNMO	
PV	h	QR	eÉ	RRMPKVOM	ééÄ	NKS	NSSVOTQKSN	RMMM	NNMKMU	UVKU	NNMO	
QM	`~	QR	eO	RRRSKPTT	ééÄ	MKN	NVNUSMONKUM	RMMM	NNNKNP	UVKU	NNMO	[=HLJ-NMB
RN	s	UV	eÉ	ORKSMS	ééÄ	NKR	NMSVNRKCQ	CR	NMOKQO	UVKU	NNMO	
RO	`ê	UV	eÉ	ORKSUN	ééÄ	NKM	NPSMOOKPV	CR	NMOKTO	UVKU	NNMO	
RR	j å	UV	eÉ	ORKPQU	ééÄ	NKM	STVORKOS	CR	NMNKPV	UVKU	NNMO	
RS	cÉ	UV	eO	RPPMKUN	ééÄ	NKQ	SSUSQNOTKSN	RMMM	NMSKS	UVKU	NNMO	
RV	`ç	UV	eÉ	OSKPVS	ééÄ	MKQ	OPSMMQKOO	CR	NMRKRU	UVKU	NNMO	
SM	ká	UV	eÉ	OSKNRO	ééÄ	NKM	SSMMVKRQ	CR	NMQKSN	UVKU	NNMO	
SP	`ì	UV	eÉ	OSKRTQ	ééÄ	NKR	NUOVMNKTM	CR	NMSKP	UVKU	NNMO	
SS	wå	UV	eÉ	ORKVSP	ééÄ	NKU	PMPSRKSN	CR	NMPKUR	UVKU	NNMO	
TR	^ë	UV	eÉ	ORKTOR	ééÄ	NKM	OOTQTKRP	CR	NMOKV	UVKU	NNMO	
TU	pÉ	UV	eO	OQKVRP	ééÄ	MKQ	NOOOPKOT	CR	VVKUN	UVKU	NNMO	
UU	pê	UV	eÉ	OSKMPO	ééÄ	MKT	UOMMVKUP	CR	NMQKNP	UVKU	NNMO	
VR	j ç	UV	eÉ	PPKPRM	ééÄ	MKQ	VVQNUKQV	CR	NPPKQ	UVKU	NNMO	[=HLJ-NMB
NMT	^Ö	UV	eÉ	OSKVPR	ééÄ	MKR	OUUNNRKNS	CR	NMTKTQ	UVKU	NNMO	
NNN	`Ç	UV	eÉ	OSKTMV	ééÄ	MKU	PVMOQKTT	CR	NMSKUQ	UVKU	NNMO	
NNU	på	NRV	eÉ	ORKMTM	ééÄ	MKR	TRNTSKPO	CR	NMMKOU	UVKU	NNMO	
NON	pÄ	NRV	kç=d~ë	ORKOUP	ééÄ	MKP	RSOQRNKOS	CR	NMNKNP	UVKU	NNMO	
NPT	_~	NRV	kç=d~ë	ORKOTM	ééÄ	NKM	NSRMTSKMR	CR	NMNKMU	UVKU	NNMO	
NUO	t	NRV	kç=d~ë	OSKNRQ	ééÄ	OKP	PPQTSPKOT	CR	NMQKSO	UVKU	NNMO	
OMR	qä	OMV	kç=d~ë	ORKTTN	ééÄ	OKM	TNNNUUKUN	CR	NMPKMU	UVKU	NNMO	
OMU	mÄ	OMV	kç=d~ë	OSKQMP	ééÄ	NKR	NMONTSMKTR	CR	NMRKSN	UVKU	NNMO	
OPO	qÜ	OMV	kç=d~ë	OSKTRR	ééÄ	NKM	VMUNSPKSM	CR	NMTKMO	UVKU	NNMO	
OPU	r	OMV	kç=d~ë	OTKOOS	ééÄ	NKP	URQSPRKMQ	CR	NMUKV	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑmp	B=oÉÄ	B n`=ïçï	B n`=eäÜÜ	n`=c ä-Ö
i á	S	kç=d~ë	ONOMPNOKQV	NKV	ONNUNUQKUQ	NMMKN	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QOQVUQQKSQ	NKO	QPOQMMUKRR	VUKOU	RVKR	NOMQ	
pÅ	QR	eO	VUOOUMSO	NKT	NMQSVRMKNV	VPKUO	RVKR	NOMQ	
pÅ	QR	eÉ	NQPVRSKOM	NKO	NRSVOPKTQ	VNKTO	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VVVQVOKVQ	NKR	NMMTQVOKRQ	VVKON	RVKR	NOMQ	
dÉ	TO	eO	PVRTORKSR	NKV	ONUTVMKQQ	VQKQV	RVKR	NOMQ	
dÉ	TO	eÉ	NNMTMUKVR	NKO	NNVPVMKOU	VOKTP	RVKR	NOMQ	
v	UV	eO	QQRMOMOKCP	NKP	QSPMSRQKU	VSKN	RVKR	NOMQ	
v	UV	eÉ	TRSMPPKMU	MKP	UMTOTPKVP	VPKSR	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SSPOQSVKSO	NKN	SORQMVSKN	NVSKMV	RVKR	NOMQ	
qÄ	NRV	eÉ	OSTVVNUKOU	NKN	OTPRTROKPS	VTKVS	RVKR	NOMQ	
_á	OMV	kç=d~ë	PPUUONMKOM	NKN	OVRURQRKMT	NNQKRO	RVKR	NOMQ	
_á	OMV	eÉ	NRPOPNVKTS	OKS	NRQQSOOKMP	VVKO	RVKR	NOMQ	

`çåíáåì åÖ=~ëÄê~íáçå=_ä~åâ=É``_F=oÉéçê

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MPN``_KÇ

a~í~=m~íÜ=k~ã É aWj^ÖäÉáíÝ^mj eyNya^q^yOMOPyMPJ ^oyi n`OP^kÅ

^Åè=qáã É PLOPLOMOP=OMMPVMN

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáç~å NMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑc äÉk~ã É MNQ^i_KÇ

p~ã éáÉ=n`=m~ëëlc á~ä c~ää

fpqa=n`=m~ëëlc~ää m~ëë

l éÉê~íçê **~Çã áã**

n`=^å~äóíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	r åáë	opa	==\ mp==	iãäá	n`=c ä~Ö
V	_É	S	kç=d~ë	MMMNO	éé Ä	SRKQ	NSSMST	MO	
NN	_	S	kç=d~ë	MMNPM	éé Ä	NNRT	NQVMNCN	Q	
OP	k~	QR	eÉ	PSKUCR	éé Ä	NKP	SSSQRMOS	OMM	
OQ	j Ö	QR	eÉ	OTKURQ	éé Ä	THP	VVUUKQO	OM	c~äê^ äëj ÉíÜçÇë& c~äÉÇ=a ça
OT	^ä	QR	eÉ	OPMPRO	éé Ä	OKN	PNNMMPV	OM	c~äê^ äëj ÉíÜçÇë& c~äÉÇ=a ça
OU	pá	QR	eO	JMKNNT	éé Ä	k L^	SVMMTR	NMM	
PV	h	QR	eÉ	PSKRNU	éé Ä	THR	PVTMUKMR	OMM	
QM	`~	QR	eO	PMKNQV	éé Ä	PMS	NOMUCPMPR	OM	c~äê^ äëj ÉíÜçÇë& c~äÉÇ=a ça
RN	s	UV	eÉ	MKMPN	éé Ä	PSKU	PMNKNO	N	
RO	`ê	UV	eÉ	JMKMMQ	éé Ä	k L^	TTVMCN	N	
RR	j å	UV	eÉ	JMKMMQ	éé Ä	k L^	NSRMVT	MQ	
RS	cÉ	UV	eO	OSKTVS	éé Ä	OKU	PSRNTOKMU	OM	c~äê^ äëj ÉíÜçÇë& c~äÉÇ=a ça
RV	`ç	UV	eÉ	MKMNN	éé Ä	NRMN	OQQOCP	MO	
SM	ká	UV	eÉ	JMKONN	éé Ä	k L^	STOOCR	MQ	c~äÉÇ=a ça
SP	`ì	UV	eÉ	MKMNS	éé Ä	PVMR	SNTMUM	MS	
SS	wå	UV	eÉ	MKNQM	éé Ä	OTHR	ORNKNO	O	
TR	^ë	UV	eÉ	MKMPS	éé Ä	OQRT	ROMPQ	N	
TU	pÉ	UV	eO	MKMPR	éé Ä	ORKM	OUKST	N	
UU	pê	UV	eÉ	MKMOP	éé Ä	PMMP	NMTMTU	N	
VR	j ç	UV	eÉ	NKORT	éé Ä	PKP	PVSUKQO	N	c~äê^ äëj ÉíÜçÇë& c~äÉÇ=a ça
NMT	^Ö	UV	eÉ	MKMNM	éé Ä	NRMT	NUSMST	MO	
NNN	`Ç	UV	eÉ	MKMNN	éé Ä	RSKQ	OUKMR	MO	
NNU	på	NRV	eÉ	MKMRT	éé Ä	QRMP	PQRMRT	N	
NON	pÄ	NRV	kç=d~ë	MKMPM	éé Ä	PNMS	NMQQKQU	MO	
NPT	_~	NRV	kç=d~ë	MKMON	éé Ä	OMMP	ONSKMM	MQ	
NUO	t	NRV	kç=d~ë	MKNTM	éé Ä	OKP	OPONKVS	N	
OMR	qä	OMV	kç=d~ë	MKMPS	éé Ä	PRMT	OPPOMSU	MO	
OMU	mÄ	OMV	kç=d~ë	MKMNQ	éé Ä	NMKQ	NQQUKOP	MO	
OPO	qÜ	OMV	kç=d~ë	JMKMNM	éé Ä	k L^	OQMSMKM	N	
OPU	r	OMV	kç=d~ë	MKMNV	éé Ä	OMMS	USQKOU	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ= mp	B=oÉÁ	B n`=ç ï	B n`=cëÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	OMVSSPNKMM	MMR	ONNUNUQKUQ	VUKVU	RVMR	NOMKQ	
pÅ	QR	kç=d~ë	QNPTRURKMM	NMP	QPOQMMUMRR	VRMSV	RVMR	NOMKQ	
pÅ	QR	eO	VUQVNMKQM	NKM	NMQSVRMKNV	VQKMT	RVMR	NOMKQ	
pÅ	QR	eÉ	NQNVQUMPN	NKM	NRSVCPMTQ	VMKQR	RVMR	NOMKQ	
dÉ	TO	kç=d~ë	NMNPOTTKUV	MKU	NMMTQVOMRQ	NMMMRT	RVMR	NOMKQ	
dÉ	TO	eO	PVNRQUKNQ	NKM	QNUTVMKQQ	VPMR	RVMR	NOMKQ	
dÉ	TO	eÉ	NMVVUMPPP	MMP	NNVPVMKOU	VOKNO	RVMR	NOMKQ	
v	UV	eO	QQRRMDSKOS	NKT	QSPMSRQKU	VSKON	RVMR	NOMKQ	
v	UV	eÉ	TQTQOMKVS	MMR	UMTOTPKVP	VOMRV	RVMR	NOMKQ	
qÄ	NRV	kç=d~ë	SUONNUMKUT	MKV	SCROMMSKN	NMVMN	RVMR	NOMKQ	
qÄ	NRV	eÉ	OSUTVURKSV	NKN	OTPRTROMPS	VUKOR	RVMR	NOMKQ	
_á	OMV	kç=d~ë	PQRTVQMRRM	MKU	OVRURQRMMT	NNSKUU	RVMR	NOMKQ	
_á	OMV	eÉ	NRQTRRMMPM	NKN	NRQQSOOMMP	NMMKNV	RVMR	NOMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` ONfj t O
cáÉ=k~ã É	MPOpj mi KÇ
a~í~=m~íÜ=k~ã É	a Wy^ÖäÉáíyf` mj e yNya^q^yOMOPyMPJ ^o yi n` OP` KÄ
^Åè=qãã É	PLOPLOMOP=OMWOUWRS
p~ã éäÉ=qóéÉ	m_
qçí~ä=a ãä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MNQ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==` mp==	i ãã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	MKMNP	ééÄ	NRUKV	NNNKNN	MKR	
_	NN	S	k ç=d ~ë	MKVTS	ééÄ	NMKQ	NTOMKNQ	NM	
k~	OP	QR	e É	NMUKNNQ	ééÄ	PKR	RRQVPKQS	RMM	
j Ö	OQ	QR	e É	RNKUTQ	ééÄ	SKR	PVUOKVO	RM	m_=SMOM=c~âë=a ça
^ä	OT	QR	e É	SNKTMP	ééÄ	QKR	NSSPKQS	RM	m_=SMOM=c~âë=a ça
pá	OU	QR	e O	NOKMUS	ééÄ	VKN	NTURKPO	ORM	
h	PV	QR	e É	UVKRSS	ééÄ	VKS	PPPQVKVM	RMM	
` ~	QM	QR	e O	UUKQNN	ééÄ	NKO	TQTPTKSR	RM	m_=SMOM=c~âë=a ça
s	RN	UV	e É	MKRPR	ééÄ	RKS	RVSKSV	OKR	
` ê	RO	UV	e É	MKPUV	ééÄ	NPKO	NNTMKRM	OKR	
j å	RR	UV	e É	NKSRO	ééÄ	OKP	NMOMKRN	N	m_=SMOM=c~âë=a ça
cÉ	RS	UV	e O	VQKONM	ééÄ	OKT	ORSSTRKTO	RM	m_=SMOM=c~âë=a ça
` ç	RV	UV	e É	MKMVQ	ééÄ	RORKT	NQQKQR	MKR	
k á	SM	UV	e É	JMKUUO	ééÄ	k L^	TPRKRV	N	
` ì	SP	UV	e É	NKQMP	ééÄ	RKQ	OPQUKVO	NKR	
wå	SS	UV	e É	OTKMVS	ééÄ	NKP	SNRVKOR	R	m_=SMOM=c~âë=a ça & m_=SMOM=c~âë=k çåJa ça
^ë	TR	UV	e É	MKNSR	ééÄ	PPKO	QUKST	OKR	
pÉ	TU	UV	e O	MKMQV	ééÄ	RQKN	NRKUP	OKR	
pê	UU	UV	e É	MKMPU	ééÄ	QNKO	RTKTU	OKR	
j ç	VR	UV	e É	PKMNP	ééÄ	RKV	NVUTKVS	OKR	m_=SMOM=c~âë=a ça
^Ö	NMT	UV	e É	MKMVP	ééÄ	PRUKO	URKRR	MKR	
` Ç	NNN	UV	e É	MKMMT	ééÄ	OMUKS	NPKTN	MKR	
på	NNU	NRV	e É	MKPOS	ééÄ	NVKU	PSSKSU	OKR	
pÄ	NON	NRV	k ç=d ~ë	MKNMU	ééÄ	NMKN	URMKVO	MKR	
_~	NPT	NRV	k ç=d ~ë	MKNSM	ééÄ	PMKU	OVMKPN	N	
t	NUO	NRV	k ç=d ~ë	MKPRN	ééÄ	QKT	PMNSKUS	OKR	
qä	OMR	OMV	k ç=d ~ë	JMKMMU	ééÄ	k L^	NPMNKQQ	MKR	
mÄ	OMU	OMV	k ç=d ~ë	MKMMS	ééÄ	PNOKR	VUNKMT	MKR	
qÜ	OPO	OMV	k ç=d ~ë	JMKMTS	ééÄ	k L^	OOUOKSQ	OKR	
r	OPU	OMV	k ç=d ~ë	MKMNM	ééÄ	UVKO	POMKPQ	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	OMTQRSNKMS	NKR	ONNUNUOKUQ	VTKVQ	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	QMQUOQQOKNT	MKS	QPOQMMUKRR	VPHSO	RVKR	NOMQ	
pÅ	QR	eO	VQTPQQKVT	NKR	NMQSVRMKNV	VMKQV	RVKR	NOMQ	
pÅ	QR	eÉ	NPUOSQKTT	MKU	NRSVQPKTQ	UUKN	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VSOPPNKVN	NKR	NMMTQVOKRQ	VRHRO	RVKR	NOMQ	
dÉ	TO	eO	PTVMSNKNO	MKQ	ONUTVMKQQ	VMKRN	RVKR	NOMQ	
dÉ	TO	eÉ	NMSUMUKUV	MKS	NNVPVMKOU	UVKQS	RVKR	NOMQ	
v	UV	eO	QPNNOTMKSM	MKV	QSPMSRQKU	VPHN	RVKR	NOMQ	
v	UV	eÉ	TOSQTOKPS	MKR	UMTOTPKVP	UVKVV	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	SUNMSROKVU	NKP	SORQMMSKN	NMUKVQ	RVKR	NOMQ	
qÄ	NRV	eÉ	OSSSUSQKNM	MKT	OTPRTROKPS	VTKQU	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PRPMQRUKRQ	NKO	OVRURQRKMT	NMVKPP	RVKR	NOMQ	
_á	OMV	eÉ	NRSNMTTKTU	NKQ	NRQQSOOKMP	NMNKMT	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i `pt n`ONfj t O
cáÉ=k~ã É	MPPpj mi kÇ
a~í~=m~íÜ=k~ã É	aWf'Öá£Éáíyf` mj eyNya^q^yOMOPyMPuj ^oyi n`OP' kÄ
^Åè=qáã É	PLOPLOMOP=OMRPQMP
p~ã éäÉ=qóéÉ	i `pt
qçí~äaáãíáçå	RKMMMM
`çã ã Éáí	JJJ
fpqa=oÉÑcáäÉk~ã É	MNQ ^i _kÇ
p~ã éäÉ=n`=m~ëëlc á~ä	c~äi
fpqa=n`=m~ëëlc~äi	m~ëë
l éÉê~íçê	**~Çã åä**

n`=^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÄK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B içï	B eáÖÜ	n`=ä-Ö
_É	V	S	k ç=d ~ë	RSKTVP	ééÄ	NKS	SCUPTKNV	RM	COKTO	TVKR	NOMQ	
_	NN	S	k ç=d ~ë	RPVKNPR	ééÄ	MKR	PURSSNKUT	RMM	ONKRT	TVKR	NOMQ	
k~	OP	QR	e É	UQRRKNVO	ééÄ	NKV	NMUPVPPKNU	TRMM	COKRR	TVKR	NOMQ	
j Ö	OQ	QR	e É	RPSTKSRQ	ééÄ	NKM	PRNSQMKPU	RMMM	ONKQT	TVKR	NOMQ	
^ä	OT	QR	e É	OCURKRRN	ééÄ	MKV	RSRCOKTT	OMMM	COKUS	TVKR	NOMQ	
pá	OU	QR	e O	NVQUKSTV	ééÄ	MKT	VPNCOKPQ	NMMM	OMKVT	M	OMM	
h	PV	QR	e É	NVONMKNCU	ééÄ	MKT	SMVCQNKVP	NMMMM	OMKQO	TVKR	NOMQ	
`~	QM	QR	e O	OTMVKRCS	ééÄ	MKU	NUNNQSMKRQ	ORMM	ONKSU	TVKR	NOMQ	
s	RN	UV	e É	RRTKVCS	ééÄ	MKV	CQUNCOKMO	RMM	COKPO	TVKR	NOMQ	
`ê	RO	UV	e É	CONKTNN	ééÄ	MKQ	CORSONKNO	OMM	COKNT	TVKR	NOMQ	
j å	RR	UV	e É	RQTKRMQ	ééÄ	NKO	CUOMMPKQM	RMM	ONKV	TVKR	NOMQ	
cÉ	RS	UV	e O	NNVUKVSR	ééÄ	MKU	OTNPPMVKVR	NMMM	COKNS	TVKR	NOMQ	
`ç	RV	UV	e É	RVMKUCU	ééÄ	NKT	NMNTMVSKRQ	RMM	OPKSP	TVKR	NOMQ	aça
ká	SM	UV	e É	RTVKNNU	ééÄ	MKV	OTTRSVKNT	RMM	OPKNS	TVKR	NOMQ	
`ì	SP	UV	e É	OVQKVVP	ééÄ	NKM	PVMQQTHPP	ORM	OPHS	TVKR	NOMQ	
wå	SS	UV	e É	RRVMPQS	ééÄ	NKM	NCRTNQKRV	RMM	COKPT	TVKR	NOMQ	
^ë	TR	UV	e É	NMQKNNR	ééÄ	NKM	NTTPRKTU	NMM	OMKUO	TVKR	NOMQ	
pÉ	TU	UV	e O	NMNKTNS	ééÄ	NKQ	VSPNKTM	NMM	OMPQ	TVKR	NOMQ	
pê	UU	UV	e É	RNVKPTQ	ééÄ	MKQ	PNRMDVKTT	RMM	OMKTU	TVKR	NOMQ	
j ç	VR	UV	e É	NNOKPTM	ééÄ	MKV	SQSMSKSR	NMM	COKQT	TVKR	NOMQ	
^Ö	NMT	UV	e É	RRKPNU	ééÄ	NKT	NNQMMVKPO	RM	COKNP	TVKR	NOMQ	
`Ç	NNN	UV	e É	OTMVKVM	ééÄ	NKP	TSCQRKQR	ORM	ONKSU	TVKR	NOMQ	
på	NNU	NRV	e É	QVPKVQS	ééÄ	MKS	OVCOVTKMO	RMM	NVKTS	TVKR	NOMQ	
pÄ	NON	NRV	k ç=d ~ë	VUKSMN	ééÄ	NKO	QPVVNTKMQ	NMM	NVKTO	TVKR	NOMQ	
_~	NPT	NRV	k ç=d ~ë	ONUNKOTV	ééÄ	MKP	CURSPVOKVN	OMMM	ONKUN	TVKR	NOMQ	
t	NUO	NRV	k ç=d ~ë	NNNKOSR	ééÄ	NKT	CURVNVKUN	NMM	COKOR	TVKR	NOMQ	
qä	OMR	OMV	k ç=d ~ë	NVPKVQV	ééÄ	NKR	RUUVRUKRN	NMM	OMKTV	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=d ~ë	NVRKUSS	ééÄ	NKN	UQMVUQKQR	NMM	ONKNT	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=d ~ë	NVQKPPO	ééÄ	NKM	TOTPTNKVO	NMM	OMKUT	TVKR	NOMQ	
r	OPU	OMV	k ç=d ~ë	NNMKVOQ	ééÄ	OKM	TNQRCQKRS	NMM	COKNU	TVKR	NOMQ	

n`=fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä-Ö
iá	S	kç=d~ë	NVTSNMVNPS	MKP	CNNUNUCKUQ	VPKOV	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QMCUQCMCKUN	NKM	QPCQMMUKRR	VPKNS	RVKR	NOMQ	
pÅ	QR	eO	VQPPTPKCU	NKQ	NMQSVRMKNV	VMKNN	RVKR	NOMQ	
pÅ	QR	eÉ	NPTRQMKNU	MKR	NRSVQPKTQ	UTHSO	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VSSQQQKVN	MKR	NMMTQVCKRQ	VRKVO	RVKR	NOMQ	
dÉ	TO	eO	PTRMQNKMM	NKT	QNUTVMKQQ	UVKRR	RVKR	NOMQ	
dÉ	TO	eÉ	NMTOTQKVM	MKS	NNVPVMKCU	UVKUR	RVKR	NOMQ	
v	UV	eO	QPMMSQSKVU	MKV	QSPMSRQKU	VCKUT	RVKR	NOMQ	
v	UV	eÉ	TCUMVCKMT	MKU	UMTOTPKVP	VMKNV	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SSRMCUPKRR	MKT	SCRCMMSKN	NMSKPT	RVKR	NOMQ	
qÄ	NRV	eÉ	OSQUMVCKRV	MKV	OTPRTRCKPS	VSKUP	RVKR	NOMQ	
_á	QW	kç=d~ë	PQTSRSCKCM	NKM	OVRURQRKMT	NNTKRN	RVKR	NOMQ	
_á	QW	eÉ	NRQNSNPKPS	MKS	NRQQSCCKMP	VVKUN	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NMNRJMCQ

cãÉ=k~ã É MPCpj mi hÇ

a~í~=m~íÜ=k~ã É aWf ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` CP' hÅ

^Åè=qãã É PLCPLCMCP=CMQQCMQS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RhMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MhMNS	éé Ä	NVQKQ	NNPKPQ	NMM	
NN	_	S	k ç=d ~ë	CKCMS	éé Ä	PKQ	PMTUKNS	NMMM	
CP	k ~	CR	e É	SQKQNP	éé Ä	VKR	RMTTQKVN	CMMMMM	
CQ	j Ö	CR	e É	NSKTVS	éé Ä	TKU	NTMMKNS	CMMMMM	
CT	^ ä	CR	e É	NVKQNS	éé Ä	NCKM	SCPKPS	CMMMMM	
CU	pá	CR	e O	NSKCQP	éé Ä	TKO	CNVCKQV	NMMMM	
PV	h	CR	e É	RSKSNV	éé Ä	CCKP	PNVMCKNU	CMMMMM	
QM	` ~	CR	e O	CUKCRP	éé Ä	CKS	PRPPMKVQ	CMMMMM	
RN	s	UV	e É	MKUQN	éé Ä	TKQ	UQTKUO	NMMM	
RO	` ê	UV	e É	MCRT	éé Ä	CQKU	NVCPKUQ	CMMM	
RR	j å	UV	e É	MPRV	éé Ä	QKS	PRVKOT	CMMM	
RS	cÉ	UV	e O	CKhVS	éé Ä	CSKS	PPTTCKTV	NMMMM	
RV	` ç	UV	e É	MPRT	éé Ä	PKS	TRRKSN	NMMM	
SM	k á	UV	e É	JMKTNQ	éé Ä	k L^	UCNKhR	NMMM	
SP	` ì	UV	e É	MCMT	éé Ä	CUKS	TTQKQU	CMMM	
SS	wå	UV	e É	PKMVP	éé Ä	VKT	TURKRV	CMMM	
TR	^ ë	UV	e É	MCRS	éé Ä	CNKR	SQKSU	NMMM	
TU	pÉ	UV	e O	MKhQU	éé Ä	SKS	CRKST	NMMM	
UU	pê	UV	e É	MPRQ	éé Ä	TKR	CRNKhO	CMMM	
VR	j ç	UV	e É	NKPTO	éé Ä	TKQ	NVRTKUQ	NMMM	
NMT	^ Ö	UV	e É	MhMNR	éé Ä	RUKS	NNNKhN	NMM	
NNN	` Ç	UV	e É	MhKQU	éé Ä	NTKV	RPKTM	NMMM	
NNU	på	NRV	e É	MRTPQ	éé Ä	NMKR	SNTKUM	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MhSSS	éé Ä	CRKR	NNCNKCQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	NKUQQ	éé Ä	NKV	CRRVKSN	CMMM	
NUO	t	NRV	k ç=d ~ë	MKPUP	éé Ä	PMKS	PNNPKSV	NMMM	
OMR	qä	OMV	k ç=d ~ë	MhKQV	éé Ä	CRKP	CCRVKOS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MhMVO	éé Ä	NMKS	NTNRKCM	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MRUQ	éé Ä	CKR	TNMCKUQ	NMMM	
OPU	r	OMV	k ç=d ~ë	MhMSQ	éé Ä	PQKO	SUTKQO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¨ çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	CMSRUTVKPS	CKQ	CNNUNUQKUQ	VTKRP	RVKR	NCMKQ	
pÅ	CR	k ç=d ~ë	CNRRTPPKhVR	MKS	CPCQCMMUKRR	VSKhN	RVKR	NCMKQ	
pÅ	CR	e O	VSQCOTTKQP	MKU	NMQCSVRMKhV	VCKN	RVKR	NCMKQ	
pÅ	CR	e É	NQMNVNKQV	MKS	NRSVCPKTQ	UVKPP	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	VVNCMQKTV	NKM	NMMTQVCKRQ	VUKPU	RVKR	NCMKQ	
d É	TO	e O	PUPMSMKSV	NKP	CNUTVMKQQ	VNKQT	RVKR	NCMKQ	
d É	TO	e É	NMVNRNKRU	MKS	NNVPVMKCU	VNKQO	RVKR	NCMKQ	
v	UV	e O	QPVRMRVMhR	MKT	QSPMSRQKU	VQKVN	RVKR	NCMKQ	
v	UV	e É	TPNRMPKRR	MKO	UMTOTPKVP	VMKSN	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SUPTNVUKNT	MKU	SCRCMMSKN	NMVKPS	RVKR	NCMKQ	
qÄ	NRV	e É	OTMNSNSKCP	MKR	OTPRTRCKPS	VUKTR	RVKR	NCMKQ	
_á	OMV	k ç=d ~ë	PSNPTVSKOV	MKS	OVRURQRKMT	NCCKNR	RVKR	NCMKQ	SMCMa ça
_á	OMV	e É	NRTSRCMKUR	MKV	NRQQSCCKMP	NMCKMT	RVKR	NCMKQ	

p~ã éäÉ=k~ã É pn NOMNUMMV

cãÉ=k~ã É MPRpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` CP' hÅ

^Åè=qãã É PLCPLOMCP=OMQQTVRQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMKMDS	éé Ä	k L^	SQKQQ	NMM	
NN	_	S	k ç=d ~ë	NKUTS	éé Ä	TKO	CPCPKRT	NMMM	
CP	k ~	CR	e É	USKSNP	éé Ä	RKM	RNUMVKVT	CMMMMM	
CQ	j Ö	CR	e É	NSKCSP	éé Ä	NNKQ	NSMVKMQ	CMMMMM	
CT	^ ä	CR	e É	CMKMTP	éé Ä	NCKV	SNUKVO	CMMMMM	
CU	pá	CR	e O	UVKCVV	éé Ä	CKP	USTUKCP	NMMMM	
PV	h	CR	e É	SVKVMV	éé Ä	CMS	PNSMPKCO	CMMMMM	
QM	` ~	CR	e O	TVRTUU	éé Ä	NKN	SVQTUKQN	CMMMMM	
RN	s	UV	e É	MSCCM	éé Ä	NMCO	SRUKVO	NMMM	
RO	` ê	UV	e É	MKNQP	éé Ä	PTHP	VNPKNV	CMMM	
RR	j å	UV	e É	MKNTT	éé Ä	NVKM	OSNKOV	CMMM	
RS	cÉ	UV	e O	JNKRSO	éé Ä	k L^	CQQSVKSS	NMMMM	
RV	` ç	UV	e É	MKMTR	éé Ä	RRHP	OSQKQS	NMMM	
SM	k á	UV	e É	JMKUPN	éé Ä	k L^	TRPKPT	NMMM	
SP	` ì	UV	e É	MKCMQ	éé Ä	NVKU	TRUKVO	CMMM	
SS	wå	UV	e É	PKSCO	éé Ä	MKU	UVNKNR	CMMM	
TR	^ ë	UV	e É	MKNPM	éé Ä	SPRT	QCHPQ	NMMM	
TU	pÉ	UV	e O	MKMRO	éé Ä	VKV	NSKPP	NMMM	
UU	pê	UV	e É	MKCCN	éé Ä	NQHR	NSTKTU	CMMM	
VR	j ç	UV	e É	MKVUM	éé Ä	SHS	UCMKMQ	NMMM	
NMT	^ Ö	UV	e É	JMKMMS	éé Ä	k L^	SSHST	NMM	
NNN	` Ç	UV	e É	MKMCM	éé Ä	NVKQ	NTHKMQ	NMMM	
NNU	på	NRV	e É	MKQVS	éé Ä	NVHS	QSSKSU	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKNCR	éé Ä	CCKV	VCQHPQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	CKNTS	éé Ä	RKV	CVUPKQV	CMMM	
NUO	t	NRV	k ç=d ~ë	MKMNN	éé Ä	SRMKM	CNCCKQO	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMNS	éé Ä	k L^	NCRQKTP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKMNR	éé Ä	k L^	UNQKCN	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMCR	éé Ä	CNQKV	CVVPKRO	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMMS	éé Ä	k L^	CNPKRS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ ÉÅ	B n ` =¨ çï	B n ` =¤ äÜÜ	n ` =¤ä-Ö
i á	S	k ç=d ~ë	CMPNVSSKNR	NHR	CNNUNUQKUQ	VRKVP	RVHR	NOMQ	
pÅ	CR	k ç=d ~ë	QMVVUUSKCO	MHO	CPCQMMUHRR	VQKUO	RVHR	NOMQ	
pÅ	CR	e O	VRPUMPKSR	MHR	NMQSVRMKNV	VNKN	RVHR	NOMQ	
pÅ	CR	e É	NPRRVSKMS	MKU	NRSVCPKTQ	USKQ	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VTSTCPKRV	NKM	NMMTQVCHRQ	VSKVR	RVHR	NOMQ	
d É	TO	e O	PTUPNNRTT	MKU	CNUTVMKQQ	VMKPP	RVHR	NOMQ	
d É	TO	e É	NMTMQUKNO	MKQ	NNVPVMKCU	UVHSS	RVHR	NOMQ	
v	UV	e O	CPRVRUSKPS	NHP	CSPMSRQKU	VQKNR	RVHR	NOMQ	
v	UV	e É	TOMCRQKRT	NKQ	UMTOTPKVP	UVKCR	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	STUUURUHRV	NKM	SCRCMVSKN	NMUHRV	RVHR	NOMQ	
qÄ	NRV	e É	CSSMVPNKVS	MHR	OTPRTRCHPS	VTKOT	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRCUMRMKNV	MKT	OVRURQRKMT	NNVKCR	RVHR	NOMQ	
_á	OMV	e É	NRSVRVRKNO	NKM	NRQQSCOKMP	NMNHSO	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNM

cãÉ=k~ã É MPSpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` CP' hÅ

^Åè=qãã É PLCPLOMCP=OMRCOMN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	JMKMPN	ééÄ	k L^	RTKTU	NMM	
NN	_	S	k ç=d ~ë	NKCCO	ééÄ	NCKP	NURPKQV	NMMM	
CP	k ~	CR	e É	SRKNRS	ééÄ	TKO	QVPQUKTP	CMMMMM	
CQ	j Ö	CR	e É	UKUOT	ééÄ	CKR	NNPPKQO	CMMMMM	
CT	^ ä	CR	e É	QMKCMU	ééÄ	SKP	NNNCKCU	CMMMMM	
CU	pá	CR	e O	NRKQNV	ééÄ	TKS	QMSCKPO	NMMMM	
PV	h	CR	e É	RRKOTR	ééÄ	PMKM	PMUTMKQR	CMMMMM	
QM	` ~	CR	e O	PTKUTS	ééÄ	CKQ	QMTQNKVV	CMMMMM	
RN	s	UV	e É	MKRNR	ééÄ	VKV	RTCKCO	NMMM	
RO	` ê	UV	e É	MKCNR	ééÄ	PMKN	VTUKRO	CMMM	
RR	j å	UV	e É	NKMUV	ééÄ	NUKP	TNVKUU	CMMM	
RS	cÉ	UV	e O	PVKNUM	ééÄ	NKS	NCCPPUKSV	NMMMM	
RV	` ç	UV	e É	MKMCO	ééÄ	VVKV	NTPKPQ	NMMM	
SM	k á	UV	e É	JMKVCV	ééÄ	k L^	TMCKCR	NMMM	
SP	` ì	UV	e É	MKCPQ	ééÄ	NCKP	NMRCKCU	CMMM	
SS	wå	UV	e É	QSKPVT	ééÄ	MKS	NMPOSKCQ	CMMM	
TR	^ ë	UV	e É	MKNMV	ééÄ	PTKO	PUKST	NMMM	
TU	pÉ	UV	e O	JMKMVP	ééÄ	k L^	NMKUP	NMMM	
UU	pê	UV	e É	MKMUV	ééÄ	CCKM	UTKTU	CMMM	
VR	j ç	UV	e É	MKTMN	ééÄ	NCKN	SRTKUN	NMMM	
NMT	^ Ö	UV	e É	JMKMNU	ééÄ	k L^	QCKCO	NMM	
NNN	` Ç	UV	e É	JMKMNO	ééÄ	k L^	UKNR	NMMM	
NNU	på	NRV	e É	MKCRS	ééÄ	NNKQ	QCMKMO	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKMVR	ééÄ	CSKP	TTCKNU	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKCQM	ééÄ	NSKV	PVMKQO	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKMRT	ééÄ	k L^	NVNRKRM	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMVP	ééÄ	k L^	UMTHRS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKMOT	ééÄ	k L^	TNMKTS	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKMSS	ééÄ	k L^	OPPSKMQ	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMNV	ééÄ	k L^	NCSKUM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¢pa	oÉÑ¨ mp	B ¢ ÉÅ	B n ` =¨ çï	B n ` =¢ äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	OMNVURNKM	CKU	CNNUNUQKUQ	VRKPS	RVKR	NOMKQ	
pÅ	CR	k ç=d ~ë	PVVPVNOKTV	NKS	CPCQMMUKRR	VOKPT	RVKR	NOMKQ	
pÅ	CR	e O	VPUUSTKMM	NKS	NMQSVRMKV	UVKSU	RVKR	NOMKQ	
pÅ	CR	e É	NPRVVQKUV	MKT	NRSVCPKTQ	USKSR	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VTRNSMPO	MKO	NMMTQVOKRQ	VSKTV	RVKR	NOMKQ	
d É	TO	e O	PTPSMRKNS	NKS	CNUTVMKQQ	UVKON	RVKR	NOMKQ	
d É	TO	e É	NMRNVSKUU	CKO	NNVPVMKCU	UUKNN	RVKR	NOMKQ	
v	UV	e O	QCUUNMSKRP	MKS	QSPMSRQKU	VOKS	RVKR	NOMKQ	
v	UV	e É	TNRQTRKTN	MKU	UMTOTPKVP	UUKSP	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SSUVRMUKPU	NKS	SCRCMMSKN	NMT	RVKR	NOMKQ	
qÄ	NRV	e É	OSQCNCQKUU	NKR	OTPRTRCKPS	VSKRU	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRMPTMUKOT	MKQ	OVRURQRKMT	NNUKCP	RVKR	NOMKQ	
_á	OMV	e É	NRRQTNMKNQ	NKN	NRQQSCOKMP	NMMSR	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNN

cãÉ=k~ã É MPTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` CP' hÅ

^Åè=qãã É PLCPLOMCP=OMRRTWQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	JMKMCU	ééÄ	k L^	SOKCO	NMM	
NN	_	S	k ç=d ~ë	UKSSO	ééÄ	RKP	TOVSKQM	NMMM	
CP	k ~	QR	e É	OVVCKNCU	ééÄ	NKS	QMSRVSKRV	QMMMMM	
CQ	j Ö	QR	e É	TTNKQRN	ééÄ	QKR	RMRCNKQV	QMMMMM	
CT	^ ä	QR	e É	SNKMUQ	ééÄ	NKQ	NSCPKQR	QMMMMM	
CU	pá	QR	e O	NUNPKQTM	ééÄ	MKS	NRTCSVKNT	NMMMM	
PV	h	QR	e É	SNUKSRT	ééÄ	PKQ	SCSSCKTS	QMMMMM	
QM	` ~	QR	e O	NPRUKUQU	ééÄ	RKO	UVTRMRKQR	QMMMMM	
RN	s	UV	e É	MKSPP	ééÄ	NSKR	STMKMP	NMMM	
RO	` ê	UV	e É	MKPNQ	ééÄ	NVKU	NMUSKRM	QMMM	
RR	j å	UV	e É	NQKRNU	ééÄ	NKS	SRRPKSN	QMMM	
RS	cÉ	UV	e O	NMRKNTS	ééÄ	SVKN	QUMPVQKNV	NMMMMM	
RV	` ç	UV	e É	MKQRM	ééÄ	TKS	RSQKQR	NMMM	
SM	k á	UV	e É	JMKTSM	ééÄ	k L^	TUTKUO	NMMM	
SP	` ì	UV	e É	MKSUS	ééÄ	NKT	NPVNKQN	QMMM	
SS	wå	UV	e É	PKSMU	ééÄ	QKV	UUUKVP	QMMM	
TR	^ ë	UV	e É	MKQVT	ééÄ	NPKS	NMQKPQ	NMMM	
TU	pÉ	UV	e O	MKNSU	ééÄ	VOKQ	OSKUP	NMMM	
UU	pê	UV	e É	TKTSU	ééÄ	QKP	QTMMKUU	QMMM	
VR	j ç	UV	e É	MKVMQ	ééÄ	NOKV	TTTKUO	NMMM	
NMT	^ Ö	UV	e É	MKMMN	ééÄ	RVQKN	UNKNN	NMM	
NNN	` Ç	UV	e É	MKMRU	ééÄ	OPKV	OTKTU	NMMM	
NNU	på	NRV	e É	NKMRS	ééÄ	RKO	UMMKMQ	NMMM	
NQN	pÄ	NRV	k ç=d ~ë	MKOTO	ééÄ	NTHP	NRURKNM	NMMM	
NPT	_~	NRV	k ç=d ~ë	NQKRVN	ééÄ	MKU	NSUNUKQQ	QMMM	
NUO	t	NRV	k ç=d ~ë	JMKNQM	ééÄ	k L^	NTNUKSN	NMMM	
QMR	qä	QMV	k ç=d ~ë	JMKNQN	ééÄ	k L^	SRQKMQ	NMMM	
QMU	mÄ	QMV	k ç=d ~ë	MKMSP	ééÄ	NMKM	NQPQKUV	QMMM	
QPO	qÜ	QMV	k ç=d ~ë	JMKMVM	ééÄ	k L^	QNTVKNR	NMMM	
QPU	r	QMV	k ç=d ~ë	JMKMNU	ééÄ	k L^	NPPKQU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =ì çï	B n ` =¢ äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	QMCQUCRKSN	NKM	QNNUNUQKUQ	VRKRV	RVKR	NQMKQ	
pÅ	QR	k ç=d ~ë	QMRCUNSKTS	NKR	QPCQMMUKRR	VPKTP	RVKR	NQMKQ	
pÅ	QR	e O	VCQCSUKPN	MKV	NMQSVRMKNV	UUKCU	RVKR	NQMKQ	
pÅ	QR	e É	NPSNUMKRM	NKQ	NRSVCPKTQ	USKTT	RVKR	NQMKQ	
d É	TO	k ç=d ~ë	VTQUTNKQQ	MKN	NMMTQVOKRQ	VSKTS	RVKR	NQMKQ	
d É	TO	e O	PTNMUTKMR	MKU	QNUTVMKQQ	UUKSN	RVKR	NQMKQ	
d É	TO	e É	NMSCQCQKSS	MKV	NNVPVMKCU	UVKNQ	RVKR	NQMKQ	
v	UV	e O	QCTPRMTHPT	MKV	QSPMSRQKU	VCKCV	RVKR	NQMKQ	
v	UV	e É	TONNNSKTM	MKV	UMTOTPKVP	UVKPP	RVKR	NQMKQ	
qÄ	NRV	k ç=d ~ë	STRPPTCKOT	NKO	SCRCMMSKN	NMUKMD	RVKR	NQMKQ	
qÄ	NRV	e É	OSSCSVQKRM	NKM	OTPRTRCKPS	VTKPP	RVKR	NQMKQ	
_á	QMV	k ç=d ~ë	PROTMRTKOO	NKR	OVRURQRKMT	NNVKOO	RVKR	NQMKQ	
_á	QMV	e É	NRTMPRRKQQ	NKQ	NRQQSCOKMP	NMNKST	RVKR	NQMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNO

cãÉ=k~ã É MPUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` CP' hÅ

^Åè=qáã É PLCPLOMCP=ONMOMRT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKMNR	éé Ä	k L^	TSKST	NMM	
NN	_	S	k ç=d ~ë	VKMVQ	éé Ä	RKM	TSTNKMR	NMMM	
CP	k ~	CR	e É	OVQCKVMN	éé Ä	MKN	PVUVQVKOT	CMMMMM	
CQ	j Ö	CR	e É	TQVKCQQ	éé Ä	NKN	QUUUSKTT	CMMMMM	
CT	^ ä	CR	e É	RUKTVQ	éé Ä	CKM	NRSNKCP	CMMMMM	
CU	pá	CR	e O	NUMTKCQM	éé Ä	NKP	NRSTTCKVN	NMMMM	
PV	h	CR	e É	RTCKQVT	éé Ä	CKV	RVUNUKPU	CMMMMM	
QM	` ~	CR	e O	NPRMKMTM	éé Ä	MKQ	UVCCURKPM	CMMMMM	
RN	s	UV	e É	MKTPP	éé Ä	RKU	TRCKCR	NMMM	
RO	` ê	UV	e É	MKPPV	éé Ä	NCKS	NNNRKNT	CMMM	
RR	j å	UV	e É	NCKSUR	éé Ä	MKR	SSSMKPN	CMMM	
RS	cÉ	UV	e O	TUUKUMP	éé Ä	NKS	NVPPPPUKNO	NMMMMM	
RV	` ç	UV	e É	MKNPV	éé Ä	CQKT	PTRKRT	NMMM	
SM	k á	UV	e É	JMKURM	éé Ä	k L^	TQTKUN	NMMM	
SP	` ì	UV	e É	NKTRN	éé Ä	PKQ	OTVQKTU	CMMM	
SS	wå	UV	e É	RKPRQ	éé Ä	SKT	NCUNKNV	CMMM	
TR	^ ë	UV	e É	MKRQR	éé Ä	UKR	NNCKSU	NMMM	
TU	pÉ	UV	e O	MKNCU	éé Ä	CCKN	CPKNT	NMMM	
UU	pê	UV	e É	THPRN	éé Ä	MKR	QQSRKCR	CMMM	
VR	j ç	UV	e É	MKQQP	éé Ä	NCKQ	RNTKUM	NMMM	
NMT	^ Ö	UV	e É	JMKMCN	éé Ä	k L^	PRKRS	NMM	
NNN	` Ç	UV	e É	JMKMNS	éé Ä	k L^	TKMQ	NMMM	
NNU	på	NRV	e É	MKOVV	éé Ä	VKM	PQTKTV	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKPQN	éé Ä	NMKU	NUVUKUO	NMMM	
NPT	_~	NRV	k ç=d ~ë	NCKCMO	éé Ä	NKP	NSPMPKSR	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKNCN	éé Ä	k L^	NTSUKST	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKNCM	éé Ä	k L^	SSMKTO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	CKNUR	éé Ä	NKQ	NUSMQKUU	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKMTU	éé Ä	k L^	COTRKVR	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNNM	éé Ä	NCUKO	PCPKSU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e åÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMQMTVVKSQ	NKO	CNNUNUQKUQ	VSKPR	RVKR	NOMKQ	
pÅ	CR	k ç=d ~ë	QMNQVMTKMV	CKN	CPCQMMUKRR	VOKUR	RVKR	NOMKQ	
pÅ	CR	e O	VCQQLNKVM	NKM	NMQSVRMKNV	UUKP	RVKR	NOMKQ	
pÅ	CR	e É	NPRSMSKNP	MKT	NRSVCPKTQ	USKQ	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VTNSMRKCM	NKM	NMMTQVCKRQ	VSKQQ	RVKR	NOMKQ	
d É	TO	e O	PTCMQQKPO	MKS	CNUTVMKQQ	UUKUQ	RVKR	NOMKQ	
d É	TO	e É	NMSQMNKUT	NKQ	NNVPVMKCU	UVKNO	RVKR	NOMKQ	
v	UV	e O	QCUTCLUKMT	NKM	QSPMSRQKU	VCKRU	RVKR	NOMKQ	
v	UV	e É	TCPROTKTU	NKN	UMTOTPKVP	UVKSP	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	STRQNTUKVQ	MKU	SCRCMVSKN	NMUKMP	RVKR	NOMKQ	
qÄ	NRV	e É	OSQTCRNKNV	MKT	OTPRTRCKPS	VSKTT	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRQCQVNKVP	MKO	OVRURQRKMT	NNVKTQ	RVKR	NOMKQ	
_á	OMV	e É	NRTPRCNKTP	NKO	NRQQSCCKMP	NMVKUT	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNO

cãÉ=k~ã É MPVpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖãÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OP' hÅ

^Åè=qãã É PLOPLOMOP=ONMUMP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå ORKMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKNQV	ééÄ	k L^	SNKNN	NMM	
NN	_	S	k ç=d ~ë	NMKOTV	ééÄ	VKT	ORCSKVP	NMMM	
OP	k ~	QR	e É	PNMUMNTN	ééÄ	NKQ	NNUSVSKOO	OMMMMM	
OQ	j Ö	QR	e É	TTTHPNN	ééÄ	OKN	NMTRRHRO	OMMMMM	
OT	^ ä	QR	e É	VMPNQ	ééÄ	NNKM	RTUKVN	OMMMMM	
OU	pá	QR	e O	NUPOKRUV	ééÄ	NKQ	PPONSHPN	NMMMM	
PV	h	QR	e É	TTPKTMS	ééÄ	OKU	PSVQUKRU	OMMMMM	
QM	` ~	QR	e O	NPOPKUUT	ééÄ	MKO	NVOQVVKVO	OMMMMM	
RN	s	UV	e É	MKVTR	ééÄ	NUKO	POPHPQ	NMMM	
RO	` ê	UV	e É	MMMSU	ééÄ	NNSHN	TUTKUT	OMMM	
RR	j å	UV	e É	NOKRSV	ééÄ	OKS	NQRUKQS	OMMM	
RS	cÉ	UV	e O	TQRKNMU	ééÄ	NKR	PVQPMPKMO	NMMMMM	
RV	` ç	UV	e É	JMKMOR	ééÄ	k L^	NOUKUV	NMMM	
SM	k á	UV	e É	JQKTOQ	ééÄ	k L^	TMPHPS	NMMM	
SP	` ì	UV	e É	NKUNR	ééÄ	NNHP	VTOKOT	OMMM	
SS	wå	UV	e É	UKOUR	ééÄ	UHP	QRSHSU	OMMM	
TR	^ ë	UV	e É	MRRMP	ééÄ	POKR	PTHST	NMMM	
TU	pÉ	UV	e O	JMKMTS	ééÄ	k L^	VKUP	NMMM	
UU	pê	UV	e É	THSOO	ééÄ	RKQ	VRQHRM	OMMM	
VR	j ç	UV	e É	NKQNO	ééÄ	PRHP	QOSHSU	NMMM	
NMT	^ Ö	UV	e É	JMKNOR	ééÄ	k L^	OTKTU	NMM	
NNN	` Ç	UV	e É	JMKNOO	ééÄ	k L^	QKUO	NMMM	
NNU	på	NRV	e É	MKNPM	ééÄ	NSSKU	NUUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MQOSM	ééÄ	NPHT	TUQHNU	NMMM	
NPT	_~	NRV	k ç=d ~ë	NOKVTV	ééÄ	SHT	PRVTHSQ	OMMM	
NUO	t	NRV	k ç=d ~ë	JNHPUM	ééÄ	k L^	NPVQKUV	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMTTRS	ééÄ	k L^	QUMRRO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NHVON	ééÄ	THS	QMMTKUO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	JNKMQS	ééÄ	k L^	NPPUKNR	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKNOP	ééÄ	k L^	VPHQP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¨ çï	B n ` =¤ëÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	OMTPRPTHQO	MKV	ONNUNUQKUQ	VTKUV	RVHR	NOMHQ	
pÅ	QR	k ç=d ~ë	QMQRPNTHRN	NKQ	QPOQMMUHRR	VPHRR	RVHR	NOMHQ	
pÅ	QR	e O	VQVOTPKOO	MHS	NMQSVRMKNV	VMHST	RVHR	NOMHQ	
pÅ	QR	e É	NPTTSSKNT	MKT	NRSVQPKTQ	UTKTU	RVHR	NOMHQ	
d É	TO	k ç=d ~ë	VUPTPRKVT	MKN	NMMTQVOKRQ	VTHSQ	RVHR	NOMHQ	
d É	TO	e O	PUNTVMKOS	MKT	QNUTVMKQQ	VNKHS	RVHR	NOMHQ	
d É	TO	e É	NMTOQPKQU	MKU	NNVPVMKOU	UVKUP	RVHR	NOMHQ	
v	UV	e O	QPSMQUMKV	NKO	QSPMSRQKU	VQHNT	RVHR	NOMHQ	
v	UV	e É	TOQMOTKTU	MHR	UMTOTPKVP	UVHSV	RVHR	NOMHQ	
qÄ	NRV	k ç=d ~ë	SUUPMUSKQN	NKT	SORQMVSKN	NNMKV	RVHR	NOMHQ	
qÄ	NRV	e É	OSTTRSQHSR	NHS	OTPRTROKPS	VTKUT	RVHR	NOMHQ	
_á	OMV	k ç=d ~ë	PRNQMUVKQQ	NKN	OVRURQRKMT	NNUKTU	RVHR	NOMHQ	
_á	OMV	e É	NRTUROQKQT	NKQ	NRQQSOOKMP	NVOKNV	RVHR	NOMHQ	

p~ã éäÉ=k~ã É	pn NOMNUMNO^
cãÉ=k~ã É	MOMpj mi hÇ
a~í~=m~íÜ=k~ã É	aWjt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OP' hÅ
^Åè=qãã É	PLOPLOMOP=ONNMPMN
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==ì mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	VRTOP	ééÄ	NMS	NNOONMKU	NMM	
NN	_	S	k ç=d ~ë	ONNKOOP	ééÄ	NMN	NRTPURMPU	NMMM	
OP	k ~	OR	e É	NPUSMKUTP	ééÄ	NMO	NTMQVRNMOS	OMMMMM	
OQ	j Ö	OR	e É	NTSPKQQN	ééÄ	NMT	NNOVMUMKV	OMMMMM	
OT	^ ä	OR	e É	NNNVKOQT	ééÄ	OMP	OTMOUMVP	OMMMMM	
OU	pá	OR	e O	SUPQKPUU	ééÄ	NMQ	RURORONRV	NMMMM	
PV	h	OR	e É	NVRCPMVTV	ééÄ	NMT	SNMUUMKVO	OMMMMM	
QM	` ~	OR	e O	OQNNKUQS	ééÄ	NMV	NRSSOVVMRQ	OMMMMM	
RN	s	UV	e É	RNMQRQ	ééÄ	NMP	QMSTNMMT	NMMM	
RO	` ê	UV	e É	RNMSVT	ééÄ	MMV	RONSUMMM	OMMM	
RR	j å	UV	e É	PPMOTP	ééÄ	NMV	NSVSPMSN	OMMM	
RS	cÉ	UV	e O	NTQVMNQR	ééÄ	MMV	QOORRPUMOR	NMMMMM	
RV	` ç	UV	e É	NVMTVN	ééÄ	NMV	NUPQRMUT	NMMM	
SM	k á	UV	e É	ONMMMM	ééÄ	MMP	NMVSPMPR	NMMM	
SP	` ì	UV	e É	PQMPNN	ééÄ	OMN	QQVRVMNP	OMMM	
SS	wå	UV	e É	NVUMONO	ééÄ	NMU	OPVNSMPR	OMMM	
TR	^ ë	UV	e É	RMMRTP	ééÄ	MMS	UQRTMQR	NMMM	
TU	pÉ	UV	e O	QVMOUN	ééÄ	MMV	QSOTMMR	NMMM	
UU	pê	UV	e É	RTMURQ	ééÄ	NMT	PQQPTMTM	OMMM	
VR	j ç	UV	e É	RPMSMU	ééÄ	NMQ	PMPRTMOS	NMMM	
NMT	^ Ö	UV	e É	NMMSMS	ééÄ	NMM	ONQVSMNP	NMM	
NNN	` Ç	UV	e É	NMMSOM	ééÄ	OMT	OVQMMTM	NMMM	
NNU	på	NRV	e É	QVMPTO	ééÄ	OMS	QUSSSMPN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	VMUVV	ééÄ	NMV	QQTPMMQR	NMMM	
NPT	_~	NRV	k ç=d ~ë	POMQUQ	ééÄ	PMN	QOUQVMVV	OMMM	
NUO	t	NRV	k ç=d ~ë	ROMRPO	ééÄ	NMP	NPSUPOMVP	NMMM	
OMR	qä	OMV	k ç=d ~ë	UMVSU	ééÄ	NMN	RQQURMNR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NOMPQO	ééÄ	OMN	VVTPOMNP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NVMMNQ	ééÄ	NMV	TOVRUMUN	NMMM	
OPU	r	OMV	k ç=d ~ë	NVMRVV	ééÄ	OMP	SVMUTMQP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=ɵpa	oÉÑ= mp	B ɵ ÉÁ	B n ` =ï çï	B n ` =ɵ ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMRMRTVMOQ	MMP	ONNUNUQMUQ	VSMUN	RVMR	NOMMQ	
pÅ	OR	k ç=d ~ë	PVTVOUPMMN	NMP	QPOQMMUMRR	VOMMP	RVMR	NOMMQ	
pÅ	OR	e O	VNRSMOMSU	OMP	NMQSVRMMV	UTMQR	RVMR	NOMMQ	
pÅ	OR	e É	NPPVTPMSV	NMN	NRSVQPMTQ	URMPS	RVMR	NOMMQ	
d É	TO	k ç=d ~ë	VSNTURMUN	MMS	NMMTQVORQ	VRMQS	RVMR	NOMMQ	
d É	TO	e O	PSTNQUMSV	NMP	QNUTVMMQQ	UTMST	RVMR	NOMMQ	
d É	TO	e É	NMPVTPMRN	MMS	NNVPVMMOU	UTMMV	RVMR	NOMMQ	
v	UV	e O	QORUUVNMPT	NMO	QSPMSRQMU	VNMVT	RVMR	NOMMQ	
v	UV	e É	TNPUSPMON	MMO	UMTOTPMVP	UUMQP	RVMR	NOMMQ	
qÄ	NRV	k ç=d ~ë	SSUTSVOMVV	MMO	SORQMMSMN	NMSMVT	RVMR	NOMMQ	
qÄ	NRV	e É	ORURQQNMTU	MMS	OTPRTROMPS	VQMRN	RVMR	NOMMQ	
_á	OMV	k ç=d ~ë	PRMTPQRMVS	NMP	OVRURQRMMT	NNUMRR	RVMR	NOMMQ	
_á	OMV	e É	NRPMMONMPM	NMO	NRQQSOOMMP	VVMMR	RVMR	NOMMQ	

p~ã éäÉ=k~ã É pn NOMNUMNOm

cãÉ=k~ã É MQNpj mi HÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OP' HÅ

^Åè=qãã É PLOPLOMOP=ONMUMNU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	RMPRRT	éé Ä	NKR	RTNOTHPP	NMM	
NN	_	S	k ç=d ~ë	RPVHPOT	éé Ä	NKO	PVRRNNKVN	NMMM	
OP	k ~	QR	e É	NNSVQHPQN	éé Ä	NHP	NQTNSVTHSP	OMMMMM	
OQ	j Ö	QR	e É	SOSQKMUN	éé Ä	MKV	QMTMUPKUQ	OMMMMM	
OT	^ ä	QR	e É	ONTVKNNP	éé Ä	NKV	RPQTPKNU	OMMMMM	
OU	pá	QR	e O	OUSVRTRN	éé Ä	MKU	QRONMPKUR	NMMMM	
PV	h	QR	e É	NNMMOKRRS	éé Ä	MKO	SQVOTRKMU	OMMMMM	
QM	` ~	QR	e O	QMQTKUPR	éé Ä	MKU	OSUOPPQNSU	OMMMMM	
RN	s	UV	e É	RMRHRUO	éé Ä	NKO	QMOSUSKMS	NMMM	
RO	` ê	UV	e É	OMPKURS	éé Ä	NKO	OMRTSPHRQ	OMMM	
RR	j å	UV	e É	RNQNSQS	éé Ä	MRT	OSOUTPKON	OMMM	
RS	cÉ	UV	e O	NTQNHPST	éé Ä	MKV	QORURSRKVT	NMMMM	
RV	` ç	UV	e É	RPPHTMV	éé Ä	MHS	VNMVTMKUR	NMMM	
SM	k á	UV	e É	RPNKTRR	éé Ä	NHR	ORQUPNKOM	NMMM	
SP	` ì	UV	e É	OTMRTMV	éé Ä	MRT	PRRPQVKNU	OMMM	
SS	wå	UV	e É	RNVHMNP	éé Ä	MKN	NNRSUTHPV	OMMM	
TR	^ ë	UV	e É	NMSHMOR	éé Ä	NHR	NTVNNKSU	NMMM	
TU	pÉ	UV	e O	NMOKVSQ	éé Ä	NRT	VTTPKQS	NMMM	
UU	pê	UV	e É	RPQNNPU	éé Ä	MRR	PONOVUKMR	OMMM	
VR	j ç	UV	e É	NNOKQNO	éé Ä	NHR	SQMUQKOT	NMMM	
NMT	^ Ö	UV	e É	RMVKVQQ	éé Ä	NKN	NMQNOPKOM	NMM	
NNN	` Ç	UV	e É	OTSKVNU	éé Ä	MHP	TTOSSHPT	NMMM	
NNU	på	NRV	e É	RMOKRRQ	éé Ä	NKU	OVSNSNKOR	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NMNHMVS	éé Ä	MKN	QQUPUUKUO	NMMM	
NPT	_~	NRV	k ç=d ~ë	OMPQKNUQ	éé Ä	MKU	OSQTUTSHPR	OMMM	
NUO	t	NRV	k ç=d ~ë	NNNKQNU	éé Ä	NHM	OUQSMNKQQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	VVKQNQ	éé Ä	NKU	RTOPURKNM	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NMVKUMP	éé Ä	MRT	UUSOPVKVV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NMRHMOP	éé Ä	MKU	TQPVPVHRR	NMMM	
OPU	r	OMV	k ç=d ~ë	NNPHMUU	éé Ä	MHR	TQMOPSKVQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ ÉÅ	B n ` =¡ çï	B n ` =¢ äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	OMORVNTHPV	MHR	ONNUNUQKUQ	VRHSQ	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PVVRPOUKTO	MKN	QPOQMMUHRR	VOKQ	RVHR	NOMQ	
pÅ	QR	e O	VPTUTPKUR	NHP	NMQSVRMKNV	UVHRU	RVHR	NOMQ	
pÅ	QR	e É	NPSQQVKUM	MKU	NRSVQPKTQ	USKVQ	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VRTRTOKRN	NKO	NMMTQVORQ	VRHVR	RVHR	NOMQ	
d É	TO	e O	PTPPOUKVR	NHM	QNUTVMKQQ	UVHNQ	RVHR	NOMQ	
d É	TO	e É	NMTNSSKQT	MKU	NNVPVMKOU	UVHTS	RVHR	NOMQ	
v	UV	e O	QPNNPQTKTN	NKO	QSPMSRQKU	VPHN	RVHR	NOMQ	
v	UV	e É	TOOMNNRU	NHR	UMTOTPKVP	UVKQQ	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSNMUOTHPS	NKO	SORQMVSKN	NMRRTQ	RVHR	NOMQ	
qÄ	NRV	e É	OSPUPMVKSR	NKO	OTPRTROHPS	VSKQQ	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRPOOTTKOS	MHS	OVRURQRKMT	NNVHPV	RVHR	NOMQ	
_á	OMV	e É	NRQUMOUKVO	NKN	NRQQSOOKMP	NMMKOO	RVHR	NOMQ	

`çåíaåìaåÖ=~äåÄê~íáç=sÉêâÑÅ~íáç=Ê``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MQQ``skÇ
a~í~=m~íÜk~ã É	aWj^ÖãÉáíyf^mj eyNya^q^yQMOPyMPJ ^oyi n``OP^hÅ
^Åè=qáã É	PLOPLOMOP=ONWØSWNP
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MNQ ^i _kÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÅ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	ORKQST	ééÄ	NKN	NQSUVMQU	QR	NMNKUT	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OSKOVQ	ééÄ	NKN	VUUTTMR	QR	NMRKNU	UVKU	NNMO	
OP	k ~	QR	e É	RRRSKTOQ	ééÄ	MS	PQQRPMNKOO	RMMM	NNNKP	UVKU	NNMO	[=HLJ=NMB
OQ	j Ö	QR	e É	RSNQKSSS	ééÄ	MU	NUORTRUKTQ	RMMM	NNOKOV	UVKU	NNMO	[=HLJ=NMB
OT	^ä	QR	e É	RPSKNPR	ééÄ	MP	SRUTQKTO	RMM	NMTKOP	UVKU	NNMO	
OU	pá	QR	e O	RPMKOPM	ééÄ	MT	OPPSVRKQT	RMM	NMSKMR	UVKU	NNMO	
PV	h	QR	e É	RPMUKMNM	ééÄ	MR	NROVRNRKRR	RMMM	NMSKNS	UVKU	NNMO	
QM	` ~	QR	e O	ROLPKNLN	ééÄ	NKN	NTQTOPVMKUR	RMMM	NMRKSS	UVKU	NNMO	
RN	s	UV	e É	ORKUUR	ééÄ	MS	NVONROKRN	QR	NMPKRQ	UVKU	NNMO	
RO	` ê	UV	e É	ORKUST	ééÄ	MS	NOVQLMSU	QR	NMPKQT	UVKU	NNMO	
RR	j å	UV	e É	ORKRMQ	ééÄ	MT	SQRVQKVR	QR	NMOKMO	UVKU	NNMO	
RS	cÉ	UV	e O	RNQRKTQT	ééÄ	MT	SNRNSPMVKRS	RMMM	NMOKVN	UVKU	NNMO	
RV	` ç	UV	e É	OSKSSN	ééÄ	MQ	OORQVPKSP	QR	NMSKSQ	UVKU	NNMO	
SM	k á	UV	e É	OSKQRT	ééÄ	MN	SPNMRKQR	QR	NMRKUP	UVKU	NNMO	
SP	` ì	UV	e É	OSKTSM	ééÄ	NP	NTQMTUKTQ	QR	NMTKMQ	UVKU	NNMO	
SS	wå	UV	e É	OSKSPO	ééÄ	NR	OVQPSKVV	QR	NMSKRP	UVKU	NNMO	
TR	^ë	UV	e É	ORKRMR	ééÄ	MT	ONPNSKQU	QR	NMOKMO	UVKU	NNMO	
TU	pÉ	UV	e O	ORKQSV	ééÄ	NR	NNTVQKRV	QR	NMNKMU	UVKU	NNMO	
UU	pê	UV	e É	OSKNNN	ééÄ	NS	TTTQSKVM	QR	NMQKQQ	UVKU	NNMO	
VR	j ç	UV	e É	OSKMVU	ééÄ	MT	TPRVNKPQ	QR	NMQKPV	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKPMN	ééÄ	MQ	OTSMMUKUR	QR	NMMKO	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKURV	ééÄ	NKM	PTMMVKUR	QR	NMTKQQ	UVKU	NNMO	
NNU	på	NRV	e É	OQKROM	ééÄ	NKV	TNUMTKVS	QR	VUKMU	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKUSP	ééÄ	NKU	RRRNQMKUN	QR	VVKQR	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKQLV	ééÄ	MR	NSTNQLKSV	QR	NMNKVS	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKSOV	ééÄ	NR	POVOLNKSM	QR	NMOKRO	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	OSKNNN	ééÄ	NP	TPOVQQKNS	QR	NMQKQQ	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKORM	ééÄ	NO	NMPPPSRKPT	QR	NMR	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKSTN	ééÄ	NKM	VOMUSNKNT	QR	NMSKSU	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OTKSNR	ééÄ	OKQ	UUNRSRKTU	QR	NNMQS	UVKU	NNMO	[=HLJ=NMB

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=o pa	oÉÑ=mp	B=oÉÅ	B n`=ç ï	B n`=c äÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	OMSONNMKTN	MKV	ONNUNUQKUQ	VTHPR	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	QMORQVQKOT	NKM	QPQQMMUKRR	VPHMV	RVHR	NOMQ	
pÅ	QR	e O	VQMTVQKPR	NKO	NMQSVRMKMV	UVKUS	RVHR	NOMQ	
pÅ	QR	e É	NPSSVQKMM	MKR	NRSVQPKTQ	UTHN	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VSVUMPKTN	MKP	NMMTQVOKRQ	VSKOS	RVHR	NOMQ	
d É	TO	e O	PTSVOQKVS	MKV	QNUTVMKQQ	VVM	RVHR	NOMQ	
d É	TO	e É	NMRNNRKOU	MKP	NNVPVMKOU	UUHMQ	RVHR	NOMQ	
v	UV	e O	QQQMUTPHPV	NKP	QSPMSRQKU	VNHRU	RVHR	NOMQ	
v	UV	e É	TNQRRQKST	MKP	UMTOTPKVP	UUHRN	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSRTQQVKOV	NKT	SORQMVSKN	NVSKQV	RVHR	NOMQ	
qÄ	NRV	e É	OSNTPSQKMM	NKP	OTPRTROKPS	VRHST	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PQQSPUMKNR	NKO	OVRURQRKMT	NNSKQV	RVHR	NOMQ	
_á	OMV	e É	NRQPOTVKTN	MKQ	NRQQSOOKMP	VUHSO	RVHR	NOMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=Ê``_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MOP|``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíÝ^mj eyNya^q^yOMOPyMPJ ^oyi n`OP^kÅ

^Åè=qáã É PLOPLOMOP=ONWRWRT

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáç~å NKWMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑc äÉk~ã É MNQ ^i _KÇ

p~ã éáÉ=n`=m~ëëlc á~ä m~ëë

fpqa=n`=m~ëëlc~äã m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	r åáë	opa	==\ mp==	iãäá	n`=c ä~Ö
V	_É	S	kç=d~ë	MKWNO	éé Ä	OMRT	NSSKST	MO	
NN	_	S	kç=d~ë	MKPRP	éé Ä	TKU	OPPUKWN	Q	
OP	k~	QR	eÉ	OKNUR	éé Ä	SKR	QQTCOKPN	OMM	
OQ	j Ö	QR	eÉ	OKTQR	éé Ä	NSKP	NQTRKSV	OM	
OT	^ä	QR	eÉ	MKPUS	éé Ä	OUKT	NUNKNO	OM	
OU	pá	QR	eO	MKWTU	éé Ä	POMKS	TRTKQV	NWM	
PV	h	QR	eÉ	NOKQMR	éé Ä	QKN	PNTVUKRR	OMM	
QM	`~	QR	eO	PKRPM	éé Ä	QKV	OTVOPKPS	OM	
RN	s	UV	eÉ	MKWPN	éé Ä	COKQ	OVRKRS	N	
RO	`ê	UV	eÉ	MKWMS	éé Ä	NPMKV	UNQKRQ	N	
RR	j å	UV	eÉ	MKWMO	éé Ä	NCQKR	NTVKVT	MQ	
RS	cÉ	UV	eO	NKVUV	éé Ä	QKN	RCOMVKRO	OM	
RV	`ç	UV	eÉ	MKWNR	éé Ä	PVKU	OSSKSU	MO	
SM	ká	UV	eÉ	JMKWVQ	éé Ä	kL^	TMNKWR	MQ	
SP	`ì	UV	eÉ	MKWMT	éé Ä	NNRKR	RQTKUM	MS	
SS	wå	UV	eÉ	MKWQO	éé Ä	CRKS	CQLUKVM	O	
TR	^ë	UV	eÉ	MKWOS	éé Ä	OMKP	QPKPQ	N	
TU	pÉ	UV	eO	MKWPN	éé Ä	COKV	CRKUP	N	
UU	pê	UV	eÉ	MKWCQ	éé Ä	CRKT	NMTKTU	N	
VR	j ç	UV	eÉ	MKWPU	éé Ä	NKU	SSUKVO	N	
NMT	^Ö	UV	eÉ	MKWNM	éé Ä	OUKU	NUMKWM	MO	
NNN	`Ç	UV	eÉ	MKWNO	éé Ä	RRKU	OUKWR	MO	
NNU	på	NRV	eÉ	MKWRU	éé Ä	QNKO	PQNKNO	N	
NON	pÄ	NRV	kç=d~ë	MKWPN	éé Ä	SKO	NMQQKQT	MO	
NPT	_~	NRV	kç=d~ë	MKWRT	éé Ä	TKV	QQTKWR	MQ	
NUO	t	NRV	kç=d~ë	MKWPO	éé Ä	NOKS	PTRNKWS	N	
OMR	qä	OMV	kç=d~ë	MKWPS	éé Ä	TKV	CPMRKVU	MO	
OMU	mÄ	OMV	kç=d~ë	MKWNN	éé Ä	PPKS	NPPNKQQ	MO	
OPO	qÜ	OMV	kç=d~ë	MKWRN	éé Ä	OMKS	QQLURKRR	N	
OPU	r	OMV	kç=d~ë	MKWNS	éé Ä	NSKM	TRMKUN	MO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ= mp	B=oÉÁ	B n`=ç ï	B n`=cäÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	OMVUMORKWN	MKT	ONNUNUQKUQ	VVKWR	RVHR	NOMQ	
pÅ	QR	kç=d~ë	PVTUMUNKNT	MKU	QPCQMMUKRR	VO	RVHR	NOMQ	
pÅ	QR	eO	VRSSCPKVP	NKM	NMQSVRMKW	VNKPT	RVHR	NOMQ	
pÅ	QR	eÉ	NPUPSNKSO	MKQ	NRSVCPKTQ	UUKWS	RVHR	NOMQ	
dÉ	TO	kç=d~ë	VTTNNRKON	MKV	NMMTQVOKRQ	VSKVU	RVHR	NOMQ	
dÉ	TO	eO	PUPNPVKON	MKS	QNUTVMKQQ	VNKQV	RVHR	NOMQ	
dÉ	TO	eÉ	NMTQSVKTN	MKP	NNVPVMKOU	VMKWO	RVHR	NOMQ	
v	UV	eO	QPPNCQNKWV	MKS	QSPMSRQKU	VPKRP	RVHR	NOMQ	
v	UV	eÉ	TPPUMNKSP	NKM	UMTOTPKVP	VMKV	RVHR	NOMQ	
qÄ	NRV	kç=d~ë	SSUPCQLKQO	MKS	SCROMVSKN	NVSKV	RVHR	NOMQ	
qÄ	NRV	eÉ	OSQLUMOKOO	MKR	OTPRTROKPS	VSKUO	RVHR	NOMQ	
_á	OMV	kç=d~ë	PQPCOLUPKQT	NKN	OVRURQRKWT	NNSKWN	RVHR	NOMQ	
_á	OMV	eÉ	NRORONRKVN	MKT	NRQQSOOKMP	VUKTQ	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNQp

cãÉ=k~ã É MQQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyi ÖäÉåíyi mj eyNya^q^yOMOPyMPJ ^oyi n ` OP' hÅ

^Åè=qãã É PLOPLOMOP=ONMQMQQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	RRKQPO	ééÄ	PKU	SPPPRKVQ	NMM	
NN	_	S	k ç=d ~ë	RSMKMQ	ééÄ	NKT	QNPUSPKOQ	NMMM	
OP	k ~	QR	e É	NNVPOKTSP	ééÄ	NKV	NRMITTRQKUN	OMMMMM	
OQ	j Ö	QR	e É	SPVNKQNP	ééÄ	NKV	QNTCUTKTO	OMMMMM	
OT	^ ä	QR	e É	OPMQKNOR	ééÄ	NKP	RSUMQKVN	OMMMMM	
OU	pá	QR	e O	OUUNKOMM	ééÄ	NKO	ORRVQNKMD	NMMMM	
PV	h	QR	e É	NNOSSKTST	ééÄ	NKP	SSTPNNKON	OMMMMM	
QM	` ~	QR	e O	QNNTKQSR	ééÄ	NKU	OTRUSQQKUO	OMMMMM	
RN	s	UV	e É	RRMKVUV	ééÄ	NKM	OPQSVVKNP	NMMM	
RO	` ê	UV	e É	OOMKPVN	ééÄ	MKR	OOMOVRKST	OMMM	
RR	j å	UV	e É	RSMKTQR	ééÄ	NKT	OUPSVVKQS	OMMM	
RS	cÉ	UV	e O	NUPNKNQQ	ééÄ	NKR	QQROOOVKTU	NMMMMM	
RV	` ç	UV	e É	RVRKTTO	ééÄ	OKO	NMMTNRSKTQ	NMMM	
SM	k á	UV	e É	RUNKTNR	ééÄ	NKT	OTPUSNKPQ	NMMM	
SP	` ì	UV	e É	OVSKRMN	ééÄ	MKR	PURQTMKQN	OMMM	
SS	wå	UV	e É	RSPKMTV	ééÄ	MKN	NOQPMTHPT	OMMM	
TR	^ ë	UV	e É	NMVKTRQ	ééÄ	MKT	NUPSOKVT	NMMM	
TU	pÉ	UV	e O	NVRKUOR	ééÄ	MKP	VVVOKOT	NMMM	
UU	pê	UV	e É	RRQKOPN	ééÄ	MKU	PPMNURKSQ	OMMM	
VR	j ç	UV	e É	NNTKTOO	ééÄ	NKM	SSQSSKSM	NMMM	
NMT	^ Ö	UV	e É	RQKPTQ	ééÄ	MKU	NNMMTUKRR	NMM	
NNN	` Ç	UV	e É	OUTKSUT	ééÄ	NKM	TVRMQKSU	NMMM	
NNU	på	NRV	e É	ROOKOMV	ééÄ	MKS	PMQVPSKSM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NMOKQOP	ééÄ	NKN	QSRSRVKQM	NMMM	
NPT	_~	NRV	k ç=d ~ë	ONSQKOON	ééÄ	MKQ	OUUTNMVKUT	OMMM	
NUO	t	NRV	k ç=d ~ë	NNRKTTM	ééÄ	MKO	PMOVTMKRQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	NMQKVTV	ééÄ	MKU	SMPNNPKRR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NNOKUMP	ééÄ	NKO	VMUQTOKQN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NMVKTUN	ééÄ	MKP	TTRUSTHRQ	NMMM	
OPU	r	OMV	k ç=d ~ë	NNTKNMP	ééÄ	MKS	TSQUVPKPS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤pÉÅ	B n ` =¡ çï	B n ` =¢äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	OMQNVRUKQN	OKS	ONNUNUQKUQ	VSKQ	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QMORTRPKMV	OKP	QPOQMMUKRR	VPKN	RVKR	NOMKQ	
pÅ	QR	e O	VQUQOVKRN	NKT	NMQSVRMKMV	VMKRV	RVKR	NOMKQ	
pÅ	QR	e É	NPTNMTKQR	NKR	NRSVQPKTQ	UTHPS	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VTPNVQKVR	MKV	NMMTQVOKRQ	VSHS	RVKR	NOMKQ	
d É	TO	e O	PTNRNSKNU	MKR	QNUTVMKQQ	UUKTN	RVKR	NOMKQ	
d É	TO	e É	NMSMTUKNV	MKV	NNVPVMKOU	UUKUR	RVKR	NOMKQ	
v	UV	e O	QOUTRSOKNQ	MKR	QSPMSRQKU	VOKRV	RVKR	NOMKQ	
v	UV	e É	TNRNPTKTN	MKT	UMTOTPKVP	UUKRV	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	STTQTMPKQO	NKN	SCROMVSKN	NMUHPS	RVKR	NOMKQ	
qÄ	NRV	e É	OSNPUSTKQP	MKS	OTPRTROKPS	VRHRQ	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PROQUPNKSS	NKN	OVRURQRKMT	NNVKNQ	RVKR	NOMKQ	
_á	OMV	e É	NRRVVOTHPV	MKQ	NRQQSOOKMP	NMMKV	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNP

cãÉ=k~ã É MORpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OP' hÅ

^Åè=qãã É PLOPLOMOP=ONMQMMT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKMMV	ééÄ	OQPKM	NMSKST	NMM	
NN	_	S	k ç=d ~ë	NOKMRU	ééÄ	OKU	NMMNMMPN	NMMM	
OP	k ~	QR	e É	POQQKUOO	ééÄ	NKN	OPRMVMKVU	OMMMMM	
OQ	j Ö	QR	e É	UUSKOQV	ééÄ	NKP	RTSUSHMN	OMMMMM	
OT	^ ä	QR	e É	TNKORU	ééÄ	SKN	NUSPKQV	OMMMMM	
OU	pá	QR	e O	NPNTHSUP	ééÄ	MKV	NNQRCPHMS	NMMMM	
PV	h	QR	e É	SUTKVRQ	ééÄ	NKP	SSORPHRN	OMMMMM	
QM	` ~	QR	e O	NSSUKTRV	ééÄ	NKQ	NMVVQNRKOM	OMMMMM	
RN	s	UV	e É	MKVUQ	ééÄ	OKP	VQPKPU	NMMM	
RO	` ê	UV	e É	MPPNV	ééÄ	NNKN	NMUQKRM	OMMM	
RR	j å	UV	e É	NQKOTO	ééÄ	NKO	TPVVKUT	OMMM	
RS	cÉ	UV	e O	VUSHMTR	ééÄ	MKV	OPVOONTKQO	NMMMMM	
RV	` ç	UV	e É	MQRR	ééÄ	NNKM	VMSKTP	NMMM	
SM	k á	UV	e É	JMKQUS	ééÄ	k L^	VNNKNS	NMMM	
SP	` ì	UV	e É	MKQVQ	ééÄ	SKO	NNPOKOV	OMMM	
SS	wå	UV	e É	UKURR	ééÄ	THR	OMQOKQN	OMMM	
TR	^ ë	UV	e É	MRTNQ	ééÄ	UHS	NQMKMO	NMMM	
TU	pÉ	UV	e O	MKOMR	ééÄ	ONKM	PMKNT	NMMM	
UU	pê	UV	e É	VKOUR	ééÄ	OKT	RRTSKTV	OMMM	
VR	j ç	UV	e É	MQRU	ééÄ	NQHR	RONKNP	NMMM	
NMT	^ Ö	UV	e É	MKMNS	ééÄ	PQHS	NNMKMM	NMM	
NNN	` Ç	UV	e É	MKNTM	ééÄ	PMKM	RUHRO	NMMM	
NNU	på	NRV	e É	MRTUQ	ééÄ	NSHS	SPNKNQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MQVV	ééÄ	NMHT	OSNVHST	NMMM	
NPT	_~	NRV	k ç=d ~ë	NPKVPU	ééÄ	NHS	NUSTOKTR	OMMM	
NUO	t	NRV	k ç=d ~ë	MKNRP	ééÄ	QTHU	OQUOKUR	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNOS	ééÄ	OPHP	OMUVKMR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	PKOQS	ééÄ	NHO	OTOUSHSR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKUMM	ééÄ	NNHV	URONKUV	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMTQ	ééÄ	OTHR	TQQKNR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ÉÁ	B n ` =i çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	OMTOTNMPT	NHO	ONNUNUQKUQ	VTKUR	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	OMTQQPUHSU	NHN	QPOQMMUHRR	VQKCP	RVHR	NOMQ	
pÅ	QR	e O	VOQTMPRTQ	OHN	NMQSVRMKNV	UUHPO	RVHR	NOMQ	
pÅ	QR	e É	NPRRNSKMR	MKU	NRSVCPRTQ	USHPR	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VTRSURHRN	OHP	NMMTQVOHRQ	VSKUQ	RVHR	NOMQ	
d É	TO	e O	PSUNRMKVS	PHN	ONUTVMKQQ	UTHVN	RVHR	NOMQ	
d É	TO	e É	NMQUTTHPM	MRT	NNVPVMKOU	UTKUQ	RVHR	NOMQ	
v	UV	e O	QORRTPTHOR	OHS	QSPMSRQKU	VNKV	RVHR	NOMQ	
v	UV	e É	TNSRSQKQQ	NHM	UMTOTPKVP	UURTS	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	STTROPHPV	NKU	SORCMVSHN	NMUHPT	RVHR	NOMQ	
qÄ	NRV	e É	OSPQQQTKVQ	NHN	OTPRTROHPS	VSHP	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRRSCPVKQT	NHO	OVRURQRKMT	NOMO	RVHR	NOMQ	
_á	OMV	e É	NRQSPOPKQT	MHO	NRQQSOOKMP	NMMKN	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNQ

cãÉ=k~ã É MQSpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` CP' hÅ

^Åè=qãã É PLCPLOMCP=ONMRQMR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	JMKMNT	ééÄ	k L^	TQKQR	NMM	
NN	_	S	k ç=d ~ë	UKPVS	ééÄ	CKU	TNMMKTT	NMMM	
CP	k ~	CR	e É	NSMRKRRQ	ééÄ	NKV	CPOVNUKNQ	CMMMMM	
CQ	j Ö	CR	e É	CNSKTSS	ééÄ	PKT	NQPCRKPU	CMMMMM	
CT	^ ä	CR	e É	NNRKCMM	ééÄ	MKQ	CUVMKPS	CMMMMM	
CU	pá	CR	e O	PNMMMSPS	ééÄ	NKT	OSQVQCKUS	NMMMM	
PV	h	CR	e É	VUKSMN	ééÄ	RKP	POTPMKQD	CMMMMM	
QM	` ~	CR	e O	CUVKQRT	ééÄ	MKT	CMMUPQKOT	CMMMMM	
RN	s	UV	e É	NKCRQ	ééÄ	TKN	NPMQKRP	NMMM	
RO	` ê	UV	e É	MKTUO	ééÄ	PKM	NRPPKNKO	CMMM	
RR	j å	UV	e É	NUKCUO	ééÄ	CKO	VPSCKMN	CMMM	
RS	cÉ	UV	e O	VRSKOCQN	ééÄ	CKM	CPOQRRMKRV	NMMMMM	
RV	` ç	UV	e É	MKMVP	ééÄ	CKU	QSMKMO	NMMM	
SM	k á	UV	e É	JMKTTO	ééÄ	k L^	TTNKNR	NMMM	
SP	` ì	UV	e É	MKPQV	ééÄ	CPKQ	VPTKUP	CMMM	
SS	wå	UV	e É	CKPMS	ééÄ	RKT	RVNKNP	CMMM	
TR	^ ë	UV	e É	MKRSO	ééÄ	NQKM	NNPKSU	NMMM	
TU	pÉ	UV	e O	MKMTN	ééÄ	SQKT	NTKST	NMMM	
UU	pê	UV	e É	CKVVP	ééÄ	CKM	NUMTKVP	CMMM	
VR	j ç	UV	e É	MKCPQ	ééÄ	OTKM	PVCKOQ	NMMM	
NMT	^ Ö	UV	e É	JMKMMV	ééÄ	k L^	RUKUV	NMM	
NNN	` Ç	UV	e É	MKMPU	ééÄ	CNKO	CNKUR	NMMM	
NNU	på	NRV	e É	MKCPN	ééÄ	CMKT	QCCNKNO	NMMM	
NOCN	pÄ	NRV	k ç=d ~ë	MKMSM	ééÄ	NPKN	NMTNKNU	NMMM	
NPT	_~	NRV	k ç=d ~ë	NMKQUU	ééÄ	RKS	NPVMRKNT	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKMBS	ééÄ	k L^	NUVRKQU	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMQR	ééÄ	k L^	NMVQKRQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMQT	ééÄ	QSKS	NPNQKTR	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNRM	ééÄ	SKM	PUUNKPV	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMPT	ééÄ	COKP	QVPKUT	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ÉÅ	B n ` =i çï	B n ` =¢äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	CMCQLUQKPM	NKQ	CNNUNUQKUQ	VRKS	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVVTOSUKCN	NKM	CPCQMMUKRR	VOKQQ	RVKR	NOMQ	
pÅ	CR	e O	VNCPRTKSN	MKQ	NMQSVRMKMV	UTKNQ	RVKR	NOMQ	
pÅ	CR	e É	NPPSCPKSR	NKU	NRSVCPKTQ	URKNQ	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VSPCQMQP	MKT	NMMTQVOKRQ	VRKSN	RVKR	NOMQ	
d É	TO	e O	PSQSQCOKRU	MKU	CNUTVMKQQ	UTKMT	RVKR	NOMQ	
d É	TO	e É	NMPTSSKST	NKQ	NNVPVMKCU	USKVN	RVKR	NOMQ	
v	UV	e O	QCSCUNVKNT	MKU	QSPMSRQKU	VOKMS	RVKR	NOMQ	
v	UV	e É	TNNPCRKPQ	NKM	UMTOTPKVP	UUKNO	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSVTOMNKST	NKT	SCRCMMSKN	NMTKNO	RVKR	NOMQ	
qÄ	NRV	e É	OSNSMCPKVQ	MKN	OTPRTRCKPS	VRKSO	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRPCUUCKSM	MKQ	OVRURQRKMT	NNVKQN	RVKR	NOMQ	
_á	OMV	e É	NRPRUNTKVU	NKP	NRQQSCOKMP	VVKQP	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNR

cãÉ=k~ã É MQTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJj ^oyi n ` CP' hÅ

^Åè=qãã É PLCPLOMCP=ONMRVMQQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKMCR	ééÄ	k L^	STKTU	NMM	
NN	_	S	k ç=d ~ë	TKNSU	ééÄ	CKQ	SQMCKUR	NMMM	
CP	k ~	CR	e É	NSSMKTSN	ééÄ	NKP	CQCMVSNKMU	CMMMMM	
CQ	j Ö	CR	e É	CMRKQTQ	ééÄ	MKR	NPSVNKQN	CMMMMM	
CT	^ ä	CR	e É	PSKPUV	ééÄ	PKN	NMMSKTO	CMMMMM	
CU	pá	CR	e O	OSTUKVTT	ééÄ	MKO	CPCQTPKRR	NMMMM	
PV	h	CR	e É	CMRKSVT	ééÄ	RKT	PUUTTKUM	CMMMMM	
QM	` ~	CR	e O	OSTKQVS	ééÄ	MKR	NUVRURKVV	CMMMMM	
RN	s	UV	e É	NKMUS	ééÄ	CKQ	NMNRKSN	NMMM	
RO	` ê	UV	e É	MKPQO	ééÄ	NTKU	NMVTKUP	CMMM	
RR	j å	UV	e É	NMRKQSQ	ééÄ	MKO	RPNRTHSS	CMMM	
RS	cÉ	UV	e O	PUVTKUCU	ééÄ	NKO	VQPMVUPKOS	NMMMMM	
RV	` ç	UV	e É	MKCUV	ééÄ	PNKN	SCMKMP	NMMM	
SM	k á	UV	e É	JMKTTP	ééÄ	k L^	TTMKMP	NMMM	
SP	` ì	UV	e É	NKOCP	ééÄ	PKN	CMVMKNV	CMMM	
SS	wå	UV	e É	PKPRO	ééÄ	UKR	UCMKMQ	CMMM	
TR	^ ë	UV	e É	NKCPT	ééÄ	PKO	CCRKSV	NMMM	
TU	pÉ	UV	e O	MKMMV	ééÄ	CPQKN	NOKMM	NMMM	
UU	pê	UV	e É	CKTCP	ééÄ	UKN	NSQSKUM	CMMM	
VR	j ç	UV	e É	MKNTT	ééÄ	CPKN	PSMKMN	NMMM	
NMT	^ Ö	UV	e É	JMKMDQ	ééÄ	k L^	CUKUV	NMM	
NNN	` Ç	UV	e É	JMKMDQ	ééÄ	k L^	CKUN	NMMM	
NNU	på	NRV	e É	MCRR	ééÄ	NSKV	PNUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNCQ	ééÄ	CQKM	VMQHPO	NMMM	
NPT	_~	NRV	k ç=d ~ë	NMKPTV	ééÄ	MKV	NPTQUKMR	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKNTP	ééÄ	k L^	NSNUKQV	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMVO	ééÄ	k L^	UCTHRT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMRV	ééÄ	NPKQ	NQNUKCN	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKMVS	ééÄ	k L^	OTUVKVO	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMNU	ééÄ	k L^	NPSKUN	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤pÉÅ	B n ` =¦ çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	OMUVVMPKV	MKO	CNNUNUQKUQ	VUKSS	RVRR	NOMQ	
pÅ	CR	k ç=d ~ë	PVVVOQNKSV	MKV	CPCQMMUKRR	VOKQV	RVRR	NOMQ	
pÅ	CR	e O	VOSNURRTU	MKQ	NMQSVRMKNV	UUKQT	RVRR	NOMQ	
pÅ	CR	e É	NPQQNMKCR	NKP	NRSVCPKTQ	URKSQ	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VRVPPOKVU	MKU	NMMTQVOKRQ	VRKCO	RVRR	NOMQ	
d É	TO	e O	PSSPTUKSN	MKO	CNUTVMKQQ	UTKQU	RVRR	NOMQ	
d É	TO	e É	NMQPNVRRT	NKO	NNVPVMKCU	UTKPU	RVRR	NOMQ	
v	UV	e O	QQUMVOKMN	MKV	QSPMSRQKU	VOKQR	RVRR	NOMQ	
v	UV	e É	TNMSPPKTP	MRT	UMTOTPKVP	UUKMP	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSVMUSMKQQ	NKN	SCRCMVSKN	NMTKMO	RVRR	NOMQ	
qÄ	NRV	e É	OSCQVRUKQQ	MKR	OTPRTROKPS	VRKVR	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PRRNPNCQKQN	MKO	OVRURQRKMT	NOMKMQ	RVRR	NOMQ	
_á	OMV	e É	NRRNCUPKSS	NKR	NRQQSOOKMP	NMMKCP	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNS

cãÉ=k~ã É MQUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` CP' hÅ

^Åè=qãã É PLCPLOMCP=COMCQMP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMKMJU	éé Ä	k L^	USKST	NMM	
NN	_	S	k ç=d ~ë	TKMTN	éé Ä	CKS	SCSCKRU	NMMM	
CP	k ~	CR	e É	NPCCKMRO	éé Ä	NKM	CMNPSSKMR	CMMMMM	
CQ	j Ö	CR	e É	CPPKUMO	éé Ä	MKU	NRRTRKTM	CMMMMM	
CT	^ ä	CR	e É	NRNKMMN	éé Ä	CKM	PTUUKPR	CMMMMM	
CU	pá	CR	e O	CNRVKNCN	éé Ä	CKN	NUTUNPKSU	NMMMM	
PV	h	CR	e É	NVVKQTV	éé Ä	TKM	PUTNRKUN	CMMMMM	
QM	` ~	CR	e O	CUCKSPT	éé Ä	CKR	NVVUPRKVQ	CMMMMM	
RN	s	UV	e É	NKMCV	éé Ä	VKN	VSSKTN	NMMM	
RO	` ê	UV	e É	MKPCR	éé Ä	SKQ	NMTSKRM	CMMM	
RR	j å	UV	e É	NPKQCT	éé Ä	NKM	SUUQKPT	CMMM	
RS	cÉ	UV	e O	CPVKRSP	éé Ä	CKV	NMUNCNNKUR	NMMMMM	
RV	` ç	UV	e É	MKNST	éé Ä	NNKU	QNPKPR	NMMM	
SM	k á	UV	e É	JMKTTR	éé Ä	k L^	TSRKRV	NMMM	
SP	` ì	UV	e É	MKSSM	éé Ä	CMKN	NPPMKMV	CMMM	
SS	wå	UV	e É	CKSUU	éé Ä	VKR	STNKNQ	CMMM	
TR	^ ë	UV	e É	MKPRO	éé Ä	NCKV	TUKPQ	NMMM	
TU	pÉ	UV	e O	JMKMNT	éé Ä	k L^	VKRM	NMMM	
UU	pê	UV	e É	CKTNU	éé Ä	CKM	NSPRKSU	CMMM	
VR	j ç	UV	e É	MKMCM	éé Ä	PPSKS	OTNKNO	NMMM	
NMT	^ Ö	UV	e É	JMKMNV	éé Ä	k L^	PUKUV	NMM	
NNN	` Ç	UV	e É	JMKMCP	éé Ä	k L^	RKNV	NMMM	
NNU	på	NRV	e É	MKNTR	éé Ä	CNKN	OTCKCP	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKNPS	éé Ä	RKQ	VSQKPU	NMMM	
NPT	_~	NRV	k ç=d ~ë	UKMMS	éé Ä	SKO	NMSSRKRP	CMMM	
NUO	t	NRV	k ç=d ~ë	JMCMU	éé Ä	k L^	NRPRKMR	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKNMU	éé Ä	k L^	TPMKTV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKPPT	éé Ä	NMKQ	PSPTKPV	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKMTM	éé Ä	k L^	OPNVKPP	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMNP	éé Ä	k L^	NTTMKNU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ ÉÅ	B n ` =¡ çï	B n ` =¤ äÜÜ	n ` =¤ä-Ö
i á	S	k ç=d ~ë	OMSTMVKNS	MKM	ONNUNUQKUQ	VTKRV	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVSSRRPKUV	NKS	QPCQMMUKRR	VNKTP	RVKR	NOMQ	
pÅ	CR	e O	VCUPSQKNO	CKR	NMQSVRMKMV	UUKST	RVKR	NOMQ	
pÅ	CR	e É	NPRMQUKMP	MKV	NRSVCPKTQ	USKMR	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VRTNQSKPT	MKQ	NMMTQVCKRQ	VR	RVKR	NOMQ	
d É	TO	e O	PSSCOVKSR	MKP	QNUTVMKQQ	UTKQR	RVKR	NOMQ	
d É	TO	e É	NMQRPUKMT	MKU	NNVPVMKCU	UTKRS	RVKR	NOMQ	
v	UV	e O	QDRQTCUKUP	NKP	QSPMSRQKU	VNKUU	RVKR	NOMQ	
v	UV	e É	TMTRPSKPT	NKM	UMTOTPKVP	UTKSR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	STNVONPKMO	NKM	SCRCMMSKN	NMTKQT	RVKR	NOMQ	
qÄ	NRV	e É	OSCRNVQKUP	NKM	OTPRTRCKPS	VRKVS	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRCMSQPKCN	NKO	OVRURQRKMT	NNV	RVKR	NOMQ	
_á	OMV	e É	NRRQRVTKTU	NKS	NRQQSCOKMP	NMMSR	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNT

cãÉ=k~ã É MQVpj mi hÇ

a~í~=m~íÜ=k~ã É aWµ ÖãÉåíµ mj eyNya^q^yOMCPyMPJ ^oyi n ` CP' hÅ

^Åè=qãã É PLCPLOMCP=COMMMQN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	JMKMNM	éé Ä	k L^	UCKCO	NMM	
NN	_	S	k ç=d ~ë	TKOSN	éé Ä	SKT	SPPRKVR	NMMM	
CP	k ~	CR	e É	NPOTKUNM	éé Ä	CKS	NVTSUPKTM	CMMMMM	
CQ	j Ö	CR	e É	CRTKNTN	éé Ä	MKU	NSTCUKNO	CMMMMM	
CT	^ ä	CR	e É	CMCQRQV	éé Ä	MKU	CVUCKMT	CMMMMM	
CU	pá	CR	e O	NQPVMMDS	éé Ä	CKR	NCSNCQCKOT	NMMMM	
PV	h	CR	e É	NVSKRTO	éé Ä	UKQ	PTTSRKQM	CMMMMM	
QM	` ~	CR	e O	PORKNNV	éé Ä	NKN	CCUUNRKSQ	CMMMMM	
RN	s	UV	e É	MKVUS	éé Ä	UKN	VPUKVQ	NMMM	
RO	` ê	UV	e É	MCOVU	éé Ä	PKU	NVRSKRN	CMMM	
RR	j å	UV	e É	NNKNRQ	éé Ä	NKU	RTUNKQO	CMMM	
RS	cÉ	UV	e O	QSVKCPN	éé Ä	CKS	NNRMVNQKTV	NMMMMM	
RV	` ç	UV	e É	MKNRO	éé Ä	POKR	PVNKNP	NMMM	
SM	k á	UV	e É	JMKTSN	éé Ä	k L^	TTSKTM	NMMM	
SP	` ì	UV	e É	MKTMO	éé Ä	SKO	NPVPKCP	CMMM	
SS	wå	UV	e É	PKQTR	éé Ä	NCKN	UQTKUO	CMMM	
TR	^ ë	UV	e É	MKPMS	éé Ä	PMKO	TNKMN	NMMM	
TU	pÉ	UV	e O	MKMNQ	éé Ä	VQKR	NOKPP	NMMM	
UU	pê	UV	e É	CKUMQ	éé Ä	NNKR	NSVTKVN	CMMM	
VR	j ç	UV	e É	JMKMPQ	éé Ä	k L^	CQCKCP	NMMM	
NMT	^ Ö	UV	e É	JMKMCP	éé Ä	k L^	PNKNN	NMM	
NNN	` Ç	UV	e É	JMKMDN	éé Ä	k L^	RKRR	NMMM	
NNU	på	NRV	e É	MKNUQ	éé Ä	OTKT	OTCKCP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNOR	éé Ä	NRKN	VMQKPN	NMMM	
NPT	_~	NRV	k ç=d ~ë	VKQVN	éé Ä	NKV	NORNOKPU	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKCPM	éé Ä	k L^	NQSQKVT	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKNPM	éé Ä	k L^	SMMSR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKOSM	éé Ä	NQKP	PMMPKPO	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKMRO	éé Ä	k L^	CQCOVKQU	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMMQ	éé Ä	k L^	CCPKRT	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ÉÁ	B n ` =¡çï	B n ` =¢äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	CMQSMVNRS	CKO	CNNUNUQKUQ	VSKS	RVRR	NOMQ	
pÅ	CR	k ç=d ~ë	PVTQTTPKOV	MKO	CPCQMMUKRR	VNKVO	RVRR	NOMQ	
pÅ	CR	e O	VPPPQMKVU	NKN	NMQSVRMKNV	UVKNR	RVRR	NOMQ	
pÅ	CR	e É	NPCCUUKNM	MKT	NRSVCPKTQ	UQKOV	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VSCSUVKNP	CKP	NMMTQVCKRQ	VRKRR	RVRR	NOMQ	
d É	TO	e O	PSTTTSKOV	MKP	CNUTVMKQQ	UTKUO	RVRR	NOMQ	
d É	TO	e É	NMQUSCKOT	MKQ	NNVPVMKCU	UTKUP	RVRR	NOMQ	
v	UV	e O	QCQVMTMVST	MKU	QSPMSRQKU	VNKTS	RVRR	NOMQ	
v	UV	e É	TNNSQMPN	NKO	UMTOTPKVP	UUKNR	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSRRPNSKVR	MKQ	SCRCMVSKN	NVSKQR	RVRR	NOMQ	
qÄ	NRV	e É	CRTQQCPKPQ	NKP	OTPRTRCKPS	VQKN	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PQVRTMTKVR	NKT	OVRURQRKMT	NNUKNS	RVRR	NOMQ	
_á	OMV	e É	NRPMVMUKNN	MKQ	NRQQSCOKMP	VVKVR	RVRR	NOMQ	

p~ã éäÉ=k~ã É	pn NOMNUMNU
cãÉ=k~ã É	MRMbj mi hÇ
a~í~=m~íÜ=k~ã É	aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` CP' hÅ
^Åè=qãã É	PLCPLOMCP=COMNQMM
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãä	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==: mp==	i a o	n ` =¤ä-Ö
V	_É	S	k ç=d ~ë	MKMRM	ééÄ	CQQKT	NRPHPQ	NMM	
NN	_	S	k ç=d ~ë	TKUQT	ééÄ	CHR	SUCCKUP	NMMM	
CP	k ~	QR	e É	NUNRKPNR	ééÄ	NKQ	CRTCUMPV	CMMMMM	
CQ	j Ö	QR	e É	COSKSTV	ééÄ	MKO	NQVNCKSR	CMMMMM	
CT	^ ä	QR	e É	PNUKVSN	ééÄ	CKT	TTRNKNN	CMMMMM	
CU	pá	QR	e O	PRVUKNNM	ééÄ	NKT	PNCUUMPS	NMMMM	
PV	h	QR	e É	VPKVPN	ééÄ	NCHM	PCPTPHNO	CMMMMM	
QM	` ~	QR	e O	COVKUPT	ééÄ	NKN	NSRRRUKVM	CMMMMM	
RN	s	UV	e É	NKUTQ	ééÄ	UHM	NSPPKQS	NMMM	
RO	` ê	UV	e É	MPCR	ééÄ	VHM	NVUNKUP	CMMM	
RR	j å	UV	e É	NPKTVR	ééÄ	NKO	TNVCKQQ	CMMM	
RS	cÉ	UV	e O	NUVKUPN	ééÄ	NKT	QUCVCUKCP	NMMMM	
RV	` ç	UV	e É	MKNPM	ééÄ	CNKV	PRPHPR	NMMM	
SM	k á	UV	e É	JMRTVU	ééÄ	k L^	TRUKVO	NMMM	
SP	` ì	UV	e É	NHPRU	ééÄ	RKV	CCPVKNN	CMMM	
SS	wå	UV	e É	VCKTUO	ééÄ	NKQ	CMCPCKVT	CMMM	
TR	^ ë	UV	e É	MCPT	ééÄ	NPKQ	RVHSU	NMMM	
TU	pÉ	UV	e O	MHMPN	ééÄ	UQHR	NQHMM	NMMM	
UU	pê	UV	e É	CHRVP	ééÄ	NKQ	NRTMKNO	CMMM	
VR	j ç	UV	e É	JMKMSS	ééÄ	k L^	CCQCQR	NMMM	
NMT	^ Ö	UV	e É	JMKMOT	ééÄ	k L^	CCKCO	NMM	
NNN	` Ç	UV	e É	JMKMOM	ééÄ	k L^	RKVP	NMMM	
NNU	på	NRV	e É	MCOTM	ééÄ	CQHR	PCPHPQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNRO	ééÄ	CMKN	NMCQCKQR	NMMM	
NPT	_~	NRV	k ç=d ~ë	NNKQNN	ééÄ	PKV	NRMOTHSN	CMMM	
NUO	t	NRV	k ç=d ~ë	JMPUN	ééÄ	k L^	NMTTKUR	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKNRV	ééÄ	k L^	CPTHNP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKURP	ééÄ	MKN	TUCRKUT	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKNQN	ééÄ	k L^	NUCUKTR	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMVQ	ééÄ	k L^	CPMKCR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =i çï	B n ` =¤ äÜÜ	n ` =¤ä-Ö
i á	S	k ç=d ~ë	CMSNCQMPP	MKU	CNNUNUQKUQ	VTHPN	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	QMMMMPRKQM	MHR	CPCQMMUHRR	VOHRN	RVHR	NOMQ	
pÅ	QR	e O	VCUURSKNS	MKQ	NMQSVRMKNV	UURTO	RVHR	NOMQ	
pÅ	QR	e É	NPPCMVKVV	MKN	NRSVCPKTQ	UQKUU	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VRRMVTKRP	NHM	NMMTQVORQ	VQKU	RVHR	NOMQ	
d É	TO	e O	PSQMRPKNU	MKU	CNUTVMKQQ	USKVP	RVHR	NOMQ	
d É	TO	e É	NMPOVMKMM	MKQ	NNVPVMKCU	USHRN	RVHR	NOMQ	
v	UV	e O	QCRTUCRMQ	MKU	QSPMSRQKU	VNKVR	RVHR	NOMQ	
v	UV	e É	TNMVNUKCP	MKQ	UMTOTPKVP	UUHVS	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSRQPRUKNS	MKU	SCRCMVSKN	NMSKQQ	RVHR	NOMQ	
qÄ	NRV	e É	CRVMPPUKVN	MKQ	OTPRTRCHPS	VQHSU	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRPVCPSKCM	MHS	OVRURQRMMT	NNVHSP	RVHR	NOMQ	
_á	OMV	e É	NRPPVMNKCP	NHR	NRQQSCOKMP	VVHPN	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NPNQUMMN

cãÉ=k~ã É MRNpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` CP' hÅ

^Åè=qãã É PLCPLOMCP=COMMVRV

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä c~ãä

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKVRR	ééÄ	k L^	PPKPP	NVM	
NN	_	S	k ç=d ~ë	PCQKNJV	ééÄ	MKT	CRMMMPKPQ	NVMM	
CP	k ~	CR	e É	OMCPRNJKCPV	ééÄ	MKV	CRTMJMPMCKRJ	CMMMMM	[i a o
CQ	j Ö	CR	e É	NVCKCJVN	ééÄ	PKS	NPRVPKRS	CMMMMM	
CT	^ ä	CR	e É	NCNKCPU	ééÄ	CRKU	PNVCKVT	CMMMMM	
CU	pá	CR	e O	UUCKCNU	ééÄ	CKU	TUNRCKVO	NMMMM	
PV	h	CR	e É	RMJSSPTKPSR	ééÄ	NKM	OVRRMJSSCKNN	CMMMMM	[i a o
QM	` ~	CR	e O	NCLPKCMM	ééÄ	MKU	VVCURNKCJ	CMMMMM	
RN	s	UV	e É	CKSSQ	ééÄ	PKT	CCSVMKNO	NMMM	
RO	` ê	UV	e É	NCQCRMQ	ééÄ	NKU	NCQLJOTKQM	CMMM	
RR	j å	UV	e É	PNKNSP	ééÄ	CKQ	NRVCQCKSS	CMMM	
RS	cÉ	UV	e O	OMCQCKCJM	ééÄ	NKN	CJTOTMNNKNT	NMMMM	
RV	` ç	UV	e É	NCVKTVQ	ééÄ	NKV	CNVTCPKVT	NMMM	
SM	k á	UV	e É	CRCKRMD	ééÄ	MKU	NNVSCUKMS	NMMM	
SP	` ì	UV	e É	OTPQKCRO	ééÄ	NKU	PRRQNPTKNT	CMMM	
SS	wå	UV	e É	OTCPKNPT	ééÄ	CKM	SMRURPKCR	CMMM	
TR	^ ë	UV	e É	UKNMS	ééÄ	NKT	NPTSKRR	NMMM	
TU	pÉ	UV	e O	MKNVU	ééÄ	NCKV	CUKPP	NMMM	
UU	pê	UV	e É	RKPNP	ééÄ	PKR	PCMCKSS	CMMM	
VR	j ç	UV	e É	PSKQNO	ééÄ	NKT	CMTSNKRU	NMMM	
NMT	^ Ö	UV	e É	MKTSS	ééÄ	TKO	NSOTKVN	NMM	
NNN	` Ç	UV	e É	MKNJT	ééÄ	NQKN	SPKPP	NMMM	
NNU	på	NRV	e É	RJKSRN	ééÄ	NKR	PCPUMKPR	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	CPKPUR	ééÄ	NKV	VRSCNKNQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	SRKCRP	ééÄ	NKO	TUNUCKUO	CMMM	
NUO	t	NRV	k ç=d ~ë	OSVKPPS	ééÄ	PKU	SOVTVPKVO	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKVRN	ééÄ	k L^	VCQKPQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NURKRCQR	ééÄ	MKO	NPMTTCMSO	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKRNR	ééÄ	RKS	RSPTKCR	NMMM	
OPU	r	OMV	k ç=d ~ë	MKVCN	ééÄ	PCKT	CRTKNS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` = çï	B n ` =¤ äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	CNCSVPCKCM	NKO	CNNUNUCKUQ	NMMKCN	RVKR	NCMKQ	
pÅ	CR	k ç=d ~ë	PSPSUMSKUR	NKR	CPCQMMUKRR	UQKNN	RVKR	NCMKQ	
pÅ	CR	e O	VPTTPNKOT	MKR	NMQSVRMKNV	UVKRT	RVKR	NCMKQ	
pÅ	CR	e É	NQMPQVMKV	NKO	NRSVCPKTQ	UVKCP	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	URCSMNKCS	NKN	NMMTQVCKRQ	UQKSP	RVKR	NCMKQ	
d É	TO	e O	PTNRNUKMN	MKU	CNUTVMKQQ	UUKTN	RVKR	NCMKQ	
d É	TO	e É	NMPSRQKMT	NKS	NNVPVMKCU	USKUO	RVKR	NCMKQ	
v	UV	e O	CMTVVUUKVV	MKU	CSPMSRQKU	UUKNN	RVKR	NCMKQ	
v	UV	e É	TNRTUNKRP	MKU	UMTOTPKVP	UUKST	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SMTVSPPKNO	NKS	SCRCMMSKN	VTKCQ	RVKR	NCMKQ	
qÄ	NRV	e É	CQSMSTSKTU	NKQ	OTPRTRCKPS	UVKVR	RVKR	NCMKQ	
_á	OMV	k ç=d ~ë	PMURURVKQN	MKQ	OVRURQRKMT	NMQKP	RVKR	NCMKQ	
_á	OMV	e É	NPCOVVPKQN	MKP	NRQQSCOKMP	URKSR	RVKR	NCMKQ	

p~ã éäÉ=k~ã É pn NPNQ.MMO

cãÉ=k~ã É MRQpj mi hÇ

a~í~=m~íÜ=k~ã É a\yt ÖäÉåíyt mj eyNya^q^yOMCPyMPJ ^oyi n ` CP' hÅ

^Åè=qãã É PLCPLOMCP=CCOMRMU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKMQM	éé Ä	k lÅ	RQKQR	NMM	
NN	_	S	k ç=d ~ë	CPKPCV	éé Ä	NKO	CMRCTKMS	NMMM	
CP	k ~	QR	e É	VRVVTKPUU	éé Ä	MKS	NCPRCRPSKUV	CMMMMM	
CQ	j Ö	QR	e É	NPNKMSM	éé Ä	QKV	VRNMKQN	CMMMMM	
CT	^ ä	QR	e É	QQTKSVO	éé Ä	CKU	NNSOMKPP	CMMMMM	
CU	pá	QR	e O	NNVTKRRV	éé Ä	QKM	NNMUTVKTQ	NMMMM	
PV	h	QR	e É	CPSTCMKPRM	éé Ä	MKQ	NQMQTMTSKUT	CMMMMM	
QM	` ~	QR	e O	RRSKVCV	éé Ä	MKT	QMNVMQKNO	CMMMMM	
RN	s	UV	e É	NMKNUU	éé Ä	PKV	USMVKVO	NMMM	
RO	` ê	UV	e É	NSKMSN	éé Ä	MKU	NTRVVKRT	CMMM	
RR	j å	UV	e É	NQKVUO	éé Ä	CKP	TMSVKNM	CMMM	
RS	cÉ	UV	e O	QSRKMVQ	éé Ä	CKQ	NNVRCPCKNN	NMMMM	
RV	` ç	UV	e É	MKSSR	éé Ä	QKQ	NPCCKPP	NMMM	
SM	k á	UV	e É	NVKUNM	éé Ä	NKS	SRNQKVS	NMMM	
SP	` ì	UV	e É	NRRKNSO	éé Ä	MKS	CNCMPQKUO	CMMM	
SS	wå	UV	e É	NVRKPCU	éé Ä	MKU	CQQURKNM	CMMM	
TR	^ ë	UV	e É	MKSCU	éé Ä	PKN	NPNKSU	NMMM	
TU	pÉ	UV	e O	MKMMN	éé Ä	CURMKT	NNKST	NMMM	
UU	pê	UV	e É	NKQVM	éé Ä	QKV	VSTKUP	CMMM	
VR	j ç	UV	e É	MKQSS	éé Ä	NSKS	RRNKNP	NMMM	
NMT	^ Ö	UV	e É	MKRQU	éé Ä	NMKN	NCQSKTR	NMM	
NNN	` Ç	UV	e É	JMKMNO	éé Ä	k lÅ	UKRO	NMMM	
NNU	på	NRV	e É	PKPVQ	éé Ä	CKR	CCCCKQQ	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	NKCSV	éé Ä	RKS	SCSCQKTQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	CKCTS	éé Ä	NKN	PNUTKMT	CMMM	
NUO	t	NRV	k ç=d ~ë	MKPUU	éé Ä	TKO	PNTMKQM	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKNCR	éé Ä	k lÅ	SRMKTN	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QKNQN	éé Ä	PKO	PRPCCKUQ	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKNMP	éé Ä	k lÅ	CNRRKUM	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMCP	éé Ä	k lÅ	NMSKTU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ¹ mp	B=oÉÁ	B n ` =i çï	B n ` =eáÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	CPMSOV/CKTV	NKU	CNNUNUQKUQ	NMUKUU	RVKR	NCMKQ	
pÅ	QR	k ç=d ~ë	QNNTPPSKRO	CKO	CPCQMMUKRR	VRKCO	RVKR	NCMKQ	
pÅ	QR	e O	VURMSVKQO	CKO	NMQSVRMKMV	VQKMV	RVKR	NCMKQ	
pÅ	QR	e É	NQPMSSKOM	MKQ	NRSVCPKTQ	VNKMS	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	VVPMPQKVT	CKN	NMMTQV/CKRQ	VUKRS	RVKR	NCMKQ	
d É	TO	e O	PVSOTSKPS	NKM	QNUTVMKQQ	VQKSO	RVKR	NCMKQ	
d É	TO	e É	NNMMOTKVO	NKO	NNVPVMKCU	VOKNS	RVKR	NCMKQ	
v	UV	e O	QQQVTSQKRS	MKQ	QSPMSRQKU	VSKMV	RVKR	NCMKQ	
v	UV	e É	TRMUCRKTT	MKU	UMTOTPKVP	VPKMN	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SVPVPSRKQU	MKS	SCRCMVSKN	NNMKVV	RVKR	NCMKQ	
qÄ	NRV	e É	OTMOSRUKUS	MKS	OTPRTRCKPS	VUKTV	RVKR	NCMKQ	
_á	OMV	k ç=d ~ë	PSPRRRVKTT	MKV	OVRURQRKMT	NCCKUU	RVKR	NCMKQ	SMOMa ça
_á	OMV	e É	NRQQMVQKNN	NKO	NRQQSCOKMP	VVKVT	RVKR	NCMKQ	

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NN	_	S	k ç=d ~ë	OMSKSNM	ééÄ	NKU	NRVTVTKTP	NMMM	
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OT	^ ä	QR	e É	VOSKNTR	ééÄ	NKN	OPOPRKUM	OMMMMM	
OU	pá	QR	e O	PTRKUVT	ééÄ	OKS	PQRVNKRS	NMMMM	
PV	h	QR	e É	POOPQSMKNQP	ééÄ	NKO	NURRMVOVMPQ	OMMMMM	[i a o
QM	` ~	QR	e O	UOOKRVV	ééÄ	MKQ	RTPQNTKOU	OMMMMM	
RN	s	UV	e É	OKRVU	ééÄ	PKR	OORPKRR	NMMM	
RO	` ê	UV	e É	UVKPQM	ééÄ	NKV	VNPRVKOT	OMMM	
RR	j å	UV	e É	PUKPUT	ééÄ	NKP	NVVPMKVS	OMMM	
RS	cÉ	UV	e O	RUSKSPT	ééÄ	MKV	NQPMMNRKNM	NMMMMM	
RV	` ç	UV	e É	OKSRR	ééÄ	RKR	QTMTKSR	NMMM	
SM	k á	UV	e É	QTKUON	ééÄ	MKS	OPVUMKUR	NMMM	
SP	` ì	UV	e É	QUVKRPQ	ééÄ	NKO	SQTRONKUS	OMMM	
SS	wå	UV	e É	UNSKNPM	ééÄ	NKS	NUPPRQKMS	OMMM	
TR	^ ë	UV	e É	SKRTR	ééÄ	RKU	NNPUKUP	NMMM	
TU	pÉ	UV	e O	MKUUQ	ééÄ	NQKM	NUKUP	NMMM	
UU	pê	UV	e É	PKOMN	ééÄ	QKR	NVTRKTP	OMMM	
VR	j ç	UV	e É	NRKUQR	ééÄ	OKN	VPQNKNR	NMMM	
NMT	^ Ö	UV	e É	MKNQV	ééÄ	UKT	PURKRT	NMM	
NNN	` Ç	UV	e É	MKUUN	ééÄ	QKN	PQKQQ	NMMM	
NNU	på	NRV	e É	NNKQPT	ééÄ	NKR	SSUNKTT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	UKTPO	ééÄ	OKO	PTVPOKVT	NMMM	
NPT	_~	NRV	k ç=d ~ë	OKPQR	ééÄ	RKP	PMPSKUT	OMMM	
NUO	t	NRV	k ç=d ~ë	OSOKUPN	ééÄ	PKP	SQVPONKPU	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKVSM	ééÄ	k L^	VSQKPV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OVKVMV	ééÄ	NKN	OPOVUOKQV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNST	ééÄ	NRKS	PUQQKSR	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMMN	ééÄ	UMSKP	ORPKSN	NMMM	

n ` =fpqa=q~ÄäÉ

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i á	S	k ç=d ~ë	ONOUNUOKMU	MKN	ONNUNUQKUQ	NMMKQT	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PTRSNNRKMR	NKU	QPOQMMUKRR	USKUT	RVKR	NOMKQ	
pÅ	QR	e O	VSQPRUKOQ	NKO	NMQSVRMKMV	VOKNN	RVKR	NOMKQ	
pÅ	QR	e É	NPVMNUKQP	MKV	NRSVQPKTQ	UUKRU	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VMNOTNKOV	NKP	NMMTQVOKRQ	UVKQS	RVKR	NOMKQ	
d É	TO	e O	PUTTPQKMV	NKM	QNUTVMKQQ	VOKRU	RVKR	NOMKQ	
d É	TO	e É	NMTTTMKVR	PKM	NNVPVMKOU	VMKOT	RVKR	NOMKQ	
v	UV	e O	QOQQRNMKRO	MKS	QSPMSRQKU	VNKSO	RVKR	NOMKQ	
v	UV	e É	TOUMPSKQP	NKR	UMTOTPKVP	VMKNU	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SQONRVRKRV	NKM	SORQMVSKN	NVOKTN	RVKR	NOMKQ	
qÄ	NRV	e É	ORRONQMKRT	MKT	OTPRTROKPS	VPKOV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PPVVUMRKOS	NKT	OVRURQRKMT	NNQKVN	RVKR	NOMKQ	
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NN	_	S	k ç=d ~ë	OQKVRS	ééÄ	MKO	NVONPOKPP	OR	VVKUO	UVKU	NNMO	
OP	k ~	OR	e É	RQUTKTQS	ééÄ	NKM	PRUUTUSKVQ	RMMM	NMVKTR	UVKU	NNMO	
OQ	j Ö	OR	e É	RQSPKPNP	ééÄ	MKT	NUTPSMMKVS	RMMM	NMVKOT	UVKU	NNMO	
OT	^ä	OR	e É	RPQKSPV	ééÄ	NKP	SVOTNKSM	RMM	NMSKVP	UVKU	NNMO	
OU	pá	OR	e O	RPPKSRN	ééÄ	OKM	OQVQPVKTT	RMM	NMSKTP	UVKU	NNMO	
PV	h	OR	e É	RPVQKMQP	ééÄ	NKQ	NSPURTSKPR	RMMM	NMTKUU	UVKU	NNMO	
QM	` ~	OR	e O	RPRMQMT	ééÄ	NKU	NUTSUMPPKPP	RMMM	NMTKMN	UVKU	NNMO	
RN	s	UV	e É	OSKNQU	ééÄ	NKS	NMTQRNKTU	OR	NMQKRV	UVKU	NNMO	
RO	` ê	UV	e É	ORKVQP	ééÄ	NKQ	NPRQPQKOU	OR	NMPKTT	UVKU	NNMO	
RR	j å	UV	e É	ORKUNM	ééÄ	MKS	SUMSVKOR	OR	NMPKOQ	UVKU	NNMO	
RS	cÉ	UV	e O	RNORKVQO	ééÄ	OKR	SQURNQRRKUQ	RMMM	NMOKRO	UVKU	NNMO	
RV	` ç	UV	e É	OSKUPR	ééÄ	MKS	OPSNQQKSR	OR	NMTKPQ	UVKU	NNMO	
SM	ká	UV	e É	OSKNRR	ééÄ	MKT	SQVTUKOO	OR	NMQKSO	UVKU	NNMO	
SP	` ì	UV	e É	OTKNOS	ééÄ	MKQ	NUPTRMQP	OR	NMUKR	UVKU	NNMO	
SS	wå	UV	e É	OSKOQR	ééÄ	NKV	PMONNKUQ	OR	NMQKVU	UVKU	NNMO	
TR	^ë	UV	e É	ORKSMO	ééÄ	NKM	OOOUNKTQ	OR	NMOKQN	UVKU	NNMO	
TU	pÉ	UV	e O	ORKNOT	ééÄ	OKS	NOQNOKNM	OR	NMMKRN	UVKU	NNMO	
UU	pê	UV	e É	OSKNTP	ééÄ	MKS	UNNQUKQT	OR	NMQKSV	UVKU	NNMO	
VR	j ç	UV	e É	ORKUSP	ééÄ	MKP	TRVQRKRV	OR	NMPKQR	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKOMP	ééÄ	MKT	OUSPUSKNR	OR	NMUKUN	UVKU	NNMO	
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NNU	på	NRV	e É	OQKTVQ	ééÄ	NKP	TPRQMKVV	OR	VVKNU	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKRUQ	ééÄ	NKM	RTNRMVKRS	OR	VUKPQ	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	OQKUVU	ééÄ	OKO	NSVVTUKOT	OR	VVKRV	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OQKVSO	ééÄ	NKP	PPPVTSKOO	OR	VVKUR	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	NTKRQS	ééÄ	NKT	QVTVMTKPQ	OR	TMKNU	UVKU	NNMO	[=HLJ=NMB
OMU	mÄ	OMV	k ç=d ~ë	OSKROV	ééÄ	MKV	NMRQTUTKSR	OR	NMSKNO	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKMNM	ééÄ	NKT	VMTNOVKUQ	OR	NMQKMQ	UVKU	NNMO	
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pÅ	OR	k ç=d ~ë	QONTRNPKUO	MKV	QPOQMMUKRR	VTKRQ	RVKR	NOMQ	
pÅ	OR	e O	VVUMNUMKN	OKN	NMQSVRMKV	VRKPP	RVKR	NOMQ	
pÅ	OR	e É	NQQNRTKPQ	NKP	NRSVQPKTQ	VNKUR	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NMNSTMQKPQ	NKS	NMMTQVOKRQ	NMMKVN	RVKR	NOMQ	
dÉ	TO	e O	PVUVPMKUS	MKV	QNUTVMKQQ	VRKOS	RVKR	NOMQ	
dÉ	TO	e É	NNMPRNKVV	MKQ	NNVPVMKOU	VOKQP	RVKR	NOMQ	
v	UV	e O	QQUUUNPKPU	NKQ	QSPMSRQKU	VSKVQ	RVKR	NOMQ	
v	UV	e É	TQQMVTKUM	MKO	UMTOTPKVP	VOKNT	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVPMUVMKRN	MKS	SORQMVSKN	NNMKUS	RVKR	NOMQ	
qÄ	NRV	e É	OSRMPUNKVQ	NKQ	OTPRTRQKPS	VSKUU	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQUMUSOKVS	MKS	OVRURQRKMT	NNTKSR	RVKR	NOMQ	
_á	OMV	e É	NRQRQSQKNN	NKT	NRQQSOOKMP	VUKTR	RVKR	NOMQ	

p~ã éáÉ=k~ã É	``_
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l éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==\ mp==	iãäá	n`=c~ä~Ö
V	_É	S	kç=cl~ë	MKMMO	ééÄ	NVNKM	NVSKST	MO	
NN	_	S	kç=cl~ë	MOST	ééÄ	RKV	NVSRKTO	Q	
OP	k~	QR	eÉ	STKPNM	ééÄ	SKS	UPQSVKPM	QMM	
OQ	j Ö	QR	eÉ	NKSNP	ééÄ	QQKS	NMVTKUT	QM	
OT	^ä	QR	eÉ	MKQRR	ééÄ	QQKV	NUUKUV	QM	
OU	pá	QR	eO	MKQTP	ééÄ	STKS	VQNKMP	NMM	
PV	h	QR	eÉ	NOPKTVR	ééÄ	PKP	SPQMRKSS	QMM	c~äÉÇ=a ça
QM	`~	QR	eO	PKMPT	ééÄ	QKQ	OSQQQKTO	QM	
RN	s	UV	eÉ	MKMQQ	ééÄ	SMKQ	PQRKRS	N	
RO	`ê	UV	eÉ	JMKMMU	ééÄ	kL^	TQMKRR	N	
RR	j å	UV	eÉ	MKMMS	ééÄ	NVPKU	NUVKPM	MKQ	
RS	cÉ	UV	eO	MKUOV	ééÄ	QKM	PUTMOKUU	QM	
RV	`ç	UV	eÉ	MKMMP	ééÄ	QMKP	NSSKST	MO	
SM	ká	UV	eÉ	JMKOQP	ééÄ	kL^	RUMKMO	MKQ	c~äÉÇ=a ça
SP	`ì	UV	eÉ	JMKMMN	ééÄ	kL^	QVQKQS	MKS	
SS	wå	UV	eÉ	MKNPU	ééÄ	UKN	OQQKOP	O	
TR	^ë	UV	eÉ	MKMNN	ééÄ	SQKS	PMKPP	N	
TU	pÉ	UV	eO	MKMMS	ééÄ	NSUKM	NQKNT	N	
UU	pê	UV	eÉ	MKMMR	ééÄ	NSMKT	RMKMM	N	
VR	j ç	UV	eÉ	MKMST	ééÄ	QQKS	QRUKVN	N	
NMT	^Ö	UV	eÉ	MKMMR	ééÄ	NMKN	NPRKRS	MO	
NNN	`Ç	UV	eÉ	MKMMR	ééÄ	RPKO	NVKOS	MO	
NNU	på	NRV	eÉ	MKMPR	ééÄ	QVKO	OTNKNO	N	
NON	pÄ	NRV	kç=cl~ë	MKMPS	ééÄ	OPKV	NNPNKOR	MO	
NPT	_~	NRV	kç=cl~ë	MKMNP	ééÄ	QQKQ	NSMKNT	MKQ	
NUO	t	NRV	kç=cl~ë	MKMPM	ééÄ	PQKS	OQNVKQQ	N	
OMR	qä	OMV	kç=cl~ë	MKNSU	ééÄ	NKV	RURQKNU	MO	c~äÉÇ=a ça
OMU	mÄ	OMV	kç=cl~ë	JMKMMN	ééÄ	kL^	UQMKVM	MO	
OPO	qÜ	OMV	kç=cl~ë	MKMNV	ééÄ	NOKM	PPNPKVR	N	
OPU	r	OMV	kç=cl~ë	MKMMT	ééÄ	QRKO	QQTKNR	MO	

n`=fpqa=q~ÄåÉ

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iá	S	kç=cl~ë	OMRMURMOV	NKP	ONNUNUQKUQ	VSKUO	RVKR	NOMQ	
pÅ	QR	kç=cl~ë	QNMNVTUKMV	NKP	QPOQMMUKRR	VQKUT	RVKR	NOMQ	
pÅ	QR	eO	VSPMMVKNQ	NKR	NMQSVRMKNV	VNKVU	RVKR	NOMQ	
pÅ	QR	eÉ	NPTTQSKPN	NKM	NRSVOPKTQ	UTKTT	RVKR	NOMQ	
dÉ	TO	kç=cl~ë	VVSSPRKTO	NKT	NMMTQVOKRQ	VUKVO	RVKR	NOMQ	
dÉ	TO	eO	PUUSMTKTP	MKT	QNUTVMKQQ	VOKTV	RVKR	NOMQ	
dÉ	TO	eÉ	NMUSPOKQQ	MKT	NNVPVMKOU	VMKVV	RVKR	NOMQ	
v	UV	eO	QQMSTMPKSQ	OKM	QSPMSRQKU	VRKNS	RVKR	NOMQ	
v	UV	eÉ	TOVRPUKQN	MKS	UMTOTPKVP	VMKPT	RVKR	NOMQ	
qÄ	NRV	kç=cl~ë	SRVUMVPKRU	MKR	SCROMVSKN	NVRKRR	RVKR	NOMQ	
qÄ	NRV	eÉ	OSCCRUPKMM	MKT	OTPRTROKPS	VRKUS	RVKR	NOMQ	
_á	OMV	kç=cl~ë	PPQQQPMSN	MKS	OVRURQRKMT	NNOKVU	RVKR	NOMQ	
_á	OMV	eÉ	NRNQVPNKOM	MKR	NRQQSOOKMP	VUKMU	RVKR	NOMQ	

KATAHDIN ANALYTICAL SERVICES, LLC
METALS ANALYSIS RUN INFORMATION SHEET

INSTR. ID: L (Agilent 7800) **ANALYST:** KS **ANALYSIS DATE:** 03/23/23

METHOD: ICP-MS
- ☐ 200.8
- ☑ 6020
- ☑ DOD

FILE NAME: LQC24A

Reviewed By: 4-03-27-23

The pHs of all samples that were tested by direct analysis in this analytical run were checked just prior to analysis and confirmed to be <2. The time of preservation of these samples was checked in the "Measured Turbidity and Preservation of Incoming Samples" logbook to verify that they had been preserved at least 16 hours prior to analysis. These verifications were performed by _____ (initials) on _____ (date).

STANDARDS USED:

Standard Name	Standard ID	Prep Date	Expiration Date	Standard Conc.
Cal Blk/ICB/CCB	MW21411	03/02/23	03/02/24	0 ug/L
Cal Std	MW21414	03/02/23	03/25/23	Varies by Element
ICV	MW21429	03/15/23	06/14/23	Varies by Element
PQL	MW21436	03/23/23	03/25/23	Varies by Element
LRS1	MW21330	01/17/23	03/25/23	Varies by Element
LRS2	MW21331	01/17/23	04/17/23	Varies by Element
ICSA	MW21441	03/24/23	03/31/23	Varies by Element
ICSAB	MW21438	03/23/23	03/25/23	Varies by Element
CCV	MW21439	03/23/23	03/25/23	Varies by Element
Internal Standard (ISTD)	N/A	N/A	N/A	0.2 mg/L (Li,Sc,Ge/Y,Tb,Bi)

Additional Comments and Notes:

Samples with ISTD RSDs > 8% were reanalyzed immediately.

ISTD was manually added to all standards and samples (0.08 mL of MS2459 to 8 mL).

Dilutions: Some samples were diluted based on history or due to interfering element concentrations.

Dilution preparations are as follows:

5x diln.: 1.6 mL of sample (pipet M30) + 6.4 mL of MW21411 (pipet M31)

10x diln.: 0.8 mL of sample (pipet M19) + 7.2 mL of MW21411 (pipet M31)

25x diln.: 0.32 mL of sample(pipet M19) + 7.68 mL of MW21411 (pipet M31)

Post Spike: 0.08 mL of MW21329 (pipet M27) into 8 mL final volume of appropriately diluted sample (pipet M31)

INSTRUMENT RUNLOG

Instrument: AGILENT 7800

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
CalBlank	1	LQC24A	03/24/2023	16:21	KS
CalStd	1	LQC24A	03/24/2023	16:27	KS
ICV	1	LQC24A	03/24/2023	16:38	KS
ICB	1	LQC24A	03/24/2023	16:47	KS
PQL	1	LQC24A	03/24/2023	16:52	KS
ICSA	1	LQC24A	03/24/2023	16:58	KS
ICSAB	1	LQC24A	03/24/2023	17:03	KS
LRS1	1	LQC24A	03/24/2023	17:12	KS
LRS2	1	LQC24A	03/24/2023	17:23	KS
RINSE	1	LQC24A	03/24/2023	17:35	KS
RINSE	1	LQC24A	03/24/2023	17:40	KS
CCV	1	LQC24A	03/24/2023	17:45	KS
CCB	1	LQC24A	03/24/2023	17:56	KS
PQL	1	LQC24A	03/24/2023	18:01	KS
PQL	1	LQC24A	03/24/2023	18:06	KS
ICSA	1	LQC24A	03/24/2023	18:11	KS
RINSE	1	LQC24A	03/24/2023	18:16	KS
CCV	1	LQC24A	03/24/2023	18:21	KS
CCB	1	LQC24A	03/24/2023	18:30	KS
PBWQC21IMW2	5	LQC24A	03/24/2023	18:35	KS
LCSWQC21IMW2	5	LQC24A	03/24/2023	18:41	KS
SQ1015-024	5	LQC24A	03/24/2023	18:49	KS
SQ1201-009	5	LQC24A	03/24/2023	18:54	KS
SQ1201-010	5	LQC24A	03/24/2023	18:59	KS
SQ1201-011	5	LQC24A	03/24/2023	19:04	KS
SQ1201-012	5	LQC24A	03/24/2023	19:09	KS
SQ1201-012L	25	LQC24A	03/24/2023	19:14	KS
SQ1201-012A	5	LQC24A	03/24/2023	19:19	KS
SQ1201-012P	5	LQC24A	03/24/2023	19:25	KS
CCV	1	LQC24A	03/24/2023	19:32	KS
CCB	1	LQC24A	03/24/2023	19:42	KS
SQ1201-012S	5	LQC24A	03/24/2023	19:47	KS
SQ1201-013	5	LQC24A	03/24/2023	19:55	KS
SQ1201-014	5	LQC24A	03/24/2023	20:00	KS
SQ1201-015	5	LQC24A	03/24/2023	20:05	KS
SQ1201-016	5	LQC24A	03/24/2023	20:10	KS
SQ1201-017	5	LQC24A	03/24/2023	20:15	KS
SQ1201-018	5	LQC24A	03/24/2023	20:21	KS
SQ0876-001P	5	LQC24A	03/24/2023	20:26	KS
SQ0876-001S	5	LQC24A	03/24/2023	20:31	KS
PBSQC14IMS2	5	LQC24A	03/24/2023	20:36	KS
CCV	1	LQC24A	03/24/2023	20:41	KS
CCB	1	LQC24A	03/24/2023	20:51	KS
LC2OQC14IMS2	5	LQC24A	03/24/2023	20:56	KS

US EPA Tune Check Report

Operator Name	admin
Acq/Data Batch	D:\Agilent\ICPMH\1\DATA\2023\03-MAR\LQC24A.b
Acq. Date-Time	3/24/2023 15:23:31
Report Comment	---
Instrument Name	G8421A SG18503526

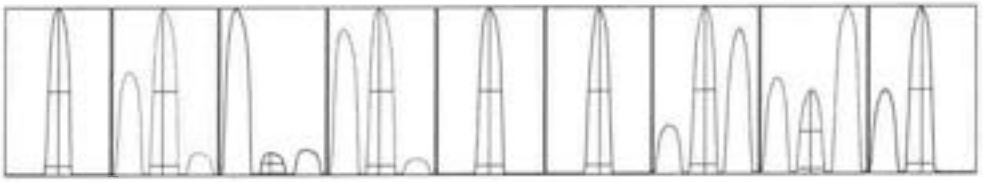
[No Gas]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
9	10.00	61525	615248.87	2.835	5.000	
24	10.00	253127	2531271.90	3.240	5.000	
25	10.00	32286	322863.28	2.984	5.000	
26	10.00	37819	378187.14	2.880	5.000	
59	10.00	469066	4690658.06	3.077	5.000	
115	10.00	528767	5287669.12	2.843	5.000	
206	10.00	101079	1010789.44	3.011	5.000	
207	10.00	86430	864301.69	2.919	5.000	
208	10.00	172260	1722604.60	3.712	5.000	

Integration Time [sec] 0.1

Resolution/Axis



Mass	Peak Height	Axis	Axis (Required)	Axis (Flag)
9	62200.58	9.05	8.90 - 9.10	
24	254532.13	23.95	23.90 - 24.10	
25	32402.89	24.95	24.90 - 25.10	
26	37066.12	25.95	25.90 - 29.10	
59	467258.59	59.00	58.90 - 59.10	
115	536321.87	115.05	114.90 - 115.10	
206	101527.18	206.00	205.90 - 206.10	
207	88219.30	206.95	206.90 - 207.10	
208	177273.89	208.00	207.90 - 208.10	

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
9	0.59	0.731	0.900	
24	0.66	0.786	0.900	
25	0.64	0.743	0.900	

US EPA Tune Check Report

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
26	0.65	0.785	0.900	
59	0.63	0.781	0.900	
115	0.59	0.740	0.900	
206	0.60	0.775	0.900	
207	0.61	0.782	0.900	
208	0.61	0.782	0.900	

Integration Time [sec] 0.1
Acquisition Time [sec] 47.0000000000001
Y Axis Linear

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	13.0 V
Extract 2	-250.0 V	Cell Entrance	-40 V	Plate Bias	-40 V
Omega Bias	-85 V	Cell Exit	-60 V		

Cell Parameters

Use Gas	No	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-8.0 V		
H2 Flow	0.0 mL/min	OctP RF	130 V		

QP Parameters

Mass Gain	120	Axis Gain	0.9982	QP Bias	-3.0 V
Mass Offset	126	Axis Offset	0.12		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.8 mm

EM

Discriminator	3.7 mV	Analog HV	2210 V	Pulse HV	1204 V

[H2]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	43880	438800.14	3.734	5.000	
89	10.00	45181	451806.87	3.235	5.000	
205	10.00	37242	372416.01	2.938	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

US EPA Tune Check Report

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-18.0 V		
H2 Flow	5.0 mL/min	OctP RF	200 V		

QP Parameters

Mass Gain	120	Axis Gain	0.9982	QP Bias	-13.0 V
Mass Offset	126	Axis Offset	0.12		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.8 mm

EM

Discriminator	3.7 mV	Analog HV	2210 V	Pulse HV	1204 V

[He]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	109178	1091781.93	3.582	5.000	
89	10.00	8489	84891.76	2.676	5.000	
205	10.00	16537	165365.55	2.845	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	4.5 mL/min	OctP Bias	-18.0 V		
H2 Flow	0.0 mL/min	OctP RF	200 V		

QP Parameters

US EPA Tune Check Report

Mass Gain	120	Axis Gain	0.9982	QP Bias	-13.0 V
Mass Offset	126	Axis Offset	0.12		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.8 mm		

EM

Discriminator	3.7 mV	Analog HV	2210 V	Pulse HV	1204 V

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OT	^ä	QR	eÉ	PRPVKPV	PKV
OU	pá	QR	eO	RPTKOQ	NRKR
PV	h	QR	eÉ	POSQSKUN	NKV
QM	` ~	QR	eO	NQOVSKOV	NKS
RN	s	UV	eÉ	OTPKPQ	QKQ
RO	` ê	UV	eÉ	UPMKRP	SKV
RR	j å	UV	eÉ	POVKOU	VKT
RS	cÉ	UV	eO	VVUMKST	OKM
RV	` ç	UV	eÉ	NPNKNO	ORKN
SM	k á	UV	eÉ	OPNKNO	NNKO
SP	` ì	UV	eÉ	QVNKNP	NMKR
SS	wå	UV	eÉ	OVMTKMO	OKM
TR	^ë	UV	eÉ	OMKMM	OSKR
TU	pÉ	UV	eO	PKNT	OQKN
UU	pê	UV	eÉ	OMKMM	QQKN
VR	j ç	UV	eÉ	VTKTU	TKN
NMT	^Ö	UV	eÉ	TKTU	SRKR
NNN	` Ç	UV	eÉ	NKNN	NMMKM
NNU	på	NRV	eÉ	RPNKNP	UKO
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NPT	_~	NRV	kç=d~ë	PPKPT	PQKS
NUO	t	NRV	kç=d~ë	TRQKNS	NMKN
OMR	qä	OMV	kç=d~ë	RPPKVN	NPKP
OMU	mÄ	OMV	kç=d~ë	USTKRV	NQKS
OPO	qÜ	OMV	kç=d~ë	NTMRKOS	OKT
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pÅ	QR	eO	NMSVRVUKVR	PKN
pÅ	QR	eÉ	NRTTPRKMO	MKR
dÉ	TO	kç=d~ë	NMSQPUQKUO	NKT
dÉ	TO	eO	QOOMNTKMN	MKV
dÉ	TO	eÉ	NOORSPKSN	MKQ
v	UV	eO	QTSOUURKNQ	NKU
v	UV	eÉ	UOVQMOKQU	MKV
qÄ	NRV	kç=d~ë	SRQQMSTKOO	NKS
qÄ	NRV	eÉ	OURMTNTKVP	MKS
_á	OMV	kç=d~ë	PONUTOUKRU	NKM
_á	OMV	eÉ	NRVQNVSKTN	NKN

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OT	^ä	QR	e É	NQNUQOKQP	NKQ
OU	pá	QR	e O	QVRTVQKMP	MKT
PV	h	QR	e É	POTQQQMKOT	MKU
QM	` ~	QR	e O	PTORVSRSKNN	MKS
RN	s	UV	e É	OOQPOQKNT	MKV
RO	` ê	UV	e É	OUOPUNKQM	MKS
RR	j å	UV	e É	NQOMNRKQS	MKS
RS	cÉ	UV	e O	NPMTQQTSPKQV	MKQ
RV	` ç	UV	e É	QUNSTSKMV	MKT
SM	k á	UV	e É	NPPVSNKMU	NKO
SP	` ì	UV	e É	PTNQPRKMP	MKQ
SS	wå	UV	e É	SOUMSKUU	NKT
TR	^ë	UV	e É	QTTRVKQS	MKS
TU	pÉ	UV	e O	ORVQSKPT	MKQ
UU	pê	UV	e É	NSUTRUKTP	MKQ
VR	j ç	UV	e É	NSQTNRKSM	NKR
NMT	^Ö	UV	e É	RVNMPUKSO	NKT
NNN	` Ç	UV	e É	TVNTUKPU	MKR
NNU	på	NRV	e É	NRPUUSKUV	MKU
NON	pÄ	NRV	k ç=d ~ë	NNNQVUVKUT	OKN
NPT	_~	NRV	k ç=d ~ë	PNVQSSKTQ	MKO
NUO	t	NRV	k ç=d ~ë	SPNOQSKVR	MKQ
OMR	qä	OMV	k ç=d ~ë	NPPPVOSKUV	OKM
OMU	mÄ	OMV	k ç=d ~ë	NURQUPUKPQ	NKP
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OPU	r	OMV	k ç=d ~ë	NROPPOSKSP	MKR

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pÅ	QR	e O	NMSNUOSKRT	MKS	NMSVRVUKVR	VVKOT	RVKR	NOMKQ	
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OT	^ä	QR	eÉ	PVUNTQM	éé Ä	MRT	RUQLJVRRS	QMM	VVKSU	UVKS	NNMVQ	
OU	pá	QR	eO	PVSKUCP	éé Ä	MKU	NVUPSMKVS	QMM	VVKCN	UVKS	NNMVQ	
PV	h	QR	eÉ	QNMQKRNQ	éé Ä	NKO	NPRUVPVKVQ	QMMM	NMCHSN	UVKS	NNMVQ	
QM	`~	QR	eO	QMUTHMQQ	éé Ä	MKR	NRPPSQNRKNV	QMMM	NMCKNU	UVKS	NNMVQ	
RN	s	UV	eÉ	QMKRMJ	éé Ä	NKO	VNVMTKNU	QM	NMCKRQ	UVKS	NNMVQ	
RO	`ê	UV	eÉ	QMKNPP	éé Ä	MKR	NNPUTQKPN	QM	NMMHSS	UVKS	NNMVQ	
RR	j å	UV	eÉ	NVKVTQ	éé Ä	MKV	RSTSVKTO	QM	VVKUT	UVKS	NNMVQ	
RS	cÉ	UV	eO	PVSSHSRQ	éé Ä	NKM	RCPPUMRCKMQ	QMMM	VVKNT	UVKS	NNMVQ	
RV	`ç	UV	eÉ	QMQQN	éé Ä	NKQ	NVSQQSHPN	QM	NMCKO	UVKS	NNMVQ	
SM	ká	UV	eÉ	QMQRN	éé Ä	OKN	RQTTPKTV	QM	NMCKCS	UVKS	NNMVQ	
SP	`ì	UV	eÉ	QMQUS	éé Ä	NHS	NRQMPSKNQ	QM	NMCKCP	UVKS	NNMVQ	
SS	wå	UV	eÉ	NVHSQQ	éé Ä	NHS	OSPNTKPM	QM	VUKCO	UVKS	NNMVQ	
TR	^ë	UV	eÉ	NVKUTS	éé Ä	NHS	NUVQQKNS	QM	VVKPU	UVKS	NNMVQ	
TU	pÉ	UV	eO	NVKQQM	éé Ä	MRT	NMNSVKTP	QM	VTKN	UVKS	NNMVQ	
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NNN	`Ç	UV	eÉ	QMHMN	éé Ä	NKV	PNRUCKRR	QM	NMMHMN	UVKS	NNMVQ	
NNU	på	NRV	eÉ	NVKURR	éé Ä	PKM	SNMTNKNQ	QM	VVKCU	UVKS	NNMVQ	
NON	pÄ	NRV	kç=cl~ë	NVKQSS	éé Ä	OKU	QPQSQTHPN	QM	VTKPP	UVKS	NNMVQ	
NPT	_~	NRV	kç=cl~ë	QMKPQQ	éé Ä	NKV	NPMNOTKPU	QM	NMNKTO	UVKS	NNMVQ	
NUO	t	NRV	kç=cl~ë	QMQST	éé Ä	NKU	ORVQMPKPM	QM	NMCKPQ	UVKS	NNMVQ	
OMR	qä	OMV	kç=cl~ë	NVKTRQ	éé Ä	OKP	RORTVVKRU	QM	VURTT	UVKS	NNMVQ	
OMU	mÄ	OMV	kç=cl~ë	NVHSOT	éé Ä	OKO	TOSPQMKUT	QM	VUKNQ	UVKS	NNMVQ	
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pÅ	QR	eO	NMSUUNMQR	NKQ	NMSVRVUKVR	VVKVP	RVKR	NQMQ	
pÅ	QR	eÉ	NRRSRQKQN	NKO	NRTTPRMVO	VUHSU	RVKR	NQMQ	
dÉ	TO	kç=cl~ë	NMRUQRQHSP	MRT	NMSQPUQKUO	VVKQQ	RVKR	NQMQ	
dÉ	TO	eO	QNUPPVKUM	NHN	QQQMNTKMN	VVKNP	RVKR	NQMQ	
dÉ	TO	eÉ	NNUTVVRTT	MKQ	NQQRSPHSN	VSKVP	RVKR	NQMQ	
v	UV	eO	QTSOPVQKVV	MRR	QTSOUURMKQ	VVKVV	RVKR	NQMQ	
v	UV	eÉ	UMPQTNKQM	NHP	UOVQMQKQU	VSKUT	RVKR	NQMQ	
qÄ	NRV	kç=cl~ë	SRVOQPORQ	NKU	SRQQMSTKOO	NMMRTQ	RVKR	NQMQ	
qÄ	NRV	eÉ	OTTNRMPRTT	NHS	OURMTNTKVP	VTKOO	RVKR	NQMQ	
_á	OMV	kç=cl~ë	PNUTPTVKUN	PHP	PONUTOUKRU	VVHMP	RVKR	NQMQ	
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I éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	råáë	opa	==\ mp==	iãáá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MKMNQ	ééÄ	NSKO	OMUKVM	MO	
NN	_	S	kç=d~ë	MKNTV	ééÄ	NSKM	NQVRKSS	Q	
CP	k~	CR	eÉ	CKVCR	ééÄ	TKM	RPVNVKCP	CMM	
CQ	j Ö	CR	eÉ	CKSPO	ééÄ	NRRT	NCQMKVV	CM	
CT	^ä	CR	eÉ	MKUTN	ééÄ	PMO	PSPNKSP	CM	
CU	pá	CR	eO	MKSVS	ééÄ	CPKO	USCQKOT	NVM	
PV	h	CR	eÉ	UKVUV	ééÄ	POKV	PRNVSKNP	CMM	
QM	`~	CR	eO	PKNVU	ééÄ	RKM	CRTNPKSM	CM	
RN	s	UV	eÉ	MKVMS	ééÄ	CMR	OVRKRS	N	
RO	`ê	UV	eÉ	MKVMV	ééÄ	VSKM	USRKUS	N	
RR	j å	UV	eÉ	MKVMT	ééÄ	NRCKO	PQPKOT	MQ	
RS	cÉ	UV	eO	PKNVV	ééÄ	PKS	RNRVCKTU	CM	
RV	`ç	UV	eÉ	MKVNM	ééÄ	OVKN	CCQKQS	MO	
SM	ká	UV	eÉ	MKVOM	ééÄ	NSKT	CUMKVN	MQ	
SP	`ì	UV	eÉ	MKVOP	ééÄ	PNKR	SRCKCR	MS	
SS	wå	UV	eÉ	JMKVQQ	ééÄ	kL^	CUMNKQQ	O	
TR	^ë	UV	eÉ	MKVON	ééÄ	CCKO	PVKST	N	
TU	pÉ	UV	eO	MKVQQ	ééÄ	CKV	OSKMM	N	
UU	pê	UV	eÉ	MKVNS	ééÄ	CCKR	TPKPQ	N	
VR	j ç	UV	eÉ	MKOMN	ééÄ	UKV	TSQKQU	N	
NMT	^Ö	UV	eÉ	MKVNQ	ééÄ	NKP	NTPKPQ	MO	
NNN	`Ç	UV	eÉ	MKVNT	ééÄ	NPKQ	CUKNR	MO	
NNU	på	NRV	eÉ	MKVPN	ééÄ	OVKR	SNSKSV	N	
NON	pÄ	NRV	kç=d~ë	MKVPR	ééÄ	NTKS	NVSQKRM	MO	
NPT	_~	NRV	kç=d~ë	MKVOM	ééÄ	UKV	NSPKRN	MQ	
NUO	t	NRV	kç=d~ë	MKNRT	ééÄ	NKM	OTOVKUS	N	
OMR	qä	OMV	kç=d~ë	MKVSM	ééÄ	SKP	ONOVKNO	MO	
OMU	mÄ	OMV	kç=d~ë	MKVNS	ééÄ	CUKN	NQQUKQQ	MO	
OPO	qÜ	OMV	kç=d~ë	MKVPT	ééÄ	OVKU	CUTPKPR	N	
OPU	r	OMV	kç=d~ë	MKVNV	ééÄ	OMKM	SMTKPP	MO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j ÇÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=cäÜÜ	n`=c~ä~Ö
iá	S	kç=d~ë	OMPQRMPKVR	MKV	ONOOPOPKQO	VRKUS	RVKR	NOMKQ	
pÅ	CR	kç=d~ë	QQRSQQUKNQ	NKU	QRNVVMMKVQ	VUKS	RVKR	NOMKQ	
pÅ	CR	eO	NMQRTOOKON	MKT	NMSVRVUKVR	VTKTT	RVKR	NOMKQ	
pÅ	CR	eÉ	NRSQRTKNQ	NKR	NRTTPRKVO	VVKNV	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	NMQOMUMKVM	OKR	NMSQPUQKUO	VTKV	RVKR	NOMKQ	
dÉ	TO	eO	QNRUTNKVQ	NKN	QOOMNTKVN	VUKRQ	RVKR	NOMKQ	
dÉ	TO	eÉ	NOMRRNKSR	NKN	NOORSPKSN	VUKPS	RVKR	NOMKQ	
v	UV	eO	QTMUSQSKMT	MKT	QTSOUURKNQ	VUKUS	RVKR	NOMKQ	
v	UV	eÉ	UNQTSTKVU	NKN	UOVQMOKQU	VUKCQ	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	SRTMMVRKSU	OKM	SRQQMSTKOO	NMMKQ	RVKR	NOMKQ	
qÄ	NRV	eÉ	OTVPQQOKVP	NKO	OURMTNTKVP	VTKVV	RVKR	NOMKQ	
_á	OMV	kç=d~ë	PNTNPSSKPR	PKP	PONUTOUKRU	VUKRP	RVKR	NOMKQ	
_á	OMV	eÉ	NRTUUMTKUQ	MKT	NRVQNVSKTN	VVKMP	RVKR	NOMKQ	

p~ã éáÉ=k~ã É	mmi
cäÉ=k~ã É	MNM f ` s kÇ
a~í~=m~íÜ=k~ã É	a W ^ Ö ä É á i y f ` m j e y N y a ^ q ^ y O M C P y M P J ^ o y i n ` O Q ^ k Å
^Åè=qãä É	PLOQLOMOP=NSVROMRU
p~ã éáÉ=qóéÉ	i i f ` s
qçí~äa ää íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=o ÉÑ¤cäÉk~ã É	MVS ^ i _ kÇ
p~ã éáÉ=n ` =m~ëëlcá~ä	c~ää
fpqa=n ` =m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áá**

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çåÅK	r åáë	o p a	==ì mp==	bñés~ä	B o ÉÅ	B i çï	B e äÖÜ
V	_É	S	k ç=d ~ë	MKNVT	éé Ä	PKP	NOVOKPM	MO	VUR	TVKR	NOMQ
NN	_	S	k ç=d ~ë	PKURU	éé Ä	MKQ	NRTNSHRS	Q	VSKQR	TVKR	NOMQ
OP	k ~	QR	e É	ONNKSTN	éé Ä	NKS	NUUVMSKQO	OMM	NVRKUQ	TVKR	NOMQ
OQ	j Ö	QR	e É	ONKVUR	éé Ä	OKT	TVVPKRV	OM	NMVKVP	TVKR	NOMQ
OT	^ ä	QR	e É	JOKSOO	éé Ä	k L ^	OVPUKNP	OM	JNPKSN	TVKR	NOMQ
OU	p á	QR	e O	VVKQUU	éé Ä	NKU	QSQQSHRU	NMM	VVKQV	TVKR	NOMQ
PV	h	QR	e É	ONNKCPT	éé Ä	NKO	VQQUPKVV	OMM	NVRHSO	TVKR	NOMQ
QM	` ~	QR	e O	OPKMVQ	éé Ä	NKM	VPQRRKMM	OM	NNRKQT	TVKR	NOMQ
RN	s	UV	e É	NKMMQ	éé Ä	PKP	QRQQKNQ	N	NMMKQ	TVKR	NOMQ
RO	` ê	UV	e É	NKMQR	éé Ä	NKO	SOQPKRQ	N	NMOKR	TVKR	NOMQ
RR	j å	UV	e É	MKPTP	éé Ä	PKV	NPMTKNR	MQ	VPKQR	TVKR	NOMQ
RS	c É	UV	e O	ONKQQT	éé Ä	MKT	OTPPOTHRN	OM	NVSKCP	TVKR	NOMQ
RV	` ç	UV	e É	MKOMP	éé Ä	SKR	NVTUKMM	MO	NMNHR	TVKR	NOMQ
SM	k á	UV	e É	MKQQR	éé Ä	PKP	NPQPKQO	MQ	NNNKQR	TVKR	NOMQ
SP	` ì	UV	e É	MKSSO	éé Ä	QKV	RNNSKRT	MKS	NNMKPP	TVKR	NOMQ
SS	w å	UV	e É	MKSPV	éé Ä	NRKO	PQMUKOS	O	PNKVR	TVKR	NOMQ
TR	^ ë	UV	e É	MKVVO	éé Ä	QKN	VNTKQS	N	VVKO	TVKR	NOMQ
TU	p É	UV	e O	MKVVN	éé Ä	PKS	QVNKSS	N	VVKN	TVKR	NOMQ
UU	p ê	UV	e É	NKMNQ	éé Ä	OKP	PQSTKNN	N	NMNKQ	TVKR	NOMQ
VR	j ç	UV	e É	NKMRS	éé Ä	QKR	PPVNKRV	N	NVRKS	TVKR	NOMQ
NMT	^ Ö	UV	e É	MKONO	éé Ä	NKN	OPUUKMP	MO	NMS	TVKR	NOMQ
NNN	` Ç	UV	e É	MKOMS	éé Ä	QKO	PNMKTQ	MO	NMP	TVKR	NOMQ
NNU	p å	NRV	e É	MKUUT	éé Ä	RKR	PMSPKTP	N	UUKT	TVKR	NOMQ
NON	p Ä	NRV	k ç=d ~ë	MKOOR	éé Ä	NMKN	RMMOKVM	MO	NNOKR	TVKR	NOMQ
NPT	_ ~	NRV	k ç=d ~ë	MKQRT	éé Ä	NMKN	OTUVKVP	MQ	NNQKCR	TVKR	NOMQ
NUO	t	NRV	k ç=d ~ë	MKVVN	éé Ä	QKM	NORNRKUV	N	VVKN	TVKR	NOMQ
OMR	q ä	OMV	k ç=d ~ë	MKONU	éé Ä	VKT	RUTTHRR	MO	NMV	TVKR	NOMQ
OMU	m Ä	OMV	k ç=d ~ë	MKONQ	éé Ä	QKP	UNRVHSP	MO	NMT	TVKR	NOMQ
OPO	q Ü	OMV	k ç=d ~ë	MKNSU	éé Ä	OKR	SSVUKUQ	MO	UQ	TVKR	NOMQ
OPU	r	OMV	k ç=d ~ë	MKOMD	éé Ä	NKR	RTQQKMR	MO	NMN	TVKR	NOMQ

n ` =c ä-Ö
c ~ äÉÇ=a ç a =& c ~ äÉÇ=SMOMb m^

n` =cä-Ö
c~áÉÇ=a ça =& c~áÉÇ=SMOMbmm^

n` =fpqa=q~ÄáÉ

k~ã É	j ~ëë	qì åÉ÷j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÅ	B n` =çï	B n` =eäÖÜ	n` =cä-Ö
iá	S	k ç=d ~ë	OMPVPOMKCP	NKV	ONCCPCPKQO	VSKMV	RVMR	NOMMQ	
pÅ	QR	k ç=d ~ë	QDQVTPQKUT	NKN	QRNVVMMMMQ	VQKMO	RVMR	NOMMQ	
pÅ	QR	e O	VVMONSKMN	MKV	NMSVRVUKVR	VORRU	RVMR	NOMMQ	
pÅ	QR	e É	NQSMOMKTO	MMS	NRTTPRMMO	VORRT	RVMR	NOMMQ	
d É	TO	k ç=d ~ë	NMMQMPNKMM	NMP	NMSCPUQKUO	VQPPP	RVMR	NOMMQ	
d É	TO	e O	PVQNQRMPQ	MRT	QDDMNTMMN	VPKQ	RVMR	NOMMQ	
d É	TO	e É	NNPOUSKMN	MMR	NOORSPMSN	VOKQP	RVMR	NOMMQ	
v	UV	e O	QDUQSMUKUM	MRT	QTSOUURMNQ	VQKNS	RVMR	NOMMQ	
v	UV	e É	TSQUOVMMS	MMS	UOVQMDKQU	VOKON	RVMR	NOMMQ	
qÄ	NRV	k ç=d ~ë	SONRQQRKQR	NRT	SRQQMSTKOO	VQKVU	RVMR	NOMMQ	
qÄ	NRV	e É	OSPQVRMPQ	NKU	OURMTNTKVP	VOKQP	RVMR	NOMMQ	
_á	OMV	k ç=d ~ë	OVSQQRMMN	NKQ	PONUTOUMRU	VOKN	RVMR	NOMMQ	
_á	OMV	e É	NRPQUTMSO	MRP	NRVQNVSRTN	VSKOU	RVMR	NOMMQ	

fåíÉâÑÉêÉåÅÉ= ÜÉÅâ=pçàíç=^=Ef`pJ^F=oÉéçê

p~ã éáÉ=k~ã É	f`p^
cäÉ=k~ã É	MNNf`p^KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyi n`OQ^HÅ
^Åè=qáã É	PLCQLOMCP=NSMRLUMR
p~ã éáÉ=qóéÉ	f`p^
qçí~äaäã íáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MMS`^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~äã
fpqa=n`=m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeäÖÜ	n`=c~Ö
_É	V	S	kç=d~ë	JMKMO	éëÄ	klᴬ	NMTKTU	JMKN	NMM	NMM	
_	NN	S	kç=d~ë	MKRNN	éëÄ	NKV	OTMNKQN	JO	NMM	NMM	
k~	OP	QR	eÉ	NMOTVTKNQS	éëÄ	NKO	SQTSQQQSKPP	NMMMMM	UM	NOM	
j Ö	QQ	QR	eÉ	NMOTSOKRUM	éëÄ	NKS	PQMUVOQTKMM	NMMMMM	UM	NOM	
^ä	OT	QR	eÉ	NMTSSMKNNT	éëÄ	MKU	NPMUTTRVMPV	NMMMMM	UM	NOM	
pá	QU	QR	eO	QKVSS	éëÄ	QKN	ORUVRTM	JRM	NMM	NMM	
h	PV	QR	eÉ	NMVRSPKSMP	éëÄ	NKP	QUSTNNVNKVN	NMMMMM	UM	NOM	
`~	QM	QR	eO	NMOURRKNSP	éëÄ	NKM	PPNQQQRRMSO	NMMMMM	UM	NOM	
s	RN	UV	eÉ	MKMOR	éëÄ	NNKV	QMTKTV	JMR	NMM	NMM	
`ê	RO	UV	eÉ	OKMTT	éëÄ	NKN	NMVRUKUR	NKR	NMM	NMM	
j å	RR	UV	eÉ	MKNVV	éëÄ	QKN	TTRKUU	MKNT	NMM	NMM	
cÉ	RS	UV	eO	VUNNNKMVQ	éëÄ	OKR	NNPSRPRCUNKVO	NMMMMM	UM	NOM	
`ç	RV	UV	eÉ	MKNNR	éëÄ	NMRT	NMUQKRO	M	NMM	NMM	
ká	SM	UV	eÉ	MKQOR	éëÄ	SKV	NNVQKRO	MKNU	NMM	NMM	
`ì	SP	UV	eÉ	MKNNM	éëÄ	RKS	NNPSKTP	JMKOO	NMM	NMM	
wå	SS	UV	eÉ	JMKVVO	éëÄ	klᴬ	NQPOKPO	MKQ	NMM	NMM	aça
^ë	TR	UV	eÉ	MKMSN	éëÄ	OVKR	SUKPQ	JMR	NMM	NMM	
pÉ	TU	UV	eO	MKMSS	éëÄ	NPKT	PPKPP	JMR	NMM	NMM	
pê	UU	UV	eÉ	MKUOR	éëÄ	RKS	OQRUKMQ	MKPT	NMM	NMM	
j ç	VR	UV	eÉ	ONTOKNNR	éëÄ	MKO	SOSVQMTKQU	OMMM	UM	NOM	
^Ö	NMT	UV	eÉ	MKMNR	éëÄ	NUKN	NRTKTU	JMKN	NMM	NMM	
`Ç	NNN	UV	eÉ	MKPPR	éëÄ	OKO	QSRKRT	MKOU	NMM	NMM	
på	NNU	NRV	eÉ	JMKMST	éëÄ	klᴬ	OUMKMN	JMR	NMM	NMM	
pÄ	NON	NRV	kç=d~ë	MKMTQ	éëÄ	MKV	NTTUKST	JMKMR	NMM	NMM	
_~	NPT	NRV	kç=d~ë	MKRPR	éëÄ	PKT	PNTTKMR	MKPP	NMM	NMM	
t	NUO	NRV	kç=d~ë	MKOPT	éëÄ	VKS	PQQMKTQ	JMKPP	NMM	NMM	
qä	OMR	OMV	kç=d~ë	MKMOO	éëÄ	NMRT	NMPTKUM	JMKN	NMM	NMM	
mÄ	OMU	OMV	kç=d~ë	MKMPT	éëÄ	UKV	OMURKSO	JMKMU	NMM	NMM	
qÜ	OPO	OMV	kç=d~ë	MKMON	éëÄ	NVKS	OOOOKRQ	JMKN	NMM	NMM	
r	OPU	OMV	kç=d~ë	MKMON	éëÄ	NMKU	SMPKVU	JMKMU	NMM	NMM	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=ïçï	Bn`=eäÖÜ	n`=c~Ö
iá	S	kç=d~ë	NVUNOQSKVQ	MKV	ONOOPOPKQO	VPKPR	RVKR	NOMKQ	
pÅ	QR	kç=d~ë	QMSQSOMKQU	MKV	QRNVVMMKMQ	UVKVP	RVKR	NOMKQ	
pÅ	QR	eO	VNUTQQKNT	NKU	NMSVRVUKVR	URKV	RVKR	NOMKQ	
pÅ	QR	eÉ	NPTNRUKRM	NKO	NRTTPRKMO	USKVS	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	VQUVTQKUQ	MKU	NMSQPUQKUO	UVKNS	RVKR	NOMKQ	
dÉ	TO	eO	PSSQSNKNQ	MKO	QQOMNTKMN	USKUQ	RVKR	NOMKQ	
dÉ	TO	eÉ	NMSNNUKMS	MKQ	NOORSPKSN	USKRU	RVKR	NOMKQ	
v	UV	eO	QNUPRNTKRP	OKN	QTSOUURKNQ	UTKUQ	RVKR	NOMKQ	
v	UV	eÉ	TMSPMSKMO	MKU	UOVQMOKQU	URKNS	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	SMRUPRNKPQ	OKR	SRQQMSTKOO	VOKRU	RVKR	NOMKQ	
qÄ	NRV	eÉ	OQVNVTNKPP	NKM	OURMTNTKVP	UTKQO	RVKR	NOMKQ	
_á	OMV	kç=d~ë	OVSSTUSKMO	NKT	PONUTOUKRU	VOKNT	RVKR	NOMKQ	
_á	OMV	eÉ	NPSSNNVKSS	MKT	NRVQNVSKTN	URKSV	RVKR	NOMKQ	

fåíÉêÑÉêÉåÅÉ=ÜÉÅâ=pçà íáç å=^_=Ef`pJ^_F=oÉéçê

p~ã éáÉ=k~ã É	f`p^_
cäÉk~ã É	MVNCf`p_KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíçf`mj eyNya^q^yOMCPyMPJ ^oyi n`OQ^kÅ
^Åè=qáã É	PLCQLOMCP=NTWPMRQ
p~ã éáÉ=qóéÉ	f`p_
qçí~äa äã íáçå	NMMMM
`çã ã Éåí	JJU
fpqa=oÉÑ¥cäÉk~ã É	MVS^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeáÖÜ	n`=c ä~Ö
V	_É	S	kç=d ~ë	NVKVSO	éé Ä	QKN	NNRRNNVSV	OM	TVfR	NOMQ	
NN	_	S	kç=d ~ë	OMVMQR	éé Ä	PKO	TSPNPKMM	OM	TVfR	NOMQ	
OP	k~	QR	eÉ	NVOTPSKOUT	éé Ä	MfR	SSUPSSMRKMU	NMMMMM	TVfR	NOMQ	
OQ	j Ö	QR	eÉ	NVNUMSKQMS	éé Ä	NKO	PQUTPSMPKPT	NMMMMM	TVfR	NOMQ	
OT	^ä	QR	eÉ	NVITPUVKTTT	éé Ä	NKQ	NPQTVVRVKOQ	NMMMMM	TVfR	NOMQ	
OU	pá	QR	eO	SOMKTNP	éé Ä	OKU	OTQSNPKOO	RMM	TVfR	NOMQ	[=HLJ=NMB
PV	h	QR	eÉ	VVTNUKRPN	éé Ä	NVS	OVPRTONPKTP	NMMMMM	TVfR	NOMQ	
QM	`~	QR	eO	NVQUSRKRPV	éé Ä	PKM	PQUOUSPTTKMP	NMMMMM	TVfR	NOMQ	
RN	s	UV	eÉ	OMfRVS	éé Ä	NKN	UPUVPKOT	OM	TVfR	NOMQ	
RO	`ê	UV	eÉ	OOKMRT	éé Ä	NKM	NNPPMRKPQ	OO	TVfR	NOMQ	
RR	j å	UV	eÉ	NVKTVO	éé Ä	NKM	RNNONKPQ	OM	TVfR	NOMQ	
RS	cÉ	UV	eO	VVPUMKQPT	éé Ä	NKP	NNUQMNNVSOKSV	NMMMMM	TVfR	NOMQ	
RV	`ç	UV	eÉ	OMfOSS	éé Ä	NfR	NTTMNNKPN	OM	TVfR	NOMQ	
SM	ká	UV	eÉ	OMKNO	éé Ä	MKV	QVQQUKRN	OM	TVfR	NOMQ	
SP	`ì	UV	eÉ	NVKVOT	éé Ä	NKT	NPQQMSKVO	OM	TVfR	NOMQ	
SS	wå	UV	eÉ	NVKSPO	éé Ä	NKQ	OPPRVKUO	ONKQ	TVfR	NOMQ	
TR	^ë	UV	eÉ	OMKNUT	éé Ä	NKM	NTQURKTT	OM	TVfR	NOMQ	
TU	pÉ	UV	eO	OMKNUM	éé Ä	MKV	VRQQKSR	OM	TVfR	NOMQ	
UU	pê	UV	eÉ	ONKMVN	éé Ä	NKN	SQRORKNT	OMKV	TVfR	NOMQ	
VR	j ç	UV	eÉ	ONVMNKVVP	éé Ä	NKQ	SRPVVRUKUS	OMMM	TVfR	NOMQ	
NMT	^Ö	UV	eÉ	NVKONV	éé Ä	NKM	OMRVNSKSO	OM	TVfR	NOMQ	
NNN	`Ç	UV	eÉ	NVKTTR	éé Ä	OKM	OUPTTKTT	OM	TVfR	NOMQ	
NNU	på	NRV	eÉ	OMfORT	éé Ä	NKP	RTPSSKOV	OM	TVfR	NOMQ	
NON	pÄ	NRV	kç=d ~ë	NVKUMV	éé Ä	NKP	QNUMTVKOV	OM	TVfR	NOMQ	
NPT	_~	NRV	kç=d ~ë	OMfSTS	éé Ä	NKP	NORMMNKRR	OM	TVfR	NOMQ	
NUO	t	NRV	kç=d ~ë	OOKRCQ	éé Ä	NKP	OSVQQOKUN	OM	TVfR	NOMQ	
OMR	qä	OMV	kç=d ~ë	NVfSMS	éé Ä	NKV	QVQVPUKQN	OM	TVfR	NOMQ	
OMU	mÄ	OMV	kç=d ~ë	OMfQMP	éé Ä	MKP	TNSNNRKRQ	OM	TVfR	NOMQ	
OPO	qÜ	OMV	kç=d ~ë	ONKMVS	éé Ä	NKT	SSOPNQKVR	OM	TVfR	NOMQ	
OPU	r	OMV	kç=d ~ë	ONKMMN	éé Ä	NKQ	SMQVTRKMT	OM	TVfR	NOMQ	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ¥mp	B=oÉÁ	Bn`=içï	Bn`=eáÖÜ	n`=c ä~Ö
i á	S	kç=d ~ë	NVUUVQQKOT	OKQ	ONOOPOPKQO	VPKTO	RVfR	NOMQ	
pÅ	QR	kç=d ~ë	QNTTUTRKOM	MKT	QRNVVMMKMQ	VOKQP	RVfR	NOMQ	
pÅ	QR	eO	VQTNSOKTR	NKV	NMSVRVUKVR	UUKRR	RVfR	NOMQ	
pÅ	QR	eÉ	NQNSOOKPR	MfR	NRTTPRKMO	UVKTU	RVfR	NOMQ	
dÉ	TO	kç=d ~ë	VVPVRSKPR	NKP	NMSQPUQKUO	VPKPU	RVfR	NOMQ	
dÉ	TO	eO	PTTRVSKVM	MKU	QOOMNTKMN	UVKQT	RVfR	NOMQ	
dÉ	TO	eÉ	NMVNPUKNQ	MKV	NOORSPKSN	UVKMR	RVfR	NOMQ	
v	UV	eO	QPMNOQMQQ	MKQ	QTSOUURKNQ	VMKPN	RVfR	NOMQ	
v	UV	eÉ	TPMNSVKNR	NKN	UOVQMOKQU	UUKMQ	RVfR	NOMQ	
qÄ	NRV	kç=d ~ë	SOOVTMOKNV	MfS	SRQQMSTKOO	VRKO	RVfR	NOMQ	
qÄ	NRV	eÉ	ORRNVNMKQT	NKM	OURMTNTKVP	UVfRO	RVfR	NOMQ	
_á	OMV	kç=d ~ë	PMONTQTKUU	NfR	PONUTOUKRU	VPKUU	RVfR	NOMQ	
_á	OMV	eÉ	NQMNTVQKVO	NKP	NRVQNVSKTN	UTKVP	RVfR	NOMQ	

ïæåÉ~ê¬ø~åÖÉ¬p~ã éäÉ¬Ei opF¬øÉéçã

p~ã éäÉ¬k~ã É	i opN
cäÉ¬k~ã É	MNPj i opKÇ
a~í~¬m~íÜ¬k~ã É	aWy^ÖäÉáíyf^ mj eyNya^q^yOMOPyMPJ ^o yi n` OQ^kÅ
^Åè¬qãã É	PLOQLOMOP¬NTWMOMP
p~ã éäÉ¬qóéÉ	i op
qçí~äaãã íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa¬ø ÉÑ¾cäÉk~ã É	MVS^ i _KÇ
p~ã éäÉ¬n` ¬m~ëëlcá~ä	m~ëë
fpqa¬n` ¬m~ëëlc~áä	m~ëë
l éÉê~íçê	**~Çã áã**

n` =^å~äöíÉ¬q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¾ mp==	bñés~ä	B o ÉÅ	B i çï	B eäÖÜ	n` ¬ø ä~Ö
V	_É	S	k ç¬ø ~ë	VPKNPO	ééÄ	MVS	RCQLJNSKUU	NMM	VPKNP	UVfR	NNMQ	
NN	_	S	k ç¬ø ~ë	QVPKUSS	ééÄ	NKO	NUNQMTSKMT	RMM	VUKTT	UVfR	NNMQ	
RN	s	UV	e É	NMQOKPTN	ééÄ	NKS	QMPTMPRKVU	NMMM	NMQKCQ	UVfR	NNMQ	
RO	` ê	UV	e É	OMTCKOTU	ééÄ	NKV	NMMJSOTMéSS	OMMM	NMPKéN	UVfR	NNMQ	
RR	j å	UV	e É	OMNSKTMR	ééÄ	MKV	QVPVVPQKNQ	OMMM	NMMKUQ	UVfR	NNMQ	
RV	` ç	UV	e É	NMSVKQPT	ééÄ	NKS	UVMMQQQKSQ	NMMM	NMSKVO	UVfR	NNMQ	
SM	k á	UV	e É	NMVQKPTM	ééÄ	NKV	CRPMOQRKMT	NMMM	NMVKQQ	UVfR	NNMQ	
SP	` ì	UV	e É	ONCQKSVT	ééÄ	NKN	NPSCQPQRKON	OMMM	NMSKCP	UVfR	NNMQ	
SS	wå	UV	e É	ONRVKUPS	ééÄ	NKQ	CCQNVTQKPS	OMMM	NMTKVV	UVfR	NNMQ	
TR	^ë	UV	e É	VVRKPNP	ééÄ	MfR	UCNPVRKQR	NMMM	VVfKRP	UVfR	NNMQ	
TU	pÉ	UV	e O	NMMNKTUO	ééÄ	MfR	QSQQSUKQO	NMMM	NMMKNU	UVfR	NNMQ	
UU	pê	UV	e É	NVUSKSQU	ééÄ	NKM	RTVRNCUKPN	OMMM	VVKPP	UVfR	NNMQ	
VR	j ç	UV	e É	NMVQKOUU	ééÄ	MKV	PNNPUNPRTM	NMMM	NMVKQP	UVfR	NNMQ	
NMT	^Ö	UV	e É	NMTHRVR	ééÄ	OKM	NMVVOUSKQU	NMM	NMTHS	UVfR	NNMQ	
NNN	` Ç	UV	e É	NMTSKTSU	ééÄ	OKQ	NQTPRVVKRS	NMMM	NMTHSU	UVfR	NNMQ	
NNU	på	NRV	e É	NMMVKONN	ééÄ	MKT	OUMMRQQKRN	NMMM	NMMKVO	UVfR	NNMQ	
NON	pÄ	NRV	k ç¬ø ~ë	VUPKPNP	ééÄ	NKP	ONTNPROUKSM	NMMM	VUKPP	UVfR	NNMQ	
NPT	_~	NRV	k ç¬ø ~ë	OMCPKPTR	ééÄ	MfR	NOUMQNUPKUQ	OMMM	NMNKNT	UVfR	NNMQ	
NUO	t	NRV	k ç¬ø ~ë	NMSPKTMP	ééÄ	MKQ	NPCUTNRMKUR	NMMM	NMSKPT	UVfR	NNMQ	
OMR	qä	OMV	k ç¬ø ~ë	NMOMKMMQ	ééÄ	NKS	CUQLUQQTQKPN	NMMM	NMOKV	UVfR	NNMQ	
OMU	mÄ	OMV	k ç¬ø ~ë	OMNUKSPR	ééÄ	MKU	TTSUNTPQKUP	OMMM	NMMKVP	UVfR	NNMQ	
OPO	qÜ	OMV	k ç¬ø ~ë	VURKTSQ	ééÄ	NKT	PPTPPVTPKOM	NMMM	VUKRU	UVfR	NNMQ	
OPU	r	OMV	k ç¬ø ~ë	NMMMKNMR	ééÄ	NKP	PNSCQTNTKNQ	NMMM	NMMKMN	UVfR	NNMQ	

n` =fpqa¬q~ÄäÉ

k~ã É	j ~ëë	qì åÉ¬j çÇÉ	` mp	` mp¬ø pa	oÉÑ¾ mp	B ¬ø ÉÅ	B n` =¾ çï	B n` ¬æ äÖÜ	n` ¬ø ä~Ö
i á	S	k ç¬ø ~ë	NVPTCURKNP	MKV	ONCCPCPKQO	VNKCU	RVfR	NOMQ	
pÅ	QR	k ç¬ø ~ë	QNMVRMTKUV	NKM	QRNVVMMMMQ	VMKTO	RVfR	NOMQ	
d É	TO	k ç¬ø ~ë	VSRPVRNPP	MKQ	NMSCQPUCKUO	VMKT	RVfR	NOMQ	
qÄ	NRV	k ç¬ø ~ë	SRCCPMRKRT	MKT	SRQQMSTKOO	VVfST	RVfR	NOMQ	
_á	OMV	k ç¬ø ~ë	PPNSTRSKNS	MfS	PCNUTCUKRU	NVPKMR	RVfR	NOMQ	
pÅ	QR	e O	VMRPNOKNV	NKN	NMSVRVUKVR	UQKSQ	RVfR	NOMQ	
d É	TO	e O	PSONPPKSU	MKT	QCCMNTKMN	URKUN	RVfR	NOMQ	
v	UV	e O	QONTRVSKPQ	MKO	QTSCUURKNQ	UUKRR	RVfR	NOMQ	
pÅ	QR	e É	NPNTVTKQO	NfR	NRTTPRKMO	UPKRS	RVfR	NOMQ	
d É	TO	e É	NMCUPMKNN	MKQ	NCCRSPKSN	UPKV	RVfR	NOMQ	
v	UV	e É	SVSPCRKTU	MKT	UCVQMCKQU	UPKVS	RVfR	NOMQ	
qÄ	NRV	e É	CROMUMSKNP	MKO	CURMTNTKVP	UUKQP	RVfR	NOMQ	
_á	OMV	e É	NQUUMCMKMV	MKV	NRVQNVSKTN	VPKPQ	RVfR	NOMQ	

p~ã éäÉ=k~ã É i o p O

cãÉ=k~ã É MNQ p j m i K Ç

a~í~=m~íÜ=k~ã É a W ÿ Ö ãÉ åíÿ ^ m j e y N y a ^ q ^ y O M C P y M P J ^ o y i n ` O Q ^ K Å

^Åè=qãã É P L C Q L O M C P = N T W P W Q T

p~ã éäÉ=qóéÉ p ~ ã é ä É

qçí~äa ãã íáçå N K M M M M

p~ã éäÉ=n ` =m~ëëlc á~ä c ~ ã ä

fpqa=n ` =m~ëëlc~ãä m ~ ë ë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çàÅK	r åáë	o p a	═ mp ═	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKVQQ	é é Ä	NMO	PTMKVN	NMVM	
NN	_	S	k ç=d ~ë	PKQQO	é é Ä	PHR	NPRTTKSS	NMVM	
OP	k ~	QR	e É	NVQLOSKRTN	é é Ä	NKM	NOORUOURTKTN	OMVMVM	
OQ	j Ö	QR	e É	NVRMVTKMOV	é é Ä	MKV	SQSROSVPKQU	OMVMVM	
OT	^ ä	QR	e É	ONNSSVKUTO	é é Ä	MKT	ORTMOPRVKMS	OMVMVM	[i a o
OU	p á	QR	e O	NVRMMKMQT	é é Ä	NHP	QQRVNRRRTO	NMVMM	[i a o
PV	h	QR	e É	NVPMNPKNUV	é é Ä	NHP	RQVQRMMMPN	OMVMVM	
QM	` ~	QR	e O	OMVOMVKMNQ	é é Ä	NRT	SPVPVPQROKSV	OMVMVM	[i a o
RN	s	UV	e É	MKPMR	é é Ä	QKN	NQNQKRQ	NMVM	
RO	` ê	UV	e É	NKMQV	é é Ä	PHS	RUNUKMV	OMVM	
RR	j å	UV	e É	NKQSN	é é Ä	NHR	PUSTKNP	OMVM	
RS	c É	UV	e O	VUOOPKVTU	é é Ä	MHP	NMUMNONMLPKMP	NMVMVM	
RV	` ç	UV	e É	NHRUS	é é Ä	QKU	NPPQMKMR	NMVM	
SM	k á	UV	e É	NKNPV	é é Ä	PHN	OUPRKVM	NMVM	
SP	` ì	UV	e É	MKVTO	é é Ä	MKO	SSSOKUM	OMVM	
SS	w å	UV	e É	NKNQV	é é Ä	NNKU	PSQORTS	OMVM	
TR	^ ë	UV	e É	MKQTS	é é Ä	NHP	QNNKMR	NMVM	
TU	p É	UV	e O	MHRRR	é é Ä	VKQ	OQQKUO	NMVM	
UU	p ê	UV	e É	OKVVQ	é é Ä	NKV	UTTQKMS	OMVM	
VR	j ç	UV	e É	OKMNS	é é Ä	QKN	RUPRKTV	NMVM	
NMT	^ Ö	UV	e É	MKMRR	é é Ä	UKO	RSSKSV	NMVM	
NNN	` Ç	UV	e É	MKOUM	é é Ä	QKM	PURHRT	NMVM	
NNU	p å	NRV	e É	MHSNR	é é Ä	QKR	OMTVKMU	NMVM	
NON	p Ä	NRV	k ç=d ~ë	MKQUN	é é Ä	SKQ	NMPQNKRR	NMVM	
NPT	_ ~	NRV	k ç=d ~ë	NKOSU	é é Ä	PHP	TSQSKVR	OMVM	
NUO	t	NRV	k ç=d ~ë	NKUST	é é Ä	NPKU	OOUQNKMT	NMVM	
OMR	q ä	OMV	k ç=d ~ë	MHRRT	é é Ä	MKO	NQNRSKNS	NMVM	
OMU	m Ä	OMV	k ç=d ~ë	NKRPP	é é Ä	MHP	RPNMRKQN	OMVM	
OPO	q Ü	OMV	k ç=d ~ë	NKMRO	é é Ä	RHT	PPQSVKRU	NMVM	
OPU	r	OMV	k ç=d ~ë	MHPVN	é é Ä	RKQ	NNMVPKOV	NMVM	

n ` =fpqa=q~ÄäÉ

k ~ã É	j ~ëë	q ì åÉ=j ÇÇÉ	` mp	` mp=o p a	o ÉÑ═ mp	B =o ÉÅ	B n ` =i çï	B n ` =c ä ÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVSOTUNKMR	NKS	ONOOPOPQQO	VOKQU	RVKR	NOMKQ	
p Å	QR	k ç=d ~ë	PVQNVTRKTS	MKS	QRNVVMMKMQ	UTHON	RVKR	NOMKQ	
p Å	QR	e O	VNMQONKRP	NKR	NMSVRVUKVR	URKNO	RVKR	NOMKQ	
p Å	QR	e É	NPTMNMHPN	NKO	NRTTPRKMO	USKUS	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VPNOQVKVN	MKS	NMSQPUQKUO	UTHQV	RVKR	NOMKQ	
d É	TO	e O	PRUTSUKMM	MKU	QOOMNTKMN	URKMN	RVKR	NOMKQ	
d É	TO	e É	NMROSQKQT	NKQ	NOORSPKSN	URKUV	RVKR	NOMKQ	
v	UV	e O	PVSVUTPKNV	MKT	QTSOUURKNQ	UPHPR	RVKR	NOMKQ	
v	UV	e É	SVUPPMKMM	MKO	UOVQMOKQU	UQKO	RVKR	NOMKQ	
q Ä	NRV	k ç=d ~ë	SNVORPOKRQ	OKS	SRQQMSTKOO	VQKSP	RVKR	NOMKQ	
q Ä	NRV	e É	OQMVOPVKOS	NKQ	OURMTNTKVP	UQKRO	RVKR	NOMKQ	
_ á	OMV	k ç=d ~ë	OVQNQURKRO	NKM	PONUTOUKRU	VNHPV	RVKR	NOMKQ	
_ á	OMV	e É	NOUTPNNKRN	NKN	NRVQNVSKTN	UMKTR	RVKR	NOMKQ	

p~ã éäÉ=k~ã É	ofk pb
cãÉ=k~ã É	MNRpj mi kÇ
a~í~=m~íÜ=k~ã É	aWÿ ÖäÉåíÿ mj eyNya^q^yOMCPyMPJ ^o yi n ` OQ^kA
^Åè=qãã É	PLOQLOMCP=NTMRRMQS
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãä íáçå	NKMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	c~åä
fpqa=n ` =m~ëëlc~åä	c~åä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==mp==	i a o	n ` =cä-Ö
V	_É	S	k ç=d ~ë	PKUUO	éé Ä	PTKQ	NQMKMM	NMM	
NN	_	S	k ç=d ~ë	NVMKCOM	éé Ä	CKO	QCPNKUS	NMMM	
OP	k ~	QR	e É	NMPTQVKTRQ	éé Ä	NPKO	TRNPRKRV	OMMMMM	
OQ	j Ö	QR	e É	OQRRNKRNS	éé Ä	NPKP	VPSNKOU	OMMMMM	
OT	^ ä	QR	e É	OSVPQKTON	éé Ä	NOKU	PTSTKOR	OMMMMM	
OU	pá	QR	e O	QVPVKMST	éé Ä	NMKS	CRQOKO	NMMMM	
PV	h	QR	e É	NPMRSQKOVU	éé Ä	NQKT	QOTOUKSR	OMMMMM	
QM	` ~	QR	e O	OTQVPKROS	éé Ä	NMKM	NMRUTRKUO	OMMMMM	
RN	s	UV	e É	NNUOKOQP	éé Ä	TKQ	SMUKVN	NMMM	[i a o
RO	` ê	UV	e É	RSVRKTUM	éé Ä	PKO	PSUTKTU	OMMM	[i a o
RR	j å	UV	e É	NQPOKVVQ	éé Ä	UKS	QSTKOR	OMMM	
RS	cÉ	UV	e O	NQTNUMKOVM	éé Ä	NNKV	OTNUNMKTP	NMMMMM	[i a o
RV	` ç	UV	e É	OQMKUTO	éé Ä	SKN	OSSKSU	NMMM	
SM	k á	UV	e É	NNNPKMQS	éé Ä	UKQ	PQOKOP	NMMM	[i a o
SP	` ì	UV	e É	NTPSKNSQ	éé Ä	PKQ	NQUNKOO	OMMM	
SS	wå	UV	e É	OOMQNKSRV	éé Ä	QKV	PMQMKPV	OMMM	[i a o
TR	^ ë	UV	e É	VSRKRRM	éé Ä	OKP	NMSKMN	NMMM	
TU	pÉ	UV	e O	TOVKSTR	éé Ä	ONKR	RPKMM	NMMM	
UU	pê	UV	e É	OTQKTRR	éé Ä	NMKP	NMSKST	OMMM	
VR	j ç	UV	e É	SOMQKOUO	éé Ä	QKR	OPQUKMO	NMMM	[i a o
NMT	^ Ö	UV	e É	OQKSQQ	éé Ä	SOKV	PPKPP	NMM	
NNN	` Ç	UV	e É	NNRKVPR	éé Ä	NRKV	ONKMN	NMMM	
NNU	på	NRV	e É	NNOMVKOMV	éé Ä	RKV	QOPUKRP	NMMM	[i a o
NON	pÄ	NRV	k ç=d ~ë	RMVKSMP	éé Ä	VKO	NUQOKMS	NMMM	
NPT	_~	NRV	k ç=d ~ë	NQVQKQMQ	éé Ä	NSKT	NRPUKPV	OMMM	
NUO	t	NRV	k ç=d ~ë	QPOPKPVP	éé Ä	OPKT	UTTOKPN	NMMM	[i a o
OMR	qä	OMV	k ç=d ~ë	NQSKUPN	éé Ä	TKM	PMQSKVO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	VOKROR	éé Ä	SKR	OSTOKVS	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OPPKMVQ	éé Ä	VKT	SMMNKNP	NMMM	
OPU	r	OMV	k ç=d ~ë	NUKUPU	éé Ä	NOKU	QQTKNS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ=mp	B=oÉÅ	B n ` = çï	B n ` =eáÜÜ	n ` =cä-Ö
i á	S	k ç=d ~ë	NOOUNKQM	NKU	ONOOPOPKQO	MKRU	RVKR	NOMKQ	SMOOMa ça
pÅ	QR	k ç=d ~ë	RRTUKTO	PKV	QRNVVMMKMQ	MKNO	RVKR	NOMKQ	SMOOMa ça
pÅ	QR	e O	NNMOKRM	SKT	NMSVRVUKVR	MKN	RVKR	NOMKQ	SMOOMa ça
pÅ	QR	e É	NRVMPM	NNKV	NRTTPRKMO	MKN	RVKR	NOMKQ	SMOOMa ça & eáÜÜ=fpqa=opa
d É	TO	k ç=d ~ë	TORVKNV	OKT	NMSOPUOKUO	MKSU	RVKR	NOMKQ	SMOOMa ça
d É	TO	e O	QURKVO	UKN	QOOMNTKMN	MKNO	RVKR	NOMKQ	SMOOMa ça & eáÜÜ=fpqa=opa
d É	TO	e É	NMNKVU	NVKS	NOORSPKSN	MKMU	RVKR	NOMKQ	SMOOMa ça & eáÜÜ=fpqa=opa
v	UV	e O	STPKUV	NPKS	QTSOUURKNQ	MKMN	RVKR	NOMKQ	SMOOMa ça & eáÜÜ=fpqa=opa
v	UV	e É	VOKSR	NKO	UOVOMOKQU	MKMN	RVKR	NOMKQ	SMOOMa ça
qÄ	NRV	k ç=d ~ë	NMTPKNU	NNKM	SRQOMSTKOO	MKVO	RVKR	NOMKQ	SMOOMa ça & eáÜÜ=fpqa=opa
qÄ	NRV	e É	PQQKSN	TKV	OURMTNTKVP	MKMN	RVKR	NOMKQ	SMOOMa ça
_á	OMV	k ç=d ~ë	OQVRKTU	UKR	PONUTOUKRU	MKMU	RVKR	NOMKQ	SMOOMa ça & eáÜÜ=fpqa=opa
_á	OMV	e É	NQOUKQU	OKT	NRVQNMSKTN	MKMV	RVKR	NOMKQ	SMOOMa ça

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É	ofk pb
cãÉ=k~ã É	MNSpj mi kÇ
a~í~=m~íÜ=k~ã É	aWyÖäÉåíyî mj eyNya^q^yOMOPyMPJ ^oyi n ` OQ^kA
^Åè=qãã É	PLOQLOMOP=NTWQMQO
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	NKMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	c~åä
fpqa=n ` =m~ëëlc~åä	c~åä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	iao	n ` =cä-Ö
V	_É	S	kç=d ~ë	QKOMO	éé Ä	SKN	NMUKUV	NMM	
NN	_	S	kç=d ~ë	OMPKRST	éé Ä	PKR	PQQSKMP	NMMM	
OP	k ~	QR	eÉ	NMOUUTKOQM	éé Ä	QKU	SPOQPKQM	OMMMMM	
OQ	j Ö	QR	eÉ	NRQRVKORT	éé Ä	NMKQ	QVVSKSN	OMMMMM	
OT	^ä	QR	eÉ	NTSSSKNOM	éé Ä	NNKV	OMVQKSQ	OMMMMM	
OU	pá	QR	eO	QQPSKNQM	éé Ä	SKT	OMSOKPN	NMMMM	
PV	h	QR	eÉ	NPUMOMSSS	éé Ä	QKS	PUPURKMT	OMMMMM	
QM	` ~	QR	eO	NTNSUKOPP	éé Ä	PKV	SMMVMKPQ	OMMMMM	
RN	s	UV	eÉ	NSRTKPTQ	éé Ä	OPKO	RPOKOQ	NMMM	[i a o
RO	` ê	UV	eÉ	VOMTKQMS	éé Ä	NSKO	PTQTRTV	OMMM	[i a o
RR	j å	UV	eÉ	OOVQKUSN	éé Ä	NMKO	QSUKRV	OMMM	[i a o
RS	cÉ	UV	eO	OTQNTOKNRQ	éé Ä	PKV	OPTSSMKVN	NMMMMM	[i a o
RV	` ç	UV	eÉ	OQSKNPV	éé Ä	NTKQ	NTNKNO	NMMM	
SM	ká	UV	eÉ	NTNSKTRQ	éé Ä	NRKU	PPPKPQ	NMMM	[i a o
SP	` ì	UV	eÉ	OQQQKUOM	éé Ä	NOKP	NPNSKTR	OMMM	[i a o
SS	wå	UV	eÉ	OORSVKRPV	éé Ä	NTKN	NVRRKTP	OMMM	[i a o
TR	^ë	UV	eÉ	NNPRKQTR	éé Ä	NOKU	TUKSU	NMMM	[i a o
TU	pÉ	UV	eO	NMOOKRMO	éé Ä	SKR	PRKNT	NMMM	[i a o
UU	pê	UV	eÉ	ORUKQOM	éé Ä	NPKT	SPKPP	OMMM	
VR	j ç	UV	eÉ	TMMMKTMS	éé Ä	NSKV	NSSQKRU	NMMM	[i a o
NMT	^Ö	UV	eÉ	OTKVSS	éé Ä	PUKN	OPKPQ	NMM	
NNN	` Ç	UV	eÉ	NMPKTUQ	éé Ä	RUKV	NNKQU	NMMM	
NNU	på	NRV	eÉ	NURQVKURN	éé Ä	NMKU	PSRSKNO	NMMM	[i a o
NON	pÄ	NRV	kç=d ~ë	NMOUMVQU	éé Ä	NOKS	NPTNKRP	NMMM	[i a o
NPT	_~	NRV	kç=d ~ë	TOQKUVT	éé Ä	NNKO	OUMKPM	OMMM	
NUO	t	NRV	kç=d ~ë	TSPMKMVM	éé Ä	NRKU	RTRMKSS	NMMM	[i a o
OMR	qä	OMV	kç=d ~ë	NQRKTNV	éé Ä	RKN	OMQVKMO	NMMM	
OMU	mÄ	OMV	kç=d ~ë	USKOPU	éé Ä	SKU	NSUNKUP	OMMM	
OPO	qÜ	OMV	kç=d ~ë	NUVKTUN	éé Ä	RKQ	POVPKVQ	NMMM	
OPU	r	OMV	kç=d ~ë	NNKSVN	éé Ä	NSKV	NUSKUS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B n ` =¤ÉÅ	B n ` =¤ çï	B n ` =¤ äÖÜ	n ` =cä-Ö
iá	S	kç=d ~ë	UUTRKNT	OKR	ONOOPOPKQO	MKQO	RVKR	NOMKQ	SMOOMa ça
pÅ	QR	kç=d ~ë	QTPNKOO	OKO	QRNVVMMKMQ	MKN	RVKR	NOMKQ	SMOOMa ça
pÅ	QR	eO	VVUKRN	RKQ	NMSVRVUKVR	MKMV	RVKR	NOMKQ	SMOOMa ça
pÅ	QR	eÉ	NPPKVU	PKV	NRTTPRKMO	MKMU	RVKR	NOMKQ	SMOOMa ça
dÉ	TO	kç=d ~ë	SUUVKMS	OKT	NMSOPUOKOO	MKSR	RVKR	NOMKQ	SMOOMa ça
dÉ	TO	eO	PTOKSM	PKO	QOOMNTKMN	MKMV	RVKR	NOMKQ	SMOOMa ça
dÉ	TO	eÉ	TNKPO	OUKS	NOORSPKSN	MKMS	RVKR	NOMKQ	SMOOMa ça & eäÖÜ=fpqa=¤pa
v	UV	eO	PNPKOU	QKO	QTSOUURKNQ	MKMN	RVKR	NOMKQ	SMOOMa ça
v	UV	eÉ	RVKPO	NTKP	UOVQMOKQU	MKMN	RVKR	NOMKQ	SMOOMa ça & eäÖÜ=fpqa=¤pa
qÄ	NRV	kç=d ~ë	PVSKSM	TKT	SRQQMSTKOO	MKMN	RVKR	NOMKQ	SMOOMa ça
qÄ	NRV	eÉ	NUMKSP	NOKN	OURMTNTKVP	MKMN	RVKR	NOMKQ	SMOOMa ça & eäÖÜ=fpqa=¤pa
_á	OMV	kç=d ~ë	NSUPKNP	PKS	PONUTOURKU	MKMR	RVKR	NOMKQ	SMOOMa ça
_á	OMV	eÉ	VURKUR	MKO	NRVQNMSKTN	MKMS	RVKR	NOMKQ	SMOOMa ça

`çåíaåìåaÖ=~äåÄê~íáç=sÉêáÑ~íáç=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cáÉ=k~ã É	MVTJ``sKÇ
a~í~=m~íÜ=k~ã É	aWy^ÖáÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n``OQ^kÄ
^Åè=qáã É	PLOQLOMOP=NTWRMRS
p~ã éáÉ=qóéÉ	``s
qçí~äa ãi íáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑ¥cáÉk~ã É	MVS^i_KÇ
p~ã éáÉ=n``=m~ëëlcá~ä	m~ëë
fpqa=n``=m~ëëlc~áí	m~ëë
l éÉê~íçê	**~Çã áå**

n``=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n``=c ä~Ö
V	_É	S	k ç=d ~ë	ORKMVV	éëÄ	MKQ	NQMTCOKCP	CR	NMMKQ	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKMOU	éëÄ	MKQ	VONQNKCO	CR	NMMKNN	UVKU	NNMO	
OP	k ~	QR	e É	RPNRKQSU	éëÄ	NKP	PQRTCOQKQT	RMMM	NMSKPN	UVKU	NNMO	
OQ	j Ö	QR	e É	RPMMRQO	éëÄ	MKQ	NTVPOMNKON	RMMM	NMSKMN	UVKU	NNMO	
OT	^ä	QR	e É	RONKUMU	éëÄ	NKT	STTVSKUU	RMM	NMQKPS	UVKU	NNMO	
OU	pá	QR	e O	RMPKOTS	éëÄ	NKN	OONUCUKTN	RMM	NMMKSS	UVKU	NNMO	
PV	h	QR	e É	ROPPKSQT	éëÄ	MKV	NRQUVRQKPQ	RMMM	NMQKST	UVKU	NNMO	
QM	` ~	QR	e O	RNVOKVNP	éëÄ	MKU	NTNUTTSPKSP	RMMM	NMPKUS	UVKU	NNMO	
RN	s	UV	e É	ORKSMS	éëÄ	MKV	NMPRUVKTQ	CR	NMOKQO	UVKU	NNMO	
RO	` ê	UV	e É	ORKRTM	éëÄ	MKR	NPMQONKSP	CR	NMOKOU	UVKU	NNMO	
RR	j å	UV	e É	ORKMTQ	éëÄ	MKU	SQQUVKMM	CR	NMMKP	UVKU	NNMO	
RS	cÉ	UV	e O	RNMTKUSR	éëÄ	NKS	SMPTOQQOKUO	RMMM	NMOKNS	UVKU	NNMO	
RV	` ç	UV	e É	OSKMUT	éëÄ	MKQ	OOSQOVKRR	CR	NMQKPR	UVKU	NNMO	
SM	ká	UV	e É	ORKVV	éëÄ	MKV	SOUQTHPV	CR	NMQ	UVKU	NNMO	
SP	` ì	UV	e É	OSKNRS	éëÄ	MKN	NTROOMPO	CR	NMQKSO	UVKU	NNMO	
SS	wå	UV	e É	ORKNQV	éëÄ	NKS	OVTNUKSP	CR	NMMKS	UVKU	NNMO	
TR	^ë	UV	e É	ORKORQ	éëÄ	MKT	ONVMTKQS	CR	NMNKUO	UVKU	NNMO	
TU	pÉ	UV	e O	OQKTPP	éëÄ	MKP	NNSMQKNN	CR	VUKVP	UVKU	NNMO	
UU	pê	UV	e É	ORKSPM	éëÄ	MKN	TTVOSHRQ	CR	NMOKRO	UVKU	NNMO	
VR	j ç	UV	e É	OQKUOQ	éëÄ	MKV	TPSVSKVO	CR	VVHP	UVKU	NNMO	
NMT	^Ö	UV	e É	ORKSRS	éëÄ	MKS	OTPOMNKPU	CR	NMOKSO	UVKU	NNMO	
NNN	` Ç	UV	e É	ORKSTM	éëÄ	NKP	PSSNOKVP	CR	NMOKSU	UVKU	NNMO	
NNU	på	NRV	e É	OQKTUQ	éëÄ	MKQ	TMUTRKTP	CR	VVKNQ	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	ORKMTP	éëÄ	NKN	RCUMTRKNQ	CR	NMMKOV	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKUTM	éëÄ	NKU	NRSMVQKVS	CR	NMPKQU	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKNPP	éëÄ	MKR	OVVVUNKTN	CR	NMMKRP	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKPST	éëÄ	OKS	SQNSPQKUS	CR	NMNKQT	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKNVS	éëÄ	NKV	VONPPQKOR	CR	NMQKTU	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OQKUNP	éëÄ	MKU	TTTMQSKUQ	CR	VVKOR	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	ORKUTM	éëÄ	OKR	TQSTRVKMS	CR	NMPKQU	UVKU	NNMO	

n``=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ¥mp	B=oÉÄ	B n``=ïçï	B n``=eäÜÜ	n``=c ä~Ö
i á	S	k ç=d ~ë	NVOSPUMKRT	MKR	ONOOPOPKQO	VMKTT	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QMSRQMMKOV	NKV	QRNVVMMMMQ	UVKVQ	RVKR	NOMQ	
pÅ	QR	e O	VQOVQVKOT	NKO	NMSVRVUKVR	UUKNS	RVKR	NOMQ	
pÅ	QR	e É	NPVURMSU	NKO	NRTTPRKMO	UUHSS	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VSTQOOKOT	MKV	NMSQPUQKUO	VMKUV	RVKR	NOMQ	
d É	TO	e O	PTNNVPKRT	MKR	QOOMNTKMN	UTKVS	RVKR	NOMQ	
d É	TO	e É	NMTSMRKRM	MKV	NOORSPKSN	UTKU	RVKR	NOMQ	
v	UV	e O	QOSTMPRKTV	NKQ	QTSOUURKNQ	UVKRV	RVKR	NOMQ	
v	UV	e É	TORSQTKVT	MKT	UOVQMOKQU	UTKQV	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SONTSTSKMN	MKS	SRQQMSTKOO	VRKMN	RVKR	NOMQ	
qÄ	NRV	e É	ORUMSVRKPS	NKT	OURMTNTKVP	VMKRP	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PMOVONMKQR	NKU	PONUTOUKRU	VQKNN	RVKR	NOMQ	
_á	OMV	e É	NQSRRUSKTM	NKS	NRVQNVSKTN	VNKVP	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáçå=_ä~åâ=É``_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MNUJ``_KÇ

a~í~=m~íÜ=k~ã É aWj^ÖäÉáíÝ^mj eyNya^q^yOMOPyMPJ ^oyi n`OQ^kÂ

^Åè=qáã É PLOQLOMOP=NTVRSMU

p~ã éáÉ=qóéÉ ``_

qçí~äa äã íáçå NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑc äÉk~ã É MVS^i_KÇ

p~ã éáÉ=n`=m~ëëlcá~ä c~äã

fpqa=n`=m~ëëlc~äã m~ëë

l éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	råáë	opa	==\ mp==	iãáá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MKMU	ééÄ	QOKP	NTNKN	MO	
NN	_	S	kç=d~ë	MKPCU	ééÄ	QKV	OMQQKQN	Q	
OP	k~	QR	eÉ	NQKMU	ééÄ	RKQ	RRRTMSV	OMM	
OQ	j Ö	QR	eÉ	SKQVM	ééÄ	TKM	OQLUMPM	OM	
OT	^ä	QR	eÉ	JONKQSM	ééÄ	kL^	QVOKOQ	OM	c~äë^ äëj ÉíÜçÇë& c~äÉÇ=a ça
OU	pá	QR	eO	MKQTQ	ééÄ	OOKU	TNMRTT	NMM	
PV	h	QR	eÉ	OQKMTQ	ééÄ	NNKO	PSVOMKNS	OMM	
QM	`~	QR	eO	SKNRS	ééÄ	RKQ	PQPTMKVR	OM	
RN	s	UV	eÉ	MKNNN	ééÄ	NMMKM	OVUKVM	N	
RO	`ê	UV	eÉ	MKMOQ	ééÄ	NOKS	UVPKNV	N	
RR	j å	UV	eÉ	JMKMSN	ééÄ	kL^	NPVMPN	MQ	
RS	cÉ	UV	eO	QKNQR	ééÄ	NKM	SNPUOKQM	OM	
RV	` ç	UV	eÉ	MKMMV	ééÄ	PSKS	OMSKST	MO	
SM	k á	UV	eÉ	MKMNN	ééÄ	NPRQKU	ONQKQR	MQ	
SP	`ì	UV	eÉ	MKMNQ	ééÄ	PNKQ	RRQKOQ	MS	
SS	wå	UV	eÉ	JOKNQN	ééÄ	kL^	OQNKNO	O	c~äë^ äëj ÉíÜçÇë& c~äÉÇ=a ça
TR	^ë	UV	eÉ	MKMOU	ééÄ	TKP	QQKMM	N	
TU	pÉ	UV	eO	MKMQQ	ééÄ	RKN	OQKUP	N	
UU	pê	UV	eÉ	MKMNR	ééÄ	QMKQ	SSKST	N	
VR	j ç	UV	eÉ	MKPPQ	ééÄ	VKT	NNOUKVS	N	
NMT	^Ö	UV	eÉ	MKMNN	ééÄ	OSKR	NPNKNN	MO	
NNN	`Ç	UV	eÉ	MKMNO	ééÄ	NNKU	NUKUV	MO	
NNU	på	NRV	eÉ	MKMMD	ééÄ	NNQQKO	RNNKNP	N	
NON	pÄ	NRV	kç=d~ë	MKMPO	ééÄ	NTTKR	NMMNKMV	MO	
NPT	_~	NRV	kç=d~ë	MKMPO	ééÄ	UKU	OPSKVO	MQ	
NUO	t	NRV	kç=d~ë	MKPPM	ééÄ	OOKU	QVQSKON	N	
OMR	qä	OMV	kç=d~ë	MKMSP	ééÄ	OMKV	OOROKRV	MO	
OMU	mÄ	OMV	kç=d~ë	MKMON	ééÄ	OMKS	NSRRKNP	MO	
OPO	qÜ	OMV	kç=d~ë	MKMRT	ééÄ	NUKN	PSQNKMT	N	
OPU	r	OMV	kç=d~ë	MKMNV	ééÄ	TKN	SMTHPO	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=íçï	Bn`=cäÜÜ	n`=c~ä~Ö
iá	S	kç=d~ë	OMMUPTVKN	NKO	ONOOPOPKQO	VQKSP	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QORVVTRKPS	NKO	QRNVVMMKMQ	VQKOR	RVKR	NOMQ	
pÅ	QR	eO	VUPORUKON	NKQ	NMSVRVUKVR	VNKVP	RVKR	NOMQ	
pÅ	QR	eÉ	NQPSTOKVO	MKS	NRTTPRKMO	VNKMU	RVKR	NOMQ	
dÉ	TO	kç=d~ë	NMONSVNKUU	OKQ	NMSQPUQKUO	VRKVV	RVKR	NOMQ	
dÉ	TO	eO	PVMOQOKNO	MKR	QOOMNTKMN	VOKQT	RVKR	NOMQ	
dÉ	TO	eÉ	NNPONOKVU	MKS	NOORSPKSN	VOKPT	RVKR	NOMQ	
v	UV	eO	QRONRVMKSR	MKT	QTSOUURKNQ	VQKVP	RVKR	NOMQ	
v	UV	eÉ	TSNSMUKQR	NKM	UOVQMOKQU	VNKUP	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SSNUNSSKNR	NKN	SRQQMSTKOO	NMNKNP	RVKR	NOMQ	
qÄ	NRV	eÉ	OTMROOPKTU	MKU	OURMTNTKVP	VQKV	RVKR	NOMQ	
_á	OMV	kç=d~ë	PORCOQSKQQ	NKP	PONUTOUKRU	NMNKMQ	RVKR	NOMQ	
_á	OMV	eÉ	NRRPUTMKPS	MKQ	NRVQNVSKTN	VTKQT	RVKR	NOMQ	

p~ã éáÉ=k~ã É	mmi
cäÉ=k~ã É	MNMf`sHÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOMOPyMPJ ^oyin`OQ^HÅ
^Åè=qáã É	PLOQLOMOP=NUMNMNQ
p~ã éáÉ=qóéÉ	iif`s
qçí~äaäã íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=o ÉÑ¶cäÉk~ã É	MVS^i_HÇ
p~ã éáÉ=n` =m~ëëlcá~ä	c~ää
fpqa=n` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã áã**

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çåÅK	r åáë	opa	==ì mp==	bñés~ä	BoÉÅ	Bi çï	BeåÖÜ
V	_É	S	kç=d~ë	MKMVU	éé Ä	SKV	NOPMKMT	MO	VV	TVfR	NOMQ
NN	_	S	kç=d~ë	OKMVM	éé Ä	OKN	NSMVPKSM	Q	NMQKTR	TVfR	NOMQ
OP	k~	QR	eÉ	OOMKMV	éé Ä	MKU	NUOOR=PKQV	OM	NNMKQR	TVfR	NOMQ
OQ	j Ö	QR	eÉ	OSKRQT	éé Ä	PKU	UVSVKUM	OM	NPOKTQ	TVfR	NOMQ
OT	^ä	QR	eÉ	MKMVS	éé Ä	RVMKT	PMTPKTN	OM	MKRP	TVfR	NOMQ
OU	pá	QR	eO	NMMKSMV	éé Ä	MKR	QQNTSKUS	NMM	NMMKSN	TVfR	NOMQ
PV	h	QR	eÉ	OOQKPVM	éé Ä	NKP	VNTVVKMO	OM	NNOKO	TVfR	NOMQ
QM	` ~	QR	eO	OTKPNV	éé Ä	OKM	NMNSVNKUU	OM	NPSKS	TVfR	NOMQ
RN	s	UV	eÉ	NKMPO	éé Ä	PKP	QPSTKQN	N	NMPKO	TVfR	NOMQ
RO	` ê	UV	eÉ	NKMQO	éé Ä	RKO	RVRVKQS	N	NMQKO	TVfR	NOMQ
RR	j å	UV	eÉ	MKPQM	éé Ä	TKM	NNQTKNS	MQ	UR	TVfR	NOMQ
RS	cÉ	UV	eO	OQKNSM	éé Ä	NKP	OVPMPRKOT	OM	NOMKU	TVfR	NOMQ
RV	` ç	UV	eÉ	MKONM	éé Ä	TKU	NVOMKOM	MO	NMR	TVfR	NOMQ
SM	ká	UV	eÉ	MKQQM	éé Ä	TKN	NORNKNV	MQ	NNM	TVfR	NOMQ
SP	` ì	UV	eÉ	MKSTN	éé Ä	NKV	QUTOKMQ	MS	NNNKUP	TVfR	NOMQ
SS	wå	UV	eÉ	JMKMMT	éé Ä	kL^	ORNQKTO	O	JMPR	TVfR	NOMQ
TR	^ë	UV	eÉ	NKMOP	éé Ä	NKR	UVMKNO	N	NMOKP	TVfR	NOMQ
TU	pÉ	UV	eO	NKMPU	éé Ä	MKU	QUTKQV	N	NMPKU	TVfR	NOMQ
UU	pê	UV	eÉ	NKMQR	éé Ä	NKU	PNSUKOM	N	NMQKR	TVfR	NOMQ
VR	j ç	UV	eÉ	NKOMT	éé Ä	PKP	PSPQKVV	N	NOMKT	TVfR	NOMQ
NMT	^Ö	UV	eÉ	MKOMP	éé Ä	SKP	ONQTKVV	MO	NMNKR	TVfR	NOMQ
NNN	` Ç	UV	eÉ	MKONQ	éé Ä	SKT	PMPKTN	MO	NMT	TVfR	NOMQ
NNU	på	NRV	eÉ	MKVPO	éé Ä	OKV	PMVOKUS	N	VPKO	TVfR	NOMQ
NON	pÄ	NRV	kç=d~ë	MKONV	éé Ä	MKU	QVPOKTV	MO	NMVKR	TVfR	NOMQ
NPT	_~	NRV	kç=d~ë	MKQRT	éé Ä	PKO	OUNSKSN	MQ	NNQKCR	TVfR	NOMQ
NUO	t	NRV	kç=d~ë	NKNUS	éé Ä	OKO	NQVVNKNR	N	NNUKS	TVfR	NOMQ
OMR	qä	OMV	kç=d~ë	MKOQU	éé Ä	OKP	SUQOKQN	MO	NOQ	TVfR	NOMQ
OMU	mÄ	OMV	kç=d~ë	MKOPR	éé Ä	TKT	VNVMKVV	MO	NNTHR	TVfR	NOMQ
OPO	qÜ	OMV	kç=d~ë	MKNVN	éé Ä	PKM	TSTPKTT	MO	VRKR	TVfR	NOMQ
OPU	r	OMV	kç=d~ë	MKOOS	éé Ä	RKT	SSPRKQN	MO	NNP	TVfR	NOMQ

n` =ç ä~Ö
c~áÉÇ=a ça =& c~áÉÇ=SMOMb m^
c~áÉÇ=a ça =& c~áÉÇ=SMOMb m^
c~áÉÇ=a ça =& c~áÉÇ=SMOMb m^
c~áÉÇ=a ça =

n ` ≈ c ä - Ö
c ~ á É Ç = a ç a = & c ~ á É Ç = S M O M b m ^
c ~ á É Ç = a ç a =
c ~ á É Ç = a ç a =

n ` ≈ f p q a = q ~ Ä á É

k ~ ã É	j ~ ë ë	q ì å É ≠ j ç Ç É	` m p	` m p = ¤ p a	o É Ñ ≠ m p	B = ¤ É Å	B n ` ≈ ç ï	B n ` ≈ e ä Ö Ü	n ` ≈ c ä - Ö
i á	S	k ç = d ~ ë	NVPMUNNKPP	NKN	ONCCPCPKQO	VMKVU	RVMR	NOMQ	
p Å	QR	k ç = d ~ ë	QMRVMVPKVO	MRR	QRNVVMMMQ	UVKU	RVMR	NOMQ	
p Å	QR	e O	VPNQRQKUQ	OKM	NMSVRVUKVR	UTKMU	RVMR	NOMQ	
p Å	QR	e É	NPSQMUKUT	NKN	NRTTPRKMO	USKQU	RVMR	NOMQ	
d É	TO	k ç = d ~ ë	VSVRUVKPV	NKO	NMSQPUQKUO	VNKMV	RVMR	NOMQ	
d É	TO	e O	PTNOUOKRN	MKP	QOOMNTKMN	UTKVU	RVMR	NOMQ	
d É	TO	e É	NMSRPMMQ	MKU	NOORSPHSN	USKVO	RVMR	NOMQ	
v	UV	e O	QOQSQMQKQN	NKU	QTSOUURKNQ	UVKNS	RVMR	NOMQ	
v	UV	e É	TNVTUSKUS	NKQ	UOVQMOKQU	USKTU	RVMR	NOMQ	
q Ä	NRV	k ç = d ~ ë	SOUPTNSKOS	NKP	SRQQMSTKOO	VSKMO	RVMR	NOMQ	
q Ä	NRV	e É	ORRPPSSKVN	MKO	OURMTNTKVP	UVKRT	RVMR	NOMQ	
_ á	OMV	k ç = d ~ ë	PMSQRPSKUV	MKU	PONUTOUKRU	VRKON	RVMR	NOMQ	
_ á	OMV	e É	NQSOORQKMM	NKN	NRVQNVSKTN	VNKTO	RVMR	NOMQ	

p~ã éáÉ=k~ã É	mmi
cäÉ=k~ã É	MOM f ` sKÇ
a~í~=m~íÜ=k~ã É	aWª ÖäÉáíyf ` mj eyNya ^ q ^ yOMOPyMPJ ^ o y i n ` OQ^ kÅ
^ Åè=qãä É	PLOQLOMOP=NUMWSWQN
p~ã éáÉ=qóéÉ	i i f ` s
qçí~äa ãä íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=o ÉÑ¤cäÉk~ã É	MWS ` ^ i _ KÇ
p~ã éáÉ=n ` =m~ëëLcá~ä	c~ãä
fpqa=n ` =m~ëëLc~ãä	m~ëë
I éÉê~íçê	**~Çã áã**

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==¹ mp==	bñés~ä	B o ÉÅ	B i çï	B e äÖÜ
V	_É	S	k ç=d ~ë	MKNUQ	éé Ä	PKP	NNQUKVR	MO	VO	TVfR	NOMQ
NN	_	S	k ç=d ~ë	QKMRT	éé Ä	NKU	NRRTTKQT	Q	NMNKQP	TVfR	NOMQ
OP	k ~	QR	e É	OOMKMMR	éé Ä	NKU	NTUQQQKNU	OMM	NNM	TVfR	NOMQ
OQ	j Ö	QR	e É	OPKTTM	éé Ä	TKM	TVNNKPN	OM	NNUKUR	TVfR	NOMQ
OT	^ ä	QR	e É	JNKRQM	éé Ä	k L^	OUOPKSS	OM	JTKT	TVfR	NOMQ
OU	p á	QR	e O	VVKONN	éé Ä	NKU	QOTUNKRO	NMM	VVKON	TVfR	NOMQ
PV	h	QR	e É	OOPKOPN	éé Ä	NKP	UVUPVKPM	OMM	NNNKSO	TVfR	NOMQ
QM	` ~	QR	e O	OPKVMR	éé Ä	MKP	UUVORKUM	OM	NNVKRP	TVfR	NOMQ
RN	s	UV	e É	NKMQV	éé Ä	PKV	QPTQKNM	N	NVQKV	TVfR	NOMQ
RO	` ê	UV	e É	NKMPQ	éé Ä	MKT	RUPUKTT	N	NVPKQ	TVfR	NOMQ
RR	j å	UV	e É	MKPRQ	éé Ä	QKN	NNSPKUP	MQ	UUKR	TVfR	NOMQ
RS	c É	UV	e O	ONKQRM	éé Ä	MKV	QRSRNSKOS	OM	NMTKQR	TVfR	NOMQ
RV	` ç	UV	e É	MKOMD	éé Ä	QKU	NUOQKSO	MO	NMN	TVfR	NOMQ
SM	k á	UV	e É	MKQMT	éé Ä	RKU	NNRSKTQ	MQ	NMNKTR	TVfR	NOMQ
SP	` ì	UV	e É	MKSPM	éé Ä	NKU	QRPQKNQ	MS	NMR	TVfR	NOMQ
SS	wå	UV	e É	JMKMOV	éé Ä	k L^	OQRRKUN	O	JNKQR	TVfR	NOMQ
TR	^ ë	UV	e É	MKVVP	éé Ä	PKT	URQKNO	N	VVKP	TVfR	NOMQ
TU	p É	UV	e O	NKMST	éé Ä	SKS	QVNKUO	N	NMSKT	TVfR	NOMQ
UU	p ê	UV	e É	MKVUV	éé Ä	QKP	OVRQKUO	N	VUKV	TVfR	NOMQ
VR	j ç	UV	e É	NKNSU	éé Ä	PKP	PQSUKOT	N	NNSKU	TVfR	NOMQ
NMT	^ Ö	UV	e É	MKONQ	éé Ä	QKU	OOPQKST	MO	NMT	TVfR	NOMQ
NNN	` Ç	UV	e É	MKSVV	éé Ä	RKU	OTUKRO	MO	VVKR	TVfR	NOMQ
NNU	p å	NRV	e É	MKVOP	éé Ä	TKM	PMQUKNU	N	VOKP	TVfR	NOMQ
NON	p Ä	NRV	k ç=d ~ë	MKOMN	éé Ä	QKO	QRQUKUT	MO	NMMKR	TVfR	NOMQ
NPT	_ ~	NRV	k ç=d ~ë	MKOPN	éé Ä	RKT	OSQSKPV	MQ	NMTKTR	TVfR	NOMQ
NUO	t	NRV	k ç=d ~ë	NKNRV	éé Ä	QKQ	NQRVPKRR	N	NNRKV	TVfR	NOMQ
OMR	qä	OMV	k ç=d ~ë	MKOOP	éé Ä	MKT	SORUKNP	MO	NNNKR	TVfR	NOMQ
OMU	mÄ	OMV	k ç=d ~ë	MKONT	éé Ä	MKT	USMPKRV	MO	NMUKR	TVfR	NOMQ
OPO	qÜ	OMV	k ç=d ~ë	MKNTV	éé Ä	VKQ	TPOSKRP	MO	UVKR	TVfR	NOMQ
OPU	r	OMV	k ç=d ~ë	MKOMS	éé Ä	SKP	SMUNKOP	MO	NMP	TVfR	NOMQ

n ` =c ä-Ö
c ~ãÉÇ=a ça =& c ~ãÉÇ=SMOMb m^

n ` =c ä-Ö
c ~áÉÇ=a ça =& c ~áÉÇ=SMOMb m^

n ` =fpqa =q~ÄáÉ

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ÉÅ	B n ` ÷ çï	B n ` =¤ äÖÜ	n ` =c ä-Ö
i á	S	k ç=d ~ë	NVOTNQNKCP	OKT	ONCCPCPKQO	VMKU	RVMR	NOMQ	
pÅ	QR	k ç=d ~ë	PVTNNSTKNQ	NKO	QRNVVMMMQ	UTKUS	RVMR	NOMQ	
pÅ	QR	e O	VNQSQTKMV	MKT	NMSVRVUKVR	URKRN	RVMR	NOMQ	
pÅ	QR	e É	NPPVSUKNM	MKR	NRTTPRKMO	UQKVP	RVMR	NOMQ	
d É	TO	k ç=d ~ë	VQPNOMKUR	NKO	NMSQPUQKUO	UUKSN	RVMR	NOMQ	
d É	TO	e O	PSSNRTKUS	NKO	QOOMNTKMN	USKTS	RVMR	NOMQ	
d É	TO	e É	NMQSPVKTP	MKV	NOORSPHSN	URKPU	RVMR	NOMQ	
v	UV	e O	QNTMQUUKVT	MKV	QTSOUURKNQ	UTKRS	RVMR	NOMQ	
v	UV	e É	TMVPSOKMT	NKM	UOVQMOKQU	URKRP	RVMR	NOMQ	
qÄ	NRV	k ç=d ~ë	SOROMMPKUV	NKM	SRQQMSTKOO	VRHRQ	RVMR	NOMQ	
qÄ	NRV	e É	ORPRTPSHSQ	OKO	OURMTNTKVP	UUKVR	RVMR	NOMQ	
_á	OMV	k ç=d ~ë	PMUQRPOKQT	NHS	PONUTOUHRU	VRKUP	RVMR	NOMQ	
_á	OMV	e É	NQSVSQQKVS	OKM	NRVQNVSKTN	VOKNV	RVMR	NOMQ	

fåíÉêÑÉêÉåÅÉ= ÜÉÅâ=pçàíç=^=Ef`pJ^F=oÉéçëí

p~ã éáÉ=k~ã É	f`p^
cäÉ=k~ã É	MONf`p^KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyi n`OQ^kÅ
^Åè=qáã É	PLOQLOMCP=NUMNMQV
p~ã éáÉ=qóéÉ	f`p^
qçí~äaäã íáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVS`^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~äã
fpqa=n`=m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äõíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeäÖÜ	n`=c ä~Ö
_É	V	S	kç=d~ë	JMKMVS	éé Ä	kL^	USIKST	JMKN	NVM	NVM	
_	NN	S	kç=d~ë	MKRSP	éé Ä	QKR	CUNRKUU	JO	NVM	NVM	
k~	OP	QR	eÉ	NVPRQPKSMD	éé Ä	NKQ	SONTPPQRKPO	NMMMMM	UM	NOM	
j Ö	OQ	QR	eÉ	NVOUURKSMM	éé Ä	NKP	PQROVORMKVM	NMMMMM	UM	NOM	
^ä	OT	QR	eÉ	NVUURNKRQM	éé Ä	NKR	NOSNNNPOKRV	NMMMMM	UM	NOM	
pá	OU	QR	eO	QKRCQ	éé Ä	RKP	CCUVKCU	JRM	NVM	NVM	
h	PV	QR	eÉ	NVMRQVKCRU	éé Ä	CKO	OTPCONTTKPV	NMMMMM	UM	NOM	
`~	QM	QR	eO	NVQSNRKVCN	éé Ä	CKN	PONSVTCPMKTS	NMMMMM	UM	NOM	
s	RN	UV	eÉ	MKMRN	éé Ä	NVKU	QNSKSU	JMKR	NVM	NVM	
`ê	RO	UV	eÉ	CKNCU	éé Ä	NKM	NMTSUKMR	NKR	NVM	NVM	
j å	RR	UV	eÉ	MCRM	éé Ä	NNKR	USSKRP	MKNT	NVM	NVM	
cÉ	RS	UV	eO	VVVMPKTRQ	éé Ä	NKR	NNMSTTNNQRKQV	NMMMMM	UM	NOM	
`ç	RV	UV	eÉ	MKMMU	éé Ä	SKP	VUCKOV	M	NVM	NVM	
ká	SM	UV	eÉ	MCPV	éé Ä	TKT	NNTTKUR	MKNU	NVM	NVM	
`ì	SP	UV	eÉ	MKMVN	éé Ä	NCKP	VTPKPV	JMCCO	NVM	NVM	
wå	SS	UV	eÉ	JNKPNT	éé Ä	kL^	NMQSRTP	MKQ	NVM	NVM	aça
^ë	TR	UV	eÉ	MKMTV	éé Ä	VKR	UMKMN	JMKR	NVM	NVM	
pÉ	TU	UV	eO	MKMVO	éé Ä	NQKT	QPKNT	JMKR	NVM	NVM	
pê	UU	UV	eÉ	MCUNV	éé Ä	UKM	OPQQKSU	MKPT	NVM	NVM	
j ç	VR	UV	eÉ	ONUTKTNT	éé Ä	MKT	SMSQPNTKUV	OMMM	UM	NOM	
^Ö	NMT	UV	eÉ	MKMNR	éé Ä	VKV	NSMKMM	JMKN	NVM	NVM	
`Ç	NNN	UV	eÉ	MKPRU	éé Ä	PKT	QTUKNS	MKCU	NVM	NVM	
på	NNU	NRV	eÉ	JMKMRN	éé Ä	kL^	PNPKPQ	JMKR	NVM	NVM	
pÄ	NON	NRV	kç=d~ë	MKMUP	éé Ä	NRKT	NVURKRT	JMKMR	NVM	NVM	
_~	NPT	NRV	kç=d~ë	MKRMT	éé Ä	QKT	PMQPKRR	MKPP	NVM	NVM	
t	NUO	NRV	kç=d~ë	MKPPT	éé Ä	TKU	QSRCKQQ	JMKPP	NVM	NVM	
qä	OMR	OMV	kç=d~ë	MKMCO	éé Ä	UPKP	NMSTKUR	JMKN	NVM	NVM	
mÄ	OMU	OMV	kç=d~ë	MKMQT	éé Ä	SNKS	OQQVKPU	JMKMU	NVM	NVM	
qÜ	OPO	OMV	kç=d~ë	MKMRN	éé Ä	OMKM	PNSTKNM	JMKN	NVM	NVM	
r	OPU	OMV	kç=d~ë	MKMPM	éé Ä	PQKO	UVMKVV	JMKMU	NVM	NVM	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=ïçï	Bn`=eäÖÜ	n`=c ä~Ö
iá	S	kç=d~ë	NVOSUPVKRM	NKP	ONCCPOPKQO	VMKTV	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PUQVMQTHPV	MKU	QRNVVMMKMQ	URKNS	RVKR	NOMQ	
pÅ	QR	eO	UTSTRVKNR	NKP	NMSVRVUKVR	UNKVT	RVKR	NOMQ	
pÅ	QR	eÉ	NPMTNRKMS	MKQ	NRTTPRKMO	UCKUT	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VOQQRSKCO	MKP	NMSGPUQKUO	USKUR	RVKR	NOMQ	
dÉ	TO	eO	PRNVUMKMQ	MKQ	QCCMNTKMN	UPKQ	RVKR	NOMQ	
dÉ	TO	eÉ	NMNRROKNP	MKP	NCCRSPKSN	UCKUS	RVKR	NOMQ	
v	UV	eO	PVVVRPVKCN	MKS	QTSCUURKNQ	UPKVT	RVKR	NOMQ	
v	UV	eÉ	STUPQQRRR	MKO	UOVQMOKQU	UNKTV	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SNCPRCUKNU	NKU	SRQQMSTKOO	VPKRT	RVKR	NOMQ	
qÄ	NRV	eÉ	CQMNPTRKQP	NKN	CURMTNTKVP	UQKCQ	RVKR	NOMQ	
_á	OMV	kç=d~ë	PMNPMNUKPQ	NKM	PONUTCUKRU	VPKSN	RVKR	NOMQ	
_á	OMV	eÉ	NPCRNVNKRO	NKS	NRVQNVSKTN	UPKNP	RVKR	NOMQ	

p~ã éäÉ=k~ã É ofk pb

cãÉ=k~ã É MOOpj mi kÇ

a~í~=m~íÜ=k~ã É aWµ ÖãÉåíµ mj eyNya^q^yOMOPyMPJ ^oyi n` OO^kA

^Åè=qãã É PLOOLOMOP=NUNMSMRU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå NKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä c~åä

fpqa=n` =m~ëëlc~åä c~åä

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=¤l ~ë	OKTTP	ééÄ	OTKQ	NNRKRS	NMM	
NN	_	S	k ç=¤l ~ë	SUKMUN	ééÄ	OKP	NUQQKRV	NMMM	
OP	k ~	QR	e É	RRVVRKURT	ééÄ	UKS	NNVQTQKNU	OMMMMM	
OQ	j Ö	QR	e É	OSQNTKQMP	ééÄ	POKV	PNVRUKSQ	OMMMMM	
OT	^ä	QR	e É	OUOPQKMVS	ééÄ	POKM	NORORKNR	OMMMMM	
OU	pá	QR	e O	NPMOKNOR	ééÄ	PPKR	NVQRKRN	NMMMM	
PV	h	QR	e É	SRQQNKNSV	ééÄ	NNKS	SOPMVKVU	OMMMMM	
QM	` ~	QR	e O	PNOUQKSQM	ééÄ	PVKR	PVRQVOKOP	OMMMMM	
RN	s	UV	e É	VNKRRQ	ééÄ	QPKV	QNTKTV	NMMM	
RO	` ê	UV	e É	SROKRNS	ééÄ	QTKV	PSNVKNN	OMMM	
RR	j å	UV	e É	NRSKPTP	ééÄ	QMKT	QRVKVO	OMMM	
RS	cÉ	UV	e O	USSTQKPTV	ééÄ	OKV	NRNSOONKNO	NMMMM	
RV	` ç	UV	e É	NUKMVM	ééÄ	NVKM	ONPKPR	NMMM	
SM	k á	UV	e É	NOVKOOV	ééÄ	RUKM	PONKNO	NMMM	
SP	` ì	UV	e É	NVMKRSV	ééÄ	QQKT	NQONKON	OMMM	
SS	wå	UV	e É	ORQSKVUQ	ééÄ	RNKO	OVOTKMD	OMMM	[i a o
TR	^ë	UV	e É	QNKOTS	ééÄ	QQKM	QMPQ	NMMM	
TU	pÉ	UV	e O	PNKPNP	ééÄ	RNKN	NTKNT	NMMM	
UU	pê	UV	e É	OPKSUT	ééÄ	NPKT	NMUKUV	OMMM	
VR	j ç	UV	e É	RMMUKSQS	ééÄ	PUKN	NTOPOKST	NMMM	[i a o
NMT	^Ö	UV	e É	NKQMU	ééÄ	QQKS	OOKOO	NMM	
NNN	` Ç	UV	e É	RKOVP	ééÄ	RMKM	NPKPP	NMMM	
NNU	på	NRV	e É	NPPSKTVS	ééÄ	ROKS	PRPQKVT	NMMM	[i a o
NON	pÄ	NRV	k ç=¤l ~ë	SNKQMV	ééÄ	NVKN	URTKSM	NMMM	
NPT	_~	NRV	k ç=¤l ~ë	OUQKVVU	ééÄ	NQKV	NNQTKVP	OMMM	
NUO	t	NRV	k ç=¤l ~ë	OUQKMPS	ééÄ	OMKN	OOQQKRT	NMMM	
OMR	qä	OMV	k ç=¤l ~ë	NQKTOR	ééÄ	UKV	NMOQKQR	NMMM	
OMU	mÄ	OMV	k ç=¤l ~ë	NOKTNV	ééÄ	NPKS	NOOTKVV	OMMM	
OPO	qÜ	OMV	k ç=¤l ~ë	OPKRVM	ééÄ	SKM	OMOUKVV	NMMM	
OPU	r	OMV	k ç=¤l ~ë	MKVRT	ééÄ	ONKM	TSKTR	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B n¤ÉÅ	B n` =ç ï	B n` =¤äÜÜ	n` =¤ä-Ö
i á	S	k ç=¤l ~ë	NQOQMKNU	NKN	ONOOPOPKQO	MKST	RVKR	NOMKQ	SMOOMa ça
pÅ	QR	k ç=¤l ~ë	NNRRRKVT	RKR	QRNVVMMKMQ	MKOS	RVKR	NOMKQ	SMOOMa ça
pÅ	QR	e O	PPUMKRM	OSKP	NMSVRVUKVR	MKPO	RVKR	NOMKQ	SMOOMa ça& eäÜÜ=fpqa=¤pa
pÅ	QR	e É	QSSKRV	PSKN	NRTTPRKMO	MKP	RVKR	NOMKQ	SMOOMa ça& eäÜÜ=fpqa=¤pa
d É	TO	k ç=¤l ~ë	QQQTKOM	OKO	NMSOPUOKUO	MKQD	RVKR	NOMKQ	SMOOMa ça
d É	TO	e O	NMUSKRN	PUKO	QOOMNTKMN	MKOS	RVKR	NOMKQ	SMOOMa ça& eäÜÜ=fpqa=¤pa
d É	TO	e É	OSVKOV	ROKP	NOORSPKSN	MKOO	RVKR	NOMKQ	SMOOMa ça& eäÜÜ=fpqa=¤pa
v	UV	e O	SPVVKSO	SUKM	QTSOUURKNQ	MKNP	RVKR	NOMKQ	SMOOMa ça& eäÜÜ=fpqa=¤pa
v	UV	e É	NMPNKVQ	TOKR	UOVOMOKQU	MKNO	RVKR	NOMKQ	SMOOMa ça& eäÜÜ=fpqa=¤pa
qÄ	NRV	k ç=¤l ~ë	QNVTKPR	NPKU	SRQQMSTKOO	MKMS	RVKR	NOMKQ	SMOOMa ça& eäÜÜ=fpqa=¤pa
qÄ	NRV	e É	POPVKQV	TPKU	OURMTNTKVP	MKNN	RVKR	NOMKQ	SMOOMa ça& eäÜÜ=fpqa=¤pa
_á	OMV	k ç=¤l ~ë	UPQNKOO	TKM	PONUTOUKRU	MKOS	RVKR	NOMKQ	SMOOMa ça
_á	OMV	e É	RSSQKRS	OQKU	NRVQNVSKTN	MKPS	RVKR	NOMKQ	SMOOMa ça& eäÜÜ=fpqa=¤pa

`çåíäåì åäÖ=~ëäÄê~íáçå=sÉêëÑÅ~íáçå=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cäÉ=k~ã É	MOP|``skÇ
a~í~=m~íÜ=k~ã É	aWyªÖäÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n` OQ^kÄ
^Åè=qáã É	PLOQLOMOP=NUWNMO
p~ã éáÉ=qóéÉ	``s
qçí~äaãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVS^i_kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=cä-Ö
V	_É	S	k ç=d ~ë	OQKTVV	éëÄ	OKT	NPTNPOKCU	CR	VVKO	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OQKSPR	éëÄ	PKO	UVCRQKNU	CR	VUKRQ	UVKU	NNMO	
OP	k ~	CR	e É	RPTTKMUQ	éëÄ	MKO	PQSVURRKOP	RMMM	NMTKRQ	UVKU	NNMO	
OQ	j Ö	CR	e É	RPUUKNTP	éëÄ	MKV	NUMUSVVKPR	RMMM	NMTKTS	UVKU	NNMO	
OT	^ä	CR	e É	RRUKQMV	éëÄ	NKN	TNTTRKMN	RMM	NNNKSU	UVKU	NNMO	[=HLJ=NMB
OU	pá	CR	e O	RMSKVVM	éëÄ	NKR	ONVRQVKQO	RMM	NMNKQ	UVKU	NNMO	
PV	h	CR	e É	RORPKVVN	éëÄ	MKS	NRQOTUVKNS	RMMM	NMRKMU	UVKU	NNMO	
QM	` ~	CR	e O	RONTKPVU	éëÄ	NKT	NSVSRUNUKVO	RMMM	NMQKPR	UVKU	NNMO	
RN	s	UV	e É	ORKSVO	éëÄ	MKT	NMOTTMRS	CR	NMOKTT	UVKU	NNMO	
RO	` ê	UV	e É	ORKTSV	éëÄ	NKM	NOVVSNKUV	CR	NMPKMU	UVKU	NNMO	
RR	j å	UV	e É	ORKPUR	éëÄ	NKP	SQPRSKRR	CR	NMNKRQ	UVKU	NNMO	
RS	cÉ	UV	e O	RNQUKQQR	éëÄ	NKQ	SMRUPVRSKUO	RMMM	NMOKVT	UVKU	NNMO	
RV	` ç	UV	e É	OSKNPM	éëÄ	NKU	OOQQQOKMS	CR	NMQKRO	UVKU	NNMO	
SM	ká	UV	e É	ORKUQU	éëÄ	NKM	SNTUNKSV	CR	NMPKPV	UVKU	NNMO	
SP	` ì	UV	e É	OSKONS	éëÄ	NKM	NTPSRMKNU	CR	NMQKUS	UVKU	NNMO	
SS	wå	UV	e É	ORKOPO	éëÄ	NKN	OVQTQKTR	CR	NMMKVP	UVKU	NNMO	
TR	^ë	UV	e É	ORKPOR	éëÄ	MKS	ONRRPKRN	CR	NMNKP	UVKU	NNMO	
TU	pÉ	UV	e O	OQKSST	éëÄ	MKS	NNRONKRQ	CR	VUKST	UVKU	NNMO	
UU	pê	UV	e É	ORKNNV	éëÄ	NKN	TRROOKNM	CR	NMMKQU	UVKU	NNMO	
VR	j ç	UV	e É	OTKQQQ	éëÄ	MKS	UMRRPKUP	CR	NMVKTU	UVKU	NNMO	
NMT	^Ö	UV	e É	ORKVSR	éëÄ	MKP	OTPPVMKOM	CR	NMPKUS	UVKU	NNMO	
NNN	` Ç	UV	e É	ORKTQR	éëÄ	MKV	PSPNNKMP	CR	NMOKVU	UVKU	NNMO	
NNU	på	NRV	e É	ORKMST	éëÄ	NKP	TMTVOKMM	CR	NMMKOT	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKUQR	éëÄ	MKS	RCUQMMKTT	CR	VVKPU	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKRNT	éëÄ	OKN	NRRQTNKNN	CR	NMOKMT	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKNRS	éëÄ	MKR	PMPNTSKOP	CR	NMMKSO	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKPUQ	éëÄ	NKQ	SQSUPTKNP	CR	NMNKRQ	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKNOM	éëÄ	MKQ	VORQQQKMT	CR	NMQKQU	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OQKVPT	éëÄ	MKV	TUSSOPKRP	CR	VVKTR	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	ORKUSU	éëÄ	NKR	TROOPNKSR	CR	NMPKQT	UVKU	NNMO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ï çï	B n`=eäÜÜ	n`=cä-Ö
iá	S	k ç=d ~ë	NVMMOVRKPO	NKQ	ONOOPOPKQO	UVKRQ	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	QMQTORTKRQ	NKR	ORNVVMMMVQ	UVKRQ	RVKR	NOMQ	
pÅ	CR	e O	VOSRROKVV	OKN	NMSVRVUKVR	USKSP	RVKR	NOMQ	
pÅ	CR	e É	NPUTRVKTM	MKU	NRTTPRKMO	UTKVT	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	VSNVUUKSS	MKU	NMSCPUQKUO	VMKPU	RVKR	NOMQ	
dÉ	TO	e O	PTNVSOKTN	NKM	QOOMNTKMN	UUKNQ	RVKR	NOMQ	
dÉ	TO	e É	NMTNRVKMM	MKQ	NOORSPKSN	UTKQP	RVKR	NOMQ	
v	UV	e O	QOQTTQVKSV	MKQ	QTSCUURKNQ	UVKNU	RVKR	NOMQ	
v	UV	e É	TNTRPTKUQ	MKT	UOVQMOKQU	USKRN	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SOTUOQQKPR	MKP	SRQQMSTKOO	VRKVQ	RVKR	NOMQ	
qÄ	NRV	e É	ORQUTVRKNR	MKT	OURMTNTKVP	UVKQN	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PMRNMSTKRS	NKN	PONUTOUKRU	VQKTV	RVKR	NOMQ	
_á	OMV	e É	NQSSQNVKUP	MKR	NRVQNVSKTN	VNKVU	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=Ê`_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MOOJ``_KÇ

a~í~=m~íÜ=k~ã É aWj^ÖäÉáíÝ^mj eyNya^q^yOMOPyMPJ ^oyi n`OO^kÅ

^Åè=qáã É PLOOLOMOP=NUARMOOT

p~ã éáÉ=qóéÉ ``_

qçí~äa äáçå NKMMMM

`çã ã Éâí JJJ

fpqa=oÉÑcäÉk~ã É MMS^i_KÇ

p~ã éáÉ=n`=m~ëëlcá~ä c~äá

fpqa=n`=m~ëëlc~áä m~ëë

l éÉê~íçê **~Çã áñ**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÅK	r åáë	opa	==\ mp==	i ãä á	n`=c~ä~Ö
V	_É	S	k ç=d ~ë	MKMNR	éé Ä	UKS	OMOJOCR	MO	
NN	_	S	k ç=d ~ë	MKNQT	éé Ä	NKR	NOVSKTR	Q	
OP	k~	QR	e É	OPKMNM	éé Ä	NMKR	SMUNPKVV	OMM	
OQ	j Ö	QR	e É	NOKTVM	éé Ä	TKQ	QSNUKTN	OM	c~äÉÇ=a ça
OT	^ä	QR	e É	JNPKVRM	éé Ä	k L^	NQPPKQP	OM	c~äÉÇ=a ça
OU	pá	QR	e O	MKSMS	éé Ä	PTKN	TSTHRM	NMM	
PV	h	QR	e É	OVKVSV	éé Ä	NMKM	PUOTVKTV	OMM	
QM	`~	QR	e O	NQKNUU	éé Ä	OKU	SNTRRKNT	OM	c~äÉÇ=a ça
RN	s	UV	e É	MKMNP	éé Ä	NMNKR	PMPKPQ	N	
RO	`ê	UV	e É	MKMNP	éé Ä	OVKS	UCQJKRP	N	
RR	j å	UV	e É	JMKVSM	éé Ä	k L^	NPVVKVU	MQ	
RS	cÉ	UV	e O	NPKRRQ	éé Ä	QKR	NTRQSMKVP	OM	c~äÉÇ=a ça
RV	` ç	UV	e É	MKMMV	éé Ä	PPKR	OMOJOCP	MO	
SM	k á	UV	e É	MKMNP	éé Ä	NMOKV	OCPKPQ	MQ	
SP	` ì	UV	e É	MKMNO	éé Ä	OQKS	RPMKMO	MS	
SS	wå	UV	e É	JOKMVT	éé Ä	k L^	NTRKRS	O	c~äá^ äáj ÉíÜçÇë& c~äÉÇ=a ça
TR	^ë	UV	e É	MKVOV	éé Ä	PNKM	QQJKMN	N	
TU	pÉ	UV	e O	MKVRM	éé Ä	NOKM	OTHKPP	N	
UU	pê	UV	e É	MKVOO	éé Ä	RVKS	UTKTU	N	
VR	j ç	UV	e É	MKSUO	éé Ä	PKQ	ONVQJKSS	N	c~äÉÇ=a ça
NMT	^Ö	UV	e É	MKMNT	éé Ä	UKQ	NVSKST	MO	
NNN	`Ç	UV	e É	MKMNP	éé Ä	RTKU	OMKTQ	MO	
NNU	på	NRV	e É	JMKVPR	éé Ä	k L^	PURKRT	N	
NON	pÄ	NRV	k ç=d ~ë	MKVPO	éé Ä	RKO	VVTKTR	MO	
NPT	_~	NRV	k ç=d ~ë	MKVOO	éé Ä	QOKV	NTSKUS	MQ	
NUO	t	NRV	k ç=d ~ë	MKOPU	éé Ä	OTHS	PTPTKUU	N	
OMR	qä	OMV	k ç=d ~ë	MKVSQ	éé Ä	RKT	OOQJKRS	MO	
OMU	mÄ	OMV	k ç=d ~ë	MKMNR	éé Ä	NOKU	NQMUKNV	MO	
OPO	qÜ	OMV	k ç=d ~ë	MKVQM	éé Ä	OOKM	PMVPKRP	N	
OPU	r	OMV	k ç=d ~ë	MKVOO	éé Ä	UKQ	SVQKMV	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ= mp	B=oÉÁ	B n`=ç ïï	B n`=eåÜÜ	n`=c~ä~Ö
iá	S	k ç=d ~ë	NVOPMRTHRV	NKM	ONOOPOPKQO	VMSN	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QNMTONUKSP	NKV	QRNVVMMMVQ	VMKUT	RVKR	NOMQ	
pÅ	QR	e O	VTUMTQRTU	MRT	NMSVRVUKVR	VNKQQ	RVKR	NOMQ	
pÅ	QR	e É	NQOOMNST	NRT	NRTTPRMVO	VMKNR	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	VVNPPMSO	MKV	NMSQPUQKUO	VPKNQ	RVKR	NOMQ	
dÉ	TO	e O	PUUTUQJOM	NKM	QOOMNTKMN	VOKNP	RVKR	NOMQ	
dÉ	TO	e É	NNNQOOKNQ	MKV	NOORSPKSN	VMKVP	RVKR	NOMQ	
v	UV	e O	QQOSOUOKRN	MKP	QTSOUURKNQ	VOKVP	RVKR	NOMQ	
v	UV	e É	TRRQOOMVS	MKP	UOVQMOKQU	VNKMU	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SRRMURSKPS	NKQ	SRQOMSTKOO	NMMKN	RVKR	NOMQ	
qÄ	NRV	e É	OSMUVPPKNT	NKU	OURMTNTKVP	VNKRO	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PNUQNRSKSO	PKR	PONUTOUKRU	VUKVP	RVKR	NOMQ	
_á	OMV	e É	NQVTNUPKON	NKP	NRVQNVSKTN	VPKVN	RVKR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` ONfj t O
cáÉ=k~ã É	MOR| m_KÇ
a~í~=m~íÜ=k~ã É	a Wy^ ÖäÉáíyf` mj e yNya^q^yOMOPyMPJ ^o yi n` OQ^ kÄ
^Åè=qãã É	PLOQLOMOP=NUMRRMRQ
p~ã éäÉ=qóéÉ	m_
qçí~ä=a ãä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==` mp==	i ãã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	MKMMV	ééÄ	NUOKU	NONKNN	MKR	
_	NN	S	k ç=d ~ë	NKMMQ	ééÄ	NKO	NQNMKNM	NM	
k~	OP	QR	e É	NOQKTVS	ééÄ	NOKO	RTRSMKRO	RMM	
j Ö	OQ	QR	e É	PRKNPQ	ééÄ	PKP	OQQSKVT	RM	
^ä	OT	QR	e É	JVNKMMU	ééÄ	k L^	UPOKOS	RM	m_=SMOM=c~ãë=a ça
pá	OU	QR	e O	VKSUN	ééÄ	SKS	NOTQKTP	ORM	
h	PV	QR	e É	NSRKRUS	ééÄ	QKQ	PSPRRKTN	RMM	
` ~	QM	QR	e O	RUKPVU	ééÄ	OKR	QVOVOKSV	RM	m_=SMOM=c~ãë=a ça
s	RN	UV	e É	MKQPU	ééÄ	NTKM	RTOKOQ	OKR	
` ê	RO	UV	e É	MKNTV	ééÄ	OTKU	UTTKOM	OKR	
j å	RR	UV	e É	MKMQO	ééÄ	VUKR	OVUKSN	N	
cÉ	RS	UV	e O	OUKNTO	ééÄ	QKP	TPQSVKPR	RM	
` ç	RV	UV	e É	JMKMMR	ééÄ	k L^	NMOKOP	MKR	
k á	SM	UV	e É	MKMUV	ééÄ	NTKQ	OPSKST	N	
` ì	SP	UV	e É	MKPPQ	ééÄ	NUKN	UQRKSM	NKR	
wå	SS	UV	e É	PKUQS	ééÄ	NMKU	PORTKNM	R	
^ë	TR	UV	e É	MKNSU	ééÄ	ONKP	QQKST	OKR	
pÉ	TU	UV	e O	MKNPQ	ééÄ	OUKS	NRKMM	OKR	
pê	UU	UV	e É	MKMTN	ééÄ	RSKQ	RUKUV	OKR	
j ç	VR	UV	e É	OKOPS	ééÄ	TKV	NPSOKPO	OKR	
^Ö	NMT	UV	e É	MKMPU	ééÄ	NPKN	URKRS	MKR	
` Ç	NNN	UV	e É	MKMOT	ééÄ	SMKU	UKRO	MKR	
på	NNU	NRV	e É	MKRQU	ééÄ	NUKO	TTNKNQ	OKR	
pÄ	NON	NRV	k ç=d ~ë	MKNOO	ééÄ	SKS	TVQKOM	MKR	
_~	NPT	NRV	k ç=d ~ë	MKOMT	ééÄ	OQKS	OUPKSP	N	
t	NUO	NRV	k ç=d ~ë	MKSTR	ééÄ	VKO	OPROKTM	OKR	
qä	OMR	OMV	k ç=d ~ë	MKNMV	ééÄ	PTKS	NNMTKUV	MKR	
mÄ	OMU	OMV	k ç=d ~ë	MKMPP	ééÄ	OUKV	NNMQKRO	MKR	
qÜ	OPO	OMV	k ç=d ~ë	MKNOR	ééÄ	TKP	ORNSKOQ	OKR	
r	OPU	OMV	k ç=d ~ë	MKMQN	ééÄ	NMKN	OTMKOV	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eäÖÜ	n`=cä-Ö
iá	S	kç=dl~ë	NUNUPMNKMN	NKU	CNCCPCPKQO	URKSU	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	PVTPMPPKVT	NKQ	QRNVVMMKMQ	UTKV	RVKR	NOMQ	
pÅ	QR	eO	VMTCNCKRT	NKS	NMSVRVUKVR	UQKUO	RVKR	NOMQ	
pÅ	QR	eÉ	NPNUPRKSS	MKN	NRTTPRKMO	UPKRU	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VQRPVCKQO	MKV	NMSCPUQKUO	UUKUO	RVKR	NOMQ	
dÉ	TO	eO	PRUCOMKSP	MKS	QCOMNTKMN	UQKUU	RVKR	NOMQ	
dÉ	TO	eÉ	NMCSMTKTV	NKM	NCCRSPKSN	UPKTO	RVKR	NOMQ	
v	UV	eO	QNRNOMCKTQ	NKP	QTSCUURKNQ	UTKNS	RVKR	NOMQ	
v	UV	eÉ	TMMPNTKQO	MKV	UCVQMCKQU	UQKQQ	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	SCUVVRMQT	NKV	SRQQMSTKCO	VSKNO	RVKR	NOMQ	
qÄ	NRV	eÉ	CRNPOVCKVM	NKN	CURMTNTKVP	UUKNS	RVKR	NOMQ	
_á	CMV	kç=dl~ë	PNVCQUTKVQ	NKP	PCNUTCUKRU	VVKNU	RVKR	NOMQ	
_á	CMV	eÉ	NQTUUTTKQP	MKN	NRVQNVSKTN	VCKTT	RVKR	NOMQ	

i ~ÄçêíçêóÈçåíêçäæp~ã éäÉÈi `pF¤oÉéçã

p~ã éäÉ¤k~ã É	i `pt n`ONfj t O
cäÉ¤k~ã É	MDSi `pt kÇ
a~í~¤m~íÜ¤k~ã É	aWf^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJ ^oyi n` OQ^kÄ
^Åè¤qãã É	PLOQLOMOP¤NUWQNMMO
p~ã éäÉ¤qóéÉ	i `pt
qçí~äeäãi íáçå	RKMMMM
` çã ã Éäí	JJJ
fpqa¤oÉÑcäÉk~ã É	MMS` ^i _kÇ
p~ã éäÉ¤n` ¤m~ëëlcá~ä	c~äi
fpqa¤n` ¤m~ëëlc~äi	m~ëë
l éÉê~íçê	**~Çã åã**

n` ¤^å~äöíÉ¤q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	¤¤¤ mp¤¤¤	bñés~ä	B¤oÉÁ	B i çï	B eáÖÜ	n` ¤cä-Ö
_É	V	S	k ç¤dl~ë	RRKNUT	éëÄ	NKV	RUOVNKRV	RM	OOKMT	TVKR	NOMQ	
_	NN	S	k ç¤dl~ë	RNSKSQO	éëÄ	NKQ	PRRTNMKRN	RMM	OMST	TVKR	NOMQ	
k~	OP	QR	e É	UQTQKQOU	éëÄ	NKU	NMSPUVPKTN	TRMM	OOKS	TVKR	NOMQ	
j Ö	OQ	QR	e É	RPNQKPOM	éëÄ	MKP	PPTTVMKPN	RMMM	ONKOS	TVKR	NOMQ	
^ä	OT	QR	e É	ONURKURM	éëÄ	MKS	RPUNRKTP	OMMM	ONKUS	TVKR	NOMQ	
pá	OU	QR	e O	NVPPKMQP	éëÄ	NKU	URSVTKMS	NMMM	OMSS	M	OMM	
h	PV	QR	e É	NMQPNKMN	éëÄ	MKP	RVSNQRKUR	NMMMM	OMUS	TVKR	NOMQ	
` ~	QM	QR	e O	OTNTKNSS	éëÄ	NKM	NSVUPSSKTS	ORMM	ONKTQ	TVKR	NOMQ	
s	RN	UV	e É	RSNKUNN	éëÄ	MKV	QPNPOOKQT	RMM	OOKQT	TVKR	NOMQ	
`ê	RO	UV	e É	OORKQQQ	éëÄ	NKT	ONUMUPKQP	OMM	OOKRQ	TVKR	NOMQ	
j å	RR	UV	e É	RRRKOTR	éëÄ	MKS	OSVTROKNO	RMM	OOKON	TVKR	NOMQ	
cÉ	RS	UV	e O	NNOPKQTT	éëÄ	MKT	ORUQVQPKMP	NMMM	OOKQT	TVKR	NOMQ	
` ç	RV	UV	e É	RVMKTNP	éëÄ	MKS	VTQPVOKSN	RMM	OPKSP	TVKR	NOMQ	a ça
ká	SM	UV	e É	RTTKSNP	éëÄ	MKR	OSQTVNKPP	RMM	OPKN	TVKR	NOMQ	
`ì	SP	UV	e É	OUUKPPP	éëÄ	MKT	PSSTPQKMP	ORM	OPKMT	TVKR	NOMQ	
wå	SS	UV	e É	RSSKPUM	éëÄ	MKU	NNUTTTKPT	RMM	OOKSS	TVKR	NOMQ	
^ë	TR	UV	e É	NMQKTOU	éëÄ	NKS	NTNQMKSP	NMM	OMKVR	TVKR	NOMQ	
pÉ	TU	UV	e O	NVOKNRN	éëÄ	NKM	VOVUKUP	NMM	OMKQP	TVKR	NOMQ	
pê	UU	UV	e É	RCOKPQM	éëÄ	MKS	PMNUURKSV	RMM	OMKUV	TVKR	NOMQ	
j ç	VR	UV	e É	NMVMKVQR	éëÄ	MKP	SNRRTKMT	NMM	ONKUN	TVKR	NOMQ	
^Ö	NMT	UV	e É	RPKMRR	éëÄ	MKS	NMTQMUKOV	RM	ONKOO	TVKR	NOMQ	
` Ç	NNN	UV	e É	OSUKUNM	éëÄ	MKO	TOUVPKPU	ORM	ONKR	TVKR	NOMQ	
på	NNU	NRV	e É	RMUKNQU	éëÄ	NKO	OUMOSMKUO	RMM	OMKPP	TVKR	NOMQ	
pÄ	NON	NRV	k ç¤dl~ë	VUKVRR	éëÄ	MKV	QNTTQUKPR	NMM	NVKTV	TVKR	NOMQ	
_~	NPT	NRV	k ç¤dl~ë	OOPSKOQO	éëÄ	MKO	OTMPRTMKOT	OMMM	OOKPS	TVKR	NOMQ	
t	NUO	NRV	k ç¤dl~ë	NNMKRPS	éëÄ	NKT	OSQQUTKQQ	NMM	OOKNN	TVKR	NOMQ	
qä	OMR	OMV	k ç¤dl~ë	NVOKNSM	éëÄ	MKQ	RQQTTSKTQ	NMM	OMKQP	TVKR	NOMQ	
mÄ	OMU	OMV	k ç¤dl~ë	NVRKSRR	éëÄ	MKU	TUPPOVKUS	NMM	ONKNP	TVKR	NOMQ	
qÜ	OPO	OMV	k ç¤dl~ë	NMMKVQR	éëÄ	NKN	SSSQVQKNN	NMM	OMKNV	TVKR	NOMQ	
r	OPU	OMV	k ç¤dl~ë	NMTKSMQ	éëÄ	NKO	SRQUSSKUR	NMM	ONKRO	TVKR	NOMQ	

n` ¤fpqa¤q~ÄäÉ

i ~Äçê~íçêó=`çåíêçä=p~ã éäÉ=Ei `pF=oÉéçêí

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÖÜ	n ` =cä~Ö
i á	S	k ç=d ~ë	NUNOTNMKUM	MKS	ONOOPOPKQO	URKQN	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVOOQMPKVP	NKO	QRNVVMMKMQ	USKTU	RVKR	NOMKQ	
pÅ	QR	e O	UUQUPPKPQ	OKT	NMSVRVUKVR	UOKTP	RVKR	NOMKQ	
pÅ	QR	e É	NPNPMVKSP	MKQ	NRTTPRKMO	UPKOR	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VQNVOOKNO	MKT	NMSOPUQKUO	UUKQV	RVKR	NOMKQ	
d É	TO	e O	PRQPNQKPP	MKT	QOOMNTKMN	UPKVS	RVKR	NOMKQ	
d É	TO	e É	NMOSNRKVP	NKN	NOORSPKSN	UPKTO	RVKR	NOMKQ	
v	UV	e O	QNPVPTQKPO	MKV	QTSOUURKNQ	USKVN	RVKR	NOMKQ	
v	UV	e É	SUVTVVKTM	MKT	UOVQMOKQU	UPKNT	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SOPMNRSKNM	MKP	SRQQMSTKOO	VRKO	RVKR	NOMKQ	
qÄ	NRV	e É	ORMNQVUKUT	NKO	OURMTNTKVP	UTKTR	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PNVNQVMKQR	MKM	PONUTOUKRU	VVKNR	RVKR	NOMKQ	
_á	OMV	e É	NQTNNVUKQP	MKV	NRVQNVSKTN	VOKOU	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NMNRJMOQ

cãÉ=k~ã É MOTpj mi hÇ

a~í~=m~íÜ=k~ã É aWf ÖãÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OQ^hÅ

^Åè=qãã É PLOQLOMOP=NUWQMNM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MMVPS	ééÄ	RQKM	NRVMVM	NVM	
NN	_	S	k ç=d ~ë	PMVV	ééÄ	RKO	OVQNKQS	NVMM	
OP	k ~	QR	e É	UTKOSM	ééÄ	NNKQ	RPVOVKRV	OMMMM	
OQ	j Ö	QR	e É	OPKQSO	ééÄ	TKV	NTPNKCU	OMMMM	
OT	^ ä	QR	e É	JVUKRUN	ééÄ	k L^	SSSKSV	OMMMM	
OU	pá	QR	e O	NVKUUQ	ééÄ	SKO	ONCRKTO	NVMMM	
PV	h	QR	e É	NPQKMCP	ééÄ	QKP	PRCOSKSS	OMMMM	
QM	` ~	QR	e O	QQKPNP	ééÄ	NKN	PUUQRKRS	OMMMM	
RN	s	UV	e É	MRTTO	ééÄ	PKQ	UQQKQV	NVMM	
RO	` ê	UV	e É	MPPPU	ééÄ	NOKM	NVQTKUQ	OMMM	
RR	j å	UV	e É	MMSSN	ééÄ	NPOKP	PNOKSN	OMMM	
RS	cÉ	UV	e O	VKVUP	ééÄ	MKU	PNQTQKUU	NVMMMM	
RV	` ç	UV	e É	MPPPU	ééÄ	QKU	SUSKTN	NVMM	
SM	k á	UV	e É	MPPMN	ééÄ	NQKR	PQMKMN	NVMM	
SP	` ì	UV	e É	MOONV	ééÄ	OQKU	TMTKUN	OMMM	
SS	wå	UV	e É	JUKQQV	ééÄ	k L^	TMOKOR	OMMM	
TR	^ ë	UV	e É	MRNVT	ééÄ	ONKR	RVMPQ	NVMM	
TU	pÉ	UV	e O	MOUS	ééÄ	NVKU	OUKST	NVMM	
UU	pê	UV	e É	MPVVR	ééÄ	NTNS	ORCKCP	OMMM	
VR	j ç	UV	e É	NKCPS	ééÄ	TKV	VNTKUP	NVMM	
NVT	^ Ö	UV	e É	MRMPV	ééÄ	NQKP	UUKUV	NVM	
NNN	` Ç	UV	e É	MRSSS	ééÄ	NUKP	QTKQN	NVMM	
NNU	på	NRV	e É	MRNVU	ééÄ	PQKV	RUCKCR	NVMM	
NON	pÄ	NRV	k ç=d ~ë	MRNQN	ééÄ	VKQ	VNVKVV	NVMM	
NPT	_~	NRV	k ç=d ~ë	NKVMP	ééÄ	OKS	OQPVKQV	OMMM	
NUO	t	NRV	k ç=d ~ë	MSOOV	ééÄ	NRKV	OPNVKPN	NVMM	
OVR	qä	OMV	k ç=d ~ë	MOUN	ééÄ	OKV	OVTRKTN	NVMM	
OVU	mÄ	OMV	k ç=d ~ë	MRVUU	ééÄ	OTKQ	NRQUKPR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MRTUN	ééÄ	RKT	TMVOKSV	NVMM	
OPU	r	OMV	k ç=d ~ë	MRVUP	ééÄ	UKM	RQMKRV	NVMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =i çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NUPVQVNKNT	NKO	ONCOPOPKQO	USKCR	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVUVSTQKQP	NKQ	QRNVVMMMVQ	UUKOT	RVKR	NOMKQ	
pÅ	QR	e O	VMOORSKQN	NKV	NMSVRVUKVR	UQKPR	RVKR	NOMKQ	
pÅ	QR	e É	NPQNOOKNM	MKV	NRTTPRMVO	URMVP	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VRTNOPKNV	MKQ	NMSQPUQKUO	UVKVO	RVKR	NOMKQ	
d É	TO	e O	PSPUPPKVP	MKO	QOOMNTMVN	USKON	RVKR	NOMKQ	
d É	TO	e É	NMRNQVKUM	MRT	NOORSPKSN	URRTV	RVKR	NOMKQ	
v	UV	e O	QNOSVTNKUQ	MKU	QTSOUURKNQ	USKSR	RVKR	NOMKQ	
v	UV	e É	TNMSRSKNO	MKS	UOVQMOKQU	URKSU	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SRNTONUKRN	OKM	SRQQMSTKOO	VVKRV	RVKR	NOMKQ	
qÄ	NRV	e É	ORPOVOPKNO	MKR	OURMTNTKVP	UUKUR	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	POTMNPSKVR	NKQ	PONUTOUKRU	NMNKS	RVKR	NOMKQ	
_á	OMV	e É	NRVMPRTKRN	MKR	NRVQNVSKTN	VQKNN	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMMV

cãÉ=k~ã É MOUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyt mj eyNya^q^yOMOPyMPJ ^oyi n ` OO^hÅ

^Åè=qáã É PLOOLOMOP=NUMROMU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==: mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKVOR	ééÄ	k L^	UPHPQ	NMM	
NN	_	S	k ç=d ~ë	OKOSU	ééÄ	PHS	OOQMOCN	NMMM	
OP	k ~	QR	e É	NMRHRQT	ééÄ	RHR	RRSNTHRQ	OMMMMM	
OQ	j Ö	QR	e É	NMKQPO	ééÄ	OKN	NQRRHSU	OMMMMM	
OT	^ ä	QR	e É	JVUHSCO	ééÄ	k L^	SRUKVO	OMMMMM	
OU	pá	QR	e O	VNHKCO	ééÄ	NKV	UMPTHPT	NMMMM	
PV	h	QR	e É	NPQKNNV	ééÄ	NRHS	PQLUSTHSS	OMMMMM	
QM	` ~	QR	e O	UTHTRP	ééÄ	OKM	SSVMMHSM	OMMMMM	
RN	s	UV	e É	MHRMO	ééÄ	VHS	SOOKOR	NMMM	
RO	` ê	UV	e É	MKOQR	ééÄ	PNKU	VQOKRO	OMMM	
RR	j å	UV	e É	JMKMTN	ééÄ	k L^	OQPKOV	OMMM	
RS	cÉ	UV	e O	SKOVT	ééÄ	PKO	OOVSVHSP	NMMMMM	
RV	` ç	UV	e É	MHNMV	ééÄ	NMKN	OVPHPR	NMMM	
SM	k á	UV	e É	MHNMP	ééÄ	NUKO	OQPKPQ	NMMM	
SP	` ì	UV	e É	MKOOM	ééÄ	NTHS	TMMKMP	OMMM	
SS	wå	UV	e É	JTHSOO	ééÄ	k L^	USRHSM	OMMM	
TR	^ ë	UV	e É	MHMVN	ééÄ	OUKN	POKMM	NMMM	
TU	pÉ	UV	e O	MHNMP	ééÄ	OUHR	NOKMM	NMMM	
UU	pê	UV	e É	MKONP	ééÄ	NOKN	NQOKCP	OMMM	
VR	j ç	UV	e É	MKVVQ	ééÄ	OKV	SROKOR	NMMM	
NMT	^ Ö	UV	e É	MHMNS	ééÄ	QSKV	PUKUV	NMM	
NNN	` Ç	UV	e É	MHMTT	ééÄ	NUKU	OOKOO	NMMM	
NNU	på	NRV	e É	JMKMMP	ééÄ	k L^	QTOKOQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MHNOO	ééÄ	OKN	UMQKOM	NMMM	
NPT	_~	NRV	k ç=d ~ë	OKNUV	ééÄ	RKQ	OTPSHRM	OMMM	
NUO	t	NRV	k ç=d ~ë	MKPVM	ééÄ	OPHR	NSURKOO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MHMUP	ééÄ	OUHM	VVQKQO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MHMMO	ééÄ	VOSKU	UVQKPM	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKOMV	ééÄ	NRKO	PNOTHMQ	NMMM	
OPU	r	OMV	k ç=d ~ë	MHMOS	ééÄ	OOKO	NUPKRP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c ä~Ö	n ` =c ä~Ö
i á	S	k ç=d ~ë	NTURQUNKGS	MKU	ONOOPOPKQO	UQKNP	RVHR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVTRQVVKTT	NKV	QRNVVMMHMQ	UTKVS	RVHR	NOMKQ	
pÅ	QR	e O	UVOVNSKNT	NHR	NMSVRVUKVR	UPKQU	RVHR	NOMKQ	
pÅ	QR	e É	NPOTRPKQV	MKU	NRTTPRHMO	UQKNS	RVHR	NOMKQ	
d É	TO	k ç=d ~ë	VRNUUVKON	MKU	NMSQPUQKUO	UVKQP	RVHR	NOMKQ	
d É	TO	e O	PRRSNSHRQ	NHR	QOOMNTHMN	UQKOT	RVHR	NOMKQ	
d É	TO	e É	NMQOOQVKVS	NKU	NOORSPHSN	URHMS	RVHR	NOMKQ	
v	UV	e O	QNNPOTOKRU	MKN	QTSOUURKNQ	USHPS	RVHR	NOMKQ	
v	UV	e É	TMNPVMKTR	MKU	UOVQMOKQU	UQKRR	RVHR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SPSRMNTHRQ	MKT	SRQQMSTKOO	VTKOS	RVHR	NOMKQ	
qÄ	NRV	e É	ORQQVVQHMO	NHR	OURMTNTKVP	UVKOU	RVHR	NOMKQ	
_á	OMV	k ç=d ~ë	PORVMNVHMV	NKU	PONUTOUKRU	NMNKOR	RVHR	NOMKQ	
_á	OMV	e É	NQUPRRRHMT	NKQ	NRVQNVSKTN	VPHMS	RVHR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNM

cãÉ=k~ã É MOVpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OO^ hÅ

^Åè=qãã É PLOQLOMOP=NUMRVWOS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKMNT	éé Ä	k L^	VOKOO	NMM	
NN	_	S	k ç=d ~ë	NKTST	éé Ä	SKM	NVMQKSM	NMMM	
OP	k ~	QR	e É	NVOKVUN	éé Ä	NKR	RQUVQKMS	OMMMMM	
OQ	j Ö	QR	e É	OSKPTM	éé Ä	TKS	NUUSKUR	OMMMMM	
OT	^ ä	QR	e É	JSOKMRO	éé Ä	k L^	NRMTKUV	OMMMMM	
OU	pá	QR	e O	OMKUOV	éé Ä	NMKT	ONTVKNQ	NMMMM	
PV	h	QR	e É	NPRKVPQ	éé Ä	NNKT	PQTNOKPS	OMMMMM	
QM	` ~	QR	e O	SMKRRP	éé Ä	OKV	QVUNRKPO	OMMMMM	
RN	s	UV	e É	MKQUP	éé Ä	NPKU	SMNKNP	NMMM	
RO	` ê	UV	e É	MKPSV	éé Ä	VKQ	NMRNKUQ	OMMM	
RR	j å	UV	e É	NKOPM	éé Ä	NKM	UTQKRP	OMMM	
RS	cÉ	UV	e O	NSRKPVO	éé Ä	NKQ	PVNNTSKPO	NMMMMM	
RV	` ç	UV	e É	MKMRM	éé Ä	RSKO	NVPKPQ	NMMM	
SM	k á	UV	e É	MKOSN	éé Ä	NUKO	PNPKPQ	NMMM	
SP	` ì	UV	e É	MKQVU	éé Ä	NNKM	NVQSKTO	OMMM	
SS	wå	UV	e É	PVKUMR	éé Ä	NKR	NMSQQKON	OMMM	
TR	^ ë	UV	e É	MKNPU	éé Ä	OSKN	PVMPP	NMMM	
TU	pÉ	UV	e O	MKMVR	éé Ä	POKO	NNKRM	NMMM	
UU	pê	UV	e É	MKNRR	éé Ä	QOKS	NMSKST	OMMM	
VR	j ç	UV	e É	NKMPV	éé Ä	UKO	STMKMP	NMMM	
NMT	^ Ö	UV	e É	MKMOM	éé Ä	STKS	QSKST	NMM	
NNN	` Ç	UV	e É	MKMSV	éé Ä	PSKS	NVKSP	NMMM	
NNU	på	NRV	e É	MKMNP	éé Ä	PRQKU	QTSKSV	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNOV	éé Ä	OKQ	UOTKRT	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKQOS	éé Ä	NMKR	RRPKVQ	OMMM	
NUO	t	NRV	k ç=d ~ë	MKQOR	éé Ä	TKT	NTRRKPN	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMTQ	éé Ä	NVKM	VQQKPT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMSN	éé Ä	PVKR	NPPQKTU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNUM	éé Ä	VKO	OVPSKTV	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMQV	éé Ä	TKN	PPMKPR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` = çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NTUUSOUKUO	NKN	ONOOPOPQQO	UQKOU	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PVQSTNOKOQ	OKR	QRNVVMMKMQ	UTHPO	RVKR	NOMQ	
pÅ	QR	e O	UVOMUSKNN	NKT	NMSVRVUKVR	UPKQ	RVKR	NOMQ	
pÅ	QR	e É	NPNTTQKOV	NKM	NRTTPRKMO	UPKRQ	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VQPOOTKMO	MKU	NMSQPUQKUO	UUKSO	RVKR	NOMQ	
d É	TO	e O	PRQSTSKOO	MKU	QOOMNTKMN	UQKMQ	RVKR	NOMQ	
d É	TO	e É	NMORRMKQR	NKO	NOORSPKSN	UPKST	RVKR	NOMQ	
v	UV	e O	QNTQNQSKVV	MKU	QTSOUURKNQ	UTKSQ	RVKR	NOMQ	
v	UV	e É	SVOVUOKSQ	MKT	UOVQMOKQU	UPKRR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPMUMSTKVP	MKV	SRQQMSTKOO	VSKPV	RVKR	NOMQ	
qÄ	NRV	e É	ORNVRNOKUT	MKP	OURMTNTKVP	UUKPU	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	POROQVRKSV	OKM	PONUTOUKRU	NMNKOQ	RVKR	NOMQ	
_á	OMV	e É	NQUMTSPKPP	NKM	NRVQNVSKTN	VOKUU	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNN

cãÉ=k~ã É MPMpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf^ mj eyNya^q^yOMCPyMPJ ^oyi n` OQ^hÅ

^Åè=qáã É PLOQLOMCP=NVMMQMRR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==\ mp==	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	JMMNM	éé Ä	k L^	NMMMM	NMM	
NN	_	S	k ç=d ~ë	VMNPO	éé Ä	NMP	SVOVMRQ	NMMM	
OP	k ~	QR	e É	OVPNMMSP	éé Ä	NMM	PVVPVUMPM	OMMMMM	
OQ	j Ö	QR	e É	TPSMSOU	éé Ä	MO	QTQQSMNR	OMMMMM	
OT	^ ä	QR	e É	JURMQQT	éé Ä	k L^	VSTKUP	OMMMMM	
OU	pá	QR	e O	NTRCMVRO	éé Ä	MP	NQTOSPMTQ	NMMMM	
PV	h	QR	e É	SRPHPQT	éé Ä	PMM	SPQVRKQV	OMMMMM	
QM	` ~	QR	e O	NPCQMRTU	éé Ä	OMT	UQSOQUMVN	OMMMMM	
RN	s	UV	e É	MQQVV	éé Ä	NNMT	SNTKUM	NMMM	
RO	` ê	UV	e É	MPPNP	éé Ä	OMV	NMVRKUR	OMMM	
RR	j å	UV	e É	NOMOSO	éé Ä	NMV	SPMQKUU	OMMM	
RS	cÉ	UV	e O	TSMVRS	éé Ä	OMP	NUQQVRMPQ	NMMMMM	
RV	` ç	UV	e É	MMNPO	éé Ä	VKU	PPNMNP	NMMM	
SM	k á	UV	e É	MMNRR	éé Ä	SVKO	OSSMST	NMMM	
SP	` ì	UV	e É	MMSRP	éé Ä	NNMR	NORQMRO	OMMM	
SS	wå	UV	e É	JTMVTN	éé Ä	k L^	TVMMUP	OMMM	
TR	^ ë	UV	e É	MQQVS	éé Ä	NUMP	UQMMN	NMMM	
TU	pÉ	UV	e O	MMNST	éé Ä	NVMP	NTMKUP	NMMM	
UU	pê	UV	e É	TMTMT	éé Ä	MO	QRCUMSN	OMMM	
VR	j ç	UV	e É	MMTQT	éé Ä	OMP	RMUMVN	NMMM	
NMT	^ Ö	UV	e É	MMMNN	éé Ä	PMMP	OUMUV	NMM	
NNN	` Ç	UV	e É	MMVOR	éé Ä	NRMP	TMTU	NMMM	
NNU	på	NRV	e É	MQSSM	éé Ä	NSMT	TQQMQU	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MQSSO	éé Ä	SMR	NPTQMUS	NMMM	
NPT	_~	NRV	k ç=d ~ë	NPMQUV	éé Ä	NMS	NSOTTMMU	OMMM	
NUO	t	NRV	k ç=d ~ë	MMPOT	éé Ä	NQMS	NQVNMST	NMMM	
OMR	qä	OMV	k ç=d ~ë	MMMPU	éé Ä	PPMQ	TPQMNQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MMMUM	éé Ä	PPMR	NQQUMCP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MMMTU	éé Ä	PMMV	ONVVMQM	NMMM	
OPU	r	OMV	k ç=d ~ë	MMVQU	éé Ä	OMN	NVPMRQ	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n` =i çï	B n` =e åÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	NTVSVPRMNQ	NMP	ONCCPCPMQO	UQMST	RVMR	NOMMQ	
pÅ	QR	k ç=d ~ë	PVONCRCMMU	NMN	QRNVVMMMMQ	USMTS	RVMR	NOMMQ	
pÅ	QR	e O	UVTTVQMTQ	NMO	NMSVRVUMVR	UPMVQ	RVMR	NOMMQ	
pÅ	QR	e É	NPCRSOMTU	NMQ	NRTTPRMMO	UQMMQ	RVMR	NOMMQ	
d É	TO	k ç=d ~ë	VQRTTPMUR	MMU	NMSQPUQMUO	UUMUS	RVMR	NOMMQ	
d É	TO	e O	PRSRNSMRU	MMT	QCCMNTMMN	UQMQU	RVMR	NOMMQ	
d É	TO	e É	NMQCCCMOV	MMN	NCCRSPMSN	URMMR	RVMR	NOMMQ	
v	UV	e O	QNNVMTRMPQ	NMP	QTSCUURMNQ	USMQU	RVMR	NOMMQ	
v	UV	e É	SVUTSNMQM	MMV	UCVQMCMQU	UQMCR	RVMR	NOMMQ	
qÄ	NRV	k ç=d ~ë	SOMRQVQMSN	NMN	SRQQMVSTMOO	VQMUP	RVMR	NOMMQ	
qÄ	NRV	e É	CROMQMNMMT	NMM	CURMTNTMVP	UUMQN	RVMR	NOMMQ	
_á	OMV	k ç=d ~ë	PNUTTUVMQO	NMP	PONUTCUMRU	VVMMQ	RVMR	NOMMQ	
_á	OMV	e É	NQTQPRUMUN	NMQ	NRVQNVSMTN	VQMQU	RVMR	NOMMQ	

p~ã éäÉ=k~ã É	pn NOMNUMNO
cãÉ=k~ã É	MPNpj mi hÇ
a~í~=m~íÜ=k~ã É	aWjt ÖãÉåíyf^ mj eyNya^q^yOMOPyMPJ ^oyi n ` OO^ hÅ
^Åè=qãã É	PLOQLOMOP=NVMMMOP
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMMOP	ééÄ	k L^	USMST	NMM	
NN	_	S	k ç=d ~ë	VKOPN	ééÄ	NHP	TMORMS	NMMM	
OP	k ~	OR	e É	OVORHPRO	ééÄ	OKO	PVTPNSHRQ	OMMMMM	
OQ	j Ö	OR	e É	TPNHPNN	ééÄ	NKT	QSVQMKM	OMMMMM	
OT	^ ä	OR	e É	JSQKSVN	ééÄ	k L^	NQRMKM	OMMMMM	
OU	pá	OR	e O	NTRQKRPM	ééÄ	OKM	NQRUOQKQV	NMMMM	
PV	h	OR	e É	SPVHPNP	ééÄ	PHR	SOQNUHRR	OMMMMM	
QM	` ~	OR	e O	NPNSKTSM	ééÄ	OKQ	UPOOSVKMR	OMMMMM	
RN	s	UV	e É	MSSOS	ééÄ	NUKN	TOMKMP	NMMM	
RO	` ê	UV	e É	MHPUN	ééÄ	SKQ	NMTSHRM	OMMM	
RR	j å	UV	e É	NOKONQ	ééÄ	NHP	SPMUKOO	OMMM	
RS	cÉ	UV	e O	UMMKQOS	ééÄ	MKN	NUPRMOUKUP	NMMMMM	
RV	` ç	UV	e É	MKNPU	ééÄ	QMKQ	PQOKOQ	NMMM	
SM	k á	UV	e É	MKOPQ	ééÄ	OSHP	PMQKQR	NMMM	
SP	` ì	UV	e É	NKTTV	ééÄ	OKS	OTNQKTS	OMMM	
SS	wå	UV	e É	JRHRRP	ééÄ	k L^	NOVUKVT	OMMM	
TR	^ ë	UV	e É	MKQTU	ééÄ	VKM	VSHPQ	NMMM	
TU	pÉ	UV	e O	MKNTO	ééÄ	UKV	NUHPP	NMMM	
UU	pê	UV	e É	THQUO	ééÄ	PHN	QONSHPQ	OMMM	
VR	j ç	UV	e É	MHRVM	ééÄ	NOKR	QONKNP	NMMM	
NMT	^ Ö	UV	e É	MKMMQ	ééÄ	NOVHS	NQKQQ	NMM	
NNN	` Ç	UV	e É	MKMNT	ééÄ	OQKS	RHRS	NMMM	
NNU	på	NRV	e É	JMKONM	ééÄ	k L^	PRTKTV	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOTP	ééÄ	QMKQ	NQONHRT	NMMM	
NPT	_~	NRV	k ç=d ~ë	NOKVNS	ééÄ	PHP	NRSMRHQQ	OMMM	
NUO	t	NRV	k ç=d ~ë	MKONO	ééÄ	OQKM	NOONHPR	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMMS	ééÄ	k L^	QVPKUT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OKNRV	ééÄ	PHP	NSSUNKTV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMSN	ééÄ	QMHR	OMTRKTN	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMNU	ééÄ	PMKT	NPPKQU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ÉÅ	B n ` =¡ çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NUMVPPPHRR	NKN	ONOOPOPQQO	URHOR	RVHR	NOMQ	
pÅ	OR	k ç=d ~ë	PVPPRPTKQN	NHP	QRNVVMMMVQ	UTHMP	RVHR	NOMQ	
pÅ	OR	e O	UUUPMUKQS	NHS	NMSVRVUKVR	UPHMR	RVHR	NOMQ	
pÅ	OR	e É	NPONMPKUO	MHS	NRTTPRHMO	UPKTR	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VQVUSORRR	MHP	NMSQPUQKUO	UVKOQ	RVHR	NOMQ	
d É	TO	e O	PRQVOVMMV	MKQ	QOOMNTHMN	UQKN	RVHR	NOMQ	
d É	TO	e É	NMPUPRKTS	NKO	NOORSPHSN	UQKTO	RVHR	NOMQ	
v	UV	e O	QNNUTMNKON	MKU	QTSOUURKNQ	USKQT	RVHR	NOMQ	
v	UV	e É	TMNTOUKNQ	MHS	UOVQMOKQU	UQKSN	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SONQSRPKTU	MKT	SRQQMSTKOO	VQKVT	RVHR	NOMQ	
qÄ	NRV	e É	ORRNRMOKOM	NKQ	OURMTNTKVP	UVHR	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PNRVUNNKVS	NKM	PONUTOUKRU	VUKNT	RVHR	NOMQ	
_á	OMV	e É	NRNOUTRKPN	MHP	NRVQNVSKTN	VQKV	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNO

cãÉ=k~ã É MPOpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖãÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OO^ hÅ

^Åè=qãã É PLOQLOMOP=NVMNQMN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå ORKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKOMM	ééÄ	k L^	TOKOO	NMM	
NN	_	S	k ç=d ~ë	NMKVPS	ééÄ	PKT	OPOQKST	NMMM	
OP	k ~	OR	e É	PMOPKVQQ	ééÄ	MKV	NNUMMPKRM	OMMMMM	
OQ	j Ö	OR	e É	TRNKNNN	ééÄ	OKQ	VVUPKTS	OMMMMM	
OT	^ ä	OR	e É	JRNTKRNU	ééÄ	k L^	RRNKNP	OMMMMM	
OU	pá	OR	e O	NUQTKUTT	ééÄ	MKT	PNTNUKNM	NMMMM	
PV	h	OR	e É	NNQTKRVR	ééÄ	PKP	OMSSNKUR	OMMMMM	
QM	` ~	OR	e O	NPSQKNTN	ééÄ	NKR	NURSMUKCN	OMMMMM	
RN	s	UV	e É	MKRUQ	ééÄ	NUKV	POTKTV	NMMM	
RO	` ê	UV	e É	MKRSN	ééÄ	VKN	UCSKRQ	OMMM	
RR	j å	UV	e É	NNKMRT	ééÄ	NKN	NPVPKNQ	OMMM	
RS	cÉ	UV	e O	TURKUVN	ééÄ	NKU	PTSTCUKCO	NMMMM	
RV	` ç	UV	e É	JMKMRN	ééÄ	k L^	VRKRS	NMMM	
SM	k á	UV	e É	JMKNOS	ééÄ	k L^	NUSKST	NMMM	
SP	` ì	UV	e É	NKVQU	ééÄ	NOKV	VPQKQV	OMMM	
SS	wå	UV	e É	JQTKUTS	ééÄ	k L^	QSRKRT	OMMM	
TR	^ ë	UV	e É	MKQTT	ééÄ	NMKS	PPKPP	NMMM	
TU	pÉ	UV	e O	MKQVS	ééÄ	NRKU	NOKMM	NMMM	
UU	pê	UV	e É	TKQTM	ééÄ	VKM	VNMKVR	OMMM	
VR	j ç	UV	e É	OKQMQ	ééÄ	RKP	PSQKQS	NMMM	
NMT	^ Ö	UV	e É	MKMOS	ééÄ	NUKM	NTKTU	NMM	
NNN	` Ç	UV	e É	MKMPS	ééÄ	UQKV	OKVS	NMMM	
NNU	på	NRV	e É	JOKRRT	ééÄ	k L^	NURKRS	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKPPV	ééÄ	NRKT	RSTKOU	NMMM	
NPT	_~	NRV	k ç=d ~ë	NPKNTT	ééÄ	RKV	POSPKUQ	OMMM	
NUO	t	NRV	k ç=d ~ë	NKOMP	ééÄ	NPKQ	NPNNKOR	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMOR	ééÄ	k L^	RMMKRQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OKMSU	ééÄ	NPKN	PVMQKPV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKNUQ	ééÄ	k L^	NQQNKSP	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMOO	ééÄ	VSKN	RMMKR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B¤ÉÅ	B n ` =i çï	B n ` =¤ëÛÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NUVVRQUKPP	MKT	ONOOPOPKQO	UVKR	RVKR	NOMKQ	
pÅ	OR	k ç=d ~ë	PVUPTOQKMM	MKO	ORNVVMMKVQ	UUKNQ	RVKR	NOMKQ	
pÅ	OR	e O	VMSSSPKMQ	QKN	NMSVRVUKVR	UQKTT	RVKR	NOMKQ	
pÅ	OR	e É	NPQRNMKSP	NKO	NRTTPRKMO	URKOU	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VSMRORKUM	MKP	NMSQPUQKUO	VMKOQ	RVKR	NOMKQ	
d É	TO	e O	PSPRRRKUV	PKS	QOOMNTKMN	USKNR	RVKR	NOMKQ	
d É	TO	e É	NMRSPPKSQ	MKR	NOORSPKSN	USKNV	RVKR	NOMKQ	
v	UV	e O	QOOQNNRKQN	NKQ	OTSOUURKNQ	UUKSV	RVKR	NOMKQ	
v	UV	e É	TNPPUVKST	MKS	UOVQMOKQU	USKMN	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SPONSQNKSP	MKV	SRQQMSTKOO	VSKS	RVKR	NOMKQ	
qÄ	NRV	e É	ORNPROTKNV	NKU	OURMTNTKVP	UUKNT	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PNTUORCKCP	NKM	PONUTOUKRU	VUKTQ	RVKR	NOMKQ	
_á	OMV	e É	NORSNNVKRO	NKV	NRVQNVSKTN	VNKPQ	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNO^

cãÉ=k~ã É MPPpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖãÉåíyf^ mj eyNya^q^yOMOPyMPJ ^oyi n` OO^ HÅ

^Åè=qáã É PLOQLOMOP=NVMMVMRV

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä¬Ö
V	_É	S	k ç=d ~ë	NVMKOS	ééÄ	OKQ	NVBSTKQR	NVM	
NN	_	S	k ç=d ~ë	ONQKSNT	ééÄ	OKU	NQTVQVKQQ	NVMM	
OP	k ~	QR	e É	NPTNOKSPN	ééÄ	NKN	NSTSVUTKMT	OMMMM	
OQ	j Ö	QR	e É	NTRVMPOP	ééÄ	NKR	NNMTPQKNQ	OMMMM	
OT	^ ä	QR	e É	VTTKMRO	ééÄ	OKM	ORQMMSM	OMMMM	
OU	pá	QR	e O	SSPSKMVV	ééÄ	NMS	RQPQMVPM	NMMM	
PV	h	QR	e É	NVBMOKTPU	ééÄ	NKQ	RVUVSQKRR	OMMMM	
QM	` ~	QR	e O	OPVNKMVR	ééÄ	NMS	NQUOVMNKVQ	OMMMM	
RN	s	UV	e É	ROKMNR	ééÄ	OKM	QMMUMKRU	NMMM	
RO	` ê	UV	e É	RNKTUV	ééÄ	MKV	RMRSUKRS	OMMM	
RR	j å	UV	e É	PPKOSP	ééÄ	NKU	NSPVQKQO	OMMM	
RS	cÉ	UV	e O	NUOOKVUM	ééÄ	OKN	QNPTTUVMSO	NMMMM	
RV	` ç	UV	e É	NVMSMT	ééÄ	NKR	NTRUMKQU	NMMM	
SM	k á	UV	e É	ONKRPP	ééÄ	NKT	NMVOOKSU	NMMM	
SP	` ì	UV	e É	PQKPMR	ééÄ	MKO	QPVPVKOO	OMMM	
SS	wå	UV	e É	NVOKTRM	ééÄ	OKN	OPQVRKSS	OMMM	
TR	^ ë	UV	e É	ROKMMU	ééÄ	NKO	URMVKNR	NMMM	
TU	pÉ	UV	e O	RMKSPO	ééÄ	NKR	QRRQKPS	NMMM	
UU	pê	UV	e É	RTKSPV	ééÄ	MKP	PPOUTKOM	OMMM	
VR	j ç	UV	e É	ROKMUP	ééÄ	OKR	OVQMQKNN	NMMM	
NMT	^ Ö	UV	e É	NVKSNS	ééÄ	OKM	ONQSUKPP	NMM	
NNN	` Ç	UV	e É	NVKQST	ééÄ	PKP	OUPRKNP	NMMM	
NNU	på	NRV	e É	RMKNQU	ééÄ	NKN	OTTQNKMM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	VKVSO	ééÄ	NKP	QONOVKTP	NMMM	
NPT	_~	NRV	k ç=d ~ë	PQKQQO	ééÄ	NKO	QNRMNKNS	OMMM	
NUO	t	NRV	k ç=d ~ë	RQKQUN	ééÄ	NKN	NPMNVSKSV	NMMM	
OMR	qä	OMV	k ç=d ~ë	VKOPP	ééÄ	MKS	RMSOOKPS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NOKNQR	ééÄ	MKS	VOQRTKQQ	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	VKUUV	ééÄ	MKV	SUMQMKPV	NMMM	
OPU	r	OMV	k ç=d ~ë	NVKOMS	ééÄ	MKV	SPOSUKNR	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n` =ï çï	B n` =¤ä ÜÜ	n` =¤ä¬Ö
i á	S	k ç=d ~ë	NUNMTMUKUT	OKU	ONOOPOPKQO	URKPO	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVNQSNOKNN	MKU	QRNVVMMKMQ	USHSN	RVKR	NOMKQ	
pÅ	QR	e O	UTTNSMKUQ	NKT	NMSVRVUKVR	UOKMN	RVKR	NOMKQ	
pÅ	QR	e É	NOVUURKPP	NKP	NRTTPRKMO	UOKPQ	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VPNUUPKSQ	MKO	NMSQPUQKUO	UTHRR	RVKR	NOMKQ	
d É	TO	e O	PRQOUPKOM	NKQ	QOOMNTKMN	UPKVR	RVKR	NOMKQ	
d É	TO	e É	NMPNPRKMT	NKP	NOORSPKSN	UQKNR	RVKR	NOMKQ	
v	UV	e O	QMUVNONKVO	MKT	OTSOUURKNQ	URKUR	RVKR	NOMKQ	
v	UV	e É	SUUVQVKVR	MKV	UOVQMOKQU	UPKMT	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SOMRCPVKOR	MKV	SRQQMSTKOO	VQKUO	RVKR	NOMKQ	
qÄ	NRV	e É	OQTNQNMKPS	NKP	OURMTNTKVP	USHSV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	POQVTOMKUO	MKV	PONUTOUKRU	NMMKVS	RVKR	NOMKQ	
_á	OMV	e É	NQTRUTVHSQ	MKQ	NRVQNVSKTN	VOKRU	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNOm

cãÉ=k~ã É MPQpj mi HÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OQ^HÅ

^Åè=qãã É PLOQLOMOP=NMWRMT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	RMKUQR	éé Ä	NHP	RPSTNKTP	NMM	
NN	_	S	k ç=d ~ë	RPQKVVT	éé Ä	OHS	PSTVUSKQV	NMMM	
OP	k ~	QR	e É	NNQMUKTVV	éé Ä	NKT	NQOSNNQKPT	OMMMMM	
OQ	j Ö	QR	e É	SMSTHSQV	éé Ä	MKT	PUTVQNKTR	OMMMMM	
OT	^ ä	QR	e É	OMOPKMSQ	éé Ä	NKV	RMTVNKQQ	OMMMMM	
OU	pá	QR	e O	OUSNKTPQ	éé Ä	NKQ	OPTTTPVKPU	NMMMM	
PV	h	QR	e É	NNMVRKOQV	éé Ä	OKM	SPSMRVKV	OMMMMM	
QM	` ~	QR	e O	QMSOKMVM	éé Ä	NKM	ORQSQMRKRP	OMMMMM	
RN	s	UV	e É	RMVKNUN	éé Ä	MKQ	PVPMOOKMR	NMMM	
RO	` ê	UV	e É	OMRKPON	éé Ä	NKM	NVVTOUKRP	OMMM	
RR	j å	UV	e É	RNTKOTN	éé Ä	MKU	ORCSOMKTU	OMMM	
RS	cÉ	UV	e O	NTUUHSQS	éé Ä	MKP	QNSQPNNKQM	NMMMMM	
RV	` ç	UV	e É	ROTKNPQ	éé Ä	MKQ	UTQMVTKTV	NMMM	
SM	k á	UV	e É	RORKUUQ	éé Ä	MKO	OQQPSUKTM	NMMM	
SP	` ì	UV	e É	OSVKVNV	éé Ä	MKP	PQRNQRKTO	OMMM	
SS	wå	UV	e É	ROVKVPQ	éé Ä	MKR	NNNUTTKNS	OMMM	
TR	^ ë	UV	e É	NMSKMUO	éé Ä	MKU	NTQRQKMT	NMMM	
TU	pÉ	UV	e O	NMQKOMU	éé Ä	NKP	VSNNKRO	NMMM	
UU	pê	UV	e É	RPOKPRM	éé Ä	MKR	PMVPMQKTN	OMMM	
VR	j ç	UV	e É	NNMKVMV	éé Ä	NKM	SOVPRKRS	NMMM	
NMT	^ Ö	UV	e É	QVKORP	éé Ä	NKN	NMVOPQKSQ	NMM	
NNN	` Ç	UV	e É	OTQKQRT	éé Ä	NKP	TQUNTKOU	NMMM	
NNU	på	NRV	e É	ROPKUMQ	éé Ä	MKP	OUUNNQKPP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NMVKONT	éé Ä	OKN	QOTNNMKVU	NMMM	
NPT	_~	NRV	k ç=d ~ë	OMTUKPVN	éé Ä	OKP	ORPSSRUKPQ	OMMM	
NUO	t	NRV	k ç=d ~ë	NNPKOUT	éé Ä	NKO	OTPSTOKMQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	NMVKROV	éé Ä	NKQ	RPVMPVKOV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NMVKVVQ	éé Ä	MKU	UNVVTTKTR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NMOKPVU	éé Ä	MKQ	STVUMTHSN	NMMM	
OPU	r	OMV	k ç=d ~ë	NMVKTNM	éé Ä	NKP	STNPSVKVM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ ÉÅ	B n ` =¨ çï	B n ` =¤ äÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NUNNQONKPU	NKR	ONOOPOPKQO	URKPR	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVPOOPRKON	NKR	QRNVVMMKMQ	UT	RVKR	NOMKQ	
pÅ	QR	e O	UUUUUVKUQ	MKT	NMSVRVUKVR	UPKN	RVKR	NOMKQ	
pÅ	QR	e É	NPOMVTKNS	MKT	NRTTPRKMO	UPKTR	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VPQMTVKUV	MKS	NMSQPUQKUO	UTKTS	RVKR	NOMKQ	
d É	TO	e O	PRVMOPKPT	MKT	QOOMNTKMN	URKMT	RVKR	NOMKQ	
d É	TO	e É	NMOVTPKON	MKS	NOORSPKSN	UQKMO	RVKR	NOMKQ	
v	UV	e O	QNVPTOSKRP	MKQ	QTSOUURKNQ	UUKVR	RVKR	NOMKQ	
v	UV	e É	SVPQQUKRV	NKN	UOVQMOKQU	UPKSN	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SOVNQSRKMU	OKM	SRQQMSTKOO	VSKNQ	RVKR	NOMKQ	
qÄ	NRV	e É	OQVQSUNKTT	MKU	OURMTNTKVP	UTHRN	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	POMVNVRKQN	MKQ	PONUTOUKRU	VVKT	RVKR	NOMKQ	
_á	OMV	e É	NQSNRQUKNP	OKP	NRVQNVSKTN	VNKSU	RVKR	NOMKQ	

`çåíaåìåaÖ=~äåÄê~íáçå=sÉêáÑáÅ~íáçå=E``sF=oÉéçêí

p~ã éäÉ=k~ã É	``s
cãÉ=k~ã É	MPR|``sKÇ
a~í~=m~íÜk~ã É	aWy^ÖãÉáíyf^mj eyNya^q^yQMOPyMPJ ^oyi n``OQ^kÄ
^Åè=qáã É	PLOQLOMOP=NVMROMRQ
p~ã éäÉ=qóéÉ	``s
qçí~äa ãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MVS^i_KÇ
p~ã éäÉ=n``=m~ëëlcá~ä	m~ëë
fpqa=n``=m~ëëlc~äí	m~ëë
l éÉê~íçê	**~Çã áå**

n``=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n``=c ä~Ö
V	_É	S	k ç=d ~ë	OQKUVM	éëÄ	MKU	NPSVTNKCN	CR	VVKRS	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OQKVOU	éëÄ	MKO	VMVUQKTV	CR	VVKTN	UVKU	NNMO	
OP	k ~	CR	e É	RPSNKQTU	éëÄ	OKQ	PPNUSPOKUQ	RMMM	NMTKOP	UVKU	NNMO	
OQ	j Ö	CR	e É	RQPMKPMV	éëÄ	NKN	NTQURVRKSV	RMMM	NMUKSN	UVKU	NNMO	
OT	^ä	CR	e É	RMUKTRO	éëÄ	NKM	SOVVQKNU	RMM	NMNKTR	UVKU	NNMO	
OU	pá	CR	e O	RMPKVNN	éëÄ	MKR	ONSPVNKUV	RMM	NMMKTU	UVKU	NNMO	
PV	h	CR	e É	RNSPKSPN	éëÄ	MKP	NQRQVUPKUT	RMMM	NMPKOT	UVKU	NNMO	
QM	` ~	CR	e O	RNSNKVQU	éëÄ	MKS	NSSQSPMPKPS	RMMM	NMPKOQ	UVKU	NNMO	
RN	s	UV	e É	ORKQRP	éëÄ	OKQ	VUUVMKQS	CR	NMNKUN	UVKU	NNMO	
RO	` ê	UV	e É	ORKQPO	éëÄ	NKU	NOQRUPKPM	CR	NMNKTP	UVKU	NNMO	
RR	j å	UV	e É	ORMVSR	éëÄ	NKR	SNTOOKNM	CR	NMMKOS	UVKU	NNMO	
RS	cÉ	UV	e O	RNTPKMNN	éëÄ	MKO	RUPTVMNVKUU	RMMM	NMPKQS	UVKU	NNMO	
RV	` ç	UV	e É	ORKTUS	éëÄ	MKV	ONQVQOKRR	CR	NMPKNQ	UVKU	NNMO	
SM	k á	UV	e É	ORKQVO	éëÄ	OKO	RVNTUKPR	CR	NMNKVT	UVKU	NNMO	
SP	` ì	UV	e É	ORKTRP	éëÄ	NKP	NSRSUUKUS	CR	NMPKMN	UVKU	NNMO	
SS	wå	UV	e É	OQKTSN	éëÄ	NKN	OUNPUKTR	CR	VVKMQ	UVKU	NNMO	
TR	^ë	UV	e É	ORKQMN	éëÄ	MKQ	OMUPNKPV	CR	NMMKU	UVKU	NNMO	
TU	pÉ	UV	e O	ORKQMV	éëÄ	MKS	NNOVNKMQ	CR	NMMKUQ	UVKU	NNMO	
UU	pê	UV	e É	ORKQMS	éëÄ	MKT	TQNUVKRT	CR	NMNKSO	UVKU	NNMO	
VR	j ç	UV	e É	OQKQUR	éëÄ	NKU	SVUNNKMQ	CR	VTKVQ	UVKU	NNMO	
NMT	^Ö	UV	e É	ORKSNU	éëÄ	MKU	OSNVUOKPO	CR	NMOKQT	UVKU	NNMO	
NNN	` Ç	UV	e É	ORKVRQ	éëÄ	MKS	PRRRPKUN	CR	NMPKUO	UVKU	NNMO	
NNU	på	NRV	e É	OQKVNT	éëÄ	MKS	SUPROKVQ	CR	VVKST	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKOTS	éëÄ	MKP	ROQPMOKRM	CR	VTKN	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKTOP	éëÄ	MKR	NRVNRQKRM	CR	NMOKUV	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKORQ	éëÄ	MKU	PMVMTNKTV	CR	NMNKMO	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	OQKTPT	éëÄ	NKR	SRSQTNKNM	CR	VUKVR	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	ORKTTQ	éëÄ	MKT	VRNMNSKOV	CR	NMPKN	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	ORKRQO	éëÄ	NKO	UPVMRRKQM	CR	NMOKNT	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKOVM	éëÄ	NKN	TVSQPQKQO	CR	NMRKNS	UVKU	NNMO	

n``=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n``=ç ïï	B n``=c äÜÜ	n``=c ä~Ö
i á	S	k ç=d ~ë	NUVMTVQKPU	NKM	ONOOPOPKQO	UVKMV	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVOOMTSKRM	MKQ	QRNVVMMKMQ	USKTT	RVKR	NOMQ	
pÅ	CR	e O	VNUSSTKQN	MKU	NMSVRVUKVR	URKUV	RVKR	NOMQ	
pÅ	CR	e É	NPPNMSKUU	MKS	NRTTPRKMO	UQKPV	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VQSPSTKUP	MKP	NMSQPUQKUO	UUKVN	RVKR	NOMQ	
d É	TO	e O	PSPPVTKPU	NKN	QOOMNTKMN	USKNN	RVKR	NOMQ	
d É	TO	e É	NMPTRMKRP	NKS	NOORSPKSN	UQKSR	RVKR	NOMQ	
v	UV	e O	QMTPRVSKVU	NKQ	QTSOUURKNQ	URKRP	RVKR	NOMQ	
v	UV	e É	SVSVNQKTQ	MKS	UOVQMOKQU	UQKMP	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPTRSTPKOM	MKP	SRQQMSTKOO	VTKQP	RVKR	NOMQ	
qÄ	NRV	e É	OQTRROPKVU	MKO	OURMTNTKVP	USKUQ	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PNTTPUMKOR	MKU	PONUTOUKRU	VUKTO	RVKR	NOMQ	
_á	OMV	e É	NQNVVRMKRM	NKT	NRVQNVSKTN	UVKMT	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=Ê`_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MPS|``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíyî mj eyNya^q^yOMOPyMPJ ^oyi n`OQ^kÂ

^Åè=qáã É PLOQLOMOP=NVMQOMT

p~ã éáÉ=qóéÉ ``_

qçí~äa äã íáçå NKMMMM

`çã ã Éåí JJJ

fpqa=oÉÑc äÉk~ã É MVS^i_KÇ

p~ã éáÉ=n`=m~ëëlcá~ä c~ää

fpqa=n`=m~ëëlc~äã m~ëë

l éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÄK	r åáë	opa	==\ mp==	i ãì á	n`=c ä~Ö
V	_É	S	k ç=d ~ë	MKMNM	éé Ä	QVKV	NTSKST	MO	
NN	_	S	k ç=d ~ë	MKPQR	éé Ä	RKN	QVSRKTP	Q	
OP	k~	QR	e É	SKNUV	éé Ä	NNKT	QUUOVKUU	QVM	
OQ	j Ö	QR	e É	PKRVQ	éé Ä	NRKR	NQOVKMO	QM	
OT	^ä	QR	e É	JOPKTSV	éé Ä	k L^	NVOKOP	QM	c~äë^ äëj ÉÍÜçÇë& c~äÉÇ=a ça
OU	pá	QR	e O	MKSOV	éé Ä	NUKM	TPMKTV	NVM	
PV	h	QR	e É	NVKUQN	éé Ä	NMKN	PQRUOKNQ	QVM	
QM	`~	QR	e O	QKSSS	éé Ä	VKS	OTPORKRQ	QM	
RN	s	UV	e É	MKMNP	éé Ä	SUKU	OVRKRS	N	
RO	`ê	UV	e É	MKMOM	éé Ä	RPKN	UPTKOM	N	
RR	j å	UV	e É	JMKMRU	éé Ä	k L^	NQOKSQ	MQ	
RS	cÉ	UV	e O	PKRPO	éé Ä	NVKT	QVUVUKVN	QM	
RV	` ç	UV	e É	MKMNT	éé Ä	ORKT	OSOKOQ	MO	
SM	k á	UV	e É	JMKMVN	éé Ä	k L^	QVOKOP	MQ	
SP	` ì	UV	e É	MKMNP	éé Ä	QUKV	ROPKPR	MS	
SS	wå	UV	e É	JOKNST	éé Ä	k L^	QVQKQR	O	c~äë^ äëj ÉÍÜçÇë& c~äÉÇ=a ça
TR	^ë	UV	e É	MKMOR	éé Ä	SKN	PVKPP	N	
TU	pÉ	UV	e O	MKMQO	éé Ä	NKU	OOKMM	N	
UU	pê	UV	e É	MKMOT	éé Ä	PQKS	NVNKNN	N	
VR	j ç	UV	e É	MKNUN	éé Ä	QKR	SPNKNQ	N	
NVT	^Ö	UV	e É	MKMNP	éé Ä	NSKT	NRNKNO	MO	
NNN	` Ç	UV	e É	MKMNP	éé Ä	OSKR	QVMKM	MO	
NNU	på	NRV	e É	JMKMNM	éé Ä	k L^	QRRKRT	N	
NON	pÄ	NRV	k ç=d ~ë	MKMOT	éé Ä	OPKR	UUQKOV	MO	
NPT	_~	NRV	k ç=d ~ë	MKMSQ	éé Ä	PNKT	QPTKNQ	MQ	
NUO	t	NRV	k ç=d ~ë	MKOMP	éé Ä	QRKR	PPMMKRT	N	
OVR	qä	OVV	k ç=d ~ë	MKMSP	éé Ä	NPKT	OQRVKOU	MO	
OVU	mÄ	OVV	k ç=d ~ë	MKMMU	éé Ä	SKN	NNUQKSM	MO	
OPO	qÜ	OVV	k ç=d ~ë	MKMUS	éé Ä	PNKV	QSMRKTO	N	
OPU	r	OVV	k ç=d ~ë	MKMOO	éé Ä	NVMP	SVQKMU	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ= mp	B=oÉÁ	B n`=ç ï	B n`=cëÜ	n`=c ä~Ö
iá	S	k ç=d ~ë	NVTMOUQKRP	NKU	ONOOPOPKQO	VOKUQ	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QMNTQOOKSP	OKR	QRNVVMMKMQ	UUKUU	RVKR	NOMQ	
pÅ	QR	e O	VNVRTTKMT	OKQ	NMSVRVUKVR	URKVT	RVKR	NOMQ	
pÅ	QR	e É	NPVPPUKPS	MKN	NRTTPRKMO	UUKPQ	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	VUNVOPKNO	MKU	NMSQPUQKUO	VOKOR	RVKR	NOMQ	
dÉ	TO	e O	PTNMPMKOT	OKM	QOOMNTKMN	UTKVO	RVKR	NOMQ	
dÉ	TO	e É	NMUUQMKO	MKR	NOORSPKSN	UUKU	RVKR	NOMQ	
v	UV	e O	QOMPOQUKTR	NKP	QTSOUURKNQ	UUKOR	RVKR	NOMQ	
v	UV	e É	TPROVVKRQ	MKQ	UOVQMOKQU	UUKSR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SRRSPROKVP	NKR	SRQQMSTKOO	NMVKNV	RVKR	NOMQ	
qÄ	NRV	e É	OSMPVMSKQV	MKU	OURMTNTKVP	VNKPQ	RVKR	NOMQ	
_á	OVV	k ç=d ~ë	POTMPMTKVQ	OKV	PONUTOUKRU	NMNKS	RVKR	NOMQ	
_á	OVV	e É	NROVUTVKNR	MKP	NRVQNVSKTN	VRKVT	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNQp

cãÉ=k~ã É MPTpj mi hÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ hÅ

^Åè=qãã É PLOQLOMCP=NMVQTNMP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==\ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	RRKQST	ééÄ	MKU	RURVRKVQ	NMM	
NN	_	S	k ç=d ~ë	RRVKUPP	ééÄ	NKP	PUQUQPKQO	NMMM	
OP	k ~	QR	e É	NNSPPKNSO	ééÄ	NKV	NQQVUPUKQO	OMMMMM	
OQ	j Ö	QR	e É	SOVRKVOT	ééÄ	NKR	PVRUTOKTR	OMMMMM	
OT	^ ä	QR	e É	ONSTKUPM	ééÄ	NKT	RPRTMKPT	OMMMMM	
OU	pá	QR	e O	OUPUKUQN	ééÄ	OKN	OPSRVOKUR	NMMMM	
PV	h	QR	e É	NNPRMSRN	ééÄ	NKR	SQURSSKUQ	OMMMMM	
QM	` ~	QR	e O	ONSRKNRM	ééÄ	NKQ	OSNSSOPKNQ	OMMMMM	
RN	s	UV	e É	RRMKUSP	ééÄ	OKS	QORNSOKPS	NMMM	
RO	` ê	UV	e É	OOMKOTN	ééÄ	PKN	ONQOOUKTR	OMMM	
RR	j å	UV	e É	RSNKOQV	ééÄ	OKP	OTQNMNKMR	OMMM	
RS	cÉ	UV	e O	NVOOKMSP	ééÄ	NKQ	OPRSUURKUM	NMMMMM	
RV	` ç	UV	e É	RTVKMTO	ééÄ	OKN	VSMPSRKNU	NMMM	
SM	k á	UV	e É	RSNKMVO	ééÄ	OKM	ORUSMOKPR	NMMM	
SP	` ì	UV	e É	OUQKTQN	ééÄ	OKR	PSQMTUKMO	OMMM	
SS	wå	UV	e É	RSTKMUR	ééÄ	NKV	NNVRSOKTQ	OMMM	
TR	^ ë	UV	e É	NMUKUSU	ééÄ	OKP	NTVNNKPR	NMMM	
TU	pÉ	UV	e O	NVSKVPQ	ééÄ	MKS	VRVOKNU	NMMM	
UU	pê	UV	e É	RRNKVSR	ééÄ	NKP	POMTRVKRN	OMMM	
VR	j ç	UV	e É	NNOKMSR	ééÄ	MKS	SPSMRKPR	NMMM	
NMT	^ Ö	UV	e É	ROKNTU	ééÄ	NKQ	NMSOMSKOS	NMM	
NNN	` Ç	UV	e É	OUNKSMT	ééÄ	NKQ	TSTTSKMR	NMMM	
NNU	på	NRV	e É	RPNKRSN	ééÄ	MKN	OVOPMNKSO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NVPKVRP	ééÄ	MKO	QONRUMKMT	NMMM	
NPT	_~	NRV	k ç=d ~ë	OOSPKNRV	ééÄ	MKT	OTRPOSSKNQ	OMMM	
NUO	t	NRV	k ç=d ~ë	NNSHPRO	ééÄ	NKM	OUMNMVKUO	NMMM	
OMR	qä	OMV	k ç=d ~ë	NVPHPUN	ééÄ	OKS	RRVUNVKRM	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NNOKUMV	ééÄ	NKR	UQVQQQOKUV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NVSKMUR	ééÄ	NKP	TNNPUTHPT	NMMM	
OPU	r	OMV	k ç=d ~ë	NNOKSMO	ééÄ	MKQ	SVSOMOKPP	NMMM	

n ` =fpqa=q~ÄäÉ

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUNVMUNKNU	MKN	ONOOPOPKQO	URKOV	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVMRVPPKQU	NKV	QRNVVMMKMQ	USKQO	RVKR	NOMKQ	
pÅ	QR	e O	UVNQPNKTO	MKS	NMSVRVUKVR	UPHPQ	RVKR	NOMKQ	
pÅ	QR	e É	NPNTVVKSS	NKU	NRTTPRKMO	UPHRS	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VPUMTUKSU	NKS	NMSQPUQKUO	UUKNP	RVKR	NOMKQ	
d É	TO	e O	PRQQONKST	MKN	QOOMNTKMN	UPKVU	RVKR	NOMKQ	
d É	TO	e É	NMOOVKOP	NKM	NOORSPKSN	UPKQT	RVKR	NOMKQ	
v	UV	e O	QMTVTTPKVV	MKU	QTSOUURKNQ	URKSS	RVKR	NOMKQ	
v	UV	e É	SVPSOPKVN	NKT	UOVQMOKQU	UPKSP	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SOSVPPPKQT	NKR	SRQQMSTKOO	VRKU	RVKR	NOMKQ	
qÄ	NRV	e É	ORNNNRTKRU	NKM	OURMTNTKVP	UUKMV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	POQOOSOKTT	OKU	PONUTOUKRU	NMVKTQ	RVKR	NOMKQ	
_á	OMV	e É	NQTSMTPKOP	NKQ	NRVQNVSKTN	VOKRV	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNP

cãÉ=k~ã É MPUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf^ mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ hÅ

^Åè=qãã É PLCQLOMCP=NVMRRVQR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MMVCP	ééÄ	RQKM	NPRKRS	NMM	
NN	_	S	k ç=d ~ë	NCKCNM	ééÄ	MKR	VNCRKCR	NMMM	
CP	k ~	QR	e É	PCQSKSMN	ééÄ	CHP	CPOSRSKTP	CMMMMM	
CQ	j Ö	QR	e É	UUSKMTU	ééÄ	NKR	RSPRUKUT	CMMMMM	
CT	^ ä	QR	e É	JRNKCCO	ééÄ	k L^	NTRVMKNQ	CMMMMM	
CU	pá	QR	e O	NPPTKCRN	ééÄ	NKQ	NNNNNUKTU	NMMMM	
PV	h	QR	e É	TRCKSCS	ééÄ	CKO	SUMSPKMU	CMMMMM	
QM	` ~	QR	e O	NSUNKTQV	ééÄ	NKQ	NVRUCPVKTV	CMMMMM	
RN	s	UV	e É	MKVQS	ééÄ	PKS	VSQKRM	NMMM	
RO	` ê	UV	e É	MKRMQ	ééÄ	NVKQ	NNVNKNS	CMMM	
RR	j å	UV	e É	NQKMRR	ééÄ	CHP	TNUNKNO	CMMM	
RS	cÉ	UV	e O	NMNMCRQ	ééÄ	NKV	CPMUSRTHSV	NMMMM	
RV	` ç	UV	e É	MKRUR	ééÄ	NUKO	NMUSKTR	NMMM	
SM	k á	UV	e É	MKQVU	ééÄ	PKR	QCRKRT	NMMM	
SP	` ì	UV	e É	MKRQR	ééÄ	UKM	NNNQKRN	CMMM	
SS	wå	UV	e É	JNKRUS	ééÄ	k L^	CNNSKUT	CMMM	
TR	^ ë	UV	e É	MKSSQ	ééÄ	CKQ	NCSKSU	NMMM	
TU	pÉ	UV	e O	MKCUV	ééÄ	NSKT	CUKUP	NMMM	
UU	pê	UV	e É	VKPMQ	ééÄ	NKR	RQSMKMS	CMMM	
VR	j ç	UV	e É	MKSQO	ééÄ	NNKS	QCQUKVN	NMMM	
NMT	^ Ö	UV	e É	MKMRO	ééÄ	OSKS	NNPHPQ	NMM	
NNN	` Ç	UV	e É	MKCPR	ééÄ	CPKS	SRKRS	NMMM	
NNU	på	NRV	e É	MKPNP	ééÄ	CRKU	SQMMVP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKQRO	ééÄ	PKN	CCCCKRO	NMMM	
NPT	_~	NRV	k ç=d ~ë	NQKUVR	ééÄ	NKT	NUPSUKQV	CMMM	
NUO	t	NRV	k ç=d ~ë	MKSSU	ééÄ	OQKO	CPRSKMQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKOSO	ééÄ	NRKN	NVRCKCO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	PKCPQ	ééÄ	PKQ	CRNQSKMR	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	NKNNS	ééÄ	NVKV	VNSSKQM	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNMV	ééÄ	NOKT	SVQKMU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =i çï	B n ` =¤ äÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NUNSRSSKCN	MKP	CNCCPCPKQO	URKRV	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PVCSNRQKSQ	MKN	QRNVVMMKMQ	USKUS	RVKR	NOMQ	
pÅ	QR	e O	UUTNCUKNN	NKM	NMSVRVUKVR	UCKVQ	RVKR	NOMQ	
pÅ	QR	e É	NPNMVRKVM	NKO	NRTTPRKMO	UPKVR	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VQROVQKSM	MKR	NMSQPUQKUO	UUKUN	RVKR	NOMQ	
d É	TO	e O	PRRUSPKSV	NKO	QCCMNTKMN	UQKPO	RVKR	NOMQ	
d É	TO	e É	NMQNNSKUQ	NKN	NCCRSPKSN	UQKVR	RVKR	NOMQ	
v	UV	e O	QNNMQVUKRS	NKS	QTSCUURKNQ	USKP	RVKR	NOMQ	
v	UV	e É	SVUCSSKQM	MKS	UCVQMCKQU	UQKMV	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPQQTPQKCS	NKM	SRQQMSTKOO	VSKVR	RVKR	NOMQ	
qÄ	NRV	e É	CRMRUUCKQN	NKO	CURMTNTKVP	UTKV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PCPQUNQKQR	MKT	PCNUTCUKRU	NMMKR	RVKR	NOMQ	
_á	OMV	e É	NQUSSTTKRU	OKN	NRVQNVSKTN	VPKCS	RVKR	NOMQ	

p~ã éäÉ=k~ã É	pn NOMNUMNQ
cãÉ=k~ã É	MPVpj mi hÇ
a~í~=m~íÜ=k~ã É	aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^hÅ
^Åè=qãã É	PLCQLOMCP=OMMMMRO
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKMMP	éé Ä	k L^	NNMKMM	NMM	
NN	_	S	k ç=d ~ë	UHPMM	éé Ä	CKT	SRCCKSU	NMMM	
CP	k ~	CR	e É	NRRRKCCS	éé Ä	NKU	COVSPNKQT	CMMMMM	
CQ	j Ö	CR	e É	CCPKMVT	éé Ä	CKQ	NCPTSHRQ	CMMMMM	
CT	^ ä	CR	e É	MKSCN	éé Ä	VCTKU	OVRVKCR	CMMMMM	
CU	pá	CR	e O	PNPVKCUV	éé Ä	CKR	CCTCCTKUV	NMMMM	
PV	h	CR	e É	NTNKSST	éé Ä	CKQ	PSRNCKCS	CMMMMM	
QM	` ~	CR	e O	PNMKCNR	éé Ä	NKO	NVCUMNKSS	CMMMMM	
RN	s	UV	e É	NKPTP	éé Ä	NKO	NCOVCKPN	NMMM	
RO	` ê	UV	e É	MKURN	éé Ä	VKM	NRCRKNP	CMMM	
RR	j å	UV	e É	NTKUTS	éé Ä	CKM	VMOTKUQ	CMMM	
RS	cÉ	UV	e O	NMMCKSTR	éé Ä	NKT	CCPMCMMKTO	NMMMMM	
RV	` ç	UV	e É	MKCMS	éé Ä	RKO	CRPKPS	NMMM	
SM	k á	UV	e É	MKNRR	éé Ä	NCKP	CSRKRS	NMMM	
SP	` ì	UV	e É	MKPTN	éé Ä	NCKO	UUTKUO	CMMM	
SS	wå	UV	e É	JVKMVR	éé Ä	k L^	RTCKCR	CMMM	
TR	^ ë	UV	e É	MKRUR	éé Ä	NMKS	NNPKPQ	NMMM	
TU	pÉ	UV	e O	MKNQO	éé Ä	CUKS	NRKNT	NMMM	
UU	pê	UV	e É	CKVCP	éé Ä	TKV	NTPCKPT	CMMM	
VR	j ç	UV	e É	MKRNQ	éé Ä	NCKU	PTCKQS	NMMM	
NMT	^ Ö	UV	e É	MKMCR	éé Ä	OVKT	RSKST	NMM	
NNN	` Ç	UV	e É	MKMRP	éé Ä	OTHR	NRKRS	NMMM	
NNU	på	NRV	e É	JMKNCV	éé Ä	k L^	PVCKCQ	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKNCP	éé Ä	NQKT	TVCKCM	NMMM	
NPT	_~	NRV	k ç=d ~ë	NMKTSQ	éé Ä	CKR	NPMRPKCP	CMMM	
NUO	t	NRV	k ç=d ~ë	MKQMN	éé Ä	CUKQ	NSTRKCO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNPM	éé Ä	CNKN	NCNQCKST	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMTN	éé Ä	NMKM	NPTQCKUO	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKPPV	éé Ä	CPKN	PVMQKTR	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMSU	éé Ä	NPKO	QPPKUM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =i çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NUQOTQPKUU	NKU	CNCCPCPKQO	USKUP	RVKR	NCMKQ	
pÅ	CR	k ç=d ~ë	PUVUTNNKVO	NKV	QRNVVMMKMQ	USKCS	RVKR	NCMKQ	
pÅ	CR	e O	UQOTSPKNQ	NKQ	NMSVRVUKVR	TUKTV	RVKR	NCMKQ	
pÅ	CR	e É	NPNCNTKNS	MKU	NRTTPRKMO	UPKNV	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	VOVQMSKCS	NKP	NMSCPUQKUO	UTKPO	RVKR	NCMKQ	
d É	TO	e O	PQRNMSKQP	NKR	QCCMNTKMN	UNKTU	RVKR	NCMKQ	
d É	TO	e É	NMNTTSKQS	MKU	NCCRSPKSN	UPKMQ	RVKR	NCMKQ	
v	UV	e O	QMMMRPVKCS	CKP	QTSCUURKNQ	UPKVV	RVKR	NCMKQ	
v	UV	e É	SVRVPVKQR	MKT	UCVQMCKQU	UPKVN	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SCPPQRQKUV	MKT	SRQQMSTKCO	VRKCR	RVKR	NCMKQ	
qÄ	NRV	e É	CQUSSMMKCO	NKR	CURMTNTKVP	UTKCP	RVKR	NCMKQ	
_á	OMV	k ç=d ~ë	PNTSPVUKNP	MKU	PCNUTCUKRU	VUKSU	RVKR	NCMKQ	
_á	OMV	e É	NQSVNMVKRO	MKU	NRVQNVSKTN	VCKNR	RVKR	NCMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNR

cãÉ=k~ã É MQMpj mi lÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíÿ mj eyNya^q^yOMCPyMPJ ^oyi n ` CQ^ kÅ

^Åè=qãã É PLCQLOMCP=OMMRMQN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMKMCR	éé Ä	k L^	SPHKPP	NMM	
NN	_	S	k ç=d ~ë	THSPQ	éé Ä	PKT	RVOTKVV	NMMM	
CP	k ~	CR	e É	NSPVKROT	éé Ä	CKM	CQMCUUKRO	CMMMMM	
CQ	j Ö	CR	e É	NVTHRRS	éé Ä	NKS	NOTTCKTQ	CMMMMM	
CT	^ ä	CR	e É	JUPKUSO	éé Ä	k L^	VVSKTO	CMMMMM	
CU	pá	CR	e O	OSCPKRPN	éé Ä	NKS	CNUVMPKQQ	NMMMM	
PV	h	CR	e É	OSSKNTT	éé Ä	CKM	CNTRVKRT	CMMMMM	
QM	` ~	CR	e O	OTTKQSO	éé Ä	NKU	NURSUQKCR	CMMMMM	
RN	s	UV	e É	MKVUS	éé Ä	VKV	VUQKRM	NMMM	
RO	` ê	UV	e É	MKQVM	éé Ä	NMKP	NNSQKQV	CMMM	
RR	j å	UV	e É	NVRKTCU	éé Ä	MKU	RNSCUKVV	CMMM	
RS	cÉ	UV	e O	PVUQKCRS	éé Ä	MKU	VNRQCPUNKRS	NMMMMM	
RV	` ç	UV	e É	MKOVS	éé Ä	NUKN	RVTKUN	NMMM	
SM	k á	UV	e É	MKMOV	éé Ä	NTTMKQ	CMRKRS	NMMM	
SP	` ì	UV	e É	NKCQU	éé Ä	VKQ	NVVRKTP	CMMM	
SS	wå	UV	e É	JTKCSS	éé Ä	k L^	VCRKSM	CMMM	
TR	^ ë	UV	e É	NKCNS	éé Ä	RKN	CNRKSV	NMMM	
TU	pÉ	UV	e O	MKNMQ	éé Ä	CRKQ	NCKNT	NMMM	
UU	pê	UV	e É	CKUCP	éé Ä	CKO	NSSNKCQ	CMMM	
VR	j ç	UV	e É	MKQUS	éé Ä	RKN	PRRKRT	NMMM	
NMT	^ Ö	UV	e É	MKMMT	éé Ä	TQKP	CMKMM	NMM	
NNN	` Ç	UV	e É	MKNNU	éé Ä	PPHS	RKVP	NMMM	
NNU	på	NRV	e É	JMKCNO	éé Ä	k L^	PQUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNMO	éé Ä	PKR	TMQKMV	NMMM	
NPT	_~	NRV	k ç=d ~ë	NMKRPO	éé Ä	CKS	NOTUSKNS	CMMM	
NUO	t	NRV	k ç=d ~ë	MKCRR	éé Ä	CUKT	NPPNKQU	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMPS	éé Ä	NVKR	TCQKNP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMST	éé Ä	NCKR	NPRUKNP	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNUS	éé Ä	CKM	CVCSKUM	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMNS	éé Ä	QTKO	NCMKNP	NMMM	

n ` =fpqa=q~ÄäÉ

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B =¤ ÉÅ	B n ` =ì çï	B n ` =¤ äÜÜ	n ` =¤ä-Ö
i á	S	k ç=d ~ë	NUMCNVPKCO	MKV	CNCCPCPQCQO	UQKVO	RVKR	NCMKQ	
pÅ	CR	k ç=d ~ë	PUQSSUPKVN	NKO	CRNVVMMKMQ	URKSN	RVKR	NCMKQ	
pÅ	CR	e O	UVCSURKVO	NKM	NMSVRVUKVR	UPKQS	RVKR	NCMKQ	
pÅ	CR	e É	NPNRCMKVT	CKN	NRTTPRKMO	UPHPU	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	VCVTMSKTO	MKQ	NMSCPUQKUO	UTHPR	RVKR	NCMKQ	
d É	TO	e O	PRRCRPHPV	MKR	QCCMNTKMN	UQKSU	RVKR	NCMKQ	
d É	TO	e É	NMPMCMKRU	MKU	NCCRSPHSN	UQKMR	RVKR	NCMKQ	
v	UV	e O	QNQPTCCKTV	NKN	QTSCUURKNQ	UT	RVKR	NCMKQ	
v	UV	e É	SVMQNCKMO	MKQ	UCVQMCKQU	UPKCQ	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SCQCRRSKSS	CKM	SRQQMSTKCO	VRHPV	RVKR	NCMKQ	
qÄ	NRV	e É	CQVSRCVKMN	NKO	CURMTNTKVP	UTHRU	RVKR	NCMKQ	
_á	OMV	k ç=d ~ë	PCMNMVCKRV	MKO	PCNUTCUKRU	VVKQR	RVKR	NCMKQ	
_á	OMV	e É	NQTSMVNKVR	NKM	NRVQNVSKTN	VCKRV	RVKR	NCMKQ	

p~ã éäÉ=k~ã É	pn NOMNUMNS
cãÉ=k~ã É	MQNpj mi hÇ
a~í~=m~íÜ=k~ã É	aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ hÅ
^Åè=qãã É	PLCQLOMCP=OMNMMRM
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äa ãã íáçå	RKMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¦ mp==	i a o	n ` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMKMDS	éé Ä	k L^	UPHPP	NMM	
NN	_	S	k ç=d ~ë	THOTO	éé Ä	PHS	RTCRHSU	NMMM	
OP	k ~	QR	e É	NPOQHSRU	éé Ä	OHM	OMNCQTHMR	OMMMMM	
OQ	j Ö	QR	e É	OPUHMNR	éé Ä	PHU	NRCSSHQP	OMMMMM	
OT	^ ä	QR	e É	OUHCOS	éé Ä	OQHV	PRVNHSP	OMMMMM	
OU	pá	QR	e O	ONPTHRSU	éé Ä	NHV	NTUVRMCO	NMMMM	
PV	h	QR	e É	OSRHQSV	éé Ä	PHP	ONRNMRTM	OMMMMM	
QM	` ~	QR	e O	OVQHMUN	éé Ä	MHV	NVSSUMHQR	OMMMMM	
RN	s	UV	e É	MHVMU	éé Ä	PHQ	VPMMMR	NMMM	
RO	` ê	UV	e É	MHQSN	éé Ä	NOHN	NNQPHNS	OMMM	
RR	j å	UV	e É	NPHMVN	éé Ä	NHV	SSSUHVU	OMMM	
RS	cÉ	UV	e O	QRMMNTU	éé Ä	NRT	NMPSMUUHMP	NMMMMM	
RV	` ç	UV	e É	MHNSS	éé Ä	NPHM	PUQHQS	NMMM	
SM	k á	UV	e É	MHNQR	éé Ä	UHO	OSMHMN	NMMM	
SP	` ì	UV	e É	MHSRP	éé Ä	NSHQ	NCQSRTQ	OMMM	
SS	wå	UV	e É	JUHQTO	éé Ä	k L^	SUNHNQ	OMMM	
TR	^ ë	UV	e É	MHPPO	éé Ä	NVHV	TNHPQ	NMMM	
TU	pÉ	UV	e O	MHMUM	éé Ä	NHM	NVHMM	NMMM	
UU	pê	UV	e É	OHSTN	éé Ä	QHN	NRTNHCP	OMMM	
VR	j ç	UV	e É	MHPNQ	éé Ä	NUHQ	OSMHMN	NMMM	
NMT	^ Ö	UV	e É	MHMMS	éé Ä	SVHS	NUHUV	NMM	
NNN	` Ç	UV	e É	MHMNU	éé Ä	RTHU	RHVP	NMMM	
NNU	på	NRV	e É	JMPHMP	éé Ä	k L^	OVQHQR	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MHNMQ	éé Ä	QHV	TMTHQQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	UHRNR	éé Ä	MHU	NVOTUHON	OMMM	
NUO	t	NRV	k ç=d ~ë	MHPNU	éé Ä	QUHT	NQSUHPO	NMMM	
OVR	qä	OMV	k ç=d ~ë	MHMPN	éé Ä	OVHN	SUQHMT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MHPMS	éé Ä	RHN	PMTSHTP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MHNPQ	éé Ä	RNHN	CRCSHOT	NMMM	
OPU	r	OMV	k ç=d ~ë	MHMDS	éé Ä	PVHV	NTSHUR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` = çï	B n ` =¤ äÜÜ	n ` =¤ä-Ö
i á	S	k ç=d ~ë	NUNTRPPHRQ	NHV	ONCCPCPHQO	URHSQ	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PURQQUQHPV	MHQ	QRNVVMMHMQ	URHCU	RVHR	NOMQ	
pÅ	QR	e O	UVRPSNHQN	NHV	NMSVRVUHVR	UPHTN	RVHR	NOMQ	
pÅ	QR	e É	NPMUQTHUT	NHP	NRTTPRHMO	UCHVR	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VCCUSPHPO	NHV	NMSCPUQHUO	USHT	RVHR	NOMQ	
d É	TO	e O	PRTCSCHVN	MHT	QCCMNTHMN	UQHSS	RVHR	NOMQ	
d É	TO	e É	NMCPSRHUS	MHO	NCCRSPHSN	UPHRO	RVHR	NOMQ	
v	UV	e O	QNNVSCTHNR	MHT	QTSCUURHNQ	USHQV	RVHR	NOMQ	
v	UV	e É	SVQPMRHMN	NHS	UCVQMCHQU	UPHTN	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SOMNUVTHMQ	NHT	SRQQMSTHCO	VQHTT	RVHR	NOMQ	
qÄ	NRV	e É	CQRVPTUHRQ	MHR	CURMTNTHVP	USHOT	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PNPTUNQHV	NHS	PCNUTCUHRU	VTHQV	RVHR	NOMQ	
_á	OMV	e É	NQSTPPTHMM	NHM	NRVQNVSHTN	VCHMQ	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNT

cãÉ=k~ã É MQQpj mi lÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OQ^ kÅ

^Åè=qáã É PLCQLOMCP=OMNNRMU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RkMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==i mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMkMNQ	éé Ä	k L^	VSkST	NMM	
NN	_	S	k ç=d ~ë	TkQTP	éé Ä	PkO	RURRkTP	NMMM	
OP	k ~	QR	e É	NOUMkUNO	éé Ä	OkM	NVTRRRkMD	OMMMMM	
OQ	j Ö	QR	e É	ORSkMTR	éé Ä	OkN	NSRQPkPV	OMMMMM	
OT	^ ä	QR	e É	NOOkVOO	éé Ä	NMkQ	RUPPkRO	OMMMMM	
OU	pá	QR	e O	NQQMkNSS	éé Ä	PkS	NNVNVSkVV	NMMMM	
PV	h	QR	e É	OSPkQOV	éé Ä	NkV	QNTOVkQP	OMMMMM	
QM	` ~	QR	e O	PPSkUQM	éé Ä	NkR	OOMTQOkVR	OMMMMM	
RN	s	UV	e É	MkUQQ	éé Ä	RkT	UTPkPU	NMMM	
RO	` ê	UV	e É	MkQPN	éé Ä	NPkV	NNMRkNT	OMMM	
RR	j å	UV	e É	NNkRMN	éé Ä	NkS	RUQSkNM	OMMM	
RS	cÉ	UV	e O	QUNkSNN	éé Ä	MkN	NMVTPQPkTQ	NMMMMM	
RV	` ç	UV	e É	MkNRR	éé Ä	ORkV	PSQkQS	NMMM	
SM	k á	UV	e É	MkNSQ	éé Ä	NTkT	OSSkST	NMMM	
SP	` ì	UV	e É	MkTNM	éé Ä	QkQ	NPMUkVT	OMMM	
SS	wå	UV	e É	JTkSPP	éé Ä	k L^	UQTkUO	OMMM	
TR	^ ë	UV	e É	MkOVM	éé Ä	RkT	SQkMN	NMMM	
TU	pÉ	UV	e O	MkMUV	éé Ä	NUkS	NMkST	NMMM	
UU	pê	UV	e É	OkUQO	éé Ä	PkN	NSRSkUM	OMMM	
VR	j ç	UV	e É	MkOPV	éé Ä	OMkT	ONRkRS	NMMM	
NMT	^ Ö	UV	e É	MkMNM	éé Ä	QPkP	OSkST	NMM	
NNN	` Ç	UV	e É	MkMNM	éé Ä	OOkU	PkTM	NMMM	
NNU	på	NRV	e É	JMkPMQ	éé Ä	k L^	PMNkNO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MkMUQ	éé Ä	QOkN	SNTkPP	NMMM	
NPT	_~	NRV	k ç=d ~ë	NMkNNR	éé Ä	PkM	NOMTNkQS	OMMM	
NUO	t	NRV	k ç=d ~ë	MkNST	éé Ä	PUkQ	NNMNkOO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MkMMS	éé Ä	PTUkP	RSPkVQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MkORT	éé Ä	PkQ	OTSVkTO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MkMUN	éé Ä	OUkT	OOPOkRU	NMMM	
OPU	r	OMV	k ç=d ~ë	MkMOV	éé Ä	NMkP	OMMkON	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=ɵpa	oÉÑ= mp	B ɵ ÉÅ	B n ` =i çï	B n ` =c ä ÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUNPVSRkVT	NkR	ONOOPOPkQO	URkQT	RVkR	NOMkQ	
pÅ	QR	k ç=d ~ë	PUTNVROkPS	MkT	QRNVVMMkMQ	URkSS	RVkR	NOMkQ	
pÅ	QR	e O	UUQNUSkPS	NkP	NMSVRVUkVR	UOkST	RVkR	NOMkQ	
pÅ	QR	e É	NPNUUSkSV	MkQ	NRTTPRkMO	UPkSN	RVkR	NOMkQ	
d É	TO	k ç=d ~ë	VONSVUkNQ	MkV	NMSQPUQkUO	USkRV	RVkR	NOMkQ	
d É	TO	e O	PRPRNPkUN	MkS	QOOMNTkMN	UPkTT	RVkR	NOMkQ	
d É	TO	e É	NMONTSkVU	MkU	NOORSPkSN	UPkPT	RVkR	NOMkQ	
v	UV	e O	QMUMUNOkTQ	MkU	QTSOUURkNQ	URkSU	RVkR	NOMkQ	
v	UV	e É	SUUTRRkOS	MkR	UOVQMOkQU	UPkMQ	RVkR	NOMkQ	
qÄ	NRV	k ç=d ~ë	SNPRMSVkNO	MkT	SRQQMSTkOO	VPkTR	RVkR	NOMkQ	
qÄ	NRV	e É	QROOVOSkTQ	MkP	OURMTNTkVP	UUkR	RVkR	NOMkQ	
_á	OMV	k ç=d ~ë	POMNQONkVM	NkR	PONUTOUkRU	VVkQS	RVkR	NOMkQ	
_á	OMV	e É	NQUPUMTkMN	MkT	NRVQNVSkTN	VPkMU	RVkR	NOMkQ	

p~ã éäÉ=k~ã É pn NOMNUMNU

cãÉ=k~ã É MOPpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl^ mj eyNya^q^yOMOPyMPJ ^o yi n ` OO^ HÅ

^Åè=qã É PLOOLOMOP=OMMNMMT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãi íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãi m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMNS	éé Ä	RRHP	NPMKMM	NMM	
NN	_	S	k ç=d ~ë	UKNPQ	éé Ä	NHR	SQNTKMS	NMMM	
OP	k ~	QR	e É	NTRTHSQU	éé Ä	NHS	ORRNUTKQM	OMMMMM	
OQ	j Ö	QR	e É	OOPKOUP	éé Ä	RKQ	NQQQVKVP	OMMMMM	
OT	^ ä	QR	e É	OMRKPRP	éé Ä	PKQ	TTRSHSS	OMMMMM	
OU	pá	QR	e O	PSNTKNTM	éé Ä	OKV	OVPNPUKVR	NMMMM	
PV	h	QR	e É	NRTHPUS	éé Ä	SKV	PRVMQRTN	OMMMMM	
QM	` ~	QR	e O	OQSHRVT	éé Ä	NKQ	NSNTMMKMD	OMMMMM	
RN	s	UV	e É	NHRQT	éé Ä	NHS	NQNTKUU	NMMM	
RO	` ê	UV	e É	MRRRO	éé Ä	SKM	NOOSKQV	OMMM	
RR	j å	UV	e É	NPKQUM	éé Ä	OKP	SUPPKMD	OMMM	
RS	cÉ	UV	e O	ONMKMMM	éé Ä	OKP	QUPTPTKQR	NMMMM	
RV	` ç	UV	e É	MKMSM	éé Ä	NUKQ	PTPKPR	NMMM	
SM	k á	UV	e É	MKOMM	éé Ä	PNHR	OUQKQR	NMMM	
SP	` ì	UV	e É	NKPQP	éé Ä	NKP	ONOMKOM	OMMM	
SS	wå	UV	e É	UPKQVS	éé Ä	OKT	NVSOMKTQ	OMMM	
TR	^ ë	UV	e É	MKONP	éé Ä	UKP	RNHSU	NMMM	
TU	pÉ	UV	e O	MKMSU	éé Ä	OOHS	UKUP	NMMM	
UU	pê	UV	e É	OHSUT	éé Ä	RKQ	NRTPKQR	OMMM	
VR	j ç	UV	e É	MKPON	éé Ä	PRKU	OSPKPQ	NMMM	
NMT	^ Ö	UV	e É	MKMNQ	éé Ä	RRHN	PRKRR	NMM	
NNN	` Ç	UV	e É	MKMNU	éé Ä	SUKR	RKVP	NMMM	
NNU	på	NRV	e É	JMKMVR	éé Ä	k L^	PQUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNOR	éé Ä	PNKO	UMMKUT	NMMM	
NPT	_~	NRV	k ç=d ~ë	NNKPTO	éé Ä	PKT	NPTRQKUV	OMMM	
NUO	t	NRV	k ç=d ~ë	MKMMV	éé Ä	NTHR	VTTKTQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMNP	éé Ä	k L^	QSPKUQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKUQM	éé Ä	SKO	TNSUHPT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMRO	éé Ä	PUKP	OMRVMUN	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMPR	éé Ä	PTHR	OQMKOS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e åÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUQQVUNKOQ	MKS	ONOOPOPKQO	USKVP	RVHR	NOMKQ	
pÅ	QR	k ç=d ~ë	PUPTRRMKQM	MKR	QRNVVMMKMQ	UQKV	RVHR	NOMKQ	
pÅ	QR	e O	USTTRSHSN	NKV	NMSVRVUKVR	UNKNP	RVHR	NOMKQ	
pÅ	QR	e É	NPNUPRKUQ	MKT	NRTTPRKMO	UPHRU	RVHR	NOMKQ	
d É	TO	k ç=d ~ë	VONONOKOT	MKQ	NMSQPUQKUO	USHRR	RVHR	NOMKQ	
d É	TO	e O	PRNUTQKRP	MKT	QOOMNTKMN	UPHPU	RVHR	NOMKQ	
d É	TO	e É	NMNUTRKOT	MKQ	NOORSPHSN	UPHNO	RVHR	NOMKQ	
v	UV	e O	QMURQMSKOU	NHR	QTSOUURKNQ	URKTU	RVHR	NOMKQ	
v	UV	e É	SVNRUNKMO	MKU	UOVQMOKQU	UPHPU	RVHR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SONUSMQKNO	MKT	SRQQMSTKOO	VRKMP	RVHR	NOMKQ	
qÄ	NRV	e É	OQPNPPOKPU	MKT	OURMTNTKVP	URKOV	RVHR	NOMKQ	
_á	OMV	k ç=d ~ë	POPMQNNKTT	MKP	PONUTOUKRU	NMMKPS	RVHR	NOMKQ	
_á	OMV	e É	NOSOVRVKNU	NHP	NRVQNVSKTN	VNKTT	RVHR	NOMKQ	

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É pn MUTSJMMNm

cãÉ=k~ã É MQQpj mi hÇ

a~í~=m~íÜ=k~ã É a\Wyl ÖäÉáíyl^ mj eyNya^q^yOMCPyMPJj ^oyi n ` OQ^ hÅ

^Åè=qãã É PLOQLOMCP=OMØSNR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	OTHKNOU	éé Ä	OKU	OVNNSKNQ	NMM	
NN	_	S	k ç=d ~ë	ONUHPVR	éé Ä	MKV	NRCVQRHPN	NMMM	
OP	k ~	QR	e É	PUSOKSMP	éé Ä	OKT	RONNTTKVS	OMMMMM	
OQ	j Ö	QR	e É	VTTOKTMT	éé Ä	NHR	SPTOONKMQ	OMMMMM	
OT	^ ä	QR	e É	NOOOPNHSNU	éé Ä	MKV	OVOSVMVKNV	OMMMMM	
OU	pá	QR	e O	NNQPHPNR	éé Ä	THP	VVPPMSM	NMMMM	
PV	h	QR	e É	NMRQRKVOM	éé Ä	MKT	SNUNRSKNN	OMMMMM	
QM	` ~	QR	e O	NPSVPHPQM	éé Ä	OKP	UVMOUTVHPN	OMMMMM	
RN	s	UV	e É	PSRHRVR	éé Ä	MKT	PMQOOQMKVT	NMMM	
RO	` ê	UV	e É	ONUHSSS	éé Ä	MKO	OOVOQMRRR	OMMM	
RR	j å	UV	e É	QOPKQNR	éé Ä	NHN	OOOVQNKQN	OMMM	
RS	cÉ	UV	e O	QRTOVKQMQ	éé Ä	MKQ	NNPNUOMNUKUS	NMMMMM	
RV	` ç	UV	e É	OQTKQSV	éé Ä	MHS	QQOPTMKUR	NMMM	
SM	k á	UV	e É	OUUHPQM	éé Ä	NHM	NQPPOSKPS	NMMM	
SP	` ì	UV	e É	NVUHSUN	éé Ä	MKT	OTPVRPKUO	OMMM	
SS	wå	UV	e É	SRNKOMO	éé Ä	NKO	NQTRTUKRO	OMMM	
TR	^ ë	UV	e É	SQKOPP	éé Ä	NHS	NNPVTHRN	NMMM	
TU	pÉ	UV	e O	QNKVOR	éé Ä	MHS	QNOMKTR	NMMM	
UU	pê	UV	e É	OUUKNST	éé Ä	NHM	NUMQSTKTN	OMMM	
VR	j ç	UV	e É	QPHPMR	éé Ä	NHM	OSRQPKTT	NMMM	
NMT	^ Ö	UV	e É	ONKTUO	éé Ä	NKQ	QTTUSKQT	NMM	
NNN	` Ç	UV	e É	NNNKVQV	éé Ä	NKO	POUVPKQR	NMMM	
NNU	på	NRV	e É	OORHRQU	éé Ä	OKN	NONUMSRTM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NOKVRV	éé Ä	MHS	RQPROKOO	NMMM	
NPT	_~	NRV	k ç=d ~ë	NQRVKQMV	éé Ä	NHR	NTQRPORKQS	OMMM	
NUO	t	NRV	k ç=d ~ë	OOKNSM	éé Ä	OKT	RPMNVMKVP	NMMM	
OMR	qä	OMV	k ç=d ~ë	QRKTOT	éé Ä	OKO	OQQNVQKUT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NSUHRSO	éé Ä	MKU	NOPVPOQHPT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	RVHSMT	éé Ä	OKT	PVNNNNKOP	NMMM	
OPU	r	OMV	k ç=d ~ë	RSKOUU	éé Ä	MKV	PPVUSOHPP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ¹ mp	B=o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUPUVMSKOM	OKN	ONOOPOPQOO	USHSR	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PVTSMMOKOV	NHM	QRNVVMMMVQ	UTKVT	RVHR	NOMQ	
pÅ	QR	e O	VORUMVKNP	OKT	NMSVRVUKVR	USHRS	RVHR	NOMQ	
pÅ	QR	e É	NPQTRVMMM	NKQ	NRTTPRMVO	URKQP	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VMVRQUKNO	MHS	NMSQPUQKUO	URKQR	RVHR	NOMQ	
d É	TO	e O	PQSRPOKMU	MKU	QOOMNTMMN	UOKNN	RVHR	NOMQ	
d É	TO	e É	NMMRMQKUT	NHN	NOORSPHSN	UO	RVHR	NOMQ	
v	UV	e O	QQSTOOVMVP	MKT	QTSOUURKNQ	VPRTV	RVHR	NOMQ	
v	UV	e É	TQTQRNKOT	MKV	UOVQMOKQU	VMKNO	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SNSPOOTKNR	NKV	SRQQMSTKOO	VQKNU	RVHR	NOMQ	
qÄ	NRV	e É	OQQQNONKOO	MKN	OURMTNTKVP	URRTQ	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PNSSOPRKST	MKP	PONUTOUKRU	VUHPT	RVHR	NOMQ	
_á	OMV	e É	NQNUVRQKRQ	NHM	NRVQNVSKTN	UVKMN	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MUTSJMMNp

cãÉ=k~ã É MORpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf^ mj eyNya^q^yOMOPyMPJ ^oyi n` OQ^ hÅ

^Åè=qãã É PLOQLOMOP=OMRPNMQO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãäíáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	OTKVMO	ééÄ	NKQ	PMNMVKPO	NMVM	
NN	_	S	k ç=d ~ë	OPVKQTO	ééÄ	MKT	NSURMUKPO	NMMM	
OP	k ~	QR	e É	PVTMKUPM	ééÄ	NKN	RQMVPVKNM	OMMMMM	
OQ	j Ö	QR	e É	VRRMKNTT	ééÄ	NKQ	SOVVPMKMT	OMMMMM	
OT	^ ä	QR	e É	NNSOTNKMPM	ééÄ	MKV	OUMTUURKVT	OMMMMM	
OU	pá	QR	e O	NOTQKRUR	ééÄ	NKV	NMURPTKMP	NMMMM	
PV	h	QR	e É	NMVOMKVSP	ééÄ	NKN	SQRRVPKMQ	OMMMMM	
QM	` ~	QR	e O	NPNOUKMRR	ééÄ	NKS	UPUQQTPKRS	OMMMMM	
RN	s	UV	e É	PSUKNPO	ééÄ	MKV	PMVRPSKVV	NMMM	
RO	` ê	UV	e É	ONQKPVS	ééÄ	MKQ	OOTNOSKMT	OMMM	
RR	j å	UV	e É	QMVKKVQ	ééÄ	MKU	ONTTOMKVM	OMMM	
RS	cÉ	UV	e O	QMTPUKOQR	ééÄ	MKU	NMVRMQQSVKVM	NMMMMM	
RV	` ç	UV	e É	OQVKSMT	ééÄ	MKR	QRMURSKUO	NMMM	
SM	k á	UV	e É	OVMKTQV	ééÄ	NKQ	NQSMPNKPO	NMMM	
SP	` ì	UV	e É	OMSKPUR	ééÄ	NKP	OUTROTKNM	OMMM	
SS	wå	UV	e É	RVNKSQT	ééÄ	MKU	NPRTPPKTU	OMMM	
TR	^ ë	UV	e É	SPKTPN	ééÄ	NKU	NNQOTKOM	NMMM	
TU	pÉ	UV	e O	QOKVNR	ééÄ	OKM	QOMNKTT	NMMM	
UU	pê	UV	e É	OVPKTNP	ééÄ	MKT	NURUSTKNU	OMMM	
VR	j ç	UV	e É	QOKVOM	ééÄ	NKO	OTUNRKOS	NMMM	
NMT	^ Ö	UV	e É	OOKSUR	ééÄ	OKQ	RMOUQKQQ	NMM	
NNN	` Ç	UV	e É	NNPKMTU	ééÄ	MKU	PPRTPKST	NMMM	
NNU	på	NRV	e É	OPSKRNP	ééÄ	OKQ	NPMPVTKUM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NPKTUO	ééÄ	OKN	RUNMTKUT	NMMM	
NPT	_~	NRV	k ç=d ~ë	NQTNKVPN	ééÄ	MKU	NTTMPRTKOM	OMMM	
NUO	t	NRV	k ç=d ~ë	ONKPSS	ééÄ	NKO	RNQPUKPT	NMMM	
OMR	qä	OMV	k ç=d ~ë	QUKMQD	ééÄ	NKT	ORTNVPKQO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NSMKOTR	ééÄ	NKP	NNVNOOSKMO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	RVMSPP	ééÄ	MKV	PVRRRVKOT	NMMM	
OPU	r	OMV	k ç=d ~ë	RTKOVO	ééÄ	NKM	PQVSVMKQO	NMMM	

n` =fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ÉÅ	B n` =¡çï	B n` =¤äÜÜ	n` =¤ä~Ö
iá	S	k ç=d ~ë	NUQUOUQKSP	MKT	ONOOPOPKQO	UTKMV	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QMNNUVTKTU	MKP	ORNVVMMKMQ	UUKRQ	RVKR	NOMKQ	
pÅ	QR	e O	VMVQUTKPQ	RKM	NMSVRVUKVR	URKMP	RVKR	NOMKQ	
pÅ	QR	e É	NPSNNPKOQ	MKS	NRTTPRKMO	USKOV	RVKR	NOMKQ	
dÉ	TO	k ç=d ~ë	VONUTRKNN	MKT	NMSQPUQKUO	USKSN	RVKR	NOMKQ	
dÉ	TO	e O	PQPNOUKMO	PKP	QOOMNTKMN	UNKPN	RVKR	NOMKQ	
dÉ	TO	e É	NMNRMQKQT	NKO	NOORSPKSN	UOKUO	RVKR	NOMKQ	
v	UV	e O	QQROMRUKUO	PKP	OTSOUURKNQ	VPKQT	RVKR	NOMKQ	
v	UV	e É	TRROROQKSV	MKR	UOVQMOKQU	VNKVS	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SNVTVSUKQR	MKV	SRQQMSTKOO	VQKTN	RVKR	NOMKQ	
qÄ	NRV	e É	OQVSNOTKTP	NKO	OURMTNTKVP	UTKRS	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	POMMVUNKUS	NKR	PONUTOUKRU	VVKQR	RVKR	NOMKQ	
_á	OMV	e É	NQSOMONKQS	MKQ	NRVQNVSKTN	VNKTN	RVKR	NOMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` NQfj pO
cáÉ=k~ã É	MQSi` pl KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉåíyf` mj eyNya^q^yOMOPyMPJj ^oyin` OQ^kÄ
^Åè=qãã É	PLOQLOMOP=OMMRSVRM
p~ã éäÉ=qóéÉ	m_
qçí~ä=aäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMS` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iãã á	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMVR	ééÄ	kL^	NMSKST	MKR	
_	NN	S	kç=d~ë	PKVSV	ééÄ	PKO	PQSMKQT	NM	
k~	OP	QR	eÉ	QQKUSO	ééÄ	NTKN	QUPTMKTS	RMM	
jÖ	OQ	QR	eÉ	PSKSPT	ééÄ	NKV	ORSVKON	RM	
^ä	OT	QR	eÉ	NNPKMUO	ééÄ	VKO	RSRRKSU	RM	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
pá	OU	QR	eO	ONKRPO	ééÄ	NQKS	ONURKUN	ORM	
h	PV	QR	eÉ	NRPKQVQ	ééÄ	NNKR	PSMRMKMV	RMM	
`~	QM	QR	eO	VPKRQP	ééÄ	NNKU	SUTVMKPP	RM	m_=SMOM=c~âë=aça
s	RN	UV	eÉ	NKNPV	ééÄ	OKV	NNNTKUQ	OKR	
`ê	RO	UV	eÉ	NKNMU	ééÄ	PKT	NTURKNN	OKR	
jå	RR	UV	eÉ	MKUMQ	ééÄ	NTKS	STPKOO	N	
cÉ	RS	UV	eO	NQNKQVR	ééÄ	ONKO	POTUTSKVP	RM	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
`ç	RV	UV	eÉ	MKROQ	ééÄ	NQKR	VUSKTQ	MKR	m_=SMOM=c~âë=aça
ká	SM	UV	eÉ	NKMMQ	ééÄ	NOKM	SSNKNQ	N	m_=SMOM=c~âë=aça
`ì	SP	UV	eÉ	MKVSO	ééÄ	PKO	NSRQKRU	NKR	
wå	SS	UV	eÉ	JUKQTT	ééÄ	kL^	SURKRU	R	m_=SMOM=c~âë=aça
^ë	TR	UV	eÉ	MKOVT	ééÄ	OVKS	SSKPQ	OKR	
pÉ	TU	UV	eO	MKPNN	ééÄ	NNKU	PMKST	OKR	
pê	UU	UV	eÉ	MKUMR	ééÄ	NOKT	QUUKVN	OKR	
jç	VR	UV	eÉ	MKSQO	ééÄ	NMKO	QRMKMO	OKR	
^Ö	NMT	UV	eÉ	MKVRU	ééÄ	NPKR	NORKRS	MKR	
`Ç	NNN	UV	eÉ	MKOPM	ééÄ	OPKU	SQKMU	MKR	
på	NNU	NRV	eÉ	QMKUMS	ééÄ	PKQ	OOPVRKRU	OKR	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKNTS	ééÄ	NQKS	VUQKQN	MKR	
_~	NPT	NRV	kç=d~ë	PKVMU	ééÄ	NKS	QSNRKTQ	N	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
t	NUO	NRV	kç=d~ë	MKOSN	ééÄ	NNKU	NPMNKQR	OKR	
qä	OMR	OMV	kç=d~ë	MKQOO	ééÄ	UKR	OTNPKNS	MKR	
mÄ	OMU	OMV	kç=d~ë	MKSSP	ééÄ	UKN	RSPSKQR	MKR	m_=SMOM=c~âë=aça
qÜ	OPO	OMV	kç=d~ë	MKTRO	ééÄ	PKU	SQURKNU	OKR	
r	OPU	OMV	kç=d~ë	MKNQM	ééÄ	NSKN	URMKVP	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NUCCROMSO	OKM	ONCCPCPKQO	URKUT	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	PUUNSMRKQT	OKN	QRNVVMMKMQ	URKUU	RVKR	NOMQ	
pÅ	QR	eO	UTNQRUKVQ	NKU	NMSVRVUKVR	UNKQU	RVKR	NOMQ	
pÅ	QR	eÉ	NPPNUTKUU	NKT	NRTTPRKMO	UQKQQ	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VOMQPPKNO	NKM	NMSCPUQKUO	USKQU	RVKR	NOMQ	
dÉ	TO	eO	PRPQNQKSU	MKR	QCOMNTKMN	UPKTQ	RVKR	NOMQ	
dÉ	TO	eÉ	NMCOUUKTM	MKS	NCCRSPKSN	UPKQS	RVKR	NOMQ	
v	UV	eO	QMUQMMSKNN	NKV	QTSCUURKNQ	URKTR	RVKR	NOMQ	
v	UV	eÉ	TMMMNNKMM	NKM	UCVQMCKQU	UQKQ	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	SMQRUPNKUU	NKS	SRQQMSTKCO	VOKPV	RVKR	NOMQ	
qÄ	NRV	eÉ	OQQCPRRKRV	NKN	OURMTNTKVP	URKSU	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PNNRMVSKMR	OKM	PCNUTCUKRU	VSKTU	RVKR	NOMQ	
_á	OMV	eÉ	NQQMTTOKRM	MKT	NRVQNVSKTN	VMKPU	RVKR	NOMQ	

`çåíaåì åaÖ=~ëäÁê~íáçå=sÉêáÑáÅ~íáçå=E``sF=oÉéçêí

p~ã éáÉ=k~ã É	``s
cäÉ=k~ã É	MQTJ``sKÇ
a~í~=m~íÜ=k~ã É	aWyªÖäÉáíyˆ mj eyNya^q^yOMOPyMPJ ^oyi n` OQ^kÁ
^Åè=qáã É	PLOQLOMOP=OMQNMPV
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVS^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äí	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÁK	r åáë	opa	==mp==	bñés~ä	B=oÉÁ	B içï	B eäÜÜ	n`=cä~Ö
V	_É	S	kç=d~ë	OQKTRQ	éëÄ	NKU	NPVVTUKPP	CR	VVKMO	UVKU	NNMO	
NN	_	S	kç=d~ë	OQKUPN	éëÄ	OKM	VOOMNKRT	CR	VVKPO	UVKU	NNMO	
OP	k~	QR	eÉ	RPNUKTQT	éëÄ	MKR	PPUOVTNKQT	RMMM	NMSKPT	UVKU	NNMO	
OQ	j Ö	QR	eÉ	RPQSKSOS	éëÄ	NKQ	NTSUSQOKOP	RMMM	NMSKVP	UVKU	NNMO	
OT	^ä	QR	eÉ	RNUKOOV	éëÄ	NKP	SRUSRKUO	RMM	NMPKSR	UVKU	NNMO	
OU	pá	QR	eO	RNNKMPU	éëÄ	NKO	OOPQTOKMR	RMM	NMOKON	UVKU	NNMO	
PV	h	QR	eÉ	RNUPKNMQ	éëÄ	MKU	NRMMOSMKTP	RMMM	NMPKSS	UVKU	NNMO	
QM	`~	QR	eO	RNVUKONR	éëÄ	MKV	NTMTNVORKNS	RMMM	NMPKVS	UVKU	NNMO	
RN	s	UV	eÉ	ORKNTQ	éëÄ	MKT	NMNOSMRN	CR	NMMKT	UVKU	NNMO	
RO	`ê	UV	eÉ	ORKQMU	éëÄ	MKU	NOUUSVPM	CR	NMNKSP	UVKU	NNMO	
RR	j å	UV	eÉ	ORKNQQ	éëÄ	NKR	SQNMMKON	CR	NMMKRU	UVKU	NNMO	
RS	cÉ	UV	eO	RMUUKNNN	éëÄ	NKV	RVUTUUOMKR	RMMM	NMNKTS	UVKU	NNMO	
RV	`ç	UV	eÉ	ORKRSR	éëÄ	NKS	OOMSNVKPU	CR	NMOKOS	UVKU	NNMO	
SM	ká	UV	eÉ	ORKTOP	éëÄ	NKV	SNUOOKVP	CR	NMOKUV	UVKU	NNMO	
SP	`ì	UV	eÉ	ORKSRV	éëÄ	MKR	NTTMVNTKNN	CR	NMOKSQ	UVKU	NNMO	
SS	wå	UV	eÉ	ORKMOU	éëÄ	NKN	OVQNVKMT	CR	NMMKNN	UVKU	NNMO	
TR	^ë	UV	eÉ	ORKMTP	éëÄ	NKS	ONQRSKTM	CR	NMMKOV	UVKU	NNMO	
TU	pÉ	UV	eO	OQKSUU	éëÄ	NKM	NNRPMKTO	CR	VUKTR	UVKU	NNMO	
UU	pê	UV	eÉ	ORKSRP	éëÄ	NKS	TTRRQKSM	CR	NMOKSN	UVKU	NNMO	
VR	j ç	UV	eÉ	OQKQTV	éëÄ	MKQ	TOORUKTQ	CR	VTKVO	UVKU	NNMO	
NMT	^Ö	UV	eÉ	ORKOVP	éëÄ	MKQ	OSTTUSKUN	CR	NMNKNT	UVKU	NNMO	
NNN	`Ç	UV	eÉ	ORKQVU	éëÄ	MKU	PSNSNKMP	CR	NMNKVV	UVKU	NNMO	
NNU	på	NRV	eÉ	OQKUTT	éëÄ	OKM	SVOPMKSQ	CR	VVKRN	UVKU	NNMO	
NON	pÄ	NRV	kç=d~ë	OQKRTR	éëÄ	MKT	ROMTSRKTM	CR	VUKP	UVKU	NNMO	
NPT	_~	NRV	kç=d~ë	ORKPTU	éëÄ	NKR	NRQMRUKON	CR	NMNKRN	UVKU	NNMO	
NUO	t	NRV	kç=d~ë	OQKVQV	éëÄ	MKU	OVVSNNKSU	CR	VVKU	UVKU	NNMO	
OMR	qä	OMV	kç=d~ë	OQKSSR	éëÄ	MKT	SRMPQNKTN	CR	VUKSS	UVKU	NNMO	
OMU	mÄ	OMV	kç=d~ë	ORKSNM	éëÄ	MKR	VPUUTQKPP	CR	NMOKQQ	UVKU	NNMO	
OPO	qÜ	OMV	kç=d~ë	OQKVTQ	éëÄ	MKS	UNRNMNKNM	CR	VVKV	UVKU	NNMO	
OPU	r	OMV	kç=d~ë	ORKUUQ	éëÄ	NKM	TTVNMRKQQ	CR	NMPKRQ	UVKU	NNMO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=içï	B n`=eäÜÜ	n`=cä~Ö
iá	S	kç=d~ë	NVQPNONKVS	NKU	ONOOPOPKQO	VNKRS	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PVQVQURKSQ	NKO	QRNVVMMMVQ	UTKPU	RVKR	NOMQ	
pÅ	QR	eO	VPRSNQKNM	NKN	NMSVRVUKVR	UTKQT	RVKR	NOMQ	
pÅ	QR	eÉ	NPSTQUKVQ	MKS	NRTTPRKMO	USKT	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VQVRVUKNV	MKT	NMSQPUQKUO	UVKOO	RVKR	NOMQ	
dÉ	TO	eO	PTMUOTKUT	NKP	QOOMNTKMN	UTKUT	RVKR	NOMQ	
dÉ	TO	eÉ	NMSSVTKPS	NKT	NOORSPKSN	UTKMR	RVKR	NOMQ	
v	UV	eO	QOQTUQSKRU	MKT	QTSOUURKNQ	UVKNV	RVKR	NOMQ	
v	UV	eÉ	TONRMQKSU	MKR	UOVQMOKQU	USKVV	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SORRSRNKVR	MKS	SRQQMSTKOO	VRKRV	RVKR	NOMQ	
qÄ	NRV	eÉ	ORNNRNSKQV	MKS	OURMTNTKVP	UUKN	RVKR	NOMQ	
_á	OMV	kç=d~ë	PNRSUOMKMN	NKP	PONUTOUKRU	VUKMU	RVKR	NOMQ	
_á	OMV	eÉ	NQSMSNRKSR	MKU	NRVQNVSKTN	VNKSO	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáçå=_ä~åâ=Ê`_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MOLJ``_KÇ

a~í~=m~íÜ=k~ã É aWj^ÖäÉáíÝ^mj eyNya^q^yOMOPyMPJ ^oyi n`OQ^kÂ

^Åè=qáã É PLOQLOMOP=OMRRNMMO

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáçå NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑcäÉk~ã É MMS^i_KÇ

p~ã éáÉ=n`=m~ëëlcá~ä c~ää

fpqa=n`=m~ëëlc~ää m~ëë

l éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==\ mp==	iãäá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MKMNT	ééÄ	NMKQ	COOMKMN	MKO	
NN	_	S	kç=d~ë	MKPNQ	ééÄ	TKR	NVCRKTO	Q	
CP	k~	CR	eÉ	CKPUT	ééÄ	COCKU	CURNNKQM	CMM	
CQ	j Ö	CR	eÉ	RKTTN	ééÄ	UKM	COMMKCR	CM	
CT	^ä	CR	eÉ	JNVKRRV	ééÄ	kL^	TCQKQU	CM	c~äÉÇ=a ça
CU	pá	CR	eO	MKSPT	ééÄ	PCKQ	TSMKUO	NMM	
PV	h	CR	eÉ	CQKSCU	ééÄ	NCKP	PSRVSKMU	CMM	
QM	`~	CR	eO	TKNVT	ééÄ	CKO	PSUMMKPU	CM	
RN	s	UV	eÉ	MKMCQ	ééÄ	NVMS	PRNKNO	N	
RO	`ê	UV	eÉ	MKMCU	ééÄ	NSKN	VMCKRO	N	
RR	j å	UV	eÉ	JMKMPN	ééÄ	kL^	CNTHPM	MQ	
RS	cÉ	UV	eO	SKMV	ééÄ	NKN	VPMRNKSO	CM	
RV	`ç	UV	eÉ	MKMCQ	ééÄ	CPKU	PPTKUM	MO	
SM	ká	UV	eÉ	JMKMU	ééÄ	kL^	NVMKMM	MQ	
SP	`ì	UV	eÉ	MKMNV	ééÄ	CQCKV	RUPHPS	MS	
SS	wå	UV	eÉ	JCKNCP	ééÄ	kL^	CPSKST	O	c~äê^ äëj ÉÍÜçÇë& c~äÉÇ=a ça
TR	^ë	UV	eÉ	MKMOT	ééÄ	OVKT	CQCKST	N	
TU	pÉ	UV	eO	MKMRM	ééÄ	UKV	OTHKM	N	
UU	pê	UV	eÉ	MKMPS	ééÄ	CPKV	NPCKCP	N	
VR	j ç	UV	eÉ	MKNTP	ééÄ	UKM	SCCKCR	N	
NMT	^Ö	UV	eÉ	MKMCO	ééÄ	CKN	CCLUKVM	MO	
NNN	`Ç	UV	eÉ	MKMCP	ééÄ	NCKR	PCKCR	MO	
NNU	på	NRV	eÉ	JMKMNN	ééÄ	kL^	CSPHPR	N	
NCN	pÄ	NRV	kç=d~ë	MKMPQ	ééÄ	CNKQ	NVPNKNP	MO	
NPT	_~	NRV	kç=d~ë	MKMVQ	ééÄ	NCKV	SOMKST	MQ	
NUO	t	NRV	kç=d~ë	MKNRN	ééÄ	NNKM	OSNSKPU	N	
OMR	qä	OMV	kç=d~ë	MKMTP	ééÄ	SKQ	CCRCKUP	MO	
OMU	mÄ	OMV	kç=d~ë	MKMOV	ééÄ	TKV	NVNRKCP	MO	
OPO	qÜ	OMV	kç=d~ë	MKMSN	ééÄ	CKR	PSUTKUN	N	
OPU	r	OMV	kç=d~ë	MKMCU	ééÄ	SKU	URTHSM	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=ïçï	Bn`=ëåÜ	n`=c~ä~Ö
iá	S	kç=d~ë	NVSPNNMKUV	NKP	CNCCPCPKQO	VCKR	RVKR	NCMKQ	
pÅ	CR	kç=d~ë	CNOTNUUKTO	MKO	CRNVVMMKMQ	VNKPN	RVKR	NCMKQ	
pÅ	CR	eO	VRPMCSKMS	NKM	NMSVRVUKVR	UVKN	RVKR	NCMKQ	
pÅ	CR	eÉ	NQNTUCKRV	MKU	NRTTPRKMO	UVKUV	RVKR	NCMKQ	
dÉ	TO	kç=d~ë	NMMCCUUKTU	MKU	NMSCPUQKUO	VQKNT	RVKR	NCMKQ	
dÉ	TO	eO	PUTCCQKQU	MKS	QCCMNTKMN	VNKTS	RVKR	NCMKQ	
dÉ	TO	eÉ	NNCMCRKNR	CKP	NCCRSPHSN	VNKQO	RVKR	NCMKQ	
v	UV	eO	CPUCNVCKSS	MKT	CJTSCUURKNQ	VCKMN	RVKR	NCMKQ	
v	UV	eÉ	TRRTPTHSP	MKN	UCVCMCKQU	VNKNO	RVKR	NCMKQ	
qÄ	NRV	kç=d~ë	SQSNUNCKVO	NKN	SRQQMSTKOO	VUKTQ	RVKR	NCMKQ	
qÄ	NRV	eÉ	OSRCPNQKRR	NKQ	CURMTNTKVP	VPKMQ	RVKR	NCMKQ	
_á	OMV	kç=d~ë	PNTUROVKCR	CKM	PCNUTCUKRU	VUKTR	RVKR	NCMKQ	
_á	OMV	eÉ	NRMRPQQKTN	MKU	NRVQNVSKTN	VQKQP	RVKR	NCMKQ	

KATAHDIN ANALYTICAL SERVICES, LLC
METALS ANALYSIS RUN INFORMATION SHEET

INSTR. ID: L (Agilent 7800) **ANALYST**: KS **ANALYSIS DATE**: 03/28/23

METHOD: **ICP-MS**
- ☑ 200.8
- ☑ 6020
- ☑ DOD

FILE NAME: LQC28E

Reviewed By: EA 033023

The pHs of all samples that were tested by direct analysis in this analytical run were checked just prior to analysis and confirmed to be <2. The time of preservation of these samples was checked in the "Measured Turbidity and Preservation of Incoming Samples" logbook to verify that they had been preserved at least 16 hours prior to analysis. These verifications were performed by _____ (initials) on _____ (date).

STANDARDS USED:

Standard Name	Standard ID	Prep Date	Expiration Date	Standard Conc.
Cal Blk/ICB/CCB	MW21411	03/02/23	03/02/24	0 ug/L
Cal Std	MW21445	03/27/23	05/31/23	Varies by Element
ICV	MW21429	03/15/23	06/14/23	Varies by Element
PQL	MW21447	03/27/23	05/31/23	Varies by Element
LRS1	MW21454	03/28/23	05/31/23	Varies by Element
LRS2	MW21450	03/27/23	05/31/23	Varies by Element
ICSA	MW21441	03/24/23	03/31/23	Varies by Element
ICSAB	MW21448	03/27/23	04/03/23	Varies by Element
CCV	MW21455	03/28/23	05/31/23	Varies by Element
Internal Standard (ISTD)	N/A	N/A	N/A	0.2 mg/L (Li,Sc,Ge/Y,Tb,Bi)

Additional Comments and Notes:

Samples with ISTD RSDs > 8% were reanalyzed immediately.

ISTD was manually added to all standards and samples (0.08 mL of MS2459 to 8 mL).

Dilutions: Some samples were diluted based on history or due to interfering element concentrations.

Dilution preparations are as follows:

5x diln.: 1.6 mL of sample (pipet M30) + 6.4 mL of MW21411 (pipet M31)

10x diln.: 0.8 mL of sample (pipet M19) + 7.2 mL of MW21411 (pipet M31)

25x diln.: 0.32 mL of sample(pipet M19) + 7.68 mL of MW21411 (pipet M31)

Post Spike: 0.08 mL of MW21329 (pipet M27) into 8 mL final volume of appropriately diluted sample (pipet M31)

INSTRUMENT RUNLOG

Instrument: AGILENT 7800

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
RINSE	1	LQC28E	03/28/2023	15:39	KS
RINSE	1	LQC28E	03/28/2023	15:44	KS
RINSE	1	LQC28E	03/28/2023	15:49	KS
CalBlank	1	LQC28E	03/28/2023	15:55	KS
CalStd	1	LQC28E	03/28/2023	16:00	KS
ICV	1	LQC28E	03/28/2023	16:12	KS
ICB	1	LQC28E	03/28/2023	16:21	KS
PQL	1	LQC28E	03/28/2023	16:26	KS
ICSA	1	LQC28E	03/28/2023	16:31	KS
ICSAB	1	LQC28E	03/28/2023	16:36	KS
LRS1	1	LQC28E	03/28/2023	16:45	KS
LRS2	1	LQC28E	03/28/2023	16:57	KS
RINSE	1	LQC28E	03/28/2023	17:04	KS
RINSE	1	LQC28E	03/28/2023	17:09	KS
RINSE	1	LQC28E	03/28/2023	17:14	KS
CCV	1	LQC28E	03/28/2023	17:20	KS
CCB	1	LQC28E	03/28/2023	17:28	KS
NEWLOTTEST	1	LQC28E	03/28/2023	17:33	KS
PBSQC14IMS2	5	LQC28E	03/28/2023	17:38	KS
SQ1188-005A	5	LQC28E	03/28/2023	17:43	KS
PBSQC16IMS1	5	LQC28E	03/28/2023	17:48	KS
LCSOQC16IMS1	5	LQC28E	03/28/2023	17:54	KS
SQ1188-011	5	LQC28E	03/28/2023	18:01	KS
SQ1188-013	5	LQC28E	03/28/2023	18:07	KS
PBSQC17IMS1	5	LQC28E	03/28/2023	18:12	KS
LCSOQC17IMS1	5	LQC28E	03/28/2023	18:17	KS
SQ0941-001	5	LQC28E	03/28/2023	18:25	KS
CCV	1	LQC28E	03/28/2023	18:30	KS
CCB	1	LQC28E	03/28/2023	18:39	KS
SQ0941-003	5	LQC28E	03/28/2023	18:44	KS
SQ0941-005	5	LQC28E	03/28/2023	18:49	KS
SQ0941-007	5	LQC28E	03/28/2023	18:54	KS
SQ0941-007L	25	LQC28E	03/28/2023	18:59	KS
SQ0941-007A	5	LQC28E	03/28/2023	19:04	KS
SQ0941-007P	5	LQC28E	03/28/2023	19:09	KS
SQ0941-007S	5	LQC28E	03/28/2023	19:17	KS
SQ0941-009	5	LQC28E	03/28/2023	19:25	KS
SQ0941-011	5	LQC28E	03/28/2023	19:30	KS
SQ0961-001	5	LQC28E	03/28/2023	19:35	KS
CCV	1	LQC28E	03/28/2023	19:41	KS
CCB	1	LQC28E	03/28/2023	19:49	KS
SQ0961-003	5	LQC28E	03/28/2023	19:54	KS
SQ0961-005	5	LQC28E	03/28/2023	19:59	KS
SQ0961-009	5	LQC28E	03/28/2023	20:04	KS

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
SQ0961-011	5	LQC28E	03/28/2023	20:09	KS
PBWQC17IMW1	5	LQC28E	03/28/2023	20:14	KS
LC2WQC17IMW1	5	LQC28E	03/28/2023	20:19	KS
LCSWQC17IMW1	5	LQC28E	03/28/2023	20:28	KS
SQ1259-002	1	LQC28E	03/28/2023	20:36	KS
SQ1280-001	1	LQC28E	03/28/2023	20:41	KS
SQ1280-002	1	LQC28E	03/28/2023	20:47	KS
CCV	1	LQC28E	03/28/2023	20:52	KS
CCB	1	LQC28E	03/28/2023	21:00	KS
PBWQC17IMW2	5	LQC28E	03/28/2023	21:05	KS
LCSWQC17IMW2	5	LQC28E	03/28/2023	21:10	KS
SQ0960-001	5	LQC28E	03/28/2023	21:19	KS
SQ0960-002	5	LQC28E	03/28/2023	21:24	KS
SQ0960-003	5	LQC28E	03/28/2023	21:29	KS
SQ0960-004	5	LQC28E	03/28/2023	21:34	KS
SQ0960-005	5	LQC28E	03/28/2023	21:39	KS
SQ0960-006	5	LQC28E	03/28/2023	21:44	KS
SQ0960-007	5	LQC28E	03/28/2023	21:49	KS
SQ0960-008	5	LQC28E	03/28/2023	21:55	KS
CCV	1	LQC28E	03/28/2023	22:00	KS
CCB	1	LQC28E	03/28/2023	22:08	KS
SQ0960-009	5	LQC28E	03/28/2023	22:13	KS
SQ0960-010	5	LQC28E	03/28/2023	22:18	KS
SQ0960-012	5	LQC28E	03/28/2023	22:23	KS
SQ0960-013	5	LQC28E	03/28/2023	22:28	KS
PBWQC21IMW2	5	LQC28E	03/28/2023	22:33	KS
LCSWQC21IMW2	5	LQC28E	03/28/2023	22:38	KS
SQ1015-024	5	LQC28E	03/28/2023	22:46	KS
SQ1201-009	5	LQC28E	03/28/2023	22:51	KS
SQ1201-010	5	LQC28E	03/28/2023	22:57	KS
SQ1201-011	5	LQC28E	03/28/2023	23:02	KS
CCV	1	LQC28E	03/28/2023	23:07	KS
CCB	1	LQC28E	03/28/2023	23:15	KS
SQ1201-012	5	LQC28E	03/28/2023	23:20	KS
SQ1201-012L	25	LQC28E	03/28/2023	23:25	KS
SQ1201-012A	5	LQC28E	03/28/2023	23:31	KS
SQ1201-013	5	LQC28E	03/28/2023	23:36	KS
SQ1201-014	5	LQC28E	03/28/2023	23:41	KS
SQ1201-015	5	LQC28E	03/28/2023	23:46	KS
SQ1201-016	5	LQC28E	03/28/2023	23:51	KS
SQ1201-017	5	LQC28E	03/28/2023	23:56	KS
SQ1201-018	5	LQC28E	03/29/2023	00:01	KS
TESTICSA1	1	LQC28E	03/29/2023	00:07	KS
CCV	1	LQC28E	03/29/2023	00:12	KS
CCB	1	LQC28E	03/29/2023	00:20	KS
TESTICSA2	1	LQC28E	03/29/2023	00:25	KS
TESTICSA3	1	LQC28E	03/29/2023	00:30	KS

US EPA Tune Check Report

Operator Name	admin
Acq/Data Batch	D:\Agilent\ICPMH\1\DATA\2023\03-MAR\LQC28[illegible].b
Acq. Date-Time	3/28/2023 14:56:18
Report Comment	---
Instrument Name	G8421A SG18503526

KS 3/30/23

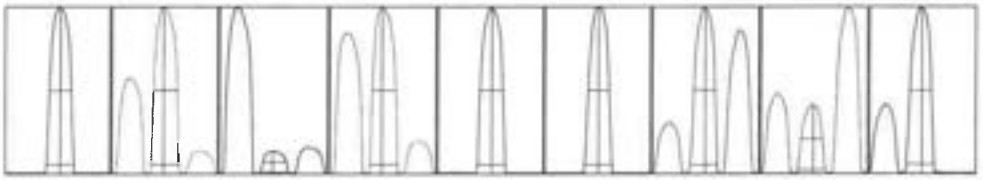
[No Gas]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
9	10.00	60507	605071.36	3.783	5.000	
24	10.00	262919	2629186.84	3.523	5.000	
25	10.00	34691	346911.08	4.416	5.000	
26	10.00	41467	414669.72	3.330	5.000	
59	10.00	560397	5603969.55	3.590	5.000	
115	10.00	651098	6510977.08	3.103	5.000	
206	10.00	105357	1053567.63	3.419	5.000	
207	10.00	89612	896122.28	3.883	5.000	
208	10.00	219298	2192981.17	4.253	5.000	

Integration Time [sec] 0.1

Resolution/Axis



Mass	Peak Height	Axis	Axis (Required)	Axis (Flag)
9	62546.00	9.10	8.90 - 9.10	
24	273281.45	24.00	23.90 - 24.10	
25	35853.87	25.00	24.90 - 25.10	
26	42339.17	26.00	25.90 - 29.10	
59	567772.85	59.05	58.90 - 59.10	
115	651456.65	115.05	114.90 - 115.10	
206	108038.95	206.00	205.90 - 206.10	
207	93169.45	207.00	206.90 - 207.10	
208	225484.57	208.00	207.90 - 208.10	

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
9	0.62	0.780	0.900	
24	0.68	0.790	0.900	
25	0.67	0.787	0.900	

US EPA Tune Check Report

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
26	0.67	0.790	0.900	
59	0.64	0.788	0.900	
115	0.59	0.775	0.900	
206	0.60	0.771	0.900	
207	0.61	0.780	0.900	
208	0.61	0.781	0.900	

Integration Time [sec] 0.1
Acquisition Time [sec] 47.0000000000001
Y Axis Linear

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.34 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	13.0 V
Extract 2	-250.0 V	Cell Entrance	-40 V	Plate Bias	-40 V
Omega Bias	-85 V	Cell Exit	-60 V		

Cell Parameters

Use Gas	No	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-8.0 V		
H2 Flow	0.0 mL/min	OctP RF	130 V		

QP Parameters

Mass Gain	121	Axis Gain	0.9980	QP Bias	-3.0 V
Mass Offset	125	Axis Offset	0.17		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.8 mm

EM

Discriminator	3.5 mV	Analog HV	2216 V	Pulse HV	1206 V

[H2]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	41752	417523.10	3.377	5.000	
89	10.00	42555	425547.15	2.803	5.000	
205	10.00	35982	359824.81	3.382	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

US EPA Tune Check Report

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.34 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-18.0 V		
H2 Flow	5.0 mL/min	OctP RF	200 V		

QP Parameters

Mass Gain	121	Axis Gain	0.9980	QP Bias	-13.0 V
Mass Offset	125	Axis Offset	0.17		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.8 mm		

EM

Discriminator	3.5 mV	Analog HV	2216 V	Pulse HV	1206 V

[He]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	132030	1320301.29	4.074	5.000	
89	10.00	8990	89895.05	3.589	5.000	
205	10.00	17898	178983.42	3.543	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.34 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	4.5 mL/min	OctP Bias	-18.0 V		
H2 Flow	0.0 mL/min	OctP RF	200 V		

QP Parameters

US EPA Tune Check Report

Mass Gain	121	Axis Gain	0.9980	QP Bias	-13.0 V
Mass Offset	125	Axis Offset	0.17		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	0.8 mm		

EM

Discriminator	3.5 mV	Analog HV	2216 V	Pulse HV	1206 V

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^Åè=qãã É	PLOULOMOP=NRWRRMU
p~ã éäÉ=qóéÉ	` ~ä_äâ
qçí~ä=aãã íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MMQ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	m~ëë
fpqa=n` =m~ëëLc~ãä	m~ëë
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j ~ëë	k~ã É	fpqa	qì åÉ	==` mp==	opa
V	_É	S	k ç=d~ë	OPTKTV	NKS
NN	_	S	k ç=d~ë	VPSKTN	QKR
OP	k~	QR	e É	QVOSUKOT	MKQ
OQ	j Ö	QR	e É	SPRKRV	NPKT
OT	^ä	QR	e É	OONKNO	NPKT
OU	pá	QR	e O	QUTKNV	NKO
PV	h	QR	e É	PQNRVKSS	NKM
QM	` ~	QR	e O	NRRSOKNN	NKQ
RN	s	UV	e É	OURKRS	NSKS
RO	` ê	UV	e É	NNNNKUP	VKR
RR	j å	UV	e É	NRNKVT	PKR
RS	cÉ	UV	e O	NPQSMKSR	OKU
RV	` ç	UV	e É	OUUKVM	NNKQ
SM	k á	UV	e É	NTRKRS	NOKS
SP	` ì	UV	e É	RSUKVN	OKV
SS	wå	UV	e É	OMTKTU	UKU
TR	^ë	UV	e É	ONKMM	QKU
TU	pÉ	UV	e O	NMKNT	NQKO
UU	pê	UV	e É	ROKOO	PKT
VR	j ç	UV	e É	OSNKNO	VKS
NMT	^Ö	UV	e É	QNKNN	QMKM
NNN	` Ç	UV	e É	NMKTQ	QNKU
NNU	på	NRV	e É	PONKNO	RKT
NON	pÄ	NRV	k ç=d~ë	UOTKRT	NOKQ
NPT	_~	NRV	k ç=d~ë	NSSKUQ	VKO
NUO	t	NRV	k ç=d~ë	OPUOKTO	NMKT
OMR	qä	OMV	k ç=d~ë	SSQKMR	RKT
OMU	mÄ	OMV	k ç=d~ë	OOPVKNO	RKT
OPO	qÜ	OMV	k ç=d~ë	ORMOKVN	PKP
OPU	r	OMV	k ç=d~ë	OMMKON	OSKR

n` =fpqa=q~ÄäÉ

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i á	S	k ç=d~ë	NUVQNRTKMT	PKR
pÅ	QR	k ç=d~ë	QRTPSTVKOQ	MKQ
pÅ	QR	e O	VURSOPKUN	OKS
pÅ	QR	e É	NSMVPNKOP	MKQ
d É	TO	k ç=d~ë	NMTQOQSKRP	NKU
d É	TO	e O	PVPUSVKSQ	OKP
d É	TO	e É	NORORSSKVR	MKT
v	UV	e O	QPMNURSKUS	NKT
v	UV	e É	UQNPQOKNU	NKN
qÄ	NRV	k ç=d~ë	SRVNQQQKUP	MKO
qÄ	NRV	e É	OUSSNVMKNM	MKV
_á	OMV	k ç=d~ë	PNTPQTOKSU	NKO
_á	OMV	e É	NSMVTVTKOQ	NKT

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p~ã éäÉ=k~ã É	` ~äpíÇ
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V	_É	S	k ç=d ~ë	OUSTNSKTV	MKQ
NN	_	S	k ç=d ~ë	NUTNQRKOR	MKV
OP	k~	QR	e É	TQNUTOQKQR	NKT
OQ	j Ö	QR	e É	PUUUSVSKUO	NKR
OT	^ä	QR	e É	NQQQTMKSM	OKP
OU	pá	QR	e O	QTQPNTKTO	NKO
PV	h	QR	e É	PPPSRRUKNV	MKS
QM	` ~	QR	e O	PRRQVVNUKVO	NKP
RN	s	UV	e É	OPTUPRKOU	MKS
RO	` ê	UV	e É	OVURSUKMO	NKO
RR	j å	UV	e É	NQUVOVKPU	NKT
RS	cÉ	UV	e O	NORRMMNVRKTT	NKQ
RV	` ç	UV	e É	RNMMQOKUN	MKV
SM	k á	UV	e É	NQOURQKQP	NKT
SP	` ì	UV	e É	PVSTVPKMU	NKQ
SS	wå	UV	e É	STNPUKMM	NKR
TR	^ë	UV	e É	QVMRVKUS	NKS
TU	pÉ	UV	e O	OPQTOKQR	MKP
UU	pê	UV	e É	NTRVPRKNR	NKR
VR	j ç	UV	e É	NTOPUQKOQ	NKP
NMT	^Ö	UV	e É	SNQMNUKUR	NKN
NNN	` Ç	UV	e É	UOONTKUU	NKN
NNU	på	NRV	e É	NSNSRVKPU	OKO
NON	pÄ	NRV	k ç=d ~ë	NNPOPSSKUM	NKM
NPT	_~	NRV	k ç=d ~ë	POVOMRKRT	MKR
NUO	t	NRV	k ç=d ~ë	SQSNVRKMQ	MKR
OMR	qä	OMV	k ç=d ~ë	NQOPTNOKRO	MKS
OMU	mÄ	OMV	k ç=d ~ë	NVQTRSRKOR	NKP
OPO	qÜ	OMV	k ç=d ~ë	NTNOSVQKSP	NKO
OPU	r	OMV	k ç=d ~ë	NRVNUMTKVM	MKO

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ= mp	B=o ÉÅ	B n` =i çï	B n` =e äÖÜ	n` =cä~Ö
i á	S	k ç=d ~ë	OMNONOQKOO	NKU	NUVQNRTKMT	NMSKOP	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QTMTTPMKNP	NKS	QRTPSTVKOQ	NMOKVP	RVKR	NOMKQ	
pÅ	QR	e O	NMOUNSRKRR	NKN	VURSOPKUN	NMQKPO	RVKR	NOMKQ	
pÅ	QR	e É	NSRONMKVO	MKS	NSMVPNKOP	NMOKSS	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	NMVQMNTKVO	MKP	NMTQOQSKRP	NMNKUQ	RVKR	NOMKQ	
d É	TO	e O	QMSRRTKUN	NKP	PVPUSVKSQ	NMPKOO	RVKR	NOMKQ	
d É	TO	e É	NOVSOSKOM	MKU	NOROSSKVR	NMPKQU	RVKR	NOMKQ	
v	UV	e O	QPUQOVVKNO	NKM	QPMNURSKUS	NMNKVO	RVKR	NOMKQ	
v	UV	e É	USMVOUKTQ	NKU	UQNPQOKNU	NMOKPP	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SVQVTQOKMT	MKO	SRVNQQQKUP	NMRKQQ	RVKR	NOMKQ	
qÄ	NRV	e É	OVQNVVRKMQ	NKS	OUSSNVMKN	NMOKSQ	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PPVTUVTKSQ	NKO	PNTPQTOKSU	NMTKMT	RVKR	NOMKQ	
_á	OMV	e É	NSSTTTMKPT	OKS	NSMVTVTKOQ	NMPKS	RVKR	NOMKQ	

fåáíá~ëà=`~ëáÄÂê~íáçå=sÉëëáçåÅ~íáçå=Ef`sF=oÉéçêí

p~ã éáÉ=k~ã É	f`s
cãÉ=k~ã É	MVSjf`sKÇ
a~í~=m~íÜ=k~ã É	aWÿÖãÉáíÿf`mj eyNya^q^yOMOPyMPJ ^oyi n` OUbkÅ
^Åè=qáã É	PLOULOMOP=NSWNOMPT
p~ã éáÉ=qóéÉ	f`s
qçí~äaãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MVOJ ^i _KÇ
p~ã éáÉ=n` =m~ëëlcá~ä	m~ëë
fpqa=n` =m~ëëlc~ãä	m~ëë
l éÉê~íçê	~Çã áã

n` =^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åãë	opa	═ mp═	bñés~ä	B=oÉÁ	Bi çï	Beáöü	n` =cä~Ö
V	_É	S	kç=cl~ë	NVKTTQ	ééÄ	QKS	NNQNPPKUN	QM	VUKUT	UVKS	NNMQ	
NN	_	S	kç=cl~ë	QNKPTQ	ééÄ	PKT	UNMMRKMR	QM	NMSKUT	UVKS	NNMQ	
QP	k~	QR	eÉ	QNUQKPPQ	ééÄ	MKQ	PNMPQPRKQN	QMMM	NMQKRS	UVKS	NNMQ	
QQ	j Ö	QR	eÉ	QQNRKQTQ	ééÄ	NKT	NSQQPTVKNU	QMMM	NMRKPV	UVKS	NNMQ	
QT	^ä	QR	eÉ	QNTKMPO	ééÄ	NKQ	RVUNUKCU	QMM	NMQKOS	UVKS	NNMQ	
QU	pá	QR	eO	QMVKNNU	ééÄ	MKV	NVOSSUKRU	QMM	NMOKOU	UVKS	NNMQ	
PV	h	QR	eÉ	QNVNKVRO	ééÄ	MKP	NQMRVRNKQQ	QMMM	NMQKU	UVKS	NNMQ	
QM	`~	QR	eO	QNSPKQMN	ééÄ	NKR	NQSUNPUMKUV	QMMM	NMQKMU	UVKS	NNMQ	
RN	s	UV	eÉ	QMKQUO	ééÄ	MKT	VSNSMKVP	QM	NMOKQN	UVKS	NNMQ	
RO	`ê	UV	eÉ	QMKQST	ééÄ	NKQ	NONMSQKTR	QM	NMOKPQ	UVKS	NNMQ	
RR	j å	UV	eÉ	QMKRVO	ééÄ	NKM	SMRNOKQQ	QM	NMOKVS	UVKS	NNMQ	
RS	cÉ	UV	eO	PVURKQUP	ééÄ	NKP	RMQPPSNQKPQ	QMMM	VVKSQ	UVKS	NNMQ	
RV	`ç	UV	eÉ	QNKNOT	ééÄ	NKR	QNORMRKSN	QM	NMRKSQ	UVKS	NNMQ	
SM	ká	UV	eÉ	QMKVOO	ééÄ	NKM	RUVUVKVT	QM	NMQKSN	UVKS	NNMQ	
SP	`ì	UV	eÉ	QMKVOU	ééÄ	NKO	NSPVQSKVR	QM	NMQKSQ	UVKS	NNMQ	
SS	wå	UV	eÉ	QNKOTS	ééÄ	NKS	CUOSQKQS	QM	NMSKPU	UVKS	NNMQ	
TR	^ë	UV	eÉ	QMQNN	ééÄ	NKP	NVTQPKPQ	QM	NMOKMS	UVKS	NNMQ	
TU	pÉ	UV	eO	QMMMOS	ééÄ	MKQ	VQUQKTU	QM	NMMKNP	UVKS	NNMQ	
UU	pê	UV	eÉ	QMKSUO	ééÄ	MKU	TNTOOKOT	QM	NMPKQN	UVKS	NNMQ	
VR	j ç	UV	eÉ	QMKQTO	ééÄ	MKR	NPTRNPKVN	QM	NMNKNU	UVKS	NNMQ	
NMT	^Ö	UV	eÉ	QMKTPU	ééÄ	MKP	ORMVPMKVN	QM	NMPKSV	UVKS	NNMQ	
NNN	`Ç	UV	eÉ	QMKTMV	ééÄ	MKV	PPRRSKOQ	QM	NMPKRQ	UVKS	NNMQ	
NNU	på	NRV	eÉ	NVKVNQ	ééÄ	NKT	SRMMNKOP	QM	VVKRT	UVKS	NNMQ	
NON	pÄ	NRV	kç=cl~ë	NVKTOT	ééÄ	NKR	QSNOMUKNS	QM	VUKSQ	UVKS	NNMQ	
NPT	_~	NRV	kç=cl~ë	QMKSQT	ééÄ	NKP	NQMDVQKTP	QM	NMPKOP	UVKS	NNMQ	
NUO	t	NRV	kç=cl~ë	QNKSRS	ééÄ	NKQ	OVMMQUKRP	QM	NMUKOU	UVKS	NNMQ	
QMR	qä	QMV	kç=cl~ë	NVKQQP	ééÄ	OKO	RTQVTOKMV	QM	VTKOO	UVKS	NNMQ	
QMU	mÄ	QMV	kç=cl~ë	NVKVOO	ééÄ	NKT	UMSTORKOS	QM	VVKSN	UVKS	NNMQ	
QPO	qÜ	QMV	kç=cl~ë	NVKOVQ	ééÄ	QKS	SUTRUOKVS	QM	VSKQT	UVKS	NNMQ	
QPU	r	QMV	kç=cl~ë	NVKPMO	ééÄ	QKS	SPTTPUKSU	QM	VSKRN	UVKS	NNMQ	

n` =fpqa=q~ÄáÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑë mp	B=oÉÁ	Bn` =i çï	Bn` =eáÖÜ	n` =cä~Ö
íá	S	kç=cl~ë	QMDQNMQKUQ	PKN	NUVQNRTHMT	NMSKUS	RVKR	NOMQ	
pÅ	QR	kç=cl~ë	QUMSUVUKPU	NKU	QRTPSTVKOQ	NMRKN	RVKR	NOMQ	
pÅ	QR	eO	NMNVOTUKTU	MKQ	VURSOPKUN	NMPKQN	RVKR	NOMQ	
pÅ	QR	eÉ	NSPSUOKMT	MKS	NSMVPNKOP	NMNKTN	RVKR	NOMQ	
dÉ	TO	kç=cl~ë	NNOSTVOKVN	NKV	NMTQOQSKRP	NMQKUV	RVKR	NOMQ	
dÉ	TO	eO	PVUMMSKVR	MKQ	PVPUSVKSQ	NMNKMR	RVKR	NOMQ	
dÉ	TO	eÉ	NOTUQSKNS	NKO	NORQSSKVR	NMOKMS	RVKR	NOMQ	
v	UV	eO	QQQMPOUKQV	NKQ	QPMNURSKUS	NMOKTR	RVKR	NOMQ	
v	UV	eÉ	UQUNMPKQT	MKO	UQNPQOKNU	NMMKU	RVKR	NOMQ	
qÄ	NRV	kç=cl~ë	TNSSPTRKPO	MKV	SRVNQQQKUP	NMUKTO	RVKR	NOMQ	
qÄ	NRV	eÉ	OVSNOQQKSP	MKR	OUSSNVMKN	NMPKPO	RVKR	NOMQ	
_á	QMV	kç=cl~ë	PROSNMQKTV	NKO	PNTPQTOKSU	NNNKSN	RVKR	NOMQ	
_á	QMV	eÉ	NSVRTTQKPR	MKT	NSMVTVTKOQ	NMRKPQ	RVKR	NOMQ	

fåáá<ë=~ëÄÂê<íáçå=_ä<åâ=Ef`_F=oÉéçã

p~ã éáÉ=k~ã É	f`_
cäÉ=k~ã É	MVMT|f`_ÍÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOVOCPyVPJ ^oyi n`OUbkÂ
^Åè=qáã É	PLOULOVOCP=NSVØNVPQ
p~ã éáÉ=qóéÉ	f`_
qçí~äa ãäíáç å	NKMVMVM
`çã ã Éåí	JJJ
fpqa=oÉÑncäÉk~ã É	MVQ ^i_ÍÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äã	m~ëë
I éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄæÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	råáë	opa	==\ mp==	iãäá	n`=c<ä~Ö
V	_É	S	kç=d~ë	MKMNO	ééÄ	SPHP	PIVOKCR	MO	
NN	_	S	kç=d~ë	MKNVO	ééÄ	NPHN	NSCOKRS	Q	
CP	k~	CR	eÉ	CKSNM	ééÄ	COOKU	RIVSCNKNO	CMM	
CQ	j Ö	CR	eÉ	CKSVR	ééÄ	VKT	NRSCKPS	CM	
CT	^ä	CR	eÉ	JMKNVR	ééÄ	kL^	NVUKUV	CM	
CU	pá	CR	eO	MKPVN	ééÄ	UTHR	SNTHPP	NVM	
PV	h	CR	eÉ	SKRUT	ééÄ	CRHP	PQVCSKON	CMM	
QM	`~	CR	eO	PKVRT	ééÄ	THR	CRTCSKVT	CM	
RN	s	UV	eÉ	MKMVM	ééÄ	kL^	OTRKRS	N	
RO	`ê	UV	eÉ	MKMVV	ééÄ	NCSKT	NNCRKUP	N	
RR	j å	UV	eÉ	MKMVQ	ééÄ	NONKT	NRTKVT	MQ	
RS	cÉ	UV	eO	PKOVQ	ééÄ	PKU	RPRNUKSR	CM	
RV	`ç	UV	eÉ	JMKMVR	ééÄ	kL^	CPPHPQ	MO	
SM	ká	UV	eÉ	MKMVM	ééÄ	PQSSTKU	NTMKMM	MQ	
SP	`ì	UV	eÉ	MKMVQ	ééÄ	RCHS	RUNKNP	MS	
SS	wå	UV	eÉ	MKVPN	ééÄ	NNHP	CQMKMM	O	
TR	^ë	UV	eÉ	MKVNT	ééÄ	PPKN	PSKMM	N	
TU	pÉ	UV	eO	MKVOS	ééÄ	OVHS	ONKUP	N	
UU	pê	UV	eÉ	MKMVM	ééÄ	OURSKT	RNKNN	N	
VR	j ç	UV	eÉ	MKOMT	ééÄ	CKO	VORHSM	N	
NMT	^Ö	UV	eÉ	MKVNO	ééÄ	PNKM	NUPHPQ	MO	
NNN	`Ç	UV	eÉ	MKVNQ	ééÄ	PQKV	PNKQU	MO	
NNU	på	NRV	eÉ	MKVOQ	ééÄ	OTHM	PVPHPR	N	
NON	pÄ	NRV	kç=d~ë	MKVPS	ééÄ	TKT	NSRNKUR	MO	
NPT	_~	NRV	kç=d~ë	MKMVQ	ééÄ	TMQ	NVSKUU	MQ	
NUO	t	NRV	kç=d~ë	MKNPP	ééÄ	ONKU	QNCRKVD	N	
OMR	qä	OMV	kç=d~ë	MKVRV	ééÄ	NPKN	OCPRKVM	MO	
OMU	mÄ	OMV	kç=d~ë	JMKMVT	ééÄ	kL^	NVVUKUR	MO	
OPO	qÜ	OMV	kç=d~ë	MKVNM	ééÄ	QUHP	CUOVKVU	N	
OPU	r	OMV	kç=d~ë	MKVNU	ééÄ	ORKN	TQMKUM	MO	

n`=fpqa=q~ÄæÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ= mp	B=oÉÁ	B n`=çï	B n`=c<äÜÜ	n`=c<ä~Ö
iá	S	kç=d~ë	NVNNCPPHPP	NKU	NUVQNRTHMT	NMMKV	RVHR	NOMQ	
pÅ	CR	kç=d~ë	CQQTPNURKTR	MKU	CRTPSTVKOQ	VTKU	RVHR	NOMQ	
pÅ	CR	eO	VTSCPMKRP	NKQ	VURSCPKUN	VVKVR	RVHR	NOMQ	
pÅ	CR	eÉ	NRRMOVKVS	MKV	NSMVPNKCP	VSHPP	RVHR	NOMQ	
dÉ	TO	kç=d~ë	NMUUPSNKOQ	MKV	NMTQOQSKRP	NMNHPN	RVHR	NOMQ	
dÉ	TO	eO	PUNSONKVP	MKR	PVPUSVKSQ	VSKUV	RVHR	NOMQ	
dÉ	TO	eÉ	NOOQTVKTU	NKT	NORCSSKVR	VTKTU	RVHR	NOMQ	
v	UV	eO	QOSMTMPKOS	MKR	QPMNURSKUS	VVKVQ	RVHR	NOMQ	
v	UV	eÉ	UNQQRTKVQ	MKT	UQNPQOOKNU	VSKU	RVHR	NOMQ	
qÄ	NRV	kç=d~ë	STUONMSKSV	OKQ	SRVNQQQKUP	NMOKUV	RVHR	NOMQ	
qÄ	NRV	eÉ	OUQTONOKTP	MKS	OUSSNVMKN	VVHPQ	RVHR	NOMQ	
_á	OMV	kç=d~ë	PNUSRTVKQT	OKR	PNTPQTOKSU	NMMQN	RVHR	NOMQ	
_á	OMV	eÉ	NRVRSNVKNO	MKV	NSMVTVTKOQ	VVKNO	RVHR	NOMQ	

p~ã éáÉ=k~ã É	mmi
cäÉ=k~ã É	MVUJ f ` s KÇ
a~í~=m~íÜ=k~ã É	aWª ÖäÉáíyf ` mj e yNya ^ q ^ yOMCPyMPJ ^ o y i n ` OUb kÅ
^ Åè=qáã É	PLOULOMCP=NSW0SWQO
p~ã éáÉ=qóéÉ	i i f ` s
qçí~äa äï íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=o ÉÑ¢cäÉk~ã É	MVQ ^ i _ KÇ
p~ã éáÉ=n ` =m~ëëlcá~ä	c~äï
fpqa=n ` =m~ëëlc~äï	m~ëë
I éÉê~íçê	**~Çã áã**

n ` =^ å~äöíÉ=q~ÄåÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==¹ mp==	bñés~ä	B o ÉÅ	B i çï	B e äÜÜ	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMVN	éé Ä	OKU	NQQJUKVU	MO	VRKR	TVfR	NOMQ	
NN	_	S	k ç=d ~ë	OKMSP	éé Ä	MKR	NTPSRKNO	Q	NMNKRT	TVfR	NOMQ	
OP	k ~	QR	e É	OMMKMCR	éé Ä	NKV	OMQRVSKTR	OMM	NMMKMN	TVfR	NOMQ	
OQ	j Ö	QR	e É	OMKQTN	éé Ä	MKT	UVMMKUP	OM	NMOKPR	TVfR	NOMQ	
OT	^ ä	QR	e É	OMKTMT	éé Ä	OKQ	PPONKRR	OM	NMPKRQ	TVfR	NOMQ	
OU	pá	QR	e O	NMMKOMR	éé Ä	OKN	QVNRNKVQ	NMM	NMMO	TVfR	NOMQ	
PV	h	QR	e É	NVTKRSQ	éé Ä	MKP	NMPSSOKVM	OMM	VUKTU	TVfR	NOMQ	
QM	` ~	QR	e O	OMKPRR	éé Ä	NKR	VMTPPKMU	OM	NMNKTU	TVfR	NOMQ	
RN	s	UV	e É	NKMPV	éé Ä	OKM	RPVSKST	N	NMPKV	TVfR	NOMQ	
RO	` ê	UV	e É	NKMQS	éé Ä	QKN	TRVNKOT	N	NMQKS	TVfR	NOMQ	
RR	j å	UV	e É	MKQMS	éé Ä	OKR	NQMUKQT	MQ	NMNKR	TVfR	NOMQ	
RS	cÉ	UV	e O	OMKNUP	éé Ä	NKQ	OURTMMKUQ	OM	NMMKVO	TVfR	NOMQ	
RV	` ç	UV	e É	MKMVT	éé Ä	UKR	OPTPKSO	MO	VUKR	TVfR	NOMQ	
SM	k á	UV	e É	MKQRO	éé Ä	SKP	NRNQKRR	MQ	NNKP	TVfR	NOMQ	
SP	` ì	UV	e É	MKSCQ	éé Ä	PKO	RTMRKTM	MS	NMQ	TVfR	NOMQ	
SS	wå	UV	e É	OKQQN	éé Ä	PKP	PPNPKTV	O	NNOKMR	TVfR	NOMQ	
TR	^ ë	UV	e É	NKMNU	éé Ä	RKO	NMROKQU	N	NMNKU	TVfR	NOMQ	
TU	pÉ	UV	e O	MKVVO	éé Ä	PKO	RMUKVV	N	VVKO	TVfR	NOMQ	
UU	pê	UV	e É	NKMOT	éé Ä	NKV	PTUCKUN	N	NMOKT	TVfR	NOMQ	
VR	j ç	UV	e É	NKMQS	éé Ä	OKP	PVNVMRO	N	NMOKS	TVfR	NOMQ	
NMT	^ Ö	UV	e É	MKMVU	éé Ä	SKV	ORRNKQM	MO	VV	TVfR	NOMQ	
NNN	` Ç	UV	e É	MKQMS	éé Ä	TKM	PSNKNO	MO	NMP	TVfR	NOMQ	
NNU	på	NRV	e É	NKMPU	éé Ä	OKM	PUNSKNS	N	NMPKU	TVfR	NOMQ	
NON	pÄ	NRV	k ç=d ~ë	MKONR	éé Ä	SKO	SMVCKQT	MO	NMTTKR	TVfR	NOMQ	
NPT	_~	NRV	k ç=d ~ë	MKQNV	éé Ä	UKQ	PNNTKMM	MQ	NMQKTR	TVfR	NOMQ	
NUO	t	NRV	k ç=d ~ë	MKMMM	éé Ä	OKU	NQVUQKQN	N	VM	TVfR	NOMQ	
OMR	qä	OMV	k ç=d ~ë	MKOMM	éé Ä	SKU	SRPRKOT	MO	NMM	TVfR	NOMQ	
OMU	mÄ	OMV	k ç=d ~ë	MKMTV	éé Ä	QKR	VRTUKCU	MO	UVKR	TVfR	NOMQ	
OPO	qÜ	OMV	k ç=d ~ë	MKNRU	éé Ä	SKN	UCRNKQT	MO	TV	TVfR	NOMQ	c~äÉÇ=a ça =
OPU	r	OMV	k ç=d ~ë	MKOMN	éé Ä	SKR	STSRKRV	MO	NMMKR	TVfR	NOMQ	

n ` =fpqa=q~ÄåÉ

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ¢ mp	B =o ÉÅ	B n ` =i çï	B n ` =e äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	ONSSUSOKRO	NKU	NUVQNRTKMT	NNQKQ	RVfR	NOMQ	
pÅ	QR	k ç=d ~ë	QUVPQQMKQM	NKS	QRTPSTVKOQ	NVSKVV	RVfR	NOMQ	
pÅ	QR	e O	NMRPQVUKUP	OKU	VURSCPKUN	NVSKUV	RVfR	NOMQ	
pÅ	QR	e É	NTMTRTKVQ	MKU	NSMVPNKCP	NVSKNN	RVfR	NOMQ	
d É	TO	k ç=d ~ë	NNRQQSSKSN	NKQ	NMTQQQSKRP	NMTKQT	RVfR	NOMQ	
d É	TO	e O	QNOOSSKRU	NKV	PVPUSVKSQ	NVQKST	RVfR	NOMQ	
d É	TO	e É	NPNUCRKST	MKR	NORCSSKVR	NVRKOR	RVfR	NOMQ	
v	UV	e O	QSVNOVPKUU	MKO	CPMNURSKUS	NVVKMR	RVfR	NOMQ	
v	UV	e É	UUUQCRKOV	NKP	UQNPQOKNU	NVRKS	RVfR	NOMQ	
qÄ	NRV	k ç=d ~ë	TPUPQMUKRU	NKV	SRVNQQQKUP	NNOKMO	RVfR	NOMQ	
qÄ	NRV	e É	PMROVQTKMS	NKS	OUSSNVMKN	NVSKRO	RVfR	NOMQ	
_á	OMV	k ç=d ~ë	PQTPVPMKTO	PKO	PNTPQTOKSU	NVVKQT	RVfR	NOMQ	
_á	OMV	e É	NTTNTOOKTU	MKR	NSMVTVTKOQ	NNMKMS	RVfR	NOMQ	

fåíÉâÑÉêÉåÅÉ= ÜÉÅâ=pçàíç=^=Ef`pJ^F=oÉéçëí

p~ã éáÉ=k~ã É	f`p^
cäÉ=k~ã É	MVMf`p^KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOVOCPyVPJ ^oyi n`OUbKÅ
^Åè=qáã É	PLOULOVOCP=NSVAPNVAVM
p~ã éáÉ=qóéÉ	f`p^
qçí~äaäã íáçå	NKMVMVM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVOJ ^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äõíÉ=q~ÄäÉ

k~ã É	j~ëë	fpqa	qìåÉ	`çåÅK	råáë	opa	==mp==	bñés~ä	Bi çï	BeäÖÜ	n`=c ä~Ö
_É	V	S	kç=d~ë	JMKMNO	éé Ä	klA	NVOKQR	JMKN	NVM	NVM	
_	NN	S	kç=d~ë	MKQVR	éé Ä	PHS	OVTUHNQ	JO	NVM	NVM	
k~	OP	QR	eÉ	NVSQTMKQMN	éé Ä	NKM	TMRTMSQVKMM	NMMMMM	UM	NOM	
jÖ	OQ	QR	eÉ	NVRRQRKQPV	éé Ä	MHP	PSUVPMNNHST	NMMMMM	UM	NOM	
^ä	OT	QR	eÉ	NVVUNURTSU	éé Ä	MKV	NQQQMQTVKVO	NMMMMM	UM	NOM	
pá	OU	QR	eO	QKUVR	éé Ä	NMRT	ORNSKOU	JRM	NVM	NVM	
h	PV	QR	eÉ	NVOOTMVUJ	éé Ä	MHP	PMPUTNVOKRQ	NMMMMM	UM	NOM	
`~	QM	QR	eO	NVRQROKVUO	éé Ä	NKU	PPUTQQUUNHSO	NMMMMM	UM	NOM	
s	RN	UV	eÉ	MKVPU	éé Ä	NMVO	QOOKOQ	JMR	NVM	NVM	
`ê	RO	UV	eÉ	OKNTM	éé Ä	NKO	NORSNKOM	NHR	NVM	NVM	
j å	RR	UV	eÉ	MKQMU	éé Ä	THO	NOOQKQV	MKNT	NVM	NVM	
cÉ	RS	UV	eO	VUNVPHSQM	éé Ä	MIR	NNPVPPOVMSKNM	NMMMMM	UM	NOM	
`ç	RV	UV	eÉ	MKNMQ	éé Ä	THP	NONRHSR	M	NVM	NVM	
ká	SM	UV	eÉ	MKQOO	éé Ä	UHS	NOPSHTQ	MKNU	NVM	NVM	
`ì	SP	UV	eÉ	MKVVU	éé Ä	VHV	NONPKQN	JMKOO	NVM	NVM	
wå	SS	UV	eÉ	MKVTU	éé Ä	SHP	NPSMKVV	MKQ	NVM	NVM	
^ë	TR	UV	eÉ	MKVTP	éé Ä	NSKO	UPKVN	JMR	NVM	NVM	
pÉ	TU	UV	eO	MKVTO	éé Ä	NOKR	QMKUP	JMR	NVM	NVM	
pê	UU	UV	eÉ	MKUQV	éé Ä	PRT	OTNVKOM	MPT	NVM	NVM	
j ç	VR	UV	eÉ	OOPSKVVT	éé Ä	NKM	SUURUSPKOP	OMMM	UM	NOM	
^Ö	NMT	UV	eÉ	MKVNS	éé Ä	OQKN	OMUKUV	JMKN	NVM	NVM	
`Ç	NNN	UV	eÉ	MKPQP	éé Ä	OHP	RNQKQS	MKOU	NVM	NVM	
på	NNU	NRV	eÉ	MKVUT	éé Ä	NQKU	RTMKVO	JMR	NVM	NVM	
pÄ	NON	NRV	kç=d~ë	MKVUT	éé Ä	VHP	OUSSKSU	JMKVR	NVM	NVM	
_~	NPT	NRV	kç=d~ë	MKQTT	éé Ä	NKS	PPQMKSM	MKPP	NVM	NVM	
t	NUO	NRV	kç=d~ë	MKONR	éé Ä	UKM	RPOSKSU	JMKPP	NVM	NVM	
qä	OMR	OMV	kç=d~ë	MKVMS	éé Ä	PRKV	UVTHSS	JMKN	NVM	NVM	
mÄ	OMU	OMV	kç=d~ë	JMKVMN	éé Ä	klA	OPUVHPM	JMKVU	NVM	NVM	
qÜ	OPO	OMV	kç=d~ë	MKVNR	éé Ä	OQKV	POPPKUR	JMKN	NVM	NVM	
r	OPU	OMV	kç=d~ë	MKVNS	éé Ä	OKM	TPTKQT	JMKVU	NVM	NVM	

n`=fpqa=q~ÄäÉ

k~ã É	j~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=ïçï	Bn`=eäÖÜ	n`=c ä~Ö
iá	S	kç=d~ë	ONNOOORKUN	MRT	NUVONRTHVMT	NNNHRO	RVHR	NOMQ	
pÅ	QR	kç=d~ë	QQSUMTQKTU	NKM	QRTPSTVKOQ	VTHSV	RVHR	NOMQ	
pÅ	QR	eO	VOVRQPHPN	NKN	VURSOPKUN	VQHPN	RVHR	NOMQ	
pÅ	QR	eÉ	NQURQTKVM	MHS	NSMVPNKOP	VOKOV	RVHR	NOMQ	
dÉ	TO	kç=d~ë	NMURQSTKUM	NHS	NMTQOOSHRP	NMNHMQ	RVHR	NOMQ	
dÉ	TO	eO	PRSPQRKUV	MIP	PVPUSVHSQ	VMKQT	RVHR	NOMQ	
dÉ	TO	eÉ	NNRTQRKUM	NKQ	NORQSSKVR	VOKQ	RVHR	NOMQ	
v	UV	eO	QMRPSQNHPR	MIR	QPMNURSKUS	VQKOP	RVHR	NOMQ	
v	UV	eÉ	TSVTVPHRQ	MRT	UQNPQOKNU	VNHR	RVHR	NOMQ	
qÄ	NRV	kç=d~ë	TMMTSSUKOP	NKV	SRVNQQQKUP	NMSHPN	RVHR	NOMQ	
qÄ	NRV	eÉ	OTRPOTVKON	MHS	OUSSNVMKN	VSHMS	RVHR	NOMQ	
_á	OMV	kç=d~ë	PQRMRSRKNM	OKN	PNTPQTOHSU	NMUKTP	RVHR	NOMQ	
_á	OMV	eÉ	NQVVSQTKNU	MRT	NSMVTVTKOQ	VPKNS	RVHR	NOMQ	

p~ã éáÉ=k~ã É	f`p^_
cäáÉk~ã É	MNMf`p_KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäáÉáíçf`mj eyNya^q^yOMOPyMPJ ^oyi n`OUbkÅ
^Åè=qáã É	PLOULOMOP=NSWRSMRT
p~ã éáÉ=qóéÉ	f`p_
qçí~äa äáíçå	NMMMM
`çã ã Éåí	JJU
fpqa=oÉÑÉcäÉk~ã É	MVQ ^i_KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeáÖÜ	n`=c ä~Ö
V	_É	S	kç=d~ë	NVRTNR	éé Ä	OMS	NNSMUVRRO	OM	TVRR	NOMQ	
NN	_	S	kç=d~ë	OMRRNO	éé Ä	PKQ	TVPOMCP	OM	TVRR	NOMQ	
OP	k~	QR	eÉ	NVRSVNRRVO	éé Ä	MKU	SUCCRQTUKVN	NMMMMM	TVRR	NOMQ	
OQ	j Ö	QR	eÉ	NVRRSTKNCO	éé Ä	MKU	PRVPSSNSKQN	NMMMMM	TVRR	NOMQ	
OT	^ä	QR	eÉ	NMVMQNRRVQ	éé Ä	MKV	NPTTMTMQKCQ	NMMMMM	TVRR	NOMQ	
OU	pá	QR	eO	SCUKVVN	éé Ä	OKP	OSMCPUKPM	RMM	TVRR	NOMQ	[=HLJ=NMB
PV	h	QR	eÉ	NVCSMPKVCR	éé Ä	MKO	OVSUVNQQKCR	NMMMMM	TVRR	NOMQ	
QM	`~	QR	eO	NVRMQVKVSM	éé Ä	NKQ	PCRSVMQUQKMQ	NMMMMM	TVRR	NOMQ	
RN	s	UV	eÉ	ONKMUO	éé Ä	MKP	UTMPSKTM	OM	TVRR	NOMQ	
RO	`ê	UV	eÉ	OCKSSU	éé Ä	MKT	NNTUMPKCP	CO	TVRR	NOMQ	
RR	j å	UV	eÉ	OMKUOM	éé Ä	MKR	RPUMMKTT	OM	TVRR	NOMQ	
RS	cÉ	UV	eO	VVQQQKVPO	éé Ä	MKV	NNCCSUSVQMKTP	NMMMMM	TVRR	NOMQ	
RV	`ç	UV	eÉ	ONKMUT	éé Ä	MKV	NUSRCPKCU	OM	TVRR	NOMQ	
SM	ká	UV	eÉ	ONKNCU	éé Ä	NKT	RCPUCQKTP	OM	TVRR	NOMQ	
SP	`ì	UV	eÉ	OMSLUP	éé Ä	NKN	NQQQVQKPR	OM	TVRR	NOMQ	
SS	wå	UV	eÉ	OCQKRRV	éé Ä	MKT	CUSSNKUV	ONKQ	TVRR	NOMQ	
TR	^ë	UV	eÉ	OMKVRM	éé Ä	NKT	NTUNUKVM	OM	TVRR	NOMQ	
TU	pÉ	UV	eO	OMKPMT	éé Ä	MKV	URUCKMT	OM	TVRR	NOMQ	
UU	pê	UV	eÉ	ONKSQM	éé Ä	NKS	SRVVNKQV	OMKV	TVRR	NOMQ	
VR	j ç	UV	eÉ	OPMMKSCQ	éé Ä	NKM	SUSNQCCKUU	OMMM	TVRR	NOMQ	
NMT	^Ö	UV	eÉ	OMRRTU	éé Ä	MKU	ONUVSQKTR	OM	TVRR	NOMQ	
NNN	`Ç	UV	eÉ	OMKVQV	éé Ä	MKV	OVURMKNV	OM	TVRR	NOMQ	
NNU	på	NRV	eÉ	OMKNTM	éé Ä	MKV	RVSQTHPN	OM	TVRR	NOMQ	
NON	pÄ	NRV	kç=d~ë	NVKRUP	éé Ä	MKP	QQSSUMKTU	OM	TVRR	NOMQ	
NPT	_~	NRV	kç=d~ë	OMKTQU	éé Ä	NKN	NPTRCCKVM	OM	TVRR	NOMQ	
NUO	t	NRV	kç=d~ë	OPKCSU	éé Ä	OKM	PMPUPMKRM	OM	TVRR	NOMQ	
OMR	qä	OMV	kç=d~ë	NVKSCU	éé Ä	NKM	RSSVMSKRP	OM	TVRR	NOMQ	
OMU	mÄ	OMV	kç=d~ë	OMKTQO	éé Ä	NKT	UCMNPUKPM	OM	TVRR	NOMQ	
OPO	qÜ	OMV	kç=d~ë	ONKTRU	éé Ä	MKQ	TRTMMCKUR	OM	TVRR	NOMQ	
OPU	r	OMV	kç=d~ë	ONKURP	éé Ä	PKN	TMRMMNKSV	OM	TVRR	NOMQ	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eáÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	OMSPRVQKRS	NKU	NUVQNRTHMT	NMUKVR	RVRR	NOMQ	
pÅ	QR	kç=d~ë	QOVNMPVKVM	NKS	QRTPSTVKOQ	VPKUO	RVRR	NOMQ	
pÅ	QR	eO	UVTNNUKPS	NKN	VURSCPKUN	VNKMO	RVRR	NOMQ	
pÅ	QR	eÉ	NQQSCQKVM	MKQ	NSMVPNKCP	UVKUU	RVRR	NOMQ	
dÉ	TO	kç=d~ë	NMPRPSTKQT	OKP	NMTQQQSKRP	VSKPU	RVRR	NOMQ	
dÉ	TO	eO	PQPRTTKMN	MKP	PVPUSVMSQ	UTKCP	RVRR	NOMQ	
dÉ	TO	eÉ	NNOSVTKCU	MKV	NCRCSSKVR	UVKVT	RVRR	NOMQ	
v	UV	eO	PVQQQOVNKNU	NKT	QPMNURSKUS	VNKSV	RVRR	NOMQ	
v	UV	eÉ	TQRUNQKSS	MKQ	UQNPQCKNU	UUKSR	RVRR	NOMQ	
qÄ	NRV	kç=d~ë	SVVNNMNKCN	MKS	SRVNQQQKUP	NVSKMS	RVRR	NOMQ	
qÄ	NRV	eÉ	OSUOVPOKNU	NKT	CUSSNVMKN	VPKSN	RVRR	NOMQ	
_á	OMV	kç=d~ë	PQQQNOUKMO	OKS	PNTPQTOKSU	NMUKRP	RVRR	NOMQ	
_á	OMV	eÉ	NQSVNRNKUM	MKV	NSMVTVTKQQ	VNKOS	RVRR	NOMQ	

i åâÉ~ê¬ø~åÖÉ¬p~ã éäÉ¬Ei opF¬øÉéçã

p~ã éäÉ¬k~ã É	i opN
cäÉ¬k~ã É	MNNj i opKÇ
a~í~¬m~íÜ¬k~ã É	aWy^ÖäÉáíyf^ mj eyNya^q^yOMOPyMPJ ^o yi n` OUbkÄ
^Åè¬qãä É	PLOULOMOP¬NSWØRWØR
p~ã éäÉ¬qóéÉ	i op
qçí~äaãä íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa¬øÉÑcäÉk~ã É	MVO ^i _KÇ
p~ã éäÉ¬n` ¬m~ëëlcá~ä	c~ää
fpqa¬n` ¬m~ëëlc~ää	m~ëë
I éÉê~íçê	**~Çã áã**

n` =^å~äöíÉ¬q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çåÅK	r åáë	opa	==¬ mp==	bñés~ä	B oÉÄ	B i çï	B eäÖÜ	n` ¬ø~ä~Ö
V	_É	S	k ç¬ø~ë	VSKVMN	ééÄ	NKT	RSRUOMOR	NMM	VSKV	UVfR	NNMQ	
NN	_	S	k ç¬ø~ë	QSRKSUP	ééÄ	NKO	NTSTOTNKUR	RMM	VPKNQ	UVfR	NNMQ	
RN	s	UV	e É	NMNRKTRN	ééÄ	NKV	QMUMMNPKRN	NMMM	NMNKRU	UVfR	NNMQ	
RO	` ê	UV	e É	OMQRKQOT	ééÄ	OKQ	NMOUSTOOKPN	OMMM	NMOKOT	UVfR	NNMQ	
RR	j å	UV	e É	NMUPKNNN	ééÄ	NKS	QVUUMPMKNV	OMMM	VVKNS	UVfR	NNMQ	
RV	` ç	UV	e É	NMTURTST	ééÄ	OKR	VOVTOUOKMV	NMMM	NMTKUU	UVfR	NNMQ	
SM	k á	UV	e É	NMVSKUQN	ééÄ	NKQ	OSQRURMKMN	NMMM	NMVKSU	UVfR	NNMQ	
SP	` ì	UV	e É	ONNOKSUU	ééÄ	NKQ	NQNRPNSUKQM	OMMM	NMRKSP	UVfR	NNMQ	
SS	wå	UV	e É	OMTSKVPQ	ééÄ	NKR	OPRMNVSKUS	OMMM	NMPKUR	UVfR	NNMQ	
TR	^ë	UV	e É	VURKRUN	ééÄ	NKQ	UNTNTURTQ	NMMM	VUKRS	UVfR	NNMQ	
TU	pÉ	UV	e O	VTTKNPV	ééÄ	MKQ	QMTRONKUT	NMMM	VTKTN	UVfR	NNMQ	
UU	pê	UV	e É	NVRRKRVT	ééÄ	MKT	RUNRTVOKTS	OMMM	VTKTU	UVfR	NNMQ	
VR	j ç	UV	e É	NMTUKMMS	ééÄ	MKQ	PNPTRVQKUN	NMMM	NMTKU	UVfR	NNMQ	
NMT	^Ö	UV	e É	NNVKSUS	ééÄ	NKO	NOQQSOUKTS	NMM	NNVKSV	UVfR	NNMQ	[¬HLHNMB
NNN	` Ç	UV	e É	NVQVKRNQ	ééÄ	NKP	NQRUUPOKUS	NMMM	NVQKVR	UVfR	NNMQ	
NNU	på	NRV	e É	VQNKMVR	ééÄ	NKN	OTVVPVRKVP	NMMM	VQKN	UVfR	NNMQ	
NON	pÄ	NRV	k ç¬ø~ë	VPOKSMM	ééÄ	MKO	ONURURNNKQV	NMMM	VPKOS	UVfR	NNMQ	
NPT	_~	NRV	k ç¬ø~ë	NVSNKPQT	ééÄ	MKR	NPPSTNQMKUQ	OMMM	VUKMT	UVfR	NNMQ	
NUO	t	NRV	k ç¬ø~ë	NVRPKMRN	ééÄ	NKN	NQMQOONTKTT	NMMM	NMRKPN	UVfR	NNMQ	
OVR	qä	OMV	k ç¬ø~ë	NVOMKQNN	ééÄ	NKN	PMURTPTPKVV	NMMM	NVOKMQ	UVfR	NNMQ	
OVU	mÄ	OMV	k ç¬ø~ë	OMOVKROT	ééÄ	NKQ	UPUUQVTPKSU	OMMM	NMNKQU	UVfR	NNMQ	
OPO	qÜ	OMV	k ç¬ø~ë	NMVSKMON	ééÄ	MKV	PSRRUVSTKOS	NMMM	NMMKS	UVfR	NNMQ	
OPU	r	OMV	k ç¬ø~ë	NVPQKVTP	ééÄ	NKU	PQVVVUPNKMM	NMMM	NMPKR	UVfR	NNMQ	

n` =fpqa¬q~ÄäÉ

k~ã É	j ~ëë	qìåÉ¬j çÇÉ	` mp	` mp¬ø pa	oÉÑ¬ mp	B ¬øÉÄ	B n` =¬ çï	B n` ¬æäÖÜ	n` ¬ø~ä~Ö
i á	S	k ç¬ø~ë	OMQVTMTKQN	NKU	NUVQNRTKMT	NMUKON	RVfR	NOMQ	
pÅ	QR	k ç¬ø~ë	QPOOMMMKON	NKP	QRTPSTVKOQ	VQKR	RVfR	NOMQ	
dÉ	TO	k ç¬ø~ë	NMRONVMKPQ	OKV	NMTQOQSKRP	VTKVR	RVfR	NOMQ	
qÄ	NRV	k ç¬ø~ë	TNVTSTTKUN	OKS	SRVNQQQKUP	NMVKO	RVfR	NOMQ	
_á	OMV	k ç¬ø~ë	PSNMQVSKSS	OKS	PNTPQTOKSU	NNPKTT	RVfR	NOMQ	
pÅ	QR	e O	UQNPNNKUU	MKS	VURSOPKUN	URKPS	RVfR	NOMQ	
dÉ	TO	e O	PPRTQUKMS	NKN	PVPUSVKSQ	URKOQ	RVfR	NOMQ	
v	UV	e O	PUVSQOPKRR	MKV	QPMNURSKUS	VMKRU	RVfR	NOMQ	
pÅ	QR	e É	NPSVTTKTU	MKT	NSMVPNKOP	URKNO	RVfR	NOMQ	
dÉ	TO	e É	NNMOUVKRP	NKP	NORQSSKVR	UUKMQ	RVfR	NOMQ	
v	UV	e É	TOTUSRKVR	NKU	UQNPQOKNU	USKRN	RVfR	NOMQ	
qÄ	NRV	e É	OTNORQTKST	NKS	OUSSNVMKN	VQKSQ	RVfR	NOMQ	
_á	OMV	e É	NRUTSQUKVR	NKP	NSMVTVTKOQ	VUKSO	RVfR	NOMQ	

p~ã éãÉ=k~ã É i o p O

cãÉ=k~ã É M N Q p j m i K Ç

a~í~=m~íÜ=k~ã É a W y t Ö ãÉ å í y f ` m j e y N y a ^ q ^ y O M C P y M P J ^ o y j n ` O U b k Å

^Åè=qãã É P L O U L O M C P = N S W R T W N T

p~ã éãÉ=qóéÉ p ~ ã é ã É

qçí~äa ãã íáçå N K M M M M

p~ã éãÉ=n ` =m~ëëlc á~ä c ~ ã ä

fpqa=n ` =m~ëëlc~ãä m ~ ë ë

n ` =^ å~äóíÉ=q~ÄãÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çåÅK	r åáë	o p a	═ mp ═	i a o	n ` =cä~Ö
V	_É	S	k ç=d ~ë	M K M O Q	é é Ä	Q M K V	P V M K M N	N M M	
N N	_	S	k ç=d ~ë	P K R P Q	é é Ä	N K T	N Q Q R P K V N	N M M M	
O P	k ~	Q R	e É	O M O P O Q K Q R V	é é Ä	M K T	N O U O R T R S U K M R	O M M M M M	[i a o
O Q	j Ö	Q R	e É	N V T T P U K S T U	é é Ä	N K M	S S N C O Q L V M R T	O M M M M M	
O T	^ ä	Q R	e É	O N N N P T K T R N	é é Ä	M K U	O S N V O V P Q K M R	O M M M M M	[i a o
O U	p á	Q R	e O	N V S T Q K O M M	é é Ä	N K N	Q N Q O N S Q K O S	N M M M M	[i a o
P V	h	Q R	e É	N V O U T S K M T T	é é Ä	M K T	R Q T V U V T M K U O	O M M M M M	
Q M	` ~	Q R	e O	O M M N P S K O S V	é é Ä	M K U	R U C P V V O S S K U U	O M M M M M	[i a o
R N	s	U V	e É	M K C P T	é é Ä	N O K U	N O M R K S P	N M M M	
R O	` ê	U V	e É	M K U S P	é é Ä	S K M	R P P T K P P	O M M M	
R R	j å	U V	e É	N K Q U V	é é Ä	N K V	P V M P K N Q	O M M M	
R S	c É	U V	e O	V Q C C Q K O M U	é é Ä	M K N	V V Q R C R V R V R M K V D	N M M M M M	
R V	` ç	U V	e É	N K R O T	é é Ä	O K O	N P R M O K R Q	N M M M	
S M	k á	U V	e É	N K M T S	é é Ä	T K O	O T S R K U U	N M M M	
S P	` ì	U V	e É	M K U C O	é é Ä	Q K Q	S M P S K V S	O M M M	
S S	w å	U V	e É	P K R O T	é é Ä	P K V	Q N V U K Q V	O M M M	
T R	^ ë	U V	e É	M K Q M U	é é Ä	U K V	P R U K T N	N M M M	
T U	p É	U V	e O	M R C N	é é Ä	R K T	O N Q K P O	N M M M	
U U	p ê	U V	e É	O K U S R	é é Ä	O K Q	U S C N K T O	O M M M	
V R	j ç	U V	e É	N K T T M	é é Ä	O K M	R Q N O K O T	N M M M	
N M T	^ Ö	U V	e É	M K M R U	é é Ä	S K M	S Q Q K Q T	N M M	
N N N	` Ç	U V	e É	M K C R R	é é Ä	Q K U	P S S K P M	N M M M	
N N U	p å	N R V	e É	M K S R M	é é Ä	T K M	O N C O K Q P	N M M M	
N O N	p Ä	N R V	k ç=d ~ë	M K Q R S	é é Ä	S K V	N M V M O K S O	N M M M	
N P T	_ ~	N R V	k ç=d ~ë	N K C P R	é é Ä	Q K N	U M V Q K P O	O M M M	
N U O	t	N R V	k ç=d ~ë	N K S C O	é é Ä	N Q K P	C O T T T K Q D	N M M M	
O M R	q ä	O M V	k ç=d ~ë	M K P T Q	é é Ä	T K R	N M V R S K Q T	N M M M	
O M U	m Ä	O M V	k ç=d ~ë	N K Q U O	é é Ä	N K R	R T V V U K U P	O M M M	
O P O	q Ü	O M V	k ç=d ~ë	M K U U S	é é Ä	N N K S	P N U R Q K O S	N M M M	
O P U	r	O M V	k ç=d ~ë	M K P U R	é é Ä	S K N	N O M P U K T P	N M M M	

n ` =fpqa=q~ÄãÉ

k ~ã É	j ~ëë	q ì åÉ=j ç Ç É	` mp	` mp=o p a	o É Ñ= mp	B =o É Å	B n ` =i ç ï	B n ` =e ãÜÜ	n ` =cä~Ö
i á	S	k ç=d ~ë	O M D S P R R K C U	N K N	N U V Q N R T K M T	N V S K V U	R V R	N O M Q	
p Å	Q R	k ç=d ~ë	Q M S O T T N K V Q	N K U	Q R T P S T V K O Q	U U K U P	R V R	N O M Q	
p Å	Q R	e O	U Q Q M N M K V R	M K P	V U R S C P K U N	U R K Q P	R V R	N O M Q	
p Å	Q R	e É	N Q Q M V P K U O	M K S	N S M V P N K C P	U U K O V	R V R	N O M Q	
d É	T O	k ç=d ~ë	V T M V S T K M Q	N K N	N M T Q Q Q S K R P	V M P V	R V R	N O M Q	
d É	T O	e O	P O U R N Q K U T	N K M	P V P U S V K S Q	U P K Q N	R V R	N O M Q	
d É	T O	e É	N N M P N U K U P	N K O	N O R C S S K V R	U U K M T	R V R	N O M Q	
v	U V	e O	P S U T Q U R K N P	M K V	Q P M N U R S K U S	U R K T O	R V R	N O M Q	
v	U V	e É	T P O S U M K Q M	M K U	U Q N P Q O K N U	U T K M V	R V R	N O M Q	
q Ä	N R V	k ç=d ~ë	S T T P P V Q K P R	N K N	S R V N Q Q Q K U P	N M O K T S	R V R	N O M Q	
q Ä	N R V	e É	O R T C Q V O K M T	M K Q	O U S S N V M K N	U V K T R	R V R	N O M Q	
_ á	O M V	k ç=d ~ë	P O U O N N P K R N	M K R	P N T P Q T O K S U	N M P K Q O	R V R	N O M Q	
_ á	O M V	e É	N P T N P M U K R P	M K U	N S M V T V T K O Q	U R K N V	R V R	N O M Q	

p~ã éäÉ=k~ã É ofkpb

cãÉ=k~ã É MNPpj mi kÇ

a~í~=m~íÜ=k~ã É aWÿ ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÅ

^Åè=qãã É PLOULOMCP=NTWMQMQR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå NKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä c~åä

fpqa=n` =m~ëëlc~åä c~åä

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==i mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	QKPRM	ééÄ	NNKP	OTSKST	NMM	
NN	_	S	k ç=d ~ë	NQPKPRV	ééÄ	OKP	RUTPKRN	NMMM	
OP	k ~	QR	e É	TMPSOKPRP	ééÄ	PKU	NMRNUMSQ	OMMMMM	
OQ	j Ö	QR	e É	POVRUKPOV	ééÄ	TKU	OSMNOKTU	OMMMMM	
OT	^ ä	QR	e É	PQUOTKQMQ	ééÄ	RKU	NMNUUKRT	OMMMMM	
OU	pá	QR	e O	QNQUKQMV	ééÄ	MKS	PVOQKSV	NMMMM	
PV	h	QR	e É	UORVRKVVU	ééÄ	OKM	RROUUKRV	OMMMMM	
QM	` ~	QR	e O	PQSNVKVSO	ééÄ	PKS	OQRROOKVQ	OMMMMM	
RN	s	UV	e É	PUPKUUP	ééÄ	NRKR	UMRKRV	NMMM	
RO	` ê	UV	e É	NSRVKVVS	ééÄ	UKQ	QPTTTKNU	OMMM	
RR	j å	UV	e É	QQQKMPO	ééÄ	PKT	RUQKRT	OMMM	
RS	cÉ	UV	e O	VVVOOKSST	ééÄ	PKU	RQRMMUKPQ	NMMMM	
RV	` ç	UV	e É	NMMKVSN	ééÄ	NPKQ	QSMKMP	NMMM	
SM	k á	UV	e É	OPSKSQR	ééÄ	NOKN	PMMKMN	NMMM	
SP	` ì	UV	e É	RMQKOVU	ééÄ	NKV	NTTTKVO	OMMM	
SS	wå	UV	e É	RRTRKTSU	ééÄ	SKT	PPNNKRS	OMMM	[i a o
TR	^ ë	UV	e É	PORKTMV	ééÄ	NNKS	NQNKPR	NMMM	
TU	pÉ	UV	e O	PNUKRMV	ééÄ	OKO	SRKMM	NMMM	
UU	pê	UV	e É	NOMKQSS	ééÄ	ONKM	NUUKUV	OMMM	
VR	j ç	UV	e É	NVUNKQVV	ééÄ	VKU	PMONKRM	NMMM	[i a o
NMT	^ Ö	UV	e É	VKONO	ééÄ	NQKP	RMKMM	NMM	
NNN	` Ç	UV	e É	QOKOMT	ééÄ	NQKM	PNKSN	NMMM	
NNU	på	NRV	e É	QMSQKOOU	ééÄ	UKT	RTOPKRR	NMMM	[i a o
NON	pÄ	NRV	k ç=d ~ë	POMKQVS	ééÄ	NPKM	PRQMKUV	NMMM	
NPT	_~	NRV	k ç=d ~ë	SMNKMRS	ééÄ	VKM	NVOUKUQ	OMMM	
NUO	t	NRV	k ç=d ~ë	OONNKORV	ééÄ	NMKO	NRNOUKNP	NMMM	[i a o
OMR	qä	OMV	k ç=d ~ë	PQKVNT	ééÄ	UKQ	OPOVKPQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QSKQQR	ééÄ	UKM	QOPUKMV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NQOKOOP	ééÄ	TKU	NNPUTKON	NMMM	
OPU	r	OMV	k ç=d ~ë	NNKOSS	ééÄ	NKV	UQMKVO	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ=f mp	B n` =f çï	B n` =¤äÖÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	OONVRKRU	OKN	NUVONRTKMT	NKNT	RVKR	NOMQ	SMOMa ça
pÅ	QR	k ç=d ~ë	NVOMUKQN	OKN	QRTPSTVKOQ	MKOO	RVKR	NOMQ	SMOMa ça
pÅ	QR	e O	OMROKQP	QKS	VURSOPKUN	MKON	RVKR	NOMQ	SMOMa ça
pÅ	QR	e É	PPQKSN	QKR	NSMVPNKOP	MKON	RVKR	NOMQ	SMOMa ça
d É	TO	k ç=d ~ë	UOMSKUR	OKR	NMTQOQSKRP	MKTS	RVKR	NOMQ	SMOMa ça
d É	TO	e O	SVRKUU	UKM	PVPUSVKSQ	MKNU	RVKR	NOMQ	SMOMa ça& eäÖÜ=fpqa=¤pa
d É	TO	e É	OMMKSP	NVKU	NORQSSKVR	MKNS	RVKR	NOMQ	SMOMa ça& eäÖÜ=fpqa=¤pa
v	UV	e O	NVMTKTT	RKU	QPMVNURSKUS	MKVQ	RVKR	NOMQ	SMOMa ça
v	UV	e É	PUPKOT	UKN	UQNPQQKNU	MKVR	RVKR	NOMQ	SMOMa ça& eäÖÜ=fpqa=¤pa
qÄ	NRV	k ç=d ~ë	PQMQKQU	TKT	SRVNQQQKUP	MKVR	RVKR	NOMQ	SMOMa ça
qÄ	NRV	e É	NOVRKNS	VKM	OUSSNVMKN	MKVR	RVKR	NOMQ	SMOMa ça& eäÖÜ=fpqa=¤pa
_á	OMV	k ç=d ~ë	TVSQKVU	PKV	PNTPQTOKSU	MKOR	RVKR	NOMQ	SMOMa ça
_á	OMV	e É	PTQRKNT	NKV	NSMVTVTKOQ	MKOP	RVKR	NOMQ	SMOMa ça

p~ã éäÉ=k~ã É ofkpb

cãÉ=k~ã É MNQpj mi kÇ

a~í~=m~íÜ=k~ã É aWµ ÖäÉáíµ˜ mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=NTMMMQN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå NMMMM

p~ã éäÉ=n` =m~ëëlc á~ä c~åä

fpqa=n` =m~ëëlc~åä c~åä

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹mp==	iao	n` =cä~Ö
V	_É	S	kçªl~ë	RKMVU	ééÄ	OHR	COMKMM	NMM	
NN	_	S	kçªl~ë	NRTHRVP	ééÄ	RHS	QPURKNV	NMMM	
OP	k~	QR	eÉ	TNOTTKQUU	ééÄ	SKN	TOORRKNS	OMMMMM	
OQ	j Ö	QR	eÉ	COOVRKMPV	ééÄ	TKU	NNUSPHPO	OMMMMM	
OT	^ä	QR	eÉ	OPRVTKORO	ééÄ	NNKN	QSTRHPP	OMMMMM	
OU	pá	QR	eO	PVORHPMM	ééÄ	TKU	OSTSKQM	NMMMM	
PV	h	QR	eÉ	VOUSQKNMV	ééÄ	PHT	QONVVKNM	OMMMMM	
QM	` ~	QR	eO	ONRTTKUMS	ééÄ	SKU	NNMPPRHTR	OMMMMM	
RN	s	UV	eÉ	SPOKOMS	ééÄ	VHM	TSOKOR	NMMM	
RO	` ê	UV	eÉ	OUTPHPTT	ééÄ	NNHO	QPOVKNU	OMMM	[iao
RR	j å	UV	eÉ	UMPHTQO	ééÄ	NOHO	SMRKOP	OMMM	
RS	cÉ	UV	eO	NMMRQTHTMO	ééÄ	RHN	OUQRNNHMU	NMMMM	[iao
RV	` ç	UV	eÉ	NOUHSQP	ééÄ	OMKV	PPNHNP	NMMM	
SM	ká	UV	eÉ	QPVKURT	ééÄ	NQHN	PNTHTV	NMMM	
SP	` ì	UV	eÉ	UQOKVQQ	ééÄ	RHM	NTMMHNQ	OMMM	
SS	wå	UV	eÉ	NMMSQKNUQ	ééÄ	THS	PQONHRV	OMMM	[iao
TR	^ë	UV	eÉ	PTTHTTR	ééÄ	NPHQ	VPHSU	NMMM	
TU	pÉ	UV	eO	PTSHSRV	ééÄ	OPHP	PVHST	NMMM	
UU	pê	UV	eÉ	NRPHTPS	ééÄ	OOHP	NQMKMM	OMMM	
VR	j ç	UV	eÉ	OPRUHRSS	ééÄ	VHT	OMRVHMV	NMMM	[iao
NMT	^Ö	UV	eÉ	NRHONQ	ééÄ	OUHS	QSHST	NMM	
NNN	` Ç	UV	eÉ	SRHVVO	ééÄ	PHR	OTHTU	NMMM	
NNU	på	NRV	eÉ	TMQUHSMR	ééÄ	NMHR	RONOHON	NMMM	[iao
NON	pÄ	NRV	kçªl~ë	QPNHSRP	ééÄ	VHS	OQROHUN	NMMM	
NPT	_~	NRV	kçªl~ë	NNVQHMSM	ééÄ	NTHU	NVSUKVM	OMMM	
NUO	t	NRV	kçªl~ë	PMSSHUUV	ééÄ	NMHR	VVNQHPO	NMMM	[iao
OMR	qä	OMV	kçªl~ë	QQHQMV	ééÄ	SHS	NSMRHNP	NMMM	
OMU	mÄ	OMV	kçªl~ë	SVHONT	ééÄ	OHT	PQOPHUM	OMMM	
OPO	qÜ	OMV	kçªl~ë	NRTHOTM	ééÄ	PHO	SUPRHTS	NMMM	
OPU	r	OMV	kçªl~ë	NRHQUQ	ééÄ	NOHR	SOTHPR	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¢ mp	B¤pÉÅ	Bn` =içï	Bn` =¤äÜÜ	n` =cä~Ö
iá	S	kçªl~ë	NRMOMKUN	NHS	NUVONRTHMT	MRTV	RVHR	NOMKQ	SMOMaça
pÅ	QR	kçªl~ë	TTOTHPN	NHN	QRTPSTVHOQ	MHNT	RVHR	NOMKQ	SMOMaça
pÅ	QR	eO	NQUPHNP	RKU	VURSOPHUN	MHNR	RVHR	NOMKQ	SMOMaça
pÅ	QR	eÉ	OOTHOV	PHN	NSMVPNHOP	MHNQ	RVHR	NOMKQ	SMOMaça
dÉ	TO	kçªl~ë	TVRQHNN	MKV	NMTQOQSHRP	MRTQ	RVHR	NOMKQ	SMOMaça
dÉ	TO	eO	QVNHVN	THR	PVPUSVHSQ	MHNO	RVHR	NOMKQ	SMOMaça
dÉ	TO	eÉ	NMUHSR	THT	NORQSSHVR	MHMV	RVHR	NOMKQ	SMOMaça
v	UV	eO	VUVHUR	PHV	QPMVNURSHUS	MHMO	RVHR	NOMKQ	SMOMaça
v	UV	eÉ	ONVHVS	NNHV	UQNPQQHNU	MHMP	RVHR	NOMKQ	SMOMaça&eaÖÜ¤fpqa=¤pa
qÄ	NRV	kçªl~ë	NTQVHNO	QHU	SRVNQQQHUP	MHMP	RVHR	NOMKQ	SMOMaça
qÄ	NRV	eÉ	STUHRS	VHM	OUSSNVMHN	MHMO	RVHR	NOMKQ	SMOMaça&eaÖÜ¤fpqa=¤pa
_á	OMV	kçªl~ë	QPNVHOR	PHU	PNTPQTOHSU	MHNQ	RVHR	NOMKQ	SMOMaça
_á	OMV	eÉ	OOQVHTT	PHO	NSMVTVTHQQ	MHNQ	RVHR	NOMKQ	SMOMaça

p~ã éäÉ=k~ã É ofkpb

cãÉ=k~ã É MNRpj mi kÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyî mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=NTWMQMRS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå NKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä c~åä

fpqa=n` =m~ëëlc~åä c~åä

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==mp==	iao	n` =cä-Ö
V	_É	S	kç=d~ë	SKSTO	ééÄ	QKN	OMUKVM	NMM	
NN	_	S	kç=d~ë	NSTKNPN	ééÄ	SKQ	PPTUKCP	NMMM	
CP	k~	QR	eÉ	URMPMKVSR	ééÄ	NRKO	SRRSVKMP	OMMMMM	
CQ	j Ö	QR	eÉ	OQUCUKTVP	ééÄ	NSKV	NMMTTKCQ	OMMMMM	
CT	^ä	QR	eÉ	OQUPSKRSP	ééÄ	NNKU	PTRUKPQ	OMMMMM	
CU	pá	QR	eO	QUPSKMDT	ééÄ	TKO	CQNVKQP	NMMMM	
PV	h	QR	eÉ	NNTRPNKUUO	ééÄ	NRKP	QMSMSKSV	OMMMMM	
QM	` ~	QR	eO	OTTSVKMDT	ééÄ	OKS	NMQMSMPU	OMMMMM	
RN	s	UV	eÉ	TRCKUSV	ééÄ	NPKV	SCMKMD	NMMM	
RO	` ê	UV	eÉ	PRTSKVOV	ééÄ	RKV	PSVUKQR	OMMM	[i a o
RR	j å	UV	eÉ	NNQRKRRO	ééÄ	RKQ	RVOKRT	OMMM	
RS	cÉ	UV	eO	NOSNMNKRPQ	ééÄ	PKS	PMSVRMKON	NMMMMM	[i a o
RV	` ç	UV	eÉ	NSPKVTS	ééÄ	QKQ	OVNKNP	NMMM	
SM	ká	UV	eÉ	RUCKVSP	ééÄ	NCKO	CUUKVM	NMMM	
SP	` ì	UV	eÉ	NNCUKOMP	ééÄ	RKV	NRRQKRS	OMMM	
SS	wå	UV	eÉ	UVRQKQNO	ééÄ	TKN	OMUCKQO	OMMM	[i a o
TR	^ë	UV	eÉ	QRTKVRU	ééÄ	UKM	TUKMN	NMMM	
TU	pÉ	UV	eO	PTOKOUN	ééÄ	OUKU	PPKST	NMMM	
UU	pê	UV	eÉ	OOPKUSO	ééÄ	NVKR	NPSKST	OMMM	
VR	j ç	UV	eÉ	OTQVKVUS	ééÄ	NQKO	NSQMKNP	NMMM	[i a o
NMT	^Ö	UV	eÉ	OQKMNS	ééÄ	NQKV	RNKNN	NMM	
NNN	` Ç	UV	eÉ	NNQKOMT	ééÄ	NMKP	POKRV	NMMM	
NNU	på	NRV	eÉ	RVVTKUCO	ééÄ	NKR	PQPPKUP	NMMM	[i a o
NON	pÄ	NRV	kç=d~ë	RQPKNTS	ééÄ	SKQ	OPSVKPU	NMMM	
NPT	_~	NRV	kç=d~ë	QMSKRUU	ééÄ	NKS	RNTKOO	OMMM	
NUO	t	NRV	kç=d~ë	PMMSKSSU	ééÄ	PMKN	TPSSKSN	NMMM	[i a o
OMR	qä	OMV	kç=d~ë	SNKNTU	ééÄ	OKO	NQTNKSQ	NMMM	
OMU	mÄ	OMV	kç=d~ë	UVKMMT	ééÄ	NNKQ	OVNPKOO	OMMM	
OPO	qÜ	OMV	kç=d~ë	NRNKSUS	ééÄ	UKS	QPVOKMS	NMMM	
OPU	r	OMV	kç=d~ë	OTKTUS	ééÄ	NQKR	TQTKQU	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=opa	oÉÑ=mp	B=oÉÅ	Bn` =içï	Bn` =eáÜÜ	n` =cä-Ö
iá	S	kç=d~ë	NMVNQKQQ	OKV	NUVQNRTKMT	MKRU	RVKR	NOMKQ	SMOMa ça
pÅ	QR	kç=d~ë	RUPUKTT	RKQ	QRTPSTVKQQ	MKNP	RVKR	NOMKQ	SMOMa ça
pÅ	QR	eO	NMUQKRN	OKN	VURSCPKUN	MKNN	RVKR	NOMKQ	SMOMa ça
pÅ	QR	eÉ	NTRKPM	NQKQ	NSMVPNKCP	MKNN	RVKR	NOMKQ	SMOMa ça & eáÜÜ=fpqa=opa
dÉ	TO	kç=d~ë	SRMSKOT	PKM	NMTQQQSKRP	MKSN	RVKR	NOMKQ	SMOMa ça
dÉ	TO	eO	PORKOT	TKN	PVPUSVKSQ	MKVU	RVKR	NOMKQ	SMOMa ça
dÉ	TO	eÉ	TTKPO	NMKU	NCROSSKVR	MKVS	RVKR	NOMKQ	SMOMa ça & eáÜÜ=fpqa=opa
v	UV	eO	URNKOM	QKM	QPMNURSKUS	MKVO	RVKR	NOMKQ	SMOMa ça
v	UV	eÉ	NQVKVT	RKU	UQNPQQKNU	MKVO	RVKR	NOMKQ	SMOMa ça
qÄ	NRV	kç=d~ë	NPQQKQV	VKO	SRVNQQQKUP	MKVO	RVKR	NOMKQ	SMOMa ça & eáÜÜ=fpqa=opa
qÄ	NRV	eÉ	RONKVN	PKP	OUSSNVMKN	MKVO	RVKR	NOMKQ	SMOMa ça
_á	OMV	kç=d~ë	OUTOKQR	TKR	PNTPQTOKSU	MKVV	RVKR	NOMKQ	SMOMa ça
_á	OMV	eÉ	NQORKUN	PKR	NSMVTVTKQQ	MKVV	RVKR	NOMKQ	SMOMa ça

`çåíaåìaåÖ=~äåÄê~íáçå=sÉêâÑÑA~íáçå=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MNS|``skÇ
a~í~=m~íÜ=k~ã É	aWy^ÖãÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OUbkÄ
^Åè=qáã É	PLOULOMOP=NTW0MNMM
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MVO ^i _kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eäÖÜ	n`=c~ä-Ö
V	_É	S	k ç=d ~ë	ORKOOT	ééÄ	NKM	NQSPMQKSM	CR	NMMKVN	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKTOQ	ééÄ	NKS	VTTTNKMV	CR	NMOKV	UVKU	NNMO	
OP	k ~	CR	e É	RSOVKTPP	ééÄ	NKV	PRSTOSTKTT	RMMM	NNOKRV	UVKU	NNMO	[=HLJ=NMB
OQ	j Ö	CR	e É	RTMOKNPO	ééÄ	NKN	NUUQNSNKQN	RMMM	NNQKMQ	UVKU	NNMO	[=HLJ=NMB
OT	^ä	CR	e É	RRNKSVS	ééÄ	NKQ	STTVTKMU	RMM	NNMPQ	UVKU	NNMO	[=HLJ=NMB
OU	pá	CR	e O	RPPKROV	ééÄ	MKV	OMVRMUKMM	RMM	NMSKTN	UVKU	NNMO	
PV	h	CR	e É	RPRMQMR	ééÄ	MKQ	NRPMRVRKOV	RMMM	NMTKMN	UVKU	NNMO	
QM	` ~	CR	e O	RPMTKOPN	ééÄ	MKS	NRSNOORTKUO	RMMM	NMSKNQ	UVKU	NNMO	
RN	s	UV	e É	OSKTQQ	ééÄ	MKN	NMTRSOKTR	CR	NMSKVU	UVKU	NNMO	
RO	` ê	UV	e É	OSKSPQ	ééÄ	MKP	NPQTSQKSO	CR	NMSKRQ	UVKU	NNMO	
RR	j å	UV	e É	OSKPPS	ééÄ	MKS	SSPMTKQN	CR	NMRKPQ	UVKU	NNMO	
RS	cÉ	UV	e O	RMRUKRRS	ééÄ	NKS	RRPUNTVRKSU	RMMM	NMNKNT	UVKU	NNMO	
RV	` ç	UV	e É	OTKPQV	ééÄ	NKO	OPRTQTKSM	CR	NMVKQ	UVKU	NNMO	
SM	ká	UV	e É	OTKMMP	ééÄ	NKO	SRQSQKMN	CR	NMUKQN	UVKU	NNMO	
SP	` ì	UV	e É	OTKNTT	ééÄ	NKM	NUOPSNKRS	CR	NMUKTN	UVKU	NNMO	
SS	wå	UV	e É	OTKMQP	ééÄ	NKV	PMTQTKRU	CR	NMUKNT	UVKU	NNMO	
TR	^ë	UV	e É	OSKNPS	ééÄ	NKS	ONSSRKPV	CR	NMQKRQ	UVKU	NNMO	
TU	pÉ	UV	e O	ORKMPV	ééÄ	OKP	NMORSKTV	CR	NMMKNS	UVKU	NNMO	
UU	pê	UV	e É	ORKVUM	ééÄ	MKS	TTOOQKUT	CR	NMPKVO	UVKU	NNMO	
VR	j ç	UV	e É	OSKPSU	ééÄ	OKN	TSUTRKOS	CR	NMRKQT	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKTRT	ééÄ	NKN	OUTUUSKSR	CR	NNNKMP	UVKU	NNMO	[=HLJ=NMB
NNN	` Ç	UV	e É	OTKPVU	ééÄ	NKM	PUMROKQS	CR	NMVKRV	UVKU	NNMO	
NNU	på	NRV	e É	OQKURT	ééÄ	NKM	TPMOQKVQ	CR	VVKQP	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	ORKOQR	ééÄ	MKQ	RSPTNQKST	CR	NMMKVU	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	OSKNUN	ééÄ	NKQ	NSVVNTKNS	CR	NMQKTO	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKSVP	ééÄ	OKO	PQNMNOKNS	CR	NMSKTT	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKTOS	ééÄ	OKT	TRMTVUKNO	CR	NMOKV	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKPRO	ééÄ	NKT	NMROTUQKSQ	CR	NMRKQN	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKMRN	ééÄ	MKQ	VNRTQQKQU	CR	NMQKO	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKUQO	ééÄ	OKT	UTRRRPKRR	CR	NMTKPT	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ïçï	B n`=eäÖÜ	n`=c~ä-Ö
iá	S	k ç=d ~ë	OMPOVTPKOS	NKP	NUVQNRTKMT	NMTKPP	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	QPTUQNQKQN	NKT	QRTPSTVKQQ	VRKTP	RVKR	NOMQ	
pÅ	CR	e O	URMRPNKRS	OKQ	VURSCPKUN	USKOV	RVKR	NOMQ	
pÅ	CR	e É	NQMPRVKOM	MKT	NSMVPNKCP	UTKCO	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NMOTSUQKNQ	MKO	NMTQQQSKRP	VRKST	RVKR	NOMQ	
dÉ	TO	e O	PPTMNNKMR	MKR	PVPUSVKSQ	URKRS	RVKR	NOMQ	
dÉ	TO	e É	NNMQMOKNT	NKP	NCRCSSKVR	UUKNP	RVKR	NOMQ	
v	UV	e O	PUCQRCUKRR	NKQ	QPMNURSKUS	UUKV	RVKR	NOMQ	
v	UV	e É	TOTMOMKSM	MKR	UQNPQCOKNU	USKQN	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUQTMRMKPS	MKS	SRVNQQQKUP	NVPKUU	RVKR	NOMQ	
qÄ	NRV	e É	OSSUNMNKTT	NKO	OUSSNVMKN	VPKMV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQUNVMPKUQ	NKU	PNTPQTOKSU	NMVKTO	RVKR	NOMQ	
_á	OMV	e É	NRPSNNVKOT	NKT	NSMVTVTKOQ	VRKQO	RVKR	NOMQ	

p~ã éáÉ=k~ã É	``_
cäÉ=k~ã É	MNT]``_KÇ
a~í~=m~íÜ=k~ã É	aWi^ÖäÉáíyî mj eyNya^q^yOMOPyMPJ ^oyi n`OUbkÂ
^Åè=qáã É	PLOULOMOP=NTW0UM0T
p~ã éáÉ=qóéÉ	``_
qçí~äa ãäíáçå	NKMMMM
`çã ã ÉâíáíÇ	JJJ
fpqa=oÉÑcäÉk~ã É	MMQ ^i_KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	m~ëë
fpqa=n`=m~ëëlc~äã	m~ëë
I éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄæÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	råáë	opa	==\ mp==	iãäá	n`=c ä~Ö
V	_É	S	kç=d~ë	MKMU	éé Ä	NMPKV	PNNKNO	MO	
NN	_	S	kç=d~ë	MKPUU	éé Ä	RKT	ORRSKVQ	Q	
OP	k~	QR	eÉ	RKOMR	éé Ä	OOKR	QUUOVKVU	OMM	
OQ	j Ö	QR	eÉ	SKTTM	éé Ä	NPKT	OVQTKMU	OM	
OT	^ä	QR	eÉ	OKQSN	éé Ä	NSKT	ROOKOQ	OM	
OU	pá	QR	eO	MKVOO	éé Ä	TKQ	UNQKOO	NMM	
PV	h	QR	eÉ	NQKMMQ	éé Ä	OMKT	PRSNOKSP	OMM	
QM	`~	QR	eO	SKTMV	éé Ä	NKQ	PQRPPKRR	OM	
RN	s	UV	eÉ	MKMNV	éé Ä	OPKQ	PQPKPR	N	
RO	`ê	UV	eÉ	JMKMNU	éé Ä	kL^	VOQKRO	N	
RR	j å	UV	eÉ	MKMNM	éé Ä	ONKQ	NSRKPM	MQ	
RS	cÉ	UV	eO	RKNUP	éé Ä	OKS	TNSMQKCR	OM	
RV	`ç	UV	eÉ	MKMMN	éé Ä	NPPKT	OTTKTV	MO	
SM	k á	UV	eÉ	MKMNP	éé Ä	QUKT	NVQKQR	MQ	
SP	`ì	UV	eÉ	MKMMS	éé Ä	SMKT	RSPKPS	MS	
SS	wå	UV	eÉ	MKMTP	éé Ä	QNKR	OTUKVM	O	
TR	^ë	UV	eÉ	MKMPQ	éé Ä	OTKT	QVKMN	N	
TU	pÉ	UV	eO	MKMRS	éé Ä	NTKU	PPKPP	N	
UU	pê	UV	eÉ	MKMNM	éé Ä	NSKR	UNKNN	N	
VR	j ç	UV	eÉ	MKPPT	éé Ä	OKV	NOUOKPM	N	
NMT	^Ö	UV	eÉ	MKMNV	éé Ä	NQKU	OQTKTV	MO	
NNN	`Ç	UV	eÉ	MKMNT	éé Ä	NPKQ	PRKNU	MO	
NNU	på	NRV	eÉ	MKNOS	éé Ä	ONKT	TMSKTM	N	
NON	pÄ	NRV	kç=d~ë	MKMOV	éé Ä	NOKV	NSNNKUM	MO	
NPT	_~	NRV	kç=d~ë	MKMNU	éé Ä	NQKS	PMSKVV	MQ	
NUO	t	NRV	kç=d~ë	MKOUV	éé Ä	SKR	SRSRKOU	N	
OMR	qä	OMV	kç=d~ë	MKMQQ	éé Ä	TKO	OMTVKMR	MO	
OMU	mÄ	OMV	kç=d~ë	JMKMMV	éé Ä	kL^	ONTOKPU	MO	
OPO	qÜ	OMV	kç=d~ë	MKMQO	éé Ä	OVKM	QPVOKMR	N	
OPU	r	OMV	kç=d~ë	MKMON	éé Ä	VKT	VRQKPU	MO	

n`=fpqa=q~ÄæÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=çï	B n`=cäÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	ONMTSQMPU	NKM	NUVQNRTKMT	NNNKOT	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QPVQQTRKPU	MKT	QRTPSTVKOQ	VSKMU	RVKR	NOMQ	
pÅ	QR	eO	UURUTRKUS	MKQ	VURSOPKUN	UVKUU	RVKR	NOMQ	
pÅ	QR	eÉ	NQUOQTKUR	MKT	NSMVPNKOP	VOKNO	RVKR	NOMQ	
dÉ	TO	kç=d~ë	NMSSOUQKTV	NKP	NMTQOQSKRP	VVKOS	RVKR	NOMQ	
dÉ	TO	eO	PQUMVRKOS	NKS	PVPUSVKSQ	UUKPS	RVKR	NOMQ	
dÉ	TO	eÉ	NNTUOOKPU	MKP	NORORSSKVR	VQKMS	RVKR	NOMQ	
v	UV	eO	PVURVRSKRV	MKU	QPMNURSKUS	VOKSS	RVKR	NOMQ	
v	UV	eÉ	TTPUMNKRM	MKR	UQNPQOKNU	VNKVT	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	TPNRSQRKON	NKN	SRVNQQQKUP	NNMKVV	RVKR	NOMQ	
qÄ	NRV	eÉ	OUPQNMUKUS	NKT	OUSSNVMKN	VUKUU	RVKR	NOMQ	
_á	OMV	kç=d~ë	PSORNURKTO	MKQ	PNTPQTOKSU	NNQKOP	RVKR	NOMQ	
_á	OMV	eÉ	NSRPTTRKSP	NKS	NSMVTVTKOQ	NVOKTP	RVKR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	kbt il qqbpq
cáÉ=k~ã É	MNU| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJ ^oyin` OUbKÄ
^Åè=qãã É	PLOULOMOP=NTVRPVRP
p~ã éäÉ=qóéÉ	m_
qçí~ä=aäíáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMQ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	m~ëë
fpqa=n` =m~ëëLc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iáãáí	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMMV	ééÄ	kL^	ONPKPQ	MKR	
_	NN	S	kç=d~ë	MKOUP	ééÄ	QKV	ONVRKTS	NM	
k~	OP	QR	eÉ	SKUOO	ééÄ	NTKM	QVROVKPO	RMM	
jÖ	OQ	QR	eÉ	QKNON	ééÄ	RKQ	OMMVKNM	RM	
^ä	OT	QR	eÉ	OKSQR	ééÄ	ONKU	RQOKOQ	RM	
pá	OU	QR	eO	NKOPS	ééÄ	TKU	VPTKSV	ORM	
h	PV	QR	eÉ	NNKSNU	ééÄ	NPKM	PQSROKOS	RMM	
`~	QM	QR	eO	UKTMR	ééÄ	OKS	QMQPUKVU	RM	
s	RN	UV	eÉ	MKMNN	ééÄ	OPKM	PNMKMN	OKR	
`ê	RO	UV	eÉ	JMKMNU	ééÄ	kL^	VPNKUS	OKR	
jå	RR	UV	eÉ	MKMSS	ééÄ	SKT	PNTKVQ	N	
cÉ	RS	UV	eO	OKRNR	ééÄ	PKM	QMSMRKRQ	RM	
`ç	RV	UV	eÉ	JMKMNT	ééÄ	kL^	NMUKVM	MKR	
ká	SM	UV	eÉ	MKMRM	ééÄ	NTKV	OVNKNO	N	
`ì	SP	UV	eÉ	MKMRS	ééÄ	NVKV	VORKSM	NKR	
wå	SS	UV	eÉ	NKPMR	ééÄ	TKM	NTTMKNQ	R	
^ë	TR	UV	eÉ	MKMNR	ééÄ	ORKT	PPKMM	OKR	
pÉ	TU	UV	eO	MKMOP	ééÄ	UMKO	NUKUP	OKR	
pê	UU	UV	eÉ	MKMNS	ééÄ	NPKS	VTKTU	OKR	
jç	VR	UV	eÉ	MKONS	ééÄ	RKO	VNPKPU	OKR	
^Ö	NMT	UV	eÉ	MKMVR	ééÄ	SMKO	UUKUV	MKR	
`Ç	NNN	UV	eÉ	MKMVR	ééÄ	TUKQ	NTKMP	MKR	
på	NNU	NRV	eÉ	MKNPQ	ééÄ	NUKV	TPNKNQ	OKR	
pÄ	NON	NRV	kç=d~ë	MKMOP	ééÄ	NRKU	NQVNKSS	MKR	
_~	NPT	NRV	kç=d~ë	MKMMO	ééÄ	PVSKV	OMMKON	N	
t	NUO	NRV	kç=d~ë	MKNRQ	ééÄ	UKT	QUOSKMQ	OKR	
qä	OMR	OMV	kç=d~ë	MKMMU	ééÄ	RUKT	NMPNKNQ	MKR	
mÄ	OMU	OMV	kç=d~ë	JMKMNS	ééÄ	kL^	NVORKQP	MKR	
qÜ	OPO	OMV	kç=d~ë	JMKMNN	ééÄ	kL^	ORNSKOR	OKR	
r	OPU	OMV	kç=d~ë	MKMMT	ééÄ	NVKV	QTPKUR	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	CNRRVCQCKVO	NVR	NUVCNRTKMT	NNPKUO	RVKR	NCMCQ	
pÅ	QR	kç=dl~ë	CPVVCRVKNT	PKP	QRTPSTVKCQ	VSKNV	RVKR	NCMCQ	
pÅ	QR	eO	UUNRRQKSO	NVR	VURSCPKUN	UVKQQ	RVKR	NCMCQ	
pÅ	QR	eÉ	NQTNTCKRU	NKP	NSIVPNKCP	VNKQR	RVKR	NCMCQ	
dÉ	TO	kç=dl~ë	NMUUVNSKRS	MKV	NMTQCQSKRP	NMNKPT	RVKR	NCMCQ	
dÉ	TO	eO	PQQQPCKRM	MKT	PVPUSVKSQ	UTKQR	RVKR	NCMCQ	
dÉ	TO	eÉ	NNSVQVKNR	MKS	NCRCSSKVR	VPKPS	RVKR	NCMCQ	
v	UV	eO	PVPMRUSKCV	MKU	CPMNURSKUS	VNKPT	RVKR	NCMCQ	
v	UV	eÉ	TTTUCVKSO	MKS	UQNPQCKNU	VCKQR	RVKR	NCMCQ	
qÄ	NRV	kç=dl~ë	TQRURPVKRQ	CKM	SRVNQQQKUP	NNPKNR	RVKR	NCMCQ	
qÄ	NRV	eÉ	CUCNCRVKNR	NKQ	CUSSNVMKN	VUKQP	RVKR	NCMCQ	
_á	CMV	kç=dl~ë	PSVNTTMUKUT	CKT	PNTPQTCKSU	NNSKPP	RVKR	NCMCQ	
_á	CMV	eÉ	NSRNRUPKRT	MKU	NSIVTVTKCQ	NMCKS	RVKR	NCMCQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éáÉ=k~ã É	m_pn`NQÇj pO
cáÉ=k~ã É	MNV| m_KÇ
a~í~=m~íÜk~ã É	aWf'ÖáÉáíyf` mj eyNya^q^yQVOCPyVPJj ^oyi n` CUbkÄ
^Åè=qã É	PLOLLOVOCP=NTVRVUVQN
p~ã éáÉ=qóéÉ	m_
qçí~äaáäíáçå	RKVMVMVM
`çã ã Éáí	JJJ
fpqa=oÉÑcáÉk~ã É	MVQJ ^i _KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~áä
fpqa=n`=m~ëëlc~áä	m~ëë
l éÉê~íçê	**~Çã áä**

n`=å~äöíÉ=q~ÄáÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	iãáí	n`=cä~Ö
_É	V	S	k ç=dl~ë	JVKVTV	éëÄ	k lÅ	NSVKVM	MKR	
_	NN	S	k ç=dl~ë	OKNQV	éëÄ	NVKU	ORRPKSN	NM	
k~	OP	QR	e É	RSKSRQ	éëÄ	NNKQ	QUONPKSO	RVM	
j Ö	OQ	QR	e É	ORKPNP	éëÄ	VKR	ONQQKSU	RM	
^ä	OT	QR	e É	RSKVMM	éëÄ	NNKU	NROVKVM	RM	m_=SMOMc~áë=a ça
pá	OU	QR	e O	NUKPNR	éëÄ	UKV	NTORKOT	ORM	
h	PV	QR	e É	VTKVOT	éëÄ	PKM	PPVUOKQU	RVM	
`~	QM	QR	e O	TQKTVO	éëÄ	MKR	RPPUMKQS	RM	m_=SMOMc~áë=a ça
s	RN	UV	e É	MKRRU	éëÄ	VKO	SUNKNQ	OKR	
`ê	RO	UV	e É	MKTRO	éëÄ	THP	NSUNKTU	OKR	
j å	RR	UV	e É	MKSQS	éëÄ	NUKT	QQSKSM	N	
cÉ	RS	UV	e O	PRKNVS	éëÄ	NKQ	UQPQVKPQ	RM	
`ç	RV	UV	e É	JVKVQO	éëÄ	k lÅ	NTPKPQ	MKR	
ká	SM	UV	e É	MKSNM	éëÄ	VKS	QPSKSU	N	
`ì	SP	UV	e É	NKVNS	éëÄ	MKQ	OVVPKTN	NKR	m_=SMOMc~áë=a ça
wå	SS	UV	e É	NPKQTP	éëÄ	UKM	PNRVKPN	R	m_=SMOMc~áë=a ça & m_=SMOMc~áë=k çåJa ça
^ë	TR	UV	e É	MKNVS	éëÄ	PUKR	QVKST	OKR	
pÉ	TU	UV	e O	MKNMQ	éëÄ	PUKP	NSKST	OKR	
pê	UU	UV	e É	MKNRN	éëÄ	NRKN	NPOKOO	OKR	
j ç	VR	UV	e É	MKVPU	éëÄ	VKM	TRRKRV	OKR	
^Ö	NMT	UV	e É	MKMMU	éëÄ	TUKO	RNKNN	MKR	
`Ç	NNN	UV	e É	MKMMO	éëÄ	RMQKV	VKSP	MKR	
på	NNU	NRV	e É	PUKPST	éëÄ	NKP	OOSSUKPM	OKR	m_=SMOMc~áë=a ça & m_=SMOMc~áë=k çåJa ça
pÄ	NON	NRV	k ç=dl~ë	MKOSR	éëÄ	NOKT	OVRUKVV	MKR	
_~	NPT	NRV	k ç=dl~ë	MKRRQ	éëÄ	SKR	VMMKVT	N	
t	NUO	NRV	k ç=dl~ë	MKSOQ	éëÄ	OPKM	QVVOKVS	OKR	
qä	OVR	OVV	k ç=dl~ë	JVKVVR	éëÄ	k lÅ	TPVKTV	MKR	
mÄ	OVU	OVV	k ç=dl~ë	MKNTS	éëÄ	NNKV	QVOOKRN	MKR	
qÜ	OPO	OVV	k ç=dl~ë	MKNNU	éëÄ	NQKO	PTONKNR	OKR	
r	OPU	OVV	k ç=dl~ë	MKMMM	éëÄ	k lÅ	OOSKVN	MKR	

n`=fpqa=q~ÄáÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NVUNNTQKVT	NKT	NUVQNRTKMT	NMQKRV	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	QNRMRPOKUU	OKR	QRTPSTVKQQ	VMKTR	RVKR	NOMQ	
pÅ	QR	eO	TVMVOPKOR	NKO	VURSOPKUN	UMKOR	RVKR	NOMQ	
pÅ	QR	eÉ	NPRNTOKUT	MKR	NSMVPNKOP	UPKVV	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	NMMPPTRKPT	OKO	NMTQQQSKRP	VPKQ	RVKR	NOMQ	
dÉ	TO	eO	PNRVVSKNS	NKM	PVPUSVKSQ	UMKOP	RVKR	NOMQ	
dÉ	TO	eÉ	NMSRQOKQO	MKM	NORQSSKVR	URKMR	RVKR	NOMQ	
v	UV	eO	PSOPRPTKMV	MKS	QPMNURSKUS	UQKOP	RVKR	NOMQ	
v	UV	eÉ	TNOOPOKRN	MKS	UQNPQOKNU	UQKSR	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	SVNNPQOKTR	NKN	SRVNQQQKUP	NMQKUR	RVKR	NOMQ	
qÄ	NRV	eÉ	OSRUNVOKRP	MKT	OUSSNVMKN	VOKTQ	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PSOSSQVKUM	NKU	PNTPQTOKSU	NNQKOU	RVKR	NOMQ	
_á	OMV	eÉ	NRSRRPMKVP	MKO	NSMVTVTKOQ	VTKOR	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMMR^

cãÉ=k~ã É MOMpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMOP=NTWPWQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	VKMMD	ééÄ	OKP	NNNUTKUQ	NMM	
NN	_	S	k ç=d ~ë	OMRKMP	ééÄ	OKM	NQUORTHRV	NMMM	
OP	k ~	QR	e É	NNNSOKVQV	ééÄ	NKN	NPPPVTUKTU	OMMMMM	
OQ	j Ö	QR	e É	NQQQHSQT	ééÄ	OKM	UUTSQRTN	OMMMMM	
OT	^ ä	QR	e É	NPOSUKVVM	ééÄ	NKT	PMNPOPKUU	OMMMMM	
OU	pá	QR	e O	UVMOKRNV	ééÄ	PKR	SPRMUUKTQ	NMMMM	
PV	h	QR	e É	NMONSKPST	ééÄ	MKV	RRUPPOKQU	OMMMMM	
QM	` ~	QR	e O	NUPTKRRS	ééÄ	NKO	VVQVMNKQO	OMMMMM	
RN	s	UV	e É	TPKMVQ	ééÄ	NKM	RTNTUKOQ	NMMM	
RO	` ê	UV	e É	TNKQTM	ééÄ	NKN	TMSPRKUQ	OMMM	
RR	j å	UV	e É	OORKUNN	ééÄ	NKT	NNMOUMKVO	OMMM	
RS	cÉ	UV	e O	NTVSPKPPU	ééÄ	NKM	PTQPVPOMKRM	NMMMM	
RV	` ç	UV	e É	NPKUST	ééÄ	MKQ	OPQOOHRQ	NMMM	
SM	k á	UV	e É	OSKNQV	ééÄ	NKR	NOPUMKVV	NMMM	
SP	` ì	UV	e É	QNKRON	ééÄ	OKO	RQQNUKQU	OMMM	
SS	wå	UV	e É	NQMKVSR	ééÄ	NKN	PMVMVKVN	OMMM	
TR	^ ë	UV	e É	RTKMON	ééÄ	NKO	VNUSKMM	NMMM	
TU	pÉ	UV	e O	QVKPQS	ééÄ	NKM	PURPKRO	NMMM	
UU	pê	UV	e É	RSKSUO	ééÄ	NKS	POTPMKQT	OMMM	
VR	j ç	UV	e É	RPKRPP	ééÄ	NKV	PMQOVKSV	NMMM	
NMT	^ Ö	UV	e É	NMKSRU	ééÄ	NKU	ONQVMKRR	NMM	
NNN	` Ç	UV	e É	NMKSTT	ééÄ	MKU	OUUSKVV	NMMM	
NNU	på	NRV	e É	USKQPQ	ééÄ	NKS	QUURTHQN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NMKOSP	ééÄ	PKQ	QSOMPKQU	NMMM	
NPT	_~	NRV	k ç=d ~ë	UURTMT	ééÄ	NKO	NNQNSUKRT	OMMM	
NUO	t	NRV	k ç=d ~ë	ROKQOQ	ééÄ	OKQ	NPQOPVKQT	NMMM	
OMR	qä	OMV	k ç=d ~ë	VKOSU	ééÄ	MKS	RSNRMKVT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	URKVRP	ééÄ	OKP	TMQUMVKOO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	QSKUOM	ééÄ	NKS	PPVNQRKNO	NMMM	
OPU	r	OMV	k ç=d ~ë	NRKUMT	ééÄ	OKP	NMRMVSKVU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ ÉÁ	B n ` =¡ çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NVQMRPNKTN	MKT	NUVQNRTHMT	NVOKQR	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PVVNPTOKTS	NKM	QRTPSTVKOQ	UTHOT	RVHR	NOMQ	
pÅ	QR	e O	TTPTRUHST	NKO	VURSOPKUN	TUHR	RVHR	NOMQ	
pÅ	QR	e É	NOVVUQPT	NKM	NSMVPNKOP	UMRTT	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VSMPMRKQT	NHR	NMTQOQSKRP	UVHPV	RVHR	NOMQ	
d É	TO	e O	PMPTPMPR	MKT	PVPUSVHSQ	TTHKN	RVHR	NOMQ	
d É	TO	e É	NMOPSRKOS	MKV	NORCSSKVR	UNKTO	RVHR	NOMQ	
v	UV	e O	PSPVTNTHPV	MKU	OPMNURSKUS	UQHSN	RVHR	NOMQ	
v	UV	e É	TMRSTTKOV	MHR	UQNPQOKNU	UPKUU	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	STUSQONKOQ	NHP	SRVNQQQKUP	NMOKVS	RVHR	NOMQ	
qÄ	NRV	e É	ORSOPQOKVR	NKQ	OUSSNVMKN	UVKQ	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRSUQTUKOP	MKT	PNTPQTOKSU	NNOKQR	RVHR	NOMQ	
_á	OMV	e É	NROTRSOKUN	OKN	NSMVTVTKOQ	VQKUV	RVHR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` NSfj pN
cáÉ=k~ã É	MON| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉåíyf` mj eyNya^q^yOMOPyMPJj ^oyin` OUbKÄ
^Åè=qãã É	PLOULOMOP=NTWQUWRR
p~ã éäÉ=qóéÉ	m_
qçí~ä=aäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMQ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iãã á	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMQS	ééÄ	kL^	NVSKST	MKR	
_	NN	S	kç=d~ë	PKQPR	ééÄ	UKP	PQVUKOS	NM	
k~	OP	QR	eÉ	TTKQPM	ééÄ	UKU	QVSTVKTU	RMM	
jÖ	OQ	QR	eÉ	OSKNVP	ééÄ	NOKQ	ONRRKUN	RM	
^ä	OT	QR	eÉ	QSKRPQ	ééÄ	NOKP	NORUKVU	RM	
pá	OU	QR	eO	POKUQT	ééÄ	OMKU	OTSTKRT	ORM	
h	PV	QR	eÉ	NOOKQRM	ééÄ	PKU	PQRVOKMS	RMM	
`~	QM	QR	eO	STKOMT	ééÄ	NKR	QUURPKMO	RM	m_=SMOM=c~åë=aça
s	RN	UV	eÉ	MKSRQ	ééÄ	SKP	TRQKQU	OKR	
`ê	RO	UV	eÉ	MKTRP	ééÄ	NPKU	NSTUKQR	OKR	
jå	RR	UV	eÉ	MKVSS	ééÄ	PKS	SMOKRT	N	
cÉ	RS	UV	eO	RTKOQP	ééÄ	NKU	NPMNOSKSR	RM	m_=SMOM=c~åë=aça
`ç	RV	UV	eÉ	JMKMST	ééÄ	kL^	NPNKNN	MKR	
ká	SM	UV	eÉ	MKRMQ	ééÄ	UKM	PURKRT	N	
`ì	SP	UV	eÉ	MKPPU	ééÄ	NKV	VOOKOT	NKR	
wå	SS	UV	eÉ	TKMQM	ééÄ	SKU	NTPMKNQ	R	m_=SMOM=c~åë=aça
^ë	TR	UV	eÉ	MKOUQ	ééÄ	OMKT	SPKSU	OKR	
pÉ	TU	UV	eO	MKOTO	ééÄ	NNKV	OVKST	OKR	
pê	UU	UV	eÉ	MKOMP	ééÄ	OPKP	NSOKOP	OKR	
jç	VR	UV	eÉ	MKURU	ééÄ	QKV	TMTKUN	OKR	
^Ö	NMT	UV	eÉ	MKMOP	ééÄ	SPKV	UNKNO	MKR	
`Ç	NNN	UV	eÉ	JMKMMO	ééÄ	kL^	UKRO	MKR	
på	NNU	NRV	eÉ	PUKQSM	ééÄ	OKP	OOPRUKUR	OKR	m_=SMOM=c~åë=aça & m_=SMOM=c~åë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKNOQ	ééÄ	NUKR	NQMNKRS	MKR	
_~	NPT	NRV	kç=d~ë	MKPMT	ééÄ	RKV	RSTKOU	N	
t	NUO	NRV	kç=d~ë	MKQSS	ééÄ	NVKQ	PSPNKMP	OKR	
qä	OMR	OMV	kç=d~ë	MKMOR	ééÄ	RVKV	UVTKSR	MKR	
mÄ	OMU	OMV	kç=d~ë	MKNTN	ééÄ	OMKO	PVONKMV	MKR	
qÜ	OPO	OMV	kç=d~ë	MKOMR	ééÄ	UKM	QOVNKVN	OKR	
r	OPU	OMV	kç=d~ë	MKMNO	ééÄ	NSKM	PMTKMM	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NVUMNTUKOU	NKQ	NUVQNRTKMT	NMQKRQ	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	QMTNOUQKUR	OKR	QRTPSTVKQQ	UVKMD	RVKR	NOMQ	
pÅ	QR	eO	TUQUSNKQT	NKO	VURSOPKUN	TVKSP	RVKR	NOMQ	
pÅ	QR	eÉ	NPOQPMKPN	NKV	NSIMVPNKCP	UOKOV	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VUUPVRKVR	NKV	NMTQOQSKRP	VOKMN	RVKR	NOMQ	
dÉ	TO	eO	PMURONKVN	MKP	PVPUSVKSQ	TUKPP	RVKR	NOMQ	
dÉ	TO	eÉ	NMRSOUKSR	NKM	NORQSSKVR	UQKPO	RVKR	NOMQ	
v	UV	eO	PSOQOVSKVM	NKM	QPMNURSKUS	UQKOR	RVKR	NOMQ	
v	UV	eÉ	TNMOVTKVR	MKS	UQNPQOKNU	UQKQO	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	STVSMNSKUO	NKU	SRVNQQQKUP	NMPKN	RVKR	NOMQ	
qÄ	NRV	eÉ	OSNSQUNKMU	NKT	OUSSNMMKN	VNKOV	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PRTNOQQKNP	NKP	PNTPQTOKSU	NNOKRP	RVKR	NOMQ	
_á	OMV	eÉ	NRSSPRMKNT	MKP	NSIMVTVTKOQ	VTHP	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäãp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` pl n ` NSfj pN
cáÉ=k~ã É	MDCI ` pl KÇ
a~í~=m~íÜ=k~ã É	aWf ÖáÉáíyf` mj eyNya ^q^ yOMOPyMPJ ^oyi n ` OUbkÄ
^Åè=qãã É	PLOULOMOP=NTWRQMP
p~ã éäÉ=qóéÉ	i ` pl
qçí~äaãäíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MMQ ^i _KÇ
p~ã éäÉ=n ` =m~ëëlcá~ä	m~ëë
fpqa=n ` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åä**

n ` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==mp==	bñés~ä	B=oÉÁ	B i çï	B eáÖÜ	n ` =c~ä-Ö
_É	V	S	k ç=dl ~ë	QVKTUT	éëÄ	OKM	RQPTPKOU	RM	NVKVN	TVKR	NOMQ	
_	NN	S	k ç=dl ~ë	QVOKUUP	éëÄ	OKN	PQVNRVKNO	RMM	NVKTO	TVKR	NOMQ	
k~	OP	QR	e É	UPUOKVRR	éëÄ	MKR	NMNOQQSKSM	TRMM	OOKPR	TVKR	NOMQ	
j Ö	OQ	QR	e É	ROTRKUPP	éëÄ	MKQ	POPROPKSM	RMMM	ONKN	TVKR	NOMQ	
^ä	OT	QR	e É	ONNNKRNR	éëÄ	MKU	QUNPTKUR	OMMM	ONKNO	TVKR	NOMQ	
pá	OU	QR	e O	UVVKMOV	éëÄ	MKT	SQTNRKUM	NMMM	NTKVU	TVKR	NOMQ	
h	PV	QR	e É	VVNNKOUU	éëÄ	MKT	RQOUUQKNU	NMMMM	NVKUO	TVKR	NOMQ	
` ~	QM	QR	e O	OSOMSNM	éëÄ	NKO	NQNURURKPN	ORMM	OMKVS	TVKR	NOMQ	
s	RN	UV	e É	QUUKTOQ	éëÄ	NKU	PTUROOKTS	RMM	NVKRR	TVKR	NOMQ	
` ê	RO	UV	e É	OMTKMSP	éëÄ	MKR	OMNRTNKTP	OMM	OMKTN	TVKR	NOMQ	
j å	RR	UV	e É	RMVKTTR	éëÄ	NKM	OQTOMMKMT	RMM	OMKPV	TVKR	NOMQ	
cÉ	RS	UV	e O	NMMVKPSP	éëÄ	NKM	OMUPQTOKQS	NMMM	OMKNV	TVKR	NOMQ	
` ç	RV	UV	e É	RPSKQMT	éëÄ	MKU	UVNNQQKPN	RMM	ONKQS	TVKR	NOMQ	
ká	SM	UV	e É	RPMKQVR	éëÄ	NKM	OQSTNSKRS	RMM	ONKOO	TVKR	NOMQ	
` ì	SP	UV	e É	OSUKRUM	éëÄ	MKO	PQTNSQKNP	ORM	ONKQV	TVKR	NOMQ	
wå	SS	UV	e É	RNOKVMS	éëÄ	NKS	NNOMMTKPR	RMM	OMKRO	TVKR	NOMQ	
^ë	TR	UV	e É	NMMKUOM	éëÄ	MKS	NSNORKMM	NMM	OMKNS	TVKR	NOMQ	
pÉ	TU	UV	e O	VSKRTO	éëÄ	NKM	TQOPKNP	NMM	NVKPN	TVKR	NOMQ	
pê	UU	UV	e É	QVMKNVO	éëÄ	MKV	OUMVOPKTN	RMM	NVKSN	TVKR	NOMQ	
j ç	VR	UV	e É	NMQKPSS	éëÄ	MKQ	RUTQMKOP	NMM	OMKUT	TVKR	NOMQ	
^Ö	NMT	UV	e É	RQKPTT	éëÄ	MKR	NMUUMUKPS	RM	ONKTR	TVKR	NOMQ	
` Ç	NNN	UV	e É	OSNKVOR	éëÄ	MKR	TMNSUKTV	ORM	OMKVS	TVKR	NOMQ	
på	NNU	NRV	e É	RMSKMSU	éëÄ	NKP	OUTVTMKPM	RMM	OMKOQ	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl ~ë	VPKSUP	éëÄ	NKR	QNTQUTKMN	NMM	NUKTQ	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl ~ë	OMOPKONR	éëÄ	NKU	OSQOQMSKQP	OMMM	OMKQP	TVKR	NOMQ	
t	NUO	NRV	k ç=dl ~ë	NMTKNUR	éëÄ	MKR	OTPSUMKON	NMM	ONKQQ	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl ~ë	VTKQTU	éëÄ	NKR	RTVSUPKNM	NMM	NVKR	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl ~ë	NMNKPNQ	éëÄ	MKT	UORMNNKPO	NMM	OMKOS	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl ~ë	VQKRSO	éëÄ	NKR	STTSSSKQO	NMM	NUKVN	TVKR	NOMQ	
r	OPU	OMV	k ç=dl ~ë	NMPKTMV	éëÄ	NKV	SUVNNTKRQ	NMM	OMKTQ	TVKR	NOMQ	

n ` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=ÿ çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä=Ö
iá	S	kç=d~ë	NVMVMMVKUU	MKS	NUVQNRTKMT	NMMKTU	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QMUQNNUKCR	MKU	QRTPSTVKCQ	UVKP	RVKR	NOMQ	
pÅ	QR	eO	TTSPUTKQM	MKO	VURSCPKUN	TUKTT	RVKR	NOMQ	
pÅ	QR	eÉ	NPMMTRKTM	MKP	NSMVPNKCP	UMKUP	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VUPQNCKNR	MKO	NMTQCQSKRP	VNKRQ	RVKR	NOMQ	
dÉ	TO	eO	PMVSVRKSV	MKR	PVPUSVKSQ	TUKSP	RVKR	NOMQ	
dÉ	TO	eÉ	NMCPUNKCU	NKO	NCRCSSKVR	UPKPP	RVKR	NOMQ	
v	UV	eO	PRUSQRRKCO	MKT	QPMNURSKUS	UPKPT	RVKR	NOMQ	
v	UV	eÉ	TMNNSVKMS	MKR	UQNPQCKNU	UPKPQ	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SUCVTSSKNR	NKQ	SRVNQQCKUP	NMPKSO	RVKR	NOMQ	
qÄ	NRV	eÉ	CRVNVPNKQT	NKO	CUSSNVMKN	VMKCP	RVKR	NOMQ	
_á	QW	kç=d~ë	PRQRPUUKVR	NKN	PNTPQTCKSU	NNNKTO	RVKR	NOMQ	
_á	QW	eÉ	NRPSSRTKRV	MKV	NSMVTVTKCQ	VRKQS	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMNN

cãÉ=k~ã É MOPpj mi hÇ

a~í~=m~íÜ=k~ã É aWµ ÖãÉåíµ mj eyNya^q^yOMOPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMOP=NUMNMU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	MOQN	éé Ä	NVKU	RMRKRT	NMM	
NN	_	S	k ç=d ~ë	OKURP	éé Ä	SKV	OQOMOKMU	NMMM	
OP	k ~	QR	e É	USKMQT	éé Ä	OKO	RNQRRKMN	OMMMMM	
OQ	j Ö	QR	e É	NTQSKOTM	éé Ä	OKO	NNMVRTHPU	OMMMMM	
OT	^ ä	QR	e É	UONMKNQU	éé Ä	NKR	NVOUMOKNM	OMMMMM	
OU	pá	QR	e O	NOSQKNRR	éé Ä	PKR	VOMRVKQT	NMMMM	
PV	h	QR	e É	NTPMPRV	éé Ä	NKM	NONQPQKOV	OMMMMM	
QM	` ~	QR	e O	NPUVKQUS	éé Ä	NKO	TSUNOMPR	OMMMMM	
RN	s	UV	e É	OOKOQS	éé Ä	OKT	NTVNOKUM	NMMM	
RO	` ê	UV	e É	NPKUPP	éé Ä	MKU	NQTMUKNU	OMMM	
RR	j å	UV	e É	NRMKUQV	éé Ä	OKQ	TRNRQKSM	OMMM	
RS	cÉ	UV	e O	NRPTUKUUV	éé Ä	OKM	PORMONUNKQR	NMMMMM	
RV	` ç	UV	e É	OKPSU	éé Ä	OKM	QOUPKUP	NMMM	
SM	k á	UV	e É	PKORQ	éé Ä	SKN	NTMOKPR	NMMM	
SP	` ì	UV	e É	PKQNU	éé Ä	TKM	RMNOKNM	OMMM	
SS	wå	UV	e É	ORKNTV	éé Ä	OKP	RUNNKPN	OMMM	
TR	^ ë	UV	e É	QKNUP	éé Ä	PKP	TMPKTS	NMMM	
TU	pÉ	UV	e O	MOQSN	éé Ä	VKT	QRKNT	NMMM	
UU	pê	UV	e É	UKUMQ	éé Ä	PKR	ROONKMV	OMMM	
VR	j ç	UV	e É	QKMVV	éé Ä	OKV	ORUOKRN	NMMM	
NMT	^ Ö	UV	e É	MKMQU	éé Ä	OQKN	NPQKQR	NMM	
NNN	` Ç	UV	e É	MKNQT	éé Ä	VKR	QVKSP	NMMM	
NNU	på	NRV	e É	PUKPUN	éé Ä	MKT	OONQUKQN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MOQT	éé Ä	PKU	NVUOKOQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	RMKMVR	éé Ä	NKS	SRVQMKRQ	OMMM	
NUO	t	NRV	k ç=d ~ë	MKPVO	éé Ä	PMKM	PRMTKRM	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKPNV	éé Ä	TKU	OTMSKQV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	SKPOR	éé Ä	NKR	RRPQQKTT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NQKPNN	éé Ä	NKP	NMTUSSKMQ	NMMM	
OPU	r	OMV	k ç=d ~ë	OKOUQ	éé Ä	NKM	NRUOSKTN	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ ÉÁ	B n` =¡ çï	B n` =¤ äÜÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	NVOPQOUKQP	NKQ	NUVQNRTKMT	NMNKRR	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QNPMQNNKPS	NKN	QRTPSTVKOQ	VMKPN	RVKR	NOMKQ	
pÅ	QR	e O	TUSUMNKTU	MKS	VURSOPKUN	TVKUP	RVKR	NOMKQ	
pÅ	QR	e É	NPQPRSKQR	MKV	NSMVPNKOP	UPKQV	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VVQOUPKUM	NKV	NMTQOQSKRP	VOKRS	RVKR	NOMKQ	
d É	TO	e O	PMVUPQKMN	MKR	PVPUSVKSQ	TUKSS	RVKR	NOMKQ	
d É	TO	e É	NMQRSQKRS	NKN	NORQSSKVR	UPKQT	RVKR	NOMKQ	
v	UV	e O	PSVNRMRKOQ	OKM	QPMNURSKUS	URKUN	RVKR	NOMKQ	
v	UV	e É	TNVSRNKNU	NKQ	UQNPQOKNU	URKRQ	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SVNTRRSKUQ	NKO	SRVNQQQKUP	NMQKVR	RVKR	NOMKQ	
qÄ	NRV	e É	ORVSRQMKST	NKM	OUSSNVMKN	VMKRV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PSQQMRSKRP	MKT	PNTPQTOKSU	NNQKUP	RVKR	NOMKQ	
_á	OMV	e É	NRSQNNNKRT	NKQ	NSMVTVTKOQ	VTKNS	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NNUUUMNP

cãÉ=k~ã É MOQpj mi hÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMOP=NUMMTMS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKMRM	ééÄ	RQKQ	PMSKST	NMM	
NN	_	S	k ç=d ~ë	PKPQO	ééÄ	NKT	PQRMKQU	NMMM	
OP	k ~	QR	e É	QRKVSQ	ééÄ	UKM	QRPQUKMM	OMMMMM	
OQ	j Ö	QR	e É	OSRKRVR	ééÄ	NKS	NSUQSKMS	OMMMMM	
OT	^ ä	QR	e É	TTTMKPTO	ééÄ	NKM	NTTQOPKMM	OMMMMM	
OU	pá	QR	e O	NTNOKVOO	ééÄ	PKU	NOPRSOKTR	NMMMM	
PV	h	QR	e É	OURKUPT	ééÄ	PKT	QOSRNKTU	OMMMMM	
QM	` ~	QR	e O	NTNKOSV	ééÄ	MKV	NMQSVOKUV	OMMMMM	
RN	s	UV	e É	NRKUNP	ééÄ	NKO	NOQUMKNP	NMMM	
RO	` ê	UV	e É	NOKTVN	ééÄ	MKR	NPPOQKPV	OMMM	
RR	j å	UV	e É	PQKNTN	ééÄ	OKS	NSSVMKMS	OMMM	
RS	cÉ	UV	e O	UUSUKVPT	ééÄ	NKT	NUPVOQQTKQO	NMMMMM	
RV	` ç	UV	e É	MKVNM	ééÄ	NOKQ	NTRPKRN	NMMM	
SM	k á	UV	e É	PKMVU	ééÄ	OKS	NRUSKTV	NMMM	
SP	` ì	UV	e É	OKURN	ééÄ	PKO	QNRRKNQ	OMMM	
SS	wå	UV	e É	NTKOOS	ééÄ	PKU	PVOVKRN	OMMM	
TR	^ ë	UV	e É	QKNMS	ééÄ	PKV	STPKTR	NMMM	
TU	pÉ	UV	e O	MOOPS	ééÄ	NPKQ	OSKUP	NMMM	
UU	pê	UV	e É	OKVTS	ééÄ	OKT	NTQVKVP	OMMM	
VR	j ç	UV	e É	NKMVP	ééÄ	RKT	UUSKTN	NMMM	
NMT	^ Ö	UV	e É	MKMNV	ééÄ	NRKR	TPKPP	NMM	
NNN	` Ç	UV	e É	MKMSV	ééÄ	PSKS	OTKQN	NMMM	
NNU	på	NRV	e É	PUKVOT	ééÄ	NKN	OOSSQKVN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOUP	ééÄ	SKN	ONUOKQV	NMMM	
NPT	_~	NRV	k ç=d ~ë	NVKUUT	ééÄ	NKN	OSSUNKPQ	OMMM	
NUO	t	NRV	k ç=d ~ë	MKNPR	ééÄ	PQKV	OUVSKTO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMST	ééÄ	OUKV	NNSTKVS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NPKSUU	ééÄ	NKS	NNSTPMKVR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NNKURT	ééÄ	NKP	UVUOTKUR	NMMM	
OPU	r	OMV	k ç=d ~ë	NKPQR	ééÄ	UKN	VQMPKQV	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n` =ï çï	B n` =¤ä ÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	NVVOQVVKPP	NKT	NUVQNRTKMT	NVRKNV	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QMSTVNNKOQ	MKT	QRTPSTVKOQ	UUKVQ	RVKR	NOMQ	
pÅ	QR	e O	TUMOQTKVS	MKP	VURSOPKUN	TVKNS	RVKR	NOMQ	
pÅ	QR	e É	NPMSPMSU	MKN	NSMVPNKOP	UNKNT	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VUMUPUKRN	NKO	NMTQOQSKRP	VNKP	RVKR	NOMQ	
d É	TO	e O	PMSTNMKRQ	MKQ	PVPUSVKSQ	TTKUT	RVKR	NOMQ	
d É	TO	e É	NMPVSTKMR	MKU	NORCSSKVR	UP	RVKR	NOMQ	
v	UV	e O	PSOMRTOKTT	MKS	OPMNURSKUS	UQKNS	RVKR	NOMQ	
v	UV	e É	TMNOUMKMN	MKQ	UQNPOOKNU	UPKPR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	TMPTTSOKTO	NKN	SRVNOQQKUP	NMSKTT	RVKR	NOMQ	
qÄ	NRV	e É	OSOMVRNKTS	MKU	OUSSNVMKN	VNKQN	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PSQORMOKPQ	NKN	PNTPQTOKSU	NNQKTU	RVKR	NOMQ	
_á	OMV	e É	NRUPNMUKSQ	MKT	NSMVTVTKOQ	VUKPQ	RVKR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` NTfj pN
cáÉ=k~ã É	MCR| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf` mj eyNya^q^yOMCPyMPJj ^oyin` OUbKÄ
^Åè=qãã É	PLOULOMCP=NUMOMP
p~ã éäÉ=qóéÉ	m_
qçí~ä=aäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMQ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iãã á	n` =cä~Ö
_É	V	S	kç=d~ë	JMKMCP	ééÄ	kL^	NVUKVM	MKR	
_	NN	S	kç=d~ë	NKURO	ééÄ	PKO	OPOPKRS	NM	
k~	OP	QR	eÉ	QOKSPM	ééÄ	OQKV	QRRVRKUU	RMM	
jÖ	OQ	QR	eÉ	OQKOPO	ééÄ	NSKS	OMPRKTV	RM	
^ä	OT	QR	eÉ	QNKNRP	ééÄ	RKR	NNPQKRN	RM	
pá	OU	QR	eO	NVKQMN	ééÄ	SKN	NTTRKPN	ORM	
h	PV	QR	eÉ	NMVKORP	ééÄ	QKQ	PPVNOKRP	RMM	
`~	QM	QR	eO	SMKTPS	ééÄ	NKN	QQVPNKQM	RM	m_=SMOM=c~åë=aça
s	RN	UV	eÉ	MKRVV	ééÄ	TKN	SVPKPT	OKR	
`ê	RO	UV	eÉ	MKRST	ééÄ	RKV	NQRTKUM	OKR	
jå	RR	UV	eÉ	MKQSQ	ééÄ	PKR	PQTKOT	N	
cÉ	RS	UV	eO	QUKVUQ	ééÄ	PKP	NMVSSNKVU	RM	
`ç	RV	UV	eÉ	MKMMV	ééÄ	PRVKT	ORPKPR	MKR	
ká	SM	UV	eÉ	PKVMU	ééÄ	PKV	NVPTKVR	N	m_=SMOM=c~åë=aça & m_=SMOM=c~åë=k çåJaça
`ì	SP	UV	eÉ	MKQOQ	ééÄ	ORKS	NMMTKUQ	NKR	
wå	SS	UV	eÉ	QKOSU	ééÄ	RKR	NMVMKMS	R	
^ë	TR	UV	eÉ	MKNUS	ééÄ	PQKP	QSKST	OKR	
pÉ	TU	UV	eO	MKVRS	ééÄ	QRKO	NOKRM	OKR	
pê	UU	UV	eÉ	MKONO	ééÄ	OUKP	NSPKPQ	OKR	
jç	VR	UV	eÉ	MKQSQ	ééÄ	NNKR	QTOKOQ	OKR	
^Ö	NMT	UV	eÉ	MKMMU	ééÄ	PRKN	QUKUV	MKR	
`Ç	NNN	UV	eÉ	MKVPN	ééÄ	OMKU	NTKMQ	MKR	
på	NNU	NRV	eÉ	QMKQPS	ééÄ	OKS	OPQSTKTM	OKR	m_=SMOM=c~åë=aça & m_=SMOM=c~åë=k çåJaça
pÄ	NON	NRV	kç=d~ë	MKNUM	ééÄ	QKS	NSPNKUP	MKR	
_~	NPT	NRV	kç=d~ë	MKQPO	ééÄ	UKR	TOMKTV	N	
t	NUO	NRV	kç=d~ë	JMKNMN	ééÄ	kL^	ONTVKNR	OKR	
qä	OMR	OMV	kç=d~ë	MKMMQ	ééÄ	ROKO	TSTKQV	MKR	
mÄ	OMU	OMV	kç=d~ë	MKVPQ	ééÄ	QUKR	OTUVKTP	MKR	
qÜ	OPO	OMV	kç=d~ë	MKQOO	ééÄ	ORKP	RUPTKRT	OKR	
r	OPU	OMV	kç=d~ë	MKMMT	ééÄ	VQKP	OTPKSP	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NVSVQRSKTT	MKU	NUVQNRTKMT	NMPKVU	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	QMRNMUQKSN	MKQ	QRTPSTVKQQ	UUKRT	RVKR	NOMQ	
pÅ	QR	eO	TTTSUPKQQ	MKS	VURSQPKUN	TUKV	RVKR	NOMQ	
pÅ	QR	eÉ	NPQRNSKQR	NKS	NSMVPNKQP	UQKPQ	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VTSTQUKSQ	NKV	NMTQQQSKRP	VMKVO	RVKR	NOMQ	
dÉ	TO	eO	PMPRRUKMR	MKT	PVPUSVKSQ	TTKMT	RVKR	NOMQ	
dÉ	TO	eÉ	NMOTNSKSO	OKM	NQRQSSKVR	UO	RVKR	NOMQ	
v	UV	eO	PRNTSNUKNN	MKU	QPMNURSKUS	UNKTT	RVKR	NOMQ	
v	UV	eÉ	SVQOTUKQU	NKM	UQNPQQKNU	UQKQU	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	STQUMMUKVP	NKM	SRVNQQQKUP	NMQKMT	RVKR	NOMQ	
qÄ	NRV	eÉ	QSNQVVSKSR	MKV	QUSSNVMKN	VNKNT	RVKR	NOMQ	
_á	QMV	kç=dl~ë	PRSNSRVKQT	NKO	PNTPQTQKSU	NNQKQP	RVKR	NOMQ	
_á	QMV	eÉ	NRQNSUTKPM	MKV	NSMVTVTKQQ	VRKTT	RVKR	NOMQ	

i ~ÄçêíçêóÈçåíêçäp~ã éäÉÈi `pF¤oÉéçã

p~ã éäÉÈk~ã É	i ` pl n ` NTfj pN
cäÉÈk~ã É	MOSi ` pl kÇ
a~í~¤m~íÜÈk~ã É	aWf ÖäÉáíyf mj eyNya ^q^ yOMOPyMPJ ^oyi n ` OUbkÄ
^Åè¤qãã É	PLOULOMOP¤NUMNTWOM
p~ã éäÉ¤qóéÉ	i ` pl
qçí~äaäãíáçå	RKMMMM
` çã ã Éãí	JJJ
fpqa¤oÉÑcäÉk~ã É	MMQ ^i _kÇ
p~ã éäÉ¤n ` ¤m~ëëlcá~ä	m~ëë
fpqa¤n ` ¤m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åã**

n ` ¤^å~äöíÉ¤q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	¤¤ mp¤¤	bñés~ä	B¤oÉÁ	B i çï	B eáÖÜ	n ` ¤cä-Ö
_É	V	S	k ç¤dl ~ë	QVKUPN	éëÄ	NKN	RQPNQKPT	RM	NVKVP	TVKR	NOMQ	
_	NN	S	k ç¤dl ~ë	QVPKOQS	éëÄ	NKO	PQUTNOKUM	RMM	NVKTP	TVKR	NOMQ	
k~	OP	QR	e É	UPOTKPTR	éëÄ	OKO	NMNQUMQKQV	TRMM	OOKON	TVKR	NOMQ	
j Ö	OQ	QR	e É	RPRPKMNP	éëÄ	NKU	PPNNQVKTQ	RMMM	ONKQN	TVKR	NOMQ	
^ä	OT	QR	e É	ONROKNQV	éëÄ	NKT	QVQVPKQP	OMMM	ONKRO	TVKR	NOMQ	
pá	OU	QR	e O	VUNKQTV	éëÄ	PKO	SVSUTHST	NMMM	NVKSP	TVKR	NOMQ	
h	PV	QR	e É	NMNMQKTRT	éëÄ	NKO	RRTUVRKTO	NMMMM	OMKON	TVKR	NOMQ	
` ~	QM	QR	e O	OTOOKSQQ	éëÄ	NKO	NQRPUSMKVR	ORMM	ONKTU	TVKR	NOMQ	
s	RN	UV	e É	QVOKUQQ	éëÄ	NKR	PTVVOQKQP	RMM	NVKTN	TVKR	NOMQ	
` ê	RO	UV	e É	OMTKVVP	éëÄ	NKM	OMNROUKVS	OMM	OMKU	TVKR	NOMQ	
j å	RR	UV	e É	RNQKMMR	éëÄ	NKM	OQUMURKVN	RMM	OMRS	TVKR	NOMQ	
cÉ	RS	UV	e O	NMPOKOPP	éëÄ	MKV	OMSROQRKRQ	NMMM	OMSQ	TVKR	NOMQ	
` ç	RV	UV	e É	RPVKVUQ	éëÄ	NKQ	UVOUVUKRP	RMM	ONKS	TVKR	NOMQ	
ká	SM	UV	e É	ROUKVPS	éëÄ	NKP	OQQUQPKNQ	RMM	ONKNS	TVKR	NOMQ	
` ì	SP	UV	e É	OSTKNMP	éëÄ	NKR	PQPSPOKSR	ORM	ONKPT	TVKR	NOMQ	
wå	SS	UV	e É	RNSKPMS	éëÄ	NKM	NNOONSKOO	RMM	OMSR	TVKR	NOMQ	
^ë	TR	UV	e É	VUKRNR	éëÄ	NKV	NRSUPKNO	NMM	NVKT	TVKR	NOMQ	
pÉ	TU	UV	e O	VUKVPV	éëÄ	OKP	TPTMKNM	NMM	NVKTV	TVKR	NOMQ	
pê	UU	UV	e É	QVTHSSV	éëÄ	MKT	OUPUTNKRM	RMM	NVKVN	TVKR	NOMQ	
j ç	VR	UV	e É	NMRKQUO	éëÄ	NKR	RVMUTHSO	NMM	ONKN	TVKR	NOMQ	
^Ö	NMT	UV	e É	RPKVQN	éëÄ	MKR	NMTQPPKUT	RM	ONKRU	TVKR	NOMQ	
` Ç	NNN	UV	e É	OSPKUVV	éëÄ	NKR	TMPRVKMO	ORM	ONKNN	TVKR	NOMQ	
på	NNU	NRV	e É	RNMKVNN	éëÄ	NKO	OVONPQKOU	RMM	OMKQQ	TVKR	NOMQ	
pÄ	NON	NRV	k ç¤dl ~ë	VQKPTO	éëÄ	MKO	QNRUUSKQQ	NMM	NUKUT	TVKR	NOMQ	
_~	NPT	NRV	k ç¤dl ~ë	OMPOKQTN	éëÄ	MKR	ORVVQQSKOU	OMMM	OMPO	TVKR	NOMQ	
t	NUO	NRV	k ç¤dl ~ë	NMUKNTS	éëÄ	MKV	OTPMTSKVN	NMM	ONKSQ	TVKR	NOMQ	
qä	OMR	OMV	k ç¤dl ~ë	VUKRUN	éëÄ	MKS	RUMTUOKVT	NMM	NVKTO	TVKR	NOMQ	
mÄ	OMU	OMV	k ç¤dl ~ë	NMOKOOS	éëÄ	MKT	UOQSRNKPT	NMM	OMKQQ	TVKR	NOMQ	
qÜ	OPO	OMV	k ç¤dl ~ë	VSKPON	éëÄ	MKP	SUPUQPKSM	NMM	NVKOS	TVKR	NOMQ	
r	OPU	OMV	k ç¤dl ~ë	NMRKMSQ	éëÄ	MKU	SVNSSMKPS	NMM	ONKMN	TVKR	NOMQ	

n ` ¤fpqa¤q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=i çï	Bn`=eäÜÜ	n`=ä=Ö
iá	S	kç=d~ë	NVMRNQPKUV	NKO	NUVQNRTKMT	NMMRU	RVRR	NOMQ	
pÅ	QR	kç=d~ë	PVQQMRSKUR	MKS	QRTPSTVKQQ	USKCP	RVRR	NOMQ	
pÅ	QR	eO	TSSNPUKRN	NKO	VURSCPKUN	TTKTP	RVRR	NOMQ	
pÅ	QR	eÉ	NPNCRPKUV	CKO	NSMVPNKCP	UNKRS	RVRR	NOMQ	
dÉ	TO	kç=d~ë	VSNQUVKPU	NKN	NMTQQQSKRP	UVKR	RVRR	NOMQ	
dÉ	TO	eO	PMRPNSKCN	MKR	PVPUSVKSQ	TTKRO	RVRR	NOMQ	
dÉ	TO	eÉ	NMDVSQKTN	NKM	NCRCSSKVR	UCKO	RVRR	NOMQ	
v	UV	eO	PQTTTMNUKNR	CKO	QPMNURSKUS	UMKUP	RVRR	NOMQ	
v	UV	eÉ	SVTUUVKRS	MKQ	UQNPQQKNU	UCKVR	RVRR	NOMQ	
qÄ	NRV	kç=d~ë	STRPMSQKCR	MKR	SRVNQQQKUP	NMDKQR	RVRR	NOMQ	
qÄ	NRV	eÉ	OSMQQQPKNR	MKR	OUSSNVMKN	VMKUT	RVRR	NOMQ	
_á	OMV	kç=d~ë	PRNOQMRKRP	NKP	PNTPQTOKSU	NNMKSU	RVRR	NOMQ	
_á	OMV	eÉ	NRQQQTPKQQ	NKN	NSMVTVTKQQ	VRKVQ	RVRR	NOMQ	

p~ã éãÉ=k~ã É pn MVQNUMMN

cãÉ=k~ã É MOTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÃ

^Åè=qãã É PLOULOMCP=NUMRVQP

p~ã éãÉ=qóéÉ p~ã éãÉ

qçí~äaãã íáçå RKMMMM

p~ã éãÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄãÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	NKSUQ	éé Ä	QKU	OMUPKRO	NMM	
NN	_	S	k ç=d ~ë	NOKUTV	éé Ä	QKP	NMNMSKMM	NMMM	
OP	k ~	QR	e É	RRQKRPS	éé Ä	PKR	NMTURMKMP	OMMMMM	
OQ	j Ö	QR	e É	SUOUKRTU	éé Ä	NKP	QPPQQUKOQ	OMMMMM	
OT	^ ä	QR	e É	NQPSNSKOVV	éé Ä	MKU	PPTTVPVKSM	OMMMMM	
OU	pá	QR	e O	PNPQKMPU	éé Ä	NUKT	OPMSPRKTO	NMMMM	
PV	h	QR	e É	RRPOKTVT	éé Ä	MKU	POSQSOKUS	OMMMMM	
QM	` ~	QR	e O	PQUOKMOM	éé Ä	NKS	NVPOORSKUP	OMMMMM	
RN	s	UV	e É	NSOKPVT	éé Ä	OKO	NPQPMQKVT	NMMM	
RO	` ê	UV	e É	NMSKMTT	éé Ä	NKV	NNMSNQRTU	OMMM	
RR	j å	UV	e É	NOSKUSU	éé Ä	NKU	SRTNUHPN	OMMM	
RS	cÉ	UV	e O	PPPRUKTUR	éé Ä	OKP	TONRVMVSKRR	NMMMMM	
RV	` ç	UV	e É	NQKMSS	éé Ä	MKU	ORNTQKQN	NMMM	
SM	k á	UV	e É	QNKOSP	éé Ä	NRT	OMSNOKNO	NMMM	
SP	` ì	UV	e É	NVMPUP	éé Ä	NKU	OTNVNKNU	OMMM	
SS	wå	UV	e É	UTKVNS	éé Ä	OKR	OMSPQKQP	OMMM	
TR	^ ë	UV	e É	UKPUT	éé Ä	QKM	NQQTHRS	NMMM	
TU	pÉ	UV	e O	NHPNR	éé Ä	THO	NNRHPP	NMMM	
UU	pê	UV	e É	RNKNRU	éé Ä	OKR	PNPMUKNR	OMMM	
VR	j ç	UV	e É	NKUMM	éé Ä	TKU	NPMUKVT	NMMM	
NMT	^ Ö	UV	e É	MKOTP	éé Ä	VHP	SNUKVO	NMM	
NNN	` Ç	UV	e É	MHPQM	éé Ä	RHN	NMSKST	NMMM	
NNU	på	NRV	e É	QQKUQM	éé Ä	MKN	OQSRNRTO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MHRQT	éé Ä	PHM	PPMMRRT	NMMM	
NPT	_~	NRV	k ç=d ~ë	PQNMVQQO	éé Ä	NKM	QQQUSMRRU	OMMM	
NUO	t	NRV	k ç=d ~ë	MHPOV	éé Ä	ONHR	PPNPKVO	NMMM	
OMR	qä	OMV	k ç=d ~ë	NRTUS	éé Ä	NKU	NNQPMSN	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	VNHKNCR	éé Ä	MKV	TQTRUPKVT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	QOKSMN	éé Ä	MKQ	PMVMQVRRQ	NMMM	
OPU	r	OMV	k ç=d ~ë	RKUSQ	éé Ä	PKV	PVORPKMV	NMMM	

n` =fpqa=q~ÄãÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n` =ç ï	B n` =e ãÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	NVONSRRHRR	OHM	NUVQNRTHMT	NMHQR	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	QNOPNOPHPO	MHP	QRTPSTVKOQ	VMKNR	RVHR	NOMQ	
pÅ	QR	e O	TVTSTPKNP	MKU	VURSOPKUN	UMKVP	RVHR	NOMQ	
pÅ	QR	e É	NPQSVVKQR	NHM	NSMVPNKOP	UPHT	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VSRMSUKNO	MHS	NMTQOQSHRP	UVKUQ	RVHR	NOMQ	
d É	TO	e O	OVVROTHPV	MHR	PVPUSVHSQ	TSHMR	RVHR	NOMQ	
d É	TO	e É	NMPTMRKNP	NHM	NORCSSKVR	UOHTV	RVHR	NOMQ	
v	UV	e O	PTTURMOKNP	MKV	OPMNURSKUS	UTKUP	RVHR	NOMQ	
v	UV	e É	TQTVOOKQU	NKQ	UQNPQOKNU	UUKV	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SURQPSMHSR	MKO	SRVNQQQKUP	NMPKVV	RVHR	NOMQ	
qÄ	NRV	e É	ORVOSNVKNS	MHP	OUSSNVMKN	VMKQS	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRTMTSTKUR	NHM	PNTPQTOKSU	NNOKRO	RVHR	NOMQ	
_á	OMV	e É	NROURMMKVN	MKU	NSMVTVTKOQ	VQKVR	RVHR	NOMQ	

`çåíaåì åaÖ=~ëäÁê~íáç=sÉêëÑÅ~íáç=Ê``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cäÉ=k~ã É	MOUJ``skÇ
a~í~=m~íÜk~ã É	aWy^ÖäÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyjn`OUbkÁ
^Åè=qáã É	PLOULOMOP=NUAPMAPN
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVOJ ^i _kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã ää**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÁK	r åáë	opa	==mp==	bñés~ä	B=oÉÁ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	OQKQNQ	éëÄ	OKP	NQQMVMSKSN	OR	VTKSS	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKOVN	éëÄ	NKM	VTTVVKOR	OR	NMNKNS	UVKU	NNMO	
OP	k ~	OR	e É	RSOPKQTM	éëÄ	NKU	PQTMQOTKPQ	RMMM	NNOKQT	UVKU	NNMO	[=HLJ=NMB
OQ	j Ö	OR	e É	RSPUKMOP	éëÄ	NKS	NUNQQPSKRO	RMMM	NNOKTS	UVKU	NNMO	[=HLJ=NMB
OT	^ä	OR	e É	RVNKOUO	éëÄ	MKS	TMTTNKOV	RMM	NNUKOS	UVKU	NNMO	[=HLJ=NMB
OU	pá	OR	e O	RROKRRV	éëÄ	NKN	OMRPSSKPT	RMM	NNMKRN	UVKU	NNMO	[=HLJ=NMB
PV	h	OR	e É	RQMPKVST	éëÄ	MKV	NRMRVOSKQS	RMMM	NMUKMU	UVKU	NNMO	
QM	` ~	OR	e O	RPPTKSMS	éëÄ	MKR	NQUSNRRRKTR	RMMM	NMSKTR	UVKU	NNMO	
RN	s	UV	e É	OSKPUT	éëÄ	MKU	NMQQPPKTP	OR	NMRKRR	UVKU	NNMO	
RO	` ê	UV	e É	OSKOPP	éëÄ	MKV	NPMSORKNP	OR	NMQKVP	UVKU	NNMO	
RR	j å	UV	e É	OSKMMM	éëÄ	NKM	SQSSPKQR	OR	NMQKQ	UVKU	NNMO	
RS	cÉ	UV	e O	RNQQKPTT	éëÄ	NKN	RQTTVPQVKVV	RMMM	NMOKUV	UVKU	NNMO	
RV	` ç	UV	e É	OSKUMM	éëÄ	MKN	OOUMVOKSU	OR	NMTHRS	UVKU	NNMO	
SM	k á	UV	e É	OSKSQT	éëÄ	NKV	SPPPQKPT	OR	NMSKRV	UVKU	NNMO	
SP	` ì	UV	e É	OSKVPS	éëÄ	NKP	NTTURRKSO	OR	NMTKTQ	UVKU	NNMO	
SS	wå	UV	e É	OSKSMN	éëÄ	MKS	OVTSQKOO	OR	NMSKQ	UVKU	NNMO	
TR	^ë	UV	e É	ORKURR	éëÄ	MKS	ONMVMKTV	OR	NMPKQO	UVKU	NNMO	
TU	pÉ	UV	e O	ORKMQU	éëÄ	MKR	VSNSKSV	OR	NMMKMV	UVKU	NNMO	
UU	pê	UV	e É	ORKUUU	éëÄ	NKS	TRTNVMKV	OR	NMPKRR	UVKU	NNMO	
VR	j ç	UV	e É	ORKVTN	éëÄ	MKU	TQRNSKUS	OR	NMPKUU	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKRPR	éëÄ	MKP	OUNVPQKMU	OR	NNMKNQ	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKVUS	éëÄ	NKQ	PSUUNKRN	OR	NMTKVQ	UVKU	NNMO	
NNU	på	NRV	e É	OQKUOV	éëÄ	NKO	TNPUVKPO	OR	VVKPO	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKQMN	éëÄ	OKM	RQVNTQKNR	OR	VTHS	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKURU	éëÄ	NKS	NSVNQRKVO	OR	NMPKQP	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKVQN	éëÄ	NKP	PPQNNTKVR	OR	NMPKTS	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	OQKTPR	éëÄ	NKP	TPTRPVKPM	OR	VUKVQ	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKNQU	éëÄ	NKP	NMSTNQSKNT	OR	NMQKRV	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKNNR	éëÄ	PKM	VPTROTKTN	OR	NMQKQS	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKTPU	éëÄ	NKT	UVNMPNKSU	OR	NMSKVR	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=ç ï	B n`=c äÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	OMSUMNTKNU	OKP	NUVQNRTKMT	NMVKNU	RVKR	NOMQ	
pÅ	OR	k ç=d ~ë	QNTNQNNKRU	NKQ	QRTPSTVKOQ	VNKO	RVKR	NOMQ	
pÅ	OR	e O	UMQVRTKRV	MKO	VURSCPKUN	UNKST	RVKR	NOMQ	
pÅ	OR	e É	NPSTQMKNM	OKP	NSMVPNKCP	UQKVT	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	VVQTNQKUP	MKU	NMTQQQSKRP	VOKS	RVKR	NOMQ	
dÉ	TO	e O	POMOCRKPM	MKU	PVPUSVKSQ	UNKPN	RVKR	NOMQ	
dÉ	TO	e É	NMTQVTKTV	MKU	NORCSSKVR	URKUN	RVKR	NOMQ	
v	UV	e O	PRUPTTTKOR	MKT	QPMNURSKUS	UPKPN	RVKR	NOMQ	
v	UV	e É	TNRQNMKTT	MKR	UQNPQOKNU	URKMP	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVMNVOMKPM	NKP	SRVNQQQKUP	NVQKTN	RVKR	NOMQ	
qÄ	NRV	e É	OSNNNSSKRS	MKU	OUSSNVMKN	VNKN	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRRSPMUKNS	MKT	PNTPQTOKSU	NNOKMS	RVKR	NOMQ	
_á	OMV	e É	NQUTQSVKVU	NKU	NSMVTVTKOQ	VOKQ	RVKR	NOMQ	

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MOV|``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíÝ^mj eyNya^q^yOVOCPyVPJ ^oyi n` OUbkÅ

^Åè=qáã É PLOULOVOCP=NUAPVVMQ

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáç~å NKMVMVM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑc äÉk~ã É MVQ ^i _KÇ

p~ã éáÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~äã m~ëë

I éÉê~íçê **~Çã ää**

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==\ mp==	i ãäá	n` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMVQ	ééÄ	NONKV	OVMKMN	MO	
NN	_	S	k ç=d ~ë	MKPMN	ééÄ	CKQ	CCRMCO	Q	
CP	k~	CR	e É	JPKRMM	ééÄ	k L^	CONCNKSM	CMM	
CQ	j Ö	CR	e É	CKRTS	ééÄ	VKP	CNPPKRT	CM	
CT	^ä	CR	e É	SKSTU	ééÄ	CKV	NVCCKRM	CM	
CU	pá	CR	e O	MKVPV	ééÄ	PRKR	UMVKUT	NVM	
PV	h	CR	e É	UKPRM	ééÄ	NRKR	PPNVCKUM	CMM	
CM	` ~	CR	e O	CKTTU	ééÄ	CKM	CTVMPHPO	CM	
RN	s	UV	e É	MKVPM	ééÄ	NTHO	PUUKVM	N	
RO	` ê	UV	e É	JMKVNO	ééÄ	k L^	VQVKNV	N	
RR	j å	UV	e É	MKVCM	ééÄ	TQKP	NVNHPM	MQ	
RS	cÉ	UV	e O	RKRPM	ééÄ	PKU	TCSCSKVQ	CM	
RV	` ç	UV	e É	MKVVR	ééÄ	RVKV	PIVSKSU	MO	
SM	k á	UV	e É	MKVVV	ééÄ	PNKP	NUCKCP	MQ	
SP	` ì	UV	e É	MKVVU	ééÄ	RSKR	RTTKUM	MS	
SS	wå	UV	e É	MKVUQ	ééÄ	CCKN	OVMKVN	O	
TR	^ë	UV	e É	MKVPN	ééÄ	CKQ	CSHPQ	N	
TU	pÉ	UV	e O	MKVOT	ééÄ	CMQ	CMKMM	N	
UU	pê	UV	e É	MKVCR	ééÄ	NVKT	NCRKRS	N	
VR	j ç	UV	e É	MKVRP	ééÄ	NPKQ	TMTKUN	N	
NVT	^Ö	UV	e É	MKVNR	ééÄ	NUKU	CMPHPQ	MO	
NNN	` Ç	UV	e É	MKVNR	ééÄ	CNKR	POCCO	MO	
NNU	på	NRV	e É	MKVUU	ééÄ	CRKR	RUCKCR	N	
NCN	pÄ	NRV	k ç=d ~ë	MKVCN	ééÄ	CSKN	NPSUKNU	MO	
NPT	_~	NRV	k ç=d ~ë	MKVRO	ééÄ	NCKM	ROTHCQ	MQ	
NUO	t	NRV	k ç=d ~ë	MKVVR	ééÄ	PNKM	PUNQHSM	N	
OVR	qä	OVV	k ç=d ~ë	MKVQU	ééÄ	CKO	CCSCHSM	MO	
OVU	mÄ	OVV	k ç=d ~ë	JMKVNQ	ééÄ	k L^	OVMRKRP	MO	
OPO	qÜ	OVV	k ç=d ~ë	MKVQQ	ééÄ	NVKR	QRPOKPM	N	
OPU	r	OVV	k ç=d ~ë	MKVNV	ééÄ	NQKT	UUTHSQ	MO	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÁ	B n` =ç ï	B n` =c äÜÜ	n` =c ä~Ö
iá	S	k ç=d ~ë	ONPVCSUKTQ	MKV	NUVQNRTHMT	NNOKVR	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	CPUMRQVKQN	MKR	QRTPSTVKOQ	VRKTU	RVKR	NOMQ	
pÅ	CR	e O	USPUPQKUV	NKU	VURSCPKUN	UTHSQ	RVKR	NOMQ	
pÅ	CR	e É	NQQVUORRR	MKQ	NSMVPNKCP	VMKMV	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NMSTQNNKTT	NKN	NMTQCQSKRP	VVHPS	RVKR	NOMQ	
dÉ	TO	e O	PPVVNQKRM	MKT	PVPUSVHSQ	USHP	RVKR	NOMQ	
dÉ	TO	e É	NNQTORKTU	MKQ	NORCSSKVR	VNKRV	RVKR	NOMQ	
v	UV	e O	PUPNURQKQO	MHS	QPMNURSKUS	UVKMT	RVKR	NOMQ	
v	UV	e É	TSTUNRKNO	NHP	UQNPQCKNU	VNKOS	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	TMVUMVPKQM	NKU	SRVNQQQKUP	NMTHSV	RVKR	NOMQ	
qÄ	NRV	e É	OTVMMMUKVN	NKN	CUSSNVMKN	VTHPQ	RVKR	NOMQ	
_á	OVV	k ç=d ~ë	PSUNMTNHPT	NKU	PNTPQTOKSU	NNS	RVKR	NOMQ	
_á	OVV	e É	NSNUSRSKTM	NKQ	NSMVTVTKOQ	NVMKRR	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVQNUMMP

cãÉ=k~ã É MPMpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=NUMQQMM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	OKRQQ	éé Ä	QKS	PMUUKNS	NMM	
NN	_	S	k ç=d ~ë	NPKTNM	éé Ä	PKU	NMV/ONKMM	NMMM	
OP	k ~	QR	e É	UNPKMV/O	éé Ä	MKQ	NQNVVNKPM	OMMMMM	
OQ	j Ö	QR	e É	TSORKUSM	éé Ä	NKQ	QV/QSRMKVV	OMMMMM	
OT	^ ä	QR	e É	NQVNVNMVQN	éé Ä	OKQ	PRUSNRQKQP	OMMMMM	
OU	pá	QR	e O	NTRVMOTM	éé Ä	OTKQ	NPCPQNKTS	NMMMM	
PV	h	QR	e É	QUNMKUTT	éé Ä	MKR	OVPVPRKPP	OMMMMM	
QM	` ~	QR	e O	OUUMKOUQ	éé Ä	MKV	NSPPVQOKNS	OMMMMM	
RN	s	UV	e É	NRSKOQU	éé Ä	MKU	NPMVUSKUO	NMMM	
RO	` ê	UV	e É	NNQKNNR	éé Ä	MKU	NOMRPTKTR	OMMM	
RR	j å	UV	e É	NMUKVPN	éé Ä	NKU	RTOMRKQP	OMMM	
RS	cÉ	UV	e O	PMRMPKSOQ	éé Ä	OKN	SRUQRTQTKSM	NMMMMM	
RV	` ç	UV	e É	NPKTTU	éé Ä	NKN	OQVVUKRV	NMMM	
SM	k á	UV	e É	QQKQOQ	éé Ä	NKN	OOQUMRV	NMMM	
SP	` ì	UV	e É	OPKPNO	éé Ä	NKU	PPMPVKPV	OMMM	
SS	wå	UV	e É	UTKURO	éé Ä	NKU	OMUVOKSR	OMMM	
TR	^ ë	UV	e É	UKROT	éé Ä	PKT	NQVNKRT	NMMM	
TU	pÉ	UV	e O	OKONO	éé Ä	OKV	NUTKQV	NMMM	
UU	pê	UV	e É	RONVRR	éé Ä	NKQ	PCOUVKOS	OMMM	
VR	j ç	UV	e É	OKMTN	éé Ä	OKQ	NQVNKOO	NMMM	
NMT	^ Ö	UV	e É	MKQTN	éé Ä	VKO	NMRQKRM	NMM	
NNN	` Ç	UV	e É	MKNMR	éé Ä	OOKU	QMKMM	NMMM	
NNU	på	NRV	e É	QOKRRS	éé Ä	NKR	OQRRNKRM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKSNV	éé Ä	PKP	PRUQKOS	NMMM	
NPT	_~	NRV	k ç=d ~ë	PUPKQSM	éé Ä	MKU	QVOTQPKVN	OMMM	
NUO	t	NRV	k ç=d ~ë	MKQSR	éé Ä	SKN	PSONKMN	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKUNQ	éé Ä	OKU	NNQUPKUU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NQUKUUQ	éé Ä	MKP	NOMTOQRKRT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OUKNNR	éé Ä	MKS	OMOUMNKQP	NMMM	
OPU	r	OMV	k ç=d ~ë	SKVTO	éé Ä	PKN	QSPSTKQN	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ¹ mp	B =o ÉÅ	B n ` =¹ çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVSNVNTKTQ	NKU	NUVQNRTKMT	NVPKRU	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QNQPSQUKPU	MKU	QRTPSTVKOQ	VMKS	RVKR	NOMKQ	
pÅ	QR	e O	UNQOMKUO	NKP	VURSCPKUN	UOKSN	RVKR	NOMKQ	
pÅ	QR	e É	NPTSSUKMM	MKT	NSMVPNKCP	URKRQ	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VRQUTTKVT	MKT	NMTQOQSKRP	UUKUV	RVKR	NOMKQ	
d É	TO	e O	PMRVRUKSV	MKT	PVPUSVKSQ	TTKSU	RVKR	NOMKQ	
d É	TO	e É	NMRCQTKNT	NKT	NCRCSSKVR	UQKMO	RVKR	NOMKQ	
v	UV	e O	PTTMUPRKNT	NKR	QPMNURSKUS	UTKSS	RVKR	NOMKQ	
v	UV	e É	TRTVVPKTU	NKM	UQNPQOKNU	VMKMV	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	STUPTNQKTM	OKM	SRVNQQQKUP	NMOKVO	RVKR	NOMKQ	
qÄ	NRV	e É	CRVVMVQKOM	MKU	OUSSNVMKN	VMKSU	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRPPUNTKVN	OKO	PNTPQTOKSU	NNNKPR	RVKR	NOMKQ	
_á	OMV	e É	NRQQVQSKMM	MKM	NSMVTVTKOQ	VRKVT	RVKR	NOMKQ	

p~ã éäÉ=k~ã É	pn MVQNUMVR
cãÉ=k~ã É	MPNpj mi hÇ
a~í~=m~íÜ=k~ã É	aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ
^Åè=qãã É	PLOULOMCP=NUMQMVNT
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RKMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==i mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	QKVSU	éé Ä	OKS	RSQCKOV	NMM	
NN	_	S	k ç=d ~ë	NQKQMM	éé Ä	PKQ	NNNONKNP	NMMM	
OP	k ~	QR	e É	NQMMOUN	éé Ä	MKS	OORROUKSR	OMMMMM	
OQ	j Ö	QR	e É	NPSUSKRMR	éé Ä	MKO	VPQUNQKRM	OMMMMM	
OT	^ ä	QR	e É	OSONNSKOUR	éé Ä	MKS	SSPUMOQKVM	OMMMMM	
OU	pá	QR	e O	NTMVMKMUM	éé Ä	RKS	NPPSPRKMO	NMMMM	
PV	h	QR	e É	SUVRKSPP	éé Ä	MKU	QPMQVSKOS	OMMMMM	
QM	` ~	QR	e O	NUPNKTQS	éé Ä	NKN	NMUPUOOKRO	OMMMMM	
RN	s	UV	e É	PSMKNPP	éé Ä	MKP	PNNPQTHRN	NMMM	
RO	` ê	UV	e É	ONRKPOV	éé Ä	MKQ	OPPVMNKMN	OMMM	
RR	j å	UV	e É	NTVKSOS	éé Ä	MKS	VTPMMKRP	OMMM	
RS	cÉ	UV	e O	NPNVSRKTUR	éé Ä	MKN	OVPROROMUKOM	NMMMMM	
RV	` ç	UV	e É	OUKTQR	éé Ä	NKV	RPRQRKTQ	NMMM	
SM	k á	UV	e É	UNKPSM	éé Ä	NKV	QOPSRKRO	NMMM	
SP	` ì	UV	e É	PSKSQR	éé Ä	OKP	RPPNUKRP	OMMM	
SS	wå	UV	e É	NPSKVON	éé Ä	MKU	PPRMVKQS	OMMM	
TR	^ ë	UV	e É	OVKNNT	éé Ä	NKQ	RONMKUS	NMMM	
TU	pÉ	UV	e O	OKTOM	éé Ä	UKO	OPRKPO	NMMM	
UU	pê	UV	e É	RUKSQV	éé Ä	NKR	PTRQVKRO	OMMM	
VR	j ç	UV	e É	OKRUO	éé Ä	UKV	NURVKVQ	NMMM	
NMT	^ Ö	UV	e É	MKPOQ	éé Ä	SKO	TSOKOS	NMM	
NNN	` Ç	UV	e É	MKVOS	éé Ä	ONKU	NTKTU	NMMM	
NNU	på	NRV	e É	QQKVSR	éé Ä	OKP	ORVSNKVV	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKSMM	éé Ä	MKR	PQPTKQN	NMMM	
NPT	_~	NRV	k ç=d ~ë	SQPKMUT	éé Ä	MKQ	UNMUUUKCQ	OMMM	
NUO	t	NRV	k ç=d ~ë	MKMMT	éé Ä	TNVKS	OQCOKTU	NMMM	
OMR	qä	OMV	k ç=d ~ë	OKRQR	éé Ä	PKV	NRCQUKQS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NPMKVOM	éé Ä	NKU	NVCQSSPKPO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	RRKQUU	éé Ä	MKU	PUPSVRKVN	NMMM	
OPU	r	OMV	k ç=d ~ë	UKUPP	éé Ä	MKR	RSSTOKVU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVMVQMTKVU	MRT	NUVQNRTHMT	NMMKUN	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	QPRVPVSKSU	NKP	QRTPSTVKOQ	VRHPN	RVRR	NOMQ	
pÅ	QR	e O	UQRQNOPQ	NKQ	VURSOPKUN	URRTT	RVRR	NOMQ	
pÅ	QR	e É	NQRMOOKVR	MKV	NSMVPNKOP	VMKNN	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VSUPSRKRU	NKR	NMTQOQSKRP	VMKNQ	RVRR	NOMQ	
d É	TO	e O	PMORMOKQM	MKS	PVPUSVKSQ	TSKU	RVRR	NOMQ	
d É	TO	e É	NMSRRQKQO	MKS	NORCSSKVR	URKMS	RVRR	NOMQ	
v	UV	e O	PUURNVMKRM	NKQ	QPMNURSKUS	VMKPN	RVRR	NOMQ	
v	UV	e É	TUORPMKRP	NKO	UQNPOOKNU	VPKMN	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSRSTPUKOP	NKO	SRVNOQQKUP	NMMKVV	RVRR	NOMQ	
qÄ	NRV	e É	OSMOVRQKTM	MKO	OUSSNVMKN	VMKUO	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PQNNMVMKPV	OKV	PNTPQTOKSU	NMTKQV	RVRR	NOMQ	
_á	OMV	e É	NRNRPNVMKP	MKV	NSMVTVTKOQ	VQKNP	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn MVQNUMVMT

cãÉ=k~ã É MPQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=NUMRQXQR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	OKSPU	ééÄ	PMN	RQQPMPQ	NMM	
NN	_	S	k ç=d ~ë	NTKQMR	ééÄ	OMP	NPSQPMPM	NMMM	
OP	k ~	QR	e É	SSOKMUS	ééÄ	MKO	NOTPNQKMU	OMMMMM	
OQ	j Ö	QR	e É	STTRKSSV	ééÄ	MKQ	QRPPPVKNT	OMMMMM	
OT	^ ä	QR	e É	NSNNPUKNLP	ééÄ	MKT	PVVQLUTQKRV	OMMMMM	
OU	pá	QR	e O	NOONKUMP	ééÄ	SKQ	VPUSNKSN	NMMMM	
PV	h	QR	e É	QSTQKOTN	ééÄ	MKU	OVRPTOKNN	OMMMMM	
QM	` ~	QR	e O	RNOTKVVO	ééÄ	MKR	OVRQVPSKRO	OMMMMM	
RN	s	UV	e É	NRPKUNU	ééÄ	NKP	NPQMRNKUQ	NMMM	
RO	` ê	UV	e É	NMNKTNS	ééÄ	MKT	NNNTVVKMR	OMMM	
RR	j å	UV	e É	URKPTQ	ééÄ	NKR	QSSPVKRM	OMMM	
RS	cÉ	UV	e O	OQRRPKMOQ	ééÄ	OKR	RQTUVRCSKPR	NMMMMM	
RV	` ç	UV	e É	NPKTUU	ééÄ	OKS	OSMVOKSV	NMMM	
SM	k á	UV	e É	ROKPSP	ééÄ	OKM	OTRNOKVS	NMMM	
SP	` ì	UV	e É	UTKUQN	ééÄ	NKQ	NOTVQRKST	OMMM	
SS	wå	UV	e É	NMTKNQQ	ééÄ	MKU	OSQQRKPV	OMMM	
TR	^ ë	UV	e É	NNKUUP	ééÄ	NKR	ONRPKMS	NMMM	
TU	pÉ	UV	e O	RKQVT	ééÄ	OKR	QSTKUO	NMMM	
UU	pê	UV	e É	SNKQQM	ééÄ	MKU	PVSNMKMN	OMMM	
VR	j ç	UV	e É	OKUTQ	ééÄ	PKP	OMRRKTQ	NMMM	
NMT	^ Ö	UV	e É	MKSPR	ééÄ	NKQ	NQSSKTT	NMM	
NNN	` Ç	UV	e É	MKQON	ééÄ	NOKP	NPSKST	NMMM	
NNU	på	NRV	e É	QRKNNR	ééÄ	NKQ	OSRUUKUP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NKQTT	ééÄ	MKP	TPUSKQS	NMMM	
NPT	_~	NRV	k ç=d ~ë	RRMKRQQ	ééÄ	MKV	TMUNMPKPQ	OMMM	
NUO	t	NRV	k ç=d ~ë	MKOMS	ééÄ	OPKR	OVTPKQU	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKPSV	ééÄ	OKM	UTSOKOO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	PUTKSPV	ééÄ	MKP	PNNMSQRKNV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NQKMUO	ééÄ	MKO	NMOMOQKCR	NMMM	
OPU	r	OMV	k ç=d ~ë	TKTPQ	ééÄ	NKR	RMVSSKNS	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ ÉÅ	B n` =¡ çï	B n` =¤ä ÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	NVSTPPSKMS	NKR	NUVQNRTKMT	NVPKUS	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QOQPQMNKVP	NKM	QRTPSTVKOQ	VOKTU	RVKR	NOMQ	
pÅ	QR	e O	UOVVUQKCR	MKR	VURSCPKUN	UQKCN	RVKR	NOMQ	
pÅ	QR	e É	NQNVTTKVR	NKO	NSMVPNKCP	UUKCO	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VTVTRRKCP	NKS	NMTQOQSKRP	VNKO	RVKR	NOMQ	
d É	TO	e O	PNQMVNKRM	NKM	PVPUSVKSQ	TVKTR	RVKR	NOMQ	
d É	TO	e É	NMSUCOKQO	NKO	NCRCSSKVR	URKCU	RVKR	NOMQ	
v	UV	e O	PUVUMPCKUV	NKQ	CPMNURSKUS	VMKSN	RVKR	NOMQ	
v	UV	e É	TUTVMPKUP	MKO	UQNPCOKNU	VPKSR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	STVMQUPKCP	NKO	SRVNQQQKUP	NMPKMO	RVKR	NOMQ	
qÄ	NRV	e É	OSRTOMMKRS	NKN	OUSSNVMKN	VOKTN	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRMNRPNKOV	MKQ	PNTPQTOKSU	NNMKPQ	RVKR	NOMQ	
_á	OMV	e É	NRQQQVMKMP	OKP	NSMVTVTKOQ	VRKVQ	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVQNUMMTi

cãÉ=k~ã É MPPpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf˜ mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=NUMRVMPP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå ORKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	PKVSU	éé Ä	UKU	NNUCKOV	NMM	
NN	_	S	k ç=d ~ë	NUKPCP	éé Ä	MKR	PTVNKSU	NMMM	
CP	k ~	CR	e É	RCRKPCR	éé Ä	NKV	RTPQCKTS	CMMMMM	
CQ	j Ö	CR	e É	TQTTMCMM	éé Ä	NKQ	NMNCNRKCQ	CMMMMM	
CT	^ ä	CR	e É	NTTTTTRKCMP	éé Ä	NKO	UVMRNPKQT	CMMMMM	
CU	pá	CR	e O	NUPVKVCM	éé Ä	NMKP	OVMNCKNQ	NMMMM	
PV	h	CR	e É	RNNCKSRR	éé Ä	NKM	UVMQTKTV	CMMMMM	
QM	` ~	CR	e O	RRCCKMCS	éé Ä	MKV	SRSUTUKUN	CMMMMM	
RN	s	UV	e É	NTSKMCP	éé Ä	PKM	OVUSCKNT	NMMM	
RO	` ê	UV	e É	NNQKUSP	éé Ä	NKQ	CRNVMKOV	CMMM	
RR	j å	UV	e É	VSKPPU	éé Ä	MKU	NVCUCKCU	CMMM	
RS	cÉ	UV	e O	CUNVMKSQO	éé Ä	MKR	NOMSNPCRKSN	NMMMMM	
RV	` ç	UV	e É	NQKVCU	éé Ä	QKP	RSRSKUV	NMMM	
SM	k á	UV	e É	RVKMCS	éé Ä	QKP	SNOMKPO	NMMM	
SP	` ì	UV	e É	NMMKMSS	éé Ä	MKV	OURUCKVQ	CMMM	
SS	wå	UV	e É	NNVKTNM	éé Ä	OKU	RURVKSN	CMMM	
TR	^ ë	UV	e É	NQKOSM	éé Ä	SKS	RNQKQM	NMMM	
TU	pÉ	UV	e O	SKPNM	éé Ä	NKQ	NNMKMM	NMMM	
UU	pê	UV	e É	SUKMNU	éé Ä	OKP	URNRKMM	CMMM	
VR	j ç	UV	e É	OKURU	éé Ä	NOKU	RUQKQT	NMMM	
NMT	^ Ö	UV	e É	MKTNR	éé Ä	NPKN	PQTKTV	NMM	
NNN	` Ç	UV	e É	MKPPQ	éé Ä	ONKM	OVKOS	NMMM	
NNU	på	NRV	e É	SOKPMN	éé Ä	QRKM	TSUMKVV	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NKTST	éé Ä	RKM	OQPOKTU	NMMM	
NPT	_~	NRV	k ç=d ~ë	RVUKVTR	éé Ä	MKS	NRROVOKNP	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKVVT	éé Ä	k lA	NVSOKON	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKCUR	éé Ä	NTHP	OCCCKRR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QNPKVVV	éé Ä	MKV	SSMTCOKVT	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	NOKUPO	éé Ä	TKU	OMSTPKUN	NMMM	
OPU	r	OMV	k ç=d ~ë	UKMMR	éé Ä	OKT	NMSPRKTO	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=o ÉÅ	B n` =ç ï	B n` =e åÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	OMQSVCPKTQ	MKN	NUVQNRTKMT	NMUKMT	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	QNRMVOMKMT	NKS	QRTPSTVKOQ	VMKTQ	RVKR	NOMQ	
pÅ	CR	e O	UQPMROKTT	MKR	VURSCPKUN	URKRP	RVKR	NOMQ	
pÅ	CR	e É	NQPQMRKPT	MKQ	NSMVPNKCP	UVKSN	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VVQCCQSKVU	NKV	NMTQCQSKRP	VOKRR	RVKR	NOMQ	
d É	TO	e O	POTPNNKQT	NKO	PVPUSVKSQ	UPKN	RVKR	NOMQ	
d É	TO	e É	NMVUPTKUM	MKR	NORCSSKVR	UTKSU	RVKR	NOMQ	
v	UV	e O	PTQPVSCKUU	MKU	QPMNURSKUS	UTKMP	RVKR	NOMQ	
v	UV	e É	TSNUCMKTS	NKQ	UQNPCCKNU	VMKRR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUPTNTTKST	NKR	SRVNQQQKUP	NMPKTP	RVKR	NOMQ	
qÄ	NRV	e É	OSVNNNRKON	NKQ	OUSSNVMKN	VPKUV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQTNVVSKPS	MKV	PNTPQTCKSU	NMVKQN	RVKR	NOMQ	
_á	OMV	e É	NRUQRMPKNN	NKO	NSMVTVTKOQ	VUKCP	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVQNUMMT^

cãÉ=k~ã É MPQpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=NVMMQMQN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÄK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	NQKQMR	éé Ä	OKV	NSTMSKRP	NMM	
NN	_	S	k ç=d ~ë	ONUKKPN	éé Ä	OKM	NSCUTOKUP	NMMM	
OP	k ~	QR	e É	NNTRMKTSS	éé Ä	NKM	NRNRQMOKRN	OMMMMM	
OQ	j Ö	QR	e É	TVMOKRMV	éé Ä	NKN	RCPMSNKSV	OMMMMM	
OT	^ ä	QR	e É	NSMSRTKOSM	éé Ä	NKR	PVQMVRTKCP	OMMMMM	
OU	pá	QR	e O	SQTTKRTR	éé Ä	OKQ	QVSNTRKOS	NMMMM	
PV	h	QR	e É	NQTSPKCPP	éé Ä	OKN	URUSUVKQR	OMMMMM	
QM	` ~	QR	e O	SMRVKQMN	éé Ä	MKU	PQMVSQQKPV	OMMMMM	
RN	s	UV	e É	NVVMVSP	éé Ä	NKN	NTONNOKTS	NMMM	
RO	` ê	UV	e É	NRMKOTM	éé Ä	NKQ	NSPQPUKNR	OMMM	
RR	j å	UV	e É	NMQKPOV	éé Ä	NKV	RSRPSKOQ	OMMM	
RS	cÉ	UV	e O	ORPUNKUTQ	éé Ä	NKO	RRRSNOQTKON	NMMMMM	
RV	` ç	UV	e É	OPKTOO	éé Ä	OKV	QQNVTKPV	NMMM	
SM	k á	UV	e É	TNKROP	éé Ä	PKV	PTOOVKUO	NMMM	
SP	` ì	UV	e É	NNSKPMN	éé Ä	PKP	NSTVOTKOU	OMMM	
SS	wå	UV	e É	OMMKUNP	éé Ä	NKV	QVMOPKVS	OMMM	
TR	^ ë	UV	e É	SMKMNV	éé Ä	NKN	NMTNQKVM	NMMM	
TU	pÉ	UV	e O	RPKSVS	éé Ä	MKT	QQMPKSR	NMMM	
UU	pê	UV	e É	NMUKQQT	éé Ä	NKQ	SVPRQKQV	OMMM	
VR	j ç	UV	e É	RNKKQR	éé Ä	MKU	POOPOKSS	NMMM	
NMT	^ Ö	UV	e É	NMKSNQ	éé Ä	NKT	OPTNTKSQ	NMM	
NNN	` Ç	UV	e É	NMKMPV	éé Ä	OKV	PMMUKUT	NMMM	
NNU	på	NRV	e É	VORTTM	éé Ä	MKN	RPNQMKOS	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NNKPNS	éé Ä	NKN	QVTOMKUP	NMMM	
NPT	_~	NRV	k ç=d ~ë	RTVKKNPR	éé Ä	NKN	TOTTUVKUP	OMMM	
NUO	t	NRV	k ç=d ~ë	RPKUSR	éé Ä	NKO	NPQTVNKPS	NMMM	
OMR	qä	OMV	k ç=d ~ë	NMKTPP	éé Ä	OKP	SQMNUKUQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	PVTKMTR	éé Ä	NKM	POMOUOMKVR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OQKPUN	éé Ä	NKQ	NTRRQUKNP	NMMM	
OPU	r	OMV	k ç=d ~ë	NUKQQV	éé Ä	MKR	NONVMOKMM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMMRSQMRS	OKM	NUVQNRTKMT	NVRKUV	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QNVTVTTKQP	MKT	QRTPSTVKOQ	VNKTV	RVKR	NOMQ	
pÅ	QR	e O	UPMOUOKQU	NKM	VURSCPKUN	UQKOQ	RVKR	NOMQ	
pÅ	QR	e É	NQMQUNKRP	MKR	NSMVPNKCP	UTKOV	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VTOTMQKVM	NKQ	NMTQOQSKRP	VMKRR	RVKR	NOMQ	
d É	TO	e O	PNPONSKSM	MKS	PVPUSVKSQ	TVKRO	RVKR	NOMQ	
d É	TO	e É	NMTQOTKSN	MKO	NORCSSKVR	URKTS	RVKR	NOMQ	
v	UV	e O	PUCPPVUKUS	NKP	CPMNURSKUS	UUKUU	RVKR	NOMQ	
v	UV	e É	TUONRCKPM	NKV	UQNPQOKNU	VOKVS	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSPRNONKUQ	NKU	SRVNQQQKUP	NMMKSS	RVKR	NOMQ	
qÄ	NRV	e É	ORVTTOVKSU	MKQ	OUSSNVMKN	VMKSP	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRNVUNSKVO	MKS	PNTPQTOKSU	NNMKVN	RVKR	NOMQ	
_á	OMV	e É	NRNSTTUKSR	MKV	NSMVTVTKOQ	VQKOO	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVQNUMMTm

cãÉ=k~ã É MPRpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=NVMMVMQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==` mp==	i a o	n ` =c à-Ö
V	_É	S	k ç=d ~ë	RPKQPR	éé Ä	MKQ	SMOUCKMV	NMM	
NN	_	S	k ç=d ~ë	PSOKTST	éé Ä	OKM	OSRUMNKMS	NMMM	
OP	k ~	QR	e É	UMUQKVOO	éé Ä	NKQ	NMUNQPVHPU	OMMMMM	
OQ	j Ö	QR	e É	NOTQQKMON	éé Ä	NKO	USPPMTRTT	OMMMMM	
OT	^ ä	QR	e É	OMVSSOKPUR	éé Ä	NKO	RMQMRTNKVT	OMMMMM	
OU	pá	QR	e O	NUTSKUUP	éé Ä	NPHS	NQRORVHPN	NMMMM	
PV	h	QR	e É	NQVQTKMQS	éé Ä	NRT	UUVVOMRTP	OMMMMM	
QM	` ~	QR	e O	RVOTHSNO	éé Ä	MKO	PQPVPOQKRM	OMMMMM	
RN	s	UV	e É	SPNKMTT	éé Ä	NKV	RQOOPUHRQ	NMMM	
RO	` ê	UV	e É	PNOKPMT	éé Ä	MHS	PPSUORHPM	OMMM	
RR	j å	UV	e É	RQRKNNM	éé Ä	MHP	OVPPMMHPO	OMMM	
RS	cÉ	UV	e O	OUUURKNQR	éé Ä	NHS	SPUUONSMRTQ	NMMMMM	
RV	` ç	UV	e É	QVSKTQO	éé Ä	MKQ	VNRTOOKUV	NMMM	
SM	k á	UV	e É	RPMHRVP	éé Ä	MRT	OTPUNOKUQ	NMMM	
SP	` ì	UV	e É	PNSKQOR	éé Ä	MKV	QRPTRMKOM	OMMM	
SS	wå	UV	e É	RRQKPOM	éé Ä	MKV	NPQPMMHRM	OMMM	
TR	^ ë	UV	e É	VSKTSR	éé Ä	MRT	NTNTPHPR	NMMM	
TU	pÉ	UV	e O	VNKTTV	éé Ä	OKN	TRVTHRR	NMMM	
UU	pê	UV	e É	QVUKMPQ	éé Ä	MKQ	PNSSVURTU	OMMM	
VR	j ç	UV	e É	UVKMPS	éé Ä	MKV	RRSQMHSP	NMMM	
NMT	^ Ö	UV	e É	QTKOUO	éé Ä	MKV	NMQVUQKVP	NMM	
NNN	` Ç	UV	e É	OPPHSRU	éé Ä	NHM	SVQQVKVT	NMMM	
NNU	på	NRV	e É	QUSHSPT	éé Ä	MRT	OTVSQMHSS	NMMM	
NON	pÄ	NRV	k ç=d ~ë	PPKUQM	éé Ä	MHS	NQVTNRHMV	NMMM	
NPT	_~	NRV	k ç=d ~ë	OQTRKQMP	éé Ä	MRT	PNSSVTSKQR	OMMM	
NUO	t	NRV	k ç=d ~ë	RSKNQN	éé Ä	MHS	NQOVQRHNT	NMMM	
OMR	qä	OMV	k ç=d ~ë	VPHRNO	éé Ä	NHN	RRQPUQKOP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QNPHNUV	éé Ä	NHS	PPQSORPHSP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	SQKVNM	éé Ä	NKV	QSQSPUKVT	NMMM	
OPU	r	OMV	k ç=d ~ë	NMUKURV	éé Ä	MKU	TONNPSKVM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÁ	B n ` =i çï	B n ` =eáÜÜ	n ` =c à-Ö
i á	S	k ç=d ~ë	NVTCROTHPO	NHS	NUVQNRTHMT	NVQKNQ	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	QPQUMPVKVN	OKM	QRTPSTVKOQ	VRHMT	RVHR	NOMQ	
pÅ	QR	e O	UPSCPOKNV	NHR	VURSCPKUN	UQKUQ	RVHR	NOMQ	
pÅ	QR	e É	NQPURUKQU	MHS	NSMVPNKCP	UVHPV	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VUPUUVKNV	NKU	NMTQQQSKRP	VNHRV	RVHR	NOMQ	
d É	TO	e O	PNRNQMKVT	MKU	PVPUSVHSQ	UMHMN	RVHR	NOMQ	
d É	TO	e É	NMUPUTKUN	MKQ	NORCSSKVR	USHRP	RVHR	NOMQ	
v	UV	e O	PUSPNNMHST	NHR	QPMNURSKUS	UVKU	RVHR	NOMQ	
v	UV	e É	TTUMNPKOS	MHP	UQNPQOKNU	VOKQT	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	STRROMVHPO	MKU	SRVNQQQKUP	NVOKQU	RVHR	NOMQ	
qÄ	NRV	e É	OSNTMVTKNO	NKM	OUSSNVMKN	VNHPN	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRPQNTPHSP	MHR	PNTPQTOKSU	NNNHPT	RVHR	NOMQ	
_á	OMV	e É	NROROMUKSS	MKO	NSMVTVTKOQ	VQKTS	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MVQNUMMTp

cãÉ=k~ã É MPSpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=NVMMTMPN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãäíáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	RCKTVR	éé Ä	NKO	RVPSUKPV	NMM	
NN	_	S	k ç=d ~ë	PMRKOTN	éé Ä	NKM	OCPMVUKRT	NMMM	
OP	k ~	QR	e É	UMCRKNTO	éé Ä	NKP	NMTSOTPKMQ	OMMMMM	
OQ	j Ö	QR	e É	NNTRSKSOT	éé Ä	MKV	TVUQSQKTR	OMMMMM	
OT	^ ä	QR	e É	NVOQMRKUUP	éé Ä	MKU	QUQQSQRKPQ	OMMMMM	
OU	pá	QR	e O	NVNQKNRN	éé Ä	OTHP	NRMVUUKTR	NMMMM	
PV	h	QR	e É	NPUCPKQVT	éé Ä	MKS	UCUCROKQV	OMMMMM	
QM	` ~	QR	e O	RQPOKTNO	éé Ä	NKN	POMVUPQKUR	OMMMMM	
RN	s	UV	e É	SMOKPRP	éé Ä	NKN	RONVTRKMP	NMMM	
RO	` ê	UV	e É	OVVKPCR	éé Ä	MKV	PCRSNUKPN	OMMM	
RR	j å	UV	e É	RONKVMV	éé Ä	MKV	CUPOMSKPO	OMMM	
RS	cÉ	UV	e O	OTCCPKRVP	éé Ä	NKR	SMTUNSNSKNQ	NMMMMM	
RV	` ç	UV	e É	QTTTKSUU	éé Ä	NKM	UUUNQQKCN	NMMM	
SM	k á	UV	e É	RNNKMOM	éé Ä	MKQ	OSRVTQKPP	NMMM	
SP	` ì	UV	e É	PMQKSOM	éé Ä	NKT	QQMRQOKSU	OMMM	
SS	wå	UV	e É	RPUKRVM	éé Ä	MKU	NPNRUOKUP	OMMM	
TR	^ ë	UV	e É	VOKSRP	éé Ä	NKQ	NSRUQKCQ	NMMM	
TU	pÉ	UV	e O	UTKUPQ	éé Ä	NKS	TPQMKVO	NMMM	
UU	pê	UV	e É	QUMKVQN	éé Ä	MKR	PMUQRPKPP	OMMM	
VR	j ç	UV	e É	USKSNM	éé Ä	MKV	RQRVNKMS	NMMM	
NMT	^ Ö	UV	e É	QSKMRV	éé Ä	NKT	NMPNPNKSP	NMM	
NNN	` Ç	UV	e É	OCUKTMR	éé Ä	MKU	SURRSKUT	NMMM	
NNU	på	NRV	e É	QTOKQPS	éé Ä	MKR	OTRVOSKRU	NMMM	
NON	pÄ	NRV	k ç=d ~ë	PMKTUO	éé Ä	MKU	NPTCCRKMN	NMMM	
NPT	_~	NRV	k ç=d ~ë	OCNSKTMR	éé Ä	NKT	PNNPSUMKQO	OMMM	
NUO	t	NRV	k ç=d ~ë	RSKMDV	éé Ä	MKV	NQPSTQKVN	NMMM	
OMR	qä	OMV	k ç=d ~ë	VNKTNS	éé Ä	NKS	RQRSSNKMQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QMQKUUS	éé Ä	NKN	POVMUSUKRS	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	SSKTPS	éé Ä	PKO	QTVPNRKCQ	NMMM	
OPU	r	OMV	k ç=d ~ë	NMQKRQU	éé Ä	NKR	SVQVRPKSN	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÅ	B n ` =¡ çï	B n ` =eáÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVSSMRRKCN	MKQ	NUVQNRTKMT	NVPKU	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	QOUNNVSKQV	MKT	QRTPSTVKOQ	VPHSN	RVRR	NOMQ	
pÅ	QR	e O	UQUTUNKUP	MKT	VURSCPKUN	USKNO	RVRR	NOMQ	
pÅ	QR	e É	NQQCMMKUN	NKO	NSMVPNKCP	UVHS	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VVUNMVKQV	NKP	NMTQOQSKRP	VOKVN	RVRR	NOMQ	
d É	TO	e O	PNTRPUKNS	NKP	PVPUSVHSQ	UMHSO	RVRR	NOMQ	
d É	TO	e É	NMTRSMKVN	MKV	NCRCSSKVR	URKUT	RVRR	NOMQ	
v	UV	e O	PUVVSMPKRP	MKV	CPMNURSKUS	VMHSR	RVRR	NOMQ	
v	UV	e É	TUQTMNKUN	NKU	UQNPCOKNU	VPKOT	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUMCUSCKPT	NKN	SRVNQQQKUP	NMPKON	RVRR	NOMQ	
qÄ	NRV	e É	OSRVVSNKUP	MKV	CUSSNVMKN	VOKU	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PRQSRRTKTQ	MKU	PNTPQTOKSU	NNNKTS	RVRR	NOMQ	
_á	OMV	e É	NRQURUOKMM	MKS	NSMVTVTKOQ	VSKO	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn MVQNUMMV

cãÉ=k~ã É MPTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=NVMØRVQR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	SKVQS	éé Ä	NKO	TVOSKTQ	NMM	
NN	_	S	k ç=d ~ë	NTKSUN	éé Ä	MKO	NPSSVKVU	NMMM	
OP	k ~	QR	e É	NNQNKUUN	éé Ä	OKR	NVSTVTKUP	OMMMMM	
OQ	j Ö	QR	e É	VPOMKVMT	éé Ä	NKO	SRCPUVKOM	OMMMMM	
OT	^ ä	QR	e É	ORUVPTKMMN	éé Ä	NKM	STNTVRUKMO	OMMMMM	
OU	pá	QR	e O	NRCPKTQQ	éé Ä	MKT	NOCUPQKPV	NMMMM	
PV	h	QR	e É	SMPMSRT	éé Ä	MKT	PUVSRTKUM	OMMMMM	
QM	` ~	QR	e O	NMUNKUMN	éé Ä	MKO	SSRRNPKQV	OMMMMM	
RN	s	UV	e É	OOSKVQV	éé Ä	MKU	OMPRUPKMV	NMMM	
RO	` ê	UV	e É	NSUKPTR	éé Ä	MKU	NVMRUPKQN	OMMM	
RR	j å	UV	e É	VPKSSP	éé Ä	NKT	RCUTSKTT	OMMM	
RS	cÉ	UV	e O	PSOMRKNPM	éé Ä	OKU	UQMPMSRNKUS	NMMMMM	
RV	` ç	UV	e É	NUKSSU	éé Ä	NKO	PSOVOKRN	NMMM	
SM	k á	UV	e É	TOKSVP	éé Ä	MKS	PVQNQKTM	NMMM	
SP	` ì	UV	e É	RQKOMV	éé Ä	OKU	UNUNVKTP	OMMM	
SS	wå	UV	e É	NNUKNTU	éé Ä	MKS	PMNOVKRP	OMMM	
TR	^ ë	UV	e É	NPKTOS	éé Ä	MKU	ORSTKRN	NMMM	
TU	pÉ	UV	e O	TKVUN	éé Ä	NKO	TMOKPN	NMMM	
UU	pê	UV	e É	QOKNNT	éé Ä	NKM	OUMUNKPV	OMMM	
VR	j ç	UV	e É	OKVMQ	éé Ä	PKP	ONQQKSR	NMMM	
NMT	^ Ö	UV	e É	MKUVO	éé Ä	OKT	ONNOKQO	NMM	
NNN	` Ç	UV	e É	MKSPT	éé Ä	TKO	OMUKRO	NMMM	
NNU	på	NRV	e É	QSKOUU	éé Ä	OKN	OTPNPKCP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKUUV	éé Ä	NMKQ	QUQVKPP	NMMM	
NPT	_~	NRV	k ç=d ~ë	RSNKURP	éé Ä	MKS	TPCOSMKUS	OMMM	
NUO	t	NRV	k ç=d ~ë	MKOMT	éé Ä	UMKN	PMNSKUV	NMMM	
OMR	qä	OMV	k ç=d ~ë	OKCPU	éé Ä	NKN	NPTVRKOV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OTMKVNS	éé Ä	NKR	ONSQNTMKRS	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OOKVQU	éé Ä	QKT	NSPTNRKOM	NMMM	
OPU	r	OMV	k ç=d ~ë	NPKVCR	éé Ä	MKS	VNNQRKQN	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n` =ç ï	B n` =e ãÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	NVQONRQKTU	MKV	NUVQNRTKMT	NVOKRP	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QQQTPTMKQO	NKN	QRTPSTVKOQ	VTKOQ	RVKR	NOMKQ	
pÅ	QR	e O	UTNSOQKQT	NKR	VURSCPKUN	UUKQP	RVKR	NOMKQ	
pÅ	QR	e É	NQURTRKTQ	MKT	NSMVPNKCP	VOKPO	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	NMNRMSMKON	OKQ	NMTQOQSKRP	VQKQV	RVKR	NOMKQ	
d É	TO	e O	PONQNUKVV	MKV	PVPUSVKSQ	UNKSN	RVKR	NOMKQ	
d É	TO	e É	NMVQMVKRU	MKU	NORCSSKVR	UTKPQ	RVKR	NOMKQ	
v	UV	e O	QMRRMRQKSV	OKM	CPMNURSKUS	VQKOS	RVKR	NOMKQ	
v	UV	e É	UNQQOSKUT	MKS	UQNPCOKNU	VSKU	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SUUMRMNKMV	MKV	SRVNQQQKUP	NVOKPV	RVKR	NOMKQ	
qÄ	NRV	e É	OSSNOPPKMQ	MKV	OUSSNVMKN	VOKUR	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PQUQVVKSU	NKT	PNTPQTOKSU	NMVKUO	RVKR	NOMKQ	
_á	OMV	e É	NRQTNTTKRR	NKO	NSMVTVTKOQ	VSKNN	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MVQNUMNN

cãÉ=k~ã É MPUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=NVAPMMRN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	PKRVT	éé Ä	PKO	QPONKUP	NMM	
NN	_	S	k ç=d ~ë	NSKQST	éé Ä	NKO	NPMVUKPT	NMMM	
OP	k ~	QR	e É	UVVKUVM	éé Ä	NKO	NRSMVQKRR	OMMMMM	
OQ	j Ö	QR	e É	QURUKVMR	éé Ä	NKQ	PQOPPPKRU	OMMMMM	
OT	^ ä	QR	e É	NMMTMMKTUR	éé Ä	NKO	OQTQOONKMQ	OMMMMM	
OU	pá	QR	e O	NRQMSOT	éé Ä	NTKO	NNVQSRKVQ	NMMMM	
PV	h	QR	e É	PPNRKTVU	éé Ä	MKU	ONSPOSKTU	OMMMMM	
QM	` ~	QR	e O	OMPRKVMR	éé Ä	NKP	NOMOUVQKOP	OMMMMM	
RN	s	UV	e É	NMMKMVP	éé Ä	NKP	USSNOKMD	NMMM	
RO	` ê	UV	e É	SQKTTO	éé Ä	NKP	TMVNTKNV	OMMM	
RR	j å	UV	e É	RVKNNR	éé Ä	NKP	POMQRKMR	OMMM	
RS	cÉ	UV	e O	NSQQTKVNQ	éé Ä	NKP	PSTVRRQMQV	NMMMM	
RV	` ç	UV	e É	NNKPQQ	éé Ä	NKT	ONOQRKTP	NMMM	
SM	k á	UV	e É	QMKMNM	éé Ä	OKO	OMUTOKQU	NMMM	
SP	` ì	UV	e É	SNKUOQ	éé Ä	OKN	UVPTSKQO	OMMM	
SS	wå	UV	e É	NMNKPTM	éé Ä	OKN	OQUMMKNP	OMMM	
TR	^ ë	UV	e É	UKNQR	éé Ä	MKO	NQSUKRT	NMMM	
TU	pÉ	UV	e O	QKORT	éé Ä	RKU	PSRKSS	NMMM	
UU	pê	UV	e É	QQKNNQ	éé Ä	MKR	OUNVUKMT	OMMM	
VR	j ç	UV	e É	OKMNO	éé Ä	NKU	NQVVKMM	NMMM	
NMT	^ Ö	UV	e É	MKQVO	éé Ä	NKS	NNPQKRN	NMM	
NNN	` Ç	UV	e É	MKSVV	éé Ä	NMKU	ONUKRO	NMMM	
NNU	på	NRV	e É	QQKMOU	éé Ä	MKR	ORQUQKPQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKUMV	éé Ä	NKN	QPURKPS	NMMM	
NPT	_~	NRV	k ç=d ~ë	QONKPTQ	éé Ä	MKO	RPSRURKNO	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKVST	éé Ä	k lÅ	OOSOKRU	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKUPS	éé Ä	PKV	RSUMKRT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	ONTKMNP	éé Ä	MKS	NTRSMTMKRU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NMKTTN	éé Ä	PKN	TVOSSKRN	NMMM	
OPU	r	OMV	k ç=d ~ë	RKOVR	éé Ä	OKN	PRONPKQO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=o ÉÅ	B n ` =i çï	B n ` =e ä ÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVUUOOOKPQ	OKQ	NUVQNRTKMT	NVQKVT	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QPRPNPVKQQ	MKU	QRTPSTVKOQ	VRKNU	RVKR	NOMQ	
pÅ	QR	e O	UQRPVRKQO	NKT	VURSOPKUN	URKTT	RVKR	NOMQ	
pÅ	QR	e É	NQMSVRKRR	MKP	NSMVPNKOP	UTKQP	RVKR	NOMQ	
d É	TO	k ç=d ~ë	NMNRRTVKOM	NKM	NMTQOQSKRP	VQKRQ	RVKR	NOMQ	
d É	TO	e O	POMTTVKRQ	NKN	PVPUSVKSQ	UNKQQ	RVKR	NOMQ	
d É	TO	e É	NMTTMUKUN	MKS	NORCSSKVR	URKVU	RVKR	NOMQ	
v	UV	e O	PVNNSTVKVR	NKO	QPMNURSKUS	VMKVP	RVKR	NOMQ	
v	UV	e É	TUMUNUKTT	NKT	UQNPQOKNU	VOKUN	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	STONVURKON	NKT	SRVNQQQKUP	NMNKVU	RVKR	NOMQ	
qÄ	NRV	e É	OSMUSSSKVT	NKS	OUSSNVMKN	VNKMO	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRQURTMKNT	NKT	PNTPQTOKSU	NNNKNV	RVKR	NOMQ	
_á	OMV	e É	NRRTTUTKTN	OKQ	NSMVTVTKOQ	VSKTT	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSNUMMN

cãÉ=k~ã É MPVpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=NVMRRVMRT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	RKOOV	éé Ä	SKP	SOOTKMM	NMM	
NN	_	S	k ç=d ~ë	OMKMNN	éé Ä	OKM	NRURCKCQ	NMMM	
OP	k ~	QR	e É	TCUKTMT	éé Ä	NKO	NPVMPPKMP	OMMMMM	
OQ	j Ö	QR	e É	RMUSKTVN	éé Ä	NKO	PQUTONKRM	OMMMMM	
OT	^ ä	QR	e É	NQMPOSKPTT	éé Ä	OKP	PRSPNMUKUQ	OMMMMM	
OU	pá	QR	e O	NRQUKRCP	éé Ä	VKV	NCPUMNKNO	NMMMM	
PV	h	QR	e É	QNSTKTPT	éé Ä	NKT	OTPMUQKVR	OMMMMM	
QM	` ~	QR	e O	OTRVKNRR	éé Ä	NKR	NSSPMSVKVM	OMMMMM	
RN	s	UV	e É	NRMKUCP	éé Ä	NKQ	NPSRQMKNM	NMMM	
RO	` ê	UV	e É	UUKTUU	éé Ä	MKR	NMNRMNKRN	OMMM	
RR	j å	UV	e É	SNKTUS	éé Ä	NKP	PRMVUKSN	OMMM	
RS	cÉ	UV	e O	NSVRQKMSO	éé Ä	MKO	QMPSUNUQKSU	NMMMMM	
RV	` ç	UV	e É	NMKPUS	éé Ä	NKP	OMQNRKRN	NMMM	
SM	k á	UV	e É	QVKTNP	éé Ä	MKP	OTNQMKMD	NMMM	
SP	` ì	UV	e É	SVKRRS	éé Ä	NKP	NMRPQRKCO	OMMM	
SS	wå	UV	e É	URKMPV	éé Ä	NKQ	ONUQCKVP	OMMM	
TR	^ ë	UV	e É	NCKPOM	éé Ä	NKN	OPNTKTT	NMMM	
TU	pÉ	UV	e O	SKSNO	éé Ä	PKR	RVUKPN	NMMM	
UU	pê	UV	e É	QSKTOM	éé Ä	OKP	PNOVCKUO	OMMM	
VR	j ç	UV	e É	OKCPN	éé Ä	UKR	NUQQKSN	NMMM	
NMT	^ Ö	UV	e É	MKSTS	éé Ä	NKR	NSNTKVN	NMM	
NNN	` Ç	UV	e É	MKSRR	éé Ä	OKM	ONRKNV	NMMM	
NNU	på	NRV	e É	QQKTMU	éé Ä	NKT	OSPTOKTM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NKMSN	éé Ä	OKS	RVSMKVO	NMMM	
NPT	_~	NRV	k ç=d ~ë	QSOKNOU	éé Ä	NKO	RVNUQSKRR	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKUV	éé Ä	k l^	CCCCKRQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKCUV	éé Ä	QKN	UQTRKNQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OPVKVRQ	éé Ä	MKU	NVSUQCUKQV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NTKSTR	éé Ä	OKQ	NPMNPVKVM	NMMM	
OPU	r	OMV	k ç=d ~ë	UKQNS	éé Ä	OKO	RSSQVKUO	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=o ÉÅ	B n` =ç ï	B n` =e åÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	OMMSCOUKNS	MKU	NUVQNRTKMT	NVRKVO	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	QQCPPUTKRV	MRR	QRTPSTVKOQ	VSKTN	RVRR	NOMQ	
pÅ	QR	e O	USQVQMRRO	MKV	VURSCPKUN	UTKTS	RVRR	NOMQ	
pÅ	QR	e É	NQRQNPRTM	MKQ	NSMVPNKCP	VMPS	RVRR	NOMQ	
d É	TO	k ç=d ~ë	NMMSPVRKMU	OKM	NMTQCQSKRP	VPKSU	RVRR	NOMQ	
d É	TO	e O	POPVCPKNS	NKR	PVPUSVKSQ	UCKCR	RVRR	NOMQ	
d É	TO	e É	NMVRTNKMT	MKU	NCRCSSKVR	UTKQT	RVRR	NOMQ	
v	UV	e O	QNRTVSTKSU	MKS	CPMNURSKUS	VSKSS	RVRR	NOMQ	
v	UV	e É	UNUPTVKCQ	MRR	UQNPCCKNU	VTKOT	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	STSNPQQKPQ	NKP	SRVNQQQKUP	NMCKRU	RVRR	NOMQ	
qÄ	NRV	e É	OSRVCUUKQN	NKV	CUSSNVMKN	VCKTU	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PRTTUMMKVQ	MKU	PNTPQTCKSU	NNCKTQ	RVRR	NOMQ	
_á	OMV	e É	NRSQTVVKPT	NKR	NSMVTVTKOQ	VTKO	RVRR	NOMQ	

`çåíaåì aåÖ=~ëäÄê~íáç=sÉêâÑÅ~íáç=Ê``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cäÉ=k~ã É	MQM``skÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf^mj eyNya^q^yQMOPyMPJ ^oyi n`OUbkÄ
^Åè=qáã É	PLOULOMOP=NVWQNMMQ
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MVQ ^i _kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	OQKPQM	ééÄ	NKV	NQSNVMSKMM	CR	VTKPS	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OQKTCP	ééÄ	NKQ	VTPMOKMM	CR	VUKUV	UVKU	NNMO	
CP	k ~	CR	e É	RRQOKUVU	ééÄ	MKS	PRUOMVOQKQS	RMMM	NNMKUS	UVKU	NNMO	[=HLJ=NMB
CQ	j Ö	CR	e É	RSRSKTUQ	ééÄ	MKV	NVMRVVOKRQ	RMMM	NNPKNQ	UVKU	NNMO	[=HLJ=NMB
CT	^ä	CR	e É	SVPKUNU	ééÄ	NKM	TRSRVMPQ	RMM	NOMKTS	UVKU	NNMO	[=HLJ=NMB
CU	pá	CR	e O	RRNKQSQ	ééÄ	MKT	ONSNVMNKUM	RMM	NNMKOV	UVKU	NNMO	[=HLJ=NMB
PV	h	CR	e É	RPSNKTRO	ééÄ	MKT	NRSPVSOKVP	RMMM	NMTKOQ	UVKU	NNMO	
QM	` ~	CR	e O	RPNUKOMV	ééÄ	MKR	NRSNTVTQKVN	RMMM	NMSKPS	UVKU	NNMO	
RN	s	UV	e É	OSKONS	ééÄ	MKU	NMTVRTKRN	CR	NMQKUS	UVKU	NNMO	
RO	` ê	UV	e É	OSKNQT	ééÄ	NKN	NPRQTPKQO	CR	NMQKRV	UVKU	NNMO	
RR	j å	UV	e É	OSKQNS	ééÄ	MKT	SUMVQKPT	CR	NMRKSS	UVKU	NNMO	
RS	cÉ	UV	e O	RNNPKSQP	ééÄ	OKQ	RQRRTRSVKUN	RMMM	NMOKOT	UVKU	NNMO	
RV	` ç	UV	e É	OSKVMV	ééÄ	NKR	OPTQVNKOM	CR	NMTKSQ	UVKU	NNMO	
SM	ká	UV	e É	OSKTTN	ééÄ	NKT	SSOMRKCR	CR	NMTKMU	UVKU	NNMO	
SP	` ì	UV	e É	OSKUVS	ééÄ	NKV	NUQTVOKMN	CR	NMTKRU	UVKU	NNMO	
SS	wå	UV	e É	OSKSQR	ééÄ	OKM	PNMONKPS	CR	NMSKRU	UVKU	NNMO	
TR	^ë	UV	e É	OSKMTV	ééÄ	MKN	OONPQKRN	CR	NMQKPO	UVKU	NNMO	
TU	pÉ	UV	e O	OQKVQN	ééÄ	MKQ	VVRVKQO	CR	VVKTS	UVKU	NNMO	
UU	pê	UV	e É	OSKOVT	ééÄ	MKT	UMVOVKVP	CR	NMRKMV	UVKU	NNMO	
VR	j ç	UV	e É	ORKQPO	ééÄ	OKM	TRVOSKTV	CR	NMNKTP	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKOQN	ééÄ	NKM	OUVOUPKSP	CR	NMUKVS	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKVMM	ééÄ	MKS	PUORONVV	CR	NMTKS	UVKU	NNMO	
NNU	på	NRV	e É	OQKVNO	ééÄ	MKS	TPRRMKVR	CR	VVKSR	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKVNU	ééÄ	PKP	RSMVQTOKUS	CR	VVKST	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	OSKMVU	ééÄ	OKU	NTNOTRKPN	CR	NMQKTV	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKMTS	ééÄ	MKV	PPRTTTKQP	CR	NMQKP	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKTTM	ééÄ	OKM	TRNNVUKSS	CR	NMPKMU	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKUVN	ééÄ	NKU	NMTOVTRKON	CR	NMTKRS	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKOQR	ééÄ	NKU	VONOTTKSP	CR	NMQKVU	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OTKSVQ	ééÄ	OKU	VMONUOKRP	CR	NNMKTU	UVKU	NNMO	[=HLJ=NMB

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ï çï	B n`=eäÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	ONMQMNVKNU	MKR	NUVQNRTKMT	NNNKVU	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	QNVPOMMKMM	OKM	QRTPSTVKOQ	VNKSU	RVKR	NOMQ	
pÅ	CR	e O	UQMVROKRM	NKS	VURSCPKUN	USKNQ	RVKR	NOMQ	
pÅ	CR	e É	NQPNOSKTS	MKR	NSMVPNKCP	UUKVQ	RVKR	NOMQ	
d É	TO	k ç=d ~ë	NMMMMVOKNV	NKS	NMTQQQSKRP	VPKN	RVKR	NOMQ	
d É	TO	e O	PPMTMTKRR	MKT	PVPUSVKSQ	UPKVS	RVKR	NOMQ	
d É	TO	e É	NNOPPSKPT	MKV	NORCSSKVR	UVKSU	RVKR	NOMQ	
v	UV	e O	PTOTRMOKST	NKR	QPMNURSKUS	USKSR	RVKR	NOMQ	
v	UV	e É	TQQPSTKRR	MKO	UQNPQOKNU	UUKQT	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVMMSRTKVT	OKR	SRVNQQQKUP	NVQKSV	RVKR	NOMQ	
qÄ	NRV	e É	OSUNSVSKQR	NKV	OUSSNVMKN	VPKRS	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQTTSPQKQU	OKN	PNTPQTOKSU	NMVKRU	RVKR	NOMQ	
_á	OMV	e É	NRPUORQKSO	NKU	NSMVTVTKOQ	VRKRS	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=Ê``_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MQN``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíÝ^mj eyNya^q^yQMCPyMPJ ^oyi n`OUbkÂ

^Åè=qáã É PLOULOMCP=NVMQMQM

p~ã éáÉ=qóéÉ ``_

qçí~äa äã íáç~å NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑc äÉk~ã É MVQ ^i _KÇ

p~ã éáÉ=n`=m~ëëlc á~ä c~äã

fpqa=n`=m~ëëlc~äã m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	råáë	opa	==\ mp==	iãìá	n`=c~ä~Ö
V	_É	S	kç=d~ë	JMKMNO	ééÄ	kL^	OMMKMN	MO	
NN	_	S	kç=d~ë	MKNVU	ééÄ	UKN	NUUPKQU	Q	
CP	k~	QR	eÉ	JNMRUQ	ééÄ	kL^	PUSPRKMD	OMM	
CQ	j Ö	QR	eÉ	PKPUO	ééÄ	RKS	NTTTKVS	OM	
OT	^ä	QR	eÉ	NVKQRO	ééÄ	QKS	NRSSKTU	OM	c~äÉÇ=a ça
CU	pá	QR	eO	MKUNS	ééÄ	QQKN	TTMKUQ	NMM	
PV	h	QR	eÉ	NKQMO	ééÄ	NOTKR	PQMUMKOO	OMM	
QM	`~	QR	eO	PKUTM	ééÄ	OKP	QRUNNKRN	OM	
RN	s	UV	eÉ	MKMPU	ééÄ	QRKP	QPQKQQ	N	
RO	`ê	UV	eÉ	JMKMMT	ééÄ	kL^	VVRKNU	N	
RR	j å	UV	eÉ	MKMNR	ééÄ	QMS	NUNKPM	MQ	
RS	cÉ	UV	eO	RKNSO	ééÄ	PKP	TMVQQKMV	OM	
RV	`ç	UV	eÉ	MKMMM	ééÄ	NNUTKQ	OTNKNO	MO	
SM	k á	UV	eÉ	MKMMT	ééÄ	NTVKO	NUNKNO	MQ	
SP	`ì	UV	eÉ	MKMMM	ééÄ	kL^	RQUKVN	MS	
SS	wå	UV	eÉ	MKMTV	ééÄ	NNKT	OVMKMN	O	
TR	^ë	UV	eÉ	MKMQP	ééÄ	QMKQ	QMKPQ	N	
TU	pÉ	UV	eO	MKMPQ	ééÄ	NUKP	OPKUP	N	
UU	pê	UV	eÉ	MKMNM	ééÄ	NOKO	UMKMM	N	
VR	j ç	UV	eÉ	MKMVU	ééÄ	NTKV	RQUKVN	N	
NMT	^Ö	UV	eÉ	MKMNS	ééÄ	PPKU	ONQKQP	MO	
NNN	`Ç	UV	eÉ	MKMNP	ééÄ	PMKO	PMKMM	MO	
NNU	på	NRV	eÉ	MKMTM	ééÄ	NOKU	RPPHKPR	N	
NON	pÄ	NRV	kç=d~ë	MKMOM	ééÄ	OVKN	NPUNKRP	MO	
NPT	_~	NRV	kç=d~ë	MKMRT	ééÄ	OSKS	RTTKOV	MQ	
NUO	t	NRV	kç=d~ë	MKMQR	ééÄ	OOKM	PQOMKQV	N	
OMR	qä	OMV	kç=d~ë	MKMQQ	ééÄ	VKT	OMVRKTP	MO	
OMU	mÄ	OMV	kç=d~ë	JMKMMO	ééÄ	kL^	OQTVKQM	MO	
OPO	qÜ	OMV	kç=d~ë	MKMPV	ééÄ	OUKR	QPNNKVT	N	
OPU	r	OMV	kç=d~ë	MKMOM	ééÄ	NTKT	VOQKPR	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ= mp	B=oÉÁ	B n`=ç ïï	B n`=eäÜÜ	n`=c~ä~Ö
iá	S	kç=d~ë	ONUSQTVKPQ	NKT	NUVQNRTKMT	NNRKQP	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QQQQPPQKUS	MKP	QRTPSTVKOQ	VSKTP	RVKR	NOMQ	
pÅ	QR	eO	UUQTVRKNM	NKQ	VURSOPKUN	UVKTT	RVKR	NOMQ	
pÅ	QR	eÉ	NQVOOSKPR	NKR	NSMVPNKOP	VOKTP	RVKR	NOMQ	
dÉ	TO	kç=d~ë	NMTQONTKTO	MKU	NMTQQQSKRP	NMM	RVKR	NOMQ	
dÉ	TO	eO	PQVRQNKTM	MKS	PVPUSVKSQ	UUKTR	RVKR	NOMQ	
dÉ	TO	eÉ	NNUNNOKMP	NKU	NORQSSKVR	VQKOV	RVKR	NOMQ	
v	UV	eO	PVSPPOSKRM	OKM	QPMNURSKUS	VOKNP	RVKR	NOMQ	
v	UV	eÉ	TUPPPNKVO	MKS	UQNPQOKNU	VPKNN	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	TOQVRMUKRP	OKP	SRVNQQQKUP	NMVKVU	RVKR	NOMQ	
qÄ	NRV	eÉ	OUORRNTKPM	MKS	OUSSNVMKN	VUKRU	RVKR	NOMQ	
_á	OMV	kç=d~ë	PSPSUQTKRN	MKR	PNTPQTOKSU	NNQKS	RVKR	NOMQ	
_á	OMV	eÉ	NSRMUTUKRU	NKN	NSMVTVTKOQ	NVOKRR	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSNUMMP

cãÉ=k~ã É MQQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyî mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=NVMRQMQS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	RKTRR	éé Ä	MKS	SUSSKMV	NMM	
NN	_	S	k ç=d ~ë	NQKQQQ	éé Ä	QKM	NNTUMKRN	NMMM	
OP	k ~	QR	e É	UQTKVVT	éé Ä	MKS	NSNSSNKVS	OMMMMM	
OQ	j Ö	QR	e É	UTMPKNRU	éé Ä	NKO	SOPUPOKON	OMMMMM	
OT	^ ä	QR	e É	OQMONRKQUR	éé Ä	MKT	SPUNUUMKNN	OMMMMM	
OU	pá	QR	e O	NPROKTRQ	éé Ä	UKR	NNOUPOKVN	NMMMM	
PV	h	QR	e É	RQRSKOSS	éé Ä	MKO	PSQNMUKSU	OMMMMM	
QM	` ~	QR	e O	POSOKTUP	éé Ä	NKP	OMQQQUNKMU	OMMMMM	
RN	s	UV	e É	OOUKRSM	éé Ä	NKQ	OMTQPMKVV	NMMM	
RO	` ê	UV	e É	NSUKPTQ	éé Ä	NKM	NVONQSKNR	OMMM	
RR	j å	UV	e É	VVKNSV	éé Ä	PKM	RSQOUKRN	OMMM	
RS	cÉ	UV	e O	PRTSPKRSP	éé Ä	MKQ	UQPORNOMQU	NMMMMM	
RV	` ç	UV	e É	NVKRNP	éé Ä	NKP	PUOPRKPT	NMMM	
SM	k á	UV	e É	TQKTVV	éé Ä	OKP	QMUUNKNO	NMMM	
SP	` ì	UV	e É	RRKVRQ	éé Ä	NKQ	URNPNKSM	OMMM	
SS	wå	UV	e É	NNPKTVS	éé Ä	MKT	OVORTHSO	OMMM	
TR	^ ë	UV	e É	NPKPPQ	éé Ä	MKP	ORNRKNS	NMMM	
TU	pÉ	UV	e O	THKUN	éé Ä	OHS	SPPKVU	NMMM	
UU	pê	UV	e É	RTKTSO	éé Ä	OKM	PUUMUKPS	OMMM	
VR	j ç	UV	e É	OKRNT	éé Ä	SKP	NVMTKVR	NMMM	
NMT	^ Ö	UV	e É	MKTVO	éé Ä	PKP	NUVRKTO	NMM	
NNN	` Ç	UV	e É	MKQST	éé Ä	NNKM	NRTHMQ	NMMM	
NNU	på	NRV	e É	QPKSMO	éé Ä	MKT	ORVPVHST	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKUTP	éé Ä	OKQ	QTRVHKNU	NMMM	
NPT	_~	NRV	k ç=d ~ë	SOOKOMN	éé Ä	MKU	UMUOVMKOR	OMMM	
NUO	t	NRV	k ç=d ~ë	MKOTU	éé Ä	NVKU	PNUTHKNN	NMMM	
OMR	qä	OMV	k ç=d ~ë	OHSTP	éé Ä	NKR	NSQOOKPT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NVSHSQR	éé Ä	MKU	NRUMTQUHSV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OTKQUO	éé Ä	PKO	NVSSOPKRN	NMMM	
OPU	r	OMV	k ç=d ~ë	NOKMUN	éé Ä	NKR	TVRRVKTQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ¹ mp	B=o ÉÅ	B n ` =i çï	B n ` =eáÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMNTRVQKRU	NKU	NUVQNRTHMT	NVSHRO	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QQVQQUUKNS	MKV	QRTPSTVKOQ	VUKOS	RVKR	NOMQ	
pÅ	QR	e O	VMMPTQRTN	OKQ	VURSCPKUN	VNHPR	RVKR	NOMQ	
pÅ	QR	e É	NRONRNKRT	NHP	NSMVPNKCP	VQHRQ	RVKR	NOMQ	
d É	TO	k ç=d ~ë	NMNVMQUKNQ	NKM	NMTQQQSKRP	VQKUS	RVKR	NOMQ	
d É	TO	e O	PORUTTHPR	MKV	PVPUSVHSQ	UOKTQ	RVKR	NOMQ	
d É	TO	e É	NNONNNKUM	NKN	NORCSSKVR	UVKR	RVKR	NOMQ	
v	UV	e O	QNNUONMKTS	MKT	QPMNURSKUS	VRKTP	RVKR	NOMQ	
v	UV	e É	UONNVSKNP	MKT	UQNPQOKNU	VTHRV	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SURUSQPKPU	NKM	SRVNQQQKUP	NVQKVR	RVKR	NOMQ	
qÄ	NRV	e É	OSUNMOPKOT	NHP	OUSSNVMKN	VPHRQ	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRVRNSSKPN	NHS	PNTPQTOKSU	NNMKOR	RVKR	NOMQ	
_á	OMV	e É	NRTRURUKTT	MHP	NSMVTVTHOQ	VTKUV	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSNUMVR

cãÉ=k~ã É MOPpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMOP=NVMRVMRO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãäíáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c à-Ö
V	_É	S	k ç=d ~ë	QKOVR	éé Ä	THO	RNTVKVM	NMM	
NN	_	S	k ç=d ~ë	NQKRTM	éé Ä	PKV	NNUSTKOT	NMMM	
OP	k ~	QR	e É	VRUKMQS	éé Ä	MKU	NTNSTVKMR	OMMMMM	
OQ	j Ö	QR	e É	RTVUKONT	éé Ä	MKR	QMQCCURTM	OMMMMM	
OT	^ ä	QR	e É	NSCCRUKOTM	éé Ä	NKP	QNVRSVSKMN	OMMMMM	
OU	pá	QR	e O	NTSMSVQ	éé Ä	UKU	NQCTOVKNQ	NMMMM	
PV	h	QR	e É	PVMMSRR	éé Ä	MKV	OSNVUQKPT	OMMMMM	
QM	` ~	QR	e O	UUPKQSP	éé Ä	NKN	RQVQSURTS	OMMMMM	
RN	s	UV	e É	NRUKOVR	éé Ä	MKO	NQMRCSKCP	NMMM	
RO	` ê	UV	e É	NCMMVQT	éé Ä	NKQ	NPCCUUKQO	OMMM	
RR	j å	UV	e É	SQRTPS	éé Ä	NKM	PSMUNKCO	OMMM	
RS	cÉ	UV	e O	OONUNKMVU	éé Ä	MRT	RNQQTRSPKST	NMMMMM	
RV	` ç	UV	e É	NCKVTN	éé Ä	PKM	CQVQVMST	NMMM	
SM	k á	UV	e É	RPKTTR	éé Ä	NKS	CUTVPKOS	NMMM	
SP	` ì	UV	e É	SNKQSM	éé Ä	NKN	VNQMRKQU	OMMM	
SS	wå	UV	e É	SSKTTN	éé Ä	OKR	NSUTMKCP	OMMM	
TR	^ ë	UV	e É	NNKSSQ	éé Ä	NKO	ONRQKQM	NMMM	
TU	pÉ	UV	e O	RKRNV	éé Ä	OKP	QUUKMS	NMMM	
UU	pê	UV	e É	PRKMSO	éé Ä	MKP	OPMSMKVS	OMMM	
VR	j ç	UV	e É	NKUPS	éé Ä	SKP	NQCUKVV	NMMM	
NMT	^ Ö	UV	e É	MKSPQ	éé Ä	PKN	NQVOKPP	NMM	
NNN	` Ç	UV	e É	MKQNV	éé Ä	RKS	NPUKUV	NMMM	
NNU	på	NRV	e É	QQKQNQ	éé Ä	NKM	OSCPRKUO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKTRR	éé Ä	SKS	QCUNKUT	NMMM	
NPT	_~	NRV	k ç=d ~ë	QUQKURM	éé Ä	MKS	SPTNNPKNV	OMMM	
NUO	t	NRV	k ç=d ~ë	JMMVQQ	éé Ä	k lA	OPVSKMT	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKQVT	éé Ä	NRT	VUNMKUM	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NSTKUMS	éé Ä	OKS	NPUVTPTKVV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NTKSCP	éé Ä	NKV	NPMVPNKSQ	NMMM	
OPU	r	OMV	k ç=d ~ë	UKQST	éé Ä	PKQ	RTQVTKTP	NMMM	

n ` =fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c à-Ö
i á	S	k ç=d ~ë	OMNTSRNKSR	QKM	NUVQNRTKMT	NVSKRO	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QQQNOQTKSR	MRT	QRTPSTVKOQ	VTKN	RVKR	NOMQ	
pÅ	QR	e O	UTTMUPKCR	MKU	VURSCPKUN	UUKVV	RVKR	NOMQ	
pÅ	QR	e É	NQTVMSKMS	MRT	NSMVPNKCP	VNKVN	RVKR	NOMQ	
d É	TO	k ç=d ~ë	NMCPNNTKPR	NKR	NMTQCQSKRP	VRKCQ	RVKR	NOMQ	
d É	TO	e O	PCSRSRKQM	MKR	PVPUSVKSQ	UCKVN	RVKR	NOMQ	
d É	TO	e É	NNMPNNKQM	MKU	NCRCSSKVR	UUKMS	RVKR	NOMQ	
v	UV	e O	QMRMTMCKVP	MKU	CPMNURSKUS	VQKNS	RVKR	NOMQ	
v	UV	e É	UMPNMTKQT	NKN	UQNPCCKNU	VRKQS	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVPTMRMKQQ	NKS	SRVNQQQKUP	NMRKCQ	RVKR	NOMQ	
qÄ	NRV	e É	OSSOTQQKPO	NKR	OUSSNVMKN	VCKV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PSNMUPPKNT	NKP	PNTPQTCKSU	NNPKTU	RVKR	NOMQ	
_á	OMV	e É	NRSNVSCKNP	MKP	NSMVTVTKQQ	VTKMP	RVKR	NOMQ	

p~ã éãÉ=k~ã É pn MVSNUMMV

cãÉ=k~ã É MQQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=OMMQMVU

p~ã éãÉ=qóéÉ p~ã éãÉ

qçí~äa ãã íáçå RMMMM

p~ã éãÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄãÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==ì mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	PHSQM	éé Ä	QKT	QQQNKUS	NMM	
NN	_	S	k ç=d ~ë	NOKVNN	éé Ä	NKQ	NMSNMKTP	NMMM	
OP	k ~	QR	e É	RNVMKNRP	éé Ä	PKM	NNNTTQKMO	OMMMMM	
OQ	j Ö	QR	e É	RRUQKUUV	éé Ä	NHR	PUORRTKTQ	OMMMMM	
OT	^ ä	QR	e É	NRPPVOHRNT	éé Ä	NKM	PUVOVNSKQP	OMMMMM	
OU	pá	QR	e O	NSPQKONT	éé Ä	UKT	NPMPQNMPS	NMMMM	
PV	h	QR	e É	PSVQHRSQ	éé Ä	MKT	OQRQQVMVR	OMMMMM	
QM	` ~	QR	e O	RNPUKTVM	éé Ä	MKT	PMTQVMVKQT	OMMMMM	
RN	s	UV	e É	NRRKUPT	éé Ä	MKP	NPTRSRKQV	NMMM	
RO	` ê	UV	e É	NVOKUUU	éé Ä	MKQ	NNQRPVKVT	OMMM	
RR	j å	UV	e É	TMKOMU	éé Ä	OKO	PUUTOKTO	OMMM	
RS	cÉ	UV	e O	OQMSMKTTU	éé Ä	NKT	RRMSVQLNKOV	NMMMMM	
RV	` ç	UV	e É	NNHRVU	éé Ä	NKQ	OONVUKON	NMMM	
SM	k á	UV	e É	QSKMTN	éé Ä	OKN	OQRQOKVM	NMMM	
SP	` ì	UV	e É	SVKNOV	éé Ä	NKP	NVONNNKVO	OMMM	
SS	wå	UV	e É	NPMKNUQ	éé Ä	MKT	PORMRKVR	OMMM	
TR	^ ë	UV	e É	NMKMNS	éé Ä	OHR	NUQNHPO	NMMM	
TU	pÉ	UV	e O	QKUVU	éé Ä	QKN	QOUKQV	NMMM	
UU	pê	UV	e É	QVKQQS	éé Ä	MKQ	POPMMPU	OMMM	
VR	j ç	UV	e É	OKMMS	éé Ä	SHS	NROTKUV	NMMM	
NMT	^ Ö	UV	e É	MKQUR	éé Ä	RHR	NNQPKQM	NMM	
NNN	` Ç	UV	e É	MKSPM	éé Ä	NHR	OVOKOO	NMMM	
NNU	på	NRV	e É	QQKRPM	éé Ä	MKO	OSRNMKUS	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKUNQ	éé Ä	NKV	QORUKTU	NMMM	
NPT	_~	NRV	k ç=d ~ë	QSUKQVN	éé Ä	NKT	SMPMTTKPV	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKNPM	éé Ä	k lA	ONPOKQQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKQMR	éé Ä	NKM	VNTVHSS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NTOKMOV	éé Ä	NKQ	NQNPOQTKMU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NVKUVV	éé Ä	MHS	NQSOUSHSO	NMMM	
OPU	r	OMV	k ç=d ~ë	SKUNP	éé Ä	OKT	QRVPUHSP	NMMM	

n ` =fpqa=q~ÄãÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMNCQV/OKUM	OKP	NUVQNRTKMT	NVSKOR	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	QQMMPVVKQU	NHR	QRTPSTVKOQ	VSHON	RVHR	NOMQ	
pÅ	QR	e O	USNVPOKOR	OKN	VURSCPKUN	UTKQR	RVHR	NOMQ	
pÅ	QR	e É	NQRPOVKUP	NKP	NSMVPNKCP	VMPN	RVHR	NOMQ	
d É	TO	k ç=d ~ë	NMMNCRRKPR	NKT	NMTQCQSKRP	VPKOO	RVHR	NOMQ	
d É	TO	e O	PONRUPHSR	NKO	PVPUSVHSQ	UNHSR	RVHR	NOMQ	
d É	TO	e É	NNMCRSKRQ	MKV	NORCSSKVR	UUKNU	RVHR	NOMQ	
v	UV	e O	PVVTTROKUS	NKP	CPMNURSKUS	VOKVP	RVHR	NOMQ	
v	UV	e É	TVUNOSKUT	MKV	UQNPQOKNU	VQKUS	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	STVSURSKVV	NKU	SRVNQQQKUP	NMPKNO	RVHR	NOMQ	
qÄ	NRV	e É	OSUPRUPKVP	NKN	OUSSNVMKN	VPHSP	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRUNPTUKQQ	NHO	PNTPQTOKSU	NNOKUR	RVHR	NOMQ	
_á	OMV	e É	NRSQNVMKTR	MKT	NSMVTVTHOQ	VTHNT	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MVSNUMNN

cãÉ=k~ã É MORpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMOP=OMMMMOR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãäíáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	OKMNT	éé Ä	PHP	QTTUKSR	NMM	
NN	_	S	k ç=d ~ë	NOKVSM	éé Ä	NMKN	NMOSVKQN	NMMM	
OP	k ~	OR	e É	QTQKUSN	éé Ä	OKR	NMROVVKUR	OMMMMM	
OQ	j Ö	OR	e É	RNTMKPSM	éé Ä	NKQ	PRNTPVKRQ	OMMMMM	
OT	^ ä	OR	e É	NORUUQKPVS	éé Ä	OKT	PSTRRTTKRU	OMMMMM	
OU	pá	OR	e O	NSSSKPSN	éé Ä	NOKS	NPOTVMKOV	NMMMM	
PV	h	OR	e É	PUMTKMMS	éé Ä	NKN	ORMONQKSR	OMMMMM	
QM	` ~	OR	e O	QQQOKOUQ	éé Ä	NKO	OSQTNQTKTV	OMMMMM	
RN	s	UV	e É	NOUKSPO	éé Ä	NKN	NPMOPQKUN	NMMM	
RO	` ê	UV	e É	VUKMUU	éé Ä	NKP	NMUQQTHPS	OMMM	
RR	j å	UV	e É	TNKOTQ	éé Ä	MKP	PVNTMKUT	OMMM	
RS	cÉ	UV	e O	ONVORKUOS	éé Ä	OKM	RMMMRQQVKVQ	NMMMMM	
RV	` ç	UV	e É	NMKVRU	éé Ä	NKV	OMUPSKNR	NMMM	
SM	k á	UV	e É	QQKOUU	éé Ä	MKR	OPQCOKMS	NMMM	
SP	` ì	UV	e É	TNKQQQ	éé Ä	MKQ	NMQTOUKSN	OMMM	
SS	wå	UV	e É	NMUKPVM	éé Ä	OKM	OSUVTHPR	OMMM	
TR	^ ë	UV	e É	VRTMO	éé Ä	NKM	NTTMKVS	NMMM	
TU	pÉ	UV	e O	QKQQV	éé Ä	PKV	PUUKSS	NMMM	
UU	pê	UV	e É	QSKRPM	éé Ä	NKQ	PMNTOKPO	OMMM	
VR	j ç	UV	e É	NKVQT	éé Ä	NNKT	NQTVHMM	NMMM	
NMT	^ Ö	UV	e É	MKRQO	éé Ä	NKN	NOSQKRP	NMM	
NNN	` Ç	UV	e É	MKRTN	éé Ä	VKT	NUOKVT	NMMM	
NNU	på	NRV	e É	QPKNUR	éé Ä	NKS	ORSRVKNN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKVMT	éé Ä	QKP	QUPRKVV	NMMM	
NPT	_~	NRV	k ç=d ~ë	QUMKTQS	éé Ä	NKT	SNQRUMOOS	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKNQV	éé Ä	k lÅ	OMSVHMN	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKQON	éé Ä	PHR	VNQVHRV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NSVKSPP	éé Ä	MKS	NPTQUSQKTV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NVKTSM	éé Ä	OKU	NQPPNMKMO	NMMM	
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i á	S	k ç=d ~ë	NVUMVQOKVQ	NKV	NUVQNRTHMT	NVQKRP	RVHR	NOMQ	
pÅ	OR	k ç=d ~ë	OPQOVOUKUN	PHN	QRTPSTVKOQ	VQKVR	RVHR	NOMQ	
pÅ	OR	e O	USNSOPKMM	NHO	VURSOPKUN	UTHQO	RVHR	NOMQ	
pÅ	OR	e É	NQQPONKQS	NHS	NSMVPNKOP	UVHSU	RVHR	NOMQ	
d É	TO	k ç=d ~ë	NMMQURRHSV	OKM	NMTQOQSKRP	VPHRQ	RVHR	NOMQ	
d É	TO	e O	POOVOSKRT	MKU	PVPUSVHSQ	UNKVV	RVHR	NOMQ	
d É	TO	e É	NMUTTPKNP	NHR	NORCSSKVR	USKUP	RVHR	NOMQ	
v	UV	e O	PVUQNQNKOR	OHP	QPMNURSKUS	VOHSN	RVHR	NOMQ	
v	UV	e É	TVONSRKVR	MHR	UQNPQOKNU	VQHNS	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	STRMQSRKOP	OKQ	SRVNQQQKUP	NVOKQN	RVHR	NOMQ	
qÄ	NRV	e É	OSTTSQSKMR	NHP	OUSSNVMKN	VPKQO	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRPPMQOKMT	NHO	PNTPQTOKSU	NNNKPP	RVHR	NOMQ	
_á	OMV	e É	NRTPOPVKQU	MKV	NSMVTVTHOQ	VTKTQ	RVHR	NOMQ	

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^Åè=qãã É	PLOULOMOP=OMMNQMRO
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_	NN	S	k ç=d ~ë	MKPVS	ééÄ	POKT	NPRNKOM	O	
k~	OP	QR	e É	JNVKURT	ééÄ	k L^	QNPROKOM	NMM	
j Ö	OQ	QR	e É	NUKMUN	ééÄ	RKM	NTUSKUQ	NM	
^ä	OT	QR	e É	PRTKRUU	ééÄ	QKS	VNQSKQQ	NM	OMMKU=m_=c~ãë=aça & OMMKU=m_=c~ãë=åçåJaça
pá	OU	QR	e O	PPKPRV	ééÄ	VTKP	PMSRKQV	RM	
h	PV	QR	e É	OQKSTS	ééÄ	NMKR	PNUQTKMP	NMM	
` ~	QM	QR	e O	PVKVSP	ééÄ	NKU	PTNNVKUN	NM	
s	RN	UV	e É	MKPSQ	ééÄ	OQKP	RSMKMO	MKR	
` ê	RO	UV	e É	MKNPO	ééÄ	TKQ	NNPTKUP	MKR	
j å	RR	UV	e É	MKOQQ	ééÄ	QKM	OSPKVR	MKO	
cÉ	RS	UV	e O	TMKPRO	ééÄ	MKV	NSPROSKRM	NM	OMMKU=m_=c~ãë=aça
` ç	RV	UV	e É	JMKMUM	ééÄ	k L^	NNRKRS	MKN	
k á	SM	UV	e É	MKMRU	ééÄ	NTKS	NUSKST	MKO	
` ì	SP	UV	e É	MKOQM	ééÄ	NTKR	UQQKQV	MKP	
wå	SS	UV	e É	QKOMR	ééÄ	OKP	NNTRKSP	N	
^ë	TR	UV	e É	MKMNS	ééÄ	OPQKM	ONKST	MKR	
pÉ	TU	UV	e O	JMKMPQ	ééÄ	k L^	SKNT	MKR	
pê	UU	UV	e É	MKMUS	ééÄ	NTKR	NMMKMM	MKR	
j ç	VR	UV	e É	JMKMUP	ééÄ	k L^	NUQKQR	MKR	
^Ö	NMT	UV	e É	JMKMMQ	ééÄ	k L^	OTKTU	MKN	
` Ç	NNN	UV	e É	JMKMOT	ééÄ	k L^	NKUR	MKN	
på	NNU	NRV	e É	JMKNOV	ééÄ	k L^	OOQKQR	MKR	
pÄ	NON	NRV	k ç=d ~ë	MKMNP	ééÄ	NOQKR	VMTKSS	MKN	
_~	NPT	NRV	k ç=d ~ë	NKRNU	ééÄ	QKQ	ONNRKTQ	MKO	OMMKU=m_=c~ãë=aça
t	NUO	NRV	k ç=d ~ë	JMKQUS	ééÄ	k L^	NOOUKMO	MKR	
qä	OMR	OMV	k ç=d ~ë	JMKMQR	ééÄ	k L^	QRTKNS	MKN	
mÄ	OMU	OMV	k ç=d ~ë	MKPQP	ééÄ	QKN	RNNRKUO	MKN	
qÜ	OPO	OMV	k ç=d ~ë	MKMOS	ééÄ	NMUKN	OUUSKTN	MKR	
r	OPU	OMV	k ç=d ~ë	MKMMM	ééÄ	k L^	ONPKRS	MKN	

n` =fpqa=q~ÄäÉ

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iá	S	kç=dl~ë	ONMSCQMPV	NKQ	NUVQNRTKMT	NNNKO	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	QQONVTNKVT	NKV	QRTPSTVKQQ	VOKPN	RVKR	NOMQ	
pÅ	QR	eO	URRMMVKUM	NKQ	VURSCPKUN	USKTR	RVKR	NOMQ	
pÅ	QR	eÉ	NQPPTNKPM	NKN	NSIMVPNKCP	UVKMV	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	NMCRUCQKRP	MKT	NMTQCQSKRP	VRKQV	RVKR	NOMQ	
dÉ	TO	eO	PPNVSRKUQ	NKU	PVPUSVKSQ	UQKCU	RVKR	NOMQ	
dÉ	TO	eÉ	NNNSTVKVT	NKO	NCRCSSKVR	UVKNR	RVKR	NOMQ	
v	UV	eO	PTSTRNSKSO	MKO	CPMVNURSKUS	UTKRU	RVKR	NOMQ	
v	UV	eÉ	TRSCNSKRN	MKV	UQNPQCKNU	UVKUU	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	STSRUMSKMP	MKT	SRVNQQQKUP	NMCKSR	RVKR	NOMQ	
qÄ	NRV	eÉ	OSURNUQKST	MKT	OUSSNVMKN	VPKSU	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PQPNRCCKQO	NKM	PNTPQTCKSU	NMUKNP	RVKR	NOMQ	
_á	OMV	eÉ	NRSRRQPKSS	MKQ	NSIMVTVTKQQ	VTKCR	RVKR	NOMQ	

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_É	V	S	kç¤dl~ë	RMKMVMS	éëÄ	MRT	SMVRNKRQ	RM	OMKPS	TVKR	NOMQ	
_	NN	S	kç¤dl~ë	RMOKROR	éëÄ	MKO	PVMPNSKUQ	RMM	OMKN	TVKR	NOMQ	
k~	OP	QR	eÉ	URRVKRQM	éëÄ	MKU	NNOVQPTKTV	TRMM	OOKUP	TVKR	NOMQ	
j Ö	OQ	QR	eÉ	RRTVKONS	éëÄ	MKN	PTQMQQKRR	RMMM	OOKPO	TVKR	NOMQ	
^ä	OT	QR	eÉ	OPTOKRSV	éëÄ	NKS	RVNNPKOV	OMMM	OPKTP	TVKR	NOMQ	aça
pá	OU	QR	eO	NMVPKMTS	éëÄ	OKP	UTRRPKMT	NMMM	ONKUS	M	OMM	
h	PV	QR	eÉ	NMSVOKROO	éëÄ	MKS	SPTVVMKUU	NMMMM	ONKPV	TVKR	NOMQ	
` ~	QM	QR	eO	OTPUKSVT	éëÄ	NKP	NSRMSSVKNT	ORMM	ONKVN	TVKR	NOMQ	
s	RN	UV	eÉ	ROQKONU	éëÄ	NKS	QPUNSVKQQ	RMM	OMKVT	TVKR	NOMQ	
`ê	RO	UV	eÉ	ONOKUMT	éëÄ	NKU	OOPRSOKRP	OMM	ONKOU	TVKR	NOMQ	
j å	RR	UV	eÉ	RPUKMRS	éëÄ	MKS	OUNSNTKNQ	RMM	ONKRO	TVKR	NOMQ	
cÉ	RS	UV	eO	NMSTKUVM	éëÄ	NKV	OPNVUOUKSM	NMMM	ONKPS	TVKR	NOMQ	
` ç	RV	UV	eÉ	RTNKUPP	éëÄ	MKP	NMORQQTKPT	RMM	OOKUT	TVKR	NOMQ	
ká	SM	UV	eÉ	RQPKUNQ	éëÄ	NKN	OTOVTRKNO	RMM	ONKTR	TVKR	NOMQ	
` ì	SP	UV	eÉ	OTPKPSR	éëÄ	NKQ	PUNPTRKTQ	ORM	ONKUT	TVKR	NOMQ	
wå	SS	UV	eÉ	RPMKVQQ	éëÄ	NKN	NORNPQKSM	RMM	ONKOQ	TVKR	NOMQ	
^ë	TR	UV	eÉ	NMOKVMQ	éëÄ	MKS	NTTSRKQU	NMM	OMKRU	TVKR	NOMQ	
pÉ	TU	UV	eO	NMNKORU	éëÄ	NKN	UNVPKRO	NMM	OMKOR	TVKR	NOMQ	
pê	UU	UV	eÉ	ROTKUPV	éëÄ	MKU	POSRMOKSO	RMM	ONKNN	TVKR	NOMQ	
j ç	VR	UV	eÉ	NMOKRMR	éëÄ	NKP	SOOTVKQM	NMM	OMKR	TVKR	NOMQ	
^Ö	NMT	UV	eÉ	RQKRVS	éëÄ	MKR	NNTVNVKOQ	RM	ONKUQ	TVKR	NOMQ	
` Ç	NNN	UV	eÉ	OTQKTVV	éëÄ	MKP	TVQRSKSO	ORM	ONKVU	TVKR	NOMQ	
på	NNU	NRV	eÉ	QUMKVPR	éëÄ	MKT	QUVQUOKQT	RMM	NMKS	TVKR	NOMQ	
pÄ	NON	NRV	kç¤dl~ë	NMMKSMN	éëÄ	NKT	QQUNVTKNN	NMM	OMKNO	TVKR	NOMQ	
_~	NPT	NRV	kç¤dl~ë	ONSVKPUN	éëÄ	MKR	OUMRQPVKUO	OMMM	ONKSV	TVKR	NOMQ	
t	NUO	NRV	kç¤dl~ë	NMOKQUV	éëÄ	NKP	OSNTOTKOS	NMM	OMKR	TVKR	NOMQ	
qä	OMR	OMV	kç¤dl~ë	NMPKOTO	éëÄ	MKQ	SMOMQNKMS	NMM	OMKSR	TVKR	NOMQ	
mÄ	OMU	OMV	kç¤dl~ë	NMUKSUV	éëÄ	NKM	USTQVOKUQ	NMM	ONKTQ	TVKR	NOMQ	
qÜ	OPO	OMV	kç¤dl~ë	VTKTMQ	éëÄ	MKV	SUSPUMKRV	NMM	NVKRQ	TVKR	NOMQ	
r	OPU	OMV	kç¤dl~ë	NNMKQRT	éëÄ	MKP	TNVRUMKVR	NMM	OOKMV	TVKR	NOMQ	

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i á	S	k ç=d ~ë	OMVPMPMKPS	MKT	NUVQNRTKMIT	NNMKR	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QOQOMTPKTQ	MKT	QRTPSTVKOQ	VOKTR	RVKR	NOMKQ	
pÅ	QR	e O	USQTNPKOT	MKU	VURSOPKUN	UTKTP	RVKR	NOMKQ	
pÅ	QR	e É	NQOOOQKNR	MKS	NSMVPNKOP	UUKPU	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	NMONVMPKVT	MKS	NMTQOQSKRP	VRKNP	RVKR	NOMKQ	
d É	TO	e O	PPTVQUKRR	NKN	PVPUSVKSQ	URKU	RVKR	NOMKQ	
d É	TO	e É	NNOUPQKNO	MKU	NOROSSKVR	VMKMT	RVKR	NOMKQ	
v	UV	e O	PTTSOUQKQN	OKP	QPMNURSKUS	UTKTU	RVKR	NOMKQ	
v	UV	e É	TRSUQMKQT	NKM	UQNPQOKNU	UVKVS	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SUOUNRUKTO	MKR	SRVNQQQKUP	NMPKRV	RVKR	NOMKQ	
qÄ	NRV	e É	OSVNMRQKPV	MKT	OUSSNVMKN	VPKUV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PQTRSPRKOO	MKO	PNTPQTOKSU	NMVKRO	RVKR	NOMKQ	
_á	OMV	e É	NRQRSMNKRS	NKO	NSMVTVTKOQ	VSKMN	RVKR	NOMKQ	

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_É	V	S	k ç¤d ~ë	RMKNTQ	ééÄ	NKP	SMPSSKVQ	RM	OMKMT	TVKR	NOMQ	
_	NN	S	k ç¤d ~ë	QVNKMRS	ééÄ	NKV	PUPCPPKOM	RMM	NVKSQ	TVKR	NOMQ	
k~	CP	QR	e É	UQVNKPCQ	ééÄ	NKP	NNPVPPSKST	TRMM	COKSQ	TVKR	NOMQ	
j Ö	CQ	QR	e É	RQRRKPCN	ééÄ	MKR	PTNUOTKSR	RMMM	ONKUO	TVKR	NOMQ	
^ä	OT	QR	e É	COPRKVRU	ééÄ	NKO	RSSRRKTR	OMMM	COKPS	TVKR	NOMQ	
pá	CU	QR	e O	NMVVKUUR	ééÄ	MKP	USSSCKQQ	NMMM	CO	M	OMM	
h	PV	QR	e É	NMQNNKRMU	ééÄ	MKO	SPCPTVKVM	NMMMM	OMKUO	TVKR	NOMQ	
` ~	QM	QR	e O	OTRVKTMP	ééÄ	MKV	NSPSNUSKMR	ORMM	COKMU	TVKR	NOMQ	
s	RN	UV	e É	RCRKRPN	ééÄ	NKV	QPUMTPKPU	RMM	ONKMO	TVKR	NOMQ	
`ê	RO	UV	e É	ONNKCOT	ééÄ	NKT	CONPNMKNP	OMM	ONKNO	TVKR	NOMQ	
j å	RR	UV	e É	RPPKUQN	ééÄ	NKQ	OTUSPPKNQ	RMM	ONKPR	TVKR	NOMQ	
cÉ	RS	UV	e O	NMQNKQQQ	ééÄ	NKR	COSMNRNKNS	NMMM	OMKUP	TVKR	NOMQ	
` ç	RV	UV	e É	RSSKMCR	ééÄ	OKT	NMNONRMKMT	RMM	COKSQ	TVKR	NOMQ	
ká	SM	UV	e É	RQNKSQU	ééÄ	NKN	OTNNQCKUR	RMM	ONKST	TVKR	NOMQ	
` ì	SP	UV	e É	OTOKPNN	ééÄ	NKN	PTUURSKSM	ORM	ONKTU	TVKR	NOMQ	
wå	SS	UV	e É	RCUKRRP	ééÄ	OKP	NCQCCQKON	RMM	ONKNQ	TVKR	NOMQ	
^ë	TR	UV	e É	NMCKMVS	ééÄ	MKT	NTRVPKSM	NMM	OMKQQ	TVKR	NOMQ	
pÉ	TU	UV	e O	NMMQVQ	ééÄ	OKM	UNCMSR	NMM	OMKN	TVKR	NOMQ	
pê	UU	UV	e É	RCCKUSU	ééÄ	MKO	PCORPVKUS	RMM	OMKVN	TVKR	NOMQ	
j ç	VR	UV	e É	NMCKPSQ	ééÄ	MKU	SOMNVKQN	NMM	OMKOT	TVKR	NOMQ	
^Ö	NMT	UV	e É	RQKPSN	ééÄ	MKT	NNTMURKPT	RM	ONKTQ	TVKR	NOMQ	
` Ç	NNN	UV	e É	OTNKCOV	ééÄ	NKO	TUCMNKVN	ORM	ONKT	TVKR	NOMQ	
på	NNU	NRV	e É	QURKOTQ	ééÄ	MKM	CUUCSCKQO	RMM	NVKQN	TVKR	NOMQ	
pÄ	NCN	NRV	k ç¤d ~ë	VVKMUT	ééÄ	NKN	QRRNQSKTP	NMM	NVKUO	TVKR	NOMQ	
_~	NPT	NRV	k ç¤d ~ë	ONPCKSTR	ééÄ	MKR	CUQPOVQKNP	OMMM	ONKPP	TVKR	NOMQ	
t	NUO	NRV	k ç¤d ~ë	NMCKMNT	ééÄ	MKV	OSURVMKTM	NMM	OMKQ	TVKR	NOMQ	
qä	OMR	OMV	k ç¤d ~ë	NMPKUCQ	ééÄ	NKM	SNNNNVKUO	NMM	OMKTS	TVKR	NOMQ	
mÄ	OMU	OMV	k ç¤d ~ë	NMTKTSO	ééÄ	NKR	USUQNRKVU	NMM	ONKRR	TVKR	NOMQ	
qÜ	OPO	OMV	k ç¤d ~ë	VUKUQQ	ééÄ	NKR	TMNMQUKMS	NMM	NVKTT	TVKR	NOMQ	
r	OPU	OMV	k ç¤d ~ë	NMVKMVS	ééÄ	MKU	TNTSPMKQQ	NMM	ONKUO	TVKR	NOMQ	

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i á	S	k ç=d ~ë	ONMPQNUKTU	NKV	NUVQNRTKMIT	NNNKVR	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QOSOPMNKVU	NKM	QRTPSTVKOQ	VPKNV	RVKR	NOMKQ	
pÅ	QR	e O	URMTSMKRM	NKM	VURSOPKUN	USKPO	RVKR	NOMKQ	
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d É	TO	e O	PPSRUMKSR	MKU	PVPUSVKSQ	URKQR	RVKR	NOMKQ	
d É	TO	e É	NNONQVKNT	MKO	NOROSSKVR	UVKRP	RVKR	NOMKQ	
v	UV	e O	PTTNNQMKVQ	MKV	QPMNURSKUS	UTKSS	RVKR	NOMKQ	
v	UV	e É	TRQTPMKSM	MKR	UQNPQOKNU	UVKTN	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	TMPVQONKVR	MKR	SRVNQQQKUP	NMSKU	RVKR	NOMKQ	
qÄ	NRV	e É	OTMRQOOKSM	MKQ	OUSSNVMKN	VQKPV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRMVRNSKNN	NKN	PNTPQTOKSU	NNMKRV	RVKR	NOMKQ	
_á	OMV	e É	NRTTMQMKRP	MKV	NSMVTVTKOQ	VTKVT	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NORVJMMO

cãÉ=k~ã É MQMpj mi HÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMOP=OMMRSMQV

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå NMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä-Ö
V	_É	S	k ç=d ~ë	JMKMNP	éé Ä	k lA	NUPKPQ	NMM	
NN	_	S	k ç=d ~ë	NOMKNRS	éé Ä	MKP	QSQPTPKOV	NMMM	
OP	k ~	QR	e É	NMNPUPKQSP	éé Ä	MKP	SMSMOSMNKOO	OMMMMM	
OQ	j Ö	QR	e É	PPRRKSVN	éé Ä	NKP	NMRUPPQKSN	OMMMMM	
OT	^ ä	QR	e É	PPKPQU	éé Ä	NKQ	QMUPKVV	OMMMMM	
OU	pá	QR	e O	SQUPKMUM	éé Ä	NKV	OQNMVRPKVR	NMMMM	
PV	h	QR	e É	VPPVKOMN	éé Ä	MKT	ORCUOTUKVP	OMMMMM	
QM	` ~	QR	e O	NTVUVKUTN	éé Ä	MKP	RMNVONOTKRU	OMMMMM	
RN	s	UV	e É	MKPRO	éé Ä	UKP	NSQSKTV	NMMM	
RO	` ê	UV	e É	MKPOO	éé Ä	NKU	ORRVKTQ	OMMM	
RR	j å	UV	e É	SMKOVM	éé Ä	NKN	NRMRPMKTO	OMMM	
RS	cÉ	UV	e O	NSUKMQT	éé Ä	NKO	NTPPOOTKUO	NMMMMM	
RV	` ç	UV	e É	MKPQQ	éé Ä	NKU	PNUTKNQ	NMMM	
SM	k á	UV	e É	NKTVQ	éé Ä	PKQ	QQQMKTV	NMMM	
SP	` ì	UV	e É	VKNTN	éé Ä	NKM	SNQNTKOO	OMMM	
SS	wå	UV	e É	OMKUVP	éé Ä	MKV	OPSOSKVP	OMMM	
TR	^ ë	UV	e É	MKOPM	éé Ä	MKT	OMTKMO	NMMM	
TU	pÉ	UV	e O	MKNQQ	éé Ä	NOKQ	SPKST	NMMM	
UU	pê	UV	e É	NMVKSVU	éé Ä	MKT	POPSNRKUO	OMMM	
VR	j ç	UV	e É	NKSTN	éé Ä	MKU	RMOSKRU	NMMM	
NMT	^ Ö	UV	e É	MKMNS	éé Ä	NTKR	NVRKRS	NMM	
NNN	` Ç	UV	e É	MKVRO	éé Ä	NOKU	UNKNN	NMMM	
NNU	på	NRV	e É	MKTNP	éé Ä	QKU	OPNVKNP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOTM	éé Ä	NKP	SVSVKNP	NMMM	
NPT	_~	NRV	k ç=d ~ë	OOKPRM	éé Ä	MKT	NQSVRQKQS	OMMM	
NUO	t	NRV	k ç=d ~ë	MKMVS	éé Ä	NUKO	PTPTKUQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMRM	éé Ä	SKR	OOMRKUT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKQMV	éé Ä	QKR	NVMQMKUN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKONN	éé Ä	MKN	NMPMRKNN	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNPU	éé Ä	QKO	QUMOKSV	NMMM	

n ` =fpqa=q~ÄäÉ

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i á	S	k ç=d ~ë	OMUPUOUKUV	MKQ	NUVQNRTKMT	NNMKUN	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QMPRMQOKVU	MKT	QRTPSTVKOQ	UUKOO	RVKR	NOMKQ	
pÅ	QR	e O	UMTMV/TKTP	MKV	VURSOPKUN	UNKUV	RVKR	NOMKQ	
pÅ	QR	e É	NPPVQOKVR	MKP	NSMVPNKOP	UPKOP	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VVPNRVKSQ	MKU	NMTQOQSKRP	VOKQR	RVKR	NOMKQ	
d É	TO	e O	POVROQKMM	MKQ	PVPUSVKSQ	UPKSS	RVKR	NOMKQ	
d É	TO	e É	NMTMRMKVS	NKT	NORCSSKVR	URKQS	RVKR	NOMKQ	
v	UV	e O	PRTVVMRKNV	MKS	OPMNURSKUS	UPKOO	RVKR	NOMKQ	
v	UV	e É	TONUPSKUO	NKO	UQNPQOKNU	URKU	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SVPSNMVKQS	NKN	SRVNQQQKUP	NVRKOP	RVKR	NOMKQ	
qÄ	NRV	e É	ORVPMPNKNU	MKP	OUSSNVMKN	VMKQT	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRPRVRUKPO	NKV	PNTPQTOKSU	NNNKQO	RVKR	NOMKQ	
_á	OMV	e É	NQTQMOPKOR	NKS	NSMVTVTKOQ	VNKRT	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOUMMMN

cãÉ=k~ã É MRMbj mi hÇ

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^Åè=qãã É PLOULOMCP=OMQNMRS

p~ã éäÉ=qóéÉ p~ã éäÉ

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fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKMMO	éé Ä	k lA	OQSHST	NMM	
NN	_	S	k ç=d ~ë	SKSNN	éé Ä	OKM	OSMOOKRU	NMMM	
OP	k ~	QR	e É	OTRMOSKMTQ	éé Ä	OKN	NRVROOOPNHSN	OMMMMM	[i a o
OQ	j Ö	QR	e É	UMUMKQTP	éé Ä	MKS	OQTPRNMKSS	OMMMMM	
OT	^ ä	QR	e É	PTMKQMS	éé Ä	NHP	QOOPRKVO	OMMMMM	
OU	pá	QR	e O	QNORATOP	éé Ä	OKM	NQUOOONKNT	NMMMM	
PV	h	QR	e É	PRTUKMSU	éé Ä	MKS	VRTRMQKOS	OMMMMM	
QM	` ~	QR	e O	QSSPUKSPU	éé Ä	NRT	NORSQQQRRKVN	OMMMMM	
RN	s	UV	e É	MKUTM	éé Ä	NHS	PSOORTR	NMMM	
RO	` ê	UV	e É	MKSRU	éé Ä	NKR	QNPOKQU	OMMM	
RR	j å	UV	e É	QNKPRP	éé Ä	NKQ	NMMTTQKQU	OMMM	
RS	cÉ	UV	e O	VOSHRPN	éé Ä	NKV	VOOUTUSKOT	NMMMM	
RV	` ç	UV	e É	MKRMP	éé Ä	PHN	QOPQKNU	NMMM	
SM	k á	UV	e É	SKRQT	éé Ä	MKR	NRQOUHSV	NMMM	
SP	` ì	UV	e É	OKROS	éé Ä	OKN	NSUQMKOV	OMMM	
SS	wå	UV	e É	OVKQMM	éé Ä	MKR	POQSOKRO	OMMM	
TR	^ ë	UV	e É	NRTMP	éé Ä	NHS	NPUQKON	NMMM	
TU	pÉ	UV	e O	MKNRM	éé Ä	NMKN	SPKUP	NMMM	
UU	pê	UV	e É	QMSHSSR	éé Ä	MRT	NNTMNUNKON	OMMM	
VR	j ç	UV	e É	MKQSO	éé Ä	VHO	NRNVMKN	NMMM	
NMT	^ Ö	UV	e É	MKMNV	éé Ä	VHO	OQSHST	NMM	
NNN	` Ç	UV	e É	MKNNS	éé Ä	NMRT	NSRKNV	NMMM	
NNU	på	NRV	e É	MKNSV	éé Ä	PHN	TRSKTM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNNN	éé Ä	SKU	POOTKNO	NMMM	
NPT	_~	NRV	k ç=d ~ë	QNKNPO	éé Ä	MKV	ORTRUNKNO	OMMM	
NUO	t	NRV	k ç=d ~ë	MKNMS	éé Ä	QMKU	PSUTKTS	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMPQ	éé Ä	NSHM	NSTRHOO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKSRS	éé Ä	NHP	OUMOQKTQ	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMTM	éé Ä	SKO	RNMSKQT	NMMM	
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n` =fpqa=q~ÄäÉ

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i á	S	k ç=d ~ë	OMQQTQTKMT	NKQ	NUVQNRTKMT	NMTKVR	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PUTTQUOKRM	OKM	QRTPSTVKOQ	UQRTU	RVHR	NOMQ	
pÅ	QR	e O	TTVPUNKRQ	OKO	VURSCPKUN	TVKMT	RVHR	NOMQ	
pÅ	QR	e É	NPMMQNKPO	NKN	NSMVPNKCP	UMKUN	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VPTNSTKOU	MKU	NMTQQQSKRP	UTKOQ	RVHR	NOMQ	
d É	TO	e O	PNUTUNKVQ	MRT	PVPUSVHSQ	UMKVQ	RVHR	NOMQ	
d É	TO	e É	NMPRMOKOO	MKO	NORCSSKVR	UOHSP	RVHR	NOMQ	
v	UV	e O	PQTSNOSKQN	NKO	QPMNURSKUS	UMKUN	RVHR	NOMQ	
v	UV	e É	TMQOMPKNN	MKO	UQNPQOKNU	UPRT	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSMVUOQKRT	NKR	SRVNQQQKUP	NMVKOU	RVHR	NOMQ	
qÄ	NRV	e É	CRQOSOQKPP	MKQ	OUSSNVMKN	UUKTN	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PQNOPTOKUP	NKP	PNTPQTOKSU	NMTHRP	RVHR	NOMQ	
_á	OMV	e É	NQNVRTOKSN	NKQ	NSMVTVTKOQ	UUKNU	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NOUMMMO

cãÉ=k~ã É MRNpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMOP=OMQQTMP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå NMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä c~ãä

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKOR	éé Ä	k lÅ	NNOKOO	NMM	
NN	_	S	k ç=d ~ë	NTKTNM	éé Ä	MKU	SVRQOKRO	NMMM	
OP	k ~	QR	e É	QNMPQOKNQU	éé Ä	NKM	OQRMTRQRUKQV	OMMMMM	[i a o
OQ	j Ö	QR	e É	NVMRTKNRR	éé Ä	MKT	SMMRRUQKUQ	OMMMMM	
OT	^ ä	QR	e É	QSKSTR	éé Ä	NKQ	RSQMKNM	OMMMMM	
OU	pá	QR	e O	RNMRKSOO	éé Ä	NKV	NUSVMV/PKMS	NMMMM	
PV	h	QR	e É	PVRMRMS	éé Ä	MKT	NMURQV/QKQP	OMMMMM	
QM	` ~	QR	e O	SRSVRKRSO	éé Ä	MKU	NUMPQSPNTKPN	OMMMMM	
RN	s	UV	e É	MOTQ	éé Ä	NNKR	NPMMKMU	NMMM	
RO	` ê	UV	e É	MPON	éé Ä	MKR	OQUSKQO	OMMM	
RR	j å	UV	e É	NTKUSN	éé Ä	MKQ	QPQRMKRP	OMMM	
RS	cÉ	UV	e O	NMVKQOS	éé Ä	NKN	NNMVSNNKQP	NMMMMM	
RV	` ç	UV	e É	MKNQN	éé Ä	SKQ	NQMVKMN	NMMM	
SM	k á	UV	e É	THRMN	éé Ä	MKU	NTRVRKTS	NMMM	
SP	` ì	UV	e É	RKURQ	éé Ä	MKS	PUOVPKUV	OMMM	
SS	wå	UV	e É	TPKPUP	éé Ä	MKV	UMOQTKTN	OMMM	
TR	^ ë	UV	e É	NSKQPR	éé Ä	MKP	NPNRUKOQ	NMMM	
TU	pÉ	UV	e O	MKNSV	éé Ä	VKQ	TNKNT	NMMM	
UU	pê	UV	e É	QRVKSNP	éé Ä	MKS	NPNUMRSKMU	OMMM	
VR	j ç	UV	e É	NUKURM	éé Ä	NKP	RPNNOKQM	NMMM	
NMT	^ Ö	UV	e É	MKMPN	éé Ä	UKS	PQQKQS	NMM	
NNN	` Ç	UV	e É	MKMUS	éé Ä	NVKQ	NOPKTN	NMMM	
NNU	på	NRV	e É	MKOOV	éé Ä	NPKO	VMNKNS	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKTMO	éé Ä	PKP	NRVQOKUT	NMMM	
NPT	_~	NRV	k ç=d ~ë	QOKRMS	éé Ä	NKO	OSSMUUKUM	OMMM	
NUO	t	NRV	k ç=d ~ë	MKMMO	éé Ä	NSRKO	OQNOKTV	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMNQ	éé Ä	NSKQ	NMVTKUU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKNUM	éé Ä	SKM	VOOTKTN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMNN	éé Ä	SMKO	OVUPKRO	NMMM	
OPU	r	OMV	k ç=d ~ë	MKSOQ	éé Ä	NKU	NVSUOKSR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ¹ mp	B¤ ÉÅ	B n ` =¡ çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMVMPSSKPS	MKP	NUVQNRTKMT	NNMKPS	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PURQVRVKQO	MKQ	QRTPSTVKOQ	UQKOV	RVKR	NOMKQ	
pÅ	QR	e O	TVQOUUKVS	MKS	VURSCPKUN	UMKRV	RVKR	NOMKQ	
pÅ	QR	e É	NPPVMMKSQ	NKM	NSMVPNKCP	UPKO	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VPRNNMKPP	MKT	NMTQOQSKRP	UTKMR	RVKR	NOMKQ	
d É	TO	e O	PNRTVOKOM	MKR	PVPUSVKSQ	UMKNU	RVKR	NOMKQ	
d É	TO	e É	NMOMNTKPN	NKQ	NORCSSKVR	UNKQQ	RVKR	NOMKQ	
v	UV	e O	PQTVPTQKMV	MKU	QPMNURSKUS	UMKUU	RVKR	NOMKQ	
v	UV	e É	TMNUMMKTP	MKU	UQNPQOKNU	UPKQN	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SSMSVPQKCP	MKP	SRVNQQQKUP	NMMKCP	RVKR	NOMKQ	
qÄ	NRV	e É	OQTUVTQKCP	MKS	OUSSNVMKN	USKQV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PPPPNRVKTS	MKR	PNTPQTOKSU	NMRKMP	RVKR	NOMKQ	
_á	OMV	e É	NPVQOOSKUU	MKP	NSMVTVTKOQ	USKSN	RVKR	NOMKQ	

`çåíaåìåaÖ=~äåÄê~íáç=sÉêåÑÅ~íáç=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
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a~í~=m~íÜk~ã É	aWj^ÖãÉáíyf^mj eyNya^q^yQMOPyMPJ ^oyi n`OUbkÄ
^Åè=qáã É	PLOULOMOP=OMRROMN
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fpqa=oÉÑcãÉk~ã É	MVQ ^i _kÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~åä
fpqa=n`=m~ëëlc~åä	c~åä
l éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	kç=d ~ë	OPKOMU	ééÄ	MKP	NRNVNSKPR	OR	VOKUP	UVKU	NNMO	
NN	_	S	kç=d ~ë	OOKMTT	ééÄ	MKR	NMPPRMKUU	OR	VSKPN	UVKU	NNMO	
OP	k~	OR	eÉ	SPUQKTPM	ééÄ	OKR	QNMNPRRKQP	RMMM	NOTKSV	UVKU	NNMO	[=HLJ-NMB
OQ	j Ö	OR	eÉ	RSQQKRRP	ééÄ	OKO	NUVPRPNKTQ	RMMM	NNOKUV	UVKU	NNMO	[=HLJ-NMB
OT	^ä	OR	eÉ	RRSKUOO	ééÄ	NKR	SVQTSKPS	RMM	NNNKPS	UVKU	NNMO	[=HLJ-NMB
OU	pá	OR	eO	RUUKOUQ	ééÄ	NKP	OPMQOSKNQ	RMM	NNTKSS	UVKU	NNMO	[=HLJ-NMB
PV	h	OR	eÉ	RPTSKNSM	ééÄ	MKQ	NRSNRMQKOR	RMMM	NMTKRO	UVKU	NNMO	
QM	`~	OR	eO	RRVMKSTT	ééÄ	NKQ	NSQMRVNSKOU	RMMM	NNNKUN	UVKU	NNMO	[=HLJ-NMB
RN	s	UV	eÉ	ORKUNP	ééÄ	NKM	NMSSMSKNN	OR	NMPKOR	UVKU	NNMO	
RO	`ê	UV	eÉ	ORKMM	ééÄ	NKM	NPQRVOKVO	OR	NMPKS	UVKU	NNMO	
RR	j å	UV	eÉ	OSKUN	ééÄ	MKU	STSURKRS	OR	NMQKTO	UVKU	NNMO	
RS	cÉ	UV	eO	RNPQKNSS	ééÄ	NKQ	RQUVSMPUKSV	RMMM	NMOKSU	UVKU	NNMO	
RV	`ç	UV	eÉ	OSKQRS	ééÄ	MKV	OPQNTSKVS	OR	NMRKUO	UVKU	NNMO	
SM	ká	UV	eÉ	OSKOQU	ééÄ	NKR	SRNMMKNP	OR	NMQKVV	UVKU	NNMO	
SP	`ì	UV	eÉ	OSKQUR	ééÄ	NKU	NUOQTSKQS	OR	NMRKVQ	UVKU	NNMO	
SS	wå	UV	eÉ	OSKSOU	ééÄ	OKT	PNMUSKMU	OR	NMSKRN	UVKU	NNMO	
TR	^ë	UV	eÉ	ORKRMP	ééÄ	NKU	ONTMSKNQ	OR	NMOKMN	UVKU	NNMO	
TU	pÉ	UV	eO	ORKQNQ	ééÄ	NKR	NMNSTKTP	OR	NMNKSS	UVKU	NNMO	
UU	pê	UV	eÉ	OTKPSR	ééÄ	MKP	UPROOKQT	OR	NMVKQS	UVKU	NNMO	
VR	j ç	UV	eÉ	ORKTUN	ééÄ	NKR	TTNUPKPT	OR	NMPKNO	UVKU	NNMO	
NMT	^Ö	UV	eÉ	OTKMPS	ééÄ	OKN	OUTVMOKNS	OR	NMUKNQ	UVKU	NNMO	
NNN	`Ç	UV	eÉ	OSKSTM	ééÄ	NKM	PUMPQKNU	OR	NMSKSU	UVKU	NNMO	
NNU	på	NRV	eÉ	OOKUUT	ééÄ	NKQ	TPVRSKRU	OR	VVKRR	UVKU	NNMO	
NON	pÄ	NRV	kç=d ~ë	OOKOPO	ééÄ	MKO	RRSQSRKOR	OR	VSKVP	UVKU	NNMO	
NPT	_~	NRV	kç=d ~ë	OSKNUQ	ééÄ	NKR	NTQTQMKNO	OR	NMQKTQ	UVKU	NNMO	
NUO	t	NRV	kç=d ~ë	OSKOMS	ééÄ	MKT	PQQPPRKMV	OR	NMQKUO	UVKU	NNMO	
OMR	qä	OMV	kç=d ~ë	ORKSST	ééÄ	NKV	TTUOTVKOR	OR	NMOKST	UVKU	NNMO	
OMU	mÄ	OMV	kç=d ~ë	OSKRUM	ééÄ	MKV	NNMPNPOKRO	OR	NMSKPO	UVKU	NNMO	
OPO	qÜ	OMV	kç=d ~ë	OSKSNU	ééÄ	NKN	VTNTVRKQU	OR	NMSKQT	UVKU	NNMO	
OPU	r	OMV	kç=d ~ë	OTKVSP	ééÄ	NKQ	VQTSUSKNT	OR	NNNKUR	UVKU	NNMO	[=HLJ-NMB

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑmp	B=oÉÄ	B n`=ïçï	B n`=eäÜÜ	n`=c ä-Ö
i á	S	kç=d ~ë	COVQMTTKMT	NKO	NUVQNRTKMT	NONKNN	RVKR	NOMQ	SMOMa ça
pÅ	OR	kç=d ~ë	QOMQPMTKTV	NKV	QRTPSTVKOQ	VNKVO	RVKR	NOMQ	
pÅ	OR	eO	UQURVNKRS	NKO	VURSCPKUN	USKWV	RVKR	NOMQ	
pÅ	OR	eÉ	NQORQSKUU	NKO	NSMVPNKCP	UUKRS	RVKR	NOMQ	
dÉ	TO	kç=d ~ë	VVUSVRKTV	NKS	NMTQQQSKRP	VOKVT	RVKR	NOMQ	
dÉ	TO	eO	PPVVMTKVQ	NKM	PVPUSVKSQ	USKP	RVKR	NOMQ	
dÉ	TO	eÉ	NNMVNQKVN	MKS	NORQSSKVR	UTKUO	RVKR	NOMQ	
v	UV	eO	PTPQSSTKSN	MKQ	QPMNURSKUS	USKUO	RVKR	NOMQ	
v	UV	eÉ	TQSRRPKSP	NKQ	UQNPQQKNU	UUKTP	RVKR	NOMQ	
qÄ	NRV	kç=d ~ë	TMQNMPVKUV	MKT	SRVNQQQKUP	NVSKUO	RVKR	NOMQ	
qÄ	NRV	eÉ	OSVUTTVKNS	MKQ	OUSSNVMKN	VQKNS	RVKR	NOMQ	
_á	OMV	kç=d ~ë	PSNSQQRKNM	MKO	PNTPQTOKSU	NNPKVS	RVKR	NOMQ	
_á	OMV	eÉ	NRQTPVPKSQ	MKP	NSMVTVTKOQ	VSKNO	RVKR	NOMQ	

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MRP|``_KÇ

a~í~=m~íÜ=k~ã É aWl^ÖäÉáíÝ^mj eyNya^q^yOMCPyMPJ ^oyi n`OUbkÂ

^Åè=qáã É PLOULOMCP=ONMMMQQ

p~ã éáÉ=qóéÉ ``_

qçí~äa äi íáç~å NKMMMM

`çã ã Éåí JJJ

fpqa=oÉÑ=cäÉk~ã É MMQ ^i _KÇ

p~ã éáÉ=n`=m~ëëlc á~ä c~ää

fpqa=n`=m~ëëlc~ää c~ää

l éÉê~íçê **~Çã áä**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÄK	r åáë	opa	==\ mp==	i äã á	n`=c ä~Ö
V	_É	S	k ç=d ~ë	JMKMMV	éé Ä	k L^	OPMKMM	MO	
NN	_	S	k ç=d ~ë	MKQMQ	éé Ä	VKP	OUTRKUU	Q	
OP	k~	QR	e É	NPTKTQM	éé Ä	OKO	NPSVSSKOM	OMM	c~äÉÇ=a ça
OQ	j Ö	QR	e É	THRVM	éé Ä	UKP	POQTKNS	OM	
OT	^ä	QR	e É	MKVQV	éé Ä	QUKV	POTKTV	OM	
OU	pá	QR	e O	OKRVM	éé Ä	RKO	NRQRKMQ	NMM	
PV	h	QR	e É	RKMTR	éé Ä	ONKR	PPMVOKRQ	OMM	
QM	`~	QR	e O	OPKNON	éé Ä	OKN	UTSMUKUP	OM	c~äa^ äëj ÉíÜçÇë& c~äÉÇ=a ça
RN	s	UV	e É	MKMOR	éé Ä	OTKM	PTRKRT	N	
RO	`ê	UV	e É	JMKMQN	éé Ä	k L^	UNSKRQ	N	
RR	j å	UV	e É	MKMNN	éé Ä	VORT	NTMKSP	MQ	
RS	cÉ	UV	e O	PKTSO	éé Ä	RKR	RRORTKSR	OM	
RV	` ç	UV	e É	JMKMMU	éé Ä	k L^	NVPKPQ	MO	
SM	k á	UV	e É	JMKMMO	éé Ä	k L^	NRTKTU	MQ	
SP	` ì	UV	e É	MKMMN	éé Ä	RPMKT	RQOKOQ	MS	
SS	wå	UV	e É	MKMTN	éé Ä	QMKV	OUNKNO	O	
TR	^ë	UV	e É	MKMPQ	éé Ä	NUKV	RMMPQ	N	
TU	pÉ	UV	e O	MKMPO	éé Ä	OVKS	OPKMM	N	
UU	pê	UV	e É	MKNOU	éé Ä	RKM	QSNKNP	N	
VR	j ç	UV	e É	MKNPM	éé Ä	PKP	SROKOR	N	
NMT	^Ö	UV	e É	MKMNT	éé Ä	RKO	OOQKQR	MO	
NNN	` Ç	UV	e É	MKMNQ	éé Ä	OTHR	PNKQU	MO	
NNU	på	NRV	e É	MKNNR	éé Ä	RKT	STNKNQ	N	
NON	pÄ	NRV	k ç=d ~ë	MKMOO	éé Ä	PSKO	NQQQKVP	MO	
NPT	_~	NRV	k ç=d ~ë	MKMPP	éé Ä	OQKS	QNMKQQ	MQ	
NUO	t	NRV	k ç=d ~ë	MKMUQ	éé Ä	UKU	PTUNKOS	N	
OMR	qä	OMV	k ç=d ~ë	MKMQM	éé Ä	SKQ	OMSOKPQ	MO	
OMU	mÄ	OMV	k ç=d ~ë	JMKMOR	éé Ä	k L^	NRVRKMS	MO	
OPO	qÜ	OMV	k ç=d ~ë	MKMRS	éé Ä	NOKR	RNRVKUO	N	
OPU	r	OMV	k ç=d ~ë	MKMOO	éé Ä	NNKV	NMOTKUM	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=ïçï	B n`=cÄÜ	n`=c ä~Ö
iá	S	k ç=d ~ë	OPNTTSQKOQ	OKM	NUVQNRTKMT	NOOKPS	RVKR	NOMKQ	SMOMa ça
pÅ	QR	k ç=d ~ë	QQTTRRNKUM	NKO	QRTPSTVKOQ	VTKV	RVKR	NOMKQ	
pÅ	QR	e O	VNRQNUKNR	MKT	VURSOPKUN	VOKUU	RVKR	NOMKQ	
pÅ	QR	e É	NQUTVTKTO	NKN	NSMVPNKOP	VOKQS	RVKR	NOMKQ	
dÉ	TO	k ç=d ~ë	NMURQOQKRN	MKO	NMTQOQSKRP	NMNKMQ	RVKR	NOMKQ	
dÉ	TO	e O	PRQPUTHPS	MKU	PVPUSVKSQ	UVKVU	RVKR	NOMKQ	
dÉ	TO	e É	NNSNRPHPS	MKU	NORQSSKVR	VOKTO	RVKR	NOMKQ	
v	UV	e O	PVTSVTMKVS	NKS	QPMNURSKUS	VOKQR	RVKR	NOMKQ	
v	UV	e É	TUSQPSKVU	NKM	UQNPQOKNU	VPKQT	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	TPMQPNOKSR	NKN	SRVNQQQKUP	NNMKUO	RVKR	NOMKQ	
qÄ	NRV	e É	OUNURVNKMQ	NKT	OUSSNVMKN	VUKPQ	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PUMOTVRKQM	NKV	PNTPQTOKSU	NNVKUP	RVKR	NOMKQ	
_á	OMV	e É	NSPRVTOKRO	NKV	NSMVTVTKOQ	NMNKSP	RVKR	NOMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` NTfj t O
cáÉ=k~ã É	MRQ m_KÇ
a~í~=m~íÜ=k~ã É	a Wy^ÖäÉáíyf` mj e yNya^q^yOMOPyMPJ ^o yi n` OUbKÄ
^Åè=qáã É	PLOULOMOP=ONMVRVRM
p~ã éäÉ=qóéÉ	m_
qçí~ä=a áä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMQ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==` mp==	i áã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	JMKNNS	ééÄ	k L^	NOTKTU	MKR	
_	NN	S	k ç=d ~ë	OKMNU	ééÄ	UKP	OSSPKSP	NM	
k~	OP	QR	e É	PTNKSPM	ééÄ	QKU	USRRTKSQ	RMM	
j Ö	OQ	QR	e É	NRKRPU	ééÄ	TKR	NROVKMO	RM	
^ä	OT	QR	e É	NMKTQP	ééÄ	NPKT	QQNKNO	RM	
pá	OU	QR	e O	OOKOPO	ééÄ	NOKN	OMUOKPT	ORM	
h	PV	QR	e É	QMKSUS	ééÄ	NSKO	PNMOMKSP	RMM	
` ~	QM	QR	e O	SUKTRS	ééÄ	NKV	RNUSUKQR	RM	m_=SMOM=c~ãë=a ça
s	RN	UV	e É	MKRRQ	ééÄ	OMKQ	SUTKUN	OKR	
` ê	RO	UV	e É	JMKNSR	ééÄ	k L^	TVNKON	OKR	
j å	RR	UV	e É	JMKMOR	ééÄ	k L^	NNTKVU	N	
cÉ	RS	UV	e O	QKUPT	ééÄ	TKU	ONTNSKRQ	RM	
` ç	RV	UV	e É	JMKMTV	ééÄ	k L^	NNPKPQ	MKR	
k á	SM	UV	e É	JMKMSO	ééÄ	k L^	NONKNN	N	
` ì	SP	UV	e É	JMKMQO	ééÄ	k L^	QPOKOQ	NKR	
wå	SS	UV	e É	QKNSQ	ééÄ	RKQ	NNNQKRN	R	
^ë	TR	UV	e É	MKNTU	ééÄ	TKP	QTKPQ	OKR	
pÉ	TU	UV	e O	MKMSP	ééÄ	QPKT	NPKST	OKR	
pê	UU	UV	e É	MKOPP	ééÄ	ONKT	NUOKOP	OKR	
j ç	VR	UV	e É	MKOQU	ééÄ	PSKQ	PSTKTV	OKR	
^Ö	NMT	UV	e É	MKMPV	ééÄ	OUKR	NNSKST	MKR	
` Ç	NNN	UV	e É	MKMMP	ééÄ	SRMKV	NMKMM	MKR	
på	NNU	NRV	e É	MKOUT	ééÄ	NRKS	QRUKVN	OKR	
pÄ	NON	NRV	k ç=d ~ë	MKNRR	ééÄ	NUKV	NRRNKTO	MKR	
_~	NPT	NRV	k ç=d ~ë	MKMSV	ééÄ	SOKS	OSPKSN	N	
t	NUO	NRV	k ç=d ~ë	JMKNRT	ééÄ	k L^	OMTVKMQ	OKR	
qä	OMR	OMV	k ç=d ~ë	MKMPP	ééÄ	TKQ	VRQKPU	MKR	
mÄ	OMU	OMV	k ç=d ~ë	JMKONR	ééÄ	k L^	TSTKQV	MKR	
qÜ	OPO	OMV	k ç=d ~ë	MKNVO	ééÄ	QPKQ	QOQNKUU	OKR	
r	OPU	OMV	k ç=d ~ë	MKMNN	ééÄ	RVKP	PMMKPO	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	ONQRRTPKVU	MMS	NUVQNRTKMT	NNPKOT	RVMR	NOMQ	
pÅ	QR	kç=dl~ë	QNMTTUQKUV	NKT	QRTPSTVKQQ	UVKUN	RVMR	NOMQ	
pÅ	QR	eO	UNVQNPKMR	NKM	VURSQPKUN	UPKNO	RVMR	NOMQ	
pÅ	QR	eÉ	NPRTQRKQU	MMP	NSMVPNKQP	UQKPR	RVMR	NOMQ	
dÉ	TO	kç=dl~ë	VUQQURKPN	OMS	NMTQQQSKRP	VNKQS	RVMR	NOMQ	
dÉ	TO	eO	PQPSMPKQQ	NMS	PVPUSVMSQ	UQKNS	RVMR	NOMQ	
dÉ	TO	eÉ	NMSPTPKNQ	MKQ	NQRQSSKVR	UQKVO	RVMR	NOMQ	
v	UV	eO	PSUNRSVMPR	NKN	QPMNURSKUS	URKRU	RVMR	NOMQ	
v	UV	eÉ	TQQTVSKMO	MKO	UQNPQQKNU	URKVN	RVMR	NOMQ	
qÄ	NRV	kç=dl~ë	SURQVQPKQR	NKN	SRVNQQQKUP	NMQ	RVMR	NOMQ	
qÄ	NRV	eÉ	QSQPTQSKNR	MMS	QUSSNVMKN	VNKRQ	RVMR	NOMQ	
_á	QMV	kç=dl~ë	PSNQQMQKQP	MKR	PNTPQTQKSU	NNPKUP	RVMR	NOMQ	
_á	QMV	eÉ	NRRQRSVMSO	NKT	NSMVTVTKQQ	VSKRT	RVMR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i `pt n`NTfj t O
cáÉ=k~ã É	MRRi `pt kÇ
a~í~=m~íÜ=k~ã É	aWf'ÖäÉáíyf` mj eyNya^q^yOMOPyMPJ ^oyi n` CUbkÄ
^Åè=qáã É	PLOLLOMOP=ONMMMRT
p~ã éäÉ=qóéÉ	i `pt
qçí~äaäãíáçå	RKMMMM
`çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MMQ ^i _kÇ
p~ã éäÉ=n` =m~ëëlc á~ä	c~äã
fpqa=n` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åã**

n` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==i mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n` =c ä-Ö
_É	V	S	k ç=dl~ë	RNKNNO	éëÄ	NKQ	SMQNVKRR	RM	OMKQQ	TVKR	NOMKQ	
_	NN	S	k ç=dl~ë	RMTKNUN	éëÄ	MKQ	PUUVRVKSO	RMM	OMKOV	TVKR	NOMKQ	
k~	OP	QR	eÉ	VNMOKROM	éëÄ	NKS	NNPPVNRKQP	TRMM	OQKOT	TVKR	NOMKQ	SMOMk açа
j Ö	OQ	QR	eÉ	RSSOKRNP	éëÄ	MKR	PRVOSPKNV	RMMM	OOKSR	TVKR	NOMKQ	
^ä	OT	QR	eÉ	OPMPKNRT	éëÄ	MKU	RQPNMKVU	OMMM	OPKMP	TVKR	NOMKQ	
pá	OU	QR	eO	NNQQKMQN	éëÄ	MKT	URQMUKRM	NMMM	OOKUU	M	OMM	
h	PV	QR	eÉ	NMTVVKPTQ	éëÄ	MKO	SMVRCQKRU	NMMMM	ONKS	TVKR	NOMKQ	
`~	QM	QR	eO	OVMTKUMQ	éëÄ	PKR	NSPPMOTKMU	ORMM	OPKOS	TVKR	NOMKQ	
s	RN	UV	eÉ	RQNKSUS	éëÄ	MKU	QPMUMRKUP	RMM	ONKST	TVKR	NOMKQ	
`ê	RO	UV	eÉ	ONVKUUP	éëÄ	MKU	ONVTSUKNP	OMM	ONKVV	TVKR	NOMKQ	
j å	RR	UV	eÉ	RRQKOOS	éëÄ	MKU	OTRVURKPO	RMM	OOKNT	TVKR	NOMKQ	
cÉ	RS	UV	eO	NMURKMON	éëÄ	OKU	OOPSMSPKRN	NMMM	ONKT	TVKR	NOMKQ	
`ç	RV	UV	eÉ	RTSKPTM	éëÄ	MKS	VUPPSNKMO	RMM	OPKMR	TVKR	NOMKQ	açа
ká	SM	UV	eÉ	RSNKPUP	éëÄ	MKV	OSUNNTKMR	RMM	OOKQS	TVKR	NOMKQ	
`ì	SP	UV	eÉ	OUQKVNU	éëÄ	NKP	PTUNSVKRU	ORM	OOKTV	TVKR	NOMKQ	
wå	SS	UV	eÉ	RQPKQOS	éëÄ	MKR	NONURSKSP	RMM	ONKTQ	TVKR	NOMKQ	
^ë	TR	UV	eÉ	NMRKTRN	éëÄ	MKU	NTPSUKSP	NMM	ONKNR	TVKR	NOMKQ	
pÉ	TU	UV	eO	NMQKTSM	éëÄ	MKR	UMQPKNN	NMM	OMKVR	TVKR	NOMKQ	
pê	UU	UV	eÉ	RQQKRNU	éëÄ	MKT	POMQSVKON	RMM	ONKTU	TVKR	NOMKQ	
j ç	VR	UV	eÉ	NNMKNTV	éëÄ	NKN	SPSTPKQO	NMM	OOKMQ	TVKR	NOMKQ	
^Ö	NMT	UV	eÉ	RSKTUP	éëÄ	NKM	NNSSUUKTS	RM	OOKTN	TVKR	NOMKQ	
`Ç	NNN	UV	eÉ	OTVKNQO	éëÄ	MKT	TSTUTKVO	ORM	OOKPP	TVKR	NOMKQ	
på	NNU	NRV	eÉ	RNQKSQQ	éëÄ	NKS	OVQSUNKOO	RMM	OMKRV	TVKR	NOMKQ	
pÄ	NON	NRV	k ç=dl~ë	NVOKQMO	éëÄ	NKT	QRORPOKRM	NMM	OMKQU	TVKR	NOMKQ	
_~	NPT	NRV	k ç=dl~ë	OONNKSOU	éëÄ	MKU	OUPTONNKQS	OMMM	OOKNO	TVKR	NOMKQ	
t	NUO	NRV	k ç=dl~ë	NNQKTTQ	éëÄ	OKQ	OVMRTNKPR	NMM	OOKVS	TVKR	NOMKQ	
qä	OMR	OMV	k ç=dl~ë	NVPKMSO	éëÄ	OKQ	SOPMNOKTN	NMM	OMKSN	TVKR	NOMKQ	
mÄ	OMU	OMV	k ç=dl~ë	NMUKNSQ	éëÄ	NKN	UVRCPUKSM	NMM	ONKSP	TVKR	NOMKQ	
qÜ	OPO	OMV	k ç=dl~ë	NMRKSNO	éëÄ	OKN	TSVNMRKTV	NMM	ONKNO	TVKR	NOMKQ	
r	OPU	OMV	k ç=dl~ë	NNPKRUS	éëÄ	PKM	TSTOUVKNV	NMM	OOKTO	TVKR	NOMKQ	

n` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=i çï	Bn`=eäÜÜ	n`=ä~Ö
iá	S	kç=d~ë	OMSSTNPKNP	NKT	NUVQNRTKMT	NMVKNN	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PVUPMNSKUN	NHS	QRTPSTVKQQ	UTKMV	RVKR	NOMQ	
pÅ	QR	eO	UMSCQPKTM	NHS	VURSCPKUN	UNKU	RVKR	NOMQ	
pÅ	QR	eÉ	NPQRVCKNQ	NKP	NSMVPNKCP	UPKSP	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VSUCCRKPP	OKR	NMTQCQSKRP	VMKNP	RVKR	NOMQ	
dÉ	TO	eO	PCMRNTKTV	NKO	PVPUSVKSQ	UNKPU	RVKR	NOMQ	
dÉ	TO	eÉ	NMSTUMKV	MKR	NCRCSSKVR	URKCQ	RVKR	NOMQ	
v	UV	eO	PRUPMNQKQU	CKO	QPMNURSKUS	UPKOV	RVKR	NOMQ	
v	UV	eÉ	TCMMSTKPQ	MKR	UQNPQCKNU	URKRV	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	STTPTUTKPR	OKP	SRVNQQQKUP	NMCKTT	RVKR	NOMQ	
qÄ	NRV	eÉ	OSMUCRNKPT	NKP	CUSSNVMKN	VN	RVKR	NOMQ	
_á	OMV	kç=d~ë	PSMQCCQKOM	MKQ	PNTPQTCKSU	NNPKRT	RVKR	NOMQ	
_á	OMV	eÉ	NRCSRTRKTS	MKT	NSMVTVTKCQ	VQKUP	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMN

cãÉ=k~ã É MRSpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=ONMMVMM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKMVP	éé Ä	OVKN	PTRKRS	NMM	
NN	_	S	k ç=d ~ë	PRKPUR	éé Ä	OKN	OURRMKSV	NMMM	
OP	k ~	QR	e É	OOPUOKVUO	éé Ä	OKR	OSUQMPNKTM	OMMMMM	
OQ	j Ö	QR	e É	SMNRKNSU	éé Ä	OKO	PTRQMRKPS	OMMMMM	
OT	^ ä	QR	e É	NQNUKOPQ	éé Ä	NKR	POVTQKMN	OMMMMM	
OU	pá	QR	e O	RNVSKQCR	éé Ä	NKQ	PUNCUVKOV	NMMMM	
PV	h	QR	e É	OVOQKONT	éé Ä	NKM	NUCUTTKRV	OMMMMM	
QM	` ~	QR	e O	UOCQKRUR	éé Ä	MKR	QRPPSQSKOV	OMMMMM	
RN	s	UV	e É	PKQSM	éé Ä	PKR	OVRUKNP	NMMM	
RO	` ê	UV	e É	OKNNU	éé Ä	PKQ	PMOOKQO	OMMM	
RR	j å	UV	e É	NOPKMOP	éé Ä	NKO	SMSOMKOP	OMMM	
RS	cÉ	UV	e O	NUPOKSVM	éé Ä	NKQ	PTVNPPUKSR	NMMMM	
RV	` ç	UV	e É	PKTRU	éé Ä	SKS	SRTRKNN	NMMM	
SM	k á	UV	e É	SKPMV	éé Ä	MKS	PNOPKTP	NMMM	
SP	` ì	UV	e É	VKNPT	éé Ä	NKU	NOQQSKUR	OMMM	
SS	wå	UV	e É	QPKVNM	éé Ä	OKO	VUUUKNP	OMMM	
TR	^ ë	UV	e É	NKNPR	éé Ä	QKQ	OMNKSV	NMMM	
TU	pÉ	UV	e O	MOQRS	éé Ä	NPKQ	QPKST	NMMM	
UU	pê	UV	e É	ROKSQP	éé Ä	NKP	PMSQTKTS	OMMM	
VR	j ç	UV	e É	MKPOO	éé Ä	PSKR	OMOKQS	NMMM	
NMT	^ Ö	UV	e É	MKMQM	éé Ä	NUKO	NNRKRS	NMM	
NNN	` Ç	UV	e É	MOPQ	éé Ä	NVKO	TOKRV	NMMM	
NNU	på	NRV	e É	MRTOR	éé Ä	QKV	TNOKOR	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MRROM	éé Ä	TKR	POQMKQV	NMMM	
NPT	_~	NRV	k ç=d ~ë	QTKMPP	éé Ä	OKT	SOPVSKSP	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKMNR	éé Ä	k L^	OQUSKON	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNVU	éé Ä	UKR	NVTRKRS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QKUMQ	éé Ä	MKU	QOUOVKRS	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NKOQR	éé Ä	PKV	NOMRNKTQ	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNSQ	éé Ä	RKP	NPRNKRM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =i çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	ONMMVPSKVQ	NKM	NUVQNRTKMT	NNMKVO	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	OMQUMNPKSU	NKM	QRTPSTVKOQ	UUKRN	RVKR	NOMKQ	
pÅ	QR	e O	TVROSVKTR	MKT	VURSCPKUN	UMKSV	RVKR	NOMKQ	
pÅ	QR	e É	NPCQQTKUN	NKM	NSMVPNKCP	UOKOV	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VTTTQPKVQ	MKQ	NMTQQQSKRP	VNMVO	RVKR	NOMKQ	
d É	TO	e O	PNSUVPKOM	MKP	PVPUSVKSQ	UMKQS	RVKR	NOMKQ	
d É	TO	e É	NMROVQKTN	OKN	NORCSSKVR	UQKMS	RVKR	NOMKQ	
v	UV	e O	PSMPQNNKOM	NKS	QPMNURSKUS	UPKTS	RVKR	NOMKQ	
v	UV	e É	TNNPUPKRQ	MKT	UQNPCOKNU	UQKRR	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SVUSSRSKSV	NKT	SRVNQQQKUP	NMS	RVKR	NOMKQ	
qÄ	NRV	e É	OSCUNCPKUT	NKN	OUSSNVMKN	VNKSV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PSRUCOVKOT	MKO	PNTPQTOKSU	NNRKOU	RVKR	NOMKQ	
_á	OMV	e É	NRSNNUMKTO	NKU	NSMVTVTKOQ	VSKVU	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MVSMMMVO

cãÉ=k~ã É MRTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=ONWØQMT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMKMVQ	ééÄ	k L^	CRCKCP	NVM	
NN	_	S	k ç=d ~ë	PPKRNO	ééÄ	NKO	OSPTPKCN	NVMM	
CP	k ~	CR	e É	CNQTUKPVM	ééÄ	NKR	OSCCNCRKQQ	CVMMMM	
CQ	j Ö	CR	e É	RTVRKVSQ	ééÄ	NKQ	PSUMPTKSQ	CVMMMM	
CT	^ä	CR	e É	VSPKNSQ	ééÄ	NKS	CCUCQMTP	CVMMMM	
CU	pá	CR	e O	QTSCKMUU	ééÄ	PKO	PRCMSCKCR	NVMMM	
PV	h	CR	e É	CUPVKUPM	ééÄ	MKS	NUNRMSKPU	CVMMMM	
QM	` ~	CR	e O	TVQNKRRN	ééÄ	NKR	QQNNNNTKUR	CVMMMM	
RN	s	UV	e É	CKRQN	ééÄ	QKS	CCCCKSS	NVMM	
RO	` ê	UV	e É	NKSNT	ééÄ	NMKS	CRNRKTR	CVMM	
RR	j å	UV	e É	NCCRTVM	ééÄ	MKU	SMNUNKVO	CVMM	
RS	cÉ	UV	e O	NPQUKTRP	ééÄ	NKP	CUMCPVMKNR	NVMMM	
RV	` ç	UV	e É	PKQNR	ééÄ	QKN	RVSRKVQ	NVMM	
SM	k á	UV	e É	QKURU	ééÄ	QKM	CQCRKUO	NVMM	
SP	` ì	UV	e É	QKVTQ	ééÄ	PKQ	SVRSKCV	CVMM	
SS	wå	UV	e É	PPKPPQ	ééÄ	QKS	TRMUKUN	CVMM	
TR	^ë	UV	e É	NKNMO	ééÄ	SKQ	NVRKPR	NVMM	
TU	pÉ	UV	e O	MKOTV	ééÄ	UKT	PMKNT	NVMM	
UU	pê	UV	e É	QVKQCM	ééÄ	NKT	CUSNTKUN	CVMM	
VR	j ç	UV	e É	MKNQO	ééÄ	ROKU	PMMKMN	NVMM	
NMT	^Ö	UV	e É	MKMCO	ééÄ	OSKM	UMKMM	NVM	
NNN	` Ç	UV	e É	MKNNT	ééÄ	POKN	QMKTQ	NVMM	
NNU	på	NRV	e É	MKQNM	ééÄ	ONKP	ROTKUM	NVMM	
NON	pÄ	NRV	k ç=d ~ë	MKQRT	ééÄ	VKT	CUVMKMO	NVMM	
NPT	_~	NRV	k ç=d ~ë	PVKMVQ	ééÄ	NKU	RMTVOKQT	CVMM	
NUO	t	NRV	k ç=d ~ë	JMKNVS	ééÄ	k L^	NVSUKVM	NVMM	
OMR	qä	OMV	k ç=d ~ë	MKMRP	ééÄ	OTKU	NMSTKUQ	NVMM	
OMU	mÄ	OMV	k ç=d ~ë	OKPTR	ééÄ	QKM	COMPPKVV	CVMM	
OPO	qÜ	OMV	k ç=d ~ë	MKQVR	ééÄ	OTKQ	SPVNKTR	NVMM	
OPU	r	OMV	k ç=d ~ë	MKMTN	ééÄ	NPKM	TMMKTT	NVMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B=¤ÉÁ	B n` =ï çï	B n` =¤äÜÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	OMQRNVOKPT	QKT	NUVQNRTKMT	NMTKVT	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	QMQRVONKVP	OKU	QRTPSTVKOQ	UUKMO	RVRR	NOMQ	
pÅ	QR	e O	UMNPNVMKMO	MKU	VURSCPKUN	UNKP	RVRR	NOMQ	
pÅ	QR	e É	NPQTCMKQN	NKN	NSMVPNKCP	UPKTN	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VTRQMNKSQ	NKS	NMTQCQSKRP	VMKU	RVRR	NOMQ	
d É	TO	e O	PNRRNSKRP	MKQ	PVPUSVKSQ	UMKNN	RVRR	NOMQ	
d É	TO	e É	NMQPMUKUM	MKP	NCRCSSKVR	UPKOT	RVRR	NOMQ	
v	UV	e O	PSNTRRSKVV	MKV	QPMNURSKUS	UQKMV	RVRR	NOMQ	
v	UV	e É	TMTRNUKPS	MKR	UQNPQCKNU	UQKMV	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUPUCCNKPQ	NKV	SRVNQQQKUP	NMPKTR	RVRR	NOMQ	
qÄ	NRV	e É	OSNQMPQKMN	MKS	CUSSNVMKN	VNKCP	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PRUTNQCKTM	OKQ	PNTPQTCKSU	NNPKMQ	RVRR	NOMQ	
_á	OMV	e É	NRRTVQRKTV	NKO	NSMVTVTKOQ	VSKTU	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMP

cãÉ=k~ã É MRUpj mi HÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=ONWØMWQR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKNNT	ééÄ	QQKU	QMUKVM	NMM	
NN	_	S	k ç=d ~ë	QRKOTN	ééÄ	OKP	OMVRRHRM	NMMM	
OP	k ~	QR	e É	QRCSNKMVU	ééÄ	PKN	PMSMQMTHRN	OMMMMM	
OQ	j Ö	QR	e É	RTSMKNQU	ééÄ	OKP	PSPUUOKQO	OMMMMM	
OT	^ä	QR	e É	NNTPKMTT	ééÄ	OKT	OTSPRKVS	OMMMMM	
OU	pá	QR	e O	QQSSKRRU	ééÄ	MKQ	PORRQNKVT	NMMMM	
PV	h	QR	e É	ONRUKOPR	ééÄ	OKM	NQQMTPKRM	OMMMMM	
QM	` ~	QR	e O	QVNSKMTP	ééÄ	NKM	OSVSQNMKTV	OMMMMM	
RN	s	UV	e É	OKRQP	ééÄ	PKO	OCOOMOO	NMMM	
RO	` ê	UV	e É	NKTNO	ééÄ	NKT	OSMPKMU	OMMM	
RR	j å	UV	e É	VSKUMR	ééÄ	NKN	QTPRPHSN	OMMM	
RS	cÉ	UV	e O	NQMQKRPR	ééÄ	OKT	QUVTNSPKTR	NMMMMM	
RV	` ç	UV	e É	QKNNT	ééÄ	PKN	TNOQKPO	NMMM	
SM	k á	UV	e É	RKQPN	ééÄ	OKO	OSUUKMU	NMMM	
SP	` ì	UV	e É	PKSSO	ééÄ	PKP	RQPQKQN	OMMM	
SS	wå	UV	e É	QMKVUR	ééÄ	MKQ	VNSUKTP	OMMM	
TR	^ë	UV	e É	MKTMO	ééÄ	NUKM	NPMHSU	NMMM	
TU	pÉ	UV	e O	MKOOQ	ééÄ	ORKM	ORHST	NMMM	
UU	pê	UV	e É	QSKMVRS	ééÄ	NKQ	OSSMQKVO	OMMM	
VR	j ç	UV	e É	MKMNP	ééÄ	PRSKV	OOSHST	NMMM	
NMT	^Ö	UV	e É	MKMMS	ééÄ	VSKR	QSHST	NMM	
NNN	` Ç	UV	e É	MKMUS	ééÄ	NTKR	POKOO	NMMM	
NNU	på	NRV	e É	MKPNT	ééÄ	OMKQ	QTPHPR	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOOP	ééÄ	PKQ	NUTOKNN	NMMM	
NPT	_~	NRV	k ç=d ~ë	QTKNKOM	ééÄ	NKO	SNURMPPM	OMMM	
NUO	t	NRV	k ç=d ~ë	JMPSP	ééÄ	k L^	NRSUKQO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMMP	ééÄ	NVRKU	TVMKUS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NKUSS	ééÄ	PKR	NUPNQKRM	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKOUU	ééÄ	PNKN	RMOVHSU	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMQN	ééÄ	OOKU	RNPKUV	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n` =ì çï	B n` =¤ä ÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	ONOTUSUKTU	NKO	NUVQNRTHMT	NNOKPQ	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	QMVSUMPKQS	NHR	QRTPSTVKOQ	UTHSN	RVHR	NOMQ	
pÅ	QR	e O	TUVUOPKVT	OKO	VURSOPKUN	UMKNP	RVHR	NOMQ	
pÅ	QR	e É	NPQMVSNKMQ	OKO	NSMVPNKOP	UPHP	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VSSVRTKOM	MKO	NMTQOQSKRP	VMMVN	RVHR	NOMQ	
d É	TO	e O	PMVTVRKNP	PHP	PVPUSVHSQ	TUHSR	RVHR	NOMQ	
d É	TO	e É	NMRRQTKQQ	MKQ	NORCSSKVR	UQKOS	RVHR	NOMQ	
v	UV	e O	PRUUTRMMVR	NKV	QPMNURSKUS	UPKQO	RVHR	NOMQ	
v	UV	e É	TMRTOSKVU	MKV	UQNPQOKNU	UPKUU	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVNNSPMKUS	MKM	SRVNQQQKUP	NMQKUS	RVHR	NOMQ	
qÄ	NRV	e É	OSNNNOTHPN	NHS	OUSSNVMKN	VNKN	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PSTVTSQKMR	NKO	PNTPQTOKSU	NNRKVR	RVHR	NOMQ	
_á	OMV	e É	NRRCSOTKMQ	NHS	NSMVTVTHOQ	VSKQR	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMQ

cãÉ=k~ã É MRVpj mi hÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíÿ mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=ONWPQMPO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKMMM	éé Ä	TKM	PUNKNO	NMM	
NN	_	S	k ç=d ~ë	OQKSVU	éé Ä	NKU	OMM/PKNN	NMMM	
OP	k ~	QR	e É	ORQSPKOUT	éé Ä	NKP	PMTVSMNKVV	OMMMMM	
OQ	j Ö	QR	e É	RTSRKVVV	éé Ä	MKP	PSPSRUKOV	OMMMMM	
OT	^ ä	QR	e É	NMQMKTSP	éé Ä	OKO	OQTMQKVP	OMMMMM	
OU	pá	QR	e O	QQMMKMSM	éé Ä	NKO	POSONUKPQ	NMMMM	
PV	h	QR	e É	OMSPKUVQ	éé Ä	NKO	NPUTSRKMM	OMMMMM	
QM	` ~	QR	e O	QQQMKONP	éé Ä	MKU	OQSTOMRKPS	OMMMMM	
RN	s	UV	e É	OKPNT	éé Ä	SKT	OMRPKRO	NMMM	
RO	` ê	UV	e É	NKSNV	éé Ä	NKQ	ORCPKMU	OMMM	
RR	j å	UV	e É	VQKPQQ	éé Ä	NKO	QSPQTKNM	OMMM	
RS	cÉ	UV	e O	NPOQKSSU	éé Ä	NKR	OTOSUTSKNP	NMMMMM	
RV	` ç	UV	e É	PKUSP	éé Ä	QKP	STOUKRP	NMMM	
SM	k á	UV	e É	RKPPP	éé Ä	PKN	OSRPKSQ	NMMM	
SP	` ì	UV	e É	PKSNU	éé Ä	RKM	RNVVKVQ	OMMM	
SS	wå	UV	e É	PRKPPN	éé Ä	MKR	TVSNKPN	OMMM	
TR	^ ë	UV	e É	MKSPR	éé Ä	NOKS	NOMKPQ	NMMM	
TU	pÉ	UV	e O	MKNVO	éé Ä	POKM	OPKNT	NMMM	
UU	pê	UV	e É	QQKOUQ	éé Ä	NKS	ORSVPKNQ	OMMM	
VR	j ç	UV	e É	JMKMRT	éé Ä	kL^	NUTKTU	NMMM	
NMT	^ Ö	UV	e É	JMKMMO	éé Ä	kL^	PMKMM	NMM	
NNN	` Ç	UV	e É	MKMTO	éé Ä	POKM	OUKRO	NMMM	
NNU	på	NRV	e É	MKNPT	éé Ä	PVKT	PSUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNSS	éé Ä	PPKS	NSMRKNP	NMMM	
NPT	_~	NRV	k ç=d ~ë	QQKTOU	éé Ä	NKP	RRUOMKUN	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKQSM	éé Ä	kL^	NPNQKTU	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMNS	éé Ä	kL^	SRTHPU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NKMRR	éé Ä	NKS	NNORTHKNM	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKOSP	éé Ä	TKQ	QTROKSN	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMOR	éé Ä	NVKS	PVTHKV	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¡ çï	B n ` =¤eåÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	OMURONMKVN	MKV	NUVQNRTHMT	NNMKV	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QMOUSMPKPR	MKT	QRTPSTVKOQ	UUKMU	RVKR	NOMKQ	
pÅ	QR	e O	UMNTUSKRR	MKV	VURSOPKUN	UNKPR	RVKR	NOMKQ	
pÅ	QR	e É	NPPUMRKNV	NKU	NSMVPNKOP	UPKNQ	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VTMROVKVT	MKQ	NMTQOQSKRP	VMKPR	RVKR	NOMKQ	
d É	TO	e O	PNUQSPKMU	MKP	PVPUSVKSQ	UMKUR	RVKR	NOMKQ	
d É	TO	e É	NMPQRPKPP	MKU	NORQSSKVR	UOKRV	RVKR	NOMKQ	
v	UV	e O	PRUNOQMKVT	MKR	QPMNURSKUS	UPKOR	RVKR	NOMKQ	
v	UV	e É	TMUTORKRV	MKQ	UQNPQOKNU	UQKOQ	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SUTTTQTKOO	NKP	SRVNQQQKUP	NMQKPQ	RVKR	NOMKQ	
qÄ	NRV	e É	ORVRQSVKUM	MKP	OUSSNVMKN	VMKRR	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PSMRPPOKSR	MKU	PNTPQTOKSU	NNPKSN	RVKR	NOMKQ	
_á	OMV	e É	NRRMQQMKUR	NKO	NSMVTVTKOQ	VSKPN	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MVSMMMR

cãÉ=k~ã É MSMpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=ONAPVMPV

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çåÄK	r åáë	opa	==mp==	iao	n ` =cä~Ö
V	_É	S	kç=el~ë	MKMUU	éé Ä	PQKU	PSTKTV	NMM	
NN	_	S	kç=el~ë	CRKUPS	éé Ä	CKR	CNMQSKSS	NMMM	
CP	k~	CR	eÉ	CCRPTKQQP	éé Ä	NKO	CTCNPPNKPN	CMMMMM	
CQ	j Ö	CR	eÉ	RRNMKRMU	éé Ä	NKU	PQSVNNKTP	CMMMMM	
CT	^ä	CR	eÉ	NPMSKMNQ	éé Ä	MKS	PMRVPKMN	CMMMMM	
CU	pá	CR	eO	CQPQKVNV	éé Ä	MKT	PCUUNSKKN	NMMMM	
PV	h	CR	eÉ	CCUQKMCN	éé Ä	MKV	NRMMQMKMM	CMMMMM	
QM	` ~	CR	eO	RNSPKMTU	éé Ä	MKS	CUTVVUUKKO	CMMMMM	
RN	s	UV	eÉ	CKSSV	éé Ä	CKS	CPNQKSU	NMMM	
RO	` ê	UV	eÉ	NKSCU	éé Ä	PKR	CRNSKQO	CMMM	
RR	j å	UV	eÉ	VCKQVO	éé Ä	MKR	CRNSNKRN	CMMM	
RS	cÉ	UV	eO	CQCTHRRT	éé Ä	MKV	RMQSRQCKVP	NMMMM	
RV	` ç	UV	eÉ	PKTQR	éé Ä	PKP	SQVMKSQ	NMMM	
SM	k á	UV	eÉ	RKVQT	éé Ä	NKO	OVCPKSV	NMMM	
SP	` ì	UV	eÉ	PKQUP	éé Ä	CKR	QVVCKNM	CMMM	
SS	wå	UV	eÉ	QUKNTO	éé Ä	CKP	NMTCRKQM	CMMM	
TR	^ë	UV	eÉ	MKVRU	éé Ä	SKO	NTNKPR	NMMM	
TU	pÉ	UV	eO	MKNSM	éé Ä	NUKV	CNKMM	NMMM	
UU	pê	UV	eÉ	QCKVUR	éé Ä	CKQ	CQTUVKPR	CMMM	
VR	j ç	UV	eÉ	JMKVCP	éé Ä	kL^	CMRKRS	NMMM	
NMT	^Ö	UV	eÉ	MKMMQ	éé Ä	NPRKN	CPKPP	NMM	
NNN	` Ç	UV	eÉ	MKMTT	éé Ä	PRKR	OVKSP	NMMM	
NNU	på	NRV	eÉ	MKNQO	éé Ä	TMKQ	PTPKPQ	NMMM	
NON	pÄ	NRV	kç=el~ë	MKOOM	éé Ä	PPKQ	NVNRKRN	NMMM	
NPT	_~	NRV	kç=el~ë	QSKONN	éé Ä	CKO	RVTRRKCU	CMMM	
NUO	t	NRV	kç=el~ë	JMKUUQ	éé Ä	kL^	NOQNKPU	NMMM	
OMR	qä	OMV	kç=el~ë	JMKVSM	éé Ä	kL^	PVTKNM	NMMM	
OMU	mÄ	OMV	kç=el~ë	CKOTN	éé Ä	NKR	ONQUSKON	CMMM	
OPO	qÜ	OMV	kç=el~ë	MKONU	éé Ä	NPKQ	QQSOKNU	NMMM	
OPU	r	OMV	kç=el~ë	MKVOM	éé Ä	PRKV	RVMKRQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÁ	B n ` =i çï	B n ` =eáÜÜ	n ` =cä~Ö
iá	S	kç=el~ë	OMVQOMSKMT	CKQ	NUVQNRTKMT	NNMKRS	RVKR	NOMKQ	
pÅ	CR	kç=el~ë	OMCPOVNKPP	MKV	QRTPSTVKOQ	UTKVT	RVKR	NOMKQ	
pÅ	CR	eO	UMPQRMKUU	NKP	VURSCPKUN	UNKRO	RVKR	NOMKQ	
pÅ	CR	eÉ	NPPPRSKNO	NKR	NSMVPNKCP	UCKUT	RVKR	NOMKQ	
dÉ	TO	kç=el~ë	VSQTNRKNQ	NKP	NMTQOQSKRP	UVKU	RVKR	NOMKQ	
dÉ	TO	eO	PNRRTCKUU	MKT	PVPUSVKSQ	UMKNO	RVKR	NOMKQ	
dÉ	TO	eÉ	NMPQRUKSQ	NKR	NCRCSSKVR	UCKRV	RVKR	NOMKQ	
v	UV	eO	PSCPMSPKVU	MKV	CPMNURSKUS	UQKCO	RVKR	NOMKQ	
v	UV	eÉ	TMCPUVKNT	MKQ	UQNPCCKNU	UPKTO	RVKR	NOMKQ	
qÄ	NRV	kç=el~ë	SUMUCVCKCR	NKV	SRVNQQQKUP	NMPKCV	RVKR	NOMKQ	
qÄ	NRV	eÉ	OSMSCSUKMS	MKU	CUSSNVMKN	VMKVQ	RVKR	NOMKQ	
_á	OMV	kç=el~ë	PSPTCVCKTS	MKQ	PNTPQTCKSU	NNQKSO	RVKR	NOMKQ	
_á	OMV	eÉ	NRQRCPCKPR	MKT	NSMVTVTKOQ	VRKVV	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MVSMMMVS

cãÉ=k~ã É MSNpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=ONWQQWQT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	MKVSP	ééÄ	ONKO	PPPKPQ	NVM	
NN	_	S	k ç=d ~ë	OSKRPP	ééÄ	NKP	ONPMOKSN	NVMM	
OP	k ~	QR	e É	OPORVKPTT	ééÄ	MKP	OTSNNMTKUN	OMMMMM	
OQ	j Ö	QR	e É	RPMTKSPO	ééÄ	NKT	POUNNNKUN	OMMMMM	
OT	^ä	QR	e É	NQRQKQVR	ééÄ	OKR	PPQUMKTM	OMMMMM	
OU	pá	QR	e O	QVRSKPRR	ééÄ	MKP	PSQRONKVN	NMMMM	
PV	h	QR	e É	OPSQKPNN	ééÄ	NKN	NRNTTNKUR	OMMMMM	
QM	` ~	QR	e O	QSUSKMTT	ééÄ	NKM	ORUMNUMKQR	OMMMMM	
RN	s	UV	e É	PKMMO	ééÄ	MKU	ORQSKVQ	NMMM	
RO	` ê	UV	e É	NKURU	ééÄ	RKO	OTNNKTR	OMMM	
RR	j å	UV	e É	VNKOON	ééÄ	OKM	QQMTQKVU	OMMM	
RS	cÉ	UV	e O	PNSRKOVR	ééÄ	MKO	SRUVUVPKTU	NMMMMM	
RV	` ç	UV	e É	PKQPS	ééÄ	OKN	RVNOKRV	NMMM	
SM	k á	UV	e É	RKURT	ééÄ	PKO	OURNKQR	NMMM	
SP	` ì	UV	e É	PKOTO	ééÄ	NKS	QSSVKTS	OMMM	
SS	wå	UV	e É	OVKTQV	ééÄ	OKN	SSNVKQT	OMMM	
TR	^ë	UV	e É	MKVUQ	ééÄ	RKT	NTPKSV	NMMM	
TU	pÉ	UV	e O	MKNTM	ééÄ	OTKQ	ONKUP	NMMM	
UU	pê	UV	e É	QMPVM	ééÄ	OKM	OPMQUKQT	OMMM	
VR	j ç	UV	e É	JMKNNT	ééÄ	kL^	NRNKNN	NMMM	
NMT	^Ö	UV	e É	JMKMMO	ééÄ	kL^	PMKMM	NMM	
NNN	` Ç	UV	e É	MKMPR	ééÄ	POKO	NUKNR	NMMM	
NNU	på	NRV	e É	MKNTN	ééÄ	RRKT	PURKRT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOPS	ééÄ	RKN	NVOUKUQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	QQKTVP	ééÄ	OKO	RUTTPKPP	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKROU	ééÄ	kL^	NNQQKRV	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKVQV	ééÄ	kL^	QSTKNT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OKQVR	ééÄ	OKO	OPQSVKVU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKONN	ééÄ	NUKU	QQPOKNQ	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMQP	ééÄ	OPKT	RQPKVM	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B¤ ÉÅ	B n` =ì çï	B n` =¤äÜÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	OMSRQQTHPU	MKV	NUVQNRTHMT	NMVKMP	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QMNVVPQKMN	NKO	QRTPSTVKQQ	UTKUV	RVKR	NOMQ	
pÅ	QR	e O	TVOTRPHPQ	MKT	VURSCPKUN	UMKQP	RVKR	NOMQ	
pÅ	QR	e É	NPNNRPKOU	NKS	NSMVPNKCP	UNKR	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VSQQSRKRM	NKV	NMTQQQSKRP	UVKTU	RVKR	NOMQ	
d É	TO	e O	PNPTRRKRQ	NKO	PVPUSVKSQ	TVKSS	RVKR	NOMQ	
d É	TO	e É	NMPMORKQP	MKP	NORCSSKVR	UOKCQ	RVKR	NOMQ	
v	UV	e O	PSPMRPTKSV	NKM	QPMNURSKUS	UQKPV	RVKR	NOMQ	
v	UV	e É	SVTMPOKPS	NKM	UQNPQOKNU	UOKUR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVMUNMRKUO	MKR	SRVNQQQKUP	NMQKU	RVKR	NOMQ	
qÄ	NRV	e É	ORUNOSVKVT	NKU	OUSSNVMKN	VMKMS	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PSRRSQNKRV	MKT	PNTPQTOKSU	NNRKNV	RVKR	NOMQ	
_á	OMV	e É	NRPQMTVKNT	MKT	NSMVTVTKQQ	VRKP	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMT

cãÉ=k~ã É MSQpj mi HÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=ONXQMVRP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä-Ö
V	_É	S	k ç=d ~ë	MKMTP	ééÄ	SSKO	PPUKVM	NMM	
NN	_	S	k ç=d ~ë	PCKVPS	ééÄ	CKP	CRTPRKQQ	NMMM	
CP	k ~	CR	e É	CPQSRKPQN	ééÄ	NKR	OTUTVOSKNQ	OMMMMM	
CQ	j Ö	CR	e É	TMUTKSPS	ééÄ	NKO	CPUQVUKPP	OMMMMM	
CT	^ ä	CR	e É	NPMSKSNV	ééÄ	MKR	PMNPRKQM	OMMMMM	
CU	pá	CR	e O	SQPQKRQM	ééÄ	NKS	QSVMQVKCO	NMMMM	
PV	h	CR	e É	OTTRKOMU	ééÄ	MKU	NTPQVQKMT	OMMMMM	
QM	` ~	CR	e O	UQPRKQOT	ééÄ	MKQ	QSOMTPTKRQ	OMMMMM	
RN	s	UV	e É	PKMRP	ééÄ	CKQ	OSOQKTQ	NMMM	
RO	` ê	UV	e É	NKUCO	ééÄ	CKO	OTNTKMU	OMMM	
RR	j å	UV	e É	NPRKMRS	ééÄ	NKP	SSNTVKRT	OMMM	
RS	cÉ	UV	e O	NTSPKPUT	ééÄ	NKT	PSOMNRVKMQ	NMMMM	
RV	` ç	UV	e É	PKVTN	ééÄ	NKO	SUVTKRM	NMMM	
SM	k á	UV	e É	RKPPV	ééÄ	RKN	OSRNKQN	NMMM	
SP	` ì	UV	e É	SKVVR	ééÄ	CKQ	VRUVKMM	OMMM	
SS	wå	UV	e É	QUKVSV	ééÄ	MKU	NMVQTKUN	OMMM	
TR	^ ë	UV	e É	NKMUM	ééÄ	RKN	NVNKSV	NMMM	
TU	pÉ	UV	e O	MKOMR	ééÄ	OVKV	OQQKNT	NMMM	
UU	pê	UV	e É	RNKTNR	ééÄ	NKO	OVVQRKNP	OMMM	
VR	j ç	UV	e É	JMKMSU	ééÄ	k L^	NUNKNO	NMMM	
NMT	^ Ö	UV	e É	MKMMP	ééÄ	ONTKU	QMKMM	NMM	
NNN	` Ç	UV	e É	MKNMV	ééÄ	OUKM	PUKRO	NMMM	
NNU	på	NRV	e É	MKNQP	ééÄ	COKP	PSUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKPUN	ééÄ	NNKU	CROSKOQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	QRKNVR	ééÄ	MKT	RUMNUKRV	OMMM	
NUO	t	NRV	k ç=d ~ë	JMRKOR	ééÄ	k L^	NNOTKVN	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMRO	ééÄ	k L^	QQTKNR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QKMNS	ééÄ	CKU	PSPUOKMP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNSR	ééÄ	NPKU	QNNRKMD	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMOT	ééÄ	OPKV	QOMKQR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤pÉÅ	B n ` =i çï	B n ` =¤ëÅÜÜ	n ` =¤ä-Ö
i á	S	k ç=d ~ë	OMOVQTNKPP	QKM	NUVQNRTKMT	NMTKNQ	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	QMMTTPVKSN	MKR	QRTPSTVKOQ	UTHSP	RVKR	NOMQ	
pÅ	CR	e O	TVMPVSKVN	NKV	VURSCPKUN	UMKNV	RVKR	NOMQ	
pÅ	CR	e É	NPNOVSKQV	NKR	NSMVPNKCP	UNKRV	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VTMRUTKVQ	MKU	NMTQCQSKRP	VMKPR	RVKR	NOMQ	
d É	TO	e O	PNQCRSKON	MKR	PVPUSVKSQ	TVKUQ	RVKR	NOMQ	
d É	TO	e É	NMQNNPKRN	MKT	NCRCSSKVR	UPKNN	RVKR	NOMQ	
v	UV	e O	PRTRMPRKQS	MKO	CPMNURSKUS	UPKN	RVKR	NOMQ	
v	UV	e É	TMTRMQKPO	MKS	UQNPCQKNU	UQKMV	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	STRUUCQKNU	NKP	SRVNCQQKUP	NMOKRQ	RVKR	NOMQ	
qÄ	NRV	e É	QRTROTUKQQ	OKN	CUSSNVMKN	UVKUR	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PSTQUVQKQM	NKU	PNTPQTOKSU	NNRKU	RVKR	NOMQ	
_á	OMV	e É	NRPRSMMKPO	NKP	NSMVTVTKOQ	VRKPV	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMU

cãÉ=k~ã É MSPpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÃ

^Åè=qãã É PLOULOMCP=ONVRFRMMM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä-Ö
V	_É	S	k ç=d ~ë	MKMPV	ééÄ	NTHO	PMMKMN	NMM	
NN	_	S	k ç=d ~ë	PCKRPP	ééÄ	NKR	CRQQMCQR	NMMM	
CP	k ~	CR	e É	CPMRQKRVM	ééÄ	MO	OTTVSCPKUR	CMMMMM	
CQ	j Ö	CR	e É	SRTTKQOT	ééÄ	NKM	QNCUMUKCR	CMMMMM	
CT	^ ä	CR	e É	NNCPKCPN	ééÄ	MR	OSPMQKQU	CMMMMM	
CU	pá	CR	e O	SRTTMPMT	ééÄ	NKV	QUMRTRKTV	NMMMM	
PV	h	CR	e É	CUPQKCPN	ééÄ	NKU	NTVNCNMSP	CMMMMM	
QM	` ~	CR	e O	TVUMKTMN	ééÄ	NKR	CPUSSMCKRN	CMMMMM	
RN	s	UV	e É	CKSCQ	ééÄ	PKN	CCQQKST	NMMM	
RO	` ê	UV	e É	NKTUS	ééÄ	CKP	OSCUKQN	CMMM	
RR	j å	UV	e É	NCRKPCR	ééÄ	MKS	SMCMQKRU	CMMM	
RS	cÉ	UV	e O	NTPRKVQS	ééÄ	MKV	PSPTMQUKNQ	NMMMM	
RV	` ç	UV	e É	PKUMM	ééÄ	PKP	SSCUKQS	NMMM	
SM	k á	UV	e É	RKPNP	ééÄ	NKS	CRUSKVR	NMMM	
SP	` ì	UV	e É	QKTQP	ééÄ	NKS	SRCQKVU	CMMM	
SS	wå	UV	e É	PMKNTR	ééÄ	MKV	SSTUKPU	CMMM	
TR	^ ë	UV	e É	NKMTO	ééÄ	VKP	NUSKSV	NMMM	
TU	pÉ	UV	e O	MCNQ	ééÄ	NMKN	CRKPP	NMMM	
UU	pê	UV	e É	QMKTQN	ééÄ	MKS	CUCPCKRV	CMMM	
VR	j ç	UV	e É	JMKMUU	ééÄ	k L^	NSSKST	NMMM	
NMT	^ Ö	UV	e É	MKMMQ	ééÄ	NRMKS	QNKKN	NMM	
NNN	` Ç	UV	e É	MKMPR	ééÄ	OSKR	NUKKR	NMMM	
NNU	på	NRV	e É	MKNMR	ééÄ	NMCKP	PQSKSU	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MCPN	ééÄ	NMKT	OTCPKNT	NMMM	
NPT	_~	NRV	k ç=d ~ë	PUKMV	ééÄ	NKT	QUMPSKTV	CMMM	
NUO	t	NRV	k ç=d ~ë	JMQMP	ééÄ	k L^	NCMCKST	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMRS	ééÄ	k L^	QCMCQR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NKVRQ	ééÄ	CKV	NUTRNKVN	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNMP	ééÄ	PTKV	QCRUKSM	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMPU	ééÄ	NMKO	QUPKUS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¨ çï	B n ` =¤ëÛÜ	n ` =¤ä-Ö
i á	S	k ç=d ~ë	OMDTRMSKCP	OKP	NUVQNRTKMT	NMTKMQ	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVTSSMCKUQ	OKU	QRTPSTVKOQ	USKVR	RVKR	NOMQ	
pÅ	CR	e O	TVOVSQKQN	MKR	VURSCPKUN	UMKQR	RVKR	NOMQ	
pÅ	CR	e É	NPPNUPRTQ	NKP	NSMVPNKCP	UCRTS	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VRSRCPKVT	MKR	NMTQCQSKRP	UVMVQ	RVKR	NOMQ	
d É	TO	e O	PNCURMKMM	MKT	PVPUSVKSQ	TVKCP	RVKR	NOMQ	
d É	TO	e É	NMCRPMKSM	MKT	NCRCSSKVR	UNKUR	RVKR	NOMQ	
v	UV	e O	PSQUCPMKUO	MKU	CPMNURSKUS	UQKUN	RVKR	NOMQ	
v	UV	e É	SVPQVUKUV	MKS	UQNPCCKNU	UCKCP	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	STRUNNQKRT	NKV	SRVNCQQKUP	NMCKRP	RVKR	NOMQ	
qÄ	NRV	e É	CRSRMVPKNR	NKM	CUSSNVMKN	UVKQV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PSCMMVSKST	NKU	PNTPQTCKSU	NNQKMT	RVKR	NOMQ	
_á	OMV	e É	NRPQVUCKNN	NKN	NSMVTVTKOQ	VRHPR	RVKR	NOMQ	

`çåíaåìåaÖ=~äåÄê~íáçå=sÉêáÑ~Ä~íáçå=É``sF=oÉéçê

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MSQ``skÇ
a~í~=m~íÜk~ã É	aWy^ÖãÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OUbkÄ
^Åè=qáã É	PLOULOMOP=OOMMMMU
p~ã éáÉ=qóéÉ	``s
qçí~äaãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MVQ ^i _kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=cä~Ö
V	_É	S	k ç=d ~ë	OPKURR	ééÄ	OKN	NQTQUTHPS	OR	VRKQO	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OOKORU	ééÄ	NKR	VUPQTHRU	OR	VTKMP	UVKU	NNMO	
OP	k ~	OR	e É	RSPNKVUN	ééÄ	MKV	PQSRMUVKVQ	RMMM	NNOKSQ	UVKU	NNMO	[=HLH-NMB
OQ	j Ö	OR	e É	RSMSKVRQ	ééÄ	NKU	NTVUVRTKVN	RMMM	NNOKNQ	UVKU	NNMO	[=HLH-NMB
OT	^ä	OR	e É	RQVKOOP	ééÄ	MKO	SRRQPHPU	RMM	NMVKUQ	UVKU	NNMO	
OU	pá	OR	e O	RRUKOQS	ééÄ	MKU	ONPQRQKVU	RMM	NNNKSR	UVKU	NNMO	[=HLH-NMB
PV	h	OR	e É	RQMPKMSM	ééÄ	MKU	NRMMRTUKOU	RMMM	NMUKMS	UVKU	NNMO	
QM	` ~	OR	e O	RPQUKSMM	ééÄ	MKP	NRPOONNNKMO	RMMM	NMSKVT	UVKU	NNMO	
RN	s	UV	e É	ORKTNM	ééÄ	NKP	NMOQMRKVQ	OR	NMOKUQ	UVKU	NNMO	
RO	` ê	UV	e É	ORKTPM	ééÄ	NKN	NOUVRTHSU	OR	NMOKVO	UVKU	NNMO	
RR	j å	UV	e É	ORKURR	ééÄ	NKN	SQQSRKVV	OR	NMPKQO	UVKU	NNMO	
RS	cÉ	UV	e O	RNPUKORV	ééÄ	MKS	RPSRNRCPKUM	RMMM	NMOKTT	UVKU	NNMO	
RV	` ç	UV	e É	OSKORR	ééÄ	NKT	OOQNNSKSN	OR	NMRKMO	UVKU	NNMO	
SM	ká	UV	e É	OSKNMS	ééÄ	MKU	SOQQVKNU	OR	NMQKQO	UVKU	NNMO	
SP	` ì	UV	e É	OSKNTT	ééÄ	MKU	NTPVSUKUV	OR	NMQKTN	UVKU	NNMO	
SS	wå	UV	e É	OSKPOM	ééÄ	NKU	OVSPUHRO	OR	NMRKOU	UVKU	NNMO	
TR	^ë	UV	e É	ORKRNN	ééÄ	NKP	OMVQOKUV	OR	NMOKMQ	UVKU	NNMO	
TU	pÉ	UV	e O	ORKOPT	ééÄ	MKV	VUSMKNV	OR	NMMKVR	UVKU	NNMO	
UU	pê	UV	e É	OSKOMP	ééÄ	NKO	TTNQPKUR	OR	NMQKUN	UVKU	NNMO	
VR	j ç	UV	e É	ORKRCS	ééÄ	NKN	TPTONKRV	OR	NMOKN	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKONU	ééÄ	MKS	OTVSMPKVT	OR	NMUKUT	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKSSM	ééÄ	NKR	PSSTOKTT	OR	NMSKSQ	UVKU	NNMO	
NNU	på	NRV	e É	OOKVNP	ééÄ	MKP	TNQSQKOS	OR	VVKSR	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OOKOTT	ééÄ	NKR	RRPNMPKRN	OR	VTKNN	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKUVQ	ééÄ	NKO	NTNQRSKMM	OR	NMPKRU	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKONQ	ééÄ	MKU	PQNTRQKUT	OR	NMQKUS	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKQSV	ééÄ	NKR	TTMTNMPN	OR	NMNKUU	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKPUS	ééÄ	NKR	NMVOUUSKNU	OR	NMRKRQ	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKRPU	ééÄ	NKR	VSSVPTKVM	OR	NMSKNR	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OTKUUM	ééÄ	NKU	VQOVMUKNS	OR	NNNKRO	UVKU	NNMO	[=HLH-NMB

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑmp	B=oÉÄ	B n`=íçï	B n`=eäÜÜ	n`=cä~Ö
iá	S	k ç=d ~ë	ONSTNOMKQT	MKU	NUVQNRTHMT	NNQKQN	RVKR	NOMQ	
pÅ	OR	k ç=d ~ë	QNMVPOPKMM	NKQ	QRTPSTVKOQ	UVKUR	RVKR	NOMQ	
pÅ	OR	e O	UOUNUOMVS	MKU	VURSOPKUN	UQKVP	RVKR	NOMQ	
pÅ	OR	e É	NPSOVSKRP	MKT	NSMVPNKOP	UQKSV	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	VURVRMKRP	OKN	NMTQOQSKRP	VNKTU	RVKR	NOMQ	
dÉ	TO	e O	POVMQNKOQ	MKS	PVPUSVKSQ	UPKRQ	RVKR	NOMQ	
dÉ	TO	e É	NMRRQNKUT	NKR	NORCSSKVR	UQKOR	RVKR	NOMQ	
v	UV	e O	PSQTNUNKMT	MKR	QPMNURSKUS	UQKTU	RVKR	NOMQ	
v	UV	e É	TOMVOVKOS	NKP	UQNPQOKNU	URKRU	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVUSOTNKOS	MKV	SRVNQQQKUP	NVRKVV	RVKR	NOMQ	
qÄ	NRV	e É	OSMRVNVMPT	NKN	OUSSNVMKN	VMKUV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PSMVSNTHRQ	NKT	PNTPQTOKSU	NNPKTQ	RVKR	NOMQ	
_á	OMV	e É	NRNVQTRKUP	NKQ	NSMVTVTKOQ	VPKUP	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáçå=_ä~åâ=É``_F=oÉéçê

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MSRj``_KÇ

a~í~=m~íÜ=k~ã É aWj^ÖäÉáíçˆ mj eyNya^q^yOMCPyMPJ ^oyi n`OUbkÂ

^Åè=qáã É PLOULOMCP=COMUMNP

p~ã éáÉ=qóéÉ ``_

qçí~äa äáíçå NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑc äÉk~ã É MMQ ^i _KÇ

p~ã éáÉ=n`=m~ëëlcá~ä m~ëë

fpqa=n`=m~ëëlc~äá m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==mp==	iãáá	n`=c~Ö
V	_É	S	kç=d~ë	JMKMMS	ééÄ	kL^	OQNKNO	MO	
NN	_	S	kç=d~ë	MKNUS	ééÄ	UKO	NUUPKQU	Q	
OP	k~	QR	eÉ	NVKOUV	ééÄ	OKN	RROUVKTP	OMM	
OQ	j Ö	QR	eÉ	PKQMS	ééÄ	VKU	NSUSKUP	OM	
OT	^ä	QR	eÉ	MKVPS	ééÄ	PUKN	PMUKVM	OM	
OU	pá	QR	eO	NKPUU	ééÄ	NTKN	VSQKPU	NMM	
PV	h	QR	eÉ	OKNSN	ééÄ	VTKO	PMRPPKNV	OMM	
QM	`~	QR	eO	RKQMN	ééÄ	QKS	OVPNMKSR	OM	
RN	s	UV	eÉ	MKVOR	ééÄ	OSKO	PRUKVM	N	
RO	`ê	UV	eÉ	JMKVPM	ééÄ	kL^	UPPKUT	N	
RR	j å	UV	eÉ	MKNNN	ééÄ	PUNS	NSPKPM	MQ	
RS	cÉ	UV	eO	PKUON	ééÄ	QKT	RQUSRKTU	OM	
RV	`ç	UV	eÉ	JMKMNS	ééÄ	kL^	OMSKSU	MO	
SM	ká	UV	eÉ	JMKMNS	ééÄ	kL^	NQNKNN	MQ	
SP	`ì	UV	eÉ	JMKMMN	ééÄ	kL^	RMPKPR	MS	
SS	wå	UV	eÉ	MKVRO	ééÄ	RPKQ	OQRKRS	O	
TR	^ë	UV	eÉ	MKVON	ééÄ	PMKV	PTKMM	N	
TU	pÉ	UV	eO	MKVOV	ééÄ	NNKT	ONKPP	N	
UU	pê	UV	eÉ	MKNNU	ééÄ	RUKU	NMOKOO	N	
VR	j ç	UV	eÉ	MKNMN	ééÄ	NRKN	RPRKRU	N	
NMT	^Ö	UV	eÉ	MKNNT	ééÄ	ORKO	OOOKOP	MO	
NNN	`Ç	UV	eÉ	MKNNO	ééÄ	VKR	OTKQN	MO	
NNU	på	NRV	eÉ	MKVUO	ééÄ	POKM	RRSKSV	N	
NON	pÄ	NRV	kç=d~ë	MKNNV	ééÄ	POKO	NPQUKNS	MO	
NPT	_~	NRV	kç=d~ë	MKNNU	ééÄ	OKU	PMPKSS	MQ	
NUO	t	NRV	kç=d~ë	MKNMN	ééÄ	QOKR	PVRUKNQ	N	
OMR	qä	OMV	kç=d~ë	MKVOP	ééÄ	UKV	ONPOKQQ	MO	
OMU	mÄ	OMV	kç=d~ë	JMKVOQ	ééÄ	kL^	NSQNKTV	MO	
OPO	qÜ	OMV	kç=d~ë	MKVTQ	ééÄ	OQKV	RTUMKUO	N	
OPU	r	OMV	kç=d~ë	MKVON	ééÄ	TKS	VUQKQO	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j ÇÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=cäÜÜ	n`=c~Ö
iá	S	kç=d~ë	OOQSONNKOP	NKM	NUVQNRTKMT	NNUKRV	RVKR	NOMKQ	
pÅ	QR	kç=d~ë	QNSQQQUKUN	MKQ	QRTPSTVKOQ	VNKVR	RVKR	NOMKQ	
pÅ	QR	eO	URVSTRKQU	NKO	VURSOPKUN	USKPN	RVKR	NOMKQ	
pÅ	QR	eÉ	NQMVUMKQR	MKS	NSMVPNKOP	UTKS	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	NMPNSVVKTV	OKT	NMTQOQSKRP	VSKMQ	RVKR	NOMKQ	
dÉ	TO	eO	PQNVRVKRP	MKV	PVPUSVKSQ	USKUO	RVKR	NOMKQ	
dÉ	TO	eÉ	NNNSNTKTT	MKR	NORCSSKVR	UVKN	RVKR	NOMKQ	
v	UV	eO	PVMMMTPKTP	MKS	QPMNURSKUS	VMKSS	RVKR	NOMKQ	
v	UV	eÉ	TRMPUQKPQ	MKT	UQNPQOKNU	UVKNV	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	TOMQNMNKNN	NKM	SRVNQQQKUP	NMVKOV	RVKR	NOMKQ	
qÄ	NRV	eÉ	OTRCOMQKVV	NKO	OUSSNVMKN	VSKMO	RVKR	NOMKQ	
_á	OMV	kç=d~ë	PTSTPRRKPS	MKS	PNTPQTOKSU	NNUKTN	RVKR	NOMKQ	
_á	OMV	eÉ	NSNSQVPKPR	MKT	NSMVTVTKOQ	NMMKQO	RVKR	NOMKQ	

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É pn MVSMMMV

cãÉ=k~ã É MSSpj mi hÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíyî mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=COMPVQM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKMQT	ééÄ	ORKQ	PNOKCP	NMM	
NN	_	S	k ç=d ~ë	QUKTPT	ééÄ	OKS	PTVVOKQQ	NMMM	
CP	k ~	QR	e É	NTPMMKVCR	ééÄ	MKO	OMPQVSPKUR	OMMMMM	
CQ	j Ö	QR	e É	QRMRKUVR	ééÄ	NKM	OTQTQOKQT	OMMMMM	
CT	^ ä	QR	e É	NTTPKTMT	ééÄ	NKV	QMCCPKCP	OMMMMM	
CU	pá	QR	e O	UMRVKUCN	ééÄ	MKU	RTVSMMCS	NMMMM	
PV	h	QR	e É	POSNKCPT	ééÄ	MKU	NVRVVUPS	OMMMMM	
QM	` ~	QR	e O	NMMPTKTCV	ééÄ	MKT	RQCCRCNKRN	OMMMMM	
RN	s	UV	e É	QKNUN	ééÄ	OKT	PQNMKPT	NMMM	
RO	` ê	UV	e É	OKSSP	ééÄ	PKS	PQRCKSM	OMMM	
RR	j å	UV	e É	NPSKMMT	ééÄ	NKR	SRMMRKRS	OMMM	
RS	cÉ	UV	e O	NSPQKPRP	ééÄ	NKT	PPPRMVVKTR	NMMMMM	
RV	` ç	UV	e É	PKVSN	ééÄ	MKU	STNPKUN	NMMM	
SM	k á	UV	e É	SKUPQ	ééÄ	MKU	POTMKQQ	NMMM	
SP	` ì	UV	e É	NCKVUQ	ééÄ	MKN	NSVSQKVS	OMMM	
SS	wå	UV	e É	QTKNTU	ééÄ	OKV	NMOVTKPO	OMMM	
TR	^ ë	UV	e É	NKVMR	ééÄ	RKR	PNTKMQ	NMMM	
TU	pÉ	UV	e O	MKQQU	ééÄ	NSKT	QOKRM	NMMM	
UU	pê	UV	e É	QTKNMS	ééÄ	MKV	OSSNQKVQ	OMMM	
VR	j ç	UV	e É	MKPQT	ééÄ	NQKM	QMRKRT	NMMM	
NMT	^ Ö	UV	e É	MKMSN	ééÄ	NOKT	NRPKPQ	NMM	
NNN	` Ç	UV	e É	MKNRP	ééÄ	OKM	QVKOS	NMMM	
NNU	på	NRV	e É	MKOTS	ééÄ	NPKO	QQMKN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKTOQ	ééÄ	PKP	QMRNKRQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	PSKVNP	ééÄ	NKS	QTRVTKQD	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKMTU	ééÄ	k L^	OORRKVN	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNNU	ééÄ	SPKQ	UTTHSP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	UKTOT	ééÄ	OKN	TRVPTHPM	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKRMM	ééÄ	OKS	SRUUKTP	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNPQ	ééÄ	NOKT	NNRNKOT	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n` =¡ çï	B n` =¤ä ÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	OMRNMPMSP	OKV	NUVQNRTHMT	NMUKOU	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	PVQUVTQKQV	NKT	QRTPSTVKOQ	USHPQ	RVRR	NOMQ	
pÅ	QR	e O	TTVTTOKVM	NKU	VURSCPKUN	TVKNN	RVRR	NOMQ	
pÅ	QR	e É	NOVPMMKQT	MKR	NSMVPNKCP	UMPR	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VRNNUOKRS	NKM	NMTQOQSKRP	UUKRQ	RVRR	NOMQ	
d É	TO	e O	PMVVSMPQ	MKV	PVPUSVKSQ	TUKT	RVRR	NOMQ	
d É	TO	e É	NMNSNMKVP	OKQ	NORCSSKVR	UNKNO	RVRR	NOMQ	
v	UV	e O	PRROTVQKSO	MKO	QPMNURSKUS	UOKRV	RVRR	NOMQ	
v	UV	e É	SVMONRKTT	NKQ	UQNPQOKNU	UOKMQ	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	STUQNORKPT	MKP	SRVNQQQKUP	NMOKVO	RVRR	NOMQ	
qÄ	NRV	e É	ORRMRRPKQP	MKN	OUSSNVMKN	UUKVV	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PSTMRTNKRS	NKO	PNTPQTOKSU	NNRKSS	RVRR	NOMQ	
_á	OMV	e É	NRMVQTOKTM	NKP	NSMVTVTKQQ	VPKTT	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMNM

cãÉ=k~ã É MSTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qáã É PLOULOMCP=COMUMQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	MKMPS	ééÄ	NNVKU	OVRKRS	NMM	
NN	_	S	k ç=d ~ë	PUKRRP	ééÄ	NKQ	OVUSPKPU	NMMM	
OP	k ~	QR	e É	NVQQQKQMR	ééÄ	NKV	COVSRUQKUN	OMMMMM	
OQ	j Ö	QR	e É	QVPPKUPT	ééÄ	NKO	PMOVUQKSP	OMMMMM	
OT	^ ä	QR	e É	NOMSKSSS	ééÄ	MKQ	OTSCOKQQ	OMMMMM	
OU	pá	QR	e O	TNUTKQSU	ééÄ	NKP	RONSUVKUP	NMMMM	
PV	h	QR	e É	OUSRKOOV	ééÄ	MKU	NTSTVNKTR	OMMMMM	
QM	` ~	QR	e O	VNTTKNQU	ééÄ	NKN	RMVQNQMQU	OMMMMM	
RN	s	UV	e É	PKMTS	ééÄ	OKM	ORTPKSN	NMMM	
RO	` ê	UV	e É	NKVSO	ééÄ	OKO	OTTVKMU	OMMM	
RR	j å	UV	e É	NNSKQRU	ééÄ	OKN	RRRUNKPO	OMMM	
RS	cÉ	UV	e O	NOQMRQN	ééÄ	NKM	OSMUMNSKTP	NMMMM	
RV	` ç	UV	e É	PKMPO	ééÄ	PKS	RNURKSM	NMMM	
SM	k á	UV	e É	RKRVQ	ééÄ	SKV	OSVUKMU	NMMM	
SP	` ì	UV	e É	VRTOP	ééÄ	OKN	NOTVTKNU	OMMM	
SS	wå	UV	e É	QPKPOU	ééÄ	OKP	VQROKOQ	OMMM	
TR	^ ë	UV	e É	NKQQR	ééÄ	PKS	OQQKMP	NMMM	
TU	pÉ	UV	e O	MKOVM	ééÄ	UKT	PNKPP	NMMM	
UU	pê	UV	e É	QQKNOR	ééÄ	NKV	OQUUPKUT	OMMM	
VR	j ç	UV	e É	MKNNU	ééÄ	PVKQ	OTUKVM	NMMM	
NMT	^ Ö	UV	e É	MKMPM	ééÄ	NUKV	VOKOO	NMM	
NNN	` Ç	UV	e É	MKNMP	ééÄ	NQKT	PRKVP	NMMM	
NNU	på	NRV	e É	MKOOO	ééÄ	OQKV	QMTKTV	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKSOP	ééÄ	NOKP	PRUMKVP	NMMM	
NPT	_~	NRV	k ç=d ~ë	PMKNOQ	ééÄ	MKO	PUSOUKVT	OMMM	
NUO	t	NRV	k ç=d ~ë	JMPQM	ééÄ	k L^	NRUUKOR	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKOP	ééÄ	k L^	SNQKMM	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QKVRT	ééÄ	NKU	QPQNTKSU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKPQQ	ééÄ	NKO	RPPMKMV	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMTS	ééÄ	NSKV	TPTKQT	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=pÉÅ	B n ` =i çï	B n ` =eáÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	OMCPNMVRTV	NKU	NUVQNRTKMT	NVSKUN	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	QMVSPTTKSU	MKU	QRTPSTVKOQ	UTHS	RVRR	NOMQ	
pÅ	QR	e O	TUSVPQKSU	MKV	VURSCPKUN	TVKUQ	RVRR	NOMQ	
pÅ	QR	e É	NPMCQQKCU	NKO	NSMVPNKCP	UMKVP	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VUOMVMPS	NKM	NMTQQQSKRP	VNKQO	RVRR	NOMQ	
d É	TO	e O	PNNSURKNU	MKS	PVPUSVKSQ	TVKNP	RVRR	NOMQ	
d É	TO	e É	NMNUPPKMU	MKS	NORCSSKVR	UNKOV	RVRR	NOMQ	
v	UV	e O	PSRSPNVKOQ	MKQ	QPMNURSKUS	UQKVV	RVRR	NOMQ	
v	UV	e É	SUUVOQKNT	MKR	UQNPQOKNU	UNKUU	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	STQNQSMKVM	MKT	SRVNQQQKUP	NMOKCU	RVRR	NOMQ	
qÄ	NRV	e É	CRPUSQRKRQ	NKN	CUSSNVMKN	UUKRT	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PSMMVVUKSM	MKU	PNTPQTOKSU	NNPKQT	RVRR	NOMQ	
_á	OMV	e É	NRCPQSRKTN	NKS	NSMVTVTKOQ	VQKSQ	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMNO

cãÉ=k~ã É MSUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=COMPMRQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMKMNU	ééÄ	k L^	CPSKST	NMM	
NN	_	S	k ç=d ~ë	PTKVPN	ééÄ	CKU	OVTUSKRT	NMMM	
CP	k ~	CR	e É	NMVRNKSNU	ééÄ	CKR	COSTNVPKCN	CMMMMM	
CQ	j Ö	CR	e É	QUQTKOTV	ééÄ	CKR	OVVROTKVV	CMMMMM	
CT	^ ä	CR	e É	NCMCKRUV	ééÄ	CKR	CTTQTKNR	CMMMMM	
CU	pá	CR	e O	TNMPKPUR	ééÄ	NKQ	RNUPQTKCP	NMMMM	
PV	h	CR	e É	CURCKRNS	ééÄ	CKQ	NTTCQSKRN	CMMMMM	
QM	` ~	CR	e O	VNQQKTMU	ééÄ	NKO	RMNPCMVKQQ	CMMMMM	
RN	s	UV	e É	PKNCM	ééÄ	CKU	OSNVKNU	NMMM	
RO	` ê	UV	e É	CKMRO	ééÄ	CKS	CUTUKQO	CMMM	
RR	j å	UV	e É	NNRKPTT	ééÄ	NKP	RRPPPKSR	CMMM	
RS	cÉ	UV	e O	NCSRKRRU	ééÄ	NKO	OSPPSMVKUO	NMMMM	
RV	` ç	UV	e É	PKMPU	ééÄ	MKU	RCNUKVR	NMMM	
SM	k á	UV	e É	RKSTM	ééÄ	CKO	CTCRKUU	NMMM	
SP	` ì	UV	e É	NMKMPN	ééÄ	CKT	NPCQVKUR	CMMM	
SS	wå	UV	e É	QTKOTT	ééÄ	NKR	NMPQTKPQ	CMMM	
TR	^ ë	UV	e É	NKRCS	ééÄ	CKM	CRUKMP	NMMM	
TU	pÉ	UV	e O	MKPTP	ééÄ	PSKT	PTKRM	NMMM	
UU	pê	UV	e É	QQKQQP	ééÄ	MKU	CRNUQKCR	CMMM	
VR	j ç	UV	e É	MKMMP	ééÄ	NRCPKO	CNSKST	NMMM	
NMT	^ Ö	UV	e É	MKMCQ	ééÄ	NSKU	UNKNN	NMM	
NNN	` Ç	UV	e É	MKMVN	ééÄ	PTKT	POKVS	NMMM	
NNU	på	NRV	e É	MKNST	ééÄ	PPKS	PUMKN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKRSM	ééÄ	VKM	PPNTKCQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	PNKNMM	ééÄ	NKV	QMNNKQV	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKRNN	ééÄ	k L^	NNSQKSP	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKVQQ	ééÄ	k L^	QUPKUS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	RKMSU	ééÄ	CKU	CPURCKNU	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MCOSS	ééÄ	TKS	QTNRKVM	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMSU	ééÄ	OMR	STTKQN	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n` =ï çï	B n` =¤ä ÜÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	OMQVTRNKMR	MKS	NUVQNRTKMT	NMUKCN	RVRR	NOMQ	
pÅ	CR	k ç=d ~ë	PVQSVQPKMR	MKU	QRTPSTVKOQ	USKP	RVRR	NOMQ	
pÅ	CR	e O	TVNNPTKVN	MKO	VURSCPKUN	UMKOT	RVRR	NOMQ	
pÅ	CR	e É	NPNNMQRTQ	CKP	NSMVPNKCP	UNKQT	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VSNRVRKQT	NKS	NMTQQQSKRP	UVKRN	RVRR	NOMQ	
d É	TO	e O	PNQMRUKUP	MKS	PVPUSVKSQ	TVKTQ	RVRR	NOMQ	
d É	TO	e É	NMONSTKRS	MKP	NCRCSSKVR	UNKRS	RVRR	NOMQ	
v	UV	e O	PSNVQQSKOM	MKP	QPMNURSKUS	UQKNQ	RVRR	NOMQ	
v	UV	e É	SVCCPPKVS	MKR	UQNPQCKNU	UCKCU	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	STSCOTTKSR	MKQ	SRVNQQQKUP	NMCKRV	RVRR	NOMQ	
qÄ	NRV	e É	CRRRMQTKUU	NKR	CUSSNVMKN	UVKNQ	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PRSCQSRKUV	NKS	PNTPQTCKSU	NNCKCS	RVRR	NOMQ	
_á	OMV	e É	NRNOTVCKVN	NKO	NSMVTVTKQQ	VPKVT	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMNP

cãÉ=k~ã É MSVpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=COAOUAQN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKNRN	ééÄ	k L^	UOKOO	NMM	
NN	_	S	k ç=d ~ë	NKPRQ	ééÄ	UKR	OMSPKRO	NMMM	
OP	k ~	QR	e É	NPUKOPU	ééÄ	PKV	RRSSTKQQ	OMMMMM	
OQ	j Ö	QR	e É	ONKMVR	ééÄ	UKU	NUMMKNU	OMMMMM	
OT	^ ä	QR	e É	NPKORP	ééÄ	NRKM	QTTKUM	OMMMMM	
OU	pá	QR	e O	PTKNPR	ééÄ	TKS	PNMMKPM	NMMMM	
PV	h	QR	e É	PTKPTV	ééÄ	OPKS	OVQQVKTM	OMMMMM	
QM	` ~	QR	e O	SRKPQP	ééÄ	NKT	QUOPMKVN	OMMMMM	
RN	s	UV	e É	MRKVO	ééÄ	NVKU	SVMKMP	NMMM	
RO	` ê	UV	e É	JMKMV	ééÄ	k L^	VMVKUS	OMMM	
RR	j å	UV	e É	MKQUV	ééÄ	NUKQ	PRVKVQ	OMMM	
RS	cÉ	UV	e O	PKVNT	ééÄ	TKV	NVPQSKVO	NMMMM	
RV	` ç	UV	e É	JMKNMO	ééÄ	k L^	TNKNN	NMMM	
SM	k á	UV	e É	MKMRM	ééÄ	PSKU	NSTKTU	NMMM	
SP	` ì	UV	e É	MKMRT	ééÄ	QSKP	RQOKOQ	OMMM	
SS	wå	UV	e É	SKSMV	ééÄ	RKP	NRVVKMN	OMMM	
TR	^ ë	UV	e É	MKNOM	ééÄ	QVKS	PSKPQ	NMMM	
TU	pÉ	UV	e O	JMKMOS	ééÄ	k L^	SKRM	NMMM	
UU	pê	UV	e É	MKNOV	ééÄ	ORKS	NNSKST	OMMM	
VR	j ç	UV	e É	JMKMUO	ééÄ	k L^	NTMKMM	NMMM	
NMT	^ Ö	UV	e É	JMKMVP	ééÄ	k L^	OTKTU	NMM	
NNN	` Ç	UV	e É	JMKMOM	ééÄ	k L^	PKTM	NMMM	
NNU	på	NRV	e É	MKNMN	ééÄ	PUKR	PQNKNO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMPO	ééÄ	NONKS	VUQKQO	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKNTU	ééÄ	NPKU	PVTKMV	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKRRN	ééÄ	k L^	NVRTKUQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMSU	ééÄ	k L^	PQMKPS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMNV	ééÄ	UNKT	OSSVKSN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKMPP	ééÄ	k L^	ORTPKMM	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMOO	ééÄ	k L^	UMKMV	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B¤ÉÅ	B n` =¨çï	B n` =¤ëÛÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	OMTCOOQMKMU	MKO	NUVQNRTKMT	NMVKQ	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVUQTPNKUU	MKR	QRTPSTVKOQ	UTKNO	RVKR	NOMKQ	
pÅ	QR	e O	TVNCOUKUS	NKN	VURSCPKUN	UMKCU	RVKR	NOMKQ	
pÅ	QR	e É	NOVSPTKUP	NKR	NSMVPNKCP	UMKRR	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VRSCPPKSM	NKR	NMTQOQSKRP	UVKMN	RVKR	NOMKQ	
d É	TO	e O	PNSMTNKMP	MKU	PVPUSVKSQ	UMKCR	RVKR	NOMKQ	
d É	TO	e É	NMOTTSKTU	MKS	NORCSSKVR	UOKMR	RVKR	NOMKQ	
v	UV	e O	PSMNRQTHPS	NKM	QPMNURSKUS	UPKTO	RVKR	NOMKQ	
v	UV	e É	SVQRUMPR	NKR	UQNPQOKNU	UOKRS	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	STNSQTQKNR	MKO	SRVNQQQKUP	NMNKV	RVKR	NOMKQ	
qÄ	NRV	e É	CRQQSUPKSM	NKM	OUSSNVMKN	UUKTU	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRRUUSRKQM	NKP	PNTPQTOKSU	NNOKNQ	RVKR	NOMKQ	
_á	OMV	e É	NRVBSQRKRN	OKM	NSMVTVTKOQ	VPKRV	RVKR	NOMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` ONfj t O
cáÉ=k~ã É	MTM| m_KÇ
a~í~=m~íÜ=k~ã É	a Wy^ÖäÉáíyf` mj e yNya^q^yOMOPyMPJ ^o yi n` OUbKÄ
^Åè=qáã É	PLOULOMOP=OOMPVQV
p~ã éäÉ=qóéÉ	m_
qçí~ä=aáä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMQ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	m~ëë
fpqa=n` =m~ëëLc~áä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	o pa	==` mp==	i áã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	JMKNSP	ééÄ	k L^	SRKRR	MKR	
_	NN	S	k ç=d ~ë	NKMQU	ééÄ	NKU	NTTNKOR	NM	
k~	OP	QR	e É	NOPKTTP	ééÄ	TKM	RPTUUKUV	RMM	
j Ö	OQ	QR	e É	RKSTU	ééÄ	NSKP	URRKSN	RM	
^ä	OT	QR	e É	NQKRQN	ééÄ	NMKV	RMRKRT	RM	
pá	OU	QR	e O	NVKNRR	ééÄ	TKO	NTTRKPP	ORM	
h	PV	QR	e É	QOKNNU	ééÄ	RKS	OVRURKMO	RMM	
` ~	QM	QR	e O	QMKUTU	ééÄ	OKT	PQSMSKUS	RM	
s	RN	UV	e É	MKRVP	ééÄ	UKQ	SUPKPS	OKR	
` ê	RO	UV	e É	JMKMVT	ééÄ	k L^	UNTKOM	OKR	
j å	RR	UV	e É	MKQVM	ééÄ	UKO	PRTKOT	N	
cÉ	RS	UV	e O	MKUQT	ééÄ	UKV	NOUSVKQS	RM	
` ç	RV	UV	e É	JMKMVV	ééÄ	k L^	TRKRS	MKR	
k á	SM	UV	e É	JMKMNO	ééÄ	k L^	NPTKTU	N	
` ì	SP	UV	e É	MKPPQ	ééÄ	NMKV	UUTKUO	NKR	
wå	SS	UV	e É	QKONM	ééÄ	PKS	NMTMKMS	R	
^ë	TR	UV	e É	MKNNQ	ééÄ	NPKQ	PRKMM	OKR	
pÉ	TU	UV	e O	JMKMNM	ééÄ	k L^	TKST	OKR	
pê	UU	UV	e É	MKMSS	ééÄ	RPKN	UMKMM	OKR	
j ç	VR	UV	e É	JMKNNS	ééÄ	k L^	NRMKMM	OKR	
^Ö	NMT	UV	e É	JMKMMP	ééÄ	k L^	OTKTU	MKR	
` Ç	NNN	UV	e É	JMKMON	ééÄ	k L^	PKPP	MKR	
på	NNU	NRV	e É	JMKMSP	ééÄ	k L^	OQUKUV	OKR	
pÄ	NON	NRV	k ç=d ~ë	MKMOS	ééÄ	VSKV	VTQKQM	MKR	
_~	NPT	NRV	k ç=d ~ë	MKMOS	ééÄ	ONMKV	OMSKUV	N	
t	NUO	NRV	k ç=d ~ë	JMKRUN	ééÄ	k L^	NMMNKNM	OKR	
qä	OMR	OMV	k ç=d ~ë	JMKMST	ééÄ	k L^	PQTKMQ	MKR	
mÄ	OMU	OMV	k ç=d ~ë	JMKONM	ééÄ	k L^	UMQKOM	MKR	
qÜ	OPO	OMV	k ç=d ~ë	JMKMRN	ééÄ	k L^	OQQQKUN	OKR	
r	OPU	OMV	k ç=d ~ë	JMKMOQ	ééÄ	k L^	SSKTQ	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	OMVSSTSKSU	MKN	NUVQNRTKMT	NMRKVQ	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	PVVVRTNKSS	NKN	QRTPSTVKQQ	UTKQR	RVKR	NOMQ	
pÅ	QR	eO	TURSSRKTQ	MKS	VURSQPKUN	TVKTN	RVKR	NOMQ	
pÅ	QR	eÉ	NQVNQMQN	MKV	NSMVPNKQP	UMKQR	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VRRNPQKTS	MKS	NMTQQQSKRP	UUKVN	RVKR	NOMQ	
dÉ	TO	eO	PMUSVQKVN	NKN	PVPUSVKSQ	TUKPT	RVKR	NOMQ	
dÉ	TO	eÉ	NMNSQRKVT	NKR	NQRQSSKVR	UNKNP	RVKR	NOMQ	
v	UV	eO	PRRVTUQKPM	NKO	QPMNURSKUS	UQKTR	RVKR	NOMQ	
v	UV	eÉ	SUTTQSKPQ	NKN	UQNPQQKNU	UNKTQ	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	SUQTQTVKNV	MKS	SRVNQQQKUP	NMPKUU	RVKR	NOMQ	
qÄ	NRV	eÉ	QRPUNNNKVS	NKN	QUSSNVMKN	UUKRR	RVKR	NOMQ	
_á	QMV	kç=dl~ë	PRSNPVVKTP	MKU	PNTPQTQKSU	NNQKQO	RVKR	NOMQ	
_á	QMV	eÉ	NQVNQVVKOV	NKO	NSMVTVTKQQ	VQKSR	RVKR	NOMQ	

i ~ÄçêíçêóÈçåíêçäp~ã éäÉÈi `pF¤oÉéçã

p~ã éäÉ¤k~ã É	i `pt n`ONfj t O
cäÉ¤k~ã É	MTN `pt kÇ
a~í~¤m~íÜ¤k~ã É	aWf ÖäÉáíyf mj eyNya^q^yOMOPyMPJ ^oyi n`OUbkÄ
^Åè¤qã É	PLOULOMOP¤OOMPUMRS
p~ã éäÉ¤qóéÉ	i `pt
qçí~äaäi íáçå	RKMMMM
`çã ã Éáí	JJJ
fpqa¤oÉÑcäÉk~ã É	MMQ ^i _kÇ
p~ã éäÉ¤n`¤m~ëëlcá~ä	c~äi
fpqa¤n`¤m~ëëlc~äi	m~ëë
l éÉê~íçê	**~Çã åä**

n`¤å~äöíÉ¤q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÄK	r åáë	opa	==¤mp==	bñés~ä	B¤oÉÁ	Bi çï	BeáÖÜ	n`¤cä-Ö
_É	V	S	kç¤dl~ë	RPKPRV	éëÄ	MRT	SMSSRK/S	RM	ONKPQ	TVKR	NOMQ	
_	NN	S	kç¤dl~ë	RNOKMRQ	éëÄ	MK/	PTTTMRKMS	RMM	OMKQU	TVKR	NOMQ	
k~	OP	QR	eÉ	UUSMSSS	éëÄ	MK/	NMSQSMSKRO	TRMM	OPKSP	TVKR	NOMQ	açа
j Ö	OQ	QR	eÉ	RRUTKRRS	éëÄ	NKS	PQNRPUKOR	RMMM	OOKPR	TVKR	NOMQ	
^ä	OT	QR	eÉ	OPVTKMSS	éëÄ	NKP	RQQRSKNS	OMMM	OPK/T	TVKR	NOMQ	açа
pá	OU	QR	eO	NNOPKMMS	éëÄ	MRT	UNVPOKMP	NMMM	OOKQS	M	OMM	
h	PV	QR	eÉ	NMRQUKORO	éëÄ	NKP	RTQONSKUU	NMMMM	ONKN	TVKR	NOMQ	
`~	QM	QR	eO	OUOSKNST	éëÄ	MKP	NRRNQMVKQS	ORMM	OOKSN	TVKR	NOMQ	
s	RN	UV	eÉ	RSQRTVM	éëÄ	NKO	QORRNPRTM	RMM	OORRV	TVKR	NOMQ	
`ê	RO	UV	eÉ	OOUKQMP	éëÄ	NRT	ONSONRKRM	OMM	OOKUQ	TVKR	NOMQ	
j å	RR	UV	eÉ	RSTKTRU	éëÄ	OKM	OSTUOPKPV	RMM	OORTN	TVKR	NOMQ	
cÉ	RS	UV	eO	NMVSKTRP	éëÄ	NKM	OOSUROTKVP	NMMM	ONK/Q	TVKR	NOMQ	
`ç	RV	UV	eÉ	RVVKNQM	éëÄ	PKU	VSUNTORTM	RMM	OPK/S	TVKR	NOMQ	açа
ká	SM	UV	eÉ	RTVKMTQ	éëÄ	OKS	OSNVSVKOS	RMM	OPKNS	TVKR	NOMQ	
`ì	SP	UV	eÉ	OVNKRNT	éëÄ	PKN	PSSRMTHSR	ORM	OPKPO	TVKR	NOMQ	
wå	SS	UV	eÉ	RSRKUQU	éëÄ	NRT	NOMNVNKSU	RMM	OOKSP	TVKR	NOMQ	
^ë	TR	UV	eÉ	NMPKUPQ	éëÄ	NKO	NSNRSKPT	NMM	OMRTT	TVKR	NOMQ	
pÉ	TU	UV	eO	NMOKNPO	éëÄ	NKP	TUSUKPR	NMM	OMKQP	TVKR	NOMQ	
pê	UU	UV	eÉ	RPQKMVR	éëÄ	MKP	OVTUROKPP	RMM	ONKPT	TVKR	NOMQ	
j ç	VR	UV	eÉ	NMVK/QQ	éëÄ	MKU	SMNVTKTS	NMM	ONK/V	TVKR	NOMQ	
^Ö	NMT	UV	eÉ	RRRTQV	éëÄ	NKM	NMUROTKRP	RM	OOKP	TVKR	NOMQ	
`Ç	NNN	UV	eÉ	OUNRTMP	éëÄ	NKM	TPQNPRTT	ORM	OORRQ	TVKR	NOMQ	
på	NNU	NRV	eÉ	RMOKQMN	éëÄ	MK/	OTVRQMKPV	RMM	OMKN	TVKR	NOMQ	
pÄ	NON	NRV	kç¤dl~ë	NMVKUPV	éëÄ	MKP	QQNPPMKMP	NMM	OMKNT	TVKR	NOMQ	
_~	NPT	NRV	kç¤dl~ë	OOVMKQMN	éëÄ	NKQ	OVMVQQNKUV	OMMM	OOK/	TVKR	NOMQ	açа
t	NUO	NRV	kç¤dl~ë	NNQKQTV	éëÄ	NKS	OUSUVOKUR	NMM	OOK/	TVKR	NOMQ	
qä	OMR	OM/	kç¤dl~ë	NMOKTQT	éëÄ	NK/	SNOPSUKST	NMM	OMRRR	TVKR	NOMQ	
mÄ	OMU	OM/	kç¤dl~ë	NMSKTUU	éëÄ	NRR	UTNQPSKRO	NMM	ONKPS	TVKR	NOMQ	
qÜ	OPO	OM/	kç¤dl~ë	NMRKQVS	éëÄ	MRR	TRTRMRKTR	NMM	ONKN	TVKR	NOMQ	
r	OPU	OM/	kç¤dl~ë	NNOKUUN	éëÄ	MKU	TRNUPVKTO	NMM	OORRU	TVKR	NOMQ	

n`¤fpqa¤q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä-Ö
iá	S	kç=d~ë	NVUTVPUVST	NKM	NUVQNRTKMT	NMQKVR	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PVRPPVPKCP	NKP	QRTPSTVKCQ	USKQQ	RVKR	NOMQ	
pÅ	QR	eO	TUTUNMKRN	MKR	VURSCPKUN	TVKVP	RVKR	NOMQ	
pÅ	QR	eÉ	NCVSURKSV	NKQ	NSMVPNKCP	UMKRU	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VRTQMQKPU	NKT	NMTQCQSKRP	UVKNO	RVKR	NOMQ	
dÉ	TO	eO	PNCNMRKNT	MKP	PVPUSVKSQ	TVKCQ	RVKR	NOMQ	
dÉ	TO	eÉ	NMNCRUKCS	MKQ	NCRCSSKVR	UMKUP	RVKR	NOMQ	
v	UV	eO	PRVRNMTKMP	MKR	QPMNURSKUS	UPKRT	RVKR	NOMQ	
v	UV	eÉ	SUCNVVKVV	NKN	UQNPQCKNU	UNKMU	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	STMTRVCKNU	MKS	SRVNQQQKUP	NMNKTS	RVKR	NOMQ	
qÄ	NRV	eÉ	CRPCPRNKRM	MKV	CUSSNVMKN	UUKQO	RVKR	NOMQ	
_á	QMV	kç=d~ë	PRRPRSTKTN	MKS	PNTPQTCKSU	NNNKU	RVKR	NOMQ	
_á	QMV	eÉ	NQVSRVCKMS	MKU	NSMVTVTKCQ	VCKVT	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NMNRJMCQ

cãÉ=k~ã É MTCpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÃ

^Åè=qãã É PLCULCMCP=COMQSMRN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKMVR	ééÄ	k L^	NQSKST	NMM	
NN	_	S	k ç=d ~ë	PKQMQ	ééÄ	QKT	PRUUKCU	NMMM	
CP	k ~	QR	e É	SSKSRV	ééÄ	QKR	QTQTMKPQ	CMMMMM	
CQ	j Ö	QR	e É	VKMVR	ééÄ	UKS	NMSUKVT	CMMMMM	
CT	^ ä	QR	e É	OVKUQQ	ééÄ	VKR	URQKQV	CMMMMM	
CU	pá	QR	e O	NVKTRN	ééÄ	PKQ	NUPUKTO	NMMMM	
PV	h	QR	e É	NRKTVV	ééÄ	TNKR	CUPTQKST	CMMMMM	
QM	` ~	QR	e O	CQKPUR	ééÄ	PKQ	CRVPMKSO	CMMMMM	
RN	s	UV	e É	NKMNT	ééÄ	RKN	NMCMKMS	NMMM	
RO	` ê	UV	e É	MKCCN	ééÄ	NVKS	NNPRKNS	CMMM	
RR	j å	UV	e É	MKQQS	ééÄ	OVKV	PQMKSN	CMMM	
RS	cÉ	UV	e O	NKNPO	ééÄ	CMKR	NPSQTHSM	NMMMM	
RV	` ç	UV	e É	MKPRN	ééÄ	NUKV	UNTKUP	NMMM	
SM	k á	UV	e É	MKVPU	ééÄ	NTHN	RTUKVN	NMMM	
SP	` ì	UV	e É	MKCSQ	ééÄ	NSKU	UNMKMQ	CMMM	
SS	wå	UV	e É	CKNRT	ééÄ	NQKO	SQMKMP	CMMM	
TR	^ ë	UV	e É	MKCPO	ééÄ	RKU	RQHPQ	NMMM	
TU	pÉ	UV	e O	MKNPN	ééÄ	RKP	NUKST	NMMM	
UU	pê	UV	e É	MKPRS	ééÄ	NNHP	CQQSKST	CMMM	
VR	j ç	UV	e É	MKNCR	ééÄ	OVKU	CUSKST	NMMM	
NMT	^ Ö	UV	e É	MKMPP	ééÄ	NVKT	NMMKMM	NMM	
NNN	` Ç	UV	e É	MKNUN	ééÄ	NNHP	RTHKMQ	NMMM	
NNU	på	NRV	e É	MKSCP	ééÄ	CQHKM	SPCHKPO	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKNRV	ééÄ	CHKQ	NRQNKTO	NMMM	
NPT	_~	NRV	k ç=d ~ë	CKCUP	ééÄ	SKR	PMUMKPM	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKNTT	ééÄ	k L^	NVVCKOT	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNVQ	ééÄ	THN	NVCCKNT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKNMS	ééÄ	k L^	NSTNKUO	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	NKMSN	ééÄ	THM	NMRCRKRP	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNMM	ééÄ	QKR	VMMKVV	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ ÉÅ	B n ` =¡ çï	B n ` =¤ äÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	OMQRUMPKPU	NKT	NUVQNRTHMT	NMUKMN	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PVTNNRUKRN	OKU	QRTPSTVKOQ	USKUP	RVHR	NOMQ	
pÅ	QR	e O	TVQPMNKRQ	NHR	VURSCPKUN	UMKRV	RVHR	NOMQ	
pÅ	QR	e É	NOVUQQKOQ	NHR	NSMVPNKCP	UMHSU	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VSVPCOKOV	MKT	NMTQQQSKRP	VMKCP	RVHR	NOMQ	
d É	TO	e O	PNTRNVKVT	MKO	PVPUSVHSQ	UMHSO	RVHR	NOMQ	
d É	TO	e É	NMOSTSKPV	MKT	NCRCSSKVR	UNKVT	RVHR	NOMQ	
v	UV	e O	PSNCRSQKRP	NKN	CPMNURSKUS	UPKVU	RVHR	NOMQ	
v	UV	e É	SVTTRMKRV	NHR	UQNPCOKNU	UOKVP	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	STOVCNSKNU	MKT	SRVNQQQKUP	NMOKMV	RVHR	NOMQ	
qÄ	NRV	e É	CRQRRPSKMU	NHR	CUSSNVMKN	UUKUN	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PSMMQVPKTU	NKN	PNTPQTOKSU	NNPKQS	RVHR	NOMQ	
_á	OMV	e É	NRMRSNMKSV	NHP	NSMVTVTKOQ	VPHRP	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMMV

cãÉ=k~ã É MTPpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOULOMCP=COARNMRV

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKNOO	ééÄ	k L^	NNRKRS	NMM	
NN	_	S	k ç=d ~ë	NKVTN	ééÄ	VKS	ORNNKPU	NMMM	
OP	k ~	QR	e É	VRKPOT	ééÄ	NOKS	RMPQSKNU	OMMMMM	
OQ	j Ö	QR	e É	NOKTQQ	ééÄ	NTHR	NOUMKNM	OMMMMM	
OT	^ ä	QR	e É	NMKUOR	ééÄ	VKP	SOOKOR	OMMMMM	
OU	pá	QR	e O	NMNKPVR	ééÄ	NKT	TTPPKRU	NMMMM	
PV	h	QR	e É	QVKMRM	ééÄ	VKQ	OVUQRKPT	OMMMMM	
QM	` ~	QR	e O	UPKPPU	ééÄ	NKU	RTSUOKVP	OMMMMM	
RN	s	UV	e É	MKTMP	ééÄ	OKU	TSTKUN	NMMM	
RO	` ê	UV	e É	MKMSR	ééÄ	SNKP	VTNKUR	OMMM	
RR	j å	UV	e É	NKSPV	ééÄ	QKP	VMPKUS	OMMM	
RS	cÉ	UV	e O	THPOR	ééÄ	MKP	OSPPRKRT	NMMMMM	
RV	` ç	UV	e É	MKMRM	ééÄ	PSKO	PNTKTV	NMMM	
SM	k á	UV	e É	MKNUV	ééÄ	OKO	OPMKMN	NMMM	
SP	` ì	UV	e É	NKQUM	ééÄ	QKO	OPQMKOQ	OMMM	
SS	wå	UV	e É	RKTOQ	ééÄ	NKN	NPVRKSS	OMMM	
TR	^ ë	UV	e É	MKNST	ééÄ	POKO	OPHPQ	NMMM	
TU	pÉ	UV	e O	MKMNN	ééÄ	OTPKT	VKPP	NMMM	
UU	pê	UV	e É	MKOQO	ééÄ	NPKQ	NTUKVM	OMMM	
VR	j ç	UV	e É	MKMPQ	ééÄ	SOKR	OPOKOP	NMMM	
NMT	^ Ö	UV	e É	MKMMV	ééÄ	VOKP	RNKNN	NMM	
NNN	` Ç	UV	e É	MKMRV	ééÄ	NTKO	OQKQQ	NMMM	
NNU	på	NRV	e É	MKOQN	ééÄ	NUKM	QNRKRT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMSS	ééÄ	POKT	NNOTKVN	NMMM	
NPT	_~	NRV	k ç=d ~ë	NKRUT	ééÄ	THM	ONTRKUM	OMMM	
NUO	t	NRV	k ç=d ~ë	JMPTR	ééÄ	k L^	NQUQKVV	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMOT	ééÄ	NSKR	VMTHSS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKNQM	ééÄ	k L^	NPTQKUO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKOTP	ééÄ	TKO	QTTOKSN	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMOM	ééÄ	TTHS	PRTHMR	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ ÉÅ	B n` =¨ çï	B n` =¤ëÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	OMRNUNPKMP	NKP	NUVQNRTHMT	NMUHPO	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	PVQTRQQKTQ	NKN	QRTPSTVKOQ	USHPN	RVRR	NOMQ	
pÅ	QR	e O	TURVNMRTN	MKS	VURSCPKUN	TVRTQ	RVRR	NOMQ	
pÅ	QR	e É	NOUTOMQT	MKV	NSMVPNKCP	TVRVU	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VQUQTPHRR	NKU	NMTQOQSKRP	UUKOV	RVRR	NOMQ	
d É	TO	e O	PNPUONPR	MKS	PVPUSVHSQ	TVHSU	RVRR	NOMQ	
d É	TO	e É	NMNQMRKQV	NKT	NORCSSKVR	UMKVR	RVRR	NOMQ	
v	UV	e O	PRVRVSVHRS	MKV	QPMNURSKUS	UPHRV	RVRR	NOMQ	
v	UV	e É	SUUQSSKNQ	NKT	UQNPQOKNU	UNKUP	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSTPQTRKNT	NKV	SRVNQQQKUP	NMVHOQ	RVRR	NOMQ	
qÄ	NRV	e É	ORNVMUUKNO	NKT	OUSSNVMKN	UTKUV	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PRSUSUQKUV	MKR	PNTPQTOKSU	NNOKQR	RVRR	NOMQ	
_á	OMV	e É	NQVOVONKMV	MKS	NSMVTVTHOQ	VORTQ	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNM

cãÉ=k~ã É MTQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=COARTWMT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKNCR	ééÄ	k L^	URKRS	NMM	
NN	_	S	k ç=d ~ë	NKGMD	ééÄ	NMR	ONRSKUT	NMMM	
CP	k ~	CR	e É	NCUKSUS	ééÄ	THP	RQSVSKSU	CMMMMM	
CQ	j Ö	CR	e É	NQKQCR	ééÄ	SKP	NPVRKST	CMMMMM	
CT	^ ä	CR	e É	CCKQVO	ééÄ	NNKO	SUUKVO	CMMMMM	
CU	pá	CR	e O	OTKVTQ	ééÄ	NMP	CQCSKNN	NMMMM	
PV	h	CR	e É	PUKSTQ	ééÄ	CQKQ	OVRVPKCM	CMMMMM	
QM	` ~	CR	e O	RCKMNR	ééÄ	NKO	QMUOTKTQ	CMMMMM	
RN	s	UV	e É	MKSRT	ééÄ	CKM	TOTKUN	NMMM	
RO	` ê	UV	e É	MKMRN	ééÄ	NPTKQ	VRNKUR	CMMM	
RR	j å	UV	e É	MKPCP	ééÄ	NKM	OURKOU	CMMM	
RS	cÉ	UV	e O	SKGRM	ééÄ	RKP	CRNNCKNP	NMMMMM	
RV	` ç	UV	e É	JMKMCR	ééÄ	k L^	NVPKPQ	NMMM	
SM	k á	UV	e É	MKNCM	ééÄ	STKQ	NVSKST	NMMM	
SP	` ì	UV	e É	MKRCR	ééÄ	CKR	NNQTKUQ	CMMM	
SS	wå	UV	e É	VKMVV	ééÄ	PKR	CNMCKCO	CMMM	
TR	^ ë	UV	e É	MKNPO	ééÄ	PCKP	PTKST	NMMM	
TU	pÉ	UV	e O	JMKMDO	ééÄ	k L^	SKUP	NMMM	
UU	pê	UV	e É	MKMMN	ééÄ	OVKN	VUKUV	CMMM	
VR	j ç	UV	e É	JMKNCM	ééÄ	k L^	NQSKST	NMMM	
NMT	^ Ö	UV	e É	MKMMR	ééÄ	OTUKP	CPKPP	NMM	
NNN	` Ç	UV	e É	MKMDS	ééÄ	VOKR	NRKRS	NMMM	
NNU	på	NRV	e É	MKOVU	ééÄ	UKM	CQLUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMSN	ééÄ	RVKN	NNMCKRQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKTNR	ééÄ	UPKV	NMTNKCN	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKCRR	ééÄ	k L^	NOVNKQQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMMN	ééÄ	QTNQKN	TQTKQV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKMQM	ééÄ	k L^	ONTVKMR	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNRP	ééÄ	OPKV	PVMNKQM	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMOM	ééÄ	CQLUKV	PRMKPU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVUPSQRKQU	MKV	NUVQNRTKMT	NVQKTO	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVPURCCKTR	NKM	QRTPSTVKCQ	USKNN	RVKR	NOMQ	
pÅ	CR	e O	TUMVNTKNP	NKQ	VURSCPKUN	UMMVR	RVKR	NOMQ	
pÅ	CR	e É	NOVVQUKSQ	MKQ	NSMVPNKCP	UMRTR	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VQURCTKTR	MKP	NMTQCQSKRP	UUKP	RVKR	NOMQ	
d É	TO	e O	PNCCRSKSQ	MKQ	PVPUSVKSQ	TVKCU	RVKR	NOMQ	
d É	TO	e É	NMNURNKQQ	MKO	NCRCSSKVR	UNKPN	RVKR	NOMQ	
v	UV	e O	PSNVVRNKQT	MKO	CPMNURSKUS	UQKNR	RVKR	NOMQ	
v	UV	e É	SUPPUVKOV	NKM	UQNPCCKNU	UNKCP	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSVNVVRKNP	NKQ	SRVNQQQKUP	NMVKRP	RVKR	NOMQ	
qÄ	NRV	e É	CRPMCCCKVN	MKS	CUSSNVMKN	UUKOV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRSQMRCKPS	CKR	PNTPQTCKSU	NNCKPN	RVKR	NOMQ	
_á	OMV	e É	NRNNQUMKUQ	NKN	NSMVTVTKQQ	VPKUV	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNN

cãÉ=k~ã É MTRpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=CPAMOMS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKNRV	ééÄ	k L^	TOKCO	NMM	
NN	_	S	k ç=d ~ë	UKPVT	ééÄ	PKS	TQPQKCR	NMMM	
CP	k ~	CR	e É	PMMTKSMS	ééÄ	MKS	PUUVTMKPV	CMMMMM	
CQ	j Ö	CR	e É	TRTKUTP	ééÄ	NKN	QSVPUKNR	CMMMMM	
CT	^ ä	CR	e É	PNKVPT	ééÄ	RKR	VMCKRN	CMMMMM	
CU	pá	CR	e O	NUTNKQMR	ééÄ	MKU	NPSRSRKQO	NMMMM	
PV	h	CR	e É	RRRKOSV	ééÄ	NKV	RSRMSKPT	CMMMMM	
QM	` ~	CR	e O	NPQRKVMU	ééÄ	MKQ	TQSVPPKCU	CMMMMM	
RN	s	UV	e É	MKSSV	ééÄ	NPKR	TPRKRV	NMMM	
RO	` ê	UV	e É	MKMVV	ééÄ	NUKP	VVRKNU	CMMM	
RR	j å	UV	e É	NCKSCU	ééÄ	CKO	SMTVKRM	CMMM	
RS	cÉ	UV	e O	SQKCRO	ééÄ	NKS	NQRVNNKVR	NMMMMM	
RV	` ç	UV	e É	MKNVU	ééÄ	PNKO	RRPKPS	NMMM	
SM	k á	UV	e É	MKNRT	ééÄ	PNKM	CNPKPQ	NMMM	
SP	` ì	UV	e É	MKRTS	ééÄ	VKP	NNUQKRO	CMMM	
SS	wå	UV	e É	NKUMU	ééÄ	CKT	RRCKCQ	CMMM	
TR	^ ë	UV	e É	MKPRN	ééÄ	NVKT	TNKSU	NMMM	
TU	pÉ	UV	e O	MKMTV	ééÄ	PUKM	NQKUP	NMMM	
UU	pê	UV	e É	TKTNU	ééÄ	NKV	CPQSKPN	CMMM	
VR	j ç	UV	e É	JMKMVR	ééÄ	k L^	NSMKMM	NMMM	
NMT	^ Ö	UV	e É	JMKMMO	ééÄ	k L^	PMKMM	NMM	
NNN	` Ç	UV	e É	JMKMNT	ééÄ	k L^	CKCR	NMMM	
NNU	på	NRV	e É	MKSNO	ééÄ	QSKP	PQRKRT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOMN	ééÄ	UKU	NTCUKSM	NMMM	
NPT	_~	NRV	k ç=d ~ë	NCKUSN	ééÄ	CKQ	NSSMNKMS	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKRTN	ééÄ	k L^	NMNNKMM	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMQU	ééÄ	k L^	QRTKNS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKSQP	ééÄ	k L^	NPRNKCR	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMVV	ééÄ	SOKR	PRNTKRT	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMNM	ééÄ	k L^	NSMKNT	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =i çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	OMSQPVVST	CKQ	NUVQNRTKMT	NVUKVV	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVNVVRPKQS	CKP	QRTPSTVKOQ	URKTN	RVKR	NOMQ	
pÅ	CR	e O	TUVRNCKQR	NKM	VURSCPKUN	UMKN	RVKR	NOMQ	
pÅ	CR	e É	NPMNPSKVR	MKT	NSMVPNKCP	UMKUS	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VQUVTCKNP	NKM	NMTQQQSKRP	UUPQ	RVKR	NOMQ	
d É	TO	e O	PNPCCCKMR	NKS	PVPUSVKSQ	TVKRO	RVKR	NOMQ	
d É	TO	e É	NMNRVUKNR	MKU	NCRCSSKVR	UNKNN	RVKR	NOMQ	
v	UV	e O	PSRSMTQKRM	MKU	CPMNURSKUS	UQKVV	RVKR	NOMQ	
v	UV	e É	SUCPUUKCR	MKT	UQNPCCKNU	UNKNN	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	STQQUTQKSP	MKR	SRVNQQQKUP	NMCKPP	RVKR	NOMQ	
qÄ	NRV	e É	CRPNTUPKUV	NKO	CUSSNVMKN	UUKPP	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRRUQTRKPN	NKP	PNTPQTCKSU	NNCKNP	RVKR	NOMQ	
_á	OMV	e É	NRMVSTMKQO	CKM	NSMVTVTKOQ	VPKTU	RVKR	NOMQ	

`çåíaåì åaÖ=~äáÄê~íáç=sÉêáÑáÅ~íáç=Ë``sF=oÉéçê

p~ã éáÉ=k~ã É	``s
cáÉ=k~ã É	MTS|``skÇ
a~í~=m~íÜk~ã É	aWj^ÖáÉáíyf^mj eyNya^q^yOMCPyMPJ ^oyi n`OUbkÄ
^Åè=qáã É	PLOULOMCP=CPMMTMOO
p~ã éáÉ=qóéÉ	``s
qçí~äa ãi íáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MMCI ^i _kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	OCKCPU	ééÄ	MKS	NQTVMCKCV	CR	VSKVR	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OCKRUP	ééÄ	NKU	VUPRMSM	CR	VUPPP	UVKU	NNMO	
OP	k ~	CR	e É	RSCRKMUO	ééÄ	NKN	PQRRUPNKUS	RMMM	NNCKR	UVKU	NNMO	[=HLJ-NMB
OQ	j Ö	CR	e É	RTMTKMSV	ééÄ	NKO	NUCUQMCKUT	RMMM	NNQKNQ	UVKU	NNMO	[=HLJ-NMB
OT	^ä	CR	e É	RSMKPTQ	ééÄ	NKM	SSTTCKMQ	RMM	NNCKMT	UVKU	NNMO	[=HLJ-NMB
OU	pá	CR	e O	RRPHPPN	ééÄ	CKS	CNPCQTKRN	RMM	NNMKST	UVKU	NNMO	[=HLJ-NMB
PV	h	CR	e É	RQQPHSVN	ééÄ	NKO	NRMVRMTKMU	RMMM	NMUKUT	UVKU	NNMO	
QM	` ~	CR	e O	RPRRKTCR	ééÄ	MKR	NRQSQMSPKUM	RMMM	NMTKNN	UVKU	NNMO	
RN	s	UV	e É	OSKMQU	ééÄ	NKM	NMCRTMKNQ	CR	NMQKMV	UVKU	NNMO	
RO	` ê	UV	e É	CRKUSV	ééÄ	NKS	NCUNSMRRR	CR	NMPKCU	UVKU	NNMO	
RR	j å	UV	e É	OSKQST	ééÄ	MKS	SRCPCKSO	CR	NMRKUT	UVKU	NNMO	
RS	cÉ	UV	e O	RNQRKRRN	ééÄ	CKT	RQRRTPRTKVQ	RMMM	NMCKVN	UVKU	NNMO	
RV	` ç	UV	e É	OSKSUN	ééÄ	MKQ	CCRNSTHST	CR	NMSKTO	UVKU	NNMO	
SM	ká	UV	e É	OSKPSO	ééÄ	NKN	SCPPQKCM	CR	NMRKQR	UVKU	NNMO	
SP	` ì	UV	e É	OSKTNN	ééÄ	NKM	NTRQTPKRR	CR	NMSKUQ	UVKU	NNMO	
SS	wå	UV	e É	OSKSTT	ééÄ	NKO	OVSVRKPO	CR	NMSKTN	UVKU	NNMO	
TR	^ë	UV	e É	CRKRNP	ééÄ	MKV	CMTMTKNU	CR	NMCKMR	UVKU	NNMO	
TU	pÉ	UV	e O	CRKPRQ	ééÄ	MKV	NMMRVKUO	CR	NMNKQO	UVKU	NNMO	
UU	pê	UV	e É	OSKCNO	ééÄ	NKO	TSCUNKUN	CR	NMCKUR	UVKU	NNMO	
VR	j ç	UV	e É	CRKRRT	ééÄ	NKR	TOVRNKRT	CR	NMCKCP	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKQNP	ééÄ	NKU	OTUPNRKSM	CR	NMVKSR	UVKU	NNMO	
NNN	` Ç	UV	e É	OTKNSR	ééÄ	NKO	PSVPPKUN	CR	NMUKSS	UVKU	NNMO	
NNU	på	NRV	e É	OQKQNO	ééÄ	NKM	TNNRMKTQ	CR	VTHSR	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKSNO	ééÄ	MKR	RRUTMNKRM	CR	VUKQR	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	CRKTRN	ééÄ	NKN	NSVUUVKSQ	CR	NMP	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	CRKTPN	ééÄ	MKO	PPQCUQKQU	CR	NMCKVO	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	CRKTSM	ééÄ	NKS	TTQTMQKCR	CR	NMPKMQ	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKQRN	ééÄ	CKO	NMUUTSCKVO	CR	NMRKU	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKRUS	ééÄ	NKM	VSOTNNKUT	CR	NMSKPQ	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OTKSQR	ééÄ	MKU	VOVCRPKMU	CR	NNMKRU	UVKU	NNMO	[=HLJ-NMB

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ç ïï	B n`=c äÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	CNPUUCUKNP	NKM	NUVQNRTKMT	NNCKVO	RVKR	NCMQ	
pÅ	CR	k ç=d ~ë	QNOTCCUKMT	NKS	QRTPSTVKCQ	VMCCQ	RVKR	NCMQ	
pÅ	CR	e O	UPQTUQKSO	NKN	VURSCPKUN	UQRT	RVKR	NCMQ	
pÅ	CR	e É	NPSNMNKVM	NKQ	NSMVPNKCP	UQKRT	RVKR	NCMQ	
d É	TO	k ç=d ~ë	VUPTCQKUQ	MKU	NMTQCQQSKRP	VNKRT	RVKR	NCMQ	
d É	TO	e O	PPNTVPKCU	MKU	PVPUSVKSQ	UQKCQ	RVKR	NCMQ	
d É	TO	e É	NMRVQVKTR	NKP	NCRCSSKVR	UQKRU	RVKR	NCMQ	
v	UV	e O	PTMPUCSKMT	NKM	CPMNURSKUS	USKN	RVKR	NCMQ	
v	UV	e É	TNNTQNKTS	NKN	UQNPQCKNU	UQKS	RVKR	NCMQ	
qÄ	NRV	k ç=d ~ë	SVSMRCMCR	MKR	SRVNQQQKUP	NMRKS	RVKR	NCMQ	
qÄ	NRV	e É	OSQSTVSKVP	NKU	CUSSNVMKN	VOKPR	RVKR	NCMQ	
_á	OMV	k ç=d ~ë	PRUSVVTKQQ	NKM	PNTPQTCKSU	NNPKMP	RVKR	NCMQ	
_á	OMV	e É	NRCRMTMKNN	NKP	NSMVTVTKOQ	VQRTQ	RVKR	NCMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=É``_F=oÉéçã

p~ã éáÉ=k~ã É	``_
cäÉ=k~ã É	MTT|``_KÇ
a~í~=m~íÜ=k~ã É	aWi^ÖäÉáíyf^mj eyNya^q^yOMCPyMPJ ^oyi n`OUbkÂ
^Åè=qáã É	PLOULOMCP=CPMNRMQO
p~ã éáÉ=qóéÉ	``_
qçí~äa ãäíáç~å	NKMMMM
`çã ã Éåí	JJJ
fpqa=o ÉÑc äÉk~ã É	MMQ ^i _KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	m~ëë
fpqa=n`=m~ëëlc~äã	m~ëë
I éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	r åáë	opa	==\ mp==	iãäá	n`=c ä~Ö
V	_É	S	kç=d~ë	JMKMVR	éé Ä	kL^	OQSKSU	MO	
NN	_	S	kç=d~ë	MKNTS	éé Ä	SKT	NUOQKRV	Q	
CP	k~	QR	eÉ	SKUTR	éé Ä	NRKQ	QTSVQKTV	OMM	
CQ	j Ö	QR	eÉ	PKMMN	éé Ä	TKN	NRSMKNQ	OM	
OT	^ä	QR	eÉ	MKOMS	éé Ä	NSUKU	COMKMN	OM	
OU	pá	QR	eO	MKVNR	éé Ä	QOKN	TVMKUR	NMM	
PV	h	QR	eÉ	MKTMM	éé Ä	OOQKM	PMORSKMM	OMM	
QM	`~	QR	eO	QKOSM	éé Ä	OKS	OSPVNHSN	OM	
RN	s	UV	eÉ	MKMOS	éé Ä	QOKT	PSPHPQ	N	
RO	`ê	UV	eÉ	JMKMPP	éé Ä	kL^	UOUKRP	N	
RR	j å	UV	eÉ	MKMNT	éé Ä	NVPHP	NTVKVT	MQ	
RS	cÉ	UV	eO	PKTTO	éé Ä	QKM	RQOMOHRN	OM	
RV	`ç	UV	eÉ	JMKMMV	éé Ä	kL^	NUMKMN	MO	
SM	k á	UV	eÉ	JMKMMV	éé Ä	kL^	NPRKRS	MQ	
SP	`ì	UV	eÉ	JMKMMO	éé Ä	kL^	QVUKVN	MS	
SS	wå	UV	eÉ	MKMPV	éé Ä	PMKO	CPOKOP	O	
TR	^ë	UV	eÉ	MKMOM	éé Ä	PSKO	PSKMM	N	
TU	pÉ	UV	eO	MKMOT	éé Ä	OMKM	OMKRM	N	
UU	pê	UV	eÉ	MKMMS	éé Ä	CPHP	SRHRS	N	
VR	j ç	UV	eÉ	MKMUU	éé Ä	NSKT	RMOKOQ	N	
NMT	^Ö	UV	eÉ	MKMNU	éé Ä	ONKN	CPNKNO	MO	
NNN	`Ç	UV	eÉ	MKMNP	éé Ä	NNKV	OUKNR	MO	
NNU	på	NRV	eÉ	MKNMP	éé Ä	NPHO	SNSKTM	N	
NON	pÄ	NRV	kç=d~ë	MKMNT	éé Ä	NQHR	NPMNKCR	MO	
NPT	_~	NRV	kç=d~ë	MKMMT	éé Ä	NMSHP	CPPHRU	MQ	
NUO	t	NRV	kç=d~ë	MKMRO	éé Ä	SKR	PPNMKRV	N	
OMR	qä	OMV	kç=d~ë	MKMQN	éé Ä	VKQ	OMRVKMN	MO	
OMU	mÄ	OMV	kç=d~ë	JMKMOT	éé Ä	kL^	NQUUKCU	MO	
OPO	qÜ	OMV	kç=d~ë	MKMSR	éé Ä	RKR	RQOMKCP	N	
OPU	r	OMV	kç=d~ë	MKMCO	éé Ä	NTHKN	NMNNKMN	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j ÇÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=çï	B n`=cäÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	OOOOSRSKMT	MKU	NUVQNRTHMT	NNTHPQ	RVHR	NOMQ	
pÅ	QR	kç=d~ë	QNTOOVNKNV	NKQ	QRTPSTVKOQ	VNKOO	RVHR	NOMQ	
pÅ	QR	eO	USQUPTKOT	NKT	VURSOPKUN	UTKTR	RVHR	NOMQ	
pÅ	QR	eÉ	NQNSONKMP	NKO	NSMVPNKCP	UU	RVHR	NOMQ	
dÉ	TO	kç=d~ë	NMOVOSSKVQ	NKN	NMTQOQSKRP	VRKUN	RVHR	NOMQ	
dÉ	TO	eO	PQRQVNKMN	MKS	PVPUSVKSQ	UTKTO	RVHR	NOMQ	
dÉ	TO	eÉ	NNMQQTKOQ	MKN	NORCSSKVR	UUKNT	RVHR	NOMQ	
v	UV	eO	PUVOSPNKVT	MKT	CPMNURSKUS	VMKQV	RVHR	NOMQ	
v	UV	eÉ	TRSONUKNT	NKQ	UQNPQOKNU	UVKUU	RVHR	NOMQ	
qÄ	NRV	kç=d~ë	TOQQPTNKQT	NKU	SRVNQQQKUP	NMVKVN	RVHR	NOMQ	
qÄ	NRV	eÉ	OTPUPNSKRQ	MKT	OUSSNVMKN	VRHRQ	RVHR	NOMQ	
_á	OMV	kç=d~ë	PTRNPPOKPS	NKS	PNTPQTOKSU	NNUKON	RVHR	NOMQ	
_á	OMV	eÉ	NRUTUTMKUU	MKQ	NSMVTVTKOQ	VUHSQ	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNO

cãÉ=k~ã É MTUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=CPWMMQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKUV	ééÄ	k L^	NQTKTU	NMM	
NN	_	S	k ç=d ~ë	UKTNP	ééÄ	CKO	TPQMKUU	NMMM	
CP	k ~	QR	e É	OVTQKMTO	ééÄ	MKU	PUCCCUMKT	OMMMMM	
CQ	j Ö	QR	e É	TRTKTTV	ééÄ	NKU	QSRUNMQ	OMMMMM	
CT	^ ä	QR	e É	RMKNTU	ééÄ	NCKN	NPMTKUS	OMMMMM	
CU	pá	QR	e O	NUPSKRQN	ééÄ	MKS	NPQMTNKVQ	NMMMM	
PV	h	QR	e É	RQCKUMP	ééÄ	CKM	RRQQSHPO	OMMMMM	
QM	` ~	QR	e O	NPQTHSVR	ééÄ	MKS	TQUNSMKUN	OMMMMM	
RN	s	UV	e É	MKSRN	ééÄ	NTHS	TCRKRV	NMMM	
RO	` ê	UV	e É	MKNVR	ééÄ	PUKT	NMVMKRM	OMMM	
RR	j å	UV	e É	NCKUUM	ééÄ	MKS	SCCSKCM	OMMM	
RS	cÉ	UV	e O	TSSKTPQ	ééÄ	MKS	NRVCUVNHSV	NMMMMM	
RV	` ç	UV	e É	MKMRN	ééÄ	VRHP	PNTKTV	NMMM	
SM	k á	UV	e É	MKNUQ	ééÄ	PQKU	CCSKST	NMMM	
SP	` ì	UV	e É	NKSVU	ééÄ	CKT	OSMRKUQ	OMMM	
SS	wå	UV	e É	THMQV	ééÄ	THP	NSTCKPR	OMMM	
TR	^ ë	UV	e É	MKRSS	ééÄ	CNKU	NMRKPQ	NMMM	
TU	pÉ	UV	e O	MKNQS	ééÄ	PSKM	NVKUP	NMMM	
UU	pê	UV	e É	TKCNR	ééÄ	RKU	QMURKNQ	OMMM	
VR	j ç	UV	e É	MKNOT	ééÄ	RTKU	CUCKCP	NMMM	
NMT	^ Ö	UV	e É	MKMPP	ééÄ	QTHN	VTKTU	NMM	
NNN	` Ç	UV	e É	MKMNP	ééÄ	URKM	NCKCO	NMMM	
NNU	på	NRV	e É	MCOOS	ééÄ	NPHP	QMTKTV	NMMM	
NOO	pÄ	NRV	k ç=d ~ë	MKPMV	ééÄ	NMKO	CNPCKQO	NMMM	
NPT	_~	NRV	k ç=d ~ë	NCKPQU	ééÄ	RHP	NRQSNKUP	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKNPQ	ééÄ	k L^	OMPCKPQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMRR	ééÄ	PNKM	NMRQKQV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NKVNM	ééÄ	PHS	NTTNMHPV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MCUUV	ééÄ	OVKQ	QTTRKVU	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMPR	ééÄ	NVKQ	QCQTKNR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ¹ mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVTRMDSKTN	CKV	NUVQNRTHMT	NMQKOT	RVHR	NOMKQ	
pÅ	QR	k ç=d ~ë	PTVONVPKNV	PHV	QRTPSTVKOQ	UOKVN	RVHR	NOMKQ	
pÅ	QR	e O	TUVTPSKMU	NKN	VURSCPKUN	UMKNP	RVHR	NOMKQ	
pÅ	QR	e É	NOVNUTHSQ	NKT	NSMVPNKCP	UMKCU	RVHR	NOMKQ	
d É	TO	k ç=d ~ë	VONMMTKTQ	PHM	NMTQOQSKRP	URKTQ	RVHR	NOMKQ	
d É	TO	e O	PNNNUQKQR	MKS	PVPUSVHSQ	TVHMN	RVHR	NOMKQ	
d É	TO	e É	NMNUCOKPR	MKS	NCRCSSKVR	UNKCU	RVHR	NOMKQ	
v	UV	e O	PSMPQPSKVQ	MKU	QPMNURSKUS	UPKTS	RVHR	NOMKQ	
v	UV	e É	SURQRNMVR	NKO	UQNPQCKNU	UNKQT	RVHR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SRPPPQVKPO	PHR	SRVNQQQKUP	VVHNO	RVHR	NOMKQ	
qÄ	NRV	e É	QRCPSPSKPS	NHR	CUSSNVMKN	UUHVR	RVHR	NOMKQ	
_á	OMV	k ç=d ~ë	PQUTTTMKUT	PHR	PNTPQTCKSU	NMVKV	RVHR	NOMKQ	
_á	OMV	e É	NRVSUTUHRR	NKQ	NSMVTVTKOQ	VPHSN	RVHR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNO

cãÉ=k~ã É MTVpj mi kÇ

a~í~=m~íÜ=k~ã É aWyt ÖãÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OUbkÃ

^Åè=qãã É PLOULOMOP=OPWORWRS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå ORKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=¤l ~ë	JMKTOU	ééÄ	k L^	UUKUV	NMM	
NN	_	S	k ç=¤l ~ë	NMKNRO	ééÄ	SKR	ORVNKPU	NMMM	
OP	k ~	OR	e É	POPSKPSM	ééÄ	OKS	NNQQTRKNM	OMMMMM	
OQ	j Ö	OR	e É	TRVKQUN	ééÄ	OKN	VTTQKUO	OMMMMM	
OT	^ ä	OR	e É	SRKPQT	ééÄ	NTKS	QTPKPR	OMMMMM	
OU	pá	OR	e O	NVVNKSON	ééÄ	OKV	OVUTUKVT	NMMMM	
PV	h	OR	e É	TOQKVNT	ééÄ	SKO	PRMNOKVS	OMMMMM	
QM	` ~	OR	e O	NQMRKMN	ééÄ	NKN	NSUSVNKUV	OMMMMM	
RN	s	UV	e É	MKSOR	ééÄ	ROKQ	PPRKRT	NMMM	
RO	` ê	UV	e É	JMKQSU	ééÄ	k L^	UPTKUT	OMMM	
RR	j å	UV	e É	NPKTPV	ééÄ	SKO	NQSNKNP	OMMM	
RS	cÉ	UV	e O	TTVKUNP	ééÄ	MKS	PPSQMSKUU	NMMMM	
RV	` ç	UV	e É	JMKPTN	ééÄ	k L^	NNTKTU	NMMM	
SM	k á	UV	e É	JMKOOR	ééÄ	k L^	NORKRS	NMMM	
SP	` ì	UV	e É	NKSVM	ééÄ	NQKR	VNOKOT	OMMM	
SS	wå	UV	e É	NNKMVR	ééÄ	NPKV	SSOKOR	OMMM	
TR	^ ë	UV	e É	MKRRS	ééÄ	QRKU	PRKPP	NMMM	
TU	pÉ	UV	e O	JMKMOU	ééÄ	k L^	UKNT	NMMM	
UU	pê	UV	e É	TKVPP	ééÄ	RKP	VRQKRM	OMMM	
VR	j ç	UV	e É	MKOMQ	ééÄ	OSSKT	OQNKNO	NMMM	
NMT	^ Ö	UV	e É	JMKMMU	ééÄ	k L^	PNKNN	NMM	
NNN	` Ç	UV	e É	JMKMVO	ééÄ	k L^	OKMT	NMMM	
NNU	på	NRV	e É	JMKUSS	ééÄ	k L^	NUSKST	NMMM	
NON	pÄ	NRV	k ç=¤l ~ë	MKOTM	ééÄ	PTKT	NMTNKNT	NMMM	
NPT	_~	NRV	k ç=¤l ~ë	NOKQPT	ééÄ	THP	PPMTKOS	OMMM	
NUO	t	NRV	k ç=¤l ~ë	JOKNOU	ééÄ	k L^	NPRUKNT	NMMM	
OMR	qä	OMV	k ç=¤l ~ë	JMKNTV	ééÄ	k L^	RCPKVM	NMMM	
OMU	mÄ	OMV	k ç=¤l ~ë	NKNNO	ééÄ	SKR	QOSUKNN	OMMM	
OPO	qÜ	OMV	k ç=¤l ~ë	JMKPVT	ééÄ	k L^	OOMVKON	NMMM	
OPU	r	OMV	k ç=¤l ~ë	JMKMQN	ééÄ	k L^	NSSKUQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤pÉÅ	B n ` =¡ çï	B n ` =¤eåÜÜ	n ` =¤ä~Ö
i á	S	k ç=¤l ~ë	OMTVRONKOO	MKU	NUVQNRTKMT	NMVKTV	RVKR	NOMKQ	
pÅ	OR	k ç=¤l ~ë	PVNVOTOKQT	MKV	QRTPSTVKOQ	URKSV	RVKR	NOMKQ	
pÅ	OR	e O	UMPOTPKSM	OKM	VURSOPKUN	UNKR	RVKR	NOMKQ	
pÅ	OR	e É	NOVRVOKON	NKS	NSMVPNKOP	UMKRP	RVKR	NOMKQ	
d É	TO	k ç=¤l ~ë	VRRSUNKVP	MKU	NMTQOQSKRP	UUKVS	RVKR	NOMKQ	
d É	TO	e O	PONUUSKRQ	NKN	PVPUSVKSQ	UNKTO	RVKR	NOMKQ	
d É	TO	e É	NMPNMMKTS	MKV	NORCSSKVR	UOKP	RVKR	NOMKQ	
v	UV	e O	PSQMORUKMQ	MKS	OPMNURSKUS	UQKSO	RVKR	NOMKQ	
v	UV	e É	TMOPSVKOQ	MKS	UQNPOOKNU	UPKQU	RVKR	NOMKQ	
qÄ	NRV	k ç=¤l ~ë	SSSQPRRKNS	MKV	SRVNQQQKUP	NMVKNN	RVKR	NOMKQ	
qÄ	NRV	e É	ORCPVRUKRU	MKT	OUSSNVMKN	UUKVS	RVKR	NOMKQ	
_á	OMV	k ç=¤l ~ë	PRNOMTPKMV	MKS	PNTPQTOKSU	NNMKST	RVKR	NOMKQ	
_á	OMV	e É	NQURVVSKTN	OKO	NSMVTVTKOQ	VOKPN	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNO^

cãÉ=k~ã É MUMpj mi lÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=CPAPNMQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	VKNPP	ééÄ	OKS	NMVMVKUO	NMVM	
NN	_	S	k ç=d ~ë	OMPKSPV	ééÄ	NKM	NRRPOUKTU	NMVMM	
OP	k ~	QR	e É	NQPNTKPPP	ééÄ	NKV	NSRMNMTKTT	OMMMMM	
OQ	j Ö	QR	e É	NURRKQMN	ééÄ	OKR	NNMSVUKUN	OMMMMM	
OT	^ ä	QR	e É	NNQTKUMU	ééÄ	MKP	CRQSRKNU	OMMMMM	
OU	pá	QR	e O	TNNTKOMR	ééÄ	NKM	RMSROTKNT	NMVMM	
PV	h	QR	e É	NMUOUKSOV	ééÄ	MKS	RTOVSQKTR	OMMMMM	
QM	` ~	QR	e O	OQQVOKTOQ	ééÄ	NKM	NPQNSRSKRP	OMMMMM	
RN	s	UV	e É	QOKRUO	ééÄ	MKV	PUNSSHPQ	NMVMM	
RO	` ê	UV	e É	QPKVOU	ééÄ	MKV	RMVMVOKMT	OMVMM	
RR	j å	UV	e É	OVKSMQ	ééÄ	MKV	NSSQMKST	OMVMM	
RS	cÉ	UV	e O	NQTMKONV	ééÄ	NKP	PRVNNMVKNN	NMVMMM	
RV	` ç	UV	e É	VKMNM	ééÄ	MKV	NTQUMKQQ	NMVMM	
SM	k á	UV	e É	NUKNQP	ééÄ	MKS	VUSOKRN	NMVMM	
SP	` ì	UV	e É	PQKSON	ééÄ	MKR	RNVOOKOQ	OMVMM	
SS	wå	UV	e É	NVMKUPP	ééÄ	MKT	CRQTPKRR	OMVMM	
TR	^ ë	UV	e É	QOKVMP	ééÄ	OKR	TUVVKPV	NMVMM	
TU	pÉ	UV	e O	QNKTOV	ééÄ	OKV	PUMSKUQ	NMVMM	
UU	pê	UV	e É	QVKMOS	ééÄ	MKT	POPQRKMT	OMVMM	
VR	j ç	UV	e É	QRKPQO	ééÄ	NKT	OVQUMKVU	NMVMM	
NMT	^ Ö	UV	e É	VKMNS	ééÄ	NKM	OMTTOKUP	NMVM	
NNN	` Ç	UV	e É	UKVQQ	ééÄ	NKU	OTSQKPT	NMVMM	
NNU	på	NRV	e É	QUKVUU	ééÄ	NKO	OSVRPKVN	NMVMM	
NON	pÄ	NRV	k ç=d ~ë	NVMKMQM	ééÄ	MKR	QPNSMKST	NMVMM	
NPT	_~	NRV	k ç=d ~ë	PQKNSP	ééÄ	NKU	QQMRVKVS	OMVMM	
NUO	t	NRV	k ç=d ~ë	ROKPPP	ééÄ	NKU	NOTUVUKSO	NMVMM	
OMR	qä	OMV	k ç=d ~ë	UKUMV	ééÄ	MKT	ROUOSKST	NMVMM	
OMU	mÄ	OMV	k ç=d ~ë	NNKVOO	ééÄ	NKR	VUUSOKOO	OMVMM	
OPO	qÜ	OMV	k ç=d ~ë	NVKROM	ééÄ	NKM	TTRPTKSN	NMVMM	
OPU	r	OMV	k ç=d ~ë	NVKPTU	ééÄ	NKO	SUURVKTV	NMVMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B¤pÉÅ	B n ` =¡çï	B n ` =¤ëÛÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	OMQTRPUKPQ	NKN	NUVQNRTKMT	NMUKN	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PUTUSRPKTO	NKO	QRTPSTVKOQ	UQKU	RVKR	NOMQ	
pÅ	QR	e O	TTNRVPKOV	MKQ	VURSCPKUN	TUKCU	RVKR	NOMQ	
pÅ	QR	e É	NOSNVPKSP	NKO	NSMVPNKCP	TUKQN	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VPRRMOKSM	MKR	NMTQOQSKRP	UTHKU	RVKR	NOMQ	
d É	TO	e O	PMUNUQKMM	MKV	PVPUSVKSQ	TUKCR	RVKR	NOMQ	
d É	TO	e É	VUQSUKRM	MKP	NORCSSKVR	TUKSN	RVKR	NOMQ	
v	UV	e O	QORNNTVKPT	NKM	CPMNURSKUS	VUKUO	RVKR	NOMQ	
v	UV	e É	UMSMVPKOV	MKV	UQNPQOKNU	VRKUN	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQTSRVNKPU	NKM	SRVNQQQKUP	VUKOS	RVKR	NOMQ	
qÄ	NRV	e É	OQUOUQVKMU	NKS	OUSSNVMKN	USKSP	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PROVUMUKRM	MKT	PNTPQTOKSU	NNNKCP	RVKR	NOMQ	
_á	OMV	e É	NQTVSONKVT	NKR	NSMVTVTKOQ	VNKVN	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNP

cãÉ=k~ã É MUNpj mi lÇ

a~í~=m~íÜ=k~ã É aWyl ÖãÉåíyl˜ mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÃ

^Åè=qãã É PLOULOMCP=CPAWSNMN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMKNPS	éé Ä	k L^	VTKTU	NMM	
NN	_	S	k ç=d ~ë	NMKMRT	éé Ä	RKQ	URSVKPQ	NMMM	
CP	k ~	CR	e É	PPRCKSMR	éé Ä	MKS	QCPCMSKQT	CMMMMM	
CQ	j Ö	CR	e É	UURKCVP	éé Ä	CKR	RPVVUKRN	CMMMMM	
CT	^ ä	CR	e É	PPKRTN	éé Ä	TKS	VCUKVQ	CMMMMM	
CU	pá	CR	e O	NPSVKCVT	éé Ä	NKV	NMMUTSKCR	NMMMM	
PV	h	CR	e É	SURKVMV	éé Ä	NKV	SCQQCRKNP	CMMMMM	
QM	` ~	CR	e O	NSRVKVCO	éé Ä	NKV	VCSMUMPS	CMMMMM	
RN	s	UV	e É	MRTMQ	éé Ä	RKP	TSPKPT	NMMM	
RO	` ê	UV	e É	MCMP	éé Ä	CRRT	NMVRKNT	CMMM	
RR	j å	UV	e É	NPKVCM	éé Ä	NKO	SSVVKSR	CMMM	
RS	cÉ	UV	e O	VTCKRVT	éé Ä	NKN	CMPPUTMKUS	NMMMM	
RV	` ç	UV	e É	MKMQO	éé Ä	QMR	PMCKCP	NMMM	
SM	k á	UV	e É	MCNU	éé Ä	NUKS	CQNKNO	NMMM	
SP	` ì	UV	e É	MKPMV	éé Ä	NTKO	URNKNR	CMMM	
SS	wå	UV	e É	CKVUM	éé Ä	VKR	UMCKCS	CMMM	
TR	^ ë	UV	e É	MKSCP	éé Ä	VKM	NNQKMN	NMMM	
TU	pÉ	UV	e O	MCMM	éé Ä	NQKO	CQRNT	NMMM	
UU	pê	UV	e É	UKVQS	éé Ä	CKP	RMPVKUV	CMMM	
VR	j ç	UV	e É	MKNUP	éé Ä	PMKQ	PNCKCP	NMMM	
NMT	^ Ö	UV	e É	MKMCM	éé Ä	OTKQ	TCKCO	NMM	
NNN	` Ç	UV	e É	JMKMNN	éé Ä	k L^	RKVP	NMMM	
NNU	på	NRV	e É	MKNTP	éé Ä	RPKQ	PUMKMN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKPNT	éé Ä	NNKM	ONUVKNS	NMMM	
NPT	_~	NRV	k ç=d ~ë	NOKRVN	éé Ä	CKS	NRUTCKUM	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKNCU	éé Ä	k L^	CMSVKMD	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMMR	éé Ä	NRKR	TSQKNS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	CKVCP	éé Ä	NKV	OSMNTKTN	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMTU	éé Ä	NOKT	PPOTKOV	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMMN	éé Ä	UUNKN	CCSKVN	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n` =ï çï	B n` =¤ëÃÜÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	OMPNVUPKUR	NKN	NUVQNRTKMT	NMTKCU	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVPRPNTKPM	MKQ	QRTPSTVKCQ	USKMQ	RVKR	NOMQ	
pÅ	CR	e O	TVSCSQKUP	MKT	VURSCPKUN	UMKTV	RVKR	NOMQ	
pÅ	CR	e É	NCUPTTKVQ	MKP	NSMVPNKCP	TVKTT	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VRSTUTKPU	NKT	NMTQCQSKRP	UVKMT	RVKR	NOMQ	
d É	TO	e O	PNUTSPKMQ	MKP	PVPUSVKSQ	UMKVP	RVKR	NOMQ	
d É	TO	e É	NMNUPVKPV	NKM	NCRCSSKVR	UNKP	RVKR	NOMQ	
v	UV	e O	PSPCRVNKPS	MKQ	CPMNURSKUS	UQKQQ	RVKR	NOMQ	
v	UV	e É	SUPQCNKPP	MKT	UQNPQCKNU	UNKCP	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SRUSVTRKMR	MKS	SRVNQQQKUP	VVKVP	RVKR	NOMQ	
qÄ	NRV	e É	CRPCQTRKMN	NKP	CUSSNVMKN	UUKPS	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRNRSQCKUU	MKS	PNTPQTCKSU	NNMKTU	RVKR	NOMQ	
_á	OMV	e É	NRMMUNMKVP	NKM	NSMVTVTKQQ	VPKCP	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNQ

cãÉ=k~ã É MUQpj mi lÇ

a~í~=m~íÜ=k~ã É aWyl ÖãÉåíyl˜ mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÃ

^Åè=qãã É PLOULOMCP=CPVQNNMU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMKNON	éé Ä	k L^	NNQKCR	NMM	
NN	_	S	k ç=d ~ë	SKTNU	éé Ä	NKM	SMPUKMQ	NMMM	
CP	k ~	CR	e É	NRUUKTNQ	éé Ä	MKV	CCPNTTHSQ	CMMMMM	
CQ	j Ö	CR	e É	CNNKNNM	éé Ä	NKP	NPPUMKMM	CMMMMM	
CT	^ ä	CR	e É	NNTKVPS	éé Ä	CKV	CUQQKUM	CMMMMM	
CU	pá	CR	e O	PNNRKCPS	éé Ä	MKN	CPMRQSHSV	NMMMM	
PV	h	CR	e É	UMKQVV	éé Ä	NNKU	PNSRSKTQ	CMMMMM	
QM	` ~	CR	e O	OVTHPCQ	éé Ä	MKT	NTTPVPKTV	CMMMMM	
RN	s	UV	e É	NKPTV	éé Ä	RKM	NOTNKNV	NMMM	
RO	` ê	UV	e É	MKSRM	éé Ä	PKV	NRNRKUM	CMMM	
RR	j å	UV	e É	NUKPCQ	éé Ä	NKN	UTSVKMT	CMMM	
RS	cÉ	UV	e O	VSUKCPP	éé Ä	MKR	CMPOSTMKNV	NMMMM	
RV	` ç	UV	e É	MKMPQ	éé Ä	RUKV	CUUKVM	NMMM	
SM	k á	UV	e É	MKMVU	éé Ä	TRHP	NUSKST	NMMM	
SP	` ì	UV	e É	MKPSV	éé Ä	NKU	VCRKSM	CMMM	
SS	wå	UV	e É	NKVTN	éé Ä	CCKO	RUTKUM	CMMM	
TR	^ ë	UV	e É	MKRRN	éé Ä	NPHS	NVCKSU	NMMM	
TU	pÉ	UV	e O	MKMSQ	éé Ä	SQHP	NPHST	NMMM	
UU	pê	UV	e É	CKVCQ	éé Ä	SKR	NSUPKQT	CMMM	
VR	j ç	UV	e É	MKMMN	éé Ä	SRQMO	CNCKCP	NMMM	
NMT	^ Ö	UV	e É	MKMMN	éé Ä	QQTHP	PRHRS	NMM	
NNN	` Ç	UV	e É	MKMMN	éé Ä	TTVHV	UKUV	NMMM	
NNU	på	NRV	e É	MKMVP	éé Ä	QSHS	PPQKCR	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKMRU	éé Ä	TNKV	NMUNKNU	NMMM	
NPT	_~	NRV	k ç=d ~ë	NMKNUP	éé Ä	NKM	NOVCPKCP	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKQCV	éé Ä	k L^	NPPUKNQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMRP	éé Ä	k L^	QCTHNP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKNSS	éé Ä	k L^	NNQTKVN	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMRT	éé Ä	VCHM	PNUPKTT	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMMN	éé Ä	k L^	CNPHRS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =i çï	B n ` =¤ëÛÜ	n ` =¤ä-Ö
i á	S	k ç=d ~ë	OMCRRSCKMR	MKN	NUVQNRTHMT	NVSKVQ	RVHR	NOMQ	
pÅ	CR	k ç=d ~ë	PUUVTPMHPM	MKO	QRTPSTVKCQ	URHMR	RVHR	NOMQ	
pÅ	CR	e O	UMNRUQKUP	NKN	VURSCPKUN	UNHPP	RVHR	NOMQ	
pÅ	CR	e É	NOVRNNKNP	MKT	NSMVPNKCP	UMKQU	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VRNSNRKCP	MKS	NMTQCQSKRP	UUKRU	RVHR	NOMQ	
d É	TO	e O	PNQNMQKCM	NKU	PVPUSVHSQ	TVKTR	RVHR	NOMQ	
d É	TO	e É	NMNCSCKRN	NKQ	NCRCSSKVR	UMKUQ	RVHR	NOMQ	
v	UV	e O	PSQSRSSHRO	MKT	CPMNURSKUS	UQRTT	RVHR	NOMQ	
v	UV	e É	SUCSPMKNP	NHR	UQNPCCKNU	UNKNQ	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSNQVVTKTM	NKP	SRVNQQQKUP	NMMHPS	RVHR	NOMQ	
qÄ	NRV	e É	CRCQUTNKTV	NKN	CUSSNVMKN	UUKMV	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRCRQURKQR	MKV	PNTPQTCKSU	NNNKUV	RVHR	NOMQ	
_á	OMV	e É	NRNPTVNKTN	MKV	NSMVTVTHQQ	VQKMQ	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNR

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a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=CPWQSWQS

p~ã éäÉ=qóéÉ p~ã éäÉ

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n ` =^ å~äöíÉ=q~ÄäÉ

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V	_É	S	k ç=d ~ë	JMKNSP	ééÄ	k L^	SRKRS	NMM	
NN	_	S	k ç=d ~ë	SKPSP	ééÄ	CKU	RTNTKVM	NMMM	
CP	k ~	CR	e É	NTCNKSMP	ééÄ	NKN	CPSVUCKPQ	CMMMMM	
CQ	j Ö	CR	e É	CNUKMPN	ééÄ	PKU	NPTNPKST	CMMMMM	
CT	^ ä	CR	e É	PMKRSN	ééÄ	NRKQ	USPKPU	CMMMMM	
CU	pá	CR	e O	OTPQKMVQ	ééÄ	MKS	NVVRTVKMS	NMMMM	
PV	h	CR	e É	NVNKNCCQ	ééÄ	RKM	PTNQCKOT	CMMMMM	
QM	` ~	CR	e O	SMQKRUN	ééÄ	NKO	PQQTVVKCN	CMMMMM	
RN	s	UV	e É	NKMMR	ééÄ	CKS	VURKSN	NMMM	
RO	` ê	UV	e É	MKCUS	ééÄ	CCKN	NNSTKNS	CMMM	
RR	j å	UV	e É	NVSKCSM	ééÄ	MKT	RMMRSKCV	CMMM	
RS	cÉ	UV	e O	PURPKPNP	ééÄ	NKN	UMPQMURKPS	NMMMMM	
RV	` ç	UV	e É	MKNSP	ééÄ	CCKQ	CVRKRU	NMMM	
SM	k á	UV	e É	MKMCN	ééÄ	NPNKN	NRNKKN	NMMM	
SP	` ì	UV	e É	NKNUP	ééÄ	RKQ	NVCMKNT	CMMM	
SS	wå	UV	e É	CKNSU	ééÄ	RKU	NVCUKVR	CMMM	
TR	^ ë	UV	e É	NKCMR	ééÄ	NKR	CMPKSV	NMMM	
TU	pÉ	UV	e O	MKMOT	ééÄ	CCNKQ	NMKST	NMMM	
UU	pê	UV	e É	CKUUQ	ééÄ	NKT	NSCQKRU	CMMM	
VR	j ç	UV	e É	JMKMCV	ééÄ	k L^	NVRKRS	NMMM	
NMT	^ Ö	UV	e É	JMKMMP	ééÄ	k L^	OTKTU	NMM	
NNN	` Ç	UV	e É	JMKMCV	ééÄ	k L^	NKKN	NMMM	
NNU	på	NRV	e É	MKMCM	ééÄ	CMMKQ	PMRKRT	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKMCO	ééÄ	SVKP	VNTKST	NMMM	
NPT	_~	NRV	k ç=d ~ë	NNKMUO	ééÄ	CKP	NPUVRKCN	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKRMU	ééÄ	k L^	NNPQKRU	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMRV	ééÄ	k L^	PVMKQO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKNRO	ééÄ	k L^	NCSNKPS	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMMV	ééÄ	OSTKV	CUQSKST	NMMM	
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i á	S	k ç=d ~ë	OMMSUNVPU	MKU	NUVQNRTKMT	NVRKVR	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PUTTCMCKPV	MKQ	QRTPSTVKOQ	UQKTT	RVKR	NOMQ	
pÅ	CR	e O	TVMQTNKNQ	MKS	VURSCPKUN	UMKO	RVKR	NOMQ	
pÅ	CR	e É	NCUSTQKRN	MKR	NSMVPNKCP	TVKVS	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VQUVPMKUQ	MKU	NMTQCQSKRP	UUKPP	RVKR	NOMQ	
d É	TO	e O	PNQMNRKTP	MKP	PVPUSVKSQ	TVKTP	RVKR	NOMQ	
d É	TO	e É	NMMCQQKQT	NKR	NCRCSSKVR	UMKMO	RVKR	NOMQ	
v	UV	e O	PSPSVSUKTM	MKS	CPMNURSKUS	UQKRQ	RVKR	NOMQ	
v	UV	e É	STVUNCKQS	MKQ	UQNPCCKNU	UMKU	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SRQCNTTKMO	NKO	SRVNQQQKUP	VVKCR	RVKR	NOMQ	
qÄ	NRV	e É	CRPMPCSKCN	NKN	CUSSNVMKN	UUKCU	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRPPNSCQCN	MKT	PNTPQTCKSU	NNNKPP	RVKR	NOMQ	
_á	OMV	e É	NQVPPCSKRP	MKU	NSMVTVTKOQ	VCKTT	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNS

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a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OUbkÄ

^Åè=qãã É PLOULOMCP=CPARNMRR

p~ã éäÉ=qóéÉ p~ã éäÉ

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fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKNNV	ééÄ	k L^	NNSKST	NMM	
NN	_	S	k ç=d ~ë	SKPVN	ééÄ	PKN	RTURRTM	NMMM	
CP	k ~	CR	e É	NCNPKNSR	ééÄ	NKR	CMMMSNKSP	CMMMMM	
CQ	j Ö	CR	e É	CCQQKQVU	ééÄ	CKO	NRNVVRTQ	CMMMMM	
CT	^ ä	CR	e É	NRQKSRM	ééÄ	PKQ	PSCPKUR	CMMMMM	
CU	pá	CR	e O	CCPSKQSQ	ééÄ	MKS	NSQLQCQKVP	NMMMM	
PV	h	CR	e É	NUQKCSR	ééÄ	PKP	PSRNCRTR	CMMMMM	
QM	` ~	CR	e O	PMSKCSM	ééÄ	MKR	NUNRMCKCR	CMMMMM	
RN	s	UV	e É	NKMNU	ééÄ	THP	NMNNKNS	NMMM	
RO	` ê	UV	e É	MCUN	ééÄ	CQKS	NNUNKUO	CMMM	
RR	j å	UV	e É	NPKRSO	ééÄ	CKN	SSMCKPM	CMMM	
RS	cÉ	UV	e O	QNTKRCU	ééÄ	NKS	UVNSSUKPT	NMMMMM	
RV	` ç	UV	e É	MKMCR	ééÄ	PPKU	PNNKNP	NMMM	
SM	k á	UV	e É	MCCCO	ééÄ	NCKP	CQRKRS	NMMM	
SP	` ì	UV	e É	MKTMO	ééÄ	TKS	NPSNKCM	CMMM	
SS	wå	UV	e É	QKTPN	ééÄ	QKR	NNUSKTQ	CMMM	
TR	^ ë	UV	e É	MKPUQ	ééÄ	PKQ	TTKSU	NMMM	
TU	pÉ	UV	e O	MKMCP	ééÄ	URKP	NMKRM	NMMM	
UU	pê	UV	e É	CKRTT	ééÄ	SKU	NQVVKMM	CMMM	
VR	j ç	UV	e É	JMKNMT	ééÄ	k L^	NRRKRS	NMMM	
NMT	^ Ö	UV	e É	JMKMMS	ééÄ	k L^	CCKCO	NMM	
NNN	` Ç	UV	e É	JMKMNO	ééÄ	k L^	RKRS	NMMM	
NNU	på	NRV	e É	JMKMNR	ééÄ	k L^	OTSKSU	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKMUR	ééÄ	CPKM	NCNNKPQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	UKQRN	ééÄ	PKP	NMUSCKRM	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKSMN	ééÄ	k L^	VOTKSU	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMTP	ééÄ	k L^	PMSKVV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKNMQ	ééÄ	NTKV	PPPMKPS	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKVPS	ééÄ	k L^	CRCVKSM	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMVQ	ééÄ	k L^	NVSKUU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B¤¤ÉÅ	B n ` =¡ çï	B n ` =¤ëÛÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	OMCPQTMCV	CKO	NUVQNRTKMT	NVSKUP	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVPTMRNKSP	NKM	QRTPSTVKOQ	USKMU	RVKR	NOMQ	
pÅ	CR	e O	TVTUQUKQR	NKM	VURSCPKUN	UMKVR	RVKR	NOMQ	
pÅ	CR	e É	NOTTMQKQU	MKR	NSMVPNKCP	TVKPR	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VSMUSVKRO	MKU	NMTQQQSKRP	UVKQR	RVKR	NOMQ	
d É	TO	e O	PNSPNCKSN	NKM	PVPUSVKSQ	UMKPN	RVKR	NOMQ	
d É	TO	e É	NMNRSVKVR	MKQ	NCRCSSKVR	UNKMU	RVKR	NOMQ	
v	UV	e O	PSUCQCUKUN	MKS	QPMNURSKUS	URKS	RVKR	NOMQ	
v	UV	e É	SVMVCQKNV	NKP	UQNPQCKNU	UCKNO	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSUPNPNKPO	NKN	SRVNQQQKUP	NMNKPV	RVKR	NOMQ	
qÄ	NRV	e É	CRQQUPQKMN	MKS	CUSSNVMKN	UUKTV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRPNCUMKMM	NKO	PNTPQTCKSU	NNNKOT	RVKR	NOMQ	
_á	OMV	e É	NRMVQMCKTR	NKR	NSMVTVTKOQ	VPKTS	RVKR	NOMQ	

p~ã éãÉ=k~ã É pn NOMNUMNT

cãÉ=k~ã É MURpj mi lÇ

a~í~=m~íÜ=k~ã É aWjt ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÃ

^Åè=qãã É PLOULOMCP=CPARSMQP

p~ã éãÉ=qóéÉ p~ã éãÉ

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fpqa=n` =m~ëëlc~ãã m~ëë

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j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKNPV	ééÄ	k L^	VQKQR	NMM	
NN	_	S	k ç=d ~ë	SKTRV	ééÄ	PKM	SMUNKPV	NMMM	
CP	k ~	CR	e É	NPCNKQSN	ééÄ	CKT	NVRSCUKSQ	CMMMMM	
CQ	j Ö	CR	e É	CRCKCQV	ééÄ	PKM	NSNSCKVO	CMMMMM	
CT	^ä	CR	e É	NTCKVCM	ééÄ	CKT	CNRVKRT	CMMMMM	
CU	pá	CR	e O	NQSUKTTN	ééÄ	NKN	NMURNTKTT	NMMMM	
PV	h	CR	e É	NTCKUPS	ééÄ	UKS	PTMTMKCP	CMMMMM	
QM	` ~	CR	e O	PSMKRUV	ééÄ	MKT	CNNSUTKMU	CMMMMM	
RN	s	UV	e É	MKVUU	ééÄ	VKO	VUMKMR	NMMM	
RO	` ê	UV	e É	MKQUV	ééÄ	VKP	NPSVKUN	CMMM	
RR	j å	UV	e É	NNKUPM	ééÄ	NKP	RTCUKTR	CMMM	
RS	cÉ	UV	e O	QRQKTNM	ééÄ	NKM	VRRUVPKTR	NMMMMM	
RV	` ç	UV	e É	MKMUN	ééÄ	CQKT	PSSKSV	NMMM	
SM	k á	UV	e É	MKROT	ééÄ	VKO	PUCKCP	NMMM	
SP	` ì	UV	e É	MKSUQ	ééÄ	NMKP	NPCRKSQ	CMMM	
SS	wå	UV	e É	TKMCN	ééÄ	PKN	NSSRKSV	CMMM	
TR	^ë	UV	e É	MKPST	ééÄ	NNKM	TQKPQ	NMMM	
TU	pÉ	UV	e O	JMKMNU	ééÄ	k L^	TKNT	NMMM	
UU	pê	UV	e É	CKSVO	ééÄ	CKU	NRRMKNO	CMMM	
VR	j ç	UV	e É	JMKNCU	ééÄ	k L^	NQCKCP	NMMM	
NMT	^Ö	UV	e É	JMKMMQ	ééÄ	k L^	CRKRR	NMM	
NNN	` Ç	UV	e É	JMKMCN	ééÄ	k L^	PKPP	NMMM	
NNU	på	NRV	e É	JMKMOT	ééÄ	k L^	OTPKPQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMTR	ééÄ	NQKU	NNRNKOT	NMMM	
NPT	_~	NRV	k ç=d ~ë	VKVVN	ééÄ	NKU	NCSRSKNP	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKRPQ	ééÄ	k L^	NMUNKNU	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMTR	ééÄ	k L^	OVPKSR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMST	ééÄ	NSKQ	PMQSKTP	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKMMP	ééÄ	k L^	OTTPKCR	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMMO	ééÄ	k L^	ONMKCO	NMMM	

n` =fpqa=q~ÄãÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B¤ÉÁ	B n` =¨çï	B n` =¤ëÛÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	OMPMQMKQS	CKR	NUVQNRTKMT	NMTKO	RVKR	NOMKQ	
pÅ	CR	k ç=d ~ë	PVOTNURKRO	MKQ	QRTPSTVKOQ	URKUS	RVKR	NOMKQ	
pÅ	CR	e O	TVUSVVKSR	MKT	VURSCPKUN	UNKMP	RVKR	NOMKQ	
pÅ	CR	e É	NPNTRUKMU	MKT	NSMVPNKCP	UNKUT	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VSMVUPKRP	MKR	NMTQCQSKRP	UVKQS	RVKR	NOMKQ	
d É	TO	e O	PNPTCRKSV	MKQ	PVPUSVKSQ	TVKSR	RVKR	NOMKQ	
d É	TO	e É	NMNTVPKSU	MKQ	NCRCSSKVR	UNKCS	RVKR	NOMKQ	
v	UV	e O	PSCURUTKOV	MKU	CPMNURSKUS	UQKPR	RVKR	NOMKQ	
v	UV	e É	SURQCMKUS	MKU	UQNPCCKNU	UNKQT	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SSMNMCNKVV	NKM	SRVNCQQQKUP	NMMKNR	RVKR	NOMKQ	
qÄ	NRV	e É	CRTSOTMKRU	MKU	CUSSNVMKN	UVKUU	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRQTNSVKOM	MKU	PNTPQTCKSU	NNNKTU	RVKR	NOMKQ	
_á	OMV	e É	NRCPMMNKQS	CKN	NSMVTVTKOQ	VQKSN	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNU

cãÉ=k~ã É MUSpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÄ

^Åè=qãã É PLOVLOMCP=MMMMNMO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMKMTS	ééÄ	k L^	NSSKST	NMM	
NN	_	S	k ç=d ~ë	UKMQM	ééÄ	OKV	TMNRKNS	NMMM	
OP	k ~	QR	e É	NUCQKRRU	ééÄ	MKP	ORNPNVKRV	OMMMMM	
OQ	j Ö	QR	e É	OONKRUN	ééÄ	NKU	NQMSVKRU	OMMMMM	
OT	^ ä	QR	e É	PPSKVOR	ééÄ	NKQ	TUOOKQV	OMMMMM	
OU	pá	QR	e O	PTRNKMUR	ééÄ	NKP	OTSSNMKPT	NMMMM	
PV	h	QR	e É	STKNUO	ééÄ	OKQ	PNMTTKQP	OMMMMM	
QM	` ~	QR	e O	OTRKMPV	ééÄ	MKV	NSQRNSKRM	OMMMMM	
RN	s	UV	e É	NKTSN	ééÄ	OKU	NRSQKRS	NMMM	
RO	` ê	UV	e É	MKSSM	ééÄ	RKM	NRPMKQS	OMMM	
RR	j å	UV	e É	NPKVQN	ééÄ	OKM	STOQKPO	OMMM	
RS	cÉ	UV	e O	NRVMSPN	ééÄ	NKS	PQLURVPKQO	NMMMMM	
RV	` ç	UV	e É	MKMUT	ééÄ	NRKR	PTRKRU	NMMM	
SM	k á	UV	e É	MKNVV	ééÄ	NTHP	OPPKPQ	NMMM	
SP	` ì	UV	e É	NKVMP	ééÄ	NKV	OUSOKRT	OMMM	
SS	wå	UV	e É	UKUOS	ééÄ	PKQ	OMQVKMU	OMMM	
TR	^ ë	UV	e É	MKONR	ééÄ	NPKO	RMMST	NMMM	
TU	pÉ	UV	e O	MKMMS	ééÄ	NPTKN	VKNT	NMMM	
UU	pê	UV	e É	OKSUR	ééÄ	NMKR	NRQRKST	OMMM	
VR	j ç	UV	e É	JMKNSR	ééÄ	k L^	NOOKOP	NMMM	
NMT	^ Ö	UV	e É	JMKMVQ	ééÄ	k L^	ORKRS	NMM	
NNN	` Ç	UV	e É	JMKMNU	ééÄ	k L^	OKMT	NMMM	
NNU	på	NRV	e É	MKMVP	ééÄ	NOKU	PPRKRT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMQP	ééÄ	RQKQ	NMOOKOR	NMMM	
NPT	_~	NRV	k ç=d ~ë	NNKSNT	ééÄ	PKM	NQLPMRS	OMMM	
NUO	t	NRV	k ç=d ~ë	JMSRR	ééÄ	k L^	TVMKUS	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMUO	ééÄ	k L^	ORMOT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKSON	ééÄ	THO	TQVUKTV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	JMKMOR	ééÄ	k L^	OQRVKRP	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMVQ	ééÄ	k L^	NVPKRQ	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ ÉÅ	B n` =¡ çï	B n` =¤ëÃÜÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	OMONTUPKSM	MKU	NUVQNRTKMT	NVSKTQ	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PVPOVTTKQU	MKT	QRTPSTVKOQ	URKVV	RVKR	NOMQ	
pÅ	QR	e O	TVVMRNKTR	NKR	VURSCPKUN	UNKMT	RVKR	NOMQ	
pÅ	QR	e É	NOVVTPKRN	NKN	NSMVPNKCP	UMKTS	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VQQVUQKOT	NKN	NMTQOQSKRP	UTKVT	RVKR	NOMQ	
d É	TO	e O	PNTTPRKMM	NKN	PVPUSVKSQ	UMKST	RVKR	NOMQ	
d É	TO	e É	NMNPONKST	OKR	NORCSSKVR	UMKUU	RVKR	NOMQ	
v	UV	e O	PSUUPPRKMQ	MKP	QPMNURSKUS	URKTQ	RVKR	NOMQ	
v	UV	e É	SUQVRQKPU	MKO	UQNPOOKNU	UNKQN	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SSSQQMVKCP	NKS	SRVNQQQKUP	NMNKNN	RVKR	NOMQ	
qÄ	NRV	e É	ORPRSNVKPP	MKT	OUSSNVMKN	UUKQT	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PROSTPRKOQ	NKR	PNTPQTOKSU	NNNKNP	RVKR	NOMQ	
_á	OMV	e É	NRMUNMUKMU	NKM	NSMVTVTKOQ	VPKSU	RVKR	NOMQ	

p~ã éäÉ=k~ã É qbpqf` p^N

cãÉ=k~ã É MUTpj `mi HÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíyf` `mj eyNya^q^yOMCPyMPJ ^oyi n` OUbkÃ

^Åè=qãã É PLOVLOMCP=MVMVMTMVM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå NKMVMVM

p~ã éäÉ=n` =m~ëëlc á~ä c~ãä

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==` mp==	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKVDV	éé Ä	k lÅ	UCKCO	NVM	
NN	_	S	k ç=d ~ë	MKQQM	éé Ä	UKO	CRTQRTN	NVMVM	
CP	k ~	QR	e É	NVRPNTKUSO	éé Ä	NKO	SMCMNVSCKSU	CVMVMVM	
CQ	j Ö	QR	e É	NVRTMPKUCM	éé Ä	MKS	PNVSVVTPKSV	CVMVMVM	
CT	^ ä	QR	e É	NNMVRQRTSO	éé Ä	MKV	NCPQLQQQCKQR	CVMVMVM	
CU	pá	QR	e O	UKRNR	éé Ä	NRKU	PRQQKVO	NVMVM	
PV	h	QR	e É	NVNSOVMSNU	éé Ä	MKR	OSNCUUTCKVQ	CVMVMVM	
QM	` ~	QR	e O	NVCPMVMSSO	éé Ä	MKV	CUVPRMVMVMVD	CVMVMVM	
RN	s	UV	e É	MKMNP	éé Ä	STKR	OTRKRS	NVMVM	
RO	` ê	UV	e É	NKPUS	éé Ä	NKO	TOVMKRN	CVMVM	
RR	j å	UV	e É	MKPVS	éé Ä	PKO	NVPRKUQ	CVMVM	
RS	cÉ	UV	e O	VTNRQKRMQ	éé Ä	NKN	VUSMCSMRTKVV	NVMVMVM	
RV	` ç	UV	e É	MKMVU	éé Ä	VKP	NVMSKTQ	NVMVM	
SM	k á	UV	e É	MKSCP	éé Ä	QKQ	NRSQKRS	NVMVM	
SP	` ì	UV	e É	MKMVP	éé Ä	NQKR	NVCPKPV	CVMVM	
SS	wå	UV	e É	NKRRQ	éé Ä	NVKQ	NTUNKOS	CVMVM	
TR	^ ë	UV	e É	MKVCU	éé Ä	OVKR	RPKUN	NVMVM	
TU	pÉ	UV	e O	MKVOU	éé Ä	OTKS	NVKUT	NVMVM	
UU	pê	UV	e É	MKSVQ	éé Ä	CKO	NVPTKVR	CVMVM	
VR	j ç	UV	e É	OONPKSRV	éé Ä	MKS	RVONPMVKTN	NVMVM	[i a o
NVT	^ Ö	UV	e É	MKUMS	éé Ä	QOKN	VOKCP	NVM	
NNN	` Ç	UV	e É	MKPTM	éé Ä	PKO	QUNKKO	NVMVM	
NNU	på	NRV	e É	MKUNN	éé Ä	NPQKS	PMOKCP	NVMVM	
NON	pÄ	NRV	k ç=d ~ë	MKUTU	éé Ä	NVKM	OQPSKKQ	NVMVM	
NPT	_~	NRV	k ç=d ~ë	MKPNV	éé Ä	QKP	ONVOKQM	CVMVM	
NUO	t	NRV	k ç=d ~ë	MKUSR	éé Ä	QRKU	PMVSKVU	NVMVM	
OVR	qä	OMV	k ç=d ~ë	JMKVNO	éé Ä	k lÅ	PRPKTO	NVMVM	
OVU	mÄ	OMV	k ç=d ~ë	MKUTO	éé Ä	TKO	QVPRKSN	CVMVM	
OPO	qÜ	OMV	k ç=d ~ë	JMKVMS	éé Ä	k lÅ	OPPOKSV	NVMVM	
OPU	r	OMV	k ç=d ~ë	MKUNS	éé Ä	PMKM	SVOKVV	NVMVM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n` =i çï	B n` =e ãÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	NVSUMTMPU	MKP	NUVQNRTKMT	NVPKV	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PUNNUUPKPT	NKN	QRTPSTVKOQ	UPHPQ	RVKR	NOMQ	
pÅ	QR	e O	UMOTNNKNP	MKV	VURSCPKUN	UNKQQ	RVKR	NOMQ	
pÅ	QR	e É	NOURNSKQO	MKT	NSMVPNKCP	TVKUS	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VORMVNKVV	MKV	NMTQQQSKRP	USKNN	RVKR	NOMQ	
d É	TO	e O	PMVVQQRTN	MKR	PVPUSVKSQ	TUKSV	RVKR	NOMQ	
d É	TO	e É	VVNPCKTO	MKR	NORCSSKVR	TVKNQ	RVKR	NOMQ	
v	UV	e O	PRQRVSNKRT	MKV	QPMNURSKUS	UCKCP	RVKR	NOMQ	
v	UV	e É	SSUVMSKPU	MKT	UQNPQCKNU	TVKR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQONMQMKVN	NKN	SRVNQQQKUP	VTKQN	RVKR	NOMQ	
qÄ	NRV	e É	OQPNPMPKSM	MKV	OUSSNVMKN	UQKUP	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PCOMRRCKMP	NKM	PNTPQTCKSU	NMNKQU	RVKR	NOMQ	
_á	OMV	e É	NPQOMVMKTV	NKO	NSMVTVTKOQ	UPHPT	RVKR	NOMQ	

`çåíaåìåaÖ=~äåÄê~íáçå=sÉêëÑÅ~íáçå=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MUUj``skÇ
a~í~=m~íÜk~ã É	aWy^ÖãÉáíyf^mj eyNya^q^yQMCPyMPJ ^oyi n`OUbkÄ
^Åè=qáã É	PLOVLOMCP=MVMNOMV
p~ã éáÉ=qóéÉ	``s
qçí~äaãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MVQ ^i _kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=cä-Ö
V	_É	S	k ç=d ~ë	OQKVCP	ééÄ	NKU	NQSNVNKQT	CR	VSKQV	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OQKPCU	ééÄ	NKP	VSSUMKVR	CR	VTHPN	UVKU	NNMO	
CP	k ~	CR	e É	RTVRHPQQ	ééÄ	NKN	PRSRNROKTV	RMMM	NNRKVN	UVKU	NNMO	[=HLJ-NMB
CQ	j Ö	CR	e É	RUNSHSTM	ééÄ	NKV	NUSSSMVKUS	RMMM	NNSHPP	UVKU	NNMO	[=HLJ-NMB
CT	^ä	CR	e É	TNQKVVS	ééÄ	NHS	URCUQHRV	RMM	NQCP	UVKU	NNMO	[=HLJ-NMB
CU	pá	CR	e O	RQSKQPO	ééÄ	MKU	ONPUMRKQV	RMM	NMVKOV	UVKU	NNMO	
PV	h	CR	e É	RRVPHRRO	ééÄ	NKT	NRRCUCMQN	RMMM	NNNKUT	UVKU	NNMO	[=HLJ-NMB
QM	` ~	CR	e O	RSMVKQVO	ééÄ	MHR	NSQQNRTTKCR	RMMM	NNCKNV	UVKU	NNMO	[=HLJ-NMB
RN	s	UV	e É	CRHSVS	ééÄ	MHR	NVCURCHRN	CR	NVCKTU	UVKU	NNMO	
RO	` ê	UV	e É	CRKUSM	ééÄ	MKV	NPMCPPHRS	CR	NVPKQQ	UVKU	NNMO	
RR	j å	UV	e É	OSKNNO	ééÄ	MKU	SRQCMKMT	CR	NVQKCR	UVKU	NNMO	
RS	cÉ	UV	e O	ROSQRTMP	ééÄ	MKU	RUCMNOTQKCO	RMMM	NVRKOV	UVKU	NNMO	
RV	` ç	UV	e É	OSKQQN	ééÄ	MHS	CCSUCMRV	CR	NVRRTS	UVKU	NNMO	
SM	ká	UV	e É	OSKMTM	ééÄ	MKU	SCSSSKUM	CR	NVQKCU	UVKU	NNMO	
SP	` ì	UV	e É	OSKCMM	ééÄ	MKU	NTQVTNKCS	CR	NVQKU	UVKU	NNMO	
SS	wå	UV	e É	OSKCPU	ééÄ	NKO	OVSVMKUR	CR	NVQKVR	UVKU	NNMO	
TR	^ë	UV	e É	CRKVNV	ééÄ	CHM	ONPUMRKV	CR	NVPHSU	UVKU	NNMO	
TU	pÉ	UV	e O	CQKVNN	ééÄ	MKV	NVPMCPKVU	CR	VVHSQ	UVKU	NNMO	
UU	pê	UV	e É	CRKVVQ	ééÄ	MHR	TSUUTKUM	CR	NVPKVU	UVKU	NNMO	
VR	j ç	UV	e É	PPHMNR	ééÄ	MKQ	VRTPQHMO	CR	NPCHMS	UVKU	NNMO	[=HLJ-NMB
NMT	^Ö	UV	e É	OTHPMV	ééÄ	CHP	CUNUPCHMM	CR	NMVKOQ	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKTRS	ééÄ	NKU	PSVTSHQT	CR	NMTHMO	UVKU	NNMO	
NNU	på	NRV	e É	CRKMCR	ééÄ	MHS	TNTCRHRQ	CR	NMMKNU	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	CQKVVV	ééÄ	CHN	RSOTCMKMP	CR	NMM	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	OSKMCP	ééÄ	MHP	NTMCNPKUR	CR	NVQKNT	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OTHMSM	ééÄ	MKQ	PCURPCKCQ	CR	NVUKOQ	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	CQKUST	ééÄ	NKQ	TSSTCRKCU	CR	VVKQT	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	CRKVCN	ééÄ	MHS	NMVCMNRKUV	CR	NVPHSU	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKRVU	ééÄ	MKV	VUTQUNKNR	CR	NVSHPV	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OTHPPP	ééÄ	NKT	VQNVPNHSQ	CR	NMVHPP	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=i çï	B n`=eäÜÜ	n`=cä-Ö
iá	S	k ç=d ~ë	ONQCRTNKTO	CHO	NUVQNRTHMT	NNCKNS	RVHR	NOMQ	
pÅ	CR	k ç=d ~ë	QNUPSRSHPQ	NKT	QRTPSTVHQQ	VNKQT	RVHR	NOMQ	
pÅ	CR	e O	UQTPTMKVT	NKQ	VURSCPKUN	URKVT	RVHR	NOMQ	
pÅ	CR	e É	NPSPCSKQU	MHS	NSMVPNKCP	UQRTN	RVHR	NOMQ	
dÉ	TO	k ç=d ~ë	NMVRRSRHPV	MHO	NMTQCQCSKRP	VPHSN	RVHR	NOMQ	
dÉ	TO	e O	PQCCCQCKCS	MHS	PVPUSVHSQ	USKUV	RVHR	NOMQ	
dÉ	TO	e É	NMTVRVMPV	MKU	NCRCSSKVR	USHNU	RVHR	NOMQ	
v	UV	e O	PUSNSNPKVT	NHP	CPMNURSKUS	UVRTT	RVHR	NOMQ	
v	UV	e É	TCPQUSKQS	NHM	UQNPQCCKNU	URKVV	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVMPUCPHPQ	NKV	SRVNQQQKUP	NVQRTQ	RVHR	NOMQ	
qÄ	NRV	e É	OSMNRVTHPQ	MRT	CUSSNVMKN	VMRTT	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PSTTSOTHPR	NHM	PNTPQTCHSU	NNRKUV	RVHR	NOMQ	
_á	OMV	e É	NRNQMPMRTM	NKQ	NSMVTVTKQQ	VQHVR	RVHR	NOMQ	

`çåíáåì åÖ=~ëÄê~íáç=_ä~åâ=É`_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MUM``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíÝ^mj eyNya^q^yOMCPyMPJ ^oyi n`OUbkÂ

^Åè=qáã É PLOVLOMCP=MVMQMQM

p~ã éáÉ=qóéÉ ``_

qçí~äa äi íáç~å NKMMMM

`çã ã Éåí JJJ

fpqa=oÉÑ=cäÉk~ã É MVQ ^i _KÇ

p~ã éáÉ=n`=m~ëëlc á~ä c~äi

fpqa=n`=m~ëëlc~äi m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÄK	r åáë	opa	==\ mp==	i äáá	n`=c ä~Ö
V	_É	S	k ç=d ~ë	JMKMVR	éé Ä	k L^	CPTKTU	MO	
NN	_	S	k ç=d ~ë	MKNVT	éé Ä	RKT	NQURKSS	Q	
CP	k~	QR	e É	PSKRUN	éé Ä	SKV	STNCUKPT	CVM	
CQ	j Ö	QR	e É	OVKVVV	éé Ä	SKS	NVSSQKRS	CM	c~äë^ äëj ÉíÜçÇë& c~äÉÇ=a ça
CT	^ä	QR	e É	CRKVRR	éé Ä	TKO	PQCPUKOT	CM	c~äë^ äëj ÉíÜçÇë& c~äÉÇ=a ça
CU	pá	QR	e O	MKUST	éé Ä	NQKV	TVMKUS	NVM	
PV	h	QR	e É	CRKQQN	éé Ä	NVMN	PTSPPKRP	CVM	
QM	`~	QR	e O	POKURS	éé Ä	QKS	NNQPTSKRT	CM	c~äë^ äëj ÉíÜçÇë& c~äÉÇ=a ça
RN	s	UV	e É	MKVNQ	éé Ä	ONKN	PNSKSU	N	
RO	`ê	UV	e É	JMKVPP	éé Ä	k L^	UOVKUT	N	
RR	j å	UV	e É	JMKVMN	éé Ä	k L^	NPQKSQ	MQ	
RS	cÉ	UV	e O	PVKQVV	éé Ä	PKM	PSSVQNKRM	CM	c~äë^ äëj ÉíÜçÇë& c~äÉÇ=a ça
RV	` ç	UV	e É	JMKVVS	éé Ä	k L^	OVQKQR	MO	
SM	k á	UV	e É	JMKVVR	éé Ä	k L^	NQRKRS	MQ	
SP	` ì	UV	e É	MKVVV	éé Ä	RTKQ	RTTKUM	MS	
SS	wå	UV	e É	MKVRP	éé Ä	TOKS	ORVKUN	O	
TR	^ë	UV	e É	MKVCO	éé Ä	SKM	PUKVM	N	
TU	pÉ	UV	e O	MKVPV	éé Ä	PVKS	OSKPP	N	
UU	pê	UV	e É	MKVNN	éé Ä	QVKR	UNKNO	N	
VR	j ç	UV	e É	NKCRV	éé Ä	OKQ	QVSCKVN	N	c~äë^ äëj ÉíÜçÇë& c~äÉÇ=a ça
NVT	^Ö	UV	e É	MKVNR	éé Ä	PTKP	QVPKPQ	MO	
NNN	` Ç	UV	e É	MKVNV	éé Ä	NUKT	PTKTU	MO	
NNU	på	NRV	e É	MKVSS	éé Ä	CPKV	RNCKCQ	N	
NCN	pÄ	NRV	k ç=d ~ë	MKVCO	éé Ä	QVKT	NQPNKRV	MO	
NPT	_~	NRV	k ç=d ~ë	MKVMO	éé Ä	CUCKO	NVSKUU	MQ	
NUO	t	NRV	k ç=d ~ë	MKVCU	éé Ä	NKP	OVUVKNT	N	
QVR	qä	QVV	k ç=d ~ë	MKVPT	éé Ä	NSKP	NVQUKUV	MO	
QVU	mÄ	QVV	k ç=d ~ë	JMKVOT	éé Ä	k L^	NRNUKPN	MO	
CPO	qÜ	QVV	k ç=d ~ë	JMKVVR	éé Ä	k L^	QUVSKSP	N	
CPU	r	QVV	k ç=d ~ë	MKVNU	éé Ä	QKM	USTKSO	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=ç ï	B n`=cäÜÜ	n`=c ä~Ö
i á	S	k ç=d ~ë	ONQSVTSKVV	OKT	NUVQNRTKVT	NNPKPR	RVVR	NOVMQ	
pÅ	QR	k ç=d ~ë	QPNTUCRKNO	NKM	QRTPSTVKOQ	VQKQN	RVVR	NOVMQ	
pÅ	QR	e O	UUQQQNKUR	NKM	VURSCPKUN	UVKTP	RVVR	NOVMQ	
pÅ	QR	e É	NQPMPRKVV	MKP	NSMVPNKCP	UUKUU	RVVR	NOVMQ	
d É	TO	k ç=d ~ë	NMQVVSPKUS	MKR	NMTQQQSKRP	VTKTQ	RVVR	NOVMQ	
d É	TO	e O	PRCPVUKPN	MKO	PVPUSVKSQ	UVKQT	RVVR	NOVMQ	
d É	TO	e É	NNPUQTKTT	NKQ	NCRCSSKVR	VMKUU	RVVR	NOVMQ	
v	UV	e O	QMRVOSNKPN	MKP	QPMNURSKUS	VQKPS	RVVR	NOVMQ	
v	UV	e É	TSMMMSKCO	MKQ	UQNPQCKNU	VMKPP	RVVR	NOVMQ	
qÄ	NRV	k ç=d ~ë	TCQQTCPKQU	NKT	SRVNQQQKUP	NMVKSN	RVVR	NOVMQ	
qÄ	NRV	e É	OTUMTCCKRQ	NKP	CUSSNVMKN	VTKMO	RVVR	NOVMQ	
_á	QVV	k ç=d ~ë	PTTSUQVKUU	MKT	PNTPQTCKSU	NVVKUN	RVVR	NOVMQ	
_á	QVV	e É	NSNMOVMKMT	NKN	NSMVTVTKOQ	NMMKMP	RVVR	NOVMQ	

KATAHDIN ANALYTICAL SERVICES, LLC
METALS ANALYSIS RUN INFORMATION SHEET

INSTR. ID: L (Agilent 7800) **ANALYST**: EAM **ANALYSIS DATE**: 03/29/23

METHOD: **ICP-MS**
- ☑ 200.8
- ☐ 6020
- ☑ DOD

FILE NAME: LQC29A

Reviewed By: KS 3/30/23

The pHs of all samples that were tested by direct analysis in this analytical run were checked just prior to analysis and confirmed to be <2. The time of preservation of these samples was checked in the "Measured Turbidity and Preservation of Incoming Samples" logbook to verify that they had been preserved at least 16 hours prior to analysis. These verifications were performed by _____ (initials) on _____ (date).

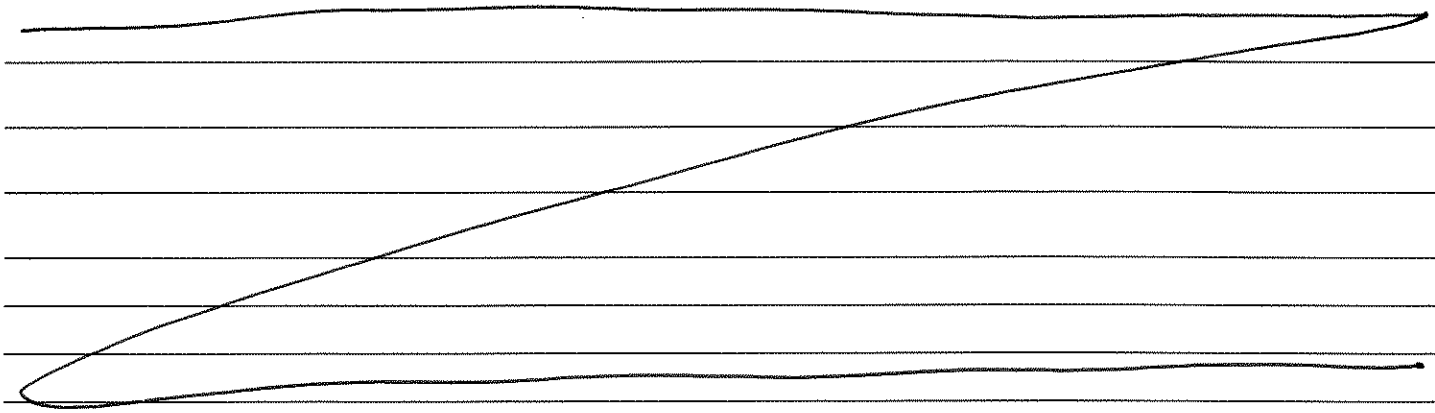
STANDARDS USED:

Standard Name	Standard ID	Prep Date	Expiration Date	Standard Conc.
Cal Blk/ICB/CCB	MW21411	03/02/23	03/02/24	0 ug/L
Cal Std	MW21445	03/27/23	05/31/23	Varies by Element
ICV	MW21429	03/15/23	06/14/23	Varies by Element
PQL	MW21447	03/27/23	05/31/23	Varies by Element
LRS1	MW21454	03/28/23	05/31/23	Varies by Element
LRS2	MW21450	03/27/23	05/31/23	Varies by Element
ICSA	MW21441	03/24/23	03/31/23	Varies by Element
ICSAB	MW21448	03/27/23	04/03/23	Varies by Element
CCV	MW21455	03/28/23	05/31/23	Varies by Element
Internal Standard (ISTD)	N/A	N/A	N/A	0.2 mg/L (Li,Sc,Ge/Y,Tb,Bi)

Additional Comments and Notes:

Samples with ISTD RSDs > 8% were reanalyzed immediately.

ISTD was manually added to all standards and samples (0.08 mL of MS2459 to 8 mL).



Dilutions: Some samples were diluted based on history or due to interfering element concentrations.

Dilution preparations are as follows:

5x diln.: 1.6 mL of sample (pipet M30) + 6.4 mL of MW21411 (pipet M31)

10x diln.: 0.8 mL of sample (pipet M19) + 7.2 mL of MW21411 (pipet M31)

25x diln.: 0.32 mL of sample(pipet M19) + 7.68 mL of MW21411 (pipet M31)

Post Spike: 0.08 mL of MW21329 (pipet M27) into 8 mL final volume of appropriately diluted sample (pipet M31)

INSTRUMENT RUNLOG

Instrument: AGILENT 7800

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
CalBlank	1	LQC29A	03/29/2023	18:45	EAM
CalStd	1	LQC29A	03/29/2023	18:50	EAM
ICV	1	LQC29A	03/29/2023	19:02	EAM
ICB	1	LQC29A	03/29/2023	19:11	EAM
PQL	1	LQC29A	03/29/2023	19:16	EAM
ICSA	1	LQC29A	03/29/2023	19:21	EAM
ICSAB	1	LQC29A	03/29/2023	19:27	EAM
LRS1	1	LQC29A	03/29/2023	19:35	EAM
LRS2	1	LQC29A	03/29/2023	19:47	EAM
RINSE	1	LQC29A	03/29/2023	19:55	EAM
CCV	1	LQC29A	03/29/2023	20:00	EAM
CCB	1	LQC29A	03/29/2023	20:10	EAM
RINSE	1	LQC29A	03/29/2023	20:15	EAM
CCV	1	LQC29A	03/29/2023	20:21	EAM
CCB	1	LQC29A	03/29/2023	20:31	EAM
PBSQC16IMS1	5	LQC29A	03/29/2023	20:36	EAM
LCSOQC16IMS1	5	LQC29A	03/29/2023	20:41	EAM
SQ1188-011	5	LQC29A	03/29/2023	20:49	EAM
SQ1188-013	5	LQC29A	03/29/2023	20:54	EAM
PBWQC17IMW1	5	LQC29A	03/29/2023	21:00	EAM
LC2WQC17IMW1	5	LQC29A	03/29/2023	21:05	EAM
LCSWQC17IMW1	5	LQC29A	03/29/2023	21:13	EAM
SQ1259-002	1	LQC29A	03/29/2023	21:22	EAM
PBWQC17IMW2	5	LQC29A	03/29/2023	21:27	EAM
LCSWQC17IMW2	5	LQC29A	03/29/2023	21:32	EAM
CCV	1	LQC29A	03/29/2023	21:41	EAM
CCB	1	LQC29A	03/29/2023	21:50	EAM
SQ0960-001	5	LQC29A	03/29/2023	21:56	EAM
SQ0960-002	5	LQC29A	03/29/2023	22:01	EAM
SQ0960-003	5	LQC29A	03/29/2023	22:06	EAM
SQ0960-004	5	LQC29A	03/29/2023	22:11	EAM
SQ0960-005	5	LQC29A	03/29/2023	22:16	EAM
SQ0960-006	5	LQC29A	03/29/2023	22:21	EAM
SQ0960-007	5	LQC29A	03/29/2023	22:26	EAM
SQ0960-008	5	LQC29A	03/29/2023	22:31	EAM
SQ0960-009	5	LQC29A	03/29/2023	22:37	EAM
SQ0960-010	5	LQC29A	03/29/2023	22:42	EAM
CCV	1	LQC29A	03/29/2023	22:47	EAM
CCB	1	LQC29A	03/29/2023	22:56	EAM
SQ0960-012	5	LQC29A	03/29/2023	23:01	EAM
SQ0960-013	5	LQC29A	03/29/2023	23:06	EAM
PBWQC21IMW2	5	LQC29A	03/29/2023	23:11	EAM
LCSWQC21IMW2	5	LQC29A	03/29/2023	23:16	EAM
SQ1015-024	5	LQC29A	03/29/2023	23:24	EAM

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
SQ1201-009	5	LQC29A	03/29/2023	23:29	EAM
SQ1201-010	5	LQC29A	03/29/2023	23:35	EAM
SQ1201-011	5	LQC29A	03/29/2023	23:40	EAM
SQ1201-012	5	LQC29A	03/29/2023	23:45	EAM
SQ1201-012L	25	LQC29A	03/29/2023	23:50	EAM
CCV	1	LQC29A	03/29/2023	23:55	EAM
CCB	1	LQC29A	03/30/2023	00:04	EAM
SQ1201-012A	5	LQC29A	03/30/2023	00:09	EAM
SQ1201-013	5	LQC29A	03/30/2023	00:14	EAM
SQ1201-014	5	LQC29A	03/30/2023	00:20	EAM
SQ1201-015	5	LQC29A	03/30/2023	00:25	EAM
SQ1201-016	5	LQC29A	03/30/2023	00:30	EAM
SQ1201-017	5	LQC29A	03/30/2023	00:35	EAM
SQ1201-018	5	LQC29A	03/30/2023	00:40	EAM
CCV	1	LQC29A	03/30/2023	00:45	EAM
CCB	1	LQC29A	03/30/2023	00:55	EAM
RINSE	1	LQC29A	03/30/2023	01:00	EAM

US EPA Tune Check Report

Operator Name	admin
Acq/Data Batch	D:\Agilent\ICPMH\1\DATA\2023\03-MAR\LQC29AA.b
Acq. Date-Time	3/29/2023 18:03:57
Report Comment	---
Instrument Name	G8421A SG18503526

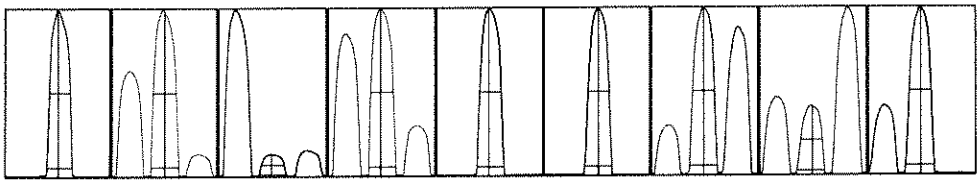
[No Gas]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
9	10.00	65080	650804.08	3.292	5.000	
24	10.00	265202	2652017.21	3.151	5.000	
25	10.00	35247	352474.30	3.544	5.000	
26	10.00	40584	405844.21	3.225	5.000	
59	10.00	537635	5376353.24	3.970	5.000	
115	10.00	632249	6322485.02	3.313	5.000	
206	10.00	114523	1145233.71	3.905	5.000	
207	10.00	98385	983845.89	3.901	5.000	
208	10.00	234749	2347487.64	3.543	5.000	

Integration Time [sec] 0.1

Resolution/Axis



Mass	Peak Height	Axis	Axis (Required)	Axis (Flag)
9	68011.88	9.05	8.90 - 9.10	
24	267153.62	24.05	23.90 - 24.10	
25	34801.78	25.00	24.90 - 25.10	
26	40728.45	26.00	25.90 - 29.10	
59	541146.68	59.00	58.90 - 59.10	
115	639220.17	115.05	114.90 - 115.10	
206	112943.48	206.00	205.90 - 206.10	
207	99803.03	207.00	206.90 - 207.10	
208	243394.09	208.00	207.90 - 208.10	

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
9	0.61	0.735	0.900	
24	0.64	0.785	0.900	
25	0.63	0.765	0.900	

US EPA Tune Check Report

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
26	0.65	0.785	0.900	
59	0.62	0.780	0.900	
115	0.59	0.772	0.900	
206	0.62	0.783	0.900	
207	0.61	0.785	0.900	
208	0.62	0.816	0.900	

Integration Time [sec] 0.1
Acquisition Time [sec] 47.0000000000001
Y Axis Linear

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.34 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	13.0 V
Extract 2	-250.0 V	Cell Entrance	-40 V	Plate Bias	-40 V
Omega Bias	-85 V	Cell Exit	-60 V		

Cell Parameters

Use Gas	No	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-8.0 V		
H2 Flow	0.0 mL/min	OctP RF	130 V		

QP Parameters

Mass Gain	120	Axis Gain	0.9981	QP Bias	-3.0 V
Mass Offset	126	Axis Offset	0.15		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	1.0 mm

EM

Discriminator	3.5 mV	Analog HV	2221 V	Pulse HV	1224 V

[H2]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	47471	474714.76	3.223	5.000	
89	10.00	51914	519141.77	3.117	5.000	
205	10.00	42609	426092.94	2.798	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

US EPA Tune Check Report

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.34 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-18.0 V		
H2 Flow	5.0 mL/min	OctP RF	200 V		

QP Parameters

Mass Gain	120	Axis Gain	0.9981	QP Bias	-13.0 V
Mass Offset	126	Axis Offset	0.15		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	1.0 mm		

EM

Discriminator	3.5 mV	Analog HV	2221 V	Pulse HV	1224 V

[He]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	122586	1225861.62	3.064	5.000	
89	10.00	8489	84891.06	3.380	5.000	
205	10.00	16674	166736.75	2.774	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.57 L/min	Dilution Gas	0.34 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	4.5 mL/min	OctP Bias	-18.0 V		
H2 Flow	0.0 mL/min	OctP RF	200 V		

QP Parameters

US EPA Tune Check Report

Mass Gain	120	Axis Gain	0.9981	QP Bias	-13.0 V
Mass Offset	126	Axis Offset	0.15		

Hardware Settings

Torch

Torch H	-0.2 mm	Torch V	1.0 mm		

EM

Discriminator	3.5 mV	Analog HV	2221 V	Pulse HV	1224 V

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OT	^ä	QR	e É	ORRKRS	QKO
OU	pá	QR	e O	QVMKRO	NOKT
PV	h	QR	e É	OVRPVKUT	NKP
QM	` ~	QR	e O	NQSPQKQN	NKR
RN	s	UV	e É	POMKMN	PKU
RO	` ê	UV	e É	USRKUS	OKN
RR	j å	UV	e É	NOUKSQ	OMKP
RS	cÉ	UV	e O	NMNTTKTP	OKQ
RV	` ç	UV	e É	OPNKNO	NMKV
SM	k á	UV	e É	NRRKRS	POKO
SP	` ì	UV	e É	PVOKOQ	NMKV
SS	wå	UV	e É	NTUKUV	NOKM
TR	^ë	UV	e É	NQKPP	NTKS
TU	pÉ	UV	e O	PKST	SNKR
UU	pê	UV	e É	ONKNN	RRKQ
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NMT	^Ö	UV	e É	NNKNN	NTKP
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pÅ	QR	e O	NMNQTQMKRN	NKU
pÅ	QR	e É	NQUSRRKMQ	NKM
d É	TO	k ç=d ~ë	NMOUNSRKPO	MKU
d É	TO	e O	QNPQVUKVS	NKM
d É	TO	e É	NNSPVNKSQ	NKV
v	UV	e O	QRVPNOQKTO	MKR
v	UV	e É	TVMSMNKUR	MKN
qÄ	NRV	k ç=d ~ë	SQRNNMQKSR	NKP
qÄ	NRV	e É	OTRQTPNKTP	MKN
_á	OMV	k ç=d ~ë	POQVPUTKTP	OKO
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OT	^ä	QR	e É	NRRNTRKRQ	MKQ
OU	pá	QR	e O	RSUNVSKOS	NKM
PV	h	QR	e É	PSTNQPRKVM	MKU
QM	` ~	QR	e O	QNTPVVTUKRR	NKN
RN	s	UV	e É	ORCUOSKSV	OKO
RO	` ê	UV	e É	PMUOQOKQN	NKP
RR	j å	UV	e É	NRQTROKOQ	NKP
RS	cÉ	UV	e O	NQRQQSSTPKOO	NKV
RV	` ç	UV	e É	RPPOSUKNO	NKU
SM	k á	UV	e É	NQVUPMKTN	MKU
SP	` ì	UV	e É	QOMOOVKOQ	MKU
SS	wå	UV	e É	SVOPRKVT	NKO
TR	^ë	UV	e É	ROOTOKMU	NKR
TU	pÉ	UV	e O	OUPVQKRP	MKS
UU	pê	UV	e É	NVMMMRKPP	MKU
VR	j ç	UV	e É	NTSURNKVO	MKT
NMT	^Ö	UV	e É	SQRSNTKPP	MKU
NNN	` Ç	UV	e É	USSNVKOV	MKM
NNU	på	NRV	e É	NTRMQMKPN	NKT
NON	pÄ	NRV	k ç=d ~ë	NOOUQTVKNP	MKR
NPT	_~	NRV	k ç=d ~ë	PSNRUMKVU	MKT
NUO	t	NRV	k ç=d ~ë	TNUPQQKMS	MKU
OMR	qä	OMV	k ç=d ~ë	NRTMTPPKVV	MKT
OMU	mÄ	OMV	k ç=d ~ë	ONUVONNKVS	MKT
OPO	qÜ	OMV	k ç=d ~ë	NVTVUNOKSV	OKM
OPU	r	OMV	k ç=d ~ë	NURUPUOKNO	OKM

n` =fpqa=q~ÄäÉ

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pÅ	QR	e O	NONRMOSKSO	MKM	NMNQTQMKRN	NNVKTQ	RVKR	NOMKQ	
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d É	TO	e É	NPSPUPKPR	MKO	NNSPVNKSQ	NNTKNU	RVKR	NOMKQ	
v	UV	e O	RPVOOPOKRQ	NKR	QRVPNOQKTO	NNTKQ	RVKR	NOMKQ	
v	UV	e É	VMUUSRKOM	NKN	TVMSMNKUR	NNQKVS	RVKR	NOMKQ	
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qçí~äaãäíáçå	NKMMMM
`çã ãÉáí	JJJ
fpqa=oÉÑcãÉk~ã É	MMJ^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~áä	m~ëë
l éÉê~íçê	~Çã áå

n`=^å~äöíÉ=q~ÄáÉ

j~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råäë	opa	==mp==	bñés~ä	B=oÉÅ	Bíçï	BeáÖÜ	n`=cä~Ö
V	_É	S	kç=ol~ë	CMSPN	ééÄ	CKP	NCNRQRKMS	CCM	NMPKNS	UVKS	NNMQ	
NN	_	S	kç=ol~ë	CNKRPP	ééÄ	NKV	UMVQUKCM	CCM	NMTKSS	UVKS	NNMQ	
CP	k~	QR	eÉ	CNRUKMPU	ééÄ	CKO	PNVNNMUKRR	QMMM	NMPKVR	UVKS	NNMQ	
CQ	jÖ	QR	eÉ	QCCMQPT	ééÄ	CKO	NSSVMVVKSU	QMMM	NMRKRN	UVKS	NNMQ	
CT	^ä	QR	eÉ	CNUKQCM	ééÄ	NKU	SOTNQKPR	QMM	NMQKSN	UVKS	NNMQ	
CU	pá	QR	eO	QMRKQQT	ééÄ	MKT	CCMSQMKCS	QMM	NMNKPN	UVKS	NNMQ	
PV	h	QR	eÉ	CNQTKTVS	ééÄ	CKT	NQUSQCMKUS	QMMM	NMPKSV	UVKS	NNMQ	
QM	`~	QR	eO	CNQTKQQQ	ééÄ	MKQ	NSRTMNVRKTO	QMMM	NMPKSU	UVKS	NNMQ	
RN	s	UV	eÉ	NVKVCR	ééÄ	NKO	VVTSVKVU	CCM	VVKSP	UVKS	NNMQ	
RO	`ê	UV	eÉ	CMKCRM	ééÄ	MKQ	NCPVPUKMU	CCM	NMNKCR	UVKS	NNMQ	
RR	jå	UV	eÉ	CMKRSN	ééÄ	MKV	SOVRVKQS	CCM	NMCKU	UVKS	NNMQ	
RS	cÉ	UV	eO	CNNCKQTU	ééÄ	NKN	RUMNMSCNKMU	QMMM	NMCKUN	UVKS	NNMQ	
RV	`ç	UV	eÉ	CMKVSO	ééÄ	NKT	CCNMNSKTP	CCM	NMQKUN	UVKS	NNMQ	
SM	ká	UV	eÉ	CMKSMS	ééÄ	NKT	SNNMSKRT	CCM	NMPKMP	UVKS	NNMQ	
SP	`ì	UV	eÉ	CMKRQQ	ééÄ	NKP	NTMUQMKPM	CCM	NMCKTO	UVKS	NNMQ	
SS	wå	UV	eÉ	CNKMTU	ééÄ	CKN	CUVRNKQN	CCM	NMRKPV	UVKS	NNMQ	
TR	^ë	UV	eÉ	CMKMSU	ééÄ	MKQ	CMTPUKRR	CCM	NMMKPQ	UVKS	NNMQ	
TU	pÉ	UV	eO	CMKMPN	ééÄ	MKT	NNMPSKGV	CCM	NMMKNS	UVKS	NNMQ	
UU	pê	UV	eÉ	CMKSRT	ééÄ	MKQ	TTRTCKMS	CCM	NMPKCV	UVKS	NNMQ	
VR	jç	UV	eÉ	QMKTNS	ééÄ	NKN	NQCCUTKMP	QCM	NMNKTV	UVKS	NNMQ	
NMT	^Ö	UV	eÉ	CMKQRU	ééÄ	NKP	OSMVTVKTO	CCM	NMCKCV	UVKS	NNMQ	
NNN	`Ç	UV	eÉ	CMKRCR	ééÄ	NKM	PRNPMKRQ	CCM	NMCKSO	UVKS	NNMQ	
NNU	på	NRV	eÉ	CMKPCO	ééÄ	NKU	SUTURKMT	CCM	NMNKGN	UVKS	NNMQ	
NON	pÄ	NRV	kç=ol~ë	CMKRCO	ééÄ	MKU	QVTUQNKSV	CCM	NMCKSN	UVKS	NNMQ	
NPT	_~	NRV	kç=ol~ë	CNKMSN	ééÄ	NKN	NRMPMVKCV	CCM	NMRKP	UVKS	NNMQ	
NUO	t	NRV	kç=ol~ë	COKMPU	ééÄ	NKT	PNOTPPKSU	CCM	NNMKNV	UVKS	NNMQ	
QMR	qä	QMV	kç=ol~ë	CMKVUN	ééÄ	MKS	SRSNUSKCM	CCM	NMQKV	UVKS	NNMQ	
QMU	mÄ	QMV	kç=ol~ë	CMKPUT	ééÄ	MKO	UVMRCNKRR	CCM	NMNKVQ	UVKS	NNMQ	
QPO	qÜ	QMV	kç=ol~ë	CMKNRS	ééÄ	NKM	TVRQPUKCU	CCM	NMMKTU	UVKS	NNMQ	
QPU	r	QMV	kç=ol~ë	CMKOSV	ééÄ	NKQ	TQVSNMKUM	CCM	NMNKPQ	UVKS	NNMQ	

n`=fpqa=q~ÄáÉ

k~ã É	j~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑë mp	B=oÉÅ	Bn`=íçï	Bn`=eáÖÜ	n`=cä~Ö
íá	S	kç=ol~ë	CMSRUSNKUU	MKR	NTURRSCKNS	NNRKT	RVKR	NOMQ	
pÅ	QR	kç=ol~ë	RMMTTUSKVV	MKP	QCRQQUNKTO	NNTKTN	RVKR	NOMQ	
pÅ	QR	eO	NNSCPVVKQT	CKN	NMNQTQMKRN	NNQKRR	RVKR	NOMQ	
pÅ	QR	eÉ	NSVRCQKTT	CKO	NQUSRRKMQ	NNQKMQ	RVKR	NOMQ	
dÉ	TO	kç=ol~ë	NCNNSQTKPR	NKP	NMCUNSRKPO	NNTKUR	RVKR	NOMQ	
dÉ	TO	eO	QSUPTUKRV	NKT	QNPQVUKVS	NNPKOT	RVKR	NOMQ	
dÉ	TO	eÉ	NPCQRNKMR	MKR	NNSPVNKSQ	NNPKU	RVKR	NOMQ	
v	UV	eO	RCCVPRQKOV	NKN	QRVPNCQKTO	NNPKUR	RVKR	NOMQ	
v	UV	eÉ	UVTUVPKRN	MKU	TVMSMNKUR	NNPKRT	RVKR	NOMQ	
qÄ	NRV	kç=ol~ë	TQTNQSCKOV	NKS	SQRNNMQKSR	NNRKUO	RVKR	NOMQ	
qÄ	NRV	eÉ	PMCPMSTKUT	NKP	OTRQTPNKTP	NNMKQT	RVKR	NOMQ	
_á	QMV	kç=ol~ë	PUQCRUTKRS	NKN	PCQVPUTKTP	NNUKOS	RVKR	NOMQ	
_á	QMV	eÉ	NTUSCCRKMN	NKR	NRSMNCCKRR	NNQKQV	RVKR	NOMQ	

fåáá~ä=`~ãÄÂê~íáçå=_ä~åâ=Ef`_F=oÉéçã

p~ã éâÉ=k~ã É	f`_
cãÉ=k~ã É	MNNJf`_ÍÇ
a~í~=m~íÜ=k~ã É	aWj^ÖãÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyi n`OV^hÂ
^Åè=qáã É	PLOVLOMCP=NVMNNQM
p~ã éâÉ=qóéÉ	f`_
qçí~äa ãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑncãÉk~ã É	MMJ^i_ÍÇ
p~ã éâÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~ãä	m~ëë
I éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	r åáë	opa	==\ mp==	iãäá	n`=c~ä~Ö
V	_É	S	kç=cl~ë	MKMNR	ééÄ	RMKT	OVSKST	MO	
NN	_	S	kç=cl~ë	MKOQV	ééÄ	VKQ	NPPSKTR	Q	
OP	k~	QR	eÉ	OKMOS	ééÄ	VKR	SSMPUKQP	OMM	
OQ	j Ö	QR	eÉ	PKRTM	ééÄ	NPKN	OMVPKRS	OM	
OT	^ä	QR	eÉ	JMKNMP	ééÄ	kL^	OPTKTU	OM	
OU	pá	QR	eO	MKRSU	ééÄ	QUKO	TRMKUO	NMM	
PV	h	QR	eÉ	UKVUQ	ééÄ	ORKM	PNTPRKCU	OMM	
QM	`~	QR	eO	PKVUO	ééÄ	RKN	CUONOKTT	OM	
RN	s	UV	eÉ	MKMMQ	ééÄ	NPPKQ	PCUKVM	N	
RO	`ê	UV	eÉ	MKMNV	ééÄ	RQKU	VQTKUR	N	
RR	j å	UV	eÉ	MKMNP	ééÄ	SQKV	NRVKPN	MQ	
RS	cÉ	UV	eO	PKUTR	ééÄ	QKS	RURMMKSU	OM	
RV	`ç	UV	eÉ	MKMMP	ééÄ	RKT	ORPKPR	MO	
SM	ká	UV	eÉ	MKMNR	ééÄ	NOKQ	NVNKNO	MQ	
SP	`ì	UV	eÉ	MKMNP	ééÄ	OQKV	QTQKQS	MS	
SS	wå	UV	eÉ	MKMPR	ééÄ	OUKR	ONSKST	O	
TR	^ë	UV	eÉ	MKMOR	ééÄ	OPKO	PSKPP	N	
TU	pÉ	UV	eO	MKMQQ	ééÄ	NMKU	ORKMM	N	
UU	pê	UV	eÉ	MKMNS	ééÄ	OPKT	TOKCO	N	
VR	j ç	UV	eÉ	MKONQ	ééÄ	UKV	TMUKVO	N	
NMT	^Ö	UV	eÉ	MKMNV	ééÄ	NSKS	OOQKQR	MO	
NNN	`Ç	UV	eÉ	MKMNP	ééÄ	RKO	ONKKN	MO	
NNU	på	NRV	eÉ	MKMPS	ééÄ	TOKO	OUQKQR	N	
NON	pÄ	NRV	kç=cl~ë	MKMNT	ééÄ	OSKO	VQTKTM	MO	
NPT	_~	NRV	kç=cl~ë	MKMNV	ééÄ	PRKQ	NSMKNT	MQ	
NUO	t	NRV	kç=cl~ë	MKMVM	ééÄ	NMKV	OVSMKNO	N	
OMR	qä	OMV	kç=cl~ë	MKMTM	ééÄ	OKQ	COVOKSP	MO	
OMU	mÄ	OMV	kç=cl~ë	JMKMNS	ééÄ	kL^	OSQVKRU	MO	
OPO	qÜ	OMV	kç=cl~ë	MKMPM	ééÄ	NTHP	OTOVKUR	N	
OPU	r	OMV	kç=cl~ë	MKMNV	ééÄ	PKM	SOTHPR	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ= mp	B=oÉÁ	B n`=ïçï	B n`=cäÜÜ	n`=c~ä~Ö
iá	S	kç=cl~ë	NUNCRUQKPP	MKT	NTURRSOKNS	NMNKRN	RVKR	NOMQ	
pÅ	QR	kç=cl~ë	QORSSVOKVU	MKQ	QORQQUNKTO	NMMKMR	RVKR	NOMQ	
pÅ	QR	eO	NMMQRCUKMO	OKO	NMNQTQMKRN	VUKVV	RVKR	NOMQ	
pÅ	QR	eÉ	NQSMROKQR	MKP	NQUSRRKMQ	VUKCR	RVKR	NOMQ	
dÉ	TO	kç=cl~ë	NMPQPRTKUN	NKN	NMOUNSRKPO	NMMKS	RVKR	NOMQ	
dÉ	TO	eO	QMTPSMKMS	MKP	QNPQVUKVS	VUKRO	RVKR	NOMQ	
dÉ	TO	eÉ	NNRROUKVN	MKV	NNSPVNKSQ	VVKOS	RVKR	NOMQ	
v	UV	eO	QSOMTRRKUS	OKS	QRVPNOQKTO	NMMKS	RVKR	NOMQ	
v	UV	eÉ	TTQTQSKMQ	MKS	TVMSMNKUR	VTKVV	RVKR	NOMQ	
qÄ	NRV	kç=cl~ë	SRONNQTKSQ	NKU	SQRNNMQKSR	NMNKMV	RVKR	NOMQ	
qÄ	NRV	eÉ	OSTNSPUKTV	MKS	OTRQTPNKTP	VSKVU	RVKR	NOMQ	
_á	OMV	kç=cl~ë	POSUMTMQKT	NKS	POQVPUTKTP	NMMKRT	RVKR	NOMQ	
_á	OMV	eÉ	NRQOVPQKOV	NKQ	NRSMNOOKRR	VUKV	RVKR	NOMQ	

p~ã éáÉ=k~ã É	mmi
cäÉ=k~ã É	MNOf s kÇ
a~í~=m~íÜ=k~ã É	aWª ÖäÉáíyf mj eyNya ^q^ yOMCPyMPJ ^o yi n ` OV^ kÅ
^Åè=qáã É	PLOVLOMCP=NVMNSVQT
p~ã éáÉ=qóéÉ	i i f ` s
qçí~äa äi íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=o ÉÑ=cäÉk~ã É	MMJ ^i _kÇ
p~ã éáÉ=n ` =m~ëëlcá~ä	m~ëë
fpqa=n ` =m~ëëlc~äi	m~ëë
l éÉê~íçê	**~Çã áã**

n ` =^ å~äöíÉ=q~ÄáÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==ì mp==	bñés~ä	B o ÉÅ	B i çï	B eäÜÜ	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKNJJJ	éé Ä	NTHS	NONQKRO	MKO	VQ	TVfR	NOMKQ	
NN	_	S	k ç=d ~ë	QKNSS	éé Ä	NKV	NQQJVSHPS	Q	NMQKNR	TVfR	NOMKQ	
OP	k ~	QR	e É	OMMKMTV	éé Ä	OKN	NVUMCPKVM	OMM	NMMKMQ	TVfR	NOMKQ	
OQ	j Ö	QR	e É	OOKURN	éé Ä	OKV	UUCPKMU	OM	NNQKOS	TVfR	NOMKQ	
OT	^ ä	QR	e É	ONKTMN	éé Ä	NKO	PNMQKUP	OM	NMUKRN	TVfR	NOMKQ	
OU	pá	QR	e O	VVHSNR	éé Ä	MKV	QTRMRKMU	NMM	VVHSO	TVfR	NOMKQ	
PV	h	QR	e É	OMTKTTT	éé Ä	NKQ	VPSTOKMU	OMM	NMPKUV	TVfR	NOMKQ	
QM	` ~	QR	e O	ONKUVV	éé Ä	MKU	VMRCPKOT	OM	NMVKR	TVfR	NOMKQ	
RN	s	UV	e É	NKMNM	éé Ä	PKS	QTRQKCN	N	NMN	TVfR	NOMKQ	
RO	` ê	UV	e É	NKMRR	éé Ä	NKU	SRMCKOS	N	NMRKR	TVfR	NOMKQ	
RR	j å	UV	e É	MQNO	éé Ä	PKR	NOPSKQV	MQ	NMP	TVfR	NOMKQ	
RS	cÉ	UV	e O	ONKRTP	éé Ä	NHS	OUMRSUKUP	OM	NMTKUS	TVfR	NOMKQ	
RV	` ç	UV	e É	MQMQ	éé Ä	SKV	ONOQKSU	MO	NMO	TVfR	NOMKQ	
SM	k á	UV	e É	MQNT	éé Ä	QKQ	NOQNKNV	MQ	NMQKCR	TVfR	NOMKQ	
SP	` ì	UV	e É	MHSNU	éé Ä	MHS	QMPKNT	MHS	NMP	TVfR	NOMKQ	
SS	wå	UV	e É	OKMMU	éé Ä	NKP	OSVUKMV	O	NMQKV	TVfR	NOMKQ	
TR	^ ë	UV	e É	NKMOM	éé Ä	QKR	VQNKQT	N	NMO	TVfR	NOMKQ	
TU	pÉ	UV	e O	NKMQU	éé Ä	SKN	RNSKSR	N	NMQKU	TVfR	NOMKQ	
UU	pê	UV	e É	NKMQU	éé Ä	NKO	PQUPKUQ	N	NMQKU	TVfR	NOMKQ	
VR	j ç	UV	e É	NKMTR	éé Ä	PKO	PPSVKPT	N	NMTKR	TVfR	NOMKQ	
NMT	^ Ö	UV	e É	MQMP	éé Ä	NKN	QOVPKRT	MO	NMNKR	TVfR	NOMKQ	
NNN	` Ç	UV	e É	MQMQ	éé Ä	QKS	PMUKUV	MO	NMO	TVfR	NOMKQ	
NNU	på	NRV	e É	MKUR	éé Ä	RKQ	PNNRKVT	N	VUKR	TVfR	NOMKQ	
NON	pÄ	NRV	k ç=d ~ë	MQNP	éé Ä	OKU	RNNSKPO	MO	NMSKR	TVfR	NOMKQ	
NPT	_~	NRV	k ç=d ~ë	MQPQ	éé Ä	PKP	OTRPKNT	MQ	NMUKR	TVfR	NOMKQ	
NUO	t	NRV	k ç=d ~ë	MKUN	éé Ä	NKT	NOUMPKNR	N	VUKN	TVfR	NOMKQ	
OMR	qä	OMV	k ç=d ~ë	MQNQ	éé Ä	SKS	SONNKQN	MO	NMT	TVfR	NOMKQ	
OMU	mÄ	OMV	k ç=d ~ë	MKNTP	éé Ä	PKV	VTUNKTT	MO	USKR	TVfR	NOMKQ	
OPO	qÜ	OMV	k ç=d ~ë	MKNTO	éé Ä	RKQ	TRVTKMM	MO	US	TVfR	NOMKQ	
OPU	r	OMV	k ç=d ~ë	MKMVP	éé Ä	QKR	SOMNKQR	MO	VSKR	TVfR	NOMKQ	

n ` =fpqa=q~ÄáÉ

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ=mp	B =o ÉÅ	B n ` =i çï	B n ` =e äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NURRTPNKSO	NKV	NTURRSOKNS	NMPKVP	RVfR	NOMKQ	
pÅ	QR	k ç=d ~ë	QPNPQVMKQV	NKS	QORQQUNKTO	NMNKPV	RVfR	NOMKQ	
pÅ	QR	e O	NMNMPMVKON	NKM	NMNQTQMRN	VVfRS	RVfR	NOMKQ	
pÅ	QR	e É	NQVNOPKQS	MKP	NQUSRRKMQ	NMMKPO	RVfR	NOMKQ	
d É	TO	k ç=d ~ë	NMPVPRQKUS	NKM	NMOUNSRKPO	NMNKMV	RVfR	NOMKQ	
d É	TO	e O	QNSSSVKOM	MKU	QNPQVUKVS	NMMKTT	RVfR	NOMKQ	
d É	TO	e É	NNTRSRKPO	MKQ	NNSPVNKSQ	NMNKMN	RVfR	NOMKQ	
v	UV	e O	QSQSNUMKPS	NKT	QRVPNOQKTO	NMNKNS	RVfR	NOMKQ	
v	UV	e É	TVMOPSKOV	MKV	TVMSMNKUR	VVfKVR	RVfR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SRRONQVKNV	NKO	SQRNNMQKSR	NMNKRT	RVfR	NOMKQ	
qÄ	NRV	e É	OSUVOQUKTP	MKV	OTRQTPNKTP	VTHSP	RVfR	NOMKQ	
_á	OMV	k ç=d ~ë	PPNSMSRKVT	OKP	POQVPUTKTP	NMOKMR	RVfR	NOMKQ	
_á	OMV	e É	NRUMNTRKTP	MKT	NRSMNOOKRR	NMNKOV	RVfR	NOMKQ	

fåíÉêÑÉêÉåÅÉ= ÜÉÅâ=pçàíç=^=Ef`pJ^F=oÉéçê

p~ã éáÉ=k~ã É	f`p^
cäÉ=k~ã É	MNPf`p^KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyjn`OV^kÅ
^Åè=qáã É	PLOMLOMCP=NMVQNMRQ
p~ã éáÉ=qóéÉ	f`p^
qçí~äaäã íáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MMJ^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeäÖÜ	n`=ä~Ö
_É	V	S	kç=d~ë	JMKMNP	éëÄ	klA	NRTTKTU	JMKN	NMM	NMM	
_	NN	S	kç=d~ë	MKRVQ	éëÄ	OKQ	OSNRKUQ	JO	NMM	NMM	
k~	OP	QR	eÉ	NVPQUTKNOV	éëÄ	NKQ	SQMQVUUSKUM	NMMMMM	UM	NOM	
j Ö	OQ	QR	eÉ	NVPRRNKPNT	éëÄ	NKO	PPTTMOOMKSN	NMMMMM	UM	NOM	
^ä	OT	QR	eÉ	NVITVQNKMPS	éëÄ	NKS	NPOURTUVKST	NMMMMM	UM	NOM	
pá	OU	QR	eO	QKTQO	éëÄ	NSKT	OSOVKUR	JRM	NMM	NMM	
h	PV	QR	eÉ	NVNTVQKUQO	éëÄ	MKV	OVQQLUPPNKMV	NMMMMM	UM	NOM	
`~	QM	QR	eO	NVQRQOKNSM	éëÄ	NKO	PQVTPPVNVKCP	NMMMMM	UM	NOM	
s	RN	UV	eÉ	MKMOU	éëÄ	QOKQ	QMSKSU	JMKR	NMM	NMM	
`ê	RO	UV	eÉ	OKNQQ	éëÄ	OKO	NNOTSKPR	NKR	NMM	NMM	
j å	RR	UV	eÉ	MKRRM	éëÄ	RKN	NQTMKQT	MKNT	NMM	NMM	
cÉ	RS	UV	eO	NVOURUKMU	éëÄ	NKO	NONMPQSRUPKVR	NMMMMM	UM	NOM	
`ç	RV	UV	eÉ	MKMMM	éëÄ	SKO	NMSOKPN	M	NMM	NMM	
ká	SM	UV	eÉ	MKQQQ	éëÄ	RKU	NOMMKMU	MKNU	NMM	NMM	
`ì	SP	UV	eÉ	MKMVU	éëÄ	UKN	NMNRKSN	JMKOO	NMM	NMM	
wå	SS	UV	eÉ	NKOPU	éëÄ	QKN	NROPKQR	MKQ	NMM	NMM	
^ë	TR	UV	eÉ	MKMTO	éëÄ	NPKV	TOKSU	JMKR	NMM	NMM	
pÉ	TU	UV	eO	MKMSM	éëÄ	THR	PMKUP	JMKR	NMM	NMM	
pê	UU	UV	eÉ	MKURN	éëÄ	RKO	ORVOKRO	MKPT	NMM	NMM	
j ç	VR	UV	eÉ	OOTRKUUO	éëÄ	MKT	SQMPRUOKOM	OMMM	UM	NOM	
^Ö	NMT	UV	eÉ	MKMNS	éëÄ	NMKU	NTUKUV	JMKN	NMM	NMM	
`Ç	NNN	UV	eÉ	MKPPT	éëÄ	SKT	QSTKQO	MKOU	NMM	NMM	
på	NNU	NRV	eÉ	MKMSO	éëÄ	NMKT	PQRKRT	JMKR	NMM	NMM	
pÄ	NON	NRV	kç=d~ë	MKMSR	éëÄ	NMKM	OMMOKOS	JMKMR	NMM	NMM	
_~	NPT	NRV	kç=d~ë	MKRQM	éëÄ	MKS	PQQQKMU	MKPP	NMM	NMM	
t	NUO	NRV	kç=d~ë	MKOTO	éëÄ	TKN	QMONKRQ	JMKPP	NMM	NMM	
qä	OMR	OMV	kç=d~ë	MKMOM	éëÄ	NUKU	VTTKTR	JMKN	NMM	NMM	
mÄ	OMU	OMV	kç=d~ë	JMKMNM	éëÄ	klA	OVRPKOT	JMKMU	NMM	NMM	
qÜ	OPO	OMV	kç=d~ë	MKMQQ	éëÄ	UKO	POTPKUV	JMKN	NMM	NMM	
r	OPU	OMV	kç=d~ë	MKMON	éëÄ	TKN	TNTKQR	JMKMU	NMM	NMM	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eäÖÜ	n`=ä~Ö
iá	S	kç=d~ë	NVOPSQSKTM	NKQ	NTURRSOKNS	NMTKTP	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QOMQUQSKPR	NKN	QORQQUNKTO	VUKUP	RVKR	NOMQ	
pÅ	QR	eO	VTQPOTKPM	NKU	NMNQTQMKRN	VSKMO	RVKR	NOMQ	
pÅ	QR	eÉ	NPVUPSKQU	MKS	NQUSRRKMQ	VQKMT	RVKR	NOMQ	
dÉ	TO	kç=d~ë	NMNUPNTKVP	MKT	NMOUNSRKPO	VVKMQ	RVKR	NOMQ	
dÉ	TO	eO	PUQQUPKMT	MKO	QNPQVUKVS	VOKVU	RVKR	NOMQ	
dÉ	TO	eÉ	NMVNMQKOU	MKU	NNSPVNKSQ	VPKTQ	RVKR	NOMQ	
v	UV	eO	QPSOTNVKPV	MKV	QRVPNOQKTO	VQKVU	RVKR	NOMQ	
v	UV	eÉ	TOPOTQKUO	MKS	TVMSMNKUR	VNKQU	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SSMQVQPKVS	NKU	SQRNNMQKSR	NMOKPU	RVKR	NOMQ	
qÄ	NRV	eÉ	ORRTVMVKRO	NKM	OTRQTPNKTP	VOKUS	RVKR	NOMQ	
_á	OMV	kç=d~ë	PPRSPPQKTV	OKO	POQVPUTKTP	NMPKOV	RVKR	NOMQ	
_á	OMV	eÉ	NQNRTNRKMV	NKO	NRSMNOOKRR	VMKTQ	RVKR	NOMQ	

p~ã éáÉ=k~ã É	f`p^_
cäÉk~ã É	MNQf`p_KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíçf`mj eyNya^q^yQMCPyWPJ ^oyi n` OV^kÅ
^Åè=qáã É	PLOVLOMCP=NMVØTWP
p~ã éáÉ=qóéÉ	f`p_
qçí~äaäã íáçå	NMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑëcäÉk~ã É	MMJ ^i_KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã ää**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeáÖÜ	n`=c ä~Ö
V	_É	S	kç=d~ë	NMKTRR	éé Ä	NMS	NMUQROKUV	QM	TVMR	NQMQ	
NN	_	S	kç=d~ë	QMKQOT	éé Ä	QKN	TNRTTKUQ	QM	TVMR	NQMQ	
CP	k~	QR	eÉ	NMPOVSKCPV	éé Ä	MKU	SPQTUPUPKCP	NMMMMM	TVMR	NQMQ	
CQ	j Ö	QR	eÉ	NMQQQMKMCN	éé Ä	MMS	PPUNTOQQKTT	NMMMMM	TVMR	NQMQ	
OT	^ä	QR	eÉ	NMUCUPKQSN	éé Ä	MKV	NPCRURQQKSS	NMMMMM	TVMR	NQMQ	
CU	pá	QR	eO	SCRKNSR	éé Ä	QKN	CUMRRUKCM	RMM	TVMR	NQMQ	[=HLJ=NMB
PV	h	QR	eÉ	NMMTOQKMSP	éé Ä	MKO	CUVPMSRNKNR	NMMMMM	TVMR	NQMQ	
QM	`~	QR	eO	NMQSVNKSRU	éé Ä	NKU	PQQUMNRPQKSQ	NMMMMM	TVMR	NQMQ	
RN	s	UV	eÉ	QMKRRS	éé Ä	NKO	UPPCPKCU	QM	TVMR	NQMQ	
RO	`ê	UV	eÉ	QCKQNM	éé Ä	NKR	NNMVTSKPM	CO	TVMR	NQMQ	
RR	j å	UV	eÉ	QMKTSV	éé Ä	NKN	RNQVTKPM	QM	TVMR	NQMQ	
RS	cÉ	UV	eO	NMPTUNKPVV	éé Ä	QKM	NCNRPRSSQTKNT	NMMMMM	TVMR	NQMQ	
RV	` ç	UV	eÉ	QMKUSN	éé Ä	MKR	NTUNCCKNP	QM	TVMR	NQMQ	
SM	k á	UV	eÉ	QMKSPP	éé Ä	NKM	QVRQUKUT	QM	TVMR	NQMQ	
SP	` ì	UV	eÉ	NVKVMO	éé Ä	MKR	NPQMQMKRO	QM	TVMR	NQMQ	
SS	wå	UV	eÉ	QNKQSS	éé Ä	NKP	CPUTSKCR	QNKQ	TVMR	NQMQ	
TR	^ë	UV	eÉ	QMKPCQ	éé Ä	NKR	NTMMTKNQ	QM	TVMR	NQMQ	
TU	pÉ	UV	eO	QMKTPT	éé Ä	MKQ	VQUSKTU	QM	TVMR	NQMQ	
UU	pê	UV	eÉ	QMKVPP	éé Ä	MKS	SPSRSKMS	QMKV	TVMR	NQMQ	
VR	j ç	UV	eÉ	CPMMKQVV	éé Ä	MKP	SRMTNVMKTQ	QMMM	TVMR	NQMQ	
NMT	^Ö	UV	eÉ	NVKTNP	éé Ä	NKN	QMPSQTKRP	QM	TVMR	NQMQ	
NNN	` Ç	UV	eÉ	QMKQMV	éé Ä	NKQ	CUCUTKCO	QM	TVMR	NQMQ	
NNU	på	NRV	eÉ	QMKNUU	éé Ä	NKQ	RTUUPKMN	QM	TVMR	NQMQ	
NON	pÄ	NRV	kç=d~ë	NVKTMT	éé Ä	QKM	QPMTQTKVV	QM	TVMR	NQMQ	
NPT	_~	NRV	kç=d~ë	QNKQNP	éé Ä	NKR	NPSPURKVM	QM	TVMR	NQMQ	
NUO	t	NRV	kç=d~ë	CCKVNV	éé Ä	NKR	OVPMOTKQU	QM	TVMR	NQMQ	
QMR	qä	QMV	kç=d~ë	QMKPPT	éé Ä	NKP	RSCSCOKRS	QM	TVMR	NQMQ	
QMU	mÄ	QMV	kç=d~ë	QNKMDV	éé Ä	MKT	UNCQCQKNQ	QM	TVMR	NQMQ	
QPO	qÜ	QMV	kç=d~ë	QNKUQR	éé Ä	NKQ	TSCPTRKQS	QM	TVMR	NQMQ	
QPU	r	QMV	kç=d~ë	QNKSUV	éé Ä	NKV	TMVRQNKVN	QM	TVMR	NQMQ	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=i çï	Bn`=eáÜÜ	n`=c ä~Ö
i á	S	kç=d~ë	NVCRNRSKNO	NKQ	NTURRSCKNS	NMTKUO	RVMR	NQMQ	
pÅ	QR	kç=d~ë	QMVUNPPKQV	NKN	QCRQQUNKTO	VSKPP	RVMR	NQMQ	
pÅ	QR	eO	VRVPNNKNP	QKM	NMNQTQMKRN	VQKRQ	RVMR	NQMQ	
pÅ	QR	eÉ	NPUUPRMS	NKO	NQUSRRMQ	VPKPV	RVMR	NQMQ	
dÉ	TO	kç=d~ë	NMMMCPCKTU	NKP	NMCUNSRKPO	VTKP	RVMR	NQMQ	
dÉ	TO	eO	PUPSRPKQQ	MKP	QNPQVUKVS	VCKTU	RVMR	NQMQ	
dÉ	TO	eÉ	NMUMCNKMT	MKO	NNSPVNKSQ	VCKUN	RVMR	NQMQ	
v	UV	eO	QPQCNNUKTT	MKO	QRVPNCQKTO	VQKRQ	RVMR	NQMQ	
v	UV	eÉ	TOTNNQCKS	MKT	TVMSMNKUR	VNKVT	RVMR	NQMQ	
qÄ	NRV	kç=d~ë	STPNNTTKQS	MKR	SQRNNMQKSR	NMQKPQ	RVMR	NQMQ	
qÄ	NRV	eÉ	CRTTUQVKUT	NKR	OTRQTPNKTP	VPKRU	RVMR	NQMQ	
_á	QMV	kç=d~ë	PPVVNTMKMN	NKM	PCQVPUTKTP	NMQKSN	RVMR	NQMQ	
_á	QMV	eÉ	NQNSTVSKSO	MKQ	NRSMNCCKRR	VMKUN	RVMR	NQMQ	

i åâÉ~ê¬ø~åÖÉ¬p~ã éäÉ¬Ei opF¬øÉéçã

p~ã éäÉ¬k~ã É	i opN
cäÉ¬k~ã É	MNRj i opKÇ
a~í~¬m~íÜ¬k~ã É	aWj^ÖäÉáíyf^ mj eyNya^q^yOMCPyMPJ ^o yi n` OV^kÄ
^Åè¬qãä É	PLOVLOMCP¬NVMRRVQM
p~ã éäÉ¬qóéÉ	i op
qçí~äaãä íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa¬øÉÑcäÉk~ã É	MVJ ^i _KÇ
p~ã éäÉ¬n` ¬m~ëëlcá~ä	c~ää
fpqa¬n` ¬m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áã**

n` =^å~äöíÉ¬q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==ì mp==	bñés~ä	B oÉÄ	B i çï	B eäÖÜ	n` ¬ø¤ä~Ö
V	_É	S	k ç¬ø~ë	VSKOTU	ééÄ	NKP	RRVQRTKPP	NMM	VSKOU	UVfR	NNMQ	
NN	_	S	k ç¬ø~ë	QSOKNPN	ééÄ	MKV	NTMQQPNKVO	RMM	VOKQP	UVfR	NNMQ	
RN	s	UV	e É	VVRKQOM	ééÄ	OKN	QMVRQNTKTR	NMMM	VVKRQ	UVfR	NNMQ	
RO	` ê	UV	e É	OMDQKUOS	ééÄ	NKT	VVNSQURKQS	OMMM	NMNKOQ	UVfR	NNMQ	
RR	j å	UV	e É	NVUTHRQM	ééÄ	NKS	QUVSSVPKNS	OMMM	VVKPU	UVfR	NNMQ	
RV	` ç	UV	e É	NVRMKTPP	ééÄ	NKR	UVOQOMPKVT	NMMM	NVRKMT	UVfR	NNMQ	
SM	k á	UV	e É	NVSOKSUU	ééÄ	PKT	CRPPUPNKNU	NMMM	NVSKOT	UVfR	NNMQ	
SP	` ì	UV	e É	OMPRKPRN	ééÄ	OKR	NPSNQQNUKOT	OMMM	NMNKTT	UVfR	NNMQ	
SS	wå	UV	e É	OMPSKORO	ééÄ	NKR	COQMDOSKOP	OMMM	NMNKUO	UVfR	NNMQ	
TR	^ë	UV	e É	VSPKNUS	ééÄ	MKS	UMONTNKVT	NMMM	VSKPO	UVfR	NNMQ	
TU	pÉ	UV	e O	VVUKUMS	ééÄ	MKO	QSSOQTKNU	NMMM	VVKUU	UVfR	NNMQ	
UU	pê	UV	e É	NVOUKPRR	ééÄ	NKP	RUPUVVRKNV	OMMM	VSKQO	UVfR	NNMQ	
VR	j ç	UV	e É	NNMPKVMQ	ééÄ	MKO	PNMVUSPKRM	NMMM	NNMKPV	UVfR	NNMQ	
NMT	^Ö	UV	e É	NONKVRT	ééÄ	NKQ	NORQSTTKPM	NMM	NONKVS	UVfR	NNMQ	[¬HLHNMB
NNN	` Ç	UV	e É	NMTPKNVO	ééÄ	NKU	NQLNPNMKOM	NMMM	NMTHPO	UVfR	NNMQ	
NNU	på	NRV	e É	VRMKQTP	ééÄ	MKT	CUCRVURKSV	NMMM	VRKMR	UVfR	NNMQ	
NON	pÄ	NRV	k ç¬ø~ë	VORKUNT	ééÄ	NKO	ONTPNRSOKUU	NMMM	VOKRU	UVfR	NNMQ	
NPT	_~	NRV	k ç¬ø~ë	NVSNKORT	ééÄ	MKO	NPRRRVVSKOR	OMMM	VUKMS	UVfR	NNMQ	
NUO	t	NRV	k ç¬ø~ë	NVRMKSNR	ééÄ	NKS	NQQNQMPOKOT	NMMM	NVRKMS	UVfR	NNMQ	
OMR	qä	OMV	k ç¬ø~ë	NVNNKQOP	ééÄ	NKO	PONNNQTOKON	NMMM	NVNKNQ	UVfR	NNMQ	
OMU	mÄ	OMV	k ç¬ø~ë	NVVTKQMQ	ééÄ	MKS	UUOSRSRNKVO	OMMM	VVKUT	UVfR	NNMQ	
OPO	qÜ	OMV	k ç¬ø~ë	VTRKURO	ééÄ	MKR	PVMOQVTNKVP	NMMM	VTKRV	UVfR	NNMQ	
OPU	r	OMV	k ç¬ø~ë	VUNKQQV	ééÄ	NKM	PSUTQTRRKRQ	NMMM	VUKNQ	UVfR	NNMQ	

n` =fpqa¬q~ÄäÉ

k~ã É	j ~ëë	qì åÉ¬j çÇÉ	` mp	` mp¬øpa	oÉÑ¬ mp	B ¬øÉÄ	B n` =ï çï	B n` ¬æäÖÜ	n` ¬ø¤ä~Ö
i á	S	k ç¬ø~ë	OMQNMSRKRV	MKT	NTURRSOKNS	NNQKPN	RVfR	NOMQ	
pÅ	QR	k ç¬ø~ë	QPTPOSVKNS	MKQ	QORQQUNKTO	NMOKTV	RVfR	NOMQ	
dÉ	TO	k ç¬ø~ë	NMRCOPMKPV	MKR	NMOUNSRKPO	NMOKPQ	RVfR	NOMQ	
qÄ	NRV	k ç¬ø~ë	TOPUQTPKOP	MKQ	SQRNNMQKSR	NNOKON	RVfR	NOMQ	
_á	OMV	k ç¬ø~ë	PVMPUTPKTO	MKV	POQVPUTKTP	NOMKNQ	RVfR	NOMQ	
pÅ	QR	e O	VQVOUVKUP	NKR	NMNQTQMKRN	VPHRR	RVfR	NOMQ	
dÉ	TO	e O	PUUVNRKTS	MKR	QNPQVUKVS	VQKMR	RVfR	NOMQ	
v	UV	e O	QQPONVQKTR	MKN	QRVPNOQKTO	VSHR	RVfR	NOMQ	
pÅ	QR	e É	NPQSQUKOU	MKT	NQUSRRKMQ	VMKRU	RVfR	NOMQ	
dÉ	TO	e É	NMTTPOKPQ	NKN	NNSPVNKSQ	VOKRS	RVfR	NOMQ	
v	UV	e É	TOQNRRKOS	NKN	TVMSMNKUR	VNKS	RVfR	NOMQ	
qÄ	NRV	e É	OSUMTQVKVR	NKT	OTRQTPNKTP	VTHPN	RVfR	NOMQ	
_á	OMV	e É	NRUVVTUKNN	OKR	NRSMNOOKRR	NMNKVN	RVfR	NOMQ	

p~ã éäÉ=k~ã É i o p O

cãÉ=k~ã É MNSpj mi kÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^o yi n ` OV^ kÄ

^Åè=qãã É PLOVLOMCP=NVMQTMN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå NMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä c~ãä

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	o p a	==` mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MMNN	éé Ä	VTKV	PMRKRT	NMM	
NN	_	S	k ç=d ~ë	PKPCO	éé Ä	NKQ	NOSTRKTS	NMMM	
OP	k ~	QR	e É	NVSMNTKRSR	éé Ä	MKT	NOOSUMRMRKPR	OMMMMM	
OQ	j Ö	QR	e É	NVRQRNKSPR	éé Ä	NKO	SQQTRMSQKRV	OMMMMM	
OT	^ ä	QR	e É	ONMMPMMVCU	éé Ä	MKO	OSNRNSRPKTU	OMMMMM	[i a o
OU	pá	QR	e O	NMOMSKKVT	éé Ä	MKS	QRVUUUQKPM	NMMMM	[i a o
PV	h	QR	e É	NVONPTKTUQ	éé Ä	MKV	RSOMPNTOKRQ	OMMMMM	
QM	` ~	QR	e O	NVTMMTKOPT	éé Ä	MKT	SRORMSQTVKNT	OMMMMM	
RN	s	UV	e É	MKNSV	éé Ä	UKV	VTSKTO	NMMM	
RO	` ê	UV	e É	MKTRU	éé Ä	MKT	QROVKOM	OMMM	
RR	j å	UV	e É	NKPVM	éé Ä	OKO	PRRVKNN	OMMM	
RS	cÉ	UV	e O	VTVSMKSTN	éé Ä	OKS	NNOVCPQSSNKRR	NMMMMM	
RV	` ç	UV	e É	NKQTP	éé Ä	OKV	NOTUSKPM	NMMM	
SM	k á	UV	e É	NKMTN	éé Ä	PKU	OTNMKPN	NMMM	
SP	` ì	UV	e É	MKTPS	éé Ä	PKS	RPMRKRR	OMMM	
SS	wå	UV	e É	PKQNS	éé Ä	SKM	PVQMSP	OMMM	
TR	^ ë	UV	e É	MKPSV	éé Ä	VKO	PCOKMQ	NMMM	
TU	pÉ	UV	e O	MKQTR	éé Ä	PKT	ONSKVV	NMMM	
UU	pê	UV	e É	OKTPO	éé Ä	QKP	UPPPKTT	OMMM	
VR	j ç	UV	e É	NKTNV	éé Ä	PKQ	QVOUKTS	NMMM	
NMT	^ Ö	UV	e É	MKMRU	éé Ä	VKO	SNNKNP	NMM	
NNN	` Ç	UV	e É	MKNUQ	éé Ä	TKN	ORTKMQ	NMMM	
NNU	på	NRV	e É	MKSMQ	éé Ä	OKU	NUUOKPU	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKPRN	éé Ä	NKS	URVNKON	NMMM	
NPT	_~	NRV	k ç=d ~ë	NKMTM	éé Ä	SKO	TNTVKRR	OMMM	
NUO	t	NRV	k ç=d ~ë	NKRVV	éé Ä	MKR	ONUPQKRT	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKPPQ	éé Ä	NKM	VUUQKOR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NKPOT	éé Ä	OKN	RRRURKTP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKUUQ	éé Ä	OKN	PPORRKRO	NMMM	
OPU	r	OMV	k ç=d ~ë	MKOUQ	éé Ä	OKU	VRQMKRM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMNSOQVPU	MKU	NTURRSOKNS	NNOKVO	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	ONUMTNTKOO	NKN	QORQQUNKTO	VUKOT	RVKR	NOMQ	
pÅ	QR	e O	VSQQSSKOT	NKN	NMNQTQMRN	VRKMR	RVKR	NOMQ	
pÅ	QR	e É	NQNQRTKPV	NKQ	NQUSRRKMQ	VRKNS	RVKR	NOMQ	
d É	TO	k ç=d ~ë	NMMUPTPKPP	OKS	NMOUNSRKPO	VUKMU	RVKR	NOMQ	
d É	TO	e O	PUOPVOKUV	MKU	ONPQVUKVS	VOKQU	RVKR	NOMQ	
d É	TO	e É	NNMUOTKPM	NKP	NNSPVNKSQ	VRKOO	RVKR	NOMQ	
v	UV	e O	QOTQVQQKNO	NKO	QRVPNOQKTO	VPKMT	RVKR	NOMQ	
v	UV	e É	TOTUOMKOO	MKU	TVMSMNKUR	VOKMS	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVUTOUNKTP	NKM	SQRNNMQKSR	NMUKPN	RVKR	NOMQ	
qÄ	NRV	e É	ORRSOSMKMU	OKM	OTRQTPNKTP	VOKU	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQTOTPMKTS	MKR	PCQVPUTKTP	NMSKUT	RVKR	NOMQ	
_á	OMV	e É	NPUQQSSKOR	OKM	NRSMNOOKRR	UUKTQ	RVKR	NOMQ	

p~ã éäÉ=ɵÉéçã

p~ã éäÉ=k~ã É	ofk pb
cãÉ=k~ã É	MNTpj mi kÇ
a~í~=m~íÜ=k~ã É	aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^o yi n ` OV^ HÅ
^Åè=qãã É	PLOVLOMOP=NVMRRVMP
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	NMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	c~åä
fpqa=n ` =m~ëëlc~åä	c~åä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==́ mp==	i a o	n ` =cä~Ö
V	_É	S	k ç=d ~ë	PKUQT	éé Ä	QKQ	QOUKVM	NMM	
NN	_	S	k ç=d ~ë	NPNMPOR	éé Ä	NMP	QVNPMQ	NMMM	
OP	k ~	QR	e É	SRTNPMPMO	éé Ä	NVKV	VQQPRMS	OMMMMM	
OQ	j Ö	QR	e É	OONOPKUTO	éé Ä	OMKU	NSTPTKQP	OMMMMM	
OT	^ ä	QR	e É	OOUTNKVVO	éé Ä	NVMP	SRPUMPM	OMMMMM	
OU	pá	QR	e O	PUORMTPU	éé Ä	PMT	PUUTKVR	NMMMM	
PV	h	QR	e É	SPNSUKOUR	éé Ä	NVMS	QOORNMRV	OMMMMM	
QM	` ~	QR	e O	OQSVUKQTQ	éé Ä	OMT	NUQQVPMU	OMMMMM	
RN	s	UV	e É	SQOMSSR	éé Ä	PMP	NVPMMVS	NMMM	
RO	` ê	UV	e É	OOQSMPSP	éé Ä	SMN	QPTRMNV	OMMM	[i a o
RR	j å	UV	e É	SOUKVUR	éé Ä	UKO	SNRKVM	OMMM	
RS	cÉ	UV	e O	NVQRMVMPQN	éé Ä	NMV	QSNONNKVR	NMMMMM	[i a o
RV	` ç	UV	e É	NOQQRSQ	éé Ä	NNMT	QOMKVO	NMMM	
SM	k á	UV	e É	PNOMSQO	éé Ä	NOMM	OVRMRS	NMMM	
SP	` ì	UV	e É	SONMVTR	éé Ä	NVMP	NSRMVNP	OMMM	
SS	wå	UV	e É	UNVUKMVV	éé Ä	TKQ	PRUQKVT	OMMM	[i a o
TR	^ ë	UV	e É	QNVKOQP	éé Ä	QMT	NPVMPR	NMMM	
TU	pÉ	UV	e O	QQQKVMT	éé Ä	TMS	TPKNT	NMMM	
UU	pê	UV	e É	NNRMVVT	éé Ä	UKU	NPUKUV	OMMM	
VR	j ç	UV	e É	OSNMVSUO	éé Ä	PMS	OVOTKVP	NMMM	[i a o
NMT	^ Ö	UV	e É	NQMRUQ	éé Ä	PRMV	SMKVM	NMM	
NNN	` Ç	UV	e É	ROMSUS	éé Ä	OMQ	OUMRO	NMMM	
NNU	på	NRV	e É	RVOTMPMP	éé Ä	UKU	SNRMVPV	NMMM	[i a o
NON	pÄ	NRV	k ç=d ~ë	ONTMRPS	éé Ä	SMT	NUNUMTP	NMMM	
NPT	_~	NRV	k ç=d ~ë	TVPMVPU	éé Ä	OMT	NVROMSV	OMMM	
NUO	t	NRV	k ç=d ~ë	OQVRKUUN	éé Ä	RMO	NONVRKOU	NMMM	[i a o
OMR	qä	OMV	k ç=d ~ë	QQMSMO	éé Ä	QMR	ORROKVR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	RRMSUQ	éé Ä	RMQ	QQQNMST	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NSRMTMM	éé Ä	QKQ	NNVQQKVO	NMMM	
OPU	r	OMV	k ç=d ~ë	NNMQLP	éé Ä	QMT	TTTMRO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=ɵpa	oÉÑ=́ mp	B n ` =ɵÉÅÅ	B n ` =ɵ çï	B n ` =ɵ äÜÜ	n ` =cä~Ö
i á	S	k ç=d ~ë	OMSUSMRT	MKV	NTURRSOMNS	NMNS	RVMR	NOMKQ	SMOMa ça
pÅ	QR	k ç=d ~ë	NVQMPKUQ	NMP	QORQQUNMTO	MMOQ	RVMR	NOMKQ	SMOMa ça
pÅ	QR	e O	ONTRMKV	OMS	NVNQTQMRN	MMON	RVMR	NOMKQ	SMOMa ça
pÅ	QR	e É	PPOMSN	NUKQ	NQUSRRMVQ	MMOO	RVMR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=ɵpa
d É	TO	k ç=d ~ë	NOSSNMPO	OMO	NVOUNSRMPO	NMOP	RVMR	NOMKQ	SMOMa ça
d É	TO	e O	VSRMNV	PMT	QNPQVUMVS	MMOP	RVMR	NOMKQ	SMOMa ça
d É	TO	e É	NUPMPM	MMS	NNSPVNMSQ	MMNS	RVMR	NOMKQ	SMOMa ça
v	UV	e O	NSPSMQR	NMV	QRVPNOQMTO	MMVQ	RVMR	NOMKQ	SMOMa ça
v	UV	e É	OUUMSO	RMQ	TVMSMNMUR	MMVQ	RVMR	NOMKQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	ORTUMQP	NMO	SQRNNVQMSR	MMVQ	RVMR	NOMKQ	SMOMa ça
qÄ	NRV	e É	VPVMUS	UMN	OTRQTPNMTP	MMVP	RVMR	NOMKQ	SMOMa ça & eäÜÜ=fpqa=ɵpa
_á	OMV	k ç=d ~ë	TMPVMOT	OMU	PQQVPUTMTP	MMOO	RVMR	NOMKQ	SMOMa ça
_á	OMV	e É	POUUMQT	OMT	NRSMNQOMRR	MMON	RVMR	NOMKQ	SMOMa ça

`çåíaåì aåÖ=~äåÄê~íáçå=sÉêáÑáÅ~íáçå=É``sF=oÉéçêí

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MNUJ``sKÇ
a~í~=m~íÜk~ã É	aWj^ÖãÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n` OV^kÄ
^Åè=qáã É	PLOVLOMOP=OMMMMRU
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑc ãÉk~ã É	MNUJ ^i _KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~åä
fpqa=n`=m~ëëlc~åä	c~åä
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==`mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä~Ö
V	_É	S	k ç=d ~ë	OQKOMQ	éëÄ	NKT	NRPUTQKQS	OR	VTHSO	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKQSM	éëÄ	NKT	NVOPSMKVR	OR	NMNKUQ	UVKU	NNMO	
OP	k~	OR	e É	RQVVKMQQ	éëÄ	NKQ	PTTRVRMSS	RMMM	NMVKVU	UVKU	NNMO	
OQ	j Ö	OR	e É	RSMNKMPS	éëÄ	NKO	NVVPMSSKMR	RMMM	NNOKMO	UVKU	NNMO	[=HLJ=NMB
OT	^ä	OR	e É	SMVKQUQ	éëÄ	MKV	UOMUMOOO	RMM	NONKV	UVKU	NNMO	[=HLJ=NMB
OU	pá	OR	e O	RONKPRT	éëÄ	MKV	ORUMUOKOR	RMM	NMQKOT	UVKU	NNMO	
PV	h	OR	e É	RPURKTRS	éëÄ	MKR	NTOTVRQKRN	RMMM	NMTKTO	UVKU	NNMO	
QM	`~	OR	e O	RPPQKMVO	éëÄ	NKR	NVPURTQTKQV	RMMM	NMSKSU	UVKU	NNMO	
RN	s	UV	e É	OSKMTT	éëÄ	MKV	NNRUUQKVV	OR	NMQKPN	UVKU	NNMO	
RO	`ê	UV	e É	OSKONR	éëÄ	MKP	NQOORSKPS	OR	NMQKUS	UVKU	NNMO	
RR	j å	UV	e É	OSKOMV	éëÄ	NKN	TNOQTKSQ	OR	NMQKUQ	UVKU	NNMO	
RS	cÉ	UV	e O	ROURKMTN	éëÄ	NKP	SVNTRVUNKUU	RMMM	NMRKT	UVKU	NNMO	
RV	`ç	UV	e É	OSKTMM	éëÄ	OKM	OQVVUNKW	OR	NMSKU	UVKU	NNMO	
SM	ká	UV	e É	OSKORU	éëÄ	NKP	SVSQQKNS	OR	NMRKUP	UVKU	NNMO	
SP	`ì	UV	e É	OSKSMS	éëÄ	NKR	NVSQMQKNN	OR	NMSKQO	UVKU	NNMO	
SS	wå	UV	e É	OSKTMS	éëÄ	OKS	PORPOKTU	OR	NMSKUO	UVKU	NNMO	
TR	^ë	UV	e É	ORKSSP	éëÄ	NKN	OPRRNKVS	OR	NMOKSR	UVKU	NNMO	
TU	pÉ	UV	e O	ORKPOT	éëÄ	NKQ	NOVQTKOP	OR	NMNKPN	UVKU	NNMO	
UU	pê	UV	e É	ORKVUP	éëÄ	MKQ	USSSOKNM	OR	NMPKVP	UVKU	NNMO	
VR	j ç	UV	e É	OTKMOT	éëÄ	MKT	UPVOMKNU	OR	NMUKNN	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKOPN	éëÄ	NKV	PMURQRKVP	OR	NMUKVO	UVKU	NNMO	
NNN	`Ç	UV	e É	OSKSOV	éëÄ	OKQ	QMQUNKSS	OR	NMSKRO	UVKU	NNMO	
NNU	på	NRV	e É	ORKMNV	éëÄ	MKT	UMTPMKVO	OR	NMMKMU	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKTOQ	éëÄ	OKR	SMTPSPKNT	OR	VUKV	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKTNS	éëÄ	NKV	NURUUNKUN	OR	NMOKUS	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKTOO	éëÄ	NKU	PUQMPNKUT	OR	NMSKUV	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKPTM	éëÄ	NKS	UORPPQKNT	OR	NMNKQU	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKMON	éëÄ	MKT	NNUNPSTKOR	OR	NMQKMU	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	ORKTPP	éëÄ	NKS	NMRRTQTKSS	OR	NMOKVP	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKMTR	éëÄ	NKQ	NMMPOMPKRR	OR	NMQKP	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ç ïï	B n`=c äÜÜ	n`=c ä~Ö
i á	S	k ç=d ~ë	OONNUUTKQV	MKP	NTURRSOKNS	NOPKUU	RVKR	NOMQ	SMOMa ça
pÅ	OR	k ç=d ~ë	QTNMPPOKTU	NKO	QORQQUNKTO	NNMKTN	RVKR	NOMQ	
pÅ	OR	e O	NMRTRTRKNP	NKN	NMNQTQMKRN	NMQKOO	RVKR	NOMQ	
pÅ	OR	e É	NRORMVKSP	MKS	NQUSRRKMQ	NMOKRV	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NNQQSOPKUR	MKV	NMOUNSRKPO	NNNKPP	RVKR	NOMQ	
dÉ	TO	e O	QOONQQKQV	MKS	QNPQVUKVS	NMOKRT	RVKR	NOMQ	
dÉ	TO	e É	NNUVTMKNU	NKQ	NNSPVNKSQ	NMOKOO	RVKR	NOMQ	
v	UV	e O	QUROVMVKRV	NKR	QRVPNOQKTO	NMRKSS	RVKR	NOMQ	
v	UV	e É	TVTRRVKVO	MKU	TVMSMNKUR	NMMKUU	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	TRTMUOVKPP	PKN	SQRNNMQKSR	NNTKPS	RVKR	NOMQ	
qÄ	NRV	e É	OVMOPMNKSR	NKM	OTRQTPNKTP	NMRKPS	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PVVTPTSKVQ	MKT	PQQVPUTKTP	NOPKMO	RVKR	NOMQ	SMOMa ça
_á	OMV	e É	NSTRTRQKVM	NKO	NRSMNOOKRR	NMTKQN	RVKR	NOMQ	

p~ã éáÉ=k~ã É ` ` _

cäÉ=k~ã É MNM| ` ` _ KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíyf^ mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ kÅ

^Åè=qáã É PLOVLOMCP=OMMMMQR

p~ã éáÉ=qóéÉ ` ` _

qçí~äa äi íáçå NKMMMM

` çã ã Éåí JJJ

fpqa=oÉÑcäÉk~ã É MMJ ^i _ KÇ

p~ã éáÉ=n ` =m~ëëlcá~ä c~ää

fpqa=n ` =m~ëëlc~äi m~ëë

l éÉê~íçê **~Çã áå**

n ` =^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==\ mp==	i äi á	n ` =c~ä~Ö
V	_É	S	k ç=d ~ë	JMKMMN	éé Ä	k L^	CPCKCP	MO	
NN	_	S	k ç=d ~ë	MRRCR	éé Ä	RKO	CCQPCKSV	Q	
CP	k ~	CR	e É	NKPMR	éé Ä	NQNKV	SCSTQKMQ	CMM	
CQ	j Ö	CR	e É	NQKRCS	éé Ä	NMMP	RRSRKTQ	CM	c~äÉÇ=a ça
CT	^ ä	CR	e É	NMKPCR	éé Ä	NPKT	NRMTKUV	CM	c~äÉÇ=a ça
CU	pá	CR	e O	MKUPQ	éé Ä	PVKP	UCTHRS	NMM	
PV	h	CR	e É	CMKCPU	éé Ä	CKV	PPRUNKVP	CMM	
QM	` ~	CR	e O	NQKUSP	éé Ä	CHP	SCMVTHRV	CM	c~äÉÇ=a ça
RN	s	UV	e É	MKMNT	éé Ä	TNKP	PTMKMN	N	
RO	` ê	UV	e É	JMKMVR	éé Ä	k L^	TUNKCN	N	
RR	j å	UV	e É	MKMOS	éé Ä	CNKT	NUQKSP	MQ	
RS	cÉ	UV	e O	VKCUO	éé Ä	RKQ	NCNUCSKSO	CM	
RV	` ç	UV	e É	MKMMQ	éé Ä	PSKO	CCQUKVM	MO	
SM	k á	UV	e É	MKMCP	éé Ä	PCKR	CMMKMN	MQ	
SP	` ì	UV	e É	MKMCU	éé Ä	CCNS	RRUKVN	MS	
SS	wå	UV	e É	MKMCN	éé Ä	USKV	CNPKPQ	O	
TR	^ ë	UV	e É	MKMQS	éé Ä	NRKM	RCHPQ	N	
TU	pÉ	UV	e O	MKMTM	éé Ä	SKN	PSKST	N	
UU	pê	UV	e É	MKMPM	éé Ä	NVKN	NNNKNN	N	
VR	j ç	UV	e É	MCRV	éé Ä	CKN	NPTTKUT	N	
NMT	^ Ö	UV	e É	MKMNR	éé Ä	TKU	NSTKTU	MO	
NNN	` Ç	UV	e É	MKMNT	éé Ä	NNNS	CSKST	MO	
NNU	på	NRV	e É	MKMMQ	éé Ä	NSKO	CUPHPR	N	
NCN	pÄ	NRV	k ç=d ~ë	MKMCQ	éé Ä	CKV	NNSTKVR	MO	
NPT	_~	NRV	k ç=d ~ë	MKMPQ	éé Ä	CKO	OTMCV	MQ	
NUO	t	NRV	k ç=d ~ë	MCMS	éé Ä	CKV	SMCCKCM	N	
OMR	qä	OMV	k ç=d ~ë	MKMSO	éé Ä	NMKO	COVVHPM	MO	
OMU	mÄ	OMV	k ç=d ~ë	JMKMMU	éé Ä	k L^	PCPSKVP	MO	
OPO	qÜ	OMV	k ç=d ~ë	MKMRS	éé Ä	NPKT	PVTNKRO	N	
OPU	r	OMV	k ç=d ~ë	MKMOT	éé Ä	PHR	VTCKCN	MO	

n ` =fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÁ	B n ` =i çï	B n ` =eåÜÜ	n ` =c~ä~Ö
i á	S	k ç=d ~ë	NVTCRRSKOV	NKT	NTURRSCKNS	NNMCQT	RVHR	NOMQ	
pÅ	CR	k ç=d ~ë	CCMTRTUKNP	NHR	CCRCCUNKTO	VUKV	RVHR	NOMQ	
pÅ	CR	e O	VCUSNUKNS	MQ	NMNCTCMRN	VPKCU	RVHR	NOMQ	
pÅ	CR	e É	NPVSNMKTR	NKM	NCUSRRMQ	VPKVO	RVHR	NOMQ	
d É	TO	k ç=d ~ë	NMCCUMMKTM	NKO	NMCUNSRHPO	NMNKCO	RVHR	NOMQ	
d É	TO	e O	PUUCRMKTP	MHS	CNPCVUKVS	VPKVQ	RVHR	NOMQ	
d É	TO	e É	NMVVSMHSV	NKO	NNSPVNHSQ	VCKCT	RVHR	NOMQ	
v	UV	e O	CCTMURCKUV	MKO	CRVPNCCKTO	VTHPQ	RVHR	NOMQ	
v	UV	e É	TPUMVCKCR	NKM	TVMSMNKUR	VPHPS	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVTTSNPHPP	NHS	SCRNNMCKSR	NMUKNS	RVHR	NOMQ	
qÄ	NRV	e É	OSRMVCVMRN	MKV	OTRCTPNKTP	VSKCP	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PSCCCMTKNR	MKU	PCCV/PUTKTP	NNNKCT	RVHR	NOMQ	
_á	OMV	e É	NRCPCRRHSV	NKV	NRSMNCCKRR	VUKVO	RVHR	NOMQ	

p~ã éäÉ=ɵÉéçã

p~ã éäÉ=k~ã É ofkpb

cãÉ=k~ã É MOMpj mi kÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ kÅ

^Åè=qã É PLOVLOMCP=OMNMRVMO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãi íáçå NKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä c~åä

fpqa=n ` =m~ëëlc~åä c~åä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==i mp==	i a o	n ` =c ä-Ö
V	_É	S	k ç=d ~ë	QKUUS	éé Ä	RKV	NSUKUV	NMM	
NN	_	S	k ç=d ~ë	NPSKUCR	éé Ä	QKV	OVTTKMP	NMMM	
CP	k ~	QR	e É	PRNSRKMUQ	éé Ä	NNKN	RTVNUKVQ	OMMMMM	
CQ	j Ö	QR	e É	OMQNKSMQ	éé Ä	NMKU	NTTNKOV	OMMMMM	
CT	^ ä	QR	e É	OQUMKNMM	éé Ä	PKU	UNTKUO	OMMMMM	
CU	pá	QR	e O	NSTVKVNU	éé Ä	TKS	COMRKUR	NMMMM	
PV	h	QR	e É	PUPRRKCRO	éé Ä	NNKP	OVRNQKVN	OMMMMM	
QM	` ~	QR	e O	PQMRKRTM	éé Ä	PKO	PCUNSKMN	OMMMMM	
RN	s	UV	e É	COVKVPT	éé Ä	CRKS	SRCKCR	NMMM	
RO	` ê	UV	e É	VURKUVQ	éé Ä	OMKV	PQPSKQQ	OMMM	
RR	j å	UV	e É	PMMKCON	éé Ä	CRKM	RCNKVN	OMMM	
RS	cÉ	UV	e O	OQQVMKNSV	éé Ä	PKR	OMTVMQKVN	NMMMM	
RV	` ç	UV	e É	PNKSQR	éé Ä	PTKM	NVNKNO	NMMM	
SM	k á	UV	e É	NQCKSVR	éé Ä	NQKS	CQTKTV	NMMM	
SP	` ì	UV	e É	CRSKMPU	éé Ä	CPKV	NCNNKNV	OMMM	
SS	wå	UV	e É	OTNUKPRU	éé Ä	CCKN	CNCNKPN	OMMM	[i a o
TR	^ ë	UV	e É	VUKUTU	éé Ä	NPKV	RVKSU	NMMM	
TU	pÉ	UV	e O	TRKSPO	éé Ä	NUKS	CRKNT	NMMM	
UU	pê	UV	e É	CUKUPP	éé Ä	NSKO	SPKPP	OMMM	
VR	j ç	UV	e É	SMVKUCU	éé Ä	CRKV	NCNVKMU	NMMM	
NMT	^ Ö	UV	e É	RKPPS	éé Ä	CUKM	PUKUV	NMM	
NNN	` Ç	UV	e É	NPKNRM	éé Ä	NCKM	NPKPP	NMMM	
NNU	på	NRV	e É	NUCUKUSN	éé Ä	OMKV	PSQVKCR	NMMM	[i a o
NCN	pÄ	NRV	k ç=d ~ë	UCKNUU	éé Ä	ONKR	NCPUKOT	NMMM	
NPT	_~	NRV	k ç=d ~ë	TMKUCS	éé Ä	PCKN	PRMKPU	OMMM	
NUO	t	NRV	k ç=d ~ë	RCSKVSV	éé Ä	OVKR	RRMTKMQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	NPKVRN	éé Ä	OKM	NPPNKQU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	ONKTUT	éé Ä	NTKN	CUSSKQV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	QRKVPQ	éé Ä	RKN	RRCMKPT	NMMM	
OPU	r	OMV	k ç=d ~ë	NKRCQ	éé Ä	NRKU	NTMKNU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=ɵpa	oÉÑ=f mp	B n ` =ɵÉÅ	B n ` =ɵçï	B n ` =ɵäÜÜ	n ` =c ä-Ö
i á	S	k ç=d ~ë	NOMQVKPU	QKU	NTURRSCKNS	MKST	RVKR	NOMKQ	SMOMa ça
pÅ	QR	k ç=d ~ë	NPTSMKNM	RKV	QORQQUNKTO	MKPO	RVKR	NOMKQ	SMOMa ça
pÅ	QR	e O	OUMQKQO	PKP	NVNQTQMKRN	MKCU	RVKR	NOMKQ	SMOMa ça
pÅ	QR	e É	PTQKSM	NNKR	NQUSRRKMQ	MKCR	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=ɵpa
d É	TO	k ç=d ~ë	TOTVKUQ	MKQ	NVCUNSRKPO	MKTN	RVKR	NOMKQ	SMOMa ça
d É	TO	e O	NVOTKNU	NKQ	QNPQVUKVS	MKCR	RVKR	NOMKQ	SMOMa ça
d É	TO	e É	CRTKVR	CKU	NNSPVNKSQ	MKCO	RVKR	NOMKQ	SMOMa ça
v	UV	e O	PNQVKTT	PKM	QRVPNCQKTO	MKMT	RVKR	NOMKQ	SMOMa ça
v	UV	e É	RPQKRU	OSKS	TVMSMNKUR	MKMT	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=ɵpa
qÄ	NRV	k ç=d ~ë	RQMQKUP	NUKQ	SQRNNMQKSR	MKMU	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=ɵpa
qÄ	NRV	e É	NUPNKNQ	OMKO	OTRQTPNKTP	MKMT	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=ɵpa
_á	OMV	k ç=d ~ë	NNTNSKRP	NNKM	PCQVPUTKTP	MKPS	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=ɵpa
_á	OMV	e É	QVRSKMP	RKV	NRSMNCCKRR	MKPO	RVKR	NOMKQ	SMOMa ça

`çåíaåì åaÖ=~ëäÁê~íáç=sÉêëÑÅ~íáç=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MON``sKÇ
a~í~=m~íÜ=k~ã É	aWy^ÖãÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OV^kÁ
^Åè=qáã É	PLOVLOMOP=OMWNMS
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MMJ ^i _KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	m~ëë
fpqa=n`=m~ëëlc~åä	c~åä
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	B=oÉÁ	B i çï	B eäÜÜ	n`=cä-Ö
V	_É	S	k ç=d ~ë	OQKPVN	ééÄ	OKM	NRCRURKCR	CR	VTKRS	UVKU	NNMO	
NN	_	S	k ç=d ~ë	OQKUMR	ééÄ	NKM	VUVQQKMV	CR	VVKOO	UVKU	NNMO	
OP	k ~	QR	e É	RQNMKNNP	ééÄ	MKR	PSPPVOOKVP	RMMM	NMUKO	UVKU	NNMO	
OQ	j Ö	QR	e É	RQSQKOMV	ééÄ	NKM	NVMNPSVKST	RMMM	NMVKOU	UVKU	NNMO	
OT	^ä	QR	e É	RPPKVUV	ééÄ	MKQ	TMPRQKUT	RMM	NMSKU	UVKU	NNMO	
OU	pá	QR	e O	RNOKPNM	ééÄ	NKT	OQUTMPKQO	RMM	NMOKQS	UVKU	NNMO	
PV	h	QR	e É	ROONKMQV	ééÄ	MKU	NSPUVVNKUR	RMMM	NMQKQO	UVKU	NNMO	
QM	` ~	QR	e O	ROQRKQTO	ééÄ	NKQ	NUSVRRTPKQT	RMMM	NMQKVN	UVKU	NNMO	
RN	s	UV	e É	ORKVRN	ééÄ	OKN	NNQQQNKRV	CR	NMPKU	UVKU	NNMO	
RO	` ê	UV	e É	OSKMSP	ééÄ	PKU	NQMMSRKNR	CR	NMQKCR	UVKU	NNMO	
RR	j å	UV	e É	OSKOPO	ééÄ	OKV	TMSOVKRQ	CR	NMQKVP	UVKU	NNMO	
RS	cÉ	UV	e O	ROPVKONP	ééÄ	NKS	STMUPPRTKSS	RMMM	NMQKTU	UVKU	NNMO	
RV	` ç	UV	e É	OSKSQU	ééÄ	OKS	OQTNQMOO	CR	NMSKRV	UVKU	NNMO	
SM	k á	UV	e É	OSKSQO	ééÄ	NKU	SVQTNKVQ	CR	NMSKRT	UVKU	NNMO	
SP	` ì	UV	e É	OSKQTN	ééÄ	OKR	NVPRSPKOS	CR	NMRKUU	UVKU	NNMO	
SS	wå	UV	e É	OSKTNT	ééÄ	OKN	PCQQOKMQ	CR	NMSKUT	UVKU	NNMO	
TR	^ë	UV	e É	ORKSQV	ééÄ	NKU	OPPNUKVM	CR	NMOKS	UVKU	NNMO	
TU	pÉ	UV	e O	ORKRVR	ééÄ	MKT	NOUMMKQP	CR	NMOKPU	UVKU	NNMO	
UU	pê	UV	e É	ORKQVS	ééÄ	NKM	UQCRMKPM	CR	NMNKVU	UVKU	NNMO	
VR	j ç	UV	e É	OSKUNR	ééÄ	NKS	UOQUPKNM	CR	NMTKOS	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKQON	ééÄ	NKU	PMTUNRKOO	CR	NMVKSU	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKSMV	ééÄ	NKN	QMMTVKMQ	CR	NMSKQQ	UVKU	NNMO	
NNU	på	NRV	e É	OQKUUS	ééÄ	NKO	TUNNSKNS	CR	VVKRQ	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKTVQ	ééÄ	PKP	SMOONQKQU	CR	VVKNU	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKVPV	ééÄ	OKM	NURPUOKPN	CR	NMPKTS	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKTVS	ééÄ	NKM	PUMTOSKRU	CR	NMTKNU	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	OSKMPN	ééÄ	PKQ	UQPNMQKSU	CR	NMQKNO	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKOUV	ééÄ	NKU	NNUUCRPKQP	CR	NMRKNS	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	ORKUTP	ééÄ	OKT	NMRSURSKVN	CR	NMPKQV	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKSRS	ééÄ	PKM	NMONNTVKQP	CR	NMSKSO	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=ïçï	B n`=eäÜÜ	n`=cä-Ö
i á	S	k ç=d ~ë	ONVQNTNKRV	NKN	NTURRSOKNS	NOOKUU	RVKR	NOMQ	SMOMa ça
pÅ	QR	k ç=d ~ë	QRORRTRKTQ	MKV	QORQQUNKTO	NMSKPT	RVKR	NOMQ	
pÅ	QR	e O	NMPTNTPKTT	MKV	NMNQTQMKRN	NMOKON	RVKR	NOMQ	
pÅ	QR	e É	NQVNPQKPU	MKS	NQUSRRKMQ	NMMKPO	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NNNNSTVKQO	OKU	NMOUNSRKPO	NMUKNO	RVKR	NOMQ	
dÉ	TO	e O	QNSSCPKMR	MKN	QNPQVUKVS	NMMKTS	RVKR	NOMQ	
dÉ	TO	e É	NNUCOTKMN	OKM	NNSPVNSQ	NMNKRU	RVKR	NOMQ	
v	UV	e O	QTQTPSPKTQ	NKO	QRVPNOQKTO	NMPKPS	RVKR	NOMQ	
v	UV	e É	TVMOQUKTV	OKO	TVMSMNKUR	VVKVS	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	TQUPPMNKMN	NKT	SQRNNMQKSR	NNS	RVKR	NOMQ	
qÄ	NRV	e É	OUOPTOSKOM	NKT	OTRQTPNKTP	NMOKR	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PVUMNQSKPQ	NKO	PQQVPUTKTP	NOOKQV	RVKR	NOMQ	SMOMa ça
_á	OMV	e É	NSTNUVUKUU	NKS	NRSMNOOKRR	NMTKNS	RVKR	NOMQ	

`çåíáåì åÖ=~äáÄê~íáçå=_ä~åâ=É``_F=oÉéçê

p~ã éáÉ=k~ã É	``_
cáÉ=k~ã É	MOOJ``_ÍÇ
a~í~=m~íÜ=k~ã É	aWj^ÖáÉáíÝ^mj eyNya^q^yOMOPyMPJ ^oyi n` OV^hÂ
^Åè=qáã É	PLOVLOMOP=OMRRNMMM
p~ã éáÉ=qóéÉ	``_
qçí~äa ãäíáçå	NKMMMM
`çã ã ÉâíáÍ	JJJ
fpqa=oÉÑcáÉk~ã É	MVU^i_ÍÇ
p~ã éáÉ=n`=m~ëëlc á~ä	m~ëë
fpqa=n`=m~ëëlc~áä	m~ëë
I éÉê~íçê	**~Çã áä**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==\ mp==	iãáá	n`=c~Ö
V	_É	S	kç=d~ë	JMKMVR	ééÄ	kL^	ONOKOP	MO	
NN	_	S	kç=d~ë	MKPRV	ééÄ	UKQ	NUSMKNR	Q	
OP	k~	QR	eÉ	JRKMNT	ééÄ	kL^	RTPUVKTN	OMM	
OQ	j Ö	QR	eÉ	UKVUO	ééÄ	UKM	PSTPKVR	OM	
OT	^ä	QR	eÉ	QKRTS	ééÄ	NMKQ	TUPKPT	OM	
OU	pá	QR	eO	MRTNQ	ééÄ	PRKU	TSTHRM	NMM	
PV	h	QR	eÉ	NSKNTT	ééÄ	VKM	PNSQRKNN	OMM	
QM	`~	QR	eO	VKOPU	ééÄ	PKN	OPQNPKSR	OM	
RN	s	UV	eÉ	MKMNV	ééÄ	ORKO	PSSKSU	N	
RO	`ê	UV	eÉ	MKMVR	ééÄ	RRKP	UNPKUT	N	
RR	j å	UV	eÉ	MKMOU	ééÄ	UKV	NUTHPM	MQ	
RS	cÉ	UV	eO	SKQUS	ééÄ	RKM	URVRQKUQ	OM	
RV	`ç	UV	eÉ	MKMMO	ééÄ	NPSHR	OOQKQS	MO	
SM	ká	UV	eÉ	MKMOQ	ééÄ	PRRT	NVUKUV	MQ	
SP	`ì	UV	eÉ	MKMPM	ééÄ	NUKM	RRUKVN	MS	
SS	wå	UV	eÉ	MKMPP	ééÄ	QSKU	NVUKVM	O	
TR	^ë	UV	eÉ	MKMPS	ééÄ	OTHR	QPKMM	N	
TU	pÉ	UV	eO	MKMRU	ééÄ	NNKV	PMKMM	N	
UU	pê	UV	eÉ	MKMOV	ééÄ	ORHR	NMTRTU	N	
VR	j ç	UV	eÉ	MKPNN	ééÄ	QHR	VPOKOT	N	
NMT	^Ö	UV	eÉ	MKMNR	ééÄ	NRKU	NSOKOO	MO	
NNN	`Ç	UV	eÉ	MKMOP	ééÄ	ORKV	PQKMT	MO	
NNU	på	NRV	eÉ	MKMVT	ééÄ	UKO	QRQKOQ	N	
NON	pÄ	NRV	kç=d~ë	MKMOS	ééÄ	OVKM	NOOUKMP	MO	
NPT	_~	NRV	kç=d~ë	MKMPU	ééÄ	POKN	OVSKVU	MQ	
NUO	t	NRV	kç=d~ë	MKOUP	ééÄ	PKN	QPTRKQN	N	
OMR	qä	OMV	kç=d~ë	MKMSV	ééÄ	QKN	OQVOKVN	MO	
OMU	mÄ	OMV	kç=d~ë	JMKMNT	ééÄ	kL^	OUTPKNT	MO	
OPO	qÜ	OMV	kç=d~ë	MKMSU	ééÄ	SKN	QPURKQN	N	
OPU	r	OMV	kç=d~ë	MKMOT	ééÄ	NPRT	VVNKUV	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j ÇÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=cäÜÜ	n`=c~Ö
iá	S	kç=d~ë	NVVMPPUKTQ	QKR	NTURRSOKNS	NNNKQT	RVHR	NOMQ	
pÅ	QR	kç=d~ë	QNMNSRNKSS	MKQ	QORQQUNKTO	VSKQN	RVHR	NOMQ	
pÅ	QR	eO	VQMSCPKTO	NKU	NMNQTQMKRN	VOKT	RVHR	NOMQ	
pÅ	QR	eÉ	NPSPNNKOR	MKP	NQUSRRMQ	VNKT	RVHR	NOMQ	
dÉ	TO	kç=d~ë	NMNSTVNKSP	NKQ	NMOUNSRKPO	VUKUV	RVHR	NOMQ	
dÉ	TO	eO	PUOQRNKVO	NKP	QNPQVUKVS	VOKQV	RVHR	NOMQ	
dÉ	TO	eÉ	NMTSOMKVT	MKR	NNSPVNKSQ	VOKQS	RVHR	NOMQ	
v	UV	eO	QPSNOTUKOT	MKU	QRVPNOQKTO	VQKVR	RVHR	NOMQ	
v	UV	eÉ	TONPOSKNR	MKV	TVMSMNKUR	VNKOQ	RVHR	NOMQ	
qÄ	NRV	kç=d~ë	SVQPTUMKCP	NHR	SQRNNMQKSR	NMTHSQ	RVHR	NOMQ	
qÄ	NRV	eÉ	OSMRVPVMSU	NKM	OTRQTPNKTP	VQKS	RVHR	NOMQ	
_á	OMV	kç=d~ë	PRVMNMPKUO	MKV	PQQVPUTKTP	NNMQV	RVHR	NOMQ	
_á	OMV	eÉ	NRNVSSTKUU	MKT	NRSMNOOKRR	VTKQN	RVHR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` NSfj pN
cáÉ=k~ã É	MOP| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJj ^oyin` OV^kÄ
^Åè=qãã É	PLOVLOMOP=OMMRSWMU
p~ã éäÉ=qóéÉ	m_
qçí~ä=aäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMU^ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iãã á	n` =cä~Ö
_É	V	S	kç=d~ë	JMKNMQ	ééÄ	kL^	NNSKST	MKR	
_	NN	S	kç=d~ë	OKRMM	ééÄ	OKM	OOVQKST	NM	
k~	OP	QR	eÉ	JMKOVR	ééÄ	kL^	RVQRSKQR	RMM	
jÖ	OQ	QR	eÉ	PRKQTN	ééÄ	PKM	PMOTKNM	RM	
^ä	OT	QR	eÉ	PPKUVS	ééÄ	UKS	NMPOKOU	RM	
pá	OU	QR	eO	NSKRNV	ééÄ	NKS	NVMOKNR	ORM	
h	PV	QR	eÉ	UOKMOS	ééÄ	SKR	PNOOTKSP	RMM	
`~	QM	QR	eO	TPKQVT	ééÄ	NKM	SMVNRKNR	RM	m_=SMOM=c~âë=aça
s	RN	UV	eÉ	MKTPP	ééÄ	OKU	UUMKMQ	OKR	
`ê	RO	UV	eÉ	MKTSO	ééÄ	VKO	NRPPKUM	OKR	
jå	RR	UV	eÉ	MKTTN	ééÄ	NKV	QVRKVO	N	
cÉ	RS	UV	eO	PTKRPS	ééÄ	NKQ	VUQSVKUR	RM	
`ç	RV	UV	eÉ	JMKMOV	ééÄ	kL^	NSOKOP	MKR	
ká	SM	UV	eÉ	MKSMQ	ééÄ	NNKU	QOUKVM	N	
`ì	SP	UV	eÉ	MKPUQ	ééÄ	UKM	UTMKMQ	NKR	
wå	SS	UV	eÉ	TKOMR	ééÄ	NKR	NTQPKQU	R	m_=SMOM=c~âë=aça
^ë	TR	UV	eÉ	MKOTN	ééÄ	OSKU	RUKMN	OKR	
pÉ	TU	UV	eO	MKNSU	ééÄ	ONKS	NVKMM	OKR	
pê	UU	UV	eÉ	MKORO	ééÄ	UKN	NTNKNO	OKR	
jç	VR	UV	eÉ	NKNPS	ééÄ	SKO	SVTKUN	OKR	
^Ö	NMT	UV	eÉ	MKMOS	ééÄ	QNKP	SPKPP	MKR	
`Ç	NNN	UV	eÉ	MKMQR	ééÄ	QMKP	NQKQQ	MKR	
på	NNU	NRV	eÉ	PUKSMR	ééÄ	MKU	OOSTPKUO	OKR	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKMTS	ééÄ	RSKV	VSTKTP	MKR	
_~	NPT	NRV	kç=d~ë	MKPOT	ééÄ	RKU	QTPKUQ	N	
t	NUO	NRV	kç=d~ë	NKMVP	ééÄ	QPKQ	PQVTKRQ	OKR	
qä	OMR	OMV	kç=d~ë	MKNNU	ééÄ	NSKO	NOONKPS	MKR	
mÄ	OMU	OMV	kç=d~ë	JMKMTT	ééÄ	kL^	PMTSKTQ	MKR	
qÜ	OPO	OMV	kç=d~ë	MKPMQ	ééÄ	QNKU	QPPOKMN	OKR	
r	OPU	OMV	kç=d~ë	MKMQO	ééÄ	PTKV	PRPKTN	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NVOUSQQKPS	PMP	NTURRSOKNS	NMUMMN	RVMR	NOMQ	
pÅ	QR	kç=dl~ë	QNRVNOPMRQ	PMP	QORQQUNKTO	VTKTS	RVMR	NOMQ	
pÅ	QR	eO	VPURSUKVP	MKU	NMNQTQMRRN	VOKQV	RVMR	NOMQ	
pÅ	QR	eÉ	NPQQQVMRU	NNS	NQUSRRMVQ	VMMPN	RVMR	NOMQ	
dÉ	TO	kç=dl~ë	NMMMQMRKTN	MKT	NMOUNSRKPO	VTHP	RVMR	NOMQ	
dÉ	TO	eO	PTUPPNKQU	MKV	QNPQVUKVS	VNHR	RVMR	NOMQ	
dÉ	TO	eÉ	NMSVMQHPV	NHP	NNSPVNHSQ	VNKUR	RVMR	NOMQ	
v	UV	eO	QPUPUSSHPP	NKM	QRVPNOQKTO	VRKQQ	RVMR	NOMQ	
v	UV	eÉ	TONTVTHPT	MKU	TVMSMNKUR	VNHP	RVMR	NOMQ	
qÄ	NRV	kç=dl~ë	SVMVTMMKVV	OKQ	SQRNNMQHSR	NMTKNN	RVMR	NOMQ	
qÄ	NRV	eÉ	OSOTNOMRTQ	OHP	OTRQTPNRTP	VRHPT	RVMR	NOMQ	
_á	OMV	kç=dl~ë	PTTUNNQKUT	NKQ	POQVPUTRTP	NNSKOT	RVMR	NOMQ	
_á	OMV	eÉ	NRTPNSSHST	MKT	NRSMNOOKRR	NMMKUQ	RVMR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` pl n ` NSfj pN
cäÉ=k~ã É	MOQ ` pl kÇ
a~í~=m~íÜ=k~ã É	aWª ÖäÉáíÿ` mj eyNya ^q^ yOMOPyMPJ ^oyi n ` OV^ kÄ
^Åè=qã É	PLOVLOMOP=OMQNMQS
p~ã éäÉ=qóéÉ	i ` pl
qçí~äaãäíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MMU ^i _kÇ
p~ã éäÉ=n ` =m~ëëlcá~ä	m~ëë
fpqa=n ` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åä**

n ` =ª å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÄK	r åáë	opa	==ª mp==	bñés~ä	B=oÉÁ	B i çï	B eáÖÜ	n ` =c~ä-Ö
_É	V	S	k ç=dl ~ë	QVKVRT	éëÄ	NKO	RPQNOKVR	RM	NVKVU	TVKR	NOMQ	
_	NN	S	k ç=dl ~ë	QVQKSNN	éëÄ	MKS	PPQUNVKOM	RMM	NVKTU	TVKR	NOMQ	
k~	OP	QR	e É	UMNQKRMP	éëÄ	MKV	VVMMSPKMM	TRMM	ONKPT	TVKR	NOMQ	
j Ö	OQ	QR	e É	ROSOKQUV	éëÄ	NKV	POPQSQKMQ	RMMM	ONKMR	TVKR	NOMQ	
^ä	OT	QR	e É	OMVNKSMP	éëÄ	OKP	QUSORKMN	OMMM	OMKVO	TVKR	NOMQ	
pá	OU	QR	e O	UUSKTMU	éëÄ	OKQ	TSRVTKMP	NMMM	NTKTP	TVKR	NOMQ	
h	PV	QR	e É	VSURKVNP	éëÄ	NKR	RRQQPPKPT	NMMMM	NVKPT	TVKR	NOMQ	
` ~	QM	QR	e O	ORVTKVVO	éëÄ	NKM	NSRPQUTKSV	ORMM	OMKTU	TVKR	NOMQ	
s	RN	UV	e É	QVRKVTS	éëÄ	OKO	PUUUMTKVU	RMM	NVKUQ	TVKR	NOMQ	
` ê	RO	UV	e É	OMUKPQM	éëÄ	OKR	NVVPQMKRV	OMM	OMKUP	TVKR	NOMQ	
j å	RR	UV	e É	RNTKUPV	éëÄ	OKT	QQUQSTKNS	RMM	OMKTN	TVKR	NOMQ	
cÉ	RS	UV	e O	NVQQKQVS	éëÄ	OKN	QQNNVTRKMD	NMMM	OMKQR	TVKR	NOMQ	
` ç	RV	UV	e É	RPUKQUP	éëÄ	OKN	UVMRSOKVN	RMM	ONKRQ	TVKR	NOMQ	
ká	SM	UV	e É	ROSKNNU	éëÄ	OKR	QQQPTPKUQ	RMM	ONKMQ	TVKR	NOMQ	
` ì	SP	UV	e É	OSQKMRU	éëÄ	NKS	PQQQSPKOR	ORM	ONKNO	TVKR	NOMQ	
wå	SS	UV	e É	RMVKTSR	éëÄ	NKR	NMVPPUKTN	RMM	OMKPV	TVKR	NOMQ	
^ë	TR	UV	e É	VUKSRQ	éëÄ	NKQ	NSMMTKUR	NMM	NVKTP	TVKR	NOMQ	
pÉ	TU	UV	e O	VSKOOS	éëÄ	OKQ	UUPNKTN	NMM	NVKOQ	TVKR	NOMQ	
pê	UU	UV	e É	QVMKNQQ	éëÄ	OKN	QUUVOOKMT	RMM	NVKSN	TVKR	NOMQ	
j ç	VR	UV	e É	NMRKVSV	éëÄ	NKV	RUNTRKTT	NMM	ONKNV	TVKR	NOMQ	
^Ö	NMT	UV	e É	RPKURS	éëÄ	OKT	NMTUSRKRQ	RM	ONKRQ	TVKR	NOMQ	
` Ç	NNN	UV	e É	OSOKOUM	éëÄ	OKT	TMQTVKTM	ORM	OMKVU	TVKR	NOMQ	
på	NNU	NRV	e É	RMNKSRV	éëÄ	MKV	QUVORTKRP	RMM	OMKMT	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl ~ë	VPKOTP	éëÄ	MKV	QOOSPPKTU	NMM	NUKSS	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl ~ë	OMQNKURQ	éëÄ	MKV	OTOMRMMKRS	OMMM	OMKQD	TVKR	NOMQ	
t	NUO	NRV	k ç=dl ~ë	NMQKTOS	éëÄ	NKM	OTTRTRKRS	NMM	OMKVQ	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl ~ë	VUKQVS	éëÄ	MKQ	SMQUVSKMN	NMM	NVKT	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl ~ë	NMMKTQT	éëÄ	MKP	USQNPQKPR	NMM	OMKNR	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl ~ë	VMKSOS	éëÄ	NKN	TMOQUSKVQ	NMM	NUKNO	TVKR	NOMQ	
r	OPU	OMV	k ç=dl ~ë	VVKRMP	éëÄ	MKT	TOOSTUKQQ	NMM	NVKV	TVKR	NOMQ	

n ` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä=Ö
iá	S	kç=d~ë	NUTMTSQKQQ	NKN	NTURRSQKNS	NMQKTT	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QNQRSQMKNN	NKP	QQRQQUNKTO	VSKVT	RVKR	NOMQ	
pÅ	QR	eO	VNMNRSKQO	MQ	NMNQTQMKRN	VMKRU	RVKR	NOMQ	
pÅ	QR	eÉ	NPNQSTKRT	NKO	NQUSRRKMQ	UUKQQ	RVKR	NOMQ	
dÉ	TO	kç=d~ë	NMNPQSPKMP	MKV	NMQUNSRKPO	VUKRT	RVKR	NOMQ	
dÉ	TO	eO	PTMMUUKPN	MQ	QNPQMUKVS	UVKR	RVKR	NOMQ	
dÉ	TO	eÉ	NMRQURKVR	NKR	NNSPVNKSQ	VMKSP	RVKR	NOMQ	
v	UV	eO	QPRSQONKVV	NKM	QRVPNQQKTO	VQKUQ	RVKR	NOMQ	
v	UV	eÉ	TMRMSQKPR	QKO	TVMSMNKUR	UVKNU	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SVTSNMQKUM	NKO	SQRNNMQKSR	NMUKNQ	RVKR	NOMQ	
qÄ	NRV	eÉ	QRVTTVQKMO	MKP	QTRQTPNKTP	VQKP	RVKR	NOMQ	
_á	QW	kç=d~ë	PTTQRQQKUO	NKP	PQQVPUTKTP	NNSKN	RVKR	NOMQ	
_á	QW	eÉ	NRRNQURKUP	MKQ	NRSMNQQKRR	VVKQR	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMNN

cãÉ=k~ã É MORpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OV^hÅ

^Åè=qãã É PLOVLOMOP=OMQQMRN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MOCCO	éé Ä	NMMP	QSSIKSU	NMM	
NN	_	S	k ç=d ~ë	RMMPS	éé Ä	OKU	PVVPIKVS	NMMM	
OP	k ~	QR	e É	QUKSTM	éé Ä	PSIKM	SCONTKUQ	OMMMMM	
OQ	j Ö	QR	e É	NTPSIKRCU	éé Ä	MKV	NMUPRSIKNP	OMMMMM	
OT	^ ä	QR	e É	UNTQKMTP	éé Ä	MIS	NVNPNSIKPU	OMMMMM	
OU	pá	QR	e O	NNPMRTMR	éé Ä	NKO	VTUTMKVN	NMMMM	
PV	h	QR	e É	NSUMKUMT	éé Ä	MKQ	NNUSRPIKPO	OMMMMM	
QM	` ~	QR	e O	NQNNRTTN	éé Ä	NKR	VMTQCQIKPO	OMMMMM	
RN	s	UV	e É	OPIKUP	éé Ä	MKT	NUVUQIKNU	NMMM	
RO	` ê	UV	e É	NPIKUNV	éé Ä	NKT	NQQNQIKSM	OMMM	
RR	j å	UV	e É	NRMKQUP	éé Ä	MKR	TQITCPIKNR	OMMM	
RS	cÉ	UV	e O	NSNVVKVQO	éé Ä	MKU	PUPQMTSTIKPP	NMMMMM	
RV	` ç	UV	e É	OIPSV	éé Ä	QKM	QCSMKUM	NMMM	
SM	k á	UV	e É	OKVOM	éé Ä	SKV	NRQQIKRS	NMMM	
SP	` ì	UV	e É	PKCQV	éé Ä	NIS	QTPRIKPP	OMMM	
SS	wå	UV	e É	OQIKSTU	éé Ä	RKR	RSOSIKTV	OMMM	
TR	^ ë	UV	e É	QKNSP	éé Ä	RKR	TNMKTS	NMMM	
TU	pÉ	UV	e O	MIPVV	éé Ä	TKO	QMIPP	NMMM	
UU	pê	UV	e É	UIPPO	éé Ä	PKP	RMVRIKRM	OMMM	
VR	j ç	UV	e É	QKRSP	éé Ä	QKM	OSQSIKVT	NMMM	
NMT	^ Ö	UV	e É	MKMRT	éé Ä	OPKO	NOTIKTU	NMM	
NNN	` Ç	UV	e É	MKNUV	éé Ä	ONKV	RQKQQ	NMMM	
NNU	på	NRV	e É	PTIKTVO	éé Ä	OKN	COCQCMKUN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNUO	éé Ä	NMKM	NQSNIKSP	NMMM	
NPT	_~	NRV	k ç=d ~ë	RMIPTR	éé Ä	NIS	STOPNKQV	OMMM	
NUO	t	NRV	k ç=d ~ë	NKMMM	éé Ä	RKM	PRSTIKRU	NMMM	
OMR	qä	OMV	k ç=d ~ë	MIPPQ	éé Ä	SKO	ORROKVT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	SIPMN	éé Ä	MKV	RTUQSIKSR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NQKMSO	éé Ä	OKM	NNNOQSIKOM	NMMM	
OPU	r	OMV	k ç=d ~ë	OKOSU	éé Ä	OIS	NSSMNKUQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =ì çï	B n ` =¤ äÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NUVSOSPIKTU	MKU	NTURRSOKNS	NVSIKO	RVIR	NOMQ	
pÅ	QR	k ç=d ~ë	QMVOTOQUKRO	MKV	QORQQUNKTO	VSIKO	RVIR	NOMQ	
pÅ	QR	e O	VOOOONKUN	MIR	NMNQTQMRN	VMKUU	RVIR	NOMQ	
pÅ	QR	e É	NPOTVRKMM	MIS	NQUSRRKMQ	UVIPP	RVIR	NOMQ	
d É	TO	k ç=d ~ë	NMNMPMKUT	NKM	NMOUNSRIPO	VUKOS	RVIR	NOMQ	
d É	TO	e O	PTOPOTIPU	MIR	QNPQVUKVS	VMMMQ	RVIR	NOMQ	
d É	TO	e É	NMQRPRKMV	NKO	NNSPVNISQ	UVKUN	RVIR	NOMQ	
v	UV	e O	QPUSSPUKNV	MIS	QRVPNOQRTO	VRIR	RVIR	NOMQ	
v	UV	e É	TOURRUIPO	MIP	TVMSMNKUR	VOKNR	RVIR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVURMOPIRN	OIS	SQRNNMQISR	NMUKOU	RVIR	NOMQ	
qÄ	NRV	e É	OSPNRVQKVO	NKU	OTRQTPNKTP	VRIRP	RVIR	NOMQ	
_á	OMV	k ç=d ~ë	PTVOPMQIRU	MKV	PCQVPUTKTP	NNSKTN	RVIR	NOMQ	
_á	OMV	e É	NRVOVVMSV	OKO	NRSMNOOIRR	NMOKNN	RVIR	NOMQ	

p~ã éäÉ=k~ã É pn NNUUUMNP

cãÉ=k~ã É MOSpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OV^ HÅ

^Åè=qãã É PLOVLOMOP=OMVRQVRS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKMPT	ééÄ	QUKS	OTPKPQ	NMM	
NN	_	S	k ç=d ~ë	PKSUS	ééÄ	QKO	PNQRKVR	NMMM	
OP	k ~	QR	e É	JNOKTPO	ééÄ	k L^	RSQTNKTS	OMMMMM	
OQ	j Ö	QR	e É	OSVKNTU	ééÄ	OKV	NTOMNKVQ	OMMMMM	
OT	^ ä	QR	e É	TSTNMSTT	ééÄ	NKM	NTSTVUKPT	OMMMMM	
OU	pá	QR	e O	NRRRKUNO	ééÄ	NKR	NPNRQRKOM	NMMMM	
PV	h	QR	e É	ORPKQPQ	ééÄ	PKS	PVSTUKMN	OMMMMM	
QM	` ~	QR	e O	NTRKPUM	ééÄ	NKM	NONSQSKPS	OMMMMM	
RN	s	UV	e É	NSKSNO	ééÄ	NKT	NPOPRKOV	NMMM	
RO	` ê	UV	e É	NOKTVU	ééÄ	NKP	NOVNMKTU	OMMM	
RR	j å	UV	e É	PQKPMT	ééÄ	NKO	NSQVOKQV	OMMM	
RS	cÉ	UV	e O	VMOMKVQQ	ééÄ	NKP	ONNSPQQUKPN	NMMMMM	
RV	` ç	UV	e É	MKURT	ééÄ	VKQ	NSNRKTN	NMMM	
SM	k á	UV	e É	PKMRN	ééÄ	UKM	NRQTKUV	NMMM	
SP	` ì	UV	e É	OKVPU	ééÄ	RKN	ONRSKOR	OMMM	
SS	wå	UV	e É	NTKRRM	ééÄ	MKU	PUVVKRN	OMMM	
TR	^ ë	UV	e É	QKOTM	ééÄ	UKO	TMNKTS	NMMM	
TU	pÉ	UV	e O	MKPMS	ééÄ	NRKM	PNKRM	NMMM	
UU	pê	UV	e É	OKVPP	ééÄ	OKS	NTPVKMQ	OMMM	
VR	j ç	UV	e É	NKQUT	ééÄ	THR	UTMKMQ	NMMM	
NMT	^ Ö	UV	e É	MKMPR	ééÄ	NOKP	UMKMM	NMM	
NNN	` Ç	UV	e É	MKMUT	ééÄ	OQKR	ORKMV	NMMM	
NNU	på	NRV	e É	PUKUPU	ééÄ	MKO	OOSPTKMT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMUT	ééÄ	NMKQ	NQTNKSP	NMMM	
NPT	_~	NRV	k ç=d ~ë	OMRKVQ	ééÄ	NKT	OTPMPKNT	OMMM	
NUO	t	NRV	k ç=d ~ë	MKSVV	ééÄ	OPHR	OQTVKRP	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNON	ééÄ	ONKV	NORQKTP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NPKSNU	ééÄ	OKQ	NONPQMSN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NNKTPS	ééÄ	NKO	VPTRNKQN	NMMM	
OPU	r	OMV	k ç=d ~ë	NKPTS	ééÄ	SKR	NMNPQKTT	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ÉÅ	B n ` =í çï	B n ` =¤äÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NVQPPORKOT	QKT	NTURRSOKNS	NMUKUQ	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QMTQQMNKRP	OKS	QORQQUNKTO	VRKTT	RVKR	NOMQ	
pÅ	QR	e O	VMNVPQKPO	MKR	NMNQTQMKRN	UUKUU	RVKR	NOMQ	
pÅ	QR	e É	NPMTQQKMO	MKP	NQUSRRKMQ	UTKVR	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VVTMSOKQM	OKT	NMOUNSRKPO	VSKVT	RVKR	NOMQ	
d É	TO	e O	PSUVPQKOS	MKS	QNPQVUKVS	UVKOO	RVKR	NOMQ	
d É	TO	e É	NMPTVMKMV	NKR	NNSPVNKSQ	UVKNT	RVKR	NOMQ	
v	UV	e O	QPQTVNUKOT	NKT	QRVPNOQKTO	VQKSS	RVKR	NOMQ	
v	UV	e É	TMNRRUKUN	MKP	TVMSMNKUR	UUKTQ	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVPOUOSKUT	NKV	SQRNNMQKSR	NMTKQT	RVKR	NOMQ	
qÄ	NRV	e É	OSMTRMOKON	MKV	OTRQTPNKTP	VQKSS	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PUNRTMTKSN	QKR	POQVPUTKTP	NNTKQP	RVKR	NOMQ	
_á	OMV	e É	NRTRONRKVT	MKN	NRSMNOOKRR	NMMKVT	RVKR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` NTfj t N
cáÉ=k~ã É	MOT| m_bKÇ
a~í~=m~íÜ=k~ã É	aWÿ^ÖäÉåíyf` mj eyNya^q^yOMOPyMPJ ^oyin` OV^kÄ
^Åè=qáã É	PLOVLOMOP=ONMMMNN
p~ã éäÉ=qóéÉ	m_OMMKU
qçí~ä=aáä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMU^ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iáã á	n` =cä~Ö
_É	V	S	kç=d~ë	JMKNMO	ééÄ	kL^	NORKRS	MKN	
_	NN	S	kç=d~ë	OKNMU	ééÄ	QKV	ONORKTR	O	
k~	OP	QR	eÉ	JRNKMOP	ééÄ	kL^	RPVQVKRN	NMM	
jÖ	OQ	QR	eÉ	POKTRU	ééÄ	OKN	OUUQKUQ	NM	
^ä	OT	QR	eÉ	QTKOUT	ééÄ	MKQ	NPSNKOM	NM	
pá	OU	QR	eO	NSKTTR	ééÄ	NNKO	NVPUKUS	RM	
h	PV	QR	eÉ	RPKQUN	ééÄ	VKO	OVVOTKNS	NMM	
`~	QM	QR	eO	RRKNPO	ééÄ	NKS	QVQPSKOR	NM	OMMKU=m_=c~ãë=aça
s	RN	UV	eÉ	MKNVV	ééÄ	OVKU	QRMKMO	MKR	
`ê	RO	UV	eÉ	MKMTM	ééÄ	VQKP	URRKOM	MKR	
jå	RR	UV	eÉ	MKPSO	ééÄ	VKV	OVPKVR	MKO	
cÉ	RS	UV	eO	QRKRVN	ééÄ	TKV	NNUQMQKSS	NM	
`ç	RV	UV	eÉ	MKMNQ	ééÄ	POVKP	OPPKPQ	MKN	
ká	SM	UV	eÉ	MKNQQ	ééÄ	RPKR	ONMKMN	MKO	
`ì	SP	UV	eÉ	MKNUU	ééÄ	OMKT	SMRKRU	MKP	
wå	SS	UV	eÉ	PKVSP	ééÄ	RKU	NMOTKUP	N	
^ë	TR	UV	eÉ	MKNMT	ééÄ	PUKQ	PMKST	MKR	
pÉ	TU	UV	eO	MKNNU	ééÄ	RKT	NQKRM	MKR	
pê	UU	UV	eÉ	MKNUS	ééÄ	MKT	NPNKNN	MKR	
jç	VR	UV	eÉ	MKUQT	ééÄ	VKS	RPPKPR	MKR	
^Ö	NMT	UV	eÉ	MKMOM	ééÄ	ORKU	RNKNN	MKN	
`Ç	NNN	UV	eÉ	MKMSM	ééÄ	QQKQ	NUKRO	MKN	
på	NNU	NRV	eÉ	MKOVP	ééÄ	RKV	PQSKSU	MKR	
pÄ	NON	NRV	kç=d~ë	MKMPO	ééÄ	SMKR	TUQKNV	MKN	
_~	NPT	NRV	kç=d~ë	MKRQP	ééÄ	OMKT	TTMKUQ	MKO	
t	NUO	NRV	kç=d~ë	MKSOP	ééÄ	TKR	OPNOKSS	MKR	
qä	OMR	OMV	kç=d~ë	MKNOO	ééÄ	NSKO	NOPQKTN	MKN	
mÄ	OMU	OMV	kç=d~ë	JMKNPU	ééÄ	kL^	ORQVKQU	MKN	
qÜ	OPO	OMV	kç=d~ë	MKPRU	ééÄ	UKP	QTQOKRU	MKR	
r	OPU	OMV	kç=d~ë	MKMUV	ééÄ	UKU	SVMKTS	MKN	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	CMDSUNPKVP	NMP	NTURRSCKNS	MNPKRN	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	QNSVUNCKUR	MKU	QQRQQUNKTO	VUKMN	RVKR	NOMQ	
pÅ	QR	eO	VQRQVSKQM	MKU	NMNQTQMKRN	VPKNU	RVKR	NOMQ	
pÅ	QR	eÉ	NPRRPMPS	NKO	NQUSRRKMQ	VNKNT	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	NMNPTMMKTN	CKT	NMCUNSRKPO	VUKRV	RVKR	NOMQ	
dÉ	TO	eO	PUCCQCKTM	NKN	QNPQVUKVS	VCKQQ	RVKR	NOMQ	
dÉ	TO	eÉ	NMRUCPKVT	NKR	NNSPVNKSQ	VMKVQ	RVKR	NOMQ	
v	UV	eO	QQNVTTNKRO	NKQ	QRVPNCQKTO	VSKCP	RVKR	NOMQ	
v	UV	eÉ	TNUTSVKTS	MKV	TVMSMNKUR	VMKVN	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	TMNVMPPKTV	NKS	SQRNNMQKSR	NMUKU	RVKR	NOMQ	
qÄ	NRV	eÉ	OSPRMQMKOU	MKV	OTRQTPNKTP	VRKSS	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PTSQTSRKPU	NKV	PCQVPUTKTP	NNRKUS	RVKR	NOMQ	
_á	OMV	eÉ	NRSNUUVKUS	NKM	NRSMNCCKRR	NMMKN	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i ` Ot n ` NTfj t N
cáÉ=k~ã É	MOUJ ` pt kÇ
a~í~=m~íÜ=k~ã É	aWª ÖáÉáíÿ` mj eyNya ^q^ yOMOPyMPJ ^o yi n ` OV^ kÄ
^Åè=qáã É	PLOVLOMOP=ONMVRMMV
p~ã éäÉ=qóéÉ	i ` pt
qçí~äaãäíáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa=oÉÑcáÉk~ã É	MMU ^i _kÇ
p~ã éäÉ=n ` =m~ëëlcá~ä	m~ëë
fpqa=n ` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åä**

n ` =^å~äöíÉ=q~ÄáÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n ` =c~ä-Ö
_É	V	S	k ç=dl ~ë	RMKSPT	éëÄ	NKO	RURSOKTQ	RM	OMKCR	TVKR	NOMKQ	
_	NN	S	k ç=dl ~ë	RMQKSMD	éëÄ	NKV	PSVQMQKRM	RMM	OMKNU	TVKR	NOMKQ	
k~	OP	QR	e É	UQTMKTOU	éëÄ	OKN	NMTNRMVKTV	TRMM	COKRV	TVKR	NOMKQ	
j Ö	OQ	QR	e É	RRPQKOMT	éëÄ	OKQ	PQVQNRKSP	RMMM	COKNQ	TVKR	NOMKQ	
^ä	OT	QR	e É	OONUKSQQ	éëÄ	NKV	ROVTSKUV	OMMM	COKNV	TVKR	NOMKQ	
pá	OU	QR	e O	NVQMKTPT	éëÄ	PKU	VOPMMKVO	NMMM	OMKUN	M	OMM	
h	PV	QR	e É	NMOSSKNTM	éëÄ	NKQ	RVVVOVKSP	NMMMM	OMKRP	TVKR	NOMKQ	
` ~	QM	QR	e O	OTNSKQST	éëÄ	NKM	NTTSMVPKPV	ORMM	ONKTP	TVKR	NOMKQ	
s	RN	UV	e É	RNUKUCP	éëÄ	NKO	QNVOTUKNM	RMM	OMKTR	TVKR	NOMKQ	
` ê	RO	UV	e É	ONPKRVN	éëÄ	MKV	ONMTNQKUT	OMM	ONKPS	TVKR	NOMKQ	
j å	RR	UV	e É	RPNKTOR	éëÄ	MKR	OSPMQSKSV	RMM	ONKOT	TVKR	NOMKQ	
cÉ	RS	UV	e O	NMUTKPRV	éëÄ	NKR	ORTVOQSKRM	NMMM	ONKTR	TVKR	NOMKQ	
` ç	RV	UV	e É	RRRKOTM	éëÄ	NKN	VQSTPNKNT	RMM	COKON	TVKR	NOMKQ	
ká	SM	UV	e É	RQQKSNO	éëÄ	MKU	ORVURVKMM	RMM	ONKT	TVKR	NOMKQ	
` ì	SP	UV	e É	OTOKNUP	éëÄ	MKQ	PSRUMQKNS	ORM	ONKTT	TVKR	NOMKQ	
wå	SS	UV	e É	RPUKMPM	éëÄ	NKR	NNUVQUKTS	RMM	ONKRO	TVKR	NOMKQ	
^ë	TR	UV	e É	NMPKQMD	éëÄ	NKU	NTOVQKRM	NMM	OMKSU	TVKR	NOMKQ	
pÉ	TU	UV	e O	NMPKPPT	éëÄ	NKP	VRPVKUN	NMM	OMKST	TVKR	NOMKQ	
pê	UU	UV	e É	RNRKQUQ	éëÄ	MKV	PNPORPKPN	RMM	OMKSO	TVKR	NOMKQ	
j ç	VR	UV	e É	NMSKRMM	éëÄ	NKP	SMOTOKRU	NMM	ONKP	TVKR	NOMKQ	
^Ö	NMT	UV	e É	RRKSQQ	éëÄ	NKV	NNQUVVKPR	RM	COKOS	TVKR	NOMKQ	
` Ç	NNN	UV	e É	OTSKTUP	éëÄ	MKV	TSSUMKVQ	ORM	COKNQ	TVKR	NOMKQ	
på	NNU	NRV	e É	QUNKVNR	éëÄ	OKN	QUNSSUKNN	RMM	NVKCU	TVKR	NOMKQ	
pÄ	NON	NRV	k ç=dl ~ë	VVKVVV	éëÄ	NKN	QRUOTQKSO	NMM	OM	TVKR	NOMKQ	
_~	NPT	NRV	k ç=dl ~ë	ONPUKVUR	éëÄ	NKP	QUUCQSPKRU	OMMM	ONKPV	TVKR	NOMKQ	
t	NUO	NRV	k ç=dl ~ë	NMPKQTV	éëÄ	MKQ	OTTQSMQV	NMM	OMKT	TVKR	NOMKQ	
qä	OMR	OMV	k ç=dl ~ë	NMSKVRR	éëÄ	NKT	SRQMUNKQM	NMM	ONKPV	TVKR	NOMKQ	
mÄ	OMU	OMV	k ç=dl ~ë	NMUKUTM	éëÄ	MKS	VOVTQNKQQ	NMM	ONKTT	TVKR	NOMKQ	
qÜ	OPO	OMV	k ç=dl ~ë	VUKMNM	éëÄ	NKU	TRSPCOKRU	NMM	NVKS	TVKR	NOMKQ	
r	OPU	OMV	k ç=dl ~ë	NMTKUTU	éëÄ	NKQ	TUMORVKVU	NMM	ONKRU	TVKR	NOMKQ	

n ` =fpqa=q~ÄáÉ

i ~Äçê~íçêó=`çåíêçä=p~ã éäÉ=Ei `pF=oÉéçêí

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÖÜ	n ` =cä~Ö
i á	S	k ç=d ~ë	OMOPRPRKMT	NKS	NTURRSOKNS	NNPKPP	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QNVRRTNKMM	MKR	QORQQUNKTO	VUKSO	RVKR	NOMKQ	
pÅ	QR	e O	VQQTPSKUT	NKP	NMNQTQMKRN	VPKN	RVKR	NOMKQ	
pÅ	QR	e É	NPRMRTKRS	NKN	NQUSRRKMQ	VMKUR	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	NMPNMUNKTO	NKP	NMOUNSRKPO	NMMKOU	RVKR	NOMKQ	
d É	TO	e O	PUPPTVKNR	MKP	QNPQVUKVS	VOKTO	RVKR	NOMKQ	
d É	TO	e É	NMUSVVKTR	MKV	NNSPVNKSQ	VPKPV	RVKR	NOMKQ	
v	UV	e O	QPUNSSOKRT	NKT	QRVPNOQKTO	VRKQ	RVKR	NOMKQ	
v	UV	e É	TOSSURKUV	MKS	TVMSMNKUR	VNKVO	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	TMRSTRQKVO	NKO	SQRNNMQKSR	NMMKPV	RVKR	NOMKQ	
qÄ	NRV	e É	OSPPSTMKVT	NKO	OTRQTPNKTP	VRKSN	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PTRTQQOKVP	NKR	POQVPUTKTP	NNRKSQ	RVKR	NOMKQ	
_á	OMV	e É	NRRVPQTKPT	NKM	NRSMNOOKRR	VVKVR	RVKR	NOMKQ	

i ~ÄçêíçêóÈçåíêçäp~ã éäÉÈi `pF¤oÉéçã

p~ã éäÉÈk~ã É	i ` pt n ` NTfj t N
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a~í~¤m~íÜÈk~ã É	aWf ÖäÉáíyf mj eyNya ^q^ yOMOPyMPuj ^ o y i n ` OV^ kÄ
^ Åè¤qãã É	PLOVLOMOP¤ONMMPMVU
p~ã éäÉ¤qóéÉ	i ` pt
qçí~äaäãi íáçå	RKMMMM
` çã ã Éãáí	JJJ
fpqa¤oÉÑcäÉk~ã É	MMU ^ i _ kÇ
p~ã éäÉ¤n ` ¤m~ëëlcá~ä	m~ëë
fpqa¤n ` ¤m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åã**

n ` ¤^ å~äöíÉ¤q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÄK	r åáë	opa	¤¤ mp¤¤	bñés~ä	B¤oÉÁ	B i çï	B eáÖÜ	n ` ¤cä-Ö
_É	V	S	k ç¤dl ~ë	OVKVPQ	éëÄ	NKQ	RTPVPKTT	RM	NVKVT	TVKR	NOMQ	
_	NN	S	k ç¤dl ~ë	OVUKSNQ	éëÄ	NKQ	PSOUPOKNO	RMM	NVKVQ	TVKR	NOMQ	
k~	OP	QR	e É	UORNKVPO	éëÄ	NKN	NVQPVOUKNM	TRMM	OOKMN	TVKR	NOMQ	
j Ö	OQ	QR	e É	RQORKSOS	éëÄ	OKQ	PQOVPRKRR	RMMM	ONKT	TVKR	NOMQ	
^ä	OT	QR	e É	ONURKUTO	éëÄ	NKS	RONONKVM	OMMM	ONKUS	TVKR	NOMQ	
pá	OU	QR	e O	NMVSKRQT	éëÄ	MKR	UUTSRKRT	NMMM	OMKNP	M	OMM	
h	PV	QR	e É	NMMUTKVUN	éëÄ	NKR	RUVNNQKRU	NMMMM	OMKNU	TVKR	NOMQ	
` ~	QM	QR	e O	OSSRKSUR	éëÄ	NKM	NTPOSVVKSQ	ORMM	ONKPP	TVKR	NOMQ	
s	RN	UV	e É	RNTKUVV	éëÄ	MKQ	QNSMVOKST	RMM	OMKTO	TVKR	NOMQ	
`ê	RO	UV	e É	ONPKRSN	éëÄ	MKN	OMVQMPKRM	OMM	ONKPS	TVKR	NOMQ	
j å	RR	UV	e É	ROVKSMM	éëÄ	MKR	OSMQNNKTQ	RMM	ONKNU	TVKR	NOMQ	
cÉ	RS	UV	e O	NMTOKPRT	éëÄ	NKN	ORNUNNNKNO	NMMM	ONKQR	TVKR	NOMQ	
` ç	RV	UV	e É	RRUKQTN	éëÄ	NKM	VQSQTVKPQ	RMM	OOKPQ	TVKR	NOMQ	
ká	SM	UV	e É	RPTKTQR	éëÄ	NKN	ORRVQSKVM	RMM	ONKRN	TVKR	NOMQ	
` ì	SP	UV	e É	OSVKMUO	éëÄ	MKV	PRVQOPKQQ	ORM	ONKRP	TVKR	NOMQ	
wå	SS	UV	e É	RPNKRMM	éëÄ	NKP	NNSTVOKPN	RMM	ONKOS	TVKR	NOMQ	
^ë	TR	UV	e É	NMOKPSV	éëÄ	MKU	NTMNVKQV	NMM	OMKQT	TVKR	NOMQ	
pÉ	TU	UV	e O	NMOKTUQ	éëÄ	MKV	VPVOKUV	NMM	OMKRS	TVKR	NOMQ	
pê	UU	UV	e É	RNMKVPO	éëÄ	MKR	PMUMSUKMN	RMM	OMKQ	TVKR	NOMQ	
j ç	VR	UV	e É	NMQKTTU	éëÄ	MKS	RUVPVKNM	NMM	OMKVS	TVKR	NOMQ	
^Ö	NMT	UV	e É	RQKTUS	éëÄ	MKR	NNOQRPKST	RM	ONKVN	TVKR	NOMQ	
` Ç	NNN	UV	e É	OTOKRQT	éëÄ	NKP	TRMQTKNS	ORM	ONKU	TVKR	NOMQ	
på	NNU	NRV	e É	QTPKNSR	éëÄ	NKN	OTTRSOKNT	RMM	NUKVP	TVKR	NOMQ	
pÄ	NON	NRV	k ç¤dl ~ë	VTKVPN	éëÄ	MKR	QRSPPPKSN	NMM	NVKRV	TVKR	NOMQ	
_~	NPT	NRV	k ç¤dl ~ë	OMUTKVOR	éëÄ	MKN	OUSMUTRKVO	OMMM	OMKUU	TVKR	NOMQ	
t	NUO	NRV	k ç¤dl ~ë	NMNKVPR	éëÄ	NKR	OTRQSPKPU	NMM	OMKON	TVKR	NOMQ	
qä	OMR	OMV	k ç¤dl ~ë	NMOKPMS	éëÄ	NKT	SPSPMQKTV	NMM	OMKQS	TVKR	NOMQ	
mÄ	OMU	OMV	k ç¤dl ~ë	NMSKTNM	éëÄ	MKV	VOSUORKSO	NMM	ONKPQ	TVKR	NOMQ	
qÜ	OPO	OMV	k ç¤dl ~ë	VTKQVT	éëÄ	MKT	TSRQORKNU	NMM	NVKR	TVKR	NOMQ	
r	OPU	OMV	k ç¤dl ~ë	NMSKTPT	éëÄ	NKT	TURMQMKSV	NMM	ONKPR	TVKR	NOMQ	

n ` ¤fpqa¤q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=ÿ çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä-Ö
iá	S	kç=d~ë	OMNNNTNKUT	NKO	NTURRSOKNS	NNOKSQ	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QOMPPQPKSN	MKQ	QORQQUNKTO	VUKU	RVKR	NOMQ	
pÅ	QR	eO	VPVMSTKRR	MKQ	NMNQTQMRN	VOKRQ	RVKR	NOMQ	
pÅ	QR	eÉ	NPQUSSKST	NKR	NQUSRRKMQ	VMKTO	RVKR	NOMQ	
dÉ	TO	kç=d~ë	NMPQRTNKPO	MKU	NMOUNSRKPO	NMMKSO	RVKR	NOMQ	
dÉ	TO	eO	PUPUVSKUR	NKN	QNPQVUKVS	VOKUQ	RVKR	NOMQ	
dÉ	TO	eÉ	NMURRSKTP	MKS	NNSPVNKSQ	VPKOT	RVKR	NOMQ	
v	UV	eO	QPPTNTOKQS	NKQ	QRVPNOQKTO	VQKQP	RVKR	NOMQ	
v	UV	eÉ	TOOOUQKW	NKM	TVMSMNKUR	VNKPS	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	TNTQSVSKOQ	MKU	SQRNNMQKSR	NNNKOO	RVKR	NOMQ	
qÄ	NRV	eÉ	OSQOVSPKMP	MKU	OTRQTPNKTP	VRKVQ	RVKR	NOMQ	
_á	OW	kç=d~ë	PUONOMRKOS	NKP	POQVPUTKTP	NNTHS	RVKR	NOMQ	
_á	OW	eÉ	NRQQMPUKTQ	MKT	NRSMNOOKRR	VUKVT	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOROVJMMO

cãÉ=k~ã É MPMpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl˜ mj eyNya^q^yOMOPyMPJ ^oyi n ` OV^ hÅ

^Åè=qãã É PLOVLOMOP=ONWØOMØO

p~ã éäÉ=qóéÉ p~ã éäÉ

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j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKMNQ	éé Ä	k lÅ	NSNKNN	NMM	
NN	_	S	k ç=d ~ë	NOMKQJM	éé Ä	NKS	QPQPRUKSO	NMMM	
OP	k ~	QR	e É	NMMPMOKOMV	éé Ä	NKN	RRSURQTSKMN	OMMMMM	
OQ	j Ö	QR	e É	POVOKQQR	éé Ä	NKN	VSPVNNRTP	OMMMMM	
OT	^ ä	QR	e É	POKRNM	éé Ä	MR	PUMRKMN	OMMMMM	
OU	pá	QR	e O	SMUUKUVS	éé Ä	OKO	CQVNUTQKQT	NMMMM	
PV	h	QR	e É	VNTTKOSS	éé Ä	MKN	CQMOMQQKQR	OMMMMM	
QM	` ~	QR	e O	NUMQSKMSS	éé Ä	OKP	RQCUPOUTKRP	OMMMMM	
RN	s	UV	e É	MKPRP	éé Ä	PKM	NSPMKNO	NMMM	
RO	` ê	UV	e É	MKPQP	éé Ä	VRT	OPRPKMU	OMMM	
RR	j å	UV	e É	SMKRPV	éé Ä	MKV	NQNVROKUO	OMMM	
RS	cÉ	UV	e O	NSSKUNR	éé Ä	OKN	NVPONONRTT	NMMMMM	
RV	` ç	UV	e É	MKPPV	éé Ä	SKR	OVPUKQN	NMMM	
SM	k á	UV	e É	NKURN	éé Ä	OKQ	QPPOKVS	NMMM	
SP	` ì	UV	e É	VKMQP	éé Ä	OKM	RTUTNKMR	OMMM	
SS	wå	UV	e É	ONRTQS	éé Ä	MR	COMVRRTQ	OMMM	
TR	^ ë	UV	e É	MKOPP	éé Ä	NQKP	NVTKMD	NMMM	
TU	pÉ	UV	e O	MKNRU	éé Ä	VKU	TQKST	NMMM	
UU	pê	UV	e É	NMUKQMD	éé Ä	MKU	PNONOPKMN	OMMM	
VR	j ç	UV	e É	NKVMT	éé Ä	PKN	RNSSKSO	NMMM	
NMT	^ Ö	UV	e É	MKMNV	éé Ä	OMRT	NVSKST	NMM	
NNN	` Ç	UV	e É	MKVRN	éé Ä	NRKP	SUKUV	NMMM	
NNU	på	NRV	e É	MRTON	éé Ä	OKU	COQPKRS	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKORQ	éé Ä	PKP	SPQUKON	NMMM	
NPT	_~	NRV	k ç=d ~ë	OOKSMV	éé Ä	NKP	NQVUQQKRU	OMMM	
NUO	t	NRV	k ç=d ~ë	MKOSP	éé Ä	RKO	QNMUKPO	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKVQU	éé Ä	NRRT	NVQUKUT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKPSV	éé Ä	PKS	NVPRVKRT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKOSR	éé Ä	OKT	NONRRKQR	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNPU	éé Ä	UKQ	RMPSKPU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVVPQONKSU	NKU	NTURRSOKNS	NNNKSQ	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PUTTQMOKQT	MKQ	QORQQUNRTO	VNKNQ	RVKR	NOMKQ	
pÅ	QR	e O	UTSOMVKQT	PKO	NMNQTQMRRN	USKPR	RVKR	NOMKQ	
pÅ	QR	e É	NORQOVKQN	MKS	NQUSRRKMQ	UQKPU	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VVPUTNKPR	MKR	NMOUNSRKPO	VSKSS	RVKR	NOMKQ	
d É	TO	e O	PTOUOOKVO	MKT	ONPQVUKVS	VMKNS	RVKR	NOMKQ	
d É	TO	e É	NMPPVMKSR	MKT	NNSPVNKSQ	UUKUP	RVKR	NOMKQ	
v	UV	e O	QOTQNVTKSM	OKM	QRVPNOQRTO	VPKMS	RVKR	NOMKQ	
v	UV	e É	SUUSRUKOQ	MKU	TVMSMNKUR	UTKNN	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SVPVQQOKPM	NKO	SQRNNMQKSR	NMTKRT	RVKR	NOMKQ	
qÄ	NRV	e É	QRVMSRMSO	NKP	OTRQTPNRTP	VQKMQ	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PTRMMSRKSN	MKU	PQQVPUTRTP	NNRKQN	RVKR	NOMKQ	
_á	OMV	e É	NQVURTUKQU	NKN	NRSMNOOKRR	VSKMS	RVKR	NOMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` NTfj t O
cáÉ=k~ã É	MPN| m_KÇ
a~í~=m~íÜ=k~ã É	a Wy^ ÖäÉåíyf` mj e yNya^q^yOMOPyMPJ ^o yi n` OV^ kÄ
^Åè=qãã É	PLOVLOMOP=ONWOTWOV
p~ã éäÉ=qóéÉ	m_
qçí~ä=a ãä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMU` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
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n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==` mp==	i ãã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	JMKNNO	ééÄ	k L^	NNOKOP	MKR	
_	NN	S	k ç=d ~ë	TKVRR	ééÄ	OKN	SPPTKMQ	NM	
k~	OP	QR	e É	SMOKOUT	ééÄ	PKQ	NOUORMKVU	RMM	m_=SMOM=c~ãë=a ça
j Ö	OQ	QR	e É	POKTSP	ééÄ	TKO	OTVUKNR	RM	
^ä	OT	QR	e É	NMKONR	ééÄ	NNKS	QSOKOQ	RM	
pá	OU	QR	e O	SOKTVM	ééÄ	TKM	RUSMKTO	ORM	
h	PV	QR	e É	URKRST	ééÄ	UKN	PMTSNKUU	RMM	
` ~	QM	QR	e O	NSTKPSP	ééÄ	QKU	NNVQPVKUN	RM	m_=SMOM=c~ãë=a ça & m_=SMOM=c~ãë=k çåJa ça
s	RN	UV	e É	MKVVP	ééÄ	NNKU	NMSPKPV	OKR	
` ê	RO	UV	e É	MKMNQ	ééÄ	RORKV	TURKON	OKR	
j å	RR	UV	e É	MKRPV	ééÄ	NPKN	PTPKOT	N	
cÉ	RS	UV	e O	OKPTO	ééÄ	SKV	NRNQTKQT	RM	
` ç	RV	UV	e É	MKMRM	ééÄ	NMTKQ	OUUKVM	MKR	
k á	SM	UV	e É	MKNOV	ééÄ	QMKR	NVUKUV	N	
` ì	SP	UV	e É	MKNVS	ééÄ	UKS	SMRKRU	NKR	
wå	SS	UV	e É	QKONQ	ééÄ	SKM	NMSOKOU	R	
^ë	TR	UV	e É	MKOPU	ééÄ	OUKN	RNKPQ	OKR	
pÉ	TU	UV	e O	MKNTQ	ééÄ	PKS	NVKPP	OKR	
pê	UU	UV	e É	MKUVR	ééÄ	TKN	RQSKSV	OKR	
j ç	VR	UV	e É	MKTMQ	ééÄ	NTKM	QQQKQS	OKR	
^Ö	NMT	UV	e É	MKMNU	ééÄ	QUKU	QSKST	MKR	
` Ç	NNN	UV	e É	MKMSS	ééÄ	NVKU	NVKSP	MKR	
på	NNU	NRV	e É	MKVSQ	ééÄ	RKQ	TPRKRV	OKR	
pÄ	NON	NRV	k ç=d ~ë	MKMRR	ééÄ	NNKR	UUQKOV	MKR	
_~	NPT	NRV	k ç=d ~ë	MKUUP	ééÄ	NMKN	NOONKPR	N	
t	NUO	NRV	k ç=d ~ë	MKUPR	ééÄ	ORKM	OUSSKTN	OKR	
qä	OMR	OMV	k ç=d ~ë	MKMVO	ééÄ	OVKP	NMTQKRO	MKR	
mÄ	OMU	OMV	k ç=d ~ë	JMKOUO	ééÄ	k L^	NPQUKNO	MKR	
qÜ	OPO	OMV	k ç=d ~ë	MKRSP	ééÄ	NVKQ	SQPNKUO	OKR	
r	OPU	OMV	k ç=d ~ë	MKMPQ	ééÄ	OMKP	OVPKSR	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	CMVRMNUKCP	NMP	NTURRSCKNS	NNCKOV	RVMR	NOMQ	
pÅ	QR	kç=dl~ë	QNRNUQQKNS	MKO	QQRQQUNKTO	VTHRV	RVMR	NOMQ	
pÅ	QR	eO	VOQMTVMPU	PKN	NMNQTQMRRN	VNHMT	RVMR	NOMQ	
pÅ	QR	eÉ	NPNQNRKTN	NKN	NQUSRRMQ	UUKQ	RVMR	NOMQ	
dÉ	TO	kç=dl~ë	NMNTUSVMU	NKV	NMOUNSRKPO	VV	RVMR	NOMQ	
dÉ	TO	eO	PSVRCSKPP	MKV	QNPQVUKVS	UVKPT	RVMR	NOMQ	
dÉ	TO	eÉ	NMOUNPKOU	NKO	NNSPVNKSQ	UUKPP	RVMR	NOMQ	
v	UV	eO	QPPORMPKTT	NKM	QRVPNOQKTO	VQKPP	RVMR	NOMQ	
v	UV	eÉ	TMRNOSKNT	MKU	TVMSMNKUR	UVKNV	RVMR	NOMQ	
qÄ	NRV	kç=dl~ë	SVVMUPRKVQ	NKT	SQRNNMOKSR	NMUKPT	RVMR	NOMQ	
qÄ	NRV	eÉ	OSOONQPKTU	NMP	OTRQTPNKTP	VRKNV	RVMR	NOMQ	
_á	OMV	kç=dl~ë	PUPMNTNKRR	NKR	POQVPUTKTP	NNTKUT	RVMR	NOMQ	
_á	OMV	eÉ	NRUMQUNKTO	OKP	NRSMNOOKRR	NMNKP	RVMR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

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cáÉ=k~ã É	MPCl `pt kÇ
a~í~=m~íÜ=k~ã É	aWl^ÖäÉáíy^ mj eyNya^q^yOMCPyMPJ ^oyi n`OV^kÄ
^Åè=qáã É	PLOVLOMCP=ONMPOMPS
p~ã éäÉ=qóéÉ	i `pt
qçí~äa ãäíáçå	RKMMMM
`çã ã Éáí	JJJ
fpqa=oÉÑcáÉk~ã É	MMU ^i _kÇ
p~ã éäÉ=n`=m~ëëlc á~ä	c~äà
fpqa=n`=m~ëëlc~äà	m~ëë
l éÉê~íçê	**~Çã åà**

n`=^å~äöíÉ=q~ÄåÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÄK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n`=cä-Ö
_É	V	S	k ç=dl~ë	RCKUUM	éëÄ	NKT	RUTQMMMT	RM	ONKMR	TVKR	NOMQ	
_	NN	S	k ç=dl~ë	RQNKTSP	éëÄ	NKP	PUNMSVMRT	RMM	ONKST	TVKR	NOMQ	
k~	OP	QR	e É	UVNPKUQN	éëÄ	OKR	NMUSVMUKMT	TRMM	OPKTT	TVKR	NOMQ	a ça
j Ö	OQ	QR	e É	RSMUKPVU	éëÄ	MKU	PQQPMMKVT	RMMM	OOKQP	TVKR	NOMQ	
^ä	OT	QR	e É	OOPVKVMR	éëÄ	OKT	RNTMSKUV	OMMM	OOKQ	TVKR	NOMQ	
pá	OU	QR	e O	NMSRKSUU	éëÄ	MKT	VMOSRKTU	NMMM	ONKPN	M	OMM	
h	PV	QR	e É	NMQNOKSSV	éëÄ	NKQ	RUTUSVKVO	NMMMM	OMKUP	TVKR	NOMQ	
`~	QM	QR	e O	OUMVKSNM	éëÄ	NKU	NTRPVNVKMT	ORMM	OOKQU	TVKR	NOMQ	
s	RN	UV	e É	RQMKRMP	éëÄ	NKR	QNVNSQKSP	RMM	ONKSO	TVKR	NOMQ	
`ê	RO	UV	e É	OOPKROQ	éëÄ	NKO	ONNRUSKNT	OMM	OOKPR	TVKR	NOMQ	
j å	RR	UV	e É	RROKQVU	éëÄ	MKR	OSOOVPKW	RMM	OOKN	TVKR	NOMQ	
cÉ	RS	UV	e O	NMVUKTNM	éëÄ	NKN	OQVPVVSKTT	NMMM	ONKVT	TVKR	NOMQ	
`ç	RV	UV	e É	RTRKMRR	éëÄ	NKR	VQMUTMKMO	RMM	OP	TVKR	NOMQ	a ça
ká	SM	UV	e É	RSNKRPN	éëÄ	NKS	ORUMPVKVM	RMM	OOKQS	TVKR	NOMQ	
`ì	SP	UV	e É	OUOKMPU	éëÄ	OKM	PSPSVTKQO	ORM	OOKRS	TVKR	NOMQ	
wå	SS	UV	e É	RRRKNNQ	éëÄ	OKO	NNTTSRKQV	RMM	OOKO	TVKR	NOMQ	
^ë	TR	UV	e É	NMSKPUT	éëÄ	NKS	NTMTRKOQ	NMM	ONKOU	TVKR	NOMQ	
pÉ	TU	UV	e O	NMRKQMN	éëÄ	NKM	VPNNNKRM	NMM	ONKMU	TVKR	NOMQ	
pê	UU	UV	e É	ROSKOUS	éëÄ	NKP	PMSUVQKSS	RMM	ONKMR	TVKR	NOMQ	
j ç	VR	UV	e É	NNSKMMM	éëÄ	MKQ	SOVVVKPT	NMM	OPKO	TVKR	NOMQ	a ça
^Ö	NMT	UV	e É	RUKNNN	éëÄ	MKS	NNRNRSKUO	RM	OPKOQ	TVKR	NOMQ	a ça
`Ç	NNN	UV	e É	OUOKQVN	éëÄ	MKV	TRNMQKVP	ORM	OOKS	TVKR	NOMQ	
på	NNU	NRV	e É	RMOKTQN	éëÄ	NKS	OUTPTTKPO	RMM	OMKNN	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl~ë	NMOKQMO	éëÄ	NKQ	QSRRPVKPT	NMM	OMKQU	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl~ë	ONUSKNCP	éëÄ	NKT	OVOOQMMKSP	OMMM	ONKUS	TVKR	NOMQ	
t	NUO	NRV	k ç=dl~ë	NNPKMST	éëÄ	MKP	PMMSTQKST	NMM	OOKSN	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl~ë	NMRKTSQ	éëÄ	MKS	SRNORUKTT	NMM	ONKNR	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl~ë	NMUKONO	éëÄ	MKT	VPMQMUKNM	NMM	ONKSQ	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl~ë	NMRKROM	éëÄ	MKT	UNVTOTKUN	NMM	ONKN	TVKR	NOMQ	
r	OPU	OMV	k ç=dl~ë	NNMKUVM	éëÄ	MKN	UMTQUTKTR	NMM	OOKNU	TVKR	NOMQ	

n`=fpqa=q~ÄåÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä~Ö
iá	S	kç=d~ë	NVQQMVMKTS	MKU	NTURRSOKNS	NMUKUU	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QNOSNPPHPV	OKN	QORQQUNKTO	VSKVU	RVKR	NOMQ	
pÅ	QR	eO	VMONRSKSM	MKT	NMNQTQMRN	UUKVN	RVKR	NOMQ	
pÅ	QR	eÉ	NPMRRUKNM	NKN	NQUSRRKMQ	UTKUP	RVKR	NOMQ	
dÉ	TO	kç=d~ë	NMMVMRMKNQ	OKO	NMOUNSRKPO	VUKNQ	RVKR	NOMQ	
dÉ	TO	eO	PSOVUPKVR	MKO	QNPQVUKVS	UTKTU	RVKR	NOMQ	
dÉ	TO	eÉ	NMPQUVKSQ	MKT	NNSPVNKSQ	UUKVO	RVKR	NOMQ	
v	UV	eO	QNVOUMMRV	NKM	QRVPNOQKTO	VNKOU	RVKR	NOMQ	
v	UV	eÉ	SVTPUOKRP	NKM	TVMSMNKUR	UUKON	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SVVVUMOKUV	MKT	SQRNNMQKSR	NMUKRN	RVKR	NOMQ	
qÄ	NRV	eÉ	ORTRRVSKTN	MKT	OTRQTPNKTP	VPHR	RVKR	NOMQ	
_á	OW	kç=d~ë	PTUOSUSKQO	MKM	POQVPUTKTP	NNSKQN	RVKR	NOMQ	
_á	OW	eÉ	NRQQUVUKOT	NKQ	NRSMNOOKRR	VVKMO	RVKR	NOMQ	

`çåíaåìåaÖ=~äåÄê~íáçå=sÉêäÑÅ~íáçå=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MPP|``sKÇ
a~í~=m~íÜk~ã É	aWyªÖãÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OV^kÄ
^Åè=qáã É	PLOVLOMOP=ONMQNMMS
p~ã éáÉ=qóéÉ	``s
qçí~äaãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MMJ ^i _KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~åä
fpqa=n`=m~ëëlc~åä	c~åä
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä~Ö
V	_É	S	k ç=d ~ë	OPKSUT	éëÄ	NKQ	NQUQMRKMU	CR	VQKTR	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKMVO	éëÄ	NKO	NMMSQMPN	CR	NMMKTT	UVKU	NNMO	
OP	k ~	QR	e É	RQUUKQUV	éëÄ	MKP	PQTVUQTKQN	RMMM	NMVKTT	UVKU	NNMO	
OQ	j Ö	QR	e É	RSMUKRNO	éëÄ	MKO	NUQQSQRKQS	RMMM	NNOKNT	UVKU	NNMO	[=HLJHNMB
OT	^ä	QR	e É	RPVKNUU	éëÄ	MKU	STMSVKNN	RMM	NMTKUQ	UVKU	NNMO	
OU	pá	QR	e O	RMUKRTT	éëÄ	NKN	OPRVUTKRO	RMM	NMNKTO	UVKU	NNMO	
PV	h	QR	e É	RONOKOMM	éëÄ	NKO	NRQQVQQKTM	RMMM	NMQKOQ	UVKU	NNMO	
QM	` ~	QR	e O	RNVRKVNQ	éëÄ	NKN	NTTTMPRRUKTT	RMMM	NMPKVO	UVKU	NNMO	
RN	s	UV	e É	OSKMMS	éëÄ	MKT	NMTVNTKOO	CR	NMQKMO	UVKU	NNMO	
RO	` ê	UV	e É	OSKSTP	éëÄ	MKV	NPRNPRKOT	CR	NMSKSV	UVKU	NNMO	
RR	j å	UV	e É	OSKPMU	éëÄ	MKV	SSTUMKUS	CR	NMRKOP	UVKU	NNMO	
RS	cÉ	UV	e O	ROPOKMRN	éëÄ	NKR	SQPRTQRUKNN	RMMM	NMQKSQ	UVKU	NNMO	
RV	` ç	UV	e É	OTKNRN	éëÄ	NKT	OPTPUPKTQ	CR	NMUKS	UVKU	NNMO	
SM	ká	UV	e É	OSKVUP	éëÄ	NKS	SSPOPKPM	CR	NMTKVP	UVKU	NNMO	
SP	` ì	UV	e É	OSKUPT	éëÄ	MKS	NUQVVOKQV	CR	NMTKPR	UVKU	NNMO	
SS	wå	UV	e É	OSKUPN	éëÄ	NKU	PMRONKQR	CR	NMTKPO	UVKU	NNMO	
TR	^ë	UV	e É	ORKTQS	éëÄ	MKT	OOMSPKTP	CR	NMOKVU	UVKU	NNMO	
TU	pÉ	UV	e O	ORKPQO	éëÄ	NKM	NONTPKQM	CR	NMNKPT	UVKU	NNMO	
UU	pê	UV	e É	ORKTTP	éëÄ	MKU	UMOSUKVQ	CR	NMPKMV	UVKU	NNMO	
VR	j ç	UV	e É	OSKTUQ	éëÄ	NKN	TTSRSKOS	CR	NMTKNQ	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKSVP	éëÄ	MKN	OVPMMVKQR	CR	NNMKTT	UVKU	NNMO	[=HLJHNMB
NNN	` Ç	UV	e É	OTKMSQ	éëÄ	MKR	PUQQNKOS	CR	NMUKOS	UVKU	NNMO	
NNU	på	NRV	e É	OQKPUP	éëÄ	MKP	TRSUPKUP	CR	VTKRP	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKQNU	éëÄ	NKV	SMNTQQKTS	CR	VTKST	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	OSKMSO	éëÄ	NKN	NUUVSQKVN	CR	NMQKOR	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKMTO	éëÄ	MKR	PTRURQKQR	CR	NMQKOV	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKOSO	éëÄ	MKV	UPSVTMKUM	CR	NMNKMR	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKPST	éëÄ	NKO	NONVMOUKUM	CR	NMRKQT	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	ORKVNP	éëÄ	MKT	NMUOUPNKQM	CR	NMPKSR	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKUMQ	éëÄ	PKM	NMQVVTVKNS	CR	NMTKOO	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑmp	B=oÉÄ	B n`=ïçï	B n`=eäÜÜ	n`=c ä~Ö
i á	S	k ç=d ~ë	ONVTVNOKMR	NKQ	NTURRSOKNS	NOPKMV	RVKR	NOMQ	SMOMa ça
pÅ	QR	k ç=d ~ë	QPUMUMVKMP	MKP	QORQQUNKTO	NMOKVT	RVKR	NOMQ	
pÅ	QR	e O	VVNPSTKQP	NKU	NMNQTQMRN	VTKT	RVKR	NOMQ	
pÅ	QR	e É	NQMUNMKNT	MKT	NQUSRRKMQ	VQKTO	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NMTOVVSKMP	MKV	NMOUNSRKPO	NMQKPS	RVKR	NOMQ	
dÉ	TO	e O	PVTVOSKTS	NKM	QNPQVUKVS	VSKOP	RVKR	NOMQ	
dÉ	TO	e É	NNMSNRKMN	MKT	NNSPVNSQ	VRKMQ	RVKR	NOMQ	
v	UV	e O	QRRVVNMKQN	NKP	QRVPNOQKTO	VVKOU	RVKR	NOMQ	
v	UV	e É	TQQTNQKMN	MKQ	TVMSMNKUR	VQKO	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	TRVNTMNKNS	NKN	SQRNNMQKSR	NNTKSU	RVKR	NOMQ	
qÄ	NRV	e É	OTVNUOMRO	NKO	OTRQTPNKTP	NMNKPR	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	QMTNTSVKSQ	OKR	PQQVPUTKTP	NORKPN	RVKR	NOMQ	SMOMa ça
_á	OMV	e É	NSQTTRVKPR	NKM	NRSMNOOKRR	NMRKSO	RVKR	NOMQ	

`çåíáåì åÖ=~ëÄê~íáçå=_ä~åâ=É``_F=oÉéçê

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MPQ``_KÇ

a~í~=m~íÜ=k~ã É aWj^ÖäÉáíÝ^ mj eyNya^q^yOMCPyMPJ ^oyi n`OV^kÂ

^Åè=qáã É PLOVLOMCP=ONARMMRS

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáçå NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑcäÉk~ã É MMJ ^i _KÇ

p~ã éáÉ=n`=m~ëëlc á~ä m~ëë

fpqa=n`=m~ëëlc~äí m~ëë

l éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	r åáë	opa	==\ mp==	iãäá	n`=c ä~Ö
V	_É	S	kç=d~ë	JMKMNP	éé Ä	kL^	NSUKUV	MO	
NN	_	S	kç=d~ë	MRTPM	éé Ä	RKT	PCPNKRP	Q	
CP	k~	CR	eÉ	JNNKRRS	éé Ä	kL^	CVVSQRTS	CMM	
CQ	j Ö	CR	eÉ	PKCQT	éé Ä	CNKU	NTPNKCU	CM	
CT	^ä	CR	eÉ	MKCTS	éé Ä	NRUKP	CRMKMN	CM	
CU	pá	CR	eO	MKSMV	éé Ä	TMRT	SVMKTR	NMM	
PV	h	CR	eÉ	NMKSUT	éé Ä	NVKN	CUNPQKRP	CMM	
QM	`~	CR	eO	PKVVN	éé Ä	MKV	CRCVVKRO	CM	
RN	s	UV	eÉ	MKMCS	éé Ä	PQKU	PTTKTV	N	
RO	`ê	UV	eÉ	MKMNM	éé Ä	QQKQ	TVUKRQ	N	
RR	j å	UV	eÉ	MKMNN	éé Ä	SSKT	NPTHPN	MQ	
RS	cÉ	UV	eO	CKUSV	éé Ä	NKO	CNTVSHPU	CM	
RV	`ç	UV	eÉ	MKMMQ	éé Ä	NCVKQ	CPRKRT	MO	
SM	k á	UV	eÉ	MKMNP	éé Ä	TPKV	NSRKRS	MQ	
SP	`ì	UV	eÉ	MKMMV	éé Ä	PRKV	QMMKMN	MS	
SS	wå	UV	eÉ	MKMNR	éé Ä	QRKT	NTNKNO	O	
TR	^ë	UV	eÉ	MKMPR	éé Ä	PUKS	QMKMM	N	
TU	pÉ	UV	eO	MKMQM	éé Ä	NCKN	CMKUP	N	
UU	pê	UV	eÉ	MKMCP	éé Ä	RVKN	URKRS	N	
VR	j ç	UV	eÉ	MKNSS	éé Ä	UKV	RMCKCQ	N	
NMT	^Ö	UV	eÉ	MKMNQ	éé Ä	NQKV	NRMKMM	MO	
NNN	`Ç	UV	eÉ	MKMCN	éé Ä	NRKU	PMKMM	MO	
NNU	på	NRV	eÉ	MKMUM	éé Ä	NMKO	PVCKCQ	N	
NCN	pÄ	NRV	kç=d~ë	MKMNT	éé Ä	NPHP	VVTKTT	MO	
NPT	_~	NRV	kç=d~ë	MKMUS	éé Ä	NPKQ	SMPKVU	MQ	
NUO	t	NRV	kç=d~ë	MKCNN	éé Ä	VKQ	PPVMKTM	N	
OMR	qä	OMV	kç=d~ë	MKMSM	éé Ä	NMHP	CCNRKUS	MO	
OMU	mÄ	OMV	kç=d~ë	JMKMQQ	éé Ä	kL^	NTRNKVN	MO	
OPO	qÜ	OMV	kç=d~ë	MKMUN	éé Ä	NSKR	QLSSKNO	N	
OPU	r	OMV	kç=d~ë	MKMCO	éé Ä	UKQ	UMTHRR	MO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ= mp	B=oÉÁ	B n`=çï	B n`=cäÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	OMNMVQTHRT	OKM	NTURRSOKNS	NNOKSO	RVKR	NOMKQ	
pÅ	CR	kç=d~ë	PVSSUVSKUO	NKN	QCRQQUNRTO	VPKCQ	RVKR	NOMKQ	
pÅ	CR	eO	UVVPUVKMU	MKV	NMNQTQMKRN	UUHSP	RVKR	NOMKQ	
pÅ	CR	eÉ	NOTQCUKMM	MKU	NQUSRRMKQ	URRTO	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	VUSTOOKQP	NKN	NMCUNSRHPO	VRKVT	RVKR	NOMKQ	
dÉ	TO	eO	PSUUUTKUN	MKS	QNPQVUKVS	UVKCN	RVKR	NOMKQ	
dÉ	TO	eÉ	NMCRPMKMV	MKR	NNSPVNHSQ	UUHMV	RVKR	NOMKQ	
v	UV	eO	QNVVNNPKVN	NKS	QRVPNCQRTO	VNKQO	RVKR	NOMKQ	
v	UV	eÉ	SUUPNOKSU	MKN	TVMSMNKUR	UTHMS	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	SUTMVNSKMN	NKM	SQRNNMQKSR	NMSHRN	RVKR	NOMKQ	
qÄ	NRV	eÉ	CROVUUUKSR	NHP	OTRQTPNRTP	VNKUQ	RVKR	NOMKQ	
_á	OMV	kç=d~ë	PSMMUCUHSP	MKU	PCQVPUTRTP	NNMKUO	RVKR	NOMKQ	
_á	OMV	eÉ	NQUPUUNKNU	NKV	NRSMNOCKRR	VRKNN	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MVSMMMN

cãÉ=k~ã É MPRpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ HÅ

^Åè=qãã É PLOVLOMCP=ONVRSMQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==i mp==	i a o	n ` =¤ä-Ö
V	_É	S	k ç=d ~ë	MKMTV	ééÄ	NVKR	POQKCR	NMM	
NN	_	S	k ç=d ~ë	PRKSPT	ééÄ	NKU	CRUVSKVS	NMMM	
CP	k ~	CR	e É	CNRPCKURU	ééÄ	CKO	CQTTVPRKSP	CMMMMM	
CQ	j Ö	CR	e É	RVVCKCPQ	ééÄ	NKM	PRSNUTKUN	CMMMMM	
CT	^ ä	CR	e É	NPSTKTCN	ééÄ	MKU	PMUPTKVS	CMMMMM	
CU	pá	CR	e O	CUQMSPR	ééÄ	MKV	PVMRTCKCR	NMMMM	
PV	h	CR	e É	CUSCKVMD	ééÄ	MKU	NTRTTCKVQ	CMMMMM	
QM	` ~	CR	e O	UCMPKPPU	ééÄ	NKV	CUTCNMSKRS	CMMMMM	
RN	s	UV	e É	PKMRN	ééÄ	RKS	OTNCKRP	NMMM	
RO	` ê	UV	e É	CKMSS	ééÄ	MKT	OTMMKQD	CMMM	
RR	j å	UV	e É	NCCKNNQ	ééÄ	NKM	RTUMQKQN	CMMM	
RS	cÉ	UV	e O	NUQRKOTS	ééÄ	NKU	QCPRRQCKNT	NMMMM	
RV	` ç	UV	e É	PKRQQ	ééÄ	RKP	RVTCKUR	NMMM	
SM	k á	UV	e É	SKNQU	ééÄ	NKM	OVQUKNQ	NMMM	
SP	` ì	UV	e É	UKVRU	ééÄ	NKS	NNUPQKW	CMMM	
SS	wå	UV	e É	QQKQQD	ééÄ	RKR	VRPMMKMT	CMMM	
TR	^ ë	UV	e É	NKNVT	ééÄ	SKS	CMPKSV	NMMM	
TU	pÉ	UV	e O	MKPVO	ééÄ	VKN	PUKRM	NMMM	
UU	pê	UV	e É	RNKOTN	ééÄ	MKU	OVTUQRTV	CMMM	
VR	j ç	UV	e É	MKSVP	ééÄ	CNKS	CPNKNP	NMMM	
NMT	^ Ö	UV	e É	MKMPU	ééÄ	NCKN	UQKCR	NMM	
NNN	` Ç	UV	e É	MKNPR	ééÄ	NSKO	PTKTU	NMMM	
NNU	på	NRV	e É	MKSOV	ééÄ	NPKQ	RPUKVN	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKCPO	ééÄ	MKR	CRQSKOT	NMMM	
NPT	_~	NRV	k ç=d ~ë	QQRTPR	ééÄ	MKQ	RUSQVKRN	CMMM	
NUO	t	NRV	k ç=d ~ë	MRTMM	ééÄ	NCKV	CQRVKRN	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNCN	ééÄ	CRKP	NCTUKMV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QKPVS	ééÄ	NKQ	QCTTCKVQ	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MRRSQ	ééÄ	TKO	SRSUKSV	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNNP	ééÄ	UKO	UVTKSR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =i çï	B n ` =¤ äÜÜ	n ` =¤ä-Ö
i á	S	k ç=d ~ë	NVSTVVNKQU	CKN	NTURRSCKNS	NNMCCO	RVRR	NCMQ	
pÅ	CR	k ç=d ~ë	QMCUPVPKSN	NKS	QCRQQUNKTO	VQKSV	RVRR	NCMQ	
pÅ	CR	e O	USOTPPKRQ	NKQ	NMNQTQMRN	URKMD	RVRR	NCMQ	
pÅ	CR	e É	NOTNSVKNM	NKN	NQUSRRKMQ	URKRR	RVRR	NCMQ	
d É	TO	k ç=d ~ë	NMMOMTSKQU	MKS	NMCUNSRKPO	VTKQS	RVRR	NCMQ	
d É	TO	e O	PRVSSQKVP	MKT	QNPQVUKVS	USKVU	RVRR	NCMQ	
d É	TO	e É	NMNNVCKSO	NKS	NNSPVNKSQ	USKVQ	RVRR	NCMQ	
v	UV	e O	QDQSTQQKRR	NKU	QRVPNCQKTO	VCKQS	RVRR	NCMQ	
v	UV	e É	SVQDSSKUN	NKM	TVMSMNKUR	UTKUN	RVRR	NCMQ	
qÄ	NRV	k ç=d ~ë	SUSMOTUKPU	NKQ	SQRNNMQKSR	NMSKPQ	RVRR	NCMQ	
qÄ	NRV	e É	OSNTTNUNKNM	NKR	OTRQTPNKTP	VRKMN	RVRR	NCMQ	
_á	OMV	k ç=d ~ë	PVMVNRVKQV	MKU	PCQVPUTKTP	NCMKP	RVRR	NCMQ	
_á	OMV	e É	NRSPRTSKVS	NKV	NRSMNCCKRR	NMMCCO	RVRR	NCMQ	

p~ã éäÉ=k~ã É pn MVSMMMO

cãÉ=k~ã É MPSpj mi lÇ

a~í~=m~íÜ=k~ã É aWjt ÖãÉåíyî mj eyNya^q^yOMCPyMPJ ^oyi n` OV^HÅ

^Åè=qãã É PLOVLOMCP=COMNMMM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	MMVPM	ééÄ	URMS	OTCKCP	NMM	
NN	_	S	k ç=d ~ë	PQKPCU	ééÄ	CKR	CRNVPHPQ	NMMM	
CP	k~	QR	e É	OMSQTKVQM	ééÄ	MKO	CQNCSQNKUM	CMMMMM	
CQ	j Ö	QR	e É	RSVMKUVN	ééÄ	NKO	PQPNSQKOT	CMMMMM	
CT	^ä	QR	e É	VPUKUCQO	ééÄ	MKU	CNRQMKVS	CMMMMM	
CU	pá	QR	e O	QPPQKPNS	ééÄ	CKT	PSQNRTHRV	NMMMM	
PV	h	QR	e É	OTNNKVNQ	ééÄ	MKU	NTTMCQMKTT	CMMMMM	
QM	` ~	QR	e O	TSSPKQSP	ééÄ	NKR	QTQMRQPKQT	CMMMMM	
RN	s	UV	e É	CKRVM	ééÄ	RKP	COTTMKCP	NMMM	
RO	` ê	UV	e É	NKTMV	ééÄ	PKR	CPRSKQN	CMMM	
RR	j å	UV	e É	NCMKUSN	ééÄ	NKN	RSVVRHPN	CMMM	
RS	cÉ	UV	e O	NPURKRCN	ééÄ	MKU	PNSVMPUKUT	NMMMMM	
RV	` ç	UV	e É	PKNRV	ééÄ	NKV	RPOTKUS	NMMM	
SM	k á	UV	e É	QKSCN	ééÄ	RKN	CCQNKPP	NMMM	
SP	` ì	UV	e É	RKNRR	ééÄ	NKU	SVPMKTP	CMMM	
SS	wå	UV	e É	PRMVSO	ééÄ	MKU	TRCQKPT	CMMM	
TR	^ë	UV	e É	NKMNV	ééÄ	UKR	NTQKSV	NMMM	
TU	pÉ	UV	e O	MKPUP	ééÄ	NKR	PTHRVM	NMMM	
UU	pê	UV	e É	QTHRCQ	ééÄ	NKT	OTRMQHRQ	CMMM	
VR	j ç	UV	e É	MRRST	ééÄ	NQKN	PSCKCP	NMMM	
NMT	^Ö	UV	e É	MKMCU	ééÄ	PRKV	SRKRS	NMM	
NNN	` Ç	UV	e É	MKMVN	ééÄ	NUKS	CRKVO	NMMM	
NNU	på	NRV	e É	MRCCO	ééÄ	NPHR	QTQKCQ	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKPSM	ééÄ	RKS	CCPVKCN	NMMM	
NPT	_~	NRV	k ç=d ~ë	PUKPQR	ééÄ	MKQ	RMRUNKRT	CMMM	
NUO	t	NRV	k ç=d ~ë	MKRMR	ééÄ	UKT	NVSRKRT	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMTQ	ééÄ	RKN	VSTKTP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	CKCSU	ééÄ	RKN	CPRUPHPP	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKQCP	ééÄ	UKS	RPSMKNU	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMUQ	ééÄ	CCKN	SSTKQM	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n` =i çï	B n` =¤ä ÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	NVURUTQKUN	NKT	NTURRSCKNS	NNNKCO	RVKR	NCMKQ	
pÅ	QR	k ç=d ~ë	QMNRQMNKPP	MKV	QCRQCUNKTO	VQKPU	RVKR	NCMKQ	
pÅ	QR	e O	UVUPCRKMV	CKO	NMNQTQMKRN	UUKRP	RVKR	NCMKQ	
pÅ	QR	e É	NCUVVNKVT	MKT	NQUSRRKMQ	USKTT	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	VUSRNRKSO	NKO	NMCUNSRKPO	VRKVR	RVKR	NCMKQ	
d É	TO	e O	PSPUTMKTM	NKR	QNPQVUKVS	UU	RVKR	NCMKQ	
d É	TO	e É	NMCUUMKPV	MKQ	NNSPVNKSQ	UUKPV	RVKR	NCMKQ	
v	UV	e O	QCCUNNTKVM	NKP	QRVPNCQKTO	VCKVR	RVKR	NCMKQ	
v	UV	e É	SVNSCQKVS	MKP	TVMSMNKUR	UTKQU	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SVMNRRSKVS	MKT	SQRNNMQKSR	NMSKVU	RVKR	NCMKQ	
qÄ	NRV	e É	QRVMMQCKVR	NKP	OTRQTPNKTP	VQKMO	RVKR	NCMKQ	
_á	OMV	k ç=d ~ë	PUROTCPKOM	NKR	PCQVPUTKTP	NNUKRT	RVKR	NCMKQ	
_á	OMV	e É	NRSUMOTKNU	MKQ	NRSMNCOKRR	NMMKRN	RVKR	NCMKQ	

p~ã éäÉ=k~ã É pn MVSMMMP

cãÉ=k~ã É MPTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n` OV^HÅ

^Åè=qãã É PLOVLOMCP=COMVSNMT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	MKNQM	éé Ä	QNKU	PVQQGS	NMM	
NN	_	S	k ç=d ~ë	OTKUTN	éé Ä	PHR	OMQTOHRU	NMMM	
OP	k ~	QR	e É	OQRSOKOMM	éé Ä	OHR	OUSNPVNHSN	OMMMMM	
OQ	j Ö	QR	e É	RTQNKVMM	éé Ä	OKM	PQSRPPKNR	OMMMMM	
OT	^ ä	QR	e É	NNRQKRRN	éé Ä	NKT	OSQSOHRM	OMMMMM	
OU	pá	QR	e O	QNPRKRPS	éé Ä	NHP	PPVVUMQO	NMMMM	
PV	h	QR	e É	OMTOKSOQ	éé Ä	NKR	NPSOUMSP	OMMMMM	
QM	` ~	QR	e O	QUTSKSOO	éé Ä	MKU	OVRRUUMPP	OMMMMM	
RN	s	UV	e É	OKSST	éé Ä	OKT	OPNNHPQ	NMMM	
RO	` ê	UV	e É	NKVOQ	éé Ä	OKU	ORPUKQO	OMMM	
RR	j å	UV	e É	VSKSPP	éé Ä	MKN	QRORSHRV	OMMM	
RS	cÉ	UV	e O	NQOOKUOQ	éé Ä	MKS	POUSSTUKST	NMMMMM	
RV	` ç	UV	e É	QKMOR	éé Ä	OKN	SSUNKUS	NMMM	
SM	k á	UV	e É	RKQTM	éé Ä	NKO	OSMUKMT	NMMM	
SP	` ì	UV	e É	PKTNO	éé Ä	PKS	RMQTHST	OMMM	
SS	wå	UV	e É	QNKVOR	éé Ä	PKV	UUVSHPP	OMMM	
TR	^ ë	UV	e É	MKSVP	éé Ä	NNKU	NOOKMN	NMMM	
TU	pÉ	UV	e O	MKOUU	éé Ä	NNHP	OVHPP	NMMM	
UU	pê	UV	e É	QRKOTS	éé Ä	NKS	OSMMVHPV	OMMM	
VR	j ç	UV	e É	MHPPR	éé Ä	NUKR	OPRKRS	NMMM	
NMT	^ Ö	UV	e É	MKMON	éé Ä	NRKV	RMKMM	NMM	
NNN	` Ç	UV	e É	MKNNO	éé Ä	UHS	PNKSN	NMMM	
NNU	på	NRV	e É	MKQTO	éé Ä	SHS	QQOKOQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKNQN	éé Ä	OOKM	NOTNKQM	NMMM	
NPT	_~	NRV	k ç=d ~ë	QTHSUR	éé Ä	OKM	SPQQNHSR	OMMM	
NUO	t	NRV	k ç=d ~ë	MHPOS	éé Ä	OKN	NRNNHSV	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMRQ	éé Ä	OQHS	UPQKOR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NKTSS	éé Ä	NHR	NVMNRHSQ	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MHPSO	éé Ä	OKM	QUOVHPT	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMSP	éé Ä	PMKM	RNMHRR	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n` =ì çï	B n` =¤ëÜÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	NVTTOTSKQV	NKM	NTURRSOKNS	NNMKTQ	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	OMTQNQVKVR	MHP	QORQQUNKTO	VRKTS	RVHR	NOMQ	
pÅ	QR	e O	UTUTVSKMU	MKO	NMNQTQMRN	USKS	RVHR	NOMQ	
pÅ	QR	e É	NOVNPNKMN	NKV	NQUSRRKMQ	USKUT	RVHR	NOMQ	
d É	TO	k ç=d ~ë	NMMNMVSNHPT	NKT	NMOUNSRHPO	VTHPS	RVHR	NOMQ	
d É	TO	e O	PSNSMPKOP	NKU	QNPQVUKVS	UTHQR	RVHR	NOMQ	
d É	TO	e É	NMORMRHPQ	MKT	NNSPVNHSQ	UUKMT	RVHR	NOMQ	
v	UV	e O	QOTMNUUKQM	MKT	QRVPNOQRTO	VOKVT	RVHR	NOMQ	
v	UV	e É	SUSRRNKUP	NKV	TVMSMNKUR	USKUQ	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVRVUSMOQN	MKT	SQRNNMQHSR	NMTHUV	RVHR	NOMQ	
qÄ	NRV	e É	QRUPSRRKOV	NKN	OTRQTPNKTP	VPKTV	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PUNOUSSKSP	NKM	PQQVPUTKTP	NNTHPQ	RVHR	NOMQ	
_á	OMV	e É	NRRTTTTHPR	OKO	NRSMNOOHRR	VVKUR	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMQ

cãÉ=k~ã É MPUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖãÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n` OV^HÅ

^Åè=qãã É PLOVLOMCP=COMNMQQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=¤l ~ë	MKNPT	ééÄ	ONHP	PURHRT	NMM	
NN	_	S	k ç=¤l ~ë	OTHKMT	ééÄ	OHN	NVSPNHPS	NMMM	
OP	k ~	QR	e É	OQTNQHPPU	ééÄ	NHN	OUPMNMPHOV	OMMMMM	
OQ	j Ö	QR	e É	RTRPHSUU	ééÄ	NHT	PQNPQQHTT	OMMMMM	
OT	^ ä	QR	e É	NMNUHRPT	ééÄ	NHN	OOVTQHQQ	OMMMMM	
OU	pá	QR	e O	QMUOHOUN	ééÄ	MHP	PPQQSTHTT	NMMMM	
PV	h	QR	e É	NVVSHOSO	ééÄ	MHU	NOVVQTHSU	OMMMMM	
QM	` ~	QR	e O	QPSQHOQQ	ééÄ	NHP	OSPTTQTHNP	OMMMMM	
RN	s	UV	e É	OHQTN	ééÄ	NHV	ONTOHQP	NMMM	
RO	` ê	UV	e É	NHTUR	ééÄ	OHT	OQNVHTR	OMMM	
RR	j å	UV	e É	VOHSVS	ééÄ	NHN	QPSNQHPP	OMMM	
RS	cÉ	UV	e O	NPPRHVOS	ééÄ	OHO	PMQRTPTHOT	NMMMMM	
RV	` ç	UV	e É	QHNUT	ééÄ	NHR	SVTRHPN	NMMM	
SM	k á	UV	e É	RHPOO	ééÄ	RHS	ORROHRM	NMMM	
SP	` ì	UV	e É	PHTSO	ééÄ	OHR	RNPRHQT	OMMM	
SS	wå	UV	e É	PTHSQR	ééÄ	NHM	UMQPHRS	OMMM	
TR	^ ë	UV	e É	MRTMP	ééÄ	UHR	NOQHMN	NMMM	
TU	pÉ	UV	e O	MORT	ééÄ	ONHM	OSHNT	NMMM	
UU	pê	UV	e É	QPHMRT	ééÄ	NHP	OQLUQTHOT	OMMM	
VR	j ç	UV	e É	MHPQR	ééÄ	ORHR	OQQHQP	NMMM	
NMT	^ Ö	UV	e É	MHMNM	ééÄ	QPHP	PMHMM	NMM	
NNN	` Ç	UV	e É	MHMVM	ééÄ	OQHO	ORHRS	NMMM	
NNU	på	NRV	e É	MQPQ	ééÄ	OMHM	QQPHPR	NMMM	
NON	pÄ	NRV	k ç=¤l ~ë	MHNPQ	ééÄ	NVHR	NOQNHPU	NMMM	
NPT	_~	NRV	k ç=¤l ~ë	QPHKSM	ééÄ	OHR	RTQQVHOS	OMMM	
NUO	t	NRV	k ç=¤l ~ë	MHPUM	ééÄ	NPHT	NSRRHNV	NMMM	
OMR	qä	OMV	k ç=¤l ~ë	MHMRP	ééÄ	QMHR	UOMHUV	NMMM	
OMU	mÄ	OMV	k ç=¤l ~ë	MHVSU	ééÄ	OHN	NOMUUHQP	OMMM	
OPO	qÜ	OMV	k ç=¤l ~ë	MHPTU	ééÄ	VHO	QVQQHUT	NMMM	
OPU	r	OMV	k ç=¤l ~ë	MHMRT	ééÄ	UHU	QSPHUQ	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n` =i çï	B n` =¤ä ÜÜ	n` =¤ä-Ö
i á	S	k ç=¤l ~ë	NVQURPOHVS	OHN	NTURRSOHNS	NMVHNP	RVHR	NOMHQ	
pÅ	QR	k ç=¤l ~ë	QMTQMRTHPU	NHQ	QORQQUNHTO	VRHTS	RVHR	NOMHQ	
pÅ	QR	e O	UTRUOUHPM	NHP	NMNQTQMRN	USHPN	RVHR	NOMHQ	
pÅ	QR	e É	NOSVNRHUP	MHT	NQUSRRHMQ	URHPU	RVHR	NOMHQ	
d É	TO	k ç=¤l ~ë	NMNNCPSHRS	OHQ	NMOUNSRHPO	VTHQ	RVHR	NOMHQ	
d É	TO	e O	PSMPPVHUT	MHU	QNPQVUHVS	UTHNQ	RVHR	NOMHQ	
d É	TO	e É	NMNNTTHSU	MHQ	NNSPVNHSQ	USHVP	RVHR	NOMHQ	
v	UV	e O	QONQRMPHNO	NHP	QRVPNOQHTO	VNHTS	RVHR	NOMHQ	
v	UV	e É	SUVSOUHNQ	MHU	TVMSMNHUR	UTHOP	RVHR	NOMHQ	
qÄ	NRV	k ç=¤l ~ë	SVSQTVMHQU	MHS	SQRNNMQHSR	NMTHVS	RVHR	NOMHQ	
qÄ	NRV	e É	ORVVSPUHVM	MHS	OTRQTPNHTP	VQHPT	RVHR	NOMHQ	
_á	OMV	k ç=¤l ~ë	PTVVVOQHVP	MHS	POQVPUTHTP	NNSHVQ	RVHR	NOMHQ	
_á	OMV	e É	NRSVRQPHPU	NHU	NRSMNOOHRR	NMMHS	RVHR	NOMHQ	

p~ã éäÉ=k~ã É pn MVSMMMR

cãÉ=k~ã É MPVpj mi hÇ

a~í~=m~íÜ=k~ã É aWf ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` OV^HÅ

^Åè=qãã É PLOVLOMCP=COMSVRN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKMVM	éé Ä	UKQ	PPRKRS	NVM	
NN	_	S	k ç=d ~ë	OUKMVU	éé Ä	QKN	OVRQNKSM	NVMM	
OP	k ~	QR	e É	OOVRVMRRP	éé Ä	MKN	QRRTUOPKQQ	OVMMMM	
OQ	j Ö	QR	e É	RROPKTNO	éé Ä	NKP	PPNNUVKRO	OVMMMM	
OT	^ ä	QR	e É	NOUVKQOR	éé Ä	NKQ	OVPPNKQQ	OVMMMM	
OU	pá	QR	e O	QNRVKQTU	éé Ä	NKM	PPUVNOKPM	NVMMM	
PV	h	QR	e É	OOOPKMOR	éé Ä	NKQ	NQOPVRKRQ	OVMMMM	
QM	` ~	QR	e O	RNNNKTPR	éé Ä	NKM	PMTMPMOKTP	OVMMMM	
RN	s	UV	e É	OKVUP	éé Ä	QKM	QRPRKUP	NVMM	
RO	` ê	UV	e É	NKTSS	éé Ä	QKN	QPTRKMU	OVMM	
RR	j å	UV	e É	VQKNPR	éé Ä	NKV	QPTTTKQM	OVMM	
RS	cÉ	UV	e O	OQQQKNUN	éé Ä	NKN	RRVSMUMRO	NVMMMM	
RV	` ç	UV	e É	PKSUR	éé Ä	QKU	SMVOKSQ	NVMM	
SM	k á	UV	e É	RKTRU	éé Ä	RKQ	OTNVKOM	NVMM	
SP	` ì	UV	e É	PKQVU	éé Ä	OKT	QTQQKOO	OVMM	
SS	wå	UV	e É	QUKURU	éé Ä	MKQ	NVOTPKVP	OVMM	
TR	^ ë	UV	e É	NKMOP	éé Ä	UKO	NTOKSV	NVMM	
TU	pÉ	UV	e O	MKPNN	éé Ä	VKR	PNKNT	NVMM	
UU	pê	UV	e É	QOKORM	éé Ä	NKO	OQNMOKTS	OVMM	
VR	j ç	UV	e É	MKPNV	éé Ä	TKM	OORKRS	NVMM	
NMT	^ Ö	UV	e É	MKMOM	éé Ä	QSKP	QUKUV	NVM	
NNN	` Ç	UV	e É	MKMSU	éé Ä	NVKM	NVKSP	NVMM	
NNU	på	NRV	e É	MKQNQ	éé Ä	TKU	QMOKQS	NVMM	
NON	pÄ	NRV	k ç=d ~ë	MKURU	éé Ä	NPKQ	NPQNKQV	NVMM	
NPT	_~	NRV	k ç=d ~ë	QSKOVV	éé Ä	MKV	SNOVMKMP	OVMM	
NUO	t	NRV	k ç=d ~ë	MKPRN	éé Ä	NQKU	NRSUKOP	NVMM	
OVR	qä	OMV	k ç=d ~ë	MKMON	éé Ä	PVKP	SOQKMM	NVMM	
OVU	mÄ	OMV	k ç=d ~ë	OKMVM	éé Ä	QKN	OORQUKNQ	OVMM	
OPO	qÜ	OMV	k ç=d ~ë	MKPVO	éé Ä	QKM	RMPSKPT	NVMM	
OPU	r	OMV	k ç=d ~ë	MKMRV	éé Ä	NPKP	QTTKNU	NVMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n` =ï çï	B n` =¤ëÛÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	NVSNURQKMM	NMS	NTURRSQKNS	NMVKUT	RVMR	NOMQ	
pÅ	QR	k ç=d ~ë	PVRSQPPKMS	MMS	QORQQUNKTO	VQKVV	RVMR	NOMQ	
pÅ	QR	e O	UTNMMPKSR	MMS	NMNQTQMRN	URKUQ	RVMR	NOMQ	
pÅ	QR	e É	NOUCQUKCQ	MMP	NQUSRRKMQ	USKOT	RVMR	NOMQ	
d É	TO	k ç=d ~ë	VSVRUQKQU	NMN	NMOUNSRKPO	VQKP	RVMR	NOMQ	
d É	TO	e O	PRPRTRKNR	MMT	QNPQVUKVS	URKRN	RVMR	NOMQ	
d É	TO	e É	NMMTRQKNT	MMV	NNSPVNKSQ	USKRS	RVMR	NOMQ	
v	UV	e O	QOPTTOMOP	MMV	QRVPNOQKTO	VOKOS	RVMR	NOMQ	
v	UV	e É	SUNTPTKVS	MMS	TVMSMNKUR	USKOP	RVMR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVOTRQUKSU	NMR	SQRNNMQKSR	NMTHPV	RVMR	NOMQ	
qÄ	NRV	e É	ORRQNOSKNT	OMM	OTRQTPNKTP	VOKTO	RVMR	NOMQ	
_á	OMV	k ç=d ~ë	PTUTQUMRM	MMR	PCQVPUTKTP	NNSKRS	RVMR	NOMQ	
_á	OMV	e É	NRRTMORKMS	NMO	NRSMNOOKRR	VVKU	RVMR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMVS

cãÉ=k~ã É MQMpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^HÅ

^Åè=qãã É PLOVLOMCP=COQQNMQN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==: mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMUQ	éé Ä	QTKT	POSKSU	NMM	
NN	_	S	k ç=d ~ë	OUKOMU	éé Ä	MKV	OMPUQKSQ	NMMM	
OP	k ~	QR	e É	OORNQKUTS	éé Ä	NKM	ORUVVUSKQS	OMMMMM	
OQ	j Ö	QR	e É	RNVRKORO	éé Ä	MKU	PMVMVNKOS	OMMMMM	
OT	^ ä	QR	e É	NPVRKORP	éé Ä	MKV	PNQTOKSS	OMMMMM	
OU	pá	QR	e O	QRSPKORM	éé Ä	OKR	PTQSVOKTT	NMMMM	
PV	h	QR	e É	OPMTKRTS	éé Ä	MKT	NQSSQTKST	OMMMMM	
QM	` ~	QR	e O	QQUMKMNP	éé Ä	OKU	OTNPQSMKNQ	OMMMMM	
RN	s	UV	e É	OKVVP	éé Ä	QKO	ORROKRM	NMMM	
RO	` ê	UV	e É	NKVSN	éé Ä	SKS	ORSPKTR	OMMM	
RR	j å	UV	e É	VMKOOV	éé Ä	MKU	QONNMKTQ	OMMM	
RS	cÉ	UV	e O	POOUKTOR	éé Ä	NKP	TPONRPNKUM	NMMMMM	
RV	` ç	UV	e É	PKQTP	éé Ä	NNKO	RTTTMKOV	NMMM	
SM	k á	UV	e É	RKUVU	éé Ä	RKO	OTVNKQP	NMMM	
SP	` ì	UV	e É	PKOUR	éé Ä	OKR	QQVNKVN	OMMM	
SS	wå	UV	e É	PMRKQN	éé Ä	PKS	SRMNKSO	OMMM	
TR	^ ë	UV	e É	NKMMN	éé Ä	NKT	NURKSV	NMMM	
TU	pÉ	UV	e O	MOOTR	éé Ä	QKV	OTHST	NMMM	
UU	pê	UV	e É	PVKPQS	éé Ä	NKM	OORORKQM	OMMM	
VR	j ç	UV	e É	MKPOQ	éé Ä	NRKR	OOUKUV	NMMM	
NMT	^ Ö	UV	e É	MKMNP	éé Ä	QTKV	PQKQQ	NMM	
NNN	` Ç	UV	e É	MKMSV	éé Ä	NNKQ	OMKMM	NMMM	
NNU	på	NRV	e É	MKPUN	éé Ä	VKT	PURKRT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMVU	éé Ä	POKR	NRONKTM	NMMM	
NPT	_~	NRV	k ç=d ~ë	QRKNUQ	éé Ä	NKS	RVVMRKUS	OMMM	
NUO	t	NRV	k ç=d ~ë	MOOUP	éé Ä	NTKU	NPVQKUV	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMNM	éé Ä	PSKS	RSPKVQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OKOMS	éé Ä	NKT	OOVOUKUV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKPUM	éé Ä	RKS	QVVSKOT	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMTR	éé Ä	NOKS	SMMKSR	NMMM	

n ` =fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B =oÉÁ	B n ` =i çï	B n ` =c åÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVQRSSNKMQ	OKQ	NTURRSOKNS	NMUKVT	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	QMPTTVRKPV	NKN	QORQQUNKTO	VQKVN	RVRR	NOMQ	
pÅ	QR	e O	UTUNTVKUS	OKP	NMNQTQMRN	USKRQ	RVRR	NOMQ	
pÅ	QR	e É	NOTOPSKPP	MKU	NQUSRRMQ	URKRV	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VVOQSQKMT	NKM	NMOUNSRKPO	VSKRP	RVRR	NOMQ	
d É	TO	e O	PRUOTVKMU	NKQ	QNPQVUKVS	USKSR	RVRR	NOMQ	
d É	TO	e É	NMNOTUKSP	NKQ	NNSPVNKSQ	UTKMO	RVRR	NOMQ	
v	UV	e O	QNVUSUMKUQ	MKP	QRVPNOQKTO	VNKQN	RVRR	NOMQ	
v	UV	e É	SUQMSVKQP	MKT	TVMSMNKUR	USKRP	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVPTSPTKTQ	MKQ	SQRNNMQKSR	NMTKRQ	RVRR	NOMQ	
qÄ	NRV	e É	QRRONPPKNS	NKM	OTRQTPNKTP	VOKSR	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PUPNUVQKQN	NKS	PQQVPUTKTP	NNTKVP	RVRR	NOMQ	
_á	OMV	e É	NRRMOPSKMS	OKQ	NRSMNOOKRR	VVKPT	RVRR	NOMQ	

p~ã éäÉ=k~ã É	pn MVSMMMT
cãÉ=k~ã É	MQNpj mi hÇ
a~í~=m~íÜ=k~ã É	aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ hÅ
^Åè=qãã É	PLOVLOMCP=OOMSVQT
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=¤l ~ë	MKVQV	éé Ä	PPKT	OUUKVM	NVM	
NN	_	S	k ç=¤l ~ë	PPKUPN	éé Ä	NKO	OQQTOKNQ	NVMM	
OP	k ~	QR	e É	OOUMOKPRP	éé Ä	NKP	OSMVMOKRKRO	OMMMMM	
OQ	j Ö	QR	e É	SVTNKVMN	éé Ä	MKR	ONOOSMKVS	OMMMMM	
OT	^ ä	QR	e É	NOQMKTRN	éé Ä	NKT	OTUSVKSU	OMMMMM	
OU	pá	QR	e O	SMPNKRRS	éé Ä	NKQ	QVTQTOKUU	NVMMM	
PV	h	QR	e É	OSUSKVVS	éé Ä	MKR	NSRTTVKNQ	OMMMMM	
QM	` ~	QR	e O	UPMVKVOT	éé Ä	MKS	RMOSRQNKMQ	OMMMMM	
RN	s	UV	e É	PKNSU	éé Ä	SKO	OSTUKMU	NVMM	
RO	` ê	UV	e É	NKVRQ	éé Ä	QKS	ORRMKQO	OMMM	
RR	j å	UV	e É	NPSKRPP	éé Ä	NKO	SPRMNKOO	OMMM	
RS	cÉ	UV	e O	NTSOKMQT	éé Ä	MKQ	QMNMVOUKSU	NMMMMM	
RV	` ç	UV	e É	QKOSO	éé Ä	OKV	TMNVKUM	NVMM	
SM	k á	UV	e É	RKPOO	éé Ä	UKQ	ORQQKTO	NVMM	
SP	` ì	UV	e É	TKNSV	éé Ä	NKM	VPTSKSR	OMMM	
SS	wå	UV	e É	RMKPOS	éé Ä	MKQ	NVRUTKRN	OMMM	
TR	^ ë	UV	e É	NKOPS	éé Ä	QKN	OVSKPR	NVMM	
TU	pÉ	UV	e O	MKOSP	éé Ä	NTKM	OSKST	NVMM	
UU	pê	UV	e É	RNKORR	éé Ä	NKT	OVPTRKMU	OMMM	
VR	j ç	UV	e É	MKPMO	éé Ä	OMKO	ONSKST	NVMM	
NMT	^ Ö	UV	e É	MKMOM	éé Ä	POKT	QUKUV	NVM	
NNN	` Ç	UV	e É	MKNNQ	éé Ä	PUKT	PNKQU	NVMM	
NNU	på	NRV	e É	MKQOT	éé Ä	NTHP	QNNKNP	NVMM	
NON	pÄ	NRV	k ç=¤l ~ë	MKPSU	éé Ä	RKM	OQUQKSN	NVMM	
NPT	_~	NRV	k ç=¤l ~ë	QRKOOM	éé Ä	MKR	RVUONKUV	OMMM	
NUO	t	NRV	k ç=¤l ~ë	MKOQV	éé Ä	ORKS	NPMNKQR	NVMM	
OMR	qä	OMV	k ç=¤l ~ë	JMKMVO	éé Ä	k L^	QUTHKNV	NVMM	
OMU	mÄ	OMV	k ç=¤l ~ë	PKUNN	éé Ä	NKU	PSURRKVR	OMMM	
OPO	qÜ	OMV	k ç=¤l ~ë	MKPOP	éé Ä	NPKS	ORROKPP	NVMM	
OPU	r	OMV	k ç=¤l ~ë	MKMTT	éé Ä	SKP	SNTHPP	NVMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n ` =i çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=¤l ~ë	NVRSOMUKOR	MKQ	NTURRSOKNS	NMVKRS	RVKR	NOMKQ	
pÅ	QR	k ç=¤l ~ë	PVTQVOSKTN	NKM	QORQQUNKTO	VPHQP	RVKR	NOMKQ	
pÅ	QR	e O	UUOMSUKUT	MKV	NMNQTQMKRN	USKVP	RVKR	NOMKQ	
pÅ	QR	e É	NOSSMQKOQ	MKU	NQUSRRKMQ	URKNT	RVKR	NOMKQ	
d É	TO	k ç=¤l ~ë	VUOVNNKNU	MKT	NMOUNSRHPO	VRHS	RVKR	NOMKQ	
d É	TO	e O	PRPTSQKMS	MKO	QNPQVUKVS	URHRR	RVKR	NOMKQ	
d É	TO	e É	NMNRUSKTM	NKP	NNSPVNHSQ	UTHOU	RVKR	NOMKQ	
v	UV	e O	QONMOSMRRO	MKT	ORVPNOQKTO	VNHSS	RVKR	NOMKQ	
v	UV	e É	SUOPSRKOS	NKP	TVMSMNKUR	USHPN	RVKR	NOMKQ	
qÄ	NRV	k ç=¤l ~ë	SVOOPTUKRQ	NKO	SQRNNMQHSR	NMTHPN	RVKR	NOMKQ	
qÄ	NRV	e É	ORRNOSPKVU	NKN	OTRQTPNKTP	VOHSO	RVKR	NOMKQ	
_á	OMV	k ç=¤l ~ë	PUPOVUNHSN	MKU	POQVPUTKTP	NNTKVS	RVKR	NOMKQ	
_á	OMV	e É	NRQORUPKUU	MKP	NRSMNOOKRR	VUKUU	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MVSMMMU

cãÉ=k~ã É MQQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ hÅ

^Åè=qáã É PLOVLOMCP=COAPNMRQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==: mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMSQ	éé Ä	RRKN	PMQKCR	NMM	
NN	_	S	k ç=d ~ë	PPKPTV	éé Ä	NKN	CCQMRCKCLU	NMMM	
CP	k ~	CR	e É	COSRMKUTM	éé Ä	NKQ	CRRPVCSKQS	CMMMMM	
CQ	j Ö	CR	e É	SSMSKCPT	éé Ä	MKS	PURNCRKOT	CMMMMM	
CT	^ ä	CR	e É	NMVCKPRP	éé Ä	NKU	CCCCQTKQV	CMMMMM	
CU	pá	CR	e O	SNRVKQLUQ	éé Ä	MKP	QVRVPQKNT	NMMMM	
PV	h	CR	e É	OTTNKUTN	éé Ä	NKP	NSTTTMUKRQ	CMMMMM	
QM	` ~	CR	e O	TUTNKQCV	éé Ä	MKV	QSSTPTOKPS	CMMMMM	
RN	s	UV	e É	CKUUT	éé Ä	VKO	CCQQVKNR	NMMM	
RO	` ê	UV	e É	NKUUT	éé Ä	NKP	CQTCKQO	CMMM	
RR	j å	UV	e É	NCNKPCQ	éé Ä	NKO	RSMTQKRP	CMMM	
RS	cÉ	UV	e O	NTTQKNUQ	éé Ä	MKV	QMCPUCMCV	NMMMM	
RV	` ç	UV	e É	PKVOS	éé Ä	PKN	SQQNKTN	NMMM	
SM	k á	UV	e É	RKOTV	éé Ä	PKM	CQVMKOT	NMMM	
SP	` ì	UV	e É	QKURM	éé Ä	QKQ	SQNMKQT	CMMM	
SS	wå	UV	e É	PMKUSN	éé Ä	MKU	SRMVKQO	CMMM	
TR	^ ë	UV	e É	NKOMO	éé Ä	NKS	NVVKSV	NMMM	
TU	pÉ	UV	e O	MKOTM	éé Ä	NTKU	OTKNT	NMMM	
UU	pê	UV	e É	QUKNSP	éé Ä	MKV	OTPNVKTO	CMMM	
VR	j ç	UV	e É	MKPMU	éé Ä	SKU	CNUKVM	NMMM	
NMT	^ Ö	UV	e É	MKMNU	éé Ä	QPKN	QPKPP	NMM	
NNN	` Ç	UV	e É	MKMRV	éé Ä	QNKT	NTKMQ	NMMM	
NNU	på	NRV	e É	MKPMR	éé Ä	NRKN	PQNKNO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKPOM	éé Ä	NRKM	OMRRKSV	NMMM	
NPT	_~	NRV	k ç=d ~ë	PUKRQV	éé Ä	NKS	RMSSRKRU	CMMM	
NUO	t	NRV	k ç=d ~ë	MKOSN	éé Ä	NUKV	NPOQKUM	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMMV	éé Ä	k L^	QPTKNQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NKVMU	éé Ä	PKN	OMNQQKCR	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKPTR	éé Ä	RKN	QVMSKNS	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMSP	éé Ä	TKN	RMTKOO	NMMM	

n ` =fpqa=q~ÄäÉ

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e åÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVQUCUCKRV	NKO	NTURRSOKNS	NMVKSN	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVRTMUPKVR	MKS	QORQQUNKTO	VPKMN	RVKR	NOMQ	
pÅ	CR	e O	USNMVNUPQ	NKQ	NMNQTQMKRN	UQKUR	RVKR	NOMQ	
pÅ	CR	e É	NCQTQNKRU	MKU	NQUSRRKMQ	UPKVN	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VTTPVNKPO	MKU	NMOUNSRKPO	VRKMS	RVKR	NOMQ	
d É	TO	e O	PROTQOKSO	MKV	QNPQVUKVS	URKPN	RVKR	NOMQ	
d É	TO	e É	NMNPOQKMQ	MKU	NNSPVNKSQ	UTKMR	RVKR	NOMQ	
v	UV	e O	QNVRNPSKTN	MKV	QRVPNOQKTO	VNKPQ	RVKR	NOMQ	
v	UV	e É	STTUVNKSS	MKP	TVMSMNKUR	URKTQ	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUTRVTTKOQ	MKR	SQRNNMQKSR	NMSKRV	RVKR	NOMQ	
qÄ	NRV	e É	ORQPNSSKTM	MKQ	OTRQTPNKTP	VOKPO	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PTVQRUUKOR	NKP	PCQVPUTKTP	NNSKTU	RVKR	NOMQ	
_á	OMV	e É	NRPVOTPKOV	MKS	NRSMNOOKRR	VUKSS	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMV

cãÉ=k~ã É MOPpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OV^ HÅ

^Åè=qãã É PLOVLOMOP=OOAPTWN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä~Ö
V	_É	S	k ç=d ~ë	MKMQT	ééÄ	PQKS	CUSIKST	NMM	
NN	_	S	k ç=d ~ë	RCKTNU	ééÄ	CKN	PTTCQKMV	NMMM	
OP	k ~	QR	e É	NSURTKSOP	ééÄ	MKV	NVOSVUNKUU	OMMMMM	
OQ	j Ö	QR	e É	QQUMKRPN	ééÄ	MKP	OSPSNPKNV	OMMMMM	
OT	^ ä	QR	e É	NTMUKPMQ	ééÄ	NKR	PTVSVKSO	OMMMMM	
OU	pá	QR	e O	TRTTKCPV	ééÄ	NKP	SMQTRSKVO	NMMMM	
PV	h	QR	e É	PNTVKPPT	ééÄ	MKT	NUVVCCKRR	OMMMMM	
QM	` ~	QR	e O	VTVMKMUQ	ééÄ	NKS	RTRNRRUKTP	OMMMMM	
RN	s	UV	e É	CKSTR	ééÄ	RKN	PTVCKUN	NMMM	
RO	` ê	UV	e É	CKTUO	ééÄ	NKV	POVMKQO	OMMM	
RR	j å	UV	e É	NPTHPNN	ééÄ	NKN	SPPVRKVT	OMMM	
RS	cÉ	UV	e O	NSRUKVOV	ééÄ	CKR	PSUSQQNKRQ	NMMMMM	
RV	` ç	UV	e É	CKMSQ	ééÄ	PKV	SSRRKNS	NMMM	
SM	k á	UV	e É	SKVUM	ééÄ	NKV	POQTKNM	NMMM	
SP	` ì	UV	e É	NPKCUM	ééÄ	CKM	NSVRPKUV	OMMM	
SS	wå	UV	e É	QVMKMSU	ééÄ	MKR	NVCRMKSM	OMMM	
TR	^ ë	UV	e É	NKTVU	ééÄ	CKN	OVCKPT	NMMM	
TU	pÉ	UV	e O	MCQSV	ééÄ	NTKN	CPKUP	NMMM	
UU	pê	UV	e É	QRKPQQ	ééÄ	MKT	CRSVVKUR	OMMM	
VR	j ç	UV	e É	MKRCM	ééÄ	TKO	PPMKMN	NMMM	
NMT	^ Ö	UV	e É	MKMQR	ééÄ	NRKT	VRKRS	NMM	
NNN	` Ç	UV	e É	MKMSO	ééÄ	NVKV	CPKTM	NMMM	
NNU	på	NRV	e É	MKPPU	ééÄ	NVKM	PSQKQS	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKRVQ	ééÄ	RKN	PPCPKVQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	PRKVTU	ééÄ	NKU	QUCPMKQU	OMMM	
NUO	t	NRV	k ç=d ~ë	MKONN	ééÄ	NOKS	NCNUKMN	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMOM	ééÄ	k L^	PUMKQN	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	UKQOV	ééÄ	CKR	TTPURKRV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKQRO	ééÄ	PKV	RRVTKNN	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNRO	ééÄ	OMP	NNTQKSQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =í çï	B n ` =¢äÜÜ	n ` =¢ä~Ö
i á	S	k ç=d ~ë	NVROTTPKPR	NKV	NTURRSCKNS	NMVKPS	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PVVRVTVKVO	MKU	QCRQQUNKTO	VPKVO	RVKR	NOMQ	
pÅ	QR	e O	URPSTNKSS	NKP	NMNQTQMKRN	UQKNP	RVKR	NOMQ	
pÅ	QR	e É	NCRROSKUT	MKV	NQUSRRKMQ	UQKQQ	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VVRMTCKSQ	CKO	NMCUNSRKPO	VSKTU	RVKR	NOMQ	
d É	TO	e O	PRNCRSKTU	CKN	QNPQVUKVS	UQKVR	RVKR	NOMQ	
d É	TO	e É	NMMVNQKTU	MKU	NNSPVNKSQ	USKT	RVKR	NOMQ	
v	UV	e O	QNMVVCPKMM	MKS	QRVPNCQKTO	UVKQU	RVKR	NOMQ	
v	UV	e É	STTPNSKUV	MKQ	TVMSMNKUR	URKST	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	TMNPSCQKPM	NKV	SQRNNMQKSR	NMUKTO	RVKR	NOMQ	
qÄ	NRV	e É	CRTQSMVKNU	MKO	OTRQTPNKTP	VPKQS	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PURSCVMKRT	NKQ	PCQVPUTKTP	NNUKSU	RVKR	NOMQ	
_á	OMV	e É	NRTMNMSKCP	MKV	NRSMNCCKRR	NMMSQ	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMNM

cãÉ=k~ã É MQQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ hÅ

^Åè=qãã É PLOVLOMCP=COMQCOMT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä-Ö
V	_É	S	k ç=d ~ë	MKMMT	ééÄ	QVOKN	CQNKNO	NMM	
NN	_	S	k ç=d ~ë	PVKTPO	ééÄ	MKQ	CUQTCKTR	NMMM	
CP	k ~	CR	e É	NVMCQKUPQ	ééÄ	NKR	CNPSTMRKOT	CMMMMM	
CQ	j Ö	CR	e É	QVQVKVCU	ééÄ	CKP	CUSPVVKQN	CMMMMM	
CT	^ ä	CR	e É	NNUMKTPR	ééÄ	NKS	CRVPNKRP	CMMMMM	
CU	pá	CR	e O	SRNCKTUN	ééÄ	NKO	RPMSUVKTP	NMMMM	
PV	h	CR	e É	OTVMSMS	ééÄ	NKN	NSTPNTHSP	CMMMMM	
QM	` ~	CR	e O	UTTTKNQT	ééÄ	MKU	RCSRCRSHSS	CMMMMM	
RN	s	UV	e É	PKQMS	ééÄ	SKO	CUNNKCR	NMMM	
RO	` ê	UV	e É	CKNRT	ééÄ	SKM	OSVPKMV	CMMM	
RR	j å	UV	e É	NNSKVUR	ééÄ	CKM	RPRPSHRR	CMMM	
RS	cÉ	UV	e O	NPNQKVNN	ééÄ	NKN	OVPTPRSKUS	NMMMM	
RV	` ç	UV	e É	PKNQV	ééÄ	THP	RNRSKTM	NMMM	
SM	k á	UV	e É	RKSSU	ééÄ	PKM	OSPUKMU	NMMM	
SP	` ì	UV	e É	VKVRS	ééÄ	NKR	NCSUMPV	CMMM	
SS	wå	UV	e É	QPKPMQ	ééÄ	CKQ	UVUNKVP	CMMM	
TR	^ ë	UV	e É	NKRSO	ééÄ	QKT	CRPKPS	NMMM	
TU	pÉ	UV	e O	MKPVR	ééÄ	VKM	PTHST	NMMM	
UU	pê	UV	e É	QPKQCQ	ééÄ	NKN	CQPVNKVN	CMMM	
VR	j ç	UV	e É	MKPPO	ééÄ	CNKP	CCUKVM	NMMM	
NMT	^ Ö	UV	e É	MKMCR	ééÄ	PPKN	RSKST	NMM	
NNN	` Ç	UV	e É	MKNQO	ééÄ	NTKT	PUKNR	NMMM	
NNU	på	NRV	e É	MKPTP	ééÄ	NQKT	PTSKSU	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKRCO	ééÄ	VKM	OVVMKNU	NMMM	
NPT	_~	NRV	k ç=d ~ë	OVKVOT	ééÄ	MKO	PVUNTHSN	CMMM	
NUO	t	NRV	k ç=d ~ë	MKNOS	ééÄ	QMS	VUQKQN	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMMR	ééÄ	k L^	QTMKRM	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QKUPO	ééÄ	PKS	QRVTSKUM	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKPQT	ééÄ	NRKM	QTSVKCU	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMVM	ééÄ	NPKN	TNQKNN	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` = çï	B n ` =¤ äÜÜ	n ` =¤ä-Ö
i á	S	k ç=d ~ë	NVQQSNCKVQ	MKT	NTURRSCKNS	NMUKVN	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVMNPCNKSR	MKQ	QCRQQUNKTO	VNKT	RVKR	NOMQ	
pÅ	CR	e O	UTNQQRKNT	NKQ	NMNQTQMKRN	URKUU	RVKR	NOMQ	
pÅ	CR	e É	NCPTPPKCP	MKT	NQUSRRKMQ	UPKCQ	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VUPQTCKTN	NKQ	NMCUNSRKPO	VRKSR	RVKR	NOMQ	
d É	TO	e O	PRUMVCKQM	MKR	QNPQVUKVS	USKS	RVKR	NOMQ	
d É	TO	e É	NMMUSPKUR	NKR	NNSPVNKSQ	USKSS	RVKR	NOMQ	
v	UV	e O	QNCUSRSKSP	MKR	QRVPNCQKTO	UVKUV	RVKR	NOMQ	
v	UV	e É	STNCCCKCR	MKV	TVMSMNKUR	UQKV	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SVRVCPVKQO	MKV	SQRNNMQKSR	NMTKUU	RVKR	NOMQ	
qÄ	NRV	e É	QROMSSNKSS	PKM	OTRQTPNKTP	VNKR	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PURRRUQKMR	CKP	PCQVPUTKTP	NNUKSS	RVKR	NOMQ	
_á	OMV	e É	NRRRPMNKUN	NKO	NRSMNCCKRR	VVKSV	RVKR	NOMQ	

`çåíaåìåaÖ=~äåÄê~íáç=sÉêáÑ~íáç=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MQR\``sKÇ
a~í~=m~íÜk~ã É	aWy^ÖãÉáíyf^mj eyNya^q^yQMQPyMPJ ^oyi n`OV^kÄ
^Åè=qáã É	PLOVLOMQP=QQAQTWNP
p~ã éáÉ=qóéÉ	``s
qçí~äaãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑ%cãÉk~ã É	MMJ ^i _KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	c~ää
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==\ mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä~Ö
V	_É	S	k ç=d ~ë	OQKPOO	ééÄ	NKS	NQTNUNKTM	QR	VTKOV	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKQPP	ééÄ	OKP	VUNOSKRR	QR	NMNKTP	UVKU	NNMO	
OP	k ~	QR	e É	RQVNKNTV	ééÄ	MKU	PPSSMSQKMQ	RMMM	NMVKUO	UVKU	NNMO	
OQ	j Ö	QR	e É	RSMPKPQR	ééÄ	MKQ	NTTVTTRKPO	RMMM	NNOKMT	UVKU	NNMO	[=HLJHNMB
OT	^ä	QR	e É	RPTKUQV	ééÄ	NKR	SQSVNKTM	RMM	NMTHRT	UVKU	NNMO	
OU	pá	QR	e O	RNRKTMU	ééÄ	OKQ	OPPOUMRS	RMM	NMPKNQ	UVKU	NNMO	
PV	h	QR	e É	RQPVKQQD	ééÄ	NKR	NRMNMQNKUR	RMMM	NMQKTV	UVKU	NNMO	
QM	` ~	QR	e O	RQMRKMUN	ééÄ	NKT	NTOUSSUVKPP	RMMM	NMQKN	UVKU	NNMO	
RN	s	UV	e É	ORKSOU	ééÄ	NKM	NMQPSNKNN	QR	NMOKRN	UVKU	NNMO	
RO	` ê	UV	e É	OSKNVO	ééÄ	MKU	NPMOPQKPV	QR	NMQKTT	UVKU	NNMO	
RR	j å	UV	e É	OSKNNU	ééÄ	NKU	SRMRPKOQ	QR	NMQKQT	UVKU	NNMO	
RS	cÉ	UV	e O	RNUQKURQ	ééÄ	NKN	SOVMNNNNKQM	RMMM	NMPKT	UVKU	NNMO	
RV	` ç	UV	e É	OSKUQM	ééÄ	OKM	OPMOQRKPP	QR	NMTHPS	UVKU	NNMO	
SM	ká	UV	e É	OSKQSM	ééÄ	NKV	SPUNTKQV	QR	NMRKUQ	UVKU	NNMO	
SP	` ì	UV	e É	OSKRRR	ééÄ	NKU	NTVSORKRS	QR	NMSKOO	UVKU	NNMO	
SS	wå	UV	e É	OTKMSV	ééÄ	PKQ	PMOMUKRS	QR	NMUKOU	UVKU	NNMO	
TR	^ë	UV	e É	ORKRNM	ééÄ	OKO	ONQQVMVR	QR	NMOKMQ	UVKU	NNMO	
TU	pÉ	UV	e O	ORKMMS	ééÄ	NKN	NNUQUKQU	QR	NMMKMO	UVKU	NNMO	
UU	pê	UV	e É	ORKQOV	ééÄ	MKR	TTTNMKUV	QR	NMNKTO	UVKU	NNMO	
VR	j ç	UV	e É	OSKTUN	ééÄ	MKS	TSNVSKVN	QR	NMTKNO	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKVNT	ééÄ	MKT	OUVURRKSU	QR	NNNKST	UVKU	NNMO	[=HLJHNMB
NNN	` Ç	UV	e É	OTKQUO	ééÄ	NKM	PUOUSKMV	QR	NMVKVP	UVKU	NNMO	
NNU	på	NRV	e É	OQKQSP	ééÄ	MKT	TRMNRKTT	QR	VTKUR	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKVPT	ééÄ	OKQ	SMVQOVKUV	QR	VVKTR	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKQVM	ééÄ	NKV	NUMRVOKRO	QR	NMNKVS	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKORM	ééÄ	NKN	PSVUNQKSR	QR	NMR	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKQQQ	ééÄ	OKT	UPTSSTKTU	QR	NMNKTU	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	ORKVSV	ééÄ	NKQ	NNVPPUUKON	QR	NMPKUU	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	ORKVPS	ééÄ	OKO	NMTSVSNKUM	QR	NMPKTQ	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKUPT	ééÄ	PKP	NMQQUPUKTP	QR	NMTHPR	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ç ï	B n`=eäÜÜ	n`=c ä~Ö
i á	S	k ç=d ~ë	ONQOVTTKNQ	NKO	NTURRSOKNS	NNUKV	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QPNQVRNKQM	MKV	QORQQUNKTO	NMNKQO	RVKR	NOMQ	
pÅ	QR	e O	VSSQPMKVM	MKR	NMNQTQMKRN	VRKOQ	RVKR	NOMQ	
pÅ	QR	e É	NPSNPRKON	NKR	NQUSRRKMQ	VNKRU	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NMSNMPVKOM	NKO	NMOUNSRKPO	NMPKO	RVKR	NOMQ	
dÉ	TO	e O	PUVPOQKQQ	MKR	QNPQVUKVS	VQKNR	RVKR	NOMQ	
dÉ	TO	e É	NMUVOSKTS	NKP	NNSPVNKSQ	VPKS	RVKR	NOMQ	
v	UV	e O	QQVTQRSKPS	MKR	QRVPNOQKTO	VTKVO	RVKR	NOMQ	
v	UV	e É	TPMUPUKVV	NKR	TVMSMNKUR	VOKQQ	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	TQNVMOOKQR	NKV	SQRNNMQKSR	NNR	RVKR	NOMQ	
qÄ	NRV	e É	OTRUNPNKUT	MKR	OTRQTPNKTP	NMMKNO	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	QMQTNNMKTQ	OKR	PQQVPUTKTP	NOQKRR	RVKR	NOMQ	SMOMa ça
_á	OMV	e É	NSPTMPQKPT	MKR	NRSMNOOKRR	NMQKVP	RVKR	NOMQ	

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MOS|``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OV^kÂ

^Åè=qáã É PLOVLOMOP=OOORSWO

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáç~å NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑcäÉk~ã É MMJ ^i _KÇ

p~ã éáÉ=n`=m~ëëlc á~ä m~ëë

fpqa=n`=m~ëëlc~äí m~ëë

I éÉê~íçê **~Çã áíí**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	r åáë	opa	==\ mp==	iãäá	n`=c ä~Ö
V	_É	S	kç=d~ë	JMKMMO	ééÄ	kL^	OOTKTV	MO	
NN	_	S	kç=d~ë	MPSQ	ééÄ	TKR	NUVRKTO	Q	
OP	k~	QR	eÉ	JNQKPOO	ééÄ	kL^	QTUURKMT	OMM	
OQ	j Ö	QR	eÉ	PKSRQ	ééÄ	NMKN	NUPNKOV	OM	
OT	^ä	QR	eÉ	MKOVP	ééÄ	NQMKN	OQUKUV	OM	
OU	pá	QR	eO	MKVTP	ééÄ	VKV	UMQKOM	NMM	
PV	h	QR	eÉ	NMKTPN	ééÄ	PSKO	OTUQOKOS	OMM	
QM	`~	QR	eO	RKPPQ	ééÄ	QKQ	OUMUMKPU	OM	
RN	s	UV	eÉ	MKMPR	ééÄ	PVKQ	QMRKRT	N	
RO	`ê	UV	eÉ	JMKMMO	ééÄ	kL^	TPMKRR	N	
RR	j å	UV	eÉ	MKMNM	ééÄ	QKT	NPOKSR	MQ	
RS	cÉ	UV	eO	PKUNQ	ééÄ	OKV	RNSRPKSQ	OM	
RV	`ç	UV	eÉ	MKMMM	ééÄ	OQQNKN	OMMKMN	MO	
SM	ká	UV	eÉ	MKMMP	ééÄ	PQRKV	NQMKMM	MQ	
SP	`ì	UV	eÉ	MKMMS	ééÄ	QUKS	PTOKOP	MS	
SS	wå	UV	eÉ	MKMOU	ééÄ	UPHP	NUOKOP	O	
TR	^ë	UV	eÉ	MKMPO	ééÄ	OTKT	PTHKPP	N	
TU	pÉ	UV	eO	MKMQT	ééÄ	NKQ	OPKUP	N	
UU	pê	UV	eÉ	MKMNS	ééÄ	OPKT	SOKOO	N	
VR	j ç	UV	eÉ	MKMRP	ééÄ	RKV	QRTKTV	N	
NMT	^Ö	UV	eÉ	MKMNS	ééÄ	NOKR	NSNKNO	MO	
NNN	`Ç	UV	eÉ	MKMNU	ééÄ	NQKQ	ORKNU	MO	
NNU	på	NRV	eÉ	MKMRO	ééÄ	UKO	PNNKNO	N	
NON	pÄ	NRV	kç=d~ë	MKMNR	ééÄ	QVKR	VRNKMQ	MO	
NPT	_~	NRV	kç=d~ë	MKMPS	ééÄ	NTHQ	OTSKVS	MQ	
NUO	t	NRV	kç=d~ë	MKNTV	ééÄ	OKV	OVQMKNR	N	
OMR	qä	OMV	kç=d~ë	MKMRV	ééÄ	THO	OOORKUU	MO	
OMU	mÄ	OMV	kç=d~ë	JMKMOR	ééÄ	kL^	NTQNKVN	MO	
OPO	qÜ	OMV	kç=d~ë	MKMTU	ééÄ	UKQ	QUMVKPS	N	
OPU	r	OMV	kç=d~ë	MKMOO	ééÄ	VKO	TVTHKRP	MO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=cäÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	OMVSPQNKPU	MKT	NTURRSOKNS	NNOKPS	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PVNMVNUOKTV	MKU	QORQQUNKTO	VNKVN	RVKR	NOMQ	
pÅ	QR	eO	URTUPPKPQ	NKM	NMNQTQMKRN	UQKRQ	RVKR	NOMQ	
pÅ	QR	eÉ	NOSMSSKVN	MKV	NQUSRRKMQ	UQKUN	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VSPSRVKMO	MKU	NMOUNSRKPO	VPKTP	RVKR	NOMQ	
dÉ	TO	eO	PRTOVUKTT	MKQ	QNPQVUKVS	USKQN	RVKR	NOMQ	
dÉ	TO	eÉ	NMVNRQKUV	MKQ	NNSPVNKSQ	USKMR	RVKR	NOMQ	
v	UV	eO	QNPNMVNUKQN	MKR	QRVPNOQKTO	UVKVQ	RVKR	NOMQ	
v	UV	eÉ	STSRVUKNT	MKR	TVMSMNKUR	URKRU	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	STVMPUMKOM	MKV	SQRNNMQKSR	NMRKOS	RVKR	NOMQ	
qÄ	NRV	eÉ	ORNMVNQTKNS	MKU	OTRQTPNKTP	VNKNO	RVKR	NOMQ	
_á	OMV	kç=d~ë	PSPTTTPKUT	NKT	POQVPUTKTP	NNNKVR	RVKR	NOMQ	
_á	OMV	eÉ	NQUQONVKQN	NKN	NRSMNOOKRR	VRKNP	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMNO

cãÉ=k~ã É MQTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ hÅ

^Åè=qáã É PLOVLOMCP=CPMMNMQM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==: mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMNS	éé Ä	CPCQKP	CRRKRS	NMM	
NN	_	S	k ç=d ~ë	PVKMQD	éé Ä	PKM	CURQNKUN	NMMM	
CP	k ~	CR	e É	NVPNRKRPV	éé Ä	MKT	CNSCUMTKSP	CMMMMM	
CQ	j Ö	CR	e É	QVCNKUQT	éé Ä	NKN	CUQMQUKNO	CMMMMM	
CT	^ ä	CR	e É	NNTRKNUQ	éé Ä	NKO	CRTQOKCR	CMMMMM	
CU	pá	CR	e O	SRCUKSUV	éé Ä	NKO	RCTMQVKCN	NMMMM	
PV	h	CR	e É	OTPSKVSM	éé Ä	MKT	NSQNQPKTV	CMMMMM	
QM	` ~	CR	e O	UTSNKCRV	éé Ä	MKR	RCMTMPUKUQ	CMMMMM	
RN	s	UV	e É	PKPVS	éé Ä	SKO	CUMPKST	NMMM	
RO	` ê	UV	e É	CKNST	éé Ä	NKS	CTMMKCN	CMMM	
RR	j å	UV	e É	NNRKCCU	éé Ä	NKR	RCTMCKMU	CMMM	
RS	cÉ	UV	e O	NPCQKVCO	éé Ä	CKS	CVRPMRCKQS	NMMMMM	
RV	` ç	UV	e É	PKNTN	éé Ä	PKV	RNURKRU	NMMM	
SM	k á	UV	e É	RKSUR	éé Ä	NKN	CSQPKSP	NMMM	
SP	` ì	UV	e É	NMKNRP	éé Ä	NKU	NCVNRKNN	CMMM	
SS	wå	UV	e É	QVKSVU	éé Ä	CKT	NMCTVKRO	CMMM	
TR	^ ë	UV	e É	NKSCU	éé Ä	MKT	OSPKPS	NMMM	
TU	pÉ	UV	e O	MKRVN	éé Ä	NUKP	RQKRM	NMMM	
UU	pê	UV	e É	QPKCUM	éé Ä	MKQ	CQQCVPKVS	CMMM	
VR	j ç	UV	e É	MKSQP	éé Ä	SKS	PVNKNO	NMMM	
NMT	^ Ö	UV	e É	MKMTT	éé Ä	SKV	NRRKRS	NMM	
NNN	` Ç	UV	e É	MKNUT	éé Ä	UKR	QVKSP	NMMM	
NNU	på	NRV	e É	MKRMD	éé Ä	NMKV	CRRKRT	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKRTQ	éé Ä	NNKP	PNSPKTO	NMMM	
NPT	_~	NRV	k ç=d ~ë	PMKCMT	éé Ä	PKQ	PVQQRKVN	CMMM	
NUO	t	NRV	k ç=d ~ë	MKQTV	éé Ä	TKU	NUTUKUM	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMTU	éé Ä	SKV	VTNKMT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QKVUO	éé Ä	NKO	QSNTQKRN	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKRSU	éé Ä	PKR	SPRRKMQ	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNCO	éé Ä	NRKN	VPNKMO	NMMM	

n ` =fpqa=q~ÄäÉ

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVUPSPMKVS	NKP	NTURRSCKNS	NNNKMV	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PVRMNUNKRU	MKP	CORQQUNKTO	VOKUR	RVKR	NOMQ	
pÅ	CR	e O	USPCUSKUR	NKO	NMNQTQMRN	URKMT	RVKR	NOMQ	
pÅ	CR	e É	NCPQNPKNO	NKN	NQUSRRKMQ	UPKMO	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VSUSVTKMM	MKT	NMCUNSRKPO	VQKCO	RVKR	NOMQ	
d É	TO	e O	PRMPUNKMU	NKT	QNPQVUKVS	UQKTQ	RVKR	NOMQ	
d É	TO	e É	VVURQKUU	NKQ	NNSPVNKSQ	URKTV	RVKR	NOMQ	
v	UV	e O	QNCMQCOTKNV	NKS	QRVPNCQKTO	UVKTN	RVKR	NOMQ	
v	UV	e É	STMTTRKRR	MKQ	TVMSMNKUR	UQKUQ	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUCRTQNKMR	MKV	SQRNNMQKSR	NMRKUN	RVKR	NOMQ	
qÄ	NRV	e É	CRSOTVSKCP	MKU	OTRQTPNKTP	VPKMP	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PTSPSVTKTS	NKN	PCQVPUTKTP	NNRKUP	RVKR	NOMQ	
_á	OMV	e É	NRSTMRQKUR	NKU	NRSMNCOKRR	NMMKQQ	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMVNP

cãÉ=k~ã É MQLpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ HÅ

^Åè=qãã É PLOVLOMCP=CPAWSWQT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKNON	ééÄ	k L^	VUKUV	NMM	
NN	_	S	k ç=d ~ë	OKNSR	ééÄ	SKN	OMTQKSP	NMMM	
OP	k ~	QR	e É	JNQKOTR	ééÄ	k L^	RPOTSKST	OMMMMM	
OQ	j Ö	QR	e É	ORKMVT	ééÄ	RKO	ONVNKPS	OMMMMM	
OT	^ ä	QR	e É	NQKQRP	ééÄ	NQKR	ROTKUM	OMMMMM	
OU	pá	QR	e O	PRKQNM	ééÄ	UKU	PNSTKMQ	NMMMM	
PV	h	QR	e É	RNKOVP	ééÄ	RKT	OTONPKMD	OMMMMM	
QM	` ~	QR	e O	TMRKVU	ééÄ	QKU	RORSQKCU	OMMMMM	
RN	s	UV	e É	MKURU	ééÄ	TKM	VNRKSM	NMMM	
RO	` ê	UV	e É	MKNMN	ééÄ	NPKO	UPMKRQ	OMMM	
RR	j å	UV	e É	MKQRN	ééÄ	NOKT	PNSKSN	OMMM	
RS	cÉ	UV	e O	NMKPMM	ééÄ	UKO	PNUMOKUU	NMMMMM	
RV	` ç	UV	e É	JMKMQV	ééÄ	k L^	NOMKMN	NMMM	
SM	k á	UV	e É	MKMRQ	ééÄ	OQKU	NRSKST	NMMM	
SP	` ì	UV	e É	MKNQM	ééÄ	QKS	RMUKVN	OMMM	
SS	wå	UV	e É	SKRMN	ééÄ	OKM	NQUQKRR	OMMM	
TR	^ ë	UV	e É	MKNVS	ééÄ	OOKN	QOKST	NMMM	
TU	pÉ	UV	e O	MKMVO	ééÄ	OUKR	NNKNT	NMMM	
UU	pê	UV	e É	MKNPO	ééÄ	PKM	VOKCP	OMMM	
VR	j ç	UV	e É	MKPQO	ééÄ	RKQ	OPRKRS	NMMM	
NMT	^ Ö	UV	e É	MKMOO	ééÄ	NTHP	RNKNN	NMM	
NNN	` Ç	UV	e É	MKMNT	ééÄ	PVKQ	SKPM	NMMM	
NNU	på	NRV	e É	MKPNN	ééÄ	OOKQ	PQOKCP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMMT	ééÄ	ONOKT	SRQKMQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKPQS	ééÄ	NPKQ	QVPKUT	OMMM	
NUO	t	NRV	k ç=d ~ë	MKPPS	ééÄ	NNKU	NRNNKSU	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMPT	ééÄ	PNKT	TOQKNO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKMQS	ééÄ	k L^	PPSPKTQ	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKOQS	ééÄ	TKV	PVMUKNO	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMON	ééÄ	NTHN	NVSKUU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVQMUMTKVQ	NKN	NTURRSOKNS	NMUKSV	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVPOTSVKVQ	MKR	QORQQUNKTO	VOKQQ	RVKR	NOMKQ	
pÅ	QR	e O	UPRSPRKSM	MKV	NMNQTQMKRN	UOKPR	RVKR	NOMKQ	
pÅ	QR	e É	NOPTQOKMS	NKP	NQUSRRKMQ	UPKOQ	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VSPSMRKTU	MKV	NMOUNSRKPO	VPKTO	RVKR	NOMKQ	
d É	TO	e O	PQVOMNKMR	MKU	QNPQVUKVS	UQKQR	RVKR	NOMKQ	
d É	TO	e É	VVTRVKQT	MKO	NNSPVNKSQ	URKTN	RVKR	NOMKQ	
v	UV	e O	QMVPVVTKVQ	NKT	QRVPNOQKTO	UVKNP	RVKR	NOMKQ	
v	UV	e É	STQQMTKOT	MKS	TVMSMNKUR	URKP	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SUPSROTKUM	MKO	SQRNNMQKSR	NMRKVT	RVKR	NOMKQ	
qÄ	NRV	e É	QRORPOTKSQ	MKN	OTRQTPNKTP	VNKST	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PTVUNMMKOR	MKT	PQQVPUTKTP	NNSKUV	RVKR	NOMKQ	
_á	OMV	e É	NRNRSQRKMD	NKM	NRSMNOOKRR	VTKNR	RVKR	NOMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` ONfj t O
cáÉ=k~ã É	MQV| m_KÇ
a~í~=m~íÜ=k~ã É	a Wy^ ÖäÉáíyf` mj e yNya^q^yOMOPyMPJ ^o yi n` OV^ kÄ
^Åè=qáã É	PLOVLOMOP=OPWNWPQ
p~ã éäÉ=qóéÉ	m_
qçí~ä=a áä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MMU^ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	m~ëë
fpqa=n` =m~ëëLc~áä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==` mp==	i áã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	JMKNQQ	ééÄ	k L^	TOKOO	MKR	
_	NN	S	k ç=d ~ë	NKUNO	ééÄ	QKM	NTVMKNR	NM	
k~	OP	QR	e É	JOTKVQT	ééÄ	k L^	RNRQOKMN	RMM	
j Ö	OQ	QR	e É	VKVNQ	ééÄ	NVKT	NPMUKVV	RM	
^ä	OT	QR	e É	NQKQSO	ééÄ	OOKN	RORKRT	RM	
pá	OU	QR	e O	OMKOUO	ééÄ	NMKM	OMMOKOQ	ORM	
h	PV	QR	e É	PVKMSO	ééÄ	OOKQ	OSQSNKVS	RMM	
` ~	QM	QR	e O	QQKQTS	ééÄ	NKQ	PTUQMKTP	RM	
s	RN	UV	e É	MKTQV	ééÄ	QKR	UOPKPT	OKR	
` ê	RO	UV	e É	JMKMNM	ééÄ	k L^	TOMKRR	OKR	
j å	RR	UV	e É	MKRPO	ééÄ	NMKQ	PQVKOT	N	
cÉ	RS	UV	e O	PKUMO	ééÄ	VKR	NTRUOKUQ	RM	
` ç	RV	UV	e É	JMKMSV	ééÄ	k L^	USKST	MKR	
k á	SM	UV	e É	JMKMOR	ééÄ	k L^	NOMKMM	N	
` ì	SP	UV	e É	MKOVM	ééÄ	OMKM	SUSKTM	NKR	
wå	SS	UV	e É	QKRSU	ééÄ	QKV	NMTQKRM	R	
^ë	TR	UV	e É	MKOMV	ééÄ	OUKT	QQKMM	OKR	
pÉ	TU	UV	e O	MKMSQ	ééÄ	PTKM	UKUP	OKR	
pê	UU	UV	e É	MKMRO	ééÄ	NUKM	QSKSS	OKR	
j ç	VR	UV	e É	MKORO	ééÄ	NNKS	NURKRS	OKR	
^Ö	NMT	UV	e É	MKMNO	ééÄ	NTKR	PNKNN	MKR	
` Ç	NNN	UV	e É	MKMMQ	ééÄ	NRSKQ	OKVS	MKR	
på	NNU	NRV	e É	MKORP	ééÄ	ONKQ	PMTKTV	OKR	
pÄ	NON	NRV	k ç=d ~ë	MKMNU	ééÄ	QOKV	TMMKTS	MKR	
_~	NPT	NRV	k ç=d ~ë	MKNRT	ééÄ	OOKV	OQSKVP	N	
t	NUO	NRV	k ç=d ~ë	MKOPR	ééÄ	UKS	NOQUKMS	OKR	
qä	OMR	OMV	k ç=d ~ë	JMKMMT	ééÄ	k L^	QRPKUP	MKR	
mÄ	OMU	OMV	k ç=d ~ë	JMKPOM	ééÄ	k L^	NMMTKTR	MKR	
qÜ	OPO	OMV	k ç=d ~ë	MKNSQ	ééÄ	NQKU	POSTKON	OKR	
r	OPU	OMV	k ç=d ~ë	MKMMQ	ééÄ	SUKN	TSKTR	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eáÜÜ	n`=ä~Ö
iá	S	kç=dl~ë	NVMNMNTHPT	MKU	NTURRSOKNS	NMSKQT	RVMR	NOMQ	
pÅ	QR	kç=dl~ë	PVSRURUHPO	NHP	QORQQUNKTO	VPHOO	RVMR	NOMQ	
pÅ	QR	eO	UQNRMQKTN	MKV	NMNQTQMRN	UOKVP	RVMR	NOMQ	
pÅ	QR	eÉ	NOPNSPHPR	MKU	NQUSRRMQ	UOKUR	RVMR	NOMQ	
dÉ	TO	kç=dl~ë	VTSSVUHMV	MKR	NMOUNSRHPO	VQKVV	RVMR	NOMQ	
dÉ	TO	eO	PQUUPQKQP	NKM	QNPQVUKVS	UQHPS	RVMR	NOMQ	
dÉ	TO	eÉ	VUPVOKQU	NHO	NNSPVNHSQ	UQKRQ	RVMR	NOMQ	
v	UV	eO	QNONRPOKOT	NKT	QRVPNOQKTO	UVKTP	RVMR	NOMQ	
v	UV	eÉ	SSRRVSHQO	NHO	TVMSMNKUR	UQHNV	RVMR	NOMQ	
qÄ	NRV	kç=dl~ë	SUPPRPSHPO	NKV	SQRNNMQHSR	NMRKVP	RVMR	NOMQ	
qÄ	NRV	eÉ	ORNNRMPKRR	OHP	OTRQTPNKTP	VNHNT	RVMR	NOMQ	
_á	OMV	kç=dl~ë	PTVOOUUKRU	MKR	POQVPUTKTP	NNSKTN	RVMR	NOMQ	
_á	OMV	eÉ	NRPRQQVMVU	NKN	NRSMNOOKRR	VUKQO	RVMR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i `pt n`ONfj t O
cáÉ=k~ã É	MRM `pt kÇ
a~í~=m~íÜ=k~ã É	aWf^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJ ^oyi n`OV^kÄ
^Åè=qáã É	PLOVLOMOP=OPWSWON
p~ã éäÉ=qóéÉ	i `pt
qçí~äa ãäíáçå	RKMMMM
`çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MMU^i_kÇ
p~ã éäÉ=n`=m~ëëlc á~ä	c~äà
fpqa=n`=m~ëëlc~äà	m~ëë
l éÉê~íçê	**~Çã åà**

n`=^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÄK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B içï	B eáÖÜ	n`=ä-Ö
_É	V	S	kç=dl~ë	RPKTTO	éëÄ	OKQ	RTTNSKNT	RM	ONKRN	TVKR	NOMQ	
_	NN	S	kç=dl~ë	ROSKPQM	éëÄ	OKS	PRTTPVKQO	RMM	ONKMR	TVKR	NOMQ	
k~	OP	QR	eÉ	URVMKMTO	éëÄ	NKR	VTUUPQKTS	TRMM	OOKSV	TVKR	NOMQ	
j Ö	OQ	QR	eÉ	RRNPKTON	éëÄ	MKR	PNSSRUKUN	RMMM	OOKMR	TVKR	NOMQ	
^ä	OT	QR	eÉ	OPMMKUQQ	éëÄ	NKO	QVVSTKPT	OMMM	OPKMN	TVKR	NOMQ	
pá	OU	QR	eO	NVQNKNQR	éëÄ	NKU	UOTMOKPT	NMMM	OMKUO	M	OMM	
h	PV	QR	eÉ	NMNTMKMMM	éëÄ	NKO	RQMUNTKMV	NMMMM	OMPQ	TVKR	NOMQ	
`~	QM	QR	eO	OTVMKQMM	éëÄ	NKU	NSPPRNPKPS	ORMM	OOKPO	TVKR	NOMQ	
s	RN	UV	eÉ	RRRKRUS	éëÄ	NKN	QMUNQPKVN	RMM	OOKOO	TVKR	NOMQ	
`ê	RO	UV	eÉ	OOUKMVR	éëÄ	OKN	OMQQTMKRM	OMM	OOKUN	TVKR	NOMQ	
j å	RR	UV	eÉ	RTMKNMV	éëÄ	NKV	ORSPQRKTO	RMM	OOKU	TVKR	NOMQ	
cÉ	RS	UV	eO	NNPRKNMU	éëÄ	OKM	OQUNVUQKPO	NMMM	OOKT	TVKR	NOMQ	
`ç	RV	UV	eÉ	SMSKNRS	éëÄ	NKT	VPVRMMKNQ	RMM	OQKOR	TVKR	NOMQ	SMOMK& açа
ká	SM	UV	eÉ	RUUKVVU	éëÄ	MKU	ORSPVVKMS	RMM	OPKRS	TVKR	NOMQ	açа
`ì	SP	UV	eÉ	OVQKTQV	éëÄ	NKS	PSMMSSKUU	ORM	OPKRU	TVKR	NOMQ	
wå	SS	UV	eÉ	RUQKTNM	éëÄ	NKT	NNTQVMKRS	RMM	OPKPV	TVKR	NOMQ	
^ë	TR	UV	eÉ	NMQKQNU	éëÄ	MKV	NRUTSKPS	NMM	OMKUU	TVKR	NOMQ	
pÉ	TU	UV	eO	NVRKORN	éëÄ	MKV	UVRTKVS	NMM	ONKMR	TVKR	NOMQ	
pê	UU	UV	eÉ	ROMKRSN	éëÄ	MKS	OUTSMOKVQ	RMM	OMKUO	TVKR	NOMQ	
j ç	VR	UV	eÉ	NNQKVOP	éëÄ	OKR	RVNOPKQP	NMM	OOKVU	TVKR	NOMQ	
^Ö	NMT	UV	eÉ	RTKVMM	éëÄ	MKU	NMUSUUKVV	RM	OPKNS	TVKR	NOMQ	
`Ç	NNN	UV	eÉ	OUPKPQO	éëÄ	OKO	TNPQUKOP	ORM	OOKST	TVKR	NOMQ	
på	NNU	NRV	eÉ	QUVKUUR	éëÄ	NKS	OTPSPOKVV	RMM	NVKS	TVKR	NOMQ	
pÄ	NON	NRV	kç=dl~ë	NMVKNVO	éëÄ	NKP	QQPQUPKTO	NMM	OMKVQ	TVKR	NOMQ	
_~	NPT	NRV	kç=dl~ë	OOPMKPTU	éëÄ	MKQ	OVMPMNQKNN	OMMM	OOKP	TVKR	NOMQ	
t	NUO	NRV	kç=dl~ë	NNOKSOU	éëÄ	MKN	OVNSNSKPQ	NMM	OOKRP	TVKR	NOMQ	
qä	OMR	OMV	kç=dl~ë	NMNKRRS	éëÄ	MKV	SOQRRSKON	NMM	OMKPN	TVKR	NOMQ	
mÄ	OMU	OMV	kç=dl~ë	NMRKSUM	éëÄ	MKR	VMTRSSKMO	NMM	ONKNQ	TVKR	NOMQ	
qÜ	OPO	OMV	kç=dl~ë	NMNKRPQ	éëÄ	NKN	TUTUNRKVQ	NMM	OMKPN	TVKR	NOMQ	
r	OPU	OMV	kç=dl~ë	NMSKUOR	éëÄ	MKU	TTSVRPKPN	NMM	ONKPS	TVKR	NOMQ	

n`=fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä-Ö
iá	S	kç=d~ë	NUTUVRPKMS	NKS	NTURRSCKNS	NMRKCP	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PUUQTTQKTN	NKQ	QQRQQUNKTO	VNKPN	RVKR	NOMQ	
pÅ	QR	eO	UQSNRMKUV	NKT	NMNQTQMKRN	UPKPV	RVKR	NOMQ	
pÅ	QR	eÉ	NCCUQNKW	MKP	NQUSRRKMQ	UQKSQ	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VSRMRSKCP	MKT	NMCUNSRKPO	VPKUS	RVKR	NOMQ	
dÉ	TO	eO	PQSUMNKRP	NKM	QNPQVUKVS	UPKUT	RVKR	NOMQ	
dÉ	TO	eÉ	VUURTKNS	MKR	NNSPVNKSQ	UQKVP	RVKR	NOMQ	
v	UV	eO	QMPVPRPKMQ	NKO	QRVPNCQKTO	UTKVQ	RVKR	NOMQ	
v	UV	eÉ	SSMSPMKNN	NKS	TVMSMNKUR	UPKRS	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SUNRQCSKTT	MKR	SQRNNMQKSR	NMRKSR	RVKR	NOMQ	
qÄ	NRV	eÉ	QRNSVCRKRU	NKS	OTRQTPNKTP	VNKPT	RVKR	NOMQ	
_á	QW	kç=d~ë	PTTTVRTKVN	MKU	PCQVPUTKTP	NNSKOT	RVKR	NOMQ	
_á	QW	eÉ	NRMCPSMCQU	NKO	NRSMNCCKRR	VSKCP	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NMNRJMOQ

cãÉ=k~ã É MRNpj mi lÇ

a~í~=m~íÜ=k~ã É aWjÖäÉáíyî mj eyNya^q^yOMOPyMPJ ^oyi n ` OV^HÅ

^Åè=qãã É PLOVLOMOP=OPWQQUU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKUO	ééÄ	k L^	NQMKM	NMM	
NN	_	S	k ç=d ~ë	QKSS	ééÄ	QKN	PQCCKSV	NMMM	
OP	k ~	QR	e É	JSPKTR	ééÄ	k L^	QTRUQKPR	OMMMMM	
OQ	j Ö	QR	e É	UKKQR	ééÄ	OTKP	NOMQKRR	OMMMMM	
OT	^ ä	QR	e É	OTKSVQ	ééÄ	RKO	UNMKMQ	OMMMMM	
OU	pá	QR	e O	ONKPSN	ééÄ	NMKQ	ONMQKPV	NMMMM	
PV	h	QR	e É	PPKMPQ	ééÄ	QKU	OSMUMTS	OMMMMM	
QM	` ~	QR	e O	OVKNTR	ééÄ	NKO	OVCPQKSO	OMMMMM	
RN	s	UV	e É	NKMTP	ééÄ	MKV	NMRUKVR	NMMM	
RO	` ê	UV	e É	MKURV	ééÄ	SKN	NQVSKQT	OMMM	
RR	j å	UV	e É	MKQQS	ééÄ	VKT	OVVKVR	OMMM	
RS	cÉ	UV	e O	PKUNT	ééÄ	PKQ	NTQURKUM	NMMMM	
RV	` ç	UV	e É	MKPQM	ééÄ	NQKS	SVNKNR	NMMM	
SM	k á	UV	e É	QKSPN	ééÄ	RKQ	ONRQKQP	NMMM	
SP	` ì	UV	e É	MKPQM	ééÄ	UKR	TQNKNQ	OMMM	
SS	wå	UV	e É	QKNVR	ééÄ	RKV	RVQKQR	OMMM	
TR	^ ë	UV	e É	MKQQN	ééÄ	VKS	QRKST	NMMM	
TU	pÉ	UV	e O	MKQNU	ééÄ	NSKP	QQKMM	NMMM	
UU	pê	UV	e É	MKPPT	ééÄ	SKN	OMQKQR	OMMM	
VR	j ç	UV	e É	MKQSM	ééÄ	NQKP	OVQKQP	NMMM	
NMT	^ Ö	UV	e É	MKMPO	ééÄ	PVKO	TMKMM	NMM	
NNN	` Ç	UV	e É	MKNUM	ééÄ	UKO	QTKQN	NMMM	
NNU	på	NRV	e É	MKTSO	ééÄ	VKR	RVTKUM	NMMM	
NQN	pÄ	NRV	k ç=d ~ë	MKMMU	ééÄ	NRKM	NNPNKQQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	QKQTP	ééÄ	PKM	PMUSKVS	OMMM	
NUO	t	NRV	k ç=d ~ë	MKRSN	ééÄ	PKR	QNQRKTV	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKQQN	ééÄ	RKQ	NVVUKVQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKQQN	ééÄ	k L^	NUSRKPS	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NKQMQ	ééÄ	NKT	NNQRMSP	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMMO	ééÄ	NVKM	UMMKUT	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVMVTNQKUP	NKN	NTURRSQKNS	NVSKVR	RVKR	NQMQ	
pÅ	QR	k ç=d ~ë	PVQQTSPKTP	NKU	QQRQQUNKTO	VQKO	RVKR	NQMQ	
pÅ	QR	e O	UQUPNVMVO	MKT	NMNQTQMRN	UPKS	RVKR	NQMQ	
pÅ	QR	e É	NQQUQRKPT	MKP	NQUSRRKMQ	UQKSQ	RVKR	NQMQ	
d É	TO	k ç=d ~ë	VUMUSMKUP	QKN	NMQUNSRKPO	VRKQ	RVKR	NQMQ	
d É	TO	e O	PRMVRVKTN	MKR	QNPQVUKVS	UQKUU	RVKR	NQMQ	
d É	TO	e É	VVNSPKVN	MKQ	NNSPVNKSQ	URKO	RVKR	NQMQ	
v	UV	e O	QMVMQSPKQM	MKP	QRVPNQQKTO	UVKVS	RVKR	NQMQ	
v	UV	e É	SSPMQPKTO	MKT	TVMSMNKUR	UPKUS	RVKR	NQMQ	
qÄ	NRV	k ç=d ~ë	TMNNQSMKTO	NKQ	SQRNNMQKSR	NMUKSV	RVKR	NQMQ	
qÄ	NRV	e É	QRPTVVUKMV	NKT	OTRQTPNKTP	VQKNP	RVKR	NQMQ	
_á	OMV	k ç=d ~ë	PUOTNQQKPO	QKO	PQQVPUTKTP	NNTKTU	RVKR	NQMQ	
_á	OMV	e É	NRQTSRUKUP	MKU	NRSMNQQKRR	VVKO	RVKR	NQMQ	

p~ã éäÉ=k~ã É pn NOMNUMMV

cãÉ=k~ã É MRQpj mi hÇ

a~í~=m~íÜ=k~ã É aWjªÖäÉáíyî mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^HÅ

^Åè=qãã É PLOVLOMCP=CPWØMWR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	JMKNQO	ééÄ	k L^	TRHRS	NMM	
NN	_	S	k ç=d ~ë	OKVTM	ééÄ	OHP	OSPNKOM	NMMM	
OP	k ~	QR	e É	JROKOJV	ééÄ	k L^	OTUSOKON	OMMMMM	
OQ	j Ö	QR	e É	NMPSN	ééÄ	NNKO	NPMSKTT	OMMMMM	
OT	^ ä	QR	e É	NTKVTM	ééÄ	NTKV	RUUKVN	OMMMMM	
OU	pá	QR	e O	VVKPVQ	ééÄ	RKR	UOUNKMU	NMMMM	
PV	h	QR	e É	QMKOVN	ééÄ	OOKV	ORVTQKSU	OMMMMM	
QM	` ~	QR	e O	UMKUPS	ééÄ	PKM	RVOVRKVS	OMMMMM	
RN	s	UV	e É	MRTOR	ééÄ	NMKN	TURKRV	NMMM	
RO	` ê	UV	e É	MKOMV	ééÄ	OVKR	UVPKUS	OMMM	
RR	j å	UV	e É	OKSRO	ééÄ	VKQ	NOTSKQV	OMMM	
RS	cÉ	UV	e O	TKQVM	ééÄ	PKU	ORTOMKQQ	NMMMMM	
RV	` ç	UV	e É	MKMST	ééÄ	UUKM	OVNKNO	NMMM	
SM	k á	UV	e É	MKNSV	ééÄ	OSKO	OMMKMN	NMMM	
SP	` ì	UV	e É	NKRVO	ééÄ	RKP	OOPMKOO	OMMM	
SS	wå	UV	e É	RKVVU	ééÄ	UHP	NPOUKVT	OMMM	
TR	^ ë	UV	e É	MKOOU	ééÄ	OQKM	QRKST	NMMM	
TU	pÉ	UV	e O	MKMTS	ééÄ	OPKS	VKUP	NMMM	
UU	pê	UV	e É	MKOQV	ééÄ	VKS	NROKOP	OMMM	
VR	j ç	UV	e É	MKOTS	ééÄ	QKT	NVPHPQ	NMMM	
NMT	^ Ö	UV	e É	MKMOT	ééÄ	OVKM	RUKUV	NMM	
NNN	` Ç	UV	e É	MKMTR	ééÄ	OPKQ	OMHPT	NMMM	
NNU	på	NRV	e É	MKQRQ	ééÄ	OQKO	QNRKRT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMON	ééÄ	UTHKN	TNTKQQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	NHPVN	ééÄ	TKU	NUSRKQQ	OMMM	
NUO	t	NRV	k ç=d ~ë	MKPPS	ééÄ	QRHR	NRNRKMN	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMSM	ééÄ	QRKO	USMKVQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKOVM	ééÄ	k L^	NQRQKSU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKQNO	ééÄ	QKV	RNTVKVQ	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMPN	ééÄ	NTHS	OTMKOV	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ÉÅ	B n ` =ì çï	B n ` =¢äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	NVPRQMOQKQN	MKV	NTURRSOKNS	NMUHPV	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PVMMOMQKVR	OKM	QORQQUNKTO	VNHST	RVHR	NOMQ	
pÅ	QR	e O	UQUMPNKOV	NHS	NMNQTQMRN	UPHRT	RVHR	NOMQ	
pÅ	QR	e É	NOMSMQKMR	NKU	NQUSRRMQ	UNKHP	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VRVPQOKRS	MHP	NMOUNSRHPO	VPHPN	RVHR	NOMQ	
d É	TO	e O	PQUQUQKST	NKN	QNPQVUKVS	UQKOU	RVHR	NOMQ	
d É	TO	e É	VSTUMSV	NKT	NNSPVNSQ	UPKNS	RVHR	NOMQ	
v	UV	e O	QNNONSRHSQ	NKQ	QRVPNOQKTO	UVHRP	RVHR	NOMQ	
v	UV	e É	SQUURVKNV	NKN	TVMSMNKUR	UOKMT	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUSNVSSKUU	MKV	SQRNNMQKSR	NMSHPT	RVHR	NOMQ	
qÄ	NRV	e É	OQUVNUPKNO	PHM	OTRQTPNKTP	VMHPS	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PTTVNOPKOS	NHR	POQVPUTKTP	NNSHP	RVHR	NOMQ	
_á	OMV	e É	NQVTTOSKMR	NKV	NRSMNOOKRR	VS	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNM

cãÉ=k~ã É MRPpj mi lÇ

a~í~=m~íÜ=k~ã É aWyl ÖãÉåíyl˜ mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ HÅ

^Åè=qãã É PLOVLOMCP=CPAWRMP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKNQO	ééÄ	k L^	TSKST	NMM	
NN	_	S	k ç=d ~ë	CKQSR	ééÄ	VKR	CPMVKNO	NMMM	
CP	k ~	CR	e É	JQSKONT	ééÄ	k L^	CUSUVKMM	CMMMMM	
CQ	j Ö	CR	e É	NCKMSP	ééÄ	CQLP	NQMSKTV	CMMMMM	
CT	^ ä	CR	e É	NVKVNN	ééÄ	TKT	SPCKCR	CMMMMM	
CU	pá	CR	e O	OSKTCU	ééÄ	NSKM	CQSVKRM	NMMMM	
PV	h	CR	e É	PTKTRU	ééÄ	PPKQ	CRVPSKOT	CMMMMM	
QM	` ~	CR	e O	QUKRNT	ééÄ	MKP	PVRSQKNR	CMMMMM	
RN	s	UV	e É	MKTVO	ééÄ	NNKP	UPUKVP	NMMM	
RO	` ê	UV	e É	MKNSQ	ééÄ	UKU	URVKUS	CMMM	
RR	j å	UV	e É	MKPCU	ééÄ	NMKQ	CRNKVS	CMMM	
RS	cÉ	UV	e O	TKOVQ	ééÄ	PKU	CQLVCQKUU	NMMMM	
RV	` ç	UV	e É	JMKMCO	ééÄ	k L^	NRTKTU	NMMM	
SM	k á	UV	e É	MKMQT	ééÄ	NPNKS	NQLKUV	NMMM	
SP	` ì	UV	e É	MKRSU	ééÄ	NQKV	NMMLKVQ	CMMM	
SS	wå	UV	e É	VKPTV	ééÄ	QKP	CMMTKVS	CMMM	
TR	^ ë	UV	e É	MKNRV	ééÄ	RKR	PRKST	NMMM	
TU	pÉ	UV	e O	MKMSM	ééÄ	OVKT	UKPP	NMMM	
UU	pê	UV	e É	MKMVQ	ééÄ	NPKN	SUKUV	CMMM	
VR	j ç	UV	e É	MCPPM	ééÄ	RKO	NTNKNO	NMMM	
NMT	^ Ö	UV	e É	MKMNM	ééÄ	VKT	OTKTU	NMM	
NNN	` Ç	UV	e É	MKMOT	ééÄ	RPKU	UKRO	NMMM	
NNU	på	NRV	e É	MCRQ	ééÄ	CUKM	QCNKNP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	JMKMMT	ééÄ	k L^	RVPKVU	NMMM	
NPT	_~	NRV	k ç=d ~ë	MCPPR	ééÄ	NMKM	SNMSS	CMMM	
NUO	t	NRV	k ç=d ~ë	MKNTP	ééÄ	QUKQ	NMUTKUU	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMPP	ééÄ	PTKO	SVMKTR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMCMMR	ééÄ	k L^	NVTRKQU	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MCPPS	ééÄ	TKN	PTVNKOT	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMNS	ééÄ	PVKT	NSPKRN	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` = ç ï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NVSCQQNKTN	CKM	NTURRSCKNS	NMVKVN	RVRR	NOMQ	
pÅ	CR	k ç=d ~ë	PVNTPSNKUS	MKU	QCRQQUNKTO	VCKMU	RVRR	NOMQ	
pÅ	CR	e O	UCUSTQKSP	MKO	NMNQTQMRN	UNKSS	RVRR	NOMQ	
pÅ	CR	e É	NCNMPRKRP	NKP	NQUSRRKMQ	UNKQO	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VSCSSQKVO	NKN	NMCUNSRKPO	VPKSP	RVRR	NOMQ	
d É	TO	e O	PQCTCQKCP	MKQ	QNPQVUKVS	UCKUU	RVRR	NOMQ	
d É	TO	e É	VTRMSKMR	NKM	NNSPVNKSQ	UPKTT	RVRR	NOMQ	
v	UV	e O	QMRCURRKNT	NKM	QRVPNCQKTO	UUKCQ	RVRR	NOMQ	
v	UV	e É	SRCUPRKQS	MKS	TVMSMNKUR	UCKRT	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUQNRMRKMS	NKM	SQRNNMQKSR	NMSKMR	RVRR	NOMQ	
qÄ	NRV	e É	QRNTTSMKUO	NKM	OTRQTPNKTP	VNKQ	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PTRQRUVKVN	MKT	PCQVPUTKTP	NNRKRR	RVRR	NOMQ	
_á	OMV	e É	NRPVOMSKVR	NKM	NRSMNCOKRR	VUKSS	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNN

cãÉ=k~ã É MRQpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^HÅ

^Åè=qãã É PLOVLOMCP=CPVØMMNN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RHMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKNPQ	éé Ä	k L^	UPHPQ	NMM	
NN	_	S	k ç=d ~ë	VHSTO	éé Ä	CKT	TCQSHPT	NMMM	
CP	k ~	CR	e É	CUCCHPQV	éé Ä	MKV	PRUSSUKOS	CMMMMM	
CQ	j Ö	CR	e É	TSNKOSU	éé Ä	NKN	CQQMPPKCR	CMMMMM	
CT	^ ä	CR	e É	CRKMPV	éé Ä	NRHP	TQSKTM	CMMMMM	
CU	pá	CR	e O	NTPCKUMV	éé Ä	NKM	NPRUSSKRN	NMMMM	
PV	h	CR	e É	RQSHPTV	éé Ä	NKV	RNTTVHKV	CMMMMM	
QM	` ~	CR	e O	NPNUHPPV	éé Ä	MKU	TSVSNUKUU	CMMMMM	
RN	s	UV	e É	MRTUO	éé Ä	NKV	UPTKUO	NMMM	
RO	` ê	UV	e É	MHPNR	éé Ä	OTHN	NMMMRN	CMMM	
RR	j å	UV	e É	NCRTRR	éé Ä	CKQ	RUNQKMM	CMMM	
RS	cÉ	UV	e O	SUKRUS	éé Ä	NKO	NRUVUQHPT	NMMMMM	
RV	` ç	UV	e É	MKNUT	éé Ä	CNRT	QUMKMP	NMMM	
SM	k á	UV	e É	MKMVN	éé Ä	PMRT	NSUKUV	NMMM	
SP	` ì	UV	e É	MRRVV	éé Ä	RHR	NVRPKQM	CMMM	
SS	wå	UV	e É	CKCCCM	éé Ä	SKT	RVCKCR	CMMM	
TR	^ ë	UV	e É	MQQQN	éé Ä	CMKO	TUHSU	NMMM	
TU	pÉ	UV	e O	MKNNQ	éé Ä	NTHS	NPHKMM	NMMM	
UU	pê	UV	e É	THPPR	éé Ä	PKO	QMRMHSU	CMMM	
VR	j ç	UV	e É	MCQQN	éé Ä	VHKM	NTTRTU	NMMM	
NMT	^ Ö	UV	e É	MHKMR	éé Ä	RVHKM	NTRTU	NMM	
NNN	` Ç	UV	e É	MHKNS	éé Ä	QNKQ	RKVP	NMMM	
NNU	på	NRV	e É	MQRN	éé Ä	NTRT	QCPHPR	NMMM	
NQN	pÄ	NRV	k ç=d ~ë	MKNSP	éé Ä	NMKN	NPQUKNR	NMMM	
NPT	_~	NRV	k ç=d ~ë	NCKRSU	éé Ä	CKP	NSQVQKCP	CMMM	
NUO	t	NRV	k ç=d ~ë	MKNSP	éé Ä	NCKO	NVSQKRN	NMMM	
OMR	qä	OMV	k ç=d ~ë	MHKMQ	éé Ä	VTKQ	RNTKOO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKCUR	éé Ä	k L^	NOVQRTP	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKCPS	éé Ä	NTHS	PTUNKQQ	NMMM	
OPU	r	OMV	k ç=d ~ë	MHKMT	éé Ä	NSKV	NMMKN	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =ì çï	B n ` =¤ äÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NVNSSQNRS	NKN	NTURRSCKNS	NMTHPQ	RVHR	NCMQ	
pÅ	CR	k ç=d ~ë	PURPSQMKMM	NKU	QCRQQUNRTO	VMRU	RVHR	NCMQ	
pÅ	CR	e O	UPSSUNKCO	MRR	NMNQTQMRN	UCKQR	RVHR	NCMQ	
pÅ	CR	e É	NCNVRRRRM	NKO	NQUSRRMQ	UCMQ	RVHR	NCMQ	
d É	TO	k ç=d ~ë	VSSRNUKNP	MKS	NMCUNSRHPO	VQ	RVHR	NCMQ	
d É	TO	e O	PQTCOSKQT	MKO	QNPQVUKVS	UPHVT	RVHR	NCMQ	
d É	TO	e É	VUNNSKSM	MKU	NNSPVNHSQ	UQHP	RVHR	NCMQ	
v	UV	e O	QMRQRUTHMT	MRT	QRVPNCQRTO	UUKCU	RVHR	NCMQ	
v	UV	e É	SRTRQSKUT	MKQ	TVMSMNKUR	UPHNT	RVHR	NCMQ	
qÄ	NRV	k ç=d ~ë	SURTPCPKNQ	NRT	SQRNNMQKSR	NMSHP	RVHR	NCMQ	
qÄ	NRV	e É	QRQNQMUKVM	NRT	OTRQTPNRTP	VCKCS	RVHR	NCMQ	
_á	OMV	k ç=d ~ë	PTRNVCVKQN	NKN	PCQVPUTRTP	NNRKQT	RVHR	NCMQ	
_á	OMV	e É	NRCUCTSHSP	NKU	NRSMNCCKRR	VTKVS	RVHR	NCMQ	

p~ã éäÉ=k~ã É pn NOMNUMNO

cãÉ=k~ã É MRRpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ HÅ

^Åè=qãã É PLOVLOMCP=CPWŒRMV

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKNRM	éé Ä	k L^	SSKST	NMM	
NN	_	S	k ç=d ~ë	VKRRO	éé Ä	MO	TCQMKUP	NMMM	
CP	k ~	QR	e É	CUMCKUTP	éé Ä	NKO	PRSQUQKSM	CMMMMM	
CQ	j Ö	QR	e É	TCVMKNPT	éé Ä	MKV	QCCCCRKRM	CMMMMM	
CT	^ ä	QR	e É	QSKQLUS	éé Ä	UKR	NCMTKUR	CMMMMM	
CU	pá	QR	e O	NTNQKUVP	éé Ä	MKS	NPQNRUKPM	NMMMM	
PV	h	QR	e É	RPRKNCCO	éé Ä	CKS	RNCPCKSS	CMMMMM	
QM	` ~	QR	e O	NPNMKSVU	éé Ä	MKQ	TSUSQRKNV	CMMMMM	
RN	s	UV	e É	MKUPV	éé Ä	UKQ	UTPKPU	NMMM	
RO	` ê	UV	e É	MKPNS	éé Ä	PMKN	VVPKUR	CMMM	
RR	j å	UV	e É	NCKVPS	éé Ä	NKS	RURRKQQ	CMMM	
RS	cÉ	UV	e O	TTSHKSUP	éé Ä	NKU	NTCNNSNKRT	NMMMMM	
RV	` ç	UV	e É	MKMTM	éé Ä	CPKR	OVTKTV	NMMM	
SM	k á	UV	e É	MKNVT	éé Ä	PPKT	CNPKPQ	NMMM	
SP	` ì	UV	e É	NKSRV	éé Ä	PKO	CPCRKUM	CMMM	
SS	wå	UV	e É	TKNVM	éé Ä	NNKP	NRTPKQR	CMMM	
TR	^ ë	UV	e É	MKQVM	éé Ä	VKM	URKPQ	NMMM	
TU	pÉ	UV	e O	MKNPU	éé Ä	OVKV	NRKNT	NMMM	
UU	pê	UV	e É	THMCU	éé Ä	CKM	PURSKNT	CMMM	
VR	j ç	UV	e É	MKCCU	éé Ä	OVKM	NTMKMM	NMMM	
NMT	^ Ö	UV	e É	MKMMU	éé Ä	CQKP	CQKQR	NMM	
NNN	` Ç	UV	e É	MKMNP	éé Ä	TSKO	RKNV	NMMM	
NNU	på	NRV	e É	MKPQO	éé Ä	NMKQ	PRUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKOMP	éé Ä	NRKN	NRPUKPU	NMMM	
NPT	_~	NRV	k ç=d ~ë	NOKPVQ	éé Ä	PKR	NSPUTKPS	CMMM	
NUO	t	NRV	k ç=d ~ë	MKNOM	éé Ä	QCKM	VSNKMS	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMMN	éé Ä	k L^	QLPKUR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NKTVR	éé Ä	CKS	NVMLMVKMU	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNSN	éé Ä	CNKM	PCPPKUP	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMMV	éé Ä	NTKQ	NNPKQS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÁ	B n ` =i çï	B n ` =e åÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NVPTMSUKTQ	NKO	NTURRSCKNS	NMUKQV	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PVNSMPRKRQ	CKN	QCRQQUNKTO	VOKMQ	RVKR	NOMKQ	
pÅ	QR	e O	UPQUMVKMO	NKO	NMNQTQMKRN	UCKOT	RVKR	NOMKQ	
pÅ	QR	e É	NCNVVVKPS	MKT	NQUSRRKMQ	UCKMT	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VSRNVPKMP	NKR	NMCUNSRKPO	VPKUU	RVKR	NOMKQ	
d É	TO	e O	PQPRPPKQP	MKV	QNPQVUKVS	UPKMU	RVKR	NOMKQ	
d É	TO	e É	VTUPVKQO	MKT	NNSPVNKSQ	UQKMS	RVKR	NOMKQ	
v	UV	e O	QMUSSPQKQV	MKP	QRVPNCQKTO	UUKVT	RVKR	NOMKQ	
v	UV	e É	SRPNVTKUP	NKP	TVMSMNKUR	UCKSO	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SVMSRQVKVS	MKU	SQRNNVQKSR	NMTKMS	RVKR	NOMKQ	
qÄ	NRV	e É	QRNTQQTKVV	NKR	OTRQTPNKTP	VNKPV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PTTTRUUKVM	NKP	PCQVPUTKTP	NNSKOS	RVKR	NOMKQ	
_á	OMV	e É	NRPNUVQKTV	NKQ	NRSMNCOKRR	VUKNV	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNO

cãÉ=k~ã É MRSpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` OV^ HÅ

^Åè=qáã É PLOVLOMOP=OPARMMQS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå ORKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKTUO	ééÄ	k L^	SOKOO	NMM	
NN	_	S	k ç=d ~ë	NPKOQN	ééÄ	QKP	OQQVVKNQ	NMMM	
OP	k ~	QR	e É	OQMQKVMT	ééÄ	PKM	NMUNRSKST	OMMMMM	
OQ	j Ö	QR	e É	TSNKMMQ	ééÄ	NKS	VRVMKOP	OMMMMM	
OT	^ ä	QR	e É	RMKPNT	ééÄ	ONKS	OPQQQS	OMMMMM	
OU	pá	QR	e O	NUOVKUQQ	ééÄ	QKN	OVPOPKSQ	NMMMM	
PV	h	QR	e É	RTUKSOT	ééÄ	VKS	PMTMNKTO	OMMMMM	
QM	` ~	QR	e O	NQMTKOUQ	ééÄ	NKP	NTRSTQKTV	OMMMMM	
RN	s	UV	e É	NKRRP	ééÄ	NVKO	RMMKMO	NMMM	
RO	` ê	UV	e É	MOORP	ééÄ	NQPKN	TTRKUT	OMMM	
RR	j å	UV	e É	NPKOTR	ééÄ	OKV	NPNPKNR	OMMM	
RS	cÉ	UV	e O	TVPKQSO	ééÄ	OKQ	PRUUMVKNU	NMMMMM	
RV	` ç	UV	e É	JMKPQS	ééÄ	k L^	USKST	NMMM	
SM	k á	UV	e É	JMKOMQ	ééÄ	k L^	NNPKPQ	NMMM	
SP	` ì	UV	e É	OKPNV	ééÄ	QKV	VMOKOT	OMMM	
SS	wå	UV	e É	NPKMPN	ééÄ	SKM	STUKVO	OMMM	
TR	^ ë	UV	e É	MKSTO	ééÄ	OQKS	POKST	NMMM	
TU	pÉ	UV	e O	MKOMU	ééÄ	QVKT	SKUP	NMMM	
UU	pê	UV	e É	THSQQ	ééÄ	OKT	UTMKMR	OMMM	
VR	j ç	UV	e É	MKTTQ	ééÄ	NOKU	NPRKRS	NMMM	
NMT	^ Ö	UV	e É	MKMOR	ééÄ	UUKT	NUKUV	NMM	
NNN	` Ç	UV	e É	MKMMT	ééÄ	PNTKT	OKOO	NMMM	
NNU	på	NRV	e É	MKMOV	ééÄ	VVQKR	NTNKNN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMMO	ééÄ	TSVUKU	SOTKPR	NMMM	
NPT	_~	NRV	k ç=d ~ë	NPKPPV	ééÄ	QKV	PRQTKRP	OMMM	
NUO	t	NRV	k ç=d ~ë	MKRSQ	ééÄ	OMO	VPTKTM	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMTQ	ééÄ	k L^	QMMQP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKQNP	ééÄ	OQKS	QQQNKSS	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNTV	ééÄ	USKO	OORQKRV	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMMQ	ééÄ	k L^	QMMQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c ä~Ö	n ` =c ä~Ö
i á	S	k ç=d ~ë	OMMVUQTHRQ	NKP	NTURRSOKNS	NNOKRS	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PUTPTNVKOR	NKP	QORQQUNKTO	VNKMR	RVKR	NOMQ	
pÅ	QR	e O	UQRTRUKUO	MKR	NMNQTQMKRN	UPKPR	RVKR	NOMQ	
pÅ	QR	e É	NOQRPNKQU	MKU	NQUSRRKMQ	UPKTT	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VRVMSSKUS	OKT	NMOUNSRKPO	VPKOU	RVKR	NOMQ	
d É	TO	e O	PRNRQOKUR	MKV	QNPQVUKVS	URKMO	RVKR	NOMQ	
d É	TO	e É	VVVVPKMM	NKN	NNSPVNKSQ	URKVN	RVKR	NOMQ	
v	UV	e O	QMUSRMOKQQ	NKN	ORVPNOQKTO	UUKVT	RVKR	NOMQ	
v	UV	e É	SSSTMUKPT	MKS	TVMSMNKUR	UQKPP	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUUNQOOKUO	OKM	SQRNNMQKSR	NMSKST	RVKR	NOMQ	
qÄ	NRV	e É	ORNVUUMKQO	MKU	OTRQTPNKTP	VNKQT	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PTRVRPQKPM	MKS	PQQVPUTKTP	NNRKT	RVKR	NOMQ	
_á	OMV	e É	NROVPNTKPV	MKR	NRSMNOOKRR	VUKMP	RVKR	NOMQ	

`çåíaåì aåÖ=~ëäÁê~íáç=sÉêëÑÅ~íáç=È``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MRT|``skÇ
a~í~=m~íÜk~ã É	aWj^ÖãÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OV^hÅ
^Åè=qáã É	PLOVLOMOP=OPVRRVMP
p~ã éáÉ=qóéÉ	``s
qçí~äaãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MMJ ^i _kÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~ää
fpqa=n`=m~ëëlc~ää	c~ää
l éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÅ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	OPKTVT	éëÄ	MKQ	NQTRUSKSN	OR	VRKNV	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKMNP	éëÄ	NKQ	VUVOSKUR	OR	NMMKVR	UVKU	NNMO	
OP	k ~	OR	e É	RRPNKSUP	éëÄ	NKR	PPOQTROKQR	RMMM	NNMKSP	UVKU	NNMO	[=HLJ-NMB
OQ	j Ö	OR	e É	RSQRKOMQ	éëÄ	OKP	NTRUPRQKOP	RMMM	NNOKV	UVKU	NNMO	[=HLJ-NMB
OT	^ä	OR	e É	RQMKQUV	éëÄ	MKV	SPTQUHRO	RMM	NMUKN	UVKU	NNMO	
OU	pá	OR	e O	RMVKUNP	éëÄ	NKN	OOQQTUHRP	RMM	NMNKVS	UVKU	NNMO	
PV	h	OR	e É	RNSRKSVN	éëÄ	NKN	NQROONMOKTP	RMMM	NMPKPN	UVKU	NNMO	
QM	` ~	OR	e O	ROMOKMPU	éëÄ	MKT	NSUMNPQNKVT	RMMM	NMQKMQ	UVKU	NNMO	
RN	s	UV	e É	ORKOQT	éëÄ	NKO	NMNVRNKCU	OR	NMMKVV	UVKU	NNMO	
RO	` ê	UV	e É	ORKTQT	éëÄ	NKS	NOSVRPKPM	OR	NMOKVV	UVKU	NNMO	
RR	j å	UV	e É	ORKUOU	éëÄ	NKV	SPTVPKSS	OR	NMPKPN	UVKU	NNMO	
RS	cÉ	UV	e O	RNSQKMVR	éëÄ	NKQ	SNMPSSQNKRT	RMMM	NMPKOU	UVKU	NNMO	
RV	` ç	UV	e É	OSKRRO	éëÄ	NKR	OORUUTKOP	OR	NMSKON	UVKU	NNMO	
SM	k á	UV	e É	OSKOVO	éëÄ	OKN	SOUUPKRT	OR	NMRKNT	UVKU	NNMO	
SP	` ì	UV	e É	OSKPVP	éëÄ	NKN	NTTMQRKTQ	OR	NMRKRT	UVKU	NNMO	
SS	wå	UV	e É	OSKSNQ	éëÄ	MKP	OVQSNKQN	OR	NMSKQS	UVKU	NNMO	
TR	^ë	UV	e É	ORKQVO	éëÄ	NKN	ONORTKQM	OR	NMNKVT	UVKU	NNMO	
TU	pÉ	UV	e O	ORKPPO	éëÄ	MKV	NNSVPKSV	OR	NMNKPP	UVKU	NNMO	
UU	pê	UV	e É	ORKSQO	éëÄ	NKV	TTTMQKSV	OR	NMOKRT	UVKU	NNMO	
VR	j ç	UV	e É	OSKVNO	éëÄ	MKT	TRVOQKTQ	OR	NMTKSR	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKVTP	éëÄ	MKV	OUTVVRKQQ	OR	NNNKUV	UVKU	NNMO	[=HLJ-NMB
NNN	` Ç	UV	e É	OTKPOO	éëÄ	MKU	PTTQOKPS	OR	NMVKOV	UVKU	NNMO	
NNU	på	NRV	e É	OPKVRV	éëÄ	MKV	TPQPUKNQ	OR	VRKUQ	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKTNM	éëÄ	MKV	RVUUNMOT	OR	VUKUQ	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKTMV	éëÄ	NKV	NUPOVNKQQ	OR	NMOKUQ	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	ORKVVR	éëÄ	MKT	PSUQTVKNV	OR	NMPKVU	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKRPQ	éëÄ	NKO	UPRVVPKNO	OR	NMOKNQ	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKMUU	éëÄ	NKU	NNVNUVTKOS	OR	NMQKPR	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	ORKTUM	éëÄ	NKN	NMSQTSPKUR	OR	NMPKNO	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OTKOQU	éëÄ	MKP	NMRROQNKTR	OR	NMUKVV	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÅ	B n`=ç ïï	B n`=ç äÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	ONTRQSQKPO	NKM	NTURRSOKNS	NONKUQ	RVKR	NOMQ	SMOMa ça
pÅ	OR	k ç=d ~ë	QOQPURNKQS	MKV	QORQQUNKTO	VVKTR	RVKR	NOMQ	
pÅ	OR	e O	VPVURNKTR	NKN	NMNQTQMKRN	VOKSO	RVKR	NOMQ	
pÅ	OR	e É	NPPRQSKPV	NKT	NQUSRRKMQ	UVKUO	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NMSPMNVKPO	NKM	NMOUNSRKPO	NMPKPV	RVKR	NOMQ	
dÉ	TO	e O	PUMSVPKTQ	MKO	QNPQVUKVS	VOKMT	RVKR	NOMQ	
dÉ	TO	e É	NMUMOOKMM	MKP	NNSPVNKSQ	VOKUN	RVKR	NOMQ	
v	UV	e O	QPUNUMTKVR	MKR	QRVPNOQKTO	VRKQ	RVKR	NOMQ	
v	UV	e É	TOQSSMKPP	MKR	TVMSMNKUR	VNKSS	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	TQSQRRSKTS	MKN	SQRNNMQKSR	NNRKTN	RVKR	NOMQ	
qÄ	NRV	e É	OTRSRQTKSQ	MKU	OTRQTPNKTP	NMMKMT	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	QMOPQTRKUM	NKR	PCQVPUTKTP	NOPKUO	RVKR	NOMQ	SMOMa ça
_á	OMV	e É	NSQMUVTKPP	NKM	NRSMNOOKRR	NMRKNU	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=É`_F=oÉéçã

p~ã éáÉ=k~ã É ```_

cäÉ=k~ã É MRUJ```_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OV^kÂ

^Åè=qáã É PLPMLOMOP=MMMMOQQS

p~ã éáÉ=qóéÉ ```_

qçí~äa ãäíáç~å NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑcäÉk~ã É MMJ ^i_KÇ

p~ã éáÉ=n`=m~ëëlcá~ä m~ëë

fpqa=n`=m~ëëlc~äã m~ëë

l éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	råáë	opa	==\ mp==	iãäá	n`=c~ä~Ö
V	_É	S	kç=d~ë	JMKMNN	ééÄ	klL^	NTTKTU	MO	
NN	_	S	kç=d~ë	MOTTP	ééÄ	VKO	NRRVKMM	Q	
OP	k~	QR	eÉ	JNUKPNR	ééÄ	klL^	QQQQPKCU	OMM	
OQ	j Ö	QR	eÉ	PKNST	ééÄ	NMKR	NSPRKTN	OM	
OT	^ä	QR	eÉ	JMKMBM	ééÄ	klL^	OMPKPQ	OM	
OU	pá	QR	eO	MKSPT	ééÄ	QKO	SSQKMR	NMM	
PV	h	QR	eÉ	VKUPO	ééÄ	PRKN	OSTRQKNM	OMM	
QM	`~	QR	eO	RKNRO	ééÄ	OKM	OTPNUKUS	OM	
RN	s	UV	eÉ	MKMNP	ééÄ	UTHP	PNSKSU	N	
RO	`ê	UV	eÉ	MKMNQ	ééÄ	NVKS	TVMKRQ	N	
RR	j å	UV	eÉ	MKMNT	ééÄ	SPKS	NQTHPN	MQ	
RS	cÉ	UV	eO	QKNOV	ééÄ	NKQ	RRNVQKSS	OM	
RV	`ç	UV	eÉ	JMKMMS	ééÄ	klL^	NQQKQR	MO	
SM	ká	UV	eÉ	JMKMMO	ééÄ	klL^	NCSKST	MQ	
SP	`ì	UV	eÉ	MKMMU	ééÄ	UMKT	PTUKVM	MS	
SS	wå	UV	eÉ	MKMPM	ééÄ	SOKQ	NUMKMM	O	
TR	^ë	UV	eÉ	MKMPN	ééÄ	PRKQ	PRKST	N	
TU	pÉ	UV	eO	MKMOV	ééÄ	NMKP	OQKRM	N	
UU	pê	UV	eÉ	MKMNQ	ééÄ	NTKV	RTKTU	N	
VR	j ç	UV	eÉ	MKNQT	ééÄ	THS	QPQKQS	N	
NMT	^Ö	UV	eÉ	MKMNV	ééÄ	ONKN	NUTKTU	MO	
NNN	`Ç	UV	eÉ	MKMNU	ééÄ	SKN	OQKMT	MO	
NNU	på	NRV	eÉ	MKMQU	ééÄ	NSKR	PMNKNO	N	
NON	pÄ	NRV	kç=d~ë	MKMOP	ééÄ	NNKR	NNPNKCR	MO	
NPT	_~	NRV	kç=d~ë	MKMPM	ééÄ	NTHP	OPSKVO	MQ	
NUO	t	NRV	kç=d~ë	MKNMM	ééÄ	SKM	PNMSKVU	N	
OMR	qä	OMV	kç=d~ë	MKMSQ	ééÄ	NOKR	OPTVKQM	MO	
OMU	mÄ	OMV	kç=d~ë	JMKMQS	ééÄ	klL^	NSUUKRM	MO	
OPO	qÜ	OMV	kç=d~ë	MKMUV	ééÄ	PKT	RCCPKOT	N	
OPU	r	OMV	kç=d~ë	MKMOU	ééÄ	NUKM	NMNQKQS	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j ÇÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=cäÜÜ	n`=c~ä~Ö
iá	S	kç=d~ë	NVVVSQUKCP	MKQ	NTURRSOKNS	NNNKVV	RVKR	NOMQ	
pÅ	QR	kç=d~ë	PTVOTMRKRQ	OKN	QORQQUNKTO	UVKNR	RVKR	NOMQ	
pÅ	QR	eO	URMSRQKTP	MKO	NMNQTQMKRN	UPKUP	RVKR	NOMQ	
pÅ	QR	eÉ	NOONRQKTU	MKS	NQUSRRKMQ	UOKNT	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VSMPUMKST	MKQ	NMOUNSRKPO	VPKQN	RVKR	NOMQ	
dÉ	TO	eO	PRSQMOKUM	MKU	QNPQVUKVS	USKNV	RVKR	NOMQ	
dÉ	TO	eÉ	VUSTOKMU	MKT	NNSPVNKSQ	UQKTU	RVKR	NOMQ	
v	UV	eO	QNPPUUQKOV	MKP	QRVPNOQKTO	VM	RVKR	NOMQ	
v	UV	eÉ	SSPUQTKSU	MKR	TVMSMNKUR	UPKVT	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SURUUVUKUP	NKQ	SQRNNMQKSR	NMSKPO	RVKR	NOMQ	
qÄ	NRV	eÉ	QROMQTPKSP	MKP	OTRQTPNKTP	VNKR	RVKR	NOMQ	
_á	OMV	kç=d~ë	PSOVUPRKRU	NKU	PQQVPUTKTP	NNNKTN	RVKR	NOMQ	
_á	OMV	eÉ	NQUUOMUKRU	NKN	NRSMNOOKRR	VRKPV	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNO^

cãÉ=k~ã É MRVpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ HÅ

^Åè=qáã É PLPMLOMCP=MMMMMRP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	VKCRM	ééÄ	CHP	NVCRVHPR	NMM	
NN	_	S	k ç=d ~ë	CMUKRCU	ééÄ	MKU	NQQMUSKSV	NMMM	
CP	k ~	CR	e É	NQNTUKNPP	ééÄ	MKQ	NRPPVMCKCN	CMMMMM	
CQ	j Ö	CR	e É	NURQKPTS	ééÄ	NKU	NMCUVQKMS	CMMMMM	
CT	^ ä	CR	e É	NNOTKQTR	ééÄ	MKR	CPSRQKCV	CMMMMM	
CU	pá	CR	e O	SRCSKUCR	ééÄ	NKM	RMCQSMCV	NMMMM	
PV	h	CR	e É	NMQNTKQSU	ééÄ	MKT	RPCCUSKUQ	CMMMMM	
QM	` ~	CR	e O	CQQVKNPP	ééÄ	MKV	NPVSSUUPS	CMMMMM	
RN	s	UV	e É	QCKMQU	ééÄ	NKS	PSPPRMD	NMMM	
RO	` ê	UV	e É	QQKUN	ééÄ	NKR	QTSPVKNR	CMMM	
RR	j å	UV	e É	PMKMP	ééÄ	NKM	NRUSRKCM	CMMM	
RS	cÉ	UV	e O	NRNPKMLP	ééÄ	MKP	PUUCRCNKTQ	NMMMM	
RV	` ç	UV	e É	VKQMQ	ééÄ	NKN	NTCPPHPP	NMMM	
SM	k á	UV	e É	NVKQPV	ééÄ	CKM	NMMCNKRP	NMMM	
SP	` ì	UV	e É	PRKQNT	ééÄ	PKM	RMUCCHRV	CMMM	
SS	wå	UV	e É	NVRKNNV	ééÄ	MKV	CQTVRHSQ	CMMM	
TR	^ ë	UV	e É	QCKSNU	ééÄ	CKN	TRTMKRO	NMMM	
TU	pÉ	UV	e O	QNKTCR	ééÄ	NKS	QNTPKQP	NMMM	
UU	pê	UV	e É	QUKPCR	ééÄ	NKT	PNNTPKQR	CMMM	
VR	j ç	UV	e É	QTHSCV	ééÄ	NKS	CUSPNHPM	NMMM	
NMT	^ Ö	UV	e É	VKPRP	ééÄ	NKN	CMQVVHMV	NMM	
NNN	` Ç	UV	e É	VKMRM	ééÄ	MKQ	CSSCKNP	NMMM	
NNU	på	NRV	e É	QUKRCV	ééÄ	NKU	CSUCCKQV	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	VKVNU	ééÄ	MKV	CPTVSKQT	NMMM	
NPT	_~	NRV	k ç=d ~ë	PPKMTU	ééÄ	MKR	QCQRNKUM	CMMM	
NUO	t	NRV	k ç=d ~ë	RNKVQT	ééÄ	NKM	NPCUPNKRO	NMMM	
OMR	qä	OMV	k ç=d ~ë	VKPCR	ééÄ	MKP	RTMQCKQQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NNKVNS	ééÄ	MKP	NMQCTPKVS	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	NMKRTQ	ééÄ	MKT	UCTPUKTV	NMMM	
OPU	r	OMV	k ç=d ~ë	NMKPPV	ééÄ	NKV	TQCCQUKVO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n ` =i çï	B n ` =¢äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	NVMRPTCKUQ	MKV	NTURRSCKNS	NMSKTN	RVHR	NCMQ	
pÅ	CR	k ç=d ~ë	PTUQQVSKRS	NKM	QCRQQUNKTO	UUKVR	RVHR	NCMQ	
pÅ	CR	e O	UCPPRSKUM	MKV	NMNQTQMRN	UNKNQ	RVHR	NCMQ	
pÅ	CR	e É	NNUNRPKUN	NKM	NQUSRRMQ	TVKQU	RVHR	NCMQ	
d É	TO	k ç=d ~ë	VPSCSTKQU	MKV	NMCUNSRHPO	VNMVS	RVHR	NCMQ	
d É	TO	e O	PPTPMRKUQ	MKT	QNPQVUKVS	UNKRT	RVHR	NCMQ	
d É	TO	e É	VRSUMKTS	NKN	NNSPVNMSQ	UCKCN	RVHR	NCMQ	
v	UV	e O	QTQQNRRKRR	MKN	QRVPNCQKTO	NMPKCV	RVHR	NCMQ	
v	UV	e É	TTMVPCKCP	MKS	TVMSMNKUR	VTHRN	RVHR	NCMQ	
qÄ	NRV	k ç=d ~ë	STNPPRUKRO	MKU	SQRNNMQKSR	NMQKMT	RVHR	NCMQ	
qÄ	NRV	e É	CQTSSUSKPN	NKO	OTRQTPNKTP	UVKVN	RVHR	NCMQ	
_á	OMV	k ç=d ~ë	PTCUTPQKPM	NKM	PCQVPUTKTP	NNQKTR	RVHR	NCMQ	
_á	OMV	e É	NRCCRSSKVN	NKO	NRSMNCCKRR	VTHRV	RVHR	NCMQ	

p~ã éäÉ=k~ã É pn NOMNUMNP

cãÉ=k~ã É MSMpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ HÅ

^Åè=qáã É PLPMLOMCP=MMMNQMV

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	JMKMVN	éé Ä	k L^	NPCKCO	NMM	
NN	_	S	k ç=d ~ë	NMKVRR	éé Ä	NKV	UCCQKSU	NMMM	
CP	k ~	CR	e É	PNPUKPMM	éé Ä	NKQ	PVPUSUKMR	CMMMMM	
CQ	j Ö	CR	e É	UTPKSNN	éé Ä	NKT	RMRVVKNP	CMMMMM	
CT	^ ä	CR	e É	PQKSUT	éé Ä	SKV	VRTKUP	CMMMMM	
CU	pá	CR	e O	NPNMRRU	éé Ä	MKR	NMOTMQKVQ	NMMMM	
PV	h	CR	e É	SQUKSUM	éé Ä	NKO	RTNPPKUN	CMMMMM	
QM	` ~	CR	e O	NSRMSTN	éé Ä	MKP	VRVNSRKQM	CMMMMM	
RN	s	UV	e É	MKUMT	éé Ä	CKR	USNKMR	NMMM	
RO	` ê	UV	e É	MKPNQ	éé Ä	NQKU	NMMRKUR	CMMM	
RR	j å	UV	e É	NQKMUQ	éé Ä	CKO	SQRMKOS	CMMM	
RS	cÉ	UV	e O	VVNKUNV	éé Ä	CKN	COMNSRSKTS	NMMMMM	
RV	` ç	UV	e É	MKMSQ	éé Ä	PPKP	OVPKPR	NMMM	
SM	k á	UV	e É	MKNTU	éé Ä	NTKR	OMTKTU	NMMM	
SP	` ì	UV	e É	MKQMM	éé Ä	NQKV	UNSKTN	CMMM	
SS	wå	UV	e É	CKSUT	éé Ä	TKQ	SVMKMP	CMMM	
TR	^ ë	UV	e É	MKSCU	éé Ä	NNKN	NMTKSU	NMMM	
TU	pÉ	UV	e O	MKPNU	éé Ä	OMKR	PMKST	NMMM	
UU	pê	UV	e É	UKTNQ	éé Ä	CKM	QUPVKUO	CMMM	
VR	j ç	UV	e É	MKSNM	éé Ä	NPKO	PSUKVM	NMMM	
NMT	^ Ö	UV	e É	MKMPQ	éé Ä	QPKV	TPKPQ	NMM	
NNN	` Ç	UV	e É	MKMRS	éé Ä	NSKV	NRKVP	NMMM	
NNU	på	NRV	e É	MKQMM	éé Ä	NVKO	PVCKCQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKPMU	éé Ä	NOKR	NVVCKOT	NMMM	
NPT	_~	NRV	k ç=d ~ë	NOKURQ	éé Ä	MKN	NSUCUKNT	CMMM	
NUO	t	NRV	k ç=d ~ë	MKSPN	éé Ä	VKN	COTRKVR	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMUO	éé Ä	CQKQ	NMMCKQQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OKTTM	éé Ä	PKU	OTSPQKNV	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKOTT	éé Ä	PKT	QNSRKNP	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMQU	éé Ä	NPKU	QMMKQP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =í çï	B n ` =¢ äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	NVPTTSMOS	MKU	NTURRSOKNS	NVUKRO	RVRR	NOMQ	
pÅ	CR	k ç=d ~ë	PUTRMQMKOM	MKU	QORQQUNKTO	VNKMU	RVRR	NOMQ	
pÅ	CR	e O	UPRQTTKMS	MKT	NMNQTQMRRN	UOKPP	RVRR	NOMQ	
pÅ	CR	e É	NOOPTTKRQ	MKU	NQUSRRKMQ	UOKPO	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VSMRSRKQV	MKO	NMOUNSRKPO	VPKQP	RVRR	NOMQ	
d É	TO	e O	PQUOMSKSS	NKS	QNPQVUKVS	UQKON	RVRR	NOMQ	
d É	TO	e É	VVMOMKQT	MKP	NNSPVNKSQ	URKMU	RVRR	NOMQ	
v	UV	e O	QMVUUQTKSM	NKN	QRVPNOQKTO	UVKOQ	RVRR	NOMQ	
v	UV	e É	SSNTRMKVQ	MKR	TVMSMNKUR	UPKT	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUPUMOMKMM	NKN	SQRNNMQKSR	NMS	RVRR	NOMQ	
qÄ	NRV	e É	CROQQUQKVO	NKQ	OTRQTPNKTP	VNKSQ	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PUMSURMKTV	MKU	PCQVPUTKTP	NNTKNS	RVRR	NOMQ	
_á	OMV	e É	NRPTSQVKTR	MKV	NRSMNOCKRR	VUKRS	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNQ

cãÉ=k~ã É MSNpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ HÅ

^Åè=qãã É PLPMLOMCP=NMMQMMR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMKNOV	ééÄ	k L^	VMKMM	NMM	
NN	_	S	k ç=d ~ë	THSPV	ééÄ	PKV	RUSSKUQ	NMMM	
CP	k ~	CR	e É	NQSSKRPQ	ééÄ	NKV	OMVUNTKCQ	OMMMMM	
CQ	j Ö	CR	e É	ONCKRPT	ééÄ	OKM	NCSTVKQM	OMMMMM	
CT	^ ä	CR	e É	NNTKNSN	ééÄ	PKT	OSVQKTR	OMMMMM	
CU	pá	CR	e O	OVNRKMVO	ééÄ	MKP	COVUMQKCQ	NMMMM	
PV	h	CR	e É	VMKQCR	ééÄ	NKU	CUQSVKUO	OMMMMM	
QM	` ~	CR	e O	OVUK/PU	ééÄ	MKN	NURMRTKTM	OMMMMM	
RN	s	UV	e É	NKQTU	ééÄ	RKU	NPQUKVU	NMMM	
RO	` ê	UV	e É	MKUOT	ééÄ	NMKO	NQRUKQT	OMMM	
RR	j å	UV	e É	NTKVCU	ééÄ	NKO	UNQRKQT	OMMM	
RS	cÉ	UV	e O	VTMKTTO	ééÄ	NMS	ONPTVMSKUO	NMMMMM	
RV	` ç	UV	e É	MKMTU	ééÄ	OMS	PNPKPR	NMMM	
SM	k á	UV	e É	MKNRQ	ééÄ	RUKV	NVSKST	NMMM	
SP	` ì	UV	e É	MKPSM	ééÄ	NRKU	TSRKRV	OMMM	
SS	wå	UV	e É	OKMVO	ééÄ	NMS	RUTKUM	OMMM	
TR	^ ë	UV	e É	MKSNS	ééÄ	NQKM	NVRKPQ	NMMM	
TU	pÉ	UV	e O	MKNCO	ééÄ	NNKO	NPKST	NMMM	
UU	pê	UV	e É	OKTTP	ééÄ	RKM	NRQRKST	OMMM	
VR	j ç	UV	e É	MKPSQ	ééÄ	NNKM	OQNKNO	NMMM	
NMT	^ Ö	UV	e É	MKMNV	ééÄ	NVKR	QRKRR	NMM	
NNN	` Ç	UV	e É	MKMNO	ééÄ	NRNKT	QKUN	NMMM	
NNU	på	NRV	e É	MKPRU	ééÄ	PQKO	PTMKMN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMOM	ééÄ	PVKN	TMTKQQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	NVKMUP	ééÄ	QKQ	NPNPSKVQ	OMMM	
NUO	t	NRV	k ç=d ~ë	MKPQP	ééÄ	NMKR	NRONKTM	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMPO	ééÄ	QVKT	SUTKQO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKORR	ééÄ	k L^	NRRRKMO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKONP	ééÄ	NVKV	PSOQKPS	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMOV	ééÄ	UKV	ORPKSN	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B =¤ÉÅ	B n ` =ì çï	B n ` =¤äÜÜ	n ` =¤ä-Ö
i á	S	k ç=d ~ë	NVOSRQSKRP	OKM	NTURRSOKNS	NMTKV	RVKR	NOMQ	
pÅ	CR	k ç=d ~ë	PUQSVNVKVR	MKP	QORQQUNKTO	VMKQO	RVKR	NOMQ	
pÅ	CR	e O	UQQONVKPN	MKQ	NMNQTQMKRN	UP	RVKR	NOMQ	
pÅ	CR	e É	NOMRUMKCP	MKU	NQUSRRKMQ	UNKNN	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VQSMQUKUP	MKS	NMOUNSRKPO	VOKMN	RVKR	NOMQ	
d É	TO	e O	PQPVPVKUU	NKQ	QNPQVUKVS	UPKNU	RVKR	NOMQ	
d É	TO	e É	VSSTPKRV	NKO	NNSPVNKSQ	UPKMS	RVKR	NOMQ	
v	UV	e O	QMSRQQOKVM	NKM	QRVPNOQKTO	UUKRN	RVKR	NOMQ	
v	UV	e É	SRUUTQKTS	MKS	TVMSMNKUR	UPKPQ	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUMOOMQKVN	NKO	SQRNNMQKSR	NVRKQQ	RVKR	NOMQ	
qÄ	NRV	e É	ORPOOMPKQS	NKS	OTRQTPNKTP	VNKVO	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PTSVPTVKUP	NKQ	POQVPUTKTP	NNS	RVKR	NOMQ	
_á	OMV	e É	NRPTOSOKVQ	MKT	NRSMNOOKRR	VUKRP	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNR

cãÉ=k~ã É MSQpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ hÅ

^Åè=qãã É PLPMLOMCP=NMMØRNMP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä-Ö
V	_É	S	k ç=d ~ë	JMKNRS	ééÄ	k L^	SMKMM	NMM	
NN	_	S	k ç=d ~ë	TKOSO	ééÄ	RKQ	RSPQKRQ	NMMM	
OP	k ~	QR	e É	NRTRKPUS	ééÄ	MKP	OONPSOKVS	OMMMMM	
OQ	j Ö	QR	e É	OMVKSSQ	ééÄ	PKT	NORNOKSP	OMMMMM	
OT	^ ä	QR	e É	PMKOQO	ééÄ	RKP	UQLUKVP	OMMMMM	
OU	pá	QR	e O	ORRTHRQLU	ééÄ	MKU	OMVPSTHUM	NMMMM	
PV	h	QR	e É	NURKVVT	ééÄ	OKP	PPOONHUU	OMMMMM	
QM	` ~	QR	e O	SMQRTQT	ééÄ	MKN	PRVRUSKTO	OMMMMM	
RN	s	UV	e É	NHUOT	ééÄ	PKT	NMVNHUU	NMMM	
RO	` ê	UV	e É	MKPRS	ééÄ	NNHM	NMPTKUQ	OMMM	
RR	j å	UV	e É	NMRKUMN	ééÄ	NKT	QTNUTKUT	OMMM	
RS	cÉ	UV	e O	PVQQKPTU	ééÄ	NHS	USOOVVUHSP	NMMMMM	
RV	` ç	UV	e É	MKOQN	ééÄ	RKP	RSQKQU	NMMM	
SM	k á	UV	e É	MKMSM	ééÄ	NORKN	NRRKRS	NMMM	
SP	` ì	UV	e É	NHPRN	ééÄ	OKM	NVTMKNU	OMMM	
SS	wå	UV	e É	QKPTP	ééÄ	RKT	NMOPKPV	OMMM	
TR	^ ë	UV	e É	NHPMU	ééÄ	OKR	ONMKMO	NMMM	
TU	pÉ	UV	e O	MKMVP	ééÄ	NSHS	NNHKNT	NMMM	
UU	pê	UV	e É	OKUTR	ééÄ	NMHS	NSMNKOQ	OMMM	
VR	j ç	UV	e É	MKPOV	ééÄ	ONHO	OOPKPQ	NMMM	
NMT	^ Ö	UV	e É	MKMMS	ééÄ	NQPHS	ONKNN	NMM	
NNN	` Ç	UV	e É	MKMMV	ééÄ	TSKP	QKMT	NMMM	
NNU	på	NRV	e É	MKONU	ééÄ	OMKV	OUPKPQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMMP	ééÄ	OUNKR	SPTKPR	NMMM	
NPT	_~	NRV	k ç=d ~ë	NMKMNR	ééÄ	OKQ	NPNOSKVP	OMMM	
NUO	t	NRV	k ç=d ~ë	MKONM	ééÄ	NNHV	NNUOKSQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKMMQ	ééÄ	NTVKM	ROMKRS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMOSP	ééÄ	k L^	NQVNHSO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNPV	ééÄ	ORHS	PMSSKVR	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMNN	ééÄ	VQKQ	NOPKQS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n ` =i çï	B n ` =¤ëÛÜ	n ` =¤ä-Ö
i á	S	k ç=d ~ë	NVPSOTUKPR	OKO	NTURRSOKNS	NMUKQQ	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PUPPTMVKNP	NHS	QORQQUNKTO	VMKNN	RVHR	NOMQ	
pÅ	QR	e O	UPSTRMKOT	NHS	NMNQTQMRN	UOKQS	RVHR	NOMQ	
pÅ	QR	e É	NOMRPVKRS	MKQ	NQUSRRMQ	UNHMV	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VQVURQKPR	MKT	NMOUNSRHPO	VOKPU	RVHR	NOMQ	
d É	TO	e O	PQPSMRKVP	NKU	QNPQVUKVS	UPHN	RVHR	NOMQ	
d É	TO	e É	VTQSQKSS	MKV	NNSPVNHSQ	UPKTQ	RVHR	NOMQ	
v	UV	e O	QMQUVNMOV	MHS	QRVPNOQKTO	UUKNR	RVHR	NOMQ	
v	UV	e É	SRUPOVKTO	MKT	TVMSMNKUR	UPKOT	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SUQNUUSKQU	NHO	SQRNNMQHSR	NMSHMS	RVHR	NOMQ	
qÄ	NRV	e É	OQTMVOTHRO	OKR	OTRQTPNKTP	UVHSS	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PTUSSVSKVR	MKT	PQQVPUTKTP	NNSHRQ	RVHR	NOMQ	
_á	OMV	e É	NRNPRVRKUO	NHS	NRSMNOOKRR	VTHMO	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNS

cãÉ=k~ã É MSPpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ HÅ

^Åè=qáã É PLPMLOMCP=MMMPMQOM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	JMKNNR	éé Ä	k L^	NMPKPQ	NMM	
NN	_	S	k ç=d ~ë	TKONU	éé Ä	OKP	RQURKRU	NMMM	
OP	k ~	QR	e É	NOPSKMUP	éé Ä	NKR	NUTSRPKPV	OMMMMM	
OQ	j Ö	QR	e É	OPTKUPU	éé Ä	NKP	NQOUPKMU	OMMMMM	
OT	^ ä	QR	e É	NOPKVRT	éé Ä	OKM	PPMOKUV	OMMMMM	
OU	pá	QR	e O	OMRVKMVO	éé Ä	OKV	NSQQNNKMV	NMMMM	
PV	h	QR	e É	NTQKQVU	éé Ä	SKM	PPMUNKMD	OMMMMM	
QM	` ~	QR	e O	PMPKSSU	éé Ä	PKM	NVMMTNKPR	OMMMMM	
RN	s	UV	e É	NKOSQ	éé Ä	RKR	NNVOKRO	NMMM	
RO	` ê	UV	e É	MKQOM	éé Ä	NRKM	NMVTKUP	OMMM	
RR	j å	UV	e É	NPKRSO	éé Ä	NKU	SOMMKNU	OMMM	
RS	cÉ	UV	e O	OPUKRNS	éé Ä	NKT	VURMVUKUS	NMMMMM	
RV	` ç	UV	e É	MKMTP	éé Ä	PMKV	PMSKSU	NMMM	
SM	k á	UV	e É	MKORS	éé Ä	NUKP	OONKNO	NMMM	
SP	` ì	UV	e É	MKTNU	éé Ä	UKO	NOMPKON	OMMM	
SS	wå	UV	e É	OKQTQ	éé Ä	OKR	NMOSKTP	OMMM	
TR	^ ë	UV	e É	MKOPR	éé Ä	NMKP	TUKMN	NMMM	
TU	pÉ	UV	e O	MKNMQ	éé Ä	RKV	NOKPP	NMMM	
UU	pê	UV	e É	OKROV	éé Ä	PKQ	NONPKOP	OMMM	
VR	j ç	UV	e É	MKOMV	éé Ä	OOKR	NSOKOP	NMMM	
NMT	^ Ö	UV	e É	MKMMV	éé Ä	POKN	OSKST	NMM	
NNN	` Ç	UV	e É	MKMNP	éé Ä	VTKU	RKNU	NMMM	
NNU	på	NRV	e É	MKNVT	éé Ä	OMKO	OTTKTV	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMOS	éé Ä	RVKP	TQMKUM	NMMM	
NPT	_~	NRV	k ç=d ~ë	UKSRP	éé Ä	NKV	NNPTSKVM	OMMM	
NUO	t	NRV	k ç=d ~ë	MKOMT	éé Ä	OOKS	NNUNKPM	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMNQ	éé Ä	k L^	QNMKQQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKMMP	éé Ä	k L^	PTRQKOM	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNOT	éé Ä	NQKU	PMVSKUS	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMNT	éé Ä	PNKP	NTPKRO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ¨ mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUVROMSKUP	NKN	NTURRSOKNS	NVSKNQ	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PVPQRVQKUS	NKR	QORQQUNKTO	VOKQU	RVKR	NOMQ	
pÅ	QR	e O	URPMVQKPV	PKS	NMNQTQMKRN	UQKMS	RVKR	NOMQ	
pÅ	QR	e É	NOONQRKMO	MKV	NQUSRRKMQ	UOKNT	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VRTVUNKVN	MKS	NMOUNSRKPO	VPKNT	RVKR	NOMQ	
d É	TO	e O	PQTSNPKQM	MKQ	QNPQVUKVS	UQKMT	RVKR	NOMQ	
d É	TO	e É	VUVVQKRQ	MKT	NNSPVNKSQ	URKMR	RVKR	NOMQ	
v	UV	e O	QNOSNMPKVP	MKP	QRVPNOQKTO	UVKUP	RVKR	NOMQ	
v	UV	e É	SSMPNUKMV	NKT	TVMSMNKUR	UPKRO	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SURUUTTKMU	NKO	SQRNNMQKSR	NMSKPO	RVKR	NOMQ	
qÄ	NRV	e É	QRONNSQKRM	MKU	OTRQTPNKTP	VNKRO	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PUOPOUQKUQ	NKO	PQQVPUTKTP	NNTHSS	RVKR	NOMQ	
_á	OMV	e É	NROSUNOKTO	MKS	NRSMNOOKRR	VTKUS	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMNT

cãÉ=k~ã É MSQpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^ HÅ

^Åè=qãã É PLPMLOMCP=MMMRRVQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä-Ö
V	_É	S	k ç=d ~ë	JMKMVU	éé Ä	k L^	NCPHPQ	NMM	
NN	_	S	k ç=d ~ë	THSCU	éé Ä	CHP	RUSNKCV	NMMM	
CP	k ~	CR	e É	NCMNHPRO	éé Ä	NKN	NUCCRCKTT	CMMMMM	
CQ	j Ö	CR	e É	CRUK/SQ	éé Ä	CKU	NRPCUKSS	CMMMMM	
CT	^ ä	CR	e É	NUMCQ/S	éé Ä	RKM	CMRPHK/T	CMMMMM	
CU	pá	CR	e O	NPVTK/CN	éé Ä	NHR	NNMNSNKCV	NMMMM	
PV	h	CR	e É	NTUHSTT	éé Ä	SKQ	PCV/RKUO	CMMMMM	
QM	` ~	CR	e O	PSSHSST	éé Ä	NKO	CCPTCM/SR	CMMMMM	
RN	s	UV	e É	NKONN	éé Ä	RKU	NNSMKMT	NMMM	
RO	` ê	UV	e É	MHSMD	éé Ä	SHS	NCSRKNR	CMMM	
RR	j å	UV	e É	NNKUCS	éé Ä	NKO	RQQMHSV	CMMM	
RS	cÉ	UV	e O	QTTHKPRM	éé Ä	PHR	NMSRSPQKMS	NMMMMM	
RV	` ç	UV	e É	MKM/S	éé Ä	CUKO	PQCKCQ	NMMM	
SM	k á	UV	e É	MKQTR	éé Ä	NTKQ	PPTKTV	NMMM	
SP	` ì	UV	e É	MKUSU	éé Ä	CKV	NPVNKCM	CMMM	
SS	wå	UV	e É	TKOTQ	éé Ä	NKV	NSNQKRT	CMMM	
TR	^ ë	UV	e É	MKPPQ	éé Ä	CPHP	SPHMN	NMMM	
TU	pÉ	UV	e O	MKM/SU	éé Ä	UKT	VKNT	NMMM	
UU	pê	UV	e É	CHSST	éé Ä	NKT	NQ/RHSS	CMMM	
VR	j ç	UV	e É	MCOOT	éé Ä	RNKV	NTCKCP	NMMM	
NMT	^ Ö	UV	e É	MKMMS	éé Ä	TMKQ	CNKNN	NMM	
NNN	` Ç	UV	e É	MKMNO	éé Ä	TUHP	CKUO	NMMM	
NNU	på	NRV	e É	MKCNQ	éé Ä	CQQR	CVMKMN	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKMQU	éé Ä	NVKU	UQMK/P	NMMM	
NPT	_~	NRV	k ç=d ~ë	VRTMR	éé Ä	MKT	NCUMPKMQ	CMMM	
NUO	t	NRV	k ç=d ~ë	MKNTQ	éé Ä	CQCO	NMVTKUU	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMNQ	éé Ä	k L^	CNMKQQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	JMKMCN	éé Ä	k L^	PRTQKMM	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNCQ	éé Ä	CNKV	CVSMKNS	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMCP	éé Ä	CMKU	CNPKRS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ ÉÅ	B n ` =¡ çï	B n ` =¢ äÜÜ	n ` =¢ä-Ö
i á	S	k ç=d ~ë	NVCSVTQKUM	PHO	NTURRSCKNS	NMTK/O	RVHR	NCMQ	
pÅ	CR	k ç=d ~ë	PUCPMUCHRV	NHS	CCRCQCUNKTO	VMKPP	RVHR	NCMQ	
pÅ	CR	e O	UQMQMQK/M	NHO	NMNQTQMRN	UCKUO	RVHR	NCMQ	
pÅ	CR	e É	NCNMQUK/N	MKQ	NQUSRRMQ	UNKCP	RVHR	NCMQ	
d É	TO	k ç=d ~ë	VRPPSVKTT	NKN	NMCUNSRHPO	VCKTP	RVHR	NCMQ	
d É	TO	e O	PQUCNMPU	NHR	CNPQ/UK/S	UQKCN	RVHR	NCMQ	
d É	TO	e É	VUNPPKCP	MKN	NNSPVNHSQ	UQKPN	RVHR	NCMQ	
v	UV	e O	QNMQTPNKCR	NHR	CRVPNCQKTO	UVHPT	RVHR	NCMQ	
v	UV	e É	SSCSVPKCM	MHS	TVMSMNKUR	UPKUO	RVHR	NCMQ	
qÄ	NRV	k ç=d ~ë	SUUCRCRKCU	MKU	SCRNNMQHSR	NMSKTO	RVHR	NCMQ	
qÄ	NRV	e É	CRPVQTPHST	MHR	OTRQTPNKTP	VCKNV	RVHR	NCMQ	
_á	OMV	k ç=d ~ë	PTVCRCRKPU	NKP	PCQV/PUTKTP	NNSKTU	RVHR	NCMQ	
_á	OMV	e É	NRPTSNUKNS	MKV	NRSMNCCHRR	VUHRS	RVHR	NCMQ	

p~ã éäÉ=k~ã É pn NOMNUMNU

cãÉ=k~ã É MSRpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` OV^HÅ

^Åè=qáã É PLPMLOMCP=NMMQMMRR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMMQU	éé Ä	k L^	NTSMST	NMM	
NN	_	S	k ç=d ~ë	NPMNSM	éé Ä	PMN	VSMPMPR	NMMM	
CP	k ~	CR	e É	NTMRMQR	éé Ä	CMM	CPRRMVMV	CMMMMM	
CQ	j Ö	CR	e É	CCUMSMN	éé Ä	NMN	NPRVRMUS	CMMMMM	
CT	^ ä	CR	e É	PRMMCCP	éé Ä	CMU	TSSPMPM	CMMMMM	
CU	pá	CR	e O	PRNTMQUQ	éé Ä	CMT	CTUSCNMCU	NMMMM	
PV	h	CR	e É	TUMCNQ	éé Ä	NPMN	CTVNMMSN	CMMMMM	
QM	` ~	CR	e O	PNPMNTV	éé Ä	CMQ	NVQCCVVMTS	CMMMMM	
RN	s	UV	e É	NMVQQ	éé Ä	VMU	NSUPMQT	NMMM	
RO	` ê	UV	e É	MMTQS	éé Ä	SMP	NPUNMUM	CMMM	
RR	j å	UV	e É	NPMVUT	éé Ä	NMV	SPRQMUV	CMMM	
RS	cÉ	UV	e O	NSSMSTP	éé Ä	MMT	PTUMQUMRR	NMMMMM	
RV	` ç	UV	e É	MMVUP	éé Ä	QUMT	PCVMMVO	NMMM	
SM	k á	UV	e É	MCCCM	éé Ä	CRMS	CCQMQR	NMMM	
SP	` ì	UV	e É	CMMPS	éé Ä	CMN	CTVRMUV	CMMM	
SS	wå	UV	e É	VMQVT	éé Ä	SMN	CMQCMQN	CMMM	
TR	^ ë	UV	e É	MCOVO	éé Ä	NRMT	RSMMN	NMMM	
TU	pÉ	UV	e O	MMMTS	éé Ä	SSMN	VMUP	NMMM	
UU	pê	UV	e É	PMCPP	éé Ä	MMQ	NTVCMPT	CMMM	
VR	j ç	UV	e É	MCCMP	éé Ä	CPMV	NRTMTU	NMMM	
NMT	^ Ö	UV	e É	MMMMR	éé Ä	NNNMQ	NUMUV	NMM	
NNN	` Ç	UV	e É	MMMNO	éé Ä	CCCMQ	CMUO	NMMM	
NNU	på	NRV	e É	MMPCV	éé Ä	CNMM	PQSMSU	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MMMMU	éé Ä	NVVMQ	SRTMPT	NMMM	
NPT	_~	NRV	k ç=d ~ë	NNMPMQ	éé Ä	CMM	NQTTTMMV	CMMM	
NUO	t	NRV	k ç=d ~ë	MMNPO	éé Ä	CPMP	VUNMMU	NMMM	
CMR	qä	CMV	k ç=d ~ë	JMMVPO	éé Ä	k L^	CVPMSR	NMMM	
CMU	mÄ	CMV	k ç=d ~ë	MMRCO	éé Ä	RMO	UCMVMSV	CMMM	
CPO	qÜ	CMV	k ç=d ~ë	MMNCM	éé Ä	CVMN	CVCMMNM	NMMM	
CPU	r	CMV	k ç=d ~ë	MMVCM	éé Ä	NQMV	NVPMRQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¨çï	B n ` =¤ëÛÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NVMRNCPMPS	MMS	NTURRSCMNS	NMSMT	RVMR	NCMMQ	
pÅ	CR	k ç=d ~ë	PUNPCCQMMR	NMM	CCRCQCUNMTO	UVMSP	RVMR	NCMMQ	
pÅ	CR	e O	UQSTTTMMNP	NMR	NMNQTQCMRN	UPMQR	RVMR	NCMMQ	
pÅ	CR	e É	NCMTNMMUP	MMR	NQUSRRMMQ	UNMO	RVMR	NCMMQ	
d É	TO	k ç=d ~ë	VQQTCRMMS	MMN	NMCUNSRMPO	VNMUV	RVMR	NCMMQ	
d É	TO	e O	PQTCQTMNN	MMR	CNPQVUMVS	UQMMP	RVMR	NCMMQ	
d É	TO	e É	VUCNSMTP	MMS	NNSPVNMSQ	UQMPU	RVMR	NCMMQ	
v	UV	e O	CNMPURUMVO	MMR	CRVPNCQMTO	UVMPR	RVMR	NCMMQ	
v	UV	e É	SRSRNTMQV	MMV	TVMSMNMUR	UPMMQ	RVMR	NCMMQ	
qÄ	NRV	k ç=d ~ë	SUCRCQMSQ	MMR	SQRNNMQMSR	NMRMU	RVMR	NCMMQ	
qÄ	NRV	e É	CQUUCPQMCN	NMP	OTRQTPNMTP	VMMPP	RVMR	NCMMQ	
_á	CMV	k ç=d ~ë	PTUNVQUMSR	NMM	PCQVPUTMTP	NNSMPV	RVMR	NCMMQ	
_á	CMV	e É	NRCMCRTMPO	MMT	NRSMNCCMRR	VTMQS	RVMR	NCMMQ	

`çåíaåì aåÖ=~ëäÄê~íáçå=sÉêëÑÅ~íáçå=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MSS|``skÇ
a~í~=m~íÜk~ã É	aWj^ÖãÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n`OV^hÄ
^Åè=qáã É	PLPMLOMOP=MMMQRVQT
p~ã éáÉ=qóéÉ	``s
qçí~äa ãáíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MMJ ^i _kÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~äá
fpqa=n`=m~ëëlc~áä	c~äá
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=cä-Ö
V	_É	S	k ç=d ~ë	OPKTVN	ééÄ	MKO	NQRNTQKQV	CR	VRKNS	UVKU	NNMKO	
NN	_	S	k ç=d ~ë	ORKNMN	ééÄ	NKN	VTSSSHPR	CR	NMMKQ	UVKU	NNMKO	
OP	k ~	CR	e É	RSPNHRUV	ééÄ	MKM	PPUSVOSKTP	RMMM	NNOKSP	UVKU	NNMKO	[=HLJHNMB
OQ	j Ö	CR	e É	RSTSKMN	ééÄ	NHS	NTSVUTSKVV	RMMM	NNPHRO	UVKU	NNMKO	[=HLJHNMB
OT	^ä	CR	e É	RQQKNTU	ééÄ	NHR	SQQPTHOO	RMM	NMUKUQ	UVKU	NNMKO	
OU	pá	CR	e O	RNMHSRQ	ééÄ	MHS	OOVVPVRTN	RMM	NMPKVP	UVKU	NNMKO	
PV	h	CR	e É	RNMPKOOP	ééÄ	OHR	NQSMITTNHRM	RMMM	NMPKUS	UVKU	NNMKO	
QM	` ~	CR	e O	ROSQKQSS	ééÄ	MHR	NTTNMOVSNKOT	RMMM	NMRKOV	UVKU	NNMKO	
RN	s	UV	e É	ORKPPS	ééÄ	MKU	NMOPQMTQ	CR	NMNHPQ	UVKU	NNMKO	
RO	` ê	UV	e É	OSKMSV	ééÄ	NKT	NOURRUKUU	CR	NMQKOU	UVKU	NNMKO	
RR	j å	UV	e É	ORKVSM	ééÄ	NKT	SQNPSHSN	CR	NMPKUQ	UVKU	NNMKO	
RS	cÉ	UV	e O	RNUPKMTU	ééÄ	MKV	SORNTSVRKVN	RMMM	NMPHSS	UVKU	NNMKO	
RV	` ç	UV	e É	OSKTPP	ééÄ	MHR	OOTQVTKMV	CR	NMSKVP	UVKU	NNMKO	
SM	k á	UV	e É	OSKRSN	ééÄ	MKU	SPRQSKCR	CR	NMSKCQ	UVKU	NNMKO	
SP	` ì	UV	e É	OSKRRT	ééÄ	MKV	NTUNURKNT	CR	NMSKCP	UVKU	NNMKO	
SS	wå	UV	e É	OTKNUQ	ééÄ	NHS	PMMVRKMO	CR	NMUKTQ	UVKU	NNMKO	
TR	^ë	UV	e É	ORKOTT	ééÄ	MKV	ONMUPKQR	CR	NMNHKN	UVKU	NNMKO	
TU	pÉ	UV	e O	ORKOTP	ééÄ	NKQ	NNVMRKNU	CR	NMNHKV	UVKU	NNMKO	
UU	pê	UV	e É	ORKPVO	ééÄ	MHS	TSVTPKVP	CR	NMNHRT	UVKU	NNMKO	
VR	j ç	UV	e É	OSKRQM	ééÄ	NKQ	TQLPURRM	CR	NMSKMU	UVKU	NNMKO	
NMT	^Ö	UV	e É	OUKMTV	ééÄ	MKV	OUVNSRKST	CR	NNOKPO	UVKU	NNMKO	[=HLJHNMB
NNN	` Ç	UV	e É	OTKUMU	ééÄ	MKQ	PUQQSKNO	CR	NNNKCP	UVKU	NNMKO	[=HLJHNMB
NNU	på	NRV	e É	OQKMTR	ééÄ	MHR	TQROSKQQ	CR	VSHP	UVKU	NNMKO	
NON	pÄ	NRV	k ç=d ~ë	OQKNRT	ééÄ	NKT	RVPUPMKMP	CR	VSHSP	UVKU	NNMKO	
NPT	_~	NRV	k ç=d ~ë	ORKNMT	ééÄ	MKT	NUNRVPKQR	CR	NMVKCP	UVKU	NNMKO	
NUO	t	NRV	k ç=d ~ë	OSKMPU	ééÄ	MKQ	PTQQNVRTV	CR	NMQKNR	UVKU	NNMKO	
OMR	qä	OMV	k ç=d ~ë	ORKNOT	ééÄ	MHS	UPSNMVKQQ	CR	NMMHRN	UVKU	NNMKO	
OMU	mÄ	OMV	k ç=d ~ë	ORKUTS	ééÄ	MKT	NOMNSPMHSP	CR	NMPHR	UVKU	NNMKO	
OPO	qÜ	OMV	k ç=d ~ë	ORHSPR	ééÄ	MKT	NMTRUSVKVS	CR	NMOKRQ	UVKU	NNMKO	
OPU	r	OMV	k ç=d ~ë	OSKUNT	ééÄ	OKQ	NMRRPOVKMP	CR	NMTKOT	UVKU	NNMKO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=çï	B n`=eäÜÜ	n`=cä-Ö
iá	S	k ç=d ~ë	ONQMPTNHSN	MKU	NTURRSOKNS	NNVKUT	RVHR	NOMKQ	
pÅ	CR	k ç=d ~ë	QOOMVNTHSP	MKU	QORQQUNKTO	VVKON	RVHR	NOMKQ	
pÅ	CR	e O	VORPOOKRT	MHS	NMNQTQMRN	VPHNS	RVHR	NOMKQ	
pÅ	CR	e É	NPPSOVKTU	MKV	NQUSRRMKQ	UVKUV	RVHR	NOMKQ	
dÉ	TO	k ç=d ~ë	NMRSNOOKTN	MKU	NMOUNSRHPO	NMOKTO	RVHR	NOMKQ	
dÉ	TO	e O	PUVTVMMMN	NKQ	ONPQVUKVS	VQKOT	RVHR	NOMKQ	
dÉ	TO	e É	NMUNUPHPV	MHR	NNSPVNHSQ	VOKVR	RVHR	NOMKQ	
v	UV	e O	QQTNVPOKNP	NKQ	QRVPNOQKTO	VTHPS	RVHR	NOMKQ	
v	UV	e É	TOQUVMKOM	NHP	TVMSMNKUR	VNHSV	RVHR	NOMKQ	
qÄ	NRV	k ç=d ~ë	TRTORVMKTP	NHM	SQRNNMQHSR	NNTHPU	RVHR	NOMKQ	
qÄ	NRV	e É	OTUQOMSHSR	NHN	OTRQTPNKTP	NMNHMT	RVHR	NOMKQ	
_á	OMV	k ç=d ~ë	QMUUUNVKUN	MKT	PCQVPUTKTP	NORKUP	RVHR	NOMKQ	SMOMa ça
_á	OMV	e É	NSPVRQRKUT	NHP	NRSMNOOKRR	NMRKMV	RVHR	NOMKQ	

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MST|``_KÇ

a~í~=m~íÜ=k~ã É aWj^ÖäÉáíÝ^mj eyNya^q^yOMCPyMPJ ^oyi n`OV^kÂ

^Åè=qáã É PLPMLOMCP=MMRRRMQ

p~ã éáÉ=qóéÉ ``_

qçí~äa äã íáç~å NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑcäÉk~ã É MMJ ^i _KÇ

p~ã éáÉ=n`=m~ëëlc á~ä m~ëë

fpqa=n`=m~ëëlc~äã m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	r åáë	opa	==\ mp==	iãäá	n`=c ä~Ö
V	_É	S	kç=d~ë	JMKMNM	éé Ä	kL^	NTTKTU	MO	
NN	_	S	kç=d~ë	MCRR	éé Ä	RKP	NQTMKNM	Q	
CP	k~	CR	eÉ	JNVKRTV	éé Ä	kL^	CQCCRPKCR	CMM	
CQ	j Ö	CR	eÉ	PKMUV	éé Ä	NRKR	NSCQMKNS	CM	
CT	^ä	CR	eÉ	JMCUQ	éé Ä	kL^	NUCKCP	CM	
CU	pá	CR	eO	MRTSO	éé Ä	PCKP	TCMRTU	NMM	
PV	h	CR	eÉ	TKCRV	éé Ä	CCCP	CSRCMKCM	CMM	
CM	`~	CR	eO	RKNNN	éé Ä	NKO	CTCQSCQRTM	CM	
RN	s	UV	eÉ	MKMCR	éé Ä	VPKU	PSNKNO	N	
RO	`ê	UV	eÉ	MKMNN	éé Ä	TKS	TUPKCM	N	
RR	j å	UV	eÉ	MKMNN	éé Ä	NSRT	NPPPKU	MQ	
RS	cÉ	UV	eO	QKOVO	éé Ä	SKO	RSUSUKUU	CM	
RV	`ç	UV	eÉ	MKMMQ	éé Ä	CCRKN	CCCQCR	MO	
SM	ká	UV	eÉ	JMKMMQ	éé Ä	kL^	NCCKCO	MQ	
SP	`ì	UV	eÉ	MKMNN	éé Ä	CRRT	PVUKVM	MS	
SS	wå	UV	eÉ	MKMCU	éé Ä	RCKM	NUMKMM	O	
TR	^ë	UV	eÉ	MKMPQ	éé Ä	PKQ	PUKMM	N	
TU	pÉ	UV	eO	MKMCP	éé Ä	CSKV	COKMM	N	
UU	pê	UV	eÉ	MKMCM	éé Ä	NCKV	TPKPP	N	
VR	j ç	UV	eÉ	MKNRU	éé Ä	NMKN	CSRKRT	N	
NMT	^Ö	UV	eÉ	MKMCR	éé Ä	NPKS	CCQUKVM	MO	
NNN	`Ç	UV	eÉ	MKMCO	éé Ä	CKT	CVKCS	MO	
NNU	på	NRV	eÉ	MKMRN	éé Ä	VKV	PMSKSU	N	
NCN	pÄ	NRV	kç=d~ë	MKMNN	éé Ä	CNKR	USCKCU	MO	
NPT	_~	NRV	kç=d~ë	MKMCR	éé Ä	CUKQ	CMPKRR	MQ	
NUO	t	NRV	kç=d~ë	MKNRV	éé Ä	NTKR	OTMVKUN	N	
OMR	qä	OMV	kç=d~ë	MKMRT	éé Ä	TKR	CNSRKUN	MO	
OMU	mÄ	OMV	kç=d~ë	JMKMCS	éé Ä	kL^	NTCNKUU	MO	
OPO	qÜ	OMV	kç=d~ë	MKMUM	éé Ä	PKU	QVMSKNO	N	
OPU	r	OMV	kç=d~ë	MKMCT	éé Ä	NPRT	NMMTKTT	MO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=çï	B n`=cäÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	NVSTTMSKUR	NKP	NTURRSOKNS	NNMO	RVKR	NOMQ	
pÅ	CR	kç=d~ë	PUCUCCCKSU	MKT	CCRCCUNKTO	VMQS	RVKR	NOMQ	
pÅ	CR	eO	URUVPTKUR	MKO	NMNCTCMRN	UQKSR	RVKR	NOMQ	
pÅ	CR	eÉ	NCCMVCKSQ	MKT	NCUSRRMQ	UPKCU	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VRCPNMKNQ	MKT	NMCUNSRKPO	VCKUO	RVKR	NOMQ	
dÉ	TO	eO	PRUCCNKTR	MKR	CNPCVUKVS	USKSQ	RVKR	NOMQ	
dÉ	TO	eÉ	VVTMTKMS	MKS	NNSPVNKSQ	URKST	RVKR	NOMQ	
v	UV	eO	CNCCTRPKCN	MKV	CRVPNCCKTO	UVKU	RVKR	NOMQ	
v	UV	eÉ	SSTUMPKCO	MKT	TVMSMNKUR	UCKCT	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SURTSUVKTP	MKV	SCRNNMCKSR	NMSKP	RVKR	NOMQ	
qÄ	NRV	eÉ	CCUTCNUKVN	CKN	OTRCTPNKTP	VMKOV	RVKR	NOMQ	
_á	OMV	kç=d~ë	PSCSNMVKNO	NKT	PCCVPUTKTP	NNCKCN	RVKR	NOMQ	
_á	OMV	eÉ	NCVMVTPKPQ	NKT	NRSMNCCKRR	VRKRT	RVKR	NOMQ	

KATAHDIN ANALYTICAL SERVICES, LLC
METALS ANALYSIS RUN INFORMATION SHEET

INSTR. ID: L (Agilent 7800) **ANALYST**: EAM **ANALYSIS DATE**: 03/30/23

METHOD: **ICP-MS**
- ☐ 200.8
- ☑ 6020
- ☑ DOD

FILE NAME: LQC30A

Reviewed By: KS 4/6/23

The pHs of all samples that were tested by direct analysis in this analytical run were checked just prior to analysis and confirmed to be <2. The time of preservation of these samples was checked in the "Measured Turbidity and Preservation of Incoming Samples" logbook to verify that they had been preserved at least 16 hours prior to analysis. These verifications were performed by ——— (initials) on ——— (date).

STANDARDS USED:

Standard Name	Standard ID	Prep Date	Expiration Date	Standard Conc.
Cal Blk/ICB/CCB	MW21411	03/02/23	03/02/24	0 ug/L
Cal Std	MW21445	03/27/23	05/31/23	Varies by Element
ICV	MW21429	03/15/23	06/14/23	Varies by Element
PQL	MW21447	03/27/23	05/31/23	Varies by Element
LRS1	MW21454	03/28/23	05/31/23	Varies by Element
LRS2	MW21450	03/27/23	05/31/23	Varies by Element
ICSA	MW21441	03/24/23	03/31/23	Varies by Element
ICSAB	MW21448	03/27/23	04/03/23	Varies by Element
CCV	MW21455	03/28/23	05/31/23	Varies by Element
Internal Standard (ISTD)	N/A	N/A	N/A	0.2 mg/L (Li,Sc,Ge/Y,Tb,Bi)

Additional Comments and Notes:

Samples with ISTD RSDs > 8% were reanalyzed immediately.

ISTD was manually added to all standards and samples (0.08 mL of MS2459 to 8 mL).

Dilutions: Some samples were diluted based on history or due to interfering element concentrations.

Dilution preparations are as follows:

5x diln.: 1.6 mL of sample (pipet M30) + 6.4 mL of MW21411 (pipet M31)

10x diln.: 0.8 mL of sample (pipet M19) + 7.2 mL of MW21411 (pipet M31)

25x diln.: 0.32 mL of sample(pipet M19) + 7.68 mL of MW21411 (pipet M31)

Post Spike: 0.08 mL of MW21329 (pipet M27) into 8 mL final volume of appropriately diluted sample (pipet M31)

INSTRUMENT RUNLOG

Instrument: AGILENT 7800

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
CalBlank	1	LQC30A	03/30/2023	16:44	EAM
CalStd	1	LQC30A	03/30/2023	16:50	EAM
ICV	1	LQC30A	03/30/2023	16:58	EAM
ICB	1	LQC30A	03/30/2023	17:04	EAM
PQL	1	LQC30A	03/30/2023	17:09	EAM
ICSA	1	LQC30A	03/30/2023	17:14	EAM
ICSAB	1	LQC30A	03/30/2023	17:19	EAM
LRS1	1	LQC30A	03/30/2023	17:24	EAM
LRS2	1	LQC30A	03/30/2023	17:36	EAM
RINSE	1	LQC30A	03/30/2023	17:41	EAM
CCV	1	LQC30A	03/30/2023	17:46	EAM
CCB	1	LQC30A	03/30/2023	17:54	EAM
RINSE	1	LQC30A	03/30/2023	17:59	EAM
CCV	1	LQC30A	03/30/2023	18:04	EAM
CCB	1	LQC30A	03/30/2023	18:12	EAM
CCV	1	LQC30A	03/30/2023	18:17	EAM
CCB	1	LQC30A	03/30/2023	18:25	EAM
PBWQC17IMW2	5	LQC30A	03/30/2023	18:30	EAM
LCSWQC17IMW2	5	LQC30A	03/30/2023	18:35	EAM
SQ0960-001	5	LQC30A	03/30/2023	18:42	EAM
SQ0960-002	5	LQC30A	03/30/2023	18:48	EAM
SQ0960-003	5	LQC30A	03/30/2023	18:53	EAM
SQ0960-004	5	LQC30A	03/30/2023	18:58	EAM
SQ0960-005	5	LQC30A	03/30/2023	19:03	EAM
SQ0960-006	5	LQC30A	03/30/2023	19:08	EAM
SQ0960-007	5	LQC30A	03/30/2023	19:13	EAM
SQ0960-008	5	LQC30A	03/30/2023	19:18	EAM
CCV	1	LQC30A	03/30/2023	19:23	EAM
CCB	1	LQC30A	03/30/2023	19:31	EAM
SQ0960-009	5	LQC30A	03/30/2023	19:36	EAM
SQ0960-010	5	LQC30A	03/30/2023	19:41	EAM
SQ0960-012	5	LQC30A	03/30/2023	19:46	EAM
SQ0960-013	5	LQC30A	03/30/2023	19:51	EAM
PBSQC21IMS1	5	LQC30A	03/30/2023	19:56	EAM
LCSOQC21IMS1	5	LQC30A	03/30/2023	20:02	EAM
SQ0982-001	5	LQC30A	03/30/2023	20:07	EAM
SQ0982-002	5	LQC30A	03/30/2023	20:12	EAM
SQ0982-003	5	LQC30A	03/30/2023	20:17	EAM
SQ0982-006	5	LQC30A	03/30/2023	20:22	EAM
CCV	1	LQC30A	03/30/2023	20:27	EAM
CCB	1	LQC30A	03/30/2023	20:35	EAM
SQ0982-008	5	LQC30A	03/30/2023	20:40	EAM
SQ0993-001	5	LQC30A	03/30/2023	20:45	EAM
SQ0993-001L	25	LQC30A	03/30/2023	20:50	EAM

SAMPLE ID	DF	FILE	DATE	TIME	ANALYST
SQ0993-001A	5	LQC30A	03/30/2023	20:55	EAM
SQ0993-001S	5	LQC30A	03/30/2023	21:00	EAM
SQ0993-001P	5	LQC30A	03/30/2023	21:05	EAM
SQ0993-002	5	LQC30A	03/30/2023	21:13	EAM
SQ0993-003	5	LQC30A	03/30/2023	21:18	EAM
SQ0993-004	5	LQC30A	03/30/2023	21:23	EAM
SQ0993-005	5	LQC30A	03/30/2023	21:28	EAM
CCV	1	LQC30A	03/30/2023	21:33	EAM
CCB	1	LQC30A	03/30/2023	21:41	EAM
SQ0993-006	5	LQC30A	03/30/2023	21:46	EAM
SQ0993-007	5	LQC30A	03/30/2023	21:51	EAM
SQ0993-008	5	LQC30A	03/30/2023	21:56	EAM
SQ0993-009	5	LQC30A	03/30/2023	22:01	EAM
PBWQC21IMW1	5	LQC30A	03/30/2023	22:06	EAM
LCSWQC21IMW1	5	LQC30A	03/30/2023	22:11	EAM
SQ0982-004	5	LQC30A	03/30/2023	22:18	EAM
SQ0982-005	5	LQC30A	03/30/2023	22:23	EAM
SQ0993-023	5	LQC30A	03/30/2023	22:29	EAM
SQ0993-024	5	LQC30A	03/30/2023	22:34	EAM
CCV	1	LQC30A	03/30/2023	22:39	EAM
CCB	1	LQC30A	03/30/2023	22:46	EAM
PBWQC21IMW2	5	LQC30A	03/30/2023	22:51	EAM
LCSWQC21IMW2	5	LQC30A	03/30/2023	22:57	EAM
SQ1015-024	5	LQC30A	03/30/2023	23:03	EAM
SQ1201-009	5	LQC30A	03/30/2023	23:09	EAM
SQ1201-010	5	LQC30A	03/30/2023	23:14	EAM
SQ1201-012S	5	LQC30A	03/30/2023	23:19	EAM
SQ1201-012P	5	LQC30A	03/30/2023	23:26	EAM
PBSQC22IMS1	5	LQC30A	03/30/2023	23:31	EAM
LCSOQC22IMS1	5	LQC30A	03/30/2023	23:36	EAM
SQ0993-010	5	LQC30A	03/30/2023	23:41	EAM
CCV	1	LQC30A	03/30/2023	23:46	EAM
CCB	1	LQC30A	03/30/2023	23:54	EAM
SQ0993-011	5	LQC30A	03/30/2023	23:59	EAM
SQ0993-012	5	LQC30A	03/31/2023	00:04	EAM
SQ0993-013	5	LQC30A	03/31/2023	00:09	EAM
SQ0993-014	5	LQC30A	03/31/2023	00:14	EAM
SQ0993-015	5	LQC30A	03/31/2023	00:20	EAM
SQ0993-016	5	LQC30A	03/31/2023	00:25	EAM
SQ0993-017	5	LQC30A	03/31/2023	00:30	EAM
SQ0993-018	5	LQC30A	03/31/2023	00:35	EAM
SQ0993-019	5	LQC30A	03/31/2023	00:40	EAM
SQ0993-020	5	LQC30A	03/31/2023	00:45	EAM
CCV	1	LQC30A	03/31/2023	00:50	EAM
CCB	1	LQC30A	03/31/2023	00:58	EAM
SQ0993-021	5	LQC30A	03/31/2023	01:03	EAM
SQ0993-022	5	LQC30A	03/31/2023	01:08	EAM

US EPA Tune Check Report

Operator Name	admin
Acq/Data Batch	D:\Agilent\ICPMH\1\DATA\2023\03-MAR\LQC30A.b
Acq. Date-Time	3/30/2023 15:35:59
Report Comment	---
Instrument Name	G8421A SG18503526

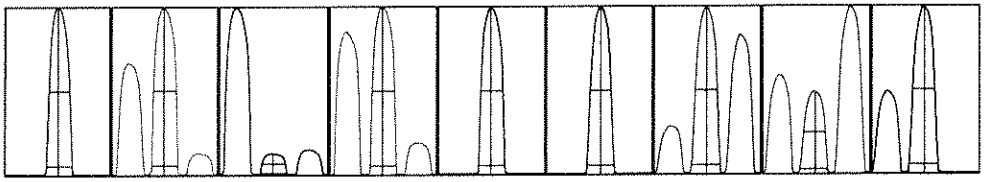
[No Gas]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
9	10.00	64931	649312.58	2.682	5.000	
24	10.00	261838	2618376.01	2.377	5.000	
25	10.00	32806	328057.27	2.485	5.000	
26	10.00	38831	388313.87	2.767	5.000	
59	10.00	474147	4741467.88	2.256	5.000	
115	10.00	538744	5387443.25	2.625	5.000	
206	10.00	107861	1078611.25	2.733	5.000	
207	10.00	91978	919779.75	2.593	5.000	
208	10.00	181077	1810770.12	2.531	5.000	

Integration Time [sec] 0.1

Resolution/Axis



Mass	Peak Height	Axis	Axis (Required)	Axis (Flag)
9	66167.97	9.05	8.90 - 9.10	
24	261436.35	24.00	23.90 - 24.10	
25	33146.18	25.00	24.90 - 25.10	
26	38666.78	26.00	25.90 - 29.10	
59	477500.17	59.00	58.90 - 59.10	
115	540998.86	115.05	114.90 - 115.10	
206	111616.53	206.00	205.90 - 206.10	
207	92516.59	207.00	206.90 - 207.10	
208	188697.66	208.00	207.90 - 208.10	

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
9	0.58	0.734	0.900	
24	0.65	0.744	0.900	
25	0.65	0.742	0.900	

US EPA Tune Check Report

Mass	W-50%	W-5%	W-5% (Required)	W-5% (Flag)
26	0.64	0.741	0.900	
59	0.63	0.741	0.900	
115	0.59	0.774	0.900	
206	0.62	0.810	0.900	
207	0.61	0.787	0.900	
208	0.62	0.817	0.900	

Integration Time [sec] 0.1
Acquisition Time [sec] 47.0000000000001
Y Axis Linear

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.56 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	13.0 V
Extract 2	-250.0 V	Cell Entrance	-40 V	Plate Bias	-40 V
Omega Bias	-85 V	Cell Exit	-60 V		

Cell Parameters

Use Gas	No	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-8.0 V		
H2 Flow	0.0 mL/min	OctP RF	130 V		

QP Parameters

Mass Gain	120	Axis Gain	0.9982	QP Bias	-3.0 V
Mass Offset	126	Axis Offset	0.13		

Hardware Settings

Torch

Torch H	-0.1 mm	Torch V	0.8 mm

EM

Discriminator	3.5 mV	Analog HV	2217 V	Pulse HV	1221 V

[H2]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	45181	451808.46	2.883	5.000	
89	10.00	50077	500766.51	2.621	5.000	
205	10.00	41845	418451.54	2.073	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

US EPA Tune Check Report

Plasma Mode	HMI	Nebulizer Gas	0.56 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-18.0 V		
H2 Flow	5.0 mL/min	OctP RF	200 V		

QP Parameters

Mass Gain	120	Axis Gain	0.9982	QP Bias	-13.0 V
Mass Offset	126	Axis Offset	0.13		

Hardware Settings

Torch

Torch H	-0.1 mm	Torch V	0.8 mm		

EM

Discriminator	3.5 mV	Analog HV	2217 V	Pulse HV	1221 V

[He]

Sensitivity

Mass	Conc. [ug/l]	Count	CPS	RSD%	RSD% (Required)	RSD% (Flag)
59	10.00	106435	1064351.28	3.467	5.000	
89	10.00	8218	82182.62	3.184	5.000	
205	10.00	16558	165577.71	2.614	5.000	

Integration Time [sec] 0.1

Tune Parameters

Plasma Parameters

Plasma Mode	HMI	Nebulizer Gas	0.56 L/min	Dilution Gas	0.33 L/min
RF Power	1600 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.20 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	10.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	10.0 V	Deflect	0.0 V
Extract 2	-250.0 V	Cell Entrance	-50 V	Plate Bias	-60 V
Omega Bias	-85 V	Cell Exit	-70 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	4.5 mL/min	OctP Bias	-18.0 V		
H2 Flow	0.0 mL/min	OctP RF	200 V		

QP Parameters

US EPA Tune Check Report

Mass Gain	120	Axis Gain	0.9982	QP Bias	-13.0 V
Mass Offset	126	Axis Offset	0.13		

Hardware Settings

Torch

Torch H	-0.1 mm	Torch V	0.8 mm		

EM

Discriminator	3.5 mV	Analog HV	2217 V	Pulse HV	1221 V

p~ã éäÉ=k~ã É ofk pb

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a~í~=m~íÜ=k~ã É aWjl ÖäÉåíyî mj eyNya^q^yOVOPyVPJ ^oyi n` PlV^kÅ

^Åè=qáã É PLPMLOVOP=NRVQMVQM

p~ã éäÉ=qóéÉ p~ã éäÉ

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pÅ	CR	k ç=d ~ë	VUCVfRP	NKV	M		RVfR	NCVKQ	
pÅ	CR	e O	CVSVRTS	CQN	M		RVfR	NCVKQ	
pÅ	CR	e É	CRRKCV	NKS	M		RVfR	NCVKQ	
d É	TO	k ç=d ~ë	PCRNKfM	PKU	M		RVfR	NCVKQ	
d É	TO	e O	PCVKVQ	MKS	M		RVfR	NCVKQ	
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v	UV	e É	NTNKVT	NNKR	M		RVfR	NCVKQ	eäÖÜ=fpqa=ɵpa
qÄ	NRV	k ç=d ~ë	SRNKCP	SKN	M		RVfR	NCVKQ	
qÄ	NRV	e É	CQVKVS	TKM	M		RVfR	NCVKQ	
_á	CMV	k ç=d ~ë	CUCNKNO	NKR	M		RVfR	NCVKQ	
_á	CMV	e É	NNRCKRM	SKQ	M		RVfR	NCVKQ	

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pÅ	QR	e O	NSMRKTV	OKT	M		RVKR	NOMKQ	
pÅ	QR	e É	ONOKSP	OKQ	M		RVKR	NOMKQ	
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d É	TO	e O	PQRKVQ	QKV	M		RVKR	NOMKQ	
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v	UV	e É	NNVKPN	TKS	M		RVKR	NOMKQ	
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^Åè=qáã É PLPMLOVOP=NRVRMVRN

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v	UV	e O	SRVfUV	NKM	M		RVfR	NOMQ	
v	UV	e É	NVRfPN	SfT	M		RVfR	NOMQ	
qÄ	NRV	k ç=d ~ë	RPVfOQ	NfO	M		RVfR	NOMQ	
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pÅ	CR	e O	NRQVKNO	PKT	M		RVKR	NOMKQ	
pÅ	CR	e É	OMOKSP	RKT	M		RVKR	NOMKQ	
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d É	TO	e O	PQSKSN	PKM	M		RVKR	NOMKQ	
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v	UV	e É	NMOKSR	NQKS	M		RVKR	NOMKQ	eäÖÜ=fpqa=ɵpa
qÄ	NRV	k ç=d ~ë	RQMKRT	RKN	M		RVKR	NOMKQ	
qÄ	NRV	e É	OOPKVS	NNKQ	M		RVKR	NOMKQ	eäÖÜ=fpqa=ɵpa
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_á	OMV	e É	URQKRP	QKQ	M		RVKR	NOMKQ	

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i á	S	k ç=d ~ë	TMSTKMO	PKM	M		RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	RNPNKVR	OKS	M		RVKR	NOMQ	
pÅ	QR	e O	NMVOKRN	OKO	M		RVKR	NOMQ	
pÅ	QR	e É	NPVKVT	NMKU	M		RVKR	NOMQ	eäÖÜ=fpqa=ɵpa
d É	TO	k ç=d ~ë	OUPVKTR	NKR	M		RVKR	NOMQ	
d É	TO	e O	OOVKOV	VKT	M		RVKR	NOMQ	eäÖÜ=fpqa=ɵpa
d É	TO	e É	SPKVV	UKP	M		RVKR	NOMQ	eäÖÜ=fpqa=ɵpa
v	UV	e O	OVPKPM	NSKM	M		RVKR	NOMQ	eäÖÜ=fpqa=ɵpa
v	UV	e É	PRKVV	PSKQ	M		RVKR	NOMQ	eäÖÜ=fpqa=ɵpa
qÄ	NRV	k ç=d ~ë	NQVKVT	UKP	M		RVKR	NOMQ	eäÖÜ=fpqa=ɵpa
qÄ	NRV	e É	RPKVV	NVKO	M		RVKR	NOMQ	eäÖÜ=fpqa=ɵpa
_á	OMV	k ç=d ~ë	NNQMKRM	QKM	M		RVKR	NOMQ	
_á	OMV	e É	RTVKVM	RKO	M		RVKR	NOMQ	

p~ã éäÉ=k~ã É ofk pb

cãÉ=k~ã É MVSpj mi kÇ

a~í~=m~íÜ=k~ã É aVyl ÖäÉåíyl mj eyNya^q^yOVOPyVPJ ^oyi n` PlV^kÅ

^Åè=qáã É PLPMLOVOP=NSWSVRS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå NKVMMM

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n` =fpqa=q~ÄäÉ

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i á	S	k ç=d ~ë	SUOSKRQ	OKR	M		RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	RNQNKVS	NKM	M		RVKR	NOMQ	
pÅ	QR	e O	NNOPKNT	QKO	M		RVKR	NOMQ	
pÅ	QR	e É	NQMSQ	NOKV	M		RVKR	NOMQ	eäÖÜ=fpqa=ɵpa
d É	TO	k ç=d ~ë	OTPSKQO	QKQ	M		RVKR	NOMQ	
d É	TO	e O	OQPKVR	SKR	M		RVKR	NOMQ	
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v	UV	e O	NQUSQ	NTKM	M		RVKR	NOMQ	eäÖÜ=fpqa=ɵpa
v	UV	e É	QPKPO	NQKU	M		RVKR	NOMQ	eäÖÜ=fpqa=ɵpa
qÄ	NRV	k ç=d ~ë	NPNKVT	NTKO	M		RVKR	NOMQ	eäÖÜ=fpqa=ɵpa
qÄ	NRV	e É	NMTKVU	NSKN	M		RVKR	NOMQ	eäÖÜ=fpqa=ɵpa
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_á	OMV	e É	RQTKVN	OKS	M		RVKR	NOMQ	

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cäÉ=k~ã É	MMTpj mi KÇ
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^Åè=qáã É	PLPMLOMOP=NSWNWRN
p~ã éäÉ=qóéÉ	p~ã éäÉ
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p~ã éäÉ=n` =m~ëëLcá~ä	m~ëë
fpqa=n` =m~ëëLc~äã	c~äã

n` =^å~äóíÉ=q~ÄäÉ

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n` =fpqa=q~ÄäÉ

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pÅ	QR	k ç=d ~ë	RORTKPN	NKN	M		RVKR	NOMKQ	
pÅ	QR	e O	NNPTKUP	PKV	M		RVKR	NOMKQ	
pÅ	QR	e É	NQPKVT	OKQ	M		RVKR	NOMKQ	
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v	UV	e O	NSPKPM	NQKN	M		RVKR	NOMKQ	eäÖÜ=fpqa=opa
v	UV	e É	OQKVM	UKP	M		RVKR	NOMKQ	eäÖÜ=fpqa=opa
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^ Åè=qãã É	PLPMLOMOP=NSWNTWMT
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n` =^ å~äóíÉ=q~ÄäÉ

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V	_É	S	k ç=d ~ë	NQTKTU	ONKQ
NN	_	S	k ç=d ~ë	RRTKUM	NSKR
OP	k~	QR	e É	SNOOOKVT	NKN
OQ	j Ö	QR	e É	RMUKVO	MKU
OT	^ä	QR	e É	NVSKST	VKM
OU	pá	QR	e O	QSPKUP	OMKQ
PV	h	QR	e É	PNUQMKQO	MKQ
QM	` ~	QR	e O	NRVPRKUN	MKT
RN	s	UV	e É	OUMKMN	SKS
RO	` ê	UV	e É	VUOKRO	SKT
RR	j å	UV	e É	NNPKVU	NSKT
RS	cÉ	UV	e O	SPMUKNM	RKO
RV	` ç	UV	e É	NPTKTV	OUKQ
SM	k á	UV	e É	NQRKRS	TKM
SP	` ì	UV	e É	QMNKNP	NMKT
SS	wå	UV	e É	NQPKPQ	NQKN
TR	^ë	UV	e É	NTKPP	PPKU
TU	pÉ	UV	e O	PKRM	RNKR
UU	pê	UV	e É	NSKST	TOKN
VR	j ç	UV	e É	SSKST	NUKM
NMT	^Ö	UV	e É	UKUV	QPKP
NNN	` Ç	UV	e É	RKNV	POKU
NNU	på	NRV	e É	NOSKST	OTKU
NON	pÄ	NRV	k ç=d ~ë	NTSKUR	PKP
NPT	_~	NRV	k ç=d ~ë	PSKTM	QNKT
NUO	t	NRV	k ç=d ~ë	TSTKRM	TKQ
OMR	qä	OMV	k ç=d ~ë	OPPKRU	NPKN
OMU	mÄ	OMV	k ç=d ~ë	NMSTKUN	UKO
OPO	qÜ	OMV	k ç=d ~ë	NTMRKOS	SKT
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n` =fpqa=q~ÄäÉ

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pÅ	QR	k ç=d ~ë	QNPOURVKOV	NKT
pÅ	QR	e O	VSTMNQKQR	NKT
pÅ	QR	e É	NQRVTPKSU	MKP
d É	TO	k ç=d ~ë	VTSNRPKTQ	NKN
d É	TO	e O	QMNQMNKQP	NKU
d É	TO	e É	NNQVTRKVM	MKR
v	UV	e O	QQRUVMVKMP	NKO
v	UV	e É	TSVTRUKUT	NKO
qÄ	NRV	k ç=d ~ë	SMPRPQSKPN	MKV
qÄ	NRV	e É	OSNTNSPKSV	MKO
_á	OMV	k ç=d ~ë	PMSVVTPKVQ	NKR
_á	OMV	e É	NROQVVPKVQ	MKU

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p~ã éáÉ=k~ã É	`~äpíÇ
cáÉ=k~ã É	MMV^ipkÇ
a~í~=m~íÜ=k~ã É	aWÿ^ÖáÉáíÿ^mj eyNya^q^yOMOPyMPJ^oyin`PM^kÄ
^Åè=qáã É	PLPMLOMOP=NSWOOMU
p~ã éáÉ=qóéÉ	`~äpíÇ
qçí~äaãäíáçå	NKMMMM
`çãã ÉåáÍ	JJJ
fpqa=oÉÑcáÉk~ã É	MMU^i_kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~áä	c~áä
l éÉê~íçê	**~Çã áã**

n`=^å~äóíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	==i mp==	opa
V	_É	S	kç=d~ë	POVVUTKTN	MKP
NN	_	S	kç=d~ë	ONOVTMKUP	MKR
OP	k~	QR	eÉ	TURCONNKNM	MKV
OQ	j Ö	QR	eÉ	QNUCNSRKUT	NKO
OT	^ä	QR	eÉ	NRQVRMKMO	NKP
OU	pá	QR	eO	RSCSRNKCP	NKR
PV	h	QR	eÉ	PRTQSMVKPV	MKP
QM	`~	QR	eO	QNSUSPVMKQV	NKM
RN	s	UV	eÉ	CRCQCNKCR	MKS
RO	`ê	UV	eÉ	PMVVUNKCR	MKT
RR	j å	UV	eÉ	NRRUTSKRQ	MKT
RS	cÉ	UV	eO	NQSMRCRMQKMO	MKV
RV	`ç	UV	eÉ	RQPPNVKRO	MKT
SM	ká	UV	eÉ	NRNRNNKSP	MKS
SP	`ì	UV	eÉ	QNVPSVKTP	NKQ
SS	wå	UV	eÉ	TNUVUKOV	MKT
TR	^ë	UV	eÉ	RRNSUKVO	MKR
TU	pÉ	UV	eO	PMRQUKOV	MKQ
UU	pê	UV	eÉ	NUUSVMKVQ	MKT
VR	j ç	UV	eÉ	NUNPMSKOM	MKT
NMT	^Ö	UV	eÉ	SRPVSVKQU	MKU
NNN	`Ç	UV	eÉ	UUTPSKUT	MKT
NNU	på	NRV	eÉ	NTQOSRKQM	NKM
NON	pÄ	NRV	kç=d~ë	NOSVMQOKNU	NKP
NPT	_~	NRV	kç=d~ë	PSVNUVKVP	MKO
NUO	t	NRV	kç=d~ë	TQNRVOKQN	NKM
OMR	qä	OMV	kç=d~ë	NSQPOMSKNQ	MKR
OMU	mÄ	OMV	kç=d~ë	OONOTQNKQT	MKO
OPO	qÜ	OMV	kç=d~ë	NVUNMOTKRQ	NKP
OPU	r	OMV	kç=d~ë	NUPURSVKTQ	NKS

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eáÖÜ	n`=eä~Ö
iá	S	kç=d~ë	OOMSOQNKOQ	MKV	NTSPPOVKSQ	NORKNO	RVKR	NOMKQ	SMOMa ça
pÅ	QR	kç=d~ë	RNNUUOTKUS	NKM	QNPOURVKOV	NOPKUS	RVKR	NOMKQ	SMOMa ça
pÅ	QR	eO	NNVUTUNKVV	MKS	VSTMNQKQR	NOPKVT	RVKR	NOMKQ	SMOMa ça
pÅ	QR	eÉ	NTRNTMKOP	MKQ	NQRVTPKSU	NOOM	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	NOOVRUNKSO	MKQ	VTSNRPKTQ	NORKVS	RVKR	NOMKQ	SMOMa ça
dÉ	TO	eO	QVNTNPKRN	MKS	QMNQVNKQP	NOOKR	RVKR	NOMKQ	SMOMa ça
dÉ	TO	eÉ	NPSUNTKRS	MKR	NNQVTRKV	NNV	RVKR	NOMKQ	
v	UV	eO	ROVOVURKQU	NKN	QQRUVMVKMP	NNUKTN	RVKR	NOMKQ	
v	UV	eÉ	VMQPSMKOT	MKQ	TSVTRUKUT	NNTKQV	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	TTNVUUMKTT	NKO	SMPRPQSKPN	NOTKVN	RVKR	NOMKQ	SMOMa ça
qÄ	NRV	eÉ	PNPPQVUKUS	NKS	OSNTNSPKSV	NNVKTP	RVKR	NOMKQ	
_á	OMV	kç=d~ë	PVNURNQKPU	NKP	PMSVVTPKVQ	NOTKSQ	RVKR	NOMKQ	SMOMa ça
_á	OMV	eÉ	NUPMVRQKQR	MKN	NRCQVVPKVQ	NOOM	RVKR	NOMKQ	

fåáíá~ëà=~ëáÄÂê~íáçå=sÉêáÑáÅ~íáçå=Ef`sF=oÉéçêí

p~ãéäÉ=k~ãÉ	f`s
cãÉ=k~ãÉ	MNMjf`sKÇ
a~í~=m~íÜ=k~ãÉ	aWjÖãÉáíjf`mj eyNya^q^yOMCPyMPJj^oyjn`PM^hÅ
^Åè=qáãÉ	PLPMLOMCP=NSWPOWV
p~ãéäÉ=qóéÉ	f`s
qçí~äaãäíáçå	NKMMMM
`çããÉåí	JJJ
fpqa=oÉÑÉcãÉk~ãÉ	MMJ^i_KÇ
p~ãéäÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~åä	c~åä
léÉê~íçê	~Çãáå

n`=^å~äöíÉ=q~ÄäÉ

j~ëë	k~ãÉ	fpqa	qìåÉ	`çåÅK	råäë	opa	==mp==	bñés~ä	B=oÉÅ	Bíçï	BeáÖÜ	n`=cä~Ö
V	_É	S	kç=cl~ë	CMKNTU	éëÄ	CKU	NPMVSPKCN	CCM	NMVKUV	UVKS	NNMKQ	
NN	_	S	kç=cl~ë	CNKQRS	éëÄ	NKO	VMCNNKCU	CCM	NMTKCU	UVKS	NNMKQ	
CP	k~	QR	eÉ	QCPPPKUCR	éëÄ	NKM	PPCPMMCKNS	QMMM	NMRKUR	UVKS	NNMKQ	
CQ	jÖ	QR	eÉ	QNVMKCNP	éëÄ	MKR	NTCVUURKMQ	QMMM	NMQKTS	UVKS	NNMKQ	
CT	^ä	QR	eÉ	QNTTKSNP	éëÄ	MKQ	SPVVVKQD	QMM	NMQKQ	UVKS	NNMKQ	
CU	pá	QR	eO	PVVMMRN	éëÄ	CKM	CCNCNTKMN	QMM	VVKTS	UVKS	NNMKQ	
PV	h	QR	eÉ	QNVPKCMV	éëÄ	NKT	NRMNPTCKCR	QMMM	NMQKUP	UVKS	NNMKQ	
QM	`~	QR	eO	QNMCKSVP	éëÄ	NKM	NSUPSVQRKMP	QMMM	NMCKRT	UVKS	NNMKQ	
RN	s	UV	eÉ	CMKCMQ	éëÄ	NKS	NMPCQCKTV	CCM	NMNKMD	UVKS	NNMKQ	
RO	`ê	UV	eÉ	CMKMMM	éëÄ	MKU	NCSRUTKCR	CCM	NMMKR	UVKS	NNMKQ	
RR	jå	UV	eÉ	CMKOSU	éëÄ	MKV	SPVNNKPM	CCM	NMNKPQ	UVKS	NNMKQ	
RS	cÉ	UV	eO	QMCTKQVQ	éëÄ	NKM	RUVVURPPKNO	QMMM	NMMKSV	UVKS	NNMKQ	
RV	`ç	UV	eÉ	CMKQUP	éëÄ	MKT	CCQVQSKRV	CCM	NMCKQD	UVKS	NNMKQ	
SM	ká	UV	eÉ	CMKMMT	éëÄ	MKT	SNSRRKTT	CCM	NMMKRQ	UVKS	NNMKQ	
SP	`ì	UV	eÉ	CMKQNN	éëÄ	NKN	NTPCCVKVV	CCM	NMCKMS	UVKS	NNMKQ	
SS	wå	UV	eÉ	CNKCQS	éëÄ	MKQ	PMVSNKOT	CCM	NMSKCP	UVKS	NNMKQ	
TR	^ë	UV	eÉ	CMKCMN	éëÄ	NKN	CCRPMKRN	CCM	NMNKMN	UVKS	NNMKQ	
TU	pÉ	UV	eO	NVKUNO	éëÄ	NKQ	NCNQNKPT	CCM	VVKMS	UVKS	NNMKQ	
UU	pê	UV	eÉ	CMKRCR	éëÄ	NKR	TUCSPKUQ	CCM	NMCKSO	UVKS	NNMKQ	
VR	jç	UV	eÉ	QMCQCS	éëÄ	NKM	NQUNMPKTM	QCM	NMNKMS	UVKS	NNMKQ	
NMT	^Ö	UV	eÉ	CMKQCM	éëÄ	MKU	CSVUCSKNT	CCM	NMCKN	UVKS	NNMKQ	
NNN	`Ç	UV	eÉ	CMKSQQ	éëÄ	MKU	PTMNUKMU	CCM	NMPKCO	UVKS	NNMKQ	
NNU	på	NRV	eÉ	CMKNCN	éëÄ	MKS	TNCCUKPR	CCM	NMMKS	UVKS	NNMKQ	
NCN	pÄ	NRV	kç=cl~ë	NVKUQT	éëÄ	PKR	RMCCQMKQN	CCM	VVKCQ	UVKS	NNMKQ	
NPT	_~	NRV	kç=cl~ë	CMKPTR	éëÄ	CKR	NRMSMPKCN	CCM	NMNKUU	UVKS	NNMKQ	
NUO	t	NRV	kç=cl~ë	CNKVPR	éëÄ	CKR	PCSNUCKUR	CCM	NMVKST	UVKS	NNMKQ	
QMR	qä	QMV	kç=cl~ë	CMKMMR	éëÄ	CKM	STNSRSKST	CCM	NMMKMD	UVKS	NNMKQ	
QMU	mÄ	QMV	kç=cl~ë	NVKVNR	éëÄ	NKM	VMNNPPKPU	CCM	VVKRT	UVKS	NNMKQ	
QPO	qÜ	QMV	kç=cl~ë	NVKTUN	éëÄ	CKT	UMNVCNKMU	CCM	VUKV	UVKS	NNMKQ	
QPU	r	QMV	kç=cl~ë	NVKSCS	éëÄ	QKV	TPSTURKUR	CCM	VUKMP	UVKS	NNMKQ	

n`=fpqa=q~ÄäÉ

k~ãÉ	j~ëë	qìåÉ=jçÇÉ	`mp	`mp=opa	oÉÑÉmp	B=oÉÅ	Bn`=íçï	Bn`=eáÖÜ	n`=cä~Ö
íá	S	kç=cl~ë	CNSURQSKCR	CKM	NTSPPCVKSQ	NCCKVU	RVKR	NCMKQ	SMCMa ça
pÅ	QR	kç=cl~ë	RMVCNNSKRV	MKT	QNPCURVKCV	NCPKCS	RVKR	NCMKQ	SMCMa ça
pÅ	QR	eO	NNTVRMSKMV	CKN	VSTMNQKCR	NCNKVT	RVKR	NCMKQ	SMCMa ça
pÅ	QR	eÉ	NTCUUNKCV	NKO	NQRVTPKSU	NNUKQP	RVKR	NCMKQ	
dÉ	TO	kç=cl~ë	NCPPTPCKCN	NKV	VTSNRPKTQ	NCSKPV	RVKR	NCMKQ	SMCMa ça
dÉ	TO	eO	QTQPNVKTV	MKU	QMNQMNKQP	NNUKNT	RVKR	NCMKQ	
dÉ	TO	eÉ	NPSUUUKSN	MKO	NNQVTRKV	NNVMKS	RVKR	NCMKQ	
v	UV	eO	RPMTVVTKNU	MKS	QQRUVMVMKP	NNVMKQ	RVKR	NCMKQ	
v	UV	eÉ	VNPSMUKCO	MKQ	TSVTRUKUT	NNUKSV	RVKR	NCMKQ	
qÄ	NRV	kç=cl~ë	TTCSRPRMKD	MKS	SMPRPQSKPN	NCUKMD	RVKR	NCMKQ	SMCMa ça
qÄ	NRV	eÉ	PNTUCUQKSQ	NKN	CSNTNSPKSV	NCNKQR	RVKR	NCMKQ	SMCMa ça
_á	QMV	kç=cl~ë	QMMCVQTKPS	CKN	PMSVVTPKVQ	NPMKPV	RVKR	NCMKQ	SMCMa ça
_á	QMV	eÉ	NUVTQSQKNP	MKU	NRCQVVPKVQ	NCQKCO	RVKR	NCMKQ	SMCMa ça

fåáá~ä=`~äáÄê~íáçå=_ä~åâ=Ef`_F=oÉéçã

p~ã éäÉ=k~ã É	f`_
cäÉ=k~ã É	MNNJf`_IÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOMOPyMPJ ^oyi n` PM^hÂ
^Åè=qáã É	PLPMLOMOP=NSNPVWQO
p~ã éäÉ=qóéÉ	f`_
qçí~äa ãäíáç~å	NKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑ=cäÉk~ã É	MMJ^i_IÇ
p~ã éäÉ=n` =m~ëëlc á~ä	m~ëë
fpqa=n` =m~ëëlc~äã	m~ëë
I éÉê~íçê	**~Çã áã**

n` =^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çåÄK	r åáë	opa	==\ mp==	iãäá	n` =c~ä~Ö
V	_É	S	kç=d~ë	MKMOP	éé Ä	OKU	OTUKVM	MO	
NN	_	S	kç=d~ë	MOOSM	éé Ä	NVS	NQUQKRR	Q	
OP	k~	QR	eÉ	NKUNR	éé Ä	SRKQ	SMNUTKON	OMM	
OQ	j Ö	QR	eÉ	PKQQR	éé Ä	NMKO	NSQQKPU	OM	
OT	^ä	QR	eÉ	MKUUN	éé Ä	VQKR	ONOKOP	OM	
OU	pá	QR	eO	MKTNQ	éé Ä	SQKT	TUMVUR	NMM	
PV	h	QR	eÉ	TKRVP	éé Ä	PTKM	POUSVKMS	OMM	
QM	` ~	QR	eO	QKNTO	éé Ä	PKQ	OVSVOKQU	OM	
RN	s	UV	eÉ	MKMMS	éé Ä	OSNKN	OVOKOP	N	
RO	` ê	UV	eÉ	MKMMU	éé Ä	NSPKR	VUTKNU	N	
RR	j å	UV	eÉ	MKMOO	éé Ä	UKQ	NSRKVT	MQ	
RS	cÉ	UV	eO	QKOQV	éé Ä	PKM	RSVTSKSR	OM	
RV	` ç	UV	eÉ	MKMNO	éé Ä	OVKU	OPRKRT	MO	
SM	k á	UV	eÉ	MKMOO	éé Ä	QQKO	NVQKQR	MQ	
SP	` ì	UV	eÉ	MKMNT	éé Ä	OVKP	RMNKNP	MS	
SS	wå	UV	eÉ	MKMMS	éé Ä	URKP	NQRKRS	O	
TR	^ë	UV	eÉ	MKMOU	éé Ä	NPKM	QNKST	N	
TU	pÉ	UV	eO	MKMST	éé Ä	SKS	PSKUP	N	
UU	pê	UV	eÉ	MKMNV	éé Ä	MKS	TPKPP	N	
VR	j ç	UV	eÉ	MOOSN	éé Ä	RKV	UPUKVP	N	
NMT	^Ö	UV	eÉ	MKMNV	éé Ä	ONKM	OMTKTU	MO	
NNN	` Ç	UV	eÉ	MKMNR	éé Ä	OOKP	OSKSS	MO	
NNU	på	NRV	eÉ	MKMRR	éé Ä	ONKT	OTUKVM	N	
NON	pÄ	NRV	kç=d~ë	MKMPP	éé Ä	NRKR	UTMKVR	MO	
NPT	_~	NRV	kç=d~ë	MKMOT	éé Ä	ORKN	OMMKON	MQ	
NUO	t	NRV	kç=d~ë	MOOOR	éé Ä	RKT	PTVNKOP	N	
OMR	qä	OMV	kç=d~ë	MKMSP	éé Ä	OMKU	NVSOKOO	MO	
OMU	mÄ	OMV	kç=d~ë	MKMNT	éé Ä	NVKV	NTPUKRR	MO	
OPO	qÜ	OMV	kç=d~ë	MKMNU	éé Ä	PQKR	OPTSKMT	N	
OPU	r	OMV	kç=d~ë	MKMOP	éé Ä	NRKU	TMTKQR	MO	

n` =fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÁ	B n` =ç ï	B n` =cåÜÜ	n` =c~ä~Ö
iá	S	kç=d~ë	NUNSOSPKMO	MKV	NTSPPOVKSQ	NMP	RVKR	NOMKQ	
pÅ	QR	kç=d~ë	QMVNVUOKUQ	OKP	QNPOURVKOV	VVKMN	RVKR	NOMKQ	
pÅ	QR	eO	VRURNTKPO	NKQ	VSTMNQKQR	VVKNO	RVKR	NOMKQ	
pÅ	QR	eÉ	NQMTVUKNN	MKP	NQRVTPKSU	VSKQR	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	VTUPMTKNN	PKQ	VTSNRPKTQ	NMMKOO	RVKR	NOMKQ	
dÉ	TO	eO	PUVTSQKVN	MKS	QMNQMNKQP	VTKN	RVKR	NOMKQ	
dÉ	TO	eÉ	NNONTRKTM	NKR	NNQVTRKV	VTKRS	RVKR	NOMKQ	
v	UV	eO	QPPTOVUKOT	MKU	QQRUVMVKMP	VTKOT	RVKR	NOMKQ	
v	UV	eÉ	TQMVROKON	MKR	TSVTRUKUT	VSKNQ	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	SPQVRMNKUN	NKS	SMPRPQSKPN	NMRKMS	RVKR	NOMKQ	
qÄ	NRV	eÉ	ORQQUOSKUP	MKP	OSNTNSPKSV	VTKNS	RVKR	NOMKQ	
_á	OMV	kç=d~ë	POOPRVOKUO	NKQ	PMSVVTPKVQ	NMR	RVKR	NOMKQ	
_á	OMV	eÉ	NQVUPSNKOR	MKU	NROQVVPKVQ	VUKOR	RVKR	NOMKQ	

` ~äÄÂê~íáçå=_ä~åâ=oÉéçê

p~ã éäÉ=k~ã É	` ~ä_ä~åâ
cãÉ=k~ã É	MNO ^ i _ KÇ
a~í~=m~íÜ=k~ã É	a Wy^ ÖäÉáíyf` mj e yNya ^ q^ yOMOPyMPJj ^ o yi n ` PM^ kÄ
^ Åè=qãã É	PLPMLOMOP=NSWQOWQV
p~ã éäÉ=qóéÉ	` ~ä_äâ
qçí~ä=a ãä íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=o ÉÑcãÉk~ã É	MNO ^ i _ KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	m~ëë
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	==` mp==	o pa
V	_É	S	k ç=d ~ë	NUMKMM	VKS
NN	_	S	k ç=d ~ë	NMVMKMS	UKS
OP	k~	QR	e É	RURSRKOP	MKU
OQ	j Ö	QR	e É	TTNKNS	VKP
OT	^ä	QR	e É	NUTKTU	NNKU
OU	pá	QR	e O	RRPKVP	NRKM
PV	h	QR	e É	PNSVNKTO	NKT
QM	` ~	QR	e O	NUTSUKOM	MKT
RN	s	UV	e É	OPRKRS	NMKM
RO	` ê	UV	e É	VQUKRO	QKP
RR	j å	UV	e É	NNTKVU	QKR
RS	cÉ	UV	e O	NUSVUKUM	PKQ
RV	` ç	UV	e É	NMSKST	NMKU
SM	k á	UV	e É	NQMKMM	NMKV
SP	` ì	UV	e É	QNMKMN	NOKR
SS	wå	UV	e É	NQRKRS	NMKP
TR	^ë	UV	e É	ORKPP	OPKN
TU	pÉ	UV	e O	NQKST	OUKS
UU	pê	UV	e É	OSKSS	ONKT
VR	j ç	UV	e É	QQUKVN	QKU
NMT	^Ö	UV	e É	RRKRS	QMKM
NNN	` Ç	UV	e É	VKSP	RVKO
NNU	på	NRV	e É	NUUKUV	NPKO
NON	pÄ	NRV	k ç=d ~ë	PTTKMT	QKN
NPT	_~	NRV	k ç=d ~ë	TPKQN	OMKU
NUO	t	NRV	k ç=d ~ë	OOURKVS	VKU
OMR	qä	OMV	k ç=d ~ë	USQKOU	NOKQ
OMU	mÄ	OMV	k ç=d ~ë	NMTQKQV	OKU
OPO	qÜ	OMV	k ç=d ~ë	NSOUKRM	QKQ
OPU	r	OMV	k ç=d ~ë	OOMKOP	NRKT

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa
i á	S	k ç=d ~ë	NTSNRRMKRM	NKT
pÅ	QR	k ç=d ~ë	QNOVNNUKRM	MKU
pÅ	QR	e O	VQNPSMKUR	NKN
pÅ	QR	e É	NQMPOUKRR	MKO
d É	TO	k ç=d ~ë	VUORTUKMV	MKT
d É	TO	e O	PVNMQPKOQ	MKQ
d É	TO	e É	NNOOOOKSN	NKM
v	UV	e O	QPPRROOKON	NKS
v	UV	e É	TQRQNOKMP	MKS
qÄ	NRV	k ç=d ~ë	SNSRONVKVS	NKT
qÄ	NRV	e É	ORRVVQSKOM	MKR
_á	OMV	k ç=d ~ë	PNTNNVSKMP	NKM
_á	OMV	e É	NRMOPPVKST	NKM

` ~äãÄê~íáçå=pí~åÇ~êÇ=oÉéçã

p~ã éäÉ=k~ã É	` ~äpíÇ
cãÉ=k~ã É	MNP` ^i pKÇ
a~í~=m~íÜ=k~ã É	a Wy^ ÖäÉáíyf` mj e yNya ^q^ yOMOPyWPJj ^o yi n` PM^ kÄ
^Åè=qãã É	PLPMLOMOP=NSWRMMMM
p~ã éäÉ=qóéÉ	` ~äpíÇ
qçí~ä=a ãä íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑ=cãÉk~ã É	MNO` ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	m~ëë
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	==` mp==	opa
V	_É	S	k ç=d ~ë	OSUSRMKVP	MKQ
NN	_	S	k ç=d ~ë	NTQVONKUM	NKQ
OP	k~	QR	e É	SQUVTQUKMN	NKU
OQ	j Ö	QR	e É	PQNMOTQKPO	MKV
OT	^ä	QR	e É	NORRTNKQS	NKM
OU	pá	QR	e O	QRMTMRKPV	NKQ
PV	h	QR	e É	OVPSNUMKVN	OKP
QM	` ~	QR	e O	PPSNNPRMKPP	MKQ
RN	s	UV	e É	OMSSNTKOS	NKQ
RO	` ê	UV	e É	OROOVTKRQ	MKV
RR	j å	UV	e É	NORPPSKQU	NKS
RS	cÉ	UV	e O	NNUPPRUMUKPN	MKQ
RV	` ç	UV	e É	QQMQPVKOR	MKO
SM	k á	UV	e É	NOPNNMKOO	MKV
SP	` ì	UV	e É	PQNURVKQV	NKR
SS	wå	UV	e É	RUONUKMT	MKV
TR	^ë	UV	e É	QQUQOKUM	NKM
TU	pÉ	UV	e O	OQQPMKMO	NKO
UU	pê	UV	e É	NRNOUSKMO	NKN
VR	j ç	UV	e É	NQSNRVKUN	MKV
NMT	^Ö	UV	e É	RPVVURKVO	MKV
NNN	` Ç	UV	e É	TPMNQKRM	MKT
NNU	på	NRV	e É	NQMVORKMU	MKR
NON	pÄ	NRV	k ç=d ~ë	NMPNPRPKPV	NKO
NPT	_~	NRV	k ç=d ~ë	PMTRUUKTQ	MKR
NUO	t	NRV	k ç=d ~ë	SMQTOQKNM	NKO
OMR	qä	OMV	k ç=d ~ë	NPQPRPPKMO	NKU
OMU	mÄ	OMV	k ç=d ~ë	NURQSTQKMQ	NKM
OPO	qÜ	OMV	k ç=d ~ë	NSRPOSVKOV	OKR
OPU	r	OMV	k ç=d ~ë	NRROPRNKUT	NKU

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÅ	B n` =i çï	B n` =eäÖÜ	n` =cä~Ö
i á	S	k ç=d ~ë	NURONOUKQT	MKV	NTSNRRMKR	NMRKNQ	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QNSQVSTKVR	NKQ	QNOVNNUKR	NMMKUT	RVKR	NOMKQ	
pÅ	QR	e O	VSTMPQKTV	NKP	VQNPSMKUR	NMOKTP	RVKR	NOMKQ	
pÅ	QR	e É	NQOSTPKQN	NKS	NQMPOUKRR	NMNKST	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VVPMVMKQR	NKO	VUORTUKMV	NMNKMT	RVKR	NOMKQ	
d É	TO	e O	PVMRSMKPQ	NKM	PVNMQPKOQ	VVKUU	RVKR	NOMKQ	
d É	TO	e É	NNNQQPKVN	MKP	NNOOOOKSN	VVKPN	RVKR	NOMKQ	
v	UV	e O	QPTTQTTKOU	NKN	QPPRROOKON	NMMKVT	RVKR	NOMKQ	
v	UV	e É	TPPOOSKNU	MKV	TQRQNOKMP	VUKPT	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SPUNSOPKOS	MKU	SNSRONVKVS	NMPKRN	RVKR	NOMKQ	
qÄ	NRV	e É	ORUTVNMKNO	NKM	ORRVVQSKO	NMNKMV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	POUVOQNKTV	NKP	PNTNNVSKMP	NMPKTO	RVKR	NOMKQ	
_á	OMV	e É	NRNVOUOKUM	MKR	NRMOPPVKST	NMNKNP	RVKR	NOMKQ	

fåáíá~ëà=~ëáÄÂê~íáçå=sÉëëÑÅ~íáçå=Ef`sF=oÉéçê

p~ã éäÉ=k~ã É	f`s
cãÉ=k~ã É	MNQf`sKÇ
a~í~=m~íÜ=k~ã É	aWÿÖãÉáíÿf`mj eyNya^q^yQMCPyMPJ ^oyi n` PMMKÅ
^Åè=qáã É	PLPMLOMCP=NSWRUMRV
p~ã éäÉ=qóéÉ	f`s
qçí~äaãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MNO^i_KÇ
p~ã éäÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	~Çã áå

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råäë	opa	==mp==	bñés~ä	B=oÉÅ	Bi çï	BeáÖÜ	n`=c~ä-Ö
V	_É	S	kç=cl~ë	CMKSUO	ééÄ	MKU	NMSURCKVN	CM	NMMKVN	UVKS	NNMQ	
NN	_	S	kç=cl~ë	CNKCRV	ééÄ	MRT	TPURCKTR	CM	NMSKP	UVKS	NNMQ	
CP	k~	CR	eÉ	CNTRKPQV	ééÄ	CKO	OTNMVUURTU	CMMM	NMCKPU	UVKS	NNMQ	
CQ	j Ö	CR	eÉ	CNPVRTSP	ééÄ	NKM	NPVROSVKSM	CMMM	NMPKQV	UVKS	NNMQ	
CT	^ä	CR	eÉ	CQMRKNP	ééÄ	NKR	RCOTUKVP	CMM	NMRKNP	UVKS	NNMQ	
CU	pá	CR	eO	CMPKUT	ééÄ	NKO	NTVRVCKTO	CMM	NMMKUO	UVKS	NNMQ	
PV	h	CR	eÉ	CNQPKSUQ	ééÄ	MKS	NCOMRPCKNO	CMMM	NMPKRV	UVKS	NNMQ	
CM	`~	CR	eO	CNOCKMVS	ééÄ	MKU	NPSUCUUTKMO	CMMM	NMPKN	UVKS	NNMQ	
RN	s	UV	eÉ	CMMVU	ééÄ	NKP	UOTTCKOO	CM	NMMCQV	UVKS	NNMQ	
RO	`ê	UV	eÉ	CMKPVS	ééÄ	MKU	NMOVQVKON	CM	NMNKVU	UVKS	NNMQ	
RR	j å	UV	eÉ	CMSRR	ééÄ	MKP	RNRUVKSN	CM	NMPKOU	UVKS	NNMQ	
RS	cÉ	UV	eO	CMRSKVSQ	ééÄ	PKM	QTTMRVNVKSS	CMMM	NMNKQO	UVKS	NNMQ	
RV	`ç	UV	eÉ	CMRTPQ	ééÄ	MKV	NUNTUUKSR	CM	NMPKST	UVKS	NNMQ	
SM	ká	UV	eÉ	CMSUU	ééÄ	MRT	RMTSRKQO	CM	NMPKQQ	UVKS	NNMQ	
SP	`ì	UV	eÉ	CMSCOS	ééÄ	MKU	NQMRRTKPO	CM	NMPKNP	UVKS	NNMQ	
SS	wå	UV	eÉ	CNKCRU	ééÄ	NKO	CQTNPKPM	CM	NMSKOV	UVKS	NNMQ	
TR	^ë	UV	eÉ	CMKPNQ	ééÄ	MKS	NUNQCKMM	CM	NMNKRT	UVKS	NNMQ	
TU	pÉ	UV	eO	CMKSTN	ééÄ	NKN	VUMNKVU	CM	NMMKUS	UVKS	NNMQ	
UU	pê	UV	eÉ	CMRTTQ	ééÄ	MKR	SCRRTKOT	CM	NMPKUT	UVKS	NNMQ	
VR	j ç	UV	eÉ	CMRTTT	ééÄ	MKP	NNUSUCKUT	CM	NMNKVQ	UVKS	NNMQ	
NMT	^Ö	UV	eÉ	CMKPCQ	ééÄ	MKR	ONUQCNKOV	CM	NMNKSO	UVKS	NNMQ	
NNN	`Ç	UV	eÉ	CMKQNS	ééÄ	MKP	OVSTMKVP	CM	NMCKMU	UVKS	NNMQ	
NNU	på	NRV	eÉ	CMKOTS	ééÄ	MKR	RTMNSKVU	CM	NMNKPU	UVKS	NNMQ	
NON	pÄ	NRV	kç=cl~ë	CMKONP	ééÄ	NKN	QNRMPNKMN	CM	NMNKMS	UVKS	NNMQ	
NPT	_~	NRV	kç=cl~ë	CMKQMV	ééÄ	NKU	NCQVRPKNU	CM	NMCKMQ	UVKS	NNMQ	
NUO	t	NRV	kç=cl~ë	COKMVP	ééÄ	CKR	OSTNRQKVT	CM	NNMKQS	UVKS	NNMQ	[=HLJ=NMB
OMR	qä	OMV	kç=cl~ë	CMRTRS	ééÄ	MKU	RRTTVTKMO	CM	NMPKTU	UVKS	NNMQ	
OMU	mÄ	OMV	kç=cl~ë	CMKPUQ	ééÄ	MKR	TRSMCUKSO	CM	NMNKVO	UVKS	NNMQ	
OPO	qÜ	OMV	kç=cl~ë	CMKNQR	ééÄ	NKQ	SSSQRNKNS	CM	NMMKTO	UVKS	NNMQ	
OPU	r	OMV	kç=cl~ë	NVKVNN	ééÄ	NKP	SNTSPNKTU	CM	VVKRS	UVKS	NNMQ	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑë mp	B=oÉÅ	Bn`=i çï	Bn`=eáÖÜ	n`=c~ä-Ö
iá	S	kç=cl~ë	NUCPNUSKTP	NKN	NTSNRRMKR	NMPKR	RVKR	NOMQ	
pÅ	CR	kç=cl~ë	CNCCMPUKRU	MKS	CNOVNNUKR	VVKUP	RVKR	NOMQ	
pÅ	CR	eO	VRPTNNKCR	NKM	VCNPSMKUR	NMNKPN	RVKR	NOMQ	
pÅ	CR	eÉ	NCMVRNKCQ	MKS	NCMPCUKRR	NMMKQQ	RVKR	NOMQ	
dÉ	TO	kç=cl~ë	VVRPQTKPT	NKS	VUCRTUKMV	NMNKP	RVKR	NOMQ	
dÉ	TO	eO	PUURSTKMR	NKO	PVNMCPKCQ	VVKPT	RVKR	NOMQ	
dÉ	TO	eÉ	NNNNCRKSM	NKU	NNCCCCKSN	VVKMD	RVKR	NOMQ	
v	UV	eO	CPQVVCUKPT	NKT	CPPRRCCKCN	NMMKPP	RVKR	NOMQ	
v	UV	eÉ	TOVRSNKCM	MKT	TCRCNCKMP	VTKUT	RVKR	NOMQ	
qÄ	NRV	kç=cl~ë	SPCVRTCKCN	NKO	SNSRCNVKVS	NMCKVV	RVKR	NOMQ	
qÄ	NRV	eÉ	CRTSSSCQKRU	MKU	CRRVVCQSKO	NMMKSR	RVKR	NOMQ	
_á	OMV	kç=cl~ë	PCURTMVKTV	NKO	PNTNNVSKMP	NMPKSN	RVKR	NOMQ	
_á	OMV	eÉ	NRNCRPRKVT	MKQ	NRMCPPVKST	NMMKUN	RVKR	NOMQ	

fåáá<ë=~ëÄÂê~íáçå=_ä<åâ=Ef`_F=oÉéçã

p~ã éäÉ=k~ã É	f`_
cäÉ=k~ã É	MNRf`_ÍÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyi n`PM^hÂ
^Åè=qáã É	PLPMLOMCP=NTWMCMS
p~ã éäÉ=qóéÉ	f`_
qçí~äa ãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑncäÉk~ã É	MNO^i_ÍÇ
p~ã éäÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äã	m~ëë
I éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	råáë	opa	==\ mp==	iãäá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MKMCU	ééÄ	VKM	POTKTV	MO	
NN	_	S	kç=d~ë	MCPO	ééÄ	RKS	NUUQKSM	Q	
CP	k~	QR	eÉ	RKRNP	ééÄ	PTKU	SMPCQKSR	CMM	
CQ	j Ö	QR	eÉ	RKPNV	ééÄ	NPKS	CQLUQKTU	CM	
OT	^ä	QR	eÉ	MKTNN	ééÄ	PRKV	OSTKTU	CM	
CU	pá	QR	eO	MKSRO	ééÄ	UKQ	UPQKOQ	NMM	
PV	h	QR	eÉ	QKVTQ	ééÄ	CQKO	PONUMKPP	CMM	
QM	`~	QR	eO	RKTNO	ééÄ	PKU	PTOOMKPS	CM	
RN	s	UV	eÉ	MKMNQ	ééÄ	ORKN	OUSKST	N	
RO	`ê	UV	eÉ	MKMCU	ééÄ	PMKT	NMRTKNT	N	
RR	j å	UV	eÉ	MKMOT	ééÄ	ORKR	NTVKVT	MQ	
RS	cÉ	UV	eO	RKTSO	ééÄ	SKT	UQTPPKMM	CM	
RV	`ç	UV	eÉ	MKMCO	ééÄ	NMKV	OVNKNP	MO	
SM	k á	UV	eÉ	MKMCO	ééÄ	RVKT	NVMKMN	MQ	
SP	`ì	UV	eÉ	MKMPR	ééÄ	NSKS	SPNKNQ	MS	
SS	wå	UV	eÉ	JMKMNP	ééÄ	kL^	NOSKST	O	
TR	^ë	UV	eÉ	MKMQO	ééÄ	QTKS	SOKMN	N	
TU	pÉ	UV	eO	MKMTR	ééÄ	NMKQ	RMKMM	N	
UU	pê	UV	eÉ	MKMOS	ééÄ	NPKN	NMQKQR	N	
VR	j ç	UV	eÉ	MKOTQ	ééÄ	NPKO	NOOPKQN	N	
NMT	^Ö	UV	eÉ	MKMOQ	ééÄ	NOKU	PNMKMN	MO	
NNN	`Ç	UV	eÉ	MKMOR	ééÄ	OQKQ	ORKVP	MO	
NNU	på	NRV	eÉ	MKMSR	ééÄ	PNKS	PTMKMN	N	
NON	pÄ	NRV	kç=d~ë	MKMPP	ééÄ	NQKR	NMOTKTV	MO	
NPT	_~	NRV	kç=d~ë	MKMPP	ééÄ	NUKP	OSSKVS	MQ	
NUO	t	NRV	kç=d~ë	MCOSP	ééÄ	NMKR	RPNSKTQ	N	
OMR	qä	OMV	kç=d~ë	MKMVM	ééÄ	RKQ	PNSTKMV	MO	
OMU	mÄ	OMV	kç=d~ë	MKMQQ	ééÄ	THP	OSNOKUT	MO	
OPO	qÜ	OMV	kç=d~ë	MKMQP	ééÄ	NMKS	OVSMKNS	N	
OPU	r	OMV	kç=d~ë	MKMPM	ééÄ	NOKU	NNMQKRS	MO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ= mp	B=oÉÁ	B n`=ç=ï	B n`=eáÜÜ	n`=c~ä~Ö
iá	S	kç=d~ë	NTURPRQKQQ	MKP	NTSNRRMKR	NMNKPR	RVKR	NOMQ	
pÅ	QR	kç=d~ë	QMPPRQMKRU	MKV	QNOVNNUKR	VTHSU	RVKR	NOMQ	
pÅ	QR	eO	VPRTUQKMP	NKU	VQNPSMKUR	VVKQN	RVKR	NOMQ	
pÅ	QR	eÉ	NPSQNRHSQ	MKT	NQMPQUKRR	VTHQN	RVKR	NOMQ	
dÉ	TO	kç=d~ë	VRTQMMKTU	MKP	VUQRTUKMV	VTHQQ	RVKR	NOMQ	
dÉ	TO	eO	PTVVOSKRP	NKO	PVNMQPKQQ	VTHSS	RVKR	NOMQ	
dÉ	TO	eÉ	NMVTSSKUU	NKN	NNQQQQKSN	VTHUN	RVKR	NOMQ	
v	UV	eO	QQSNOVVKMO	NKO	QPPRRQQKQN	VUKOV	RVKR	NOMQ	
v	UV	eÉ	TQPQQMKTU	MKO	TQRQNOKMP	VTHMR	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SNPSRMMKNO	NKM	SNSRONVKVS	VVKRP	RVKR	NOMQ	
qÄ	NRV	eÉ	ORRNVRUKVS	NKO	ORRVVQSKO	VVHSV	RVKR	NOMQ	
_á	OMV	kç=d~ë	PNPVPPVMPS	MKT	PNTNNVSKMP	VV	RVKR	NOMQ	
_á	OMV	eÉ	NRMQPONKNS	MKS	NRMQPPVMST	NMM	RVKR	NOMQ	

p~ã éáÉ=k~ã É	mmi
cäÉ=k~ã É	MNSif`sKÇ
a~í~=m~íÜ=k~ã É	aWi^ÖäÉáíyf`mj eyNya^q^yOMOPyMPJ ^oyi n` PM^kÂ
^Åè=qáã É	PLPMLOMOP=NTNWMWNP
p~ã éáÉ=qóéÉ	iif`s
qçí~äa äi íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=o ÉÑ¤cäÉk~ã É	MNO^i_KÇ
p~ã éáÉ=n` =m~ëëLcá~ä	m~ëë
fpqa=n` =m~ëëLc~äi	m~ëë
I éÉê~íçê	**~Çã áä**

n` =^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	bñés~ä	B o ÉÅ	B i çï	B eäÜÜ	n` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMVQ	éé Ä	CKO	NOVOCKOV	MO	VT	TVfR	NOMQ	
NN	_	S	k ç=d ~ë	CKNQQ	éé Ä	CKP	NRNTCKUR	Q	NVPfS	TVfR	NOMQ	
CP	k ~	CR	e É	OMTfKUOM	éé Ä	NfR	NUUTTSKQU	OMM	NVPfVN	TVfR	NOMQ	
CQ	j Ö	CR	e É	ONfPNU	éé Ä	RfV	TUSVfMT	OM	NVSfRV	TVfR	NOMQ	
OT	^ ä	CR	e É	ONfMUR	éé Ä	NfU	OTTMfPO	OM	NVRfQP	TVfR	NOMQ	
CU	p á	CR	e O	VUfRUM	éé Ä	PfT	QQQPMfRS	NMM	VUfRU	TVfR	NOMQ	
PV	h	CR	e É	OMNfNOV	éé Ä	OfM	UURRUfUR	OMM	NVMfRS	TVfR	NOMQ	
QM	` ~	CR	e O	OMfSSO	éé Ä	PfQ	UTOVTfV O	OM	NVPfPN	TVfR	NOMQ	
RN	s	UV	e É	NfUMR	éé Ä	NfU	QQNSfPP	N	NVMfR	TVfR	NOMQ	
RO	` ê	UV	e É	NfURR	éé Ä	CfP	SOVMfUT	N	NVRfR	TVfR	NOMQ	
RR	j å	UV	e É	MQQO	éé Ä	NfN	NCPQfQV	MQ	NNMfR	TVfR	NOMQ	
RS	cÉ	UV	e O	ONfCNQ	éé Ä	PfN	OTMPPUfRS	OM	NVSfMT	TVfR	NOMQ	
RV	` ç	UV	e É	MfONN	éé Ä	TfS	NVTRfTT	MO	NVRfR	TVfR	NOMQ	
SM	k á	UV	e É	MfPVQ	éé Ä	CfQ	NNNRfSO	MQ	VUfR	TVfR	NOMQ	
SP	` ì	UV	e É	MfSCO	éé Ä	OfT	QSUVfTS	MfS	NVPfST	TVfR	NOMQ	
SS	wå	UV	e É	OfMVV	éé Ä	RfP	OSMQfRO	O	NVQfVR	TVfR	NOMQ	
TR	^ ë	UV	e É	NfUPO	éé Ä	QfS	VRTfUM	N	NVPfO	TVfR	NOMQ	
TU	pÉ	UV	e O	NfURR	éé Ä	PfP	RPMfVV	N	NVRfR	TVfR	NOMQ	
UU	pê	UV	e É	NfVCR	éé Ä	PfP	PNRQfSQ	N	NVQfR	TVfR	NOMQ	
VR	j ç	UV	e É	NfUNM	éé Ä	PfU	PQNQfTO	N	NVN	TVfR	NOMQ	
NMT	^ Ö	UV	e É	MfUVQ	éé Ä	CfN	ONSTfVV	MO	VT	TVfR	NOMQ	
NNN	` Ç	UV	e É	MfOVR	éé Ä	CfO	PNNfUS	MO	NVQfR	TVfR	NOMQ	
NNU	på	NRV	e É	NfUMT	éé Ä	CfQ	PMRQfSO	N	NVMfT	TVfR	NOMQ	
NON	pÄ	NRV	k ç=d ~ë	MfOOM	éé Ä	OfR	QVNVfQM	MO	NNM	TVfR	NOMQ	
NPT	_~	NRV	k ç=d ~ë	MfQQS	éé Ä	VfO	OUNSfSM	MQ	NNNfR	TVfR	NOMQ	
NUO	t	NRV	k ç=d ~ë	MfVTQ	éé Ä	PfU	NQMSVfUO	N	VTfQ	TVfR	NOMQ	
OVR	qä	OMV	k ç=d ~ë	MfUVS	éé Ä	RfN	SMSQfRR	MO	VU	TVfR	NOMQ	
OMU	mÄ	OMV	k ç=d ~ë	MfONO	éé Ä	PfU	UUQPfUS	MO	NMS	TVfR	NOMQ	
OPO	qÜ	OMV	k ç=d ~ë	MfUUQ	éé Ä	OfV	TSQPfTO	MO	VO	TVfR	NOMQ	
OPU	r	OMV	k ç=d ~ë	MfUVV	éé Ä	RfS	SPONfSP	MO	VVfR	TVfR	NOMQ	

n` =fpqa=q~ÄáÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n` =i çï	B n` =c äÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	NUMTSVVfSO	NfQ	NTSNRRMfR	NVOfSO	RVfR	NOMQ	
pÅ	CR	k ç=d ~ë	ONOURQSfOQ	MfS	ONOVfNNUfR	VVfKV	RVfR	NOMQ	
pÅ	CR	e O	VRNVTOfMQ	NfR	VQNPSMfUR	NMNfNP	RVfR	NOMQ	
pÅ	CR	e É	NPVQPPfKP	NfN	NQMPOUfRR	VVfPS	RVfR	NOMQ	
d É	TO	k ç=d ~ë	VTUPVRfRM	MfV	VUORTUfVV	VVfRT	RVfR	NOMQ	
d É	TO	e O	PUTNVOfVO	NfR	PVNMQPfOQ	VUfVV	RVfR	NOMQ	
d É	TO	e É	NNNQVQfMS	NfN	NNOCOOfSN	VVfPR	RVfR	NOMQ	
v	UV	e O	QPURTNPfTN	NfQ	QPPRROOfON	NVNfNS	RVfR	NOMQ	
v	UV	e É	TPVPPNfVO	MfP	TQRQNOfMP	VVfNU	RVfR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPSVVVQfOR	MfR	SNSROMfVS	NVPfPO	RVfR	NOMQ	
qÄ	NRV	e É	OSNNPMQfQM	NfO	ORRVVQSfO	NVOfMN	RVfR	NOMQ	
_á	OMV	k ç=d ~ë	POQQSNUfVR	NfU	PNTNNVSfMP	NVOfOR	RVfR	NOMQ	
_á	OMV	e É	NROUSQPfTM	NfS	NRMOPPVfST	NVNfTR	RVfR	NOMQ	

fåíÉâÑÉêÉåÅÉ= ÜÉÅâ=pçàíç=^=Ef`pJ^F=oÉéçê

p~ã éáÉ=k~ã É	f`p^
cäÉ=k~ã É	MNTf`p^KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf`mj eyNya^q^yOMCPyMPJ ^oyi n`PM^hÅ
^Åè=qáã É	PLPMLOMCP=NTWKQMM
p~ã éáÉ=qóéÉ	f`p^
qçí~äaäã íáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MNO^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	m~ëë
fpqa=n`=m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeäÖÜ	n`=c ä~Ö
_É	V	S	k ç=d ~ë	JMKMP	éé Ä	kL^	NUMKMN	JMKN	NMM	NMM	
_	NN	S	k ç=d ~ë	MKQTT	éé Ä	SKN	OMMCKRS	JO	NMM	NMM	
k~	CP	CR	e É	NMPCPSKMP	éé Ä	MKU	SNQNNRRQKPV	NMMMMM	UM	NCM	
j Ö	CQ	CR	e É	NMPURPKUNV	éé Ä	NKN	POTPMVSVKQQ	NMMMMM	UM	NCM	
^ä	CT	CR	e É	NMVOSTKNQT	éé Ä	MKV	NOSSPUMSKVM	NMMMMM	UM	NCM	
pá	CU	CR	e O	QRTTV	éé Ä	NMKN	CRRSKUN	JRM	NMM	NMM	
h	PV	CR	e É	NMNSSTKMN	éé Ä	MKO	OTPNSVMQKQM	NMMMMM	UM	NCM	
`~	QM	CR	e O	NMQQSVKMM	éé Ä	MKT	PPMMCPVRTHPM	NMMMMM	UM	NCM	
s	RN	UV	e É	MKMQT	éé Ä	PNKM	PVUKVM	JMR	NMM	NMM	
`ê	RO	UV	e É	QKNQO	éé Ä	NKT	NMVSSKNS	NHR	NMM	NMM	
j å	RR	UV	e É	MKRCP	éé Ä	QKM	NPPTHNR	MKNT	NMM	NMM	
cÉ	RS	UV	e O	NMPUURKMN	éé Ä	NKV	NNRRURONMQKTO	NMMMMM	UM	NCM	
`ç	RV	UV	e É	MKNNP	éé Ä	SKQ	NMPNKNU	M	NMM	NMM	
ká	SM	UV	e É	MKQQM	éé Ä	RHP	NNQPKQM	MKNU	NMM	NMM	
`ì	SP	UV	e É	MKNNN	éé Ä	RKO	NMVNKNT	JMCO	NMM	NMM	
wå	SS	UV	e É	NHPVN	éé Ä	OKU	NSQVHMO	MKQ	NMM	NMM	
^ë	TR	UV	e É	MKMQM	éé Ä	CUKU	RTHPQ	JMR	NMM	NMM	
pÉ	TU	UV	e O	MKMPR	éé Ä	THR	PMKNT	JMR	NMM	NMM	
pê	UU	UV	e É	MKUPM	éé Ä	NKQ	CPTSKVO	MHPT	NMM	NMM	
j ç	VR	UV	e É	OOSVKQMP	éé Ä	NKM	SNVVPVRNTQ	OMMM	UM	NCM	
^Ö	NMT	UV	e É	MKMNS	éé Ä	NRKS	ONMKMN	JMKN	NMM	NMM	
`Ç	NNN	UV	e É	MKPQT	éé Ä	QKU	QUQKMV	MKCU	NMM	NMM	
på	NNU	NRV	e É	MKMTM	éé Ä	CRKV	PSTKTV	JMR	NMM	NMM	
pÄ	NON	NRV	k ç=d ~ë	MKMRT	éé Ä	NNKU	NSMNKTV	JMKMR	NMM	NMM	
_~	NPT	NRV	k ç=d ~ë	MKRPP	éé Ä	QKN	PQNTHPU	MHPP	NMM	NMM	
t	NUO	NRV	k ç=d ~ë	MKNCQ	éé Ä	VKT	PVCQHTS	JMHPP	NMM	NMM	
qä	OMR	OMV	k ç=d ~ë	JMKMNM	éé Ä	kL^	SQTHPT	JMKN	NMM	NMM	
mÄ	OMU	OMV	k ç=d ~ë	MKMPV	éé Ä	VHM	CRVSKNV	JMKMU	NMM	NMM	
qÜ	OPO	OMV	k ç=d ~ë	MKNNP	éé Ä	OCHR	ONRVKNS	JMKN	NMM	NMM	
r	OPU	OMV	k ç=d ~ë	MKNNU	éé Ä	NNHM	TVMKUT	JMKMU	NMM	NMM	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=ïçï	Bn`=eäÖÜ	n`=c ä~Ö
iá	S	k ç=d ~ë	NVNRSQPHPQ	NKU	NTSNRRMR	NMUKTR	RVHR	NOMQ	
pÅ	CR	k ç=d ~ë	PVVRPTVHPU	MKV	QNOVNNUHR	VSHTS	RVHR	NOMQ	
pÅ	CR	e O	VMVPCOCKCR	MKT	VQNPSMKUR	VSHS	RVHR	NOMQ	
pÅ	CR	e É	NPNUTRHPO	MKU	NQMPCUKRR	VPHVU	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VTRRNSHPR	MKT	VUCRTUMVV	VVHCU	RVHR	NOMQ	
d É	TO	e O	PSUPTNKTQ	NKM	PVNMCPHCQ	VQHO	RVHR	NOMQ	
d É	TO	e É	NMQPOTHPS	MKO	NNCCCCCHSN	VOKVS	RVHR	NOMQ	
v	UV	e O	QNNSSQRKNS	NKQ	QPPRRCOCKCN	VQKVR	RVHR	NOMQ	
v	UV	e É	SUTCQNKQU	MHP	TQRQNOMVP	VOHO	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQVRVQMPR	NKQ	SNSRONVKVS	NVRHPS	RVHR	NOMQ	
qÄ	NRV	e É	CQQTTRMKTO	MKS	CRRVVQSHO	VRHSO	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PPQNPMSKCN	NKO	PNTNNVSHMP	NVRHPS	RVHR	NOMQ	
_á	OMV	e É	NPUTOMCKQV	MKT	NRMCPPVHST	VOHPQ	RVHR	NOMQ	

fåíÉêÑÉêÉåÅÉ=ÜÉÅâ=pçäîÉåí=^_=Ef`pJ^_F=oÉéçêí

p~ã éáÉ=k~ã É	f`p^_
cäÉk~ã É	MNUf`p_KÇ
a~í~=m~íÜ=k~ã É	aWf`ÖäÉáíçf`mj eyNya^q^yOMOPyWPJ ^oyi n`PMVhÅ
^Åè=qáã É	PLPMLOMOP=NTMMVWV
p~ã éáÉ=qóéÉ	f`p_
qçí~äaäã íáçå	NMMMM
`çã ã Éåí	JJU
fpqa=oÉÑÉcäÉk~ã É	MNO ^i_KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~äí
fpqa=n`=m~ëëlc~äí	m~ëë
l éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	Bi çï	BeáÖÜ	n`=c ä~Ö
V	_É	S	kç=d~ë	NVRTMM	éé Ä	MKQ	NNNURQRTQ	OM	TVfR	NOMQ	
NN	_	S	kç=d~ë	OMSSO	éé Ä	NKO	TTMMUfST	OM	TVfR	NOMQ	
OP	k~	QR	eÉ	NVRRUCKUO	éé Ä	MKQ	SCQVVTTTKV	NMMMM	TVfR	NOMQ	
OQ	j Ö	QR	eÉ	NVRNURKOMT	éé Ä	MKV	POVUVMMTKUR	NMMMM	TVfR	NOMQ	
OT	^ä	QR	eÉ	NMUUUCKPPN	éé Ä	MKU	NORRUNPUKTM	NMMMM	TVfR	NOMQ	
OU	pá	QR	eO	SNRKRRU	éé Ä	MfR	ORTUUSKSN	RVM	TVfR	NOMQ	[=HLJ+NVB
PV	h	QR	eÉ	NMVRNVKMPS	éé Ä	MKU	OSUTSVMQKPU	NMMMM	TVfR	NOMQ	
QM	`~	QR	eO	NVQRSNKSUP	éé Ä	MKQ	POSORPVQQKMP	NMMMM	TVfR	NOMQ	
RN	s	UV	eÉ	OMfRMN	éé Ä	MfR	UMVOUKQN	OM	TVfR	NOMQ	
RO	`ê	UV	eÉ	OOKROV	éé Ä	NKN	NMTSVQKMS	OO	TVfR	NOMQ	
RR	j å	UV	eÉ	OMKTSU	éé Ä	MfS	QVNSQKST	OM	TVfR	NOMQ	
RS	cÉ	UV	eO	NVQMVKPTQ	éé Ä	MfR	NNRUNQMVSSKUQ	NMMMM	TVfR	NOMQ	
RV	`ç	UV	eÉ	OMfSOT	éé Ä	MfS	NTNQPOKNN	OM	TVfR	NOMQ	
SM	ká	UV	eÉ	OMfRNN	éé Ä	NfS	QTTTMNKQU	OM	TVfR	NOMQ	
SP	`ì	UV	eÉ	OMKQPV	éé Ä	MfS	NPOMNTKMV	OM	TVfR	NOMQ	
SS	wå	UV	eÉ	ONKVPN	éé Ä	NKO	OQNSMKVP	ONKQ	TVfR	NOMQ	
TR	^ë	UV	eÉ	OMfSVR	éé Ä	MKU	NTRNVKUM	OM	TVfR	NOMQ	
TU	pÉ	UV	eO	ONKMNN	éé Ä	OKN	VSSTHPV	OM	TVfR	NOMQ	
UU	pê	UV	eÉ	ONfSOT	éé Ä	MKO	SNTOVKQM	OMKV	TVfR	NOMQ	
VR	j ç	UV	eÉ	OPOOKQSM	éé Ä	NfR	SPUPNQSKUR	OMMM	TVfR	NOMQ	
NMT	^Ö	UV	eÉ	OMfOSN	éé Ä	NKQ	OMSPTTKVR	OM	TVfR	NOMQ	
NNN	`Ç	UV	eÉ	OMKUNM	éé Ä	NKO	OUSSPKQM	OM	TVfR	NOMQ	
NNU	på	NRV	eÉ	OMfRSO	éé Ä	NKM	RSTUQKVP	OM	TVfR	NOMQ	
NON	pÄ	NRV	kç=d~ë	NVKTNU	éé Ä	NfR	QPPVQPHSS	OM	TVfR	NOMQ	
NPT	_~	NRV	kç=d~ë	OMKPPV	éé Ä	NKQ	NPPQTTKQQ	OM	TVfR	NOMQ	
NUO	t	NRV	kç=d~ë	OPKOQQ	éé Ä	NKP	PMNNRRKVU	OM	TVfR	NOMQ	
OMR	qä	OMV	kç=d~ë	OMKQOV	éé Ä	NKO	RUPNPVKMR	OM	TVfR	NOMQ	
OMU	mÄ	OMV	kç=d~ë	OMKUVN	éé Ä	NKO	UOOVOPHPR	OM	TVfR	NOMQ	
OPO	qÜ	OMV	kç=d~ë	ONKTRN	éé Ä	MKP	TSQNMVKRO	OM	TVfR	NOMQ	
OPU	r	OMV	kç=d~ë	ONfSNU	éé Ä	NKO	TNOOSTKRM	OM	TVfR	NOMQ	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eáÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	NVRRMVCUKNU	MKQ	NTSNRRMVR	NNMKVU	RVfR	NOMQ	
pÅ	QR	kç=d~ë	QMSSPQOKSQ	NKM	QNOVNNUKR	VUKQU	RVfR	NOMQ	
pÅ	QR	eO	UVUNNPKVM	OKT	VQNPSMKUR	VRKQN	RVfR	NOMQ	
pÅ	QR	eÉ	NPNOPOKRM	MKV	NQMPOUKRR	VPKRO	RVfR	NOMQ	
dÉ	TO	kç=d~ë	VUPMUMKNQ	OKN	VUORTUKMV	NMMKMR	RVfR	NOMQ	
dÉ	TO	eO	PSVPRPKTN	NKV	PVNMVOPKOQ	VQKQR	RVfR	NOMQ	
dÉ	TO	eÉ	NMSPRVKUR	MfR	NNOOOOKSN	VQKTU	RVfR	NOMQ	
v	UV	eO	QNNVRSSKQN	OKQ	QPPRROOKON	VRKMO	RVfR	NOMQ	
v	UV	eÉ	SVNROPKNR	NKP	TQRQNOKMP	VOKTT	RVfR	NOMQ	
qÄ	NRV	kç=d~ë	SUMRQTNKUR	NKN	SNSRONVKVS	NNMKPU	RVfR	NOMQ	
qÄ	NRV	eÉ	ORPMITRPKUV	NKO	ORRVVQSKO	VUKUS	RVfR	NOMQ	
_á	OMV	kç=d~ë	PQVMVRQKRU	NKM	PNTNNVSKMP	NNMKMR	RVfR	NOMQ	
_á	OMV	eÉ	NQQPMSVKTM	MKQ	NRMOPPVfST	VSKMR	RVfR	NOMQ	

i åâÉ~ê¬ø~åÖÉ¬p~ã éäÉ¬Ei opF¬øÉéçã

p~ã éäÉ¬k~ã É	i opN
cäÉ¬k~ã É	MNM¦i opKÇ
a~í~¬m~íÜ¬k~ã É	aWy^ÖäÉáíyf^mj eyNya^q^yOMOPyMPJ ^o yi n` PM^kÅ
^Åè¬qáã É	PLPMLOMOP¬NTWØQWS
p~ã éäÉ¬qóéÉ	i op
qçí~äaãäí áç¿å	NKMMMM
` çã ã Éåí	JJJ
fpqa¬øÉÑcäÉk~ã É	MNO^i _KÇ
p~ã éäÉ¬n` ¬m~ëëLcá-ä	c~ää
fpqa¬n` ¬m~ëëLc~ää	m~ëë
I éÉê~íçê	**~Çã áã**

n` =^å~äöíÉ¬q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çåÅK	r åáë	opa	==¬ mp==	bñés~ä	B oÉÅ	B i çï	B eäÖÜ	n` ¬ø¿ä-Ö
V	_É	S	k ç¬ël ~ë	VUKMSO	éëÄ	OKP	RPQQPVMPV	NMM	VUKMS	UVMR	NNMQ	
NN	_	S	k ç¬ël ~ë	QTTKQMN	éëÄ	PKN	NSUPTUVKUT	RMM	VRKQU	UVMR	NNMQ	
RN	s	UV	e É	VTUKRPR	éëÄ	NKS	PSCRQVVKUQ	NMMM	VTKUR	UVMR	NNMQ	
RO	` ê	UV	e É	NVUVKRRT	éëÄ	NKP	UVTUQMSKSN	OMMM	VVKQU	UVMR	NNMQ	
RR	j å	UV	e É	NVTTKTSN	éëÄ	OKT	QQQSNTRKQN	OMMM	VUKUV	UVMR	NNMQ	
RV	` ç	UV	e É	NVOMKTRS	éëÄ	NKR	UMSVRQUMN	NMMM	NVOKMU	UVMR	NNMQ	
SM	k á	UV	e É	NVSMKQNM	éëÄ	OKT	CPQNMRTKQR	NMMM	NVSKMQ	UVMR	NNMQ	
SP	` ì	UV	e É	OMPOKMSQ	éëÄ	NKU	NCQRSQMNKPQ	OMMM	NMNKS	UVMR	NNMQ	
SS	wå	UV	e É	OMRQKOVT	éëÄ	PKO	ONQQNMOKPU	OMMM	NVOKTN	UVMR	NNMQ	
TR	^ë	UV	e É	VTNKMPU	éëÄ	NKP	TUNQNRKQN	NMMM	VTKNN	UVMR	NNMQ	
TU	pÉ	UV	e O	NVMOKMPP	éëÄ	OKM	QQTTPPKMM	NMMM	NVMKO	UVMR	NNMQ	
UU	pê	UV	e É	NVPOKQMS	éëÄ	MKU	RCQQTPRMSO	OMMM	VSKSO	UVMR	NNMQ	
VR	j ç	UV	e É	NVUMKMPO	éëÄ	NKQ	CUCRRRMKOM	NMMM	NMU	UVMR	NNMQ	
NMT	^Ö	UV	e É	NNSKTQS	éëÄ	NKP	NNPNSNRKST	NMM	NNSKTR	UVMR	NNMQ	[¬HLHNMB
NNN	` Ç	UV	e É	NVQMOCQQ	éëÄ	NKM	NPSPRSSKMN	NMMM	NVQKMQ	UVMR	NNMQ	
NNU	på	NRV	e É	VRVKUSU	éëÄ	MKT	CRUNMRRKUN	NMMM	VRKVV	UVMR	NNMQ	
NON	pÄ	NRV	k ç¬ël ~ë	VOTKRUM	éëÄ	NKQ	OMMQVVUPKQQ	NMMM	VOKTS	UVMR	NNMQ	
NPT	_~	NRV	k ç¬ël ~ë	NUUVKOPM	éëÄ	MKR	NONUNONOKSS	OMMM	VQKQS	UVMR	NNMQ	
NUO	t	NRV	k ç¬ël ~ë	NVQSKOOU	éëÄ	MKT	NPONSTPUKUU	NMMM	NVQKSO	UVMR	NNMQ	
OMR	qä	OMV	k ç¬ël ~ë	NVMUKPVQ	éëÄ	NKN	OVTVOPQSKPM	NMMM	NVMKUQ	UVMR	NNMQ	
OMU	mÄ	OMV	k ç¬ël ~ë	NVSUKRQS	éëÄ	MKU	UMOUMNMRKQM	OMMM	VUKQP	UVMR	NNMQ	
OPO	qÜ	OMV	k ç¬ël ~ë	VTVKTNP	éëÄ	MKP	PRRVUQMPKQM	NMMM	VTKVT	UVMR	NNMQ	
OPU	r	OMV	k ç¬ël ~ë	VURKSMV	éëÄ	MKV	PPSRUMVQKTQ	NMMM	VUKRS	UVMR	NNMQ	

n` =fpqa¬q~ÄäÉ

k~ã É	j ~ëë	qìåÉ¬j çÇÉ	` mp	` mp¬øpa	oÉÑ¬ mp	B ¬øÉÅ	B n` =¬ çï	B n` ¬ eäÖÜ	n` ¬ø¿ä-Ö
i á	S	k ç¬ël ~ë	NUTVNVUKSU	OKP	NTSNRRMR	NMSKSU	RVMR	NOMQ	
pÅ	QR	k ç¬ël ~ë	PUVUNMOKON	MKR	QNOVNNUR	VQKQN	RVMR	NOMQ	
d É	TO	k ç¬ël ~ë	VSOVTPKTM	NKP	VUCRTUKMV	VU	RVMR	NOMQ	
qÄ	NRV	k ç¬ël ~ë	SSVMPMSKPU	NKN	SNSRONVKVS	NMUKRO	RVMR	NOMQ	
_á	OMV	k ç¬ël ~ë	PSNUNRTKQO	MKN	PNTNNVSKMP	NNQKMV	RVMR	NOMQ	
pÅ	QR	e O	UQRSMSKNS	MKV	VQNPSMKUR	UVKUP	RVMR	NOMQ	
d É	TO	e O	PRSMNRKUM	MKT	PVNMOPKOQ	VNKMQ	RVMR	NOMQ	
v	UV	e O	OMMSPNOKQQ	OKN	OPPRROOKON	VOKQN	RVMR	NOMQ	
pÅ	QR	e É	NOORTPKRQ	NKM	NQMPOUKRR	UTHPR	RVMR	NOMQ	
d É	TO	e É	VVPQVMKMU	OKT	NNOOOOKSN	UUKRP	RVMR	NOMQ	
v	UV	e É	SRUNRNKPV	MKT	TQRQNOKMP	UUKOV	RVMR	NOMQ	
qÄ	NRV	e É	OQTNVUSKRU	MKR	ORRVVQSKO	VSKRS	RVMR	NOMQ	
_á	OMV	e É	NQSTQRPKRP	MKR	NRMOPPVKST	VTHSU	RVMR	NOMQ	

p~ã éäÉ=k~ã É i o p O

cãÉ=k~ã É MOMbj mi kÇ

a~í~=m~íÜ=k~ã É a\yt ÖäÉåíyf^ mj e yN ya ^ q ^ yOMCPyMPJ ^ o y i n ` PM^ kÅ

^Åè=qãã É PLPMLOMCP=NTWRSNMM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå NKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä c~ãä

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k ~ã É	fpqa	qì åÉ	` çåÅK	r åáë	o p a	==` mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMOM	éé Ä	OQKO	OVOKCP	NMM	
NN	_	S	k ç=d ~ë	PKPNO	éé Ä	NKN	NOQSOKCO	NMMM	
OP	k ~	QR	e É	OMRCUOKQUO	éé Ä	MKT	NNPMVQVMOKRV	OMMMMM	[i a o
OQ	j Ö	QR	e É	OMORQOKOVO	éé Ä	NKM	RVNQSNOQKSU	OMMMMM	[i a o
OT	^ ä	QR	e É	ONRSPRKVCP	éé Ä	MKU	OPNRSOSTKVV	OMMMMM	[i a o
OU	pá	QR	e O	NVSUUKTUT	éé Ä	NKM	QNNPNPNKUQ	NMMMM	[i a o
PV	h	QR	e É	NVPTRNKSSQ	éé Ä	MKT	QUOMVSSMKVT	OMMMMM	
QM	` ~	QR	e O	OMNUPSKUVO	éé Ä	MKS	RTVRUVSMQKSV	OMMMMM	[i a o
RN	s	UV	e É	MKNQN	éé Ä	NRKO	TNRKRV	NMMM	
RO	` ê	UV	e É	MKTMS	éé Ä	MKV	PVPTKNQ	OMMM	
RR	j å	UV	e É	NKPOR	éé Ä	OKV	PMNRKTR	OMMM	
RS	cÉ	UV	e O	VUPQMKOSV	éé Ä	NKV	NMMVTUVUTQKPM	NMMMMM	
RV	` ç	UV	e É	NKQPM	éé Ä	QKR	NNNRRKVV	NMMM	
SM	k á	UV	e É	MKVRP	éé Ä	TKQ	ONTVKNM	NMMM	
SP	` ì	UV	e É	MKSUO	éé Ä	SKO	QQQPKMO	OMMM	
SS	wå	UV	e É	OKQVQ	éé Ä	NKV	OSTMKPM	OMMM	
TR	^ ë	UV	e É	MKOVQ	éé Ä	VKP	ORPKMP	NMMM	
TU	pÉ	UV	e O	MKPSQ	éé Ä	TKN	NSSKVV	NMMM	
UU	pê	UV	e É	OKSRU	éé Ä	OKP	TMUTKRM	OMMM	
VR	j ç	UV	e É	NKRNT	éé Ä	PKS	QOTMKTQ	NMMM	
NMT	^ Ö	UV	e É	MKMRN	éé Ä	UKP	RPPKPS	NMM	
NNN	` Ç	UV	e É	MKMRN	éé Ä	RKU	OMOKCP	NMMM	
NNU	på	NRV	e É	MKQVS	éé Ä	QKV	NQMQKRR	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKPMN	éé Ä	SKT	SOVQKUM	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKVPS	éé Ä	NKU	RRTPKTN	OMMM	
NUO	t	NRV	k ç=d ~ë	NKOUO	éé Ä	QKP	NTMNRKTP	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKOQN	éé Ä	VKM	TMOOKTO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NKOQU	éé Ä	MKV	QRCPOKNT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKQVT	éé Ä	NKM	NTOTPKOO	NMMM	
OPU	r	OMV	k ç=d ~ë	MKONO	éé Ä	TKM	SRNNKVT	NMMM	

n ` =fpqa=q~ÄäÉ

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ= mp	B =o ÉÅ	B n ` = ç ï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUCPOOQKMV	NKQ	NTSNRRMR	NMPKR	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PSMORRTKMS	NKM	QNOVNNUKR	UTKOR	RVKR	NOMKQ	
pÅ	QR	e O	UOSRQNKOT	MKN	VQNPSMKUR	UTKU	RVKR	NOMKQ	
pÅ	QR	e É	NOONUUKMU	MKQ	NQMPOUKRR	UTKMT	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	UVNSNQKMT	NKO	VUORTUKMV	VMKTQ	RVKR	NOMKQ	
d É	TO	e O	PPTPOQKPP	NKM	PVNMOPKOQ	USKOS	RVKR	NOMKQ	
d É	TO	e É	VUTPOKNO	OKQ	NNOOOOKSN	UTKVU	RVKR	NOMKQ	
v	UV	e O	PTVVPMNKVP	NKQ	OPPRROOKON	UTKSP	RVKR	NOMKQ	
v	UV	e É	SQQMOTKOS	MKS	TQRQNOKMP	USKQ	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SMVSOUNKVS	MKS	SNSRONVKVS	VUKUU	RVKR	NOMKQ	
qÄ	NRV	e É	OOVMSQUKSN	MKP	ORRVVQSKO	UVKQU	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PNPVTURKPN	MKR	PNTNNVSKMP	VVKMN	RVKR	NOMKQ	
_á	OMV	e É	NORRVUVKUN	MKV	NRMOPPVKST	UPKS	RVKR	NOMKQ	

p~ã éäÉ=k~ã É ofk pb

cãÉ=k~ã É MÇNpj mi kÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíyf˜ mj eyNya^q^yÇMÇPyMPJ ^oyi n ` PMˆkÅ

^Åè=qã É PLPMLÇMÇP=NTWÇNWÇM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãi íáçå NWMMM

p~ã éäÉ=n ` =m~ëëlc á~ä c~åä

fpqa=n ` =m~ëëlc~åä c~åä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==ˆ mp==	i a o	n ` =cä~Ö
V	_É	S	k ç=d ~ë	OKVVV	éé Ä	NQKT	OPQKQR	NMM	
NN	_	S	k ç=d ~ë	NNNKQPM	éé Ä	MKR	RRURKSP	NMMM	
OP	k ~	QR	e É	TUQNUKTNR	éé Ä	NNKP	NMNQNRKTQ	OMMMMM	
OQ	j Ö	QR	e É	PNPQPKMVPV	éé Ä	UKU	ONRQPKVQ	OMMMMM	
OT	^ ä	QR	e É	PNRMTKMCU	éé Ä	NMKO	TVQRKTN	OMMMMM	
OU	pá	QR	e O	PVUMKTTO	éé Ä	NKS	PSPQKCU	NMMMM	
PV	h	QR	e É	UMCPPKMR	éé Ä	NMKQ	QSVNSKTS	OMMMMM	
QM	` ~	QR	e O	PQQNQKUMO	éé Ä	PKR	OPQQVNKPU	OMMMMM	
RN	s	UV	e É	QQUKTON	éé Ä	SKP	TOMKMP	NMMM	
RO	` ê	UV	e É	NUTSKVQQ	éé Ä	NNKM	PSRSKQR	OMMM	
RR	j å	UV	e É	QUOKSVS	éé Ä	NNKU	QSVKVO	OMMM	
RS	cÉ	UV	e O	NMUQVTKNPU	éé Ä	PKU	RPONPSKQV	NMMMMM	[i a o
RV	` ç	UV	e É	NOSKMVT	éé Ä	NNKT	QPNKNP	NMMM	
SM	k á	UV	e É	ORRKMUT	éé Ä	NTKO	OQQKCP	NMMM	
SP	` ì	UV	e É	RNPKTPT	éé Ä	SKO	NPSPKQP	OMMM	
SS	wå	UV	e É	RTNMKQVP	éé Ä	NNKO	ORTMKCU	OMMM	[i a o
TR	^ ë	UV	e É	PTPKNPO	éé Ä	NMKN	NOVKSU	NMMM	
TU	pÉ	UV	e O	PRVKSMU	éé Ä	QKT	TOKUP	NMMM	
UU	pê	UV	e É	VRKNSQ	éé Ä	OKV	NNOKCP	OMMM	
VR	j ç	UV	e É	OQUVKSRV	éé Ä	TKS	OUNTKMN	NMMM	[i a o
NMT	^ Ö	UV	e É	NQKQMP	éé Ä	NQKS	SNKNN	NMM	
NNN	` Ç	UV	e É	RQKPCU	éé Ä	NQKR	PMRTQ	NMMM	
NNU	på	NRV	e É	QSNSKVPT	éé Ä	SKR	QRRVKTR	NMMM	[i a o
NON	pÄ	NRV	k ç=d ~ë	NROKQPR	éé Ä	QKV	NQMNKRS	NMMM	
NPT	_~	NRV	k ç=d ~ë	QVMKTTV	éé Ä	NPKN	NPQNKQU	OMMM	
NUO	t	NRV	k ç=d ~ë	OCUSKCPN	éé Ä	UKP	NOCUUKUM	NMMM	[i a o
OMR	qä	OMV	k ç=d ~ë	OVKSVN	éé Ä	OKM	OPMRKVT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	PSKQPV	éé Ä	OKV	PVMQKPS	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	TUKSSP	éé Ä	RKM	TRMSKUO	NMMM	
OPU	r	OMV	k ç=d ~ë	SKRTS	éé Ä	VKO	RVMKSQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=ɵpa	oÉÑ=ˆ mp	B n ` =ɵÉ	B n ` =ˆ çï	B n ` =ɵäÜÜ	n ` =cä~Ö
i á	S	k ç=d ~ë	OSSPQKMV	MKV	NTSNRRMR	NMRN	RVMR	NOMKQ	SMOMa ça
pÅ	QR	k ç=d ~ë	UUNNKTO	PKM	QNOVNNUR	MKON	RVMR	NOMKQ	SMOMa ça
pÅ	QR	e O	NVSMKQP	NKR	VQNPSMKUR	MKON	RVMR	NOMKQ	SMOMa ça
pÅ	QR	e É	OUVKOU	NOKQ	NQMPOUKRR	MKON	RVMR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=ɵpa
d É	TO	k ç=d ~ë	TSQTKPN	NKP	VUORTUKMV	MKTU	RVMR	NOMKQ	SMOMa ça
d É	TO	e O	UMOKRQ	RKS	PVNMQPKOQ	MKON	RVMR	NOMKQ	SMOMa ça
d É	TO	e É	NSMKSQ	TKP	NNOCOOKSN	MKNQ	RVMR	NOMKQ	SMOMa ça
v	UV	e O	NUNRKNO	OKN	QPPRROOKON	MKVQ	RVMR	NOMKQ	SMOMa ça
v	UV	e É	OURKVR	UKV	TQRQNOKMP	MKVQ	RVMR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=ɵpa
qÄ	NRV	k ç=d ~ë	OUROKQQ	TKS	SNSROVNKVS	MKVR	RVMR	NOMKQ	SMOMa ça
qÄ	NRV	e É	VNMKRP	SKS	ORRVVQSKO	MKVQ	RVMR	NOMKQ	SMOMa ça
_á	OMV	k ç=d ~ë	VQVVKTP	NKN	PNTNNVSKMP	MKP	RVMR	NOMKQ	SMOMa ça
_á	OMV	e É	PTUNKNU	OKU	NRVOPPVKST	MKOR	RVMR	NOMKQ	SMOMa ça

`çåíaåì åaÖ=~ëäÄê~íáç=sÉêëÑÅ~íáç=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MOOJ``sKÇ
a~í~=m~íÜ=k~ã É	aWy^ÖãÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n` PM^hÅ
^Åè=qáã É	PLPMLOMOP=NTWQSMRQ
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MNOJ ^i _KÇ
p~ã éáÉ=n` =m~ëëlcá~ä	c~ää
fpqa=n` =m~ëëlc~ää	c~ää
l éÉê~íçê	**~Çã ää**

n` =^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==` mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n` =c ä-Ö
V	_É	S	k ç=d ~ë	OQKSUT	ééÄ	MKU	NTPOPVKOP	OR	VUKTR	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKPRT	ééÄ	NKT	NNSRMSKQM	OR	NMNKOP	UVKU	NNMO	
OP	k ~	OR	e É	RRPUKVUQ	ééÄ	MKQ	QMOSVUPKUO	RMMM	NNMKTU	UVKU	NNMO	[=HLJ=NMB
OQ	j Ö	OR	e É	RRRRKPOQ	ééÄ	MKN	ONMTQSNKSM	RMMM	NNNKNN	UVKU	NNMO	[=HLJ=NMB
OT	^ä	OR	e É	SNOKNRO	ééÄ	MKR	URRTPKUV	RMM	NOOKOP	UVKU	NNMO	[=HLJ=NMB
OU	pá	OR	e O	RNMKRMM	ééÄ	NKP	OSTONRKSQ	RMM	NMOKN	UVKU	NNMO	
PV	h	OR	e É	RPTPKVVO	ééÄ	NKO	NTTNOOSKPU	RMMM	NMTKQU	UVKU	NNMO	
QM	` ~	OR	e O	ROOVKSNV	ééÄ	NKP	OMQMMTOSKMU	RMMM	NMQKRV	UVKU	NNMO	
RN	s	UV	e É	ORKVNS	ééÄ	MKT	NOOSUPKOR	OR	NMPKSS	UVKU	NNMO	
RO	` ê	UV	e É	OSKOST	ééÄ	NKR	NRONTSKMQ	OR	NMRKMT	UVKU	NNMO	
RR	j å	UV	e É	ORKVMM	ééÄ	MKT	TQSOTKMO	OR	NMPKVS	UVKU	NNMO	
RS	cÉ	UV	e O	RPSPKUNP	ééÄ	MKS	TPORRMMQKVO	RMMM	NMTKOU	UVKU	NNMO	
RV	` ç	UV	e É	OSKQTM	ééÄ	MKT	OSSVNMKNO	OR	NMRKUU	UVKU	NNMO	
SM	k á	UV	e É	OSKRQO	ééÄ	MKU	TQUSPKTN	OR	NMSKNT	UVKU	NNMO	
SP	` ì	UV	e É	OSKUQN	ééÄ	NKQ	ONMONSKOR	OR	NMTHPS	UVKU	NNMO	
SS	wå	UV	e É	OSKUPV	ééÄ	NKR	PRUQMKTR	OR	NMTHPS	UVKU	NNMO	
TR	^ë	UV	e É	OSKMSU	ééÄ	MKT	OSTTRKQQ	OR	NMQKOT	UVKU	NNMO	
TU	pÉ	UV	e O	OSKNVU	ééÄ	MKT	NQTTUKTU	OR	NMQKTV	UVKU	NNMO	
UU	pê	UV	e É	OSKMUQ	ééÄ	NKM	VMPPPKMO	OR	NMQKPQ	UVKU	NNMO	
VR	j ç	UV	e É	OTKNSP	ééÄ	MKQ	VNNMQKUU	OR	NMUKSR	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKOMO	ééÄ	MKU	PPSOORKQU	OR	NMUKUN	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKQQN	ééÄ	OKM	QQNUTKUQ	OR	NMRKTS	UVKU	NNMO	
NNU	på	NRV	e É	ORKUMU	ééÄ	NKN	USMRRKOM	OR	NMPKOP	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	ORKNSP	ééÄ	MKU	SSVNTMKQ	OR	NMMKSR	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKQOR	ééÄ	MKO	OMNTVRKPV	OR	NMNKTU	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OTKQPN	ééÄ	MKQ	QOUVSQKSP	OR	NMVKTO	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKUTN	ééÄ	MKU	VOUPUMKUM	OR	NMPKQU	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	ORKSNT	ééÄ	MKV	NOSUTSMKRR	OR	NMOKQT	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKQMT	ééÄ	MKU	NNSSNOPKTQ	OR	NMRKSP	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKNNS	ééÄ	NKM	NMUONOSKSO	OR	NMQKQS	UVKU	NNMO	

n` =fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n` =i çï	B n` =eäÜÜ	n` =c ä-Ö
i á	S	k ç=d ~ë	OQNTONSKVN	MKS	NTSNRRMKR	NPTKOO	RVKR	NOMQ	SMOMa ça
pÅ	OR	k ç=d ~ë	QUQTPSMKNO	MKU	ONOVNNUKR	NNTKPV	RVKR	NOMQ	
pÅ	OR	e O	NNONTUTKUR	NKR	VQNPSMKUR	NNVKNT	RVKR	NOMQ	
pÅ	OR	e É	NRUSSQKVS	MKS	NQMPOUKRR	NNPKMT	RVKR	NOMQ	
d É	TO	k ç=d ~ë	NNVVMVKRN	MKU	VUORTUKMV	NOOKMQ	RVKR	NOMQ	SMOMa ça
d É	TO	e O	QRNSSRKTO	MKR	PVNMOPKOQ	NNRKR	RVKR	NOMQ	
d É	TO	e É	NOTPQQKVT	NKO	NNOOOOKSN	NNPKQU	RVKR	NOMQ	
v	UV	e O	RMRMVSQKSQ	MKP	OPPRROOKON	NNSKR	RVKR	NOMQ	
v	UV	e É	UPVNSSKOQ	NKS	TQRQNOKMP	NNOKRU	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	UOOQMNKRM	NKM	SNSRONVKVS	NPPKQN	RVKR	NOMQ	SMOMa ça
qÄ	NRV	e É	PMRTTROKVT	NKN	ORRVVQSKO	NNVKOR	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	OPUVNPPKQQ	MKS	PNTNNVSKMP	NPUKQN	RVKR	NOMQ	SMOMa ça
_á	OMV	e É	NUPUMOUKQQ	NKT	NRMOPPVKST	NOOKPQ	RVKR	NOMQ	SMOMa ça

p~ã éáÉ=k~ã É	``_
cäÉ=k~ã É	MOP|``_KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíÝ^mj eyNya^q^yOMOPyMPJ ^oyi n` PM^hÂ
^Åè=qáã É	PLPMLOMOP=NTVRQJRQ
p~ã éáÉ=qóéÉ	``_
qçí~äa äi íáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑc äÉk~ã É	MNO ^i_KÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áä**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÄK	r åáë	opa	==\ mp==	i äì á	n`=c ä~Ö
V	_É	S	k ç=d ~ë	MKMMS	éé Ä	TUKM	OOOOCP	MO	
NN	_	S	k ç=d ~ë	MKQTV	éé Ä	RKO	OUMOORQ	Q	
OP	k~	QR	e É	NOKVTS	éé Ä	VKP	RVVVOKST	OMM	
OQ	j Ö	QR	e É	NRKOOO	éé Ä	QKM	ROTUKVO	OM	c~äÉÇ=a ça
OT	^ä	QR	e É	NMKTVO	éé Ä	NKT	NPSQKRP	OM	c~äÉÇ=a ça
OU	pá	QR	e O	NKNTM	éé Ä	SKR	VTQKPV	NMM	
PV	h	QR	e É	ONKMOU	éé Ä	NNKO	PPUSTHRQ	OMM	
QM	` ~	QR	e O	NRKRMQ	éé Ä	PKR	SPQSOKSN	OM	c~äÉÇ=a ça
RN	s	UV	e É	MKMPN	éé Ä	OVKR	POUKVM	N	
RO	` ê	UV	e É	MKMMO	éé Ä	PTPKO	USVKOM	N	
RR	j å	UV	e É	MKMOT	éé Ä	NMKU	NSVKVT	MQ	
RS	cÉ	UV	e O	UKRQO	éé Ä	PKN	NNOONMPS	OM	
RV	` ç	UV	e É	MKMNP	éé Ä	OPKM	OMOKCP	MO	
SM	k á	UV	e É	MKMPP	éé Ä	RVKP	OMOKCP	MQ	
SP	` ì	UV	e É	MKMNU	éé Ä	OMKR	QUNKNP	MS	
SS	wå	UV	e É	MKPPM	éé Ä	NQKV	QURKRT	O	
TR	^ë	UV	e É	MKMPM	éé Ä	OMKV	QUKMN	N	
TU	pÉ	UV	e O	MKMSP	éé Ä	ONKU	QOKST	N	
UU	pê	UV	e É	MKMNP	éé Ä	NUKR	SMKMM	N	
VR	j ç	UV	e É	MKPPS	éé Ä	VKU	NPMRKSQ	N	
NMT	^Ö	UV	e É	MKMNN	éé Ä	NPKS	NSPKPQ	MO	
NNN	` Ç	UV	e É	MKMNN	éé Ä	PVKT	OQKMT	MO	
NNU	på	NRV	e É	MKMVN	éé Ä	PKS	QRCKOQ	N	
NON	pÄ	NRV	k ç=d ~ë	MKMPN	éé Ä	NVKU	NVQQKQU	MO	
NPT	_~	NRV	k ç=d ~ë	MKMOT	éé Ä	QMKR	QRMKOT	MQ	
NUO	t	NRV	k ç=d ~ë	MKPMN	éé Ä	RKS	SNPNKOU	N	
OMR	qä	OMV	k ç=d ~ë	MKMQP	éé Ä	NMKP	ONSOKQT	MO	
OMU	mÄ	OMV	k ç=d ~ë	MKMQV	éé Ä	UKM	PMUSKTR	MO	
OPO	qÜ	OMV	k ç=d ~ë	MKMPP	éé Ä	UKU	OVRSKUM	N	
OPU	r	OMV	k ç=d ~ë	MKMNV	éé Ä	VKP	URTHSN	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=ç ï	B n`=c åÜÜ	n`=c ä~Ö
i á	S	k ç=d ~ë	NUQTPPVKUM	NKO	NTSNRRMR	NMQKUT	RVMR	NOMQ	
pÅ	QR	k ç=d ~ë	PURQVRQKPU	MKS	QNOVNNUKR	VPHPS	RVMR	NOMQ	
pÅ	QR	e O	USMMSOKPV	NKO	VQNPSMKUR	VNHPS	RVMR	NOMQ	
pÅ	QR	e É	NOSMUPKTN	MKT	NQMPOUKRR	UVKUR	RVMR	NOMQ	
d É	TO	k ç=d ~ë	VRORSMKPP	MKP	VUORTUKMV	VSKVR	RVMR	NOMQ	
d É	TO	e O	PRUNOPKON	NKN	PVNMOPKOQ	VNHRU	RVMR	NOMQ	
d É	TO	e É	NMORVRKPP	MKQ	NNOOOOKSN	VNKQO	RVMR	NOMQ	
v	UV	e O	QMVQNQUKVN	MKR	QPPRROOKON	VQKQP	RVMR	NOMQ	
v	UV	e É	STQTTTKMR	NKQ	TQRQNOKMP	VMHRO	RVMR	NOMQ	
qÄ	NRV	k ç=d ~ë	SROTMORKON	MKP	SNSRONVKVS	NMRKUT	RVMR	NOMQ	
qÄ	NRV	e É	OQSQSVSHSV	MKU	ORRVVQSKO	VSKOU	RVMR	NOMQ	
_á	OMV	k ç=d ~ë	PQTVVMTKVV	MKR	PNTNNVSKMP	NMVKTP	RVMR	NOMQ	
_á	OMV	e É	NQRVVRNKMS	MKU	NRMOPPVKST	VTKNU	RVMR	NOMQ	

p~ã éäÉ=k~ã É	ofk pb
cãÉ=k~ã É	MOOpj mi kÇ
a~í~=m~íÜ=k~ã É	aWÿ ÖäÉåíÿ mj eyNya^q^yOMOPyMPJ ^o yi n ` PM^kÅ
^Åè=qãã É	PLPMLOMOP=NTVRVMQQ
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	NMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	c~åä
fpqa=n ` =m~ëëlc~åä	c~åä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==: mp==	i a o	n ` =c ä-Ö
V	_É	S	k ç=d ~ë	QKQSS	ééÄ	NQKS	NRVMMM	NMM	
NN	_	S	k ç=d ~ë	NQQKMOP	ééÄ	PKQ	PNNPKTO	NMMM	
OP	k ~	QR	e É	QRTSMRRRP	ééÄ	TKT	ROVTUKOU	OMMMMM	
OQ	j Ö	QR	e É	OVNSKQUV	ééÄ	SKU	NTUVKMT	OMMMMM	
OT	^ ä	QR	e É	PPTPKPOU	ééÄ	QKM	TSOKOR	OMMMMM	
OU	pá	QR	e O	NTURKVMD	ééÄ	SKN	NRCUKPR	NMMMM	
PV	h	QR	e É	RUPMMKUVQ	ééÄ	THS	PMQTVKSS	OMMMMM	
QM	` ~	QR	e O	RNNOKQOO	ééÄ	NKT	POSTNKOV	OMMMMM	
RN	s	UV	e É	ORUKUOR	ééÄ	PKT	QVUKVN	NMMM	
RO	` ê	UV	e É	NNPTKPOR	ééÄ	OKT	OSTNKMU	OMMM	
RR	j å	UV	e É	PQSKTVP	ééÄ	UKR	QMRKOS	OMMM	
RS	cÉ	UV	e O	OTROUKUVO	ééÄ	OKN	NSTMNNKTN	NMMMM	
RV	` ç	UV	e É	QTKMMQ	ééÄ	NOKN	NVPKPQ	NMMM	
SM	k á	UV	e É	NVUKOVO	ééÄ	OKT	OOTKTV	NMMM	
SP	` ì	UV	e É	OVOKQNQ	ééÄ	SKN	VPOKOT	OMMM	
SS	wå	UV	e É	OVQTKMTN	ééÄ	QKP	NRVTKVM	OMMM	[i a o
TR	^ ë	UV	e É	NQOKPUO	ééÄ	NMKO	RVMSU	NMMM	
TU	pÉ	UV	e O	NPNKRTO	ééÄ	NQKO	PPKMM	NMMM	
UU	pê	UV	e É	OSKSOV	ééÄ	OVMS	PTKTU	OMMM	
VR	j ç	UV	e É	UNTKQOM	ééÄ	OKV	NNNPKOM	NMMM	
NMT	^ Ö	UV	e É	NNKORU	ééÄ	RKM	RTKTU	NMM	
NNN	` Ç	UV	e É	OOKUUT	ééÄ	NSKR	NRKRR	NMMM	
NNU	på	NRV	e É	NVPMKTVS	ééÄ	QKM	ORSVKNU	NMMM	[i a o
NON	pÄ	NRV	k ç=d ~ë	NOQKSMU	ééÄ	NUKN	NVRTKUP	NMMM	
NPT	_~	NRV	k ç=d ~ë	NORKSUU	ééÄ	OMR	POMKPQ	OMMM	
NUO	t	NRV	k ç=d ~ë	NNNSKMMP	ééÄ	NRKP	RRRPKTT	NMMM	[i a o
OMR	qä	OMV	k ç=d ~ë	NVKPQS	ééÄ	NNKU	NOQUKMR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OTKTOT	ééÄ	RKO	OQTSKMR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	PRKNOS	ééÄ	QKR	OTVPKOS	NMMM	
OPU	r	OMV	k ç=d ~ë	OKRPM	ééÄ	PQKR	NVMKOM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ=f mp	B n ` =i çï	B n ` =e äÜÜ	n ` =c ä-Ö
i á	S	k ç=d ~ë	NNQVQKUS	MKN	NTSNRRMKR	MKSR	RVKR	NOMKQ	SMOMa ça
pÅ	QR	k ç=d ~ë	UMMMKMT	QKN	QNOVNNUKR	MKW	RVKR	NOMKQ	SMOMa ça
pÅ	QR	e O	NUPTKKN	NKT	VQNPSMKUR	MKO	RVKR	NOMKQ	SMOMa ça
pÅ	QR	e É	ORTKOV	TKN	NQMPOUKRR	MKSU	RVKR	NOMKQ	SMOMa ça
d É	TO	k ç=d ~ë	QRSNKUU	PKU	VUORTUKW	MKQS	RVKR	NOMKQ	SMOMa ça
d É	TO	e O	STNKOO	VKR	PVNMQPKQQ	MKNT	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=o pa
d É	TO	e É	NSNKVT	NKO	NNOOOOKSN	MKNQ	RVKR	NOMKQ	SMOMa ça
v	UV	e O	OOQRKMM	OKT	QPPRROOKON	MKVR	RVKR	NOMKQ	SMOMa ça
v	UV	e É	PQOKSN	QKN	TQRQNOKMP	MKVR	RVKR	NOMKQ	SMOMa ça
qÄ	NRV	k ç=d ~ë	OSTVKTU	NSKP	SNSROVNVKVS	MKVQ	RVKR	NOMKQ	SMOMa ça& eäÜÜ=fpqa=o pa
qÄ	NRV	e É	NOOKRKNS	SKO	ORRVVQSKO	MKVR	RVKR	NOMKQ	SMOMa ça
_á	OMV	k ç=d ~ë	TVMSKVR	PKQ	PNTNNVSKMP	MKOR	RVKR	NOMKQ	SMOMa ça
_á	OMV	e É	PRRUKQV	NKM	NRMOPPVKST	MKOQ	RVKR	NOMKQ	SMOMa ça

`çåíaåìaåÖ=~äåÄê~íáçå=sÉêáÑ~Ä~íáçå=É``sF=oÉéçê

p~ã éáÉ=k~ã É	``s
cáÉ=k~ã É	MORj``skÇ
a~í~=m~íÜk~ã É	aWy^ÖáÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n` PM^hÄ
^Åè=qáã É	PLPMLOMOP=NUMMQMU
p~ã éáÉ=qóéÉ	``s
qçí~äaãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MNO^i_kÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~äà
fpqa=n`=m~ëëlc~äà	c~äà
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=cä~Ö
V	_É	S	k ç=d ~ë	OQKSPP	ééÄ	OKQ	NSUSSNKCO	CR	VUKRP	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORRTSQ	ééÄ	NKR	NNRQTVKVN	CR	NMPKMS	UVKU	NNMO	
OP	k ~	QR	e É	RRPSKMSV	ééÄ	MKS	PVONNSMKQD	RMMM	NNMRTO	UVKU	NNMO	[=HLJ=NMB
OQ	j Ö	QR	e É	RQVTKQNR	ééÄ	MKO	OMPNSPUKRP	RMMM	NMVKVR	UVKU	NNMO	
OT	^ä	QR	e É	RQQKOQT	ééÄ	MKS	TPUTNKNN	RMM	NMUKQR	UVKU	NNMO	
OU	pá	QR	e O	RNSKMOU	ééÄ	MKV	ORUSTOKSV	RMM	NMPKON	UVKU	NNMO	
PV	h	QR	e É	ROUTKUOV	ééÄ	NKU	NSVUOOPKPT	RMMM	NMRRTS	UVKU	NNMO	
QM	` ~	QR	e O	RNVMVKUMM	ééÄ	MKU	NVPVOVMSKPU	RMMM	NMPKUO	UVKU	NNMO	
RN	s	UV	e É	ORKUMP	ééÄ	NKO	NNUPPQKON	CR	NMPKON	UVKU	NNMO	
RO	` ê	UV	e É	OSKPQS	ééÄ	MKV	NQTUTPKNS	CR	NMRKPU	UVKU	NNMO	
RR	j å	UV	e É	OSKPRQ	ééÄ	MKR	TPPMUKNM	CR	NMRKQO	UVKU	NNMO	
RS	cÉ	UV	e O	RNVTKRSM	ééÄ	NKQ	SVRTNROTKQN	RMMM	NMPKVR	UVKU	NNMO	
RV	` ç	UV	e É	OSKTNV	ééÄ	MKR	OSNMVQKVU	CR	NMSKUU	UVKU	NNMO	
SM	ká	UV	e É	OSKUMV	ééÄ	NKM	TPORPKON	CR	NMTKOQ	UVKU	NNMO	
SP	` ì	UV	e É	OSKTUV	ééÄ	NKN	OMPOTOKSM	CR	NMTKNS	UVKU	NNMO	
SS	wå	UV	e É	OSKUQR	ééÄ	MKV	PQTPMKMR	CR	NMTKPU	UVKU	NNMO	
TR	^ë	UV	e É	OSKNQN	ééÄ	NKM	OSMMUKUV	CR	NMQKRS	UVKU	NNMO	
TU	pÉ	UV	e O	ORRTMP	ééÄ	NKR	NQONNKRR	CR	NMOKUN	UVKU	NNMO	
UU	pê	UV	e É	OSKNTV	ééÄ	MKN	UTUPQKVQ	CR	NMQKTO	UVKU	NNMO	
VR	j ç	UV	e É	OTKNQT	ééÄ	MKQ	UUOMRKOO	CR	NMUKRV	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKOSV	ééÄ	MKN	POSRPPKUQ	CR	NMVKMU	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKTTM	ééÄ	NKM	OPPQQKUQ	CR	NMTKMU	UVKU	NNMO	
NNU	på	NRV	e É	ORKSTQ	ééÄ	MKV	UQPNVKVP	CR	NMOKT	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKSSU	ééÄ	NKV	SSMVRVRTV	CR	VUKST	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKNPT	ééÄ	MKU	OMVRUTKQN	CR	NMVKRR	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKTVS	ééÄ	MKQ	QONTOMKSP	CR	NMTKNU	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKPPM	ééÄ	MKU	VMUUUNKON	CR	NMNKPO	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	ORKUUS	ééÄ	NKM	NOUNVMVKVM	CR	NMPKRQ	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKNVP	ééÄ	OKO	NNRSRSTKCP	CR	NMQKTT	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKMPT	ééÄ	OKM	NMTUTSPKQN	CR	NMQKNR	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ç=ï	B n`=ceäÜÜ	n`=cä~Ö
i á	S	k ç=d ~ë	OPRUSMKQS	MKR	NTSNRRMKR	NPPKUV	RVKR	NOMQ	SMOMa ça
pÅ	QR	k ç=d ~ë	QTUVQUSKPO	MKT	QNOVNNUKR	NNRKVV	RVKR	NOMQ	
pÅ	QR	e O	NMTQQQUKNU	NKM	VQNPSMKUR	NNQKNO	RVKR	NOMQ	
pÅ	QR	e É	NRQRSVKRU	NKM	NQMPQUKRR	NNMKNR	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	NNUTUTPKVV	NKQ	VUCRTUKMV	NOMKUV	RVKR	NOMQ	SMOMa ça
dÉ	TO	e O	QPQVTNKQU	NKO	PVNMOPKOQ	NNNKOP	RVKR	NOMQ	
dÉ	TO	e É	NOPSSUKOT	NKQ	NNOCCOKSN	NNMO	RVKR	NOMQ	
v	UV	e O	QVRMROPKOT	MKR	OPPRROOKON	NNQKNV	RVKR	NOMQ	
v	UV	e É	UNOVOOKMS	MKS	TQRQNOKMP	NMVKMS	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	UOTSOUNKSQ	NKN	SNSRONVKVS	NPQKOQ	RVKR	NOMQ	SMOMa ça
qÄ	NRV	e É	PMNNRVPKMM	NKO	ORRVVQSKO	NNTKSQ	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	OPUUSSUKMU	MKV	PNTNNVSKMP	NPUKPV	RVKR	NOMQ	SMOMa ça
_á	OMV	e É	NUMUVTOKUR	MKQ	NRMOPPVKST	NOMKQN	RVKR	NOMQ	SMOMa ça

p~ã éáÉ=k~ã É	` ` _
cäÉ=k~ã É	MOS\` ` _KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíÝ^ mj eÝNÝa^q^ÝOMOPÝMPÝj ^oÝi n` PM^hÅ
^Åè=qáã É	PLPMLOMOP=NUMNOMRU
p~ã éáÉ=qóéÉ	` ` _
qçí~äa äã íáçå	NKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑc äÉk~ã É	MNO ^i _KÇ
p~ã éáÉ=n` =m~ëëlcá~ä	m~ëë
fpqa=n` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äöíÉ=q~ÄæÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==\ mp==	i ãì á	n` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMNQ	éé Ä	STKQ	OSPKPQ	MO	
NN	_	S	k ç=d ~ë	MKOMT	éé Ä	PKS	NURQKPU	Q	
OP	k~	QR	e É	JMKMRO	éé Ä	k L^	ROMTTHRO	OMM	
OQ	j Ö	QR	e É	PKUTR	éé Ä	NPKQ	NUQQKQN	OM	
OT	^ä	QR	e É	MKQUQ	éé Ä	UQKS	COMKMN	OM	
OU	pá	QR	e O	MKNTP	éé Ä	NVQKM	RSMKSM	NVM	
PV	h	QR	e É	NNKMRU	éé Ä	NUKT	PNMMPKUU	OMM	
QM	` ~	QR	e O	QKQCN	éé Ä	SKU	OVMRQHRM	OM	
RN	s	UV	e É	MKMPO	éé Ä	SKV	POSKSU	N	
RO	` ê	UV	e É	MKMMM	éé Ä	k L^	UPSKRP	N	
RR	j å	UV	e É	MKMCU	éé Ä	ORKT	NSTHPM	MQ	
RS	cÉ	UV	e O	OKMR	éé Ä	QKU	QUNNQKOT	OM	
RV	` ç	UV	e É	MKMMT	éé Ä	RTHN	NRNKNO	MO	
SM	k á	UV	e É	MKMPV	éé Ä	RUKN	ONMKMM	MQ	
SP	` ì	UV	e É	MKMNM	éé Ä	NPHP	QCQKQS	MS	
SS	wå	UV	e É	MKNST	éé Ä	NTHV	PMPHPQ	O	
TR	^ë	UV	e É	MKMCR	éé Ä	NUKV	QCQKST	N	
TU	pÉ	UV	e O	MKMCN	éé Ä	PVKS	PNKST	N	
UU	pê	UV	e É	MKMNT	éé Ä	CPKM	SUKUV	N	
VR	j ç	UV	e É	MKNRM	éé Ä	ORKV	TVMKMQ	N	
NMT	^Ö	UV	e É	MKMNO	éé Ä	NNKQ	NSRHRS	MO	
NNN	` Ç	UV	e É	MKMMT	éé Ä	QRHR	NUKNR	MO	
NNU	på	NRV	e É	MKMRS	éé Ä	NMKO	POUKVM	N	
NON	pÄ	NRV	k ç=d ~ë	MKMCP	éé Ä	TKU	UTTHSP	MO	
NPT	_~	NRV	k ç=d ~ë	MKMNU	éé Ä	NTHR	NVMKOM	MQ	
NUO	t	NRV	k ç=d ~ë	MKNUO	éé Ä	NTHR	QSCRHTO	N	
OMR	qä	OMV	k ç=d ~ë	MKMCO	éé Ä	NSHR	ONPRHTT	MO	
OMU	mÄ	OMV	k ç=d ~ë	MKMOT	éé Ä	NVHN	OCRCKQT	MO	
OPO	qÜ	OMV	k ç=d ~ë	MKMPU	éé Ä	CPHS	PNOTHMD	N	
OPU	r	OMV	k ç=d ~ë	MKMNR	éé Ä	ONHR	TPQKNP	MO	

n` =fpqa=q~ÄæÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÁ	B n` =ç ï	B n` =cäÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	NUPUVUMRT	OKP	NTSNRRMR	NMQKQ	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PUNUNUQKRP	NKT	QNOVNNUR	VOKQT	RVHR	NOMQ	
pÅ	QR	e O	UPVVQSKTS	OKM	VQNPSMKUR	UVKCP	RVHR	NOMQ	
pÅ	QR	e É	NOQUQVKUO	MKR	NQMPCUKRR	UUKVT	RVHR	NOMQ	
dÉ	TO	k ç=d ~ë	VPTNOQKRO	MKQ	VUCRTUKMV	VRHPT	RVHR	NOMQ	
dÉ	TO	e O	PRNNRPKQU	NKU	PVNMVCPKOQ	UVKU	RVHR	NOMQ	
dÉ	TO	e É	VVCUTKVT	MKU	NNOCCOKSN	UUKQT	RVHR	NOMQ	
v	UV	e O	PVRRTOQKPR	NKO	QPPRRCOKQN	VNKOQ	RVHR	NOMQ	
v	UV	e É	SRUVPTKCU	MKU	TQRQNOKMP	UUKQ	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQSVPTPKQV	NKV	SNSRONVKVS	NMQKVP	RVHR	NOMQ	
qÄ	NRV	e É	OQPOTSVKUR	MKS	ORRVVQSKO	VRHMP	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PQLPQMVKVN	NKM	PNTNNVSHMP	NMVKUR	RVHR	NOMQ	
_á	OMV	e É	NQPTVUVKTQ	NKM	NRMCPPVHST	VRHTO	RVHR	NOMQ	

`çåíaåì åaÖ=~ëäÁê~íáç=sÉêäÑÁ~íáç=Ê``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cäÉ=k~ã É	MOT|``skÇ
a~í~=m~íÜk~ã É	aWj^ÖäÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n` PM^hÁ
^Åè=qáã É	PLPMLOMOP=NUNNTWOS
p~ã éáÉ=qóéÉ	``s
qçí~äa ãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcäÉk~ã É	MNO^i_kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qì åÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÁ	B i çï	B eäÖÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	ORKPPN	éëÄ	NKR	NOURUVKVP	CR	NVNKPO	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKUMT	éëÄ	NKM	URTSPKNM	CR	NVPKCP	UVKU	NNMO	
OP	k ~	QR	e É	RQCQKRPT	éëÄ	MKS	OVSMCPPKPP	RMMM	NVUKQV	UVKU	NNMO	
OQ	j Ö	QR	e É	RRCSKVNV	éëÄ	NKO	NRTCUTQKVD	RMMM	NNMKRO	UVKU	NNMO	[=HLJHNVB
OT	^ä	QR	e É	RPOKRNM	éëÄ	CKQ	RRUTRKUN	RMM	NVSKR	UVKU	NNMO	
OU	pá	QR	e O	RCPKQQT	éëÄ	MKU	NVVCRTKPO	RMM	NVQKSV	UVKU	NNMO	
PV	h	QR	e É	RCCCKUNO	éëÄ	NKU	NCVOTUMKUR	RMMM	NVQKR	UVKU	NNMO	
QM	` ~	QR	e O	RCQTKPTM	éëÄ	MKR	NQUUTRCPKST	RMMM	NVQKVR	UVKU	NNMO	
RN	s	UV	e É	ORKSVR	éëÄ	NKN	VMSRPKRN	CR	NVCKTU	UVKU	NNMO	
RO	` ê	UV	e É	OSKCPP	éëÄ	MKT	NNPOTRKUQ	CR	NVQKVP	UVKU	NNMO	
RR	j å	UV	e É	OSKNQM	éëÄ	MKQ	RRVQNKVO	CR	NVQKRS	UVKU	NNMO	
RS	cÉ	UV	e O	RCOMKVDV	éëÄ	MKT	RQQMSNMUKPS	RMMM	NVQKQ	UVKU	NNMO	
RV	` ç	UV	e É	OSKSNS	éëÄ	MKS	OMMMOMKNS	CR	NVSKQS	UVKU	NNMO	
SM	k á	UV	e É	OTKMSR	éëÄ	MKO	RSUVRKQN	CR	NVUKCS	UVKU	NNMO	
SP	` ì	UV	e É	OSKTPP	éëÄ	MKQ	NRSMRUKVR	CR	NVSKVP	UVKU	NNMO	
SS	wå	UV	e É	OTKOMV	éëÄ	NKP	OTMTVKUS	CR	NVUKUQ	UVKU	NNMO	
TR	^ë	UV	e É	ORKRQP	éëÄ	NKO	NVRQVKTM	CR	NVOKNT	UVKU	NNMO	
TU	pÉ	UV	e O	ORKPVN	éëÄ	MKV	NMVPNKVP	CR	NVNKRS	UVKU	NNMO	
UU	pê	UV	e É	ORKVVV	éëÄ	NKM	STNMQKPN	CR	NVQ	UVKU	NNMO	
VR	j ç	UV	e É	OSKSUS	éëÄ	MKQ	SSTNPKNN	CR	NVSKTQ	UVKU	NNMO	
NVT	^Ö	UV	e É	OTKPMO	éëÄ	MKQ	ORNRCSKQV	CR	NVVKCN	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKVST	éëÄ	NKO	PPRVMKPM	CR	NVTKUT	UVKU	NNMO	
NNU	på	NRV	e É	ORKQPP	éëÄ	MKP	SQPNTKVR	CR	NVNKTP	UVKU	NNMO	
NCN	pÄ	NRV	k ç=d ~ë	ORKQQQ	éëÄ	MKV	RMTVMUKCQ	CR	NVNKTU	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKQSQ	éëÄ	MKQ	NRNRUUKQM	CR	NVNKUS	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKUCO	éëÄ	MKP	PNQUVRKNS	CR	NVTKOV	UVKU	NNMO	
OVR	qä	OMV	k ç=d ~ë	ORKTOM	éëÄ	CKU	TMSSTNKPM	CR	NVOKUU	UVKU	NNMO	
OVU	mÄ	OMV	k ç=d ~ë	OSKNOM	éëÄ	NKU	VVMSQMRV	CR	NVQKQU	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKOSV	éëÄ	MKT	UUUQUCKCN	CR	NVRKMU	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKMTS	éëÄ	MKS	UOTQVVKCP	CR	NVQKP	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=ç ïï	B n`=c äÖÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	NTQUTTUKVP	NKM	NTSNRRMR	VVKOT	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	PSNCOVRKQQ	MRR	QNOVNNUR	UTKQU	RVRR	NOMQ	
pÅ	QR	e O	UNRTRNKTT	MKP	VQNPSMKUR	USKSS	RVRR	NOMQ	
pÅ	QR	e É	NNVMRNKQO	MKT	NQMPQUKRR	UQKUQ	RVRR	NOMQ	
d É	TO	k ç=d ~ë	UVNUQQKUT	MRR	VUCRTUKMV	VMKTT	RVRR	NOMQ	
d É	TO	e O	PPRUPUKUT	MKT	PVNMQPKCQ	URKUU	RVRR	NOMQ	
d É	TO	e É	VRNQRKUN	MRR	NNCCCCKSN	UQKTU	RVRR	NOMQ	
v	UV	e O	PURQSMPKNS	MKQ	QPPRROCKCN	UUKVN	RVRR	NOMQ	
v	UV	e É	SORPVVKUO	NKO	TQRQNOKMP	UPKV	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SNTPUSQKSR	MKU	SNSRONVKVS	NMMKNQ	RVRR	NOMQ	
qÄ	NRV	e É	OPNUTUCKRQ	NKO	CRRVVQSKO	VMKRU	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PPSNSNNKSN	NKS	PNTNNVSKMP	NMS	RVRR	NOMQ	
_á	OMV	e É	NPTSVVCKTV	MRR	NRMCPPVKST	VNKSS	RVRR	NOMQ	

p~ã éáÉ=k~ã É	` ` _
cäÉ=k~ã É	MOUJ ` ` _ÍÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíÝ^ mj eyNya^q^yOMOPyMPJ ^oyi n ` PM^hÂ
^Åè=qáã É	PLPMLOMOP=NUWRWON
p~ã éáÉ=qóéÉ	` ` _
qçí~äa ãäíáç å	NMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑc äÉk~ã É	MNO ^i _ÍÇ
p~ã éáÉ=n ` =m~ëëlcá~ä	m~ëë
fpqa=n ` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã áã**

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÄK	r åáë	opa	==\ mp==	i ãäá	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKMMT	ééÄ	OMKT	OOOKOP	MO	
NN	_	S	k ç=d ~ë	MKMVS	ééÄ	VKP	NTUSKUN	Q	
OP	k ~	QR	e É	MKSSU	ééÄ	PRVKS	RNRUUKRR	OMM	
OQ	j Ö	QR	e É	PKOQM	ééÄ	UKT	NSOQKSM	OM	
OT	^ä	QR	e É	MKQRS	ééÄ	NMSKV	ONPKPQ	OM	
OU	pá	QR	e O	MKNUO	ééÄ	NNMKU	RRTKOT	NMM	
PV	h	QR	e É	NMKVUT	ééÄ	TKS	PMQSNKQS	OMM	
QM	` ~	QR	e O	PKTTR	ééÄ	NKU	OTPVUKVR	OM	
RN	s	UV	e É	MKMNU	ééÄ	PVKU	OTOKOP	N	
RO	` ê	UV	e É	JMKMVP	ééÄ	k L^	UNUKRQ	N	
RR	j å	UV	e É	MKMOO	ééÄ	QTKN	NRQKSQ	MQ	
RS	cÉ	UV	e O	OKQRR	ééÄ	QKV	QPRNTKMV	OM	
RV	` ç	UV	e É	MKMMT	ééÄ	SKP	NQUKUV	MO	
SM	k á	UV	e É	MKMPO	ééÄ	TKQ	NVPKPQ	MQ	
SP	` ì	UV	e É	MKMMU	ééÄ	SPKS	QNNKNO	MS	
SS	wå	UV	e É	MKMSQ	ééÄ	OMKR	OVTKTV	O	
TR	^ë	UV	e É	MKMNN	ééÄ	OMKR	PNKMM	N	
TU	pÉ	UV	e O	MKMOP	ééÄ	OSKQ	POKPP	N	
UU	pê	UV	e É	MKMNR	ééÄ	SQKM	SPKPQ	N	
VR	j ç	UV	e É	MKMPM	ééÄ	SKM	TPNKNQ	N	
NMT	^Ö	UV	e É	MKMNN	ééÄ	QRKU	NRSKST	MO	
NNN	` Ç	UV	e É	MKMNM	ééÄ	PTKN	ONKNN	MO	
NNU	på	NRV	e É	MKMSP	ééÄ	RKR	PPUKVM	N	
NON	pÄ	NRV	k ç=d ~ë	MKMOQ	ééÄ	NTKN	UVMKVT	MO	
NPT	_~	NRV	k ç=d ~ë	MKMNU	ééÄ	SVKM	NUSKUT	MQ	
NUO	t	NRV	k ç=d ~ë	MKMUT	ééÄ	QKT	QSSVKNM	N	
OMR	qä	OMV	k ç=d ~ë	MKMQT	ééÄ	NQKR	OOSVKOT	MO	
OMU	mÄ	OMV	k ç=d ~ë	MKMNT	ééÄ	OPKT	NUOUKSR	MO	
OPO	qÜ	OMV	k ç=d ~ë	MKMQT	ééÄ	NQKV	PQPMKTT	N	
OPU	r	OMV	k ç=d ~ë	MKMNQ	ééÄ	NPKP	SUQKMU	MO	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÁ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUNNMNNKRS	NKO	NTSNRRMKR	NVOKUN	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PTCOQSQKPU	MKR	QNOVNNUKR	VMKNR	RVKR	NOMQ	
pÅ	QR	e O	UOUUVSKPO	MKQ	VQNPSMKUR	UUKVR	RVKR	NOMQ	
pÅ	QR	e É	NOOTPNKSP	MKP	NQMPOUKRR	UTKQS	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	VNRUVUKUT	NKM	VUORTUKMV	VPKON	RVKR	NOMQ	
dÉ	TO	e O	PQUOOVKPN	MKU	PVNMOPKOQ	UVKVR	RVKR	NOMQ	
dÉ	TO	e É	VUPQVKRP	MKT	NNOOOOKSN	UTKSQ	RVKR	NOMQ	
v	UV	e O	PVTRMVSKVN	NKM	QPPRROOKON	VNKSU	RVKR	NOMQ	
v	UV	e É	SRPRTOKUT	MKU	TQRQNOKMP	UTKSU	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQQVOSQKNM	MKN	SNSRONVKVS	NVQKSN	RVKR	NOMQ	
qÄ	NRV	e É	OPUVOPOKPV	MKP	ORRVVQSKO	VPKPP	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQSSSVQKRM	MKR	PNTNNVSKMP	NVMKPO	RVKR	NOMQ	
_á	OMV	e É	NQONSURKOS	NKU	NRMOPPVKST	VQKSP	RVKR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` NTfj t O
cáÉ=k~ã É	MOV| m_KÇ
a~í~=m~íÜ=k~ã É	a Wy^ ÖäÉáíyf` mj e yNya ^ q^ yOMOPyMPJ ^ o yi n` PM^ kÄ
^ Åè=qãã É	PLPMLOMOP=NUWPMOV
p~ã éäÉ=qóéÉ	m_
qçí~ä=a áä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MNO ^ i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	m~ëë
fpqa=n` =m~ëëLc~áä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^ å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==` mp==	i áã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	JMKMPP	ééÄ	k L^	NQTKTU	MKR	
_	NN	S	k ç=d ~ë	MKURR	ééÄ	NUKQ	NSSVKMN	NM	
k~	OP	QR	e É	VKMUP	ééÄ	NSVKS	RMPOVKUU	RMM	
j Ö	OQ	QR	e É	NOKNRO	ééÄ	NMKN	NPPTKUV	RM	
^ä	OT	QR	e É	UKORO	ééÄ	OQKV	PPMKMN	RM	
pá	OU	QR	e O	NRKRMP	ééÄ	UKM	NSPNKUO	ORM	
h	PV	QR	e É	SPKOMQ	ééÄ	NTKT	OVTRRKNU	RMM	
` ~	QM	QR	e O	PPKPOM	ééÄ	OKN	PQSNOKQN	RM	
s	RN	UV	e É	MKRSQ	ééÄ	NKS	SMMKMO	OKR	
` ê	RO	UV	e É	MKMTN	ééÄ	SVKM	USQKRP	OKR	
j å	RR	UV	e É	MKNNS	ééÄ	TRKO	NQVKVT	N	
cÉ	RS	UV	e O	NKRTT	ééÄ	PKO	NVTUUKNS	RM	
` ç	RV	UV	e É	MKMMM	ééÄ	RSURKS	VNKNN	MKR	
k á	SM	UV	e É	MKNUO	ééÄ	OMKN	NVRKRS	N	
` ì	SP	UV	e É	MKMTM	ééÄ	POKU	QPMKMN	NKR	
wå	SS	UV	e É	MKVTP	ééÄ	NUKU	PNTKTV	R	
^ë	TR	UV	e É	MKNRR	ééÄ	NQKP	QRKPQ	OKR	
pÉ	TU	UV	e O	MKMTP	ééÄ	NSKR	NVKNT	OKR	
pê	UU	UV	e É	MKMRP	ééÄ	SQKT	RMKMM	OKR	
j ç	VR	UV	e É	MKPPN	ééÄ	SSKV	RQSKSV	OKR	
^Ö	NMT	UV	e É	MKMMU	ééÄ	NNVKS	SOKOO	MKR	
` Ç	NNN	UV	e É	JMKMMS	ééÄ	k L^	SKST	MKR	
på	NNU	NRV	e É	MKQNN	ééÄ	TKS	PUPKPR	OKR	
pÄ	NON	NRV	k ç=d ~ë	MKMQV	ééÄ	TSKP	RUTKPM	MKR	
_~	NPT	NRV	k ç=d ~ë	MKMVT	ééÄ	PMKQ	NVPKRQ	N	
t	NUO	NRV	k ç=d ~ë	MKNTP	ééÄ	TVKR	OTRPKOM	OKR	
qä	OMR	OMV	k ç=d ~ë	JMKMOU	ééÄ	k L^	TVQKOM	MKR	
mÄ	OMU	OMV	k ç=d ~ë	MKMNU	ééÄ	NNMKT	NPOQKTS	MKR	
qÜ	OPO	OMV	k ç=d ~ë	MKNRO	ééÄ	ONKT	OURSKSU	OKR	
r	OPU	OMV	k ç=d ~ë	JMKMMT	ééÄ	k L^	NVPKRQ	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÅ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NTTRVVRKTT	NKO	NTSNRRMKR	NMMKUO	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	PSSCRMPKUU	MKU	QNOVNNUKR	UUKT	RVKR	NOMQ	
pÅ	QR	eO	UMPONOKOT	MKV	VQNPSMKUR	URHPO	RVKR	NOMQ	
pÅ	QR	eÉ	NNUOVUKNN	NKO	NQMPOUKRR	UQHP	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VMTONNKVP	NKM	VUCRTUKMV	VOHPP	RVKR	NOMQ	
dÉ	TO	eO	PPNMVMKVR	MKV	PVNMQPKOQ	UQHST	RVKR	NOMQ	
dÉ	TO	eÉ	VRQRSKPR	NKM	NNCOOOKSN	URHMS	RVKR	NOMQ	
v	UV	eO	PUPMMSPKTQ	MKQ	QPPRROOKON	UUHPQ	RVKR	NOMQ	
v	UV	eÉ	SPNONMKOM	NKM	TQRQNOKMP	UQHSU	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	SPNTMVQKTR	MKT	SNSROMVKVS	NMOKQS	RVKR	NOMQ	
qÄ	NRV	eÉ	OPQTNSRKQT	MKT	ORRVVQSKO	VNHSV	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PQVQRNMKOP	NKQ	PNTNNVSKMP	NNMKO	RVKR	NOMQ	
_á	OMV	eÉ	NQPVUVTKTT	NKP	NRMOPPVKST	VRHUQ	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i `pt n`NTfj t O
cáÉ=k~ã É	MPM`pt kÇ
a~í~=m~íÜ=k~ã É	aWf^ÖäÉáíyf` mj eyNya^q^yOMOPyMPuj ^oyi n` PM^kÄ
^Åè=qã É	PLPMLOMOP=NUMRMT
p~ã éäÉ=qóéÉ	i `pt
qçí~äaäi íáçå	RKMMM
`çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MNO ^i _kÇ
p~ã éäÉ=n`=m~ëëlc á~ä	c~äi
fpqa=n`=m~ëëlc~äi	m~ëë
l éÉê~íçê	**~Çã åä**

n`=^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÄK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n`=cä-Ö
_É	V	S	k ç=dl~ë	ROKOPM	éëÄ	NKM	RPMSNKTM	RM	OMKUV	TVKR	NOMQ	
_	NN	S	k ç=dl~ë	RPMKTTN	éëÄ	MKQ	PQLUVOMKNV	RMM	ONKCP	TVKR	NOMQ	
k~	OP	QR	e É	UTPNKVVM	éëÄ	MKU	VSNOTMKPV	TRMM	OPKOV	TVKR	NOMQ	
j Ö	OQ	QR	e É	RSPRKOPO	éëÄ	MKP	PNPMTNKRR	RMMM	OOKRQ	TVKR	NOMQ	
^ä	OT	QR	e É	OORQKMPT	éëÄ	NKQ	QSNMRKRO	OMMM	OOKRQ	TVKR	NOMQ	
pá	OU	QR	e O	NMSRKRSO	éëÄ	OKP	TUVUQKQT	NMMM	ONKPN	M	OMM	
h	PV	QR	e É	NMQSTKVRT	éëÄ	MKS	ROMQMVKQU	NMMMM	OMKVQ	TVKR	NOMQ	
`~	QM	QR	e O	OTSVKVPQ	éëÄ	NKQ	NRPVMORKVR	ORMM	OOKNS	TVKR	NOMQ	
s	RN	UV	e É	RPVMKSQ	éëÄ	NKO	PTQTRTKMP	RMM	ONKRS	TVKR	NOMQ	
`ê	RO	UV	e É	OOOKPUQ	éëÄ	MKQ	NUUVVMKVQ	OMM	OOKOQ	TVKR	NOMQ	
j å	RR	UV	e É	RRPKOQQ	éëÄ	NKM	OPPPSTKOU	RMM	OOKNP	TVKR	NOMQ	
cÉ	RS	UV	e O	NMUPKSVM	éëÄ	MKR	OORMTNUKRM	NMMM	ONKST	TVKR	NOMQ	
`ç	RV	UV	e É	RTOKQVQ	éëÄ	MKP	UQUUUSKMQ	RMM	OOKV	TVKR	NOMQ	
ká	SM	UV	e É	RTPKNUO	éëÄ	NKR	OPTQOTKVO	RMM	OOKVP	TVKR	NOMQ	
`ì	SP	UV	e É	OUTKRQV	éëÄ	NKV	PPMVMNKNT	ORM	OP	TVKR	NOMQ	
wå	SS	UV	e É	RRSKTTQ	éëÄ	NKM	NMUVVOKUM	RMM	OOKOT	TVKR	NOMQ	
^ë	TR	UV	e É	NMSKUNV	éëÄ	NKQ	NSNQMKPP	NMM	ONKPS	TVKR	NOMQ	
pÉ	TU	UV	e O	NMRKQTV	éëÄ	NKQ	UVUTKSQ	NMM	ONKN	TVKR	NOMQ	
pê	UU	UV	e É	RPSKMPQ	éëÄ	MKV	OTPMNTKNM	RMM	ONKQQ	TVKR	NOMQ	
j ç	VR	UV	e É	NNRKQMU	éëÄ	NKN	RSVVMKTV	NMM	OPKMU	TVKR	NOMQ	a ça
^Ö	NMT	UV	e É	RTKRVP	éëÄ	NKO	NMQTQPKPQ	RM	OPKMQ	TVKR	NOMQ	
`Ç	NNN	UV	e É	OUQKMTS	éëÄ	NKN	SVUPOKVP	ORM	OOKTP	TVKR	NOMQ	
på	NNU	NRV	e É	RNSKOVS	éëÄ	MKU	OSPNNUKNT	RMM	OMKSR	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl~ë	NMPKTUT	éëÄ	NKP	QONNQTKQU	NMM	OMKTS	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl~ë	ONSMKQON	éëÄ	MKQ	OSNOVPQKOU	OMMM	ONKS	TVKR	NOMQ	
t	NUO	NRV	k ç=dl~ë	NNSKPNS	éëÄ	NKR	OTTUPMKTS	NMM	OPKOS	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl~ë	NMQKUVQ	éëÄ	MKR	SMPMOUKNV	NMM	OMKVU	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl~ë	NMTKUNO	éëÄ	MKU	URRPSQKTU	NMM	ONKRS	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl~ë	NMSKPST	éëÄ	MKS	TROSSNKPN	NMM	ONKOT	TVKR	NOMQ	
r	OPU	OMV	k ç=dl~ë	NMVKUVU	éëÄ	MKS	TOVPRMKVV	NMM	ONKVU	TVKR	NOMQ	

n`=fpqa=q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=içï	Bn`=eáÜÜ	n`=à-Ó
iá	S	kç=d~ë	NTQSCPNKTP	MKQ	NTSNRRMKR	VVKNP	RVKR	NOMKQ	
pÅ	QR	kç=d~ë	PSNQQTVKSV	MKQ	QNOVNNUKR	UTHRQ	RVKR	NOMKQ	
pÅ	QR	eO	TVNRCRKMT	MKV	VQNPSMKUR	UQKMU	RVKR	NOMKQ	
pÅ	QR	eÉ	NNRVUTHPM	MKV	NQMPCUKRR	UOKSR	RVKR	NOMKQ	
dÉ	TO	kç=d~ë	UUVVTTHRV	NKO	VUCRTUKMV	VMKRU	RVKR	NOMKQ	
dÉ	TO	eO	PPNNCPKTM	NKN	PVNMQPKCQ	UQKSU	RVKR	NOMKQ	
dÉ	TO	eÉ	VQSQQKQS	NKP	NNCCCCKSN	UQKPQ	RVKR	NOMKQ	
v	UV	eO	PUNPRPVKPP	MKR	QPPRRCCKCN	UTKVS	RVKR	NOMKQ	
v	UV	eÉ	SNTNSRKNV	MKQ	TQRQNCKMP	UCKU	RVKR	NOMKQ	
qÄ	NRV	kç=d~ë	SOTQCNSKQV	NKS	SNSRCNVKVS	NMNKTT	RVKR	NOMKQ	
qÄ	NRV	eÉ	CPQNMSQKMS	MKU	CRRVVQSKO	VNKQR	RVKR	NOMKQ	
_á	QMV	kç=d~ë	PRNQTVNKVP	NKQ	PNTNNVSKMP	NNMKUP	RVKR	NOMKQ	
_á	QMV	eÉ	NQCPTMPKRU	MKR	NRMCPPVKST	VQKTT	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MVSMMMN

cãÉ=k~ã É MPNpj mi HÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` PMl HÅ

^Åè=qãã É PLPMLOMCP=NUWQOMO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKNQT	éé Ä	NQKQ	PORKRS	NMM	
NN	_	S	k ç=d ~ë	PSKMSN	éé Ä	NKQ	OQRVQKRP	NMMM	
OP	k ~	QR	e É	ONTVOKVVU	éé Ä	OKS	OPNONMVKSS	OMMMMM	
OQ	j Ö	QR	e É	RVTMKUQS	éé Ä	NKU	POVRTOKRM	OMMMMM	
OT	^ ä	QR	e É	NPUTKSPQ	éé Ä	OKR	OUOSQKUQ	OMMMMM	
OU	pá	QR	e O	QUSVKPQU	éé Ä	NKO	PRTPSQKNQ	NMMMM	
PV	h	QR	e É	OUSMQTT	éé Ä	MKR	NSMOPUKNO	OMMMMM	
QM	` ~	QR	e O	UMNVKUVS	éé Ä	MKT	QQMOPSOKSN	OMMMMM	
RN	s	UV	e É	PKQRP	éé Ä	QKP	OSOSKVS	NMMM	
RO	` ê	UV	e É	OKPOM	éé Ä	NKV	OTUPKMU	OMMM	
RR	j å	UV	e É	NOPKMTO	éé Ä	NKN	ROSQPKUT	OMMM	
RS	cÉ	UV	e O	NUTNKOVR	éé Ä	MKV	PUQOVMPKRO	NMMMM	
RV	` ç	UV	e É	PKUUM	éé Ä	OKU	RVNQKUN	NMMM	
SM	k á	UV	e É	RKVOU	éé Ä	OKT	OSMOKRN	NMMM	
SP	` ì	UV	e É	SKPSN	éé Ä	OKR	TTQTKUQ	OMMM	
SS	wå	UV	e É	PSKSQN	éé Ä	OKS	TPTTKSP	OMMM	
TR	^ ë	UV	e É	NKNTO	éé Ä	SKN	OMMKPR	NMMM	
TU	pÉ	UV	e O	MKPVT	éé Ä	NOKQ	OSKPP	NMMM	
UU	pê	UV	e É	RNKVUV	éé Ä	NKV	OSUPQKPN	OMMM	
VR	j ç	UV	e É	MKPRP	éé Ä	PMKN	RROKOQ	NMMM	
NMT	^ Ö	UV	e É	MKMPS	éé Ä	RUKQ	NNOKOO	NMM	
NNN	` Ç	UV	e É	MKONM	éé Ä	NVKU	SMKPT	NMMM	
NNU	på	NRV	e É	MKTTT	éé Ä	NVKU	RTMKMP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKQRQ	éé Ä	TKM	OPMVKPO	NMMM	
NPT	_~	NRV	k ç=d ~ë	QRKUSN	éé Ä	OKS	RTSSMKNN	OMMM	
NUO	t	NRV	k ç=d ~ë	MKORM	éé Ä	ONKP	PMOSKUU	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKNSU	éé Ä	NUKO	NVPRKRN	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QKUVO	éé Ä	MKS	QMOQVKVS	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKUTT	éé Ä	PKU	UMRTKUP	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNRN	éé Ä	NRKM	NORUKMS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¨çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NTPTTVVKCP	MKQ	NTSNRRMKR	VUKSR	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PRRQTVPKCP	OKQ	QNOVNNUKR	USKMV	RVKR	NOMKQ	
pÅ	QR	e O	TUTOMUKOT	NKP	VQNPSMKUR	UPKSO	RVKR	NOMKQ	
pÅ	QR	e É	NNRCSRKQM	MKU	NQMPOUKRR	UOKNQ	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	UVNOVQKOQ	MKQ	VUCRTUKMV	VMRTN	RVKR	NOMKQ	
d É	TO	e O	PCQVSNKMM	NKN	PVNMCPKOQ	UPKN	RVKR	NOMKQ	
d É	TO	e É	VQNMVKTQ	MKO	NNOCCOKSN	UPKUS	RVKR	NOMKQ	
v	UV	e O	PTUCQPVKMR	MKU	QPPRRCOKQN	UTKOQ	RVKR	NOMKQ	
v	UV	e É	SORMVOKQU	NKP	TQRQNOKMP	UPKUR	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SRNPURUKUR	MKN	SNSRONVKVS	NVRKSR	RVKR	NOMKQ	
qÄ	NRV	e É	CPQURVSKMS	MKU	CRRVVQSKO	VNKTQ	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRQMVNTKVR	NKQ	PNTNNVSKMP	NNNKSS	RVKR	NOMKQ	
_á	OMV	e É	NQPVSTQKUQ	MKS	NRMOPPVKST	VRKUP	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MVSMMMVO

cãÉ=k~ã É MPOpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMOPyMPJ ^oyi n ` PMl hÅ

^Åè=qãã É PLPMLOMOP=NUVQUMN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MMUQ	ééÄ	PPKU	OSTKTV	NMM	
NN	_	S	k ç=d ~ë	PPKQMS	ééÄ	PKM	OPPNNKON	NMMM	
OP	k ~	QR	e É	ONMMNKSMP	ééÄ	NKS	OOOOQRUPKVN	OMMMMM	
OQ	j Ö	QR	e É	RTUOKVTU	ééÄ	NKO	PNUQRTHRP	OMMMMM	
OT	^ ä	QR	e É	VQRKPPP	ééÄ	MKQ	NVORUKUP	OMMMMM	
OU	pá	QR	e O	QQRSKNTT	ééÄ	MKU	POQPVVKNT	NMMMM	
PV	h	QR	e É	OTSMKPVO	ééÄ	NKM	NRRNRQKNU	OMMMMM	
QM	` ~	QR	e O	TSTUHSRS	ééÄ	NKM	QNUNQPUKRR	OMMMMM	
RN	s	UV	e É	OKSTN	ééÄ	RKQ	OMRRRTQ	NMMM	
RO	` ê	UV	e É	NKUMU	ééÄ	PKM	CPOMKQO	OMMM	
RR	j å	UV	e É	NOOKRSO	ééÄ	MKS	RNUVNKUP	OMMM	
RS	cÉ	UV	e O	NPURKVNS	ééÄ	NKR	QUNSTRSKPO	NMMMMM	
RV	` ç	UV	e É	PKRMO	ééÄ	PKN	ROVOKOT	NMMM	
SM	k á	UV	e É	RKQNT	ééÄ	SKM	OOUNKPQ	NMMM	
SP	` ì	UV	e É	RKOQO	ééÄ	PKU	SPUNKRT	OMMM	
SS	wå	UV	e É	PPKMRQ	ééÄ	QKM	SRVUKPQ	OMMM	
TR	^ ë	UV	e É	NHMNS	ééÄ	NPHR	NTQHSV	NMMM	
TU	pÉ	UV	e O	MKPOU	ééÄ	TKN	QMKMM	NMMM	
UU	pê	UV	e É	QUKVTN	ééÄ	OKN	ORMNSKPT	OMMM	
VR	j ç	UV	e É	JMKMRV	ééÄ	k L^	PQPKPQ	NMMM	
NMT	^ Ö	UV	e É	MKMMR	ééÄ	NSOKN	RQKQR	NMM	
NNN	` Ç	UV	e É	MKMUV	ééÄ	NRHS	PMKMM	NMMM	
NNU	på	NRV	e É	MQSN	ééÄ	NQKO	QMSKSU	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MPUU	ééÄ	UKV	NVTRKRS	NMMM	
NPT	_~	NRV	k ç=d ~ë	PTKSTS	ééÄ	NKN	QSMTTHMQ	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKMSQ	ééÄ	k L^	ONVOKRN	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMMP	ééÄ	k L^	VQQKPT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OKRVQ	ééÄ	PKQ	ONUMPKSS	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MQRN	ééÄ	TKS	QVVVKSM	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMSN	ééÄ	OUKQ	SRMKTM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n ` =i çï	B n ` =¤ãÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NTTCPNMVPQ	NHR	NTSNRRMR	NMMSN	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PRUPQUVKRS	NKV	QNOVNNUHR	USKTV	RVHR	NOMQ	
pÅ	QR	e O	TUMUNVPO	MHS	VQNPSMKUR	UOKVR	RVHR	NOMQ	
pÅ	QR	e É	NNQVTSRTM	MHP	NQMPOUKRR	UNKVP	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VMNSVRKUN	NHP	VUORTUHMV	VNRTT	RVHR	NOMQ	
d É	TO	e O	PORUOTKNT	MHR	PVNMOPKOQ	UPHPO	RVHR	NOMQ	
d É	TO	e É	VPQSNKMD	NHO	NNOOOOKSN	UPKOU	RVHR	NOMQ	
v	UV	e O	PTPTUUQKVT	MHR	OPPRROOKON	USKOO	RVHR	NOMQ	
v	UV	e É	SNURTMKVR	MKU	TQRQNOKMP	UOKVU	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPPQVVNKOR	NHO	SNSRONVKVS	NMOKTR	RVHR	NOMQ	
qÄ	NRV	e É	OPPSOTMKQO	MKV	ORRVVQSHO	VNKOS	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRQPTNUHRS	MHS	PNTNNVSKMP	NNNKNO	RVHR	NOMQ	
_á	OMV	e É	NQPPRRMHRO	NHP	NRMOPPVHST	VRKQO	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMP

cãÉ=k~ã É MPPpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÅ

^Åè=qãã É PLPMLOMCP=NUMRPMMU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MCPU	éé Ä	CPHR	QNUKVN	NMM	
NN	_	S	k ç=d ~ë	OSHRMV	éé Ä	NHR	NUQSTHRV	NMMM	
CP	k ~	QR	e É	CRMPUKCRU	éé Ä	MHT	OSPCPRRHSM	CMMMMM	
CQ	j Ö	QR	e É	RTTNHTSV	éé Ä	MHP	PNSRSRHPO	CMMMMM	
CT	^ ä	QR	e É	NNTNKVRP	éé Ä	MHR	CPTQPHPP	CMMMMM	
CU	pá	QR	e O	QQQTKQQM	éé Ä	MKU	PMTSMUKUO	NMMMM	
PV	h	QR	e É	CNPPKQMQ	éé Ä	NKU	NCRPMPKOS	CMMMMM	
QM	` ~	QR	e O	QURSHSTT	éé Ä	NKQ	OSPSQRVHPV	CMMMMM	
RN	s	UV	e É	CHTRT	éé Ä	RKQ	CNNSKUS	NMMM	
RO	` ê	UV	e É	NKVUU	éé Ä	THM	CQTQKQO	CMMM	
RR	j å	UV	e É	VTKQNQ	éé Ä	NHT	QNCUCHPO	CMMM	
RS	cÉ	UV	e O	NQPMPMMD	éé Ä	NHS	OVQMMQSKNT	NMMMMM	
RV	` ç	UV	e É	PKVPM	éé Ä	CKQ	RVPCKRS	NMMM	
SM	k á	UV	e É	RHPTS	éé Ä	PHT	CPQLUKMD	NMMM	
SP	` ì	UV	e É	PHSUN	éé Ä	CHM	QRUQKNS	CMMM	
SS	wå	UV	e É	PSHPQV	éé Ä	PKU	TCQSKQR	CMMM	
TR	^ ë	UV	e É	MRTNV	éé Ä	NPKQ	NCVHSU	NMMM	
TU	pÉ	UV	e O	MHNSP	éé Ä	RNHS	OSHRM	NMMM	
UU	pê	UV	e É	QRRTUO	éé Ä	NHO	CPQMCKQM	CMMM	
VR	j ç	UV	e É	JMKNPO	éé Ä	k L^	PMTRTV	NMMM	
NMT	^ Ö	UV	e É	JMKMMV	éé Ä	k L^	PMKMM	NMM	
NNN	` Ç	UV	e É	MHMM	éé Ä	NPKU	PCHRV	NMMM	
NNU	på	NRV	e É	MQSP	éé Ä	NRHP	QMQKQS	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MHNSR	éé Ä	NMKQ	NMSTKUQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	QRKVMN	éé Ä	NHT	RSQSQKMR	CMMM	
NUO	t	NRV	k ç=d ~ë	JMCQQ	éé Ä	k L^	NTTNKVV	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKVRQ	éé Ä	k L^	SQQKMQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	CHNCO	éé Ä	PKV	NTUVMKOV	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MHPRQ	éé Ä	VKN	QCTUKRT	NMMM	
OPU	r	OMV	k ç=d ~ë	MHVQN	éé Ä	CRKO	RNMKRR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¡ çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NTQTTVNHUV	QHN	NTSNRRMR	VVKCO	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PRUVSCPHPT	NHM	QNOVNNUHR	USKVP	RVHR	NOMQ	
pÅ	QR	e O	TTSTSNHTT	NHM	VQNPSMKUR	UCHRN	RVHR	NOMQ	
pÅ	QR	e É	NNQRNUHRQ	MHT	NQMPCUHRR	UNHSN	RVHR	NOMQ	
d É	TO	k ç=d ~ë	UVOTNTHPO	MKU	VUCRTUHMV	VMKUR	RVHR	NOMQ	
d É	TO	e O	PCQMVVKQN	MHS	PVNMCPKCQ	UCKUU	RVHR	NOMQ	
d É	TO	e É	VCOVVKVR	MHP	NNCCCCHSN	UCHCR	RVHR	NOMQ	
v	UV	e O	PTUNPCPHPO	MKV	QPPRRCCHQN	UTHCO	RVHR	NOMQ	
v	UV	e É	SNUVCCHPV	NHS	TQRQNCHMP	UPHMP	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPTQMRMKQQ	NHN	SNSRONVKVS	NMPHPV	RVHR	NOMQ	
qÄ	NRV	e É	CPNSNSSKVO	NHM	CRRVVQSHO	VMKQU	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PQVQNUVKQO	NHR	PNTNNVSHMP	NNMKNV	RVHR	NOMQ	
_á	OMV	e É	NCCQVPQHPM	NHP	NRMCPPVHST	VQKUR	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMMQ

cãÉ=k~ã É MPQpj mi hÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíyf^ mj eyNya^q^yOMCPyMPJ ^oyi n` PM^hÅ

^Åè=qáã É PLPMLOMCP=NUVRUMVR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãä m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä-Ö
V	_É	S	k ç=d ~ë	MCCCU	éé Ä	NCKQ	QNMKMO	NMM	
NN	_	S	k ç=d ~ë	CRKUVU	éé Ä	MKT	NUNVSKMN	NMMM	
CP	k ~	CR	e É	CCRUNKTVP	éé Ä	NKP	CRUSNVUKRM	CMMMMM	
CQ	j Ö	CR	e É	RSTTKOTV	éé Ä	CKO	PNNRNPKCP	CMMMMM	
CT	^ ä	CR	e É	NVCCKVOT	éé Ä	NKM	CMTRMKUS	CMMMMM	
CU	pá	CR	e O	QNPPKMLN	éé Ä	MKV	PMCSCPKUP	NMMMM	
PV	h	CR	e É	CMNPKSTP	éé Ä	MKT	NNVTTNKTU	CMMMMM	
QM	` ~	CR	e O	CPCCKMCU	éé Ä	MKQ	CPTPRCPKSP	CMMMMM	
RN	s	UV	e É	CKCUT	éé Ä	PKR	NVNPKRM	NMMM	
RO	` ê	UV	e É	NKTVO	éé Ä	QKV	CCUVKMU	CMMM	
RR	j å	UV	e É	VPKMMM	éé Ä	NKN	PVNMCHRT	CMMM	
RS	cÉ	UV	e O	NPCCKOVQ	éé Ä	NKS	OTNUCUTKQN	NMMMMM	
RV	` ç	UV	e É	PKVCN	éé Ä	CKU	RUTMKPN	NMMM	
SM	k á	UV	e É	RKSVT	éé Ä	NKT	CCSCKQV	NMMM	
SP	` ì	UV	e É	PKUMQ	éé Ä	QKV	QSUSKQO	CMMM	
SS	wå	UV	e É	PQKUMT	éé Ä	MKT	SUVNKUQ	CMMM	
TR	^ ë	UV	e É	MKSSQ	éé Ä	NTHP	NCMKPR	NMMM	
TU	pÉ	UV	e O	MKCMV	éé Ä	PPKO	PMKPP	NMMM	
UU	pê	UV	e É	QQKQTO	éé Ä	MKQ	CCRRPKCN	CMMM	
VR	j ç	UV	e É	JMKMSQ	éé Ä	k L^	OVMKMN	NMMM	
NMT	^ Ö	UV	e É	JMKMMT	éé Ä	k L^	PCKCO	NMM	
NNN	` Ç	UV	e É	MKMTR	éé Ä	RPHS	OSKPM	NMMM	
NNU	på	NRV	e É	MKPRM	éé Ä	QHS	PRPHPR	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKMPN	éé Ä	NRKV	VCQKPR	NMMM	
NPT	_~	NRV	k ç=d ~ë	QQKQTN	éé Ä	CKO	RCMVRKNR	CMMM	
NUO	t	NRV	k ç=d ~ë	JMCVU	éé Ä	k L^	NSPRKNR	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMTU	éé Ä	k L^	RNMKRS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NKMVQ	éé Ä	QKN	NMSCSHPQ	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MCVU	éé Ä	VHR	PUVUKMS	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMCM	éé Ä	SPKQ	PTPKTP	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ÉÅ	B n` =¨çï	B n` =¤ëÜÜ	n` =¤ä-Ö
i á	S	k ç=d ~ë	NTRNPTRKMU	NKO	NTSNRRMR	VVKQO	RVHR	NCMQ	
pÅ	CR	k ç=d ~ë	PRQSNMCKMS	MKP	QNCVNNUHR	URKUU	RVHR	NCMQ	
pÅ	CR	e O	TURNUSKSU	NKP	VQNPSMKUR	UPKQN	RVHR	NCMQ	
pÅ	CR	e É	NNQRRVMPU	MKP	NQMPCUKRR	UNKSQ	RVHR	NCMQ	
d É	TO	k ç=d ~ë	UVMRRPKRS	MKR	VUCRTUHMV	VMKSP	RVHR	NCMQ	
d É	TO	e O	PCCRVQKPS	MKP	PVNMCPKCQ	UCHR	RVHR	NCMQ	
d É	TO	e É	VCMTMKNN	MKS	NNCCCCKSN	UCKMQ	RVHR	NCMQ	
v	UV	e O	PTTQCPMKPS	NKN	CPPRRCCKCN	UTHMS	RVHR	NCMQ	
v	UV	e É	SNPVVQKCR	NKT	TQRQNCKMP	UCKPT	RVHR	NCMQ	
qÄ	NRV	k ç=d ~ë	SPQCSURKMV	NKS	SNSRCNVKVS	NMCKVN	RVHR	NCMQ	
qÄ	NRV	e É	CPRRNUUKSS	MKR	CRRVVQSKO	VO	RVHR	NCMQ	
_á	OMV	k ç=d ~ë	PRMSRVPKCP	MKR	PNTNNVSKMP	NNMKRU	RVHR	NCMQ	
_á	OMV	e É	NQCQLMRKUQ	MKQ	NRMCPPVMST	VQKUQ	RVHR	NCMQ	

p~ã éäÉ=k~ã É pn MVSMMMR

cãÉ=k~ã É MPRpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÅ

^Åè=qãã É PLPMLOMCP=NVMPVQO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKNVS	éé Ä	NSKO	PTRKRT	NMM	
NN	_	S	k ç=d ~ë	OTKMCO	éé Ä	NKM	NUSUUK/U	NMMM	
OP	k ~	QR	e É	OCQQCOKRRQ	éé Ä	MKS	OPNRCPUKTR	OMMMMM	
OQ	j Ö	QR	e É	RRVPKVUO	éé Ä	MKS	PMVCRVKUR	OMMMMM	
OT	^ ä	QR	e É	NPMSKCQN	éé Ä	MKP	CRUVSK/S	OMMMMM	
OU	pá	QR	e O	QCRRKNCP	éé Ä	NKO	PMQQMSKPO	NMMMM	
PV	h	QR	e É	OOTPKTVM	éé Ä	OKP	NOVNNNKSQ	OMMMMM	
QM	` ~	QR	e O	QVUQKQVN	éé Ä	MKQ	OSTCRVQKSR	OMMMMM	
RN	s	UV	e É	OK/NO	éé Ä	OKR	ONVVKNM	NMMM	
RO	` ê	UV	e É	NK/MN	éé Ä	PKU	CPTPKM/	OMMM	
RR	j å	UV	e É	VPKSMP	éé Ä	OKR	PVONQKCO	OMMM	
RS	cÉ	UV	e O	OCQQMRTQV	éé Ä	OKN	QVSUMTTKQV	NMMMMM	
RV	` ç	UV	e É	PKSUV	éé Ä	QKS	RRNCKPT	NMMM	
SM	k á	UV	e É	RVSRS	éé Ä	OKT	CCCPRKUO	NMMM	
SP	` ì	UV	e É	PKQSV	éé Ä	RKM	QCOVMRTP	OMMM	
SS	wå	UV	e É	OVK/UT	éé Ä	PKO	RVPPKRV	OMMM	
TR	^ ë	UV	e É	MK/QS	éé Ä	NRKO	NSCKPR	NMMM	
TU	pÉ	UV	e O	MCQQU	éé Ä	NTTKU	PPKRM	NMMM	
UU	pê	UV	e É	QCKRUQ	éé Ä	OKO	ONRCCKSO	OMMM	
VR	j ç	UV	e É	JMKNPR	éé Ä	k L^	PMPKPQ	NMMM	
NMT	^ Ö	UV	e É	MKMMN	éé Ä	UVOKN	QTRKTU	NMM	
NNN	` Ç	UV	e É	MK/UV	éé Ä	PMK/	OVKSP	NMMM	
NNU	på	NRV	e É	MKPPM	éé Ä	OMKR	PPSKSU	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKPMT	éé Ä	OPKR	NSPUKRM	NMMM	
NPT	_~	NRV	k ç=d ~ë	QQKQPN	éé Ä	NKP	RQNVOKRM	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKNCP	éé Ä	k L^	OMQRKSS	NMMM	
OMR	qä	OMV	k ç=d ~ë	MK/QU	éé Ä	ONCKS	NCPNKPT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OKTUT	éé Ä	SK/M	OPCQSKCQ	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKPRR	éé Ä	NTTKS	QPMNK/R	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNUR	éé Ä	SUKN	NQSQK/V	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NTPSVQMSP	MK/	NTSNRRMR	VUKS	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PRNPROSKNQ	NKN	QNOVNNUKR	URKM/	RVKR	NOMQ	
pÅ	QR	e O	TSTOSPK/V	MKP	VQNPSMKUR	UNKRN	RVKR	NOMQ	
pÅ	QR	e É	NNONPUKNM	MKO	NQMPOUKRR	TVK/N	RVKR	NOMQ	
d É	TO	k ç=d ~ë	UUNCOMKPT	MKU	VUCRTUKM/	UVKSU	RVKR	NOMQ	
d É	TO	e O	PCQQTOKCR	MKT	PVNMCPKCQ	UCK/U	RVKR	NOMQ	
d É	TO	e É	VNQV/CKRM	MKO	NNCCCOKSN	UNKRP	RVKR	NOMQ	
v	UV	e O	PTRPTMMKNU	NKU	CPPRRCOKCN	USKRU	RVKR	NOMQ	
v	UV	e É	SNNUPQKPV	NKR	TQRQNOKMP	UCKMU	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPNUUVRKNQ	MKR	SNSRONVK/S	NVCKQV	RVKR	NOMQ	
qÄ	NRV	e É	CPNOVVRKPR	MKT	CRRVVQSKO	VMKPR	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRNMQV/TKMP	MKU	PNTNNVSKMP	NNMKT	RVKR	NOMQ	
_á	OMV	e É	NQONTOVKPP	OKS	NRMCPPVK/ST	VQKSP	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMVS

cãÉ=k~ã É MPSpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PMˆHÅ

^Åè=qáã É PLPMLOMCP=NVMMUMRM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=¤l ~ë	MKNNO	éé Ä	COKQ	OVNKNO	NMM	
NN	_	S	k ç=¤l ~ë	OSKUCU	éé Ä	PKQ	NUSPRKRP	NMMM	
OP	k ~	QR	e É	OPVNOKRTR	éé Ä	NKO	OPVPMMSKQQ	OMMMMM	
OQ	j Ö	QR	e É	RQCMKPRM	éé Ä	OKN	CUOTSNKRM	OMMMMM	
OT	^ ä	QR	e É	NQTRKMTS	éé Ä	OKM	OUPUPKVS	OMMMMM	
OU	pá	QR	e O	QUMUKMPR	éé Ä	NKU	PPSMSNKNO	NMMMM	
PV	h	QR	e É	OPTTRTSQ	éé Ä	NKV	NPMMMUKMS	OMMMMM	
QM	` ~	QR	e O	QRVTKUVS	éé Ä	NKQ	OQNMPTVKOT	OMMMMM	
RN	s	UV	e É	OKVVP	éé Ä	PKN	ONVNKPO	NMMM	
RO	` ê	UV	e É	OKMUN	éé Ä	QKQ	OQRPKTR	OMMM	
RR	j å	UV	e É	VQKCRT	éé Ä	NKM	PUPUSKUN	OMMM	
RS	cÉ	UV	e O	PPQCKCUQ	éé Ä	NKQ	SRQMNVUKTT	NMMMMM	
RV	` ç	UV	e É	PKRRV	éé Ä	OKP	RNTMKMQ	NMMM	
SM	k á	UV	e É	SKCPO	éé Ä	OKR	CRVUKMS	NMMM	
SP	` ì	UV	e É	PKROT	éé Ä	PKO	QCPCQKMS	OMMM	
SS	wå	UV	e É	OVKVCP	éé Ä	PKQ	RTRPKRM	OMMM	
TR	^ ë	UV	e É	NKMTU	éé Ä	NKR	NTTKMO	NMMM	
TU	pÉ	UV	e O	MKNSN	éé Ä	PTKN	CRKNT	NMMM	
UU	pê	UV	e É	QMCQUV	éé Ä	NKN	NVUUVKMV	OMMM	
VR	j ç	UV	e É	JMKCPN	éé Ä	kL^	OCUKVM	NMMM	
NMT	^ Ö	UV	e É	JMKMNO	éé Ä	kL^	CPKPP	NMM	
NNN	` Ç	UV	e É	MKMSM	éé Ä	NRKV	ONKUR	NMMM	
NNU	på	NRV	e É	MKPOT	éé Ä	VKU	PPNKNO	NMMM	
NON	pÄ	NRV	k ç=¤l ~ë	MKOMU	éé Ä	OKS	NOMUKMM	NMMM	
NPT	_~	NRV	k ç=¤l ~ë	QRKSTR	éé Ä	MKQ	RQRPNKMM	OMMM	
NUO	t	NRV	k ç=¤l ~ë	JMKPVR	éé Ä	kL^	NPSUKNU	NMMM	
OMR	qä	OMV	k ç=¤l ~ë	JMKMUT	éé Ä	kL^	QRPKUO	NMMM	
OMU	mÄ	OMV	k ç=¤l ~ë	OKTRR	éé Ä	OKO	OOTNUKSQ	OMMM	
OPO	qÜ	OMV	k ç=¤l ~ë	MKOUV	éé Ä	OKT	PTVTKVN	NMMM	
OPU	r	OMV	k ç=¤l ~ë	MKMTT	éé Ä	ONKR	TQQKNQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =¨ çï	B n ` =¤eåÜÜ	n ` =¤ä~Ö
i á	S	k ç=¤l ~ë	NTQPPUMQQ	OKS	NTSNRRMR	VUKVT	RVRR	NOMQ	
pÅ	QR	k ç=¤l ~ë	PQQPTMTRN	NKO	QNOVNNUR	UPKQ	RVRR	NOMQ	
pÅ	QR	e O	TQVUNVKNP	MKT	VQNPSMKUR	TVKSR	RVRR	NOMQ	
pÅ	QR	e É	NMUVCQKQM	NKO	NQMPCUKRR	TTKSO	RVRR	NOMQ	
d É	TO	k ç=¤l ~ë	USSSMSKUT	MKR	VUCRTUKMV	UUKO	RVRR	NOMQ	
d É	TO	e O	PNMTCQKRQ	MKS	PVNMCPKCQ	TVKQS	RVRR	NOMQ	
d É	TO	e É	UVQMQKMM	NKR	NNCCCCKSN	TVKST	RVRR	NOMQ	
v	UV	e O	PSNMVQQKVQ	MKQ	QPPRRCQKQN	UPKOV	RVRR	NOMQ	
v	UV	e É	RVQSTRKMU	MKU	TQRQNOKMP	TVKTU	RVRR	NOMQ	
qÄ	NRV	k ç=¤l ~ë	SNURSNPKRR	NKN	SNSRONVKVS	NMMKPP	RVRR	NOMQ	
qÄ	NRV	e É	CQUCSRUKMO	NKP	CRRVVQSKO	UVKNT	RVRR	NOMQ	
_á	OMV	k ç=¤l ~ë	PQSVONPKRM	NKP	PNTNNVSKMP	NMVKQ	RVRR	NOMQ	
_á	OMV	e É	NPUVOMTKTT	NKN	NRMCPPVKST	VOKQT	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMT

cãÉ=k~ã É MPTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PMˆhÅ

^Åè=qãã É PLPMLOMCP=NVMPMRU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKNVT	ééÄ	NRKU	PUNKNP	NMM	
NN	_	S	k ç=d ~ë	PPKNCS	ééÄ	PKR	COVSQKMV	NMMM	
CP	k ~	CR	e É	CPPMTKPPO	ééÄ	NKT	CPTRTNRKVR	CMMMMM	
CQ	j Ö	CR	e É	TMNSKMVM	ééÄ	NKM	PTCQSPKCP	CMMMMM	
CT	^ ä	CR	e É	NCUMKVVP	ééÄ	NKQ	CRNNQKRP	CMMMMM	
CU	pá	CR	e O	SNVNKUVM	ééÄ	MKV	CQQCPRPKSR	NMMMM	
PV	h	CR	e É	OTMQKNQN	ééÄ	MKO	NQTMVVKMN	CMMMMM	
QM	` ~	CR	e O	UPVRKNQR	ééÄ	NKT	CQQUSTTTKCP	CMMMMM	
RN	s	UV	e É	PKNUR	ééÄ	QKN	CPOVKNO	NMMM	
RO	` ê	UV	e É	QKMQM	ééÄ	RKN	CQQOVKTR	CMMM	
RR	j å	UV	e É	NPTKCPO	ééÄ	NKR	RSMSRKSU	CMMM	
RS	cÉ	UV	e O	NTQUKQMP	ééÄ	NKS	PRRTRRMKRR	NMMMMM	
RV	` ç	UV	e É	QKCCM	ééÄ	MKT	SNPTKNO	NMMM	
SM	k á	UV	e É	RKSCR	ééÄ	NKU	CPSQKSV	NMMM	
SP	` ì	UV	e É	TKNNN	ééÄ	CKQ	UCPRKUU	CMMM	
SS	wå	UV	e É	QSKMVN	ééÄ	CKN	UUPRKNT	CMMM	
TR	^ ë	UV	e É	NKMUV	ééÄ	TKQ	NTVKPR	NMMM	
TU	pÉ	UV	e O	MKNTT	ééÄ	NMO	OTHRM	NMMM	
UU	pê	UV	e É	RCKRVO	ééÄ	MKN	CRVOVKCM	CMMM	
VR	j ç	UV	e É	JMKCNR	ééÄ	k L^	CRTKTV	NMMM	
NMT	^ Ö	UV	e É	JMKMMT	ééÄ	k L^	PCKCO	NMM	
NNN	` Ç	UV	e É	MKNNV	ééÄ	OTKM	PRKVO	NMMM	
NNU	på	NRV	e É	MKCUT	ééÄ	NQKO	PNNKNO	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKPSS	ééÄ	PKN	NUTRKQR	NMMM	
NPT	_~	NRV	k ç=d ~ë	QRKCVN	ééÄ	MKU	RRNVMTKNV	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKPTT	ééÄ	k L^	NQPUKCS	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMVQ	ééÄ	k L^	QNPKTU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	QKNQV	ééÄ	NKP	PPVCSKTU	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKCVR	ééÄ	UKO	PUTNKPQ	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMQQ	ééÄ	CCKV	RPMKRU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n ` =i çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NTSMQNNKMV	QKO	NTSNRRMKR	VVKVQ	RVKR	NCMKQ	
pÅ	CR	k ç=d ~ë	PQUPRRUKRN	MKO	QNCVNNUKR	UQKPT	RVKR	NCMKQ	
pÅ	CR	e O	TSSRRSKQT	MKQ	VQNPSMKUR	UNKCP	RVKR	NCMKQ	
pÅ	CR	e É	NNMUUVKNM	NKR	NQMPCUKRR	TVKMO	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	UTPPCQKNO	NKN	VUCRTUKMV	UUKUU	RVKR	NCMKQ	
d É	TO	e O	PCMURUKMS	MKS	PVNMCPKCQ	UCKMR	RVKR	NCMKQ	
d É	TO	e É	VMNVTKCR	MKT	NNCCCCKSN	UMKPT	RVKR	NCMKQ	
v	UV	e O	PTQSUVRKPP	NKN	QPPRRCCKCN	USKQO	RVKR	NCMKQ	
v	UV	e É	RVSVUNKVP	MKS	TQRQNCKMP	UMKMV	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SPMQMNNKVR	MKU	SNSRCNVKVS	NMCKCR	RVKR	NCMKQ	
qÄ	NRV	e É	CCUQCCPNKSO	NKQ	CRRVVQSKO	UVKCQ	RVKR	NCMKQ	
_á	OMV	k ç=d ~ë	PRMVMTQVKOT	MKU	PNTNNVSKMP	NNMKPV	RVKR	NCMKQ	
_á	OMV	e É	NQMRVSTKPN	NKU	NRMCPPVKST	VPKRV	RVKR	NCMKQ	

p~ã éäÉ=k~ã É pn MVSMMMU

cãÉ=k~ã É MPUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PMˆhÅ

^Åè=qáã É PLPMLOMCP=NVMNUMQS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~äã m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKMVR	éé Ä	PKV	OUTKTV	NVM	
NN	_	S	k ç=d ~ë	PNKVOV	éé Ä	NKT	OONVSKOO	NVMM	
OP	k ~	QR	e É	OOQUNKPPR	éé Ä	NKM	OOVSOMOKQR	OMMMMM	
OQ	j Ö	QR	e É	SQVQKSVQ	éé Ä	MKV	PQRPNTKQP	OMMMMM	
OT	^ ä	QR	e É	NVMSKMOT	éé Ä	NKS	ONRPVKUO	OMMMMM	
OU	pá	QR	e O	SMTQKUVT	éé Ä	NKT	QPRUOVKTM	NVMMM	
PV	h	QR	e É	OTTTKSSN	éé Ä	MKU	NRMSONKNU	OMMMMM	
QM	` ~	QR	e O	TSTRKOMV	éé Ä	MKU	QNOMOUUKQU	OMMMMM	
RN	s	UV	e É	OKTMM	éé Ä	MKP	OMMVKMS	NVMM	
RO	` ê	UV	e É	NKVNR	éé Ä	RKT	OPPOKQO	OMMM	
RR	j å	UV	e É	NOOKUSS	éé Ä	MKU	RMPQOKSR	OMMM	
RS	cÉ	UV	e O	NUMMKTPN	éé Ä	MKV	PRVTVMMKTV	NVMMMM	
RV	` ç	UV	e É	PKUUP	éé Ä	SKV	RSSRKTS	NVMM	
SM	k á	UV	e É	RKQVN	éé Ä	OKU	OPNSKVM	NVMM	
SP	` ì	UV	e É	QKURS	éé Ä	NKS	RTQQKSN	OMMM	
SS	wå	UV	e É	OVKOMV	éé Ä	NKN	RSRTKVN	OMMM	
TR	^ ë	UV	e É	NKMPR	éé Ä	UKM	NTOKMO	NVMM	
TU	pÉ	UV	e O	MKNSR	éé Ä	NTKN	OSKMM	NVMM	
UU	pê	UV	e É	QUKMPT	éé Ä	MKV	OPTQUKSM	OMMM	
VR	j ç	UV	e É	JMKPRN	éé Ä	k L^	NVPKPQ	NVMM	
NMT	^ Ö	UV	e É	JMKMMV	éé Ä	k L^	OUKUV	NVM	
NNN	` Ç	UV	e É	MKMRP	éé Ä	NVKS	OMKPT	NVMM	
NNU	på	NRV	e É	MKOVM	éé Ä	NNKO	PNTKTV	NVMM	
NON	pÄ	NRV	k ç=d ~ë	MKPOU	éé Ä	NKT	NTOUKRV	NVMM	
NPT	_~	NRV	k ç=d ~ë	PTKNRU	éé Ä	NKM	QRQMTKVM	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKQSU	éé Ä	k L^	NOOOKSV	NVMM	
OVR	qä	OMV	k ç=d ~ë	JMKNOS	éé Ä	k L^	OPPKRU	NVMM	
OVU	mÄ	OMV	k ç=d ~ë	OKMVM	éé Ä	PKT	NTUMKQN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKOVN	éé Ä	NTKO	PURNKPN	NVMM	
OPU	r	OMV	k ç=d ~ë	MKVQT	éé Ä	NOKT	RRPKVP	NVMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n ` =i çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NTSNRQOKQT	NKP	NTSNRRVMR	NVM	RVMR	NOMQ	
pÅ	QR	k ç=d ~ë	PQVURNSKUR	NKV	QNOVNNUMR	UQRTP	RVMR	NOMQ	
pÅ	QR	e O	TSVTRUMPO	MMR	VQNPSMKUR	UNRTT	RVMR	NOMQ	
pÅ	QR	e É	NNNVPPMRN	MKU	NQMPOUKRR	TVMNO	RVMR	NOMQ	
d É	TO	k ç=d ~ë	UUOORSMRS	MKQ	VUORTUMVV	UVRTV	RVMR	NOMQ	
d É	TO	e O	PNUQTNMPP	MRT	PVNMVOPKOQ	UNKQQ	RVMR	NOMQ	
d É	TO	e É	VMMNOKVN	MKO	NNOOOOKSN	UMKON	RVMR	NOMQ	
v	UV	e O	PSTVQOUKNS	MMR	OPPRROOKON	UQKUT	RVMR	NOMQ	
v	UV	e É	RVUSPTKQO	NKU	TQRQNOKMP	UMPPN	RVMR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPOVPOUKQT	MKQ	SNSRONVKVS	NVOKSS	RVMR	NOMQ	
qÄ	NRV	e É	OPONORQKMR	NKN	ORRVVQSKO	VMKSU	RVMR	NOMQ	
_á	OMV	k ç=d ~ë	PRNVORMKQS	OKN	PNTNNVSKMP	NNMKSV	RVMR	NOMQ	
_á	OMV	e É	NPVNSVOKTQ	NKO	NRMOPPVKST	VOKSQ	RVMR	NOMQ	

`çåíaåì åaÖ=`~äåÄê~íáç=sÉêåÑÑÅ~íáç=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MPV|``skÇ
a~í~=m~íÜ=k~ã É	aWyºÖãÉáíyº mj eyNya^q^yOMOPyMPJ ^oyi n` PMºkÅ
^Åè=qáã É	PLPMLOMOP=NVWØPWRP
p~ã éáÉ=qóéÉ	``s
qçí~äaãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MNO^i_kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=cä-Ö
V	_É	S	k ç=d ~ë	OQKSSR	ééÄ	OKN	NORMTVMSP	OR	VUMSS	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKOPR	ééÄ	OKN	UQQQVKUM	OR	NMNRTQ	UVKU	NNMO	
OP	k ~	OR	e É	RRSQKSRQ	ééÄ	NRT	OUPGROMPN	RMMM	NNNKOV	UVKU	NNMO	[=HLHNMB
OQ	j Ö	OR	e É	RRSVKOVP	ééÄ	OKO	NQUMPOMPP	RMMM	NNNHPV	UVKU	NNMO	[=HLHNMB
OT	^ä	OR	e É	RQRRTOP	ééÄ	NKU	RPQTTMMT	RMM	NMVKNR	UVKU	NNMO	
OU	pá	OR	e O	ROOKSOU	ééÄ	MRR	NUSMPRKPS	RMM	NMQKRP	UVKU	NNMO	
PV	h	OR	e É	RONNRTMS	ééÄ	NKV	NOMOPRMMV	RMMM	NMQKOP	UVKU	NNMO	
QM	` ~	OR	e O	RONSKPPP	ééÄ	NKM	NPUPUVORKVM	RMMM	NMQKPP	UVKU	NNMO	
RN	s	UV	e É	ORKPRQ	ééÄ	MRT	URQSUKUO	OR	NMNKQO	UVKU	NNMO	
RO	` ê	UV	e É	ORKUPU	ééÄ	MKP	NMSPSQKSU	OR	NMPHPR	UVKU	NNMO	
RR	j å	UV	e É	ORKVUM	ééÄ	MKP	ROVVRKMN	OR	NMPKVO	UVKU	NNMO	
RS	cÉ	UV	e O	RNQTKNUN	ééÄ	MKV	RMUPVQUNKMO	RMMM	NMOKVQ	UVKU	NNMO	
RV	` ç	UV	e É	OSKPPR	ééÄ	MKU	NUUSQQKSU	OR	NMRKPQ	UVKU	NNMO	
SM	ká	UV	e É	OSKRVN	ééÄ	NKP	RPOUPKSO	OR	NMSKPS	UVKU	NNMO	
SP	` ì	UV	e É	OSKUTO	ééÄ	NKN	NQVROTKTV	OR	NMTKQV	UVKU	NNMO	
SS	wå	UV	e É	OTKMSN	ééÄ	NKS	ORSTOKTT	OR	NMUKOQ	UVKU	NNMO	
TR	^ë	UV	e É	ORKQPQ	ééÄ	MKQ	NURRSKOQ	OR	NMNRTQ	UVKU	NNMO	
TU	pÉ	UV	e O	ORKPQQ	ééÄ	MKU	NMPQMPQ	OR	NMNKPU	UVKU	NNMO	
UU	pê	UV	e É	ORKUTR	ééÄ	MKS	SPSSNKQN	OR	NMPKR	UVKU	NNMO	
VR	j ç	UV	e É	OSKUNT	ééÄ	NKN	SPUVVRTU	OR	NMTKOT	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKTUM	ééÄ	MKV	OQPVORKRQ	OR	NNNKNO	UVKU	NNMO	[=HLHNMB
NNN	` Ç	UV	e É	OTKMOR	ééÄ	MRT	POMUUKOR	OR	NMUKN	UVKU	NNMO	
NNU	på	NRV	e É	OQKTPR	ééÄ	NRT	SNNTMRTM	OR	VUKVQ	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKVRP	ééÄ	MKQ	QVVRRNKPQ	OR	VVKUN	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKOOP	ééÄ	MKS	NRMRUPKVT	OR	NMMKUV	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKSOU	ééÄ	MKU	PNPRPPKNP	OR	NMSKRN	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	OSKOMU	ééÄ	NKO	TNTMPVKNO	OR	NMQKUP	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKQTV	ééÄ	MKV	VVVVQVKUS	OR	NMRKVO	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKSVQ	ééÄ	MKO	UVUUSQKSP	OR	NMSKTU	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OTKQOU	ééÄ	MKP	USSSNQKVN	OR	NMVKTN	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=i çï	B n`=eäÜÜ	n`=cä-Ö
iá	S	k ç=d ~ë	NTQTNPNKQO	NKT	NTSNRRMR	VVKNU	RVKR	NOMQ	
pÅ	OR	k ç=d ~ë	PQRRNSOKQM	MKN	QNOVNNUKR	UPKSU	RVKR	NOMQ	
pÅ	OR	e O	TSOUMVKUR	MKR	VQNPSMKUR	UNKMP	RVKR	NOMQ	
pÅ	OR	e É	NNNNTSKTU	MKQ	NQMPOUKRR	TVKOP	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	USMVMSKOT	MKP	VUORTUKMV	UTHSO	RVKR	NOMQ	
dÉ	TO	e O	POMMOUKOU	MKU	PVNMOPKOQ	UNKUQ	RVKR	NOMQ	
dÉ	TO	e É	VMMVPKRV	MKR	NNOOOOHSN	UMKOU	RVKR	NOMQ	
v	UV	e O	PSROVVUKUO	MKT	OPPRROOKON	UQKOS	RVKR	NOMQ	
v	UV	e É	RVSNMUKQP	MKQ	TQRQNOKMP	TVKVT	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SNVNSPPKUM	MKS	SNSRONVKVS	NMMKQP	RVKR	NOMQ	
qÄ	NRV	e É	OOSTTTQKSM	NKR	ORRVVQSKO	UUKRV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PPQSUMRKVQ	NKO	PNTNNVSKMP	NMRKRQ	RVKR	NOMQ	
_á	OMV	e É	NPSPPQOKOP	NKO	NRMOPPVKST	VMKTR	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=É``_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MQM``_KÇ

a~í~=m~íÜ=k~ã É aWj^ÖäÉáíÝ^mj eyNya^q^yOMCPyMPJ^oyin`PM^kÂ

^Åè=qáã É PLPMLOMCP=NVMRNMO

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáç~å NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑc äÉk~ã É MNO^i_KÇ

p~ã éáÉ=n`=m~ëëlc á~ä m~ëë

fpqa=n`=m~ëëlc~äã m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	r åáë	opa	==\ mp==	iãäá	n`=c ä~Ö
V	_É	S	kç=d~ë	MKMMQ	éé Ä	NCCKV	CMCKCR	MO	
NN	_	S	kç=d~ë	MKMUV	éé Ä	RQKR	NQNNKCN	Q	
CP	k~	CR	eÉ	JNKVQU	éé Ä	kL^	CSRPPKCN	CMM	
CQ	j Ö	CR	eÉ	CKVQQ	éé Ä	NSKN	NVTNKPO	CM	
CT	^ä	CR	eÉ	MKSCP	éé Ä	PNKV	CNSVKST	CM	
CU	pá	CR	eO	MKTTO	éé Ä	PCKP	TPTKQS	NMM	
PV	h	CR	eÉ	UKSCS	éé Ä	PRKU	OTTCMKQV	CMM	
QM	`~	CR	eO	SKMPM	éé Ä	TKR	PNURCKTV	CM	
RN	s	UV	eÉ	MKMQV	éé Ä	NSKU	PSSVKSU	N	
RO	`ê	UV	eÉ	MKMNM	éé Ä	NNUKM	UPNKUT	N	
RR	j å	UV	eÉ	MKMCR	éé Ä	NQKU	NVPKVS	MQ	
RS	cÉ	UV	eO	CKMSO	éé Ä	RKQ	RTCQCKCN	CM	
RV	` ç	UV	eÉ	MKMNT	éé Ä	PUKU	CNPKPQ	MO	
SM	k á	UV	eÉ	MKMCQ	éé Ä	QUKS	NSSVKST	MQ	
SP	`ì	UV	eÉ	MKMCR	éé Ä	RRKV	QUPKPR	MS	
SS	wå	UV	eÉ	MCMQ	éé Ä	NVKP	PCNKNO	O	
TR	^ë	UV	eÉ	MKMNV	éé Ä	OSKN	PRKST	N	
TU	pÉ	UV	eO	MKMPS	éé Ä	PPKS	OTKST	N	
UU	pê	UV	eÉ	MKMCO	éé Ä	CKS	TTKTU	N	
VR	j ç	UV	eÉ	MKMQS	éé Ä	NCKN	QUSVKSU	N	
NMT	^Ö	UV	eÉ	MKMNU	éé Ä	NCKO	CNPKPQ	MO	
NNN	`Ç	UV	eÉ	MKMNU	éé Ä	PQKV	PMKMM	MO	
NNU	på	NRV	eÉ	MKMCO	éé Ä	PNKO	OTUKVM	N	
NCN	pÄ	NRV	kç=d~ë	MKMPN	éé Ä	SKP	NVNNKNM	MO	
NPT	_~	NRV	kç=d~ë	MKMPM	éé Ä	NVKR	OSMKCU	MQ	
NUO	t	NRV	kç=d~ë	MKMVO	éé Ä	NRKT	PQQMKTT	N	
OVR	qä	OVV	kç=d~ë	MKMPP	éé Ä	NVKU	NUUCKNQ	MO	
OVU	mÄ	OVV	kç=d~ë	MKMNT	éé Ä	UKU	NUPRKPP	MO	
OPO	qÜ	OVV	kç=d~ë	MKMSR	éé Ä	UKR	CMQNKSN	N	
OPU	r	OVV	kç=d~ë	MKMCN	éé Ä	NPKR	VPNKMO	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j ÇÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=çï	B n`=cåÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	NTVTMSNKMP	NKR	NTSNRRMKR	NVCKMO	RVKR	NOMQ	
pÅ	CR	kç=d~ë	PQVVCRSKVV	MKU	QNOVNNUKR	UQRTR	RVKR	NOMQ	
pÅ	CR	eO	TTVNPUKCQ	MKV	VQNPSMKUR	UCRTT	RVKR	NOMQ	
pÅ	CR	eÉ	NNPVNMKVT	NKM	NQMPCUKRR	UNKST	RVKR	NOMQ	
dÉ	TO	kç=d~ë	UUNVUVKRO	NKO	VUCRTUKMV	UVRTS	RVKR	NOMQ	
dÉ	TO	eO	PCQSUSKSM	MRT	PVNMCPKCQ	UPKMP	RVKR	NOMQ	
dÉ	TO	eÉ	VPTPTKMD	MKP	NNCCCCKSN	UPKRP	RVKR	NOMQ	
v	UV	eO	PTQCNQCKVR	MKP	QPPRRCCKCN	USKPN	RVKR	NOMQ	
v	UV	eÉ	SCMVCCKPQ	MKV	TQRQNCKMP	UPKNU	RVKR	NOMQ	
qÄ	NRV	kç=d~ë	SPCSVUUKUR	MKR	SNSRCNVKVS	NVCKSO	RVKR	NOMQ	
qÄ	NRV	eÉ	CPPPNMVKQM	NKS	CRRVVQSKO	VNKNQ	RVKR	NOMQ	
_á	OVV	kç=d~ë	PQSMPQVKRT	CKN	PNTNNVSKMP	NMVKNO	RVKR	NOMQ	
_á	OVV	eÉ	NPVQPNSKTV	MKR	NRMCPPVKST	VCKUN	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMV

cãÉ=k~ã É MQNpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÅ

^Åè=qáã É PLPMLOMCP=NVMRSVQM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	MKUP	éé Ä	PVKS	OSQQCR	NVM	
NN	_	S	k ç=d ~ë	RMKPTO	éé Ä	MKU	PQPMTKSV	NMMM	
CP	k ~	QR	e É	NSTNMKUNM	éé Ä	NKU	NTCRCOSKVO	OMMMMM	
CQ	j Ö	QR	e É	QPTUKONT	éé Ä	MKV	CPPUQTKVR	OMMMMM	
CT	^ ä	QR	e É	NTMQKURV	éé Ä	CKQ	PPRQTHPS	OMMMMM	
CU	pá	QR	e O	TRTUKUST	éé Ä	NKT	RQMNNRKQQ	NMMMM	
PV	h	QR	e É	PNRTKUNU	éé Ä	CKO	NSUQCSKQP	OMMMMM	
QM	` ~	QR	e O	VTQNKVQP	éé Ä	NKU	RNUNTPQKMD	OMMMMM	
RN	s	UV	e É	QKPQO	éé Ä	MKU	PNCRKVS	NMMM	
RO	` ê	UV	e É	QKSNS	éé Ä	CKQ	OVNVKMU	OMMM	
RR	j å	UV	e É	NPRKCQP	éé Ä	MKV	RRRUTKTU	OMMM	
RS	cÉ	UV	e O	NSPQKSUQ	éé Ä	CHP	PCRCUPSKMU	NMMMMM	
RV	` ç	UV	e É	PKUMT	éé Ä	QKM	RRTVKMV	NMMM	
SM	k á	UV	e É	SKRTQ	éé Ä	PKO	OTSNKQP	NMMM	
SP	` ì	UV	e É	NQKVUO	éé Ä	MKU	NQURRKUS	OMMM	
SS	wå	UV	e É	QNKMNU	éé Ä	CKS	TVCPKQV	OMMM	
TR	^ ë	UV	e É	NKTUT	éé Ä	TKS	QUPKMP	NMMM	
TU	pÉ	UV	e O	MQTS	éé Ä	RKU	RNHPP	NMMM	
UU	pê	UV	e É	QSKQSQ	éé Ä	NKU	CPMQVKRV	OMMM	
VR	j ç	UV	e É	MKNPO	éé Ä	TTHR	QCQKQS	NMMM	
NMT	^ Ö	UV	e É	MKMSU	éé Ä	NSKP	NSQKQR	NMM	
NNN	` Ç	UV	e É	MKNUR	éé Ä	PMKT	RNKUR	NMMM	
NNU	på	NRV	e É	MKPUS	éé Ä	RKU	PTMKMN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKSRU	éé Ä	NQKT	PMTPHSO	NMMM	
NPT	_~	NRV	k ç=d ~ë	PSKOTR	éé Ä	MKQ	QQPPSKQN	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKNCR	éé Ä	k L^	OMCRHSS	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMNR	éé Ä	k L^	UTQKCU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	UHSVS	éé Ä	MKR	TMQUMKNP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKQVO	éé Ä	VKN	RPMSKTP	NMMM	
OPU	r	OMV	k ç=d ~ë	MKNPQ	éé Ä	NQHS	NNQNKOS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NTRTPTPKMV	NKP	NTSNRRMR	VVRTS	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PQPTUQOKRP	NKP	QNOVNNUHR	UPKOS	RVHR	NOMQ	
pÅ	QR	e O	TSQTCUKPO	NKO	VQNPSMKUR	UNKCQ	RVHR	NOMQ	
pÅ	QR	e É	NNNQQVHSM	MKN	NQMPCUKRR	TVKQO	RVHR	NOMQ	
d É	TO	k ç=d ~ë	USVQCMRV	NKR	VUCRTUKMV	UUKQU	RVHR	NOMQ	
d É	TO	e O	PNTRCOKPP	NKN	PVNMCPKCQ	UNKO	RVHR	NOMQ	
d É	TO	e É	UUVUPKVU	MKP	NNCCCOKSN	TVKOV	RVHR	NOMQ	
v	UV	e O	PSSPTQSKNT	NKT	QPPRRCOKQN	UQKRN	RVHR	NOMQ	
v	UV	e É	SMVSPTKVM	MKT	TQRQNOKMP	UMKRU	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPOVVUQKMM	NHS	SNSRONVKVS	NMOHST	RVHR	NOMQ	
qÄ	NRV	e É	CPQRQUVKPM	CKO	CRRVVQSKO	VNHSO	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRPQTTSKRV	MKQ	PNTNNVSKMP	NNNKQT	RVHR	NOMQ	
_á	OMV	e É	NQOTPNRKTU	NKV	NRMCPPVHST	VRKMN	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMNM

cãÉ=k~ã É MQQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` PMl hÅ

^Åè=qãã É PLPMLOMCP=NMVQNMQT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	MKMMT	ééÄ	PSKV	OUNKNO	NMM	
NN	_	S	k ç=d ~ë	PVKQQR	ééÄ	NKV	OSPVVK/P	NMMM	
OP	k ~	QR	e É	NVMTTKMSO	ééÄ	NKT	NVQVRTOKMM	OMMMMM	
OQ	j Ö	QR	e É	QVCPKVVP	ééÄ	NKM	OSNNNPKQS	OMMMMM	
OT	^ ä	QR	e É	NNUTKMMR	ééÄ	NKQ	CPOCMKCO	OMMMMM	
OU	pá	QR	e O	SUNNKVOT	ééÄ	OKM	QTPPVTKSQ	NMMMM	
PV	h	QR	e É	OTVVKPVQ	ééÄ	MKQ	NRNNNVKVO	OMMMMM	
QM	` ~	QR	e O	UVSQKRSV	ééÄ	MKQ	QSSMVVQKMP	OMMMMM	
RN	s	UV	e É	PKOCU	ééÄ	NKT	CPROKQT	NMMM	
RO	` ê	UV	e É	OKNSS	ééÄ	SKO	CRNPKMU	OMMM	
RR	j å	UV	e É	NNTKSRU	ééÄ	MKU	QTSVPKVN	OMMM	
RS	cÉ	UV	e O	NOVMKRRO	ééÄ	NKM	CRRRPMOKNN	NMMMM	
RV	` ç	UV	e É	PKOOV	ééÄ	NKR	QSTUKTQ	NMMM	
SM	k á	UV	e É	RKTVS	ééÄ	SKV	OQNPKRU	NMMM	
SP	` ì	UV	e É	NVKCCQ	ééÄ	PKN	NNSMPKVN	OMMM	
SS	wå	UV	e É	QNKRVR	ééÄ	NKO	TVOMKNR	OMMM	
TR	^ ë	UV	e É	NKCPN	ééÄ	SKT	OOTHPS	NMMM	
TU	pÉ	UV	e O	MKOVS	ééÄ	PKS	PSKPP	NMMM	
UU	pê	UV	e É	QQKUOM	ééÄ	OKS	ONVCPKOV	OMMM	
VR	j ç	UV	e É	JMKMVS	ééÄ	kL^	OSQKQR	NMMM	
NMT	^ Ö	UV	e É	MKMCP	ééÄ	OTHP	UQKQR	NMM	
NNN	` Ç	UV	e É	MKNOS	ééÄ	OSKM	PTKQN	NMMM	
NNU	på	NRV	e É	MKPCU	ééÄ	NPKU	PCUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKRQQ	ééÄ	NRKO	CROSKQQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	PMKNQT	ééÄ	NKS	PRSONKPP	OMMM	
NUO	t	NRV	k ç=d ~ë	JMOSP	ééÄ	kL^	NSRUKRP	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKVSU	ééÄ	kL^	RSPKVR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	RKNUU	ééÄ	NKQ	QNVSQKSN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKQMV	ééÄ	NMKS	QSRRKTR	NMMM	
OPU	r	OMV	k ç=d ~ë	MKVUN	ééÄ	NSKN	TTQKNU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n ` =i çï	B n ` =¤ãÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NTNNSNMKTT	MKT	NTSNRRMKR	VTKNT	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PQNQNTOKUV	NKT	QNOVNNUKR	UOKSV	RVKR	NOMQ	
pÅ	QR	e O	TQRTSNKPU	MKR	VQNPSMKUR	TVKCO	RVKR	NOMQ	
pÅ	QR	e É	NNMSUQKVV	MKT	NQMPOUKRR	TUKUU	RVKR	NOMQ	
d É	TO	k ç=d ~ë	USNVUMKTS	MKU	VUCRTUKMV	UTKTP	RVKR	NOMQ	
d É	TO	e O	PMVTMPKCR	MKO	PVNMCPKCQ	TVKO	RVKR	NOMQ	
d É	TO	e É	UTVVNKTV	NKP	NNCCCOKSN	TUKQN	RVKR	NOMQ	
v	UV	e O	PSQMVRUKVN	MKS	CPPRRCOKCN	UPKVS	RVKR	NOMQ	
v	UV	e É	RVONVTKVV	MKQ	TQRQNOKMP	TVKCR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SNNUPSVKRM	NKR	SNSRONVKVS	VVKCQ	RVKR	NOMQ	
qÄ	NRV	e É	COSROVSKQN	MKV	CRRVVQSKO	UUKQV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQUSUSSKVT	MKU	PNTNNVSKMP	NMVKVR	RVKR	NOMQ	
_á	OMV	e É	NPVSVQRKVO	MKU	NRMCPPVKST	VOKVU	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVSMMMNO

cãÉ=k~ã É MOPpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` PMˆHÅ

^Åè=qãã É PLPMLOMOP=NMWQSWRS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¢ä~Ö
V	_É	S	k ç=d ~ë	MKMQO	ééÄ	NRKQ	OOPKPQ	NMM	
NN	_	S	k ç=d ~ë	PTKRQM	ééÄ	MKQ	ORVQMKON	NMMM	
OP	k ~	QR	e É	NUTSOKMMN	ééÄ	MKT	NVOQNMTKVS	OMMMMM	
OQ	j Ö	QR	e É	QTUUKSPV	ééÄ	NKO	ORQTQQKUS	OMMMMM	
OT	^ ä	QR	e É	NNSPKNQN	ééÄ	MKU	OOUQLKQS	OMMMMM	
OU	pá	QR	e O	SSURKNUR	ééÄ	NKR	QTPQPOKTP	NMMMM	
PV	h	QR	e É	OTNVKVTP	ééÄ	NKS	NQUMMNKOQ	OMMMMM	
QM	` ~	QR	e O	UTTNKRNU	ééÄ	NKR	QSQSPRMKMT	OMMMMM	
RN	s	UV	e É	PKOMQ	ééÄ	SKV	OPQMKOQ	NMMM	
RO	` ê	UV	e É	OKNOS	ééÄ	PKO	OQVUKQO	OMMM	
RR	j å	UV	e É	NNQKUMO	ééÄ	NKP	QSUUQRTO	OMMM	
RS	cÉ	UV	e O	NOUNKOPT	ééÄ	OKM	ORUMNMMPO	NMMMM	
RV	` ç	UV	e É	PKMQM	ééÄ	NKT	QQQPKNM	NMMM	
SM	k á	UV	e É	RKTOR	ééÄ	NKQ	OQMPKRU	NMMM	
SP	` ì	UV	e É	NMKNPR	ééÄ	NKT	NNRVORTS	OMMM	
SS	wå	UV	e É	QNKPSR	ééÄ	NKQ	TVPSKUP	OMMM	
TR	^ ë	UV	e É	NKQRT	ééÄ	UKR	OPOKSV	NMMM	
TU	pÉ	UV	e O	MOVQ	ééÄ	NPKT	PSKUP	NMMM	
UU	pê	UV	e É	QPKQTR	ééÄ	NKT	ONQQPKSQ	OMMM	
VR	j ç	UV	e É	JMKOUV	ééÄ	kL^	OOOKOP	NMMM	
NMT	^ Ö	UV	e É	MKMOP	ééÄ	NPKO	URKRS	NMM	
NNN	` Ç	UV	e É	MKNPM	ééÄ	NPKR	PUKRO	NMMM	
NNU	på	NRV	e É	MOSQ	ééÄ	NSKR	OVUKVM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MRSN	ééÄ	RKV	OSUSKQQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	OUKVRO	ééÄ	NKU	PRQTQKNN	OMMM	
NUO	t	NRV	k ç=d ~ë	JMPTT	ééÄ	kL^	NQQQKVP	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMV	ééÄ	kL^	PVMKQO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	RKNOU	ééÄ	MKQ	ONSRMKNM	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKPQN	ééÄ	NNKR	ONUUKQU	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMUN	ééÄ	RKP	TTTKRO	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ÉÅ	B n ` =¡ çï	B n ` =¢äÜÜ	n ` =¢ä~Ö
i á	S	k ç=d ~ë	NTSQSVUKVM	NKS	NTSNRRMKR	NMMKNU	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PQSQPMQKNN	MKP	QNOVNNUKR	UPKV	RVKR	NOMKQ	
pÅ	QR	e O	TRVVSNKSS	NKP	VQNPSMKUR	UMKTP	RVKR	NOMKQ	
pÅ	QR	e É	NNNMPRKPP	NKM	NQMPOUKRR	TVKNP	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	UTSQNOKNS	MKP	VUORTUKMV	UVKO	RVKR	NOMKQ	
d É	TO	e O	PNTUONKNR	NKM	PVNMOPKOQ	UNKOU	RVKR	NOMKQ	
d É	TO	e É	VMRPVKMR	NKM	NNOOOOKSN	UMKSU	RVKR	NOMKQ	
v	UV	e O	PTMNUSVKUQ	NKP	OPPRROOKON	URKPU	RVKR	NOMKQ	
v	UV	e É	RVSSPNKTQ	MKV	TQRQNOKMP	UMKMQ	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SPQOTTOKPO	MKU	SNSRONVKVS	NVOKUU	RVKR	NOMKQ	
qÄ	NRV	e É	OOTVNTNKVS	NKN	ORRVVQSKO	UVKMP	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRMVOOQKPM	NKS	PNTNNVSKMP	NNMKPU	RVKR	NOMKQ	
_á	OMV	e É	NQMPUOOKQN	NKS	NRMOPPVKST	VPKQQ	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MVSMMNP

cãÉ=k~ã É MQQpj mi hÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÅ

^Åè=qãã É PLPMLOMCP=NVMRNMQP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKUV	ééÄ	k L^	VMKMM	NMM	
NN	_	S	k ç=d ~ë	MRVU	ééÄ	NNKO	NRMPKCP	NMMM	
CP	k ~	CR	e É	TKUST	ééÄ	UTKO	CITPCMRO	CMMMMM	
CQ	j Ö	CR	e É	NCKNPT	ééÄ	TKT	NPSSKTV	CMMMMM	
CT	^ ä	CR	e É	NMKMNN	ééÄ	SKM	PCRKRT	CMMMMM	
CU	pá	CR	e O	CUKRNV	ééÄ	UKS	CCLUCKUP	NMMMM	
PV	h	CR	e É	CMKTRN	ééÄ	NPKU	CTCCMKVU	CMMMMM	
CM	` ~	CR	e O	CCCKVNT	ééÄ	NKS	PUMUCKRU	CMMMMM	
RN	s	UV	e É	MKVSN	ééÄ	NCLQ	UPSKTN	NMMM	
RO	` ê	UV	e É	MKMVU	ééÄ	SOKV	UCCKRP	CMMM	
RR	j å	UV	e É	MKPNU	ééÄ	CKN	CCCLKSP	CMMM	
RS	cÉ	UV	e O	NKMCN	ééÄ	CNKT	NTUVMKNV	NMMMM	
RV	` ç	UV	e É	JMKMCV	ééÄ	k L^	CCLKCQ	NMMM	
SM	k á	UV	e É	MKNQT	ééÄ	CUKP	NTNKNO	NMMM	
SP	` ì	UV	e É	MKMSQ	ééÄ	NRKO	CMMKMN	CMMM	
SS	wå	UV	e É	NKVVT	ééÄ	SKR	CVRKRT	CMMM	
TR	^ ë	UV	e É	MKNSU	ééÄ	PNKR	CRKMM	NMMM	
TU	pÉ	UV	e O	JMKVRQ	ééÄ	k L^	UKMM	NMMM	
UU	pê	UV	e É	MKNPT	ééÄ	CMKQ	UUKUV	CMMM	
VR	j ç	UV	e É	JMKPMR	ééÄ	k L^	CNRKRS	NMMM	
NMT	^ Ö	UV	e É	JMKMNN	ééÄ	k L^	CCLKCQ	NMM	
NNN	` Ç	UV	e É	JMKMNU	ééÄ	k L^	PKPP	NMMM	
NNU	på	NRV	e É	MKNUP	ééÄ	CCNS	OSMKMN	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKMMM	ééÄ	VCLVTKS	PUPKTR	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKCNO	ééÄ	NCLKU	PPMKPR	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKQSS	ééÄ	k L^	NCNUKMN	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKNNR	ééÄ	k L^	OVMKPN	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKNUR	ééÄ	CKP	OSMVKRQ	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKMUS	ééÄ	CNKM	CPTCKTS	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMCU	ééÄ	k L^	SMKMS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ ÉÅ	B n ` =i çï	B n ` =¤ëÛÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NTUNRTNKNS	MKT	NTSNRRMKR	NMNKNQ	RVKR	NCMKQ	
pÅ	CR	k ç=d ~ë	PCQCSVPUKRU	NKR	CNCVNNUKR	UPKCU	RVKR	NCMKQ	
pÅ	CR	e O	TSRPPVKNV	MKU	VCNPSMKUR	UNKP	RVKR	NCMKQ	
pÅ	CR	e É	NNNRRPKMN	MKV	NCMPCUKRR	TVKQV	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	UTTSTNKVU	MKO	VUCRTUKMV	UVKPO	RVKR	NCMKQ	
d É	TO	e O	PNSURCKUR	MKT	PVNMCPKCQ	UNKMP	RVKR	NCMKQ	
d É	TO	e É	VMSPVKQT	MKS	NNCCCCKSN	UMKTT	RVKR	NCMKQ	
v	UV	e O	PSTRVUSKUN	MKQ	CPPRRCCKCN	UCKTV	RVKR	NCMKQ	
v	UV	e É	RVURTMKMM	MKV	TCRCNCKMP	UMKP	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SCSMCPMKMM	NKP	SNSRCNVKVS	NMNKRQ	RVKR	NCMKQ	
qÄ	NRV	e É	CCUVRCNKRS	CKO	CRRVVCQSKO	UVKCQ	RVKR	NCMKQ	
_á	OMV	k ç=d ~ë	PCRPNQCKPQ	MKU	PNTNNVSKMP	NMUKUV	RVKR	NCMKQ	
_á	OMV	e É	NPVMVCPKCR	NKR	NRMCPPVKST	VCKRU	RVKR	NCMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` ONfj pN
cáÉ=k~ã É	MQR| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJ ^oyin` PM^kÄ
^Åè=qãã É	PLPMLOMOP=NVWRSWRP
p~ã éäÉ=qóéÉ	m_
qçí~ä=aäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MNO ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iáãáí	n` =cä~Ö
_É	V	S	kç=d~ë	JMKNNO	ééÄ	kL^	SRKRR	MKR	
_	NN	S	kç=d~ë	MKSUS	ééÄ	SKQ	NRQTKUV	NM	
k~	OP	QR	eÉ	VKMOT	ééÄ	SKR	QTNVVKMV	RMM	
jÖ	OQ	QR	eÉ	NSKSPQ	ééÄ	NMKS	NQVNKOQ	RM	
^ä	OT	QR	eÉ	NOKOUM	ééÄ	RKP	PUTKTV	RM	
pá	OU	QR	eO	NUKPVO	ééÄ	NPKN	NTQRKOU	ORM	
h	PV	QR	eÉ	SSKRUT	ééÄ	UKV	OUMRTKSQ	RMM	
`~	QM	QR	eO	SMKQRT	ééÄ	NKR	QSVUMKMN	RM	m_=SMOM=c~âë=aça
s	RN	UV	eÉ	MKVTO	ééÄ	VKR	UQOKOS	OKR	
`ê	RO	UV	eÉ	MKTNV	ééÄ	SKR	NPQVKNQ	OKR	
jå	RR	UV	eÉ	MKQRV	ééÄ	NMKN	OUNKVR	N	
cÉ	RS	UV	eO	NNKVSN	ééÄ	NKT	PVPUOKSR	RM	
`ç	RV	UV	eÉ	MKMOV	ééÄ	RSKN	NOSKST	MKR	
ká	SM	UV	eÉ	MKQTO	ééÄ	RKM	PMNKNO	N	
`ì	SP	UV	eÉ	MKQVU	ééÄ	UKP	UUOKOT	NKR	
wå	SS	UV	eÉ	NKUOM	ééÄ	VKU	QSNKNP	R	
^ë	TR	UV	eÉ	MKNON	ééÄ	NPKP	PUKMM	OKR	
pÉ	TU	UV	eO	JMKMTO	ééÄ	kL^	SKRM	OKR	
pê	UU	UV	eÉ	MKNUQ	ééÄ	PPKR	NNOKOP	OKR	
jç	VR	UV	eÉ	JMKOUP	ééÄ	kL^	OORKRS	OKR	
^Ö	NMT	UV	eÉ	JMKMMO	ééÄ	kL^	QNKNN	MKR	
`Ç	NNN	UV	eÉ	JMKMNO	ééÄ	kL^	QKUN	MKR	
på	NNU	NRV	eÉ	PVKNMR	ééÄ	NKU	NVVNRKMR	OKR	m_=SMOM=c~âë=aça & m_=SMOM=c~âë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKMMM	ééÄ	QMRSKR	PUPKTR	MKR	
_~	NPT	NRV	kç=d~ë	MKPUO	ééÄ	SKM	RPPKVN	N	
t	NUO	NRV	kç=d~ë	JMKQSP	ééÄ	kL^	NOONKPR	OKR	
qä	OMR	OMV	kç=d~ë	JMKNNT	ééÄ	kL^	OUMKPM	MKR	
mÄ	OMU	OMV	kç=d~ë	MKMVT	ééÄ	PKS	NVPOKNM	MKR	
qÜ	OPO	OMV	kç=d~ë	MKMSO	ééÄ	PSKS	OOMVKON	OKR	
r	OPU	OMV	kç=d~ë	JMKMOS	ééÄ	kL^	TPKQN	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NTSRQOMKNT	NKO	NTSNRRMKR	NMMKOO	RVKR	NOMKQ	
pÅ	QR	kç=dl~ë	PQTUMUNKQU	MKQ	QNOVNNUKR	UQKOP	RVKR	NOMKQ	
pÅ	QR	eO	TRUQQMKUV	MKV	VQNPSMKUR	UMKRT	RVKR	NOMKQ	
pÅ	QR	eÉ	NNMVPNKPP	MKU	NQMPOUKRR	TVKMR	RVKR	NOMKQ	
dÉ	TO	kç=dl~ë	UTTSNMKOO	MKQ	VUORTUKMV	UMKPO	RVKR	NOMKQ	
dÉ	TO	eO	PNVORTKTP	MKP	PVNMQPKOQ	UNKSQ	RVKR	NOMKQ	
dÉ	TO	eÉ	UVTURKSQ	NKN	NNOOOOKSN	UMKMN	RVKR	NOMKQ	
v	UV	eO	PSROVUVKPO	MKU	QPPRROOKON	UQKOS	RVKR	NOMKQ	
v	UV	eÉ	RVTOSNKQQ	MKU	TQRQNOKMP	UMKNP	RVKR	NOMKQ	
qÄ	NRV	kç=dl~ë	SOQQUMMKON	MKQ	SNSROVMKVS	NMMKOV	RVKR	NOMKQ	
qÄ	NRV	eÉ	OPOMVSQKPS	NKR	ORRVVQSKO	VMKSS	RVKR	NOMKQ	
_á	OMV	kç=dl~ë	PQSRNONKTM	MKT	PNTNNVSKMP	NMVKOT	RVKR	NOMKQ	
_á	OMV	eÉ	NQNNVMUKTN	NKS	NRMOPPVKST	VPKVU	RVKR	NOMKQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i `pl n `ONfj pN
cáÉ=k~ã É	MQSi `pl kÇ
a~í~=m~íÜ=k~ã É	aWf^ÖáÉáíyf` mj eyNya^q^yOMOPyMPJj ^oyi n `PMf^kÄ
^Åè=qáã É	PLPMLOMOP=OMMMOMN
p~ã éäÉ=qóéÉ	i `pl
qçí~äaãäíáçå	RKMMMM
`çã ã Éáí	JJJ
fpqa=oÉÑ=cáÉk~ã É	MNO ^i _kÇ
p~ã éäÉ=n `=m~ëëlc á~ä	m~ëë
fpqa=n `=m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åä**

n `=^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	`çåÄK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n `=cä-Ö
_É	V	S	k ç=dl~ë	QUKMRN	éé Ä	OKP	QUNQSKUO	RM	NVKOO	TVKR	NOMQ	
_	NN	S	k ç=dl~ë	QURKMTP	éé Ä	OKN	PNQRNUKNP	RMM	NVKQ	TVKR	NOMQ	
k~	OP	QR	e É	UMNSKRPR	éé Ä	NKU	UQPPNQKMU	TRMM	ONKPU	TVKR	NOMQ	
j Ö	OQ	QR	e É	RNTMKOOP	éé Ä	NKN	OTPOVPKQQ	RMMM	OMKSU	TVKR	NOMQ	
^ä	OT	QR	e É	OMUSKVPR	éé Ä	MKV	QMSOPKQU	OMMM	OMKUT	TVKR	NOMQ	
pá	OU	QR	e O	VORKTNT	éé Ä	MKS	SRSUQKUO	NMMM	NUKRN	TVKR	NOMQ	
h	PV	QR	e É	VSQMKNNN	éé Ä	NKN	QRTVNOKUN	NMMMM	NVKOU	TVKR	NOMQ	
`~	QM	QR	e O	ORUTKTRQ	éé Ä	NKV	NPTSMVNKNN	ORMM	OMKT	TVKR	NOMQ	
s	RN	UV	e É	QTTKRSP	éé Ä	NKM	POMSSRKQP	RMM	NVKN	TVKR	NOMQ	
`ê	RO	UV	e É	OMNKMTR	éé Ä	MKP	NSRNMRKNQ	OMM	OMKNN	TVKR	NOMQ	
j å	RR	UV	e É	RMSKQQO	éé Ä	NKQ	OMSPNMKTP	RMM	OMKOS	TVKR	NOMQ	
cÉ	RS	UV	e O	NMMOKSVR	éé Ä	MKU	OMMVRORKOO	NMMM	OMMVR	TVKR	NOMQ	
`ç	RV	UV	e É	RONKMNS	éé Ä	MKU	TQSNMQKMT	RMM	OMKUQ	TVKR	NOMQ	
ká	SM	UV	e É	RNQKUMM	éé Ä	NKN	OMRVSNKMR	RMM	OMKRV	TVKR	NOMQ	
`ì	SP	UV	e É	ORUKQSO	éé Ä	OKR	OUTOUSKUV	ORM	OMKSU	TVKR	NOMQ	
wå	SS	UV	e É	RMQKUVT	éé Ä	OKR	VRQSQKUN	RMM	OMKO	TVKR	NOMQ	
^ë	TR	UV	e É	VSKUTU	éé Ä	NKO	NQNPVKPM	NMM	NVKPU	TVKR	NOMQ	
pÉ	TU	UV	e O	VTKTMV	éé Ä	NKM	UMOVKTS	NMM	NVKRQ	TVKR	NOMQ	
pê	UU	UV	e É	QVMKUTU	éé Ä	MKV	OQNQSNKQN	RMM	NVKSQ	TVKR	NOMQ	
j ç	VR	UV	e É	NMSKMRP	éé Ä	OKO	RMSMTKMN	NMM	ONKON	TVKR	NOMQ	
^Ö	NMT	UV	e É	RNKPMR	éé Ä	NKP	VMNNTKNT	RM	OMKRO	TVKR	NOMQ	
`Ç	NNN	UV	e É	OSQKMUT	éé Ä	MKS	SOSVUKPQ	ORM	ONKNP	TVKR	NOMQ	
på	NNU	NRV	e É	RNNKONU	éé Ä	MKQ	ORNUPSKOT	RMM	OMKQR	TVKR	NOMQ	
pÄ	NON	NRV	k ç=dl~ë	VQKUMP	éé Ä	MKS	PUOOVUKNS	NMM	NUKVS	TVKR	NOMQ	
_~	NPT	NRV	k ç=dl~ë	NVRNKQRV	éé Ä	NKP	OPQRQMNKOV	OMMM	NVKRN	TVKR	NOMQ	
t	NUO	NRV	k ç=dl~ë	NMSKTNT	éé Ä	MKS	ORPRMMKNS	NMM	ONKPQ	TVKR	NOMQ	
qä	OMR	OMV	k ç=dl~ë	VTKPON	éé Ä	OKV	RRRVNSKTN	NMM	NVKQS	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=dl~ë	VVKSRU	éé Ä	NKS	TURTQOKVP	NMM	NVKVP	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=dl~ë	VSKNPQ	éé Ä	OKO	STSMQQKNS	NMM	NVKOP	TVKR	NOMQ	
r	OPU	OMV	k ç=dl~ë	NMOKQRR	éé Ä	NKM	STRTMUKOP	NMM	OMKQV	TVKR	NOMQ	

n `=fpqa=q~ÄäÉ

i ~Äçê~íçêó=`çåíêçä=p~ã éäÉ=Ei `pF=oÉéçêí

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e áÖÜ	n ` =cä~Ö
i á	S	k ç=d ~ë	NTCCCRQKSS	NKU	NTSNRRMKR	VTKTT	RVKR	NCMKQ	
pÅ	QR	k ç=d ~ë	PQQMUSQKMV	MKQ	QNOVNNUKR	UPKPP	RVKR	NCMKQ	
pÅ	QR	e O	TRSVRNKUT	MKR	VQNPSMKUR	UMKQN	RVKR	NCMKQ	
pÅ	QR	e É	NNMPQMKTT	MKR	NQMPOUKRR	TUKSP	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	USSQUTKON	MKQ	VUCRTUKMV	UUKNV	RVKR	NCMKQ	
d É	TO	e O	PNRVPNKVT	MKO	PVNMQPKOQ	UMKTV	RVKR	NCMKQ	
d É	TO	e É	UVMVMKVU	MKV	NNCCCCKSN	TVKPV	RVKR	NCMKQ	
v	UV	e O	PSTTTMQKNP	MKR	QPPRRCCKON	UQKUP	RVKR	NCMKQ	
v	UV	e É	RVSMPVKTO	MKP	TQRQNCKMP	TVKVS	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SCPQMVCKVP	MKV	SNSRCNVKVS	NMNKNO	RVKR	NCMKQ	
qÄ	NRV	e É	CCSOVTMKMS	MKV	CRRVVQSKO	UUKQ	RVKR	NCMKQ	
_á	CMV	k ç=d ~ë	PQVCUMMKSN	NKQ	PNTNNVSKMP	NNMKNQ	RVKR	NCMKQ	
_á	CMV	e É	NPURSUPKCP	NKQ	NRMCPPVKST	VCKCQ	RVKR	NCMKQ	

p~ã éäÉ=k~ã É pn MVUOLMMN

cãÉ=k~ã É MQTpj mi kÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉáíyî mj eyNya^q^yOMOPyMPJ ^oyi n` PM^kÄ

^Åè=qãã É PLPMLOMOP=OMMMTMU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =c ä~Ö
V	_É	S	k ç=d ~ë	NKTVM	éé Ä	QKO	NTVMKNR	NMM	
NN	_	S	k ç=d ~ë	RMKPVT	éé Ä	NKM	PMSRQKVU	NMMM	
OP	k ~	QR	e É	NSPVOKTSN	éé Ä	NKM	OMPQNVVKUS	OMMMMM	
OQ	j Ö	QR	e É	NVQLJTNKNVQ	éé Ä	MKU	NOQTORTTKPO	OMMMMM	
OT	^ ä	QR	e É	QPRNNQKMTS	éé Ä	MKT	NMOQMONOKUP	OMMMMM	
OU	pá	QR	e O	NPSUKNOU	éé Ä	PKV	NNQTSRKPM	NMMMM	
PV	h	QR	e É	RNVPKPNQ	éé Ä	MKV	PNPOTNKQQ	OMMMMM	
QM	` ~	QR	e O	RRNUQMKTTR	éé Ä	NKV	PQPUNPNSPKTT	OMMMMM	
RN	s	UV	e É	NSORKORV	éé Ä	MKU	NNVNSMUKMO	NMMM	
RO	` ê	UV	e É	TNKOSS	éé Ä	NKQ	SQQRNKQU	OMMM	
RR	j å	UV	e É	VPSNKUTQ	éé Ä	NKO	QNSPUSOKRV	OMMM	
RS	cÉ	UV	e O	QSTNOUKTPV	éé Ä	MKN	NMNMOMOSRPKTP	NMMMMM	
RV	` ç	UV	e É	ORNKMQU	éé Ä	MKQ	PVOTPVKQV	NMMM	
SM	k á	UV	e É	TMKMOR	éé Ä	MKR	PMTMTKON	NMMM	
SP	` ì	UV	e É	UOVKSNU	éé Ä	MKP	NMMSRMPKOT	OMMM	
SS	wå	UV	e É	UUVKPMU	éé Ä	MKU	NUPRTTKQN	OMMM	
TR	^ ë	UV	e É	NOKOOP	éé Ä	PKU	NVSUKMN	NMMM	
TU	pÉ	UV	e O	NKPPN	éé Ä	RKQ	NPOKPO	NMMM	
UU	pê	UV	e É	TRRMKMVN	éé Ä	MKT	QMRSSNOKSU	OMMM	
VR	j ç	UV	e É	OKMOT	éé Ä	PKR	NQVPKQR	NMMM	
NMT	^ Ö	UV	e É	MKOPP	éé Ä	UKO	QVRKRT	NMM	
NNN	` Ç	UV	e É	NKMOP	éé Ä	SKT	OTUKUV	NMMM	
NNU	på	NRV	e É	PTKRVP	éé Ä	NKM	NURSUKSN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKUNP	éé Ä	NKV	PRVQKOS	NMMM	
NPT	_~	NRV	k ç=d ~ë	QPUKOVS	éé Ä	NKP	RNTQMRKNR	OMMM	
NUO	t	NRV	k ç=d ~ë	QKMNS	éé Ä	QKP	NNRRMSP	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKSVR	éé Ä	RKS	QRQUKVP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NSQKRQR	éé Ä	NKN	NNVQSRTKVP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OKQMN	éé Ä	RKV	NTNTPKNN	NMMM	
OPU	r	OMV	k ç=d ~ë	RKNMM	éé Ä	OKT	PNNVTKTV	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n` =ì çï	B n` =c äÜÜ	n` =c ä~Ö
i á	S	k ç=d ~ë	NRSVRONKUO	NKO	NTSNRRMR	UVKN	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	QMVSUQOKRU	NKR	QNOVNNUKR	VVKOO	RVKR	NOMQ	
pÅ	QR	e O	UVSSUVKMN	MKT	VQNPSMKUR	VRKOR	RVKR	NOMQ	
pÅ	QR	e É	NPPUVTKVQ	NKP	NQMPOUKRR	VRKQO	RVKR	NOMQ	
d É	TO	k ç=d ~ë	UQURPOKOP	NKM	VUORTUKMV	USHPS	RVKR	NOMQ	
d É	TO	e O	OVUQSOKVT	MKR	PVNMOPKOQ	TSHPO	RVKR	NOMQ	
d É	TO	e É	UVTORKPO	NKO	NNOOOOKSN	TVKVR	RVKR	NOMQ	
v	UV	e O	QMMMMUMKMO	MKR	OPPRROOKON	VOKOS	RVKR	NOMQ	
v	UV	e É	SRNMTPKOP	NKN	TQRQNOKMP	UTHPQ	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SNOPTUNKON	NKV	SNSRONVKVS	VVHPP	RVKR	NOMQ	
qÄ	NRV	e É	OORMPOOKUO	MKU	ORRVVQSHO	UTKVN	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PONUMUNKMR	NKS	PNTNNVSKMP	NMNKQU	RVKR	NOMQ	
_á	OMV	e É	NPOMUOTKON	MKU	NRMOPPVKST	UTKVO	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVUOLMVO

cãÉ=k~ã É MOLUpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉáíyî mj eyNya^q^yOVOPyWPJ ^oyi n ` PMˆhÅ

^Åè=qáã É PLPMLOVOP=OMNOLNT

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äóíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==ˆ mp==	i a o	n ` =c à~Ö
V	_É	S	k ç=d ~ë	PKQMR	éé Ä	QKV	PNQMKPV	NMM	
NN	_	S	k ç=d ~ë	UPKSSP	éé Ä	NKT	QLQNRKRN	NMMM	
OP	k ~	QR	e É	STTQKSMM	éé Ä	NKP	VTUQLVMKMT	OMMMMM	
OQ	j Ö	QR	e É	UPTSUKPVU	éé Ä	NKO	SMMSPSSKMO	OMMMMM	
OT	^ ä	QR	e É	OUUVNUKUMV	éé Ä	MKS	TSNTTMUKMU	OMMMMM	
OU	pá	QR	e O	NNMSKUMS	éé Ä	QKU	NMRRNPKMR	NMMMM	
PV	h	QR	e É	OSQLVKUUP	éé Ä	NKS	NVRSRPKMP	OMMMMM	
QM	` ~	QR	e O	SPTSVQKPNN	éé Ä	OKN	QRNNSVSRRKRM	OMMMMM	
RN	s	UV	e É	NPRTKRVQ	éé Ä	NKP	NNMVTVOKOT	NMMM	
RO	` ê	UV	e É	VRKNRQ	éé Ä	NKO	VRSQQKVR	OMMM	
RR	j å	UV	e É	UVMVKUNU	éé Ä	NKS	QQNQPOSKMS	OMMM	
RS	cÉ	UV	e O	QMPOMRKOUS	éé Ä	MKS	VUMPUMQLVOKSO	NMMMMM	
RV	` ç	UV	e É	OSRKQNT	éé Ä	NKO	QSOVSMKQP	NMMM	
SM	k á	UV	e É	SPKURP	éé Ä	MKV	PNOPQKMN	NMMM	
SP	` ì	UV	e É	SVOKRSP	éé Ä	NKR	VPSVMOKVS	OMMM	
SS	wå	UV	e É	STOKQQM	éé Ä	MKT	NRQUNMKNU	OMMM	
TR	^ ë	UV	e É	NPKUVN	éé Ä	OKT	QQLMKNR	NMMM	
TU	pÉ	UV	e O	NKVMQ	éé Ä	TKM	OMSKPO	NMMM	
UU	pê	UV	e É	VRMNKUTT	éé Ä	MKR	RSVONQSKTO	OMMM	
VR	j ç	UV	e É	OKMVQ	éé Ä	VKU	NSQRKSU	NMMM	
NMT	^ Ö	UV	e É	MKQOM	éé Ä	NQKN	RORKRU	NMM	
NNN	` Ç	UV	e É	NKRNR	éé Ä	NKP	QQTKQO	NMMM	
NNU	på	NRV	e É	PUKRON	éé Ä	MKS	NVOMPKVP	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKRTS	éé Ä	SKT	OSRVKTQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	NNOTKMTM	éé Ä	MKV	NPPPRPRKMV	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKOOQ	éé Ä	k lˆ	NTRRKPN	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKOUR	éé Ä	OMKO	OPUOKTR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OSMKVSM	éé Ä	MKU	NUVQTNMKNV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OKOOO	éé Ä	OKQ	NSMTPKUP	NMMM	
OPU	r	OMV	k ç=d ~ë	UKVSS	éé Ä	NKP	QVOMQKUU	NMMM	

n ` =fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =ì çï	B n ` =e äÜÜ	n ` =c à~Ö
i á	S	k ç=d ~ë	NRNONMQKUQ	MKQ	NTSNRRVMR	URKUQ	RVMR	NOMQ	
pÅ	QR	k ç=d ~ë	QSOVVQRKRT	MKR	QNOVNNUKR	NNOKNP	RVMR	NOMQ	
pÅ	QR	e O	NMNUQRTKOO	NKV	VQNPSMKUR	NMUKNV	RVMR	NOMQ	
pÅ	QR	e É	NQLVVQKPS	MKT	NQMPOUKRR	NMSKUV	RVMR	NOMQ	
d É	TO	k ç=d ~ë	USOUQTKVV	NKQ	VUORTUKMV	UTKUN	RVMR	NOMQ	
d É	TO	e O	PMQTNSKNR	MKT	PVNMQPKQQ	TTKVO	RVMR	NOMQ	
d É	TO	e É	VMSOSKUO	NKT	NNOOOOKSN	UMKTS	RVMR	NOMQ	
v	UV	e O	QQVTQLTHPV	MKR	QPPRROOKON	NMPKTQ	RVMR	NOMQ	
v	UV	e É	TORVSSKMO	MKU	TQRQNOKMP	VTHPV	RVMR	NOMQ	
qÄ	NRV	k ç=d ~ë	SNPUPUQKQR	NKP	SNSRONVKVS	VVKRS	RVMR	NOMQ	
qÄ	NRV	e É	OOTNSMTHPP	MKR	ORRVVQSKO	UUKTQ	RVMR	NOMQ	
_á	OMV	k ç=d ~ë	POPMPMQKUR	NKO	PNTNNVSKMP	NMNKUS	RVMR	NOMQ	
_á	OMV	e É	NPONMMNKRP	MKQ	NRMOPPVKST	UTKVP	RVMR	NOMQ	

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É pn MVUOJMVP

cãÉ=k~ã É MOVpj mi HÇ

a~í~=m~íÜ=k~ã É aWµ ÖäÉåíµ mj eyNya^q^yOVOPyWPJ ^oyi n` PM^HÅ

^Åè=qãã É PLPMLOVOP=OMNNTVQR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä c~åä

fpqa=n` =m~ëëlc~åä c~åä

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¢ä-Ö
V	_É	S	k ç=d ~ë	SKUTN	éé Ä	OKO	SORPKST	NMM	
NN	_	S	k ç=d ~ë	TVKRNN	éé Ä	NKR	QSSNPKCP	NMMM	
OP	k ~	QR	e É	QPSPMKRRR	éé Ä	NKN	TOTQOTOKVT	OMMMMM	
OQ	j Ö	QR	e É	NPNNRVKRVV	éé Ä	NKS	NNQTQRVUKMD	OMMMMM	
OT	^ ä	QR	e É	PQPMRSKTQM	éé Ä	NKM	NNMPSRTUKRU	OMMMMM	
OU	pá	QR	e O	NNMUKNTM	éé Ä	OKM	NOTMQRKUN	NMMMM	
PV	h	QR	e É	PQNOKTMD	éé Ä	MKS	OVRSPNKTU	OMMMMM	
QM	` ~	QR	e O	RPSOVPKMOT	éé Ä	NKO	QRSOSUNVPKOM	OMMMMM	
RN	s	UV	e É	OPOPKTST	éé Ä	MKU	ONVMOUSKUU	NMMM	
RO	` ê	UV	e É	NPUKNPT	éé Ä	MKR	NRVSQMSO	OMMM	
RR	j å	UV	e É	VTNNKMUO	éé Ä	MKT	RRRPSMMKUR	OMMM	
RS	cÉ	UV	e O	SNPURQKSON	éé Ä	NKU	NTMSMVNVPMKVP	NMMMMM	[i a o
RV	` ç	UV	e É	PPRKRQR	éé Ä	MKT	STQURQKSR	NMMM	
SM	k á	UV	e É	VUKTQQ	éé Ä	NKO	RRSNOKUP	NMMM	
SP	` ì	UV	e É	NTVKOPP	éé Ä	NKN	OTVVTMPPM	OMMM	
SS	wå	UV	e É	URMKVMD	éé Ä	MKU	OORURRKNT	OMMM	
TR	^ ë	UV	e É	NTKUNQ	éé Ä	OKQ	PSTQKOM	NMMM	
TU	pÉ	UV	e O	NKMMU	éé Ä	OKU	NPOKVV	NMMM	
UU	pê	UV	e É	TRRNKVRT	éé Ä	MKR	RONSUOUKOP	OMMM	
VR	j ç	UV	e É	NMKOVU	éé Ä	OKR	TPRSKRR	NMMM	
NMT	^ Ö	UV	e É	MKNVP	éé Ä	RKT	RPTKUM	NMM	
NNN	` Ç	UV	e É	MKQQN	éé Ä	UKO	NRTKTU	NMMM	
NNU	på	NRV	e É	PTKOOU	éé Ä	NKS	NVNPVKOR	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKVQS	éé Ä	QKP	QNQUKPQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	NSQOKSQU	éé Ä	NKO	NVRPUQPKSU	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKMTS	éé Ä	k lÅ	ONMVKMT	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKPSP	éé Ä	PKM	OTTSKRU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	OOQRTSU	éé Ä	NKM	NSOTONUKQT	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OKRUU	éé Ä	OKR	NUPOVKOV	NMMM	
OPU	r	OMV	k ç=d ~ë	VKNMT	éé Ä	MKV	RRPVSKQU	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ÉÅ	B n` =¡çï	B n` =¢äÜÜ	n` =¢ä-Ö
i á	S	k ç=d ~ë	NRPMRQQKRR	NKN	NTSNRRMR	USKUV	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	RRTTSSMKSO	MKU	QNOVNNUKR	NPRKMU	RVKR	NOMQ	SMOMa ça
pÅ	QR	e O	NOOQQTRKNR	MKV	VQNPSMKUR	NPMKMU	RVKR	NOMQ	SMOMa ça
pÅ	QR	e É	NUPMQRKQU	NKU	NQMPOUKRR	NPMKQQ	RVKR	NOMQ	SMOMa ça
d É	TO	k ç=d ~ë	VMRNNMKNT	MKT	VUORTUKMV	VOKNO	RVKR	NOMQ	
d É	TO	e O	POMSOUKPR	NKN	PVNMQPKOQ	UNKVV	RVKR	NOMQ	
d É	TO	e É	VTORPKNO	MKN	NNOOOOKSN	USKSS	RVKR	NOMQ	
v	UV	e O	RNQNRURKNQ	NKO	QPPRROOKQN	NNUKRV	RVKR	NOMQ	
v	UV	e É	UPTNNVKRT	NKM	TQRQNOKMP	NNOKP	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SNTMRTTKSM	MKP	SNSRONVKVS	NMMKMV	RVKR	NOMQ	
qÄ	NRV	e É	OPQNUNVKMM	NKR	ORRVVQSKO	VNKQU	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	POMVPVPKOO	MKQ	PNTNNVSKMP	NMNKO	RVKR	NOMQ	
_á	OMV	e É	NPPOTSMKUS	MKU	NRMOPPVKST	UUKTN	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVUOLMVS

cãÉ=k~ã É MRMbj mi hÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` PMˆHÅ

^Åè=qãã É PLPMLOMOP=OMWOMRQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä c~ãä

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	PKQRS	éé Ä	PHP	PQTUKOR	NMM	
NN	_	S	k ç=d ~ë	SPKVVN	éé Ä	NHP	QMSVQKNS	NMMM	
OP	k ~	QR	e É	RQUMSPO	éé Ä	OKO	UUTNVRKMP	OMMMMM	
OQ	j Ö	QR	e É	TORSOKNSQ	éé Ä	NKT	RTQQQMQKPS	OMMMMM	
OT	^ ä	QR	e É	PNOTNUKQNT	éé Ä	MKN	VNMOOVSKUN	OMMMMM	
OU	pá	QR	e O	VSVHKMM	éé Ä	RKT	NMOTMPKOO	NMMMM	
PV	h	QR	e É	QPMMKNMP	éé Ä	NHR	POTOQQKSV	OMMMMM	
QM	` ~	QR	e O	OMMTQVKUQN	éé Ä	MKV	NRTUSSVMUKTS	OMMMMM	
RN	s	UV	e É	NQVTKNSM	éé Ä	MHP	NQNVPSPKQR	NMMM	
RO	` ê	UV	e É	USKPUV	éé Ä	MKT	NMMUMQKNP	OMMM	
RR	j å	UV	e É	TNTNKRUV	éé Ä	MKU	QNOQTUTKUO	OMMM	
RS	cÉ	UV	e O	QNTPNQKOUM	éé Ä	NKQ	NNSSUQMTUSKPR	NMMMM	
RV	` ç	UV	e É	OTSKPUM	éé Ä	MKT	RRVMUOKNQ	NMMM	
SM	k á	UV	e É	STKRQS	éé Ä	NKR	PUPMTKMU	NMMM	
SP	` ì	UV	e É	TTQKRRP	éé Ä	OKO	NONRMQQKOR	OMMM	
SS	wå	UV	e É	SNOKOVN	éé Ä	NHP	NSPQLNKVP	OMMM	
TR	^ ë	UV	e É	OVKSQV	éé Ä	NKV	SNPNKSS	NMMM	
TU	pÉ	UV	e O	OKUUM	éé Ä	NKU	PQVKUO	NMMM	
UU	pê	UV	e É	OPTSKNUO	éé Ä	MKT	NSRMTURKNV	OMMM	
VR	j ç	UV	e É	NHPTP	éé Ä	NMKU	NQQRKSR	NMMM	
NMT	^ Ö	UV	e É	MOST	éé Ä	SKO	TORKRV	NMM	
NNN	` Ç	UV	e É	MKTSP	éé Ä	PKT	QSSKST	NMMM	
NNU	på	NRV	e É	PUKRRO	éé Ä	NKM	OVQRQKQQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	OKQSM	éé Ä	NKT	NMQSNKUO	NMMM	
NPT	_~	NRV	k ç=d ~ë	VTSKUVV	éé Ä	OKN	NNVPOMPKMV	OMMM	
NUO	t	NRV	k ç=d ~ë	MSRN	éé Ä	QKO	PVMQKTQ	NMMM	
OVR	qä	OMV	k ç=d ~ë	MKNTN	éé Ä	PKV	NUPUKTP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	ORSKUSN	éé Ä	NKQ	NVPMUQPKSO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OKRRQ	éé Ä	NKV	NUUMTKMD	NMMM	
OPU	r	OMV	k ç=d ~ë	PKONP	éé Ä	NHS	OMQQQKSV	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÅ	B n ` =i çï	B n ` =eáÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NSRQMPSKVU	NHP	NTSNRRMR	VPKTU	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	RNOTSVQKVS	OKM	QNOVNNUHR	NOQKNU	RVHR	NOMQ	SMOMa ça
pÅ	QR	e O	NNPNTRMSR	OKO	VQNPSMKUR	NOMOO	RVHR	NOMQ	
pÅ	QR	e É	NSRRVNKNS	MHS	NQMPOUKRR	NNU	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VPOVTRKUQ	MKT	VUCRTUHMV	VQKVR	RVHR	NOMQ	
d É	TO	e O	PPUPTQKMT	MKQ	PVNMQPKOQ	USKRP	RVHR	NOMQ	
d É	TO	e É	VVPPOKNS	NKM	NNOCCOKSN	UUKRN	RVHR	NOMQ	
v	UV	e O	RNTOMRQKSP	MHR	QPPRRCOKQN	NNVKOV	RVHR	NOMQ	
v	UV	e É	UQNUVOKNT	MKT	TQRQNOKMP	NNOKVQ	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPPSPRMKQM	MKQ	SNSRONVKVS	NMOKTU	RVHR	NOMQ	
qÄ	NRV	e É	OPVPVTNKVU	MKV	ORRVVQSKO	VPHRO	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PPPOVTUKQO	NKM	PNTNNVSKMP	NVRKN	RVHR	NOMQ	
_á	OMV	e É	NPVRPRMKVS	NKV	NRMOPPVKST	VOKUU	RVHR	NOMQ	

`çåíaåì åaÖ=~äáÄê~íáçå=sÉêáÑáÅ~íáçå=É``sF=oÉéçê

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MRN``skÇ
a~í~=m~íÜk~ã É	aWj^ÖãÉáíÝ^mj eyNya^q^yOMCPyMPJ ^oyi n` PM^hÅ
^Åè=qáã É	PLPMLOMCP=OMWTWQO
p~ã éáÉ=qóéÉ	``s
qçí~äaãäíáçå	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MNO^i_kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÅ	B i çï	B eåÜÜ	n`=cä-Ö
V	_É	S	k ç=d ~ë	ORKPTT	éëÄ	NKT	NPNMVOKRO	OR	NMNKRN	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKVNM	éëÄ	OKU	UTSMPKUM	OR	NMPKSQ	UVKU	NNMO	
OP	k ~	OR	e É	RQMVKTQO	éëÄ	MKT	PNRMUPSKNN	RMMM	NMUKNV	UVKU	NNMO	
OQ	j Ö	OR	e É	RRQRKQNR	éëÄ	MKR	NSUQRVOKOM	RMMM	NNMKVN	UVKU	NNMO	[=HLJ=NMB
OT	^ä	OR	e É	TMTKRPP	éëÄ	NKS	TVNTOKUU	RMM	NQNKRN	UVKU	NNMO	[=HLJ=NMB
OU	pá	OR	e O	RQMKOUU	éëÄ	NKU	ONMVVVKUO	RMM	NMQKVS	UVKU	NNMO	
PV	h	OR	e É	RPMUKVVS	éëÄ	MKR	NQMNRUTKRN	RMMM	NMSKNU	UVKU	NNMO	
QM	` ~	OR	e O	RQQVKMNP	éëÄ	OKM	NSQMURURKTP	RMMM	NMUKRU	UVKU	NNMO	
RN	s	UV	e É	OSKTTP	éëÄ	MKQ	NMVOPOKRM	OR	NMTKMV	UVKU	NNMO	
RO	` ê	UV	e É	OSKQQT	éëÄ	NKO	NONNUSKMU	OR	NMRKTV	UVKU	NNMO	
RR	j å	UV	e É	PMSKPQ	éëÄ	MKR	SVRQUKVN	OR	NOOKRQ	UVKU	NNMO	[=HLJ=NMB
RS	cÉ	UV	e O	RSMMKVVQ	éëÄ	MKT	SMQMUQVSKTU	RMMM	NNOKMO	UVKU	NNMO	[=HLJ=NMB
RV	` ç	UV	e É	OTKMQR	éëÄ	NKQ	ONRTMPKQS	OR	NMUKNU	UVKU	NNMO	
SM	ká	UV	e É	OTKOSO	éëÄ	MKR	SMUNRKMV	OR	NMVKMR	UVKU	NNMO	
SP	` ì	UV	e É	OTKPSN	éëÄ	MKR	NSVQUSKRS	OR	NMVKQQ	UVKU	NNMO	
SS	wå	UV	e É	OTKRVS	éëÄ	MKN	OVNQQKMS	OR	NNMKPU	UVKU	NNMO	[=HLJ=NMB
TR	^ë	UV	e É	ORKVVT	éëÄ	NKM	ONNNRKNR	OR	NMPKVV	UVKU	NNMO	
TU	pÉ	UV	e O	ORKRQV	éëÄ	NKO	NNPUNKTS	OR	NMOKO	UVKU	NNMO	
UU	pê	UV	e É	OUKPNT	éëÄ	NKU	TTRRQKOV	OR	NNPKOT	UVKU	NNMO	[=HLJ=NMB
VR	j ç	UV	e É	OSKRMS	éëÄ	MKQ	TMPNTKRO	OR	NMSKMO	UVKU	NNMO	
NMT	^Ö	UV	e É	OTKNNO	éëÄ	MKP	OSRMRQKVS	OR	NMUKQR	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKQUT	éëÄ	NKM	PRMNOKQN	OR	NMRKVR	UVKU	NNMO	
NNU	på	NRV	e É	ORKQMQ	éëÄ	OKO	STMNOKSO	OR	NMNKSO	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	ORKQRM	éëÄ	MKR	RNUSUSKVT	OR	NMNKU	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	OSKNOU	éëÄ	NKV	NRUTTVKOR	OR	NMQKRN	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKTMV	éëÄ	NKV	POMNMRKSN	OR	NMSKUQ	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	OSKNVP	éëÄ	MKT	TOMSPMSQ	OR	NMQKTT	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKPRV	éëÄ	MKU	NMMMVMTHSM	OR	NMRKQQ	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKNMQ	éëÄ	NKQ	UUPUPPKRV	OR	NMQKQO	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKROR	éëÄ	MKP	UQQTMSKNT	OR	NMSKN	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÅ	B n`=ç	B n`=eåÜÜ	n`=cä-Ö
iá	S	k ç=d ~ë	NTTVSVRKMU	NKV	NTSNRRMR	NMNKMP	RVKR	NOMQ	
pÅ	OR	k ç=d ~ë	PUMVONMKSS	OKM	ONOVNNUKR	VOKOS	RVKR	NOMQ	
pÅ	OR	e O	USVNSSKRT	NKM	VONPSMKUR	VOKPP	RVKR	NOMQ	
pÅ	OR	e É	NOTMRSKMV	MKS	NQMPOUKRR	VMKRQ	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	VOVVSQKUP	NKM	VUORTUKMV	VQKSR	RVKR	NOMQ	
dÉ	TO	e O	PRUMNNKST	MKO	PVNMOPKOQ	VNKRR	RVKR	NOMQ	
dÉ	TO	e É	NMNTOSKNP	MKS	NNOOOOKSN	VMKSS	RVKR	NOMQ	
v	UV	e O	PVUUVNSKNT	NKM	OPPRROOKON	VOKMN	RVKR	NOMQ	
v	UV	e É	SSPSRSKTS	MKU	TORQNOKMP	UVKMP	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPMPOPOKOT	NKQ	SNSRONVKVS	NVOKOQ	RVKR	NOMQ	
qÄ	NRV	e É	OQNUVVNKUR	NKV	ORRVVQSKO	VQKQV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PPSRNSPKPO	MKO	PNTNNVSKMP	NVSKNO	RVKR	NOMQ	
_á	OMV	e É	NQORTPPKNQ	NKT	NRMOPPVKST	VQKV	RVKR	NOMQ	

p~ã éáÉ=k~ã É	``_
cäÉ=k~ã É	MRQ``_KÇ
a~í~=m~íÜ=k~ã É	aWj^ÖäÉáíyf^mj eyNya^q^yOMOPyMPJ ^oyi n` PM^hÂ
^Åè=qáã É	PLPMLOMOP=OMARRMP
p~ã éáÉ=qóéÉ	``_
qçí~äa ãäíáç~å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑ=cäÉk~ã É	MNO^i_KÇ
p~ã éáÉ=n`=m~ëëlc á~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
I éÉê~íçê	**~Çã áã**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	r åáë	opa	==\ mp==	iãäá	n`=c ä~Ö
V	_É	S	k ç=d ~ë	MKMNS	ééÄ	RKM	OTOKOP	MO	
NN	_	S	k ç=d ~ë	MKOMM	ééÄ	NOKT	NUNMKNQ	Q	
OP	k~	QR	e É	JNPKVUQ	ééÄ	k L^	QRVQTKOR	OMM	
OQ	j Ö	QR	e É	NQKNSO	ééÄ	RKS	RNMNKMV	OM	c~äÉÇ=a ça
OT	^ä	QR	e É	PSKQTS	ééÄ	TKQ	QPOVKSP	OM	c~ä=^ äëj ÉíÜçÇë& c~äÉÇ=a ça
OU	pá	QR	e O	MRSSR	ééÄ	OUKP	TQMVUM	NMM	
PV	h	QR	e É	JMKNOS	ééÄ	k L^	OVORQKTR	OMM	
QM	`~	QR	e O	QUKQVN	ééÄ	OKR	NSPUVQKOR	OM	c~ä=^ äëj ÉíÜçÇë& c~äÉÇ=a ça
RN	s	UV	e É	MKNUO	ééÄ	RKR	VOOKOT	N	
RO	`ê	UV	e É	MKMMQ	ééÄ	NPOKN	UVSKRO	N	
RR	j å	UV	e É	MKUSU	ééÄ	RKV	ONQVKTS	MQ	c~ä=^ äëj ÉíÜçÇë& c~äÉÇ=a ça
RS	cÉ	UV	e O	SOKQSO	ééÄ	PKN	TNMUNVKNV	OM	c~ä=^ äëj ÉíÜçÇë& c~äÉÇ=a ça
RV	`ç	UV	e É	MKMQR	ééÄ	NOKO	QTPKPS	MO	
SM	k á	UV	e É	MKMSV	ééÄ	NOKV	OUTKTV	MQ	
SP	`ì	UV	e É	MKMVT	ééÄ	PKQ	NMMPKPV	MS	
SS	wå	UV	e É	MKOSN	ééÄ	NPKS	ONUKVM	O	
TR	^ë	UV	e É	MKMPQ	ééÄ	VKO	ROKPQ	N	
TU	pÉ	UV	e O	MKMPO	ééÄ	PSKT	OUKRM	N	
UU	pê	UV	e É	MKQQS	ééÄ	PKU	NOVOKPN	N	
VR	j ç	UV	e É	MKMPS	ééÄ	PKO	RNOKOQ	N	
NMT	^Ö	UV	e É	MKMON	ééÄ	NQKV	OSPKPQ	MO	
NNN	`Ç	UV	e É	MKMOP	ééÄ	NTHR	QMKTQ	MO	
NNU	på	NRV	e É	MKMQM	ééÄ	OKR	OVNKNO	N	
NON	pÄ	NRV	k ç=d ~ë	MKMPN	ééÄ	ONKV	NMQTKUN	MO	
NPT	_~	NRV	k ç=d ~ë	MKMRN	ééÄ	SKM	NMNNKNN	MQ	
NUO	t	NRV	k ç=d ~ë	MKMTN	ééÄ	NVKS	PQQTKNT	N	
OMR	qä	OMV	k ç=d ~ë	MKMPT	ééÄ	NMKR	NVVUKVQ	MO	
OMU	mÄ	OMV	k ç=d ~ë	MKMRU	ééÄ	TKO	PQRTKNV	MO	
OPO	qÜ	OMV	k ç=d ~ë	MKMOT	ééÄ	NVKN	OTOPKNU	N	
OPU	r	OMV	k ç=d ~ë	MKMOQ	ééÄ	OQKN	NMNTKTV	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	B n`=ç ïï	B n`=cäÜÜ	n`=c ä~Ö
iá	S	k ç=d ~ë	NUNVRTMOT	MKU	NTSNRRMR	NMPKOV	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PURMNURKRQ	NKU	QNOVNNUKR	VPKOQ	RVKR	NOMQ	
pÅ	QR	e O	UTMNMQKMQ	NKU	VQNPSMKUR	VOKQP	RVKR	NOMQ	
pÅ	QR	e É	NOVSVOKMQ	MKV	NQMPOUKRR	VOKQO	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	VPVNVUKRV	NKQ	VUORTUKMV	VRKRV	RVKR	NOMQ	
dÉ	TO	e O	PSSRMMPT	MKV	PVNMOPKOQ	VPKTO	RVKR	NOMQ	
dÉ	TO	e É	NMPVTVKOM	NKR	NNOOOOKSN	VOKSR	RVKR	NOMQ	
v	UV	e O	QNMSMOUKOU	NKO	QPPRROOKON	VQKTN	RVKR	NOMQ	
v	UV	e É	SUUNTUKTS	MKP	TQRQNOKMP	VOKPO	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQPRVUQKRM	MKU	SNSROMVKVS	NMQKPV	RVKR	NOMQ	
qÄ	NRV	e É	OQUOVRQKMQ	MKU	ORRVVQSKO	VSKVV	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQSRQVTKOM	OKM	PNTNNVSKMP	NMVKOU	RVKR	NOMQ	
_á	OMV	e É	NQRMSNTKRS	MKP	NRMOPPVKST	VSKRS	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVUOLMMU

cãÉ=k~ã É MRPpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` PM^hÄ

^Åè=qãã É PLPMLOMOP=OMOQMMM

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãäíáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==mp==	iao	n ` =cä~Ö
V	_É	S	kç=d~ë	OKTVS	éé Ä	RMN	OVRUKNO	NMM	
NN	_	S	kç=d~ë	UOKRRM	éé Ä	NKO	RQQRMSO	NMMM	
OP	k~	QR	eÉ	NPSTRKPOS	éé Ä	NMN	OMRVSRNKPU	OMMMMM	
OQ	j Ö	QR	eÉ	USNPOKPUS	éé Ä	NMN	SSRQLUPPKPM	OMMMMM	
OT	^ä	QR	eÉ	PVPVVNMMNS	éé Ä	NMN	NNNVOTQSKRM	OMMMMM	
OU	pá	QR	eO	NQLMPKURP	éé Ä	QKP	NQSMTNKUV	NMMMM	
PV	h	QR	eÉ	TMOVKPMS	éé Ä	MKU	QVUVOTKRR	OMMMMM	
QM	` ~	QR	eO	PQMTTTKMMM	éé Ä	NMS	OSPQONOUVKQN	OMMMMM	
RN	s	UV	eÉ	NTTQKNTS	éé Ä	MKU	NRTOPNQKVN	NMMM	
RO	` ê	UV	eÉ	TVKTPQ	éé Ä	MMS	UTMRPKPU	OMMM	
RR	j å	UV	eÉ	SSOKRKOVM	éé Ä	MMR	PRSOPSMKPP	OMMM	
RS	cÉ	UV	eO	QROTRQKPSP	éé Ä	NMN	NNTSTONOOSKQQ	NMMMMM	
RV	` ç	UV	eÉ	OONKUSN	éé Ä	MKO	QNVRTUKNS	NMMM	
SM	k á	UV	eÉ	TSKMMO	éé Ä	OKQ	QMOTPKSU	NMMM	
SP	` ì	UV	eÉ	VROKRUQ	éé Ä	OKO	NPVSUUOKPO	OMMM	
SS	wå	UV	eÉ	SRMMMTM	éé Ä	NKO	NSOORQKOO	OMMM	
TR	^ë	UV	eÉ	NNKURM	éé Ä	OKR	OPMTKNM	NMMM	
TU	pÉ	UV	eO	OKPQM	éé Ä	SKU	OSTKPO	NMMM	
UU	pê	UV	eÉ	PVOQKNST	éé Ä	NMS	ORQUSUSKOP	OMMM	
VR	j ç	UV	eÉ	PKTOM	éé Ä	NKP	QUMNKQR	NMMM	
NMT	^Ö	UV	eÉ	MKUUV	éé Ä	SKU	ONNVKMV	NMM	
NNN	` Ç	UV	eÉ	NKTSO	éé Ä	OKT	RSOKSN	NMMM	
NNU	på	NRV	eÉ	QMQGSO	éé Ä	NKR	ONNPVKNO	NMMM	
NON	pÄ	NRV	kç=d~ë	MKSVS	éé Ä	RKP	POPPKUN	NMMM	
NPT	_~	NRV	kç=d~ë	UOOKMRM	éé Ä	NKQ	NMMPQNMKKR	OMMM	
NUO	t	NRV	kç=d~ë	MKMNT	éé Ä	ORTKT	OPUSKMV	NMMM	
OMR	qä	OMV	kç=d~ë	MKONT	éé Ä	NRKS	OMVOKPT	NMMM	
OMU	mÄ	OMV	kç=d~ë	POOKTQT	éé Ä	MMR	OQOVRTUKVP	OMMM	
OPO	qÜ	OMV	kç=d~ë	OKRNR	éé Ä	QKM	NURSVKVP	NMMM	
OPU	r	OMV	kç=d~ë	QKMQQ	éé Ä	NKV	ORTMVKTM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÁ	B n ` =ì çï	B n ` =eáÜÜ	n ` =cä~Ö
iá	S	kç=d~ë	NTNSVUOKNP	NKO	NTSNRRMR	VTKQT	RVRR	NOMQ	
pÅ	QR	kç=d~ë	QVOVPNTKMN	NKV	QNOVNNUKR	NNVKPU	RVRR	NOMQ	
pÅ	QR	eO	NNNOQTMKTP	MKT	VQNPSMKUR	NNUKNU	RVRR	NOMQ	
pÅ	QR	eÉ	NSNSMTKQM	NKM	NQMPOUKRR	NNRKNS	RVRR	NOMQ	
dÉ	TO	kç=d~ë	VOUPPUKVN	MKU	VUORTUKMV	VQKQU	RVRR	NOMQ	
dÉ	TO	eO	PPQVNPKQV	MRR	PVNMOPKOQ	URKSR	RVRR	NOMQ	
dÉ	TO	eÉ	VURRVKQT	MKT	NNOOOOKSN	UTKUO	RVRR	NOMQ	
v	UV	eO	QUMTRUSKVN	MKS	OPPRROOKON	NNMKUV	RVRR	NOMQ	
v	UV	eÉ	TUTMOOQKUS	MRR	TQRQNOKMP	NMRKRU	RVRR	NOMQ	
qÄ	NRV	kç=d~ë	SPPOVUPKRT	NKR	SNSROMVKVS	NMOKTO	RVRR	NOMQ	
qÄ	NRV	eÉ	OPUNTPPKMP	NKR	ORRVVQSKO	VPKMQ	RVRR	NOMQ	
_á	OMV	kç=d~ë	PPPTUQMKQV	MKU	PNTNNVSKMP	NMRKOR	RVRR	NOMQ	
_á	OMV	eÉ	NPTRUSRKQQ	MKN	NRMOPPVKST	VNKRU	RVRR	NOMQ	

p~ã éäÉ=k~ã É	pn MVVPJMMN
cãÉ=k~ã É	MRQpj mi hÇ
a~í~=m~íÜ=k~ã É	aWjt ÖäÉåíyf^ mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÄ
^Åè=qãã É	PLPMLOMCP=OMQRMU
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==ì mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	OKSPV	éé Ä	PHP	OVCQRTV	NMM	
NN	_	S	k ç=d ~ë	QCKQMV	éé Ä	NKU	OVSPMKSR	NMMM	
OP	k ~	QR	e É	SCRHPRR	éé Ä	OKS	NCQRSSKTN	OMMMMM	
OQ	j Ö	QR	e É	UUUUKOSM	éé Ä	NHP	RQMNSCKRV	OMMMMM	
OT	^ ä	QR	e É	NSQSNTHRTTR	éé Ä	NKQ	PSTQCTSKSR	OMMMMM	
OU	pá	QR	e O	NQPMVCPV	éé Ä	NHP	NNTTQUHSO	NMMMM	
PV	h	QR	e É	RVQCKMPO	éé Ä	MRT	PPRUNUKUM	OMMMMM	
QM	` ~	QR	e O	RSRTNHPSM	éé Ä	MVR	PQSCPPNSKQP	OMMMMM	
RN	s	UV	e É	OMNHRNV	éé Ä	MKV	NSNMTUKUP	NMMM	
RO	` ê	UV	e É	NTNHRSR	éé Ä	MVR	NSTTMPRTR	OMMM	
RR	j å	UV	e É	SMRKUQQ	éé Ä	MKO	OVPRSTKVV	OMMM	
RS	cÉ	UV	e O	TSRPNKOUP	éé Ä	MKU	NTUQMQTSMKNQ	NMMMMM	
RV	` ç	UV	e É	OQKRPN	éé Ä	OKM	QNUUPHSQ	NMMM	
SM	k á	UV	e É	NVPHSPO	éé Ä	NHS	QVQCMRU	NMMM	
SP	` ì	UV	e É	NQRRRTSS	éé Ä	NHS	NVCCUSTKMM	OMMM	
SS	wå	UV	e É	RSQPKOMD	éé Ä	MHP	NOSTUPUKPR	OMMM	
TR	^ ë	UV	e É	PRKVCS	éé Ä	MVR	SCRCHPV	NMMM	
TU	pÉ	UV	e O	RKOVP	éé Ä	OKP	RCPKUO	NMMM	
UU	pê	UV	e É	PRMHSPR	éé Ä	NHN	OMRNRVRTO	OMMM	
VR	j ç	UV	e É	PRTST	éé Ä	SKQ	CRRMKOV	NMMM	
NMT	^ Ö	UV	e É	NKQTV	éé Ä	MKM	PNQNHRP	NMM	
NNN	` Ç	UV	e É	TKMSO	éé Ä	QKO	OMPMKVM	NMMM	
NNU	på	NRV	e É	SSHSPO	éé Ä	MKQ	PRQTQKNT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NPQKUMQ	éé Ä	NHN	RSNOMMRS	NMMM	
NPT	_~	NRV	k ç=d ~ë	UTQKOSS	éé Ä	OKT	NMUQLUUQKQT	OMMM	
NUO	t	NRV	k ç=d ~ë	MKNTQ	éé Ä	SUHS	OUMSHSQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	NHTQQ	éé Ä	NRT	NNMOMSS	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	TPVUKUUM	éé Ä	MRT	RUVQTVUNKQP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	OMKUOT	éé Ä	MKU	NQVSQTHPV	NMMM	
OPU	r	OMV	k ç=d ~ë	VKNUN	éé Ä	MKQ	SNQVTKNR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=o ÉÅ	B n ` =i çï	B n ` =e ãÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NTVCPVVHPP	OKT	NTSNRRMR	NMNHTR	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PUUVOQVKQU	NKM	QNOVNNUHR	VQHSV	RVHR	NOMQ	
pÅ	QR	e O	UUMQOVKNV	NKN	VQNPSMKUR	VPHRP	RVHR	NOMQ	
pÅ	QR	e É	NOSVUTKUT	MKV	NQMPOUKRR	VMKQV	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VOPUVNKUO	MHS	VUCRTUHMV	VQHMP	RVHR	NOMQ	
d É	TO	e O	PQQCCPHSO	MKU	PVNMCPKOQ	UUHMP	RVHR	NOMQ	
d É	TO	e É	VUPUMSS	NHS	NNOCCOHSN	UTHST	RVHR	NOMQ	
v	UV	e O	QPNNUCRHSO	NHR	QPPRRCOKON	VVKQR	RVHR	NOMQ	
v	UV	e É	TMVMNRKOM	NKO	TQRQNOKMP	VRHNO	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SCPUQSOKRN	NKO	SNSRONVKVS	NMQKCP	RVHR	NOMQ	
qÄ	NRV	e É	OQONNQQKVS	MKO	CRRVVQSKO	VQHRU	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRPCQCUKTU	MKN	PNTNNVSHMP	NNNKQR	RVHR	NOMQ	
_á	OMV	e É	NQSCQQMKCR	NKT	NRMCPPVHST	VTHPQ	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MVVPJMMN

cãÉ=k~ã É MRRpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÅ

^Åè=qãã É PLPMLOMCP=OMRMMQR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå CRKMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çàÅK	r åáë	opa	==¹ mp==	iao	n ` =cä~Ö
V	_É	S	kç=d ~ë	CKPSS	éé Ä	CKU	TMQKQU	NMM	
NN	_	S	kç=d ~ë	QQKSMR	éé Ä	QKN	TNPUKRR	NMMM	
CP	k~	CR	e É	NCPKPPV	éé Ä	CUKT	RRQSSKUO	CMMMMM	
CQ	j Ö	CR	e É	VNPMCTT	éé Ä	NKR	NNMUCPKRM	CMMMMM	
CT	^ä	CR	e É	NSPVNRKPVV	éé Ä	NKN	TOTCUUKSU	CMMMMM	
CU	pá	CR	e O	NRMNKUVQ	éé Ä	RKR	CRPMCKRU	NMMMM	
PV	h	CR	e É	RUSRKURQ	éé Ä	MKO	UUTRVKTS	CMMMMM	
QM	` ~	CR	e O	RUPNQKVSO	éé Ä	NKM	TNVQRSUKRT	CMMMMM	
RN	s	UV	e É	CNNKTST	éé Ä	MKS	PCRVRKTU	NMMM	
RO	` ê	UV	e É	NUMMVPM	éé Ä	MKV	PQPVNKUS	CMMM	
RR	j å	UV	e É	SRUKMSP	éé Ä	MKR	SNNSRKNO	CMMM	
RS	cÉ	UV	e O	UCPSSKSMR	éé Ä	MKV	PSUUNQQUKQU	NMMMMM	
RV	` ç	UV	e É	CRKSQV	éé Ä	NKP	UQSRKMS	NMMM	
SM	k á	UV	e É	NNNKMUR	éé Ä	CKU	NMCQTKCQ	NMMM	
SP	` ì	UV	e É	NRNUKMSN	éé Ä	NKO	PUQQMUKVV	CMMM	
SS	wå	UV	e É	SMDTKQUT	éé Ä	NKN	CRVQVQKPV	CMMM	
TR	^ë	UV	e É	PUKVSR	éé Ä	PKN	NPNSKUT	NMMM	
TU	pÉ	UV	e O	RKCMV	éé Ä	VKM	NNMKNT	NMMM	
UU	pê	UV	e É	PUNKQVR	éé Ä	NKQ	QDTTTKUU	CMMM	
VR	j ç	UV	e É	CKMRV	éé Ä	VKN	SQCKCR	NMMM	
NMT	^Ö	UV	e É	NKQSN	éé Ä	NCKV	SPQKQT	NMM	
NNN	` Ç	UV	e É	TKCQQ	éé Ä	SKS	QMMKTR	NMMM	
NNU	på	NRV	e É	SSKTST	éé Ä	NKT	TOVCKMU	NMMM	
NON	pÄ	NRV	kç=d ~ë	NPRKQUP	éé Ä	MKT	NNRRSMKUS	NMMM	
NPT	_~	NRV	kç=d ~ë	UTCKPQN	éé Ä	NKR	CONCRUKNV	CMMM	
NUO	t	NRV	kç=d ~ë	JNKUMO	éé Ä	k lÅ	NRQNKTO	NMMM	
OMR	qä	OMV	kç=d ~ë	NKCUN	éé Ä	NPKS	CQVSKCP	NMMM	
OMU	mÄ	OMV	kç=d ~ë	TRPUKTRO	éé Ä	MKS	NCOTNTCRKCR	CMMM	
OPO	qÜ	OMV	kç=d ~ë	NUKTPO	éé Ä	NKQ	OVMCCKRT	NMMM	
OPU	r	OMV	kç=d ~ë	UKUSN	éé Ä	NKT	NCPOVKMP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=opa	oÉÑ¹ mp	B=oÉÅ	Bn ` =içï	Bn ` =eáÜÜ	n ` =cä~Ö
iá	S	kç=d ~ë	NUTMRQSKTQ	NKM	NTSNRRMR	NMSKMV	RVKR	NOMQ	
pÅ	CR	kç=d ~ë	PURSRQMKQM	MKV	QNOVNNUKR	VPKQ	RVKR	NOMQ	
pÅ	CR	e O	UURTQUKTR	CKN	VQNPSMKUR	VQKMV	RVKR	NOMQ	
pÅ	CR	e É	NOSNVNKRO	MKV	NQMPCUKRR	UVKVP	RVKR	NOMQ	
d É	TO	kç=d ~ë	VQNUPMKCP	NKN	VUCRTUKMV	VRKUR	RVKR	NOMQ	
d É	TO	e O	PRQQQPKMU	MKR	PVNMCPKCQ	VMKSQ	RVKR	NOMQ	
d É	TO	e É	NMMVRPKRV	MKT	NNCCCCKSN	UVKNS	RVKR	NOMQ	
v	UV	e O	QNPVRVPKVM	NKS	CPPRRCCKCN	VRKQU	RVKR	NOMQ	
v	UV	e É	STVMUVKUN	NKN	TQRQNCKMP	VNKN	RVKR	NOMQ	
qÄ	NRV	kç=d ~ë	SRTSVRNKSQ	MKP	SNSRCNVKVS	NMSKSU	RVKR	NOMQ	
qÄ	NRV	e É	CQQUMCPKCN	MKS	CRRVVQSKO	VRKSP	RVKR	NOMQ	
_á	OMV	kç=d ~ë	PSNMPTTHPV	NKQ	PNTNNVSKMP	NNPKUR	RVKR	NOMQ	
_á	OMV	e É	NQURPCQKSP	MKP	NRMCPPVKST	VUKUT	RVKR	NOMQ	

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É pn MVVPJMMN^

cãÉ=k~ã É MRSpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÅ

^Åè=qãã É PLPMLOMCP=OMMRRMRO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	NOKRCS	éé Ä	NKM	NPMPMKRM	NMM	
NN	_	S	k ç=d ~ë	OQQKMQS	éé Ä	MKQ	NSPNCPKSM	NMMM	
OP	k ~	QR	e É	NMVQTKVQM	éé Ä	OKN	NCUMRNMKSP	OMMMMM	
OQ	j Ö	QR	e É	VTQMSNT	éé Ä	MKR	RUMPQCKMN	OMMMMM	
OT	^ ä	QR	e É	NSRTMRKCRN	éé Ä	NKN	PSCSPURKRT	OMMMMM	
OU	pá	QR	e O	SSNVKTUU	éé Ä	SKM	RCSPPCKSV	NMMMM	
PV	h	QR	e É	NRPCQRTMM	éé Ä	NKM	UMQTCMCQ	OMMMMM	
QM	` ~	QR	e O	RTPQUKCNS	éé Ä	MKS	PQMCQTNRKMR	OMMMMM	
RN	s	UV	e É	CQQCKUN	éé Ä	NKU	NUVPUQKVR	NMMM	
RO	` ê	UV	e É	ONRKSVO	éé Ä	NKR	OMRQUSKPT	OMMM	
RR	j å	UV	e É	SNUKSTQ	éé Ä	MKU	OVCRMUKSO	OMMM	
RS	cÉ	UV	e O	TSSNUKCVN	éé Ä	NKR	NTQQCUUSSKMR	NMMMMM	
RV	` ç	UV	e É	PPKTRR	éé Ä	NKU	RSNVPKRM	NMMM	
SM	k á	UV	e É	NCPKPUQ	éé Ä	NKR	RTPVRKPP	NMMM	
SP	` ì	UV	e É	NQTVKSCN	éé Ä	NKN	NVMTNMCKNS	OMMM	
SS	wå	UV	e É	RTSPKTRU	éé Ä	MKS	NCSPRCUKSV	OMMM	
TR	^ ë	UV	e É	UCKRST	éé Ä	MKU	NPVVMQT	NMMM	
TU	pÉ	UV	e O	RCKPMP	éé Ä	MKT	QVOTKVT	NMMM	
UU	pê	UV	e É	PVQMVQN	éé Ä	MKR	CCQVUMKVT	OMMM	
VR	j ç	UV	e É	RPKNCV	éé Ä	NKV	OVSPCKPT	NMMM	
NMT	^ Ö	UV	e É	NNKNNP	éé Ä	NKR	CCSVSKVT	NMM	
NNN	` Ç	UV	e É	NSKRPO	éé Ä	NKP	QRSQKNO	NMMM	
NNU	på	NRV	e É	NNRKRNT	éé Ä	MKN	RVNPSKNU	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NQQMRR	éé Ä	NKN	RVCCPUMP	NMMM	
NPT	_~	NRV	k ç=d ~ë	UVQKCUO	éé Ä	MKS	NMVSMSUKVM	OMMM	
NUO	t	NRV	k ç=d ~ë	RPKVMQ	éé Ä	MKQ	NPNTSMCOS	NMMM	
OMR	qä	OMV	k ç=d ~ë	NNKCCS	éé Ä	NKQ	SRNPCKUQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	TQQTKCUS	éé Ä	MKR	RUTTNOTNKPV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	PNKPMM	éé Ä	MKR	CCNUSNKCP	NMMM	
OPU	r	OMV	k ç=d ~ë	NVKPTS	éé Ä	MKV	NCUCUNKCM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ÉÅ	B n ` =¡çï	B n ` =¤ëÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NTSVPNSKSS	MKQ	NTSNRRMKR	NMMKQQ	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PTVCSNQKUR	OKQ	QNOVNNUKR	VNKUR	RVKR	NOMKQ	
pÅ	QR	e O	URPQQRMKQ	MKV	VQNPSMKUR	VMKSS	RVKR	NOMKQ	
pÅ	QR	e É	NCQRMPMKR	MKU	NQMPCUKRR	UUKTO	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VMQCUSKRT	MKS	VUCRTUKMV	VCMKP	RVKR	NOMKQ	
d É	TO	e O	PPVNQUKTM	NKT	PVNMCPKCQ	USKTP	RVKR	NOMKQ	
d É	TO	e É	VSRUTKVN	MKV	NNCCCCKSN	USKMT	RVKR	NOMKQ	
v	UV	e O	QCNMTSSKCN	MKQ	CPPRRCCKCN	VTKNO	RVKR	NOMKQ	
v	UV	e É	SVNUQTKPP	NKQ	TQRQNCKMP	VCKUN	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SPRUPPSKTR	MKV	SNSRCNVKVS	NMPKNP	RVKR	NOMKQ	
qÄ	NRV	e É	CPCSPNCKUP	NKO	CRRVVQSKO	VNKSR	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRMMSVUKPP	MKO	PNTNNVSKMP	NNMKPV	RVKR	NOMKQ	
_á	OMV	e É	NQCUPRRKUM	NKM	NRMCPPVKST	VRKMU	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MVVPJMMNp

cãÉ=k~ã É MRTpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PMˆhÅ

^Åè=qãã É PLPMLOMCP=ONMMMQN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==ˆmp==	iao	n ` =cä~Ö
V	_É	S	kç=d ~ë	QUKSMV	ééÄ	MKV	RNMONKMT	NMM	
NN	_	S	kç=d ~ë	PRRKOTM	ééÄ	MKV	OQNSMVRTV	NMMM	
OP	k~	QR	eÉ	TUVQKMQQ	ééÄ	MKP	VPMPNPKMM	OMMMMM	
OQ	j Ö	QR	eÉ	NONTTKTTO	ééÄ	MKU	TNVRRRRRN	OMMMMM	
OT	^ä	QR	eÉ	NQVUUUKSSR	ééÄ	NKR	PORPVRNKQN	OMMMMM	
OU	pá	QR	eO	NNSPKMMR	ééÄ	QKQ	VPPRVKOT	NMMMM	
PV	h	QR	eÉ	NPRVVKVSN	ééÄ	NKM	TNNRTUKRP	OMMMMM	
QM	` ~	QR	eO	RNOTRKVVT	ééÄ	MKQ	PMRSRTRQKUO	OMMMMM	
RN	s	UV	eÉ	SMTKSVV	ééÄ	NKN	QSQNUOKTU	NMMM	
RO	` ê	UV	eÉ	POTKTTR	ééÄ	MKV	PMRSSPKNT	OMMM	
RR	j å	UV	eÉ	VPPKSNO	ééÄ	NKN	QPOSOUKUV	OMMM	
RS	cÉ	UV	eO	SVNNSKSVM	ééÄ	NKT	NRSUVSQPRKVN	NMMMMM	
RV	` ç	UV	eÉ	QUTKPVP	ééÄ	MKR	TVQMVUKRM	NMMM	
SM	k á	UV	eÉ	RRQKUNN	ééÄ	MKQ	ORORPQKMO	NMMM	
SP	` ì	UV	eÉ	NTUMKQRT	ééÄ	NKV	OOQVPUOKSU	OMMM	
SS	wå	UV	eÉ	RVOOKPSU	ééÄ	NKM	NOTOSOUKPS	OMMM	
TR	^ë	UV	eÉ	NNRKUVS	ééÄ	MKR	NVOQMRU	NMMM	
TU	pÉ	UV	eO	UVKONR	ééÄ	MKV	UPTNKOU	NMMM	
UU	pê	UV	eÉ	TPNKTVS	ééÄ	MKV	QMVRPTKRO	OMMM	
VR	j ç	UV	eÉ	UVKVVO	ééÄ	MKU	QUVOMKVM	NMMM	
NMT	^Ö	UV	eÉ	QQKTTN	ééÄ	NKP	UVQTSKRM	NMM	
NNN	` Ç	UV	eÉ	OPUKTVV	ééÄ	NKM	SQRMPKST	NMMM	
NNU	på	NRV	eÉ	QSVKRNN	ééÄ	MKU	OQQUTMKMT	NMMM	
NON	pÄ	NRV	kç=d ~ë	NSSHPOV	ééÄ	MKU	SVNOROKSV	NMMM	
NPT	_~	NRV	kç=d ~ë	OSSTKMMT	ééÄ	NKV	PPMQPNNKPR	OMMM	
NUO	t	NRV	kç=d ~ë	RNKPRN	ééÄ	NKO	NOTMVOKQO	NMMM	
OMR	qä	OMV	kç=d ~ë	VNKVOT	ééÄ	MKT	RPSNPVKUU	NMMM	
OMU	mÄ	OMV	kç=d ~ë	RTQMKOTM	ééÄ	MKV	QSNPMOSSKPR	OMMM	
OPO	qÜ	OMV	kç=d ~ë	TPKNRU	ééÄ	NKQ	RORSRSKVT	NMMM	
OPU	r	OMV	kç=d ~ë	NMOKTOP	ééÄ	NKN	SVNQUVRTQ	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ=mp	B=oÉÅ	Bn ` =içï	Bn ` =eáÜÜ	n ` =cä~Ö
iá	S	kç=d ~ë	NUMPTRMSP	MKN	NTSNRRMR	NMOKQ	RVHR	NOMQ	
pÅ	QR	kç=d ~ë	PUMUOPMKMM	OKP	QNOVNNUHR	VOKOP	RVHR	NOMQ	
pÅ	QR	eO	URTQPOKUP	MHR	VQNPSMKUR	VNHMU	RVHR	NOMQ	
pÅ	QR	eÉ	NOPRMNKPV	MKN	NQMPOUKRR	UUHMN	RVHR	NOMQ	
dÉ	TO	kç=d ~ë	VNUCOTKVO	MKV	VUCRTUHMV	VPKQR	RVHR	NOMQ	
dÉ	TO	eO	PQQNOVKUM	NKN	PVNMOPKOQ	UU	RVHR	NOMQ	
dÉ	TO	eÉ	VTMTMKNR	MKN	NNOCOOKSN	USHR	RVHR	NOMQ	
v	UV	eO	QNVURVSHMP	MHS	OPPRROOKON	VSKUQ	RVHR	NOMQ	
v	UV	eÉ	STUNQMRQ	MKQ	TQRQNOKMP	VMKVU	RVHR	NOMQ	
qÄ	NRV	kç=d ~ë	SQOTURMRRR	MKQ	SNSRONVKVS	NMOKOS	RVHR	NOMQ	
qÄ	NRV	eÉ	OPTSNVUKTS	MKT	ORRVVQSKO	VOKUO	RVHR	NOMQ	
_á	OMV	kç=d ~ë	PRSQVRVMKVP	MHR	PNTNNVSHMP	NNOKQO	RVHR	NOMQ	
_á	OMV	eÉ	NQRVTSTKRR	MKV	NRVOPPVHST	VTKNT	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MVVPJMMNm

cãÉ=k~ã É MRUpj mi HÇ

a~í~=m~íÜ=k~ã É aWjtÖäÉáíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PMtHÄ

^Åè=qãã É PLPMLOMCP=ONMRVQU

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãä íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	QUKSUS	ééÄ	NKN	RMNTOKRT	NMM	
NN	_	S	k ç=d ~ë	QNVKSUU	ééÄ	NKO	QUMMNNKTT	NMMM	
OP	k ~	QR	e É	TSNNKPVQ	ééÄ	OKR	VNRUUTKQT	OMMMMM	
OQ	j Ö	QR	e É	NUVOUKTPU	ééÄ	NKR	NNPVPMUKUP	OMMMMM	
OT	^ ä	QR	e É	NRQMURKMPO	ééÄ	MKP	PQMUTNNKTO	OMMMMM	
OU	pá	QR	e O	NRNPKVSP	ééÄ	OMKT	NONPSNKCQ	NMMMM	
PV	h	QR	e É	NQNOQKQRR	ééÄ	MKT	TRNVVSKNQ	OMMMMM	
QM	` ~	QR	e O	QTSSOKQOQ	ééÄ	MKR	OUPSSMOQKMD	OMMMMM	
RN	s	UV	e É	SOSKRSU	ééÄ	NKR	QUTSSPKRO	NMMM	
RO	` ê	UV	e É	PNSKCPQ	ééÄ	NKM	PMMRPOKQS	OMMM	
RR	j å	UV	e É	NNSOKTNN	ééÄ	MKQ	RQMVNSKCR	OMMM	
RS	cÉ	UV	e O	TVOURKSQP	ééÄ	OKO	NTVTOSPMVKVU	NMMMMM	
RV	` ç	UV	e É	QUQKQUV	ééÄ	NKM	UMCPRQKUP	NMMM	
SM	k á	UV	e É	RQNKCPU	ééÄ	MKT	ORNNPOKNS	NMMM	
SP	` ì	UV	e É	NPMNKTUP	ééÄ	NKR	NSTSMOUKVU	OMMM	
SS	wå	UV	e É	ROVQKSOM	ééÄ	NKP	NNRVPNPKOM	OMMM	
TR	^ ë	UV	e É	NNOKPSU	ééÄ	MKV	NVMMVKVO	NMMM	
TU	pÉ	UV	e O	USKRSM	ééÄ	NKR	UNNMKNQ	NMMM	
UU	pê	UV	e É	SVRKPOT	ééÄ	NKN	PVSRNTKSQ	OMMM	
VR	j ç	UV	e É	UUKQNV	ééÄ	NKM	QUVUTKTT	NMMM	
NMT	^ Ö	UV	e É	QPKQVT	ééÄ	MKT	UURUTKOU	NMMM	
NNN	` Ç	UV	e É	OORKUMS	ééÄ	MKO	SONRTKSS	NMMM	
NNU	på	NRV	e É	QSOKOTP	ééÄ	NKV	OQOTPVKRR	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NQVKUMU	ééÄ	OKO	SOPNOVKNQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	OQUUKTUV	ééÄ	MKU	PMUSQMTKQQ	OMMM	
NUO	t	NRV	k ç=d ~ë	QVKOSO	ééÄ	NKQ	NOOMPUKVQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	VNKMOM	ééÄ	NKR	RQQVPOKVM	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	SPMSKRNQ	ééÄ	NKP	RMNNOVOOKPN	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	UNKQSM	ééÄ	MKS	RTURQOKUO	NMMM	
OPU	r	OMV	k ç=d ~ë	NMMKTSS	ééÄ	NKP	STMTNUKQV	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=oÉÁ	B n ` =i çï	B n ` =eáÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NTTTMVMUKUT	MKR	NTSNRRMKR	NMMKRP	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PUNRQQUKUT	MKU	QNOVNNUKR	VOKQ	RVKR	NOMQ	
pÅ	QR	e O	URRVUNKPV	OKP	VQNPSMKUR	VMKVP	RVKR	NOMQ	
pÅ	QR	e É	NORURQKSP	MKR	NQMPOUKRR	UVKSU	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VNOTUMKVQ	MKO	VUORTUKMV	VOKV	RVKR	NOMQ	
d É	TO	e O	PQOMVPKVS	MKQ	PVNMOPKOQ	UTKQS	RVKR	NOMQ	
d É	TO	e É	VSUUOKRS	NKN	NNOOOOKSN	USKPP	RVKR	NOMQ	
v	UV	e O	QNVOPPUKUR	NKM	OPPRROOKON	VSKT	RVKR	NOMQ	
v	UV	e É	SVNMOTKUM	NKM	TQRQNOKMP	VOKTN	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SOPQNMMKSP	NKU	SNSRONVKVS	NMOKPS	RVKR	NOMQ	
qÄ	NRV	e É	OQNOONUKRQ	MKU	ORRVVQSKO	VQKOP	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRORPPMKSN	NKR	PNTNNVSKMP	NNNKNT	RVKR	NOMQ	
_á	OMV	e É	NQQMROQKSO	NKQ	NRMOPPVKST	VRKUV	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn MVVPJMMO

cãÉ=k~ã É MRVpj mi hÇ

a~í~=m~íÜ=k~ã É aWjtÖäÉáíyî mj eyNya^q^yOMOPyMPJ ^oyi n ` PMˆhÅ

^Åè=qãã É PLPMLOMOP=ONWMPMMQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	OKOPS	éé Ä	PHS	OTQVKOM	NMM	
NN	_	S	k ç=d ~ë	POKPTP	éé Ä	OKT	OPNTPKOS	NMMM	
OP	k ~	QR	e É	PQQKOTR	éé Ä	PHM	VOTMTKTS	OMMMMM	
OQ	j Ö	QR	e É	QVVTKVQU	éé Ä	MHP	PMRMSRKRU	OMMMMM	
OT	^ ä	QR	e É	NPNUTQKQUM	éé Ä	MKQ	OVRPPVQKOS	OMMMMM	
OU	pá	QR	e O	NOVSKORP	éé Ä	NNHR	NMTSUOKMP	NMMMM	
PV	h	QR	e É	PSOPKTTT	éé Ä	NHS	ONSSVNHMP	OMMMMM	
QM	` ~	QR	e O	UNVNKQUO	éé Ä	MKV	RMTPOOSKNM	OMMMMM	
RN	s	UV	e É	NPPHRQR	éé Ä	NHS	NMRSNVKOP	NMMM	
RO	` ê	UV	e É	NMRKQTQ	éé Ä	MKR	NMOOUOKRU	OMMM	
RR	j å	UV	e É	URKNTM	éé Ä	NHM	QMVMNKVU	OMMM	
RS	cÉ	UV	e O	POPPSKRTO	éé Ä	NKN	TSPPNQTQKSO	NMMMMM	
RV	` ç	UV	e É	NPKPUU	éé Ä	OKO	OOSQUHMM	NMMM	
SM	k á	UV	e É	RMRRVN	éé Ä	OKN	OPVOSKOQ	NMMM	
SP	` ì	UV	e É	NNONKTOQ	éé Ä	MHS	NQSROOTKQS	OMMM	
SS	wå	UV	e É	NUOTKVQT	éé Ä	MKT	QMSNSNKVQ	OMMM	
TR	^ ë	UV	e É	NQKUMP	éé Ä	OKP	ORSNHNT	NMMM	
TU	pÉ	UV	e O	PKVUR	éé Ä	OKU	QMOHSS	NMMM	
UU	pê	UV	e É	SVKPUU	éé Ä	NHM	QMNSRKSP	OMMM	
VR	j ç	UV	e É	NKRMR	éé Ä	TKT	NOSNKOM	NMMM	
NMT	^ Ö	UV	e É	MKROM	éé Ä	PKV	NNOSKTQ	NMM	
NNN	` Ç	UV	e É	OKVTR	éé Ä	QHN	UPVHSS	NMMM	
NNU	på	NRV	e É	QPKNST	éé Ä	MKV	OOUNOKVN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NVHNNR	éé Ä	OHN	QPNQPKSO	NMMM	
NPT	_~	NRV	k ç=d ~ë	RMOHSPU	éé Ä	NHS	SPPTPNHNN	OMMM	
NUO	t	NRV	k ç=d ~ë	JMHUQ	éé Ä	k lˆ	NVSUKVM	NMMM	
OMR	qä	OMV	k ç=d ~ë	NHSSN	éé Ä	PKU	NMSMUKUU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	UQNHTTV	éé Ä	MKV	STQRNNPHMU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NTKUMM	éé Ä	OHM	NOUUTQHMN	NMMM	
OPU	r	OMV	k ç=d ~ë	SHNQP	éé Ä	NHS	QNQRRHMS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ¹ mp	B=oÉÁ	B n ` =i çï	B n ` =eáÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUNRPVTHPV	NHT	NTSNRRMR	NMPHMS	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PVNPMMNHMS	NHT	QNOVNNUHR	VQHTT	RVHR	NOMQ	
pÅ	QR	e O	UUUOSUHSS	NHM	VQNPSMKUR	VQHPS	RVHR	NOMQ	
pÅ	QR	e É	NOTQMTKVS	NHO	NQMPOUHRR	VMRTV	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VPUTNQKUP	NHM	VUORTUHMV	VRHRQ	RVHR	NOMQ	
d É	TO	e O	PROSTMHMV	MHR	PVNMOPKOQ	VMHSV	RVHR	NOMQ	
d É	TO	e É	VVVQNHRO	MHR	NNOOOOHSN	UVHMS	RVHR	NOMQ	
v	UV	e O	QPSOTOOHNM	MHS	QPPRROOHON	NMMHSP	RVHR	NOMQ	
v	UV	e É	TMNMVMVRO	MHT	TQRQNOHMP	VQHMQ	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SRQMVRPKTS	NHS	SNSROMVKVS	NMSHMV	RVHR	NOMQ	
qÄ	NRV	e É	OQNMPRQHSQ	MHN	ORRVVQSHO	VQHNS	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PRRQOUMKNV	NHT	PNTNNVSHMP	NNOHMU	RVHR	NOMQ	
_á	OMV	e É	NQQVMUNHRN	MKU	NRMOPPVHST	VSHQR	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MVVPJMMP

cãÉ=k~ã É MSMpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÅ

^Åè=qãã É PLPMLOMCP=ONMMJMMN

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =cä~Ö
V	_É	S	k ç=d ~ë	OKUVQ	éé Ä	OKM	POOMKQN	NMM	
NN	_	S	k ç=d ~ë	PTKQOV	éé Ä	MKT	OSRPPKRO	NMMM	
OP	k ~	QR	e É	SUQKRQS	éé Ä	NKO	NPMSOMKRT	OMMMMM	
OQ	j Ö	QR	e É	OTPMSKRUU	éé Ä	OKN	NSQUSRTKUM	OMMMMM	
OT	^ ä	QR	e É	NMVRROKMRO	éé Ä	MKU	OQPNVNUKVV	OMMMMM	
OU	pá	QR	e O	NVOMQUO	éé Ä	TKV	UQMVSKRO	NMMMM	
PV	h	QR	e É	VOSRKUVS	éé Ä	MKV	RMQTVUKTN	OMMMMM	
QM	` ~	QR	e O	SMOUVKMQV	éé Ä	NKP	PSUPVMRQKQR	OMMMMM	
RN	s	UV	e É	PSUKOUU	éé Ä	MKU	OVOPTTKMT	NMMM	
RO	` ê	UV	e É	NOVKSVN	éé Ä	NKM	NOSOMRKMS	OMMM	
RR	j å	UV	e É	NVRSKSRS	éé Ä	MKS	RMUTQPKTU	OMMM	
RS	cÉ	UV	e O	URQMOKVUO	éé Ä	OKN	NVUVNUUPNKUO	NMMMMM	
RV	` ç	UV	e É	ORKQRU	éé Ä	NKS	QPNVQKQR	NMMM	
SM	k á	UV	e É	QTNKSVQ	éé Ä	MKS	OOPMVSKVO	NMMM	
SP	` ì	UV	e É	PSRKVPQ	éé Ä	MKR	QUMSUPKOM	OMMM	
SS	wå	UV	e É	OSPVKVVU	éé Ä	NKM	RUVRMUKST	OMMM	
TR	^ ë	UV	e É	ORKTNP	éé Ä	MKR	QQRPKUQ	NMMM	
TU	pÉ	UV	e O	NKUMR	éé Ä	SKQ	NUTKVV	NMMM	
UU	pê	UV	e É	NPTHPRN	éé Ä	MKP	TVUUPKQQ	OMMM	
VR	j ç	UV	e É	SKRMS	éé Ä	RKS	QMSUKQR	NMMM	
NMT	^ Ö	UV	e É	NKNSN	éé Ä	OKQ	OQSOKQV	NMM	
NNN	` Ç	UV	e É	UKOMQ	éé Ä	NKQ	OPNNHPO	NMMM	
NNU	på	NRV	e É	SMKRPS	éé Ä	MKS	PNTVOKNO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	UKTUM	éé Ä	NKN	PSTNUKNU	NMMM	
NPT	_~	NRV	k ç=d ~ë	RSSKOMM	éé Ä	MKV	SVUTPSKPM	OMMM	
NUO	t	NRV	k ç=d ~ë	SKPOQ	éé Ä	PKV	NTSRPKUO	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKNSO	éé Ä	QKU	TRQSKUQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	PRQPKMOP	éé Ä	MKV	OTTTUSRNKNS	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	QVKTUR	éé Ä	NKM	PQVRPTKMR	NMMM	
OPU	r	OMV	k ç=d ~ë	NRKQVV	éé Ä	OKP	NMNVVOKPM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=o ÉÅ	B n ` =i çï	B n ` =eáÜÜ	n ` =cä~Ö
i á	S	k ç=d ~ë	NUMVNPPKTP	MKV	NTSNRRMR	NMOKT	RMR	NOMQ	
pÅ	QR	k ç=d ~ë	PVPMITRQKQP	NKM	QNOVNNUKR	VRKO	RMR	NOMQ	
pÅ	QR	e O	UTVNOSKTR	NKT	VQNPSMKUR	VPHPV	RMR	NOMQ	
pÅ	QR	e É	NOSOUTKVR	NKS	NQMPOUKRR	UVKVV	RMR	NOMQ	
d É	TO	k ç=d ~ë	VOQNMOKUS	MKQ	VUORTUKMV	VQMVR	RMR	NOMQ	
d É	TO	e O	PQTVMNKOQ	MKR	PVNMOPKOQ	UUKVT	RMR	NOMQ	
d É	TO	e É	VUVVUKQM	MKQ	NNOOOOKSN	UUKOO	RMR	NOMQ	
v	UV	e O	QPMUQUTKVN	NKR	QPPRROOKON	VVHPU	RMR	NOMQ	
v	UV	e É	TMQRVNKVV	MKR	TQRQNOKMP	VQHRO	RMR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQMONOOKRP	NKO	SNSRONVKVS	NMPKUQ	RMR	NOMQ	
qÄ	NRV	e É	OQMMUOQKTN	NKT	ORRVVQSKO	VPKTU	RMR	NOMQ	
_á	OMV	k ç=d ~ë	PQTUMTPKNV	NKM	PNTNNVSKMP	NMVKSU	RMR	NOMQ	
_á	OMV	e É	NQPNRMRKQT	NKP	NRMOPPVKST	VRKOV	RMR	NOMQ	

p~ã éäÉ=k~ã É pn MVVPJMMQ

cãÉ=k~ã É MSNpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PMˆhÅ

^Åè=qãã É PLPMLOMCP=ONWPMV

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä c~ãä

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^ å~äóíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c à~Ö
V	_É	S	k ç=d ~ë	QKRTR	éé Ä	OKN	QVRMKVP	NMM	
NN	_	S	k ç=d ~ë	QUKMUP	éé Ä	NKN	PPRQQKTO	NMMM	
OP	k ~	QR	e É	SUOKUSO	éé Ä	PKO	NPRQNQKQP	OMMMMM	
OQ	j Ö	QR	e É	NUNPOKMRO	éé Ä	MKS	NNPTNTVKNM	OMMMMM	
OT	^ ä	QR	e É	NUTROMKSTV	éé Ä	MKV	QPONUUMKNU	OMMMMM	
OU	pá	QR	e O	NQNRKOPO	éé Ä	SKO	NOMORSKMR	NMMMM	
PV	h	QR	e É	NNRNOKUMQ	éé Ä	NKN	SQQMVQKNM	OMMMMM	
QM	` ~	QR	e O	ROROVKQRR	éé Ä	NKM	PPNVTPRPKNO	OMMMMM	
RN	s	UV	e É	SVUKURN	éé Ä	MKT	RSSRQPKSO	NMMM	
RO	` ê	UV	e É	OOMMVRQ	éé Ä	MKU	ONUNMPKQN	OMMM	
RR	j å	UV	e É	NMMMRQP	éé Ä	MKT	QVOMVSKTQ	OMMM	
RS	cÉ	UV	e O	NQMMTSKSPT	éé Ä	OKT	PPPTPMUQRKTS	NMMMMM	
RV	` ç	UV	e É	QNKNRQ	éé Ä	NKR	TNORTKUR	NMMM	
SM	k á	UV	e É	OMVKPNQ	éé Ä	NKV	NMNOMMSU	NMMM	
SP	` ì	UV	e É	SRVKSPS	éé Ä	MKU	UUQTVUKSS	OMMM	
SS	wå	UV	e É	ONOTHPQQ	éé Ä	MKS	QUROTPKVR	OMMM	
TR	^ ë	UV	e É	PVKNRP	éé Ä	NKV	SVNRKNM	NMMM	
TU	pÉ	UV	e O	PKQNT	éé Ä	NKS	PRMKVV	NMMM	
UU	pê	UV	e É	NSSKMQR	éé Ä	OKM	VUSPVKSV	OMMM	
VR	j ç	UV	e É	UKMSO	éé Ä	NKR	RMQSKRT	NMMM	
NMT	^ Ö	UV	e É	NKNMR	éé Ä	OKU	OPVSKVO	NMM	
NNN	` Ç	UV	e É	UKONM	éé Ä	PKU	ORPQHPP	NMMM	
NNU	på	NRV	e É	UNKRNU	éé Ä	MKP	QOTUPKQV	NMMM	
NON	pÄ	NRV	k ç=d ~ë	ORKMPS	éé Ä	NKO	NMQTVQKPM	NMMM	
NPT	_~	NRV	k ç=d ~ë	VNOKVMO	éé Ä	MKT	NNPRTOVKNS	OMMM	
NUO	t	NRV	k ç=d ~ë	MKQTU	éé Ä	NSKR	PRRTHRV	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKTVU	éé Ä	NKU	NNNTPHPT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NOPQNKQPV	éé Ä	NKS	VSUQSSVTHSS	OMMM	[i a o
OPO	qÜ	OMV	k ç=d ~ë	RQKPMV	éé Ä	NKQ	PUNQVNKTM	NMMM	
OPU	r	OMV	k ç=d ~ë	NVKNTT	éé Ä	NKU	STNNQKOO	NMMM	

n ` =fpqa=q~ÄåÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ÉÅ	B n ` =¡çï	B n ` =¤ãÜÜ	n ` =c à~Ö
i á	S	k ç=d ~ë	NTVTQMUKSU	NKO	NTSNRRMR	NVOKMQ	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	QMNQSTMKTT	MKN	QNOVNNUKR	VTHCP	RVRR	NOMQ	
pÅ	QR	e O	VMVNPOKNM	NKQ	VQNPSMKUR	VSKRU	RVRR	NOMQ	
pÅ	QR	e É	NPNNOQKRR	NKO	NQMPOUKRR	VPKQQ	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VOOOOSKOS	MKP	VUORTUKMV	VPKUS	RVRR	NOMQ	
d É	TO	e O	PQUQOTHSO	MKR	PVNMOPKOQ	UVKN	RVRR	NOMQ	
d É	TO	e É	VVOSRKSU	MKV	NNOOOOKSN	UUKQR	RVRR	NOMQ	
v	UV	e O	QQMUMTPKOM	NKU	OPPRROOKON	NMNKST	RVRR	NOMQ	
v	UV	e É	TNVTRVKPR	MKS	TQRQNOKMP	VSKRS	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQRPSOOKUV	MKV	SNSRONVKVS	NMQKSU	RVRR	NOMQ	
qÄ	NRV	e É	OQMORCOKTR	MKR	ORRVVQSKO	VPKUR	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PQUNSTVKUU	NKU	PNTNNVSKMP	NMVKTV	RVRR	NOMQ	
_á	OMV	e É	NQOTMPNKOU	MKR	NRMOPPVKST	VQKVV	RVRR	NOMQ	

p~ã éäÉ=k~ã É pn MVVPJMVR

cãÉ=k~ã É MSQpj mi lÇ

a~í~=m~íÜ=k~ã É aWyl ÖäÉåíyl˜ mj eyNya^q^yOVCPyWPJ ^oyi n ` PlV^HÅ

^Åè=qãã É PLPMLOVCP=ONWQUWQS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãäíáçå RKMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãä m~ëë

n ` =^å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	QKPST	éé Ä	QKR	QTPPKMT	NMM	
NN	_	S	k ç=d ~ë	QRKURS	éé Ä	MKU	NURQTKTN	NMMM	
OP	k ~	QR	e É	TPQKSRM	éé Ä	OKV	NQMPMPKMT	OMMMMM	
OQ	j Ö	QR	e É	NPNMSKMVQ	éé Ä	NKO	UNQLVCPKRU	OMMMMM	
OT	^ ä	QR	e É	OMROVOKSUV	éé Ä	MKV	QSUVSOMKUM	OMMMMM	
OU	pá	QR	e O	NRQMKUNM	éé Ä	PKS	NOSRNOKSR	NMMMM	
PV	h	QR	e É	TUUUKSQV	éé Ä	NKM	QQSSTQRTP	OMMMMM	
QM	` ~	QR	e O	OOMQUKRST	éé Ä	MKV	NPPVTQMQKNN	OMMMMM	
RN	s	UV	e É	OQQKVUU	éé Ä	MKV	NVQRPQKRT	NMMM	
RO	` ê	UV	e É	NTRKRVU	éé Ä	MKP	NTNVOSKMP	OMMM	
RR	j å	UV	e É	PPSKVSO	éé Ä	MKT	NSPSNMKNO	OMMM	
RS	cÉ	UV	e O	TSNSTKRSS	éé Ä	MKP	NTTSSQLVMPKSR	NMMMM	
RV	` ç	UV	e É	PQKQUU	éé Ä	NKT	RRNUTKPS	NMMM	
SM	k á	UV	e É	NNRKVNP	éé Ä	NKM	RRPSQKUP	NMMM	
SP	` ì	UV	e É	SQQKOVO	éé Ä	MKS	URQTUQKNS	OMMM	
SS	wå	UV	e É	OQRRKMRN	éé Ä	MKT	RRQSPQKTO	OMMM	
TR	^ ë	UV	e É	OMKTOU	éé Ä	OKO	PSQPKRO	NMMM	
TU	pÉ	UV	e O	QKUQR	éé Ä	OKT	QTUKVV	NMMM	
UU	pê	UV	e É	NNSKRMS	éé Ä	MKO	SUPMTKVN	OMMM	
VR	j ç	UV	e É	RKMOV	éé Ä	SKS	POSTKNN	NMMM	
NMT	^ Ö	UV	e É	MKRVT	éé Ä	RKR	NPMQKPN	NMM	
NNN	` Ç	UV	e É	OKVMU	éé Ä	NKS	UPNKUU	NMMM	
NNU	på	NRV	e É	QUKMVT	éé Ä	NKQ	QQSNTKQQ	NMMM	
NON	pÄ	NRV	k ç=d ~ë	RKRRV	éé Ä	PKN	QOTQQKVU	NMMM	
NPT	_~	NRV	k ç=d ~ë	UUQKUST	éé Ä	NKN	NMSMVRTKMV	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKMVR	éé Ä	k lÅ	OMUQKPT	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKVUV	éé Ä	PKS	NONQNKVP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NNRSKOSR	éé Ä	MKV	UVUUOTSKVQ	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	PQKUQP	éé Ä	MKR	OQQVNUKRO	NMMM	
OPU	r	OMV	k ç=d ~ë	NMKQRN	éé Ä	NKQ	SUQSQKUM	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B¤¤ÉÅ	B n ` =¨ çï	B n ` =¤ëÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NTVSUNPKVV	MKU	NTSNRRMR	NMO	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PVPSPSNKUN	NKN	QNOVNNUKR	VRKPP	RVKR	NOMQ	
pÅ	QR	e O	UTPPVTKVS	MKV	VQNPSMKUR	VOKTU	RVKR	NOMQ	
pÅ	QR	e É	NOVVSMKNV	MKR	NQMPOUKRR	VOKSN	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VNQOSOKVR	MKP	VUORTUKVV	VPKVR	RVKR	NOMQ	
d É	TO	e O	PQPURMKOQ	MKU	PVNMOPKOQ	UTKVP	RVKR	NOMQ	
d É	TO	e É	VURMRKMO	MKR	NNOOOOKSN	UTKTU	RVKR	NOMQ	
v	UV	e O	QPNQNPNKTQ	NKM	QPPRROOKON	VVKRN	RVKR	NOMQ	
v	UV	e É	TNMOPSKOR	MKT	TQRQNOKMP	VRKOU	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SONVQVTKUN	NKO	SNSRONVKVS	NMMKUU	RVKR	NOMQ	
qÄ	NRV	e É	OPPSPRPKQQ	MKR	ORRVVQSKO	VNKOT	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQQTVVSKSS	MKU	PNTNNVSKMP	NMUKTP	RVKR	NOMQ	
_á	OMV	e É	NPVNPNTKUP	MKQ	NRMOPPVKST	VOKSN	RVKR	NOMQ	

`çåíaåì aåÖ=~ëåÄê~íáç=sÉêâÑÅ~íáç=É``sF=oÉéçã

p~ã éáÉ=k~ã É	``s
cãÉ=k~ã É	MSP|``skÇ
a~í~=m~íÜk~ã É	aWy^ÖãÉáíyf^mj eyNya^q^yOMCPyMPUj ^oyi n`PM^hÅ
^Åè=qáã É	PLPMLOMCP=ONMPMP
p~ã éáÉ=qóéÉ	``s
qçí~äaãäíáç;å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MNO^i_kÇ
p~ã éáÉ=n`=m~ëëlcá~ä	c~ää
fpqa=n`=m~ëëlc~ää	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==mp==	bñés~ä	B=oÉÄ	B i çï	B eäÜÜ	n`=c ä-Ö
V	_É	S	k ç=d ~ë	OQKUSM	éëÄ	OKN	NPRNSUKNV	CR	VVKQQ	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKNSV	éëÄ	OKV	UVRVUKRP	CR	NMMSU	UVKU	NNMO	
OP	k~	QR	e É	RQQVKUTS	éëÄ	NKT	PMUSQTPKQT	RMMM	NMR	UVKU	NNMO	
OQ	j Ö	QR	e É	RQNOKUUS	éëÄ	NKP	NSRVOOOKTV	RMMM	NMUKOS	UVKU	NNMO	
OT	^ä	QR	e É	SMVMRNN	éëÄ	OKR	SUUPQKNS	RMM	NONKV	UVKU	NNMO	[=HLJ-NMB
OU	pá	QR	e O	ROTKOPM	éëÄ	NKM	ONUQQMKPR	RMM	NMRKQR	UVKU	NNMO	
PV	h	QR	e É	ROVRKNPQ	éëÄ	NKN	NQNMQVMKMS	RMMM	NMRKV	UVKU	NNMO	
QM	`~	QR	e O	RQPUKOTO	éëÄ	MKT	NSNTSMVRKTP	RMMM	NMQKTT	UVKU	NNMO	
RN	s	UV	e É	ORKTNN	éëÄ	MKS	VTNVTKRV	CR	NMOKUQ	UVKU	NNMO	
RO	`ê	UV	e É	OSKPMQ	éëÄ	MKQ	NONTMPKVP	CR	NMRKOO	UVKU	NNMO	
RR	j å	UV	e É	OSKRPV	éëÄ	NKM	SMUQSKSP	CR	NMSKNS	UVKU	NNMO	
RS	cÉ	UV	e O	RPMTKONR	éëÄ	NKO	RUQVMPMSKRU	RMMM	NMSKNQ	UVKU	NNMO	
RV	`ç	UV	e É	OSKPTN	éëÄ	NKM	ONOPROKMR	CR	NMRKQU	UVKU	NNMO	
SM	ká	UV	e É	OSKSOQ	éëÄ	OKO	RVVTOKVP	CR	NMSKR	UVKU	NNMO	
SP	`ì	UV	e É	OTKMPR	éëÄ	MKO	NSVMVPKRU	CR	NMUKNQ	UVKU	NNMO	
SS	wå	UV	e É	OTKPVO	éëÄ	OKP	OVOMSKQN	CR	NMVKRT	UVKU	NNMO	
TR	^ë	UV	e É	ORKTVV	éëÄ	NKP	ONNRSKUT	CR	NMPKO	UVKU	NNMO	
TU	pÉ	UV	e O	ORKSQM	éëÄ	MKP	NNSTPKPP	CR	NMOKRS	UVKU	NNMO	
UU	pê	UV	e É	OSKQUV	éëÄ	OKP	TOSVTKPS	CR	NMRKNS	UVKU	NNMO	
VR	j ç	UV	e É	OSKMOQ	éëÄ	MKU	SVTNRKTO	CR	NMQKN	UVKU	NNMO	
NMT	^Ö	UV	e É	OSKUMP	éëÄ	NKN	OSQRQRKPU	CR	NMTKON	UVKU	NNMO	
NNN	`Ç	UV	e É	OSKOQN	éëÄ	MKS	PRMOOKQP	CR	NMQKVS	UVKU	NNMO	
NNU	på	NRV	e É	ORKRNQ	éëÄ	NKQ	STQNUKVT	CR	NMOKMS	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	OQKURU	éëÄ	MKV	ROMVRQKQT	CR	VVKQP	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKTTS	éëÄ	MKU	NSMUNQKNP	CR	NMPKN	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKSPU	éëÄ	MKU	POTTRNKSP	CR	NMSKRR	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKTNR	éëÄ	NKP	TOUUTOKOO	CR	NMOKUS	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OUKOOM	éëÄ	MKU	NNMPUUVKUM	CR	NNOKUU	UVKU	NNMO	[=HLJ-NMB
OPO	qÜ	OMV	k ç=d ~ë	OSKQRQ	éëÄ	OKN	VOOTOTKRN	CR	NMRKUO	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKSUR	éëÄ	NKP	UTPQNSKNU	CR	NMSKTQ	UVKU	NNMO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	B n`=ç ïï	B n`=eäÜÜ	n`=c ä-Ö
i á	S	k ç=d ~ë	NUTPROMKRO	OKT	NTSNRRMKR	NMSKPS	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PUNTSSVMKMR	MKV	QNOVNNUKR	VOKQS	RVKR	NOMQ	
pÅ	QR	e O	UUTVSRKRR	NKU	VQNPSMKUR	VQKPP	RVKR	NOMQ	
pÅ	QR	e É	NOUONMKRO	OKN	NQMPOUKRR	VNKPS	RVKR	NOMQ	
dÉ	TO	k ç=d ~ë	VPMMVMKTT	NKM	VUORTUKMV	VQKSS	RVKR	NOMQ	
dÉ	TO	e O	PSSNNPKSU	MKN	PVNMOPKOQ	VPKSO	RVKR	NOMQ	
dÉ	TO	e É	NMMVMMSU	MKO	NNOOOOKSN	UVKVN	RVKR	NOMQ	
v	UV	e O	QMTSOMSKNT	NKO	QPPRROOKON	VQKMO	RVKR	NOMQ	
v	UV	e É	STMMTQKNR	MKU	TQRQNOKMP	UVKUV	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQTMNUNKTR	NKO	SNSRONVKVS	NVQKVR	RVKR	NOMQ	
qÄ	NRV	e É	OQOOVMKRN	MKS	ORRVVQSKO	VQKSR	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQSSVTRKVN	MKR	PNTNNVSKMP	NMVKPP	RVKR	NOMQ	
_á	OMV	e É	NQNQPOMKMS	MKT	NRMOPPVKST	VQKNQ	RVKR	NOMQ	

`çåíáåì åÖ=~äÄê~íáçå=_ä~åâ=É``_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MSQ``_KÇ

a~í~=m~íÜ=k~ã É aWj^ÖäÉáíÝ^mj eyNya^q^yOMCPyMPJ ^oyi n` PM^kÂ

^Åè=qáã É PLPMLOMCP=ONMQNMMQ

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáç~å NMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑ=cäÉk~ã É MNO^i_KÇ

p~ã éáÉ=n`=m~ëëlc á~ä c~ää

fpqa=n`=m~ëëlc~ää m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄåÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÄK	r åáë	opa	==\ mp==	iãäá	n`=c~ä~Ö
V	_É	S	kç=d~ë	MMNR	éé Ä	PPMM	OTQKQR	MO	
NN	_	S	kç=d~ë	MOQM	éé Ä	NPMN	OMCPMRO	Q	
CP	k~	QR	eÉ	JONKUSP	éé Ä	kL^	ONMNTMOT	OMM	
CQ	j Ö	QR	eÉ	RMRVT	éé Ä	NPMQ	OQCSMVS	OM	
OT	^ä	QR	eÉ	NSMVNN	éé Ä	NMN	OMUQMSP	OM	c~äÉÇ=a ça
CU	pá	QR	eO	MRTT	éé Ä	PSMR	TTQKNT	NMM	
PV	h	QR	eÉ	JPMQQO	éé Ä	kL^	OUNRTMUM	OMM	
QM	`~	QR	eO	UMVQO	éé Ä	OMU	QSNOSMSV	OM	
RN	s	UV	eÉ	MMUUM	éé Ä	RMQ	RCOKOQ	N	
RO	`ê	UV	eÉ	MMVOS	éé Ä	OTMR	VUUMRN	N	
RR	j å	UV	eÉ	MMNNV	éé Ä	NPMT	PSNKOT	MQ	
RS	cÉ	UV	eO	NRMPUM	éé Ä	RMO	NVNNOMMN	OM	c~äÉÇ=a ça
RV	`ç	UV	eÉ	MMUOO	éé Ä	OQCR	OTTKTV	MO	
SM	ká	UV	eÉ	MMUUU	éé Ä	SMS	POUKVM	MQ	
SP	`ì	UV	eÉ	MMUUU	éé Ä	SMN	VPPMPU	MS	
SS	wå	UV	eÉ	MOPV	éé Ä	SMR	SVRMRU	O	
TR	^ë	UV	eÉ	MMVPQ	éé Ä	NVMO	RNMPQ	N	
TU	pÉ	UV	eO	MMVPR	éé Ä	NRMR	PVMNT	N	
UU	pê	UV	eÉ	MMVPU	éé Ä	PMM	NPVMMM	N	
VR	j ç	UV	eÉ	MMVPP	éé Ä	TNMT	RVMMMO	N	
NVT	^Ö	UV	eÉ	MMVOM	éé Ä	NQMP	OQLKVM	MO	
NNN	`Ç	UV	eÉ	MMNNT	éé Ä	PQMN	PNMQU	MO	
NNU	på	NRV	eÉ	MMVRM	éé Ä	OPMS	PNRMRT	N	
NON	pÄ	NRV	kç=d~ë	MMVPM	éé Ä	OUMR	NVPTMUN	MO	
NPT	_~	NRV	kç=d~ë	MMNOM	éé Ä	NNMT	UPVMVN	MQ	
NUO	t	NRV	kç=d~ë	MMVRM	éé Ä	OUMT	PVPVMOO	N	
OVR	qä	OVV	kç=d~ë	MMVOP	éé Ä	NQMS	ONURMUQ	MO	
OVU	mÄ	OVV	kç=d~ë	MMSOU	éé Ä	PMR	OSNSNMUU	MO	c~äá^ äáíj ÉÍÜçÇë& c~äÉÇ=a ça
OPO	qÜ	OVV	kç=d~ë	MMVOP	éé Ä	NVMN	PPOPMVU	N	
OPU	r	OVV	kç=d~ë	MMVOR	éé Ä	ONMV	NVUTMUT	MO	

n`=fpqa=q~ÄåÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=ïçï	Bn`=eäÜÜ	n`=c~ä~Ö
iá	S	kç=d~ë	NUVOSUQMQO	MVR	NTSNRRVMR	NVMTMQQ	RVMR	NOVMQ	
pÅ	QR	kç=d~ë	PUVTVQMVUS	NMQ	QNOVMNNUMR	VQMQ	RVMR	NOVMQ	
pÅ	QR	eO	VMQPVPMVO	NMO	VQNPSMVUR	VSMVT	RVMR	NOVMQ	
pÅ	QR	eÉ	NOUSUNMVU	NMN	NQMPOUMRR	VNMT	RVMR	NOVMQ	
dÉ	TO	kç=d~ë	VRNVUUMUS	MMS	VUORTUMVV	VSMUV	RVMR	NOVMQ	
dÉ	TO	eO	PTNMVSQMUP	NMR	PVNMVOPMQQ	VQMUV	RVMR	NOVMQ	
dÉ	TO	eÉ	NMPQVPMUU	MMU	NNOOOOMSN	VOMOO	RVMR	NOVMQ	
v	UV	eO	QNQRONNMTQ	NMT	QPPRROOMON	VRMSN	RVMR	NOVMQ	
v	UV	eÉ	STVVSVMSU	MMS	TQRQNOMVP	VNMOO	RVMR	NOVMQ	
qÄ	NRV	kç=d~ë	SROPNTMVMT	MMN	SNSRONVMVS	NVRMUN	RVMR	NOVMQ	
qÄ	NRV	eÉ	OQSORMPMTP	NMM	ORRVVQSMO	VSMVV	RVMR	NOVMQ	
_á	OVV	kç=d~ë	PROQVPQMU	MMV	PNTNNVSMVP	NNNMVR	RVMR	NOVMQ	
_á	OVV	eÉ	NQSNTSUMPV	OMM	NRVOPPVMST	VTMP	RVMR	NOVMQ	

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É pn MVVPJMMS

cãÉ=k~ã É MSRpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÄ

^Åè=qãã É PLPMLOMCP=ONWQSMO

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	PKOUO	ééÄ	QHR	PSPOKTQ	NMM	
NN	_	S	k ç=d ~ë	NTKMMN	ééÄ	NHR	NOSUMKNT	NMMM	
OP	k ~	QR	e É	QPUKTNV	ééÄ	NKN	NNMVUMKQO	OMMMMM	
OQ	j Ö	QR	e É	NMRCQKNNR	ééÄ	NKO	SUTSMQKRU	OMMMMM	
OT	^ ä	QR	e É	OQQRVSKPUV	ééÄ	NHR	RUTMPMTKVM	OMMMMM	
OU	pá	QR	e O	NRCPKRNV	ééÄ	NMHS	NPPSMVKTU	NMMMM	
PV	h	QR	e É	RSVQKOMR	ééÄ	NKN	PQTPNRKVP	OMMMMM	
QM	` ~	QR	e O	QRQQKSTO	ééÄ	MKT	OVTVPVQKNV	OMMMMM	
RN	s	UV	e É	QNTKTMO	ééÄ	MKO	PPSRNMKMN	NMMM	
RO	` ê	UV	e É	ONMHSVN	ééÄ	MKT	OMTRMTKCO	OMMM	
RR	j å	UV	e É	NTQKWQ	ééÄ	MKO	URCMVKMS	OMMM	
RS	cÉ	UV	e O	NTTQSPKNRN	ééÄ	MKV	QNVOTOMOTKCS	NMMMMM	
RV	` ç	UV	e É	PMKVRM	ééÄ	OKN	RPCSSHSM	NMMM	
SM	k á	UV	e É	UPKTON	ééÄ	NKO	QMOVRKVN	NMMM	
SP	` ì	UV	e É	QQKMTU	ééÄ	MKT	RVNMRKUS	OMMM	
SS	wå	UV	e É	ONPKTOM	ééÄ	MKU	QURSNKPU	OMMM	
TR	^ ë	UV	e É	PMRKQM	ééÄ	NKT	RPSQKCS	NMMM	
TU	pÉ	UV	e O	QHSVV	ééÄ	NKM	QTOKVV	NMMM	
UU	pê	UV	e É	QSKURU	ééÄ	MKV	OTSTQKTP	OMMM	
VR	j ç	UV	e É	OKMOM	ééÄ	NKU	NRTVHMN	NMMM	
NMT	^ Ö	UV	e É	MKPPQ	ééÄ	VKN	TRSKTM	NMM	
NNN	` Ç	UV	e É	MKNCQ	ééÄ	ONKU	QQKCR	NMMM	
NNU	på	NRV	e É	QNKVMQ	ééÄ	NKT	CCCNQKNN	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKTUU	ééÄ	THM	PSPTHSU	NMMM	
NPT	_~	NRV	k ç=d ~ë	SQMKPRV	ééÄ	MKV	TUTMUMKUS	OMMM	
NUO	t	NRV	k ç=d ~ë	MKMUT	ééÄ	VPKV	ORSVHSO	NMMM	
OMR	qä	OMV	k ç=d ~ë	OKQNO	ééÄ	OKT	NQQTVKTQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NPVKVON	ééÄ	OKO	NMTMSURKMP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	RRKVPS	ééÄ	NKO	PUOTOMKUR	NMMM	
OPU	r	OMV	k ç=d ~ë	TKVMD	ééÄ	OKV	RMUNQKVU	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ ÉÅ	B n ` =¡ çï	B n ` =¤ äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUNNRCOKMM	MKQ	NTSNRRMR	NVOKUQ	RVHR	NOMKQ	
pÅ	QR	k ç=d ~ë	QNONRVSHST	NHR	QNOVNNUHR	VVKUO	RVHR	NOMKQ	
pÅ	QR	e O	VPUMNMKVM	MKN	VQNPSMKUR	VVHSQ	RVHR	NOMKQ	
pÅ	QR	e É	NPSRQQKMT	MHS	NQMPOUKRR	VTHP	RVHR	NOMKQ	
d É	TO	k ç=d ~ë	VQOTUNKNS	MKP	VUCRTUKMV	VRKVR	RVHR	NOMKQ	
d É	TO	e O	PRQVSQKVN	MKP	PVNMCPKCQ	VMRTT	RVHR	NOMKQ	
d É	TO	e É	NMMPOVKRP	MKR	NNCCCOKSN	UVKQ	RVHR	NOMKQ	
v	UV	e O	QPSVVSPKTM	MKQ	QPPRRCOKON	NMMKTV	RVHR	NOMKQ	
v	UV	e É	TNRMSRKVS	MKP	TQRQNOKMP	VRKVP	RVHR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SPTSPMSKQM	MKU	SNSRONVKVS	NMPKQO	RVHR	NOMKQ	
qÄ	NRV	e É	CQNTNSTKQQ	MHS	ORRVVQSKO	VQKQO	RVHR	NOMKQ	
_á	OMV	k ç=d ~ë	PPVNRPVKUP	NKQ	PNTNNVSKMP	NMSKVR	RVHR	NOMKQ	
_á	OMV	e É	NQPQONVKUU	NHS	NRMCPPVHST	VRKQT	RVHR	NOMKQ	

p~ã éäÉ=k~ã É pn MVVPJMMT

cãÉ=k~ã É MSSpj mi hÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÅ

^Åè=qãã É PLPMLOMCP=ONVRNMV

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	NRTNM	ééÄ	CKU	NVVPHRN	NMM	
NN	_	S	k ç=d ~ë	NCKMPO	ééÄ	MKV	NMTPMKUP	NMMM	
CP	k ~	CR	e É	RRMMNV	ééÄ	CKQ	NNSSVMPU	CMMMMM	
CQ	j Ö	CR	e É	PVNTHMDM	ééÄ	NKM	CPVVSPHU	CMMMMM	
CT	^ä	CR	e É	SVUMSHMV	ééÄ	NKP	NRSUCSSKQV	CMMMMM	
CU	pá	CR	e O	NMDMPCU	ééÄ	UKV	UQQNRRTM	NMMMM	
PV	h	CR	e É	PRUSKNUP	ééÄ	NKN	ONRQMPHRQ	CMMMMM	
QM	` ~	CR	e O	RRVRKCRU	ééÄ	PKO	PQCCRTOHPR	CMMMMM	
RN	s	UV	e É	TUKUOV	ééÄ	NKN	SNQQSKNM	NMMM	
RO	` ê	UV	e É	RNKOTV	ééÄ	MKV	QVPUTKUT	CMMM	
RR	j å	UV	e É	STKOVS	ééÄ	NKN	PNUCSKQD	CMMM	
RS	cÉ	UV	e O	NSQTTHMUM	ééÄ	CHP	PTRQURUNHMN	NMMMMM	
RV	` ç	UV	e É	UKUQN	ééÄ	MKU	NQTROHTP	NMMM	
SM	k á	UV	e É	PMRTVQ	ééÄ	CKO	NQPUMKVN	NMMM	
SP	` ì	UV	e É	SNKNTT	ééÄ	NHS	TUVVPHRR	CMMM	
SS	wå	UV	e É	NSNKUUS	ééÄ	CKO	PRRNTKTS	CMMM	
TR	^ë	UV	e É	UKQQN	ééÄ	PKM	NQQTKCP	NMMM	
TU	pÉ	UV	e O	OHPUQ	ééÄ	QKV	CPUHPO	NMMM	
UU	pê	UV	e É	RPKQPT	ééÄ	MKU	PMQQRKNR	CMMM	
VR	j ç	UV	e É	NHSMT	ééÄ	TKV	NOVSKTR	NMMM	
NMT	^Ö	UV	e É	MKQQS	ééÄ	PKV	VNTKUO	NMM	
NNN	` Ç	UV	e É	NKMPV	ééÄ	PHS	OVQKQR	NMMM	
NNU	på	NRV	e É	QNKTVV	ééÄ	NKU	CQQMVHST	NMMM	
NQN	pÄ	NRV	k ç=d ~ë	NHRRS	ééÄ	QKM	STTRHRO	NMMM	
NPT	_~	NRV	k ç=d ~ë	OQVHRMV	ééÄ	MKQ	PMRRNSKUO	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKNNS	ééÄ	k L^	OMTRHSV	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKUQP	ééÄ	SKU	RTTMKTN	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	CRUKTNQ	ééÄ	MKT	OMQNSQSKVP	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	NRKMCO	ééÄ	NKQ	NMTPRQKNS	NMMM	
OPU	r	OMV	k ç=d ~ë	PKTVP	ééÄ	CHP	CROVUHRP	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	oÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =c äÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUCPPMCKVT	NHR	NTSNRRMR	NVPHRN	RVHR	NOMQ	
pÅ	CR	k ç=d ~ë	PUUCQMNKVT	NKM	QNOVNNUHR	VQKMD	RVHR	NOMQ	
pÅ	CR	e O	UTSNPVKQV	NKT	VQNPSMKUR	VPHMT	RVHR	NOMQ	
pÅ	CR	e É	NOTUMMKUV	NHO	NQMPCUKRR	VNKMT	RVHR	NOMQ	
d É	TO	k ç=d ~ë	VPCQTMKNT	MKQ	VUCRTUHMV	VQKV	RVHR	NOMQ	
d É	TO	e O	PROVMRKQM	CHR	PVNMCPKCQ	VMKCR	RVHR	NOMQ	
d É	TO	e É	VVTTCHRM	MHS	NNCCCCHSN	UUKVN	RVHR	NOMQ	
v	UV	e O	QCNPPVQRRS	MKU	CPPRRCCHCN	VTHKU	RVHR	NOMQ	
v	UV	e É	SUVVMRKMN	MKV	TQRQNCHMP	VCHRR	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPRNMTPKUT	NKN	SNSRCNVKVS	NVPKMN	RVHR	NOMQ	
qÄ	NRV	e É	CQCCVRQHSU	NKM	CRRVVQSHO	VQHSR	RVHR	NOMQ	
_á	OMV	k ç=d ~ë	PQVURSCHSP	NKM	PNTNNVSKMP	NNMPO	RVHR	NOMQ	
_á	OMV	e É	NQSRPNTKUU	MKT	NRMCPPVHST	VTHRQ	RVHR	NOMQ	

p~ã éäÉ=k~ã É pn MVVPJMMU

cãÉ=k~ã É MSTpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÄ

^Åè=qãã É PLPMLOMCP=ONVRSVQS

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =c ä~Ö
V	_É	S	k ç=d ~ë	PMMNP	éé Ä	MKR	PPVUKCP	NMM	
NN	_	S	k ç=d ~ë	NCKPRN	éé Ä	PMN	VSRCKCS	NMMM	
CP	k ~	CR	e É	UCUKCCS	éé Ä	NKR	NRVMTUKCO	CMMMMM	
CQ	j Ö	CR	e É	VCNCKCSO	éé Ä	MKQ	SNRUMCMSS	CMMMMM	
CT	^ ä	CR	e É	CNCLURCKMVR	éé Ä	MKU	RNSNVUNKCU	CMMMMM	
CU	pá	CR	e O	NCPMCCCP	éé Ä	NKR	NCUPVRRTQ	NMMMM	
PV	h	CR	e É	RCVCKTPP	éé Ä	MKN	PCRPCVKCR	CMMMMM	
QM	` ~	CR	e O	NVUNRTVV	éé Ä	MRT	NPQNCSNKVV	CMMMMM	
RN	s	UV	e É	CNRKMCS	éé Ä	MKO	NUPNRSKVO	NMMM	
RO	` ê	UV	e É	NRNRTCU	éé Ä	MRT	NRUNSUKMP	CMMM	
RR	j å	UV	e É	NPPKNRV	éé Ä	MKR	SUURRKRT	CMMM	
RS	cÉ	UV	e O	PVVVTKRPO	éé Ä	CKP	VVUSPMTCKUV	NMMMMM	
RV	` ç	UV	e É	NVRTMQ	éé Ä	NKU	PRUTPKRT	NMMM	
SM	k á	UV	e É	RVKQSM	éé Ä	NKM	PMCUCKMP	NMMM	
SP	` ì	UV	e É	NSRTNS	éé Ä	NKP	CPVQNKVP	CMMM	
SS	wå	UV	e É	NNUKMRT	éé Ä	CKU	CUQMRKVM	CMMM	
TR	^ ë	UV	e É	VKURS	éé Ä	MKV	NUQSKSR	NMMM	
TU	pÉ	UV	e O	PKMNQ	éé Ä	PMN	POSKNS	NMMM	
UU	pê	UV	e É	RMKCVN	éé Ä	NKQ	PNPUNRTM	CMMM	
VR	j ç	UV	e É	NKMMV	éé Ä	NSRT	NMSNKNT	NMMM	
NMT	^ Ö	UV	e É	MKCVO	éé Ä	UKR	TMRKRV	NMM	
NNN	` Ç	UV	e É	MKMVO	éé Ä	CCRT	PTKQN	NMMM	
NNU	på	NRV	e É	QCKCMU	éé Ä	NKM	CPMNMKVV	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKQCR	éé Ä	TMN	CCSRKVN	NMMM	
NPT	_~	NRV	k ç=d ~ë	RNVMPRQ	éé Ä	MKP	SQVSSPKUP	CMMM	
NUO	t	NRV	k ç=d ~ë	JMCCQT	éé Ä	k lÅ	NTVUKSU	NMMM	
OMR	qä	OMV	k ç=d ~ë	CKPTQ	éé Ä	QKS	NQSCMKRM	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	VUKMPN	éé Ä	MRT	TUMMSUKNV	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	QVKVCM	éé Ä	NKP	PRRNSUKPN	NMMM	
OPU	r	OMV	k ç=d ~ë	UKQCO	éé Ä	CRT	RSCSTKQR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B=o ÉÅ	B n ` =i çï	B n ` =e ä ÜÜ	n ` =c ä~Ö
i á	S	k ç=d ~ë	NUPTROVRTP	NKU	NTSNRRMR	NVQKPN	RVRR	NOMQ	
pÅ	CR	k ç=d ~ë	QMTVQNQKSR	MKU	QNOVNNUR	VUKU	RVRR	NOMQ	
pÅ	CR	e O	VSMMVMSU	NKP	VQNPSMKUR	NMNKVV	RVRR	NOMQ	
pÅ	CR	e É	NPSSTUKQM	MKQ	NQMPCUKRR	VTKQ	RVRR	NOMQ	
d É	TO	k ç=d ~ë	VQMSVSKRT	NKN	VUCRTUKMV	VRRTQ	RVRR	NOMQ	
d É	TO	e O	PSPPSNKPR	MKS	PVNMCPKCQ	VCKVO	RVRR	NOMQ	
d É	TO	e É	NMPTQCKVR	MKU	NNCCCCKSN	VCKQQ	RVRR	NOMQ	
v	UV	e O	QSNUPOTHPN	NKR	CPPRRCCKCN	NMSKRO	RVRR	NOMQ	
v	UV	e É	TRRRTPKTO	MKU	TQRQNCKMP	NMNHPS	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQUUTVTHKN	NKN	SNSRONVKVS	NMRKCR	RVRR	NOMQ	
qÄ	NRV	e É	CQUSNNUHRN	MRT	CRRVVQSKO	VTHKO	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PRCQTPNHRO	NKO	PNTNNVSKMP	NNNKNR	RVRR	NOMQ	
_á	OMV	e É	NQTVUQTHSP	MKP	NRVCPPVHST	VUKR	RVRR	NOMQ	

p~ã éãÉ=k~ã É	pn MVVPJMMV
cãÉ=k~ã É	MSUpj mi hÇ
a~í~=m~íÜ=k~ã É	aWyt ÖãÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÅ
^Åè=qãã É	PLPMLOMCP=COMNMPQ
p~ã éãÉ=qóéÉ	p~ã éãÉ
qçí~äaãã íáçå	RKMMMM
p~ã éãÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äóíÉ=q~ÄãÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==ì mp==	i a o	n ` =cä~Ö
V	_É	S	k ç=d ~ë	OKPUR	éé Ä	MKT	OTPSKVT	NMM	
NN	_	S	k ç=d ~ë	NMKUVV	éé Ä	OKM	USTTKNT	NMMM	
OP	k ~	QR	e É	RSQKQUM	éé Ä	RKP	NOQRPUKRN	OMMMMM	
OQ	j Ö	QR	e É	SCPPKORR	éé Ä	MKV	QMNQONKOQ	OMMMMM	
OT	^ ä	QR	e É	NQVCPQKVTV	éé Ä	NKN	PROTUUMKRM	OMMMMM	
OU	pá	QR	e O	NNSTKVQN	éé Ä	TKR	NMMTVPKUP	NMMMM	
PV	h	QR	e É	PVQNMSMO	éé Ä	MKR	OQSNPTKUQ	OMMMMM	
QM	` ~	QR	e O	NVPUKNPP	éé Ä	NKT	NORVVPOKRP	OMMMMM	
RN	s	UV	e É	NQQKOOS	éé Ä	MKS	NNTPVRKMM	NMMM	
RO	` ê	UV	e É	NMRKOMU	éé Ä	MKT	NMSQVNKVV	OMMM	
RR	j å	UV	e É	VNMSVU	éé Ä	NKM	QRVRNKVM	OMMM	
RS	cÉ	UV	e O	ORSQVMSRO	éé Ä	MKS	SOMUUCUOKTS	NMMMMM	
RV	` ç	UV	e É	NPKTTO	éé Ä	OKS	OQPNOKVV	NMMM	
SM	k á	UV	e É	QQKOTO	éé Ä	NKS	ONUSVMSR	NMMM	
SP	` ì	UV	e É	NUKUMR	éé Ä	OKV	OSMPOKPS	OMMM	
SS	wå	UV	e É	VUKUPS	éé Ä	MKQ	OPMRRKVU	OMMM	
TR	^ ë	UV	e É	UKQQQ	éé Ä	NKS	NRPRKRU	NMMM	
TU	pÉ	UV	e O	OKSRP	éé Ä	QKU	OUMKNS	NMMM	
UU	pê	UV	e É	QQKPVT	éé Ä	NKN	ORSCQKST	OMMM	
VR	j ç	UV	e É	MKSUP	éé Ä	UKN	UPTKUO	NMMM	
NMT	^ Ö	UV	e É	MKOUS	éé Ä	RKU	STNKNQ	NMM	
NNN	` Ç	UV	e É	MKONT	éé Ä	VKU	TOKRV	NMMM	
NNU	på	NRV	e É	PVKVRN	éé Ä	RKP	ONQQMSM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKQRR	éé Ä	RKO	OPNOKSQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	PTRKOVM	éé Ä	MKS	QTNCCRKVM	OMMM	
NUO	t	NRV	k ç=d ~ë	JMPQS	éé Ä	k lA	NRSNKTQ	NMMM	
OMR	qä	OMV	k ç=d ~ë	NKTCR	éé Ä	PKP	NMVPOKTV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	VTKVNS	éé Ä	MKU	TUCRRRKVP	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	PRKOTM	éé Ä	OKQ	ORCRCUKRQ	NMMM	
OPU	r	OMV	k ç=d ~ë	TKOON	éé Ä	MKT	QUQVTKNN	NMMM	

n ` =fpqa=q~ÄãÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=opa	oÉÑ= mp	B =oÉÅ	B n ` =i çï	B n ` =eáÜÜ	n ` =cä~Ö
i á	S	k ç=d ~ë	NUQOSMRKNQ	NKN	NTSNRRMR	NMQKS	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	QMVMVMPTKQU	NKM	QNOVNNUKR	VVKMR	RVKR	NOMKQ	
pÅ	QR	e O	VOOMROKQQ	NKN	VQNPSMKUR	VTKVR	RVKR	NOMKQ	
pÅ	QR	e É	NPQQUMKOO	MKQ	NQMPOUKRR	VRKUP	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VRSRQRMKQ	MKV	VUCRTUKMV	VTHPR	RVKR	NOMKQ	
d É	TO	e O	PSOTRNMPR	NKQ	PVNMOPKOQ	VOKTT	RVKR	NOMKQ	
d É	TO	e É	NMPSVQKOO	NKM	NNOCCOKSN	VOKQ	RVKR	NOMKQ	
v	UV	e O	QQTSNUQKRT	NKN	OPPRRCOKON	NMPKOQ	RVKR	NOMKQ	
v	UV	e É	TPNSUPKVT	MKP	TQRQNOKMP	VUKNS	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SRNPMTRKMM	MKQ	SNSRONVKVS	NMRKSQ	RVKR	NOMKQ	
qÄ	NRV	e É	OQQTSSMKPM	OKN	ORRVVQSKO	VRKSN	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRQMONMKUN	NKU	PNTNNVSKMP	NNNKSQ	RVKR	NOMKQ	
_á	OMV	e É	NQQONSQKRS	MKV	NRMCPPVKST	VRKVV	RVKR	NOMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` ONfj t N
cáÉ=k~ã É	MSV| m_KÇ
a~í~=m~íÜ=k~ã É	a Wy^ ÖäÉåíyf` mj e yNya ^ q^ yOMOPyMPJj ^ o yi n` PM^ kÄ
^ Åè=qãã É	PLPMLOMOP=OOMVSWQN
p~ã éäÉ=qóéÉ	m_
qçí~ä=a áä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MNO ^ i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^ å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÅK	r åáë	o pa	==` mp==	i ãã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	JMKMTQ	ééÄ	k L^	NNNKNN	MKR	
_	NN	S	k ç=d ~ë	MKTOV	ééÄ	RKP	NSTTKVM	NM	
k~	OP	QR	e É	JNOPKOSU	ééÄ	k L^	PVUOOKUS	RMM	
j Ö	OQ	QR	e É	NUKMPP	ééÄ	PKM	NUPRKTQ	RM	
^ä	OT	QR	e É	OUMKUTP	ééÄ	PKN	SRVQKVV	RM	m_=SMOM=c~âë=a ça & m_=SMOM=c~âë=k çåJa ça
pá	OU	QR	e O	NPKVPT	ééÄ	NQKP	NSTNKUU	ORM	
h	PV	QR	e É	JPRKMUU	ééÄ	k L^	OTRNMKNU	RMM	
` ~	QM	QR	e O	ONKNVN	ééÄ	RKQ	PMTPVKNQ	RM	
s	RN	UV	e É	MKUUT	ééÄ	QKN	UVTKUO	OKR	
` ê	RO	UV	e É	MKNPO	ééÄ	PRKN	VVOKRN	OKR	
j å	RR	UV	e É	MKOOP	ééÄ	OPKT	ONNKVS	N	
cÉ	RS	UV	e O	TPKORV	ééÄ	OKN	NUNORMKVM	RM	m_=SMOM=c~âë=a ça
` ç	RV	UV	e É	MKMMU	ééÄ	ONOKR	NNNKNN	MKR	
k á	SM	UV	e É	MKOVR	ééÄ	NPKM	OSPKPQ	N	
` ì	SP	UV	e É	MKNMN	ééÄ	PQKP	RMQKQS	NKR	
wå	SS	UV	e É	MKVUR	ééÄ	OOKS	PQSKSU	R	
^ë	TR	UV	e É	MKMUM	ééÄ	QVKS	PSKST	OKR	
pÉ	TU	UV	e O	JMKMTQ	ééÄ	k L^	TKNT	OKR	
pê	UU	UV	e É	MKMVN	ééÄ	RKQ	TRKRS	OKR	
j ç	VR	UV	e É	JMKQUV	ééÄ	k L^	NQRKRS	OKR	
^Ö	NMT	UV	e É	JMKMNS	ééÄ	k L^	NUKUV	MKR	
` Ç	NNN	UV	e É	JMKMOQ	ééÄ	k L^	OKOO	MKR	
på	NNU	NRV	e É	MKORO	ééÄ	OQKM	PNQKQR	OKR	
pÄ	NON	NRV	k ç=d ~ë	JMKMNU	ééÄ	k L^	PNTKMN	MKR	
_~	NPT	NRV	k ç=d ~ë	MKVOS	ééÄ	NUKR	NOOQKSV	N	
t	NUO	NRV	k ç=d ~ë	JMKSOV	ééÄ	k L^	URQKOS	OKR	
qä	OMR	OMV	k ç=d ~ë	JMKMUU	ééÄ	k L^	QQTKNR	MKR	
mÄ	OMU	OMV	k ç=d ~ë	MKQRM	ééÄ	QKT	QTMRKPQ	MKR	
qÜ	OPO	OMV	k ç=d ~ë	MKQRR	ééÄ	RKP	QVRVKRU	OKR	
r	OPU	OMV	k ç=d ~ë	JMKMNS	ééÄ	k L^	NQMKNR	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NUTUVUTHSV	MKV	NTSNRRMKR	NMSKST	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	PUTTVNMPP	OHS	QNOVNNUKR	VPKVO	RVKR	NOMQ	
pÅ	QR	eO	UUSTSMHSM	MKQ	VQNPSMKUR	VQKO	RVKR	NOMQ	
pÅ	QR	eÉ	NPMMPTHSN	MKV	NQMPOUKRR	VOHST	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VQUOTVHNS	OHM	VUORTUHMV	VSHRN	RVKR	NOMQ	
dÉ	TO	eO	PSUNTNHNP	MKP	PVNMQPHOQ	VQHNR	RVKR	NOMQ	
dÉ	TO	eÉ	NMNVTMPU	MHS	NNOOOOHSN	VMKUS	RVKR	NOMQ	
v	UV	eO	QNOTNTNHSQ	MKT	QPPRROOKON	VRHNV	RVKR	NOMQ	
v	UV	eÉ	SUOUPSHST	NKR	TQRQNOHMP	VNHSN	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	SQOTTROKPO	MKR	SNSROMVKVS	NMQKOS	RVKR	NOMQ	
qÄ	NRV	eÉ	OOQUVUOKPT	NKU	ORRVVQSKO	VRHST	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PQTTRVOKOM	PKO	PNTNNVSHMP	NMVHSS	RVKR	NOMQ	
_á	OMV	eÉ	NQSNROPKOT	MKO	NRMOPPVHST	VTKOU	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i `pt n`ONfj t N
cáÉ=k~ã É	MTM`pt kÇ
a~í~=m~íÜ=k~ã É	aWf^ÖäÉáíyf` mj eyNya^q^yOMOPyMPuj ^oyi n` PMf^kÄ
^Åè=qáã É	PLPMLOMOP=OOMNMQU
p~ã éäÉ=qóéÉ	i `pt
qçí~äaäãíáçå	RKMMMM
`çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MNO^i _kÇ
p~ã éäÉ=n` =m~ëëlc á~ä	c~äã
fpqa=n` =m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åã**

n` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==i mp==	bñés~ä	B=oÉÄ	B i çï	B eáÖÜ	n` =c ä-Ö
_É	V	S	k ç=d ~ë	RPKSNN	éëÄ	OKQ	RTQPVKOQ	RM	ONKQQ	TVKR	NOMQ	
_	NN	S	k ç=d ~ë	ROPKQOQ	éëÄ	PKO	PSQOSOKPQ	RMM	ONKMD	TVKR	NOMQ	
k~	OP	QR	e É	UPOMKMSO	éëÄ	NKP	NMVRRPQKSP	TRMM	OOKNV	TVKR	NOMQ	
j Ö	OQ	QR	e É	RQSOKMQS	éëÄ	MKU	PPOPMTKSR	RMMM	ONKUR	TVKR	NOMQ	
^ä	OT	QR	e É	OPVPKQNT	éëÄ	MKS	RPSMQKUS	OMMM	OPKVP	TVKR	NOMQ	a ça
pá	OU	QR	e O	NMVSKRMU	éëÄ	OKO	UVROTKON	NMMM	ONKVP	M	OMM	
h	PV	QR	e É	NMQUTKUPN	éëÄ	NKM	RTMVNMVKUQ	NMMMM	OMKVU	TVKR	NOMQ	
`~	QM	QR	e O	OTVOKOUU	éëÄ	NKU	NTMUUMRKVS	ORMM	OOKPQ	TVKR	NOMQ	
s	RN	UV	e É	RQMKUMM	éëÄ	MKV	QMPSPQKTN	RMM	ONKSP	TVKR	NOMQ	
`ê	RO	UV	e É	OONKPTM	éëÄ	MKV	OMNVTRKMQ	OMM	OOKNQ	TVKR	NOMQ	
j å	RR	UV	e É	RRTKUNR	éëÄ	MKT	ORQSMTKVO	RMM	OOKPN	TVKR	NOMQ	
cÉ	RS	UV	e O	NNPRKTPU	éëÄ	NKO	ORQQQORKOT	NMMM	OOKTN	TVKR	NOMQ	
`ç	RV	UV	e É	RSTKVOO	éëÄ	MKV	VMQMRPKNN	RMM	OOKTO	TVKR	NOMQ	
ká	SM	UV	e É	RSQKONU	éëÄ	MKT	ORMVONKQM	RMM	OOKRT	TVKR	NOMQ	
`ì	SP	UV	e É	OURKUUO	éëÄ	NKN	PRPOMMKNN	ORM	OOKUT	TVKR	NOMQ	
wå	SS	UV	e É	RQSKRVO	éëÄ	MKU	NNQUTUKMO	RMM	ONKUS	TVKR	NOMQ	
^ë	TR	UV	e É	NMSKQOS	éëÄ	NKP	NTOSQKQS	NMM	ONKOU	TVKR	NOMQ	
pÉ	TU	UV	e O	NMSKORU	éëÄ	MKP	VSVPKRT	NMM	ONKOR	TVKR	NOMQ	
pê	UU	UV	e É	RPRKOQO	éëÄ	NKM	OVOSSQKTR	RMM	ONKQN	TVKR	NOMQ	
j ç	VR	UV	e É	NNNKRUV	éëÄ	NKM	RVNTRKSO	NMM	OOKPO	TVKR	NOMQ	
^Ö	NMT	UV	e É	RNKTRO	éëÄ	MKV	NMNMRMKNQ	RM	OMKT	TVKR	NOMQ	
`Ç	NNN	UV	e É	OTTKOVR	éëÄ	NKO	TPNUNKQP	ORM	OOKNU	TVKR	NOMQ	
på	NNU	NRV	e É	RPNKQNU	éëÄ	NKO	OTTNUOKNS	RMM	ONKOS	TVKR	NOMQ	
pÄ	NON	NRV	k ç=d ~ë	NMPKUOM	éëÄ	MKT	QPMSVOKQV	NMM	OMKTS	TVKR	NOMQ	
_~	NPT	NRV	k ç=d ~ë	ONTSKRTM	éëÄ	MKR	OSVMVTPKUO	OMMM	ONKTT	TVKR	NOMQ	
t	NUO	NRV	k ç=d ~ë	NNQKOOS	éëÄ	NKM	OTVMPRKSQ	NMM	OOKUR	TVKR	NOMQ	
qä	OMR	OMV	k ç=d ~ë	NMSKONM	éëÄ	MKT	SMVVUMKQP	NMM	ONKOQ	TVKR	NOMQ	
mÄ	OMU	OMV	k ç=d ~ë	NMVKPRS	éëÄ	MKT	USSTRSKUM	NMM	ONKUT	TVKR	NOMQ	
qÜ	OPO	OMV	k ç=d ~ë	NMSKRUU	éëÄ	MKR	TRPQPUKRU	NMM	ONKPO	TVKR	NOMQ	
r	OPU	OMV	k ç=d ~ë	NMUKUTN	éëÄ	MKT	TONUMTKST	NMM	ONKTT	TVKR	NOMQ	

n` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑÉ mp	B=oÉÄ	Bn`=i çï	Bn`=eäÜÜ	n`=ä=Ö
i á	S	k ç=d ~ë	NUQCRSMKSR	OKS	NTSNRRMKR	NMQKS	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PUMTOVMKMQ	NKR	QNOVNNUKR	VOKON	RVKR	NOMKQ	
pÅ	QR	e O	UTOMONKUS	OKQ	VQNPSMKUR	VOKSP	RVKR	NOMKQ	
pÅ	QR	e É	NOTMNVKMP	MKT	NQMPOUKRR	VMKRO	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VQNROVKMN	NKM	VUCRTUKMV	VRKUO	RVKR	NOMKQ	
d É	TO	e O	PSNVMNKMP	NKN	PVNMQPKCQ	VOKRR	RVKR	NOMKQ	
d É	TO	e É	NMMNSSKQM	NKR	NNCCCCKSN	UVKOS	RVKR	NOMKQ	
v	UV	e O	QMUOVQVKCU	MKU	QPPRRCCKON	VQKNT	RVKR	NOMKQ	
v	UV	e É	SSCRUCKNO	MKR	TQRQNOKMP	UUKUV	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SQNPUNPKNN	MKU	SNSRONVKVS	NMQKMP	RVKR	NOMKQ	
qÄ	NRV	e É	OPVSMOTKRN	MKQ	ORRVVQSKO	VPKS	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PRNNNURKSV	MKT	PNTNNVSKMP	NNMKTO	RVKR	NOMKQ	
_á	OMV	e É	NQQVTVVKRM	MKS	NRMOPPVKST	VSKR	RVKR	NOMKQ	

p~ã éäÉ=k~ã É pn MVUOJMVQ

cãÉ=k~ã É MTNpj mi hÇ

a~í~=m~íÜ=k~ã É aWÿ ÖäÉåíÿ˜ mj eyNya^q^yOVOPyWPJ ^oyi n ` PM^hÅ

^Åè=qãã É PLPMLOVOP=OOMUVQQ

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^ å~äóíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKMVR	éé Ä	k L^	NUQKQR	NVM	
NN	_	S	k ç=d ~ë	PKNQQ	éé Ä	PKQ	PPQQKUV	NVMM	
OP	k ~	QR	e É	JPOKMSQ	éé Ä	k L^	QUOSTKNN	OVMMMM	
OQ	j Ö	QR	e É	OVKORR	éé Ä	TKR	OQOMKCU	OVMMMM	
OT	^ ä	QR	e É	SOKSUV	éé Ä	QKM	NRPRKSS	OVMMMM	
OU	pá	QR	e O	PTNKUQM	éé Ä	PKO	OVVTSKPQ	NVMMM	
PV	h	QR	e É	PKNRM	éé Ä	QTPKQ	QUONSKNR	OVMMMM	
QM	` ~	QR	e O	NNVKQUQ	éé Ä	NKS	UTSROKTO	OVMMMM	
RN	s	UV	e É	NKMTS	éé Ä	UKR	NMVOKCU	NVMM	
RO	` ê	UV	e É	MKONN	éé Ä	ONKN	NVOQKRN	OVMM	
RR	j å	UV	e É	MKVOR	éé Ä	RKN	RNUKRU	OVMM	
RS	cÉ	UV	e O	NTKSON	éé Ä	NKR	RRQLPKRS	NVMMMM	
RV	` ç	UV	e É	MKPRO	éé Ä	VKO	SQLKVP	NVMM	
SM	k á	UV	e É	MKUMO	éé Ä	UKO	QTSKSU	NVMM	
SP	` ì	UV	e É	OKPPV	éé Ä	RKR	POONKRR	OVMM	
SS	wå	UV	e É	NKSNN	éé Ä	NRKQ	QSPKPR	OVMM	
TR	^ ë	UV	e É	MKOMU	éé Ä	OOKQ	RRKSU	NVMM	
TU	pÉ	UV	e O	MKMVQ	éé Ä	RMKO	OOKMM	NVMM	
UU	pê	UV	e É	NKNSR	éé Ä	QKP	SRQKQT	OVMM	
VR	j ç	UV	e É	JMKOMU	éé Ä	k L^	OUSKSU	NVMM	
NMT	^ Ö	UV	e É	MKNNN	éé Ä	SUKT	TMKMM	NVM	
NNN	` Ç	UV	e É	MKRRR	éé Ä	VKQ	QUKUV	NVMM	
NNU	på	NRV	e É	MKTMV	éé Ä	NSKU	RRQKOQ	NVMM	
NON	pÄ	NRV	k ç=d ~ë	MKMVU	éé Ä	OSKS	TVTKRP	NVMM	
NPT	_~	NRV	k ç=d ~ë	OKMPQ	éé Ä	MKV	ORUSKPQ	OVMM	
NUO	t	NRV	k ç=d ~ë	QKRRR	éé Ä	RKM	NPPUMKVN	NVMM	
OVR	qä	OMV	k ç=d ~ë	MKNPR	éé Ä	OSKR	NTRUKSR	NVMM	
OVU	mÄ	OMV	k ç=d ~ë	MKNUU	éé Ä	NVKU	OTNVKST	OVMM	
OPO	qÜ	OMV	k ç=d ~ë	MKSUT	éé Ä	RKS	STRQKOS	NVMM	
OPU	r	OMV	k ç=d ~ë	MKMTP	éé Ä	NRKV	TQMKUN	NVMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤ ÉÅ	B n ` =¡ çï	B n ` =¤ äÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NURVMSRKRT	MKU	NTSNRRMR	NVRKRQ	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PUQOUUNKUU	MKV	QNOVNNUKR	VPKMT	RVKR	NOMQ	
pÅ	QR	e O	URNPVOKNT	NKN	VQNPSMKUR	VMKQQ	RVKR	NOMQ	
pÅ	QR	e É	NOQOROQKQM	MKV	NQMPOUKRR	UUKRR	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VQNQVNKVV	MKQ	VUORTUKMV	VRKUO	RVKR	NOMQ	
d É	TO	e O	PRSRROQKUN	NKM	PVNMOPKOQ	VNKSU	RVKR	NOMQ	
d É	TO	e É	VVMSTKPO	MKP	NNOOOOKSN	UUKOU	RVKR	NOMQ	
v	UV	e O	QMMUUQVKPR	MKU	OPPRROOKON	VOKQT	RVKR	NOMQ	
v	UV	e É	SRSPPMKNP	MKS	TQRQNOKMP	UUKMR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQMNTPVKSN	MKR	SNSRONVKVS	NVPKUQ	RVKR	NOMQ	
qÄ	NRV	e É	OQOPUNQKPR	NKR	ORRVVQSKO	VQKSU	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRSTQNNKSR	NKR	PNTNNVSKMP	NNOKQV	RVKR	NOMQ	
_á	OMV	e É	NQQQMQTKNS	MKV	NRMOPPVKST	VSKNO	RVKR	NOMQ	

p~ã éäÉ=k~ã É	pn MVUOLMVR
cãÉ=k~ã É	MTOpj mi hÇ
a~í~=m~íÜ=k~ã É	aWjt ÖãÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` PM^hÅ
^Åè=qãã É	PLPMLOMOP=OOMPMRQ
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKMTT	éé Ä	k L^	NMOKOR	NMM	
NN	_	S	k ç=d ~ë	OKPUQ	éé Ä	OKT	OTPVKOM	NMMM	
OP	k ~	OR	e É	JSOKQUU	éé Ä	k L^	OPSTUMVR	OMMMMM	
OQ	j Ö	OR	e É	NNKSPT	éé Ä	NKM	NPQQKRR	OMMMMM	
OT	^ ä	OR	e É	OMKUVU	éé Ä	OKQ	NMPSKTO	OMMMMM	
OU	pá	OR	e O	NPRKUUQ	éé Ä	PKO	NNNRSKMU	NMMMM	
PV	h	OR	e É	OKUPM	éé Ä	PTRKU	OTSMMKOO	OMMMMM	
QM	` ~	OR	e O	TMKVOV	éé Ä	NKN	RUPPQKNQ	OMMMMM	
RN	s	UV	e É	MKUSP	éé Ä	RKT	UOSKTN	NMMM	
RO	` ê	UV	e É	MKNNU	éé Ä	PTKU	VOMKRO	OMMM	
RR	j å	UV	e É	MKQVR	éé Ä	TKT	PNUKSN	OMMM	
RS	cÉ	UV	e O	OKPPQ	éé Ä	SKT	OOMUTKMT	NMMMMM	
RV	` ç	UV	e É	MKMVV	éé Ä	PVKS	OQQQKQS	NMMM	
SM	k á	UV	e É	MKPVV	éé Ä	ONKP	OVOKOP	NMMM	
SP	` ì	UV	e É	NKVRR	éé Ä	OKR	OSVNKQO	OMMM	
SS	wå	UV	e É	NKUVR	éé Ä	NNKT	RNNKNP	OMMM	
TR	^ ë	UV	e É	MKMVO	éé Ä	OPKV	PSKPP	NMMM	
TU	pÉ	UV	e O	JMKVRM	éé Ä	k L^	VKMM	NMMM	
UU	pê	UV	e É	MKQNU	éé Ä	RKR	OQQQKQR	OMMM	
VR	j ç	UV	e É	JMKQQO	éé Ä	k L^	NSNKNN	NMMM	
NMT	^ Ö	UV	e É	JMKMVS	éé Ä	k L^	PSKST	NMM	
NNN	` Ç	UV	e É	MKMPQ	éé Ä	ORKQ	NTKMQ	NMMM	
NNU	på	NRV	e É	MKSMN	éé Ä	NNKV	QUTKUM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMPM	éé Ä	PTKT	RNMKRR	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKVON	éé Ä	PKP	NOMQKSS	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKQUM	éé Ä	k L^	NOMNKPP	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMOT	éé Ä	k L^	TVTKRQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKNPQ	éé Ä	NMKV	OQQQKQR	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKOPQ	éé Ä	NRKQ	PQPTKQS	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMMV	éé Ä	NPTKT	PMPKSS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B ¤pÉÅ	B n ` =¡ çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NUMVQSQKTM	QKM	NTSNRRMR	NMOKTO	RVMR	NOMQ	
pÅ	QR	k ç=d ~ë	PTPTMVNKRM	MKR	QNOVNNUMR	VMKRN	RVMR	NOMQ	
pÅ	QR	e O	UQQSVOKMV	MKR	VQNPSMKUR	UVKRO	RVMR	NOMQ	
pÅ	QR	e É	NONRUSKVM	MKQ	NQMPOUKRR	USKSQ	RVMR	NOMQ	
d É	TO	k ç=d ~ë	VOMVSOKQP	MKR	VUORTUKMV	VPKSQ	RVMR	NOMQ	
d É	TO	e O	PRNVQNKST	NKM	PVNMOPKOQ	VM	RVMR	NOMQ	
d É	TO	e É	VTRQPKOU	MKO	NNOOOOKSN	USKVO	RVMR	NOMQ	
v	UV	e O	PVSMVQNKUN	NMR	QPPRROOKON	VNKPS	RVMR	NOMQ	
v	UV	e É	SQONMPKUU	MKS	TQRQNOKMP	USKNQ	RVMR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPRSSMRKRN	MKQ	SNSRONVKVS	NMPKN	RVMR	NOMQ	
qÄ	NRV	e É	OPUPRUMSU	NKR	ORRVVQSKO	VPKNN	RVMR	NOMQ	
_á	OMV	k ç=d ~ë	PQVTQOMQU	MKS	PNTNNVSKMP	NNMOV	RVMR	NOMQ	
_á	OMV	e É	NQQQSTQKUS	MKT	NRMOPPVKST	VSKNS	RVMR	NOMQ	

p~ã éäÉ=k~ã É pn MVVPJMOP

cãÉ=k~ã É MTPpj mi hÇ

a~í~=m~íÜ=k~ã É aWµ ÖäÉåíµ mj eyNya^q^yOMOPyMPJ ^oyi n` PM^hÅ

^Åè=qãã É PLPMLOMOP=OOØVMP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äa ãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKMVR	ééÄ	k L^	USKST	NMM	
NN	_	S	k ç=d ~ë	NKKQP	ééÄ	PKS	NVOMKNS	NMMM	
OP	k ~	QR	e É	JNNNKNTM	ééÄ	k L^	PUSSRKNP	OMMMMM	
OQ	j Ö	QR	e É	TKQNU	ééÄ	NOKO	NNMOKPM	OMMMMM	
OT	^ ä	QR	e É	NSKUNO	ééÄ	COOU	ROPKPR	OMMMMM	
OU	pá	QR	e O	NRKRNQ	ééÄ	SKS	NSVRKOO	NMMMM	
PV	h	QR	e É	JNUKUSM	ééÄ	k L^	OSRVTKOO	OMMMMM	
QM	` ~	QR	e O	ORKTRU	ééÄ	MKQ	PNRSRKPV	OMMMMM	
RN	s	UV	e É	MKUOU	ééÄ	NNNS	UMPKPT	NMMM	
RO	` ê	UV	e É	MKNUV	ééÄ	OVKU	VUSKRO	OMMM	
RR	j å	UV	e É	MKSPO	ééÄ	NRKP	PTVKVQ	OMMM	
RS	cÉ	UV	e O	QNKVOT	ééÄ	PKP	NMTMMMKQV	NMMMMM	
RV	` ç	UV	e É	MKMPR	ééÄ	USKQ	NQSKST	NMMM	
SM	k á	UV	e É	MKQOM	ééÄ	NQKV	PMOKOP	NMMM	
SP	` ì	UV	e É	MKPQV	ééÄ	PKM	TTOKOS	OMMM	
SS	wå	UV	e É	NVKRVQ	ééÄ	MKR	QNOOKVM	OMMM	
TR	^ ë	UV	e É	MKNQV	ééÄ	OVKT	QRKPQ	NMMM	
TU	pÉ	UV	e O	JMKMP	ééÄ	k L^	QKPP	NMMM	
UU	pê	UV	e É	MKUUQ	ééÄ	PRKN	STKTU	OMMM	
VR	j ç	UV	e É	JMKRMQ	ééÄ	k L^	NPMKMM	NMMM	
NMT	^ Ö	UV	e É	JMKMNS	ééÄ	k L^	NTKTU	NMM	
NNN	` Ç	UV	e É	JMKMMS	ééÄ	k L^	SKST	NMMM	
NNU	på	NRV	e É	MKOVQ	ééÄ	RKU	PORKRT	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMMD	ééÄ	OSQKQ	QMPKTT	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKRNP	ééÄ	PPKQ	TNQKNN	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKRVN	ééÄ	k L^	VQTKTM	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKNMQ	ééÄ	k L^	PRTKMR	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMVM	ééÄ	NOKQ	NUURKPV	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNNS	ééÄ	RKS	ORVVKTM	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMNS	ééÄ	k L^	NPSKUN	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ÉÅ	B n` =¨çï	B n` =¤äÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	NUPNOVPKUM	NKR	NTSNRRMR	NVPKVS	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PTQTQOOKTS	MKO	QNOVNNUKR	VMKTS	RVKR	NOMQ	
pÅ	QR	e O	UPQOPUKMP	MKR	VQNPSMKUR	UUKSO	RVKR	NOMQ	
pÅ	QR	e É	NONVNTKPN	MKN	NQMPOUKRR	USKUU	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VONSMTKNM	MKS	VUORTUKMV	VPKTV	RVKR	NOMQ	
d É	TO	e O	PQTPRPKMM	NKP	PVNMOPKOQ	UUKUP	RVKR	NOMQ	
d É	TO	e É	VTTSTKUQ	MKR	NNOOOOKSN	UTKNO	RVKR	NOMQ	
v	UV	e O	PVSSRQPKOT	NKM	QPPRROOKON	VNKQV	RVKR	NOMQ	
v	UV	e É	SQPUOQKUV	MKP	TQRQNOKMP	USKPT	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SQPOVSPKPO	MKT	SNSRONVKVS	NMOKPQ	RVKR	NOMQ	
qÄ	NRV	e É	OPSPUSRKUS	NKN	ORRVVQSKO	VOKPQ	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PQUNORPKSP	OKM	PNTNNVSKMP	NMVKTU	RVKR	NOMQ	
_á	OMV	e É	NQQRTURKSV	MKS	NRMOPPVKST	VSKOQ	RVKR	NOMQ	

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É	pn MVVPJMCQ
cãÉ=k~ã É	MTQpj mi hÇ
a~í~=m~íÜ=k~ã É	aWÿ ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^hÅ
^Åè=qãã É	PLPMLOMCP=COAPQMO
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RKMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKUV	ééÄ	k L^	VNKN	NMM	
NN	_	S	k ç=d ~ë	NKMRT	ééÄ	NNKN	NUCSKUN	NMMM	
OP	k ~	QR	e É	JNMUKMCO	ééÄ	k L^	PUSTRKQN	OMMMMM	
OQ	j Ö	QR	e É	VKMTV	ééÄ	NPKV	NNUUKVV	OMMMMM	
OT	^ ä	QR	e É	NQKMQM	ééÄ	RKN	QSMKMO	OMMMMM	
OU	pá	QR	e O	NQKRRQ	ééÄ	NRKM	NRUUKQQ	NMMMM	
PV	h	QR	e É	JNUKOSR	ééÄ	k L^	OSPVRHPM	OMMMMM	
QM	` ~	QR	e O	NUKRUN	ééÄ	SKQ	OSUSRKST	OMMMMM	
RN	s	UV	e É	MKTTM	ééÄ	NMKR	TRNKMR	NMMM	
RO	` ê	UV	e É	MKMSS	ééÄ	RQKV	USRKOM	OMMM	
RR	j å	UV	e É	MKNUV	ééÄ	OPHP	NUOKSP	OMMM	
RS	cÉ	UV	e O	MKUQN	ééÄ	OQKV	NURPUHPN	NMMMMM	
RV	` ç	UV	e É	JMKMMS	ééÄ	k L^	UOKOP	NMMM	
SM	k á	UV	e É	MKQOV	ééÄ	NNKN	PMOKOP	NMMM	
SP	` ì	UV	e É	MKMSU	ééÄ	UOKQ	OPMKMN	OMMM	
SS	wå	UV	e É	PKMOP	ééÄ	PHP	TPOKOR	OMMM	
TR	^ ë	UV	e É	MKNQO	ééÄ	NRKM	OPHST	NMMM	
TU	pÉ	UV	e O	JMKMSR	ééÄ	k L^	THRM	NMMM	
UU	pê	UV	e É	MKMSN	ééÄ	PPHP	RQKOR	OMMM	
VR	j ç	UV	e É	JMKRQQ	ééÄ	k L^	NMTKTU	NMMM	
NMT	^ Ö	UV	e É	JMKMNT	ééÄ	k L^	NRKRR	NMM	
NNN	` Ç	UV	e É	JMKMMV	ééÄ	k L^	RKVP	NMMM	
NNU	på	NRV	e É	MKONU	ééÄ	RMHP	OURKRS	NMMM	
NON	pÄ	NRV	k ç=d ~ë	JMKMNV	ééÄ	k L^	PNMKPP	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKNTQ	ééÄ	NPHS	OUSKVT	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKSNP	ééÄ	k L^	UTTHSO	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKNNO	ééÄ	k L^	PMSKVV	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMTO	ééÄ	PMKO	NTORKOO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNNM	ééÄ	OPHT	ORQSKOS	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMOV	ééÄ	k L^	RPHPV	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ ÉÅ	B n ` =í çï	B n ` =¤ äÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NTVTTQOHPS	MKU	NTSNRRMR	NMOKMR	RMR	NOMQ	
pÅ	QR	k ç=d ~ë	PSVRRVTKUM	MKS	QNOVNNUHR	UMR	RMR	NOMQ	
pÅ	QR	e O	UNTVMVKNM	NKM	VQNPSMKUR	USKUV	RMR	NOMQ	
pÅ	QR	e É	NOMUSRHPR	NKO	NQMPOUKRR	USKNP	RMR	NOMQ	
d É	TO	k ç=d ~ë	VNOTQVKSV	MKQ	VUCRTUKMV	VOKUV	RMR	NOMQ	
d É	TO	e O	PQNSMNHPO	MHP	PVNMOPKOQ	UTHPS	RMR	NOMQ	
d É	TO	e É	VSMNTHRM	MKN	NNOCOOKSN	URKRS	RMR	NOMQ	
v	UV	e O	PUUTNPUKMP	MKT	QPPRRCOKON	UVKSS	RMR	NOMQ	
v	UV	e É	SPQVVOKOO	MKS	TQRQNOKMP	URKNV	RMR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPMTMMTHRN	MKN	SNSRONVKVS	NMOHP	RMR	NOMQ	
qÄ	NRV	e É	OPRTVRVHRM	OKR	ORRVVQSKO	VOKNN	RMR	NOMQ	
_á	OMV	k ç=d ~ë	PQQMUUVKQS	NKM	PNTNNVSKMP	NMUHR	RMR	NOMQ	
_á	OMV	e É	NQNURVNKVQ	NKT	NRMOPPVKST	VQKQP	RMR	NOMQ	

`çåíáåìåÖ=~äÄê~íáç=sÉêÑÛA~íáç=É``sF=oÉéçã

p~ã éäÉ=k~ã É	``s
cãÉ=k~ã É	MTR``skÇ
a~í~=m~íÜ=k~ã É	aWf^ÖãÉáíf^mj eyNya^q^yOMOPyMPJ ^oyi n` PM^hÅ
^Åè=qáã É	PLPMLOMOP=OOAPVVQM
p~ã éäÉ=qóéÉ	``s
qçí~äa ãäíáç=å	NKMMMM
`çã ã Éåí	JJJ
fpqa=oÉÑcãÉk~ã É	MNO^i_kÇ
p~ã éäÉ=n`=m~ëëlc á~ä	m~ëë
fpqa=n`=m~ëëlc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n`=^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	r åáë	opa	==ì mp==	bñés~ä	B=oÉÅ	B i çï	B eäÖÜ	n`=cä-Ö
V	_É	S	k ç=d ~ë	OQKUNV	éëÄ	NKV	NPQSTOKQR	CR	VVKOU	UVKU	NNMO	
NN	_	S	k ç=d ~ë	ORKMVP	éëÄ	OKO	UVNRUKMS	CR	NMMKPT	UVKU	NNMO	
OP	k ~	QR	e É	RPVMVKVM	éëÄ	NKQ	PMTSRQUKSM	RMMM	NMTKUO	UVKU	NNMO	
OQ	j Ö	QR	e É	RQUQKTPR	éëÄ	NKO	NSPORPQUPT	RMMM	NMVKSV	UVKU	NNMO	
OT	^ä	QR	e É	RQTKTUV	éëÄ	NKU	SMNMPKVM	RMM	NMVKRS	UVKU	NNMO	
OU	pá	QR	e O	ROVKTVN	éëÄ	OKR	ONOQVVKSV	RMM	NMRKVS	UVKU	NNMO	
PV	h	QR	e É	ROTTKUQS	éëÄ	MKP	NPSRPVRKVV	RMMM	NMRKRS	UVKU	NNMO	
QM	` ~	QR	e O	RORQKQSO	éëÄ	NKT	NRTMPQVOKVS	RMMM	NMRKVR	UVKU	NNMO	
RN	s	UV	e É	ORKSMS	éëÄ	MKO	VQRTSKVV	CR	NMOKQO	UVKU	NNMO	
RO	` ê	UV	e É	ORKVQN	éëÄ	NKN	NNTOTNKQR	CR	NMPKTS	UVKU	NNMO	
RR	j å	UV	e É	OSKMPN	éëÄ	NKN	RUPNQKCR	CR	NMQKNO	UVKU	NNMO	
RS	cÉ	UV	e O	RQUPKVMU	éëÄ	MKT	RSPTVQSMKUN	RMMM	NMRKSU	UVKU	NNMO	
RV	` ç	UV	e É	OSKQMM	éëÄ	NKP	OMTSUPKPV	CR	NMRKS	UVKU	NNMO	
SM	k á	UV	e É	OSKQCO	éëÄ	MKU	RUNQSKNU	CR	NMRKSV	UVKU	NNMO	
SP	` ì	UV	e É	OSKQNO	éëÄ	NKT	NSNQMNKVQ	CR	NMRKSR	UVKU	NNMO	
SS	wå	UV	e É	OSKTRO	éëÄ	OKM	OTUTMPR	CR	NMTKMN	UVKU	NNMO	
TR	^ë	UV	e É	ORKTMU	éëÄ	NKM	OMRVTKVT	CR	NMOKUP	UVKU	NNMO	
TU	pÉ	UV	e O	ORKUSM	éëÄ	MKR	NNPVTKQR	CR	NMPKQQ	UVKU	NNMO	
UU	pê	UV	e É	OSKMMU	éëÄ	NKS	TMOTQKSP	CR	NMQKMP	UVKU	NNMO	
VR	j ç	UV	e É	OSKQMU	éëÄ	NKQ	SVNMVKRS	CR	NMRKSP	UVKU	NNMO	
NMT	^Ö	UV	e É	OSKSUN	éëÄ	NKT	ORTOTVKRO	CR	NMSKTO	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKQPP	éëÄ	MKS	PQQSUKVS	CR	NMRKTP	UVKU	NNMO	
NNU	på	NRV	e É	ORKSMV	éëÄ	NKT	SRTMUKQN	CR	NMOKQQ	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	ORKOMS	éëÄ	MKP	RNUPSVKTO	CR	NMVKUO	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKRSQ	éëÄ	NKU	NRSTVNKCP	CR	NMOKOS	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKQVV	éëÄ	NKR	POMRMVKRS	CR	NMS	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKUUQ	éëÄ	NKO	TOTPTPKVN	CR	NMPKRQ	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	OSKNPT	éëÄ	MKT	NMNPUCPKMV	CR	NMQKRR	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKOQU	éëÄ	MKT	VMTVQMKMO	CR	NMQKVV	UVKU	NNMO	
OPU	r	OMV	k ç=d ~ë	OSKVPO	éëÄ	NKN	UTPVPNKQQ	CR	NMTKTP	UVKU	NNMO	

n`=fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÅ	B n`=ï çï	B n`=eäÖÜ	n`=cä-Ö
iá	S	k ç=d ~ë	NUSVQSUKUV	NKU	NTSNRRMR	NMSKNP	RVRR	NOMQ	
pÅ	QR	k ç=d ~ë	PTQPOVPKUM	MKV	QNOVNNUR	VMSS	RVRR	NOMQ	
pÅ	QR	e O	URVUNVMPV	NKV	VQNPSMKUR	VNPQ	RVRR	NOMQ	
pÅ	QR	e É	NOQQVQKOS	MKT	NQMPQUKRR	UUKTO	RVRR	NOMQ	
dÉ	TO	k ç=d ~ë	VNNOPRMU	MKU	VUORTUKMV	VOKTQ	RVRR	NOMQ	
dÉ	TO	e O	PRPPONMST	NKQ	PVNMQPKOQ	VMPR	RVRR	NOMQ	
dÉ	TO	e É	VURNPKSO	MKN	NNOOOOKSN	UTKTU	RVRR	NOMQ	
v	UV	e O	PVQSMVKMV	MKN	QPPRROOKON	VNKMO	RVRR	NOMQ	
v	UV	e É	SRQSTUPS	NKM	TQRQNOKMP	UTKUP	RVRR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPSMPUMKUU	MKV	SNSRONVKVS	NVPKNT	RVRR	NOMQ	
qÄ	NRV	e É	OPRPMQSKSV	NKR	ORRVVQSKO	VNKVO	RVRR	NOMQ	
_á	OMV	k ç=d ~ë	PQPTSUNKCP	NKV	PNTNNVSKMP	NMUKQ	RVRR	NOMQ	
_á	OMV	e É	NQMVPTVKTQ	NKN	NRMOPPVKST	VPKUN	RVRR	NOMQ	

`çåíáåì åÖ=~äÄê~íáç=_ä~åâ=É``_F=oÉéçã

p~ã éáÉ=k~ã É ``_

cäÉ=k~ã É MTS|``_KÇ

a~í~=m~íÜ=k~ã É aWi^ÖäÉáíyf^mj eyNya^q^yOMCPyMPJ^oyi n`PM^hÂ

^Åè=qáã É PLPMLOMCP=COOQSVMN

p~ã éáÉ=qóéÉ ``_

qçí~äa ãäíáç=å NKMMMM

`çã ã ÉâíáÍ JJJ

fpqa=oÉÑc äÉk~ã É MNO^i_KÇ

p~ã éáÉ=n`=m~ëëlc á~ä m~ëë

fpqa=n`=m~ëëlc~äã m~ëë

I éÉê~íçê **~Çã áã**

n`=^å~äöíÉ=q~ÄáÉ

j ~ëë	k~ã É	fpqa	qìåÉ	`çåÅK	råáë	opa	==\ mp==	iãäá	n`=c ä~Ö
V	_É	S	kç=d~ë	MKMNN	éé Ä	RPHR	ORMKMN	MO	
NN	_	S	kç=d~ë	MKNQN	éé Ä	NOHS	NSRNKCP	Q	
CP	k~	QR	eÉ	JCNKCQT	éé Ä	kL^	QMNNQKW	CMM	
CQ	j Ö	QR	eÉ	QRTNR	éé Ä	CKQ	QMVNKPR	CM	
CT	^ä	QR	eÉ	NKCVR	éé Ä	VKO	PMUKVM	CM	
CU	pá	QR	eO	MKPCN	éé Ä	RMS	SPTHPS	NMM	
PV	h	QR	eÉ	JMRRPO	éé Ä	kL^	QUMPTHSS	CMM	
QM	`~	QR	eO	RKRPN	éé Ä	UKM	PPUTQKNR	CM	
RN	s	UV	eÉ	MKVCO	éé Ä	CQKM	PSSKSU	N	
RO	`ê	UV	eÉ	MKMVS	éé Ä	UUR	UTQKRP	N	
RR	j å	UV	eÉ	MKVCQ	éé Ä	CUKQ	QVRKPM	MQ	
RS	cÉ	UV	eO	RKVRM	éé Ä	QKN	TOVVUKTN	CM	
RV	` ç	UV	eÉ	MKVNT	éé Ä	NPKV	QPNKNO	MO	
SM	k á	UV	eÉ	MKVRU	éé Ä	PRKN	QRQKQR	MQ	
SP	` ì	UV	eÉ	MKVNU	éé Ä	PSKR	QTTKTV	MS	
SS	wå	UV	eÉ	MKNUR	éé Ä	VKM	POQKQR	O	
TR	^ë	UV	eÉ	MKVCU	éé Ä	CCKR	QRKPQ	N	
TU	pÉ	UV	eO	MKVQN	éé Ä	CPKT	POKRM	N	
UU	pê	UV	eÉ	MKVOT	éé Ä	PTKQ	VSKST	N	
VR	j ç	UV	eÉ	MKVCQ	éé Ä	TTHR	QSPKPR	N	
NMT	^Ö	UV	eÉ	MKVNU	éé Ä	PKS	CCCKCP	MO	
NNN	` Ç	UV	eÉ	MKVNU	éé Ä	NSKV	POKCO	MO	
NNU	på	NRV	eÉ	MKVSM	éé Ä	OSKR	PPQKQR	N	
NON	pÄ	NRV	kç=d~ë	MKVPO	éé Ä	OVKT	NVQTKUO	MO	
NPT	_~	NRV	kç=d~ë	MKVPT	éé Ä	PQKM	PMVKPO	MQ	
NUO	t	NRV	kç=d~ë	MKVRN	éé Ä	QMKV	OVUVKNS	N	
OMR	qä	OMV	kç=d~ë	MKVQN	éé Ä	NNKV	QNVRKTQ	MO	
OMU	mÄ	OMV	kç=d~ë	MKVRO	éé Ä	SKT	PNVSKUV	MO	
OPO	qÜ	OMV	kç=d~ë	MKVTP	éé Ä	QKM	QPVUKSS	N	
OPU	r	OMV	kç=d~ë	MKVOT	éé Ä	SKV	NNNNKCP	MO	

n`=fpqa=q~ÄáÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÁ	Bn`=çï	Bn`=cåÜÜ	n`=c ä~Ö
iá	S	kç=d~ë	NUSTMURKVO	MO	NTSNRRVMR	NVRKVV	RVMR	NOMQ	
pÅ	QR	kç=d~ë	PTQTMVVKUP	MP	QNOVNNUMR	VVMTR	RVMR	NOMQ	
pÅ	QR	eO	USRQLUPKOV	QKN	VQNPSVKUR	VNKVQ	RVMR	NOMQ	
pÅ	QR	eÉ	NOQTQTRTQ	MKS	NQVPOUKRR	UUKV	RVMR	NOMQ	
dÉ	TO	kç=d~ë	VOUQSTRTR	MKR	VUCRTUKVV	VQKQV	RVMR	NOMQ	
dÉ	TO	eO	PRVTORKPT	MKT	PVNVOPKOQ	VNKVV	RVMR	NOMQ	
dÉ	TO	eÉ	VVTNVMSS	MKR	NNOCOOKSN	UUKUR	RVMR	NOMQ	
v	UV	eO	QVSOTPPKVP	NKP	QPPRROOKQN	VPRTN	RVMR	NOMQ	
v	UV	eÉ	SSQSVVRTS	NKM	TQRQNOKVP	UVKNT	RVMR	NOMQ	
qÄ	NRV	kç=d~ë	SPTTUUNKVQ	NKV	SNSRONVKVS	NVPKQR	RVMR	NOMQ	
qÄ	NRV	eÉ	OQNRNUQKRP	NKU	ORRVVQSKO	VQKPR	RVMR	NOMQ	
_á	OMV	kç=d~ë	PQQTQPPKPO	MKQ	PNTNNVSKVP	NVUKTN	RVMR	NOMQ	
_á	OMV	eÉ	NQPVTSSKNV	MKP	NRVOPPVKST	VRKOQ	RVMR	NOMQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_t n` ONfj t O
cáÉ=k~ã É	MTT| m_KÇ
a~í~=m~íÜ=k~ã É	a Wy^ÖäÉáíyf` mj e yNya^q^yOMOPyMPJ ^o yi n` PM^kÄ
^Åè=qãã É	PLPMLOMOP=OOVRNVRV
p~ã éäÉ=qóéÉ	m_
qçí~ä=a ãä íáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MNO^ ^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	m~ëë
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	o pa	==` mp==	i ãã á	n` =cä~Ö
_É	V	S	k ç=d ~ë	JMKMQU	ééÄ	k L^	NPRKRS	MKR	
_	NN	S	k ç=d ~ë	MKTUN	ééÄ	NPKP	NSTOKPR	NM	
k~	OP	QR	e É	JNMSKTPM	ééÄ	k L^	PVRRUKUU	RMM	
j Ö	OQ	QR	e É	NOKRQS	ééÄ	NPKM	NQNRKSU	RM	
^ä	OT	QR	e É	NNKOOM	ééÄ	NKQ	QMTKTV	RM	
pá	OU	QR	e O	NNKPVR	ééÄ	NPKN	NPTQKUR	ORM	
h	PV	QR	e É	JVKPNV	ééÄ	k L^	OTPRPKOV	RMM	
` ~	QM	QR	e O	ONKVMQ	ééÄ	PKR	OVPNPKVN	RM	
s	RN	UV	e É	MKSUP	ééÄ	NMKN	TMMKMP	OKR	
` ê	RO	UV	e É	MKMOV	ééÄ	ORKM	UQSKRP	OKR	
j å	RR	UV	e É	MKMQQ	ééÄ	POKT	NONKPN	N	
cÉ	RS	UV	e O	RKOPQ	ééÄ	QKN	OUPORKOT	RM	
` ç	RV	UV	e É	MKMNR	ééÄ	SRKS	NNRKRS	MKR	
k á	SM	UV	e É	MKOSO	ééÄ	PKV	OPQKQR	N	
` ì	SP	UV	e É	MKMUQ	ééÄ	OPKN	QRRKRT	NKR	
wå	SS	UV	e É	MKVVP	ééÄ	NOKS	POUKVM	R	
^ë	TR	UV	e É	MKNTN	ééÄ	QMKR	QVKMM	OKR	
pÉ	TU	UV	e O	JMKMNS	ééÄ	k L^	NOKMM	OKR	
pê	UU	UV	e É	MKMQQ	ééÄ	PUKS	QSKST	OKR	
j ç	VR	UV	e É	JMKPNN	ééÄ	k L^	OOUKVM	OKR	
^Ö	NMT	UV	e É	MKMOO	ééÄ	OPKO	VMKMM	MKR	
` Ç	NNN	UV	e É	MKMNR	ééÄ	TTKR	NOKOO	MKR	
på	NNU	NRV	e É	MKONV	ééÄ	QKT	OVMKMN	OKR	
pÄ	NON	NRV	k ç=d ~ë	MKMPR	ééÄ	QOKU	ROTKOQ	MKR	
_~	NPT	NRV	k ç=d ~ë	MKMUQ	ééÄ	QUKR	NTSKUS	N	
t	NUO	NRV	k ç=d ~ë	JMKOTM	ééÄ	k L^	NSURKOO	OKR	
qä	OMR	OMV	k ç=d ~ë	JMKMOP	ééÄ	k L^	UOQKOP	MKR	
mÄ	OMU	OMV	k ç=d ~ë	MKMTO	ééÄ	PRKV	NTRRKOQ	MKR	
qÜ	OPO	OMV	k ç=d ~ë	MKOOP	ééÄ	QPKP	PPSTKPQ	OKR	
r	OPU	OMV	k ç=d ~ë	MKMNT	ééÄ	VRKR	PRTKMR	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NUPPSMQKTU	PKM	NTSNRRMKR	NMQKMV	RVKR	NOMQ	
pÅ	QR	kç=dl~ë	PSVROVQKTP	NKR	QNOVNNUKR	UVKQV	RVKR	NOMQ	
pÅ	QR	eO	UPPTOUKMU	MKQ	VQNPSMKUR	UUKRT	RVKR	NOMQ	
pÅ	QR	eÉ	NOPNVRKTS	MKV	NQMPOUKRR	UTKTV	RVKR	NOMQ	
dÉ	TO	kç=dl~ë	VMVUVVKSP	NKN	VUORTUKMV	VOKS	RVKR	NOMQ	
dÉ	TO	eO	PQSTPOKSM	NKM	PVNMQPKOQ	UUKST	RVKR	NOMQ	
dÉ	TO	eÉ	VUMVQKUP	MKS	NNOOOOKSN	UTKPP	RVKR	NOMQ	
v	UV	eO	PVSROSNKQQ	MKT	QPPRROOKON	VNKQS	RVKR	NOMQ	
v	UV	eÉ	SQRNNSKNS	MKU	TQRQNOKMP	USKRQ	RVKR	NOMQ	
qÄ	NRV	kç=dl~ë	SOUMTVQKOS	NKN	SNSROONVKVS	NMNKUT	RVKR	NOMQ	
qÄ	NRV	eÉ	OPUVSNVKMS	NKM	ORRVVQSKO	VPKPR	RVKR	NOMQ	
_á	OMV	kç=dl~ë	PRNNMTRKUP	NKT	PNTNNVSKMP	NNMKTO	RVKR	NOMQ	
_á	OMV	eÉ	NQQPMOVKRU	MKU	NRMOPPVKST	VSKMR	RVKR	NOMQ	

i ~Äçê~íçêó=`çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

p~ã éäÉ=k~ã É	i `pt n`ONfj t O
cáÉ=k~ã É	MTUi `pt kÇ
a~í~=m~íÜ=k~ã É	aWi^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJj ^oyi n` PMi^kÄ
^Åè=qáã É	PLPMLOMOP=OOMRTMU
p~ã éäÉ=qóéÉ	i `pt
qçí~äa äãíáçå	RKMMMM
`çã ã Éáí	JJJ
fpqa=oÉÑcäÉk~ã É	MNO ^i _kÇ
p~ã éäÉ=n` =m~ëëlc á~ä	c~äà
fpqa=n` =m~ëëlc~äà	m~ëë
l éÉê~íçê	**~Çã åà**

n` =^å~äöíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÄK	r åáë	opa	==i mp==	bñés~ä	B=oÉÁ	B i çï	B eáÖÜ	n` =c~ä-Ö
_É	V	S	k ç=dl ~ë	RRKTSN	éëÄ	NKR	RTVPPKRU	RiM	COKP	TViR	NOMiQ	
_	NN	S	k ç=dl ~ë	RPPKTPT	éëÄ	OKN	PRUUTUKPU	RiMM	ONKPR	TViR	NOMiQ	
k~	OP	QR	e É	UPTTKTNQ	éëÄ	NKV	VTPOOSKPN	TRiMM	COKPQ	TViR	NOMiQ	
j Ö	OQ	QR	e É	RQQMKVNQ	éëÄ	NKQ	PNUPMOKST	RiMMM	ONKTS	TViR	NOMiQ	
^ä	OT	QR	e É	OPQQKNMU	éëÄ	MKR	RiMQLUKMQ	OiMMM	OPKQQ	TViR	NOMiQ	a ça
pá	OU	QR	e O	NMUSKMNU	éëÄ	MKS	UQRiMRKNQ	NiMMM	ONKTO	M	OiMM	
h	PV	QR	e É	NMNMNKROT	éëÄ	MKP	RPQQTVKOP	NiMMMM	OMKPU	TViR	NOMiQ	
`~	QM	QR	e O	OTPTKRSV	éëÄ	NKV	NRVTMPSKQV	ORiMM	ONKV	TViR	NOMiQ	
s	RN	UV	e É	RRMKNSV	éëÄ	NKO	QMONSSKVU	RiMM	COKMN	TViR	NOMiQ	
`ê	RO	UV	e É	OOPKURR	éëÄ	MKV	OMMiPNKMP	OiMM	COKPV	TViR	NOMiQ	
j å	RR	UV	e É	RSRKSTU	éëÄ	NKU	ORMUTUKQU	RiMM	COKSP	TViR	NOMiQ	
cÉ	RS	UV	e O	NNOUKOUU	éëÄ	MKQ	OQNTOPOKVR	NiMMM	COKRT	TViR	NOMiQ	
`ç	RV	UV	e É	RUSKMTN	éëÄ	OKM	VNPTNMPV	RiMM	OPKQQ	TViR	NOMiQ	a ça
ká	SM	UV	e É	RUNKMRR	éëÄ	NKT	ORPMUNKNS	RiMM	OPKOQ	TViR	NOMiQ	
`ì	SP	UV	e É	OVMKRPP	éëÄ	NKO	PRNRTMKTM	ORiM	OPKOQ	TViR	NOMiQ	
wå	SS	UV	e É	RSRKNRR	éëÄ	MKT	NNSPPMKPT	RiMM	COKSN	TViR	NOMiQ	
^ë	TR	UV	e É	NMPKOUS	éëÄ	MKU	NSQNNKPS	NiMM	OMKSS	TViR	NOMiQ	
pÉ	TU	UV	e O	NMPKVRV	éëÄ	NKQ	VNQMKRS	NiMM	OMKTV	TViR	NOMiQ	
pê	UU	UV	e É	ROUKPVU	éëÄ	MKU	OUOVTVKPQ	RiMM	ONKNQ	TViR	NOMiQ	
j ç	VR	UV	e É	NMUKPQT	éëÄ	NKO	RSOURKRT	NiMM	ONKST	TViR	NOMiQ	
^Ö	NMT	UV	e É	RPKUQO	éëÄ	NKN	NMOVSUKTV	RiM	ONKRQ	TViR	NOMiQ	
`Ç	NNN	UV	e É	OTOKPVU	éëÄ	MKN	TMQNPKRT	ORiM	ONKTV	TViR	NOMiQ	
på	NNU	NRV	e É	RNNKPOV	éëÄ	NKN	OSQLPOKSQ	RiMM	OMKOR	TViR	NOMiQ	
pÄ	NON	NRV	k ç=dl ~ë	NMMSOM	éëÄ	MKT	QNRSRTKTO	NiMM	OMKNO	TViR	NOMiQ	
_~	NPT	NRV	k ç=dl ~ë	OONTKUVN	éëÄ	OKQ	OTOVVTPKTU	OiMM	COKNU	TViR	NOMiQ	
t	NUO	NRV	k ç=dl ~ë	NNOKMQO	éëÄ	OKN	OTORMSKQU	NiMM	COKQN	TViR	NOMiQ	
qä	OMR	OMV	k ç=dl ~ë	NMPKMTR	éëÄ	NKO	RURNMOKMQ	NiMM	OMKSO	TViR	NOMiQ	
mÄ	OMU	OMV	k ç=dl ~ë	NMRKOOU	éëÄ	MKS	UOOPUSKSV	NiMM	ONKVR	TViR	NOMiQ	
qÜ	OPO	OMV	k ç=dl ~ë	NMOKQVO	éëÄ	MKT	TPMMUSKUR	NiMM	OMKV	TViR	NOMiQ	
r	OPU	OMV	k ç=dl ~ë	NMUKRMM	éëÄ	MKU	TNNMORKUN	NiMM	ONKT	TViR	NOMiQ	

n` =fpqa=q~ÄäÉ

i ~Äçê~íçêó=`çåíêçä=p~ã éäÉ=Ei `pF=oÉéçêí

k ~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=o pa	o ÉÑ= mp	B =o ÉÅ	B n ` =i çï	B n ` =e áÖÜ	n ` =cä~Ö
i á	S	k ç=d ~ë	NTUSRTVKMS	NKU	NTSNRRMKR	NMNKQO	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PTQNQNRKUQ	NKN	QNOVNNUKR	VMKSN	RVKR	NOMKQ	
pÅ	QR	e O	UPMVRSKUP	MKU	VQNPSMKUR	UUKOT	RVKR	NOMKQ	
pÅ	QR	e É	NOONQMKRT	MKT	NQMPOUKRR	UTKMQ	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VNOSPUKRU	MKQ	VUORTUKMV	VOKUU	RVKR	NOMKQ	
d É	TO	e O	PQSPMRKOV	MKR	PVNMQPKOQ	UUKRS	RVKR	NOMKQ	
d É	TO	e É	VTVRQKSR	MKS	NNOOOOKSN	UTKOV	RVKR	NOMKQ	
v	UV	e O	PVPQVVMKTM	MKR	QPPRROOKON	VMKTS	RVKR	NOMKQ	
v	UV	e É	SQUVRUKMR	MKS	TQRQNOKMP	UTKMS	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SPUSUQOKMM	NKO	SNSRONVKVS	NMPKRV	RVKR	NOMKQ	
qÄ	NRV	e É	OPTVPSSKTU	NKQ	ORRVVQSKO	VOKVR	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PQTMQRPKOV	MKQ	PNTNNVSKMP	NMVKQQ	RVKR	NOMKQ	
_á	OMV	e É	NQQNPTTKOR	MKS	NRMOPPVKST	VRKVQ	RVKR	NOMKQ	

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É	pn NMNRJMOQ
cãÉ=k~ã É	MTVpj mi hÇ
a~í~=m~íÜ=k~ã É	aWjt ÖäÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` PMˆhÅ
^Åè=qãã É	PLPMLOMOP=OPAMPMRT
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äa ãã íáçå	RKMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¦ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKVOT	éé Ä	k L^	NRSKST	NMM	
NN	_	S	k ç=d ~ë	OKVRS	éé Ä	SKQ	PNPNKRM	NMMM	
OP	k ~	QR	e É	JNMNKTNO	éé Ä	k L^	QMVOSKTP	OMMMMM	
OQ	j Ö	QR	e É	NPKORM	éé Ä	NPKO	NQRPKQS	OMMMMM	
OT	^ ä	QR	e É	NPKNSM	éé Ä	NPKU	QQLUKVM	OMMMMM	
OU	pá	QR	e O	NTKNVM	éé Ä	NNKU	NUQLUKTQ	NMMMM	
PV	h	QR	e É	JQKVRV	éé Ä	k L^	OTRMUKRM	OMMMMM	
QM	` ~	QR	e O	OQKUQQ	éé Ä	QKP	PNQQRKNS	OMMMMM	
RN	s	UV	e É	MKVPM	éé Ä	TKO	UVPKPT	NMMM	
RO	` ê	UV	e É	MKOOQ	éé Ä	SOKU	NVPRKNU	OMMM	
RR	j å	UV	e É	MKQPU	éé Ä	UKT	OVVKVR	OMMM	
RS	cÉ	UV	e O	NKSUS	éé Ä	PKU	OMTNTKNS	NMMMM	
RV	` ç	UV	e É	MKPTP	éé Ä	OMKO	SUMKMQ	NMMM	
SM	k á	UV	e É	MKRSS	éé Ä	NNKN	PTOKOQ	NMMM	
SP	` ì	UV	e É	MKOVO	éé Ä	NMKM	TNSKTM	OMMM	
SS	wå	UV	e É	NKOOQ	éé Ä	OQKQ	QOPKPR	OMMM	
TR	^ ë	UV	e É	MKNSM	éé Ä	OVKM	QLUKVM	NMMM	
TU	pÉ	UV	e O	MKMSR	éé Ä	PPKU	NVKNT	NMMM	
UU	pê	UV	e É	MKPVR	éé Ä	ONKP	OPSKST	OMMM	
VR	j ç	UV	e É	JMKOPP	éé Ä	k L^	OTPKPQ	NMMM	
NMT	^ Ö	UV	e É	MKMOT	éé Ä	PQKN	NMNKKN	NMM	
NNN	` Ç	UV	e É	MKNPR	éé Ä	NUKP	OPKTM	NMMM	
NNU	på	NRV	e É	MKTNT	éé Ä	OKV	RRMMKMO	NMMM	
NON	pÄ	NRV	k ç=d ~ë	MKMUO	éé Ä	ONKP	TOQKNO	NMMM	
NPT	_~	NRV	k ç=d ~ë	NKSTM	éé Ä	PKP	ONNVKMV	OMMM	
NUO	t	NRV	k ç=d ~ë	JMKNOT	éé Ä	k L^	OMQLUKVV	NMMM	
OMR	qä	OMV	k ç=d ~ë	MKOMO	éé Ä	NMKP	ONMVKMT	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKNPU	éé Ä	NKR	OOTVKNU	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKVPT	éé Ä	NNKV	UPURKMR	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMSM	éé Ä	NTKT	SPTHPS	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤pÉÅ	B n ` =i çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NUNNRSOKNV	MKP	NTSNRRMR	NMOKUQ	RVKR	NOMQ	
pÅ	QR	k ç=d ~ë	PTRPMQPKUV	NKT	QNOVNNUKR	VMKUV	RVKR	NOMQ	
pÅ	QR	e O	UQRQPRKQV	MKU	VQNPSMKUR	UVKTV	RVKR	NOMQ	
pÅ	QR	e É	NOOVMRKNR	MKS	NQMPQUKRR	UTHKU	RVKR	NOMQ	
d É	TO	k ç=d ~ë	VNVVTSKPN	NKM	VUQRTUKMV	VPHSP	RVKR	NOMQ	
d É	TO	e O	PQTPSNKRV	MKQ	PVNMQPKOQ	UUKUP	RVKR	NOMQ	
d É	TO	e É	VUUSVKQV	MKU	NNOOOOKSN	UUHN	RVKR	NOMQ	
v	UV	e O	PVSQSRPKQQ	MKT	QPPRRQOKQN	VNKQR	RVKR	NOMQ	
v	UV	e É	SRRSNOKNR	NKM	TQRQNOKMP	UTKVR	RVKR	NOMQ	
qÄ	NRV	k ç=d ~ë	SPQVPPRKMR	NKM	SNSRONVKVS	NMOKVV	RVKR	NOMQ	
qÄ	NRV	e É	QPVOUVNKTU	MKO	QRRVVQSKO	VPHQT	RVKR	NOMQ	
_á	OMV	k ç=d ~ë	PRMOUUMKMN	MKR	PNTNNVSKMP	NNMQS	RVKR	NOMQ	
_á	OMV	e É	NQPUTTVKTR	MKV	NRMOPPVKST	VRKTT	RVKR	NOMQ	

p~ã éäÉ=k~ã É pn NOMNUMMV

cãÉ=k~ã É MUMpj mi lÇ

a~í~=m~íÜ=k~ã É aWyt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` PM^HÅ

^Åè=qãã É PLPMLOMCP=CPAMVAMR

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RKMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKUM	ééÄ	k L^	NMNKN	NMM	
NN	_	S	k ç=d ~ë	NKSUM	ééÄ	CKS	CCRSKUU	NMMM	
CP	k ~	CR	e É	JVRKMN	ééÄ	k L^	CMTSVKTS	CMMMMM	
CQ	j Ö	CR	e É	NNKVNT	ééÄ	NCKM	NPTRKSU	CMMMMM	
CT	^ ä	CR	e É	NMKVRU	ééÄ	NTHP	CMNKNP	CMMMMM	
CU	pá	CR	e O	UVKRUQ	ééÄ	CKU	TQTVKUQ	NMMMM	
PV	h	CR	e É	MCRQ	ééÄ	CURQKN	OTTUPKTS	CMMMMM	
QM	` ~	CR	e O	TSKPCU	ééÄ	NKV	SNNQNKQU	CMMMMM	
RN	s	UV	e É	MKTTU	ééÄ	CKO	TTMKMP	NMMM	
RO	` ê	UV	e É	MKOMT	ééÄ	NVKN	NMMSKRN	CMMM	
RR	j å	UV	e É	MKCRU	ééÄ	NMKO	PMQKSN	CMMM	
RS	cÉ	UV	e O	NKSVN	ééÄ	CRKR	CMQVCKVS	NMMMMM	
RV	` ç	UV	e É	MKNQS	ééÄ	VKM	PCMKMN	NMMM	
SM	k á	UV	e É	MKQQT	ééÄ	PMKS	PNRKRS	NMMM	
SP	` ì	UV	e É	MKONN	ééÄ	NCKN	SNMKMO	CMMM	
SS	wå	UV	e É	NKOTT	ééÄ	TKT	PUTKTV	CMMM	
TR	^ ë	UV	e É	MKNOT	ééÄ	NMKQ	QCKMM	NMMM	
TU	pÉ	UV	e O	JMKMCU	ééÄ	k L^	NMKUP	NMMM	
UU	pê	UV	e É	MKCQM	ééÄ	UKT	NRNKKN	CMMM	
VR	j ç	UV	e É	JMKPUN	ééÄ	k L^	NVPKPQ	NMMM	
NMT	^ Ö	UV	e É	MKMMV	ééÄ	USKM	SQKCR	NMM	
NNN	` Ç	UV	e É	MKMRR	ééÄ	NPKO	COKRV	NMMM	
NNU	på	NRV	e É	MKPSV	ééÄ	CCKQ	PSSKSU	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	MKMNU	ééÄ	VPKM	QSPKUP	NMMM	
NPT	_~	NRV	k ç=d ~ë	NKCRO	ééÄ	CKN	NURCKMU	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKQVN	ééÄ	k L^	NNTQKSP	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMOO	ééÄ	k L^	UNQKOO	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMRN	ééÄ	CPKM	NRSNKSV	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKOTR	ééÄ	VKM	PSRTKTN	NMMM	
OPU	r	OMV	k ç=d ~ë	MKMMS	ééÄ	NCQKN	CUMKPM	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ= mp	B ¤ ÉÅ	B n` =ï çï	B n` =¤ä ÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	NUMRQRVKPQ	MKU	NTSNRRMR	NVCKQV	RVKR	NCMKQ	
pÅ	QR	k ç=d ~ë	PSVMCTSKTU	MKR	QNCVNNUKR	UVKPT	RVKR	NCMKQ	
pÅ	QR	e O	UPTVPSKVP	NKQ	VQNPSMKUR	UVKMN	RVKR	NCMKQ	
pÅ	QR	e É	NCCVPQKRR	MKS	NQMPCUKRR	UTHS	RVKR	NCMKQ	
d É	TO	k ç=d ~ë	VNVTPNKRQ	MKS	VUCRTUKMV	VPHS	RVKR	NCMKQ	
d É	TO	e O	PQUCVCKVO	NKO	PVNMCPKCQ	UVKMT	RVKR	NCMKQ	
d É	TO	e É	VUMPVKVO	NKN	NNCCCCKSN	UTHPS	RVKR	NCMKQ	
v	UV	e O	PVCMUTMKMT	NKP	QPPRRCCKCN	VMKQQ	RVKR	NCMKQ	
v	UV	e É	SQSPVUKRO	NKM	TQRQNCKMP	USKTO	RVKR	NCMKQ	
qÄ	NRV	k ç=d ~ë	SPQTQTSKVO	NKT	SNSRCNVKVS	NMCKVS	RVKR	NCMKQ	
qÄ	NRV	e É	CPTVUVQKPQ	MKR	CRRVVQSKO	VCKVT	RVKR	NCMKQ	
_á	OMV	k ç=d ~ë	PQPQRSTKTS	MKS	PNTNNVSKMP	NMUKPN	RVKR	NCMKQ	
_á	OMV	e É	NQPMPUPKRS	MKR	NRMCPPVKST	VRKCN	RVKR	NCMKQ	

p~ã éäÉ=k~ã É pn NOMVNUMVNM

cãÉ=k~ã É MUNpj mi lÇ

a~í~=m~íÜ=k~ã É aWjtÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n` PM^HÅ

^Åè=qãã É PLPMLOMCP=CPMNQMP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n` =m~ëëlc á~ä m~ëë

fpqa=n` =m~ëëlc~ãã m~ëë

n` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çàÅK	r åáë	opa	==¹ mp==	i a o	n` =¤ä~Ö
V	_É	S	k ç=d ~ë	JMKUU	ééÄ	k L^	VOKCP	NMM	
NN	_	S	k ç=d ~ë	NKCQR	ééÄ	NMKU	NVSCKPV	NMMM	
CP	k ~	QR	e É	JNMQKRUO	ééÄ	k L^	PVPQMKVP	CMMMMM	
CQ	j Ö	QR	e É	UKTTT	ééÄ	NNNS	NNUMKMV	CMMMMM	
CT	^ ä	QR	e É	NMKSNN	ééÄ	PQKT	PVMKMN	CMMMMM	
CU	pá	QR	e O	NTKMNN	ééÄ	CQKS	NUMUKSV	NMMMM	
PV	h	QR	e É	JNRKMUQ	ééÄ	k L^	OSTRCKQD	CMMMMM	
QM	` ~	QR	e O	CCKTSQ	ééÄ	NKU	OVTUMKPQ	CMMMMM	
RN	s	UV	e É	MKSVT	ééÄ	CKV	TNMKMP	NMMM	
RO	` ê	UV	e É	MKNTR	ééÄ	CSKR	VTRKNU	CMMM	
RR	j å	UV	e É	MKNVR	ééÄ	CRKQ	NUTKVT	CMMM	
RS	cÉ	UV	e O	JMKQMS	ééÄ	k L^	NRVTVKCP	NMMMM	
RV	` ç	UV	e É	MKMSO	ééÄ	NQKR	NUUKVM	NMMM	
SM	k á	UV	e É	MKSMU	ééÄ	TKN	PUQKQS	NMMM	
SP	` ì	UV	e É	NKNPO	ééÄ	VKM	NTNRKSV	CMMM	
SS	wå	UV	e É	NKVRQ	ééÄ	PKR	RCRKRT	CMMM	
TR	^ ë	UV	e É	MKNNV	ééÄ	QMKT	QMKST	NMMM	
TU	pÉ	UV	e O	JMKMTM	ééÄ	k L^	TKNT	NMMM	
UU	pê	UV	e É	MKNMP	ééÄ	NNKN	TTKTU	CMMM	
VR	j ç	UV	e É	JMKQVN	ééÄ	k L^	NPSKST	NMMM	
NMT	^ Ö	UV	e É	JMKMMV	ééÄ	k L^	PNKNN	NMM	
NNN	` Ç	UV	e É	MKMMV	ééÄ	RCKQ	NMKTQ	NMMM	
NNU	på	NRV	e É	MKPCN	ééÄ	CMKU	PQNKNO	NMMM	
NCN	pÄ	NRV	k ç=d ~ë	JMKMNM	ééÄ	k L^	PQTKMQ	NMMM	
NPT	_~	NRV	k ç=d ~ë	MKPCU	ééÄ	CNKU	RMMKRQ	CMMM	
NUO	t	NRV	k ç=d ~ë	JMKRSR	ééÄ	k L^	VVQKQO	NMMM	
OMR	qä	OMV	k ç=d ~ë	JMKMUN	ééÄ	k L^	QTTKNU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	MKMQN	ééÄ	CNKR	NQTQKVP	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	MKNTS	ééÄ	NVKM	OVRSKUN	NMMM	
OPU	r	OMV	k ç=d ~ë	JMKMMT	ééÄ	k L^	NVMKOM	NMMM	

n` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤ ÉÅ	B n` =¨ çï	B n` =¤ äÜÜ	n` =¤ä~Ö
i á	S	k ç=d ~ë	NUMSVNMQR	NKO	NTSNRRMR	NVCKRU	RVKR	NCMQ	
pÅ	QR	k ç=d ~ë	PTNOVTQKSS	MKR	QNOVNNUKR	UVKVO	RVKR	NCMQ	
pÅ	QR	e O	UPCURVKSS	MKO	VQNPSMKUR	UUKQT	RVKR	NCMQ	
pÅ	QR	e É	NONTTUKCU	NKN	NQMPCUKRR	USKTU	RVKR	NCMQ	
d É	TO	k ç=d ~ë	VNOQCVMPQ	MKR	VUCRTUKMV	VCKUS	RVKR	NCMQ	
d É	TO	e O	PQCRQPKCU	NKO	PVNMCPKCQ	UUKNN	RVKR	NCMQ	
d É	TO	e É	VSQSMKST	NKU	NNCCCCKSN	URKVR	RVKR	NCMQ	
v	UV	e O	PVMONVCKMS	MKR	CPPRRCCKCN	VMKMN	RVKR	NCMQ	
v	UV	e É	SQRPCCKUP	NKQ	TQRQNCKMP	USKRU	RVKR	NCMQ	
qÄ	NRV	k ç=d ~ë	SPCPRTTKUO	MKT	SNSRONVKVS	NMCKRT	RVKR	NCMQ	
qÄ	NRV	e É	CPTQURUKSQ	NKP	CRRVVQSKO	VCKTT	RVKR	NCMQ	
_á	OMV	k ç=d ~ë	PQNONNUKVS	NKM	PNTNNVSKMP	NMTKS	RVKR	NCMQ	
_á	OMV	e É	NQPPTUQKQT	NKN	NRMCPPVKST	VRKQQ	RVKR	NCMQ	

p~ã éäÉ=¤ÉéçÃ

p~ã éäÉ=k~ã É	pn NOMNUMNQp
cãÉ=k~ã É	MUQpj mi HÇ
a~í~=m~íÜ=k~ã É	aWjt ÖäÉåíyf mj eyNya^q^yOMCPyMPJ ^oyi n ` PM^HÅ
^Åè=qãã É	PLPMLOMCP=CPAMMVQQO
p~ã éäÉ=qóéÉ	p~ã éäÉ
qçí~äaãã íáçå	RKMMMM
p~ã éäÉ=n ` =m~ëëlc á~ä	m~ëë
fpqa=n ` =m~ëëlc~ãã	m~ëë

n ` =^ å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qì åÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	RRHPSU	ééÄ	PKM	RSMUMKSR	NMM	
NN	_	S	k ç=d ~ë	RRVKQTQ	ééÄ	MKV	PSSUQPKUN	NMMM	
OP	k ~	QR	e É	NNSQRRTPM	ééÄ	OKN	NQUVSQPKMT	OMMMMM	
OQ	j Ö	QR	e É	SPRPKONS	ééÄ	NKU	PRVQSSKQS	OMMMMM	
OT	^ ä	QR	e É	OPNRKOVS	ééÄ	NKR	QUQQRKMU	OMMMMM	
OU	pá	QR	e O	OVOQKMVM	ééÄ	MKS	CQQLUMPKNN	NMMMM	
PV	h	QR	e É	NNNLUMOTQ	ééÄ	NKT	RSQQQQKVU	OMMMMM	
QM	` ~	QR	e O	QNQTHPTS	ééÄ	MKO	OPVMUONKON	OMMMMM	
RN	s	UV	e É	RPRKNSU	ééÄ	MKO	PUMQQLUKQS	NMMM	
RO	` ê	UV	e É	OONKVUP	ééÄ	NKO	NVOUVTHPS	OMMM	
RR	j å	UV	e É	RTRKOQM	ééÄ	NKN	OQLUMVSKUO	OMMM	
RS	cÉ	UV	e O	NVMVKUSV	ééÄ	MKO	QMNLUUQKRU	NMMMM	
RV	` ç	UV	e É	RTNKTVN	ééÄ	MKV	USSVOUKTQ	NMMM	
SM	k á	UV	e É	RTMKRSM	ééÄ	NKO	OQNSTUHST	NMMM	
SP	` ì	UV	e É	OVMKVSM	ééÄ	NKV	PQQPTSHPV	OMMM	
SS	wå	UV	e É	RRTHMTV	ééÄ	NKR	NNNRMUKVQ	OMMM	
TR	^ ë	UV	e É	NNMKNSV	ééÄ	NKN	NTMOOKNP	NMMM	
TU	pÉ	UV	e O	NVUHRUM	ééÄ	MKU	VQMPHPV	NMMM	
UU	pê	UV	e É	RRMMVQO	ééÄ	MKR	OUSQSOKNP	OMMM	
VR	j ç	UV	e É	NNSHMVN	ééÄ	MKP	RURTRHMV	NMMM	
NMT	^ Ö	UV	e É	RPHMVOO	ééÄ	MKV	VUSNOKNU	NMM	
NNN	` Ç	UV	e É	OUPHMVM	ééÄ	NKP	TNNRUKQS	NMMM	
NNU	på	NRV	e É	RPOKTVV	ééÄ	MKV	OSVOMQKRM	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NVSHKNSU	ééÄ	OKP	QQSNTNKPV	NMMM	
NPT	_~	NRV	k ç=d ~ë	ONTRKQUR	ééÄ	MKV	OSMPMNVKNP	OMMM	
NUO	t	NRV	k ç=d ~ë	NNTKVNT	ééÄ	NKM	OTUSTMKRP	NMMM	
OMR	qä	OMV	k ç=d ~ë	NVMVKQT	ééÄ	NKQ	RRURQSKOP	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NNPHSRQ	ééÄ	MKP	USTTRMKON	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NVUKOUQ	ééÄ	MKS	TPTPQPHPV	NMMM	
OPU	r	OMV	k ç=d ~ë	NNOKUUP	ééÄ	MKP	TONMMMST	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qì åÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¹ mp	B¤pÉÅ	B n ` =¡çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NTQONTQKOQ	NKS	NTSNRRVMR	VUKV	RVHR	NOMKQ	
pÅ	QR	k ç=d ~ë	PSTPUVSKRS	MKP	QNOVNNUHR	UUKVU	RVHR	NOMKQ	
pÅ	QR	e O	UOPVSSKUS	NKM	VQNPSMKUR	UTHRP	RVHR	NOMKQ	
pÅ	QR	e É	NNUNTURTM	NKS	NQMPOUKRR	UQKOO	RVHR	NOMKQ	
d É	TO	k ç=d ~ë	UVRVVQKRM	MKP	VUORTUHMV	VNHMV	RVHR	NOMKQ	
d É	TO	e O	PQMUSQKOV	MKU	PVNMOPKOQ	UTHNT	RVHR	NOMKQ	
d É	TO	e É	VRNUTHRP	NKN	NNOOOOKSN	UQKUO	RVHR	NOMKQ	
v	UV	e O	PUTSNMNKOQ	MKO	OPPRROOKON	UVKQ	RVHR	NOMKQ	
v	UV	e É	SPNMTTHRP	MKS	TQRQNOKMP	UQKSS	RVHR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SOMTVSMKOU	NKT	SNSROMVKVS	NMMKSV	RVHR	NOMKQ	
qÄ	NRV	e É	OPONOQSKNT	NKN	ORRVVQSKO	VMKSU	RVHR	NOMKQ	
_á	OMV	k ç=d ~ë	PPUORNRKTO	MKT	PNTNNVSKMP	NMSKSS	RVHR	NOMKQ	
_á	OMV	e É	NPUUOVMKQN	NKP	NRMOPPVKST	VOKQN	RVHR	NOMKQ	

p~ã éäÉ=k~ã É pn NOMNUMNOm

cãÉ=k~ã É MUPpj mi hÇ

a~í~=m~íÜ=k~ã É aWjt ÖãÉåíyf mj eyNya^q^yOMOPyMPJ ^oyi n ` PM^hÅ

^Åè=qãã É PLPMLOMOP=OPWØSMP

p~ã éäÉ=qóéÉ p~ã éäÉ

qçí~äaãã íáçå RMMMM

p~ã éäÉ=n ` =m~ëëlc á~ä m~ëë

fpqa=n ` =m~ëëlc~ãã m~ëë

n ` =^å~äöíÉ=q~ÄäÉ

j ~ëë	k~ã É	fpqa	qìåÉ	` çåÅK	r åáë	opa	==¹ mp==	i a o	n ` =¤ä~Ö
V	_É	S	k ç=d ~ë	QVKVRO	ééÄ	OKS	RONNPKTS	NMM	
NN	_	S	k ç=d ~ë	RPUKQMO	ééÄ	OKO	PSPQOOQKSM	NMMM	
OP	k ~	QR	e É	NNQRRKOMV	ééÄ	NKM	NOUVUVVKOQ	OMMMMM	
OQ	j Ö	QR	e É	SNVVKTQM	ééÄ	NKS	PRSQUSKVV	OMMMMM	
OT	^ä	QR	e É	ONOOQKPUV	ééÄ	NKP	QQVVRKPT	OMMMMM	
OU	pá	QR	e O	OUTRKONR	ééÄ	NKM	OONPPNKNO	NMMMM	
PV	h	QR	e É	NMUPSKNPR	ééÄ	MKP	RRSTOPKOV	OMMMMM	
QM	` ~	QR	e O	QMVPKPRR	ééÄ	MKS	OPSOVPSKPP	OMMMMM	
RN	s	UV	e É	RMMKTNT	ééÄ	NKO	PRTTUSKOQ	NMMM	
RO	` ê	UV	e É	OMSKMVS	ééÄ	OKO	NUMNRNKOP	OMMM	
RR	j å	UV	e É	RPOKVSR	ééÄ	NKQ	OPNMRNKOM	OMMM	
RS	cÉ	UV	e O	NUORKROO	ééÄ	MKS	PUSQOOQSKMV	NMMMM	
RV	` ç	UV	e É	RPSKPPQ	ééÄ	NKR	UNTPRNKRN	NMMM	
SM	k á	UV	e É	RPMKUTM	ééÄ	NKS	OOSMNVKTQ	NMMM	
SP	` ì	UV	e É	OSTKRTO	ééÄ	NKM	PNSRMOKMQ	OMMM	
SS	wå	UV	e É	RNQKTPV	ééÄ	NKR	NMPRTNKTS	OMMM	
TR	^ë	UV	e É	NMRKPTR	ééÄ	MKQ	NSPSRKSP	NMMM	
TU	pÉ	UV	e O	NMRKUUQ	ééÄ	NKT	VOOOKQQ	NMMM	
UU	pê	UV	e É	RPSKQPV	ééÄ	NKN	OUMUMOKNT	OMMM	
VR	j ç	UV	e É	NNNKQRN	ééÄ	MKT	RSRUMKNP	NMMM	
NMT	^Ö	UV	e É	RMKNQO	ééÄ	MKS	VPTPPHPT	NMM	
NNN	` Ç	UV	e É	OTRKSPS	ééÄ	NKQ	SVSQNKVM	NMMM	
NNU	på	NRV	e É	RNPKSUM	ééÄ	NKU	OSNSNPKSV	NMMM	
NON	pÄ	NRV	k ç=d ~ë	NMOKMVU	ééÄ	NKM	QNRTUUKMS	NMMM	
NPT	_~	NRV	k ç=d ~ë	OMPVKQNP	ééÄ	MKU	OQTOSQNKRQ	OMMM	
NUO	t	NRV	k ç=d ~ë	NNPKQUT	ééÄ	MKT	OTNUPSKTN	NMMM	
OMR	qä	OMV	k ç=d ~ë	VUKNOU	ééÄ	NKV	RRMRPNKPQ	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NMVKSNV	ééÄ	NKV	UQUSROKNO	OMMM	
OPO	qÜ	OMV	k ç=d ~ë	NMSKSNU	ééÄ	NKN	TPSOORKPT	NMMM	
OPU	r	OMV	k ç=d ~ë	NMVKTSV	ééÄ	NKV	TNMVMUKVR	NMMM	

n ` =fpqa=q~ÄäÉ

k~ã É	j ~ëë	qìåÉ=j çÇÉ	` mp	` mp=¤pa	oÉÑ¨ mp	B ¤pÉÅ	B n ` =i çï	B n ` =¤ä ÜÜ	n ` =¤ä~Ö
i á	S	k ç=d ~ë	NTVPVOVKTS	PKO	NTSNRRMKR	NMNKUQ	RVKR	NOMKQ	
pÅ	QR	k ç=d ~ë	PSUTRPOKRU	NKS	QNOVNNUKR	UVKPN	RVKR	NOMKQ	
pÅ	QR	e O	UORMPOKVR	MKR	VQNPSMKUR	UTHSQ	RVKR	NOMKQ	
pÅ	QR	e É	NOMMSTKTO	MKR	NQMPOUKRR	URKRS	RVKR	NOMKQ	
d É	TO	k ç=d ~ë	VMSMRTKOV	MKS	VUORTUKMV	VOKON	RVKR	NOMKQ	
d É	TO	e O	PQQOMPKPQ	NKN	PVNMOPKOQ	UUKMO	RVKR	NOMKQ	
d É	TO	e É	VRVSVKUU	NKP	NNOOOOKSN	URKRO	RVKR	NOMKQ	
v	UV	e O	PUVURNMKMM	MKT	OPPRROOKON	UVKVO	RVKR	NOMKQ	
v	UV	e É	SPQPOOKQM	MKR	TQRQNOKMP	URKN	RVKR	NOMKQ	
qÄ	NRV	k ç=d ~ë	SOVMVRQKQR	NKN	SNSRONVKVS	NMOKMO	RVKR	NOMKQ	
qÄ	NRV	e É	OPPVRTRKTS	MKQ	ORRVVQSKO	VNKPV	RVKR	NOMKQ	
_á	OMV	k ç=d ~ë	PQPMPTUKSR	NKU	PNTNNVSKMP	NMUKNT	RVKR	NOMKQ	
_á	OMV	e É	NQMTNUQKOV	NKS	NRMOPPVKST	VPKST	RVKR	NOMKQ	

mêÉé=_ä~åâ=Em_F=oÉéçã

p~ã éäÉ=k~ã É	m_pn` OOfj pN
cáÉ=k~ã É	MUQ| m_KÇ
a~í~=m~íÜ=k~ã É	aWy^ÖäÉáíyf` mj eyNya^q^yOMOPyMPJj ^oyin` PM^kÄ
^Åè=qãã É	PLPMLOMOP=OPVPNMNN
p~ã éäÉ=qóéÉ	m_
qçí~ä=aäíáçå	RKMMMM
` çã ã Éåí	JJJ
fpqa=oÉÑcáÉk~ã É	MNO^i _KÇ
p~ã éäÉ=n` =m~ëëLcá~ä	c~ãä
fpqa=n` =m~ëëLc~ãä	m~ëë
l éÉê~íçê	**~Çã áå**

n` =^å~äóíÉ=q~ÄäÉ

k~ã É	j ~ëë	fpqa	qìåÉ	` çåÅK	r åáë	opa	==` mp==	iáãáí	n` =cä~Ö
_É	V	S	kç=d~ë	JMKVPN	ééÄ	kL^	NRQKQR	MKR	
_	NN	S	kç=d~ë	RKOPM	ééÄ	SKQ	QTOUKSQ	NM	
k~	OP	QR	eÉ	JSTKQRO	ééÄ	kL^	QORMMKPQ	RMM	
jÖ	OQ	QR	eÉ	ONKPUR	ééÄ	UKV	NUTPKRO	RM	
^ä	OT	QR	eÉ	PUKVRV	ééÄ	MKV	VTRKSN	RM	
pá	OU	QR	eO	NSKRON	ééÄ	VKP	NTQNKVQ	ORM	
h	PV	QR	eÉ	QQKRTQ	ééÄ	PQKP	OVMTQKNP	RMM	
`~	QM	QR	eO	QNKPVM	ééÄ	PKU	PVVMPKVQ	RM	
s	RN	UV	eÉ	NKQMQ	ééÄ	PKN	NOMNKNU	OKR	
`ê	RO	UV	eÉ	MKUNS	ééÄ	PKP	NRNPKTV	OKR	
jå	RR	UV	eÉ	NKMVO	ééÄ	VKP	RTOKRT	N	m_=SMOM=c~åë=aça
cÉ	RS	UV	eO	OMKUNO	ééÄ	QKP	SMVTTKTS	RM	
`ç	RV	UV	eÉ	MKTQO	ééÄ	SKR	NOOMKNM	MKR	m_=SMOM=c~åë=aça
ká	SM	UV	eÉ	NKORM	ééÄ	NMKQ	SRMKVP	N	m_=SMOM=c~åë=aça
`ì	SP	UV	eÉ	MKSUS	ééÄ	RKU	NNRTKUQ	NKR	
wå	SS	UV	eÉ	OKSPU	ééÄ	NPKP	SRPKPS	R	
^ë	TR	UV	eÉ	MKPNT	ééÄ	OKT	TMKSU	OKR	
pÉ	TU	UV	eO	MKOUP	ééÄ	NPKR	PUKVM	OKR	
pê	UU	UV	eÉ	MKUNR	ééÄ	VKP	QQUKVM	OKR	
jç	VR	UV	eÉ	MKNNT	ééÄ	OOKS	QQMKVN	OKR	
^Ö	NMT	UV	eÉ	MKVSR	ééÄ	OSKP	NSUKUV	MKR	
`Ç	NNN	UV	eÉ	MKPUM	ééÄ	SKQ	NMQKMT	MKR	
på	NNU	NRV	eÉ	PVKUST	ééÄ	MKV	OMQSRKVP	OKR	m_=SMOM=c~åë=aça & m_=SMOM=c~åë=kçåJaça
pÄ	NON	NRV	kç=d~ë	MKNVQ	ééÄ	SKU	NNUQKSR	MKR	
_~	NPT	NRV	kç=d~ë	PKOOQ	ééÄ	RKV	QMONKRR	N	m_=SMOM=c~åë=aça & m_=SMOM=c~åë=kçåJaça
t	NUO	NRV	kç=d~ë	MKNRP	ééÄ	ONKM	OTNVKUO	OKR	
qä	OMR	OMV	kç=d~ë	MKPRM	ééÄ	NSKT	OVQSKUM	MKR	
mÄ	OMU	OMV	kç=d~ë	MKOQV	ééÄ	OKN	PNQPKQU	MKR	
qÜ	OPO	OMV	kç=d~ë	NKNRO	ééÄ	RKT	VUTQKOU	OKR	
r	OPU	OMV	kç=d~ë	MKNPR	ééÄ	NSKU	NNPNKOS	MKR	

n` =fpqa=q~ÄäÉ

k~ãÉ	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÅ	Bn`=içï	Bn`=eäÖÜ	n`=cä~Ö
iá	S	kç=dl~ë	NUPCPOMRR	NHS	NTSNRRMR	NMQKMO	RVR	NOMQ	
pÅ	QR	kç=dl~ë	PSSSTMPKQS	MHS	QNOVNNUR	UUKU	RVR	NOMQ	
pÅ	QR	eO	UNVRMNRQ	NKN	VQNPSMKUR	UTKVR	RVR	NOMQ	
pÅ	QR	eÉ	NNVNUUKSR	NKN	NQMPOUKRR	UQKVQ	RVR	NOMQ	
dÉ	TO	kç=dl~ë	VMOURVKUM	MKQ	VUORTUKW	VNKUV	RVR	NOMQ	
dÉ	TO	eO	PPUQQQKTR	NKT	PVNMQPKOQ	USKRR	RVR	NOMQ	
dÉ	TO	eÉ	VRPVUKMO	MKV	NNOOOOKSN	URKMN	RVR	NOMQ	
v	UV	eO	PVNUOOUKPR	NKO	QPPRROOKON	VMKPU	RVR	NOMQ	
v	UV	eÉ	SPPMVQKUM	NKN	TQRQNOKMP	UQKVP	RVR	NOMQ	
qÄ	NRV	kç=dl~ë	SPQUVVOKTM	NKR	SNSROMVKVS	NMOKVU	RVR	NOMQ	
qÄ	NRV	eÉ	OPQMMQRKPR	NHS	ORRVVQSKO	VNKQN	RVR	NOMQ	
_á	OMV	kç=dl~ë	PQVNUTPKTS	NKP	PNTNNVSKMP	NNMKN	RVR	NOMQ	
_á	OMV	eÉ	NQNNPVRKSQ	OKQ	NRMOPPVKST	VPKVR	RVR	NOMQ	

i ~ÄçêíçêóÈ çåíêçäæp~ã éäÉÈi `pF¤oÉéçã

p~ã éäÉÈk~ã É	i ` pl n ` OOj pN
cäÉÈk~ã É	MURi ` pl lÇ
a~í~¤m~íÜÈk~ã É	aWf ÖäÉáíyf mj eyNya ^q^ yOMOPyMPuj ^o yi n ` PMf lÄ
^Åè¤qãã É	PLPMLOMOP¤OPWSWMV
p~ã éäÉ¤qóéÉ	i ` pl
qçí~äæäãi íáçå	RKMMMM
` çã ã Éáí	JJJ
fpqa¤oÉÑcäÉk~ã É	MNO ^i _lÇ
p~ã éäÉ¤n ` ¤m~ëëlcá~ä	m~ëë
fpqa¤n ` ¤m~ëëlc~äã	m~ëë
l éÉê~íçê	**~Çã åã**

n ` ¤f å~äöíÉ¤q~ÄäÉ

k~ã É	j ~ëë	fpqa	qì åÉ	` çåÄK	r åáë	opa	¤¤ mp¤¤	bñés~ä	B¤oÉÁ	B i çï	B eáÖÜ	n ` ¤cä-Ö
_É	V	S	k ç¤dl ~ë	QUKTQM	éëÄ	NKQ	QVVNVMRV	RM	NVMR	TVMR	NOMQ	
_	NN	S	k ç¤dl ~ë	QUUKOSR	éëÄ	NKT	POPSMVKUO	RMM	NVMRP	TVMR	NOMQ	
k~	OP	QR	e É	TUTMKONQ	éëÄ	OKM	UVMUVPKRO	TRMM	OMKVV	TVMR	NOMQ	
j Ö	OQ	QR	e É	RNOVKOVN	éëÄ	MKR	OVNQOVKQV	RMMM	OMRO	TVMR	NOMQ	
^ä	OT	QR	e É	OMVTKMVU	éëÄ	MKT	QPUTSKON	OMMM	OMKVT	TVMR	NOMQ	
pá	OU	QR	e O	VQVKTMS	éëÄ	NKQ	TOPTMKRU	NMMM	NUKVV	TVMR	NOMQ	
h	PV	QR	e É	VTSOKPQV	éëÄ	NKM	QVUMRMKU	NMMMM	NVKRO	TVMR	NOMQ	
` ~	QM	QR	e O	ORVPKPOS	éëÄ	NKS	NQUNPQNKUP	ORMM	OMKTR	TVMR	NOMQ	
s	RN	UV	e É	QTUKMNS	éëÄ	NKS	PPUNTVKPV	RMM	NVKNO	TVMR	NOMQ	
` ê	RO	UV	e É	OMOKPMS	éëÄ	MKP	NTRMOOKVR	OMM	OMKOP	TVMR	NOMQ	
j å	RR	UV	e É	RNMKPTU	éëÄ	MKQ	ONVMTPKQR	RMM	OMKQO	TVMR	NOMQ	
cÉ	RS	UV	e O	NVQMKSMS	éëÄ	OKP	ONSQPOSKQN	NMMM	OMKUN	TVMR	NOMQ	
` ç	RV	UV	e É	RNVKVSR	éëÄ	MKU	TUQRQTKSR	RMM	OMKU	TVMR	NOMQ	
ká	SM	UV	e É	RNTKQRQ	éëÄ	NKM	ONUNOSKOM	RMM	OMKT	TVMR	NOMQ	
` ì	SP	UV	e É	OSMKUOS	éëÄ	MKU	PMRQSUKUN	ORM	OMKUT	TVMR	NOMQ	
wå	SS	UV	e É	RMQKOSO	éëÄ	MKR	NMMQSNKQU	RMM	OMKNT	TVMR	NOMQ	
^ë	TR	UV	e É	VUKOVR	éëÄ	NKR	NRNNRKQO	NMM	NVKSS	TVMR	NOMQ	
pÉ	TU	UV	e O	VVKQRQ	éëÄ	NKT	UQURKPQ	NMM	NVKUV	TVMR	NOMQ	
pê	UU	UV	e É	QVUKVOS	éëÄ	NKS	ORURURKUU	RMM	NVKVS	TVMR	NOMQ	
j ç	VR	UV	e É	NMOKUTO	éëÄ	MKP	RNTPRKTN	NMM	OMKRT	TVMR	NOMQ	
^Ö	NMT	UV	e É	QSKSQS	éëÄ	NKR	USPPSKNP	RM	NUKSS	TVMR	NOMQ	
` Ç	NNN	UV	e É	ORTKURU	éëÄ	MKV	SQRMRKPV	ORM	OMKSP	TVMR	NOMQ	
på	NNU	NRV	e É	RNSKUVQ	éëÄ	MKR	OSMOTUKVR	RMM	OMKSU	TVMR	NOMQ	
pÄ	NON	NRV	k ç¤dl ~ë	VQKUUO	éëÄ	MKT	PUQMVTKTQ	NMM	NUKVU	TVMR	NOMQ	
_~	NPT	NRV	k ç¤dl ~ë	OMMVKRTN	éëÄ	OKM	OQOQOQTKRO	OMMM	OMKN	TVMR	NOMQ	
t	NUO	NRV	k ç¤dl ~ë	NMQKVMN	éëÄ	NKM	ORMNUVKOT	NMM	OMKVU	TVMR	NOMQ	
qä	OMR	OMV	k ç¤dl ~ë	VTKPUT	éëÄ	NKQ	RQPSOPKNM	NMM	NVKQU	TVMR	NOMQ	
mÄ	OMU	OMV	k ç¤dl ~ë	VVMKMOQ	éëÄ	NKQ	TSOUSOKOP	NMM	NVKU	TVMR	NOMQ	
qÜ	OPO	OMV	k ç¤dl ~ë	VRKPQR	éëÄ	NKP	SRROMNKVO	NMM	NVKMT	TVMR	NOMQ	
r	OPU	OMV	k ç¤dl ~ë	NMNKUVO	éëÄ	OKM	SRSRMUKVS	NMM	OMKPU	TVMR	NOMQ	

n ` ¤fpqa¤q~ÄäÉ

i ~Äçê~íçêó=çåíêçäæp~ã éäÉ=Ei `pF=oÉéçã

k~ã É	j ~ëë	qìåÉ=j çÇÉ	`mp	`mp=opa	oÉÑ=mp	B=oÉÄ	Bn`=içï	Bn`=eäÜÜ	n`=ä=Ö
iá	S	kç=d~ë	NTSMOVTHPN	NKU	NTSNRRMR	VVKVP	RVR	NOMQ	
pÅ	QR	kç=d~ë	PSQNTMOKVS	NKQ	QNOVNNUR	UUHO	RVR	NOMQ	
pÅ	QR	eO	UNPMSPKMQ	MR	VQNPSMUR	USKPT	RVR	NOMQ	
pÅ	QR	eÉ	NNUSMOKCR	NKP	NQMPOUKRR	UQRRO	RVR	NOMQ	
dÉ	TO	kç=d~ë	UVQTRNKRM	MP	VUCRTUKW	VNKVS	RVR	NOMQ	
dÉ	TO	eO	PPSNOUKTV	MR	PVNMQPKOQ	URKVS	RVR	NOMQ	
dÉ	TO	eÉ	VQUNSKMO	MKQ	NNCCCCKSN	UQKQV	RVR	NOMQ	
v	UV	eO	PUNURQUHSS	NKN	QPPRRCCKON	UUKVU	RVR	NOMQ	
v	UV	eÉ	SOUMNPKVS	MP	TQRQNOKMP	UQKCR	RVR	NOMQ	
qÄ	NRV	kç=d~ë	SCRUPUVKPO	MKN	SNSRONVKVS	NMNKRN	RVR	NOMQ	
qÄ	NRV	eÉ	OPNPPOMPU	OKO	ORRVVQSKO	VMKPT	RVR	NOMQ	
_á	OW	kç=d~ë	PQNOUNNKOQ	NKS	PNTNNVSKMP	NMTHSO	RVR	NOMQ	
_á	OW	eÉ	NPUVOQTKMP	NKV	NRMOPPVKST	VOKQT	RVR	NOMQ	

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^Åè=qãã É PLPMLOMCP=CPWQNWQS

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CP	k ~	QR	e É	RQRKCNR	ééÄ	CKO	NMVRTUHPP	CMMMMM	
CQ	j Ö	QR	e É	RNTVKUPS	ééÄ	NHP	OVVNVQHSS	CMMMMM	
CT	^ ä	QR	e É	NNQJUUKMRP	ééÄ	CKN	CCPRMQLKUV	CMMMMM	
CU	pá	QR	e O	NPSPKQJT	ééÄ	CKR	NMRUSMHSO	NMMMM	
PV	h	QR	e É	PVVVKCSM	ééÄ	MHS	CCPRNTKQV	CMMMMM	
QM	` ~	QR	e O	NSTMKNQN	ééÄ	MKU	VTVTSQKCP	CMMMMM	
RN	s	UV	e É	NNRRTMN	ééÄ	MHP	USMCPKVM	NMMM	
RO	` ê	UV	e É	UPKUTP	ééÄ	MKU	TSSMQKNQ	CMMM	
RR	j å	UV	e É	SUKMRQ	ééÄ	MKQ	PMTPCKCQ	CMMM	
RS	cÉ	UV	e O	CNSURRPSO	ééÄ	NRT	QLUPRMRCMKVM	NMMMMM	
RV	` ç	UV	e É	VKVSM	ééÄ	CKR	NRURSKNV	NMMM	
SM	k á	UV	e É	PQKNTT	ééÄ	NHS	NRCOTHPT	NMMM	
SP	` ì	UV	e É	PQKPSV	ééÄ	MHS	QCRPUKCS	CMMM	
SS	wå	UV	e É	TRKMVS	ééÄ	CKS	NRUMNHPV	CMMM	
TR	^ ë	UV	e É	NMKVCU	ééÄ	CKN	NTUCHSP	NMMM	
TU	pÉ	UV	e O	QKPMM	ééÄ	MKO	QMVKQV	NMMM	
UU	pê	UV	e É	PNKMMM	ééÄ	MKU	NSUTSKNO	CMMM	
VR	j ç	UV	e É	NHSMN	ééÄ	THN	NCPRHSP	NMMM	
NMT	^ Ö	UV	e É	MKQVT	ééÄ	CKO	NMNPHPV	NMM	
NNN	` Ç	UV	e É	MRRRN	ééÄ	NNKV	NRCKVS	NMMM	
NNU	på	NRV	e É	QCKVTQ	ééÄ	PHN	CNURNKCV	NMMM	
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OMR	qä	OMV	k ç=d ~ë	NKUUM	ééÄ	QHR	NNTNQHPU	NMMM	
OMU	mÄ	OMV	k ç=d ~ë	NQQKVOM	ééÄ	MHR	NNQSCMMKMM	CMMM	
OPO	qÜ	OMV	k ç=d ~ë	CCKTCU	ééÄ	CKM	NSNTVTKQT	NMMM	
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i á	S	k ç=d ~ë	NTVRUUCKPR	MHP	NTSNRRMHR	NMNKVR	RVHR	NOMQ	
pÅ	QR	k ç=d ~ë	PTQTSPQKUN	NKV	QNOVNNUHR	VMHTS	RVHR	NOMQ	
pÅ	QR	e O	UPMMNCKSM	MHS	VQNPSMKUR	UUKNT	RVHR	NOMQ	
pÅ	QR	e É	NOMRUMHPV	MKV	NQMPCUKRR	URKVP	RVHR	NOMQ	
d É	TO	k ç=d ~ë	UVVSMPKRS	MHR	VUCRTUKMV	VNHRS	RVHR	NOMQ	
d É	TO	e O	PPTQQMKMQ	MKU	PVNMCPKCQ	USKCV	RVHR	NOMQ	
d É	TO	e É	VQRCSKSQ	MKV	NNCCCCKSN	UQKCP	RVHR	NOMQ	
v	UV	e O	QNCCSURKTU	MHP	CPPRRCCKCN	VRHMV	RVHR	NOMQ	
v	UV	e É	SRUTTMKQR	MKT	TQRQNCKMP	UUHPU	RVHR	NOMQ	
qÄ	NRV	k ç=d ~ë	SCQTPVUKQQ	NHS	SNSRCNVKVS	NMNHPP	RVHR	NOMQ	
qÄ	NRV	e É	CPNVCSPKMN	MHS	CRRVVQSKO	VMHS	RVHR	NOMQ	
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NN	_	S	k ç=d ~ë	ORKVCQ	ééÄ	PKM	VOSMQKPR	CR	NMPKT	UVKU	NNMO	
OP	k ~	CR	e É	RRMQKNMV	ééÄ	MKQ	PMVVUQUKRQ	RMMM	NNMKU	UVKU	NNMO	
OQ	j Ö	CR	e É	RSMNKTRP	ééÄ	MKR	NSCRVTMKNR	RMMM	NNOKMQ	UVKU	NNMO	[=HLJ-NMB
OT	^ä	CR	e É	RTUKMRS	ééÄ	NKT	SCRVTKUQ	RMM	NNRKGN	UVKU	NNMO	[=HLJ-NMB
OU	pá	CR	e O	RPMKNQO	ééÄ	NKR	OMUCSMKPN	RMM	NMSKMP	UVKU	NNMO	
PV	h	CR	e É	RPMPKOSM	ééÄ	NKP	NPRQCPMKSV	RMMM	NMSKMT	UVKU	NNMO	
QM	` ~	CR	e O	RPPQKPQO	ééÄ	NKR	NRSNVMQVKQV	RMMM	NMSKGV	UVKU	NNMO	
RN	s	UV	e É	OSKMRV	ééÄ	MKR	VQUQSKNR	CR	NMQKOQ	UVKU	NNMO	
RO	` ê	UV	e É	OSKNRO	ééÄ	OKO	NNSQVNKON	CR	NMQKSN	UVKU	NNMO	
RR	j å	UV	e É	OSKQTV	ééÄ	NKV	RUCRQKOQ	CR	NMRKVO	UVKU	NNMO	
RS	cÉ	UV	e O	ROTQKPRN	ééÄ	MKV	RSCSOTPSKNT	RMMM	NMRKQV	UVKU	NNMO	
RV	` ç	UV	e É	OSKPVN	ééÄ	MKV	OMQSMVKCR	CR	NMRKRS	UVKU	NNMO	
SM	k á	UV	e É	OSKSSP	ééÄ	NKO	RTUCMRQ	CR	NMSKSR	UVKU	NNMO	
SP	` ì	UV	e É	OSKRVM	ééÄ	NKM	NSMNPMKCU	CR	NMSKPS	UVKU	NNMO	
SS	wå	UV	e É	OTKMNQ	ééÄ	NKP	OTTPQKQV	CR	NMUKMS	UVKU	NNMO	
TR	^ë	UV	e É	ORKSUM	ééÄ	NKS	OMOTRKUN	CR	NMOKTO	UVKU	NNMO	
TU	pÉ	UV	e O	OSKMNO	ééÄ	MKS	NNQSNKRM	CR	NMQKMR	UVKU	NNMO	
UU	pê	UV	e É	OSKMUQ	ééÄ	MKQ	SVQRTHPO	CR	NMQKPQ	UVKU	NNMO	
VR	j ç	UV	e É	OSKOOS	ééÄ	MKT	STSQRKVQ	CR	NMQKV	UVKU	NNMO	
NMT	^Ö	UV	e É	OSKUQN	ééÄ	NKQ	ORRNNSKCP	CR	NMTHPS	UVKU	NNMO	
NNN	` Ç	UV	e É	OSKRSQ	ééÄ	OKO	PQNPUKTQ	CR	NMSKOS	UVKU	NNMO	
NNU	på	NRV	e É	ORKRSO	ééÄ	OKN	SRUVVHRN	CR	NMOKCR	UVKU	NNMO	
NON	pÄ	NRV	k ç=d ~ë	ORKPSM	ééÄ	MKU	RNUQMOKON	CR	NMNKQQ	UVKU	NNMO	
NPT	_~	NRV	k ç=d ~ë	ORKVNV	ééÄ	MKQ	NRUMMMSS	CR	NMPKGU	UVKU	NNMO	
NUO	t	NRV	k ç=d ~ë	OSKTUQ	ééÄ	NKP	POOMMTKMT	CR	NMTKNQ	UVKU	NNMO	
OMR	qä	OMV	k ç=d ~ë	ORKTOM	ééÄ	NKO	TPMRTQKCQ	CR	NMOKUU	UVKU	NNMO	
OMU	mÄ	OMV	k ç=d ~ë	ORKVCP	ééÄ	MKS	NMNSPOMSO	CR	NMPKSV	UVKU	NNMO	
OPO	qÜ	OMV	k ç=d ~ë	OSKSNM	ééÄ	NKQ	VPMNRVKQR	CR	NMSKQQ	UVKU	NNMO	
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pÅ	CR	k ç=d ~ë	PTNUONPKUS	MKU	QNOVNNUKR	VMKMR	RVKR	NOMQ	
pÅ	CR	e O	UQNUVOKNQ	MKO	VQNPSMKUR	UVKQP	RVKR	NOMQ	
pÅ	CR	e É	NOOUVPKUT	MKP	NQMPOUKRR	UTHRU	RVKR	NOMQ	
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d É	TO	e O	PRORNSKVS	MKS	PVNMOPKCQ	VMKNR	RVKR	NOMQ	
d É	TO	e É	VTQMUKNU	NKR	NNOCCOKSN	USKU	RVKR	NOMQ	
v	UV	e O	PVQRMUTKQM	MKO	QPPRROOKON	VMKVV	RVKR	NOMQ	
v	UV	e É	SQRNTVKTU	NKO	TQRQNOKMP	USKRR	RVKR	NOMQ	
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_á	OMV	k ç=d ~ë	PQTQOMVKPQ	NKN	PNTNNVSKMP	NMVKRS	RVKR	NOMQ	
_á	OMV	e É	NQMNURRKNQ	OKP	NRMOPPVKST	VPHPN	RVKR	NOMQ	

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CP	k~	QR	eÉ	JCMKPMT	éé Ä	kL^	QMCQMKVR	CMM	
CQ	j Ö	QR	eÉ	RKRQR	éé Ä	CKU	CPNRKUP	CM	
CT	^ä	QR	eÉ	TKTMM	éé Ä	NCKP	NMMNKNS	CM	
CU	pá	QR	eO	MKTPR	éé Ä	SKU	TVQKNV	NMM	
PV	h	QR	eÉ	MKNVQ	éé Ä	NQCSKM	OTVQCKTR	CMM	
QM	`~	QR	eO	RKGRT	éé Ä	RKR	PPTVVKSN	CM	
RN	s	UV	eÉ	MKMSV	éé Ä	NPKT	QRUKVM	N	
RO	`ê	UV	eÉ	MKMNR	éé Ä	NVQKS	UVRKNV	N	
RR	j å	UV	eÉ	MKMSU	éé Ä	NKU	QRRKCU	MQ	
RS	cÉ	UV	eO	SKOTS	éé Ä	CKR	UQLUSQKNN	CM	
RV	`ç	UV	eÉ	MKMPV	éé Ä	NTKQ	QMCKCR	MO	
SM	k á	UV	eÉ	MKMRM	éé Ä	QKR	CPCKCP	MQ	
SP	`ì	UV	eÉ	MKMQO	éé Ä	NPKU	SNMKMO	MS	
SS	wå	UV	eÉ	MKNTV	éé Ä	MKT	PNCKCP	O	
TR	^ë	UV	eÉ	MKMPS	éé Ä	PTKU	RMKST	N	
TU	pÉ	UV	eO	MKMQO	éé Ä	NRKS	POKNT	N	
UU	pê	UV	eÉ	MKMQR	éé Ä	NVKU	NQPKPQ	N	
VR	j ç	UV	eÉ	MKMCP	éé Ä	RVKN	QRNKNP	N	
NMT	^Ö	UV	eÉ	MKMNV	éé Ä	UKR	CPPKPQ	MO	
NNN	`Ç	UV	eÉ	MKMOQ	éé Ä	OVKQ	QMKMM	MO	
NNU	på	NRV	eÉ	MKNMQ	éé Ä	NMKQ	QQTKTV	N	
NON	pÄ	NRV	kç=d~ë	MKMCU	éé Ä	PKV	VSTKTP	MO	
NPT	_~	NRV	kç=d~ë	MKNNS	éé Ä	NRKO	TVMKUT	MQ	
NUO	t	NRV	kç=d~ë	MKMSS	éé Ä	ONKQ	PNTPKTQ	N	
OMR	qä	OMV	kç=d~ë	MKMQS	éé Ä	NPKR	CCOVKOO	MO	
OMU	mÄ	OMV	kç=d~ë	MKMQV	éé Ä	NOKQ	PMTMKMS	MO	
OPO	qÜ	OMV	kç=d~ë	MKMTT	éé Ä	NNKM	QQSOKNT	N	
OPU	r	OMV	kç=d~ë	MKMPM	éé Ä	QKO	NONQKSU	MO	

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pÅ	QR	kç=d~ë	PTSOUNQKQM	NKS	QNOVNNUR	VNKNP	RVMR	NOMQ	
pÅ	QR	eO	URPVMTKQM	NKS	VQNPSMKUR	VMRTN	RVMR	NOMQ	
pÅ	QR	eÉ	NOPRONRTM	MKV	NQMPOUKRR	UUMVO	RVMR	NOMQ	
dÉ	TO	kç=d~ë	VNVMSOKCP	MKQ	VUCRTUKMV	VPHRQ	RVMR	NOMQ	
dÉ	TO	eO	PRSQVSKMU	MKR	PVNMOPKOQ	VNKNT	RVMR	NOMQ	
dÉ	TO	eÉ	VUPSNKRN	NKP	NNOCOOKSN	UTHSR	RVMR	NOMQ	
v	UV	eO	PVUURVQKNV	NKO	QPPRROOKCN	VO	RVMR	NOMQ	
v	UV	eÉ	SRNNMPKRS	NKN	TQRQNOKMP	UTHPR	RVMR	NOMQ	
qÄ	NRV	kç=d~ë	SQNVUVUKSQ	NKR	SNSRONVKVS	NMQKNP	RVMR	NOMQ	
qÄ	NRV	eÉ	OPVTNQMKMU	MKR	ORRVVQSKO	VPHSQ	RVMR	NOMQ	
_á	OMV	kç=d~ë	PQSMVRVKTU	MKT	PNTNNVSKMP	NMVKNQ	RVMR	NOMQ	
_á	OMV	eÉ	NQPPRUMKMS	MKV	NRMOPPVKST	VRHQO	RVMR	NOMQ	

Logbooks and Supporting Documents

Katahdin Analytical Services, Inc.

Reagents and Consumables Information:

Metals Preparation Benchsheet

Method: 3010

HNO3: MSR 309 HCL: MSR 303 Digestion Vessels: MD 0260000205

1:1 HNO3: MR 3561 1:1 HCL: MR 3544

Pipet **LCS/Spiking Information:**

M33 CLPP-SPK-1 (ID/Vol): MS 2349 / 0.05 mL

M35 CLPP-SPK-INT1 (ID/Vol): MW 21391 / 0.5 mL

M35 CLPP-SPK-INT2 (ID/Vol): MW 21392 / 0.5 mL

— Spike (ID/Vol): — / — mL

Heat Source ID: B

Start Time: 1024 /Temp. 94 °C

End Time: ~~1617~~ /Temp. 96 °C

Thermometer ID/Pos: ALC25 / 1,5

BCF 3-16-23 17:11

Sample ID	Batch ID	Initial Wt/Vol	Initial Units	Final Vol	Final Units	MX	Meth	Anal.	Date	Bottle	pH <2
LCSWQC16ICW1	QC16ICW1	0.05	L	0.05	L	AQ	IC	BCF	03/16/2023	—	—
PBWQC16ICW1	QC16ICW1		L		L	AQ	IC	BCF	03/16/2023	—	—
SQ1201-001	QC16ICW1		L		L	AQ	IC	BCF	03/16/2023	C	✓
SQ1201-002	QC16ICW1		L		L	AQ	IC	BCF	03/16/2023	I	
SQ1201-002P	QC16ICW1		L		L	AQ	IC	BCF	03/16/2023		
SQ1201-002S	QC16ICW1		L		L	AQ	IC	BCF	03/16/2023		
SQ1201-003	QC16ICW1		L		L	AQ	IC	BCF	03/16/2023	C	
SQ1201-004	QC16ICW1		L		L	AQ	IC	BCF	03/16/2023		
SQ1201-005	QC16ICW1		L		L	AQ	IC	BCF	03/16/2023		
SQ1201-006	QC16ICW1		L		L	AQ	IC	BCF	03/16/2023		
SQ1201-007	QC16ICW1		L		L	AQ	IC	BCF	03/16/2023		
SQ1201-008	QC16ICW1		L		L	AQ	IC	BCF	03/16/2023	E	

REVIEWED

3/31/23

KATAHDIN ANALYTICAL METALS SECTION

Digestion performed by: BCF / KS On: 3-16-23

Katahdin Analytical Services, Inc.

Reagents and Consumables Information:

Metals Preparation Benchsheet

Method: 3010-MS

HNO3: MS2309 HCL: MS2303 Digestion Vessels: MLD0260000208

1:1 HNO3: M23561 1:1 HCL: M23564

Pipet	LCS/Spiking Information:
M33	CLPP-SPK-1 (ID/Vol): MS2349 / 0.05 mL
M35	CLPP-SPK-INT1 (ID/Vol): ~~MW21426~~ 340 / 0.5 mL MW21431
M35	CLPP-SPK-INT2 (ID/Vol): ~~MW21434~~ 344 / 0.5 mL MW21430
-	- Spike (ID/Vol): - / - mL

Heat Source ID: A

Start Time: 1002 /Temp. 90 °C

End Time: 1729 /Temp. 92 °C

Thermometer ID/Pos: AIC 30 / 3.8

Sample ID	Batch ID	Initial Wt/Vol	Initial Units	Final Vol	Final Units	MX	Meth	Anal.	Date	Bottle	pH <2
LCSWQC21IMW2	QC21IMW2	0.05	L	0.05	L	AQ	IM	CD	03/21/2023	-	✓
PBWQC21IMW2	QC21IMW2		L		L	AQ	IM	CD	03/21/2023	-	
SQ1015-024	QC21IMW2		L		L	AQ	IM	CD	03/21/2023	A	
SQ1201-009	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1201-010	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1201-011	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1201-012	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1201-012P	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1201-012S	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1201-013	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1201-014	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1201-015	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1201-016	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1201-017	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1201-018	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1312-001	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1312-002	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1312-003	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1312-004	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1312-005	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1312-006	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		
SQ1312-007	QC21IMW2		L		L	AQ	IM	CD	03/21/2023		

REVIEWED

[signature] 032223

KATAHDIN ANALYTICAL METALS SECTION

QA-064-Revision 5 -12/07/2018 Digestion performed by: CD On: 3-21-23 Page: QC094 Revision: 00

CONVENTIONAL AND PHYSICAL ANALYTICAL DATA

QC Summary Section

Katahdin
ANALYTICAL SERVICES

Quality Control Report

Blank Sample Summary Report

Alkalinity

QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	Units	LOQ	MDL	LOD
WG334311	STDM 2320B	24-MAR-23	N/A	J2.4	mg/L	5.0	0.23	4.0

Chloride

QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	Units	LOQ	MDL	LOD
WG334130	EPA 300.0	20-MAR-23	N/A	U1.0	mg/L	2.0	0.099	1.0

Sulfate

QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	Units	LOQ	MDL	LOD
WG334130	EPA 300.0	20-MAR-23	N/A	U0.50	mg/L	1.0	0.064	0.50

Katahdin
ANALYTICAL SERVICES

Cert No E87604

Quality Control Report

Laboratory Control Sample Summary Report

Alkalinity

Laboratory Sample ID	Sample Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amount	Result	Recovery (%)	Acceptance Range	RPD
WG334311-2	LCS	WG334311	24-MAR-23	N/A	mg/L	120	130	106	85-115	
WG334311-3	LCSD	WG334311	24-MAR-23	N/A	mg/L	120	130	106	85-115	0

Chloride

Laboratory Sample ID	Sample Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amount	Result	Recovery (%)	Acceptance Range	RPD
WG334130-2	LCS	WG334130	20-MAR-23	N/A	mg/L	3.75	3.74	99.7	90-110	

Sulfate

Laboratory Sample ID	Sample Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amount	Result	Recovery (%)	Acceptance Range	RPD
WG334130-2	LCS	WG334130	20-MAR-23	N/A	mg/L	3.75	3.68	98.1	90-110	

Katahdin
ANALYTICAL SERVICES

Cert No E87604

Quality Control Report

Matrix Spike Sample Summary Report

Chloride

Matrix Spike Sample ID	Sample Type	Original Sample ID	QC Batch	Analysis Date	Units	Spike Amount	Sample Result	MS Result	Recovery (%)	Acceptance Range	RPD
WG334130-3	MS	SQ1201-2	WG334130	20-MAR-23	mg/L	3.947368421	3.6	7.7	102	90 - 110	
WG334130-4	MSD	SQ1201-2	WG334130	20-MAR-23	mg/L	3.947368421	3.6	7.8	105	90 - 110	1

Sulfate

Matrix Spike Sample ID	Sample Type	Original Sample ID	QC Batch	Analysis Date	Units	Spike Amount	Sample Result	MS Result	Recovery (%)	Acceptance Range	RPD
WG334130-3	MS	SQ1201-2	WG334130	20-MAR-23	mg/L	3.947368421	J 0.67	4.6	100	90 - 110	
WG334130-4	MSD	SQ1201-2	WG334130	20-MAR-23	mg/L	3.947368421	J 0.67	4.7	102	90 - 110	2

Sample Data Section

KATAHDIN ANALYTICAL SERVICES – INORGANIC DATA QUALIFIERS

The sampled date indicated on the attached Report(s) of Analysis (ROA) is the date for which a grab sample was collected or the date for which a composite sample was completed. Beginning and start times for composite samples can be found on the Chain-of-Custody.

U Indicates the compound was analyzed for but not detected above the specified level. This level may be the Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client.

Note: All results reported as "U" MDL have a 50% rate for false negatives compared to those results reported as "U" PQL "U" LOQ or "U" LOD, where the rate of false negatives is <1%.

E Estimated value. This flag identifies compounds whose concentrations exceed the upper level of the calibration range of the instrument for that specific analysis.

J Estimated value. The analyte was detected in the sample at a concentration less than the laboratory Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), but above the Method Detection Limit (MDL).

I-7 The laboratory's Practical Quantitation Level (PQL) or LOQ could not be achieved for this parameter due to sample composition, matrix effects, sample volume, or quantity used for analysis.

A-4 Please refer to cover letter or narrative for further information.

H_ Please note that the regulatory holding time for _____ is "analyze immediately". Ideally, this analysis must be performed in the field at the time of sample collection. _____ for this sample was not performed at the time of sample collection. The analysis was performed as soon as possible after receipt by the laboratory.

H1 - pH H2 - DO H3 - sulfite H4 - residual chlorine

T1 The client did not provide the full volume of at least one liter for analysis of TSS. Therefore, the PQL of 2.5 mg/L could not be achieved.

T2 The client provided the required volume of at least one liter for analysis of TSS, but the laboratory could not filter the full one liter volume due to the sample matrix. Therefore, the PQL of 2.5 mg/L could not be achieved.

M1 The matrix spike and/or matrix spike duplicate recovery performed on this sample was outside of the laboratory acceptance criteria. Sample matrix is suspected. The laboratory criteria was met for the Laboratory Control Sample (LCS) analyzed concurrently with this sample.

M2 The matrix spike and/or matrix spike duplicate recovery was outside of the laboratory acceptance criteria. The native sample concentration is greater than four times the spike added concentration so the spike added could not be distinguished from the native sample concentration.

R1 The relative percent difference (RPD) between the duplicate analyses performed on this sample was outside of the laboratory acceptance criteria (when both values are greater than ten times the PQL).

MCL	Maximum Contaminant Level	NL	No limit
NFL	No Free Liquid Present	FLP	Free Liquid Present
NOD	No Odor Detected	TON	Threshold Odor Number

D-1 As required by Method 5210B, APHA Standard Methods for the Examination of Water and Wastewater (21st edition), the BOD value reported for this sample is 'qualified' because the check standard run concurrently with the sample analysis did not meet the criteria specified in the method (198 +/- 30.5 mg/L). These results may not be reportable for compliance purposes.

D-2 The measured final dissolved oxygen concentrations of all dilutions were less than the method-specified limit of 1 mg/L. The reported BOD result was calculated assuming a final oxygen concentration equal to 1 mg/L. The reported value should be considered a minimum value.

D-3 The dilution water used to prepare this sample did not meet the method and/or regulatory criteria of less than 0.2 or 0.4 mg/L dissolved oxygen (DO) uptake over the five day period of incubation. These results may not be reportable for compliance purposes.

Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

Lab Sample ID: SQ1201-1
Client ID: SWDUP
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 00:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	3.6 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 17:28	N/A	N/A	
Sulfate	J0.64 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 17:28	N/A	N/A	

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Report of Analytical Results

Lab Sample ID: SQ1201-2
Client ID: JACKSON-SWMC3-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 14:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	3.6 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 17:46	N/A	N/A	
Sulfate	J0.67 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 17:46	N/A	N/A	

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Report of Analytical Results

Lab Sample ID: SQ1201-3
Client ID: JACKSON-SWMC2-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 11:30	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	4.3 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 18:37	N/A	N/A	
Sulfate	J0.78 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 18:37	N/A	N/A	

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Report of Analytical Results

Lab Sample ID: SQ1201-4
Client ID: JACKSON-SWJC1-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 13:30	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	2.3 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 18:55	N/A	N/A	
Sulfate	J0.15 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 18:55	N/A	N/A	

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ANALYTICAL SERVICES

Report of Analytical Results

Lab Sample ID: SQ1201-5
Client ID: JACKSON-SWMC1-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 11:50	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	2.2 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 19:12	N/A	N/A	
Sulfate	J0.64 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 19:12	N/A	N/A	

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Report of Analytical Results

Lab Sample ID: SQ1201-6
Client ID: JACKSON-SWCC3-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 14:15	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	2.0 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 19:29	N/A	N/A	
Sulfate	J0.60 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 19:29	N/A	N/A	

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Report of Analytical Results

Lab Sample ID: SQ1201-7
Client ID: JACKSON-SWCC4-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 09:40	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Chloride	J2.0 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 19:46	N/A	N/A	
Sulfate	J0.94 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 19:46	N/A	N/A	

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Report of Analytical Results

Lab Sample ID: SQ1201-8
Client ID: JACKSON-SWCC2-DC-01
SDG: SQ1201
Report Date: 29-MAR-23

Matrix	Date Sampled	Date Received
AQ	08-MAR-23 10:00	10-MAR-23

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Alkalinity	U4.0 mg/L	5.0	0.23	4.0	STDM 2320B	WG334311	24-MAR-23 11:28	N/A	N/A	
Chloride	2.7 mg/L	2.0	0.099	1.0	EPA 300.0	WG334130	20-MAR-23 20:38	N/A	N/A	
Sulfate	1.5 mg/L	1.0	0.064	0.50	EPA 300.0	WG334130	20-MAR-23 20:38	N/A	N/A	

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Raw Data Section

WET CHEMISTRY BATCH REPORT
Mar 28 2023, 11:26 am
Batch: WG334311 Run ID 1: R611930 Run ID 2: NONE

Parameter: Alkalinity

Date Analyzed: 24-MAR-23

Analyst Initials: CJB

Prep Date: N/A

Prep Method: N/A

Prep Chemist: N/A

Sample	Samp Type	Method	Initial Amt.	Final Amt.	Rpt. DF	Result	Rpt Result	TS(%)	PQL	MDL	Adj PQL	RPD	%Rec
SQ1201-8	SAMP	STDM 2320B	50.0mL	50.0mL	1	0	U4.0 mg/L	NA	5	0.23	5.0		
SQ1294-2	SAMP	STDM 2320B	50.0mL	50.0mL	1	18.931	19. mg/L	NA	5	0.23	5.0		
SQ1339-2	SAMP	STDM 2320B	50.0mL	50.0mL	1	63.829	64. mg/L	NA	5	0.23	5.0		
SQ1339-4	SAMP	STDM 2320B	50.0mL	50.0mL	1	383.366	380 mg/L	NA	5	0.23	5.0		
WG334311-1	MBLANK	STDM 2320B	50.0mL	50.0mL	1	2.391	J2.4 mg/L	NA	5	0.23	5.0		
WG334311-2	LCS	STDM 2320B	50.0mL	50.0mL	1	127.02	130 mg/L	NA	5	0.23	5.0		106
WG334311-3	LCSD	STDM 2320B	50.0mL	50.0mL	1	126.957	130 mg/L	NA	5	0.23	5.0	0	106
WG334311-4	MS	STDM 2320B	50.0mL	50.0mL	1	130.738	130 mg/L	NA	5	0.23	5.0		95
WG334311-5	MSD	STDM 2320B	50.0mL	50.0mL	1	134.693	130 mg/L	NA	5	0.23	5.0	3	98

Comments:

SQ1294-2	MS/MSD
WG334311-1	SQ1201-8
WG334311-2	SQ1201-8
WG334311-3	SQ1201-8
WG334311-4	SQ1294-2
WG334311-5	SQ1294-2

Entered by: CJB Date: 3-28-23 Accepted by: SS Date: 3/29/23

Katahdin Analytical Services SQ1201 Page 1065 of 1130

WET CHEMISTRY BATCH REPORT
Mar 28 2023, 11:26 am
Batch: WG334312 Run ID 1: R611931 Run ID 2: NONE

Parameter: Bicarbonate (As CaCO3)

Date Analyzed: 24-MAR-23

Analyst Initials: CJB

Prep Date: N/A

Prep Method: N/A

Prep Chemist: N/A

Sample	Samp Type	Method	Initial Amt.	Final Amt.	Rpt. DF	Result	Rpt Result	TS(%)	PQL	MDL	Adj PQL	RPD	%Rec
SQ1294-2	SAMP	SM4500CO2 D	50.000mL	50.000mL	1	18.93032	19. mg/L	NA	5	0.50	5.0		
SQ1339-2	SAMP	SM4500CO2 D	50.000mL	50.000mL	1	63.82335	64. mg/L	NA	5	0.50	5.0		
SQ1339-4	SAMP	SM4500CO2 D	50.000mL	50.000mL	1	380.13674	380 mg/L	NA	5	0.50	5.0		
WG334312-1	MBLANK	SM4500CO2 D	50.000mL	50.000mL	1	2.39071	U5.0 mg/L	NA	5	0.50	5.0		

Comments:

SQ1294-2 MS/MSD
WG334312-1 SQ1294-2

Entered by: CJB Date: 3-28-23 Accepted by: SS Date: 3/29/23

WET CHEMISTRY BATCH REPORT
Mar 28 2023, 11:26 am
Batch: WG334313 Run ID 1: R611932 Run ID 2: NONE

Parameter: Carbonate (As CaCO3)

Prep Date: N/A

Date Analyzed: 24-MAR-23

Prep Method: N/A

Analyst Initials: CJB

Prep Chemist: N/A

Sample	Samp Type	Method	Initial Amt.	Final Amt.	Rpt. DF	Result	Rpt Result	TS(%)	PQL	MDL	Adj PQL	RPD	%Rec
SQ1294-2	SAMP	SM4500CO2 D	50.000mL	50.000mL	1	.00053	U5.0 mg/L	NA	5	0.50	5.0		
SQ1339-2	SAMP	SM4500CO2 D	50.000mL	50.000mL	1	.00521	U5.0 mg/L	NA	5	0.50	5.0		
SQ1339-4	SAMP	SM4500CO2 D	50.000mL	50.000mL	1	3.18469	U5.0 mg/L	NA	5	0.50	5.0		
WG334313-1	MBLANK	SM4500CO2 D	50.000mL	50.000mL	1	.00009	U5.0 mg/L	NA	5	0.50	5.0		

Comments:

SQ1294-2	MS/MSD
WG334313-1	SQ1294-2

Entered by: CJB Date: 3-28-23 Accepted by: SS Date: 3/29/23

Start time: 3/24/2023 11:08

Results

No.	Comment / ID	Start time	Rx	Result	Unit	Name
1/4	CCV	3/24/2023 11:09:22 AM	R1 =	8.827	mg/L	P Alkalinity- pH8.2
	98.5%		R2 =	123.105	mg/L	Total Alkalinity
			R3 =	8.741	pH	pH
			R4 =	19.9	oC	TEMPERATURE
2/4	CCB	3/24/2023 11:12:30 AM	R1 =	0	mg/L	P Alkalinity- pH8.2
			R2 =	2.391	mg/L	Total Alkalinity
			R3 =	5.607	pH	pH
			R4 =	20.8	oC	TEMPERATURE
3/4	LCS	3/24/2023 11:14:23 AM	R1 =	72.79	mg/L	P Alkalinity- pH8.2
	105.9%		R2 =	127.02	mg/L	Total Alkalinity
			R3 =	10.645	pH	pH
			R4 =	20.7	oC	TEMPERATURE
4/4	LCSD	3/24/2023 11:17:32 AM	R1 =	69.813	mg/L	P Alkalinity- pH8.2
	108.3%		R2 =	126.957	mg/L	Total Alkalinity
			R3 =	10.633	pH	pH
			R4 =	21	oC	TEMPERATURE

Start time: 3/24/2023 11:26

Results

No.	Comment / ID	Start time	Rx	Result	Unit	Name
1/8	SQ1201-8	3/24/2023 11:28:15 AM	R1 =	0	mg/L	P Alkalinity- pH8.2
			R2 =	NaN	mg/L	Total Alkalinity
			R3 =	4.422	pH	pH
			R4 =	11.9	oC	TEMPERATURE
2/8	SQ1294-2	3/24/2023 11:29:50 AM	R1 =	0	mg/L	P Alkalinity- pH8.2
			R2 =	18.931	mg/L	Total Alkalinity
			R3 =	5.476	pH	pH
			R4 =	10.3	oC	TEMPERATURE
3/8	SQ1339-2	3/24/2023 11:32:19 AM	R1 =	0	mg/L	P Alkalinity- pH8.2
			R2 =	63.829	mg/L	Total Alkalinity
			R3 =	5.939	pH	pH
			R4 =	10.2	oC	TEMPERATURE
4/8	SQ1339-4	3/24/2023 11:35:06 AM	R1 =	0	mg/L	P Alkalinity- pH8.2
			R2 =	383.366	mg/L	Total Alkalinity
			R3 =	7.95	pH	pH
			R4 =	11	oC	TEMPERATURE
5/8	SQ1294-2MS	3/24/2023 11:40:12 AM	R1 =	0	mg/L	P Alkalinity- pH8.2
			R2 =	130.738	mg/L	Total Alkalinity
			R3 =	6.294	pH	pH
			R4 =	12.9	oC	TEMPERATURE
6/8	SQ1294-2MSD	3/24/2023 11:43:29 AM	R1 =	0	mg/L	P Alkalinity- pH8.2
			R2 =	134.693	mg/L	Total Alkalinity
			R3 =	6.282	pH	pH
			R4 =	13.3	oC	TEMPERATURE
7/8	CCV	3/24/2023 11:46:35 AM	R1 =	10.063	mg/L	P Alkalinity- pH8.2
	101.8%		R2 =	127.195	mg/L	Total Alkalinity
			R3 =	8.835	pH	pH
			R4 =	19.3	oC	TEMPERATURE
8/8	CCB	3/24/2023 11:49:37 AM	R1 =	0	mg/L	P Alkalinity- pH8.2
			R2 =	2.147	mg/L	Total Alkalinity
			R3 =	5.645	pH	pH
			R4 =	20.6	oC	TEMPERATURE

Start time: 3/24/2023 10:26

Results

No.	Comment / ID	Start time	Rx	Result	Unit	Name

Calibration data

Number of segments	1	
Slope	-57.88 mV/pH	
Zero point	6.964 pH	
Calibration temperature	25.0 oC	

KATAHDIN ANALYTICAL SERVICES

ALKALINITY, BICARBONATE, CARBONATE, FREE CO2 - DL 25 AUTOTITRATOR

Analysis: EPA 310.1 SM2320B **Calculations:** SM 4500-CO2 D

CJB 3/24/23

pH Probe ID: DG111-SC	
Alkalinity Acid Reagent: W21460	**Buffer pH 4 ID:** SWL5008
Acid Concentration: 0.02N H_2SO_4	**Buffer pH 7 ID:** SWL5016
Alkalinity Check Standard: W21714 TV=125	**Buffer pH 10 ID:** SWL5007
Alkalinity MS: W2171 W21689 TV=120	**Pipette IDs:** W15
Sulfuric Acid Titrant ID: —	

Sample ID	Run #	Volume (mL)	Sample ID	Run #	Volume (mL)	Comments - Must indicate which sample
CCV	1	50				
CCB	2	"				
LCS	3	"				
LCSD	4	"				
SQ1201-8	1	50				
SQ1294-2	2	"				
SQ1339-2	3	"				
1 4	4	"				
SQ1294-2MS	5	"				
SQ1294-2MSD	6	"				
CCV	7	"				
CCB	8	"				
				CJB	3/24/23	

Analyst: CJB **Date:** 3-24-23

Checked By: RAS **Date:** 3/27/23

ALK: WG334511 → R611930 Bicarb: WG334312 → R611931 Carb: WG334313 → R611932

Katahdin
ANALYTICAL SERVICES

Cert No E87604

Wet Chemistry Batch Report

Analyst Initials: RAD
Date Analyzed: 20-MAR-23

Batch: WG334130
Prep Method: E300.0
Prep Chemist: RAD

Sample	Samp Type	Method	Parameter	DF	Result		Rpt. Result	Units	PQL	Adj. PQL	MDL	Adj. MDL	RPD	Rec.
SQ1201-1	SAMP	EPA 300.0	Chloride	1	3.5816		3.6	mg/L	2	2.0	.0993	0.099		
SQ1201-1	SAMP	EPA 300.0	Sulfate	1	.6432	J	0.64	mg/L	1	1.0	.0637	0.064		
SQ1201-2	SAMP	EPA 300.0	Chloride	1	3.6341		3.6	mg/L	2	2.0	.0993	0.099		
SQ1201-2	SAMP	EPA 300.0	Sulfate	1	.6692	J	0.67	mg/L	1	1.0	.0637	0.064		
SQ1201-3	SAMP	EPA 300.0	Chloride	1	4.2829		4.3	mg/L	2	2.0	.0993	0.099		
SQ1201-3	SAMP	EPA 300.0	Sulfate	1	.7847	J	0.78	mg/L	1	1.0	.0637	0.064		
SQ1201-4	SAMP	EPA 300.0	Chloride	1	2.2866		2.3	mg/L	2	2.0	.0993	0.099		
SQ1201-4	SAMP	EPA 300.0	Sulfate	1	.1513	J	0.15	mg/L	1	1.0	.0637	0.064		
SQ1201-5	SAMP	EPA 300.0	Chloride	1	2.1951		2.2	mg/L	2	2.0	.0993	0.099		
SQ1201-5	SAMP	EPA 300.0	Sulfate	1	.6421	J	0.64	mg/L	1	1.0	.0637	0.064		
SQ1201-6	SAMP	EPA 300.0	Chloride	1	2.0003		2.0	mg/L	2	2.0	.0993	0.099		
SQ1201-6	SAMP	EPA 300.0	Sulfate	1	.6021	J	0.60	mg/L	1	1.0	.0637	0.064		
SQ1201-7	SAMP	EPA 300.0	Chloride	1	1.9789	J	2.0	mg/L	2	2.0	.0993	0.099		
SQ1201-7	SAMP	EPA 300.0	Sulfate	1	.9373	J	0.94	mg/L	1	1.0	.0637	0.064		
SQ1201-8	SAMP	EPA 300.0	Chloride	1	2.6934		2.7	mg/L	2	2.0	.0993	0.099		
SQ1201-8	SAMP	EPA 300.0	Sulfate	1	1.4953		1.5	mg/L	1	1.0	.0637	0.064		
SQ1282-1	SAMP	EPA 300.0	Bromide	1	.0365	U	0.50	mg/L	.5	0.50	.136	0.14		
SQ1282-2	SAMP	EPA 300.0	Bromide	1	.2536	U	0.50	mg/L	.5	0.50	.136	0.14		
SQ1282-3	SAMP	EPA 300.0	Bromide	1	.1633	U	0.50	mg/L	.5	0.50	.136	0.14		
SQ1282-3	SAMP	EPA 300.0	Chloride	1	36.8766		37.	mg/L	2	2.0	.0993	0.099		
SQ1282-4	SAMP	EPA 300.0	Bromide	1	.1514	U	0.50	mg/L	.5	0.50	.136	0.14		
SQ1282-4	SAMP	EPA 300.0	Chloride	1	36.4472		36.	mg/L	2	2.0	.0993	0.099		
SQ1282-5	SAMP	EPA 300.0	Bromide	1	.1582	U	0.50	mg/L	.5	0.50	.136	0.14		
SQ1282-5	SAMP	EPA 300.0	Chloride	1	36.9343		37.	mg/L	2	2.0	.0993	0.099		
SQ1282-6	SAMP	EPA 300.0	Bromide	1	.0062	U	0.50	mg/L	.5	0.50	.136	0.14		
SQ1282-7	SAMP	EPA 300.0	Bromide	1	.0947	U	0.50	mg/L	.5	0.50	.136	0.14		
SQ1282-8	SAMP	EPA 300.0	Bromide	1	.0136	U	0.50	mg/L	.5	0.50	.136	0.14		
WG334130-1	MBLANK	EPA 300.0	Bromide	1	.0013	U	0.40	mg/L	.5	0.50	.136	0.14		
WG334130-1	MBLANK	EPA 300.0	Chloride	1	.0113	U	1.0	mg/L	2	2.0	.0993	0.099		
WG334130-1	MBLANK	EPA 300.0	Sulfate	1	.0099	U	0.50	mg/L	1	1.0	.0637	0.064		
WG334130-2	LCS	EPA 300.0	Bromide	1	3.4644		3.46	mg/L	.5	0.50	.136	0.14		92.3
WG334130-2	LCS	EPA 300.0	Chloride	1	3.7412		3.74	mg/L	2	2.0	.0993	0.099		99.7
WG334130-2	LCS	EPA 300.0	Sulfate	1	3.6849		3.68	mg/L	1	1.0	.0637	0.064		98.1
WG334130-3	MS	EPA 300.0	Chloride	1	7.68168		7.7	mg/L	2	2.0	.0993	0.099		102
WG334130-3	MS	EPA 300.0	Sulfate	1	4.61832		4.6	mg/L	1	1.0	.0637	0.064		100
WG334130-4	MSD	EPA 300.0	Chloride	1	7.7761		7.8	mg/L	2	2.0	.0993	0.099	1	105
WG334130-4	MSD	EPA 300.0	Sulfate	1	4.69905		4.7	mg/L	1	1.0	.0637	0.064	2	102

Comments:

SQ1201-1	1 amber received 031
SQ1201-2	MS/MSD
SQ1201-5	2 ambers received 031
SQ1201-6	2 ambers received 031
SQ1201-7	2 ambers received 031
SQ1282-1	Anions = Cl, Br

Entered by: RAD Date: 3/21/23 Accepted by: SS Date: 3/29/23

Katahdin
ANALYTICAL SERVICES

Cert No E87604

Wet Chemistry Batch Report

Analyst Initials: RAD
Date Analyzed: 20-MAR-23

Batch: WG334130
Prep Method: E300.0
Prep Chemist: RAD

Sample	Samp Type	Method	Parameter	DF	Result	Rpt. Result	Units	PQL	Adj. PQL	MDL	Adj. MDL	RPD	Rec.
SQ1282-2		Anions = Cl, Br											
SQ1282-3		Anions = Cl, Br											
SQ1282-4		Anions = Cl, Br											
SQ1282-5		Anions = Cl, Br											
SQ1282-6		Anions = Br											
SQ1282-7		Anions = Cl, Br											
SQ1282-8		Anions = Cl, Br											
WG334130-1		SQ1201-1											
WG334130-2		SQ1201-1											
WG334130-3		SQ1201-2											
WG334130-4		SQ1201-2											

Entered by: RAD Date: 3/21/23 Accepted by: SS Date: 3/29/23

Katahdin Analytical Services SQ1201 Page 1071 of 1130

IC STANDARDS PREPARATION

Fill sheet in completely and file with each batch of samples analyzed.

IC8 MIX ID:	EXPIRATION DATE:	ICAL DATE:	CCV STOCK ID:	EXPIRATION DATE:
W21620	2/23/23	2/09/23	IC8:W21695	03/29/23

ALALYTE	INITIAL AMOUNT (mL)	OF	STOCK CONC. (mg/L)	TO	FINAL VOLUME (mL)	=	FINAL CONC. (mg/L)
Cl	2.0	OF	1000	TO	100	=	20
NO2 (as N)	0.8		1000				8
NO3 (as N)	0.8		1000				8
Br	4.0		1000				40
SO4	4.0		1000				40
F	1.0		1000				10
PO4 (as P)	1.0		1000				10

WORKING STANDARDS

Standards prepared on each day of use.

STD.	INITIAL AMOUNT (mL)	OF	FINAL VOLUME (mL)	FINAL CONC. (mg/L)							STD ID*
				Cl	NO2	NO3	Br	SO4	PO4	F	
IC8	5	IC8	5	40	16	16	80	80	20	20	IC8-020923
IC7	2.5	IC8	5	20	8	8	40	40	10	10	IC7-020923
IC6	2.5	IC7	5	10	4	4	20	20	5	5	IC6-020923
IC5	1.25	IC7	5	5	2	2	10	10	2.5	2.5	IC5-020923
IC4	1.25	IC6	5	2.5	1	1	5	5	1.25	1.25	IC4-020923
IC3	0.5	IC6	5	1	0.4	0.4	2	2	0.5	0.5	IC3-020923
IC2	0.5	IC3	5	0.1	0.04	0.04	0.2	0.2	0.05	0.05	IC2-020923
CCV	2.5	IC7	5	10	4	4	20	20	5	5	CCV-032023

* STD ID is prefix followed by the date of preparation (ie. IC6-020216)

LCS/MATRIX SPIKE MIX ID: W21713	EXPIRATION DATE: 04/03/23

3.75 mL of High Purity Multi-Element IC Standard Solution "A" and 3.75 mL of High Purity Multi-Element IC Standard Solution "B" diluted to 50 mL. For MS, add 0.25 mL of mix to 4.75 mL of sample. For LCS, add 0.25 mL of mix to 4.75 mL of DI water.

FINAL CONCENTRATIONS (mg/L)

Cl	NO2 (as N)	NO3 (as N)	Br	SO4	PO4 (as P)	F	STD ID*
3.75	1.14	0.845	3.75	3.75	1.22	3.75	IC-LCS-032023

PIPETTES: W00, W16

2x dil = 2.5mL samp + 2.5mL DI	**5x dil** = 1.0mL samp + 4.0mL DI	**10x dil** = 0.5mL samp + 4.5mL DI
20x dil = 0.25mL samp + 4.75mL DI	**50x dil** = 0.1mL samp + 4.9mL DI	**100x dil** = 0.05mL samp + 4.95mL DI
200x dil = 0.025mL samp + 4.975mL DI	**500x dil** = 0.01mL samp + 4.99mL DI	**1000x dil** = 0.005mL samp + 4.995mL DI

RAD 3/21/23

Katahdin Analytical Services **ION CHROMATOGRAPHY RUNLOG** Dionex ICS-2100 (Instrument IC-3)

Analysis Date: 3/20/23	**Analytical Column S/N:** 220503194	**Calibration Date:** ~~3/17/23~~ 2/9/23
Analysis Sequence: 032023 A	**Guard Column S/N:** 220406208	**Calibration Sequence:** ~~032723 CAL~~ 020923 CAL
Analyst: RAD	**Suppressor S/N:** 221170086	☐ If box at left is checked, continued from previous page. Refer to previous page for header information.

Reporting / Reanalysis Codes: ✓ Report without manipulation; S Report, peak automatically reintegrated with SmartPeak; M Report, peak manually integrated; A Report, peak manually assigned; R Do not report, reanalyze sample

Method Codes: E EPA 300.0; SW SW846 9056A

Katahdin Sample Number	Dilution Factor	Method Code	Report or Reanalyze (enter appropriate code): F	Cl	NO_2	SO_4	Br	NO_3	PO_4	Comments
CCV			✓	✓	✓	✓	✓	✓		
CCB			M	M	M	M	M	M		
LCS			✓	✓	✓	✓	✓	✓		
SQ1201-1	1	E		✓		✓				
-2				✓		✓				
-2 MS				✓		✓				
-2 MSD				✓		✓				
-3				✓		✓				
-4				✓		✓				
-5				✓		✓				
-6				✓		✓				
-7				✓		✓				
CCV			✓	✓	✓	✓	✓	✓		
CCB			M	M	M	M	M	M		
-8	1	E		✓		✓				
SQ1282-1				R			✓			Cl=2x
-2				R			✓			Cl=2x
-3				✓			✓			
-4				✓			✓			
-5				✓			✓			
-6							✓			
-7				R			✓			Cl=50x

Reviewed by: SS Review Date: 3/29/23

Katahdin Analytical Services SQ1201 Page 1073 of 1130 4083411974 Rev 1

Katahdin Analytical Services **ION CHROMATOGRAPHY RUNLOG** Dionex ICS-2100 (Instrument IC-3)

Analysis Date:	**Analytical Column S/N:**	**Calibration Date:**
Analysis Sequence:	**Guard Column S/N:**	**Calibration Sequence:**
Analyst:	**Suppressor S/N:**	☑ If box at left is checked, continued from previous page. Refer to previous page for header information.

Reporting / Reanalysis Codes:
✓ Report without manipulation
S Report, peak automatically reintegrated with SmartPeak
M Report, peak manually integrated
A Report, peak manually assigned
R Do not report, reanalyze sample

Method Codes:
E EPA 300.0
SW SW846 9056A

Katahdin Sample Number	Dilution Factor	Method Code	Report or Reanalyze (enter appropriate code): F	Cl	NO_2	SO_4	Br	NO_3	PO_4	Comments
SQ 1282-8	1	E		R			✓			Cl=2x
CCV			✓	✓	✓	✓	✓	✓		
CCB			M	M	M	M	M	M		

RAD 3/21/23

Reviewed by: SS Review Date: 3/29/23

Sequence Overview

Sequence Details

Name:	**032023 A REPROC**	*Created On:*	**28/Dec/22 13:33:49**
Directory:	**2023\03-MAR**	*Created By:*	**wetlab**
Data Vault:	**ChromeleonLocal**	*Updated On:*	**21/Mar/23 10:48:11**
No. of Injections:	**25**	*Updated By:*	**wetlab**

Injection Details

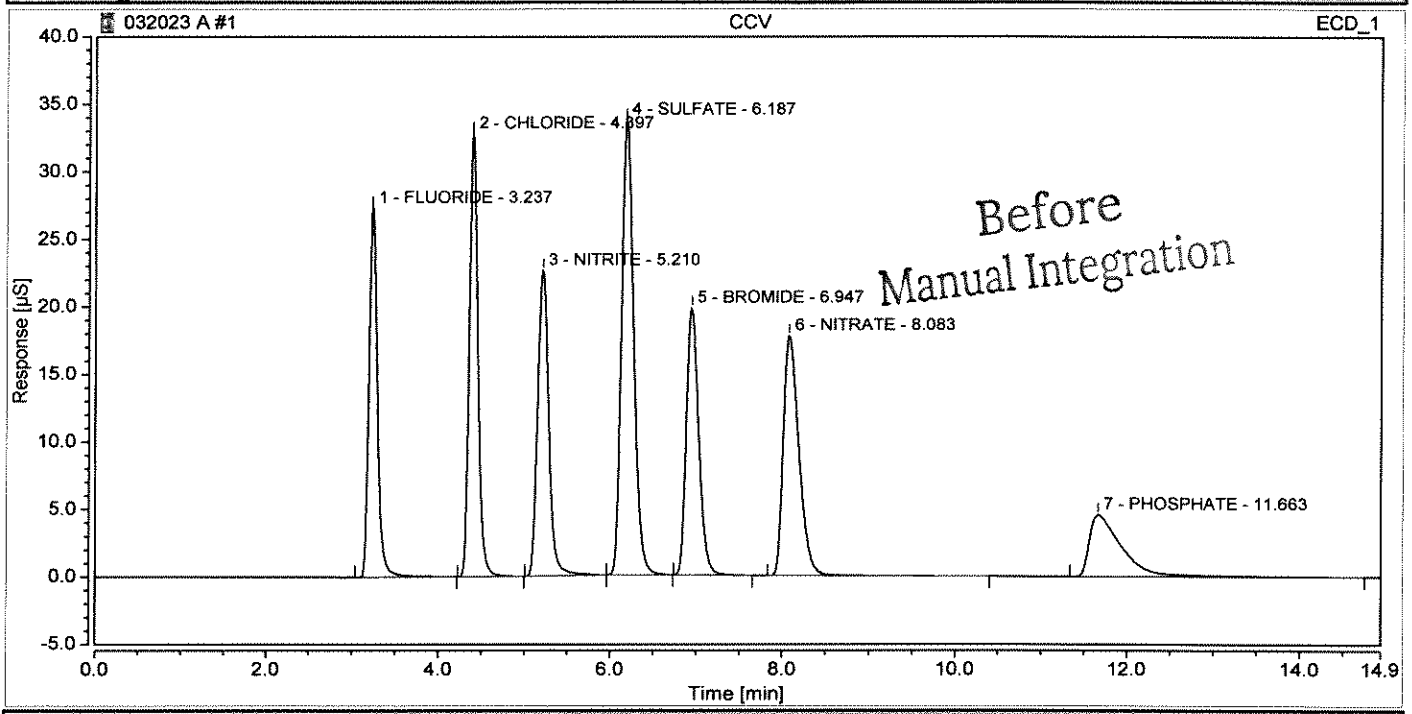
No.	Injection Name	Position	Type	Level	Inject Time	Status
1	CCV	1	Check Standard	06	20/Mar/23 16:37:31	Finished
2	CCB	2	Blank		20/Mar/23 16:54:16	Finished
3	LCS	3	Check Standard	09	20/Mar/23 17:11:32	Finished
4	SQ1201-1	4	Unknown		20/Mar/23 17:28:48	Finished
5	SQ1201-2	5	Unknown		20/Mar/23 17:46:04	Finished
6	SQ1201-2 MS	6	Unknown		20/Mar/23 18:03:20	Finished
7	SQ1201-2 MSD	7	Unknown		20/Mar/23 18:20:36	Finished
8	SQ1201-3	8	Unknown		20/Mar/23 18:37:52	Finished
9	SQ1201-4	9	Unknown		20/Mar/23 18:55:08	Finished
10	SQ1201-5	10	Unknown		20/Mar/23 19:12:24	Finished
11	SQ1201-6	11	Unknown		20/Mar/23 19:29:41	Finished
12	SQ1201-7	12	Unknown		20/Mar/23 19:46:57	Finished
13	CCV	13	Check Standard	06	20/Mar/23 20:04:13	Finished
14	CCB	14	Blank		20/Mar/23 20:21:29	Finished
15	SQ1201-8	15	Unknown		20/Mar/23 20:38:44	Finished
16	SQ1282-1	16	Unknown		20/Mar/23 20:56:00	Finished
17	SQ1282-2	17	Unknown		20/Mar/23 21:13:15	Finished
18	SQ1282-3	18	Unknown		20/Mar/23 21:30:32	Finished
19	SQ1282-4	19	Unknown		20/Mar/23 21:47:48	Finished
20	SQ1282-5	20	Unknown		20/Mar/23 22:05:04	Finished
21	SQ1282-6	21	Unknown		20/Mar/23 22:22:20	Finished
22	SQ1282-7	22	Unknown		20/Mar/23 22:39:35	Finished
23	SQ1282-8	23	Unknown		20/Mar/23 22:56:52	Finished
24	CCV	24	Check Standard	06	20/Mar/23 23:14:07	Finished
25	CCB	25	Blank		20/Mar/23 23:31:23	Finished

Chromatogram and Results

Injection Details

Injection Name:	**CCV**	*Run Time (min):*	**14.94**
Vial Number:	**1**	*Injection Volume:*	**200.00**
Injection Type:	**Check Standard**	*Channel:*	**ECD_1**
Calibration Level:	**06**	*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 16:37**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

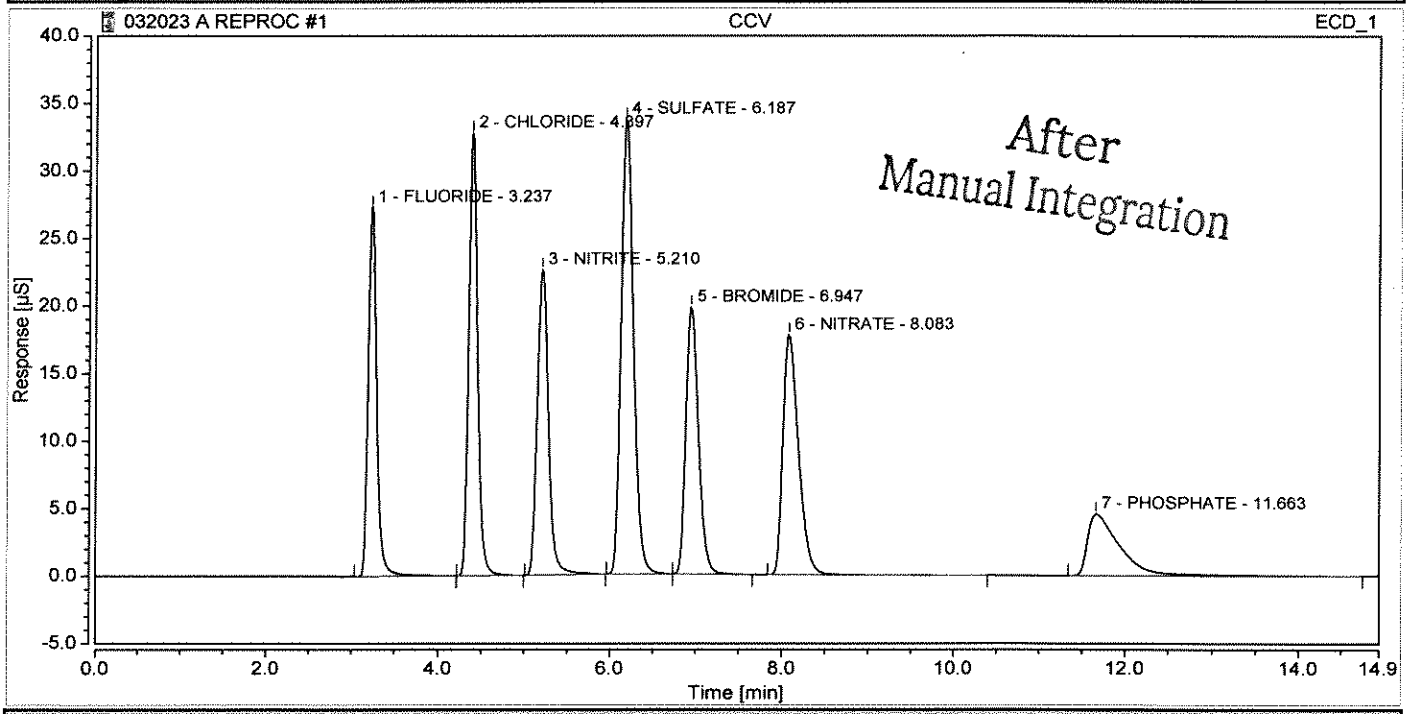
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.237	3.117	27.332	12.41	17.24	5.3381	6.7625
2	CHLORIDE	4.397	3.827	32.779	15.23	20.68	10.2994	2.9941
3	NITRITE	5.210	3.444	22.609	13.71	14.26	4.1455	3.6367
4	SULFATE	6.187	5.637	33.691	22.44	21.25	20.6505	3.2523
5	BROMIDE	6.947	3.352	19.774	13.34	12.47	20.5038	2.5192
6	NITRATE	8.083	3.742	17.769	14.89	11.21	4.0965	2.4128
7	PHOSPHATE	11.663	2.005	4.576	7.98	2.89	5.3697	7.3943
Total:			**25.125**	**158.531**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**CCV**	*Run Time (min):*	**14.94**
Vial Number:	**1**	*Injection Volume:*	**200.00**
Injection Type:	**Check Standard**	*Channel:*	**ECD_1**
Calibration Level:	**06**	*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 16:37**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

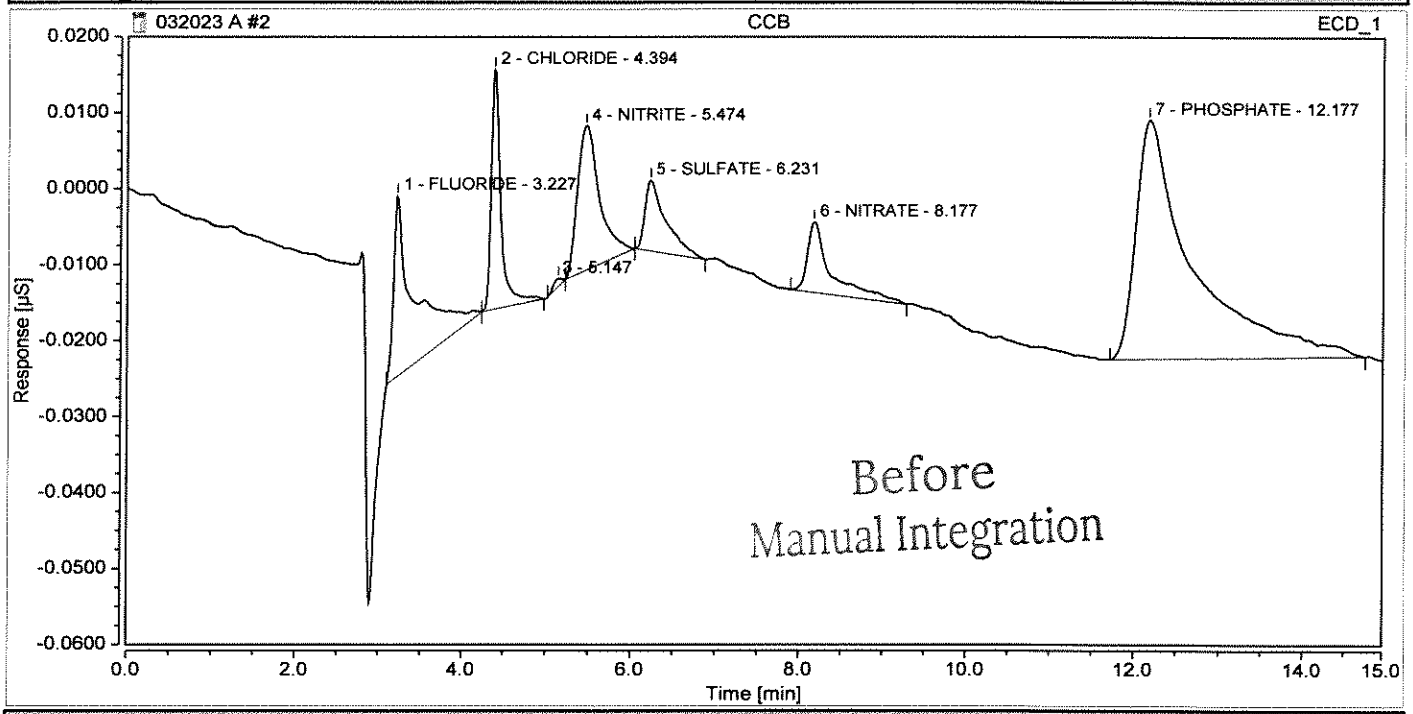
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.237	3.117	27.332	12.41	17.24	5.3381	6.7625
2	CHLORIDE	4.397	3.827	32.779	15.23	20.68	10.2994	2.9941
3	NITRITE	5.210	3.444	22.609	13.71	14.26	4.1455	3.6367
4	SULFATE	6.187	5.637	33.691	22.44	21.25	20.6505	3.2523
5	BROMIDE	6.947	3.352	19.774	13.34	12.47	20.5038	2.5192
6	NITRATE	8.083	3.742	17.769	14.89	11.21	4.0965	2.4128
7	PHOSPHATE	11.663	2.005	4.576	7.98	2.89	5.3697	7.3943
Total:			**25.125**	**158.531**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**CCB**	*Run Time (min):*	**14.95**
Vial Number:	**2**	*Injection Volume:*	**200.00**
Injection Type:	**Blank**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 16:54**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

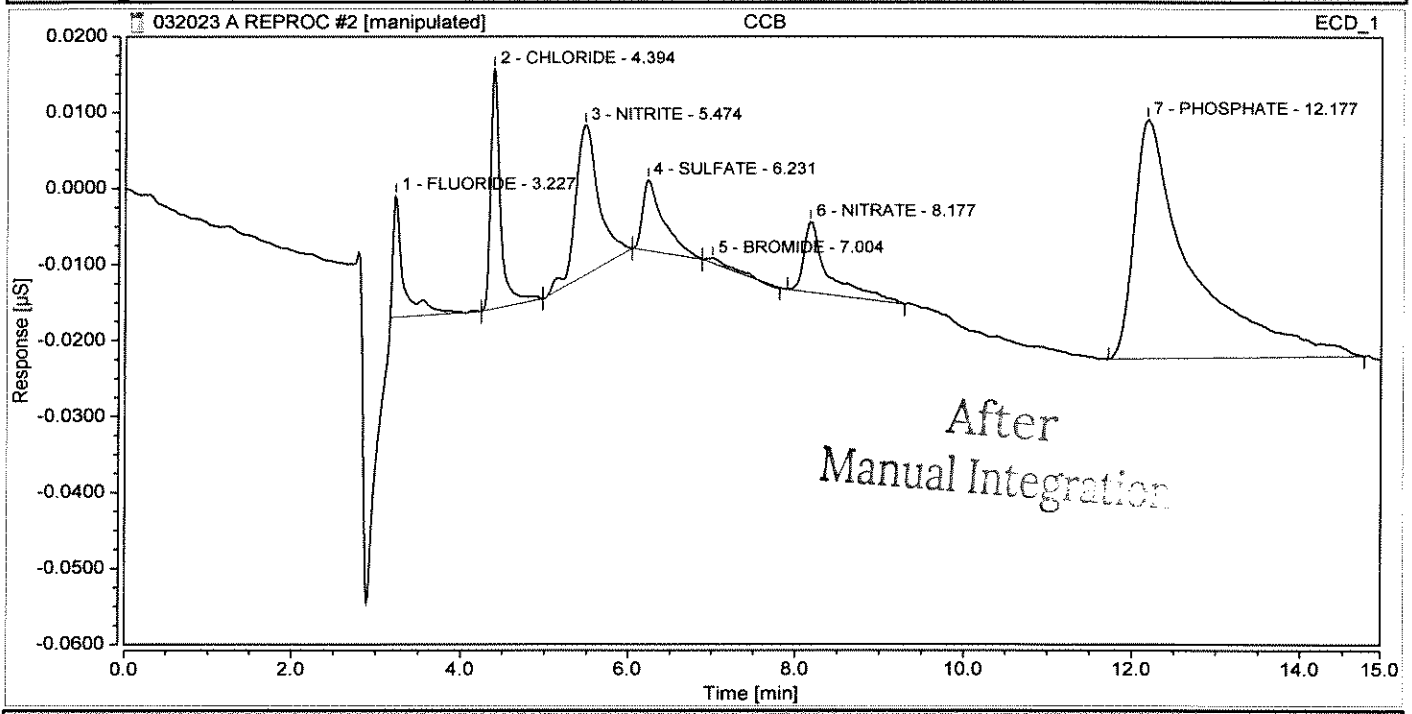
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.227	0.007	0.024	14.53	18.94	0.0186	n.a.
2	CHLORIDE	4.394	0.004	0.032	8.85	25.16	0.0113	n.a.
3		5.147	0.000	0.001	0.26	0.82	n.a.	n.a.
4	NITRITE	5.474	0.006	0.019	12.07	15.16	n.a.	n.a.
5	SULFATE	6.231	0.003	0.009	5.66	7.43	0.0099	n.a.
n.a.	BROMIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
6	NITRATE	8.177	0.003	0.009	6.30	7.40	0.0033	n.a.
7	PHOSPHATE	12.177	0.025	0.031	52.33	25.09	0.0667	n.a.
Total:			**0.048**	**0.125**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**CCB**	*Run Time (min):*	**14.95**
Vial Number:	**2**	*Injection Volume:*	**200.00**
Injection Type:	**Blank**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 16:54**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

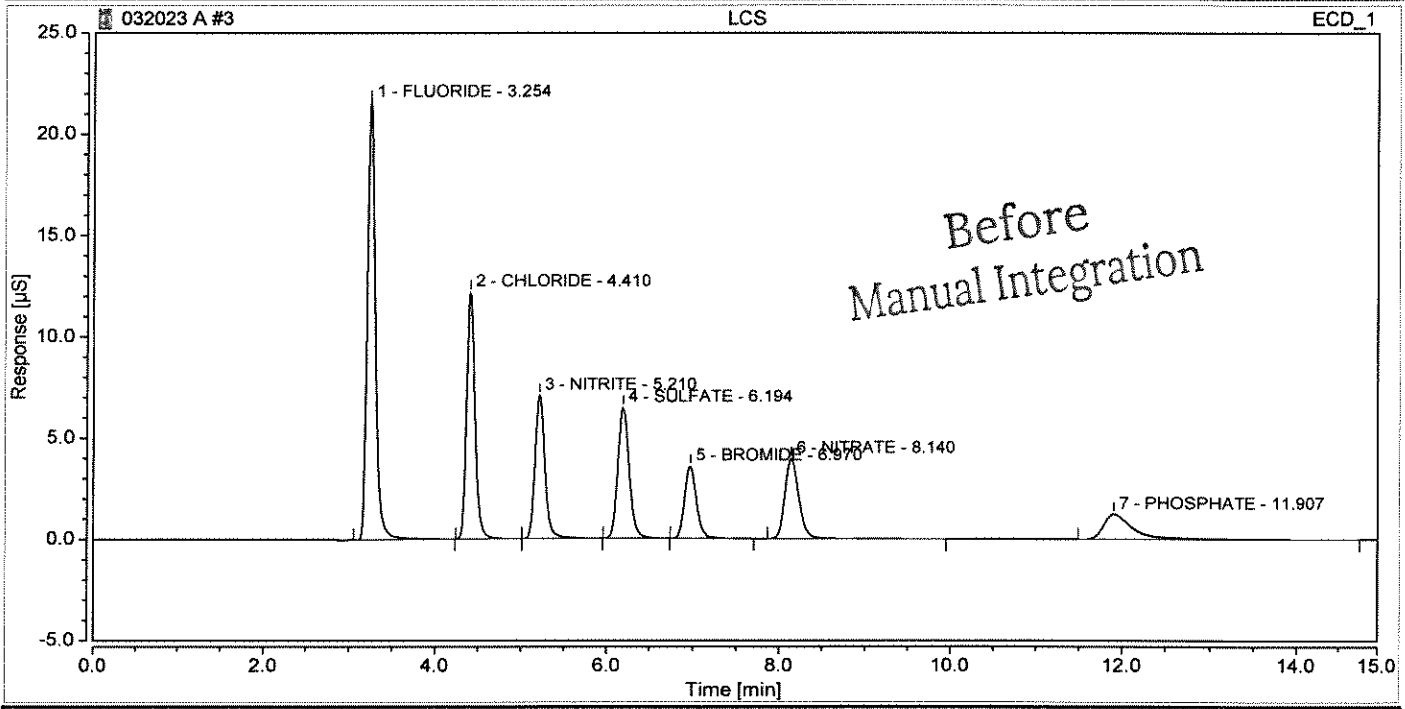
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.227	0.002	0.016	5.35	13.64	0.0111	n.a.
2	CHLORIDE	4.394	0.004	0.032	9.63	26.72	0.0113	n.a.
3	NITRITE	5.474	0.006	0.020	14.57	16.69	n.a.	n.a.
4	SULFATE	6.231	0.003	0.009	6.16	7.89	0.0099	n.a.
5	BROMIDE	7.004	0.000	0.001	0.48	0.55	0.0013	n.a.
6	NITRATE	8.177	0.003	0.009	6.86	7.86	0.0033	n.a.
7	PHOSPHATE	12.177	0.025	0.031	56.96	26.65	0.0667	n.a.
Total:			**0.044**	**0.118**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**LCS**	*Run Time (min):*	**14.95**
Vial Number:	**3**	*Injection Volume:*	**200.00**
Injection Type:	**Check Standard**	*Channel:*	**ECD_1**
Calibration Level:	**09**	*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 17:11**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

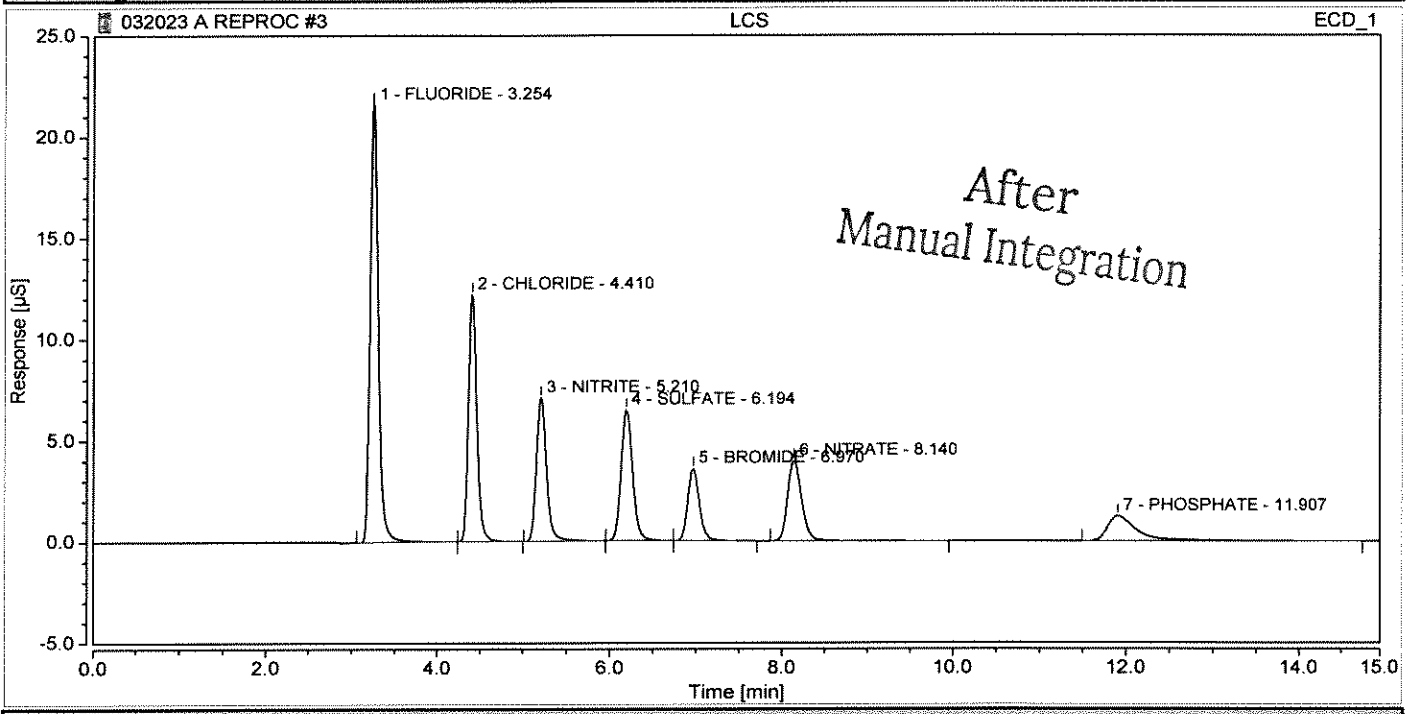
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.254	2.388	21.602	31.51	38.51	4.0507	8.0177
2	CHLORIDE	4.410	1.390	12.192	18.34	21.74	3.7412	-0.2339
3	NITRITE	5.210	0.968	7.077	12.76	12.62	1.1367	-0.2872
4	SULFATE	6.194	1.006	6.461	13.27	11.52	3.6849	-1.7368
5	BROMIDE	6.970	0.566	3.564	7.47	6.35	3.4644	-7.6163
6	NITRATE	8.140	0.751	3.954	9.90	7.05	0.8219	-2.7374
7	PHOSPHATE	11.907	0.511	1.241	6.74	2.21	1.3690	12.2158
Total:			**7.581**	**56.092**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**LCS**	*Run Time (min):*	**14.95**
Vial Number:	**3**	*Injection Volume:*	**200.00**
Injection Type:	**Check Standard**	*Channel:*	**ECD_1**
Calibration Level:	**09**	*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 17:11**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

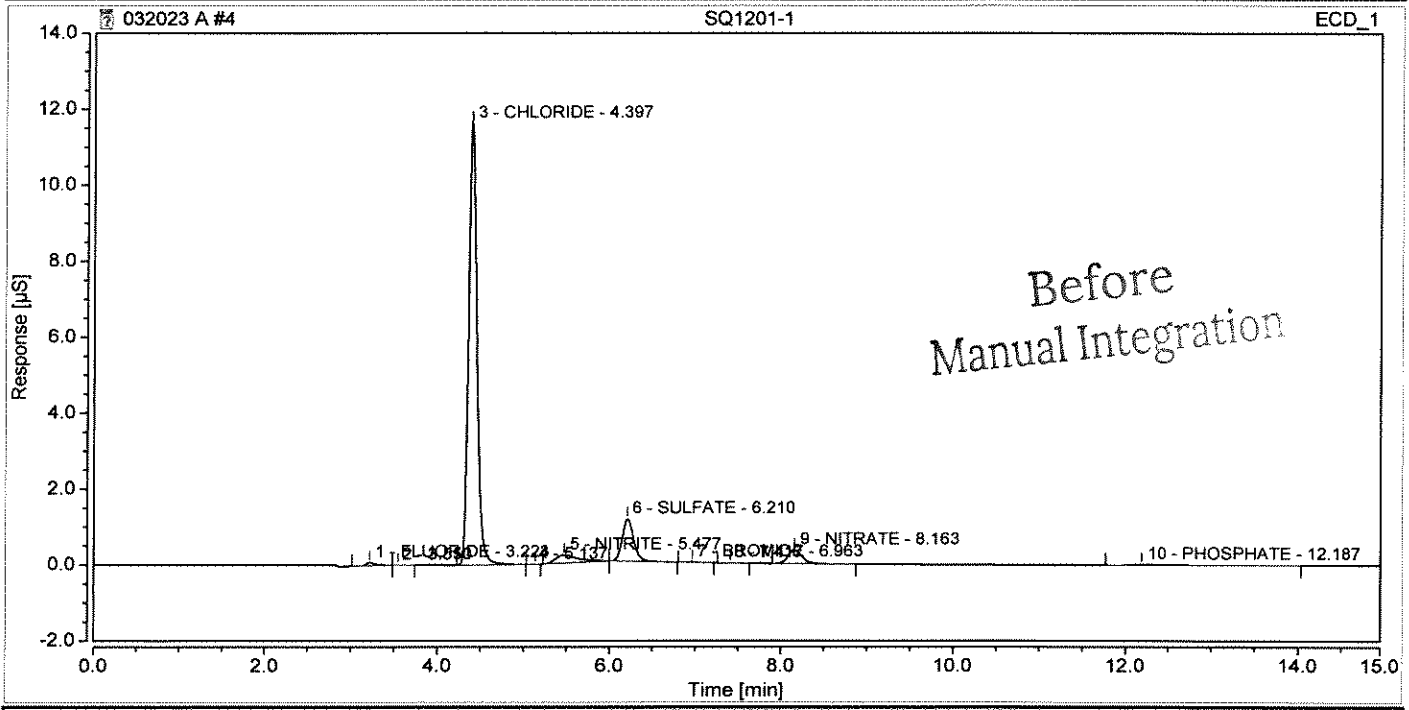
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.254	2.388	21.602	31.51	38.51	4.0507	8.0177
2	CHLORIDE	4.410	1.390	12.192	18.34	21.74	3.7412	-0.2339
3	NITRITE	5.210	0.968	7.077	12.76	12.62	1.1367	-0.2872
4	SULFATE	6.194	1.006	6.461	13.27	11.52	3.6849	-1.7368
5	BROMIDE	6.970	0.566	3.564	7.47	6.35	3.4644	-7.6163
6	NITRATE	8.140	0.751	3.954	9.90	7.05	0.8219	-2.7374
7	PHOSPHATE	11.907	0.511	1.241	6.74	2.21	1.3690	12.2158
Total:			**7.581**	**56.092**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-1**	*Run Time (min):*	**14.95**
Vial Number:	**4**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 17:28**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

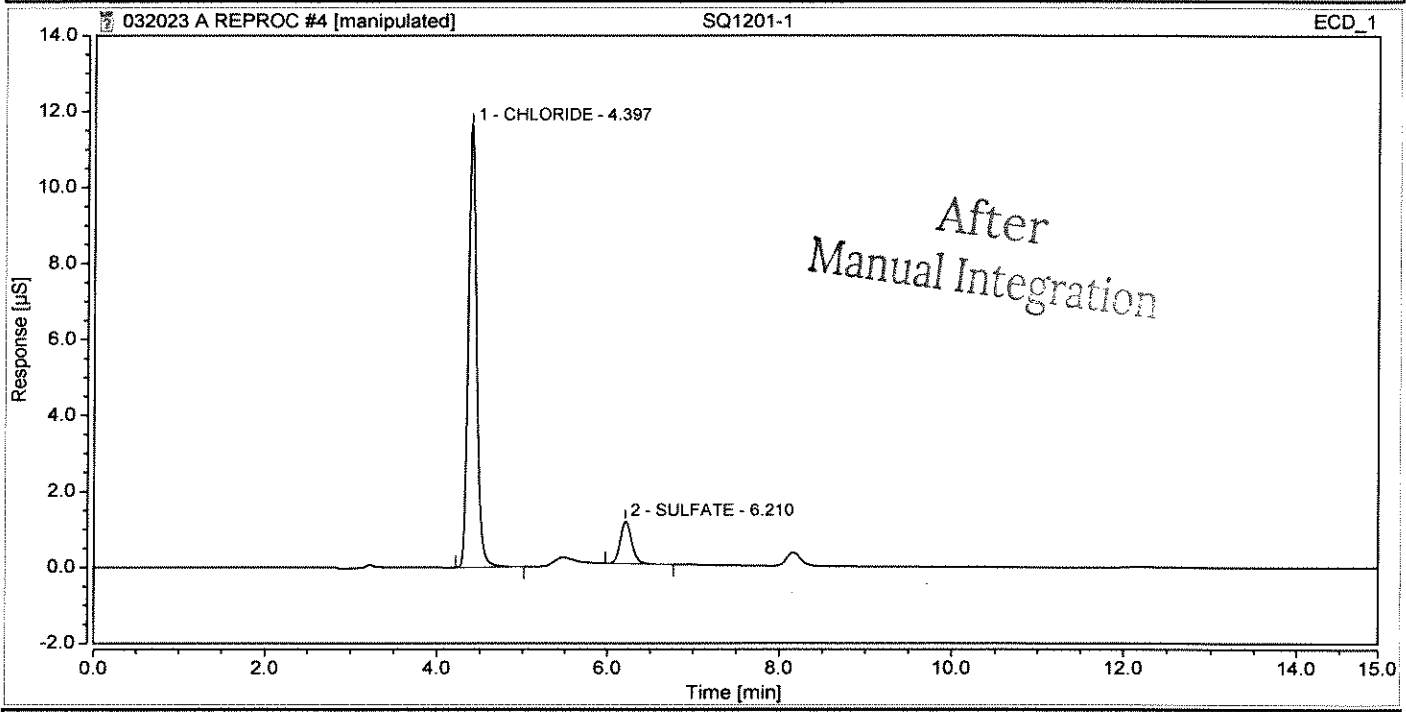
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.223	0.010	0.082	0.61	0.61	0.0238	n.a.
2		3.550	0.000	0.003	0.02	0.02	n.a.	n.a.
3	CHLORIDE	4.397	1.331	11.633	79.84	86.52	3.5817	n.a.
4		5.137	0.000	0.001	0.01	0.01	n.a.	n.a.
5	NITRITE	5.477	0.066	0.213	3.96	1.59	0.0681	n.a.
6	SULFATE	6.210	0.176	1.116	10.53	8.30	0.6431	n.a.
7	BROMIDE	6.963	0.002	0.015	0.14	0.11	0.0142	n.a.
8		7.417	0.000	0.001	0.01	0.01	n.a.	n.a.
9	NITRATE	8.163	0.069	0.364	4.15	2.71	0.0758	n.a.
10	PHOSPHATE	12.187	0.012	0.018	0.74	0.13	0.0330	n.a.
Total:			**1.667**	**13.446**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-1**	*Run Time (min):*	**14.95**
Vial Number:	**4**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 17:28**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

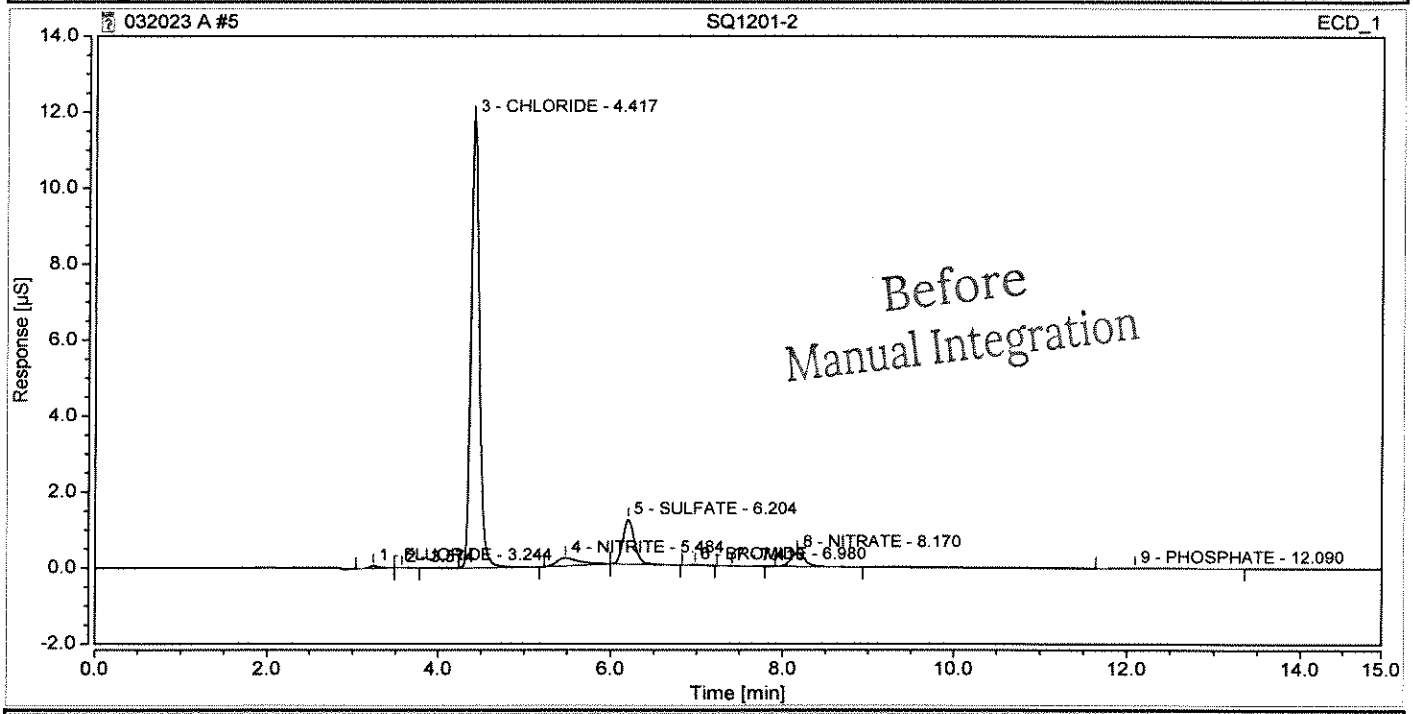
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.397	1.331	11.633	88.35	91.25	3.5816	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	SULFATE	6.210	0.176	1.116	11.65	8.75	0.6432	n.a.
n.a.	BROMIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**1.507**	**12.749**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-2**	*Run Time (min):*	**14.96**
Vial Number:	**5**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 17:46**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

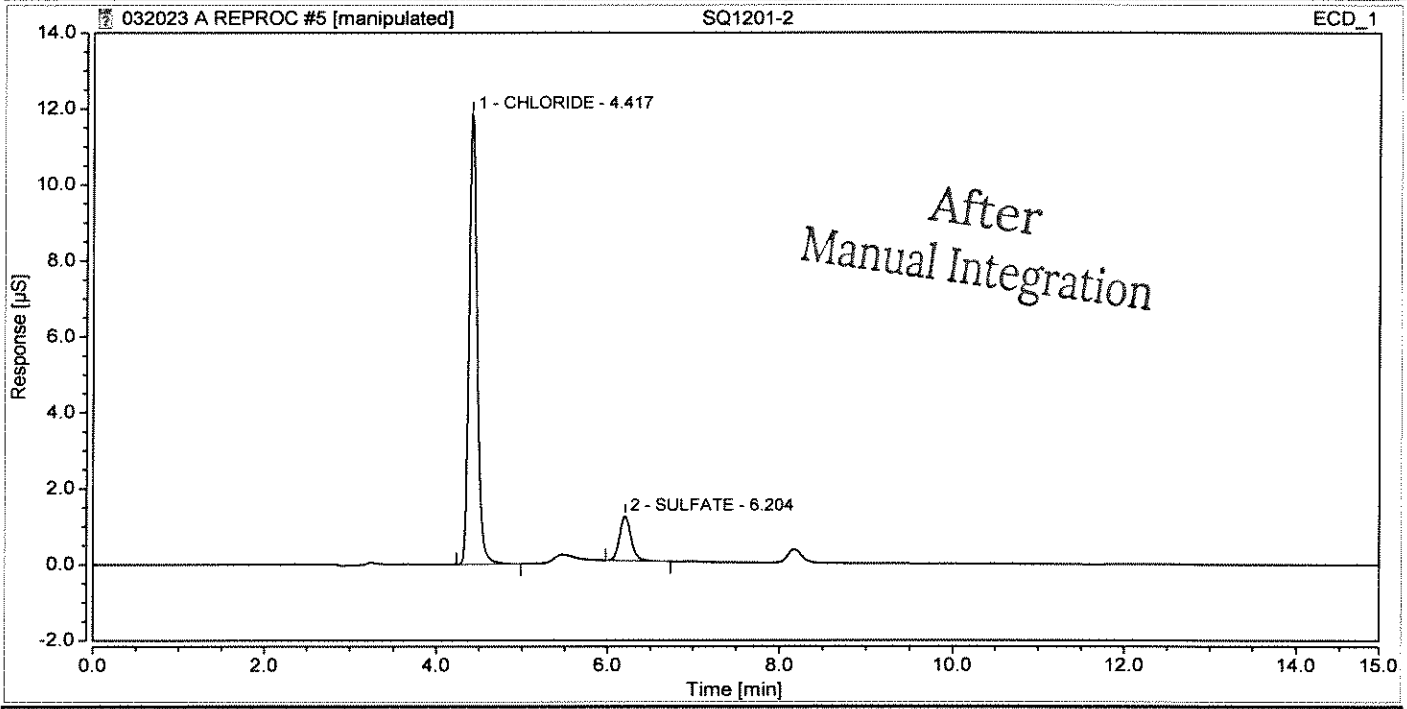
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.244	0.009	0.069	0.53	0.50	0.0219	n.a.
2		3.574	0.001	0.004	0.03	0.03	n.a.	n.a.
3	CHLORIDE	4.417	1.352	11.862	80.28	86.55	3.6380	n.a.
4	NITRITE	5.484	0.063	0.206	3.75	1.50	0.0647	n.a.
5	SULFATE	6.204	0.183	1.173	10.86	8.56	0.6699	n.a.
6	BROMIDE	6.980	0.002	0.014	0.13	0.10	0.0131	n.a.
7		7.410	0.000	0.001	0.02	0.01	n.a.	n.a.
8	NITRATE	8.170	0.070	0.368	4.13	2.68	0.0761	n.a.
9	PHOSPHATE	12.090	0.005	0.008	0.29	0.06	0.0129	n.a.
Total:			**1.684**	**13.705**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-2**	*Run Time (min):*	**14.96**
Vial Number:	**5**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 17:46**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

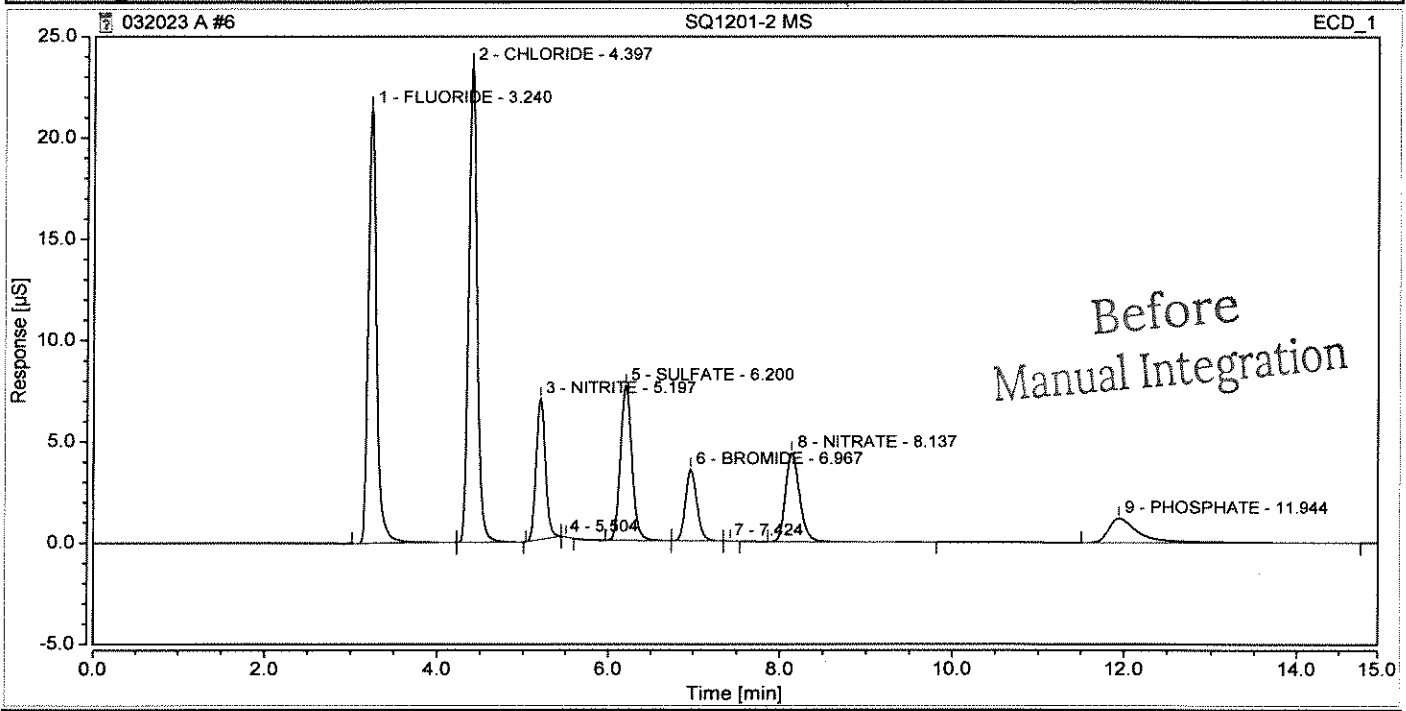
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.417	1.350	11.861	88.09	91.00	3.6341	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	SULFATE	6.204	0.183	1.173	11.91	9.00	0.6692	n.a.
n.a.	BROMIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**1.533**	**13.034**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-2 MS**	*Run Time (min):*	**14.95**
Vial Number:	**6**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 18:03**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

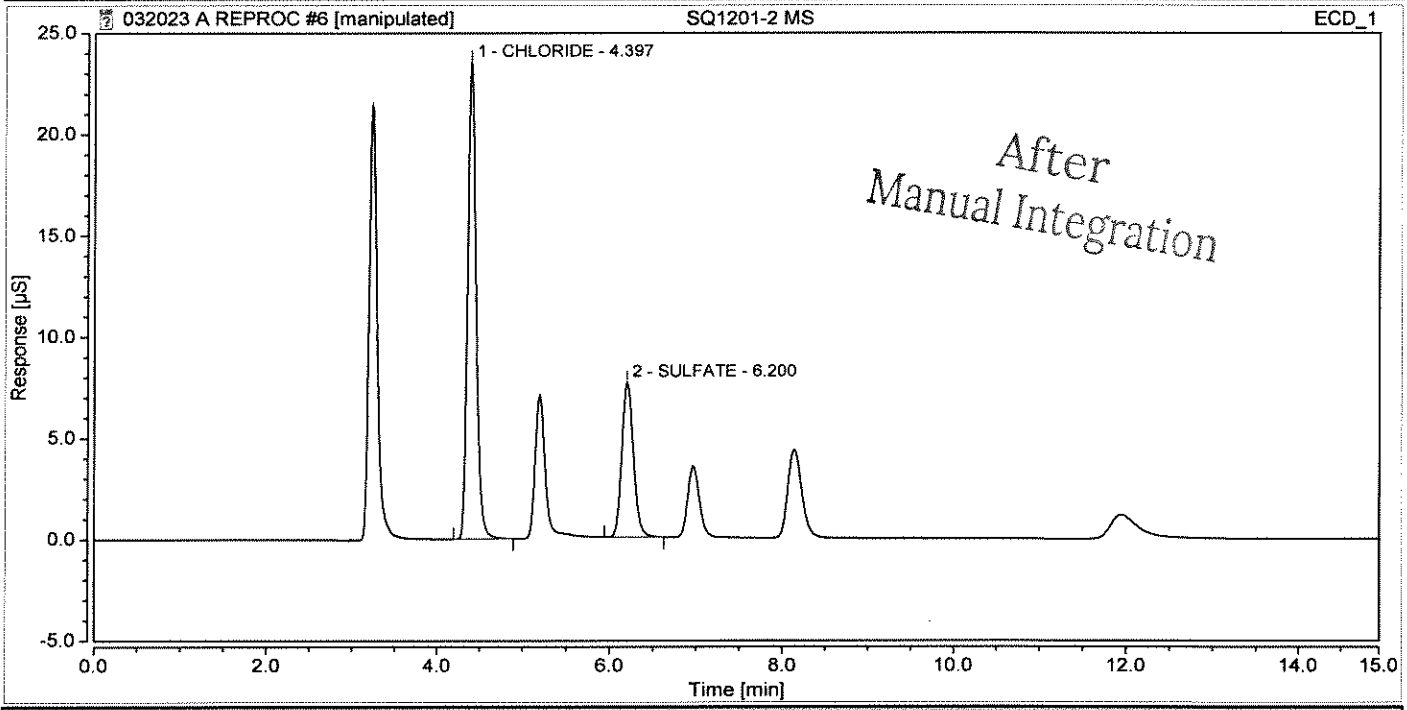
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.240	2.408	21.482	26.43	31.26	4.0855	n.a.
2	CHLORIDE	4.397	2.716	23.544	29.80	34.26	7.3075	n.a.
3	NITRITE	5.197	0.898	6.953	9.85	10.12	1.0536	n.a.
4		5.504	0.000	0.006	0.01	0.01	n.a.	n.a.
5	SULFATE	6.200	1.202	7.641	13.19	11.12	4.4027	n.a.
6	BROMIDE	6.967	0.553	3.520	6.07	5.12	3.3856	n.a.
7		7.424	0.000	0.003	0.00	0.00	n.a.	n.a.
8	NITRATE	8.137	0.831	4.382	9.12	6.38	0.9101	n.a.
9	PHOSPHATE	11.944	0.504	1.200	5.53	1.75	1.3495	n.a.
Total:			**9.113**	**68.729**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-2 MS**	*Run Time (min):*	**14.95**
Vial Number:	**6**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 18:03**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

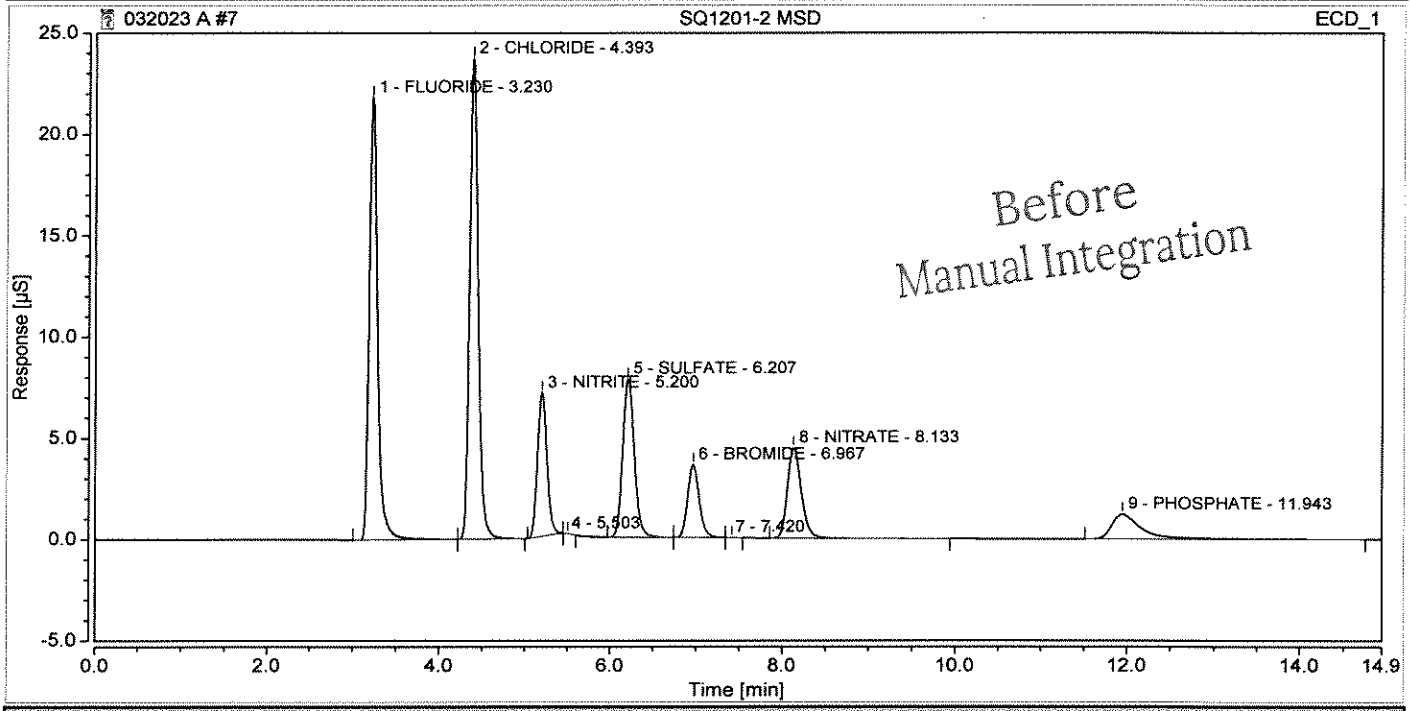
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.397	2.712	23.540	69.37	75.51	7.2976	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	SULFATE	6.200	1.198	7.637	30.63	24.49	4.3874	n.a.
n.a.	BROMIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**3.910**	**31.177**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-2 MSD**	*Run Time (min):*	**14.95**
Vial Number:	**7**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 18:20**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

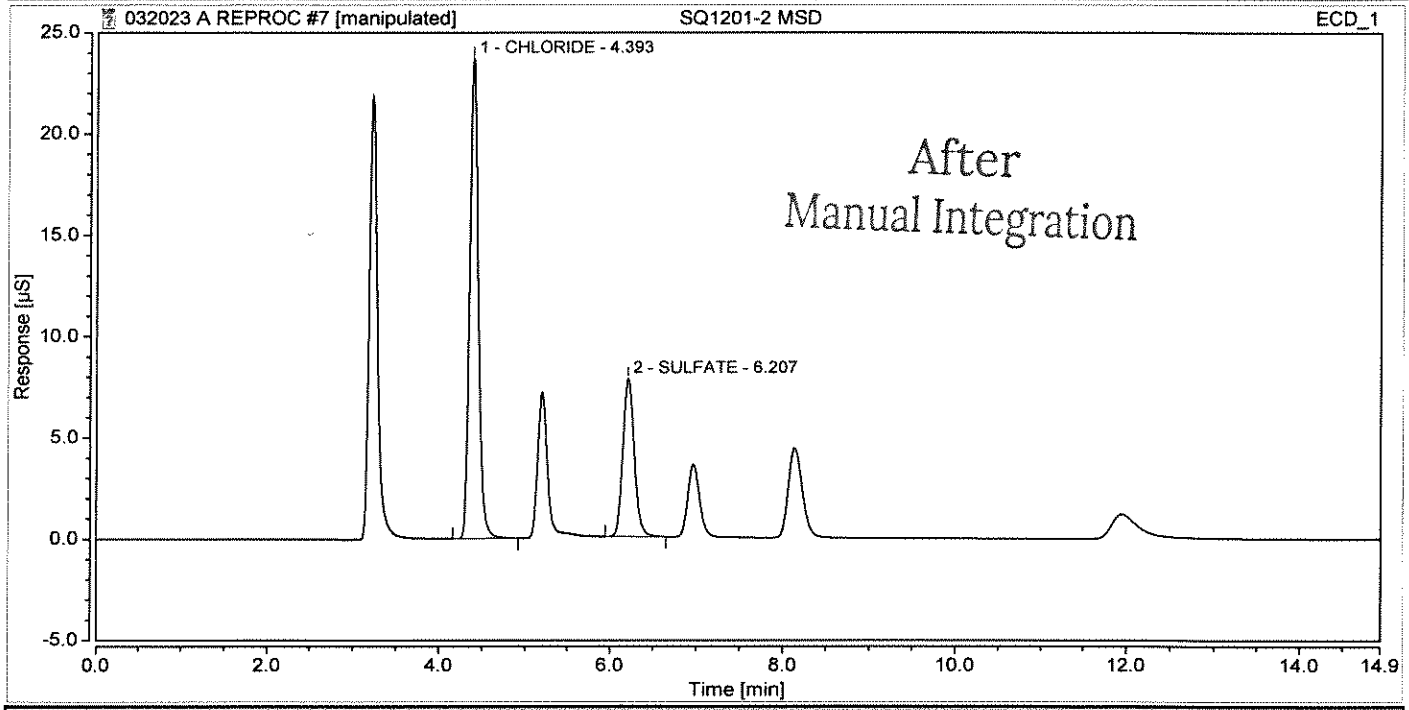
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.230	2.456	21.827	26.51	31.33	4.1698	n.a.
2	CHLORIDE	4.393	2.748	23.705	29.65	34.02	7.3954	n.a.
3	NITRITE	5.200	0.918	7.073	9.91	10.15	1.0781	n.a.
4		5.503	0.001	0.007	0.01	0.01	n.a.	n.a.
5	SULFATE	6.207	1.222	7.800	13.18	11.19	4.4756	n.a.
6	BROMIDE	6.967	0.565	3.584	6.10	5.14	3.4560	n.a.
7		7.420	0.000	0.003	0.00	0.00	n.a.	n.a.
8	NITRATE	8.133	0.849	4.458	9.16	6.40	0.9291	n.a.
9	PHOSPHATE	11.943	0.508	1.222	5.49	1.75	1.3613	n.a.
Total:			**9.268**	**69.678**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-2 MSD**	*Run Time (min):*	**14.95**
Vial Number:	**7**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 18:20**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

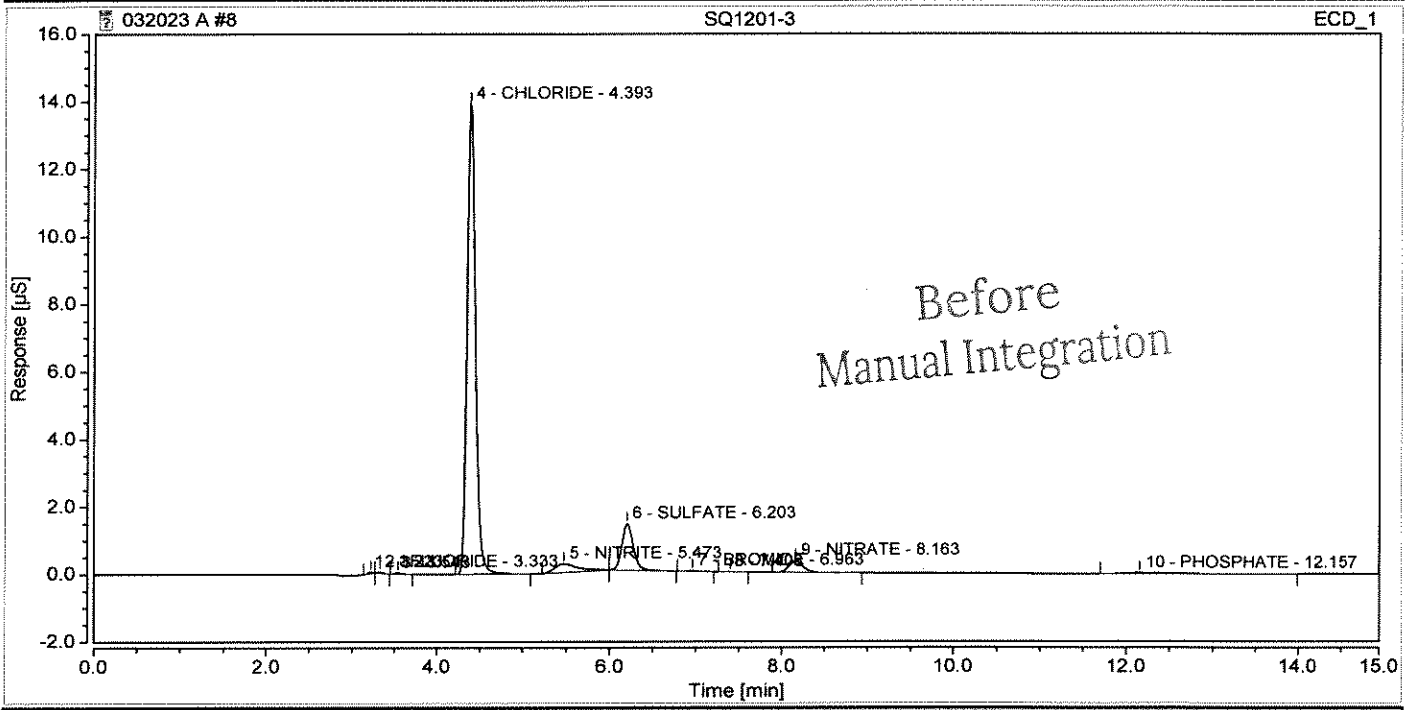
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.393	2.745	23.702	69.26	75.25	7.3873	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	SULFATE	6.207	1.219	7.797	30.74	24.75	4.4641	n.a.
n.a.	BROMIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**3.964**	**31.499**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-3**	*Run Time (min):*	**14.95**
Vial Number:	**8**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 18:37**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

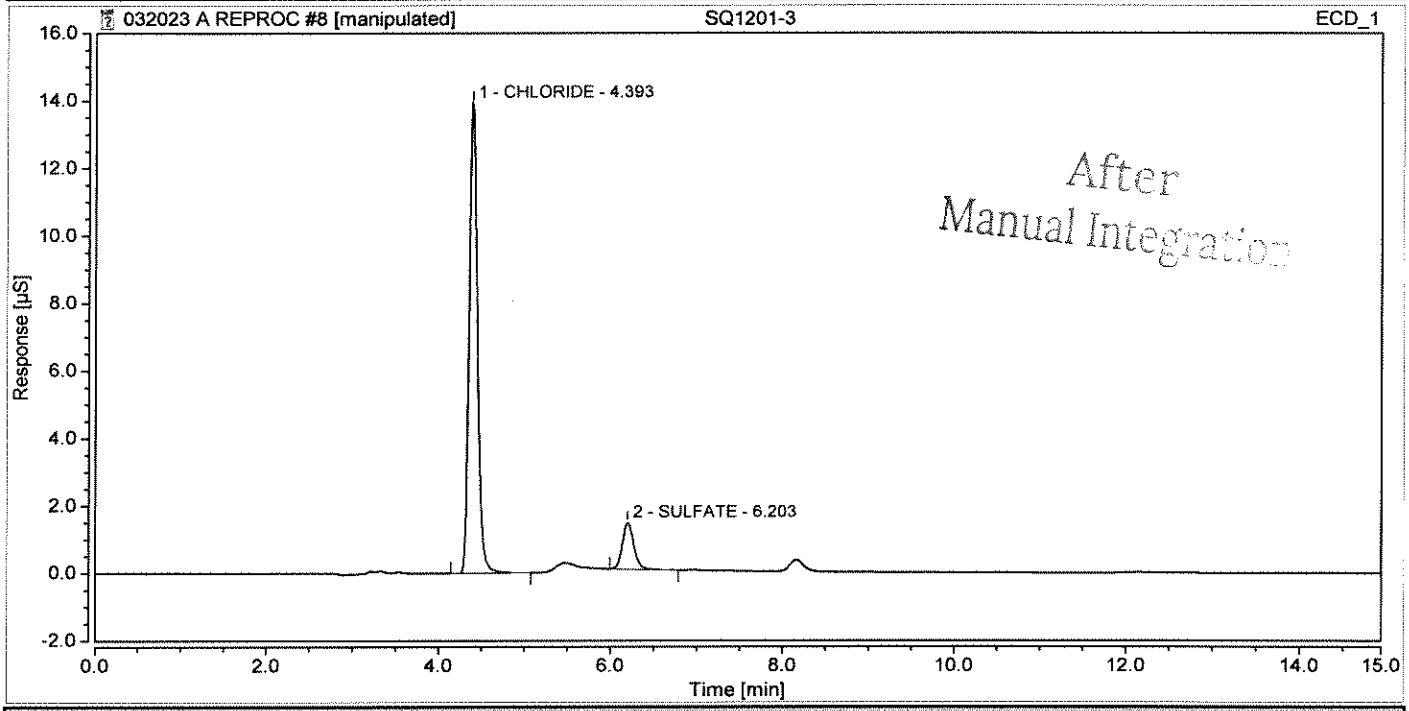
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1		3.223	0.003	0.041	0.15	0.26	n.a.	n.a.
2	FLUORIDE	3.333	0.003	0.036	0.14	0.22	0.0120	n.a.
3		3.543	0.003	0.035	0.17	0.22	n.a.	n.a.
4	CHLORIDE	4.393	1.592	13.931	80.51	86.76	4.2849	n.a.
5	NITRITE	5.473	0.078	0.251	3.96	1.56	0.0827	n.a.
6	SULFATE	6.203	0.214	1.376	10.83	8.57	0.7847	n.a.
7	BROMIDE	6.963	0.003	0.016	0.13	0.10	0.0160	n.a.
8		7.403	0.000	0.001	0.01	0.01	n.a.	n.a.
9	NITRATE	8.163	0.066	0.347	3.35	2.16	0.0726	n.a.
10	PHOSPHATE	12.157	0.015	0.023	0.74	0.14	0.0391	n.a.
Total:			**1.978**	**16.058**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-3**	*Run Time (min):*	**14.95**
Vial Number:	**8**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 18:37**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

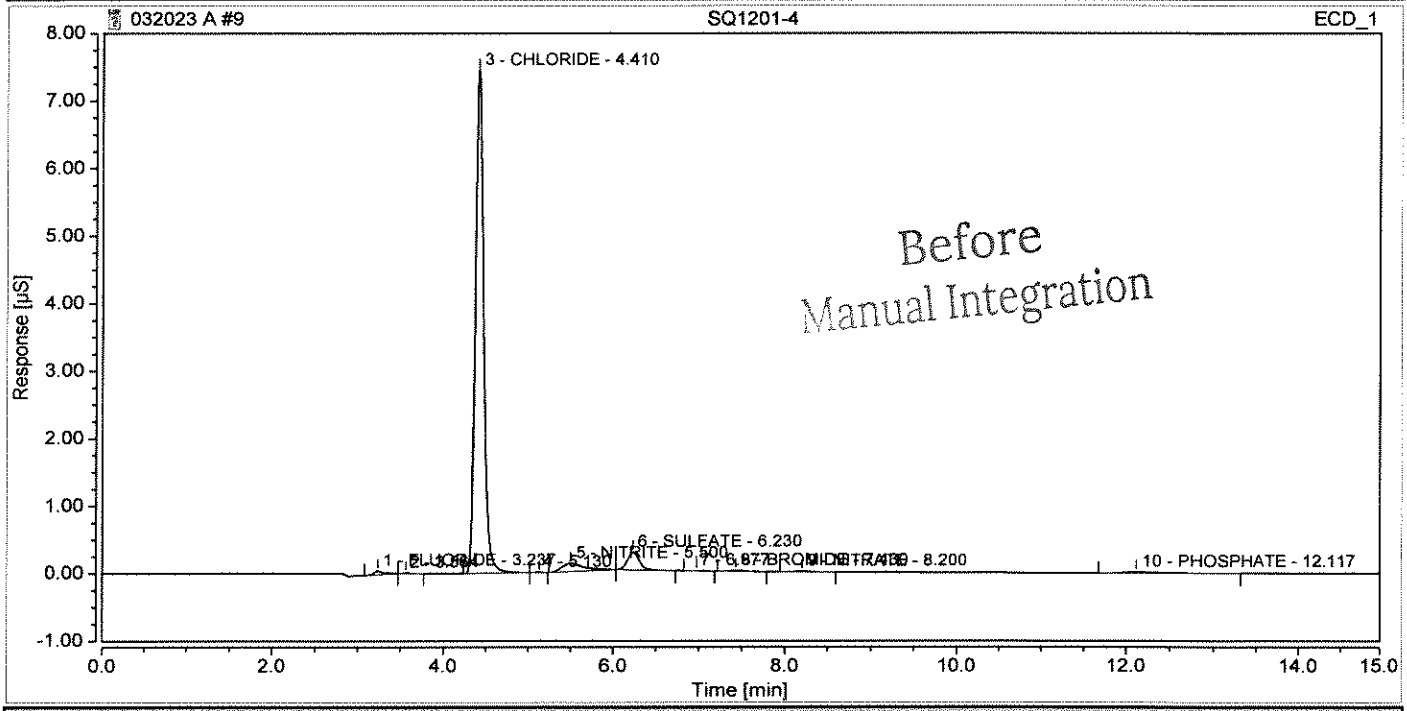
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.393	1.592	13.930	88.14	91.01	4.2829	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	SULFATE	6.203	0.214	1.376	11.86	8.99	0.7847	n.a.
n.a.	BROMIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**1.806**	**15.305**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-4**	*Run Time (min):*	**14.95**
Vial Number:	**9**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 18:55**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

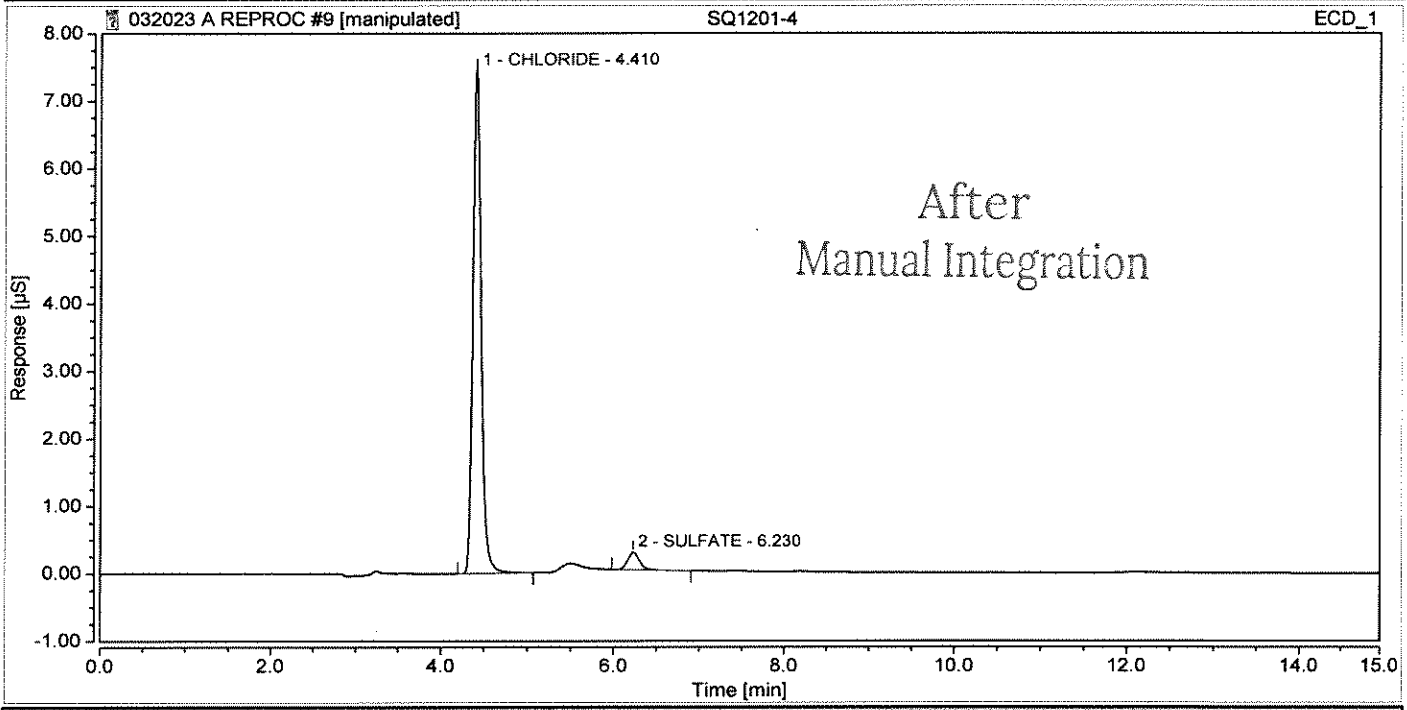
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.237	0.007	0.055	0.75	0.70	0.0190	n.a.
2		3.564	0.001	0.008	0.09	0.10	n.a.	n.a.
3	CHLORIDE	4.410	0.850	7.448	89.47	93.90	2.2874	n.a.
4		5.130	0.000	0.003	0.03	0.04	n.a.	n.a.
5	NITRITE	5.500	0.037	0.121	3.91	1.53	0.0341	n.a.
6	SULFATE	6.230	0.042	0.259	4.42	3.26	0.1538	n.a.
7		6.977	0.001	0.003	0.05	0.04	n.a.	n.a.
8	BROMIDE	7.430	0.002	0.010	0.22	0.13	0.0130	n.a.
9	NITRATE	8.200	0.002	0.010	0.21	0.13	0.0022	n.a.
10	PHOSPHATE	12.117	0.008	0.014	0.83	0.18	0.0211	n.a.
Total:			**0.950**	**7.932**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-4**	*Run Time (min):*	**14.95**
Vial Number:	**9**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 18:55**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

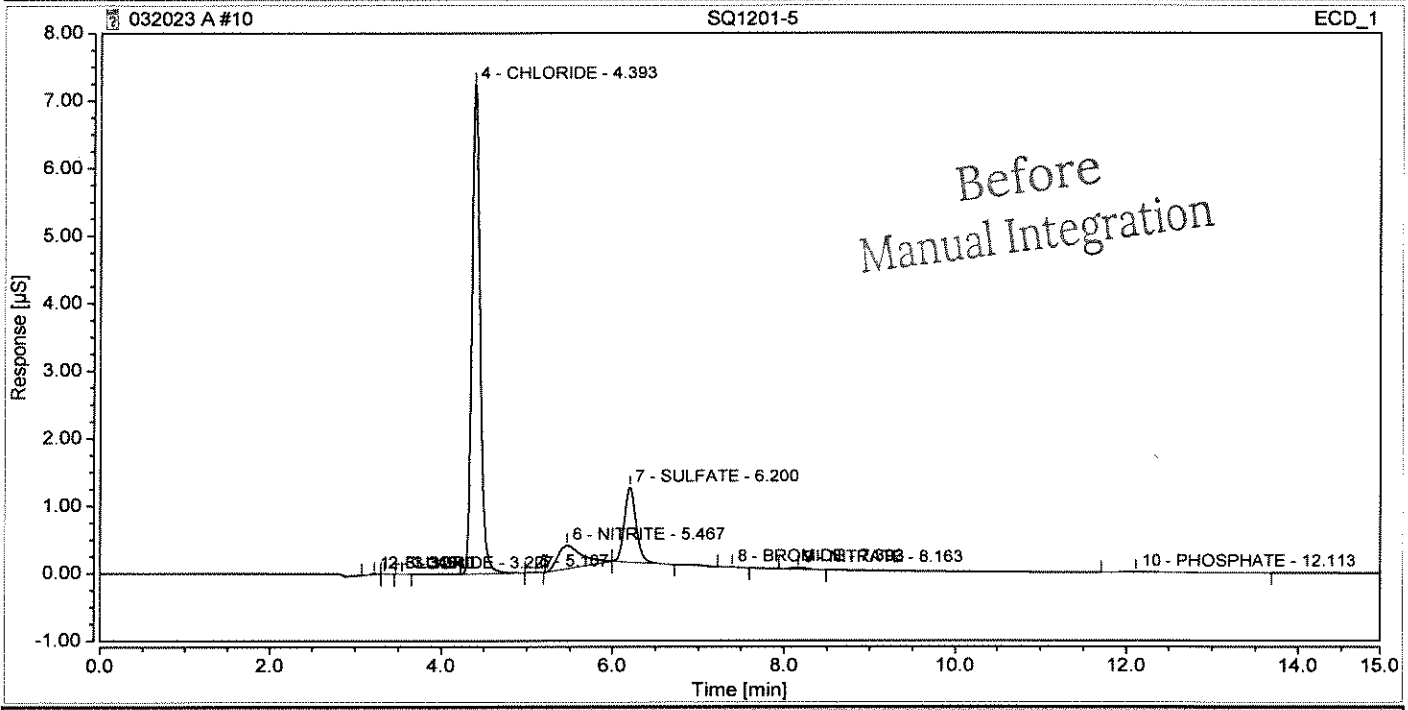
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.410	0.850	7.447	95.36	96.65	2.2866	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	SULFATE	6.230	0.041	0.258	4.64	3.35	0.1513	n.a.
n.a.	BROMIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**0.891**	**7.705**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-5**	*Run Time (min):*	**14.96**
Vial Number:	**10**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 19:12**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

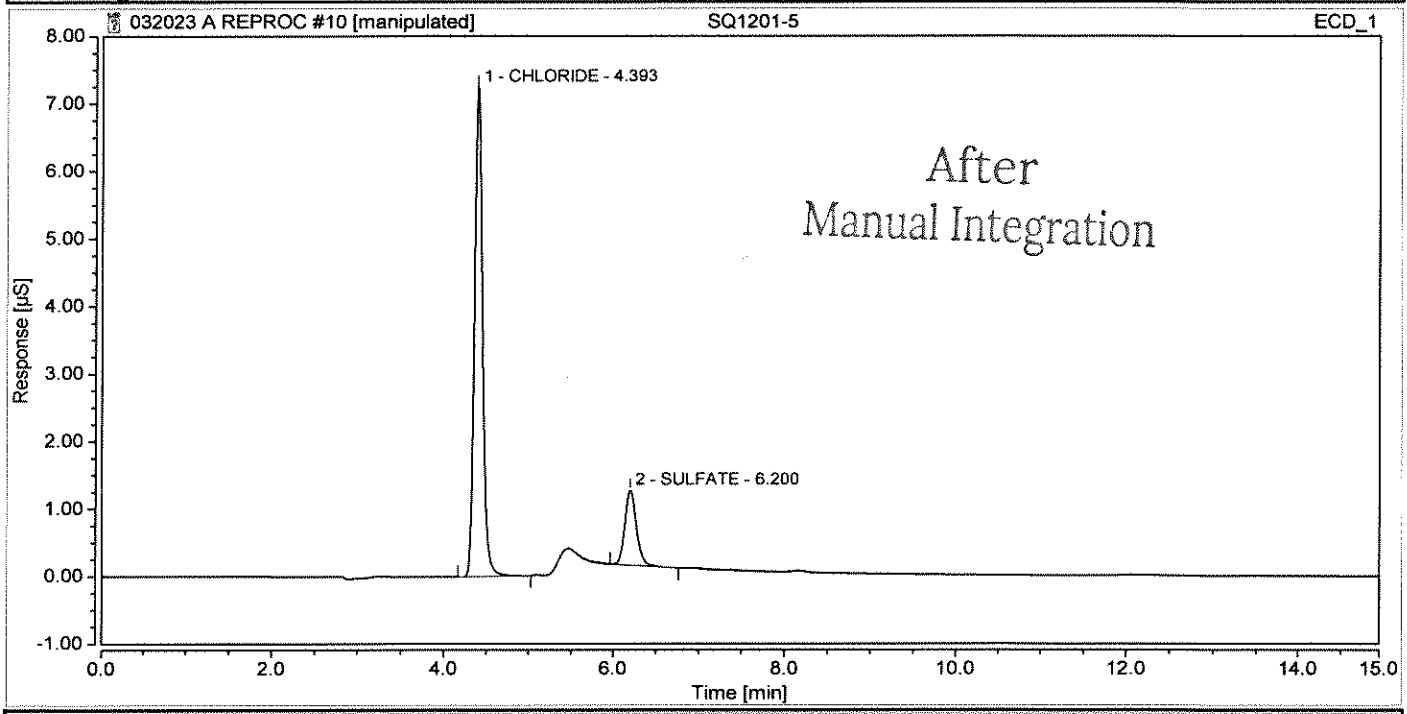
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.227	0.001	0.011	0.08	0.13	0.0088	n.a.
2		3.340	0.000	0.003	0.02	0.03	n.a.	n.a.
3		3.540	0.000	0.001	0.01	0.02	n.a.	n.a.
4	CHLORIDE	4.393	0.817	7.252	73.13	82.72	2.1991	n.a.
5		5.107	0.001	0.008	0.07	0.09	n.a.	n.a.
6	NITRITE	5.467	0.112	0.345	10.00	3.93	0.1220	n.a.
7	SULFATE	6.200	0.175	1.110	15.67	12.66	0.6416	n.a.
8	BROMIDE	7.393	0.001	0.003	0.05	0.03	0.0032	n.a.
9	NITRATE	8.163	0.004	0.022	0.37	0.26	0.0046	n.a.
10	PHOSPHATE	12.113	0.007	0.012	0.60	0.13	0.0179	n.a.
Total:			**1.118**	**8.767**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-5**	*Run Time (min):*	**14.96**
Vial Number:	**10**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 19:12**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

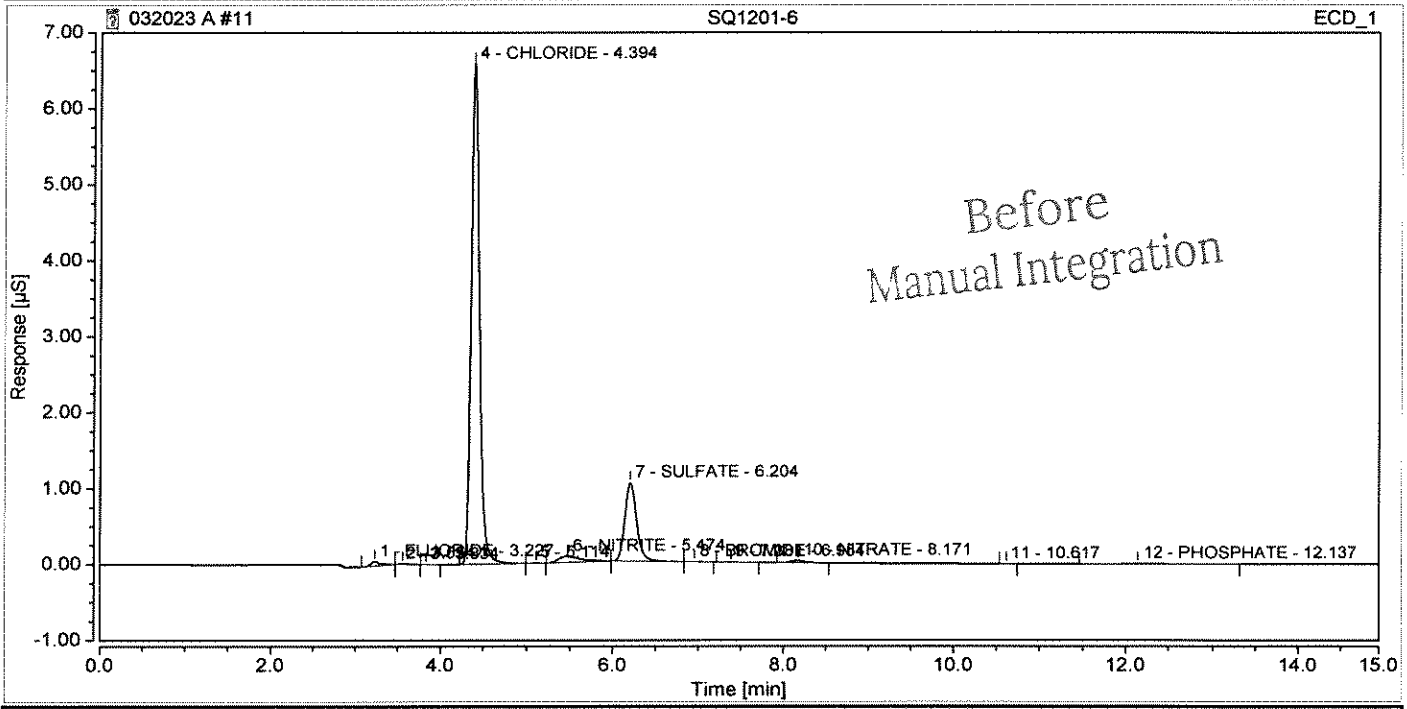
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.393	0.816	7.250	82.31	86.72	2.1951	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	SULFATE	6.200	0.175	1.110	17.69	13.28	0.6421	n.a.
n.a.	BROMIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**0.991**	**8.361**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-6**	*Run Time (min):*	**14.95**
Vial Number:	**11**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 19:29**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

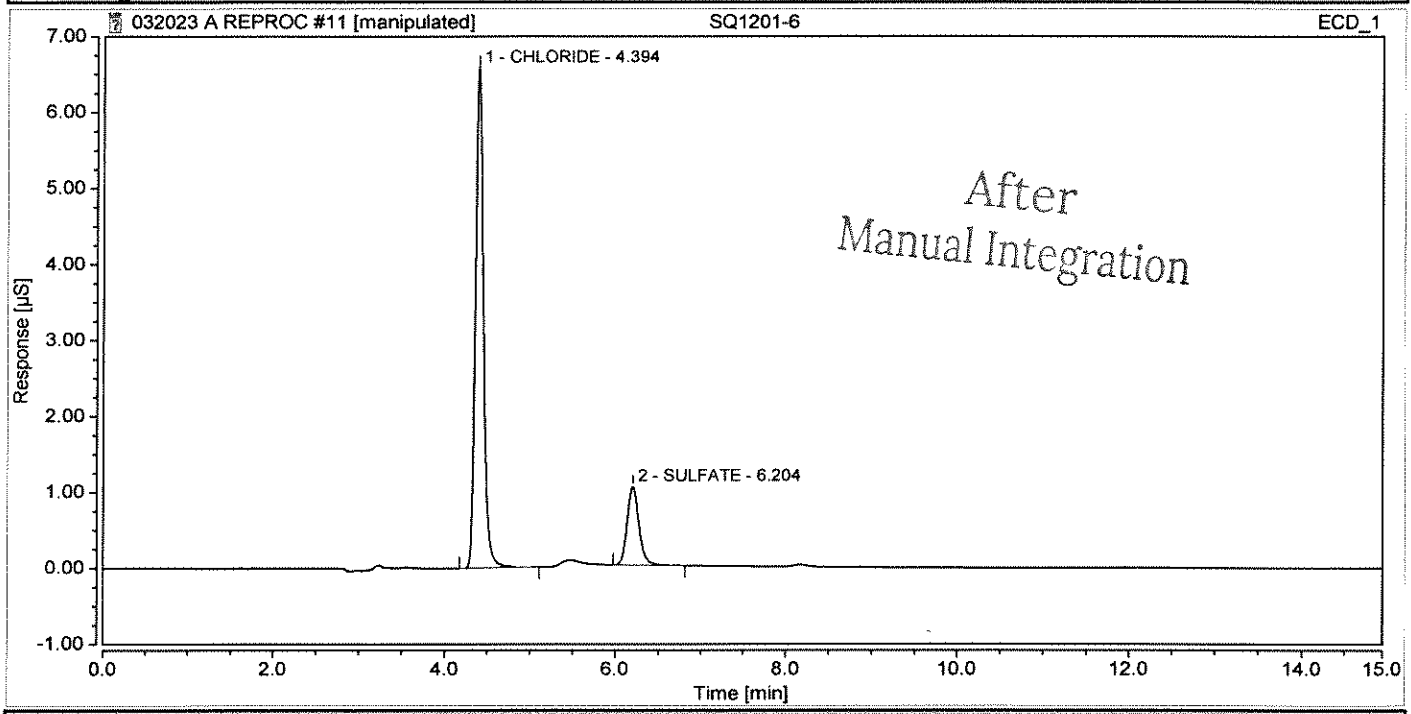
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.227	0.008	0.058	0.82	0.75	0.0201	n.a.
2		3.554	0.001	0.009	0.12	0.12	n.a.	n.a.
3		3.834	0.000	0.001	0.01	0.01	n.a.	n.a.
4	CHLORIDE	4.394	0.745	6.585	78.11	84.23	2.0049	n.a.
5		5.114	0.001	0.005	0.06	0.06	n.a.	n.a.
6	NITRITE	5.474	0.024	0.082	2.55	1.05	0.0190	n.a.
7	SULFATE	6.204	0.164	1.036	17.24	13.25	0.6022	n.a.
8	BROMIDE	6.954	0.000	0.003	0.04	0.03	0.0024	n.a.
9		7.381	0.001	0.003	0.07	0.04	n.a.	n.a.
10	NITRATE	8.171	0.006	0.029	0.58	0.37	0.0061	n.a.
11		10.617	0.000	0.000	0.00	0.00	n.a.	n.a.
12	PHOSPHATE	12.137	0.004	0.007	0.41	0.09	0.0105	n.a.
Total:			**0.954**	**7.818**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-6**	*Run Time (min):*	**14.95**
Vial Number:	**11**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 19:29**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

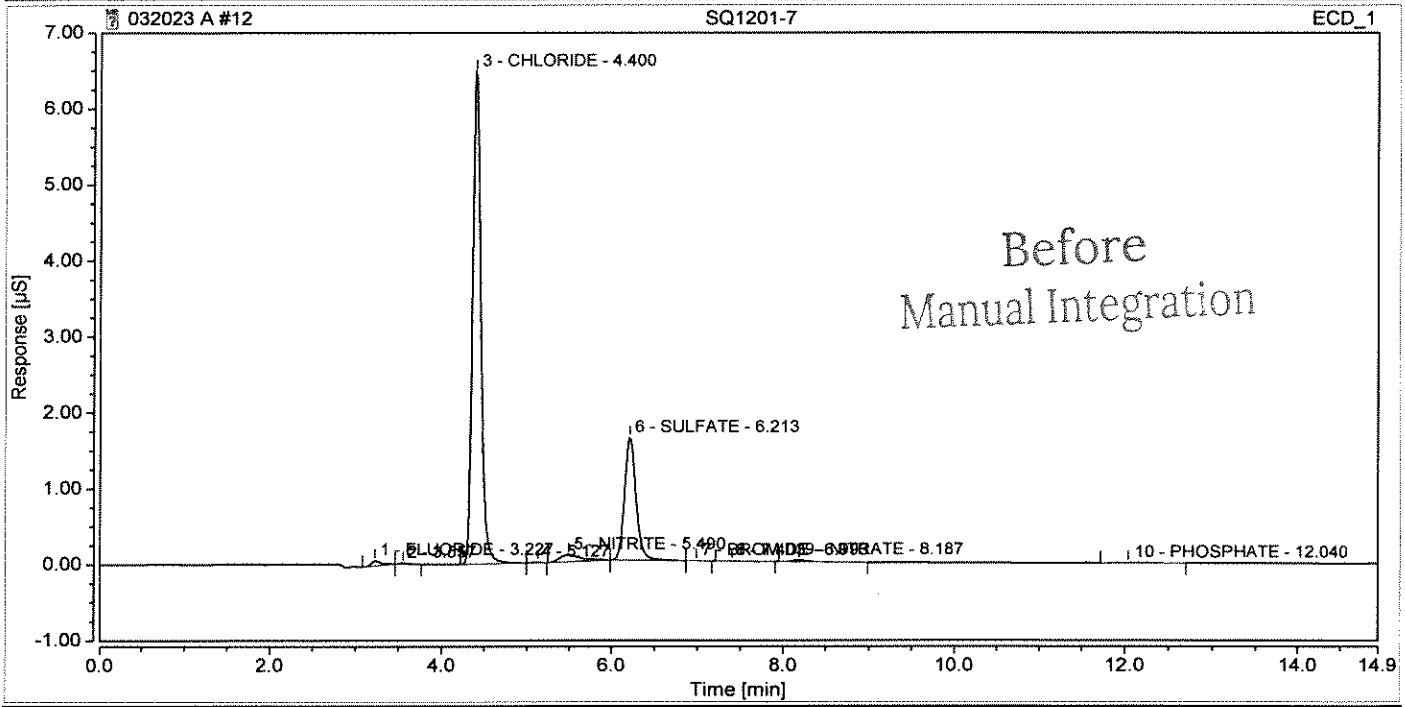
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.394	0.743	6.584	81.89	86.41	2.0003	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	SULFATE	6.204	0.164	1.036	18.11	13.59	0.6021	n.a.
n.a.	BROMIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**0.908**	**7.619**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-7**	*Run Time (min):*	**14.95**
Vial Number:	**12**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 19:46**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

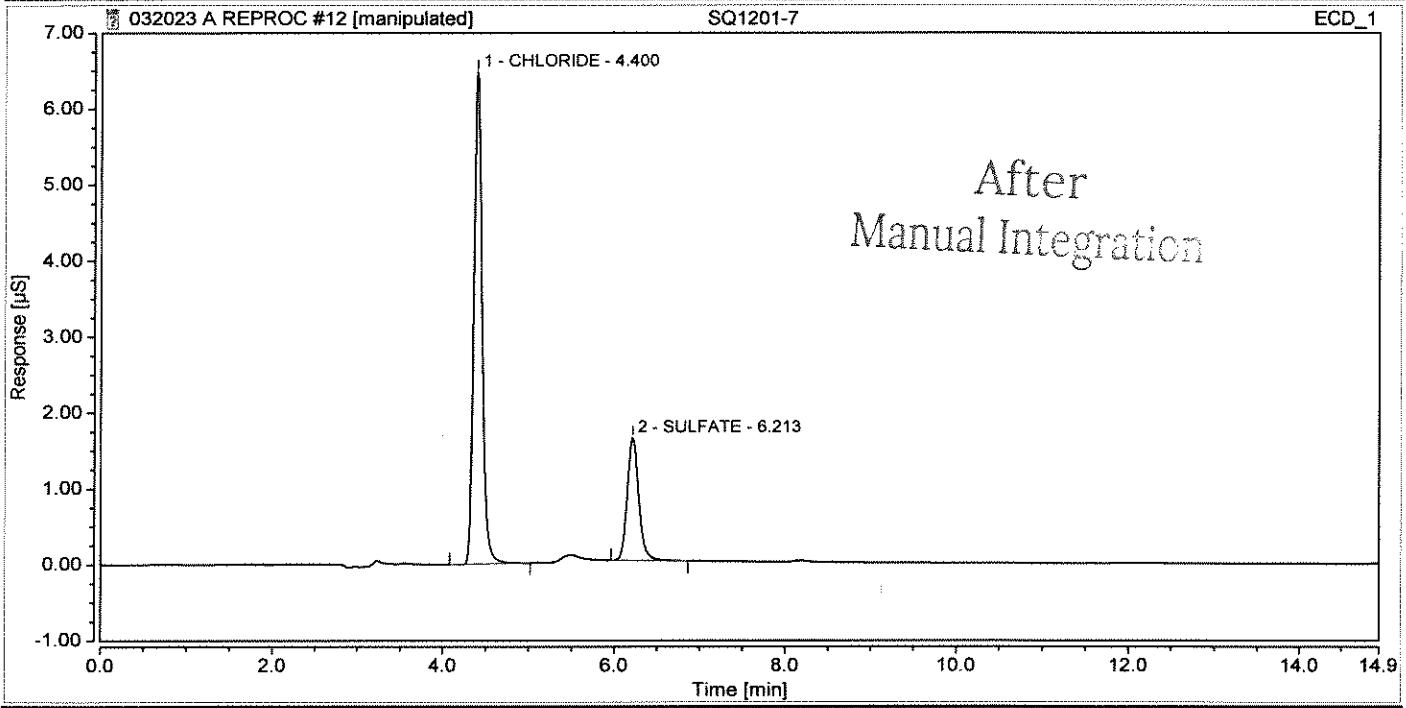
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.227	0.009	0.067	0.88	0.81	0.0223	n.a.
2		3.557	0.001	0.013	0.14	0.15	n.a.	n.a.
3	CHLORIDE	4.400	0.737	6.483	70.95	78.05	1.9823	n.a.
4		5.127	0.001	0.006	0.07	0.07	n.a.	n.a.
5	NITRITE	5.490	0.026	0.090	2.54	1.08	0.0214	n.a.
6	SULFATE	6.213	0.256	1.615	24.65	19.45	0.9374	n.a.
7	BROMIDE	6.993	0.000	0.001	0.02	0.02	0.0012	n.a.
8		7.403	0.001	0.005	0.12	0.07	n.a.	n.a.
9	NITRATE	8.187	0.005	0.021	0.45	0.25	0.0051	n.a.
10	PHOSPHATE	12.040	0.002	0.004	0.18	0.05	0.0050	n.a.
Total:			**1.038**	**8.306**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-7**	*Run Time (min):*	**14.95**
Vial Number:	**12**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 19:46**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

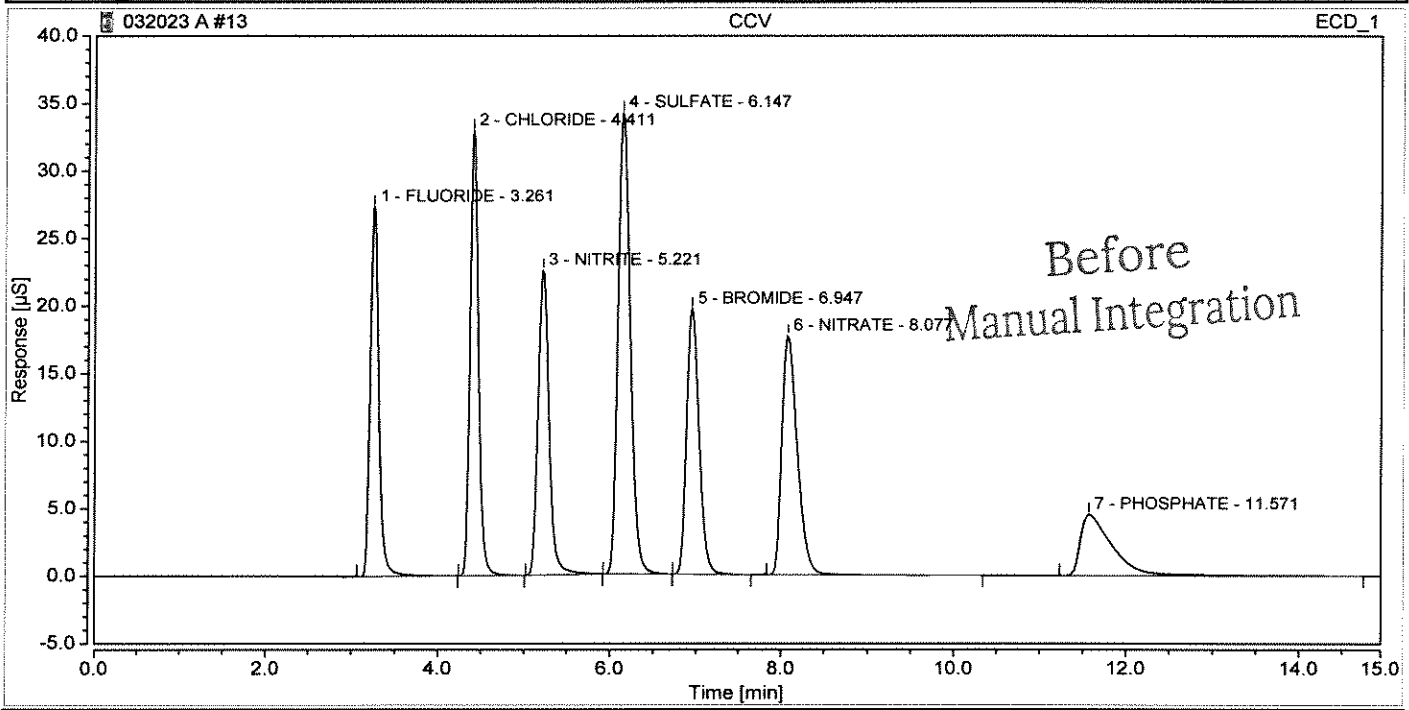
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.400	0.735	6.481	74.19	80.05	1.9789	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	SULFATE	6.213	0.256	1.615	25.81	19.95	0.9373	n.a.
n.a.	BROMIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**0.991**	**8.096**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**CCV**	*Run Time (min):*	**14.95**
Vial Number:	**13**	*Injection Volume:*	**200.00**
Injection Type:	**Check Standard**	*Channel:*	**ECD_1**
Calibration Level:	**06**	*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 20:04**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

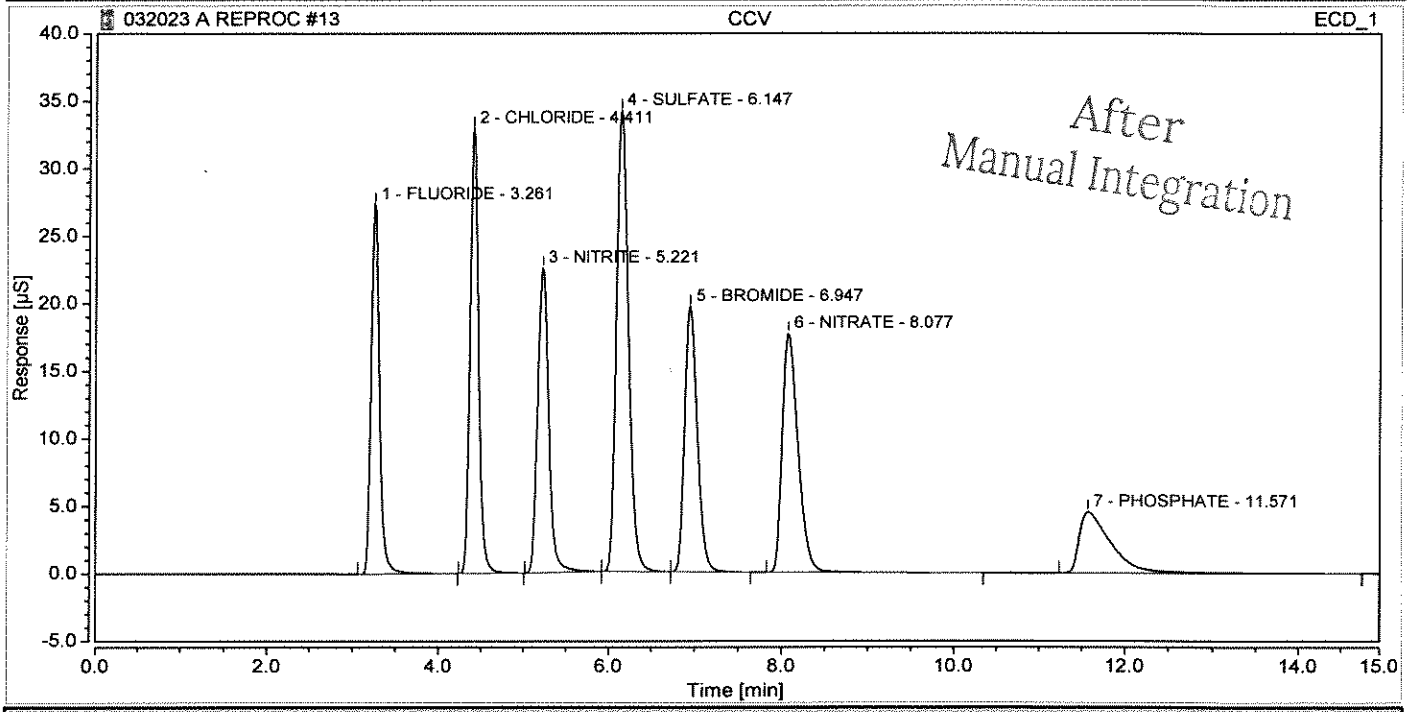
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.261	3.105	27.353	12.42	17.22	5.3158	6.3164
2	CHLORIDE	4.411	3.829	32.941	15.32	20.74	10.3027	3.0272
3	NITRITE	5.221	3.433	22.551	13.73	14.20	4.1318	3.2954
4	SULFATE	6.147	5.620	34.141	22.48	21.49	20.5862	2.9310
5	BROMIDE	6.947	3.333	19.634	13.33	12.36	20.3869	1.9343
6	NITRATE	8.077	3.718	17.695	14.87	11.14	4.0702	1.7553
7	PHOSPHATE	11.571	1.960	4.530	7.84	2.85	5.2483	4.9664
Total:			**24.997**	**158.846**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**CCV**	*Run Time (min):*	**14.95**
Vial Number:	**13**	*Injection Volume:*	**200.00**
Injection Type:	**Check Standard**	*Channel:*	**ECD_1**
Calibration Level:	**06**	*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 20:04**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

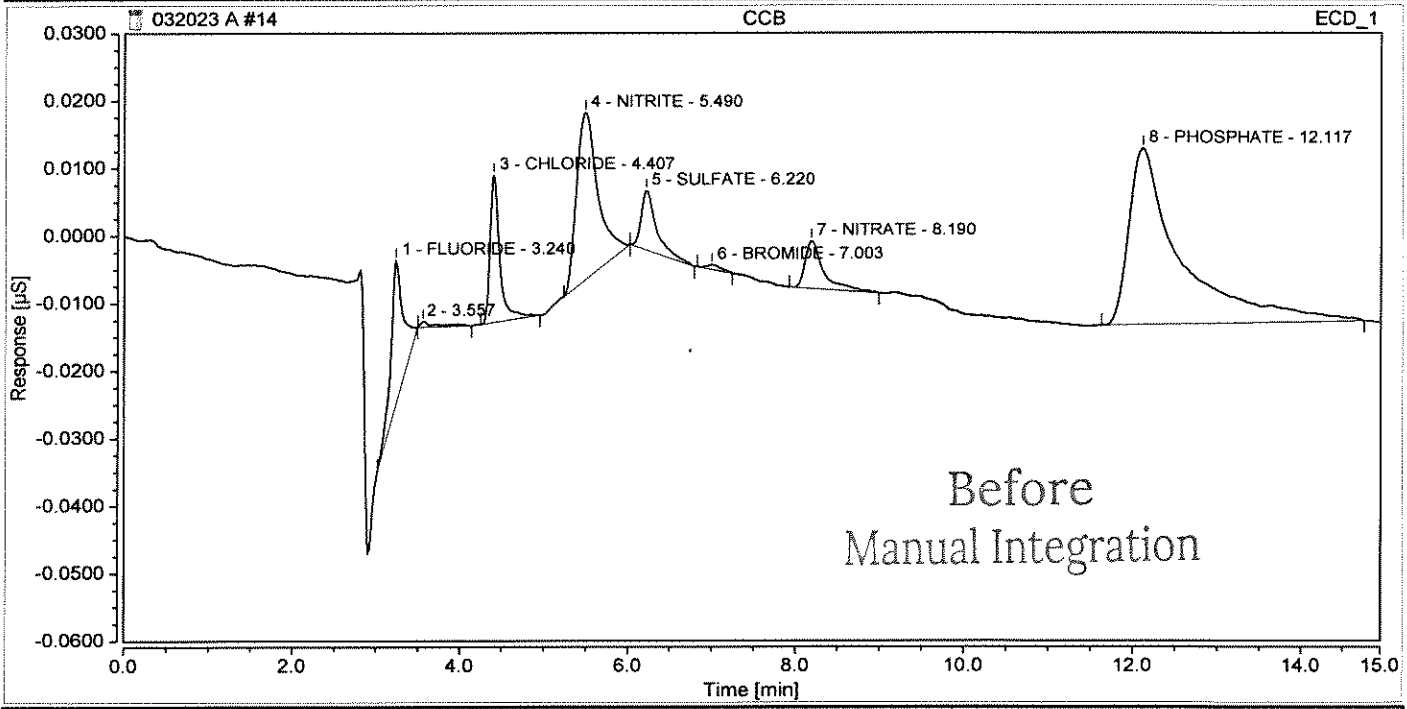
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.261	3.105	27.353	12.42	17.22	5.3158	6.3164
2	CHLORIDE	4.411	3.829	32.941	15.32	20.74	10.3027	3.0272
3	NITRITE	5.221	3.433	22.551	13.73	14.20	4.1318	3.2954
4	SULFATE	6.147	5.620	34.141	22.48	21.49	20.5862	2.9310
5	BROMIDE	6.947	3.333	19.634	13.33	12.36	20.3869	1.9343
6	NITRATE	8.077	3.718	17.695	14.87	11.14	4.0702	1.7553
7	PHOSPHATE	11.571	1.960	4.530	7.84	2.85	5.2483	4.9664
Total:			**24.997**	**158.846**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**CCB**	*Run Time (min):*	**14.96**
Vial Number:	**14**	*Injection Volume:*	**200.00**
Injection Type:	**Blank**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 20:21**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

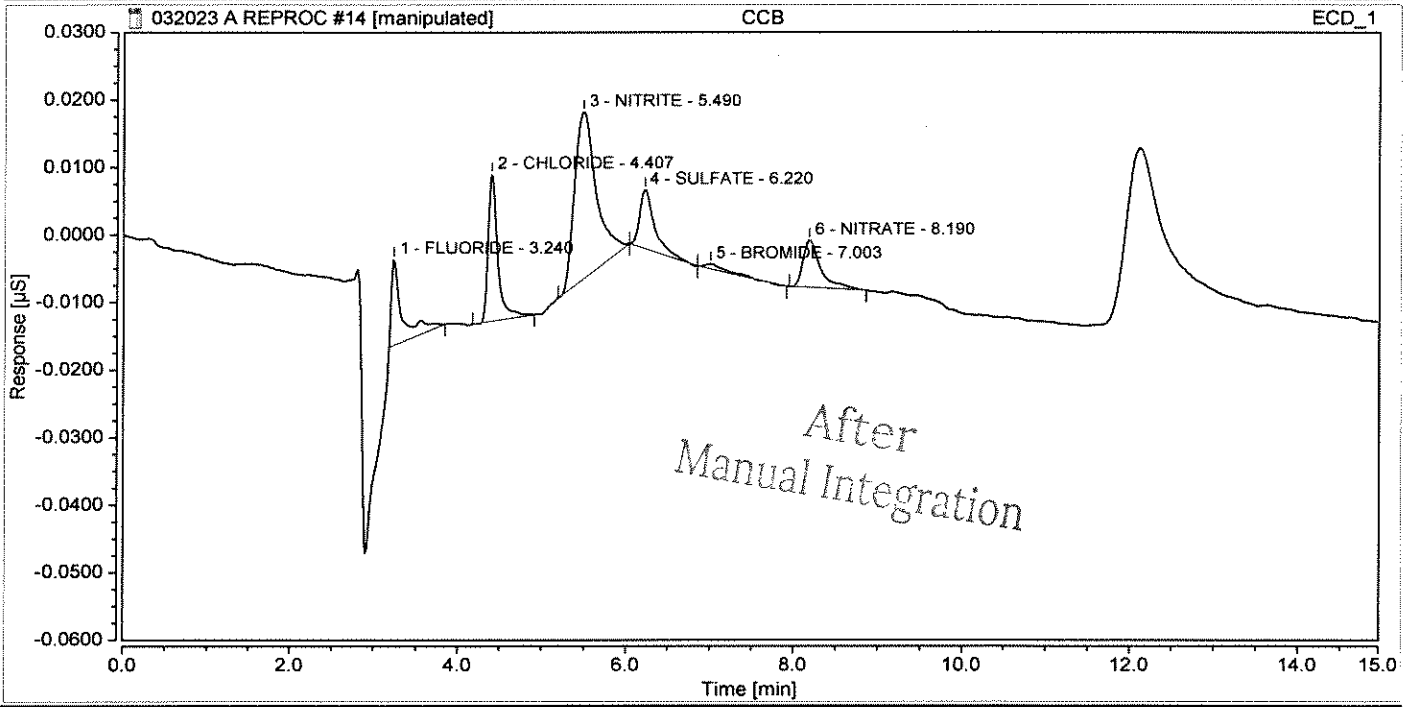
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.240	0.003	0.021	9.58	19.12	0.0130	n.a.
2		3.557	0.000	0.001	0.51	0.74	n.a.	n.a.
3	CHLORIDE	4.407	0.003	0.022	8.10	19.62	0.0079	n.a.
4	NITRITE	5.490	0.007	0.025	20.07	22.21	n.a.	n.a.
5	SULFATE	6.220	0.002	0.009	5.21	7.93	0.0070	n.a.
6	BROMIDE	7.003	0.000	0.001	0.38	0.64	0.0009	n.a.
7	NITRATE	8.190	0.002	0.007	4.91	6.34	0.0020	n.a.
8	PHOSPHATE	12.117	0.019	0.026	51.24	23.42	0.0500	n.a.
Total:			**0.036**	**0.111**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**CCB**	*Run Time (min):*	**14.96**
Vial Number:	**14**	*Injection Volume:*	**200.00**
Injection Type:	**Blank**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 20:21**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

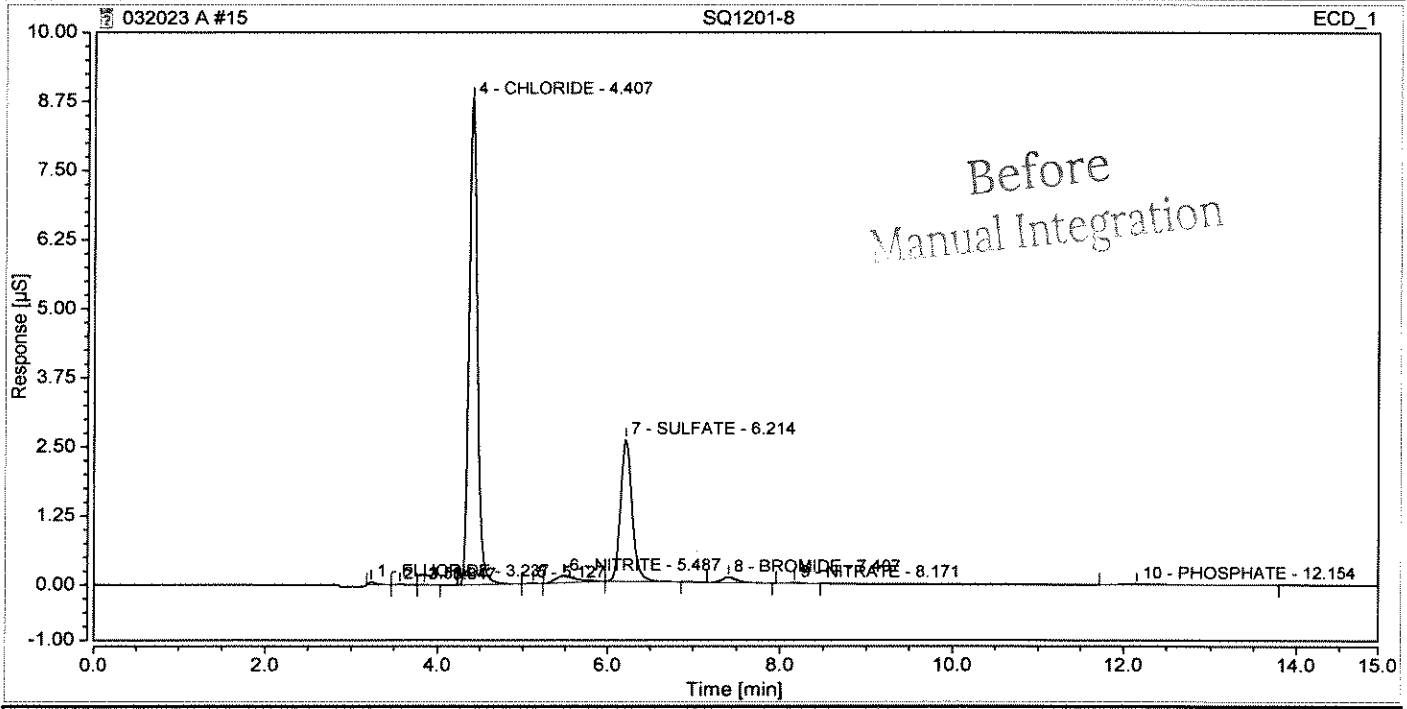
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.240	0.002	0.013	11.94	16.85	0.0104	n.a.
2	CHLORIDE	4.407	0.003	0.022	18.44	28.76	0.0078	n.a.
3	NITRITE	5.490	0.007	0.025	46.42	32.63	n.a.	n.a.
4	SULFATE	6.220	0.002	0.009	11.47	11.55	0.0066	n.a.
5	BROMIDE	7.003	0.000	0.001	1.24	1.00	0.0012	n.a.
6	NITRATE	8.190	0.002	0.007	10.49	9.21	0.0018	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**0.016**	**0.076**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-8**	*Run Time (min):*	**14.96**
Vial Number:	**15**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 20:38**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

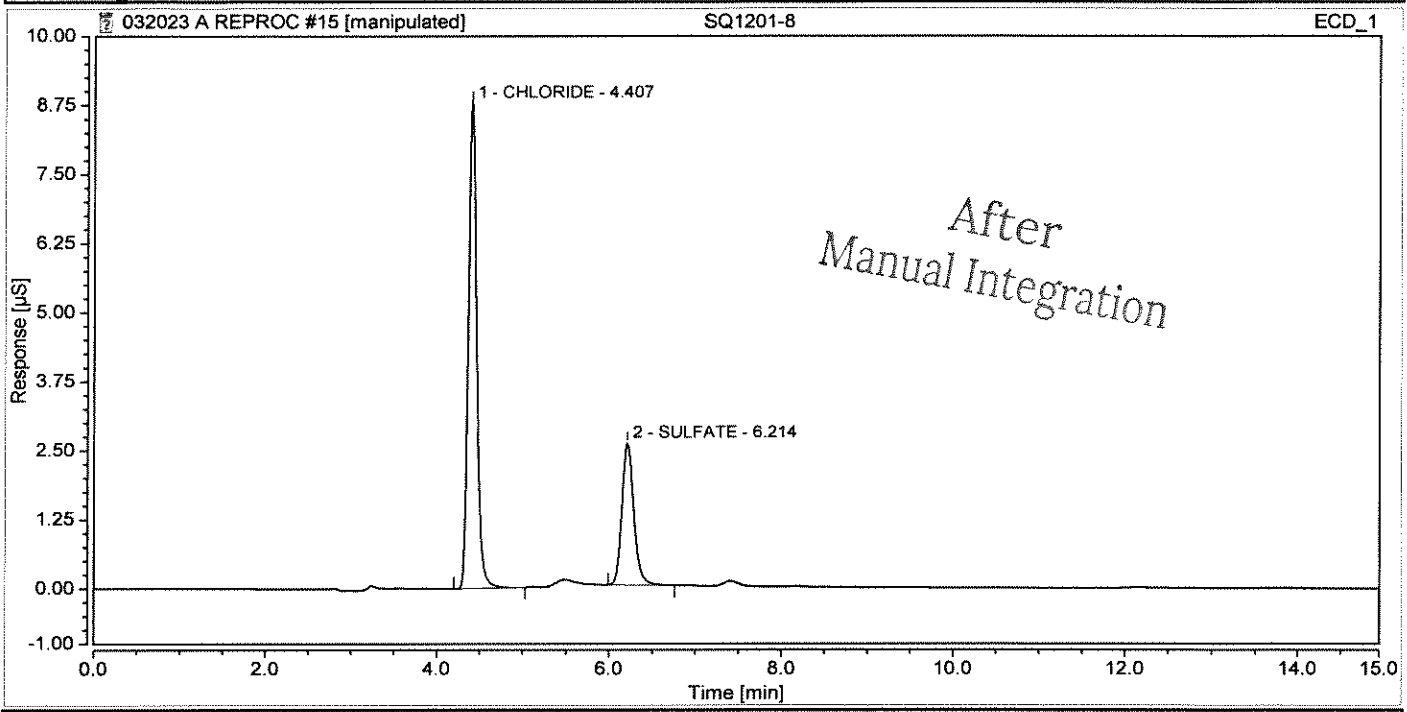
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.237	0.005	0.053	0.33	0.46	0.0154	n.a.
2		3.564	0.001	0.011	0.08	0.09	n.a.	n.a.
3		3.847	0.000	0.001	0.01	0.01	n.a.	n.a.
4	CHLORIDE	4.407	1.002	8.786	67.54	75.27	2.6963	n.a.
5		5.127	0.002	0.014	0.11	0.12	n.a.	n.a.
6	NITRITE	5.487	0.036	0.124	2.42	1.06	0.0326	n.a.
7	SULFATE	6.214	0.410	2.566	27.61	21.98	1.5005	n.a.
8	BROMIDE	7.407	0.019	0.096	1.30	0.83	0.1184	n.a.
9	NITRATE	8.171	0.002	0.009	0.12	0.08	0.0019	n.a.
10	PHOSPHATE	12.154	0.007	0.012	0.47	0.10	0.0189	n.a.
Total:			**1.484**	**11.672**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1201-8**	*Run Time (min):*	**14.96**
Vial Number:	**15**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 20:38**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

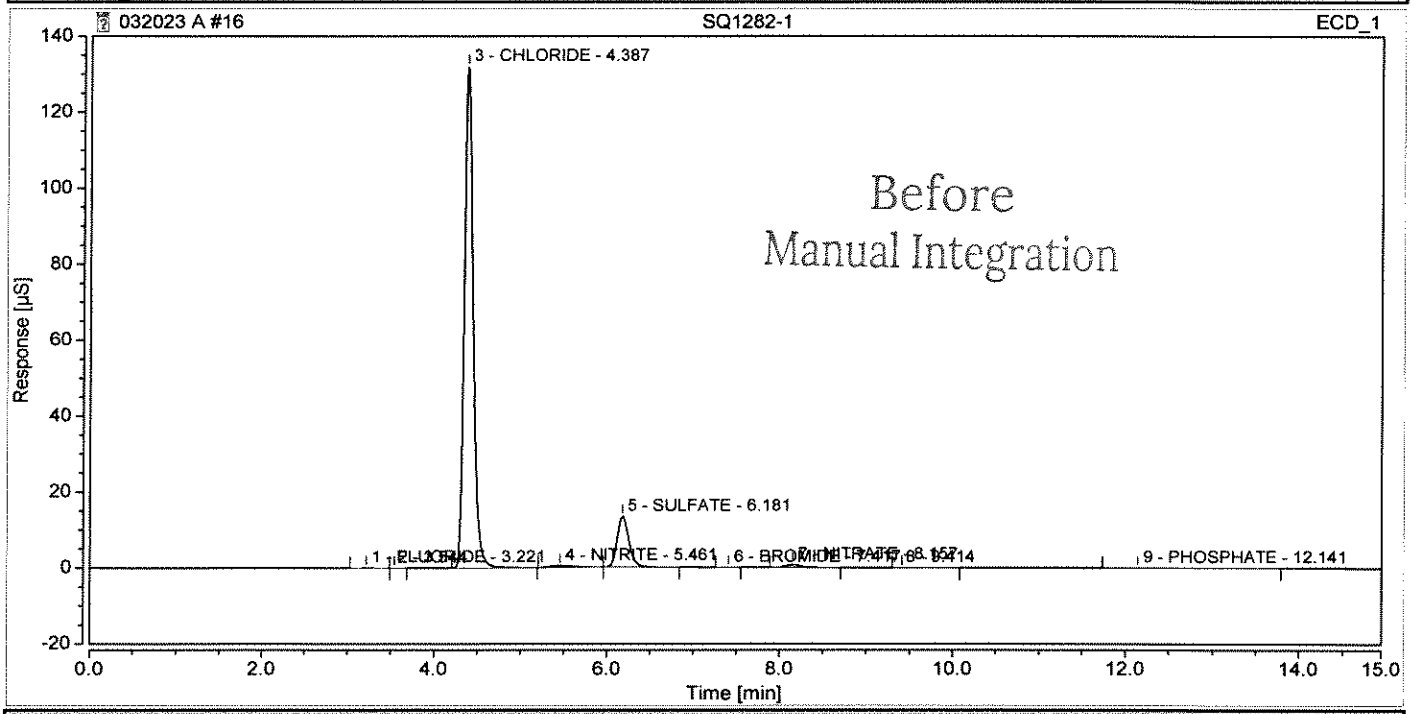
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.407	1.001	8.785	71.03	77.41	2.6934	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	SULFATE	6.214	0.408	2.564	28.97	22.59	1.4953	n.a.
n.a.	BROMIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**1.409**	**11.349**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-1**	*Run Time (min):*	**14.95**
Vial Number:	**16**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 20:56**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

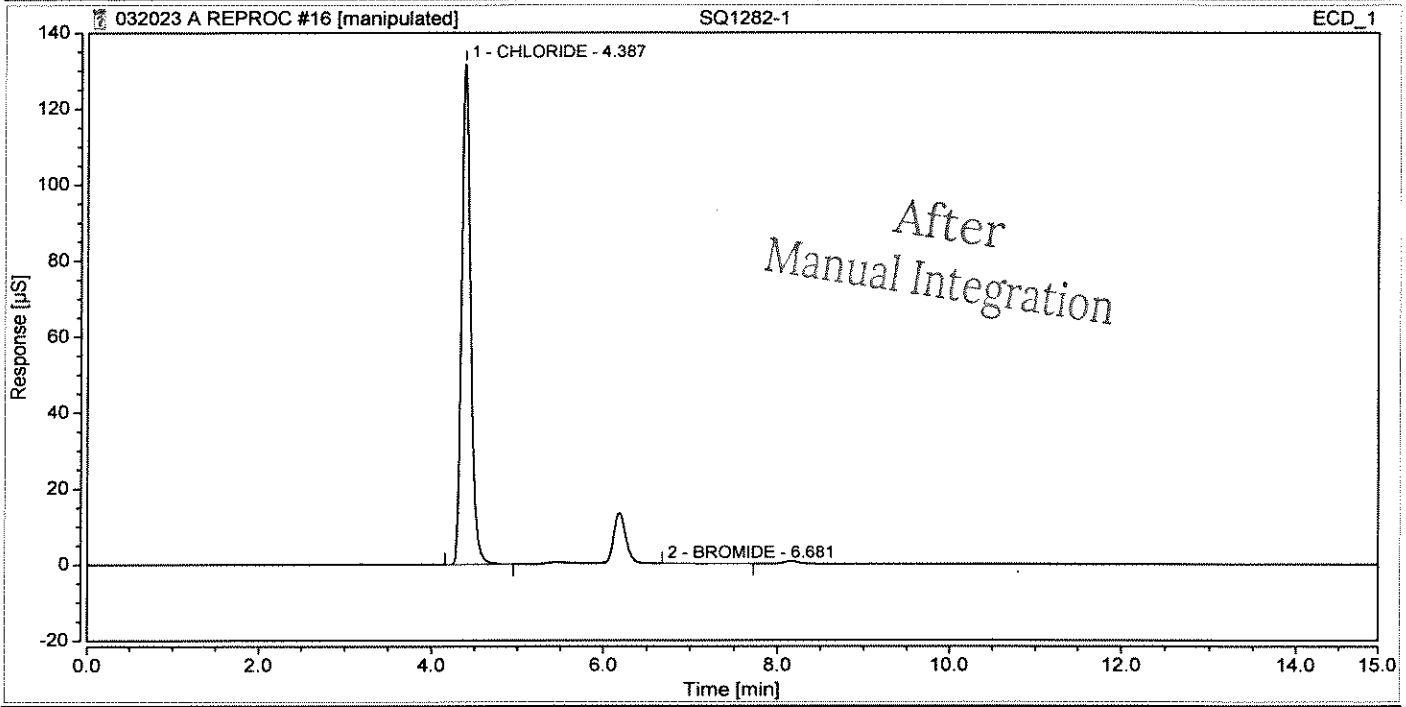
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.221	0.011	0.085	0.06	0.06	0.0251	n.a.
2		3.544	0.000	0.001	0.00	0.00	n.a.	n.a.
3	CHLORIDE	4.387	15.799	132.037	86.64	90.03	42.5144	n.a.
4	NITRITE	5.461	0.141	0.434	0.77	0.30	0.1562	n.a.
5	SULFATE	6.181	2.132	13.328	11.69	9.09	7.8115	n.a.
6	BROMIDE	7.417	0.000	0.001	0.00	0.00	0.0009	n.a.
7	NITRATE	8.157	0.142	0.749	0.78	0.51	0.1551	n.a.
8		9.414	0.001	0.003	0.01	0.00	n.a.	n.a.
9	PHOSPHATE	12.141	0.009	0.014	0.05	0.01	0.0230	n.a.
Total:			**18.235**	**146.652**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-1**	*Run Time (min):*	**14.95**
Vial Number:	**16**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 20:56**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

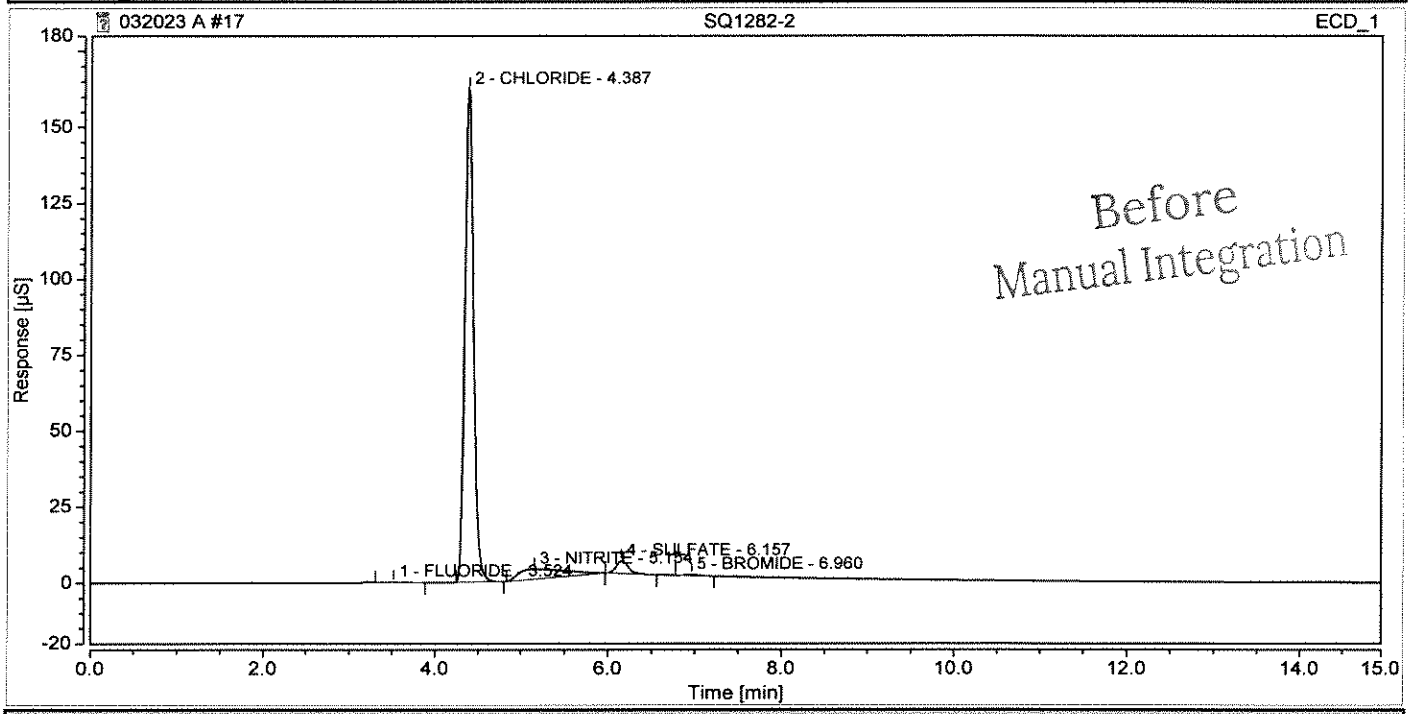
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.387	15.773	132.021	99.96	100.00	42.4450	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	SULFATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	BROMIDE	6.681	0.006	0.000	0.04	0.00	0.0365	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**15.779**	**132.021**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-2**	*Run Time (min):*	**14.95**
Vial Number:	**17**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 21:13**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

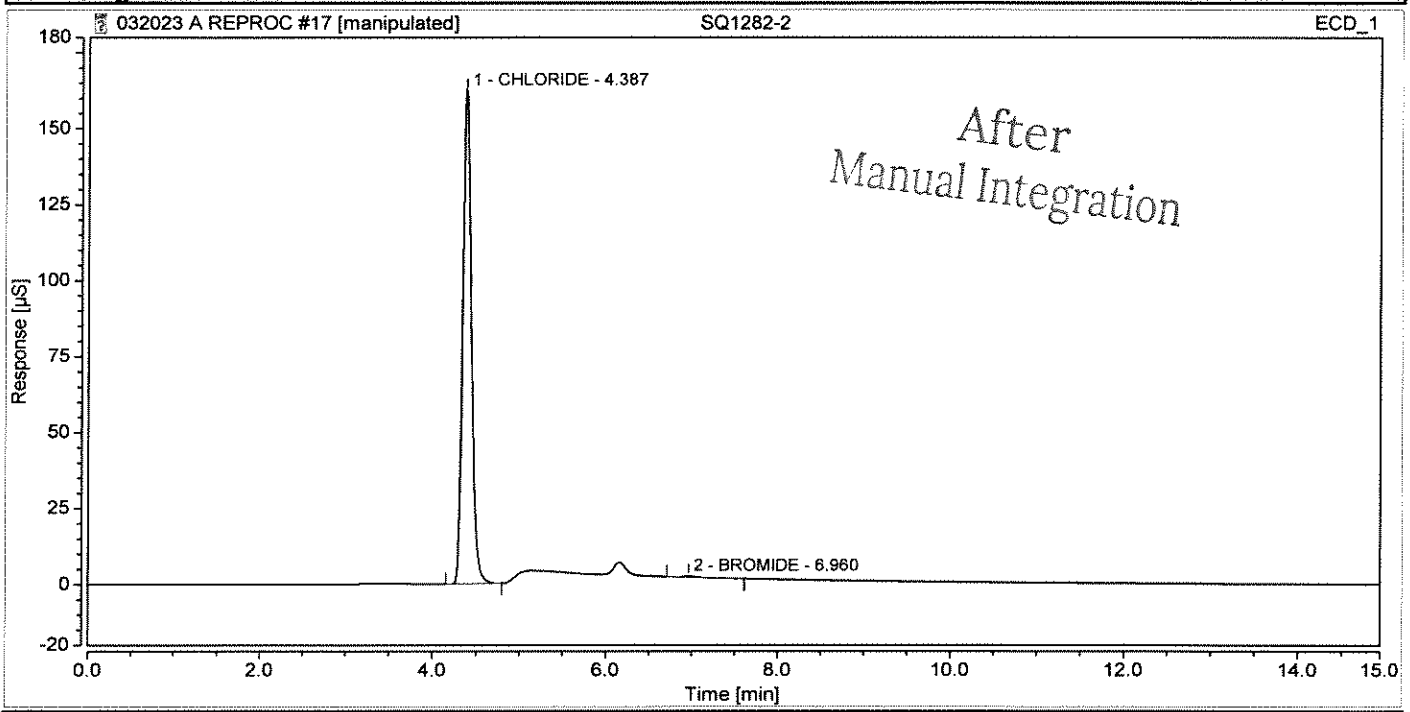
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.524	0.042	0.181	0.19	0.11	0.0758	n.a.
2	CHLORIDE	4.387	18.974	162.238	87.08	95.31	51.0577	n.a.
3	NITRITE	5.154	2.039	3.314	9.36	1.95	2.4246	n.a.
4	SULFATE	6.157	0.685	4.179	3.14	2.46	2.5103	n.a.
5	BROMIDE	6.960	0.051	0.312	0.23	0.18	0.3089	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**21.790**	**170.224**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-2**	*Run Time (min):*	**14.95**
Vial Number:	**17**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 21:13**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

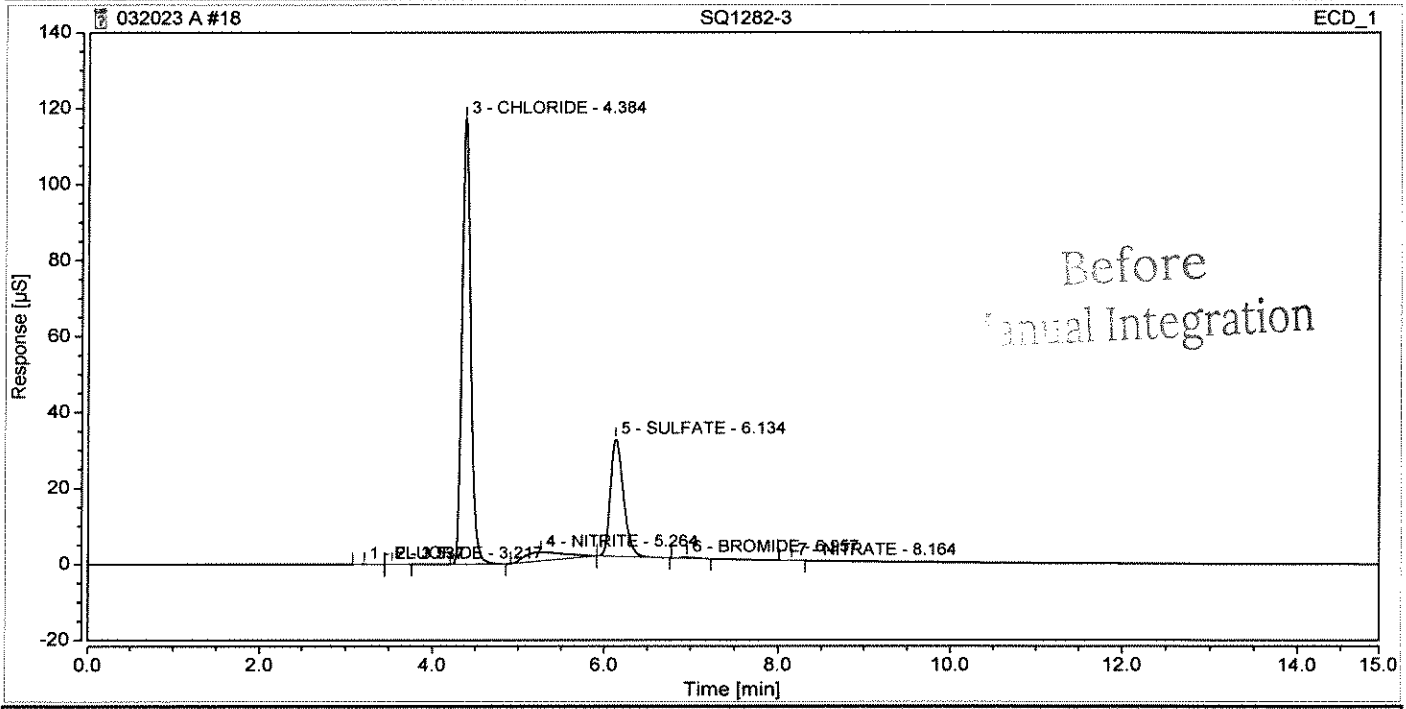
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.387	19.009	162.337	99.78	99.82	51.1532	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	SULFATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	BROMIDE	6.960	0.041	0.300	0.22	0.18	0.2536	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**19.051**	**162.638**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-3**	*Run Time (min):*	**14.95**
Vial Number:	**18**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 21:30**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

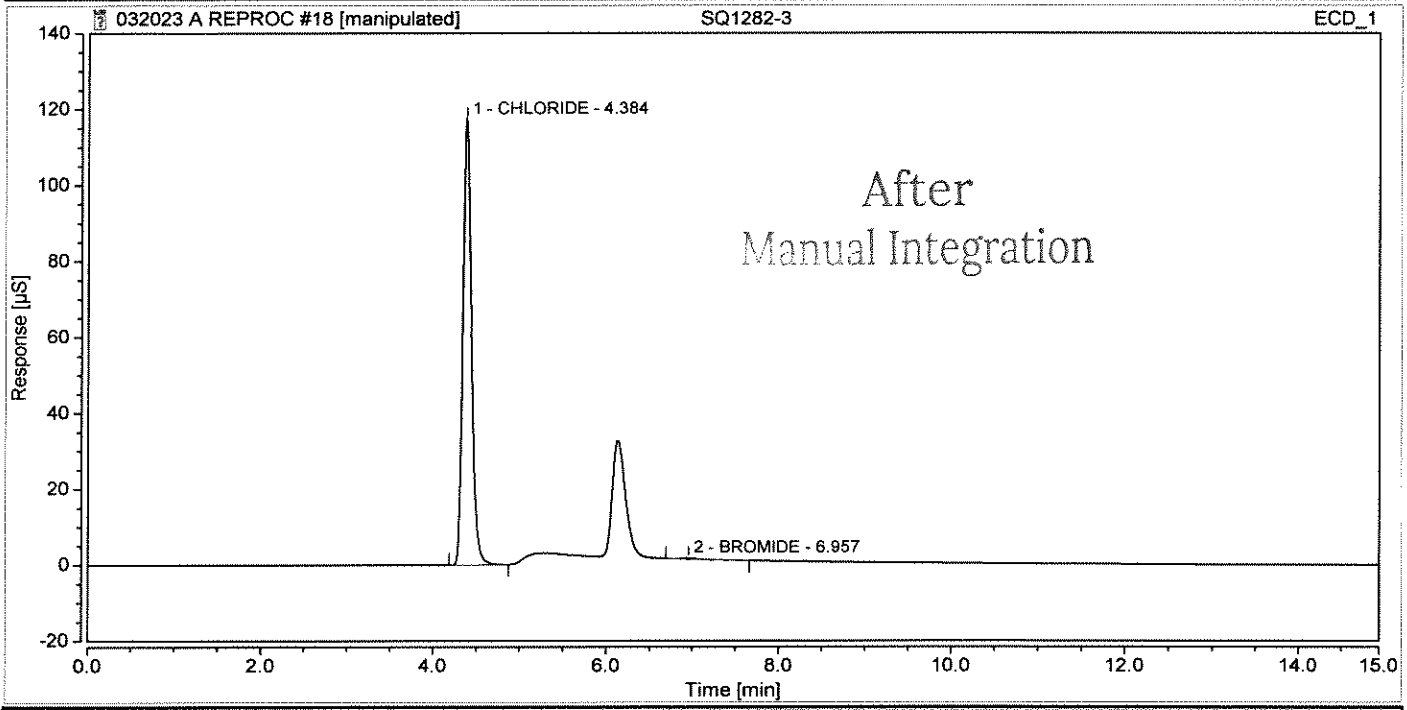
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.217	0.011	0.086	0.05	0.06	0.0253	n.a.
2		3.537	0.002	0.017	0.01	0.01	n.a.	n.a.
3	CHLORIDE	4.384	13.705	117.354	67.06	77.80	36.8810	n.a.
4	NITRITE	5.264	1.242	2.261	6.08	1.50	1.4650	n.a.
5	SULFATE	6.134	5.435	30.863	26.59	20.46	19.9108	n.a.
6	BROMIDE	6.957	0.042	0.255	0.20	0.17	0.2548	n.a.
7	NITRATE	8.164	0.001	0.006	0.00	0.00	0.0010	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**20.438**	**150.841**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-3**	*Run Time (min):*	**14.95**
Vial Number:	**18**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 21:30**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

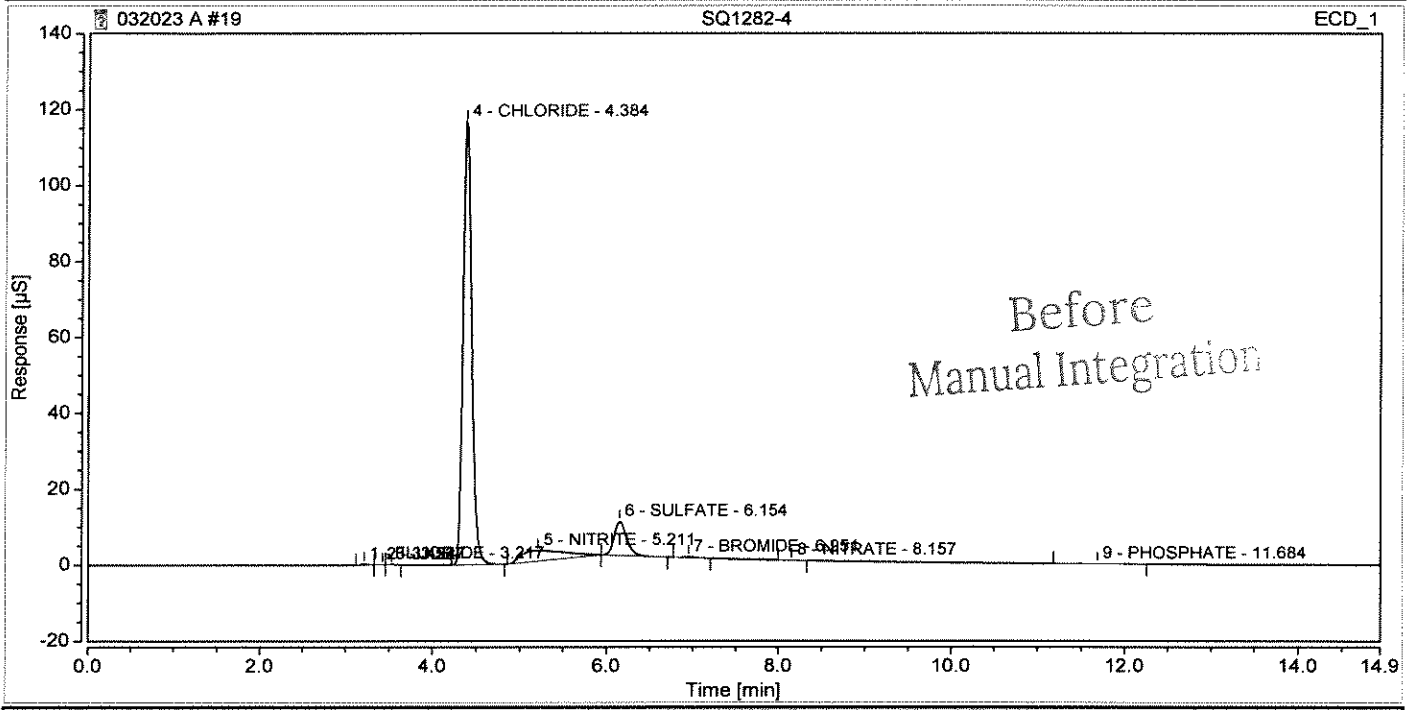
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.384	13.704	117.351	99.81	99.80	36.8766	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	SULFATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	BROMIDE	6.957	0.027	0.239	0.19	0.20	0.1633	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**13.731**	**117.590**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-4**	*Run Time (min):*	**14.95**
Vial Number:	**19**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 21:47**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

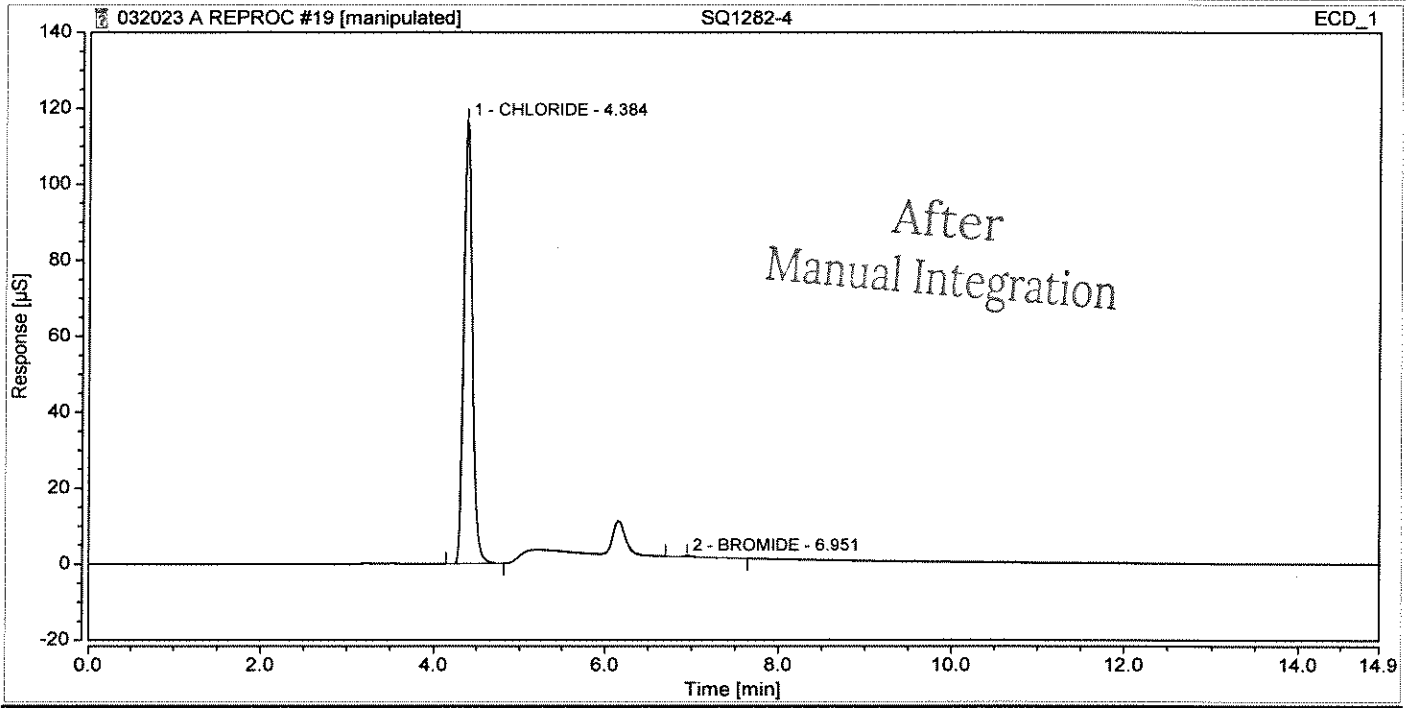
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.217	0.023	0.257	0.13	0.20	0.0443	n.a.
2		3.424	0.001	0.013	0.01	0.01	n.a.	n.a.
3		3.527	0.005	0.053	0.03	0.04	n.a.	n.a.
4	CHLORIDE	4.384	13.551	116.647	80.89	90.49	36.4655	n.a.
5	NITRITE	5.211	1.622	2.731	9.68	2.12	1.9215	n.a.
6	SULFATE	6.154	1.504	8.959	8.98	6.95	5.5086	n.a.
7	BROMIDE	6.951	0.037	0.226	0.22	0.18	0.2249	n.a.
8	NITRATE	8.157	0.001	0.009	0.01	0.01	0.0016	n.a.
9	PHOSPHATE	11.684	0.009	0.017	0.05	0.01	0.0234	n.a.
Total:			**16.753**	**128.912**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-4**	*Run Time (min):*	**14.95**
Vial Number:	**19**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 21:47**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

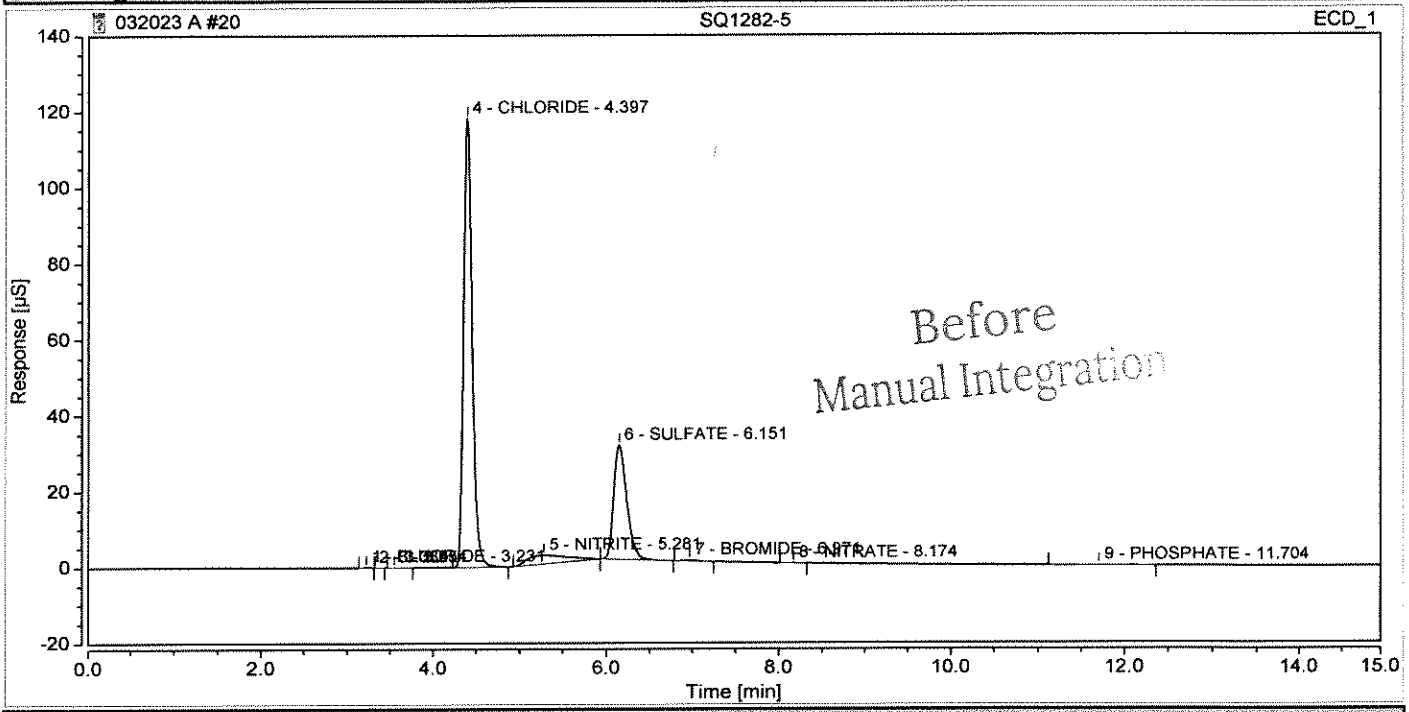
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.384	13.544	116.633	99.82	99.82	36.4472	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	SULFATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	BROMIDE	6.951	0.025	0.211	0.18	0.18	0.1514	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**13.569**	**116.845**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-5**	*Run Time (min):*	**14.96**
Vial Number:	**20**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 22:05**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

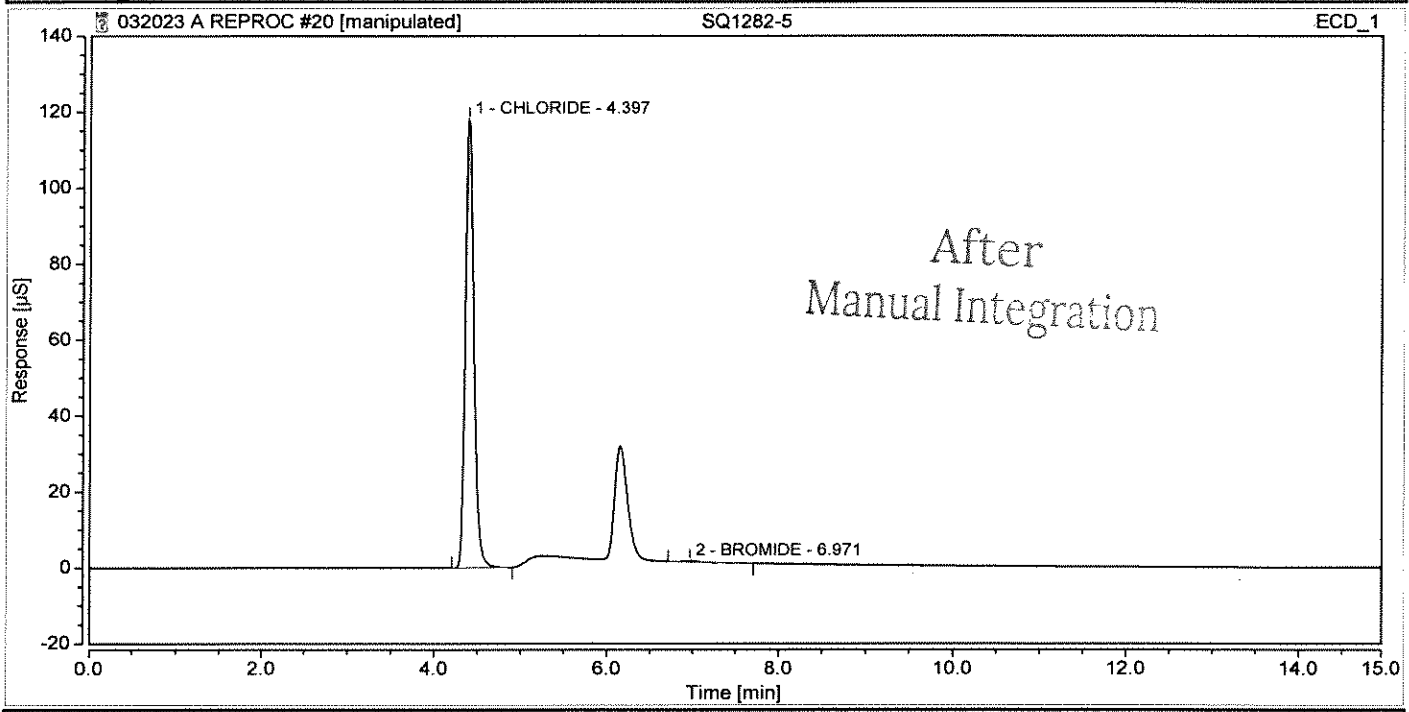
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.231	0.005	0.065	0.03	0.04	0.0162	n.a.
2		3.334	0.000	0.003	0.00	0.00	n.a.	n.a.
3		3.554	0.002	0.016	0.01	0.01	n.a.	n.a.
4	CHLORIDE	4.397	13.729	118.131	67.71	78.34	36.9443	n.a.
5	NITRITE	5.281	1.230	2.244	6.07	1.49	1.4503	n.a.
6	SULFATE	6.151	5.251	30.043	25.90	19.92	19.2378	n.a.
7	BROMIDE	6.971	0.042	0.257	0.21	0.17	0.2561	n.a.
8	NITRATE	8.174	0.001	0.007	0.01	0.00	0.0012	n.a.
9	PHOSPHATE	11.704	0.017	0.029	0.08	0.02	0.0452	n.a.
Total:			**20.278**	**150.795**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-5**	*Run Time (min):*	**14.96**
Vial Number:	**20**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 22:05**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

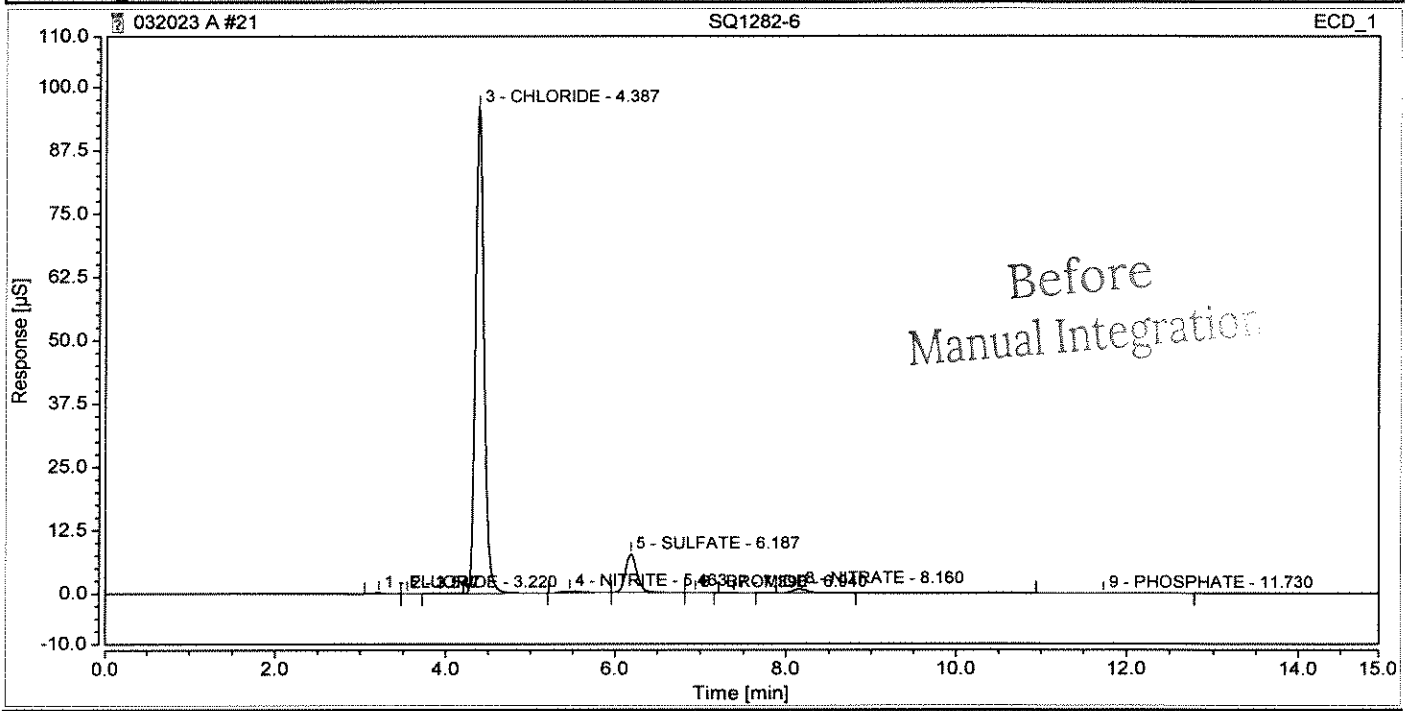
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.397	13.725	118.126	99.81	99.80	36.9343	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	SULFATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	BROMIDE	6.971	0.026	0.241	0.19	0.20	0.1582	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**13.751**	**118.367**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-6**	*Run Time (min):*	**14.95**
Vial Number:	**21**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 22:22**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

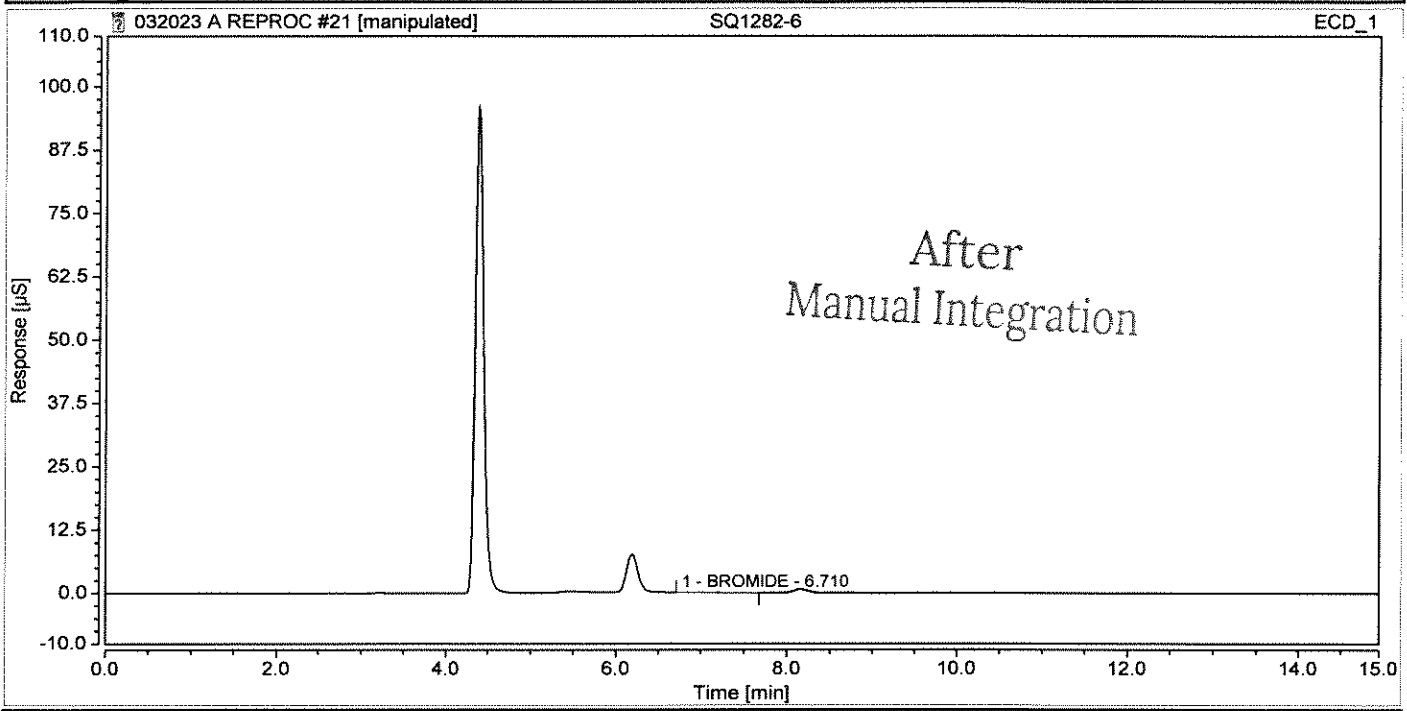
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.220	0.016	0.148	0.13	0.14	0.0342	n.a.
2		3.547	0.001	0.006	0.00	0.01	n.a.	n.a.
3	CHLORIDE	4.387	11.240	95.957	88.41	91.57	30.2461	n.a.
4	NITRITE	5.463	0.093	0.297	0.73	0.28	0.0999	n.a.
5	SULFATE	6.187	1.194	7.567	9.39	7.22	4.3751	n.a.
6	BROMIDE	6.940	0.002	0.010	0.01	0.01	0.0103	n.a.
7		7.390	0.001	0.005	0.01	0.00	n.a.	n.a.
8	NITRATE	8.160	0.145	0.769	1.14	0.73	0.1588	n.a.
9	PHOSPHATE	11.730	0.022	0.030	0.17	0.03	0.0579	n.a.
Total:			**12.713**	**104.788**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-6**	*Run Time (min):*	**14.95**
Vial Number:	**21**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 22:22**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

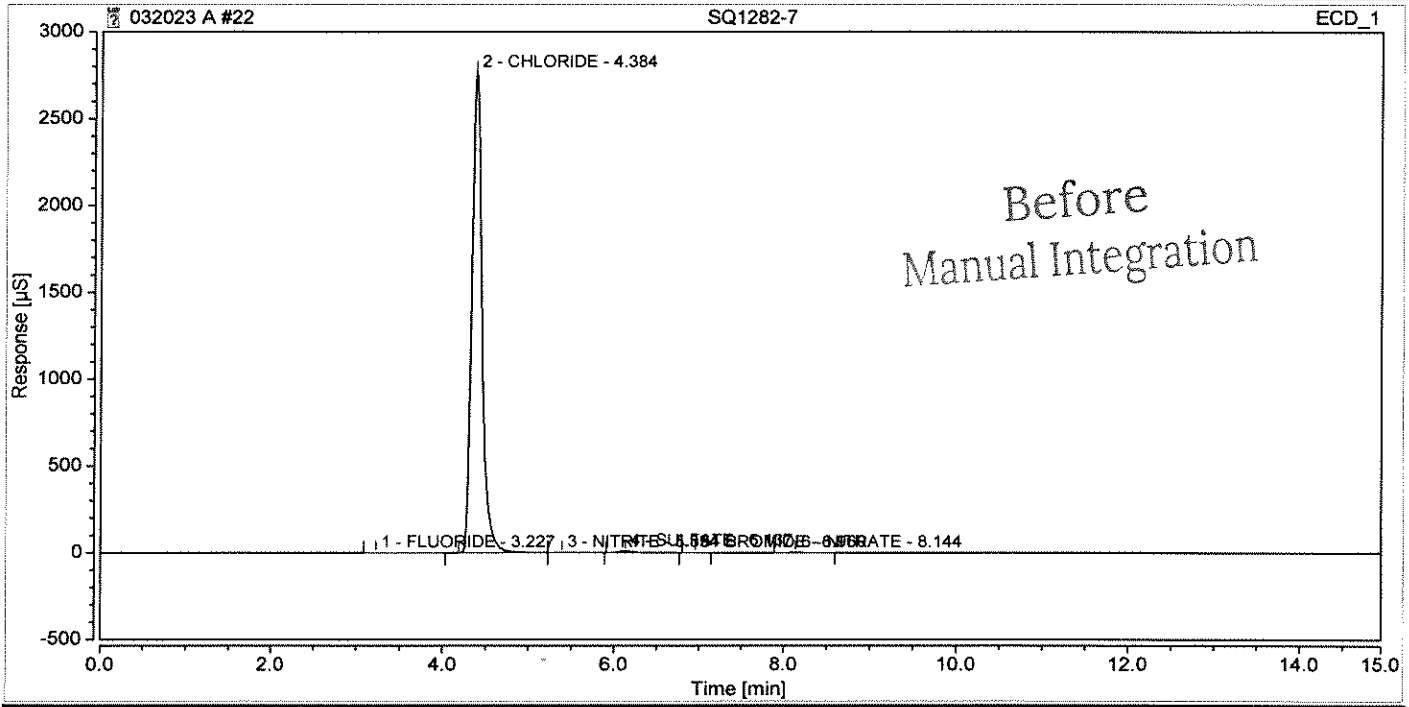
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	CHLORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	SULFATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	BROMIDE	6.710	0.001	0.000	100.00	n.a.	0.0062	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**0.001**	**0.000**	**100.00**	**0.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-7**	*Run Time (min):*	**14.95**
Vial Number:	**22**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 22:39**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

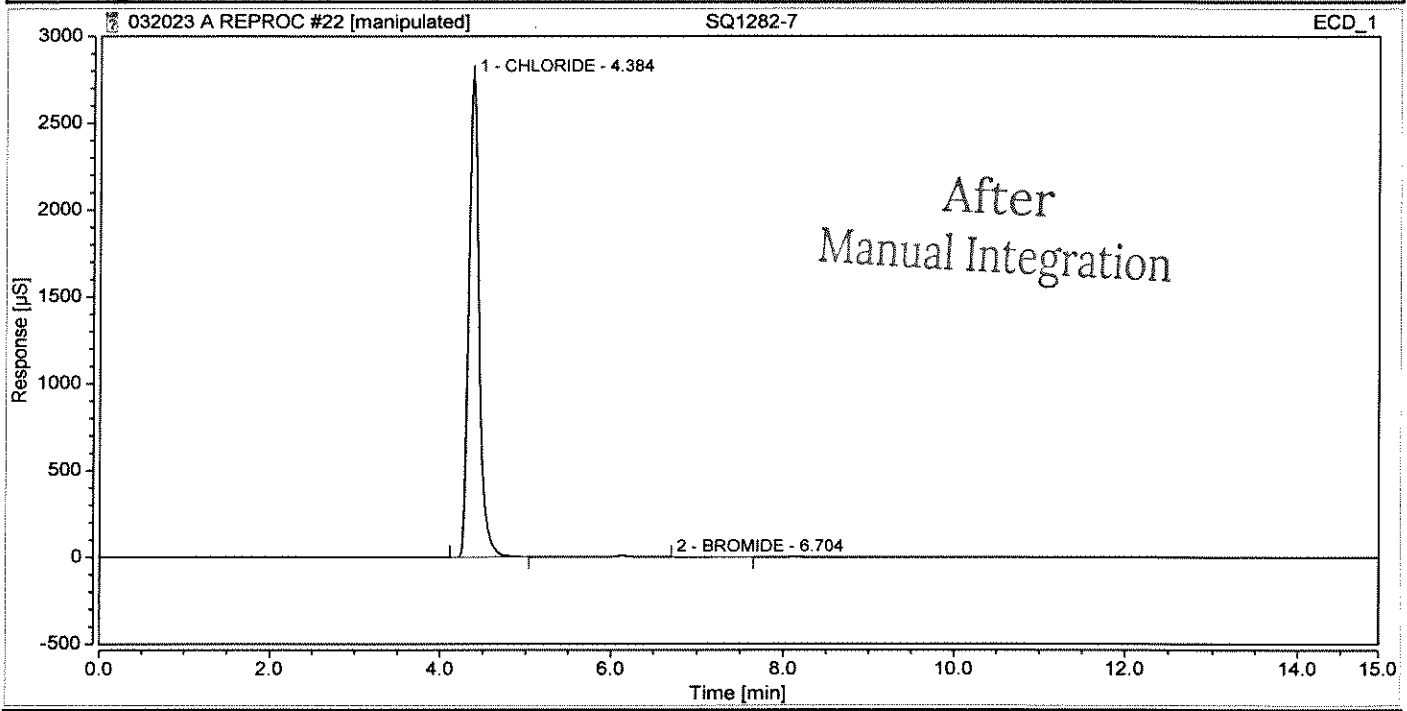
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.227	0.017	0.109	0.00	0.00	0.0359	n.a.
2	CHLORIDE	4.384	388.182	2766.130	99.60	99.67	1044.5867	n.a.
3	NITRITE	5.394	0.096	0.348	0.02	0.01	0.1030	n.a.
4	SULFATE	6.137	1.335	7.962	0.34	0.29	4.8904	n.a.
5	BROMIDE	6.960	0.002	0.017	0.00	0.00	0.0153	n.a.
6	NITRATE	8.144	0.118	0.605	0.03	0.02	0.1296	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**389.751**	**2775.171**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-7**	*Run Time (min):*	**14.95**
Vial Number:	**22**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 22:39**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

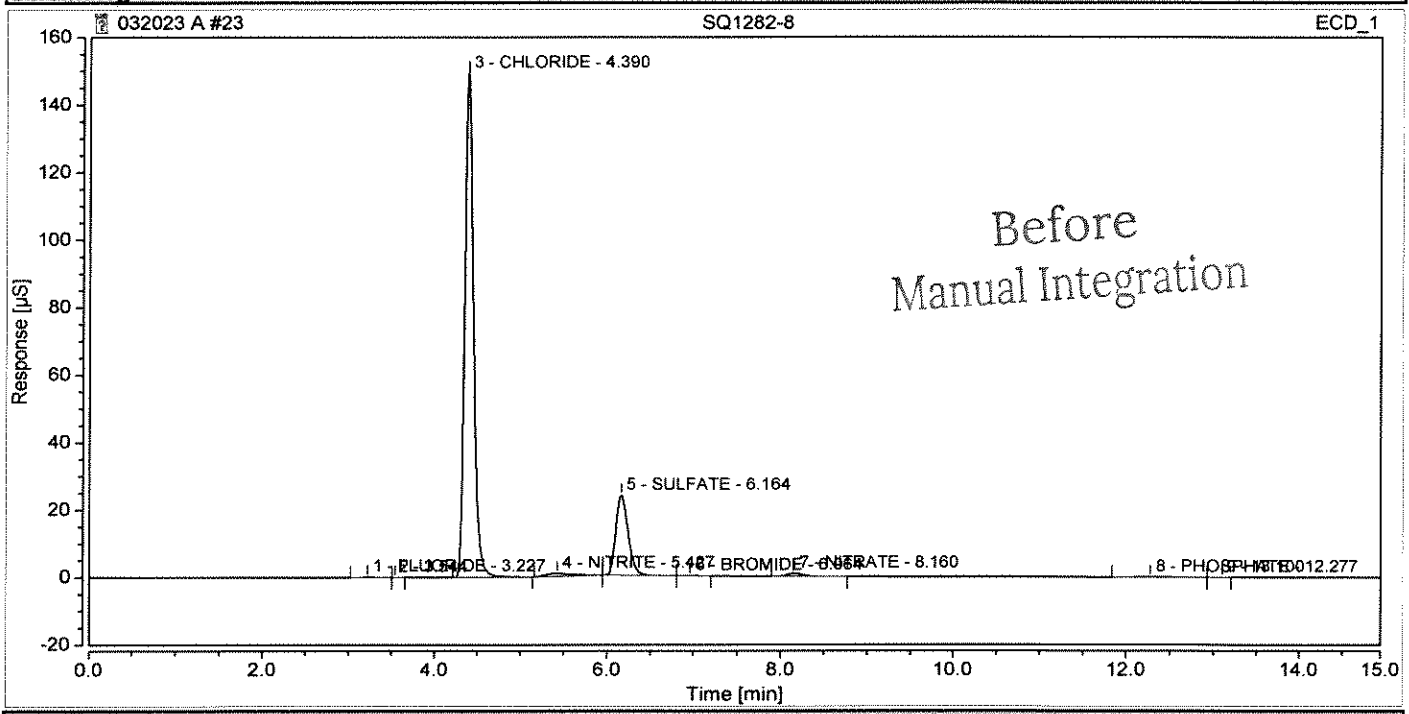
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.384	387.706	2765.836	100.00	100.00	1043.3060	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	SULFATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	BROMIDE	6.704	0.015	0.000	0.00	0.00	0.0947	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**387.722**	**2765.836**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-8**	*Run Time (min):*	**14.95**
Vial Number:	**23**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 22:56**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

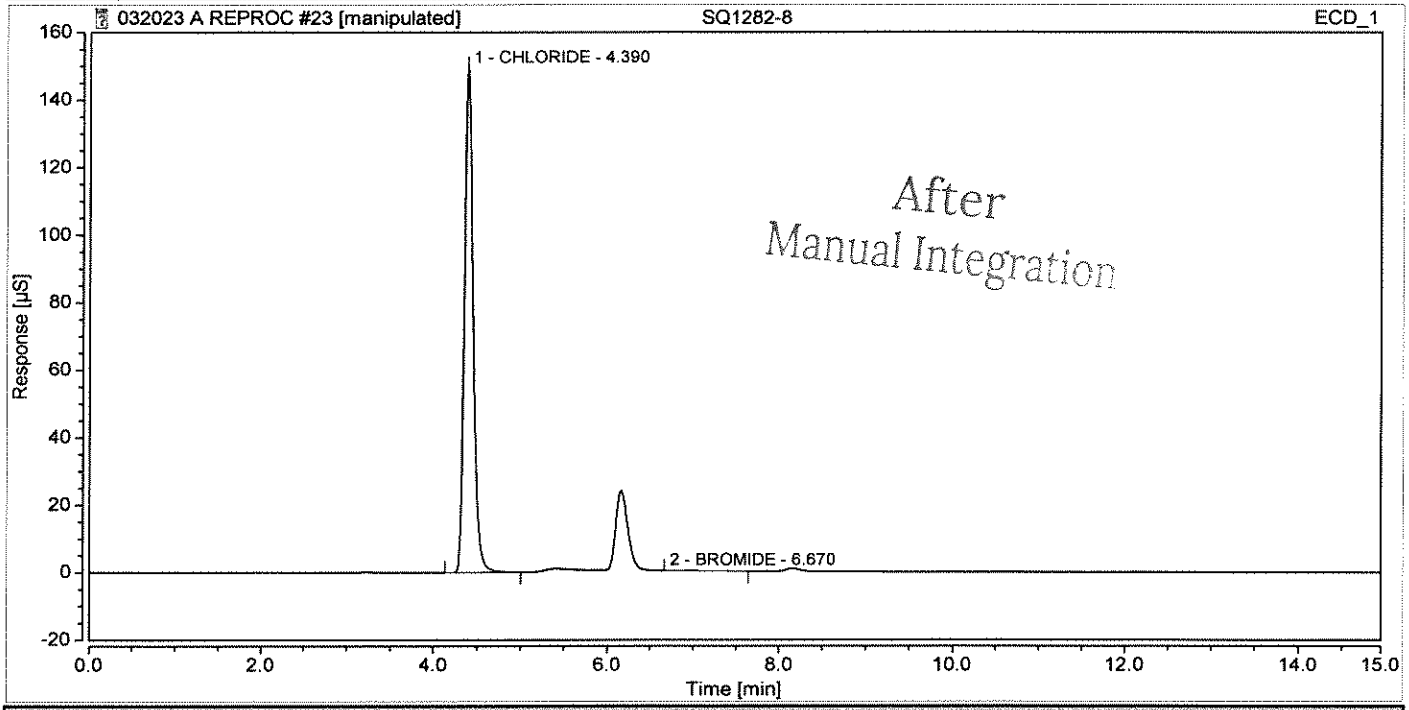
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.227	0.024	0.208	0.11	0.12	0.0459	n.a.
2		3.544	0.000	0.001	0.00	0.00	n.a.	n.a.
3	CHLORIDE	4.390	17.784	149.403	80.04	85.29	47.8565	n.a.
4	NITRITE	5.427	0.301	0.828	1.35	0.47	0.3453	n.a.
5	SULFATE	6.164	3.919	23.740	17.64	13.55	14.3549	n.a.
6	BROMIDE	6.964	0.009	0.055	0.04	0.03	0.0537	n.a.
7	NITRATE	8.160	0.175	0.931	0.79	0.53	0.1918	n.a.
8	PHOSPHATE	12.277	0.007	0.012	0.03	0.01	0.0179	n.a.
9		13.100	0.000	0.001	0.00	0.00	n.a.	n.a.
Total:			**22.218**	**175.179**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**SQ1282-8**	*Run Time (min):*	**14.95**
Vial Number:	**23**	*Injection Volume:*	**200.00**
Injection Type:	**Unknown**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 22:56**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

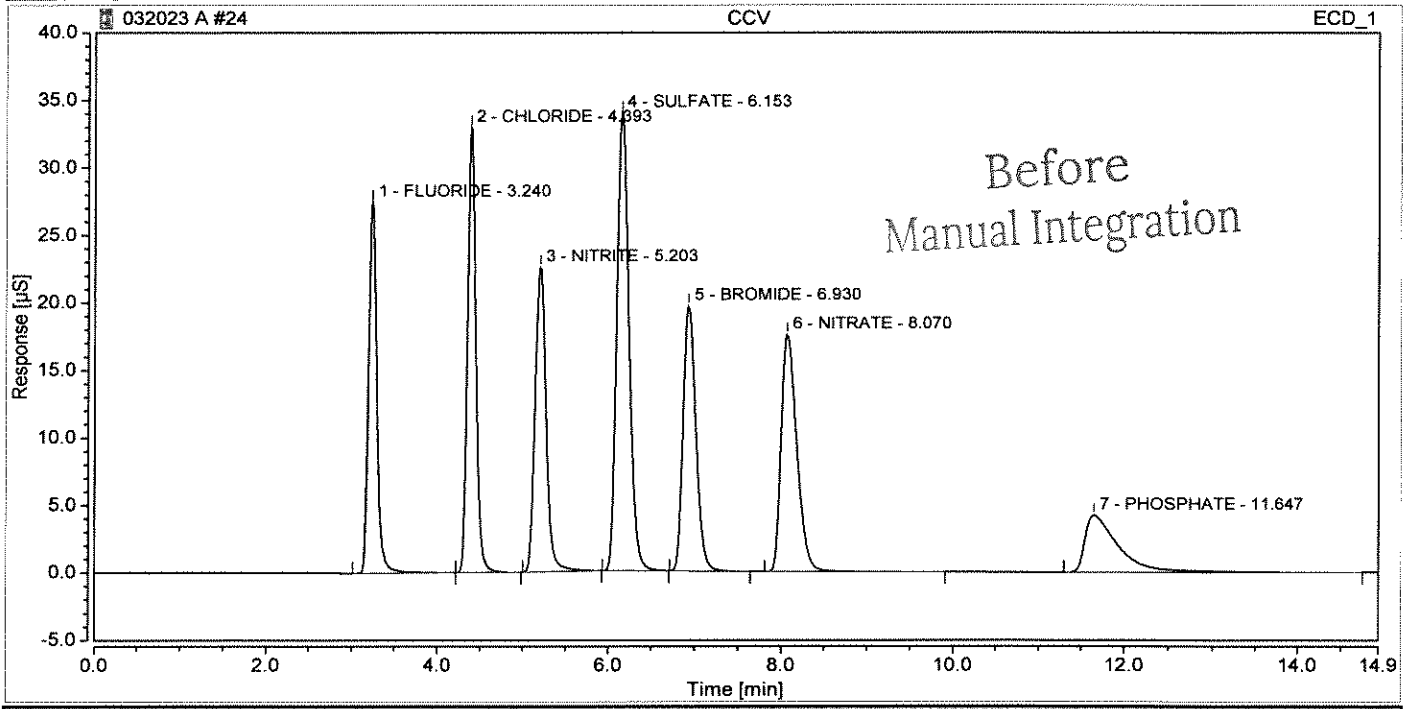
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
n.a.	FLUORIDE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1	CHLORIDE	4.390	17.764	149.385	99.99	100.00	47.8024	n.a.
n.a.	NITRITE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	SULFATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	BROMIDE	6.670	0.002	0.000	0.01	0.00	0.0136	n.a.
n.a.	NITRATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**17.766**	**149.385**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**CCV**	*Run Time (min):*	**14.95**
Vial Number:	**24**	*Injection Volume:*	**200.00**
Injection Type:	**Check Standard**	*Channel:*	**ECD_1**
Calibration Level:	**06**	*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 23:14**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

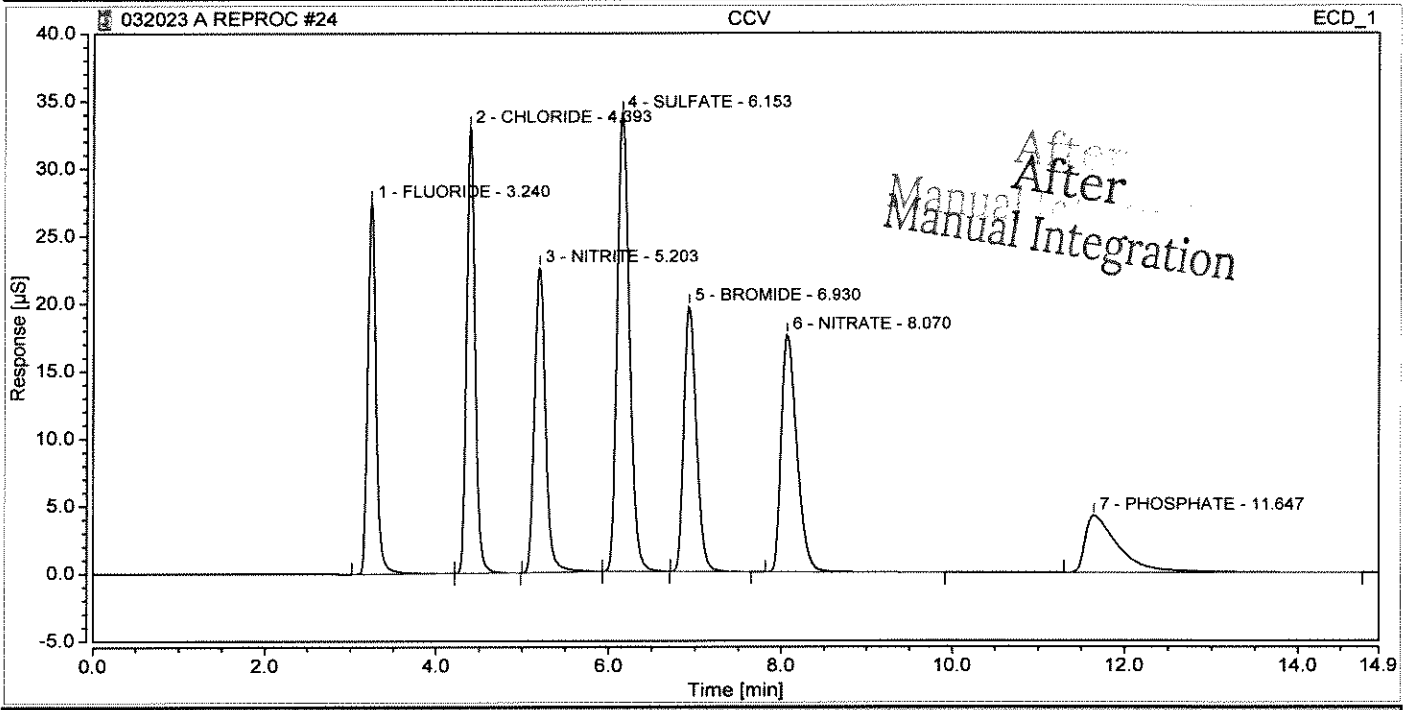
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.240	3.096	27.503	12.45	17.35	5.3006	6.0115
2	CHLORIDE	4.393	3.806	32.973	15.30	20.80	10.2410	2.4098
3	NITRITE	5.203	3.412	22.586	13.72	14.25	4.1054	2.6359
4	SULFATE	6.153	5.609	33.944	22.55	21.42	20.5478	2.7391
5	BROMIDE	6.930	3.324	19.661	13.37	12.41	20.3330	1.6648
6	NITRATE	8.070	3.706	17.581	14.90	11.09	4.0564	1.4092
7	PHOSPHATE	11.647	1.916	4.240	7.71	2.68	5.1312	2.6243
Total:			**24.869**	**158.489**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**CCV**	*Run Time (min):*	**14.95**
Vial Number:	**24**	*Injection Volume:*	**200.00**
Injection Type:	**Check Standard**	*Channel:*	**ECD_1**
Calibration Level:	**06**	*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 23:14**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

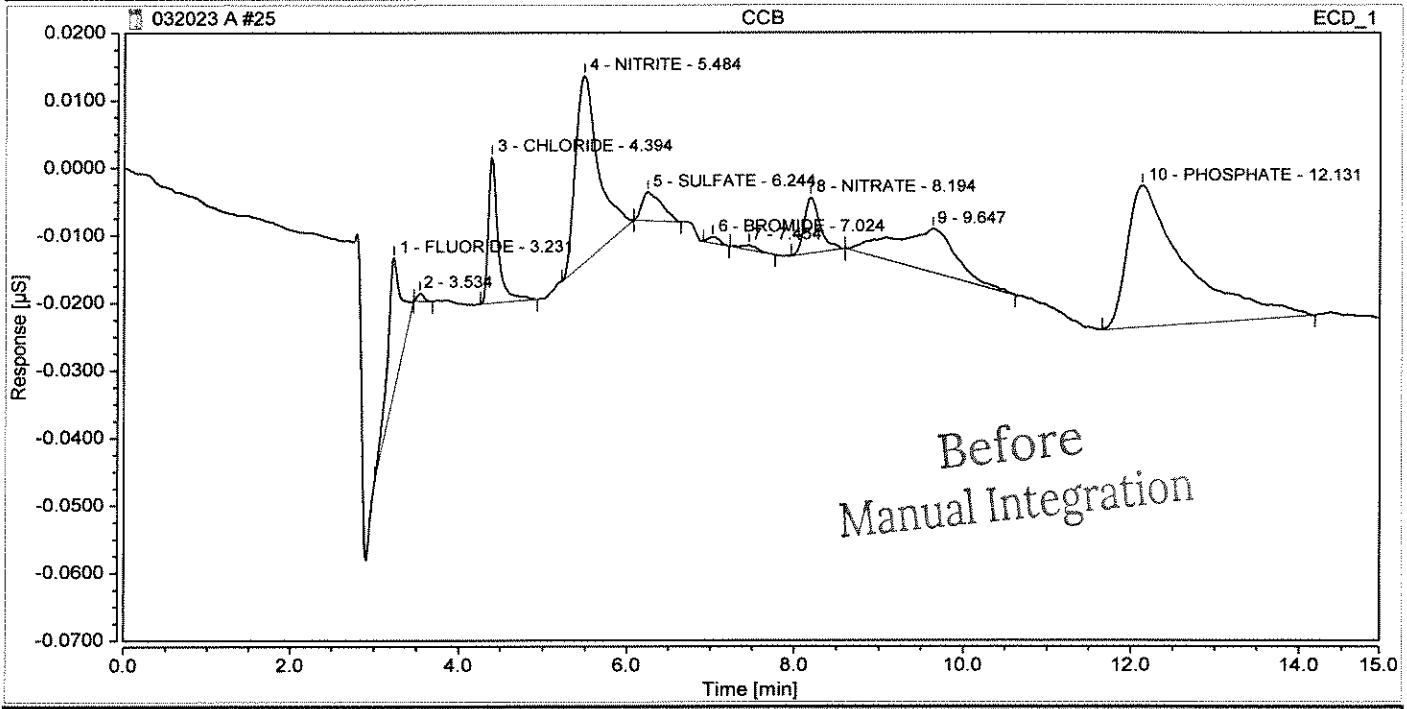
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.240	3.096	27.503	12.45	17.35	5.3006	6.0115
2	CHLORIDE	4.393	3.806	32.973	15.30	20.80	10.2410	2.4098
3	NITRITE	5.203	3.412	22.586	13.72	14.25	4.1054	2.6359
4	SULFATE	6.153	5.609	33.944	22.55	21.42	20.5478	2.7391
5	BROMIDE	6.930	3.324	19.661	13.37	12.41	20.3330	1.6648
6	NITRATE	8.070	3.706	17.581	14.90	11.09	4.0564	1.4092
7	PHOSPHATE	11.647	1.916	4.240	7.71	2.68	5.1312	2.6243
Total:			**24.869**	**158.489**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**CCB**	*Run Time (min):*	**14.95**
Vial Number:	**25**	*Injection Volume:*	**200.00**
Injection Type:	**Blank**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 23:31**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

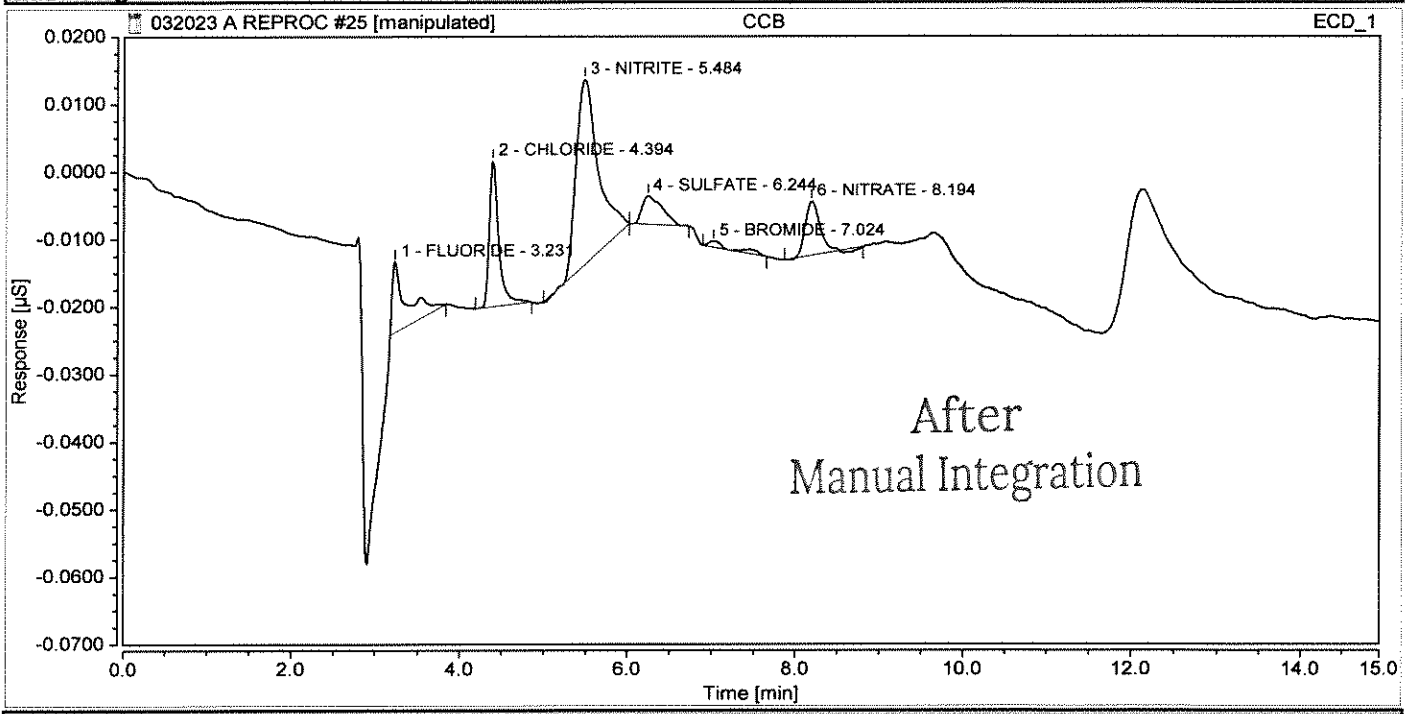
No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.231	0.004	0.020	8.70	17.80	0.0131	n.a.
2		3.534	0.000	0.001	0.27	1.03	n.a.	n.a.
3	CHLORIDE	4.394	0.003	0.022	7.20	19.33	0.0079	n.a.
4	NITRITE	5.484	0.009	0.028	21.42	24.74	0.0007	n.a.
5	SULFATE	6.244	0.001	0.004	2.87	3.78	0.0043	n.a.
6	BROMIDE	7.024	0.000	0.001	0.36	0.82	0.0009	n.a.
7		7.454	0.000	0.001	0.39	0.63	n.a.	n.a.
8	NITRATE	8.194	0.002	0.008	4.39	7.39	0.0020	n.a.
9		9.647	0.005	0.006	13.09	5.77	n.a.	n.a.
10	PHOSPHATE	12.131	0.017	0.021	41.31	18.70	0.0451	n.a.
Total:			**0.041**	**0.112**	**100.00**	**100.00**		

Chromatogram and Results

Injection Details

Injection Name:	**CCB**	*Run Time (min):*	**14.95**
Vial Number:	**25**	*Injection Volume:*	**200.00**
Injection Type:	**Blank**	*Channel:*	**ECD_1**
Calibration Level:		*Wavelength:*	**n.a.**
Instrument Method:	**32mM80mA**	*Bandwidth:*	**n.a.**
Processing Method:	**KAT01**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**20/Mar/23 23:31**	*Sample Weight:*	**1.0000**

Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area µS*min	Height µS	Relative Area %	Relative Height %	Amount mg/L	Amnt.Dev. mg/L
1	FLUORIDE	3.231	0.002	0.010	12.05	14.40	0.0105	n.a.
2	CHLORIDE	4.394	0.003	0.022	17.67	29.74	0.0077	n.a.
3	NITRITE	5.484	0.008	0.027	51.93	37.75	0.0003	n.a.
4	SULFATE	6.244	0.001	0.004	7.13	5.78	0.0042	n.a.
5	BROMIDE	7.024	0.000	0.001	1.77	1.30	0.0018	n.a.
6	NITRATE	8.194	0.002	0.008	9.44	11.03	0.0017	n.a.
n.a.	PHOSPHATE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total:			**0.016**	**0.073**	**100.00**	**100.00**		

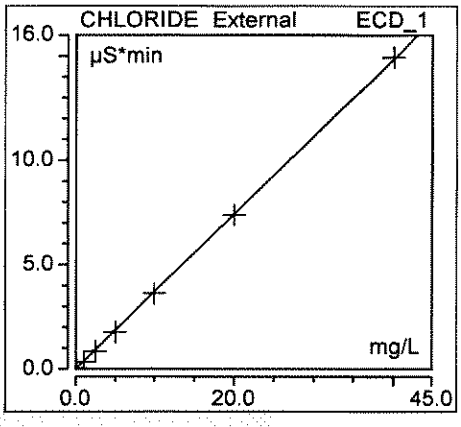
Calibration Batch Report

Sequence:	**020923 CAL REPROC**	*Injection Volume:*	**200.00**
Instrument Method:	**32mM80mA**	*Operator:*	**wetlab**
Inj. Date / Time:	**09-Feb-2023 / 17:31**	*Run Time:*	**14.957167**

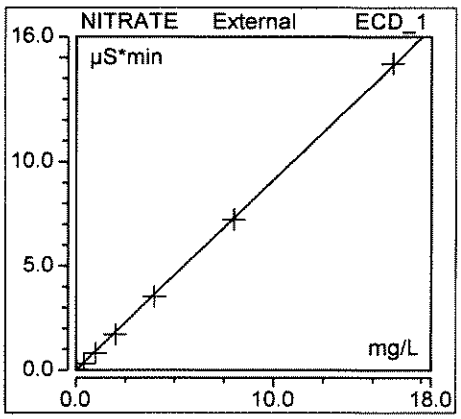
Calibration Summary

Peak Name	Eval.Type	Cal.Type	Points	Offset (C0)	Slope (C1)	Curve (C2)	Coeff.Det. %
FLUORIDE	Area	ly2, WithOff	8.000	-0.004	0.609	-0.005	99.9994
CHLORIDE	Area	Lin	8.000	0.000	0.372	0.000	99.9825
NITRITE	Area	ly2, WithOff	8.000	0.008	0.850	-0.005	99.9993
SULFATE	Area	Lin	8.000	0.000	0.273	0.000	99.9920
BROMIDE	Area	Lin	8.000	0.000	0.163	0.000	99.9674
NITRATE	Area	Lin	8.000	0.000	0.914	0.000	99.9701
PHOSPHATE	Area	Lin	8.000	0.000	0.373	0.000	99.9901
		AVERAGE:		0.0005	0.5077	-0.0014	99.9858

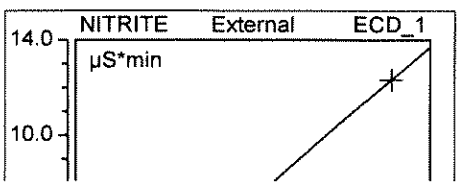
Injection Name **CHLORIDE**	Ret.Time min CHLORIDE	Area µS*min CHLORIDE	Height µS CHLORIDE	Amount mg/L CHLORIDE
	ECD_1	ECD_1	ECD_1	ECD_1
IC1	4.293	0.0028	0.025	0.007
IC2	4.294	0.0309	0.274	0.083
IC3	4.290	0.3271	3.061	0.880
IC4	4.290	0.8506	7.936	2.289
IC5	4.291	1.7639	16.364	4.747
IC6	4.290	3.6194	33.271	9.740
IC7	4.284	7.3827	67.374	19.867
IC8	4.281	14.9313	135.805	40.180
Average	4.289			
Rel. Std. Dev.	0.109 %			



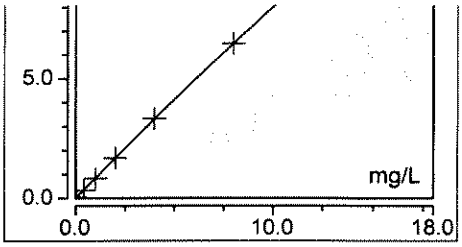
Injection Name **NITRATE**	Ret.Time min NITRATE	Area µS*min NITRATE	Height µS NITRATE	Amount mg/L NITRATE
	ECD_1	ECD_1	ECD_1	ECD_1
IC1	8.217	0.0036	0.019	0.004
IC2	8.211	0.0308	0.159	0.034
IC3	8.190	0.3074	1.641	0.337
IC4	8.170	0.8131	4.283	0.890
IC5	8.141	1.7088	8.664	1.871
IC6	8.097	3.5312	16.761	3.866
IC7	8.024	7.2384	30.709	7.924
IC8	7.917	14.7044	52.954	16.096
Average	8.121			
Rel. Std. Dev.	1.287 %			



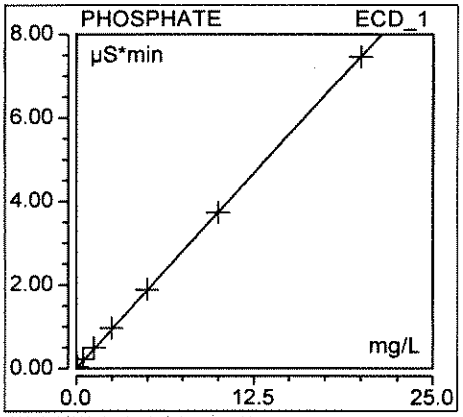
Injection Name **NITRITE**	Ret.Time min NITRITE	Area µS*min NITRITE	Height µS NITRITE	Amount mg/L NITRITE
	ECD_1	ECD_1	ECD_1	ECD_1
IC1	5.327	0.0231	0.101	0.018



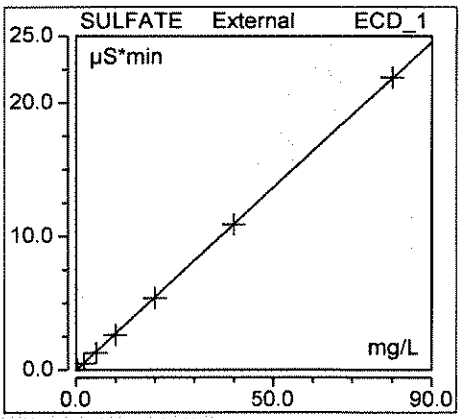
IC2	5.124	0.0503	0.209	0.050
IC3	5.120	0.3327	2.496	0.383
IC4	5.124	0.8374	6.379	0.982
IC5	5.121	1.6865	12.563	1.999
IC6	5.117	3.3364	23.616	4.012
IC7	5.114	6.4811	42.258	7.997
IC8	5.101	12.3117	72.095	16.000
Average	5.143			
Rel. Std. Dev.	1.448 %			



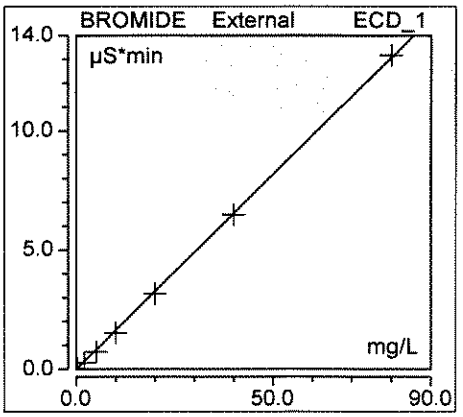
Injection Name **PHOSPHATE**	Ret.Time min PHOSPHATE	Area µS*min PHOSPHATE	Height µS PHOSPHATE	Amount mg/L PHOSPHATE
	ECD_1	ECD_1	ECD_1	ECD_1
IC1	12.507	0.0078	0.017	0.021
IC2	12.481	0.0371	0.078	0.099
IC3	12.400	0.2266	0.550	0.607
IC4	12.317	0.5019	1.281	1.344
IC5	12.217	0.9655	2.416	2.585
IC6	12.054	1.8850	4.295	5.047
IC7	11.827	3.7300	7.168	9.987
IC8	11.511	7.4600	11.427	19.975
Average	12.164			
Rel. Std. Dev.	2.869 %			



Injection Name **SULFATE**	Ret.Time min SULFATE	Area µS*min SULFATE	Height µS SULFATE	Amount mg/L SULFATE
	ECD_1	ECD_1	ECD_1	ECD_1
IC1	6.217	0.0021	0.011	0.008
IC2	6.214	0.0468	0.293	0.171
IC3	6.204	0.4917	3.205	1.801
IC4	6.197	1.2741	8.230	4.667
IC5	6.184	2.6287	16.662	9.630
IC6	6.154	5.3741	32.928	19.687
IC7	6.110	10.8898	62.449	39.893
IC8	6.037	21.8939	111.270	80.204
Average	6.165			
Rel. Std. Dev.	1.015 %			

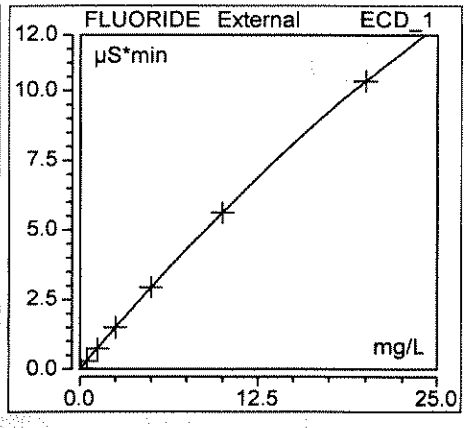


Injection Name **BROMIDE**	Ret.Time min BROMIDE	Area µS*min BROMIDE	Height µS BROMIDE	Amount mg/L BROMIDE
	ECD_1	ECD_1	ECD_1	ECD_1
IC1	6.717	0.0001	0.000	0.000
IC2	6.961	0.0236	0.145	0.144
IC3	6.954	0.2722	1.734	1.665
IC4	6.944	0.7231	4.608	4.423
IC5	6.931	1.5201	9.499	9.298
IC6	6.904	3.1585	18.984	19.321
IC7	6.864	6.4753	36.532	39.610
IC8	6.797	13.1595	66.354	80.497
Average	6.884			



Rel. Std. Dev.	1.262 %

Injection Name **FLUORIDE**	Ret.Time min FLUORIDE	Area µS*min FLUORIDE	Height µS FLUORIDE	Amount mg/L FLUORIDE
	ECD_1	ECD_1	ECD_1	ECD_1
IC1	3.440	0.0038	0.012	0.013
IC2	3.091	0.0246	0.252	0.048
IC3	3.090	0.2902	3.077	0.485
IC4	3.094	0.7408	7.764	1.234
IC5	3.097	1.4961	15.217	2.510
IC6	3.100	2.9411	28.564	5.025
IC7	3.107	5.6186	51.165	9.981
IC8	3.114	10.3409	86.910	20.004
Average	3.142			
Rel. Std. Dev.	3.847 %			



Anion Summary Report

No. CHLORIDE	Name CHLORIDE	Time min CHLORIDE ECD_1	Area µS*min CHLORIDE ECD_1	Rel.Area % CHLORIDE ECD_1	Height µS CHLORIDE ECD_1	Rel.Height % CHLORIDE ECD_1	Amount mg/L CHLORIDE ECD_1
1	IC1	4.293	0.0028	6.39	0.03	13.58	0.0074
2	IC2	4.294	0.0309	12.65	0.27	19.46	0.0831
3	IC3	4.290	0.3271	14.55	3.06	19.42	0.8802
4	IC4	4.290	0.8506	14.82	7.94	19.60	2.2889
5	IC5	4.291	1.7639	14.99	16.36	20.11	4.7467
6	IC6	4.290	3.6194	15.18	33.27	21.00	9.7398
7	IC7	4.284	7.3827	15.44	67.37	22.64	19.8666
8	IC8	4.281	14.9313	15.75	135.81	25.30	40.1796
	Sum:	34.313	28.909	109.761	264.109	161.105	77.792
	Average:	4.289	3.614	13.720	33.014	20.138	9.724
	Rel.Std.Dev:	0.109 %	144.185 %	22.654 %	143.499 %	16.558 %	144.185 %

No. NITRATE	Name NITRATE	Time min NITRATE ECD_1	Area µS*min NITRATE ECD_1	Rel.Area % NITRATE ECD_1	Height µS NITRATE ECD_1	Rel.Height % NITRATE ECD_1	Amount mg/L NITRATE ECD_1
1	IC1	8.217	0.0036	8.38	0.02	10.12	0.0040
2	IC2	8.211	0.0308	12.61	0.16	11.29	0.0337
3	IC3	8.190	0.3074	13.68	1.64	10.41	0.3365
4	IC4	8.170	0.8131	14.16	4.28	10.58	0.8900
5	IC5	8.141	1.7088	14.52	8.66	10.65	1.8706
6	IC6	8.097	3.5312	14.81	16.76	10.58	3.8655
7	IC7	8.024	7.2384	15.14	30.71	10.32	7.9237
8	IC8	7.917	14.7044	15.51	52.95	9.86	16.0964
	Sum:	64.966	28.338	108.810	115.189	83.806	31.020
	Average:	8.121	3.542	13.601	14.399	10.476	3.878
	Rel.Std.Dev:	1.287 %	144.889 %	16.867 %	130.346 %	4.030 %	144.889 %

No. NITRITE	Name NITRITE	Time min NITRITE ECD_1	Area µS*min NITRITE ECD_1	Rel.Area % NITRITE ECD_1	Height µS NITRITE ECD_1	Rel.Height % NITRITE ECD_1	Amount mg/L NITRITE ECD_1
1	IC1	5.327	0.0231	53.47	0.10	54.57	0.0176
2	IC2	5.124	0.0503	20.61	0.21	14.80	0.0496
3	IC3	5.120	0.3327	14.80	2.50	15.83	0.3828
4	IC4	5.124	0.8374	14.59	6.38	15.76	0.9816
5	IC5	5.121	1.6865	14.33	12.56	15.44	1.9988
6	IC6	5.117	3.3364	13.99	23.62	14.91	4.0122
7	IC7	5.114	6.4811	13.55	42.26	14.20	7.9973
8	IC8	5.101	12.3117	12.99	72.10	13.43	16.0000
	Sum:	41.146	25.059	158.329	159.717	158.936	31.440
	Average:	5.143	3.132	19.791	19.965	19.867	3.930
	Rel.Std.Dev:	1.448 %	137.512 %	69.791 %	127.804 %	70.696 %	141.870 %

No. PHOSPHATE	Name PHOSPHATE	Time min PHOSPHATE ECD_1	Area µS*min PHOSPHATE ECD_1	Rel.Area % PHOSPHATE ECD_1	Height µS PHOSPHATE ECD_1	Rel.Height % PHOSPHATE ECD_1	Amount mg/L PHOSPHATE ECD_1
1	IC1	12.507	0.0078	18.11	0.02	9.44	0.0210
2	IC2	12.481	0.0371	15.21	0.08	5.52	0.0994

3	IC3	12.400	0.2266	10.08	0.55	3.49	0.6067
4	IC4	12.317	0.5019	8.74	1.28	3.17	1.3439
5	IC5	12.217	0.9655	8.20	2.42	2.97	2.5854
6	IC6	12.054	1.8850	7.91	4.30	2.71	5.0474
7	IC7	11.827	3.7300	7.80	7.17	2.41	9.9874
8	IC8	11.511	7.4600	7.87	11.43	2.13	19.9751
	Sum:	97.313	14.814	83.928	27.233	31.831	39.666
	Average:	12.164	1.852	10.491	3.404	3.979	4.958
	Rel.Std.Dev:	2.869 %	139.817 %	37.728 %	119.326 %	61.288 %	139.817 %

No. SULFATE	Name SULFATE	Time min SULFATE ECD_1	Area µS*min SULFATE ECD_1	Rel.Area % SULFATE ECD_1	Height µS SULFATE ECD_1	Rel.Height % SULFATE ECD_1	Amount mg/L SULFATE ECD_1
1	IC1	6.217	0.0021	4.81	0.01	5.82	0.0076
2	IC2	6.214	0.0468	19.17	0.29	20.77	0.1714
3	IC3	6.204	0.4917	21.88	3.20	20.33	1.8014
4	IC4	6.197	1.2741	22.19	8.23	20.33	4.6674
5	IC5	6.184	2.6287	22.33	16.66	20.47	9.6296
6	IC6	6.154	5.3741	22.54	32.93	20.79	19.6870
7	IC7	6.110	10.8898	22.77	62.45	20.98	39.8926
8	IC8	6.037	21.8939	23.09	111.27	20.73	80.2041
	Sum:	49.316	42.601	158.787	235.048	150.224	156.061
	Average:	6.165	5.325	19.848	29.381	18.778	19.508
	Rel.Std.Dev:	1.015 %	143.496 %	31.215 %	133.782 %	27.902 %	143.496 %

No. BROMIDE	Name BROMIDE	Time min BROMIDE ECD_1	Area µS*min BROMIDE ECD_1	Rel.Area % BROMIDE ECD_1	Height µS BROMIDE ECD_1	Rel.Height % BROMIDE ECD_1	Amount mg/L BROMIDE ECD_1
1	IC1	6.717	0.0001	0.13	0.00	0.14	0.0003
2	IC2	6.961	0.0236	9.66	0.15	10.28	0.1442
3	IC3	6.954	0.2722	12.11	1.73	11.00	1.6649
4	IC4	6.944	0.7231	12.59	4.61	11.38	4.4230
5	IC5	6.931	1.5201	12.92	9.50	11.67	9.2985
6	IC6	6.904	3.1585	13.25	18.98	11.98	19.3207
7	IC7	6.864	6.4753	13.54	36.53	12.27	39.6097
8	IC8	6.797	13.1595	13.88	66.35	12.36	80.4972
	Sum:	55.070	25.332	88.071	137.855	81.101	154.959
	Average:	6.884	3.167	11.009	17.232	10.138	19.370
	Rel.Std.Dev:	1.262 %	145.098 %	41.669 %	135.862 %	40.402 %	145.098 %

No. FLUORIDE	Name FLUORIDE	Time min FLUORIDE ECD_1	Area µS*min FLUORIDE ECD_1	Rel.Area % FLUORIDE ECD_1	Height µS FLUORIDE ECD_1	Rel.Height % FLUORIDE ECD_1	Amount mg/L FLUORIDE ECD_1
1	IC1	3.440	0.0038	8.71	0.01	6.32	0.0135
2	IC2	3.091	0.0246	10.08	0.25	17.87	0.0477
3	IC3	3.090	0.2902	12.91	3.08	19.52	0.4853
4	IC4	3.094	0.7408	12.90	7.76	19.18	1.2345
5	IC5	3.097	1.4961	12.71	15.22	18.70	2.5100
6	IC6	3.100	2.9411	12.33	28.56	18.03	5.0246
7	IC7	3.107	5.6186	11.75	51.16	17.19	9.9809
8	IC8	3.114	10.3409	10.91	86.91	16.19	20.0037
	Sum:	25.133	21.456	92.315	192.960	132.997	39.300
	Average:	3.142	2.682	11.539	24.120	16.625	4.913
	Rel.Std.Dev:	3.847 %	135.522 %	13.226 %	127.634 %	25.868 %	141.871 %

SUBCONTRACTED DATA

PERCHLORATE

eurofins | Environment Testing

ANALYTICAL REPORT

PREPARED FOR

Attn: Heather Manz
Katahdin Analytical Services
600 Technology Way
Scarborough ME 04074

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JOB DESCRIPTION

Fort Jackson

JOB NUMBER

280-173651-1

Eurofins Denver
4955 Yarrow Street
Arvada CO 80002

See page two for job notes and contact information.

myEOL

Eurofins Denver

Job Notes

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The Lab Certification ID# is 4025.

Reporting limits are adjusted for sample size used, dilutions and moisture content if applicable.

The test results in this report relate only to the samples as received by the laboratory and will meet all requirements of the methodology, with any exceptions noted. This report shall not be reproduced except in full, without the express written approval of the laboratory. All questions should be directed to the Eurofins TestAmerica Project Manager.

Authorization

Shelby Turner

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Qualifiers

LCMS

Qualifier	Qualifier Description
J	Estimated: The analyte was positively identified; the quantitation is an estimation
M	Manual integrated compound.
U	Undetected at the Limit of Detection.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

CASE NARRATIVE

Client: Katahdin Analytical Services

Project: Fort Jackson

Report Number: 280-173651-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

RECEIPT

The samples were received on 3/16/2023 11:05 AM. Unless otherwise noted below, the samples arrived in good condition, and where required, properly preserved and on ice. The temperature of the cooler at receipt was 1.7º C.

PERCHLORATE

Samples SWDUP (280-173651-1), JACKSON-SWMC3-DC-01 (280-173651-2), JACKSON-SWMC2-DC-01 (280-173651-3), JACKSON-SWJC1-DC-01 (280-173651-4), JACKSON-SWMC1-DC-01 (280-173651-5), JACKSON-SWCC3-DC-01 (280-173651-6), JACKSON-SWCC4-DC-01 (280-173651-7), JACKSON-SWCC2-DC-01 (280-173651-8), JACKSON-EB-01 (280-173651-9) and JACKSON-CB-01 (280-173651-10) were analyzed for Perchlorate in accordance with SW 846 6850. The samples were analyzed on 03/22/2023.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Detection Summary

Client: Katahdin Analytical Services
Project/Site: Fort Jackson

Job ID: 280-173651-1

Client Sample ID: SWDUP — Lab Sample ID: 280-173651-1

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
Perchlorate	0.044	J M	0.20	0.013	ug/L	1		6850	Total/NA

Client Sample ID: JACKSON-SWMC3-DC-01 — Lab Sample ID: 280-173651-2

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
Perchlorate	0.028	J M	0.20	0.013	ug/L	1		6850	Total/NA

Client Sample ID: JACKSON-SWMC2-DC-01 — Lab Sample ID: 280-173651-3

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
Perchlorate	0.023	J M	0.20	0.013	ug/L	1		6850	Total/NA

Client Sample ID: JACKSON-SWJC1-DC-01 — Lab Sample ID: 280-173651-4

No Detections.

Client Sample ID: JACKSON-SWMC1-DC-01 — Lab Sample ID: 280-173651-5

No Detections.

Client Sample ID: JACKSON-SWCC3-DC-01 — Lab Sample ID: 280-173651-6

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
Perchlorate	0.019	J M	0.20	0.013	ug/L	1		6850	Total/NA

Client Sample ID: JACKSON-SWCC4-DC-01 — Lab Sample ID: 280-173651-7

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
Perchlorate	0.015	J M	0.20	0.013	ug/L	1		6850	Total/NA

Client Sample ID: JACKSON-SWCC2-DC-01 — Lab Sample ID: 280-173651-8

No Detections.

Client Sample ID: JACKSON-EB-01 — Lab Sample ID: 280-173651-9

No Detections.

Client Sample ID: JACKSON-CB-01 — Lab Sample ID: 280-173651-10

No Detections.

This Detection Summary does not include radiochemical test results.

Client Sample ID: SWDUP
Lab Sample ID: 280-173651-1
Date Collected: 03/08/23 00:00
Matrix: Water
Date Received: 03/16/23 11:05

Method: EPA 6850 - Perchlorate by LC/MS or LC/MS/MS

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Perchlorate	0.044	J M	0.20	0.013	ug/L			03/22/23 17:06	1

Client Sample ID: JACKSON-SWMC3-DC-01
Lab Sample ID: 280-173651-2
Date Collected: 03/08/23 14:00
Matrix: Water
Date Received: 03/16/23 11:05

Method: EPA 6850 - Perchlorate by LC/MS or LC/MS/MS

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Perchlorate	0.028	J M	0.20	0.013	ug/L			03/22/23 17:11	1

Client Sample ID: JACKSON-SWMC2-DC-01
Lab Sample ID: 280-173651-3
Date Collected: 03/08/23 11:30
Matrix: Water
Date Received: 03/16/23 11:05

Method: EPA 6850 - Perchlorate by LC/MS or LC/MS/MS

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Perchlorate	0.023	J M	0.20	0.013	ug/L			03/22/23 17:27	1

Client Sample ID: JACKSON-SWJC1-DC-01
Lab Sample ID: 280-173651-4
Date Collected: 03/08/23 13:30
Matrix: Water
Date Received: 03/16/23 11:05

Method: EPA 6850 - Perchlorate by LC/MS or LC/MS/MS

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Perchlorate	0.10	U	0.20	0.013	ug/L			03/22/23 17:49	1

Client Sample ID: JACKSON-SWMC1-DC-01
Lab Sample ID: 280-173651-5
Date Collected: 03/08/23 11:50
Matrix: Water
Date Received: 03/16/23 11:05

Method: EPA 6850 - Perchlorate by LC/MS or LC/MS/MS

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Perchlorate	0.10	U	0.20	0.013	ug/L			03/22/23 17:54	1

Client Sample ID: JACKSON-SWCC3-DC-01
Lab Sample ID: 280-173651-6
Date Collected: 03/08/23 14:15
Matrix: Water
Date Received: 03/16/23 11:05

Method: EPA 6850 - Perchlorate by LC/MS or LC/MS/MS

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Perchlorate	0.019	J M	0.20	0.013	ug/L			03/22/23 17:59	1

Client Sample ID: JACKSON-SWCC4-DC-01
Lab Sample ID: 280-173651-7
Date Collected: 03/08/23 09:40
Matrix: Water
Date Received: 03/16/23 11:05

Method: EPA 6850 - Perchlorate by LC/MS or LC/MS/MS

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Perchlorate	0.015	J M	0.20	0.013	ug/L			03/22/23 18:05	1

Client Sample ID: JACKSON-SWCC2-DC-01
Lab Sample ID: 280-173651-8

Date Collected: 03/08/23 10:00
Matrix: Water
Date Received: 03/16/23 11:05

Method: EPA 6850 - Perchlorate by LC/MS or LC/MS/MS

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Perchlorate	0.10	U	0.20	0.013	ug/L			03/22/23 18:10	1

Client Sample ID: JACKSON-EB-01
Lab Sample ID: 280-173651-9

Date Collected: 03/08/23 15:30
Matrix: Water
Date Received: 03/16/23 11:05

Method: EPA 6850 - Perchlorate by LC/MS or LC/MS/MS

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Perchlorate	0.10	U	0.20	0.013	ug/L			03/22/23 18:15	1

Client Sample ID: JACKSON-CB-01
Lab Sample ID: 280-173651-10

Date Collected: 03/08/23 16:00
Matrix: Water
Date Received: 03/16/23 11:05

Method: EPA 6850 - Perchlorate by LC/MS or LC/MS/MS

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Perchlorate	0.10	U	0.20	0.013	ug/L			03/22/23 18:21	1

Default Detection Limits

Client: Katahdin Analytical Services
Job ID: 280-173651-1
Project/Site: Fort Jackson

Method: 6850 - Perchlorate by LC/MS or LC/MS/MS

Analyte	LOQ	DL	Units
Perchlorate	0.20	0.013	ug/L

Method: 6850 - Perchlorate by LC/MS or LC/MS/MS

Lab Sample ID: DLCK 280-605949/13
Matrix: Water
Analysis Batch: 605949

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	DLCK Result	DLCK Qualifier	Unit	D	%Rec	%Rec Limits		
Perchlorate			0.200	0.204	M	ug/L		102	50 - 150		

Lab Sample ID: MB 280-606020/55
Matrix: Water
Analysis Batch: 606020

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Perchlorate	0.10	U	0.20	0.013	ug/L			03/22/23 16:39	1

Lab Sample ID: LCS 280-606020/56
Matrix: Water
Analysis Batch: 606020

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Perchlorate			0.200	0.197	J	ug/L		99	84 - 119		

Lab Sample ID: 280-173651-2 MS
Matrix: Water
Analysis Batch: 606020

Client Sample ID: JACKSON-SWMC3-DC-01
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec Limits		
Perchlorate	0.028	J M	0.200	0.226		ug/L		99	84 - 119		

Lab Sample ID: 280-173651-2 MSD
Matrix: Water
Analysis Batch: 606020

Client Sample ID: JACKSON-SWMC3-DC-01
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Perchlorate	0.028	J M	0.200	0.217		ug/L		95	84 - 119	4	15

Lab Sample ID: INF 280-606020/57
Matrix: Water
Analysis Batch: 606020

Client Sample ID: Lab Control Sample

Analyte			Spike Added	INF Result	INF Qualifier	Unit	D	%Rec	%Rec Limits		
Perchlorate			0.200	0.174	J	ug/L		87	80 - 120		

QC Association Summary

Client: Katahdin Analytical Services
Project/Site: Fort Jackson

Job ID: 280-173651-1

LCMS

Analysis Batch: 605949

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
DLCK 280-605949/13	Lab Control Sample	Total/NA	Water	6850	

Analysis Batch: 606020

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-173651-1	SWDUP	Total/NA	Water	6850	
280-173651-2	JACKSON-SWMC3-DC-01	Total/NA	Water	6850	
280-173651-3	JACKSON-SWMC2-DC-01	Total/NA	Water	6850	
280-173651-4	JACKSON-SWJC1-DC-01	Total/NA	Water	6850	
280-173651-5	JACKSON-SWMC1-DC-01	Total/NA	Water	6850	
280-173651-6	JACKSON-SWCC3-DC-01	Total/NA	Water	6850	
280-173651-7	JACKSON-SWCC4-DC-01	Total/NA	Water	6850	
280-173651-8	JACKSON-SWCC2-DC-01	Total/NA	Water	6850	
280-173651-9	JACKSON-EB-01	Total/NA	Water	6850	
280-173651-10	JACKSON-CB-01	Total/NA	Water	6850	
MB 280-606020/55	Method Blank	Total/NA	Water	6850	
INF 280-606020/57	Lab Control Sample		Water	6850	
LCS 280-606020/56	Lab Control Sample	Total/NA	Water	6850	
280-173651-2 MS	JACKSON-SWMC3-DC-01	Total/NA	Water	6850	
280-173651-2 MSD	JACKSON-SWMC3-DC-01	Total/NA	Water	6850	

Client Sample ID: SWDUP
Lab Sample ID: 280-173651-1
Date Collected: 03/08/23 00:00
Matrix: Water
Date Received: 03/16/23 11:05

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	6850		1			606020	03/22/23 17:06	AGCM	EET DEN

Client Sample ID: JACKSON-SWMC3-DC-01
Lab Sample ID: 280-173651-2
Date Collected: 03/08/23 14:00
Matrix: Water
Date Received: 03/16/23 11:05

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	6850		1			606020	03/22/23 17:11	AGCM	EET DEN

Client Sample ID: JACKSON-SWMC2-DC-01
Lab Sample ID: 280-173651-3
Date Collected: 03/08/23 11:30
Matrix: Water
Date Received: 03/16/23 11:05

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	6850		1			606020	03/22/23 17:27	AGCM	EET DEN

Client Sample ID: JACKSON-SWJC1-DC-01
Lab Sample ID: 280-173651-4
Date Collected: 03/08/23 13:30
Matrix: Water
Date Received: 03/16/23 11:05

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	6850		1			606020	03/22/23 17:49	AGCM	EET DEN

Client Sample ID: JACKSON-SWMC1-DC-01
Lab Sample ID: 280-173651-5
Date Collected: 03/08/23 11:50
Matrix: Water
Date Received: 03/16/23 11:05

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	6850		1			606020	03/22/23 17:54	AGCM	EET DEN

Client Sample ID: JACKSON-SWCC3-DC-01
Lab Sample ID: 280-173651-6
Date Collected: 03/08/23 14:15
Matrix: Water
Date Received: 03/16/23 11:05

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	6850		1			606020	03/22/23 17:59	AGCM	EET DEN

Client Sample ID: JACKSON-SWCC4-DC-01
Lab Sample ID: 280-173651-7
Date Collected: 03/08/23 09:40
Matrix: Water
Date Received: 03/16/23 11:05

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	6850		1			606020	03/22/23 18:05	AGCM	EET DEN

Lab Chronicle

Client: Katahdin Analytical Services
Job ID: 280-173651-1
Project/Site: Fort Jackson

Client Sample ID: JACKSON-SWCC2-DC-01
Lab Sample ID: 280-173651-8

Date Collected: 03/08/23 10:00
Matrix: Water
Date Received: 03/16/23 11:05

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	6850		1			606020	03/22/23 18:10	AGCM	EET DEN

Client Sample ID: JACKSON-EB-01
Lab Sample ID: 280-173651-9

Date Collected: 03/08/23 15:30
Matrix: Water
Date Received: 03/16/23 11:05

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	6850		1			606020	03/22/23 18:15	AGCM	EET DEN

Client Sample ID: JACKSON-CB-01
Lab Sample ID: 280-173651-10

Date Collected: 03/08/23 16:00
Matrix: Water
Date Received: 03/16/23 11:05

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	6850		1			606020	03/22/23 18:21	AGCM	EET DEN

Laboratory References:

EET DEN = Eurofins Denver, 4955 Yarrow Street, Arvada, CO 80002, TEL (303)736-0100

Accreditation/Certification Summary

Client: Katahdin Analytical Services
Job ID: 280-173651-1
Project/Site: Fort Jackson

Laboratory: Eurofins Denver

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
A2LA	Dept. of Defense ELAP	2907.01	10-31-23

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
6850		Water	Perchlorate

Method Summary

Client: Katahdin Analytical Services
Job ID: 280-173651-1
Project/Site: Fort Jackson

Method	Method Description	Protocol	Laboratory
6850	Perchlorate by LC/MS or LC/MS/MS	EPA	EET DEN

Protocol References:

EPA = US Environmental Protection Agency

Laboratory References:

EET DEN = Eurofins Denver, 4955 Yarrow Street, Arvada, CO 80002, TEL (303)736-0100

Sample Summary

Client: Katahdin Analytical Services
Job ID: 280-173651-1
Project/Site: Fort Jackson

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
280-173651-1	SWDUP	Water	03/08/23 00:00	03/16/23 11:05
280-173651-2	JACKSON-SWMC3-DC-01	Water	03/08/23 14:00	03/16/23 11:05
280-173651-3	JACKSON-SWMC2-DC-01	Water	03/08/23 11:30	03/16/23 11:05
280-173651-4	JACKSON-SWJC1-DC-01	Water	03/08/23 13:30	03/16/23 11:05
280-173651-5	JACKSON-SWMC1-DC-01	Water	03/08/23 11:50	03/16/23 11:05
280-173651-6	JACKSON-SWCC3-DC-01	Water	03/08/23 14:15	03/16/23 11:05
280-173651-7	JACKSON-SWCC4-DC-01	Water	03/08/23 09:40	03/16/23 11:05
280-173651-8	JACKSON-SWCC2-DC-01	Water	03/08/23 10:00	03/16/23 11:05
280-173651-9	JACKSON-EB-01	Water	03/08/23 15:30	03/16/23 11:05
280-173651-10	JACKSON-CB-01	Water	03/08/23 16:00	03/16/23 11:05

LCMS MANUAL INTEGRATION SUMMARY

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Instrument ID: LC_LCMS10 Analysis Batch Number: 605949

Lab Sample ID: STD00100 280-605949/3 I Client Sample ID:

Date Analyzed: 03/21/23 14:11 Lab File ID: LC1023C21027.d GC Column: ID:

COMPOUND NAME	RETENTION TIME	MANUAL INTEGRATION		
		REASON	ANALYST	DATE
Perchlorate	3.53	Baseline	PE6P	03/22/23 08:33

Lab Sample ID: STD00200 280-605949/4 I Client Sample ID:

Date Analyzed: 03/21/23 14:17 Lab File ID: LC1023C21028.d GC Column: ID:

COMPOUND NAME	RETENTION TIME	MANUAL INTEGRATION		
		REASON	ANALYST	DATE
Perchlorate	3.56	Baseline	PE6P	03/22/23 08:32

Lab Sample ID: DLCK 280-605949/13 Client Sample ID:

Date Analyzed: 03/21/23 15:06 Lab File ID: LC1023C21037.d GC Column: ID:

COMPOUND NAME	RETENTION TIME	MANUAL INTEGRATION		
		REASON	ANALYST	DATE
Perchlorate	3.58	Baseline	PE6P	03/22/23 08:34

LCMS MANUAL INTEGRATION SUMMARY

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Instrument ID: LC_LCMS10 Analysis Batch Number: 606020

Lab Sample ID: 280-173651-1 Client Sample ID: SWDUP

Date Analyzed: 03/22/23 17:06 Lab File ID: LC1023C22074.d GC Column: ID:

COMPOUND NAME	RETENTION TIME	MANUAL INTEGRATION		
		REASON	ANALYST	DATE
Perchlorate	3.53	Baseline	PE6P	03/28/23 09:45

Lab Sample ID: 280-173651-2 Client Sample ID: JACKSON-SWMC3-DC-01

Date Analyzed: 03/22/23 17:11 Lab File ID: LC1023C22075.d GC Column: ID:

COMPOUND NAME	RETENTION TIME	MANUAL INTEGRATION		
		REASON	ANALYST	DATE
Perchlorate	3.53	Baseline	PE6P	03/28/23 09:45

Lab Sample ID: 280-173651-3 Client Sample ID: JACKSON-SWMC2-DC-01

Date Analyzed: 03/22/23 17:27 Lab File ID: LC1023C22078.d GC Column: ID:

COMPOUND NAME	RETENTION TIME	MANUAL INTEGRATION		
		REASON	ANALYST	DATE
Perchlorate	3.56	Baseline	PE6P	03/28/23 09:46

Lab Sample ID: 280-173651-6 Client Sample ID: JACKSON-SWCC3-DC-01

Date Analyzed: 03/22/23 17:59 Lab File ID: LC1023C22084.d GC Column: ID:

COMPOUND NAME	RETENTION TIME	MANUAL INTEGRATION		
		REASON	ANALYST	DATE
Perchlorate	3.56	Baseline	PE6P	03/28/23 09:46

Lab Sample ID: 280-173651-7 Client Sample ID: JACKSON-SWCC4-DC-01

Date Analyzed: 03/22/23 18:05 Lab File ID: LC1023C22085.d GC Column: ID:

COMPOUND NAME	RETENTION TIME	MANUAL INTEGRATION		
		REASON	ANALYST	DATE
Perchlorate	3.56	Baseline	PE6P	03/28/23 09:47

REAGENT TRACEABILITY SUMMARY

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Reagent ID	Exp Date	Prep Date	Dilutant Used	Reagent Final Volume	Parent Reagent		Analyte	Concentration
					Reagent ID	Volume Added		
ClO4ICVStockW_00004	10/10/23	10/10/22	H2O, Lot 209218	100 mL	ClO4ICVStock3_00013	2 mL	Perchlorate	0.02 ug/mL
.ClO4ICVStock3_00013	10/10/23	10/10/22	H2O, Lot 209218	10 mL	ClO4ICVStock2_00010	1 mL	Perchlorate	1 ug/mL
..ClO4ICVStock2_00010	10/10/23	10/10/22	H2O, Lot 209218	10 mL	ClO4ICVStock1_00006	0.1 mL	Perchlorate	10 ug/mL
...ClO4ICVStock1_00006	03/26/24	Absolute Standards, Lot 032621			(Purchased Reagent)		Perchlorate	1000 ug/mL
PTX-IS-Spike_00012	12/05/28	02/14/23	ELGA Water, Lot N. Elga	100 mL	PTX-ISStock2_00008	4 mL	Perchlorate-18O	0.0408 ug/mL
.PTX-ISStock2_00008	12/05/28	04/02/21	H2O, Lot 249632	50 mL	Ptx-ISStock1_00002	0.5 mL	Perchlorate-18O	1.02 ug/mL
..Ptx-ISStock1_00002	12/05/28	Cambridge, Lot SDIH-016			(Purchased Reagent)		Perchlorate-18O	102 ug/mL
PtxCalStockW_00016	10/10/23	10/10/22	H2O, Lot 266760	100 mL	PtxCalStock3_00008	2 mL	Perchlorate	0.02 ug/mL
.PtxCalStock3_00008	10/10/23	10/10/22	H2O, Lot 249362	10 mL	PTXCalStock2_00009	1 mL	Perchlorate	1 ug/mL
..PTXCalStock2_00009	10/10/23	10/10/22	H2O, Lot 249362	10 mL	PTXStockClO4_00005	0.1 mL	Perchlorate	10 ug/mL
...PTXStockClO4_00005	08/14/24	Accustandard, Lot 222075022			(Purchased Reagent)		Perchlorate	1000 ug/mL

Reagent

ClO4ICVStock1_00006

Absolute Standards, Inc.
800-368-1131
www.absolutestandards.com

Certified Reference Material CRM

ANAB ISO 17034 Accredited
AR-1539 Certificate Number
https://Absolutestandards.com

CERTIFIED WEIGHT REPORT:

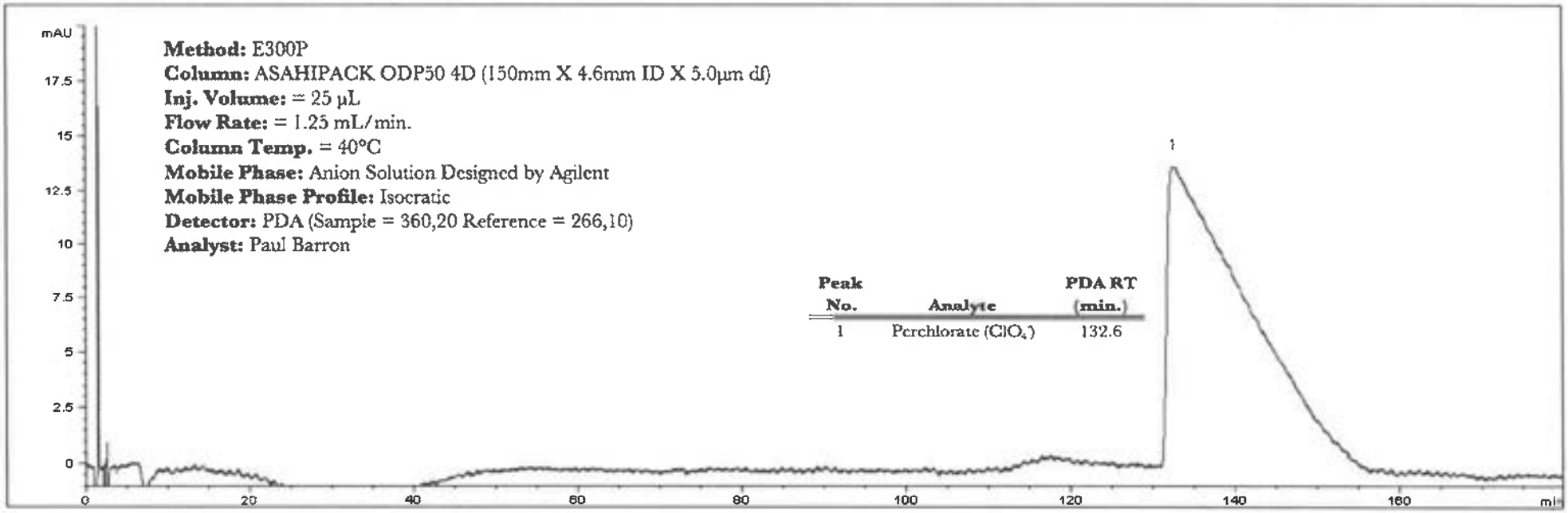
Part Number: 57001
Lot Number: 032621
Description: Perchlorate (ClO_4^-)

Lot #
Solvent: 032621 ASTM Type 1 Water

Expiration Date: 032624
Recommended Storage: Refrigerate (4 °C)
Nominal Concentration (µg/mL): 1000
NIST Test Number: 6UTB 5E-05 Balance Uncertainty
Weight shown below was diluted to (mL): 1999.53 0.100 Flask Uncertainty

Formulated By:	Giovanni Esposito	032621
Reviewed By:	Pedro L. Rentas	032621

Compound	RM#	Lot Number	Nominal Conc. (µg/mL)	Purity (%)	Uncertainty Purity (%)	Assay (%)	Target Weight (g)	Actual Weight (g)	Actual Conc. (µg/mL)	Expanded Uncertainty +/- (µg/mL)	SDS Information (Solvent Safety Info. On Attached pg.) CAS#	OSHA PEL (TWA)	LD50	NIST SRM
1. Sodium Perchlorate (ClO4)	IN119	MKBN1540V	1000	98.0	0.10	81.2	2.51200	2.51208	**1000.0**	**2.0**	7601-89-0	NA	NA	3152a



* The certified value is the concentration calculated from gravimetric and volumetric measurements unless otherwise stated.
* Purified acids, 18.2 megohm deionized water, calibrated Class A glassware and the highest purity raw materials are used in the preparation of all standards.
* All standard containers are meticulously cleaned prior to use.
* Standards are prepared gravimetrically using balances that are calibrated with weights traceable to NIST (see above).
* Standards are certified (+/-) 0.5% of the stated value, unless otherwise stated.
* All standards should be stored with caps tight and under appropriate laboratory conditions.
* Uncertainty Reference: Taylor, B.N. and Kuyat, C.E., "Guidelines for Evaluating and Expressin the Uncertainty of NIST Measurement Result," NIST Technical Note 1297, U.S. Government Printing Office, Washington, D.C. (1994).

Reagent

Ptx-ISStock1_00002

Certificate of Analysis

Product Name: (Isotopic Label & Enrichment Specification)	PERCHLORIC ACID, SODIUM SALT (18O4, 90%+) 100 UG/ML IN WATER
Lot Number:	SDIH-016
Catalog Number:	OLM-7310-S

Product Information

Chemical Purity Specification:	≥98%
MW*: *For isotopically labeled compounds, MW listed is for the fully enriched product.	130.44
Labeled CAS Number:	NA
Unlabeled CAS Number:	7601-89-0
Chemical Formula:	NaCl*O4
Storage:	Store at room temperature away from light and moisture.
Stability:	See storage and expiration date.
Intended Use:	For Research Use Only. Not for use in diagnostic procedures.

$NaCl^{18}O_4$

Certification

Cambridge Isotope Laboratories, Inc. guarantees that this material meets or exceeds the specifications stated. Absolute identity as well as chemical and isotopic purities are assured by the use of unambiguous synthetic routes and multiple chemical analyses whenever possible. Results are representative of QC testing at time of release from Quality Control unless otherwise stated. CIL Certificates of Analysis are occasionally updated with new data following recertification. We recommend checking the website for the latest version.

Volumetric measurements were made with Class A glassware. Gravimetry is traceable to the NIST through calibrated balances and certified, calibrated, standard weights. The calibrations are traceable to the NIST under Test No. 822/270236-04. The calibrations also meet specifications outlined in ISO 9001, ISO/IEC 17025, ANSI/NSCL Z540-1-1994, NCR Document 10CFR50 Appendix B, and applicable subdocuments.

This COA references the bulk catalog number before packaging. The COA also applies to the CIL finished good catalog number . Some possible packaging sizes and their corresponding suffix are -1.2, -1, -0.5, -10, or -0.1.

Approved by: Sashi Sivendran-Basak

Sashi Sivendran-Basak, Ph.D., Quality Review

Quality Control Tests and Results

QC Release Date	12/05/2018
Expiration Date	12/05/2028
Concentration Based on Gravimetry (of the salt)	100.0 ± 1.0 µg/mL (k=2)
Chemical Purity of Neat Material(s)	98%

(continued on next page)

Product Name: PERCHLORIC ACID, SODIUM SALT
(Isotopic Label & Enrichment Specification) (18O4, 90%+) 100 UG/ML IN WATER

Lot Number: SDIH-016

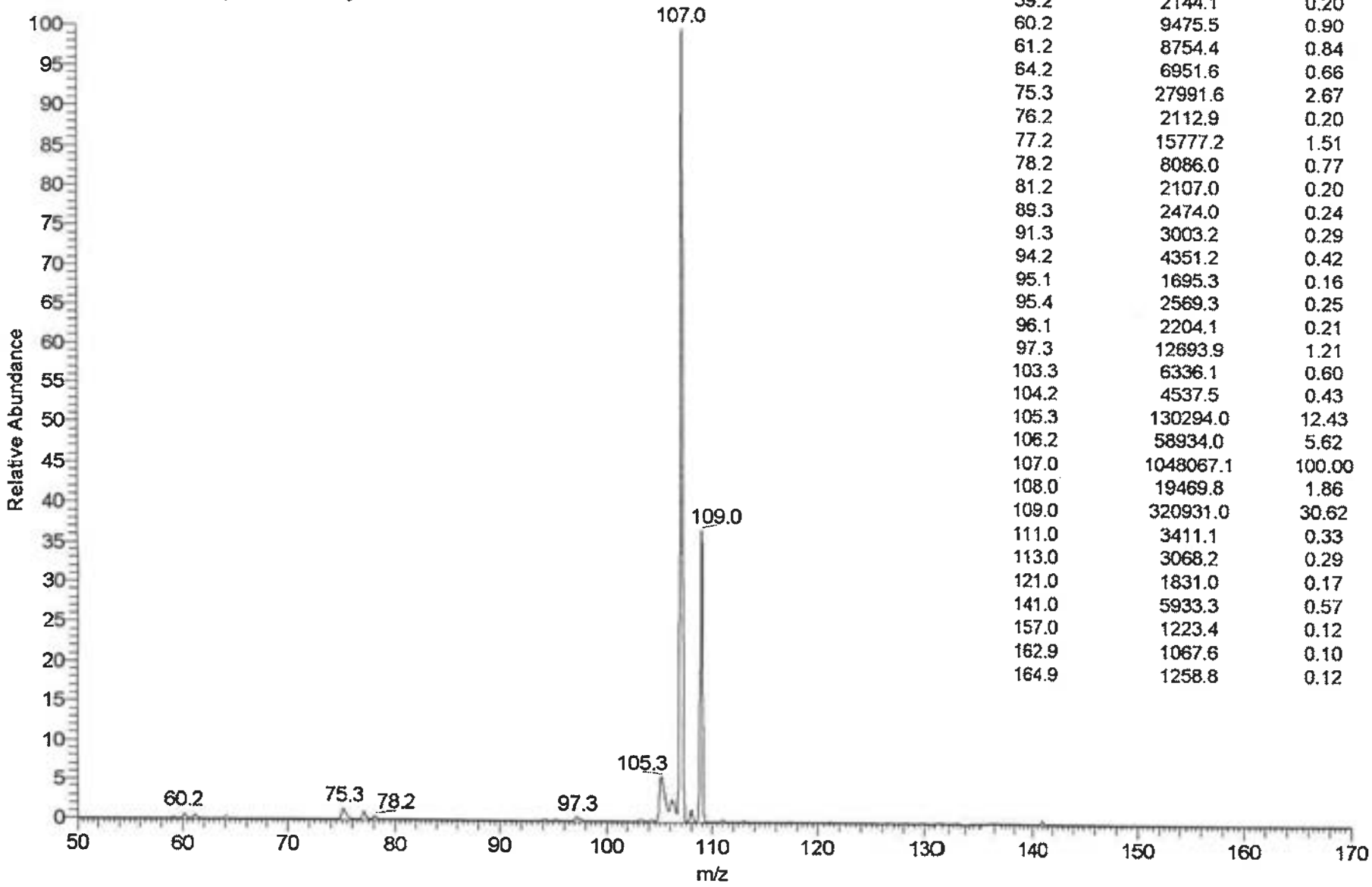
Catalog Number: OLM-7310-S

Quality Control Tests and Results (continued)

LC/MS for Concentration	105.4 ± 1.1 µg/mL (k=2)

Perchloric Acid, Sodium Salt, 18O4, 100 ug/mL in water, OLM-7310-S, SDIH-016

2018_11_14_016 #38-46 RT: 0.27-0.31 AV: 9 NL: 1.49E5
F: ITMS - p ESI E Full ms [50.00-200.00]



m/z	Intensity	Relative
59.2	2144.1	0.20
60.2	9475.5	0.90
61.2	8754.4	0.84
64.2	6951.6	0.66
75.3	27991.6	2.67
76.2	2112.9	0.20
77.2	15777.2	1.51
78.2	8086.0	0.77
81.2	2107.0	0.20
89.3	2474.0	0.24
91.3	3003.2	0.29
94.2	4351.2	0.42
95.1	1695.3	0.16
95.4	2569.3	0.25
96.1	2204.1	0.21
97.3	12693.9	1.21
103.3	6336.1	0.60
104.2	4537.5	0.43
105.3	130294.0	12.43
106.2	58934.0	5.62
107.0	1048067.1	100.00
108.0	19469.8	1.86
109.0	320931.0	30.62
111.0	3411.1	0.33
113.0	3068.2	0.29
121.0	1831.0	0.17
141.0	5933.3	0.57
157.0	1223.4	0.12
162.9	1067.6	0.10
164.9	1258.8	0.12

PERCHLORIC ACID, SODIUM SALT (18O4, 90%+) 100 UG/ML IN WATER

Safety Data Sheet

according to Regulation (EC) No. 453/2010 and according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 25/02/2014 Revision date: 10/02/2016 Supersedes: 25/02/2014 Version: 2.0

OLM-7310-S

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form : Mixtures

Product name : PERCHLORIC ACID, SODIUM SALT (18O4, 90%+) 100 UG/ML IN WATER

Product code : OLM-7310-S

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.2.1. Relevant identified uses

Industrial/Professional use spec : Industrial.
For professional use only.

1.2.2. Uses advised against

No additional information available

1.3. Details of the supplier of the safety data sheet

Cambridge Isotope Laboratories, Inc.
50 Frontage Road
Andover, MA 01810
USA

USA: 1-800-322-1174 Int: 1-978-749-8000
cilsales@isotope.com www.isotope.com

Emergency telephone number

Emergency numbers:

Chemtrec: 1-800-424-9300 (24 hours)
International: 1-703-741-5970 (24 hours)

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Not classified

Classification according to Directive 67/548/EEC or 1999/45/EC

O; R8
O; R9

Full text of R-phrases: see section 16

Classification (GHS-US)

Not classified

Adverse physicochemical, human health and environmental effects

No additional information available

2.2. Label elements

Labeling according to Regulation (EC) No. 1272/2008 [CLP]

No labeling applicable

GHS-US labeling

No labeling applicable

2.3. Other hazards

No additional information available

SECTION 3: Composition/information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Name	Product identifier	%	Classification according to Directive 67/548/EEC
WATER UNLABELED	(CAS No) 7732-18-5 (EC no) 231-791-2	99.99	Not classified
PERCHLORIC ACID, SODIUM SALT (18O4, 90%+)	(CAS No) 7601-89-0 (Unlabeled) (EC no) 231-511-9 (EC index no) 017-010-00-6	0.01	O; R8 O; R9 Xn; R22

Name	Product identifier	%	Classification according to Regulation (EC) No. 1272/2008 [CLP]
WATER UNLABELED	(CAS No) 7732-18-5 (EC no) 231-791-2	99.99	Not classified
PERCHLORIC ACID, SODIUM SALT (18O4, 90%+)	(CAS No) 7601-89-0 (Unlabeled) (EC no) 231-511-9 (EC index no) 017-010-00-6	0.01	Ox. Sol. 1, H271 Acute Tox. 4 (Oral), H302

Full text of R-, H- and EUH-phrases: see section 16

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : If not breathing give artificial respiration.

First-aid measures after ingestion : Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2. Most important symptoms and effects, both acute and delayed

No additional information available

4.3. Indication of any immediate medical attention and special treatment needed

No additional information available

SECTION 5: Firefighting measures

5.1. Extinguishing media

suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2. Special hazards arising from the substance or mixture

Reactivity : Not available.

5.3. Advice for firefighters

Firefighting instructions : The product itself does not burn.

Protection during firefighting : Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

Prevent entry to sewers and public waters.

6.3. Methods and material for containment and cleaning up

For containment : Wipe up with absorbent material (e.g. cloth, fleece).

6.4. Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Store at room temperature away from light and moisture.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No additional information available

8.2. Exposure controls

Personal protective equipment : Safety glasses. Gloves. Protective clothing. Respiratory protection of the dependent type.

Hand protection : Wear suitable protective clothing and gloves.

Eye protection : Wear safety glasses with side shields (or goggles) and a face shield.

Skin and body protection : Choose body protection according to the amount and concentration of the dangerous substance at the work place.

Respiratory protection : When appropriate, use NIOSH/CEN approved respirator.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

The properties listed below are for the solvent, the main component of this mixture.

Physical state	: Liquid
Appearance	: Liquid.
Molecular mass	: 18.02 g/mol
Color	: Colourless.
Odor	: No data available.
Odor threshold	: No data available
pH	: 6.0 - 8.0 at 25 °C (77 °F)
Relative evaporation rate (butyl acetate=1)	: No data available
Melting point	: 0.0 °C (32.0 °F)
Freezing point	: No data available
Boiling point	: 100.0 °C (212.0 °F)
Flash point	: No data available
Self ignition temperature	: No data available
Decomposition temperature	: No data available
Flammability (solid, gas)	: No data available
Vapor pressure	: No data available
Relative vapor density at 20 °C	: No data available
Relative density	: No data available
Density	: 1 g/ml at 20 °C (68 °F)
Solubility	: Water: Completely miscible
Log Pow	: No data available
Log Kow	: No data available
Viscosity, kinematic	: No data available
Viscosity, dynamic	: No data available
Explosive properties	: No data available
Oxidizing properties	: No data available
Explosive limits	: No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

Not available.

10.2. Chemical stability

See storage and expiration date on CoA.

10.3. Possibility of hazardous reactions

No additional information available

10.4. Conditions to avoid

Not available.

10.5. Incompatible materials

No data available.

10.6. Hazardous decomposition products

No data available.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified

PERCHLORIC ACID, SODIUM SALT (18O4, 90%+) 100 UG/ML IN WATER	
LD50 oral rat	> 90000 mg/kg

WATER UNLABELED (7732-18-5)	
LD50 oral rat	> 90000 mg/kg

PERCHLORIC ACID, SODIUM SALT (18O4, 90%+) (7601-89-0 (Unlabeled))	
ATE (oral)	500.000 mg/kg body weight

Skin corrosion/irritation : Not classified
No data available
pH: 6.0 - 8.0 at 25 °C (77 °F)

Serious eye damage/irritation : Not classified
No data available
pH: 6.0 - 8.0 at 25 °C (77 °F)

Respiratory or skin sensitization : Not available
No data available

Germ cell mutagenicity : Not available

Carcinogenicity : Not classified

Reproductive toxicity : Not available

Specific target organ toxicity (single exposure) : Not classified
No data available

Specific target organ toxicity (repeated exposure) : Not classified
No data available

Aspiration hazard : Not classified

Potential Adverse human health effects and symptoms : To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

SECTION 12: Ecological information

12.1. Toxicity

No additional information available

12.2. Persistence and degradability

PERCHLORIC ACID, SODIUM SALT (18O4, 90%+) (7601-89-0 (Unlabeled))	
Persistence and degradability	Not available.

12.3. Bioaccumulative potential

PERCHLORIC ACID, SODIUM SALT (18O4, 90%+) (7601-89-0 (Unlabeled))	
Bioaccumulative potential	Not available.

12.4. Mobility in soil

PERCHLORIC ACID, SODIUM SALT (18O4, 90%+) (7601-89-0 (Unlabeled))	
Ecology - soil	Not available.

12.5. Results of PBT and vPvB assessment

No additional information available

12.6. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Regional legislation (waste) : Waste materials should be disposed of under conditions which meet Federal, State, and Local environmental control regulations.

Waste disposal recommendations : Dispose in a safe manner in accordance with local/national regulations.

SECTION 14: Transport information

In accordance with ADR / RID / ADNR / IMDG / ICAO / IATA

14.1. UN number

Not applicable

14.2. UN proper shipping name

Not applicable

14.3. Additional information

Other information : No supplementary information available.

Special transport precautions : Not dangerous goods.

Overland transport

No additional information available

Transport by sea

No additional information available

Air transport

No additional information available

14.4. Environmental hazards

Other information : No supplementary information available.

14.5. Special precautions for user

Special transport precautions : Not dangerous goods.

14.6. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable

SECTION 15: Regulatory information

15.1. US Federal regulations

No additional information available

15.2. International regulations

CANADA

PERCHLORIC ACID, SODIUM SALT (18O4, 90%+) 100 UG/ML IN WATER
Listed on the Canadian DSL (Domestic Substances List) inventory.

15.2.1. National regulations

No additional information available

15.3. US State regulations

PERCHLORIC ACID, SODIUM SALT (18O4, 90%+) 100 UG/ML IN WATER()	
State or local regulations	U.S. - Pennsylvania - RTK (Right to Know) List U.S. - New Jersey - Right to Know Hazardous Substance List This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

SECTION 16: Other information

Other information : This product is not radioactive. The data given for this product are those of the corresponding unlabeled compound, unless specifically indicated otherwise. Health and safety data for labeled compounds are generally not available, but are assumed to be similar or identical to the corresponding unlabeled compound.

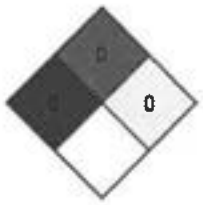
Full text of R-, H- and EUH-phrases::

Acute Tox. 4 (Oral)	Acute toxicity (oral) Category 4
Ox. Sol. 1	Oxidizing solids Category 1
H271	May cause fire or explosion; strong oxidiser
H302	Harmful if swallowed
R22	Harmful if swallowed
R8	Contact with combustible material may cause fire
R9	Explosive when mixed with combustible material
O	Oxidizing
Xn	Harmful

NFPA health hazard : 0 - Exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials.

NFPA fire hazard : 0 - Materials that will not burn.

NFPA reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health : 0 Minimal Hazard - No significant risk to health

Flammability : 0 Minimal Hazard

Physical : 0 Minimal Hazard

CIL Mixture SDS

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product

Reagent

PTXStockClO4_00005

125 Market Street
New Haven, CT 06513
USA

AccuStandard®

Tel (203)786-5290
Fax (203)786-5287
www.AccuStandard.com

CERTIFICATE OF ANALYSIS

AccuTrace™ Reference Standard

Catalog No: IC-PER-10X-1
Description: Perchlorate Standard
Element: Perchlorate (ClO_4)
SRM: ind. Std.
Lot: 222075022
Matrix: Water
Hazards: *Refer to SDS for complete safety information*

Signal Word: None

Date Certified: Jul 14, 2022
Expiration: Aug 14, 2024
Sample Size: 100 mL
Components: 1
Storage Condition: Ambient (>5 °C)

Certified Reference Material

ANAB AR-1463

Component		SRM #	Certified Concentration (µg/mL)
ClO_4	Perchlorate	Ind. Std.	1000

This Certified Reference Material was verified in accordance with ISO/IEC 17025

A product with a suffix (-1A, -2B, etc. or -01, -02, etc.) on its lot number has had its expiration date extended and is identical to the same lot number without the suffix.

The gravimetric uncertainty for this product is ±0.24%. The CRM uncertainty is ±2.4%.

The final solution was checked against an independent standard to verify its concentration.

We use the highest purity raw materials available to minimize impurity levels in the final solution. Typically 99.999%+ pure starting materials are used as well as ASTM Type I 18 megaohm deionized water.

All glassware used in preparation is Class A.

All weights are traceable through NIST, Test No. 684/289871-17

All bottles are triple rinsed with deionized water prior to use.

Shake bottle prior to use and do not pipette directly out of the bottle. Use only cleaned Class A volumetric glassware. Keep bottle tightly capped.

Certified By: Meigan O'Leary

Meigan O'Leary, Inorganic QC Manager

For use in routine laboratory analysis.

AccuStandard is accredited to ISO 17034, ISO/IEC 17025 and certified to ISO 9001:2015

6850_DOD5

Perchlorate by LC/MS or LC/MS/MS

FORM III
LCMS LAB CONTROL SAMPLE RECOVERY

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Matrix: Water Level: Low Lab File ID: LC1023C22070.d

Lab ID: LCS 280-606020/56 Client ID:

COMPOUND	SPIKE ADDED (ug/L)	LCS CONCENTRATION (ug/L)	LCS % REC	QC LIMITS REC	#
Perchlorate	0.200	0.197 J	99	84-119	

Column to be used to flag recovery and RPD values

FORM III 6850

FORM III
LCMS MATRIX SPIKE RECOVERY

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Matrix: Water Level: Low Lab File ID: LC1023C22076.d

Lab ID: 280-173651-2 MS Client ID: JACKSON-SWMC3-DC-01 MS

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC	QC LIMITS REC	#
Perchlorate	0.200	0.028 J	0.226	99	84-119	

Column to be used to flag recovery and RPD values

FORM III 6850

FORM III
LCMS MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Matrix: Water Level: Low Lab File ID: LC1023C22077.d

Lab ID: 280-173651-2 MSD Client ID: JACKSON-SWMC3-DC-01 MSD

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC	% RPD	QC LIMITS RPD	QC LIMITS REC	#
Perchlorate	0.200	0.217	95	4	15	84-119	

Column to be used to flag recovery and RPD values

FORM III 6850

FORM III
LCMS DETECTION LIMIT CHECK STANDARD RECOVERY

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Matrix: Water Level: Low Lab File ID: LC1023C21037.d

Lab ID: DLCK 280-605949/13 Client ID:

COMPOUND	SPIKE ADDED (ug/L)	DLCK CONCENTRATION (ug/L)	DLCK % REC	QC LIMITS REC	#
Perchlorate	0.200	0.204	102	50-150	M

Column to be used to flag recovery and RPD values

FORM III 6850

FORM III
LCMS LC INTERFERENCE CHECK STANDARD RECOVERY

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Matrix: Water Level: Low Lab File ID: LC1023C22071.d

Lab ID: INF 280-606020/57 Client ID:

COMPOUND	SPIKE ADDED (ug/L)	INF CONCENTRATION (ug/L)	INF % REC	QC LIMITS REC	#
Perchlorate	0.200	0.174 J	87	80-120	

Column to be used to flag recovery and RPD values

FORM III 6850

FORM IV
LCMS METHOD BLANK SUMMARY

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Lab File ID: LC1023C22069.d Lab Sample ID: MB 280-606020/55

Matrix: Water Date Extracted:

Instrument ID: LC_LCMS10 Date Analyzed: 03/22/2023 16:39

Level:(Low/Med) Low

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES:

CLIENT SAMPLE ID	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED
	LCS 280-606020/56	LC1023C22070.d	03/22/2023 16:44
SWDUP	280-173651-1	LC1023C22074.d	03/22/2023 17:06
JACKSON-SWMC3-DC-01	280-173651-2	LC1023C22075.d	03/22/2023 17:11
JACKSON-SWMC3-DC-01 MS	280-173651-2 MS	LC1023C22076.d	03/22/2023 17:16
JACKSON-SWMC3-DC-01 MSD	280-173651-2 MSD	LC1023C22077.d	03/22/2023 17:22
JACKSON-SWMC2-DC-01	280-173651-3	LC1023C22078.d	03/22/2023 17:27
JACKSON-SWJC1-DC-01	280-173651-4	LC1023C22082.d	03/22/2023 17:49
JACKSON-SWMC1-DC-01	280-173651-5	LC1023C22083.d	03/22/2023 17:54
JACKSON-SWCC3-DC-01	280-173651-6	LC1023C22084.d	03/22/2023 17:59
JACKSON-SWCC4-DC-01	280-173651-7	LC1023C22085.d	03/22/2023 18:05
JACKSON-SWCC2-DC-01	280-173651-8	LC1023C22086.d	03/22/2023 18:10
JACKSON-EB-01	280-173651-9	LC1023C22087.d	03/22/2023 18:15
JACKSON-CB-01	280-173651-10	LC1023C22088.d	03/22/2023 18:21

FORM VIII
LCMS INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Instrument I LC_LCMS10 Calibration Start Date: 03/21/2023 14:11

GC Column: ID: () Calibration End Date: 03/21/2023 14:49

Calibration ID: 78245

		ClO418					
		AREA #	RT #	#	RT #	#	RT #
INITIAL CALIBRATION MEAN AREA AND MEAN RT		9967	3.56				
UPPER LIMIT		14951	4.56				
LOWER LIMIT		4984	2.56				
LAB SAMPLE ID	CLIENT SAMPLE ID						
ICB 280-605949/11		9547	3.58				
ICV 280-605949/12		9685	3.58				
DLCK 280-605949/13		9028	3.58				
CCV 280-606020/52		11108	3.53				
CCVL 280-606020/53		10670	3.53				
CCB 280-606020/54		10668	3.53				
MB 280-606020/55		10545	3.53				
LCS 280-606020/56		11133	3.53				
INF 280-606020/57		11239	3.53				
280-173651-1	SWDUP	10652	3.53				
280-173651-2	JACKSON-SWMC3-DC-01	11033	3.53				
280-173651-2 MS	JACKSON-SWMC3-DC-01 MS	10958	3.53				
280-173651-2 MSD	JACKSON-SWMC3-DC-01 MSD	11197	3.53				
280-173651-3	JACKSON-SWMC2-DC-01	10915	3.53				
CCV 280-606020/65		11167	3.53				
CCVL 280-606020/66		10933	3.53				
CCB 280-606020/67		11442	3.53				
280-173651-4	JACKSON-SWJC1-DC-01	11272	3.53				
280-173651-5	JACKSON-SWMC1-DC-01	11950	3.56				
280-173651-6	JACKSON-SWCC3-DC-01	11551	3.53				
280-173651-7	JACKSON-SWCC4-DC-01	11230	3.53				
280-173651-8	JACKSON-SWCC2-DC-01	11283	3.53				
280-173651-9	JACKSON-EB-01	11642	3.53				
280-173651-10	JACKSON-CB-01	10752	3.53				
CCV 280-606020/78		12389	3.53				
CCVL 280-606020/79		11505	3.53				
CCB 280-606020/80		12533	3.53				

ClO418 = Perchlorate-18O

Area Limit = 50%-150% of internal standard area
RT Limit = ± 1 minutes of internal standard RT

Column used to flag values outside QC limits

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: SWDUP | Lab Sample ID: 280-173651-1

Matrix: Water | Lab File ID: LC1023C22074.d

Analysis Method: 6850 | Date Collected: 03/08/2023 00:00

Extraction Method: | Date Extracted:

Sample wt/vol: 0(mL) | Date Analyzed: 03/22/2023 17:06

Con. Extract Vol.: | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: ID:

% Moisture: % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.044	J M	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22074.d
Lims ID: 280-173651-A-1
Client ID: SWDUP
Sample Type: Client
Inject. Date: 22-Mar-2023 17:06:03 ALS Bottle#: 12 Worklist Smp#: 60
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: 280-173651-A-1
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:44 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:45:18

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		10652	816.0		302	
2 Perchlorate									M
99.00 > 82.80	3.534	3.584	-0.050	1.000	906	43.9	Target=3.25	28.3	M
101.00 > 85.00	3.584	3.584	0.0	1.014	296		3.06(2.30-3.80)	26.0	M

QC Flag Legend

Processing Flags
Review Flags
M - Manually Integrated

Reagents:

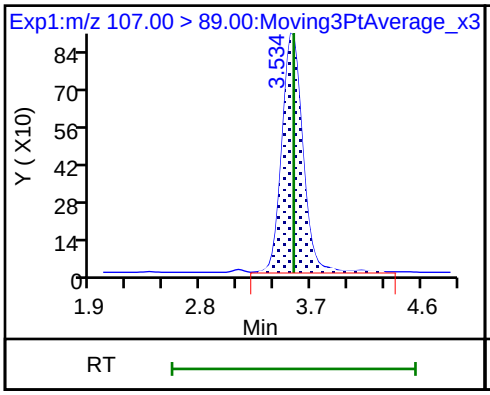
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:48 Chrom Revision: 2.3 16-Mar-2023 15:40:40

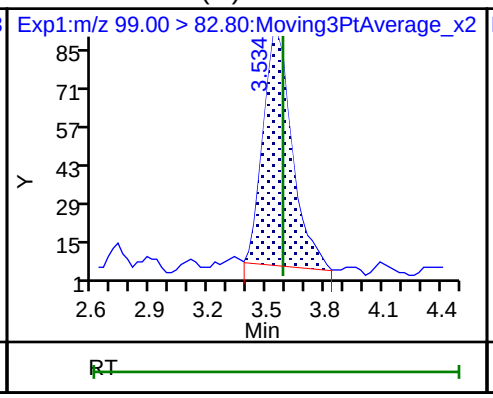
Eurofins Denver

Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22074.d				
Injection Date:	22-Mar-2023 17:06:03	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-1	Lab Sample ID:	280-173651-1		
Client ID:	SWDUP				
Operator ID:	DENLCMS	ALS Bottle#:	12	Worklist Smp#:	60
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		

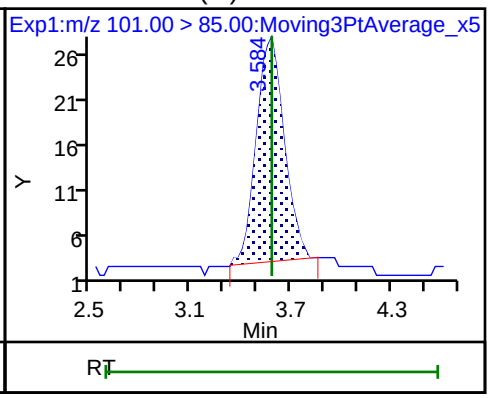
* 1 Perchlorate-18O



2 Perchlorate (M)



2 Perchlorate (M)



Manual Integration/User Assign Peak Report

Eurofins Denver

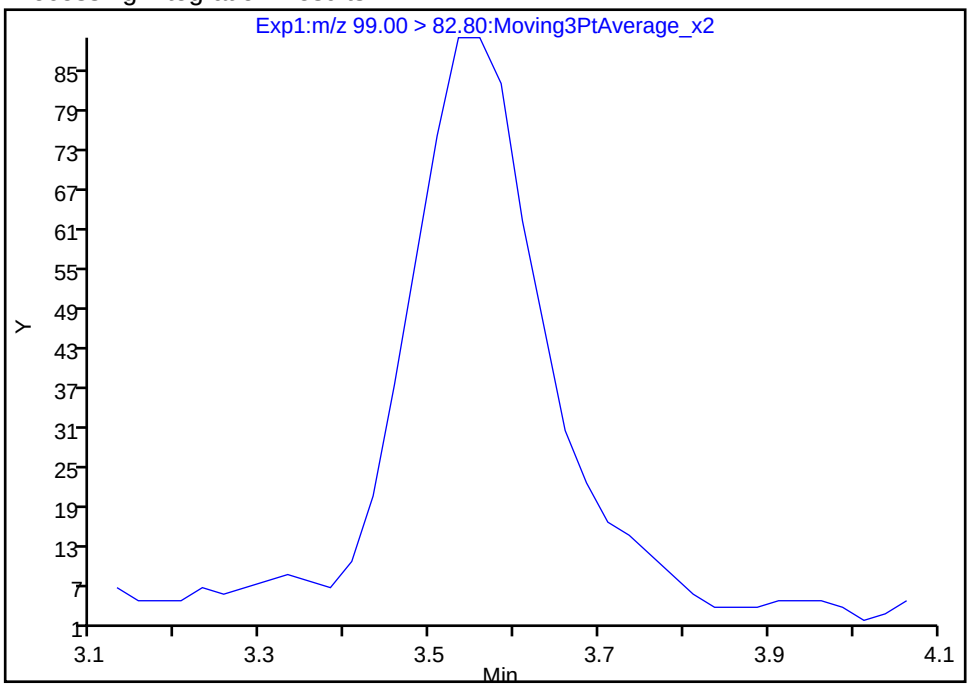
Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22074.d				
Injection Date:	22-Mar-2023 17:06:03	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-1	Lab Sample ID:	280-173651-1		
Client ID:	SWDUP				
Operator ID:	DENLCMS	ALS Bottle#:	12	Worklist Smp#:	60
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		
Column:		Detector	EXP1		

2 Perchlorate, CAS: 14797-73-0

Signal: 1

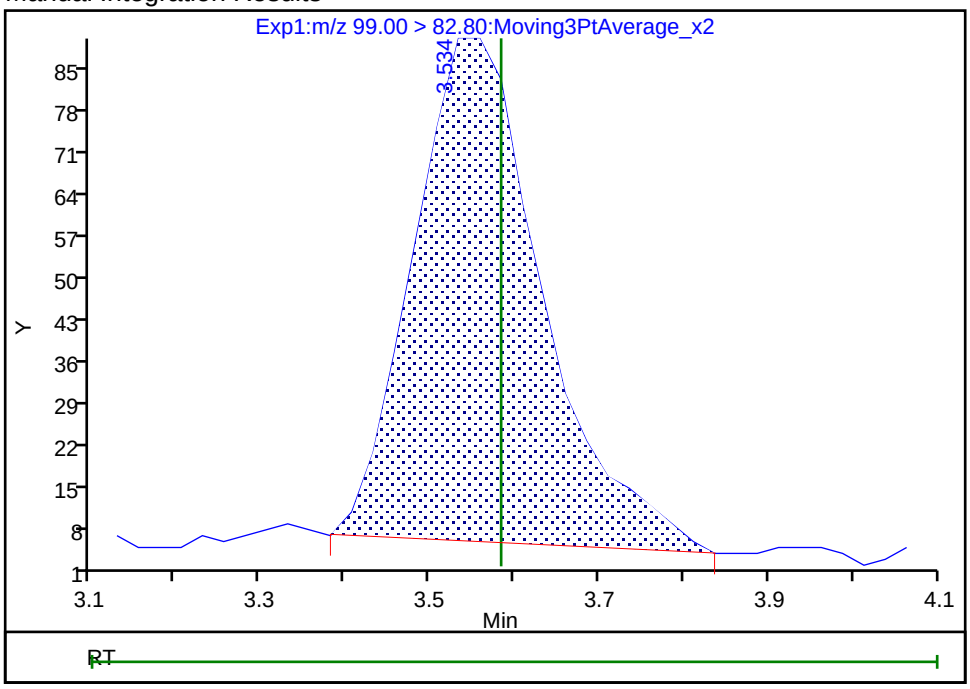
Not Detected
Expected RT: 3.58

Processing Integration Results



Manual Integration Results

RT: 3.53
Area: 906
Amount: 43.873480
Amount Units: ng/l



Reviewer: PE6P, 28-Mar-2023 09:45:14
Audit Action: Manually Integrated Audit Reason: Baseline

Manual Integration/User Assign Peak Report

Eurofins Denver

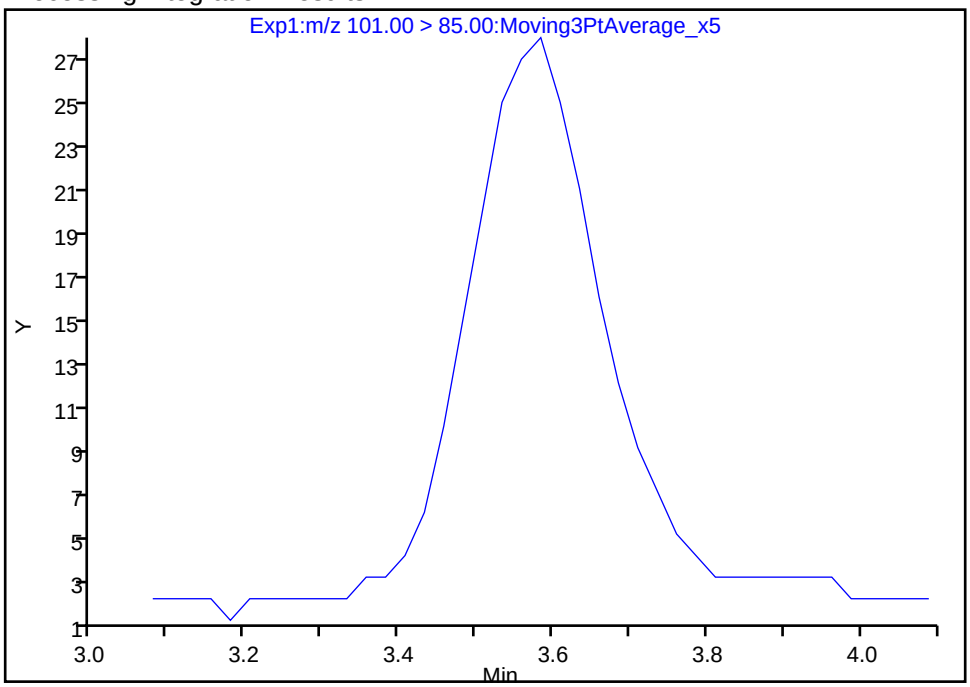
Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22074.d				
Injection Date:	22-Mar-2023 17:06:03	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-1	Lab Sample ID:	280-173651-1		
Client ID:	SWDUP				
Operator ID:	DENLCMS	ALS Bottle#:	12	Worklist Smp#:	60
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		
Column:		Detector	EXP1		

2 Perchlorate, CAS: 14797-73-0

Signal: 2

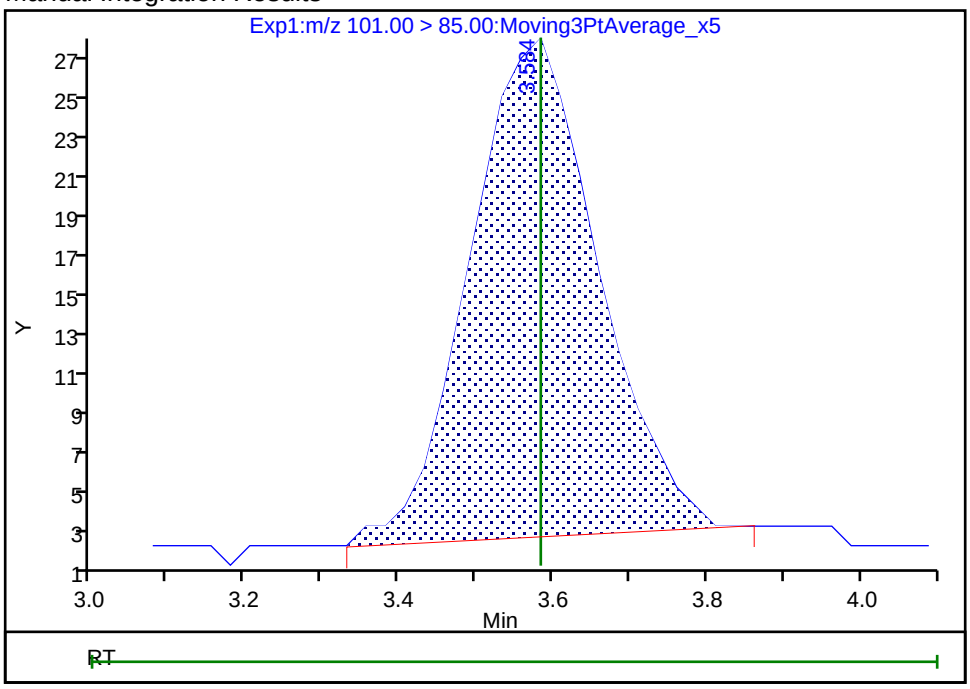
Processing Integration Results

Not Detected
Expected RT: 3.58



Manual Integration Results

RT: 3.58
Area: 296
Amount: 43.873480
Amount Units: ng/l



Reviewer: PE6P, 28-Mar-2023 09:45:16
Audit Action: Manually Integrated Audit Reason: Baseline

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: JACKSON-SWMC3-DC-01 | Lab Sample ID: 280-173651-2

Matrix: Water | Lab File ID: LC1023C22075.d

Analysis Method: 6850 | Date Collected: 03/08/2023 14:00

Extraction Method: | Date Extracted:

Sample wt/vol: 0(mL) | Date Analyzed: 03/22/2023 17:11

Con. Extract Vol.: | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: ID:

% Moisture: % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.028	J M	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22075.d
Lims ID: 280-173651-A-2
Client ID: JACKSON-SWMC3-DC-01
Sample Type: Client
Inject. Date: 22-Mar-2023 17:11:23 ALS Bottle#: 13 Worklist Smp#: 61
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: 280-173651-A-2
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:44 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:45:29

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11033	816.0		936	
2 Perchlorate									M
99.00 > 82.80	3.534	3.584	-0.050	1.000	598	28.0	Target=3.25	14.3	M
101.00 > 85.00	3.559	3.584	-0.025	1.007	177		3.38(2.30-3.80)	10.5	M

QC Flag Legend

Processing Flags
Review Flags
M - Manually Integrated

Reagents:

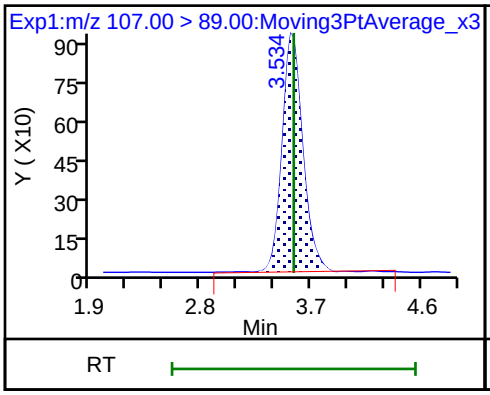
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:48 Chrom Revision: 2.3 16-Mar-2023 15:40:40

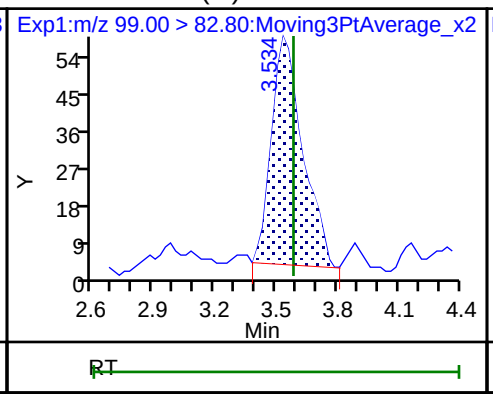
Eurofins Denver

Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22075.d				
Injection Date:	22-Mar-2023 17:11:23	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-2	Lab Sample ID:	280-173651-2		
Client ID:	JACKSON-SWMC3-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	13	Worklist Smp#:	61
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		

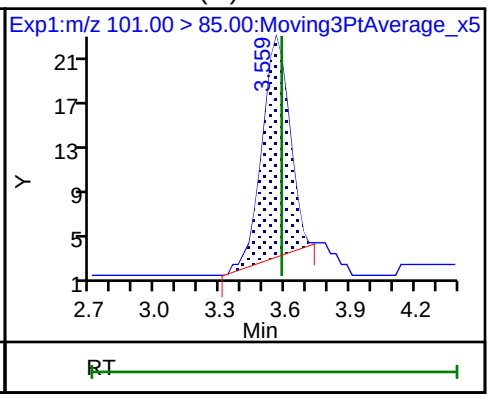
* 1 Perchlorate-18O



2 Perchlorate (M)



2 Perchlorate (M)



Manual Integration/User Assign Peak Report

Eurofins Denver

Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22075.d				
Injection Date:	22-Mar-2023 17:11:23	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-2	Lab Sample ID:	280-173651-2		
Client ID:	JACKSON-SWMC3-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	13	Worklist Smp#:	61
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		
Column:		Detector	EXP1		

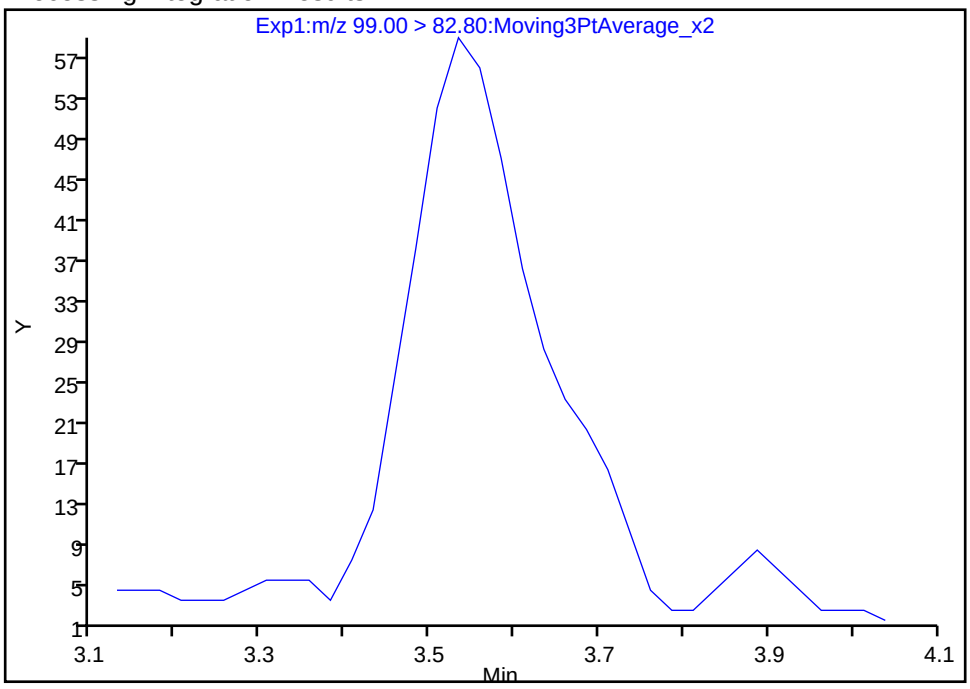
2 Perchlorate, CAS: 14797-73-0

Signal: 1

Processing Integration Results

Not Detected

Expected RT: 3.58



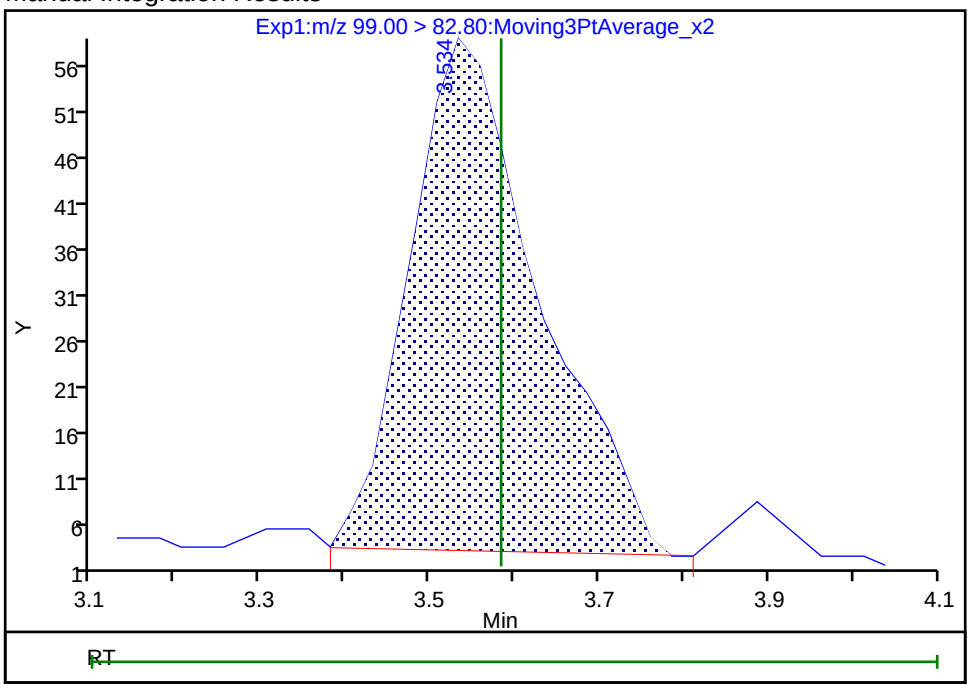
Manual Integration Results

RT: 3.53

Area: 598

Amount: 27.958419

Amount Units: ng/l



Reviewer: PE6P, 28-Mar-2023 09:45:23

Audit Action: Manually Integrated Audit Reason: Baseline

Manual Integration/User Assign Peak Report

Eurofins Denver

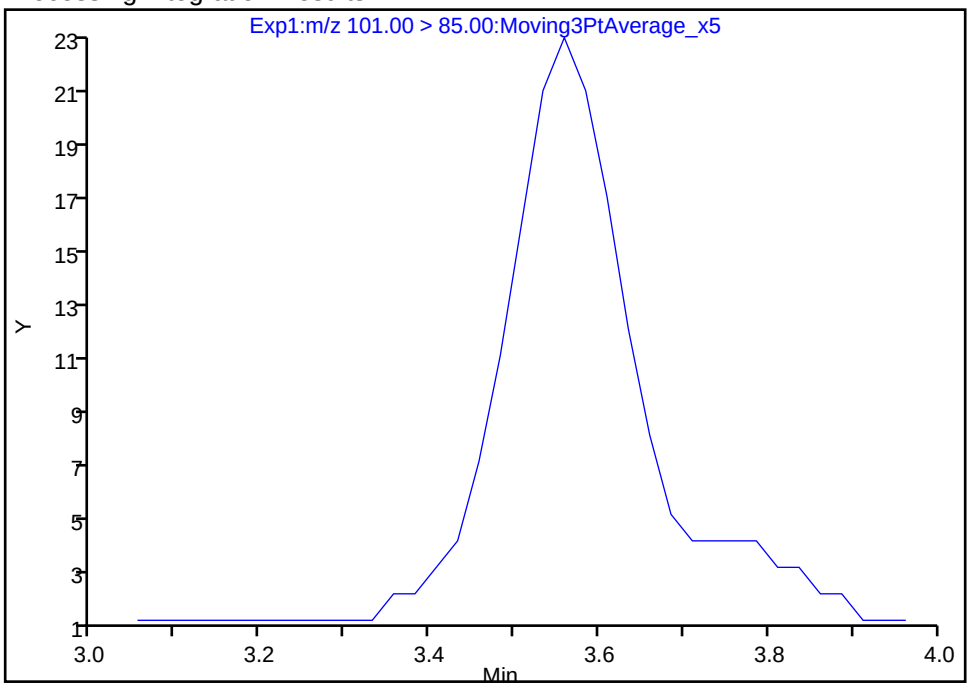
Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22075.d				
Injection Date:	22-Mar-2023 17:11:23	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-2	Lab Sample ID:	280-173651-2		
Client ID:	JACKSON-SWMC3-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	13	Worklist Smp#:	61
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		
Column:		Detector	EXP1		

2 Perchlorate, CAS: 14797-73-0

Signal: 2

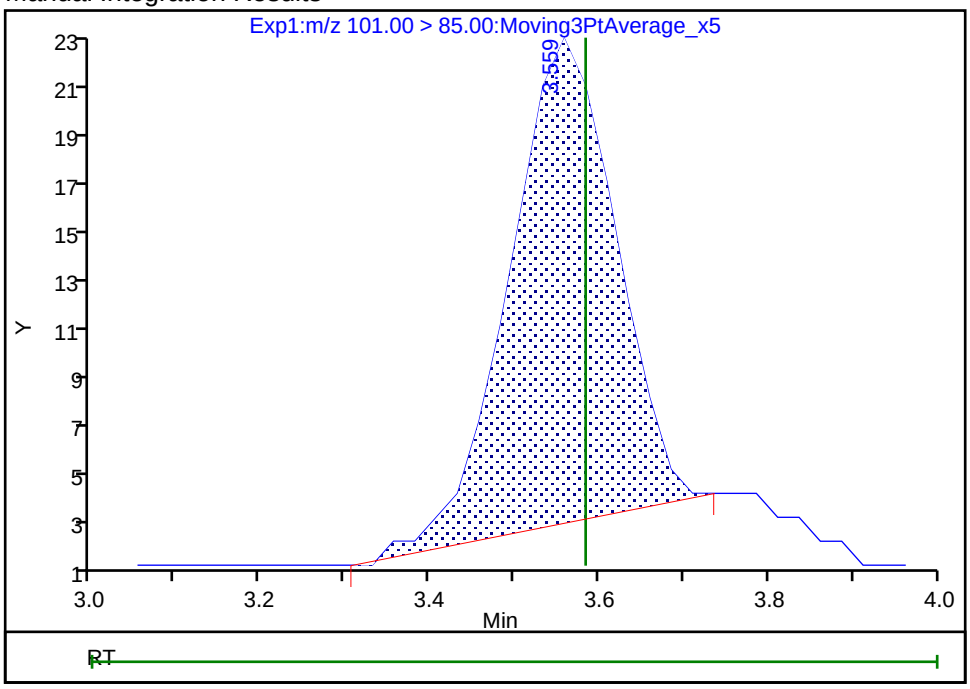
Not Detected
Expected RT: 3.58

Processing Integration Results



Manual Integration Results

RT: 3.56
Area: 177
Amount: 27.958419
Amount Units: ng/l



Reviewer: PE6P, 28-Mar-2023 09:45:27
Audit Action: Manually Integrated Audit Reason: Baseline

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Client Sample ID: JACKSON-SWMC2-DC-01 Lab Sample ID: 280-173651-3

Matrix: Water Lab File ID: LC1023C22078.d

Analysis Method: 6850 Date Collected: 03/08/2023 11:30

Extraction Method: Date Extracted:

Sample wt/vol: 0(mL) Date Analyzed: 03/22/2023 17:27

Con. Extract Vol.: Dilution Factor: 1

Injection Volume: 25(uL) GC Column: ID:

% Moisture: % Solids: GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.023	J M	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22078.d
Lims ID: 280-173651-A-3
Client ID: JACKSON-SWMC2-DC-01
Sample Type: Client
Inject. Date: 22-Mar-2023 17:27:33 ALS Bottle#: 16 Worklist Smp#: 64
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: 280-173651-A-3
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:44 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:46:27

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		10915	816.0		459	
2 Perchlorate									M
99.00 > 82.80	3.559	3.584	-0.025	1.007	486	23.0	Target=3.25	21.0	M
101.00 > 85.00	3.559	3.584	-0.025	1.007	204		2.38(2.30-3.80)	17.0	M

QC Flag Legend

Processing Flags
Review Flags
M - Manually Integrated

Reagents:

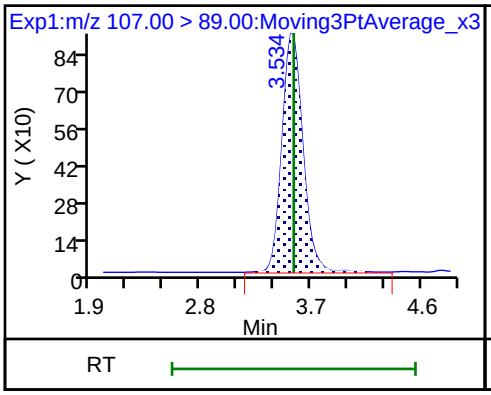
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:49 Chrom Revision: 2.3 16-Mar-2023 15:40:40

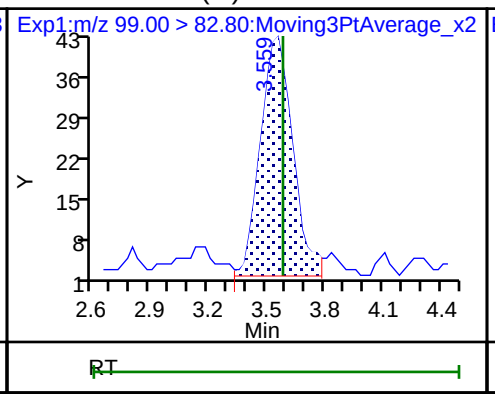
Eurofins Denver

Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22078.d				
Injection Date:	22-Mar-2023 17:27:33	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-3	Lab Sample ID:	280-173651-3		
Client ID:	JACKSON-SWMC2-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	16	Worklist Smp#:	64
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		

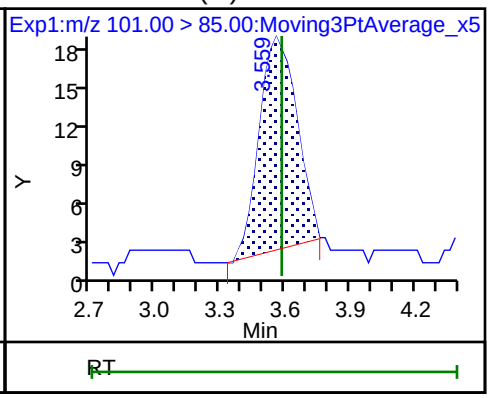
* 1 Perchlorate-18O



2 Perchlorate (M)



2 Perchlorate (M)



Manual Integration/User Assign Peak Report

Eurofins Denver

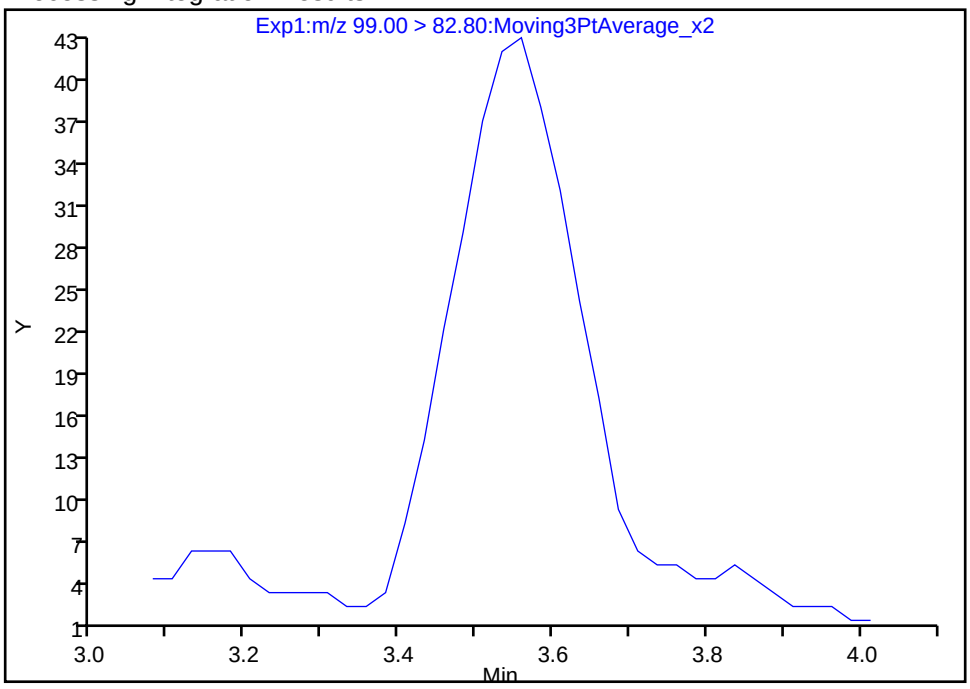
Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22078.d				
Injection Date:	22-Mar-2023 17:27:33	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-3	Lab Sample ID:	280-173651-3		
Client ID:	JACKSON-SWMC2-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	16	Worklist Smp#:	64
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		
Column:		Detector	EXP1		

2 Perchlorate, CAS: 14797-73-0

Signal: 1

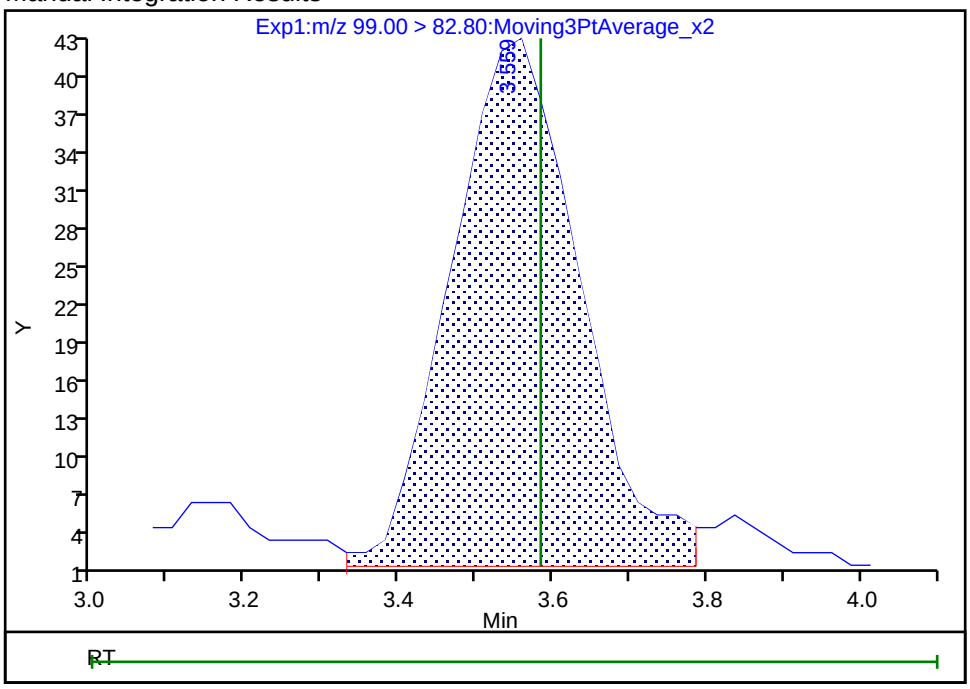
Processing Integration Results

Not Detected
Expected RT: 3.58



Manual Integration Results

RT: 3.56
Area: 486
Amount: 22.967703
Amount Units: ng/l



Reviewer: PE6P, 28-Mar-2023 09:46:16
Audit Action: Manually Integrated Audit Reason: Baseline

Manual Integration/User Assign Peak Report

Eurofins Denver

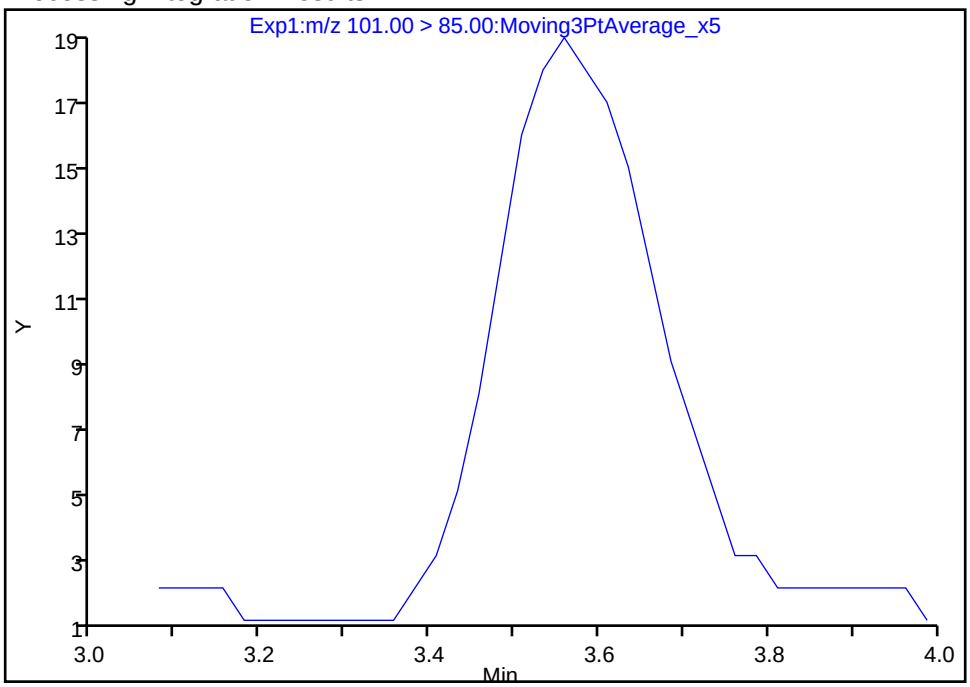
Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22078.d				
Injection Date:	22-Mar-2023 17:27:33	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-3	Lab Sample ID:	280-173651-3		
Client ID:	JACKSON-SWMC2-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	16	Worklist Smp#:	64
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		
Column:		Detector	EXP1		

2 Perchlorate, CAS: 14797-73-0

Signal: 2

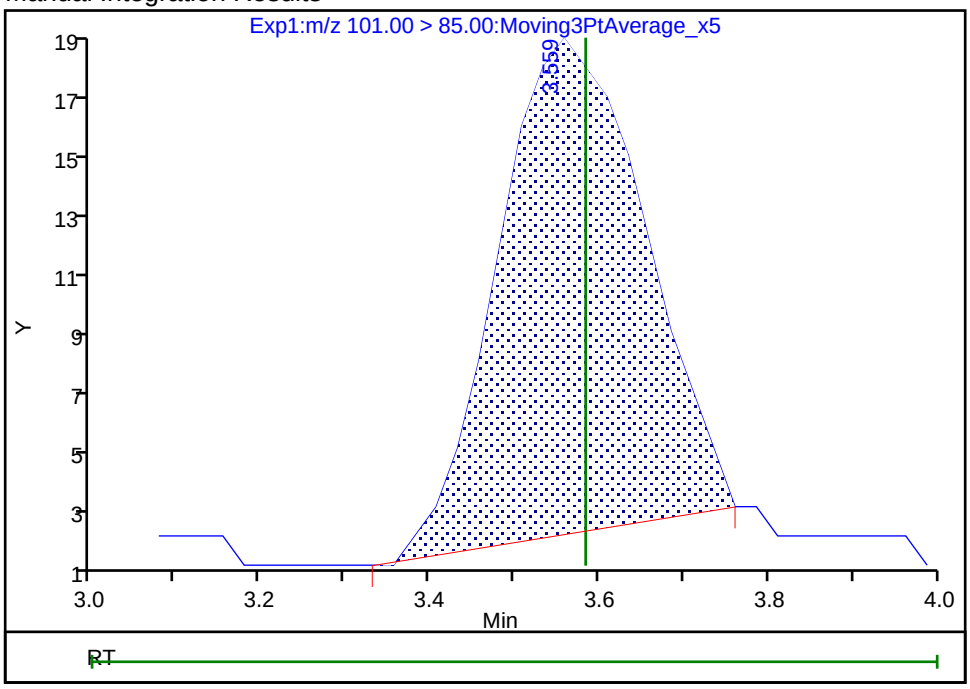
Processing Integration Results

Not Detected
Expected RT: 3.58



Manual Integration Results

RT: 3.56
Area: 204
Amount: 22.967703
Amount Units: ng/l



Reviewer: PE6P, 28-Mar-2023 09:46:23
Audit Action: Manually Integrated Audit Reason: Baseline

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: JACKSON-SWJC1-DC-01 | Lab Sample ID: 280-173651-4

Matrix: Water | Lab File ID: LC1023C22082.d

Analysis Method: 6850 | Date Collected: 03/08/2023 13:30

Extraction Method: | Date Extracted:

Sample wt/vol: 0(mL) | Date Analyzed: 03/22/2023 17:49

Con. Extract Vol.: | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: ID:

% Moisture: % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.10	U	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22082.d				
Lims ID:	280-173651-A-4				
Client ID:	JACKSON-SWJC1-DC-01				
Sample Type:	Client				
Inject. Date:	22-Mar-2023 17:49:00	ALS Bottle#:	17	Worklist Smp#:	68
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Sample Info:	280-173651-A-4				
Misc. Info.:	Plate: 3 Rack: 1				
Operator ID:	DENLCMS	Instrument ID:	LC_LCMS10		
Method:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m				
Limit Group:	LC - 6850				
Last Update:	28-Mar-2023 09:48:50	Calib Date:	21-Mar-2023 14:49:53		
Integrator:	Picker				
Quant Method:	Internal Standard	Quant By:	Initial Calibration		
Last ICal File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d				
Column 1 :			Det: EXP1		
Process Host:	CTX1643				
First Level Reviewer: PE6P		Date:	28-Mar-2023 09:46:35		

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11272	816.0		500	

QC Flag Legend

Processing Flags

Reagents:

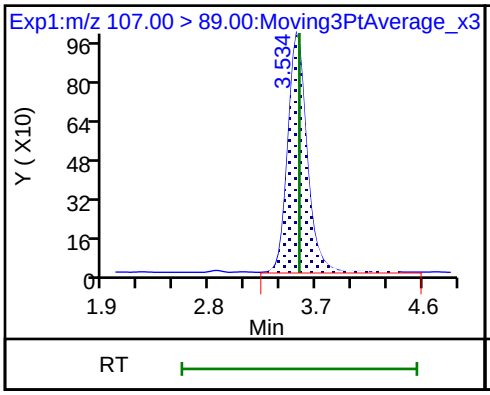
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:51 Chrom Revision: 2.3 16-Mar-2023 15:40:40

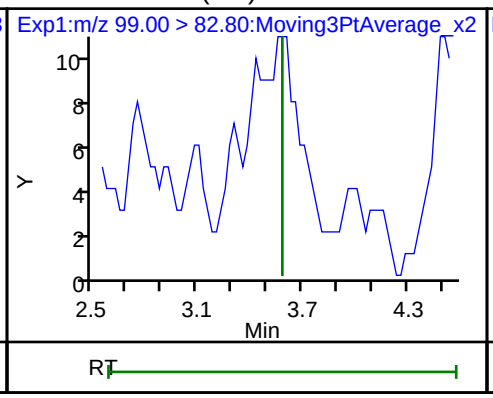
Eurofins Denver

Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22082.d				
Injection Date:	22-Mar-2023 17:49:00	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-4	Lab Sample ID:	280-173651-4		
Client ID:	JACKSON-SWJC1-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	17	Worklist Smp#:	68
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		

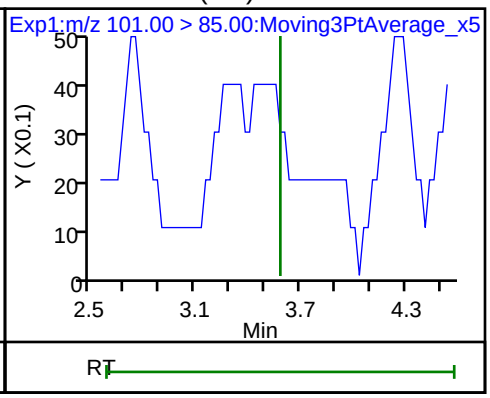
* 1 Perchlorate-18O



2 Perchlorate (ND)



2 Perchlorate (ND)



FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: JACKSON-SWMC1-DC-01 | Lab Sample ID: 280-173651-5

Matrix: Water | Lab File ID: LC1023C22083.d

Analysis Method: 6850 | Date Collected: 03/08/2023 11:50

Extraction Method: | Date Extracted:

Sample wt/vol: 0(mL) | Date Analyzed: 03/22/2023 17:54

Con. Extract Vol.: | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: ID:

% Moisture: % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.10	U	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22083.d
Lims ID: 280-173651-A-5
Client ID: JACKSON-SWMC1-DC-01
Sample Type: Client
Inject. Date: 22-Mar-2023 17:54:25 ALS Bottle#: 18 Worklist Smp#: 69
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: 280-173651-A-5
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:50 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:46:36

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.559	3.559	0.0		11950	816.0		1027	

QC Flag Legend
Processing Flags

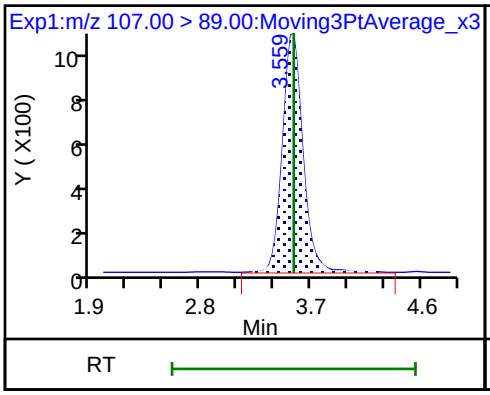
Reagents:
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:51 Chrom Revision: 2.3 16-Mar-2023 15:40:40

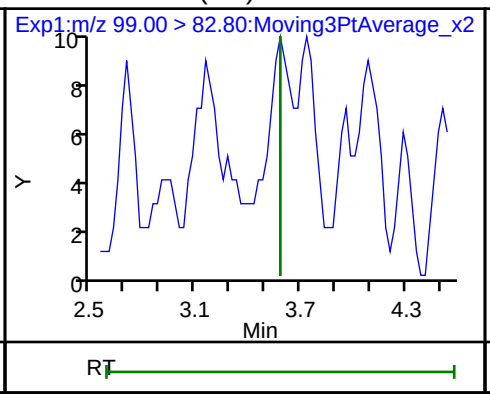
Eurofins Denver

Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22083.d				
Injection Date:	22-Mar-2023 17:54:25	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-5	Lab Sample ID:	280-173651-5		
Client ID:	JACKSON-SWMC1-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	18	Worklist Smp#:	69
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		

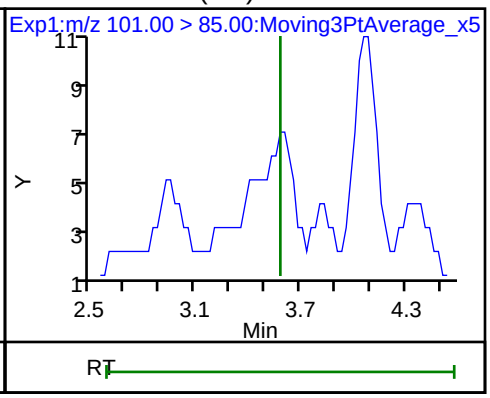
* 1 Perchlorate-18O



2 Perchlorate (ND)



2 Perchlorate (ND)



FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Client Sample ID: JACKSON-SWCC3-DC-01 Lab Sample ID: 280-173651-6

Matrix: Water Lab File ID: LC1023C22084.d

Analysis Method: 6850 Date Collected: 03/08/2023 14:15

Extraction Method: Date Extracted:

Sample wt/vol: 0(mL) Date Analyzed: 03/22/2023 17:59

Con. Extract Vol.: Dilution Factor: 1

Injection Volume: 25(uL) GC Column: ID:

% Moisture: % Solids: GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.019	J M	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22084.d
Lims ID: 280-173651-A-6
Client ID: JACKSON-SWCC3-DC-01
Sample Type: Client
Inject. Date: 22-Mar-2023 17:59:48 ALS Bottle#: 19 Worklist Smp#: 70
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: 280-173651-A-6
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:50 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:47:05

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11551	816.0		343	
2 Perchlorate									M
99.00 > 82.80	3.559	3.584	-0.025	1.007	434	19.4	Target=3.25	15.0	M
101.00 > 85.00	3.508	3.584	-0.076	0.993	134		3.24(2.30-3.80)	5.0	M

QC Flag Legend

Processing Flags
Review Flags
M - Manually Integrated

Reagents:

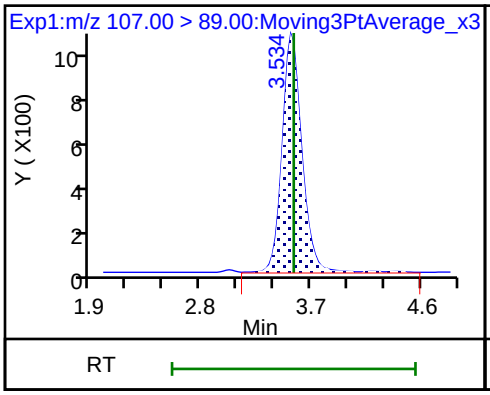
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:51 Chrom Revision: 2.3 16-Mar-2023 15:40:40

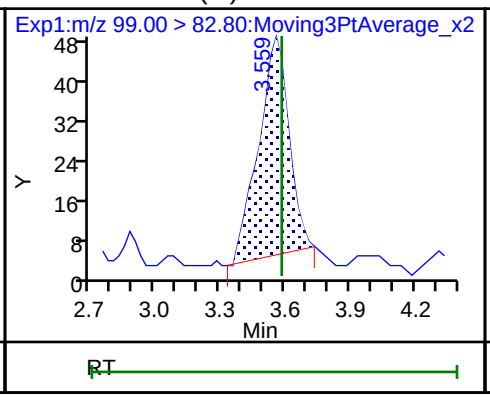
Eurofins Denver

Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22084.d				
Injection Date:	22-Mar-2023 17:59:48	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-6	Lab Sample ID:	280-173651-6		
Client ID:	JACKSON-SWCC3-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	19	Worklist Smp#:	70
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		

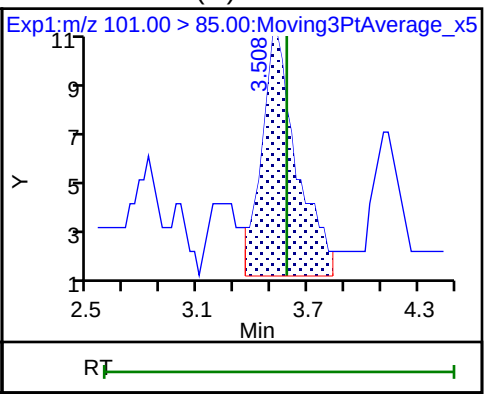
* 1 Perchlorate-18O



2 Perchlorate (M)



2 Perchlorate (M)



Manual Integration/User Assign Peak Report

Eurofins Denver

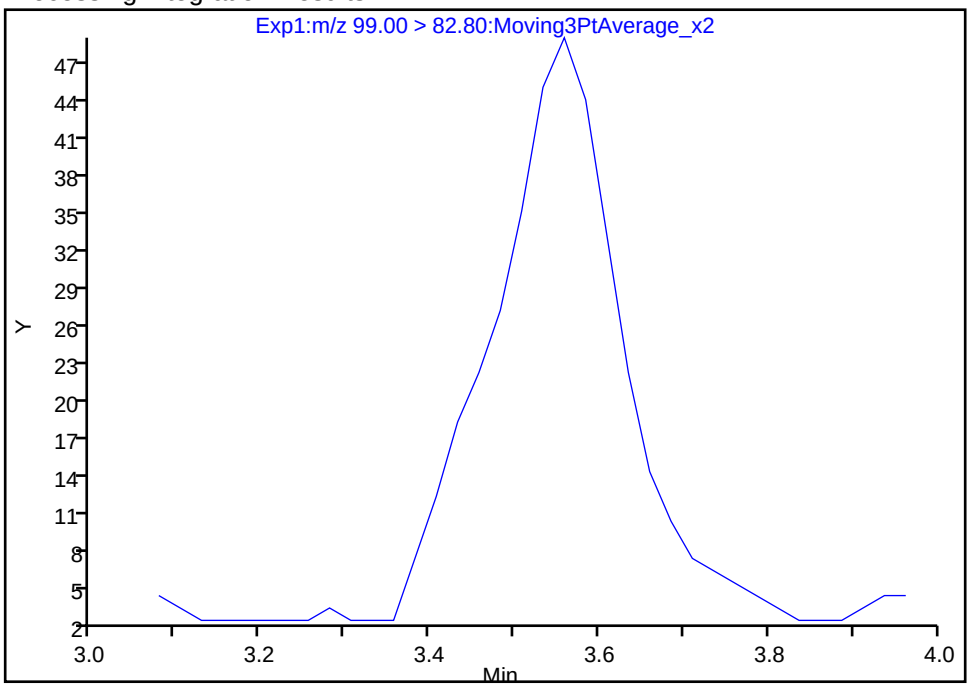
Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22084.d				
Injection Date:	22-Mar-2023 17:59:48	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-6	Lab Sample ID:	280-173651-6		
Client ID:	JACKSON-SWCC3-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	19	Worklist Smp#:	70
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		
Column:		Detector	EXP1		

2 Perchlorate, CAS: 14797-73-0

Signal: 1

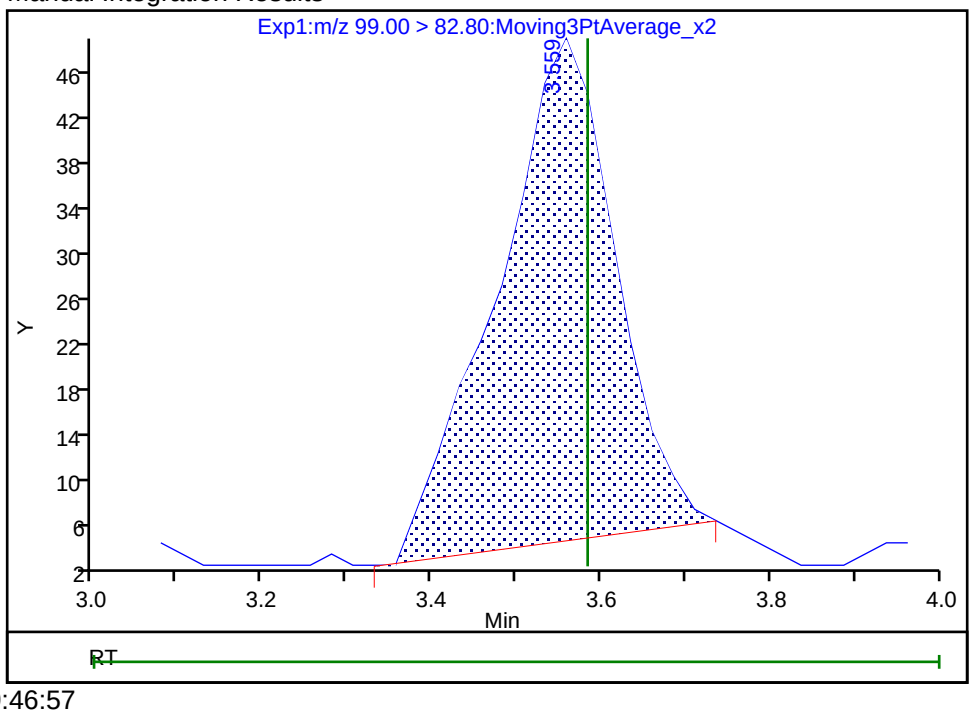
Processing Integration Results

Not Detected
Expected RT: 3.58



Manual Integration Results

RT: 3.56
Area: 434
Amount: 19.380956
Amount Units: ng/l



Reviewer: PE6P, 28-Mar-2023 09:46:57
Audit Action: Manually Integrated Audit Reason: Baseline

Manual Integration/User Assign Peak Report

Eurofins Denver

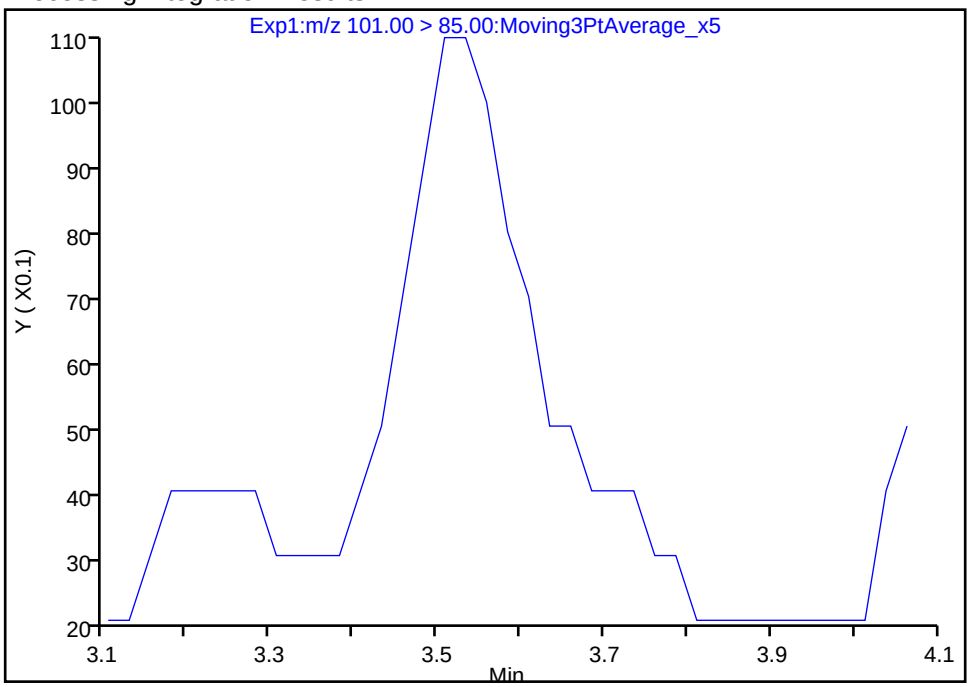
Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22084.d				
Injection Date:	22-Mar-2023 17:59:48	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-6	Lab Sample ID:	280-173651-6		
Client ID:	JACKSON-SWCC3-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	19	Worklist Smp#:	70
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		
Column:		Detector	EXP1		

2 Perchlorate, CAS: 14797-73-0

Signal: 2

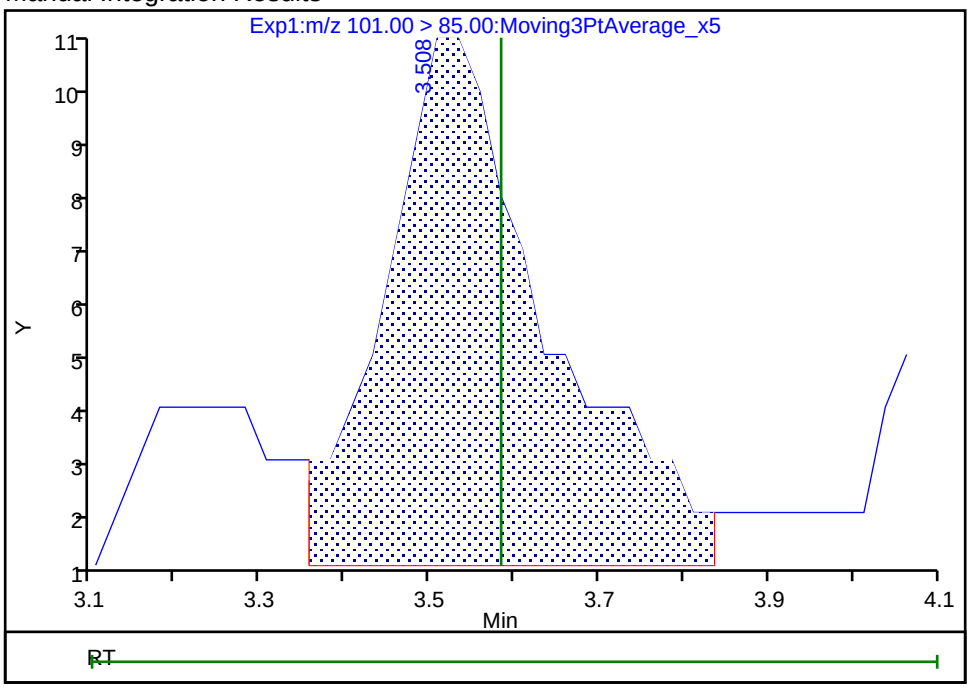
Not Detected
Expected RT: 3.58

Processing Integration Results



Manual Integration Results

RT: 3.51
Area: 134
Amount: 19.380956
Amount Units: ng/l



Reviewer: PE6P, 28-Mar-2023 09:47:02
Audit Action: Manually Integrated Audit Reason: Baseline

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Client Sample ID: JACKSON-SWCC4-DC-01 Lab Sample ID: 280-173651-7

Matrix: Water Lab File ID: LC1023C22085.d

Analysis Method: 6850 Date Collected: 03/08/2023 09:40

Extraction Method: Date Extracted:

Sample wt/vol: 0(mL) Date Analyzed: 03/22/2023 18:05

Con. Extract Vol.: Dilution Factor: 1

Injection Volume: 25(uL) GC Column: ID:

% Moisture: % Solids: GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.015	J M	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22085.d
Lims ID: 280-173651-A-7
Client ID: JACKSON-SWCC4-DC-01
Sample Type: Client
Inject. Date: 22-Mar-2023 18:05:12 ALS Bottle#: 20 Worklist Smp#: 71
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: 280-173651-A-7
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:50 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:47:15

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11230	816.0		974	
2 Perchlorate									M
99.00 > 82.80	3.559	3.584	-0.025	1.007	318	14.6	Target=3.25	14.3	M
101.00 > 85.00	3.559	3.584	-0.025	1.007	114		2.79(2.30-3.80)	4.0	M

QC Flag Legend

Processing Flags
Review Flags
M - Manually Integrated

Reagents:

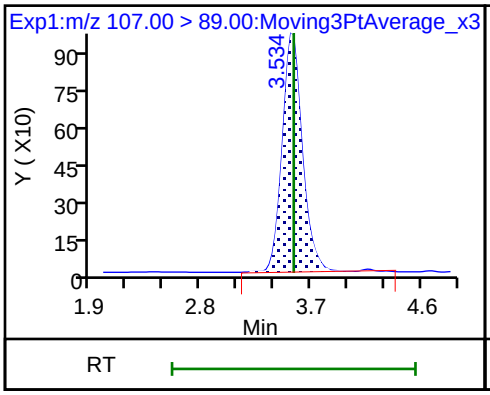
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:52 Chrom Revision: 2.3 16-Mar-2023 15:40:40

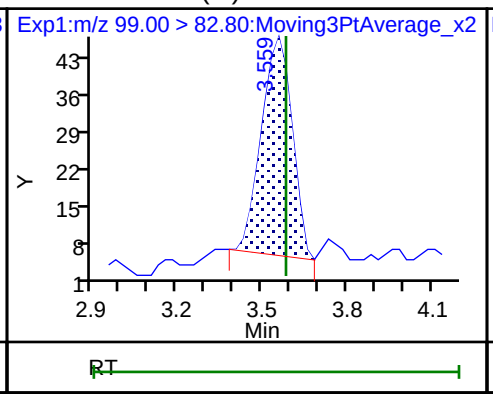
Eurofins Denver

Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22085.d				
Injection Date:	22-Mar-2023 18:05:12	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-7	Lab Sample ID:	280-173651-7		
Client ID:	JACKSON-SWCC4-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	20	Worklist Smp#:	71
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		

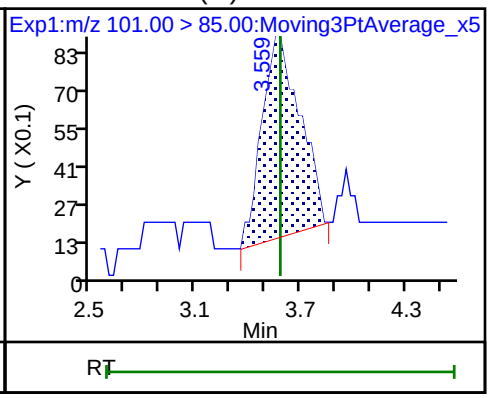
* 1 Perchlorate-18O



2 Perchlorate (M)



2 Perchlorate (M)



Manual Integration/User Assign Peak Report

Eurofins Denver

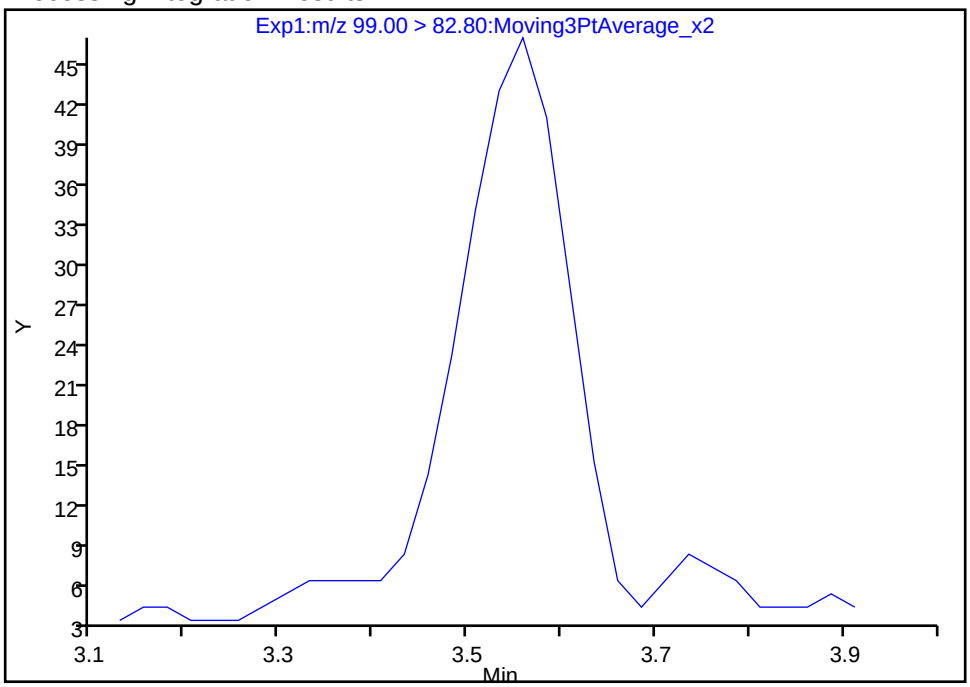
Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22085.d				
Injection Date:	22-Mar-2023 18:05:12	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-7	Lab Sample ID:	280-173651-7		
Client ID:	JACKSON-SWCC4-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	20	Worklist Smp#:	71
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		
Column:		Detector	EXP1		

2 Perchlorate, CAS: 14797-73-0

Signal: 1

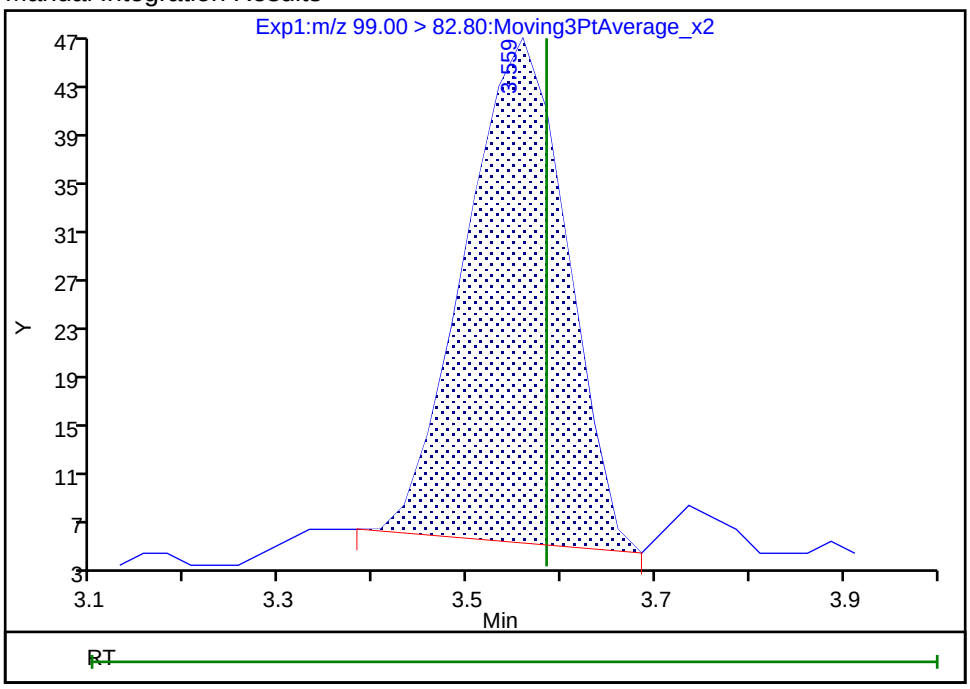
Processing Integration Results

Not Detected
Expected RT: 3.58



Manual Integration Results

RT: 3.56
Area: 318
Amount: 14.606710
Amount Units: ng/l



Reviewer: PE6P, 28-Mar-2023 09:47:11
Audit Action: Manually Integrated Audit Reason: Baseline

Manual Integration/User Assign Peak Report

Eurofins Denver

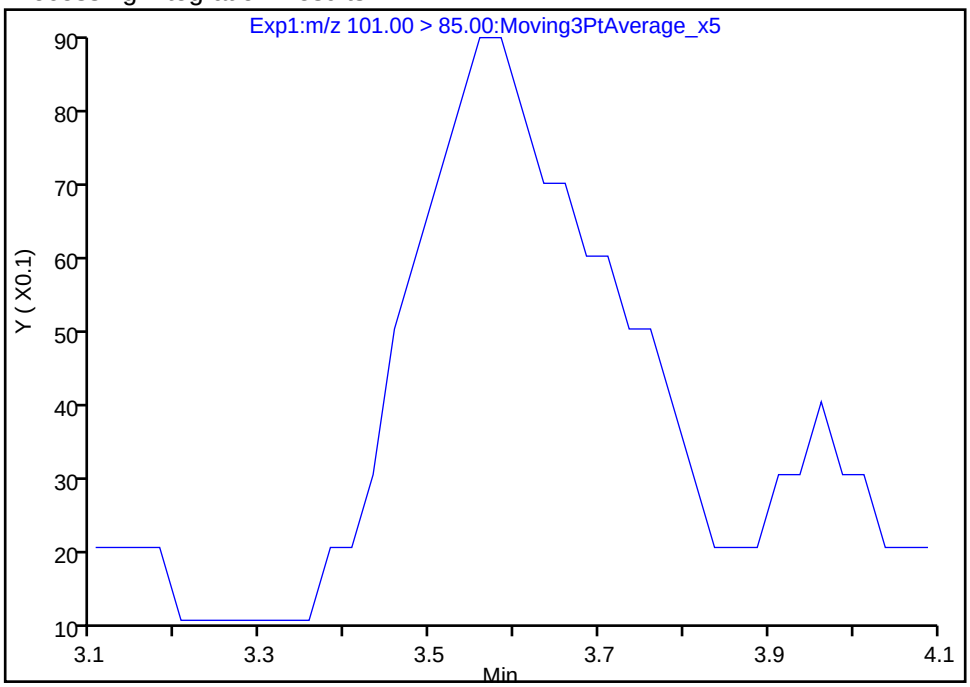
Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22085.d				
Injection Date:	22-Mar-2023 18:05:12	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-7	Lab Sample ID:	280-173651-7		
Client ID:	JACKSON-SWCC4-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	20	Worklist Smp#:	71
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		
Column:		Detector	EXP1		

2 Perchlorate, CAS: 14797-73-0

Signal: 2

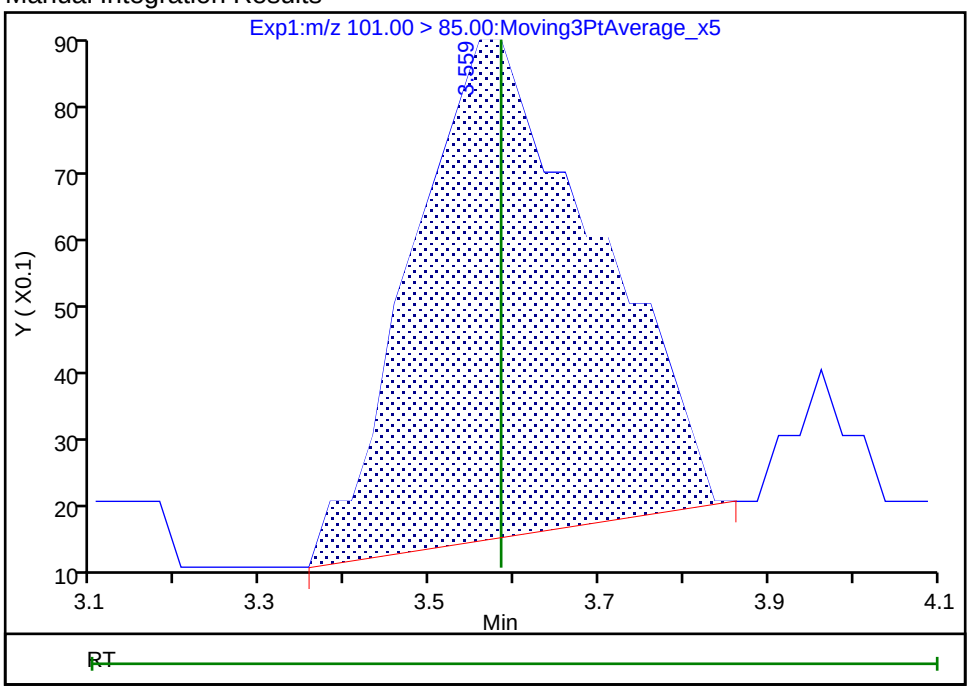
Not Detected
Expected RT: 3.58

Processing Integration Results



Manual Integration Results

RT: 3.56
Area: 114
Amount: 14.606710
Amount Units: ng/l



Reviewer: PE6P, 28-Mar-2023 09:47:13
Audit Action: Manually Integrated Audit Reason: Baseline

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: JACKSON-SWCC2-DC-01 | Lab Sample ID: 280-173651-8

Matrix: Water | Lab File ID: LC1023C22086.d

Analysis Method: 6850 | Date Collected: 03/08/2023 10:00

Extraction Method: | Date Extracted:

Sample wt/vol: 0(mL) | Date Analyzed: 03/22/2023 18:10

Con. Extract Vol.: | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: ID:

% Moisture: % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.10	U	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22086.d
Lims ID: 280-173651-A-8
Client ID: JACKSON-SWCC2-DC-01
Sample Type: Client
Inject. Date: 22-Mar-2023 18:10:35 ALS Bottle#: 21 Worklist Smp#: 72
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: 280-173651-A-8
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:50 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:47:17

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11283	816.0		992	

QC Flag Legend

Processing Flags

Reagents:

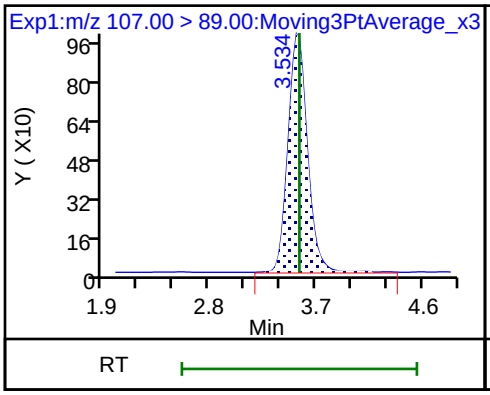
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:52 Chrom Revision: 2.3 16-Mar-2023 15:40:40

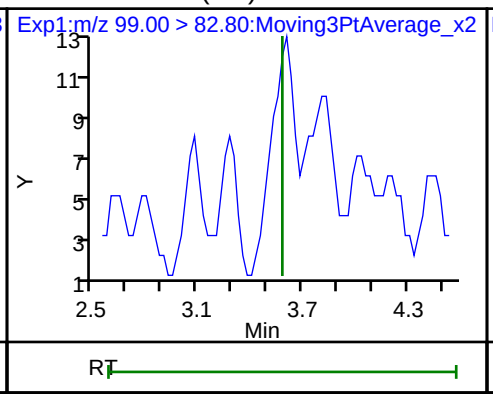
Eurofins Denver

Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22086.d				
Injection Date:	22-Mar-2023 18:10:35	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-8	Lab Sample ID:	280-173651-8		
Client ID:	JACKSON-SWCC2-DC-01				
Operator ID:	DENLCMS	ALS Bottle#:	21	Worklist Smp#:	72
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		

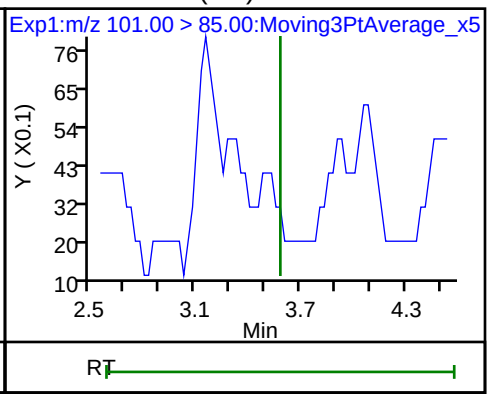
* 1 Perchlorate-18O



2 Perchlorate (ND)



2 Perchlorate (ND)



FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: JACKSON-EB-01 | Lab Sample ID: 280-173651-9

Matrix: Water | Lab File ID: LC1023C22087.d

Analysis Method: 6850 | Date Collected: 03/08/2023 15:30

Extraction Method: | Date Extracted:

Sample wt/vol: 0(mL) | Date Analyzed: 03/22/2023 18:15

Con. Extract Vol.: | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: ID:

% Moisture: % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.10	U	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22087.d
Lims ID: 280-173651-A-9
Client ID: JACKSON-EB-01
Sample Type: Client
Inject. Date: 22-Mar-2023 18:15:58 ALS Bottle#: 22 Worklist Smp#: 73
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: 280-173651-A-9
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:50 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:47:19

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11642	816.0		1044	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

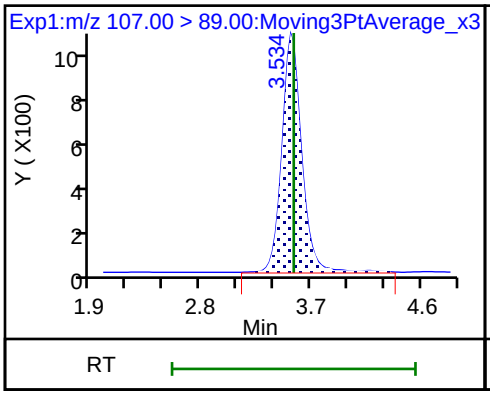
Report Date: 28-Mar-2023 09:48:52 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

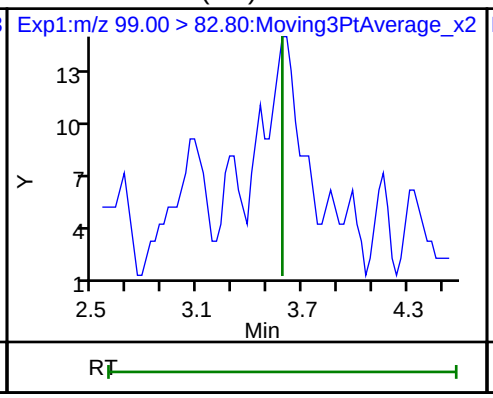
Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22087.d

Injection Date:	22-Mar-2023 18:15:58	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-9	Lab Sample ID:	280-173651-9		
Client ID:	JACKSON-EB-01				
Operator ID:	DENLCMS	ALS Bottle#:	22	Worklist Smp#:	73
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		

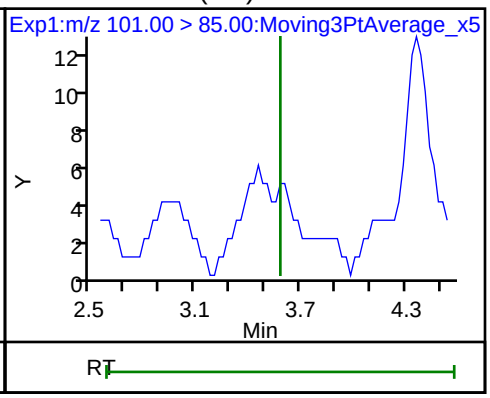
* 1 Perchlorate-18O



2 Perchlorate (ND)



2 Perchlorate (ND)



FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: JACKSON-CB-01 | Lab Sample ID: 280-173651-10

Matrix: Water | Lab File ID: LC1023C22088.d

Analysis Method: 6850 | Date Collected: 03/08/2023 16:00

Extraction Method: | Date Extracted:

Sample wt/vol: 0(mL) | Date Analyzed: 03/22/2023 18:21

Con. Extract Vol.: | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: ID:

% Moisture: % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.10	U	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22088.d
Lims ID: 280-173651-A-10
Client ID: JACKSON-CB-01
Sample Type: Client
Inject. Date: 22-Mar-2023 18:21:19 ALS Bottle#: 23 Worklist Smp#: 74
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: 280-173651-A-10
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:50 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:47:21

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		10752	816.0		948	

QC Flag Legend

Processing Flags

Reagents:

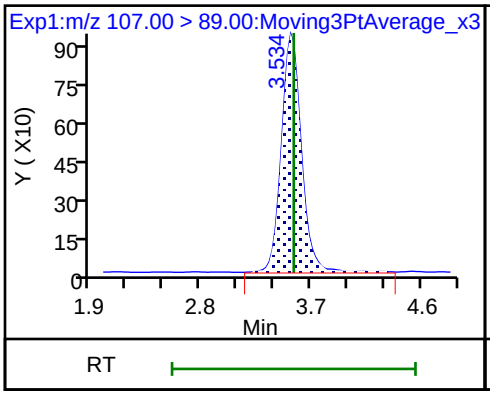
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:53 Chrom Revision: 2.3 16-Mar-2023 15:40:40

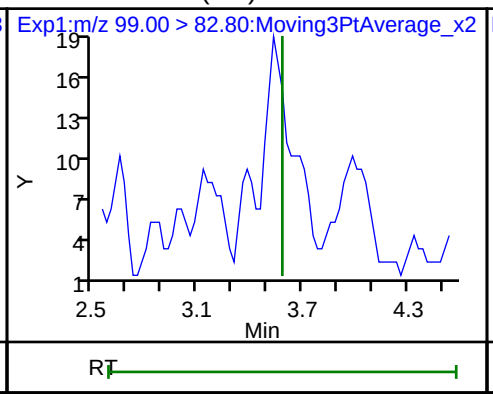
Eurofins Denver

Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22088.d				
Injection Date:	22-Mar-2023 18:21:19	Instrument ID:	LC_LCMS10		
Lims ID:	280-173651-A-10	Lab Sample ID:	280-173651-10		
Client ID:	JACKSON-CB-01				
Operator ID:	DENLCMS	ALS Bottle#:	23	Worklist Smp#:	74
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		

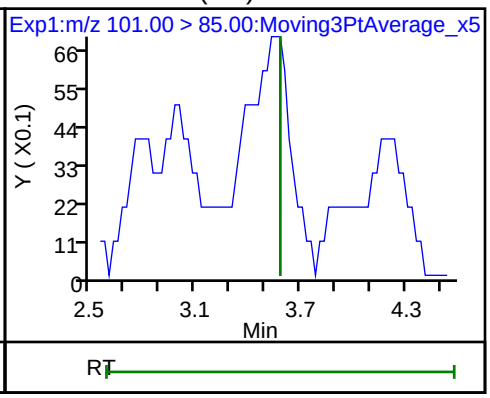
* 1 Perchlorate-18O



2 Perchlorate (ND)



2 Perchlorate (ND)



FORM VI
LCMS BY INTERNAL STANDARD - INITIAL CALIBRATION DATA
CURVE EVALUATION

Lab Name: Eurofins Denver Job No.: 280-173651-1 Analy Batch No.: 605949

SDG No.:

Instrument ID: LC_LCMS10 GC Column: ID: Heated Purge: (Y/N) N

Calibration Start Date: 03/21/2023 14:11 Calibration End Date: 03/21/2023 14:49 Calibration ID: 78245

Calibration Files

LEVEL:	LAB SAMPLE ID:	LAB FILE ID:
Level 1	STD00100 280-605949/3	LC1023C21027.d
Level 2	STD00200 280-605949/4	LC1023C21028.d
Level 3	STD00400 280-605949/5	LC1023C21029.d
Level 4	STD01000 280-605949/6	LC1023C21030.d
Level 5	STD02000 280-605949/7	LC1023C21031.d
Level 6	STD04000 280-605949/8	LC1023C21032.d
Level 7	STD10000 280-605949/9	LC1023C21033.d
Level 8	STD20000 280-605949/10	LC1023C21034.d

ANALYTE	RRF					CURVE TYPE	COEFFICIENT			#	MIN RRF	%RSD /RSE	#	MAX %RSD /RSE	R^2 OR COD	#	MIN R^2 OR COD
	LVL 1 LVL 6	LVL 2 LVL 7	LVL 3 LVL 8	LVL 4	LVL 5		B	M1	M2								
Perchlorate	1.9740 1.5579	1.2843 1.5256	1.7083 1.5988	1.4805	1.5260	Ave		1.5819				12.5		15.0			

Note: The M1 coefficient is the same as Ave RRF for an Ave curve type. RSD is calculated for Ave curve types. RSE is used for all other types.

FORM VI
LCMS BY INTERNAL STANDARD - INITIAL CALIBRATION DATA
RESPONSE AND CONCENTRATION

Lab Name: Eurofins Denver Job No.: 280-173651-1 Analy Batch No.: 605949

SDG No.:

Instrument ID: LC_LCMS10 GC Column: ID: Heated Purge: (Y/N) N

Calibration Start Date: 03/21/2023 14:11 Calibration End Date: 03/21/2023 14:49 Calibration ID: 78245

Calibration Files

LEVEL:	LAB SAMPLE ID:	LAB FILE ID:
Level 1	STD00100 280-605949/3	LC1023C21027.d
Level 2	STD00200 280-605949/4	LC1023C21028.d
Level 3	STD00400 280-605949/5	LC1023C21029.d
Level 4	STD01000 280-605949/6	LC1023C21030.d
Level 5	STD02000 280-605949/7	LC1023C21031.d
Level 6	STD04000 280-605949/8	LC1023C21032.d
Level 7	STD10000 280-605949/9	LC1023C21033.d
Level 8	STD20000 280-605949/10	LC1023C21034.d

ANALYTE	IS REF	CURVE TYPE	RESPONSE					CONCENTRATION (NG/L)				
			LVL 1 LVL 6	LVL 2 LVL 7	LVL 3 LVL 8	LVL 4	LVL 5	LVL 1 LVL 6	LVL 2 LVL 7	LVL 3 LVL 8	LVL 4	LVL 5
Perchlorate	ClO4 18	Ave	2594 74048	3340 177575	8550 352293	18468	36750	100 4000	200 10000	400 20000	1000	2000

Curve Type Legend
Ave = Average ISTD

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21027.d
Lims ID: std00100
Client ID:
Sample Type: IC Calib Level: 1
Inject. Date: 21-Mar-2023 14:11:14 ALS Bottle#: 2 Worklist Smp#: 3
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: std00100
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\6850.m
Limit Group: LC - 6850
Last Update: 22-Mar-2023 08:39:08 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1683

First Level Reviewer: PE6P Date: 22-Mar-2023 08:32:34

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		10723	816.0		450	
2 Perchlorate									M
99.00 > 82.80	3.534	3.584	-0.050	1.000	2594	124.8	Target=3.25	40.3	M
101.00 > 85.00	3.534	3.584	-0.050	1.000	703		3.69(2.30-3.80)	28.5	M

QC Flag Legend

Processing Flags
Review Flags
M - Manually Integrated

Reagents:

PtxCalStockW_00016 Amount Added: 5.00 Units: uL
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 22-Mar-2023 08:39:08 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21027.d

Injection Date: 21-Mar-2023 14:11:14 Instrument ID: LC_LCMS10

Lims ID: std00100

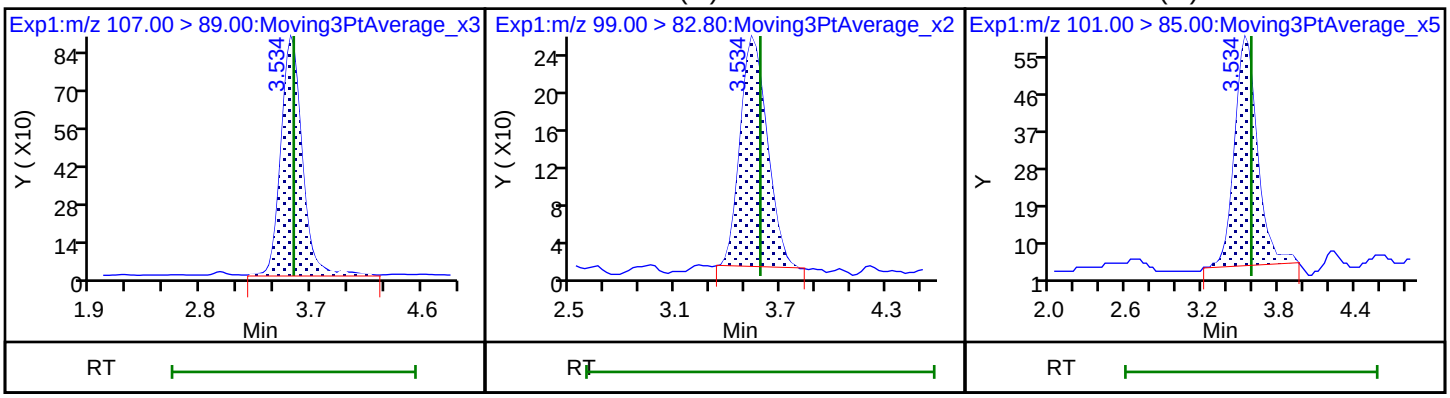
Client ID:

Operator ID: DENLCMS ALS Bottle#: 2 Worklist Smp#: 3

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate (M) 2 Perchlorate (M)



Manual Integration/User Assign Peak Report

Eurofins Denver

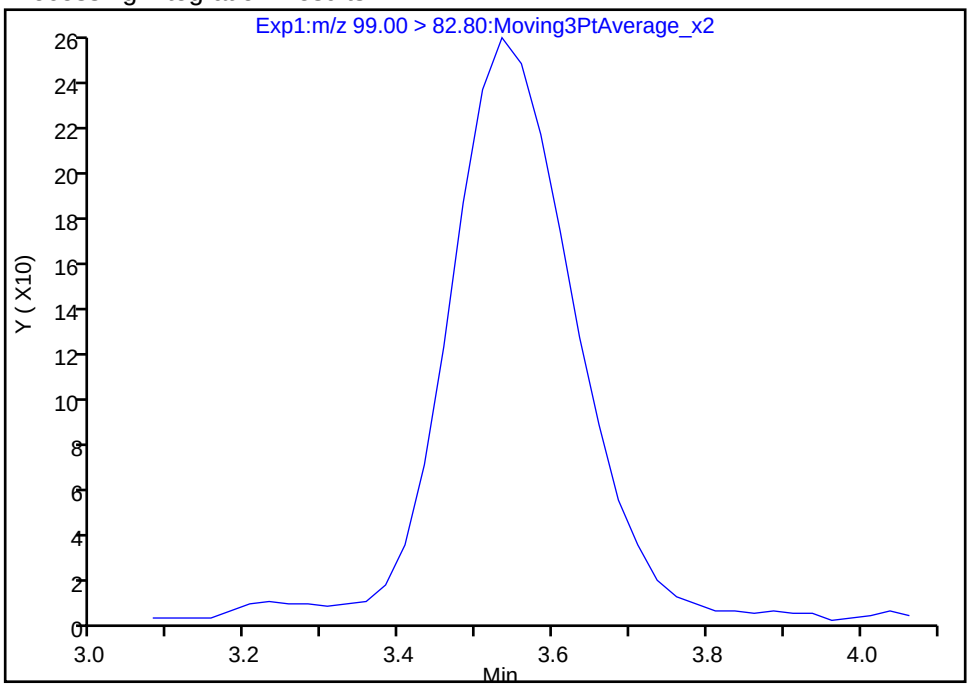
Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21027.d
Injection Date: 21-Mar-2023 14:11:14 Instrument ID: LC_LCMS10
Lims ID: std00100
Client ID:
Operator ID: DENLCMS ALS Bottle#: 2 Worklist Smp#: 3
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Method: 6850 Limit Group: LC - 6850
Column: Detector EXP1

2 Perchlorate, CAS: 14797-73-0

Signal: 1

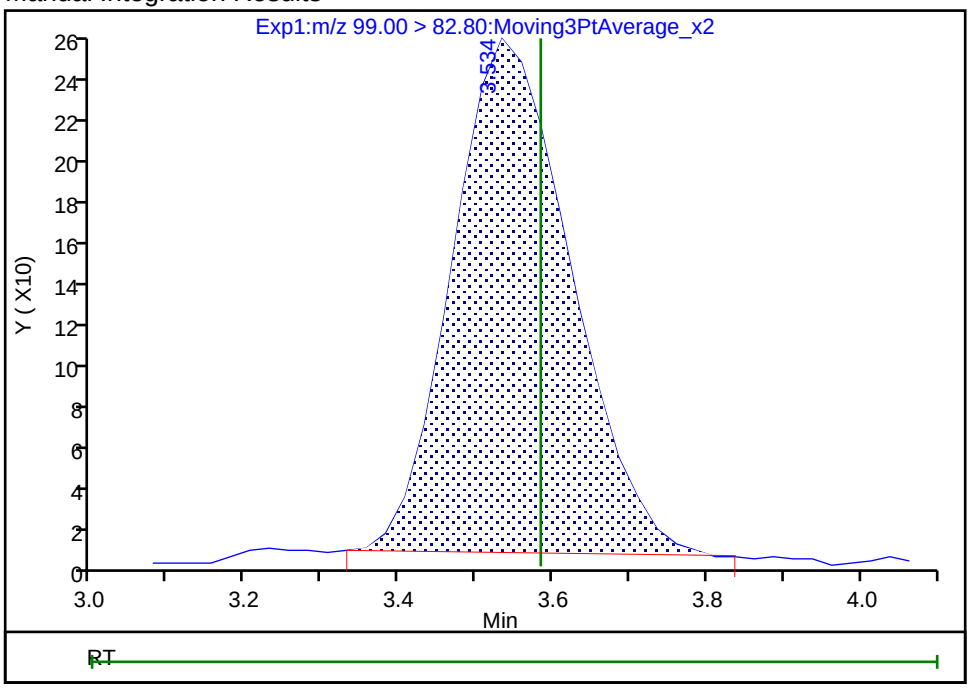
Processing Integration Results

Not Detected
Expected RT: 3.58



Manual Integration Results

RT: 3.53
Area: 2594
Amount: 124.7839
Amount Units: ng/l



Reviewer: PE6P, 22-Mar-2023 08:33:45
Audit Action: Manually Integrated Audit Reason: Baseline

Manual Integration/User Assign Peak Report

Eurofins Denver

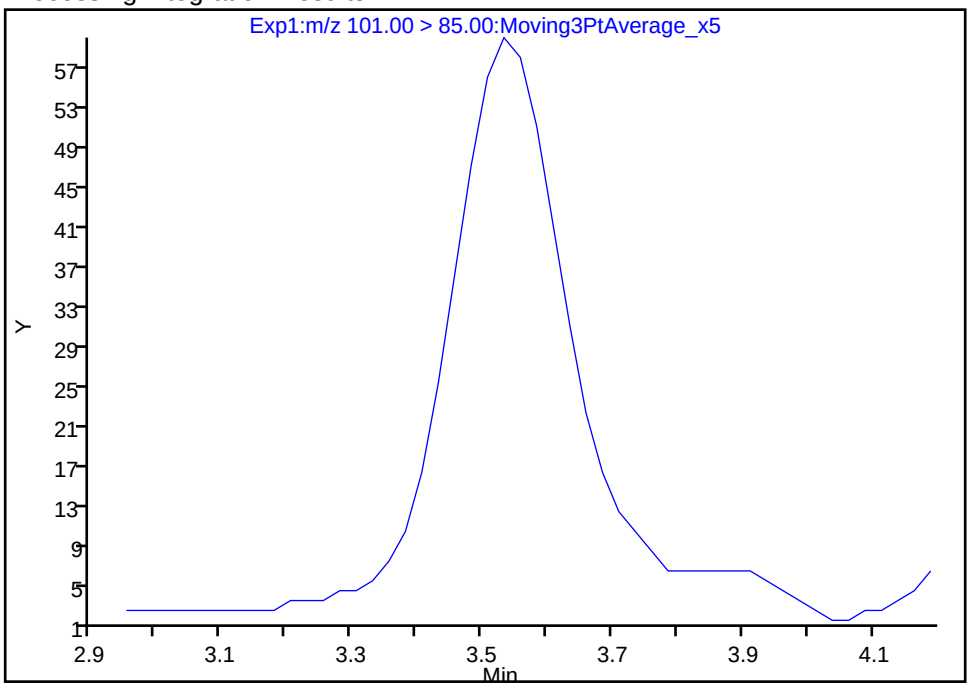
Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21027.d
Injection Date: 21-Mar-2023 14:11:14 Instrument ID: LC_LCMS10
Lims ID: std00100
Client ID:
Operator ID: DENLCMS ALS Bottle#: 2 Worklist Smp#: 3
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Method: 6850 Limit Group: LC - 6850
Column: Detector EXP1

2 Perchlorate, CAS: 14797-73-0

Signal: 2

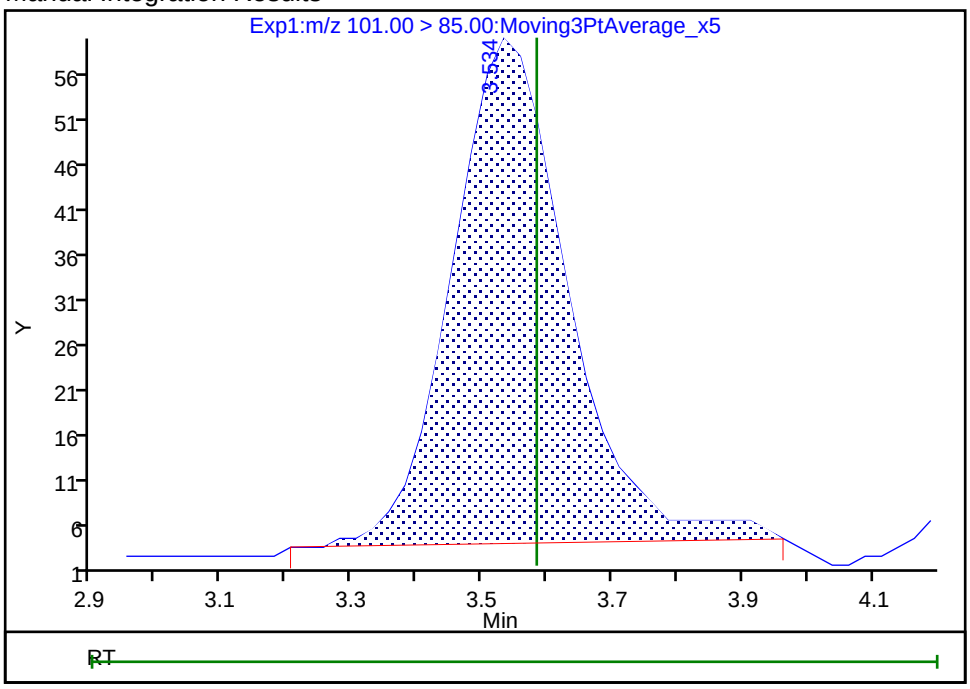
Not Detected
Expected RT: 3.58

Processing Integration Results



Manual Integration Results

RT: 3.53
Area: 703
Amount: 124.7839
Amount Units: ng/l



Reviewer: PE6P, 22-Mar-2023 08:33:48
Audit Action: Manually Integrated Audit Reason: Baseline

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21028.d
Lims ID: std00200
Client ID:
Sample Type: IC Calib Level: 2
Inject. Date: 21-Mar-2023 14:17:42 ALS Bottle#: 3 Worklist Smp#: 4
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: std00200
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\6850.m
Limit Group: LC - 6850
Last Update: 22-Mar-2023 08:39:09 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1683

First Level Reviewer: PE6P Date: 22-Mar-2023 08:32:48

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		10611	816.0		880	
2 Perchlorate									Ma
99.00 > 82.80	3.559	3.584	-0.025	1.007	3340	162.4	Target=3.25	56.2	a
101.00 > 85.00	3.559	3.584	-0.025	1.007	999		3.34(2.30-3.80)	37.5	M

QC Flag Legend

Processing Flags
Review Flags
M - Manually Integrated
a - User Assigned ID

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
PtxCalStockW_00016 Amount Added: 10.00 Units: uL

Report Date: 22-Mar-2023 08:39:09 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21028.d

Injection Date: 21-Mar-2023 14:17:42 Instrument ID: LC_LCMS10

Lims ID: std00200

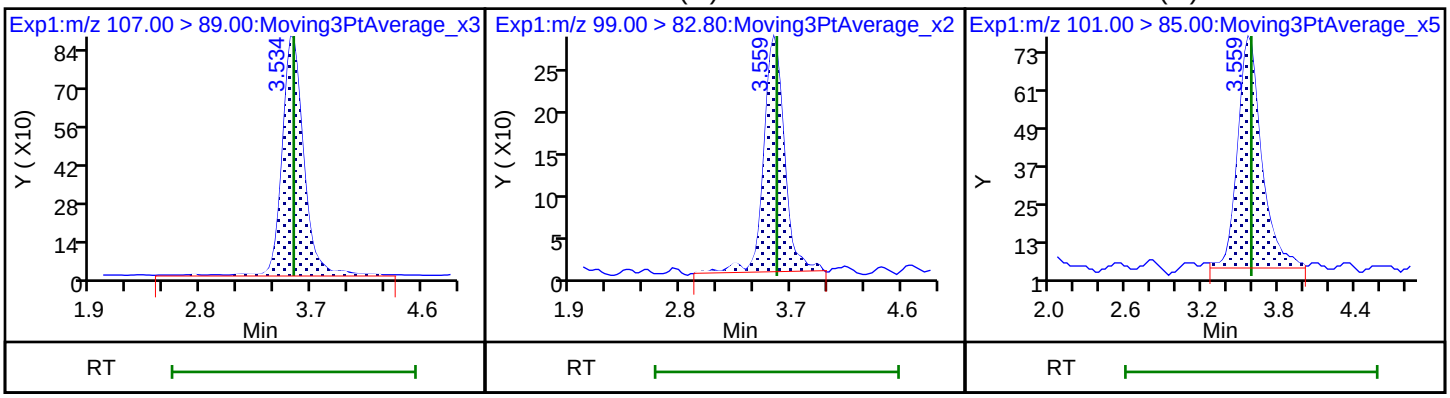
Client ID:

Operator ID: DENLCMS ALS Bottle#: 3 Worklist Smp#: 4

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate (M) 2 Perchlorate (M)



Manual Integration/User Assign Peak Report

Eurofins Denver

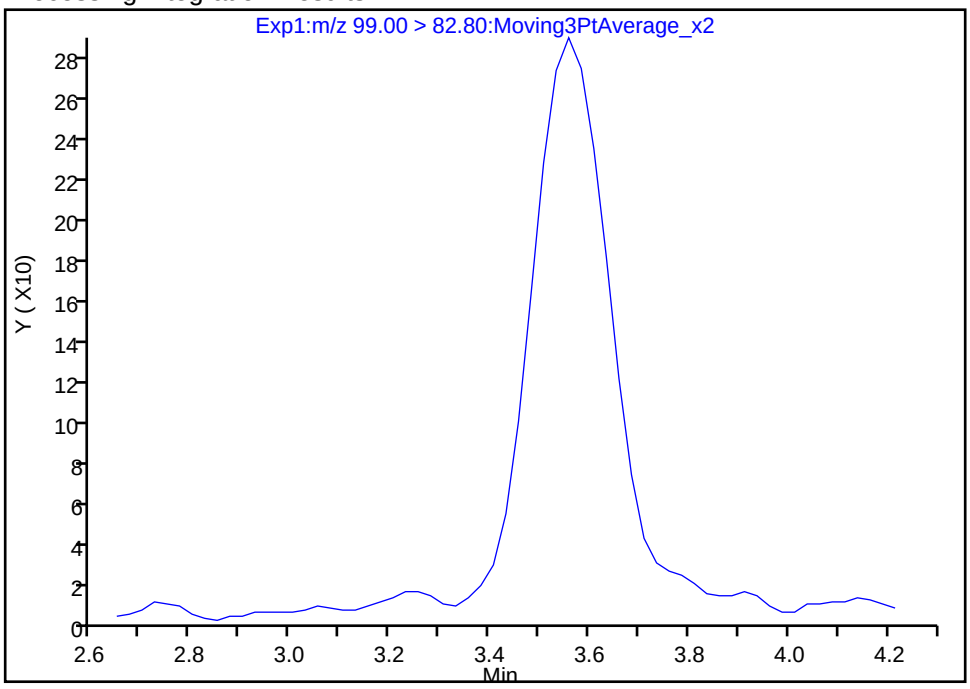
Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21028.d				
Injection Date:	21-Mar-2023 14:17:42	Instrument ID:	LC_LCMS10		
Lims ID:	std00200				
Client ID:					
Operator ID:	DENLCMS	ALS Bottle#:	3	Worklist Smp#:	4
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Method:	6850	Limit Group:	LC - 6850		
Column:		Detector	EXP1		

2 Perchlorate, CAS: 14797-73-0

Signal: 1

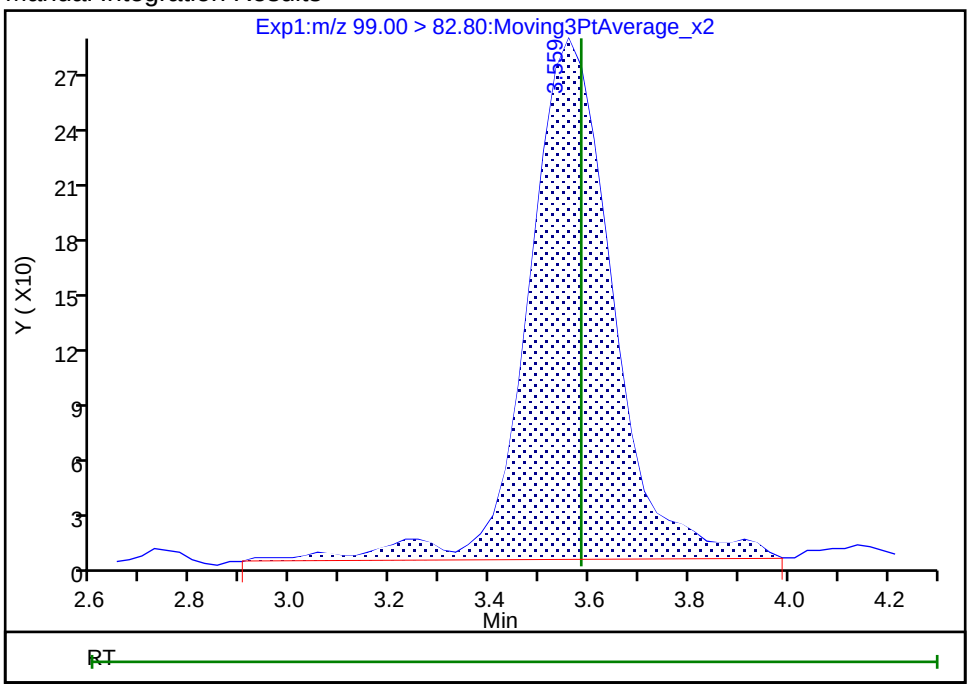
Not Detected
Expected RT: 3.58

Processing Integration Results



Manual Integration Results

RT: 3.56
Area: 3340
Amount: 162.3660
Amount Units: ng/l



Reviewer: PE6P, 22-Mar-2023 08:32:40
Audit Action: Assigned Compound ID Audit Reason: Baseline

Manual Integration/User Assign Peak Report

Eurofins Denver

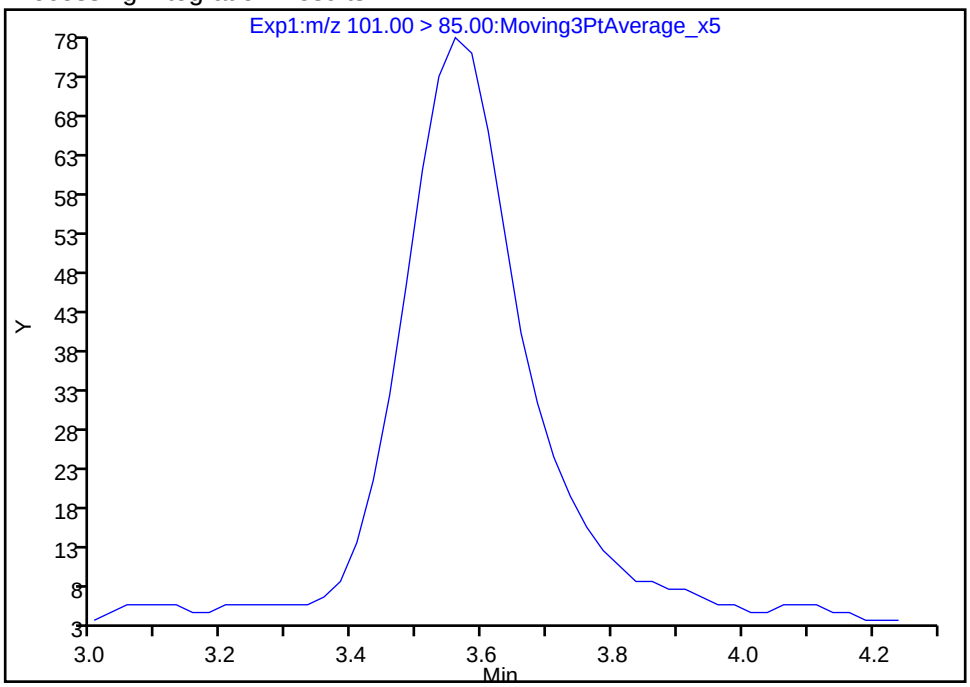
Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21028.d
Injection Date: 21-Mar-2023 14:17:42 Instrument ID: LC_LCMS10
Lims ID: std00200
Client ID:
Operator ID: DENLCMS ALS Bottle#: 3 Worklist Smp#: 4
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Method: 6850 Limit Group: LC - 6850
Column: Detector EXP1

2 Perchlorate, CAS: 14797-73-0

Signal: 2

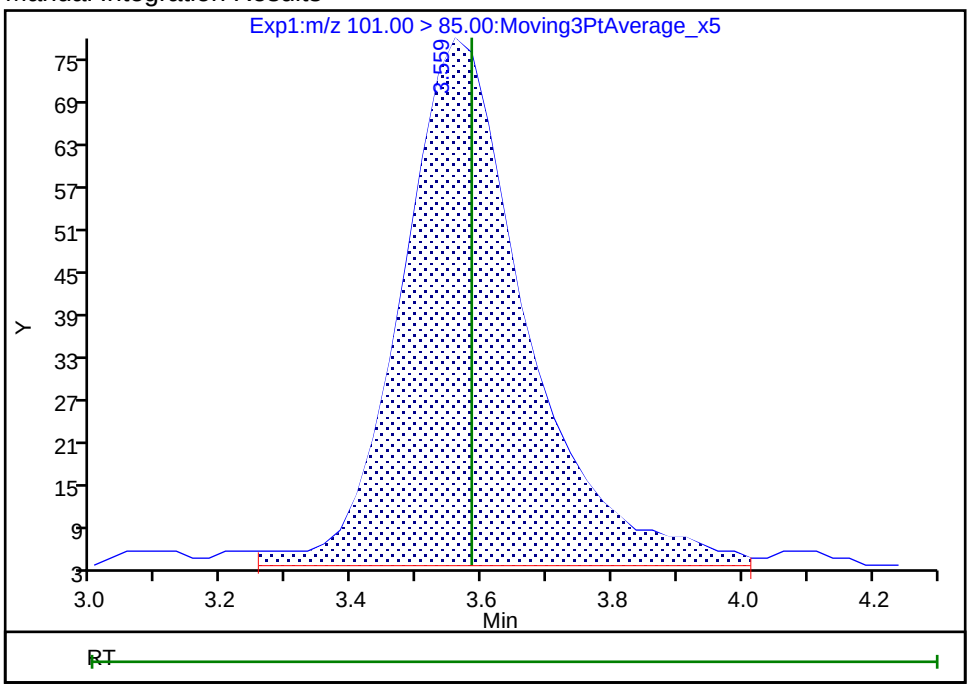
Not Detected
Expected RT: 3.58

Processing Integration Results



Manual Integration Results

RT: 3.56
Area: 999
Amount: 162.3660
Amount Units: ng/l



Reviewer: PE6P, 22-Mar-2023 08:32:46
Audit Action: Manually Integrated Audit Reason: Baseline

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21029.d
Lims ID: std00400
Client ID:
Sample Type: IC Calib Level: 3
Inject. Date: 21-Mar-2023 14:23:04 ALS Bottle#: 4 Worklist Smp#: 5
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: std00400
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\6850.m
Limit Group: LC - 6850
Last Update: 22-Mar-2023 08:39:09 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1683

First Level Reviewer: PE6P Date: 22-Mar-2023 08:32:52

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.559	3.559	0.0		10210	816.0		432	
2 Perchlorate									
99.00 > 82.80	3.559	3.584	-0.025	1.000	8550	432.0	Target=3.25	132	
101.00 > 85.00	3.584	3.584	0.0	1.007	2580		3.31(2.30-3.80)	103	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
PtxCalStockW_00016 Amount Added: 20.00 Units: uL

Report Date: 22-Mar-2023 08:39:09 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21029.d

Injection Date: 21-Mar-2023 14:23:04 Instrument ID: LC_LCMS10

Lims ID: std00400

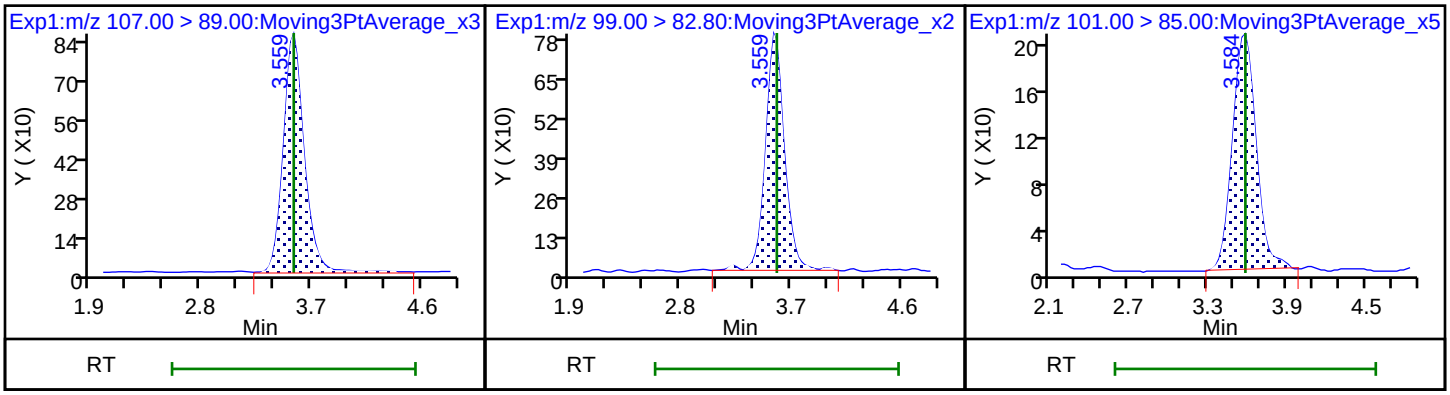
Client ID:

Operator ID: DENLCMS ALS Bottle#: 4 Worklist Smp#: 5

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21030.d
Lims ID: std01000
Client ID:
Sample Type: IC Calib Level: 4
Inject. Date: 21-Mar-2023 14:28:25 ALS Bottle#: 5 Worklist Smp#: 6
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: std01000
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\6850.m
Limit Group: LC - 6850
Last Update: 22-Mar-2023 08:39:10 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1683

First Level Reviewer: PE6P Date: 22-Mar-2023 08:32:55

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.559	3.559	0.0		10179	816.0		887	
2 Perchlorate									
99.00 > 82.80	3.559	3.584	-0.025	1.000	18468	935.9	Target=3.25	326	
101.00 > 85.00	3.584	3.584	0.0	1.007	5297		3.49(2.30-3.80)	218	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
PtxCalStockW_00016 Amount Added: 50.00 Units: uL

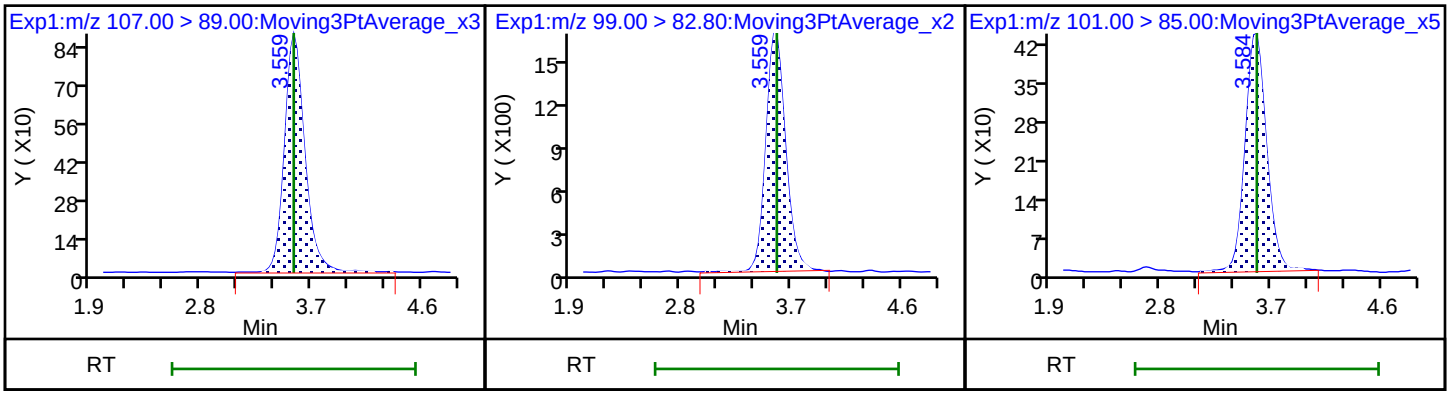
Report Date: 22-Mar-2023 08:39:10 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21030.d

Injection Date:	21-Mar-2023 14:28:25	Instrument ID:	LC_LCMS10
Lims ID:	std01000		
Client ID:			
Operator ID:	DENLCMS	ALS Bottle#:	5 Worklist Smp#: 6
Injection Vol:	25.0 ul	Dil. Factor:	1.0000
Method:	6850	Limit Group:	LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21031.d
Lims ID: std02000
Client ID:
Sample Type: ICISAV Calib Level: 5
Inject. Date: 21-Mar-2023 14:33:46 ALS Bottle#: 6 Worklist Smp#: 7
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: std02000
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\6850.m
Limit Group: LC - 6850
Last Update: 22-Mar-2023 08:39:10 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1683

First Level Reviewer: PE6P Date: 22-Mar-2023 08:32:57

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.559	3.559	0.0		9826	816.0		801	
2 Perchlorate									
99.00 > 82.80	3.584	3.584	0.0	1.007	36750	1929.2	Target=3.25	672	
101.00 > 85.00	3.584	3.584	0.0	1.007	11241		3.27(2.30-3.80)	306	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
PtxCalStockW_00016 Amount Added: 100.00 Units: uL

Report Date: 22-Mar-2023 08:39:10 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21031.d

Injection Date: 21-Mar-2023 14:33:46 Instrument ID: LC_LCMS10

Lims ID: std02000

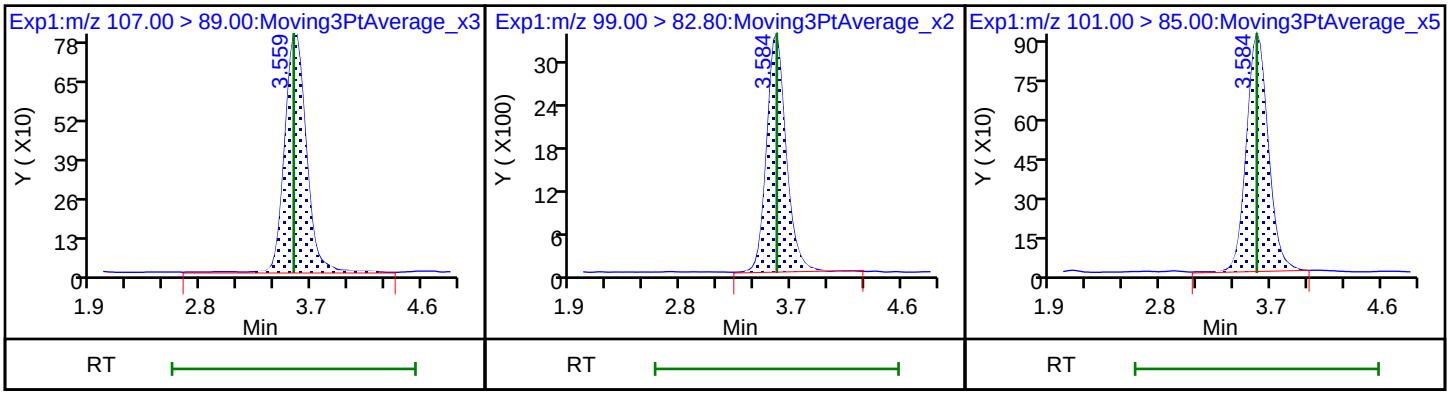
Client ID:

Operator ID: DENLCMS ALS Bottle#: 6 Worklist Smp#: 7

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21032.d
Lims ID: std04000
Client ID:
Sample Type: IC Calib Level: 6
Inject. Date: 21-Mar-2023 14:39:09 ALS Bottle#: 7 Worklist Smp#: 8
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: std04000
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\6850.m
Limit Group: LC - 6850
Last Update: 22-Mar-2023 08:39:11 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1683

First Level Reviewer: PE6P Date: 22-Mar-2023 08:33:00

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.559	3.559	0.0		9696	816.0		420	
2 Perchlorate									
99.00 > 82.80	3.584	3.584	0.0	1.007	74048	3939.4	Target=3.25	955	
101.00 > 85.00	3.584	3.584	0.0	1.007	22202		3.34(2.30-3.80)	596	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
PtxCalStockW_00016 Amount Added: 200.00 Units: uL

Report Date: 22-Mar-2023 08:39:11 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21032.d

Injection Date: 21-Mar-2023 14:39:09 Instrument ID: LC_LCMS10

Lims ID: std04000

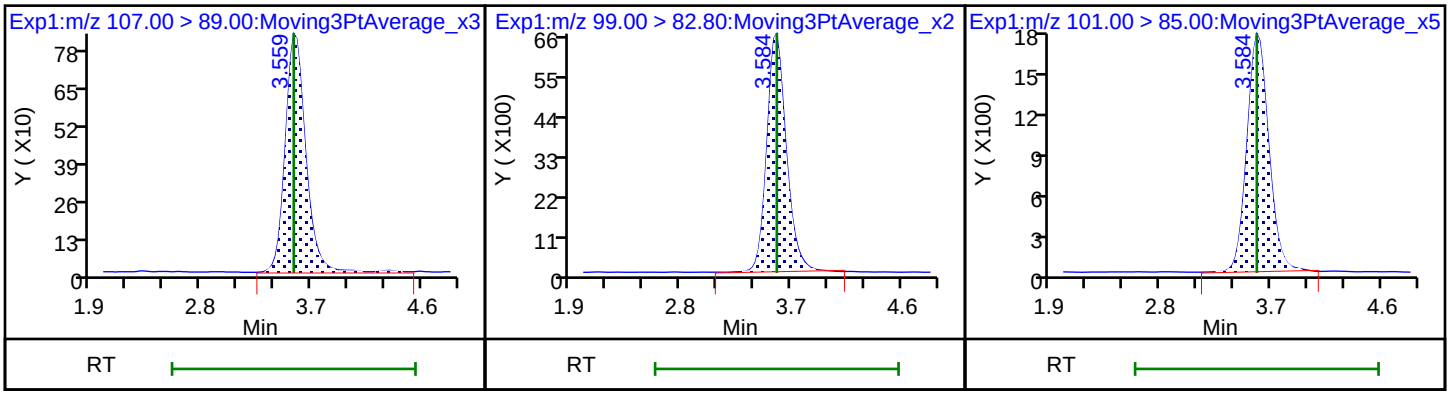
Client ID:

Operator ID: DENLCMS ALS Bottle#: 7 Worklist Smp#: 8

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21033.d
Lims ID: std10000
Client ID:
Sample Type: IC Calib Level: 7
Inject. Date: 21-Mar-2023 14:44:32 ALS Bottle#: 8 Worklist Smp#: 9
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: std10000
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\6850.m
Limit Group: LC - 6850
Last Update: 22-Mar-2023 08:39:11 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1683

First Level Reviewer: PE6P Date: 22-Mar-2023 08:33:02

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.584	3.559	0.025		9498	816.0		403	
2 Perchlorate									
99.00 > 82.80	3.584	3.584	0.0	1.000	177575	9643.9	Target=3.25	1983	
101.00 > 85.00	3.584	3.584	0.0	1.000	53931		3.29(2.30-3.80)	1421	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
PtxCalStockW_00016 Amount Added: 500.00 Units: uL

Report Date: 22-Mar-2023 08:39:11 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21033.d

Injection Date: 21-Mar-2023 14:44:32 Instrument ID: LC_LCMS10

Lims ID: std10000

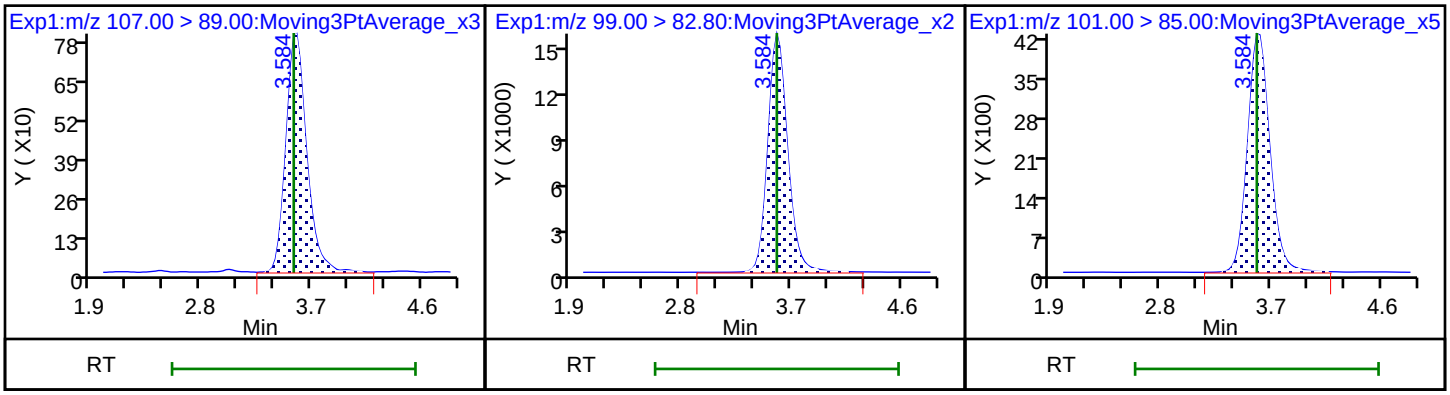
Client ID:

Operator ID: DENLCMS ALS Bottle#: 8 Worklist Smp#: 9

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d
Lims ID: std20000
Client ID:
Sample Type: IC Calib Level: 8
Inject. Date: 21-Mar-2023 14:49:53 ALS Bottle#: 9 Worklist Smp#: 10
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: std20000
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\6850.m
Limit Group: LC - 6850
Last Update: 22-Mar-2023 08:39:12 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1683

First Level Reviewer: PE6P Date: 22-Mar-2023 08:33:04

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.584	3.559	0.025		8990	816.0		377	
2 Perchlorate									
99.00 > 82.80	3.584	3.584	0.0	1.000	352293	20214	Target=3.25	2806	
101.00 > 85.00	3.609	3.584	0.025	1.007	106979		3.29(2.30-3.80)	1696	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
PtxCalStockW_00016 Amount Added: 1000.00 Units: uL

Report Date: 22-Mar-2023 08:39:12 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Injection Date: 21-Mar-2023 14:49:53 Instrument ID: LC_LCMS10

Lims ID: std20000

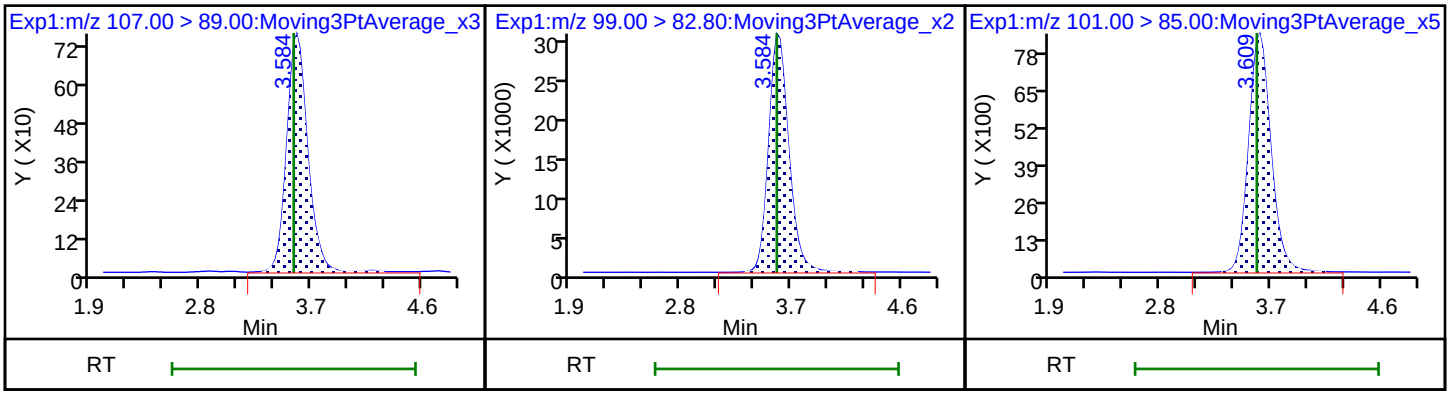
Client ID:

Operator ID: DENLCMS ALS Bottle#: 9 Worklist Smp#: 10

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



Calibration / Perchlorate

Curve Type:	Average
Weighting:	Conc_Sq
Origin:	Force
Dependency:	Response
Calib Mode:	ISTD
Response Base:	AREA
RF Rounding:	0

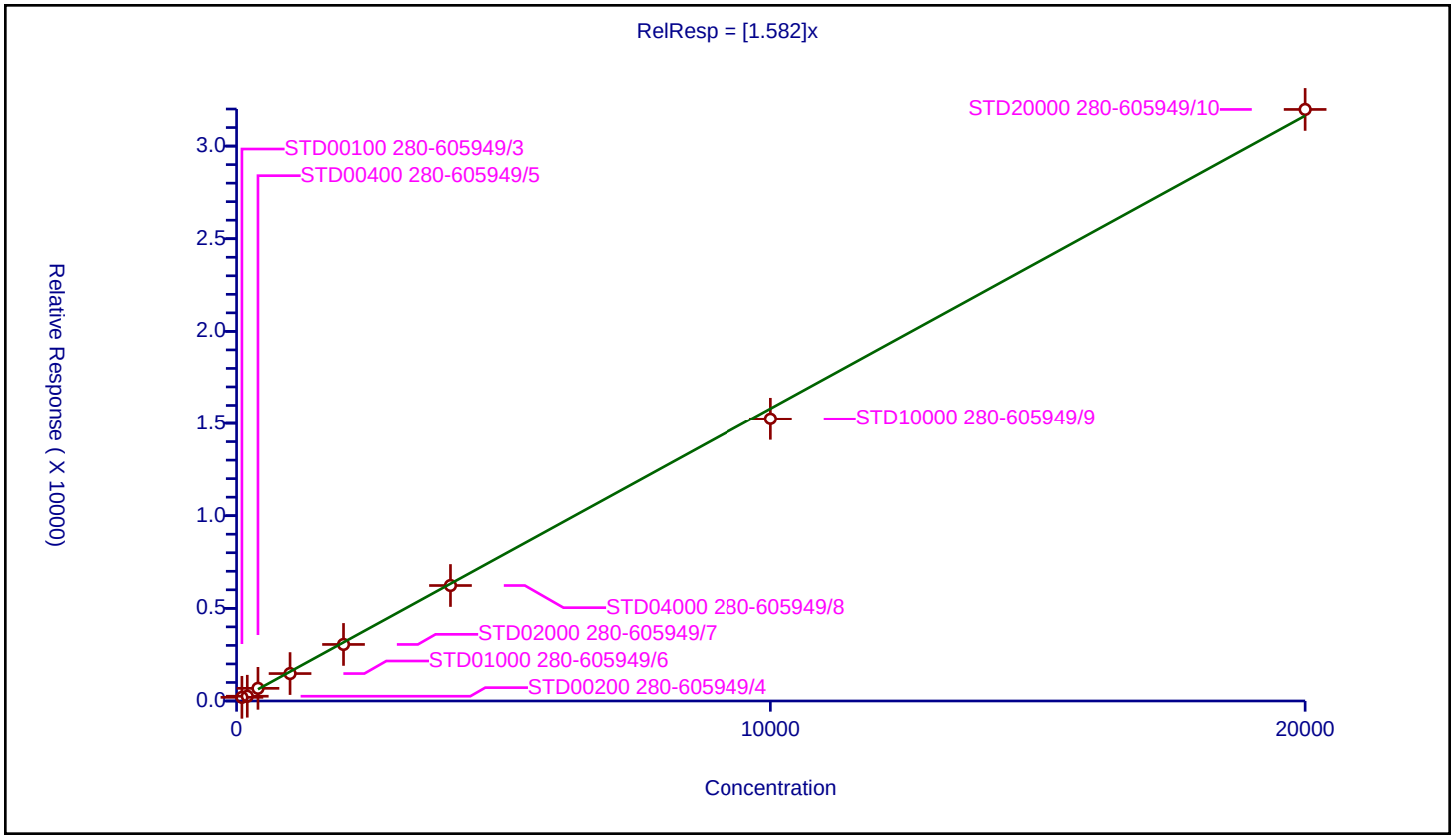
Curve Coefficients

Intercept:	0
Slope:	1.582

Error Coefficients

Standard Error:	139000
Relative Standard Error:	12.5
Correlation Coefficient:	1.000
Coefficient of Determination (Adjusted):	0.977

ID	Level	Concentration	Rel. Resp.	IS Amount	IS Response	RRF	Used
1	STD00100 280-605949/3	100.0	197.398489	816.0	10723.0	1.973985	Y
2	STD00200 280-605949/4	200.0	256.850438	816.0	10611.0	1.284252	Y
3	STD00400 280-605949/5	400.0	683.330069	816.0	10210.0	1.708325	Y
4	STD01000 280-605949/6	1000.0	1480.488064	816.0	10179.0	1.480488	Y
5	STD02000 280-605949/7	2000.0	3051.903114	816.0	9826.0	1.525952	Y
6	STD04000 280-605949/8	4000.0	6231.762376	816.0	9696.0	1.557941	Y
7	STD10000 280-605949/9	10000.0	15255.969678	816.0	9498.0	1.525597	Y
8	STD20000 280-605949/10	20000.0	31976.761735	816.0	8990.0	1.598838	Y



FORM VII
LCMS CONTINUING CALIBRATION DATA

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Lab Sample ID: ICV 280-605949/12 Calibration Date: 03/21/2023 15:00

Instrument ID: LC_LCMS10 Calib Start Date: 03/21/2023 14:11

GC Column: ID: Calib End Date: 03/21/2023 14:49

Lab File ID: LC1023C21036.d Conc. Units: ug/L

ANALYTE	CURVE TYPE	AVE RRF	RRF	MIN RRF	CALC AMOUNT	SPIKE AMOUNT	%D	MAX %D
Perchlorate	Ave	1.582	1.540		1.95	2.00	-2.6	15.0

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21036.d
Lims ID: ICV
Client ID:
Sample Type: ICV
Inject. Date: 21-Mar-2023 15:00:38 ALS Bottle#: 11 Worklist Smp#: 12
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: ICV
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\6850.m
Limit Group: LC - 6850
Last Update: 22-Mar-2023 08:40:07 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1683

First Level Reviewer: PE6P Date: 22-Mar-2023 08:34:14

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.584	3.559	0.025		9685	816.0		811	
2 Perchlorate									
99.00 > 82.80	3.584	3.584	0.0	1.000	36562	1947.3	Target=3.25	671	
101.00 > 85.00	3.584	3.584	0.0	1.000	10858		3.37(2.30-3.80)	288	

QC Flag Legend
Processing Flags

Reagents:
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
ClO4ICVStockW_00004 Amount Added: 100.00 Units: uL

Report Date: 22-Mar-2023 08:40:07 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21036.d

Injection Date: 21-Mar-2023 15:00:38 Instrument ID: LC_LCMS10

Lims ID: ICV

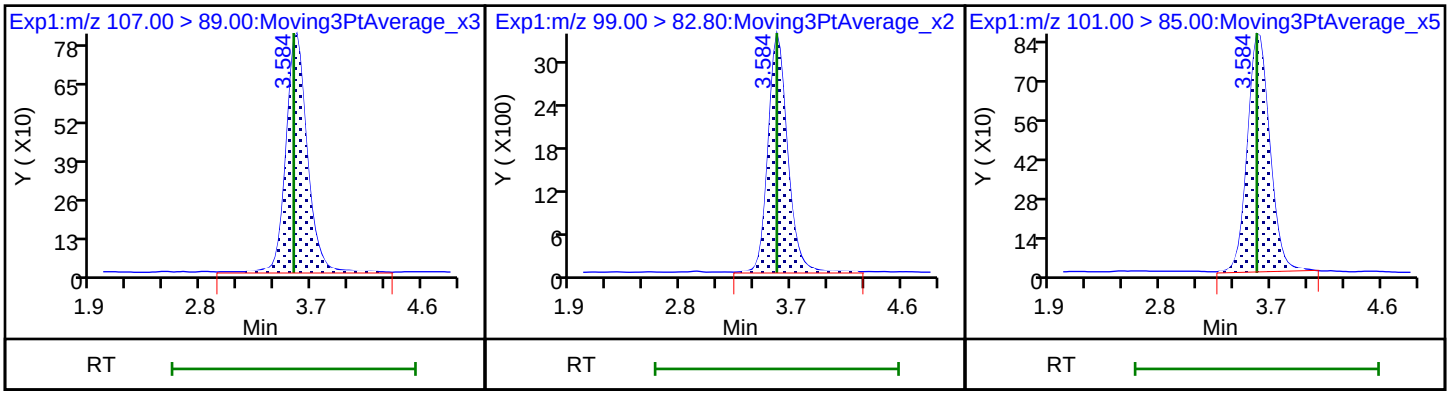
Client ID:

Operator ID: DENLCMS ALS Bottle#: 11 Worklist Smp#: 12

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



FORM VII
LCMS CONTINUING CALIBRATION DATA

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Lab Sample ID: CCV 280-606020/52 Calibration Date: 03/22/2023 16:23

Instrument ID: LC_LCMS10 Calib Start Date: 03/21/2023 14:11

GC Column: ID: Calib End Date: 03/21/2023 14:49

Lab File ID: LC1023C22066.d Conc. Units: ug/L

ANALYTE	CURVE TYPE	AVE RRF	RRF	MIN RRF	CALC AMOUNT	SPIKE AMOUNT	%D	MAX %D
Perchlorate	Ave	1.582	1.485		1.88	2.00	-6.1	15.0

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22066.d
Lims ID: CCV
Client ID:
Sample Type: CCV
Inject. Date: 22-Mar-2023 16:23:10 ALS Bottle#: 13 Worklist Smp#: 52
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: CCV
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:44 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:44:53

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11108	816.0		976	
2 Perchlorate									
99.00 > 82.80	3.559	3.584	-0.025	1.007	40424	1877.2	Target=3.25	752	
101.00 > 85.00	3.559	3.584	-0.025	1.007	11874		3.40(2.30-3.80)	490	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
PtxCalStockW_00016 Amount Added: 100.00 Units: uL

Report Date: 28-Mar-2023 09:48:44 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22066.d

Injection Date: 22-Mar-2023 16:23:10 Instrument ID: LC_LCMS10

Lims ID: CCV

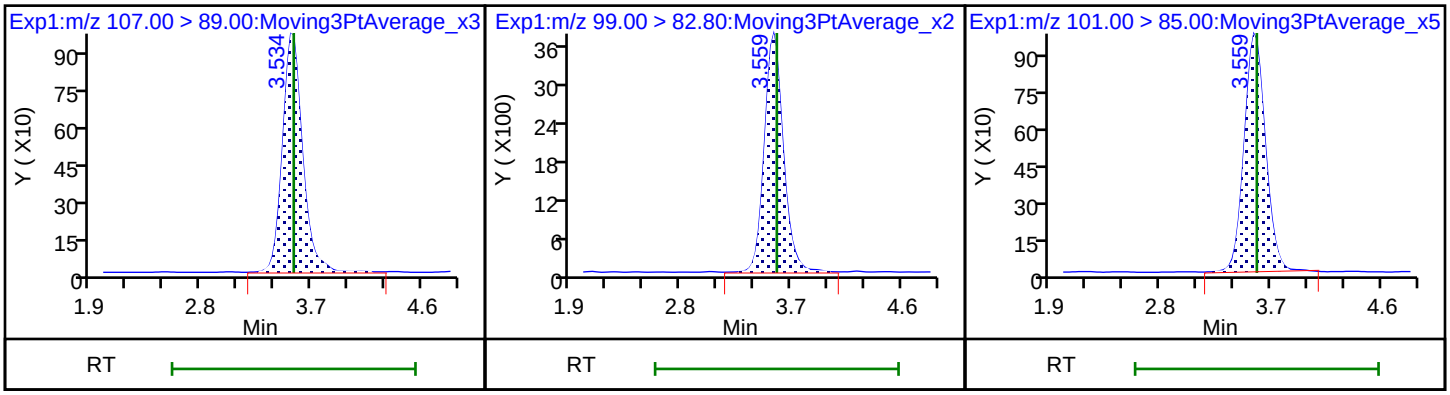
Client ID:

Operator ID: DENLCMS ALS Bottle#: 13 Worklist Smp#: 52

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



FORM VII
LCMS CONTINUING CALIBRATION DATA

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Lab Sample ID: CCVL 280-606020/53 Calibration Date: 03/22/2023 16:28

Instrument ID: LC_LCMS10 Calib Start Date: 03/21/2023 14:11

GC Column: ID: Calib End Date: 03/21/2023 14:49

Lab File ID: LC1023C22067.d Conc. Units: ug/L

ANALYTE	CURVE TYPE	AVE RRF	RRF	MIN RRF	CALC AMOUNT	SPIKE AMOUNT	%D	MAX %D
Perchlorate	Ave	1.582	1.684		0.213	0.200	6.5	50.0

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22067.d
Lims ID: CCVL
Client ID:
Sample Type: CCVL
Inject. Date: 22-Mar-2023 16:28:31 ALS Bottle#: 14 Worklist Smp#: 53
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: CCVL
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:44 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:44:55

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		10670	816.0		931	
2 Perchlorate									
99.00 > 82.80	3.559	3.584	-0.025	1.007	4404	212.9	Target=3.25	133	
101.00 > 85.00	3.559	3.584	-0.025	1.007	1293		3.41(2.30-3.80)	56.0	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
PtxCalStockW_00016 Amount Added: 10.00 Units: uL

Report Date: 28-Mar-2023 09:48:45 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22067.d

Injection Date: 22-Mar-2023 16:28:31 Instrument ID: LC_LCMS10

Lims ID: CCVL

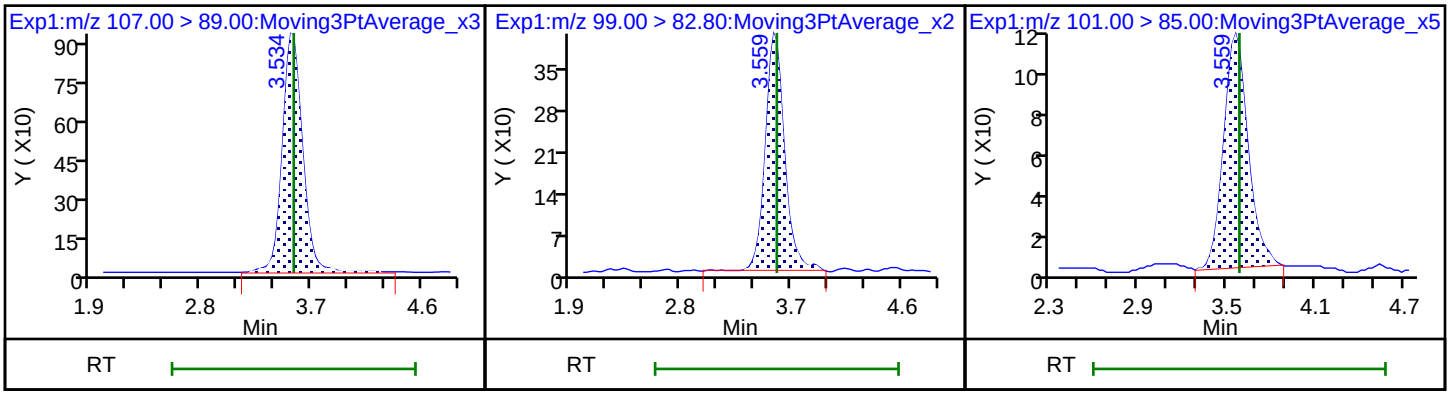
Client ID:

Operator ID: DENLCMS ALS Bottle#: 14 Worklist Smp#: 53

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



FORM VII
LCMS CONTINUING CALIBRATION DATA

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Lab Sample ID: CCV 280-606020/65 Calibration Date: 03/22/2023 17:32

Instrument ID: LC_LCMS10 Calib Start Date: 03/21/2023 14:11

GC Column: ID: Calib End Date: 03/21/2023 14:49

Lab File ID: LC1023C22079.d Conc. Units: ug/L

ANALYTE	CURVE TYPE	AVE RRF	RRF	MIN RRF	CALC AMOUNT	SPIKE AMOUNT	%D	MAX %D
Perchlorate	Ave	1.582	1.491		1.89	2.00	-5.7	15.0

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22079.d
Lims ID: CCV
Client ID:
Sample Type: CCV
Inject. Date: 22-Mar-2023 17:32:57 ALS Bottle#: 13 Worklist Smp#: 65
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: CCV
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:49 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:46:29

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11167	816.0		977	
2 Perchlorate									
99.00 > 82.80	3.559	3.584	-0.025	1.007	40821	1885.6	Target=3.25	929	
101.00 > 85.00	3.559	3.584	-0.025	1.007	12701		3.21(2.30-3.80)	504	

QC Flag Legend

Processing Flags

Reagents:

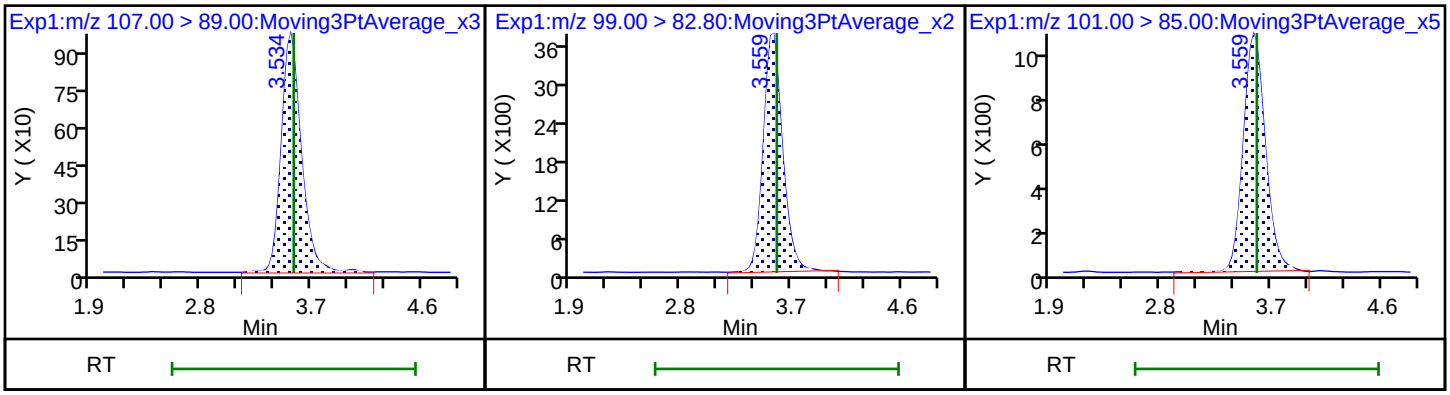
PtxCalStockW_00016 Amount Added: 100.00 Units: uL
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:49 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22079.d
Injection Date: 22-Mar-2023 17:32:57 Instrument ID: LC_LCMS10
Lims ID: CCV
Client ID:
Operator ID: DENLCMS ALS Bottle#: 13 Worklist Smp#: 65
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



FORM VII
LCMS CONTINUING CALIBRATION DATA

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Lab Sample ID: CCVL 280-606020/66 Calibration Date: 03/22/2023 17:38

Instrument ID: LC_LCMS10 Calib Start Date: 03/21/2023 14:11

GC Column: ID: Calib End Date: 03/21/2023 14:49

Lab File ID: LC1023C22080.d Conc. Units: ug/L

ANALYTE	CURVE TYPE	AVE RRF	RRF	MIN RRF	CALC AMOUNT	SPIKE AMOUNT	%D	MAX %D
Perchlorate	Ave	1.582	1.653		0.209	0.200	4.5	50.0

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22080.d
Lims ID: CCVL
Client ID:
Sample Type: CCVL
Inject. Date: 22-Mar-2023 17:38:19 ALS Bottle#: 14 Worklist Smp#: 66
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: CCVL
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:50 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:46:31

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		10933	816.0		483	
2 Perchlorate									
99.00 > 82.80	3.559	3.584	-0.025	1.007	4429	209.0	Target=3.25	142	
101.00 > 85.00	3.559	3.584	-0.025	1.007	1508		2.94(2.30-3.80)	118	

QC Flag Legend
Processing Flags

Reagents:
PtxCalStockW_00016 Amount Added: 10.00 Units: uL
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:50 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22080.d

Injection Date: 22-Mar-2023 17:38:19 Instrument ID: LC_LCMS10

Lims ID: CCVL

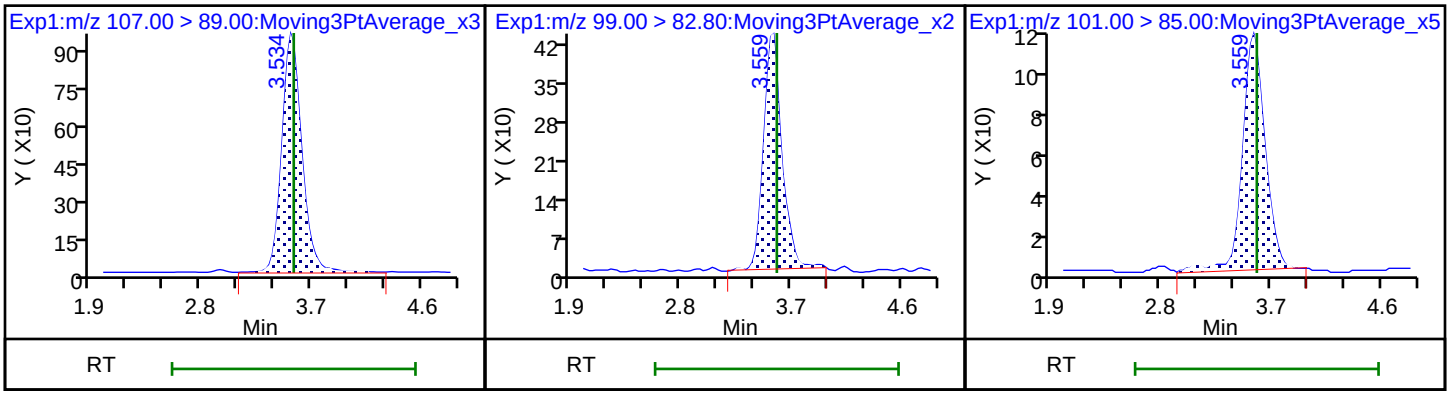
Client ID:

Operator ID: DENLCMS ALS Bottle#: 14 Worklist Smp#: 66

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



FORM VII
LCMS CONTINUING CALIBRATION DATA

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Lab Sample ID: CCV 280-606020/78 Calibration Date: 03/22/2023 18:42

Instrument ID: LC_LCMS10 Calib Start Date: 03/21/2023 14:11

GC Column: ID: Calib End Date: 03/21/2023 14:49

Lab File ID: LC1023C22092.d Conc. Units: ug/L

ANALYTE	CURVE TYPE	AVE RRF	RRF	MIN RRF	CALC AMOUNT	SPIKE AMOUNT	%D	MAX %D
Perchlorate	Ave	1.582	1.519		1.92	2.00	-4.0	15.0

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22092.d
Lims ID: CCV
Client ID:
Sample Type: CCV
Inject. Date: 22-Mar-2023 18:42:49 ALS Bottle#: 13 Worklist Smp#: 78
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: CCV
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:54 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:47:29

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		12389	816.0		1121	
2 Perchlorate									
99.00 > 82.80	3.559	3.584	-0.025	1.007	46134	1920.8	Target=3.25	868	
101.00 > 85.00	3.559	3.584	-0.025	1.007	14035		3.29(2.30-3.80)	573	

QC Flag Legend

Processing Flags

Reagents:

PtxCalStockW_00016 Amount Added: 100.00 Units: uL
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:54 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22092.d

Injection Date: 22-Mar-2023 18:42:49 Instrument ID: LC_LCMS10

Lims ID: CCV

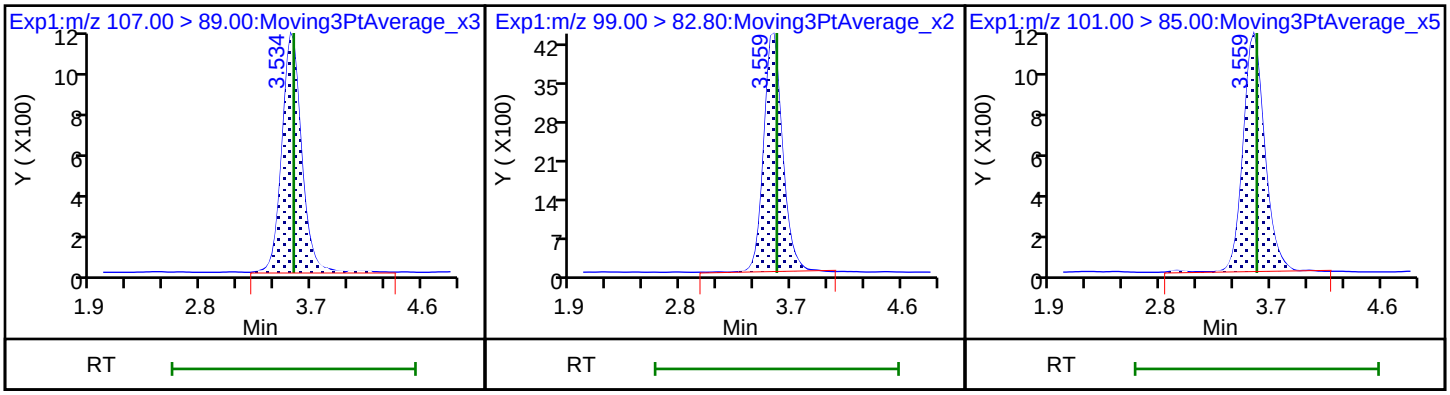
Client ID:

Operator ID: DENLCMS ALS Bottle#: 13 Worklist Smp#: 78

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



FORM VII
LCMS CONTINUING CALIBRATION DATA

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Lab Sample ID: CCVL 280-606020/79 Calibration Date: 03/22/2023 18:48

Instrument ID: LC_LCMS10 Calib Start Date: 03/21/2023 14:11

GC Column: ID: Calib End Date: 03/21/2023 14:49

Lab File ID: LC1023C22093.d Conc. Units: ug/L

ANALYTE	CURVE TYPE	AVE RRF	RRF	MIN RRF	CALC AMOUNT	SPIKE AMOUNT	%D	MAX %D
Perchlorate	Ave	1.582	1.719		0.217	0.200	8.7	50.0

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22093.d
Lims ID: CCVL
Client ID:
Sample Type: CCVL
Inject. Date: 22-Mar-2023 18:48:10 ALS Bottle#: 14 Worklist Smp#: 79
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: CCVL
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10
Sublist: chrom-6850*sub1

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:54 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:47:35

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11505	816.0		501	
2 Perchlorate									
99.00 > 82.80	3.534	3.584	-0.050	1.000	4848	217.4	Target=3.25	145	
101.00 > 85.00	3.559	3.584	-0.025	1.007	1730		2.80(2.30-3.80)	136	

QC Flag Legend

Processing Flags

Reagents:

PtxCalStockW_00016 Amount Added: 10.00 Units: uL
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:54 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22093.d

Injection Date: 22-Mar-2023 18:48:10 Instrument ID: LC_LCMS10

Lims ID: CCVL

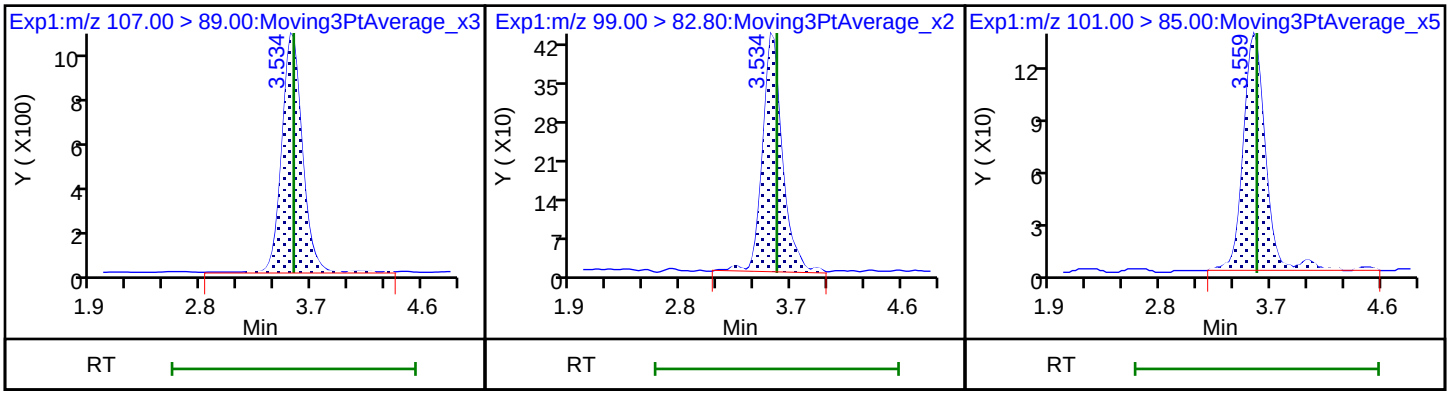
Client ID:

Operator ID: DENLCMS ALS Bottle#: 14 Worklist Smp#: 79

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



Acquisition Method

perchlorate111022

Mass Spec 4.500 min
Period 1.500 min
-MRM
LC System
Equilibrate
Injection

Mass Spectrometer Method Properties

Period 1:

Scans in Period: 59
Relative Start Time: 180000.00 msec
Scheduled Ionization: Off
Experiments in Period: 1

Period 1 Experiment 1:

Scan Type: MRM (MRM)
Scheduled MRM: No
Polarity: Negative
Scan Mode: N/A
Ion Source: Turbo Spray
Resolution Q1: Unit
Resolution Q3: Unit
Intensity Thres.: 0.00 cps
Settling Time: 0.0000 msec
MR Pause: 5.0070 msec
MCA: No
Step Size: 0.00 Da

Q1 Mass (Da)	Q3 Mass (Da)	Dwell (msec)	Param	Start	Stop	ID
101.000	85.000	500.00	CE	-35.00	-35.00	Perchlorate 1

Q1 Mass (Da)	Q3 Mass (Da)	Dwell (msec)	Param	Start	Stop	ID
99.000	82.800	500.00	CE	-35.00	-35.00	Perchlorate 2

Q1 Mass (Da)	Q3 Mass (Da)	Dwell (msec)	Param	Start	Stop	ID
107.000	89.000	500.00	CE	-40.00	-40.00	Perchlorate IS

Parameter Table (Period 1 Experiment 1):

CAD:	12.00
CUR:	40.00
GS1:	55.00
GS2:	50.00
IS:	-3500.00
TEM:	550.00
ihe:	OFF
DP	-55.00
EP	-10.00
CXP	-10.00

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Client Sample ID: Lab Sample ID: MB 280-606020/55

Matrix: Water Lab File ID: LC1023C22069.d

Analysis Method: 6850 Date Collected:

Extraction Method: Date Extracted:

Sample wt/vol: 0(mL) Date Analyzed: 03/22/2023 16:39

Con. Extract Vol.: Dilution Factor: 1

Injection Volume: 25(uL) GC Column: ID:

% Moisture: % Solids: GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.10	U	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22069.d
Lims ID: MB
Client ID:
Sample Type: MB
Inject. Date: 22-Mar-2023 16:39:15 ALS Bottle#: 7 Worklist Smp#: 55
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: MB
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:44 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:44:59

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		10545	816.0		961	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:45 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22069.d

Injection Date: 22-Mar-2023 16:39:15 Instrument ID: LC_LCMS10

Lims ID: MB

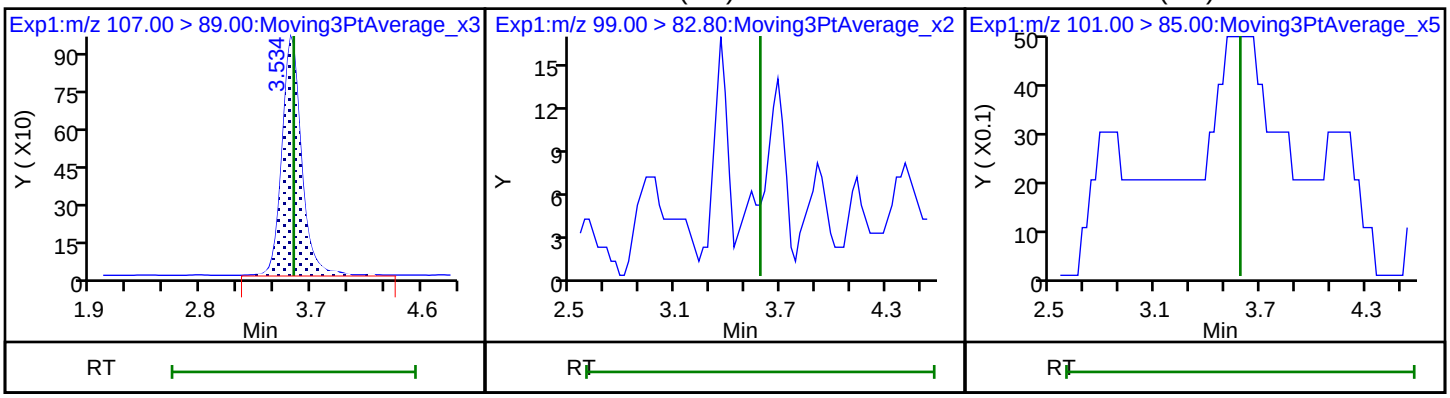
Client ID:

Operator ID: DENLCMS ALS Bottle#: 7 Worklist Smp#: 55

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate (ND) 2 Perchlorate (ND)



FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: | Lab Sample ID: CCB 280-606020/54

Matrix: Water | Lab File ID: LC1023C22068.d

Analysis Method: 6850 | Date Collected:

Extraction Method: | Date Extracted:

Sample wt/vol: 1(mL) | Date Analyzed: 03/22/2023 16:33

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: | ID:

% Moisture: | % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.10	U	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22068.d
Lims ID: CCB
Client ID:
Sample Type: CCB
Inject. Date: 22-Mar-2023 16:33:52 ALS Bottle#: 15 Worklist Smp#: 54
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: CCB
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:44 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:44:57

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		10668	816.0		471	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:45 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22068.d

Injection Date: 22-Mar-2023 16:33:52 Instrument ID: LC_LCMS10

Lims ID: CCB

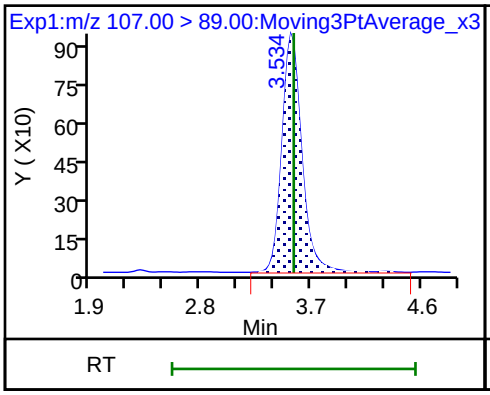
Client ID:

Operator ID: DENLCMS ALS Bottle#: 15 Worklist Smp#: 54

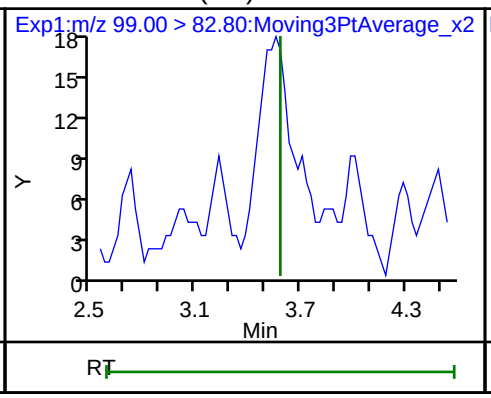
Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

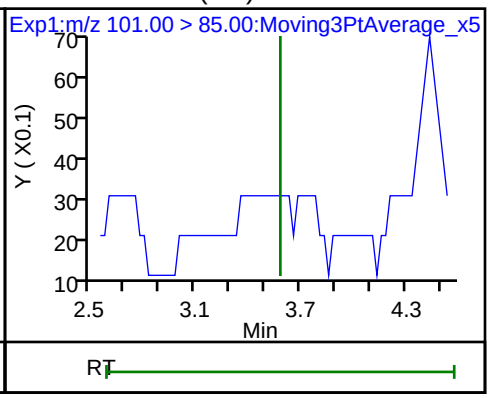
* 1 Perchlorate-18O



2 Perchlorate (ND)



2 Perchlorate (ND)



FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Client Sample ID: Lab Sample ID: CCB 280-606020/67

Matrix: Water Lab File ID: LC1023C22081.d

Analysis Method: 6850 Date Collected:

Extraction Method: Date Extracted:

Sample wt/vol: 0(mL) Date Analyzed: 03/22/2023 17:43

Con. Extract Vol.: Dilution Factor: 1

Injection Volume: 25(uL) GC Column: ID:

% Moisture: % Solids: GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.10	U	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22081.d
Lims ID: CCB
Client ID:
Sample Type: CCB
Inject. Date: 22-Mar-2023 17:43:39 ALS Bottle#: 15 Worklist Smp#: 67
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: CCB
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:50 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:46:33

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11442	816.0		1003	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:50 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22081.d

Injection Date: 22-Mar-2023 17:43:39 Instrument ID: LC_LCMS10

Lims ID: CCB

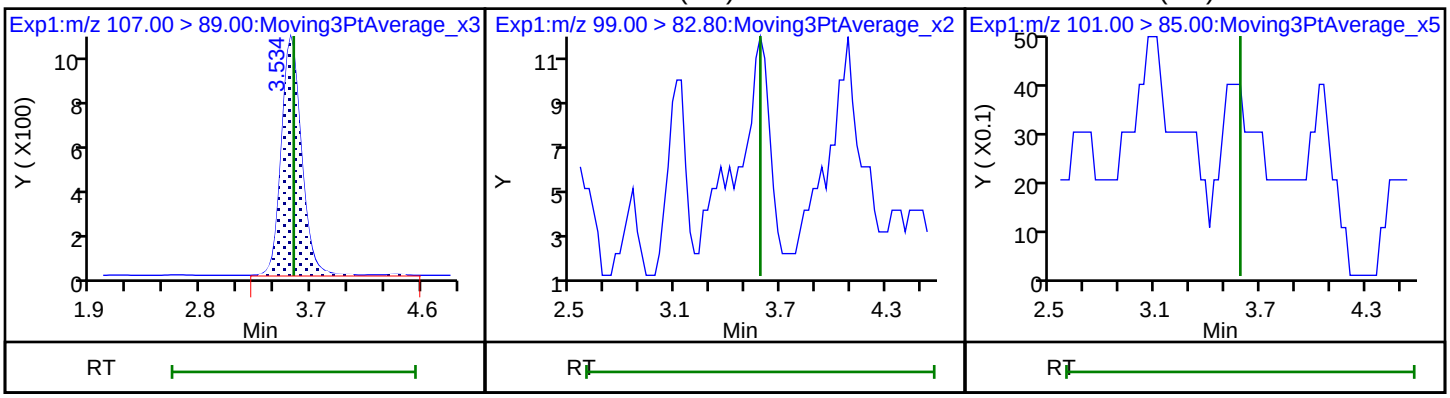
Client ID:

Operator ID: DENLCMS ALS Bottle#: 15 Worklist Smp#: 67

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate (ND) 2 Perchlorate (ND)



FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Client Sample ID: Lab Sample ID: CCB 280-606020/80

Matrix: Water Lab File ID: LC1023C22094.d

Analysis Method: 6850 Date Collected:

Extraction Method: Date Extracted:

Sample wt/vol: 0(mL) Date Analyzed: 03/22/2023 18:53

Con. Extract Vol.: Dilution Factor: 1

Injection Volume: 25(uL) GC Column: ID:

% Moisture: % Solids: GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.10	U	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22094.d				
Lims ID:	CCB				
Client ID:					
Sample Type:	CCB				
Inject. Date:	22-Mar-2023 18:53:32	ALS Bottle#:	15	Worklist Smp#:	80
Injection Vol:	25.0 ul	Dil. Factor:	1.0000		
Sample Info:	CCB				
Misc. Info.:	Plate: 1 Rack: 1				
Operator ID:	DENLCMS	Instrument ID:	LC_LCMS10		
Method:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m				
Limit Group:	LC - 6850				
Last Update:	28-Mar-2023 09:48:54	Calib Date:	21-Mar-2023 14:49:53		
Integrator:	Picker				
Quant Method:	Internal Standard	Quant By:	Initial Calibration		
Last ICal File:	\\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d				
Column 1 :			Det: EXP1		
Process Host:	CTX1643				
First Level Reviewer: PE6P		Date:	28-Mar-2023 09:49:03		

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		12533	816.0		551	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:50:07 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22094.d

Injection Date: 22-Mar-2023 18:53:32 Instrument ID: LC_LCMS10

Lims ID: CCB

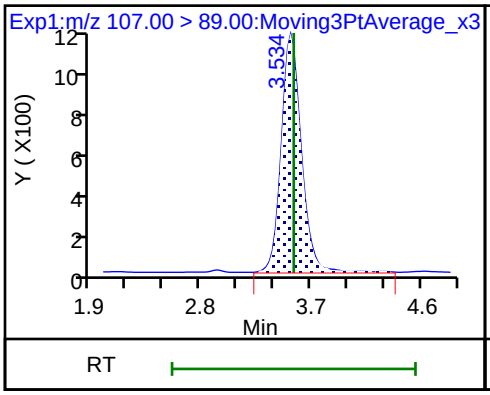
Client ID:

Operator ID: DENLCMS ALS Bottle#: 15 Worklist Smp#: 80

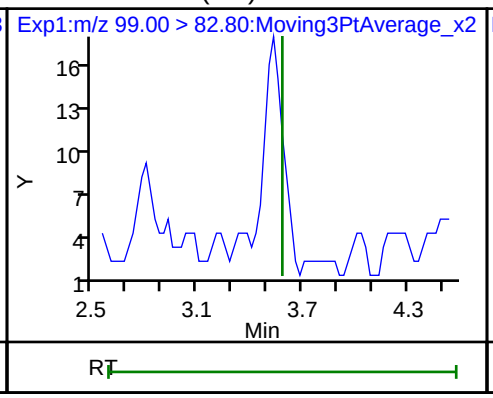
Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

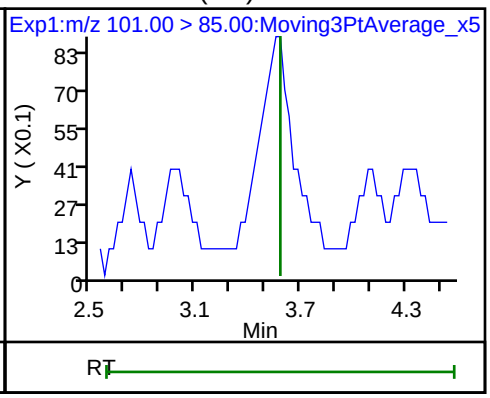
* 1 Perchlorate-18O



2 Perchlorate (ND)



2 Perchlorate (ND)



FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: | Lab Sample ID: ICB 280-605949/11

Matrix: Water | Lab File ID: LC1023C21035.d

Analysis Method: 6850 | Date Collected:

Extraction Method: | Date Extracted:

Sample wt/vol: 1(mL) | Date Analyzed: 03/21/2023 14:55

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: | ID:

% Moisture: | % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 605949 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.10	U	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21035.d
Lims ID: ICB
Client ID:
Sample Type: ICB
Inject. Date: 21-Mar-2023 14:55:14 ALS Bottle#: 10 Worklist Smp#: 11
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: ICB
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\6850.m
Limit Group: LC - 6850
Last Update: 22-Mar-2023 08:39:12 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1683

First Level Reviewer: PE6P Date: 22-Mar-2023 08:34:11

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.584	3.559	0.025		9547	816.0		824	

QC Flag Legend

Processing Flags

Reagents:

PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 22-Mar-2023 08:40:06 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21035.d

Injection Date: 21-Mar-2023 14:55:14 Instrument ID: LC_LCMS10

Lims ID: ICB

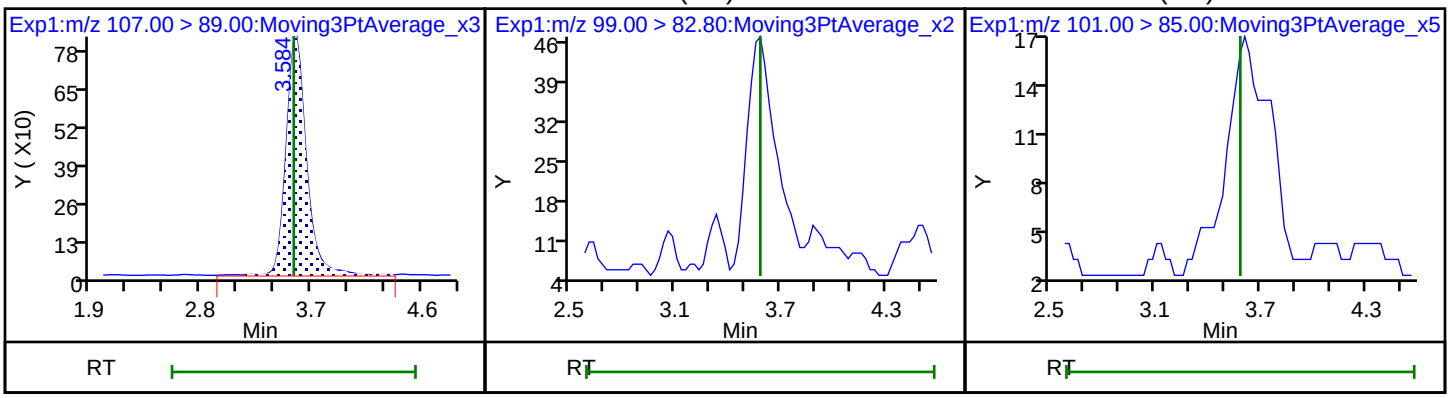
Client ID:

Operator ID: DENLCMS ALS Bottle#: 10 Worklist Smp#: 11

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate (ND) 2 Perchlorate (ND)



FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: | Lab Sample ID: LCS 280-606020/56

Matrix: Water | Lab File ID: LC1023C22070.d

Analysis Method: 6850 | Date Collected:

Extraction Method: | Date Extracted:

Sample wt/vol: 0(mL) | Date Analyzed: 03/22/2023 16:44

Con. Extract Vol.: | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: | ID:

% Moisture: | % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.197	J	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22070.d
Lims ID: LCS
Client ID:
Sample Type: LCS
Inject. Date: 22-Mar-2023 16:44:38 ALS Bottle#: 8 Worklist Smp#: 56
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: LCS
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:44 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:45:02

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11133	816.0		980	
2 Perchlorate									
99.00 > 82.80	3.534	3.584	-0.050	1.000	4252	197.0	Target=3.25	125	
101.00 > 85.00	3.559	3.584	-0.025	1.007	1341		3.17(2.30-3.80)	53.5	

QC Flag Legend
Processing Flags

Reagents:
PtxCalStockW_00016 Amount Added: 10.00 Units: uL
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 28-Mar-2023 09:48:46 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22070.d

Injection Date: 22-Mar-2023 16:44:38 Instrument ID: LC_LCMS10

Lims ID: LCS

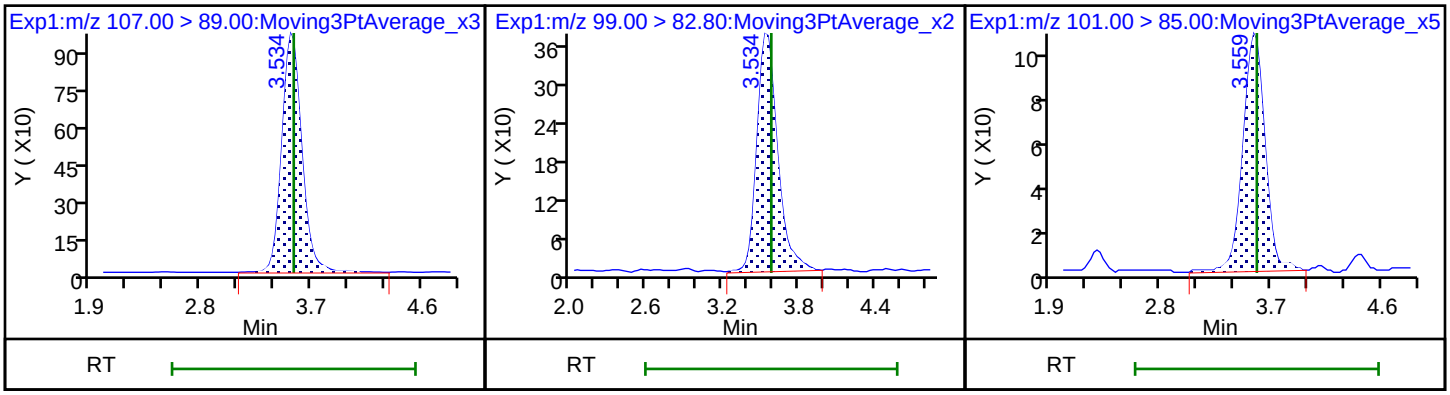
Client ID:

Operator ID: DENLCMS ALS Bottle#: 8 Worklist Smp#: 56

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: | Lab Sample ID: DLCK 280-605949/13

Matrix: Water | Lab File ID: LC1023C21037.d

Analysis Method: 6850 | Date Collected:

Extraction Method: | Date Extracted:

Sample wt/vol: 1(mL) | Date Analyzed: 03/21/2023 15:06

Con. Extract Vol.: 1(mL) | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: | ID:

% Moisture: | % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 605949 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.204	M	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21037.d
Lims ID: DLCK
Client ID:
Sample Type: DLCK
Inject. Date: 21-Mar-2023 15:06:02 ALS Bottle#: 12 Worklist Smp#: 13
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: DLCK
Misc. Info.: Plate: 1 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\6850.m
Limit Group: LC - 6850
Last Update: 22-Mar-2023 08:40:07 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1683

First Level Reviewer: PE6P Date: 22-Mar-2023 08:34:28

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.584	3.559	0.025		9028	816.0		388	
2 Perchlorate									Ma
99.00 > 82.80	3.584	3.584	0.0	1.000	3569	203.9	Target=3.25	114	a
101.00 > 85.00	3.584	3.584	0.0	1.000	1093		3.27(2.30-3.80)	49.0	M

QC Flag Legend

Processing Flags
Review Flags
M - Manually Integrated
a - User Assigned ID

Reagents:

PtxCalStockW_00016 Amount Added: 10.00 Units: uL
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL

Report Date: 22-Mar-2023 08:40:07 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21037.d

Injection Date: 21-Mar-2023 15:06:02 Instrument ID: LC_LCMS10

Lims ID: DLCK

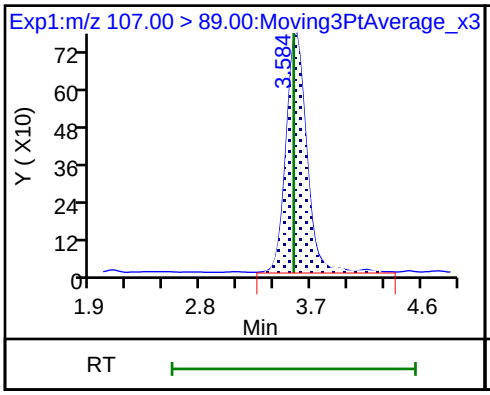
Client ID:

Operator ID: DENLCMS ALS Bottle#: 12 Worklist Smp#: 13

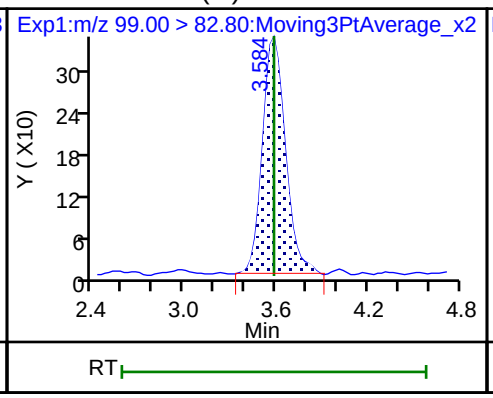
Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

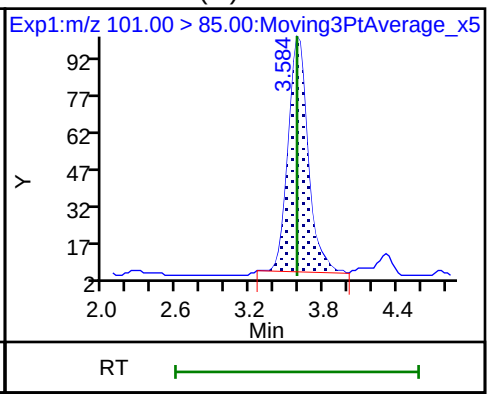
* 1 Perchlorate-18O



2 Perchlorate (M)



2 Perchlorate (M)



Manual Integration/User Assign Peak Report

Eurofins Denver

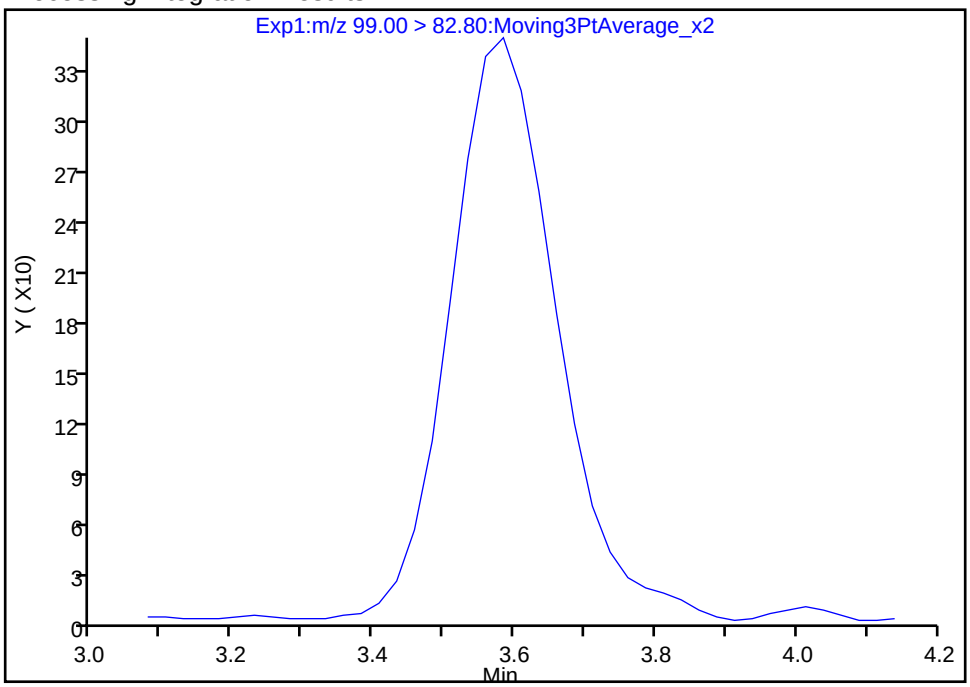
Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21037.d
Injection Date: 21-Mar-2023 15:06:02 Instrument ID: LC_LCMS10
Lims ID: DLCK
Client ID:
Operator ID: DENLCMS ALS Bottle#: 12 Worklist Smp#: 13
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Method: 6850 Limit Group: LC - 6850
Column: Detector EXP1

2 Perchlorate, CAS: 14797-73-0

Signal: 1

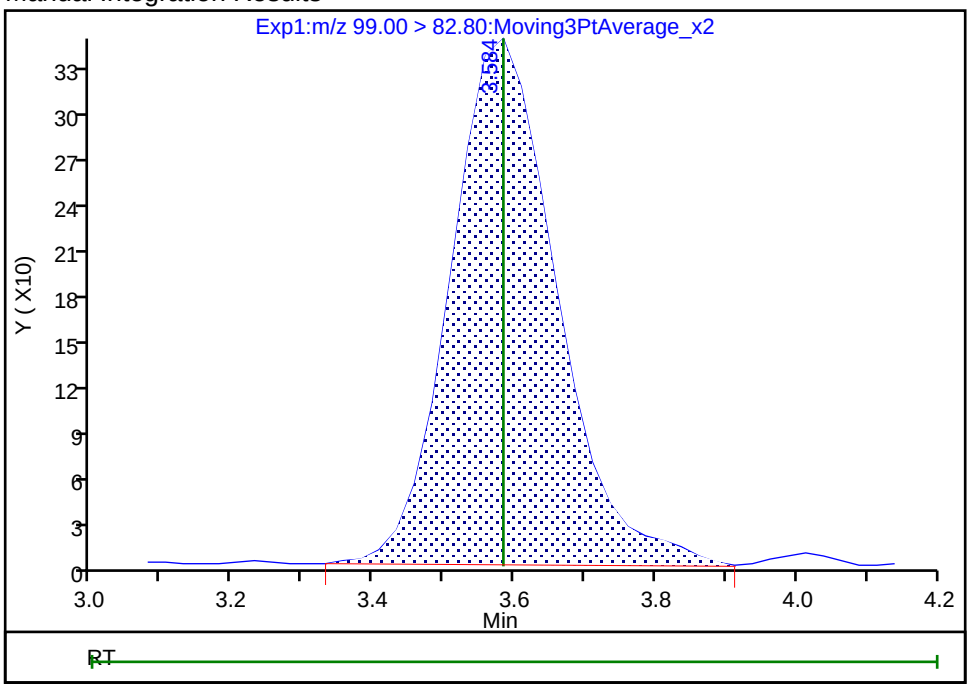
Not Detected
Expected RT: 3.58

Processing Integration Results



Manual Integration Results

RT: 3.58
Area: 3569
Amount: 203.9201
Amount Units: ng/l



Reviewer: PE6P, 22-Mar-2023 08:34:19
Audit Action: Assigned Compound ID Audit Reason: Baseline

Manual Integration/User Assign Peak Report

Eurofins Denver

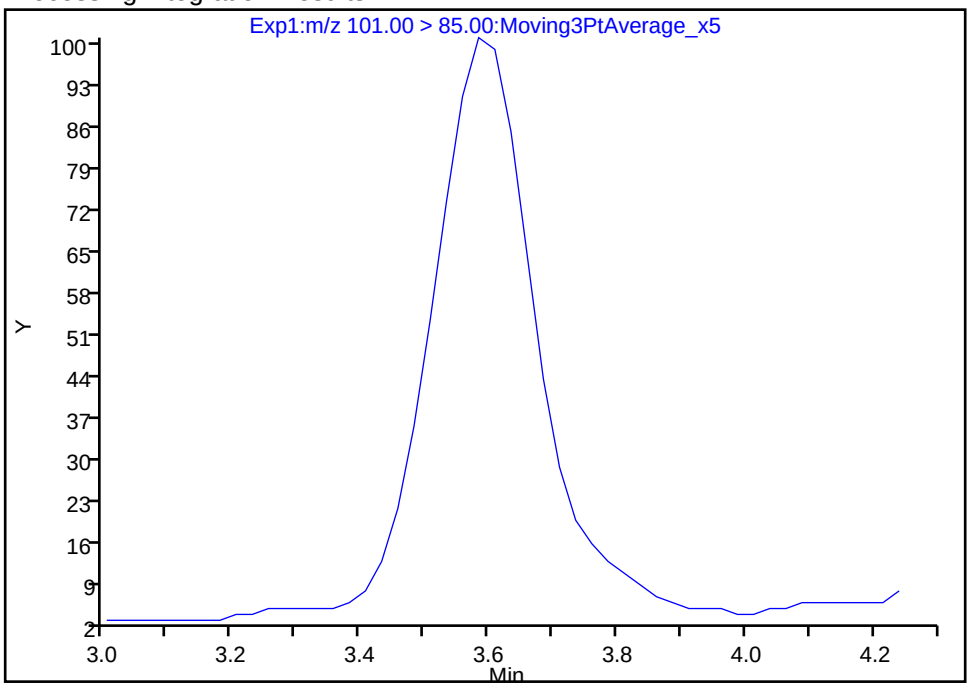
Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21037.d
Injection Date: 21-Mar-2023 15:06:02 Instrument ID: LC_LCMS10
Lims ID: DLCK
Client ID:
Operator ID: DENLCMS ALS Bottle#: 12 Worklist Smp#: 13
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Method: 6850 Limit Group: LC - 6850
Column: Detector EXP1

2 Perchlorate, CAS: 14797-73-0

Signal: 2

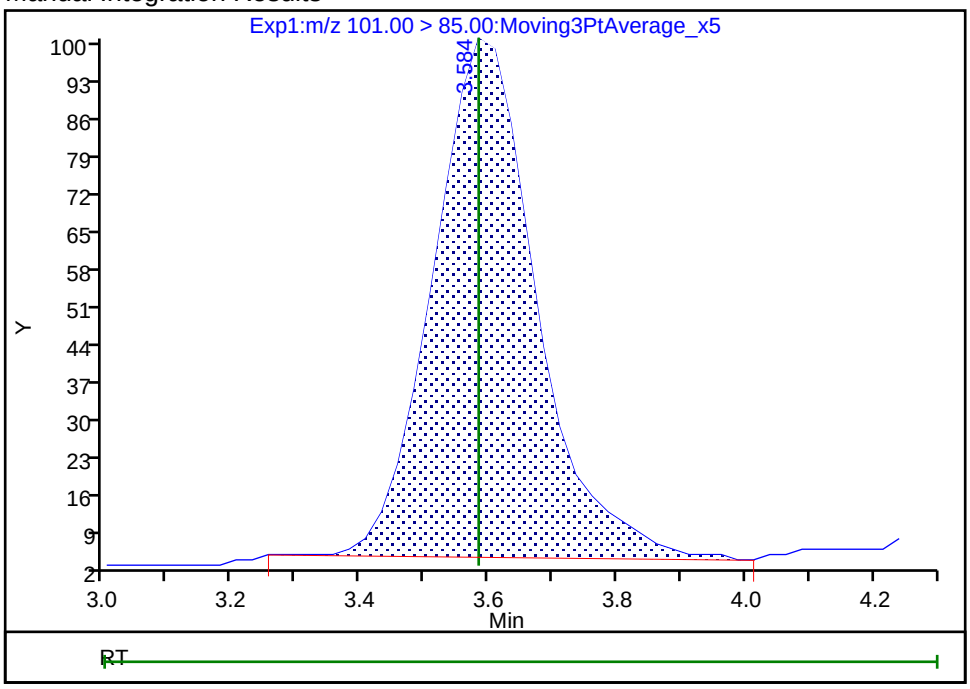
Not Detected
Expected RT: 3.58

Processing Integration Results



Manual Integration Results

RT: 3.58
Area: 1093
Amount: 203.9201
Amount Units: ng/l



Reviewer: PE6P, 22-Mar-2023 08:34:23
Audit Action: Manually Integrated Audit Reason: Baseline

FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: | Lab Sample ID: INF 280-606020/57

Matrix: Water | Lab File ID: LC1023C22071.d

Analysis Method: 6850 | Date Collected:

Extraction Method: | Date Extracted:

Sample wt/vol: 0(mL) | Date Analyzed: 03/22/2023 16:49

Con. Extract Vol.: | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: ID:

% Moisture: % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.174	J	0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22071.d
Lims ID: INF
Client ID:
Sample Type: INF
Inject. Date: 22-Mar-2023 16:49:59 ALS Bottle#: 9 Worklist Smp#: 57
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: INF
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:44 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:45:05

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11239	816.0		1021	
2 Perchlorate									
99.00 > 82.80	3.534	3.584	-0.050	1.000	3798	174.3	Target=3.25	115	
101.00 > 85.00	3.534	3.584	-0.050	1.000	1262		3.01(2.30-3.80)	51.5	

QC Flag Legend

Processing Flags

Reagents:

PtxCalStockW_00016 Amount Added: 10.00 Units: uL
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
6850_INF_Soln_00002 Amount Added: 990.00 Units: uL

Report Date: 28-Mar-2023 09:48:47 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22071.d

Injection Date: 22-Mar-2023 16:49:59 Instrument ID: LC_LCMS10

Lims ID: INF

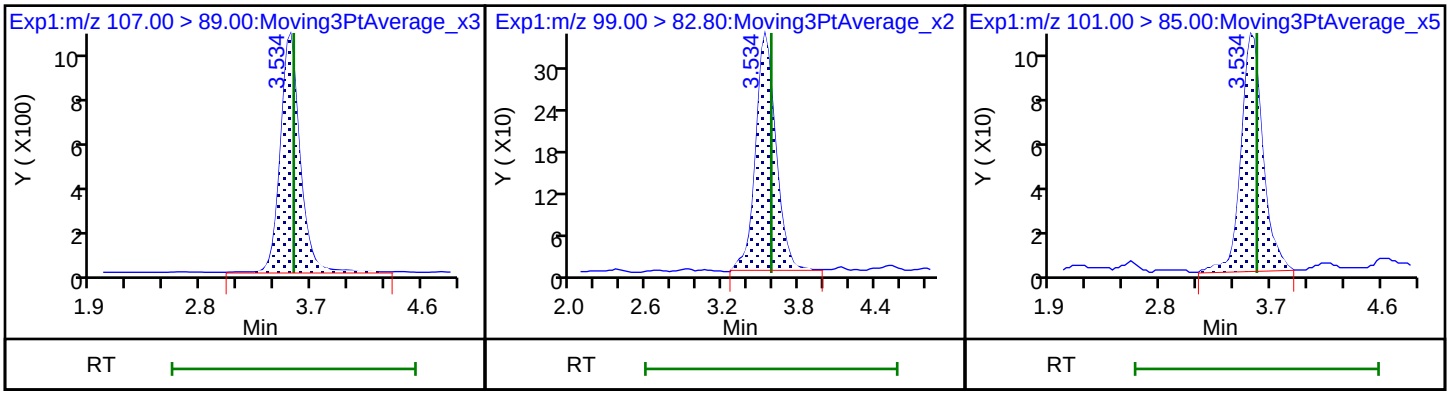
Client ID:

Operator ID: DENLCMS ALS Bottle#: 9 Worklist Smp#: 57

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Client Sample ID: JACKSON-SWMC3-DC-01 MS Lab Sample ID: 280-173651-2 MS

Matrix: Water Lab File ID: LC1023C22076.d

Analysis Method: 6850 Date Collected: 03/08/2023 14:00

Extraction Method: Date Extracted:

Sample wt/vol: 0(mL) Date Analyzed: 03/22/2023 17:16

Con. Extract Vol.: Dilution Factor: 1

Injection Volume: 25(uL) GC Column: ID:

% Moisture: % Solids: GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.226		0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22076.d
Lims ID: 280-173651-A-2 MS
Client ID: JACKSON-SWMC3-DC-01
Sample Type: MS
Inject. Date: 22-Mar-2023 17:16:47 ALS Bottle#: 14 Worklist Smp#: 62
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: 280-173651-A-2 MS
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:44 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:45:31

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		10958	816.0		961	
2 Perchlorate									
99.00 > 82.80	3.559	3.584	-0.025	1.007	4807	226.3	Target=3.25	207	
101.00 > 85.00	3.584	3.584	0.0	1.014	1539		3.12(2.30-3.80)	59.0	

QC Flag Legend
Processing Flags

Reagents:
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
PtxCalStockW_00016 Amount Added: 10.00 Units: uL

Report Date: 28-Mar-2023 09:48:48 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22076.d

Injection Date: 22-Mar-2023 17:16:47 Instrument ID: LC_LCMS10

Lims ID: 280-173651-A-2 MS

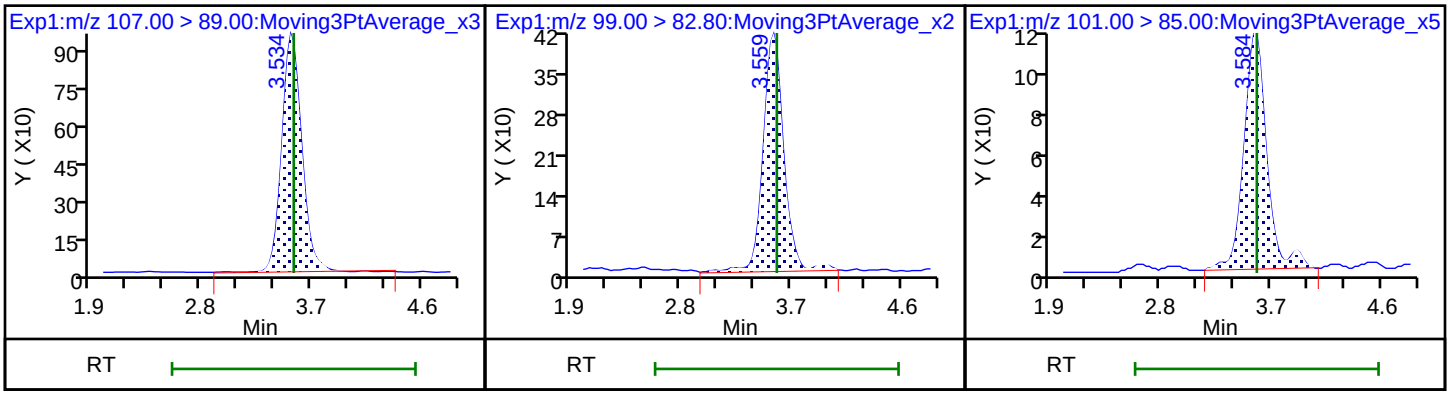
Client ID: JACKSON-SWMC3-DC-01

Operator ID: DENLCMS ALS Bottle#: 14 Worklist Smp#: 62

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



FORM I
LCMS ORGANICS ANALYSIS DATA SHEET

Lab Name: Eurofins Denver | Job No.: 280-173651-1

SDG No.:

Client Sample ID: JACKSON-SWMC3-DC-01 MSD | Lab Sample ID: 280-173651-2 MSD

Matrix: Water | Lab File ID: LC1023C22077.d

Analysis Method: 6850 | Date Collected: 03/08/2023 14:00

Extraction Method: | Date Extracted:

Sample wt/vol: 0(mL) | Date Analyzed: 03/22/2023 17:22

Con. Extract Vol.: | Dilution Factor: 1

Injection Volume: 25(uL) | GC Column: ID:

% Moisture: % Solids: | GPC Cleanup:(Y/N) N

Cleanup Factor:

Analysis Batch No.: 606020 | Units: ug/L

CAS NO.	COMPOUND NAME	RESULT	Q	LOQ	LOD	DL
14797-73-0	Perchlorate	0.217		0.20	0.10	0.013

Eurofins Denver
Target Compound Quantitation Report

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22077.d
Lims ID: 280-173651-A-2 MSD
Client ID: JACKSON-SWMC3-DC-01
Sample Type: MSD
Inject. Date: 22-Mar-2023 17:22:09 ALS Bottle#: 15 Worklist Smp#: 63
Injection Vol: 25.0 ul Dil. Factor: 1.0000
Sample Info: 280-173651-A-2 MSD
Misc. Info.: Plate: 3 Rack: 1
Operator ID: DENLCMS Instrument ID: LC_LCMS10

Method: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\6850.m
Limit Group: LC - 6850
Last Update: 28-Mar-2023 09:48:44 Calib Date: 21-Mar-2023 14:49:53
Integrator: Picker
Quant Method: Internal Standard Quant By: Initial Calibration
Last ICal File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119677.b\LC1023C21034.d

Column 1 : Det: EXP1
Process Host: CTX1643

First Level Reviewer: PE6P Date: 28-Mar-2023 09:45:33

Signal	RT	EXP RT	DLT RT	REL RT	Response	Amount ng/l	Ratio(Limits)	S/N	Flags
* 1 Perchlorate-18O									
107.00 > 89.00	3.534	3.559	-0.025		11197	816.0		1014	
2 Perchlorate									
99.00 > 82.80	3.559	3.584	-0.025	1.007	4713	217.1	Target=3.25	143	
101.00 > 85.00	3.559	3.584	-0.025	1.007	1451		3.25(2.30-3.80)	113	

QC Flag Legend
Processing Flags

Reagents:
PTX-IS-Spike_00012 Amount Added: 20.00 Units: uL
PtxCalStockW_00016 Amount Added: 10.00 Units: uL

Report Date: 28-Mar-2023 09:48:49 Chrom Revision: 2.3 16-Mar-2023 15:40:40

Eurofins Denver

Data File: \\chromfs\Denver\ChromData\LC_LCMS10\20230322-119685.b\LC1023C22077.d

Injection Date: 22-Mar-2023 17:22:09 Instrument ID: LC_LCMS10

Lims ID: 280-173651-A-2 MSD

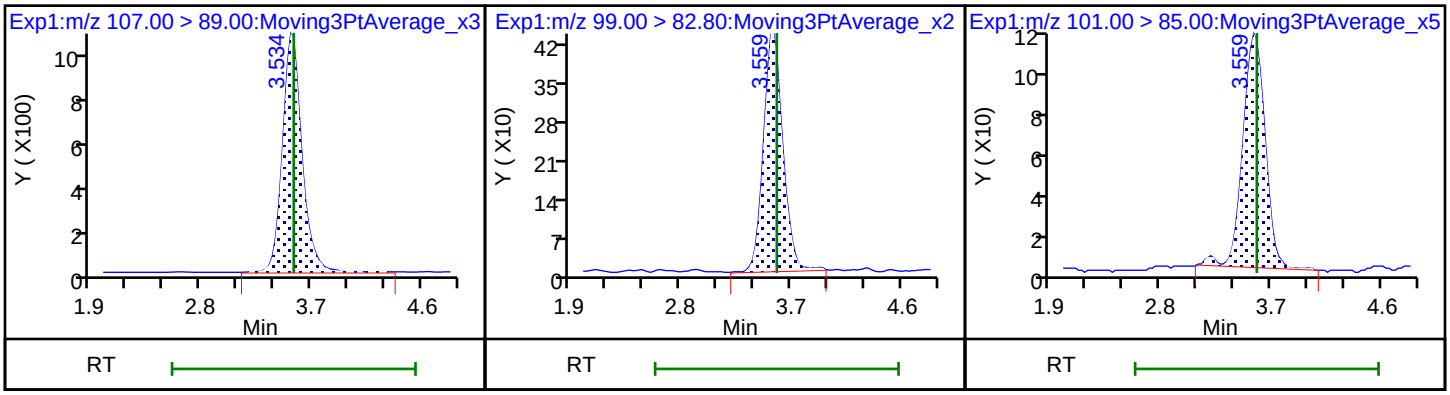
Client ID: JACKSON-SWMC3-DC-01

Operator ID: DENLCMS ALS Bottle#: 15 Worklist Smp#: 63

Injection Vol: 25.0 ul Dil. Factor: 1.0000

Method: 6850 Limit Group: LC - 6850

* 1 Perchlorate-18O 2 Perchlorate 2 Perchlorate



LCMS ANALYSIS RUN LOG

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Instrument ID: LC_LCMS10 Start Date: 03/21/2023 14:11

Analysis Batch Number: 605949 End Date: 03/21/2023 15:06

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE ANALYZED	DILUTION FACTOR	LAB FILE ID	COLUMN ID
STD00100 280-605949/3 IC		03/21/2023 14:11	1	LC1023C21027.d	
STD00200 280-605949/4 IC		03/21/2023 14:17	1	LC1023C21028.d	
STD00400 280-605949/5 IC		03/21/2023 14:23	1	LC1023C21029.d	
STD01000 280-605949/6 IC		03/21/2023 14:28	1	LC1023C21030.d	
STD02000 280-605949/7 ICISAV		03/21/2023 14:33	1	LC1023C21031.d	
STD04000 280-605949/8 IC		03/21/2023 14:39	1	LC1023C21032.d	
STD10000 280-605949/9 IC		03/21/2023 14:44	1	LC1023C21033.d	
STD20000 280-605949/10 IC		03/21/2023 14:49	1	LC1023C21034.d	
ICB 280-605949/11		03/21/2023 14:55	1	LC1023C21035.d	
ICV 280-605949/12		03/21/2023 15:00	1	LC1023C21036.d	
DLCK 280-605949/13		03/21/2023 15:06	1	LC1023C21037.d	

LCMS ANALYSIS RUN LOG

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Instrument ID: LC_LCMS10 Start Date: 03/22/2023 16:23

Analysis Batch Number: 606020 End Date: 03/22/2023 18:53

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE ANALYZED	DILUTION FACTOR	LAB FILE ID	COLUMN ID
CCV 280-606020/52		03/22/2023 16:23	1	LC1023C22066.d	
CCVL 280-606020/53		03/22/2023 16:28	1	LC1023C22067.d	
CCB 280-606020/54		03/22/2023 16:33	1	LC1023C22068.d	
MB 280-606020/55		03/22/2023 16:39	1	LC1023C22069.d	
LCS 280-606020/56		03/22/2023 16:44	1	LC1023C22070.d	
INF 280-606020/57		03/22/2023 16:49	1	LC1023C22071.d	
ZZZZZ		03/22/2023 16:55	1		
ZZZZZ		03/22/2023 17:00	1		
280-173651-1	SWDUP	03/22/2023 17:06	1	LC1023C22074.d	
280-173651-2	JACKSON-SWMC3-DC-01	03/22/2023 17:11	1	LC1023C22075.d	
280-173651-2 MS	JACKSON-SWMC3-DC-01 MS	03/22/2023 17:16	1	LC1023C22076.d	
280-173651-2 MSD	JACKSON-SWMC3-DC-01 MSD	03/22/2023 17:22	1	LC1023C22077.d	
280-173651-3	JACKSON-SWMC2-DC-01	03/22/2023 17:27	1	LC1023C22078.d	
CCV 280-606020/65		03/22/2023 17:32	1	LC1023C22079.d	
CCVL 280-606020/66		03/22/2023 17:38	1	LC1023C22080.d	
CCB 280-606020/67		03/22/2023 17:43	1	LC1023C22081.d	
280-173651-4	JACKSON-SWJC1-DC-01	03/22/2023 17:49	1	LC1023C22082.d	
280-173651-5	JACKSON-SWMC1-DC-01	03/22/2023 17:54	1	LC1023C22083.d	
280-173651-6	JACKSON-SWCC3-DC-01	03/22/2023 17:59	1	LC1023C22084.d	
280-173651-7	JACKSON-SWCC4-DC-01	03/22/2023 18:05	1	LC1023C22085.d	
280-173651-8	JACKSON-SWCC2-DC-01	03/22/2023 18:10	1	LC1023C22086.d	
280-173651-9	JACKSON-EB-01	03/22/2023 18:15	1	LC1023C22087.d	
280-173651-10	JACKSON-CB-01	03/22/2023 18:21	1	LC1023C22088.d	
ZZZZZ		03/22/2023 18:26	1		
ZZZZZ		03/22/2023 18:32	1		
ZZZZZ		03/22/2023 18:37	1		
CCV 280-606020/78		03/22/2023 18:42	1	LC1023C22092.d	
CCVL 280-606020/79		03/22/2023 18:48	1	LC1023C22093.d	
CCB 280-606020/80		03/22/2023 18:53	1	LC1023C22094.d	

LCMS BATCH WORKSHEET

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Batch Number: 605949 Batch Start Date: 03/21/23 14:11 Batch Analyst: Meyer, Andrew GC

Batch Method: 6850 Batch End Date:

Lab Sample ID	Client Sample ID	Method Chain	Basis	FinalAmount	ClO4ICVStockW 00004	PTX-IS-Spike 00012	PtxCalStockW 00016		
STD00100 280-605949/3 IC		6850		1 mL		20 uL	5 uL		
STD00200 280-605949/4 IC		6850		1 mL		20 uL	10 uL		
STD00400 280-605949/5 IC		6850		1 mL		20 uL	20 uL		
STD01000 280-605949/6 IC		6850		1 mL		20 uL	50 uL		
STD02000 280-605949/7 ICISAV		6850		1 mL		20 uL	100 uL		
STD04000 280-605949/8 IC		6850		1 mL		20 uL	200 uL		
STD10000 280-605949/9 IC		6850		1 mL		20 uL	500 uL		
STD20000 280-605949/10 IC		6850		1 mL		20 uL	1000 uL		
ICB 280-605949/11		6850		1 mL		20 uL			
ICV 280-605949/12		6850		1 mL	100 uL	20 uL			
DLCK 280-605949/13		6850		1 mL		20 uL	10 uL		

Batch Notes	

Basis	Basis Description

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

LCMS BATCH WORKSHEET

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Batch Number: 606020 Batch Start Date: 03/22/23 16:23 Batch Analyst: Meyer, Andrew GC

Batch Method: 6850 Batch End Date:

Lab Sample ID	Client Sample ID	Method Chain	Basis	FinalAmount	6850_INF_Soln 00002	PTX-IS-Spike 00012	PtxCalStockW 00016		
CCV 280-606020/52		6850		1 mL		20 uL	100 uL		
CCVL 280-606020/53		6850		1 mL		20 uL	10 uL		
CCB 280-606020/54		6850		1 mL		20 uL			
MB 280-606020/55		6850				20 uL			
LCS 280-606020/56		6850				20 uL	10 uL		
INF 280-606020/57		6850			990 uL	20 uL	10 uL		
280-173651-A-1	SWDUP	6850	T			20 uL			
280-173651-A-2	JACKSON-SWMC3-DC-01	6850	T			20 uL			
280-173651-A-2 MS	JACKSON-SWMC3-DC-01	6850	T			20 uL	10 uL		
280-173651-A-2 MSD	JACKSON-SWMC3-DC-01	6850	T			20 uL	10 uL		
280-173651-A-3	JACKSON-SWMC2-DC-01	6850	T			20 uL			
CCV 280-606020/65		6850				20 uL	100 uL		
CCVL 280-606020/66		6850				20 uL	10 uL		
CCB 280-606020/67		6850				20 uL			
280-173651-A-4	JACKSON-SWJC1-DC-01	6850	T			20 uL			
280-173651-A-5	JACKSON-SWMC1-DC-01	6850	T			20 uL			
280-173651-A-6	JACKSON-SWCC3-DC-01	6850	T			20 uL			
280-173651-A-7	JACKSON-SWCC4-DC-01	6850	T			20 uL			
280-173651-A-8	JACKSON-SWCC2-DC-01	6850	T			20 uL			
280-173651-A-9	JACKSON-EB-01	6850	T			20 uL			
280-173651-A-10	JACKSON-CB-01	6850	T			20 uL			
CCV 280-606020/78		6850				20 uL	100 uL		

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

LCMS BATCH WORKSHEET

Lab Name: Eurofins Denver Job No.: 280-173651-1

SDG No.:

Batch Number: 606020 Batch Start Date: 03/22/23 16:23 Batch Analyst: Meyer, Andrew GC

Batch Method: 6850 Batch End Date:

Lab Sample ID	Client Sample ID	Method Chain	Basis	FinalAmount	6850_INF_Soln 00002	PTX-IS-Spike 00012	PtxCalStockW 00016		
CCVL 280-606020/79		6850				20 uL	10 uL		
CCB 280-606020/80		6850				20 uL			

Batch Notes	

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

Shipping and Receiving Documents

Eurofins Denver

Katahdin ANALYTICAL SERVICES

Sub-contract Laboratory Chain of Custody

Client:	Contact:	Email:		Phone #:
Katahdin Analytical Services	Heather Manz	hmanz@katahdinlab.com		(207) 874-2400
Address:	**City:**	**State:**	**Zip:**	**Project Name:**
600 Technology Way	Scarborough	Maine	04074	Fort Jackson
KAS WO #:	**Quote #:**	**Purchase Order #:**		**TAT:** 2 week
SQ1201		SQ1201		**Verbal TAT:** N/A
RPT Level: 4	**Reporting Format:** DOD	**EDD:** EQuIS EQEDD		**Analysis:** Perchlorate

Sample ID:	Collect Date/Time:	Matrix:	No. of Containers	Pres.	MS/MSD Dup.	Analysis: Perchlorate Filtered? Y / N	Analysis: ~~Analysis:~~ Filtered? Y / N	Analysis: ~~Analysis:~~ Filtered? Y / N
SWDUP	08-MAR-23 00:00	AQ	1	UN PRES	NO	✓		
JACKSON-SWMC3-DC-01	08-MAR-23 14:00	AQ	X 3		yes	✓		
JACKSON-SWMC2-DC-01	08-MAR-23 11:30	AQ	1		NO	✓		
JACKSON-SWJC1-DC-01	08-MAR-23 13:30	AQ	1			✓		
JACKSON-SWMC1-DC-01	08-MAR-23 11:50	AQ	1			✓		
JACKSON-SWCC3-DC-01	08-MAR-23 14:15	AQ	1			✓		
JACKSON-SWCC4-DC-01	08-MAR-23 09:40	AQ	1			✓		
JACKSON-SWCC2-DC-01	08-MAR-23 10:00	AQ	1			✓		
JACKSON-EB-01	08-MAR-23 15:30	AQ	1			✓		
JACKSON-CB-01	08-MAR-23 16:00	AQ	1			✓		
[redacted]								
[redacted]								

Relinquished By:	Date/Time:	Received By:
[redacted]	3/15/23 1000	[redacted] 3-16-23 1105

Comments:
same project as 280-171513

1.6 cf 0.1 BIY

280-173651 Chain of Custody

ORIGIN ID:SFMA (207) 874-2400
MIKE FLANDERS
KATAHDIN ANALYTICAL SERVICES
600 TECHNOLOGY WAY

SCARBOROUGH, ME 04074
UNITED STATES US

SHIP DATE: 15MAR23
ACTWGT: 10.55 LB
CAD: 0802138/CAFE3621
DIMS: 12x10x10 IN

BILL SENDER

TO SAMPLE RECIEVING
EUROFINS DENVER
4955 YARROW ST, ARVADA

ARVADA CO 80002
(303) 736-0100
INV:
PO: REF:
DEPT:

FedE
Expr

THU - 16 MAR 10:3
PRIORITY OVERNIGI

TRK# 0201 6323 0721 8182

XA LAAA

8000
CO-US

156148-434 MTW EXP 01/24

280-173651 Waybill

Login Sample Receipt Checklist

Client: Katahdin Analytical Services

Job Number: 280-173651-1

Login Number: 173651
List Number: 1
Creator: Roehsner, Karen P

List Source: Eurofins Denver

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	N/A	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

SUBCONTRACTED DATA

eurofins | Environment Testing

ANALYTICAL REPORT

PREPARED FOR

Attn: Heather Manz
Katahdin Analytical Services
600 Technology Way
Scarborough ME 04074

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JOB DESCRIPTION

Fort Jackson

JOB NUMBER

680-232120-1

Eurofins Savannah
5102 LaRoche Avenue
Savannah GA 31404

See page two for job notes and contact information.

myEOL

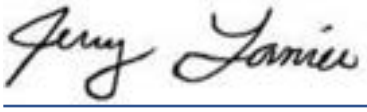
Eurofins Savannah

Job Notes

The test results in this report meet NELAP requirements for parameters for which accreditation is required or available. Any exceptions to the NELAP requirements are noted. Results pertain only to samples listed in this report. This report may not be reproduced, except in full, without the written approval of the laboratory. Questions should be directed to the person who signed this report.

The test results in this report relate only to the samples as received by the laboratory and will meet all requirements of the methodology, with any exceptions noted. This report shall not be reproduced except in full, without the express written approval of the laboratory. All questions should be directed to the Eurofins Environment Testing Southeast, LLC Project Manager.

Authorization



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Authorized for release by
Jerry A Lanier, Project Manager I
Jerry.Lanier@et.eurofinsus.com
912 250-0281

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Definitions/Glossary

Client: Katahdin Analytical Services
Job ID: 680-232120-1
Project/Site: Fort Jackson

Qualifiers

General Chemistry

Qualifier	Qualifier Description
U	Undetected at the Limit of Detection.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Job Narrative
680-232120-1

Receipt
The samples were received on 3/16/2023 10:00 AM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was 0.7°C

General Chemistry
No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Detection Summary

Client: Katahdin Analytical Services
Project/Site: Fort Jackson

Job ID: 680-232120-1

Client Sample ID: SWDUP — Lab Sample ID: 680-232120-1

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
DOC Result 1	6.2		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 2	6.1		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 3	6.1		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 4	6.2		1.0	0.50	mg/L	1		9060A	Dissolved
Dissolved Organic Carbon	6.2		1.0	0.50	mg/L	1		9060A	Dissolved

Client Sample ID: JACKSON-SWMC3-DC-01 — Lab Sample ID: 680-232120-2

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
Alkalinity	11		5.0	2.2	mg/L	1		2320B-2011	Total/NA
DOC Result 1	3.6		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 2	3.6		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 3	3.7		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 4	3.7		1.0	0.50	mg/L	1		9060A	Dissolved
Dissolved Organic Carbon	3.7		1.0	0.50	mg/L	1		9060A	Dissolved

Client Sample ID: JACKSON-SWMC2-DC-01 — Lab Sample ID: 680-232120-3

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
Alkalinity	12		5.0	2.2	mg/L	1		2320B-2011	Total/NA
DOC Result 1	4.9		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 2	4.8		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 3	4.7		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 4	4.7		1.0	0.50	mg/L	1		9060A	Dissolved
Dissolved Organic Carbon	4.8		1.0	0.50	mg/L	1		9060A	Dissolved

Client Sample ID: JACKSON-SWJC1-DC-01 — Lab Sample ID: 680-232120-4

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
Alkalinity	5.5		5.0	2.2	mg/L	1		2320B-2011	Total/NA
DOC Result 1	3.3		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 2	3.3		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 3	3.3		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 4	3.2		1.0	0.50	mg/L	1		9060A	Dissolved
Dissolved Organic Carbon	3.3		1.0	0.50	mg/L	1		9060A	Dissolved

Client Sample ID: JACKSON-SWMC1-DC-01 — Lab Sample ID: 680-232120-5

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
DOC Result 1	7.9		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 2	7.9		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 3	7.9		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 4	7.9		1.0	0.50	mg/L	1		9060A	Dissolved
Dissolved Organic Carbon	7.9		1.0	0.50	mg/L	1		9060A	Dissolved

Client Sample ID: JACKSON-SWCC3-DC-01 — Lab Sample ID: 680-232120-6

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
Alkalinity	5.3		5.0	2.2	mg/L	1		2320B-2011	Total/NA
DOC Result 1	4.4		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 2	4.3		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 3	4.4		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 4	4.4		1.0	0.50	mg/L	1		9060A	Dissolved

This Detection Summary does not include radiochemical test results.

Client Sample ID: JACKSON-SWCC3-DC-01 (Continued) — Lab Sample ID: 680-232120-6

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
Dissolved Organic Carbon	4.4		1.0	0.50	mg/L	1		9060A	Dissolved

Client Sample ID: JACKSON-SWCC4-DC-01 — Lab Sample ID: 680-232120-7

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
Alkalinity	5.1		5.0	2.2	mg/L	1		2320B-2011	Total/NA
DOC Result 1	5.5		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 2	5.5		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 3	5.6		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 4	5.6		1.0	0.50	mg/L	1		9060A	Dissolved
Dissolved Organic Carbon	5.6		1.0	0.50	mg/L	1		9060A	Dissolved

Client Sample ID: JACKSON-SWCC2-DC-01 — Lab Sample ID: 680-232120-8

Analyte	Result	Qualifier	LOQ	DL	Unit	Dil Fac	D	Method	Prep Type
DOC Result 1	11		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 2	11		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 3	11		1.0	0.50	mg/L	1		9060A	Dissolved
DOC Result 4	11		1.0	0.50	mg/L	1		9060A	Dissolved
Dissolved Organic Carbon	11		1.0	0.50	mg/L	1		9060A	Dissolved

This Detection Summary does not include radiochemical test results.

Client Sample ID: SWDUP
Lab Sample ID: 680-232120-1
Date Collected: 03/08/23 00:00
Matrix: Water
Date Received: 03/16/23 10:00

General Chemistry

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity (SM 2320B-2011)	5.0	U	5.0	2.2	mg/L			03/22/23 18:46	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
DOC Result 1 (SW846 9060A)	6.2		1.0	0.50	mg/L			03/21/23 21:53	1
DOC Result 2 (SW846 9060A)	6.1		1.0	0.50	mg/L			03/21/23 21:53	1
DOC Result 3 (SW846 9060A)	6.1		1.0	0.50	mg/L			03/21/23 21:53	1
DOC Result 4 (SW846 9060A)	6.2		1.0	0.50	mg/L			03/21/23 21:53	1
Dissolved Organic Carbon (SW846 9060A)	6.2		1.0	0.50	mg/L			03/21/23 21:53	1

Client Sample ID: JACKSON-SWMC3-DC-01
Lab Sample ID: 680-232120-2
Date Collected: 03/08/23 14:00
Matrix: Water
Date Received: 03/16/23 10:00

General Chemistry

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity (SM 2320B-2011)	11		5.0	2.2	mg/L			03/22/23 22:06	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
DOC Result 1 (SW846 9060A)	3.6		1.0	0.50	mg/L			03/21/23 22:09	1
DOC Result 2 (SW846 9060A)	3.6		1.0	0.50	mg/L			03/21/23 22:09	1
DOC Result 3 (SW846 9060A)	3.7		1.0	0.50	mg/L			03/21/23 22:09	1
DOC Result 4 (SW846 9060A)	3.7		1.0	0.50	mg/L			03/21/23 22:09	1
Dissolved Organic Carbon (SW846 9060A)	3.7		1.0	0.50	mg/L			03/21/23 22:09	1

Client Sample ID: JACKSON-SWMC2-DC-01
Lab Sample ID: 680-232120-3
Date Collected: 03/08/23 11:30
Matrix: Water
Date Received: 03/16/23 10:00

General Chemistry

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity (SM 2320B-2011)	12		5.0	2.2	mg/L			03/22/23 19:16	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
DOC Result 1 (SW846 9060A)	4.9		1.0	0.50	mg/L			03/21/23 22:57	1
DOC Result 2 (SW846 9060A)	4.8		1.0	0.50	mg/L			03/21/23 22:57	1
DOC Result 3 (SW846 9060A)	4.7		1.0	0.50	mg/L			03/21/23 22:57	1
DOC Result 4 (SW846 9060A)	4.7		1.0	0.50	mg/L			03/21/23 22:57	1
Dissolved Organic Carbon (SW846 9060A)	4.8		1.0	0.50	mg/L			03/21/23 22:57	1

Client Sample ID: JACKSON-SWJC1-DC-01
Lab Sample ID: 680-232120-4
Date Collected: 03/08/23 13:30
Matrix: Water
Date Received: 03/16/23 10:00

General Chemistry

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity (SM 2320B-2011)	5.5		5.0	2.2	mg/L			03/22/23 18:52	1

Client Sample ID: JACKSON-SWJC1-DC-01

Lab Sample ID: 680-232120-4

Date Collected: 03/08/23 13:30
Matrix: Water
Date Received: 03/16/23 10:00

General Chemistry - Dissolved

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
DOC Result 1 (SW846 9060A)	3.3		1.0	0.50	mg/L			03/21/23 23:12	1
DOC Result 2 (SW846 9060A)	3.3		1.0	0.50	mg/L			03/21/23 23:12	1
DOC Result 3 (SW846 9060A)	3.3		1.0	0.50	mg/L			03/21/23 23:12	1
DOC Result 4 (SW846 9060A)	3.2		1.0	0.50	mg/L			03/21/23 23:12	1
Dissolved Organic Carbon (SW846 9060A)	3.3		1.0	0.50	mg/L			03/21/23 23:12	1

Client Sample ID: JACKSON-SWMC1-DC-01

Lab Sample ID: 680-232120-5

Date Collected: 03/08/23 11:50
Matrix: Water
Date Received: 03/16/23 10:00

General Chemistry

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity (SM 2320B-2011)	5.0	U	5.0	2.2	mg/L			03/22/23 18:59	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
DOC Result 1 (SW846 9060A)	7.9		1.0	0.50	mg/L			03/21/23 23:30	1
DOC Result 2 (SW846 9060A)	7.9		1.0	0.50	mg/L			03/21/23 23:30	1
DOC Result 3 (SW846 9060A)	7.9		1.0	0.50	mg/L			03/21/23 23:30	1
DOC Result 4 (SW846 9060A)	7.9		1.0	0.50	mg/L			03/21/23 23:30	1
Dissolved Organic Carbon (SW846 9060A)	7.9		1.0	0.50	mg/L			03/21/23 23:30	1

Client Sample ID: JACKSON-SWCC3-DC-01

Lab Sample ID: 680-232120-6

Date Collected: 03/08/23 14:15
Matrix: Water
Date Received: 03/16/23 10:00

General Chemistry

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity (SM 2320B-2011)	5.3		5.0	2.2	mg/L			03/22/23 19:04	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
DOC Result 1 (SW846 9060A)	4.4		1.0	0.50	mg/L			03/21/23 23:46	1
DOC Result 2 (SW846 9060A)	4.3		1.0	0.50	mg/L			03/21/23 23:46	1
DOC Result 3 (SW846 9060A)	4.4		1.0	0.50	mg/L			03/21/23 23:46	1
DOC Result 4 (SW846 9060A)	4.4		1.0	0.50	mg/L			03/21/23 23:46	1
Dissolved Organic Carbon (SW846 9060A)	4.4		1.0	0.50	mg/L			03/21/23 23:46	1

Client Sample ID: JACKSON-SWCC4-DC-01

Lab Sample ID: 680-232120-7

Date Collected: 03/08/23 09:40
Matrix: Water
Date Received: 03/16/23 10:00

General Chemistry

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity (SM 2320B-2011)	5.1		5.0	2.2	mg/L			03/22/23 19:09	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
DOC Result 1 (SW846 9060A)	5.5		1.0	0.50	mg/L			03/22/23 00:02	1

Client Sample ID: JACKSON-SWCC4-DC-01
Lab Sample ID: 680-232120-7

Date Collected: 03/08/23 09:40
Matrix: Water
Date Received: 03/16/23 10:00

General Chemistry - Dissolved (Continued)

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
DOC Result 2 (SW846 9060A)	5.5		1.0	0.50	mg/L			03/22/23 00:02	1
DOC Result 3 (SW846 9060A)	5.6		1.0	0.50	mg/L			03/22/23 00:02	1
DOC Result 4 (SW846 9060A)	5.6		1.0	0.50	mg/L			03/22/23 00:02	1
Dissolved Organic Carbon (SW846 9060A)	5.6		1.0	0.50	mg/L			03/22/23 00:02	1

Client Sample ID: JACKSON-SWCC2-DC-01
Lab Sample ID: 680-232120-8

Date Collected: 03/08/23 10:00
Matrix: Water
Date Received: 03/16/23 10:00

General Chemistry - Dissolved

Analyte	Result	Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
DOC Result 1 (SW846 9060A)	11		1.0	0.50	mg/L			03/22/23 00:18	1
DOC Result 2 (SW846 9060A)	11		1.0	0.50	mg/L			03/22/23 00:18	1
DOC Result 3 (SW846 9060A)	11		1.0	0.50	mg/L			03/22/23 00:18	1
DOC Result 4 (SW846 9060A)	11		1.0	0.50	mg/L			03/22/23 00:18	1
Dissolved Organic Carbon (SW846 9060A)	11		1.0	0.50	mg/L			03/22/23 00:18	1

Default Detection Limits

Client: Katahdin Analytical Services
Job ID: 680-232120-1
Project/Site: Fort Jackson

General Chemistry

Analyte	LOQ	DL	Units
Alkalinity	5.0	2.2	mg/L

General Chemistry - Dissolved

Analyte	LOQ	DL	Units
Dissolved Organic Carbon	1.0	0.50	mg/L
DOC Result 1	1.0	0.50	mg/L
DOC Result 2	1.0	0.50	mg/L
DOC Result 3	1.0	0.50	mg/L
DOC Result 4	1.0	0.50	mg/L

Method: 2320B-2011 - Alkalinity, Total

Lab Sample ID: MB 680-769235/4
Matrix: Water
Analysis Batch: 769235

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity	5.0	U	5.0	2.2	mg/L			03/22/23 18:10	1

Lab Sample ID: LCS 680-769235/6
Matrix: Water
Analysis Batch: 769235

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Alkalinity			250	255		mg/L		102	90 - 112		

Lab Sample ID: LCSD 680-769235/31
Matrix: Water
Analysis Batch: 769235

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Alkalinity			250	256		mg/L		102	90 - 112	0	30

Method: 9060A - Organic Carbon, Dissolved (DOC)

Lab Sample ID: MB 680-768986/3
Matrix: Water
Analysis Batch: 768986

Client Sample ID: Method Blank
Prep Type: Dissolved

Analyte	MB Result	MB Qualifier	LOQ	DL	Unit	D	Prepared	Analyzed	Dil Fac
DOC Result 1	0.50	U	1.0	0.50	mg/L			03/21/23 20:45	1
DOC Result 2	0.50	U	1.0	0.50	mg/L			03/21/23 20:45	1
DOC Result 3	0.50	U	1.0	0.50	mg/L			03/21/23 20:45	1
DOC Result 4	0.50	U	1.0	0.50	mg/L			03/21/23 20:45	1
Dissolved Organic Carbon	0.50	U	1.0	0.50	mg/L			03/21/23 20:45	1

Lab Sample ID: LCS 680-768986/4
Matrix: Water
Analysis Batch: 768986

Client Sample ID: Lab Control Sample
Prep Type: Dissolved

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
DOC Result 1			20.0	19.3		mg/L		96	80 - 120		
DOC Result 2			20.0	19.0		mg/L		95	80 - 120		
DOC Result 3			20.0	18.8		mg/L		94	80 - 120		
DOC Result 4			20.0	19.1		mg/L		96	80 - 120		
Dissolved Organic Carbon			20.0	19.0		mg/L		95	80 - 120		

Lab Sample ID: LCSD 680-768986/5
Matrix: Water
Analysis Batch: 768986

Client Sample ID: Lab Control Sample Dup
Prep Type: Dissolved

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
DOC Result 1			20.0	19.3		mg/L		96	80 - 120	0	20
DOC Result 2			20.0	18.9		mg/L		94	80 - 120	1	20
DOC Result 3			20.0	19.0		mg/L		95	80 - 120	1	20
DOC Result 4			20.0	19.1		mg/L		96	80 - 120	0	20
Dissolved Organic Carbon			20.0	19.1		mg/L		95	80 - 120	0	20

Method: 9060A - Organic Carbon, Dissolved (DOC)

Lab Sample ID: 680-232120-2 MS
Client Sample ID: JACKSON-SWMC3-DC-01
Matrix: Water
Prep Type: Dissolved
Analysis Batch: 768986

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec Limits		
DOC Result 1	3.6		20.0	24.1		mg/L		102	80 - 120		
DOC Result 2	3.6		20.0	24.0		mg/L		102	80 - 120		
DOC Result 3	3.7		20.0	24.4		mg/L		103	80 - 120		
DOC Result 4	3.7		20.0	24.0		mg/L		102	80 - 120		
Dissolved Organic Carbon	3.7		20.0	24.1		mg/L		102	80 - 120		

Lab Sample ID: 680-232120-2 MSD
Client Sample ID: JACKSON-SWMC3-DC-01
Matrix: Water
Prep Type: Dissolved
Analysis Batch: 768986

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
DOC Result 1	3.6		20.0	24.4		mg/L		104	80 - 120	1	20
DOC Result 2	3.6		20.0	23.8		mg/L		101	80 - 120	1	20
DOC Result 3	3.7		20.0	23.7		mg/L		100	80 - 120	3	20
DOC Result 4	3.7		20.0	24.0		mg/L		101	80 - 120	0	20
Dissolved Organic Carbon	3.7		20.0	24.0		mg/L		101	80 - 120	1	20

QC Association Summary

Client: Katahdin Analytical Services
Project/Site: Fort Jackson

Job ID: 680-232120-1

General Chemistry

Analysis Batch: 768986

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
680-232120-1	SWDUP	Dissolved	Water	9060A	
680-232120-2	JACKSON-SWMC3-DC-01	Dissolved	Water	9060A	
680-232120-3	JACKSON-SWMC2-DC-01	Dissolved	Water	9060A	
680-232120-4	JACKSON-SWJC1-DC-01	Dissolved	Water	9060A	
680-232120-5	JACKSON-SWMC1-DC-01	Dissolved	Water	9060A	
680-232120-6	JACKSON-SWCC3-DC-01	Dissolved	Water	9060A	
680-232120-7	JACKSON-SWCC4-DC-01	Dissolved	Water	9060A	
680-232120-8	JACKSON-SWCC2-DC-01	Dissolved	Water	9060A	
MB 680-768986/3	Method Blank	Dissolved	Water	9060A	
LCS 680-768986/4	Lab Control Sample	Dissolved	Water	9060A	
LCSD 680-768986/5	Lab Control Sample Dup	Dissolved	Water	9060A	
680-232120-2 MS	JACKSON-SWMC3-DC-01	Dissolved	Water	9060A	
680-232120-2 MSD	JACKSON-SWMC3-DC-01	Dissolved	Water	9060A	

Analysis Batch: 769235

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
680-232120-1	SWDUP	Total/NA	Water	2320B-2011	
680-232120-2	JACKSON-SWMC3-DC-01	Total/NA	Water	2320B-2011	
680-232120-3	JACKSON-SWMC2-DC-01	Total/NA	Water	2320B-2011	
680-232120-4	JACKSON-SWJC1-DC-01	Total/NA	Water	2320B-2011	
680-232120-5	JACKSON-SWMC1-DC-01	Total/NA	Water	2320B-2011	
680-232120-6	JACKSON-SWCC3-DC-01	Total/NA	Water	2320B-2011	
680-232120-7	JACKSON-SWCC4-DC-01	Total/NA	Water	2320B-2011	
MB 680-769235/4	Method Blank	Total/NA	Water	2320B-2011	
LCS 680-769235/6	Lab Control Sample	Total/NA	Water	2320B-2011	
LCSD 680-769235/31	Lab Control Sample Dup	Total/NA	Water	2320B-2011	

Lab Chronicle

Client: Katahdin Analytical Services
Project/Site: Fort Jackson

Job ID: 680-232120-1

Client Sample ID: SWDUP — Lab Sample ID: 680-232120-1

Date Collected: 03/08/23 00:00 — **Matrix: Water**
Date Received: 03/16/23 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	2320B-2011		1	769235	PG	EET SAV	03/22/23 18:46
Dissolved	Analysis	9060A		1	768986	JU	EET SAV	03/21/23 21:53

Client Sample ID: JACKSON-SWMC3-DC-01 — Lab Sample ID: 680-232120-2

Date Collected: 03/08/23 14:00 — **Matrix: Water**
Date Received: 03/16/23 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	2320B-2011		1	769235	PG	EET SAV	03/22/23 22:06
Dissolved	Analysis	9060A		1	768986	JU	EET SAV	03/21/23 22:09

Client Sample ID: JACKSON-SWMC2-DC-01 — Lab Sample ID: 680-232120-3

Date Collected: 03/08/23 11:30 — **Matrix: Water**
Date Received: 03/16/23 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	2320B-2011		1	769235	PG	EET SAV	03/22/23 19:16
Dissolved	Analysis	9060A		1	768986	JU	EET SAV	03/21/23 22:57

Client Sample ID: JACKSON-SWJC1-DC-01 — Lab Sample ID: 680-232120-4

Date Collected: 03/08/23 13:30 — **Matrix: Water**
Date Received: 03/16/23 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	2320B-2011		1	769235	PG	EET SAV	03/22/23 18:52
Dissolved	Analysis	9060A		1	768986	JU	EET SAV	03/21/23 23:12

Client Sample ID: JACKSON-SWMC1-DC-01 — Lab Sample ID: 680-232120-5

Date Collected: 03/08/23 11:50 — **Matrix: Water**
Date Received: 03/16/23 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	2320B-2011		1	769235	PG	EET SAV	03/22/23 18:59
Dissolved	Analysis	9060A		1	768986	JU	EET SAV	03/21/23 23:30

Client Sample ID: JACKSON-SWCC3-DC-01 — Lab Sample ID: 680-232120-6

Date Collected: 03/08/23 14:15 — **Matrix: Water**
Date Received: 03/16/23 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	2320B-2011		1	769235	PG	EET SAV	03/22/23 19:04
Dissolved	Analysis	9060A		1	768986	JU	EET SAV	03/21/23 23:46

Lab Chronicle

Client: Katahdin Analytical Services
Project/Site: Fort Jackson

Job ID: 680-232120-1

Client Sample ID: JACKSON-SWCC4-DC-01

Lab Sample ID: 680-232120-7

Date Collected: 03/08/23 09:40

Matrix: Water

Date Received: 03/16/23 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	2320B-2011		1	769235	PG	EET SAV	03/22/23 19:09
Dissolved	Analysis	9060A		1	768986	JU	EET SAV	03/22/23 00:02

Client Sample ID: JACKSON-SWCC2-DC-01

Lab Sample ID: 680-232120-8

Date Collected: 03/08/23 10:00

Matrix: Water

Date Received: 03/16/23 10:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	9060A		1	768986	JU	EET SAV	03/22/23 00:18

Laboratory References:

EET SAV = Eurofins Savannah, 5102 LaRoche Avenue, Savannah, GA 31404, TEL (912)354-7858

Accreditation/Certification Summary

Client: Katahdin Analytical Services
Job ID: 680-232120-1
Project/Site: Fort Jackson

Laboratory: Eurofins Savannah

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
ANAB	Dept. of Defense ELAP	L2463	09-22-24

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
9060A		Water	DOC Result 1
9060A		Water	DOC Result 2
9060A		Water	DOC Result 3
9060A		Water	DOC Result 4

Method Summary

Client: Katahdin Analytical Services
Job ID: 680-232120-1
Project/Site: Fort Jackson

Method	Method Description	Protocol	Laboratory
2320B-2011	Alkalinity, Total	SM	EET SAV
9060A	Organic Carbon, Dissolved (DOC)	SW846	EET SAV

Protocol References:

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

EET SAV = Eurofins Savannah, 5102 LaRoche Avenue, Savannah, GA 31404, TEL (912)354-7858

Sample Summary

Client: Katahdin Analytical Services
Job ID: 680-232120-1
Project/Site: Fort Jackson

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
680-232120-1	SWDUP	Water	03/08/23 00:00	03/16/23 10:00
680-232120-2	JACKSON-SWMC3-DC-01	Water	03/08/23 14:00	03/16/23 10:00
680-232120-3	JACKSON-SWMC2-DC-01	Water	03/08/23 11:30	03/16/23 10:00
680-232120-4	JACKSON-SWJC1-DC-01	Water	03/08/23 13:30	03/16/23 10:00
680-232120-5	JACKSON-SWMC1-DC-01	Water	03/08/23 11:50	03/16/23 10:00
680-232120-6	JACKSON-SWCC3-DC-01	Water	03/08/23 14:15	03/16/23 10:00
680-232120-7	JACKSON-SWCC4-DC-01	Water	03/08/23 09:40	03/16/23 10:00
680-232120-8	JACKSON-SWCC2-DC-01	Water	03/08/23 10:00	03/16/23 10:00

GENERAL CHEMISTRY

COVER PAGE
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job Number: 680-232120-1

SDG No.:

Project: Fort Jackson

Client Sample ID	Lab Sample ID
SWDUP	680-232120-1
JACKSON-SWMC3-DC-01	680-232120-2
JACKSON-SWMC2-DC-01	680-232120-3
JACKSON-SWJC1-DC-01	680-232120-4
JACKSON-SWMC1-DC-01	680-232120-5
JACKSON-SWCC3-DC-01	680-232120-6
JACKSON-SWCC4-DC-01	680-232120-7
JACKSON-SWCC2-DC-01	680-232120-8

Comments:

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: SWDUP
Lab Sample ID: 680-232120-1
Lab Name: Eurofins Savannah
Job No.: 680-232120-1
SDG ID.:
Matrix: Water
Date Sampled: 03/08/2023 00:00
Reporting Basis: WET
Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	Alkalinity	5.0	5.0	2.2	mg/L	U		1	2320B-2011

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY - DISSOLVED

Client Sample ID: SWDUP
Lab Sample ID: 680-232120-1
Lab Name: Eurofins Savannah
Job No.: 680-232120-1
SDG ID.:
Matrix: Water
Date Sampled: 03/08/2023 00:00
Reporting Basis: WET
Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	DOC Result 1	6.2	1.0	0.50	mg/L			1	9060A
	DOC Result 2	6.1	1.0	0.50	mg/L			1	9060A
	DOC Result 3	6.1	1.0	0.50	mg/L			1	9060A
	DOC Result 4	6.2	1.0	0.50	mg/L			1	9060A
7440-44-0	Dissolved Organic Carbon	6.2	1.0	0.50	mg/L			1	9060A

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SWMC3-DC-01 Lab Sample ID: 680-232120-2

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 14:00

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	Alkalinity	11	5.0	2.2	mg/L			1	2320B-2011

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY - DISSOLVED

Client Sample ID: JACKSON-SWMC3-DC-01 Lab Sample ID: 680-232120-2

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 14:00

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	DOC Result 1	3.6	1.0	0.50	mg/L			1	9060A
	DOC Result 2	3.6	1.0	0.50	mg/L			1	9060A
	DOC Result 3	3.7	1.0	0.50	mg/L			1	9060A
	DOC Result 4	3.7	1.0	0.50	mg/L			1	9060A
7440-44-0	Dissolved Organic Carbon	3.7	1.0	0.50	mg/L			1	9060A

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SWMC2-DC-01 Lab Sample ID: 680-232120-3

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 11:30

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	Alkalinity	12	5.0	2.2	mg/L			1	2320B-2011

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY - DISSOLVED

Client Sample ID: JACKSON-SWMC2-DC-01 Lab Sample ID: 680-232120-3

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 11:30

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	DOC Result 1	4.9	1.0	0.50	mg/L			1	9060A
	DOC Result 2	4.8	1.0	0.50	mg/L			1	9060A
	DOC Result 3	4.7	1.0	0.50	mg/L			1	9060A
	DOC Result 4	4.7	1.0	0.50	mg/L			1	9060A
7440-44-0	Dissolved Organic Carbon	4.8	1.0	0.50	mg/L			1	9060A

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SWJC1-DC-01 Lab Sample ID: 680-232120-4

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 13:30

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	Alkalinity	5.5	5.0	2.2	mg/L			1	2320B-2011

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY - DISSOLVED

Client Sample ID: JACKSON-SWJC1-DC-01 Lab Sample ID: 680-232120-4

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 13:30

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	DOC Result 1	3.3	1.0	0.50	mg/L			1	9060A
	DOC Result 2	3.3	1.0	0.50	mg/L			1	9060A
	DOC Result 3	3.3	1.0	0.50	mg/L			1	9060A
	DOC Result 4	3.2	1.0	0.50	mg/L			1	9060A
7440-44-0	Dissolved Organic Carbon	3.3	1.0	0.50	mg/L			1	9060A

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SWMC1-DC-01 Lab Sample ID: 680-232120-5

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 11:50

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	Alkalinity	5.0	5.0	2.2	mg/L	U		1	2320B-2011

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY - DISSOLVED

Client Sample ID: JACKSON-SWMC1-DC-01 Lab Sample ID: 680-232120-5

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 11:50

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	DOC Result 1	7.9	1.0	0.50	mg/L			1	9060A
	DOC Result 2	7.9	1.0	0.50	mg/L			1	9060A
	DOC Result 3	7.9	1.0	0.50	mg/L			1	9060A
	DOC Result 4	7.9	1.0	0.50	mg/L			1	9060A
7440-44-0	Dissolved Organic Carbon	7.9	1.0	0.50	mg/L			1	9060A

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SWCC3-DC-01 Lab Sample ID: 680-232120-6

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 14:15

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	Alkalinity	5.3	5.0	2.2	mg/L			1	2320B-2011

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY - DISSOLVED

Client Sample ID: JACKSON-SWCC3-DC-01 Lab Sample ID: 680-232120-6

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 14:15

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	DOC Result 1	4.4	1.0	0.50	mg/L			1	9060A
	DOC Result 2	4.3	1.0	0.50	mg/L			1	9060A
	DOC Result 3	4.4	1.0	0.50	mg/L			1	9060A
	DOC Result 4	4.4	1.0	0.50	mg/L			1	9060A
7440-44-0	Dissolved Organic Carbon	4.4	1.0	0.50	mg/L			1	9060A

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY

Client Sample ID: JACKSON-SWCC4-DC-01 Lab Sample ID: 680-232120-7

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 09:40

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	Alkalinity	5.1	5.0	2.2	mg/L			1	2320B-2011

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY - DISSOLVED

Client Sample ID: JACKSON-SWCC4-DC-01 Lab Sample ID: 680-232120-7

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 09:40

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	DOC Result 1	5.5	1.0	0.50	mg/L			1	9060A
	DOC Result 2	5.5	1.0	0.50	mg/L			1	9060A
	DOC Result 3	5.6	1.0	0.50	mg/L			1	9060A
	DOC Result 4	5.6	1.0	0.50	mg/L			1	9060A
7440-44-0	Dissolved Organic Carbon	5.6	1.0	0.50	mg/L			1	9060A

1B-IN
INORGANIC ANALYSIS DATA SHEET
GENERAL CHEMISTRY - DISSOLVED

Client Sample ID: JACKSON-SWCC2-DC-01 Lab Sample ID: 680-232120-8

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG ID.:

Matrix: Water Date Sampled: 03/08/2023 10:00

Reporting Basis: WET Date Received: 03/16/2023 10:00

CAS No.	Analyte	Result	LOQ	DL	Units	C	Q	DIL	Method
	DOC Result 1	11	1.0	0.50	mg/L			1	9060A
	DOC Result 2	11	1.0	0.50	mg/L			1	9060A
	DOC Result 3	11	1.0	0.50	mg/L			1	9060A
	DOC Result 4	11	1.0	0.50	mg/L			1	9060A
7440-44-0	Dissolved Organic Carbon	11	1.0	0.50	mg/L			1	9060A

2-IN
CALIBRATION QUALITY CONTROL
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Analyst: JU Batch Start Date: 03/18/2023

Reporting Units: mg/L Analytical Batch No.: 768767

Sample Number	QC Type	Time	Analyte	Result	Spike Amount	(%) Recovery	Limits	Qual	Reagent
2	ICV	14:33	DOC Result 1	19.2	20.0	96	90-110		TOC LCS unpr_00098
			DOC Result 2	19.1	20.0	96	90-110		TOC LCS unpr_00098
			DOC Result 3	18.9	20.0	95	90-110		TOC LCS unpr_00098
			DOC Result 4	19.0	20.0	95	90-110		TOC LCS unpr_00098
			Dissolved Organic Carbon	19.1	20.0	95	90-110		TOC LCS unpr_00098
3	ICB	14:52	DOC Result 1	0.50				U	
			DOC Result 2	0.50				U	
			DOC Result 3	0.50				U	
			DOC Result 4	0.50				U	
			Dissolved Organic Carbon	0.50				U	

Note! Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM II-IN

2-IN
CALIBRATION QUALITY CONTROL
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Analyst: JU Batch Start Date: 03/21/2023

Reporting Units: mg/L Analytical Batch No.: 768986

Sample Number	QC Type	Time	Analyte	Result	Spike Amount	(%) Recovery	Limits	Qual	Reagent
2	CCV	20:25	DOC Result 1	49.8	50.0	100	90-110		TOC_CALSTD_6_00151
			DOC Result 2	48.4	50.0	97	90-110		TOC_CALSTD_6_00151
			DOC Result 3	48.2	50.0	96	90-110		TOC_CALSTD_6_00151
			DOC Result 4	47.8	50.0	96	90-110		TOC_CALSTD_6_00151
			Dissolved Organic Carbon	48.6	50.0	97	90-110		TOC_CALSTD_6_00151
17	CCV	00:35	DOC Result 1	48.3	50.0	97	90-110		TOC_CALSTD_6_00151
			DOC Result 2	48.7	50.0	97	90-110		TOC_CALSTD_6_00151
			DOC Result 3	49.1	50.0	98	90-110		TOC_CALSTD_6_00151
			DOC Result 4	49.2	50.0	98	90-110		TOC_CALSTD_6_00151
			Dissolved Organic Carbon	48.8	50.0	98	90-110		TOC_CALSTD_6_00151
18	CCB	00:52	DOC Result 1	0.50				U	
			DOC Result 2	0.50				U	
			DOC Result 3	0.50				U	
			DOC Result 4	0.50				U	
			Dissolved Organic Carbon	0.50				U	

Note! Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM II-IN

3-IN
METHOD BLANK
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Method	Lab Sample ID	Analyte	Result	Qual	Units	LOQ	Dil
Batch ID: 769235 Date: 03/22/2023 18:10							
2320B-2011	MB 680-769235/4	Alkalinity	5.0	U	mg/L	5.0	1
Batch ID: 768986 Date: 03/21/2023 20:45							
9060A	MB 680-768986/3	DOC Result 1	0.50	U	mg/L	1.0	1
9060A	MB 680-768986/3	DOC Result 2	0.50	U	mg/L	1.0	1
9060A	MB 680-768986/3	DOC Result 3	0.50	U	mg/L	1.0	1
9060A	MB 680-768986/3	DOC Result 4	0.50	U	mg/L	1.0	1
9060A	MB 680-768986/3	Dissolved Organic Carbon	0.50	U	mg/L	1.0	1

5-IN
MATRIX SPIKE SAMPLE RECOVERY
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Matrix: Water

Method	Lab Sample ID	Analyte	Result	C	Unit	Spike Amount	Pct. Rec.	Limits	RPD	RPD Limit	Q
Batch ID: 768986 Date: 03/21/2023 22:25											
9060A	680-232120-2	DOC Result 1	3.6		mg/L						
9060A	680-232120-2 MS	DOC Result 1	24.1		mg/L	20.0	102	80-120			
9060A	680-232120-2	DOC Result 2	3.6		mg/L						
9060A	680-232120-2 MS	DOC Result 2	24.0		mg/L	20.0	102	80-120			
9060A	680-232120-2	DOC Result 3	3.7		mg/L						
9060A	680-232120-2 MS	DOC Result 3	24.4		mg/L	20.0	103	80-120			
9060A	680-232120-2	DOC Result 4	3.7		mg/L						
9060A	680-232120-2 MS	DOC Result 4	24.0		mg/L	20.0	102	80-120			
9060A	680-232120-2	Dissolved Organic Carbon	3.7		mg/L						
9060A	680-232120-2 MS	Dissolved Organic Carbon	24.1		mg/L	20.0	102	80-120			

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM V-IN

5-IN
MATRIX SPIKE DUPLICATE SAMPLE RECOVERY
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Matrix: Water

Method	Lab Sample ID	Analyte	Result	C	Unit	Spike Amount	Pct. Rec.	Limits	RPD	RPD Limit	Q
Batch ID: 768986 Date: 03/21/2023 22:40											
9060A	680-232120-2 MSD	DOC Result 1	24.4		mg/L	20.0	104	80-120	1	20	
9060A	680-232120-2 MSD	DOC Result 2	23.8		mg/L	20.0	101	80-120	1	20	
9060A	680-232120-2 MSD	DOC Result 3	23.7		mg/L	20.0	100	80-120	3	20	
9060A	680-232120-2 MSD	DOC Result 4	24.0		mg/L	20.0	101	80-120	0	20	
9060A	680-232120-2 MSD	Dissolved Organic Carbon	24.0		mg/L	20.0	101	80-120	1	20	

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM V-IN

7A-IN
LAB CONTROL SAMPLE
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Matrix: Water

Method	Lab Sample ID	Analyte	Result	C	Unit	Spike Amount	Pct. Rec.	Limits	RPD	RPD Limit	Q
Batch ID: 769235	Date: 03/22/2023 18:26										
						LCS Source: AlkalinityLCS_00228					
2320B-2011	LCS 680-769235/6	Alkalinity	255		mg/L	250	102	90-112	0	30	
Batch ID: 768986	Date: 03/21/2023 21:01										
						LCS Source: TOC LCS unpr_00098					
9060A	LCS 680-768986/4	DOC Result 1	19.3		mg/L	20.0	96	80-120	0	20	
9060A	LCS 680-768986/4	DOC Result 2	19.0		mg/L	20.0	95	80-120	1	20	
9060A	LCS 680-768986/4	DOC Result 3	18.8		mg/L	20.0	94	80-120	1	20	
9060A	LCS 680-768986/4	DOC Result 4	19.1		mg/L	20.0	96	80-120	0	20	
9060A	LCS 680-768986/4	Dissolved Organic Carbon	19.0		mg/L	20.0	95	80-120	0	20	

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIIA-IN

7A-IN
LAB CONTROL SAMPLE DUPLICATE
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Matrix: Water

Method	Lab Sample ID	Analyte	Result	C	Unit	Spike Amount	Pct. Rec.	Limits	RPD	RPD Limit	Q
Batch ID: 769235	Date: 03/22/2023 22:36										
						LCSD Source: AlkalinityLCS_00228					
2320B-2011	LCSD 680-769235/31	Alkalinity	256		mg/L	250	102	90-112	0	30	
Batch ID: 768986	Date: 03/21/2023 21:18										
						LCSD Source: TOC LCS unpr_00098					
9060A	LCSD 680-768986/5	DOC Result 1	19.3		mg/L	20.0	96	80-120	0	20	
9060A	LCSD 680-768986/5	DOC Result 2	18.9		mg/L	20.0	94	80-120	1	20	
9060A	LCSD 680-768986/5	DOC Result 3	19.0		mg/L	20.0	95	80-120	1	20	
9060A	LCSD 680-768986/5	DOC Result 4	19.1		mg/L	20.0	96	80-120	0	20	
9060A	LCSD 680-768986/5	Dissolved Organic Carbon	19.1		mg/L	20.0	95	80-120	0	20	

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIIA-IN

9-IN
CALIBRATION BLANK DETECTION LIMITS
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job Number: 680-232120-1

SDG Number:

Matrix: Water Instrument ID: MANTECH 2

Method: 2320B-2011 XRL Date: 04/01/2010 09:47

Analyte	Wavelength/ Mass	XRL (mg/L)	
Alkalinity		5	

9-IN
DETECTION LIMITS
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job Number: 680-232120-1

SDG Number:

Matrix: Water Instrument ID: MANTECH 2

Method: 2320B-2011 DL Date: 06/08/2022 08:44

Analyte	Wavelength/ Mass	LOQ (mg/L)	DL (mg/L)
Alkalinity		5	2.2

9-IN
DETECTION LIMITS
GENERAL CHEMISTRY - DISSOLVED

Lab Name: Eurofins Savannah Job Number: 680-232120-1

SDG Number:

Matrix: Water Instrument ID: TOC7

Method: 9060A DL Date: 06/02/2009 00:00

Analyte	Wavelength/ Mass	LOQ (mg/L)	DL (mg/L)
Dissolved Organic Carbon		1	0.5
DOC Result 1		1	0.5
DOC Result 2		1	0.5
DOC Result 3		1	0.5
DOC Result 4		1	0.5

9-IN
CALIBRATION BLANK DETECTION LIMITS
GENERAL CHEMISTRY - DISSOLVED

Lab Name: Eurofins Savannah Job Number: 680-232120-1

SDG Number:

Matrix: Water Instrument ID: TOC7

Method: 9060A XMDL Date: 10/14/2008 09:06

Analyte	Wavelength/ Mass	XRL (mg/L)	XMDL (mg/L)
Dissolved Organic Carbon		1	0.5
DOC Result 1		1	0.5
DOC Result 2		1	0.5
DOC Result 3		1	0.5
DOC Result 4		1	0.5

13-IN
ANALYSIS RUN LOG
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Instrument ID: MANTECH 2 Analysis Method: 2320B-2011

Start Date: 03/22/2023 17:46 End Date: 03/22/2023 22:56

Lab Sample Id	D/F	Type	Time	Analytes																								
				Alk																								
ZZZZZZ			17:46																									
ZZZZZZ			18:01																									
ZZZZZZ			18:05																									
MB 680-769235/4	1	T	18:10	X																								
ZZZZZZ			18:16																									
LCS 680-769235/6	1	T	18:26	X																								
ZZZZZZ			18:33																									
ZZZZZZ			18:41																									
680-232120-1	1	T	18:46	X																								
680-232120-4	1	T	18:52	X																								
680-232120-5	1	T	18:59	X																								
680-232120-6	1	T	19:04	X																								
680-232120-7	1	T	19:09	X																								
680-232120-3	1	T	19:16	X																								
ZZZZZZ			19:23																									
ZZZZZZ			19:37																									
ZZZZZZ			19:44																									
ZZZZZZ			20:04																									
ZZZZZZ			20:14																									
ZZZZZZ			20:24																									
ZZZZZZ			20:39																									
ZZZZZZ			20:50																									
ZZZZZZ			20:55																									
ZZZZZZ			21:05																									
ZZZZZZ			21:23																									
ZZZZZZ			21:37																									
ZZZZZZ			21:46																									
ZZZZZZ			21:59																									
680-232120-2	1	T	22:06	X																								
ZZZZZZ			22:26																									
LCSD 680-769235/31	1	T	22:36	X																								
ZZZZZZ			22:52																									
ZZZZZZ			22:56																									

Prep Types:
T = Total/NA

FORM XIII-IN

13-IN
ANALYSIS RUN LOG
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Instrument ID: TOC7 Analysis Method: 9060A

Start Date: 03/18/2023 14:15 End Date: 03/18/2023 19:48

Lab Sample Id	D/F	Type	Time	Analytes																										
				DOC	DOC2	DOCR1	DOCR3	DOCR4																						
ZZZZZZ			14:15																											
ICV 680-768365/14-A	1		14:33	X	X	X	X	X																						
ICB 680-768365/15-A	1		14:52	X	X	X	X	X																						
ZZZZZZ			15:06																											
ZZZZZZ			15:22																											
ZZZZZZ			15:37																											
ZZZZZZ			15:55																											
ZZZZZZ			16:53																											
ZZZZZZ			17:12																											
ZZZZZZ			17:27																											
ZZZZZZ			17:44																											
ZZZZZZ			18:01																											
ZZZZZZ			18:18																											
ZZZZZZ			18:39																											
ZZZZZZ			18:58																											
ZZZZZZ			19:15																											
CCV 680-768767/17			19:32																											
CCB 680-768767/18			19:48																											

Prep Types:
=

FORM XIII-IN

13-IN
ANALYSIS RUN LOG
GENERAL CHEMISTRY

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Instrument ID: TOC7 Analysis Method: 9060A

Start Date: 03/21/2023 20:07 End Date: 03/22/2023 00:52

Lab Sample Id	D/F	Type	Time	Analytes																										
				DOC	DOC2	DOCR1	DOCR3	DOCR4																						
ZZZZZZ			20:07																											
CCV 680-768986/2	1		20:25	X	X	X	X	X																						
MB 680-768986/3	1	D	20:45	X	X	X	X	X																						
LCS 680-768986/4	1	D	21:01	X	X	X	X	X																						
LCSD 680-768986/5	1	D	21:18	X	X	X	X	X																						
ZZZZZZ			21:37																											
680-232120-1	1	D	21:53	X	X	X	X	X																						
680-232120-2	1	D	22:09	X	X	X	X	X																						
680-232120-2 MS	1	D	22:25	X	X	X	X	X																						
680-232120-2 MSD	1	D	22:40	X	X	X	X	X																						
680-232120-3	1	D	22:57	X	X	X	X	X																						
680-232120-4	1	D	23:12	X	X	X	X	X																						
680-232120-5	1	D	23:30	X	X	X	X	X																						
680-232120-6	1	D	23:46	X	X	X	X	X																						
680-232120-7	1	D	00:02	X	X	X	X	X																						
680-232120-8	1	D	00:18	X	X	X	X	X																						
CCV 680-768986/17	1		00:35	X	X	X	X	X																						
CCB 680-768986/18	1		00:52	X	X	X	X	X																						

Prep Types:
D = Dissolved

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Batch Number: 769235 Batch Start Date: 03/22/23 10:31 Batch Analyst: Gardner, Patrick

Batch Method: 2320B-2011 Batch End Date: 03/23/23 10:41

Lab Sample ID	Client Sample ID	Method Chain	Basis	CalcMsg	AlkalinityLCS 00228				
MB 680-769235/4		2320B-2011		InitialAmount is blank					
LCS 680-769235/6		2320B-2011		InitialAmount is blank	25 mL				
680-232120-A-1	SWDUP	2320B-2011	T	InitialAmount is blank					
680-232120-A-4	JACKSON-SWJC1-DC-01	2320B-2011	T	InitialAmount is blank					
680-232120-A-5	JACKSON-SWMC1-DC-01	2320B-2011	T	InitialAmount is blank					
680-232120-A-6	JACKSON-SWCC3-DC-01	2320B-2011	T	InitialAmount is blank					
680-232120-A-7	JACKSON-SWCC4-DC-01	2320B-2011	T	InitialAmount is blank					
680-232120-A-3	JACKSON-SWMC2-DC-01	2320B-2011	T	InitialAmount is blank					
680-232120-A-2	JACKSON-SWMC3-DC-01	2320B-2011	T	InitialAmount is blank					
LCSD 680-769235/31		2320B-2011		InitialAmount is blank	25 mL				

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Batch Number: 769235 Batch Start Date: 03/22/23 10:31 Batch Analyst: Gardner, Patrick

Batch Method: 2320B-2011 Batch End Date: 03/23/23 10:41

Batch Notes	
Nominal Amount Used	25 mL
pH Meter ID	PC-Titrate
Acid ID	7964179
Normality of First Titrant	0.02 N
Titrant Standardization Date	04/18/2022
Sodium Carbonate ID	PC-Titrate
Indicator Reagent ID	PC-Titrate
pH Buffer 1 ID	8125649
pH Buffer 2 ID	8057390
pH Buffer 3 ID	8036878
pH Buffer 4 ID	7964171
pH Buffer 5 ID	8088372
pH Buffer 6 ID	7743796
Pipette/Syringe/Dispenser ID	PC-Titrate
Probe ID	PC-Titrate

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Batch Number: 768365 Batch Start Date: 03/18/23 13:50 Batch Analyst: Marsi, Julia

Batch Method: FILTRATION Batch End Date: 03/21/23 10:20

Lab Sample ID	Client Sample ID	Method Chain	Basis	TOC LCS unpr 00098					
ICV 680-768365/14		FILTRATION, 9060A		40 mL					

Batch Notes	
Pipette/Syringe/Dispenser ID	IC15
Filter ID	7084780
Batch Comment	SM5310_DOC

Basis	Basis Description

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Batch Number: 768767 Batch Start Date: 03/18/23 14:15 Batch Analyst: Marsi, Julia

Batch Method: 9060A Batch End Date: 03/18/23 19:48

Lab Sample ID	Client Sample ID	Method Chain	Basis	InitialAmount	FinalAmount	Initial pH	Final pH	AnalysisComment	
ICV 680-768365/14-A		9060A		40 mL	40 mL	>2.0 SU	<2.0 SU	The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.	
ICB 680-768365/15-A		9060A		40 mL	40 mL	>2.0 SU	<2.0 SU	The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.	

Batch Notes	
Sulfuric Acid Reagent ID Number	7992406
Pipette ID	IC15
Pipette/Syringe/Dispenser ID	IC15
pH Paper ID	7593904
Filter ID	7084780
Batch Comment	Preserve Check: 768389

Basis	Basis Description

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Batch Number: 768986 Batch Start Date: 03/21/23 20:07 Batch Analyst: Marsi, Julia

Batch Method: 9060A Batch End Date: 03/22/23 00:52

Lab Sample ID	Client Sample ID	Method Chain	Basis	InitialAmount	FinalAmount	Initial pH	Final pH	TOC LCS STOCK 00040	TOC LCS unpr 00098
CCV 680-768986/2		9060A		40 mL	40 mL	<2.0 SU	<2.0 SU		
MB 680-768986/3		9060A		40 mL	40 mL	>2.0 SU	<2.0 SU		
LCS 680-768986/4		9060A		40 mL	40 mL	<2.0 SU	<2.0 SU		40 mL
LCSD 680-768986/5		9060A		40 mL	40 mL	<2.0 SU	<2.0 SU		40 mL
680-232120-B-1	SWDUP	9060A	D	40 mL	40 mL	<2.0 SU	<2.0 SU		
680-232120-B-2	JACKSON-SWMC3-DC-01	9060A	D	40 mL	40 mL	<2.0 SU	<2.0 SU		
680-232120-B-2 MS	JACKSON-SWMC3-DC-01	9060A	D	49 mL	50 mL	<2.0 SU	<2.0 SU	1 mL	
680-232120-B-2 MSD	JACKSON-SWMC3-DC-01	9060A	D	49 mL	50 mL	<2.0 SU	<2.0 SU	1 mL	
680-232120-B-3	JACKSON-SWMC2-DC-01	9060A	D	40 mL	40 mL	<2.0 SU	<2.0 SU		
680-232120-B-4	JACKSON-SWJC1-DC-01	9060A	D	40 mL	40 mL	<2.0 SU	<2.0 SU		
680-232120-B-5	JACKSON-SWMC1-DC-01	9060A	D	40 mL	40 mL	<2.0 SU	<2.0 SU		
680-232120-B-6	JACKSON-SWCC3-DC-01	9060A	D	40 mL	40 mL	<2.0 SU	<2.0 SU		
680-232120-C-7	JACKSON-SWCC4-DC-01	9060A	D	40 mL	40 mL	<2.0 SU	<2.0 SU		
680-232120-B-8	JACKSON-SWCC2-DC-01	9060A	D	40 mL	40 mL	<2.0 SU	<2.0 SU		
CCV 680-768986/17		9060A		40 mL	40 mL	<2.0 SU	<2.0 SU		
CCB 680-768986/18		9060A		40 mL	40 mL	>2.0 SU	<2.0 SU		

Lab Sample ID	Client Sample ID	Method Chain	Basis	TOC_CALSTD_6 00151	AnalysisComment				
CCV 680-768986/2		9060A		40 mL	The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Batch Number: 768986 Batch Start Date: 03/21/23 20:07 Batch Analyst: Marsi, Julia

Batch Method: 9060A Batch End Date: 03/22/23 00:52

Lab Sample ID	Client Sample ID	Method Chain	Basis	TOC_CALSTD_6 00151	AnalysisComment				
MB 680-768986/3		9060A			The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				
LCS 680-768986/4		9060A			The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				
LCSD 680-768986/5		9060A			The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				
680-232120-B-1	SWDUP	9060A	D		The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				
680-232120-B-2	JACKSON-SWMC3-DC-01	9060A	D		The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				
680-232120-B-2 MS	JACKSON-SWMC3-DC-01	9060A	D		The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				
680-232120-B-2 MSD	JACKSON-SWMC3-DC-01	9060A	D		The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Batch Number: 768986 Batch Start Date: 03/21/23 20:07 Batch Analyst: Marsi, Julia

Batch Method: 9060A Batch End Date: 03/22/23 00:52

Lab Sample ID	Client Sample ID	Method Chain	Basis	TOC_CALSTD_6 00151	AnalysisComment				
680-232120-B-3	JACKSON-SWMC2-DC -01	9060A	D		The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				
680-232120-B-4	JACKSON-SWJC1-DC -01	9060A	D		The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				
680-232120-B-5	JACKSON-SWMC1-DC -01	9060A	D		The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				
680-232120-B-6	JACKSON-SWCC3-DC -01	9060A	D		The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				
680-232120-C-7	JACKSON-SWCC4-DC -01	9060A	D		The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				
680-232120-B-8	JACKSON-SWCC2-DC -01	9060A	D		The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				
CCV 680-768986/17		9060A		40 mL	The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: Eurofins Savannah Job No.: 680-232120-1

SDG No.:

Batch Number: 768986 Batch Start Date: 03/21/23 20:07 Batch Analyst: Marsi, Julia

Batch Method: 9060A Batch End Date: 03/22/23 00:52

Lab Sample ID	Client Sample ID	Method Chain	Basis	TOC_CALSTD_6 00151	AnalysisComment				
CCB 680-768986/18		9060A			The final volume of these samples was fixed at 50 by the TOCControlV preprocessor.				

Batch Notes	
Acid ID	7992406
Pipette/Syringe/Dispenser ID	IC15
Filter ID	7084780
pH Paper ID	7593904
Batch Comment	Preserve Check: 768915

Basis	Basis Description
D	Dissolved

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

General Chemistry Raw Data Report

Job ID: 680-232120-1

Batch: 769235 **Analyst Initials: PG**

Method: 2320B-2011 **Instrument: PC Titrate**

Lab Sample ID: MB 680-769235/4 **Analysis Date: Mar 22, 2023 18:10**

Analyte	Detector	Dilution	Raw Result	Unit
Alkalinity	None	1	-6.4187	mg/L

Lab Sample ID: LCS 680-769235/6 **Analysis Date: Mar 22, 2023 18:26**

Analyte	Detector	Dilution	Raw Result	Unit
Alkalinity	None	1	254.5479	mg/L

Lab Sample ID: 680-232120-A-1 **Analysis Date: Mar 22, 2023 18:46**

Analyte	Detector	Dilution	Raw Result	Unit
Alkalinity	None	1	-6.4581	mg/L

Lab Sample ID: 680-232120-A-4 **Analysis Date: Mar 22, 2023 18:52**

Analyte	Detector	Dilution	Raw Result	Unit
Alkalinity	None	1	5.5041	mg/L

Lab Sample ID: 680-232120-A-5 **Analysis Date: Mar 22, 2023 18:59**

Analyte	Detector	Dilution	Raw Result	Unit
Alkalinity	None	1	0.7405	mg/L

Lab Sample ID: 680-232120-A-6 **Analysis Date: Mar 22, 2023 19:04**

Analyte	Detector	Dilution	Raw Result	Unit
Alkalinity	None	1	5.2857	mg/L

Lab Sample ID: 680-232120-A-7 **Analysis Date: Mar 22, 2023 19:09**

Analyte	Detector	Dilution	Raw Result	Unit
Alkalinity	None	1	5.1445	mg/L

Lab Sample ID: 680-232120-A-3 **Analysis Date: Mar 22, 2023 19:16**

Analyte	Detector	Dilution	Raw Result	Unit
Alkalinity	None	1	11.6140	mg/L

Lab Sample ID: 680-232120-A-2 **Analysis Date: Mar 22, 2023 22:06**

Analyte	Detector	Dilution	Raw Result	Unit
Alkalinity	None	1	11.1338	mg/L

Lab Sample ID: LCSD 680-769235/31 **Analysis Date: Mar 22, 2023 22:36**

Analyte	Detector	Dilution	Raw Result	Unit
Alkalinity	None	1	255.7094	mg/L

MANTECH

Date: 2023-03-23 04:45:25
Analyst: gardnerp

Sample Report

Run Template: 03222023alk
Run ID: 656
Date Started: 2023-03-22 17:21:20
Date Completed: 2023-03-23 04:45:24

Sample Data

Sample ID	Script Template	Date Started	Date Completed	TAlkalinity	PAlkalinity	Hydroxide	Carbonate	Bicarbonate
ph icv	Conductivity pH Alkalinity CO2	2023-03-22 17:21:20	2023-03-22 17:46:21	0.0000	0.0000	0.0000	0.0000	0.0000
12	Conductivity pH Alkalinity CO2	2023-03-22 17:46:22	2023-03-22 18:01:40	628.3095	591.5797	554.8499	73.4596	0.0000
2	Conductivity pH Alkalinity CO2	2023-03-22 18:01:40	2023-03-22 18:05:33	0.0000	0.0000	0.0000	0.0000	0.0000
mb	Conductivity pH Alkalinity CO2	2023-03-22 18:05:33	2023-03-22 18:10:22	-6.4187	0.0000	0.0000	0.0000	-6.4187
llcs	Conductivity pH Alkalinity CO2	2023-03-22 18:10:22	2023-03-22 18:16:29	10.7491	5.5694	0.3897	10.3594	0.0000
lcs	Conductivity pH Alkalinity CO2	2023-03-22 18:16:29	2023-03-22 18:26:16	254.5479	185.4759	116.4039	138.1440	0.0000
752-4490-C-1	Conductivity pH Alkalinity CO2	2023-03-22 18:26:17	2023-03-22 18:33:43	30.9791	0.0000	0.0000	0.0000	30.9791
752-4490-C-1 du	Conductivity pH Alkalinity CO2	2023-03-22 18:33:43	2023-03-22 18:41:55	30.8458	0.0000	0.0000	0.0000	30.8458
680-232120-A-1	Conductivity pH Alkalinity CO2	2023-03-22 18:41:55	2023-03-22 18:46:44	-6.4581	0.0000	0.0000	0.0000	-6.4581
680-232120-A-4	Conductivity pH Alkalinity CO2	2023-03-22 18:46:44	2023-03-22 18:52:32	5.5041	0.0000	0.0000	0.0000	5.5041
680-232120-A-5	Conductivity pH Alkalinity CO2	2023-03-22 18:52:32	2023-03-22 18:59:21	0.7405	0.0000	0.0000	0.0000	0.7405
680-232120-A-6	Conductivity pH Alkalinity CO2	2023-03-22 18:59:21	2023-03-22 19:04:29	5.2857	0.0000	0.0000	0.0000	5.2857
680-232120-A-7	Conductivity pH Alkalinity CO2	2023-03-22 19:04:29	2023-03-22 19:09:33	5.1445	0.0000	0.0000	0.0000	5.1445
680-232120-A-3	Conductivity pH Alkalinity CO2	2023-03-22 19:09:34	2023-03-22 19:16:22	11.6140	0.0000	0.0000	0.0000	11.6140
752-4380-D-1	Conductivity pH Alkalinity CO2	2023-03-22 19:16:22	2023-03-22 19:23:11	0.5684	0.0000	0.0000	0.0000	0.5684
752-4385-A-3	Conductivity pH Alkalinity CO2	2023-03-22 19:23:11	2023-03-22 19:37:42	682.2429	0.0000	0.0000	0.0000	682.2429

MANTECH

Date: 2023-03-23 04:45:25
Analyst: gardnerp

Sample Report

Run Template: 03222023alk
Run ID: 656
Date Started: 2023-03-22 17:21:20
Date Completed: 2023-03-23 04:45:24

Sample Data

Conductivity	Interface Temperature	Final Titrant Volume	pH reading 1	pH reading 2	Free CO2
12000.0000	19.7628	17.9050	7.0632	7.0653	0.0000
9910.0000	20.0354	6.2850	12.1263	12.1378	0.0000
11640.0000	19.9864	0.0050	2.0420	2.0451	0.0000
12.9900	19.8712	0.0700	4.4735	4.4811	-427.7373
9.4800	19.8441	0.1150	8.5996	8.5760	0.0000
395.0000	19.7764	2.6350	9.2132	9.2138	0.0000
154.9000	19.9186	0.3500	7.3129	7.3169	3.0005
153.8000	20.0212	0.3500	7.1989	7.2179	3.8179
24.9000	19.7899	0.0700	4.4980	4.5019	-408.4931
13.1500	19.9119	0.0600	5.5699	5.5744	29.4826
17.6300	19.9525	0.1200	5.9170	5.9317	1.7628
14.7300	19.8983	0.0600	5.1267	5.1311	78.5656
16.0900	19.7899	0.0600	4.9322	4.9410	119.0620
33.6000	19.8848	0.1200	6.4254	6.4392	8.5844
18.4800	19.9390	0.1200	5.6478	5.6627	2.5144
1912.0000	19.9932	6.8800	6.7918	6.8093	215.9827

MANTECH

Date: 2023-03-23 04:45:25
Analyst: gardnerp

Sample Report

Run Template: 03222023alk
Run ID: 656
Date Started: 2023-03-22 17:21:20
Date Completed: 2023-03-23 04:45:24

Sample Data

Sample ID	Script Template	Date Started	Date Completed	TAlkalinity	PAlkalinity	Hydroxide	Carbonate	Bicarbonate
752-4385-A-4	Conductivity pH Alkalinity CO2	2023-03-22 19:37:42	2023-03-22 19:44:06	10.7604	0.0000	0.0000	0.0000	10.7604
ccvph	Conductivity pH Alkalinity CO2	2023-03-22 19:44:06	2023-03-22 20:04:31	1425.7028	0.0000	0.0000	0.0000	1425.7028
752-4385-A-10	Conductivity pH Alkalinity CO2	2023-03-22 20:04:31	2023-03-22 20:14:48	127.7149	0.0000	0.0000	0.0000	127.7149
752-4385-A-10 du	Conductivity pH Alkalinity CO2	2023-03-22 20:14:48	2023-03-22 20:24:34	122.8324	0.0000	0.0000	0.0000	122.8324
752-4385-B-11	Conductivity pH Alkalinity CO2	2023-03-22 20:24:34	2023-03-22 20:39:15	698.4647	0.0000	0.0000	0.0000	698.4647
752-4385-A-12	Conductivity pH Alkalinity CO2	2023-03-22 20:39:15	2023-03-22 20:50:19	268.6431	0.0000	0.0000	0.0000	268.6431
752-4380-D-2	Conductivity pH Alkalinity CO2	2023-03-22 20:50:19	2023-03-22 20:55:31	6.5428	0.0000	0.0000	0.0000	6.5428
752-4385-B-2	Conductivity pH Alkalinity CO2	2023-03-22 20:55:31	2023-03-22 21:05:59	208.3569	0.0000	0.0000	0.0000	208.3569
752-4385-B-1	Conductivity pH Alkalinity CO2	2023-03-22 21:05:59	2023-03-22 21:23:04	948.5637	0.0000	0.0000	0.0000	948.5637
752-4385-B-8	Conductivity pH Alkalinity CO2	2023-03-22 21:23:04	2023-03-22 21:37:19	620.8119	0.0000	0.0000	0.0000	620.8119
752-4385-B-19	Conductivity pH Alkalinity CO2	2023-03-22 21:37:20	2023-03-22 21:46:32	57.5634	0.0000	0.0000	0.0000	57.5634
752-4385-A-9	Conductivity pH Alkalinity CO2	2023-03-22 21:46:32	2023-03-22 21:59:14	460.9415	0.0000	0.0000	0.0000	460.9415
680-232120-A-2	Conductivity pH Alkalinity CO2	2023-03-22 21:59:14	2023-03-22 22:06:04	11.1338	0.0000	0.0000	0.0000	11.1338
ccvph2	Conductivity pH Alkalinity CO2	2023-03-22 22:06:04	2023-03-22 22:26:34	1425.0722	0.0000	0.0000	0.0000	1425.0722
lcsd	Conductivity pH Alkalinity CO2	2023-03-22 22:26:34	2023-03-22 22:36:43	255.7094	182.7555	109.8016	145.9078	0.0000
12du	Conductivity pH Alkalinity CO2	2023-03-22 22:36:43	2023-03-22 22:52:13	625.5738	555.3992	485.2246	140.3492	0.0000

MANTECH

Date: 2023-03-23 04:45:25
Analyst: gardnerp

Sample Report

Run Template: 03222023alk
Run ID: 656
Date Started: 2023-03-22 17:21:20
Date Completed: 2023-03-23 04:45:24

Sample Data

Conductivity	Interface Temperature	Final Titrant Volume	pH reading 1	pH reading 2	Free CO2
17.9300	20.1349	0.1200	5.9846	5.9968	21.9866
7310.0000	19.8577	14.3300	7.0093	7.0115	278.3934
360.0000	20.2769	1.4000	7.1536	7.1662	17.6755
355.0000	20.0496	1.3400	7.0266	7.0459	22.5992
2110.0000	19.9525	7.0200	7.1601	7.1749	94.9892
705.0000	19.9661	2.7000	7.2678	7.2846	28.4450
6.0400	19.8035	0.0700	5.5251	5.5308	38.8011
742.0000	19.8644	2.0900	8.0137	8.0228	3.9957
3270.0000	19.9796	9.5400	6.9856	6.9986	193.1953
2050.0000	19.9999	6.2500	6.9426	6.9577	139.2644
117.8000	19.8983	0.5900	7.1494	7.1621	8.0432
1124.0000	19.7899	4.6300	7.9380	7.9455	10.5421
30.4000	19.8306	0.1150	6.8822	6.8802	2.9273
7300.0000	19.5325	14.3150	7.0093	7.0115	278.2703
411.0000	19.7561	2.5950	9.2002	9.2032	0.0000
9700.0000	19.7222	6.3350	12.0930	12.1005	0.0000

MANTECH

Date: 2023-03-23 04:45:25
Analyst: gardnerp

Sample Report

Run Template: 03222023alk
Run ID: 656
Date Started: 2023-03-22 17:21:20
Date Completed: 2023-03-23 04:45:24

Sample Data

Sample ID	Script Template	Date Started	Date Completed	TAlkalinity	PAlkalinity	Hydroxide	Carbonate	Bicarbonate
2du	Conductivity pH Alkalinity CO2	2023-03-22 22:52:13	2023-03-22 22:56:06	0.0000	0.0000	0.0000	0.0000	0.0000
ph-icv	Conductivity pH Alkalinity CO2	2023-03-22 22:56:07	2023-03-22 23:19:56	0.0000	0.0000	0.0000	0.0000	0.0000
12-1	Conductivity pH Alkalinity CO2	2023-03-22 23:19:56	2023-03-22 23:35:33	628.6559	550.8675	473.0791	155.5768	0.0000
2-1	Conductivity pH Alkalinity CO2	2023-03-22 23:35:33	2023-03-22 23:39:26	0.0000	0.0000	0.0000	0.0000	0.0000
mb2	Conductivity pH Alkalinity CO2	2023-03-22 23:39:26	2023-03-22 23:43:04	0.0000	0.0000	0.0000	0.0000	0.0000
llcs2	Conductivity pH Alkalinity CO2	2023-03-22 23:43:04	2023-03-22 23:49:55	10.6478	0.0000	0.0000	0.0000	10.6478
lcs2	Conductivity pH Alkalinity CO2	2023-03-22 23:49:55	2023-03-22 23:59:21	252.7789	183.8924	115.0059	137.7730	0.0000
680-232251-B-1	Conductivity pH Alkalinity CO2	2023-03-22 23:59:21	2023-03-23 00:06:46	21.8078	0.0000	0.0000	0.0000	21.8078
680-232251-B-1 du	Conductivity pH Alkalinity CO2	2023-03-23 00:06:46	2023-03-23 00:15:07	34.9994	0.0000	0.0000	0.0000	34.9994
752-4650-D-1	Conductivity pH Alkalinity CO2	2023-03-23 00:15:08	2023-03-23 00:24:57	192.4029	0.0000	0.0000	0.0000	192.4029
752-4650-B-2	Conductivity pH Alkalinity CO2	2023-03-23 00:24:57	2023-03-23 00:37:03	398.1646	0.0000	0.0000	0.0000	398.1646
752-4650-B-3	Conductivity pH Alkalinity CO2	2023-03-23 00:37:03	2023-03-23 00:42:59	5.5557	0.0000	0.0000	0.0000	5.5557
752-4650-D-8	Conductivity pH Alkalinity CO2	2023-03-23 00:42:59	2023-03-23 00:49:44	11.1642	0.0000	0.0000	0.0000	11.1642
752-4650-D-9	Conductivity pH Alkalinity CO2	2023-03-23 00:49:44	2023-03-23 00:58:15	21.2051	0.0000	0.0000	0.0000	21.2051
752-4650-C-7	Conductivity pH Alkalinity CO2	2023-03-23 00:58:16	2023-03-23 01:09:30	337.5120	0.0000	0.0000	0.0000	337.5120
752-4650-D-6	Conductivity pH Alkalinity CO2	2023-03-23 01:09:30	2023-03-23 01:21:44	409.1423	0.0000	0.0000	0.0000	409.1423

MANTECH

Date: 2023-03-23 04:45:25
Analyst: gardnerp

Sample Report

Run Template: 03222023alk
Run ID: 656
Date Started: 2023-03-22 17:21:20
Date Completed: 2023-03-23 04:45:24

Sample Data

Conductivity	Interface Temperature	Final Titrant Volume	pH reading 1	pH reading 2	Free CO2
11740.0000	19.7290	0.0050	2.0525	2.0536	0.0000
12020.0000	19.4377	17.9050	7.0719	7.0740	0.0000
9700.0000	19.6138	6.3050	12.0737	12.0872	0.0000
11740.0000	19.5799	0.0050	2.0489	2.0488	0.0000
647.0000	19.3903	0.0050	3.2036	3.2075	0.0000
9.7700	19.6138	0.1150	8.1091	8.0905	0.1692
397.0000	19.5325	2.5650	9.2062	9.2089	0.0000
66.4000	19.6138	0.3500	7.2313	7.2333	2.5547
65.5000	19.6951	0.2000	6.7334	6.7510	12.6733
649.0000	19.7222	1.9300	6.9619	6.9770	41.2849
1870.0000	19.7561	4.0000	6.8154	6.8285	119.9893
8.2200	19.8170	0.0600	5.5030	5.5114	34.5596
48.0000	19.7357	0.1200	5.6772	5.6919	46.1644
55.8000	19.8915	0.3500	6.5977	6.6113	10.5431
672.0000	19.8441	3.3900	6.7788	6.7920	110.6418
1636.0000	19.8103	4.1200	6.6645	6.6758	174.8857

MANTECH

Date: 2023-03-23 04:45:25
Analyst: gardnerp

Sample Report

Run Template: 03222023alk
Run ID: 656
Date Started: 2023-03-22 17:21:20
Date Completed: 2023-03-23 04:45:24

Sample Data

Sample ID	Script Template	Date Started	Date Completed	TAlkalinity	PAlkalinity	Hydroxide	Carbonate	Bicarbonate
680-232102-A-10	Conductivity pH Alkalinity CO2	2023-03-23 01:21:44	2023-03-23 01:27:41	5.3386	0.0000	0.0000	0.0000	5.3386
680-232102-B-4	Conductivity pH Alkalinity CO2	2023-03-23 01:27:41	2023-03-23 01:52:53	0.0000	0.0000	0.0000	0.0000	0.0000
ccvph3	Conductivity pH Alkalinity CO2	2023-03-23 01:52:53	2023-03-23 02:14:35	1451.4036	0.0000	0.0000	0.0000	1451.4036
680-232102-A-1	Conductivity pH Alkalinity CO2	2023-03-23 02:14:35	2023-03-23 02:21:57	3.1666	0.0000	0.0000	0.0000	3.1666
680-232102-A-1 du	Conductivity pH Alkalinity CO2	2023-03-23 02:21:57	2023-03-23 02:27:55	6.3817	0.0000	0.0000	0.0000	6.3817
680-232102-A-2	Conductivity pH Alkalinity CO2	2023-03-23 02:27:55	2023-03-23 02:33:48	6.2367	0.0000	0.0000	0.0000	6.2367
680-232102-C-8	Conductivity pH Alkalinity CO2	2023-03-23 02:33:48	2023-03-23 02:42:29	53.0491	0.0000	0.0000	0.0000	53.0491
680-232102-C-9	Conductivity pH Alkalinity CO2	2023-03-23 02:42:29	2023-03-23 02:50:49	29.1238	0.0000	0.0000	0.0000	29.1238
680-232102-A-3	Conductivity pH Alkalinity CO2	2023-03-23 02:50:49	2023-03-23 02:59:03	33.8017	0.0000	0.0000	0.0000	33.8017
680-232102-A-11	Conductivity pH Alkalinity CO2	2023-03-23 02:59:03	2023-03-23 03:07:16	30.8257	0.0000	0.0000	0.0000	30.8257
680-232149-A-1	Conductivity pH Alkalinity CO2	2023-03-23 03:07:16	2023-03-23 03:16:30	103.2475	0.0000	0.0000	0.0000	103.2475
680-232220-C-2	Conductivity pH Alkalinity CO2	2023-03-23 03:16:30	2023-03-23 03:30:46	637.8842	0.0000	0.0000	0.0000	637.8842
680-232220-C-1	Conductivity pH Alkalinity CO2	2023-03-23 03:30:46	2023-03-23 03:44:28	522.2204	11.5735	0.0000	23.1470	499.0734
752-4514-B-2	Conductivity pH Alkalinity CO2	2023-03-23 03:44:28	2023-03-23 03:55:00	210.6690	0.0000	0.0000	0.0000	210.6690
ccvph4	Conductivity pH Alkalinity CO2	2023-03-23 03:55:00	2023-03-23 04:15:29	1411.3796	0.0000	0.0000	0.0000	1411.3796
lcsd2	Conductivity pH Alkalinity CO2	2023-03-23 04:15:29	2023-03-23 04:25:58	254.7758	178.7144	102.6530	152.1228	0.0000

MANTECH

Date: 2023-03-23 04:45:25
Analyst: gardnerp

Sample Report

Run Template: 03222023alk
Run ID: 656
Date Started: 2023-03-22 17:21:20
Date Completed: 2023-03-23 04:45:24

Sample Data

Conductivity	Interface Temperature	Final Titrant Volume	pH reading 1	pH reading 2	Free CO2
41.2000	19.8035	0.0600	5.1453	5.1542	75.6323
15350.0000	19.6951	16.8500	12.7632	12.7722	0.0000
7290.0000	19.7222	14.5900	7.0373	7.0352	267.0350
44.2000	19.7967	0.1200	5.8198	5.8321	9.4553
41.6000	19.7493	0.0700	5.2241	5.2378	74.9922
48.9000	19.6274	0.0700	5.0168	5.0281	118.4499
128.6000	19.5596	0.5400	6.5867	6.6023	26.9903
71.2000	19.6003	0.3500	6.3604	6.3719	25.0685
45.1000	19.5867	0.2000	6.3884	6.3998	27.2815
93.6000	19.6003	0.3550	6.4272	6.4451	22.5836
257.0000	19.6138	1.0400	6.5458	6.5571	58.0042
2720.0000	19.7899	6.4200	8.2769	8.2791	6.7262
2180.0000	19.8238	5.2500	8.3414	8.3437	4.5357
1811.0000	19.7561	2.1100	7.9858	7.9931	4.3170
7270.0000	19.4648	14.1700	7.0072	7.0093	276.9643
410.0000	19.4445	2.5900	9.1807	9.1838	0.0000

MANTECH

Date: 2023-03-23 04:45:25
Analyst: gardnerp

Sample Report

Run Template: 03222023alk
Run ID: 656
Date Started: 2023-03-22 17:21:20
Date Completed: 2023-03-23 04:45:24

Sample Data

Sample ID	Script Template	Date Started	Date Completed	TAlkalinity	PAlkalinity	Hydroxide	Carbonate	Bicarbonate
12du-1	Conductivity pH Alkalinity CO2	2023-03-23 04:25:58	2023-03-23 04:40:42	623.6406	512.1136	400.5866	223.0540	0.0000
2du-1	Conductivity pH Alkalinity CO2	2023-03-23 04:40:42	2023-03-23 04:45:24	0.0000	0.0000	0.0000	0.0000	0.0000

MANTECH

Date: 2023-03-23 04:45:25
Analyst: gardnerp

Sample Report

Run Template: 03222023alk
Run ID: 656
Date Started: 2023-03-22 17:21:20
Date Completed: 2023-03-23 04:45:24

Sample Data

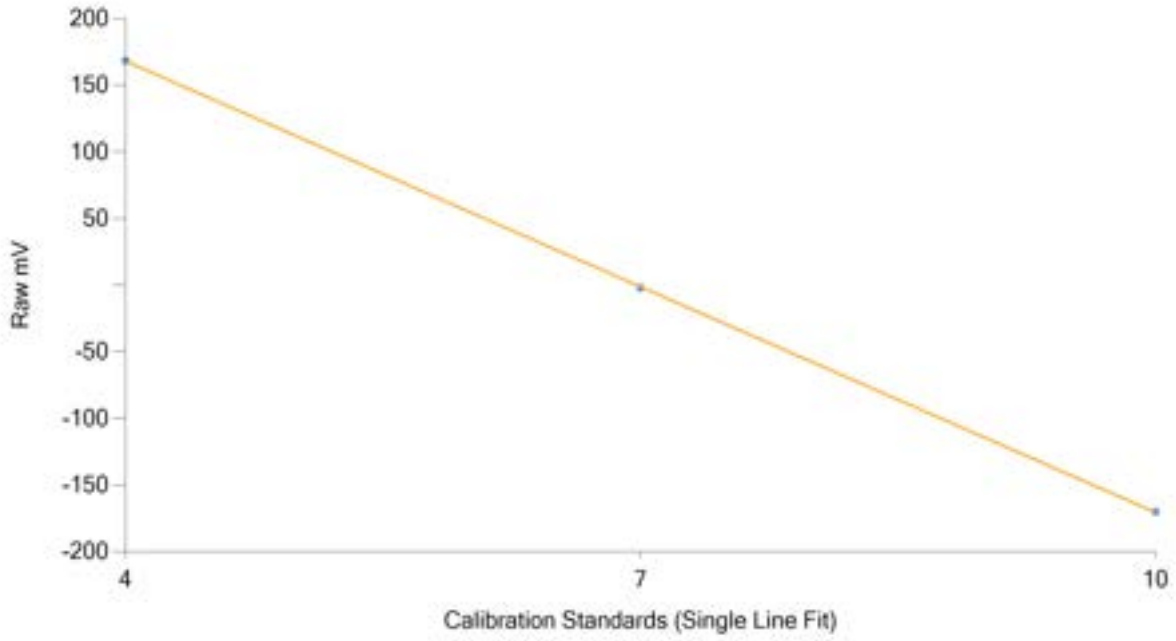
Conductivity	Interface Temperature	Final Titrant Volume	pH reading 1	pH reading 2	Free CO2
9380.0000	19.2819	6.2750	12.0065	12.0199	0.0000
11710.0000	19.2819	0.0050	2.0466	2.0460	0.0000

MANTECH

Date: 2023-03-22 12:29:03
Analyst: gardnerp

Single Line Calibration Report

Calibration Template:	pH Calibration	Analysis Type:	Single Line Fit
Probe Type:	pH	Temperature:	18.2454
Port:	1	Date Started:	2023-03-22 12:27:48
Probe ID:	pH Electrode	Date Completed:	2023-03-22 12:27:48



Calibration Data

Result: PASS

Equation: y = -56.4168x - 1.302

	Result	Minimum	Maximum
Slope:	-56.4168	-62.0000	-53.0000
Intercept:	-1.3020	-100.0000	100.0000
Correlation:	1.0000	0.9900	1.0000

Calibration Standard	Recorded Standard
4.0000	168.3350
7.0000	-2.0750
10.0000	-170.1660

Instr.Information

Instrument Options	TOC/ASI/IC Unit/
Catalyst	Regular Sensitivity

Sample

Sample Name:	BICARB/CARB
Sample ID:	Untitled
Origin:	TOCCurve.cal
Status	Completed
Chk. Result	

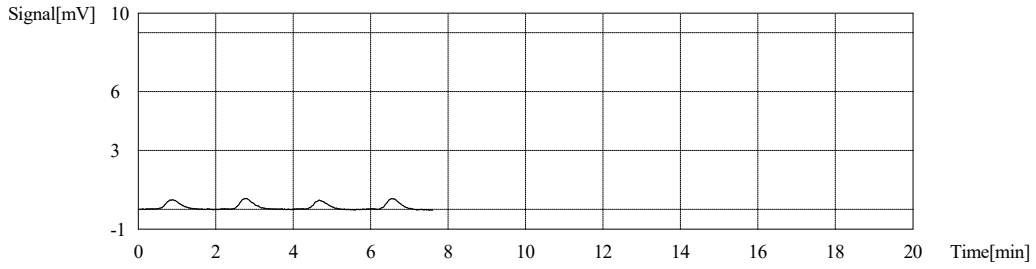
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2663mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.197	0.2582mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:15:58 PM
2	1.277	0.2755mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:18:05 PM
3	1.130	0.2438mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:20:12 PM
4	1.334	0.2878mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:22:19 PM

Mean Area	1.235
Mean Conc.	0.2663mg/L



Sample

Sample Name: ICV
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

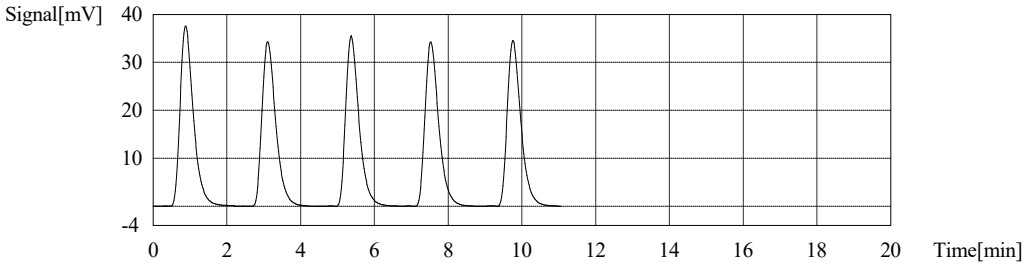
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:19.07mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	93.62	20.20mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:31:26 PM
2	88.91	19.18mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:33:57 PM
3	88.71	19.14mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:36:18 PM
4	87.71	18.92mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:38:46 PM
5	88.27	19.04mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:41:11 PM

Mean Area 88.40
Mean Conc. 19.07mg/L



Sample

Sample Name: ICB
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

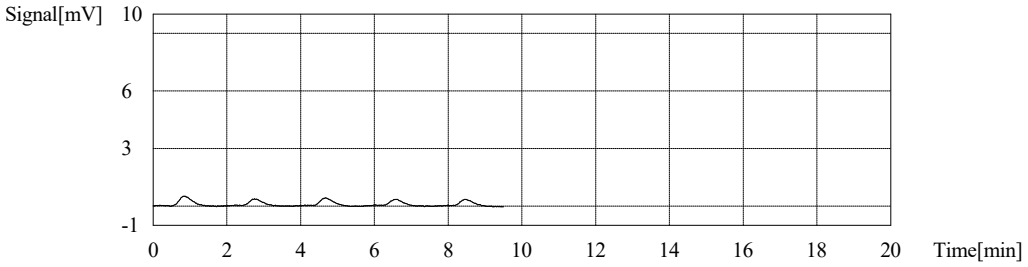
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1858mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.298	0.2800mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:50:09 PM
2	0.8179	0.1765mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:52:16 PM
3	1.026	0.2213mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:54:23 PM
4	0.7535	0.1626mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:56:30 PM
5	0.8472	0.1828mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 2:58:37 PM

Mean Area 0.8612
Mean Conc. 0.1858mg/L



Sample

Sample Name: MB
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

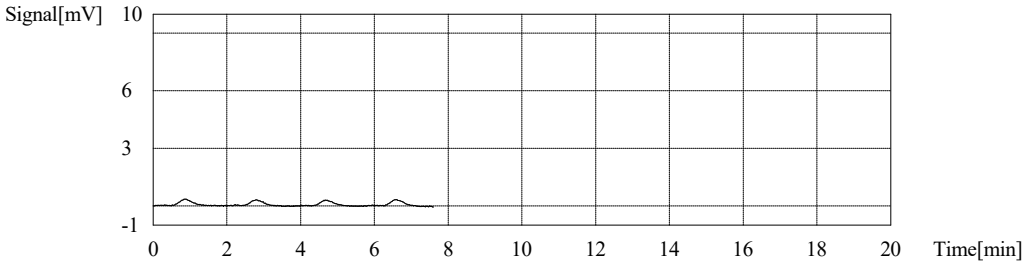
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1528mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.7317	0.1579mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:06:31 PM
2	0.6893	0.1487mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:08:38 PM
3	0.7361	0.1588mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:10:45 PM
4	0.6768	0.1460mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:12:52 PM

Mean Area 0.7085
Mean Conc. 0.1528mg/L



Sample

Sample Name: LCS
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

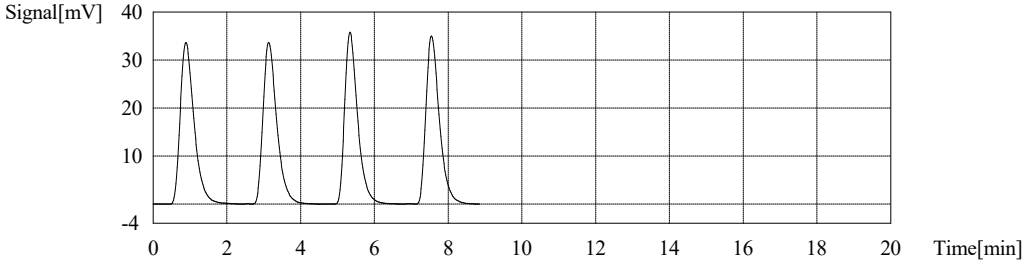
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:18.86mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	87.33	18.84mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:22:00 PM
2	87.13	18.80mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:24:28 PM
3	86.92	18.75mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:26:52 PM
4	88.22	19.03mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:29:17 PM

Mean Area 87.40
Mean Conc. 18.86mg/L



Sample

Sample Name: LCSD
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

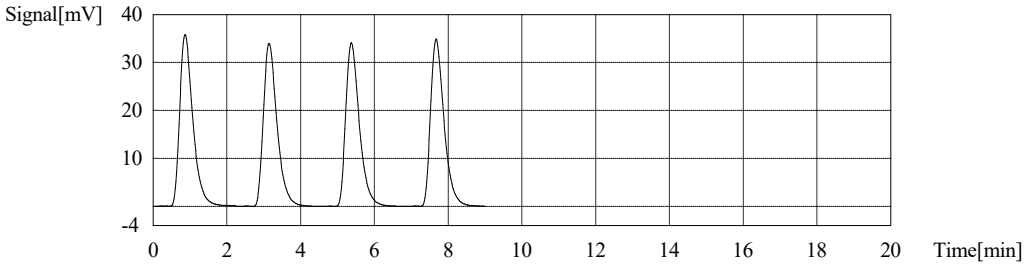
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:18.93mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	88.17	19.02mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:37:18 PM
2	87.35	18.84mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:39:48 PM
3	87.34	18.84mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:42:19 PM
4	88.18	19.02mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:44:46 PM

Mean Area 87.76
Mean Conc. 18.93mg/L



Sample

Sample Name: LLCS
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

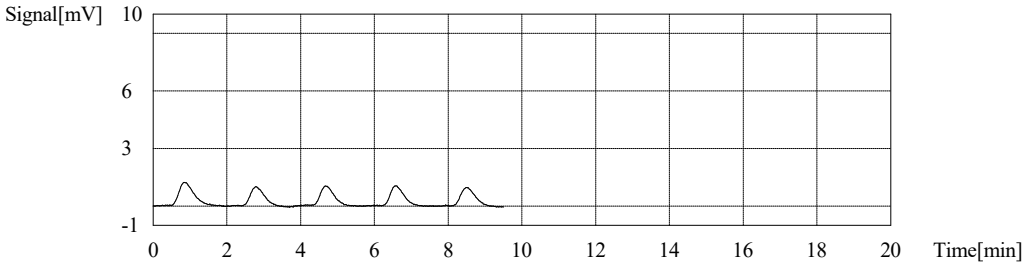
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.5699mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	3.316	0.7154mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:53:33 PM
2	2.670	0.5760mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:55:40 PM
3	2.533	0.5465mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:57:47 PM
4	2.641	0.5698mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 3:59:54 PM
5	2.722	0.5872mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 4:02:01 PM

Mean Area 2.641
Mean Conc. 0.5699mg/L



Sample

Sample Name: 680-232021-d-1
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

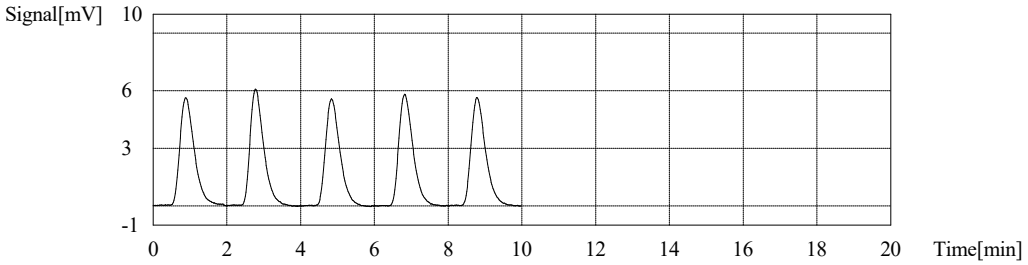
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:3.306mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	14.84	3.202mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 4:51:07 PM
2	15.47	3.337mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 4:53:21 PM
3	15.00	3.236mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 4:55:34 PM
4	15.49	3.342mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 4:57:44 PM
5	15.34	3.309mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:00:03 PM

Mean Area 15.32
Mean Conc. 3.306mg/L



Sample

Sample Name: 680-232021-d-1 MS
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

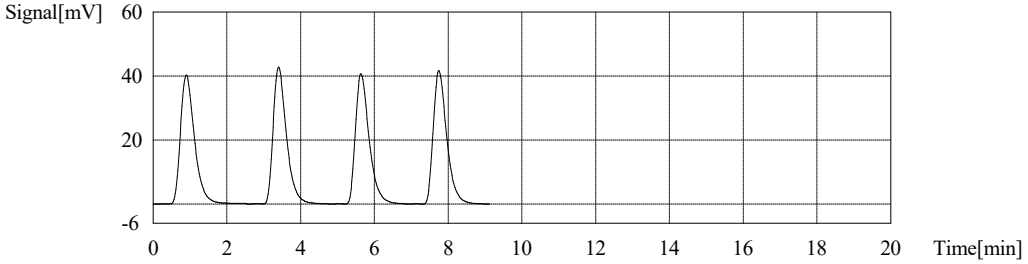
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:22.77mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	105.6	22.78mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:12:23 PM
2	106.5	22.98mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:14:51 PM
3	104.4	22.52mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:17:12 PM
4	105.7	22.80mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:19:43 PM

Mean Area 105.6
Mean Conc. 22.77mg/L



Sample

Sample Name: 680-232021-d-1 MSD
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

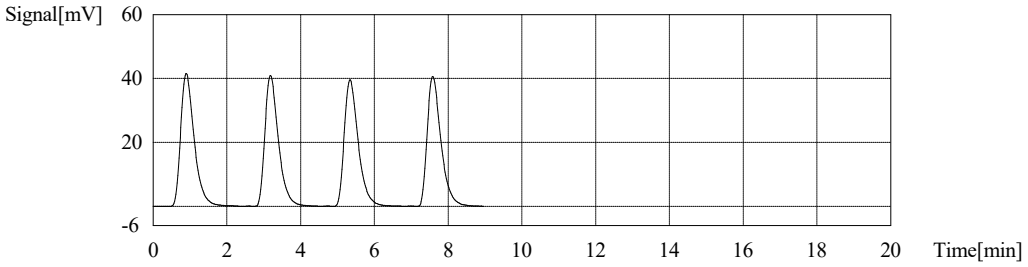
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:22.52mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	105.4	22.74mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:27:47 PM
2	103.7	22.37mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:30:11 PM
3	103.4	22.31mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:32:42 PM
4	105.0	22.65mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:35:13 PM

Mean Area 104.4
Mean Conc. 22.52mg/L



Sample

Sample Name: 680-232021-d-2
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

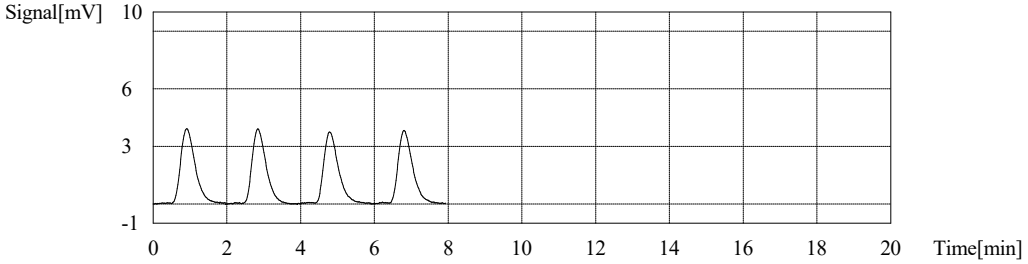
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:2.209mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	10.34	2.231mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:44:02 PM
2	10.39	2.242mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:46:14 PM
3	10.13	2.185mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:48:27 PM
4	10.10	2.179mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:50:42 PM

Mean Area 10.24
Mean Conc. 2.209mg/L



Sample

Sample Name: 680-232058-b-1
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

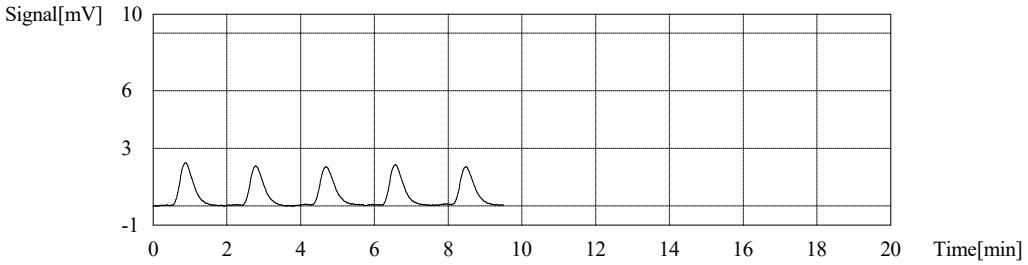
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:1.127mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	5.682	1.226mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 5:59:28 PM
2	5.206	1.123mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:01:35 PM
3	5.258	1.134mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:03:42 PM
4	5.318	1.147mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:05:52 PM
5	5.112	1.103mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:07:59 PM

Mean Area 5.223
Mean Conc. 1.127mg/L



Sample

Sample Name: 680-232058-d-2
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

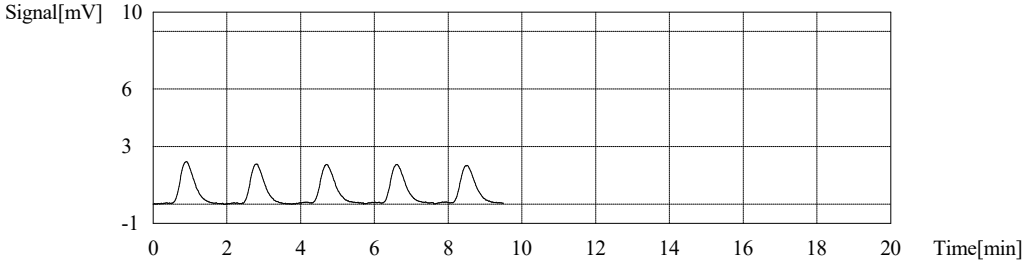
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:1.182mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	5.704	1.231mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:16:40 PM
2	5.372	1.159mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:18:47 PM
3	5.366	1.158mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:20:54 PM
4	5.607	1.210mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:23:03 PM
5	5.562	1.200mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:25:11 PM

Mean Area 5.477
Mean Conc. 1.182mg/L



Sample

Sample Name: 680-232058-c-3
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

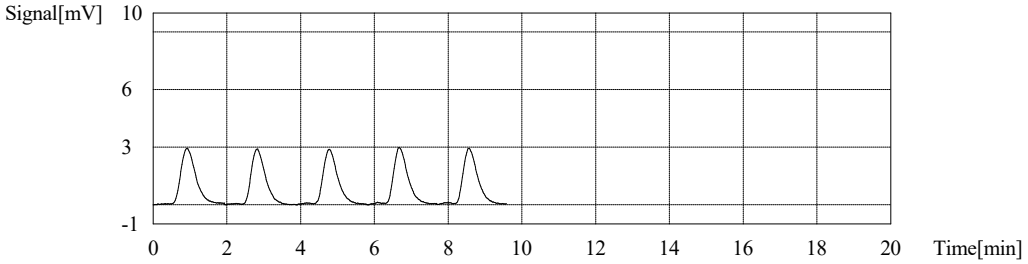
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:1.696mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	7.925	1.710mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:39:38 PM
2	7.546	1.628mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:41:50 PM
3	7.776	1.678mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:43:58 PM
4	7.817	1.686mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:46:05 PM
5	7.920	1.709mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:48:14 PM

Mean Area 7.860
Mean Conc. 1.696mg/L



Sample

Sample Name: 680-231726-n-4
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

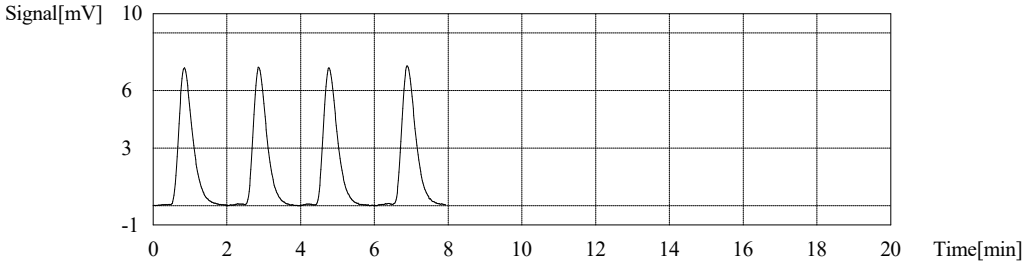
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:40.01mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	18.36	39.61mg/L	50uL	10.00		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 6:58:00 PM
2	18.15	39.16mg/L	50uL	10.00		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:00:07 PM
3	18.79	40.54mg/L	50uL	10.00		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:02:27 PM
4	18.89	40.75mg/L	50uL	10.00		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:04:34 PM

Mean Area 18.55
Mean Conc. 40.01mg/L



Sample

Sample Name: 680-232074-a-1
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

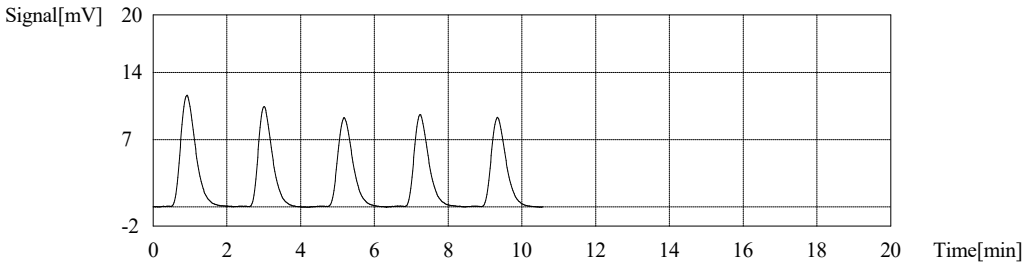
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:5.660mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	32.42	6.994mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:13:34 PM
2	27.46	5.924mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:15:56 PM
3	26.06	5.622mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:18:14 PM
4	25.80	5.566mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:20:32 PM
5	25.62	5.527mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:22:54 PM

Mean Area 26.24
Mean Conc. 5.660mg/L



Sample

Sample Name: CCV
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

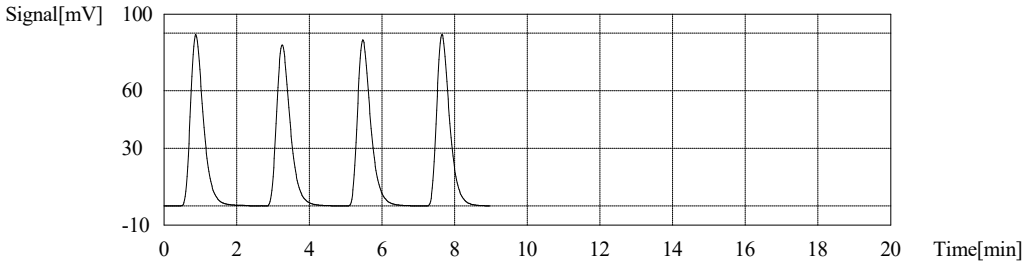
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:47.33mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	220.4	47.55mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:32:03 PM
2	218.3	47.10mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:34:33 PM
3	218.5	47.14mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:37:00 PM
4	220.4	47.55mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:39:26 PM

Mean Area 219.4
Mean Conc. 47.33mg/L



Sample

Sample Name: CCB
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

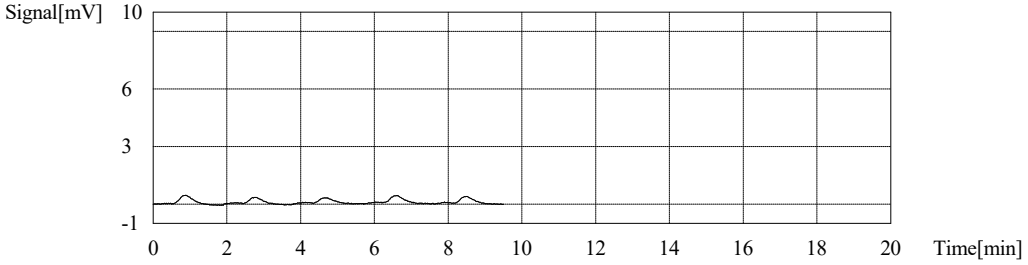
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2186mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.161	0.2505mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:48:11 PM
2	0.8830	0.1905mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:50:19 PM
3	0.8406	0.1813mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:52:26 PM
4	1.335	0.2880mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:54:33 PM
5	1.169	0.2522mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 7:56:40 PM

Mean Area 1.013
Mean Conc. 0.2186mg/L



Sample

Sample Name: LCS
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

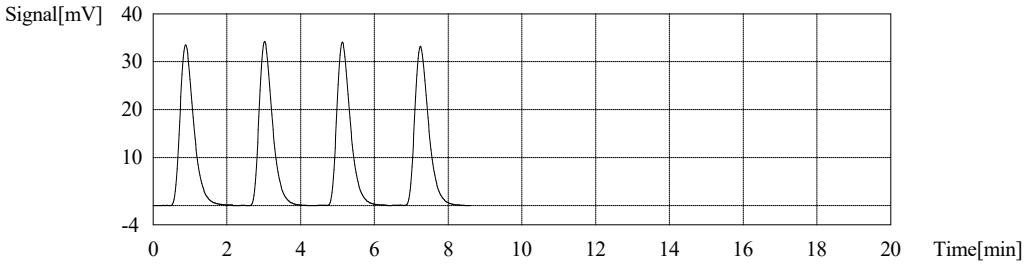
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:18.54mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	85.96	18.54mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:05:41 PM
2	85.62	18.47mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:08:01 PM
3	86.10	18.57mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:10:20 PM
4	86.12	18.58mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:12:50 PM

Mean Area 85.95
Mean Conc. 18.54mg/L



Sample

Sample Name: LCSD
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

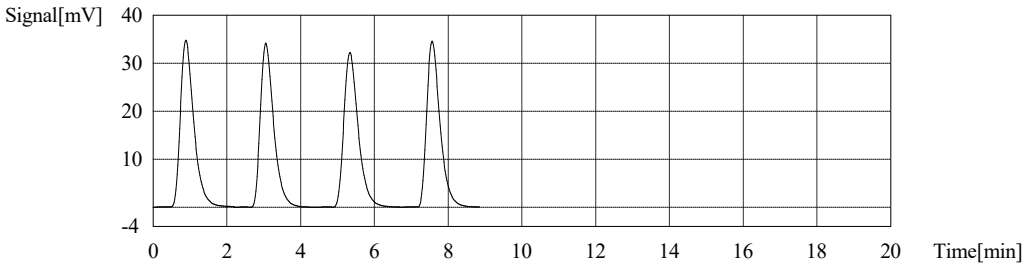
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:18.68mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	87.43	18.86mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:20:47 PM
2	85.64	18.48mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:23:16 PM
3	86.83	18.73mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:25:46 PM
4	86.40	18.64mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:28:08 PM

Mean Area 86.57
Mean Conc. 18.68mg/L



Sample

Sample Name: LLCS
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

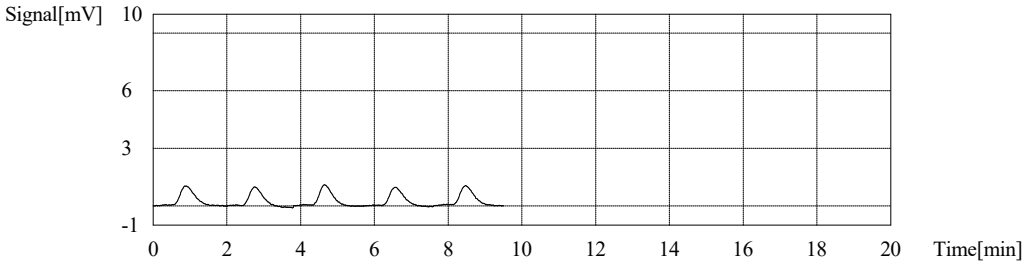
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.5486mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	2.654	0.5726mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:37:06 PM
2	2.720	0.5868mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:39:13 PM
3	2.572	0.5549mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:41:22 PM
4	2.463	0.5314mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:43:29 PM
5	2.482	0.5355mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:45:36 PM

Mean Area 2.543
Mean Conc. 0.5486mg/L



Sample

Sample Name: 680-232038-e-1
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

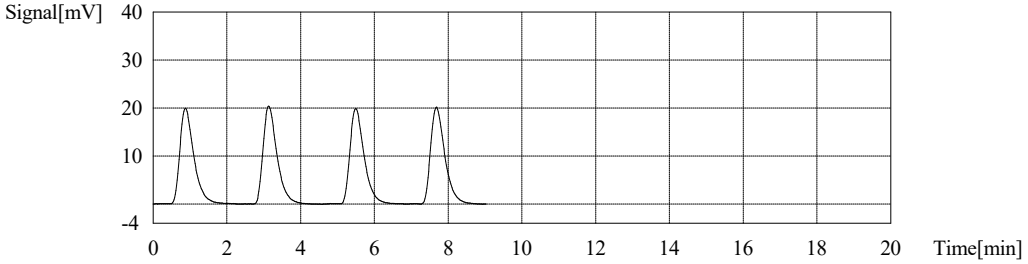
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:11.43mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	52.02	11.22mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:54:42 PM
2	53.54	11.55mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:57:16 PM
3	52.61	11.35mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 8:59:40 PM
4	53.84	11.62mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:02:08 PM

Mean Area 53.00
Mean Conc. 11.43mg/L



Sample

Sample Name: 680-232058-c-1
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

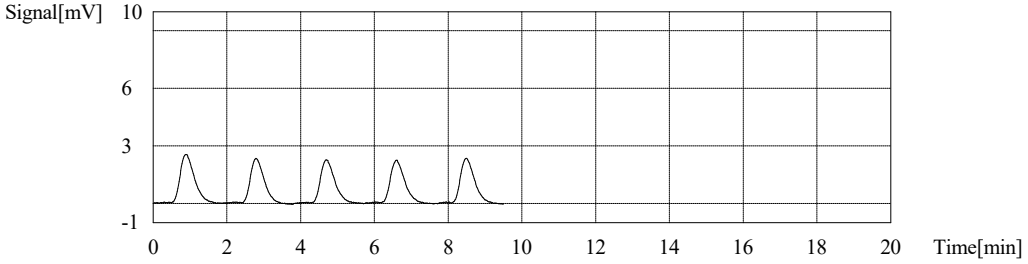
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:1.303mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	6.649	1.434mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:10:54 PM
2	5.999	1.294mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:13:02 PM
3	5.993	1.293mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:15:10 PM
4	5.881	1.269mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:17:18 PM
5	6.295	1.358mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:19:26 PM

Mean Area 6.042
Mean Conc. 1.303mg/L



Sample

Sample Name: 680-232058-c-1 MS
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

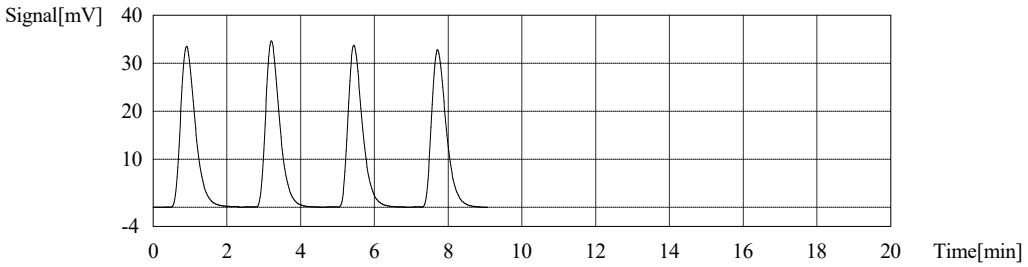
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:19.59mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	91.89	19.82mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:28:33 PM
2	90.98	19.63mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:31:02 PM
3	90.24	19.47mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:33:32 PM
4	90.13	19.44mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:36:01 PM

Mean Area 90.81
Mean Conc. 19.59mg/L



Sample

Sample Name: 680-232058-c-1 MSD
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

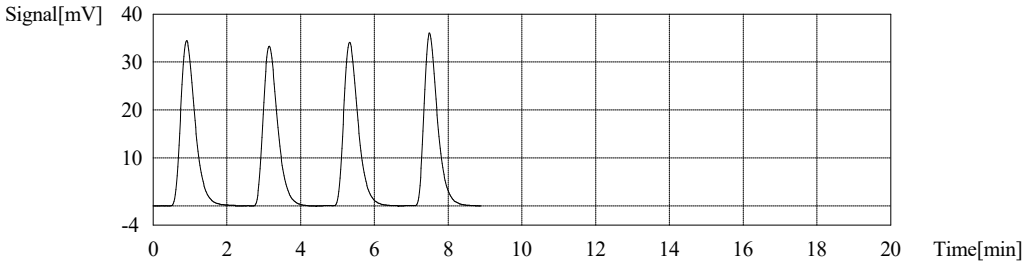
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:19.71mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	92.94	20.05mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:44:02 PM
2	90.32	19.49mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:46:29 PM
3	91.68	19.78mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:48:56 PM
4	90.57	19.54mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 9:51:24 PM

Mean Area 91.38
Mean Conc. 19.71mg/L



Sample

Sample Name: 680-232058-c-2
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

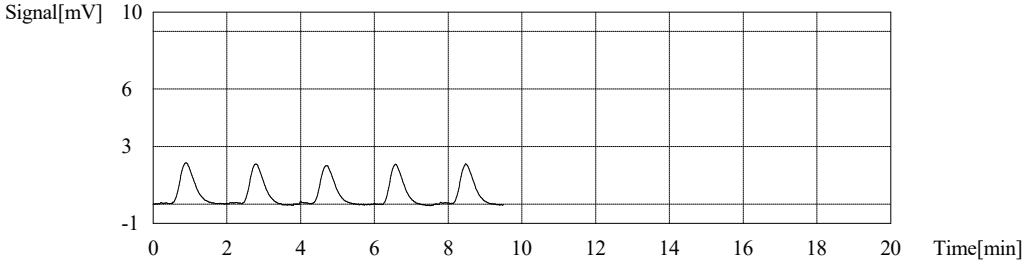
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:1.165mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	5.754	1.241mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:00:11 PM
2	5.344	1.153mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:02:19 PM
3	5.366	1.158mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:04:28 PM
4	5.388	1.162mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:06:36 PM
5	5.498	1.186mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:08:44 PM

Mean Area 5.399
Mean Conc. 1.165mg/L



Sample

Sample Name: 680-232058-b-3
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

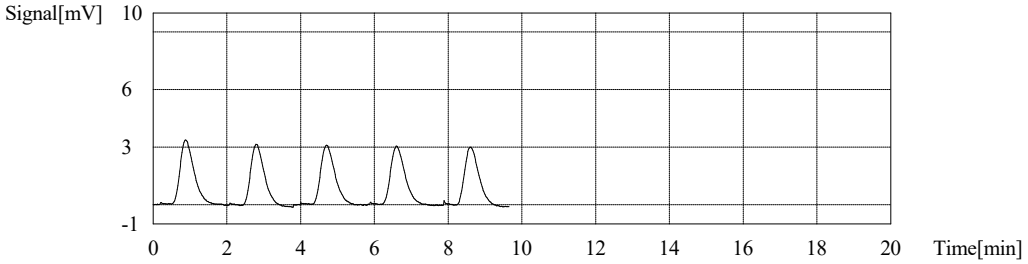
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:1.785mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	8.625	1.861mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:17:26 PM
2	8.234	1.776mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:19:34 PM
3	8.180	1.765mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:21:43 PM
4	8.502	1.834mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:23:57 PM
5	8.180	1.765mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:26:09 PM

Mean Area 8.274
Mean Conc. 1.785mg/L



Sample

Sample Name: 680-231996-i-1
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

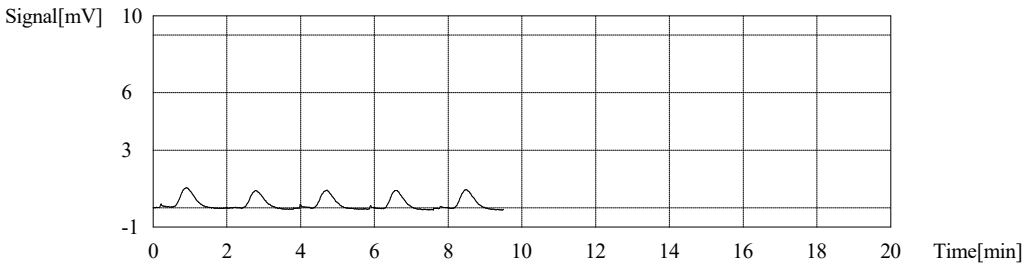
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.5314mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	2.705	0.5836mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:34:51 PM
2	2.416	0.5212mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:36:59 PM
3	2.407	0.5193mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:39:07 PM
4	2.429	0.5240mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:41:15 PM
5	2.600	0.5609mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:43:23 PM

Mean Area 2.463
Mean Conc. 0.5314mg/L



Sample

Sample Name: 680-231996-i-2
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

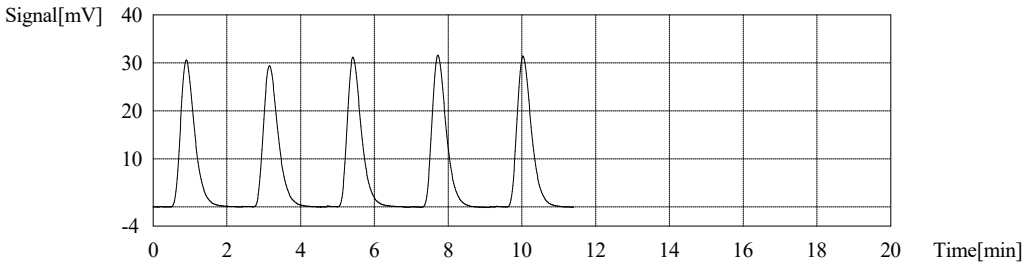
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:17.76mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	80.82	17.44mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:52:26 PM
2	81.40	17.56mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:54:57 PM
3	82.33	17.76mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 10:57:28 PM
4	84.80	18.29mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:00:00 PM
5	85.37	18.42mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:02:31 PM

Mean Area 82.34
Mean Conc. 17.76mg/L



Sample

Sample Name: 680-231996-i-3
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

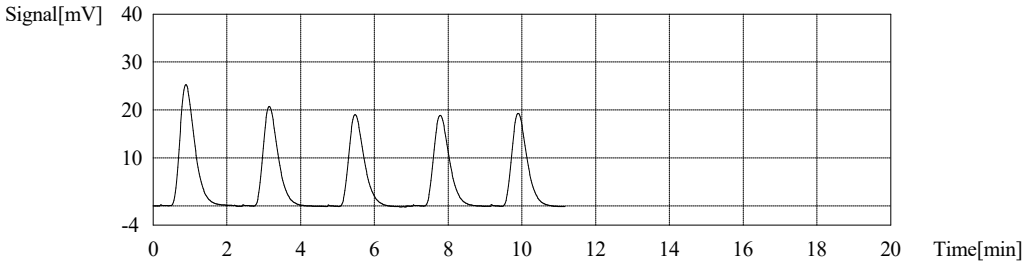
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:12.04mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	69.76	15.05mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:11:34 PM
2	58.13	12.54mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:14:07 PM
3	55.00	11.87mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:16:39 PM
4	55.18	11.90mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:19:00 PM
5	54.85	11.83mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:21:25 PM

Mean Area 55.79
Mean Conc. 12.04mg/L



Sample

Sample Name: 680-231996-i-4
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

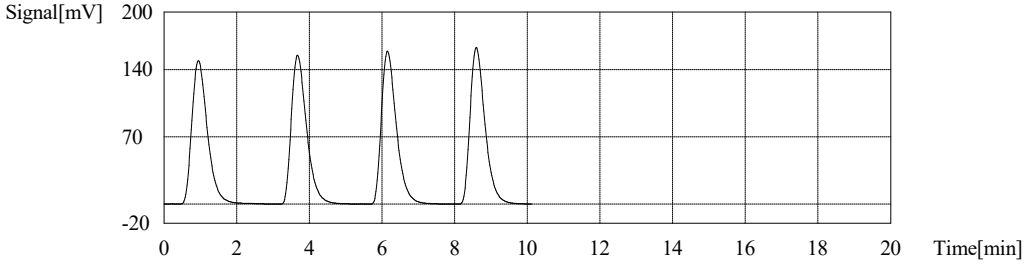
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:97.88mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	442.6	95.49mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:30:58 PM
2	452.0	97.51mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:33:42 PM
3	456.0	98.38mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:36:22 PM
4	464.2	100.1mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:39:03 PM

Mean Area 453.7
Mean Conc. 97.88mg/L



Sample

Sample Name: CCV
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

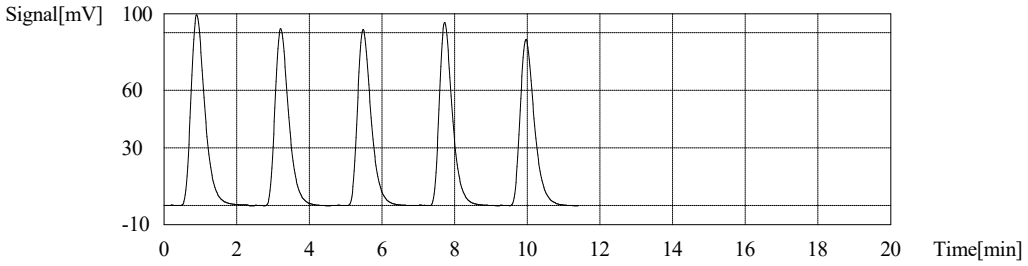
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:51.17mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	262.3	56.59mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:48:19 PM
2	240.4	51.86mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:50:50 PM
3	237.2	51.17mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:53:20 PM
4	236.4	51.00mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:55:47 PM
5	234.7	50.63mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/18/2023 11:58:21 PM

Mean Area 237.2
Mean Conc. 51.17mg/L



Sample

Sample Name: CCB
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

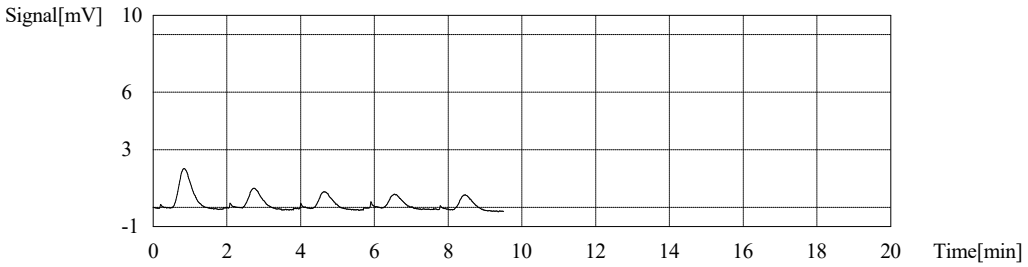
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.4438mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	4.952	1.068mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/19/2023 12:07:16 AM
2	2.368	0.5109mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/19/2023 12:09:24 AM
3	2.220	0.4789mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/19/2023 12:11:33 AM
4	1.779	0.3838mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/19/2023 12:13:41 AM
5	1.862	0.4017mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/19/2023 12:15:49 AM

Mean Area 2.057
Mean Conc. 0.4438mg/L



Sample

Sample Name: ICV
Sample ID: TC Curve
Origin: TCCURVE.cal
Status Completed
Chk. Result

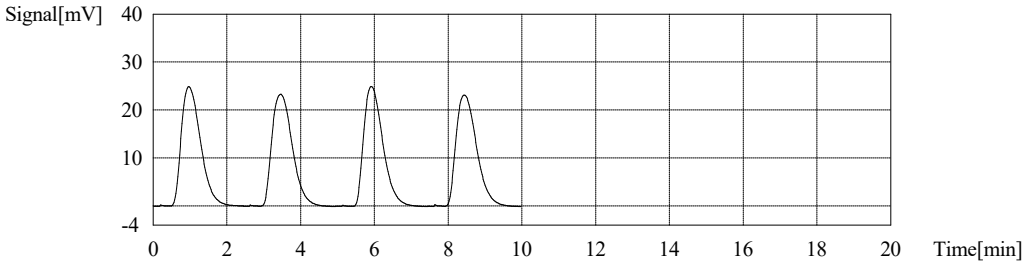
Type	Anal.	Manual Dilution	Result
Unknown	TC	1.000	TC:19.08mg/L

1. Det

Anal.: TC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	89.99	19.13mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:20:51 AM
2	89.45	19.01mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:23:35 AM
3	90.19	19.17mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:26:19 AM
4	89.48	19.02mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:29:04 AM

Mean Area 89.78
Mean Conc. 19.08mg/L



Sample

Sample Name: ICB
Sample ID: TC Curve
Origin: TCCURVE.cal
Status Completed
Chk. Result

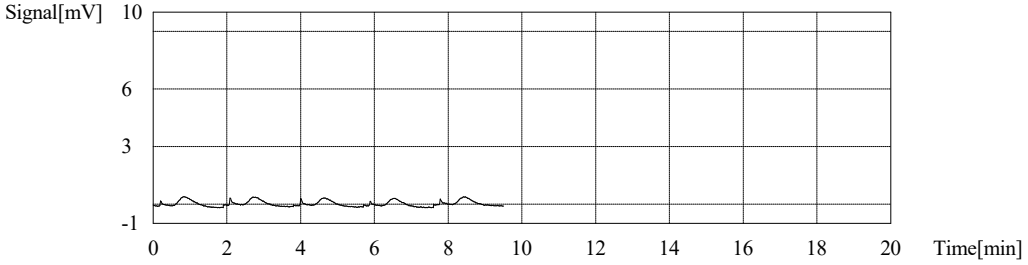
Type	Anal.	Manual Dilution	Result
Unknown	TC	1.000	TC:0.2146mg/L

1. Det

Anal.: TC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.309	0.2782mg/L	50uL	1.000	E	TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:33:37 AM
2	1.023	0.2175mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:35:45 AM
3	1.032	0.2194mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:37:53 AM
4	0.9868	0.2098mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:40:01 AM
5	0.9957	0.2117mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:42:09 AM

Mean Area 1.009
Mean Conc. 0.2146mg/L



Sample

Sample Name: MB
Sample ID: TC Curve
Origin: TCCURVE.cal
Status Completed
Chk. Result

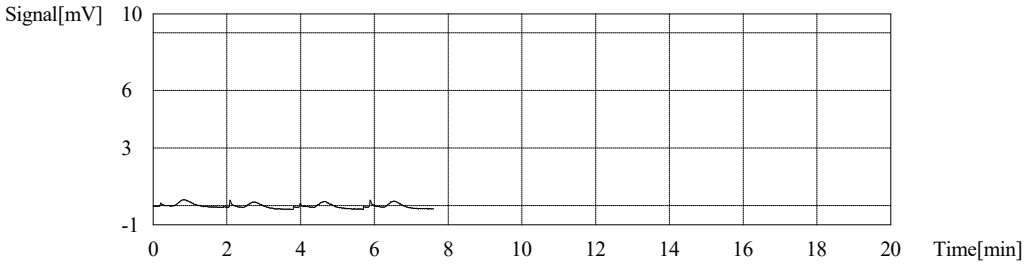
Type	Anal.	Manual Dilution	Result
Unknown	TC	1.000	TC:0.1590mg/L

1. Det

Anal.: TC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.7904	0.1680mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:45:38 AM
2	0.7554	0.1606mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:47:46 AM
3	0.6935	0.1474mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:49:54 AM
4	0.7534	0.1601mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:52:02 AM

Mean Area 0.7482
Mean Conc. 0.1590mg/L



Sample

Sample Name: LCS
Sample ID: TC Curve
Origin: TCCURVE.cal
Status Completed
Chk. Result

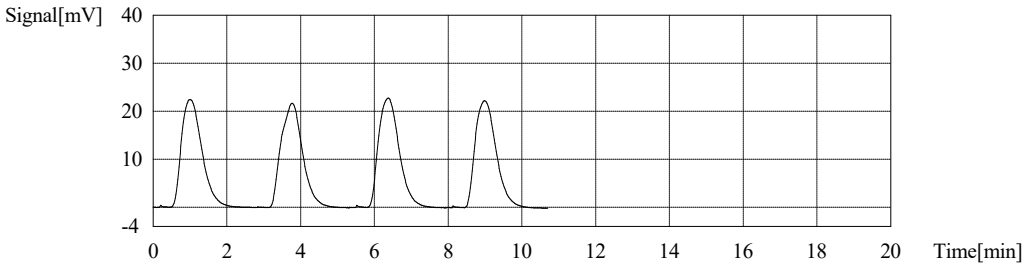
Type	Anal.	Manual Dilution	Result
Unknown	TC	1.000	TC:18.62mg/L

1. Det

Anal.: TC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	86.32	18.35mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 12:57:36 AM
2	87.94	18.69mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:00:30 AM
3	88.45	18.80mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:03:22 AM
4	87.63	18.63mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:06:22 AM

Mean Area 87.58
Mean Conc. 18.62mg/L



Sample

Sample Name: LCSD
Sample ID: TC Curve
Origin: TCCURVE.cal
Status Completed
Chk. Result

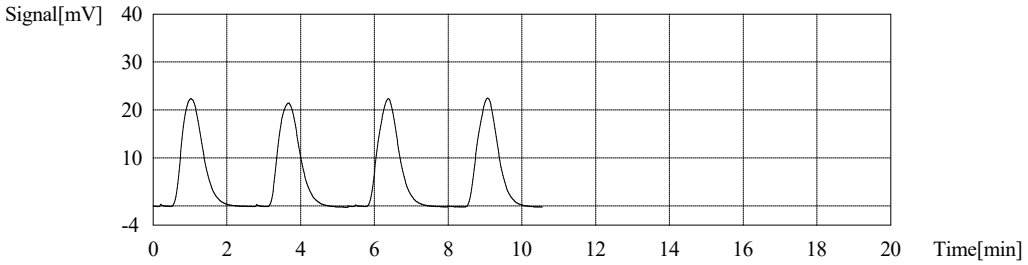
Type	Anal.	Manual Dilution	Result
Unknown	TC	1.000	TC:18.47mg/L

1. Det

Anal.: TC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	87.35	18.57mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:10:33 AM
2	86.27	18.34mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:13:27 AM
3	86.74	18.44mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:16:24 AM
4	87.20	18.54mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:19:12 AM

Mean Area 86.89
Mean Conc. 18.47mg/L



Sample

Sample Name: LLCS
Sample ID: TC Curve
Origin: TCCURVE.cal
Status Completed
Chk. Result

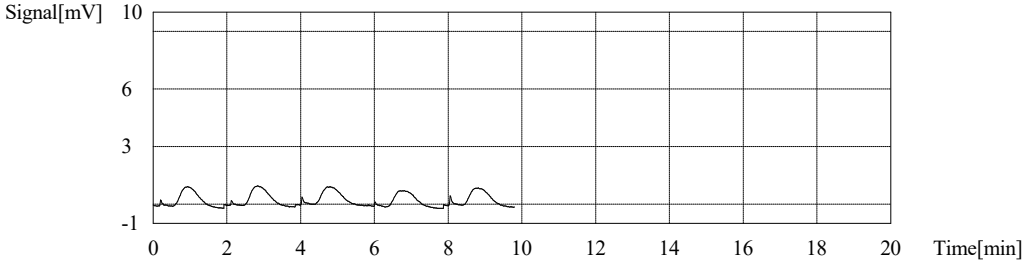
Type	Anal.	Manual Dilution	Result
Unknown	TC	1.000	TC:0.7052mg/L

1. Det

Anal.: TC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	3.378	0.7180mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:23:46 AM
2	3.523	0.7489mg/L	50uL	1.000	E	TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:25:59 AM
3	3.268	0.6947mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:28:12 AM
4	3.323	0.7064mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:30:28 AM
5	3.301	0.7017mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:32:38 AM

Mean Area 3.318
Mean Conc. 0.7052mg/L



Sample

Sample Name: 680-232058-c-1
Sample ID: TC Curve
Origin: TCCURVE.cal
Status Completed
Chk. Result

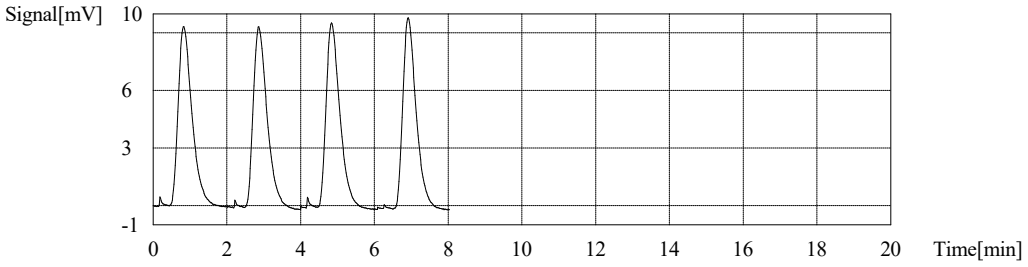
Type	Anal.	Manual Dilution	Result
Unknown	TC	1.000	TC:5.237mg/L

1. Det

Anal.: TC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	24.21	5.146mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:37:23 AM
2	24.57	5.223mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:39:35 AM
3	24.83	5.278mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:41:56 AM
4	24.93	5.299mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:44:07 AM

Mean Area 24.63
Mean Conc. 5.237mg/L



Sample

Sample Name: 680-232058-c-1 DU
Sample ID: TC Curve
Origin: TCCURVE.cal
Status Completed
Chk. Result

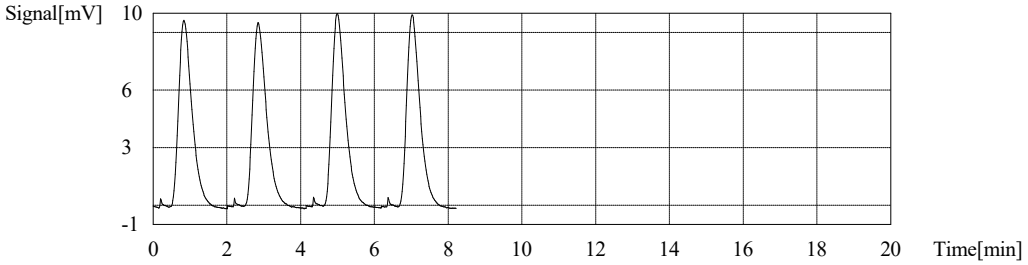
Type	Anal.	Manual Dilution	Result
Unknown	TC	1.000	TC:5.313mg/L

1. Det

Anal.: TC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	24.72	5.255mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:47:41 AM
2	24.92	5.297mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:50:03 AM
3	25.41	5.401mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:52:19 AM
4	24.92	5.297mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:54:35 AM

Mean Area 24.99
Mean Conc. 5.313mg/L



Sample

Sample Name: 680-232058-c-2
Sample ID: TC Curve
Origin: TCCURVE.cal
Status Completed
Chk. Result

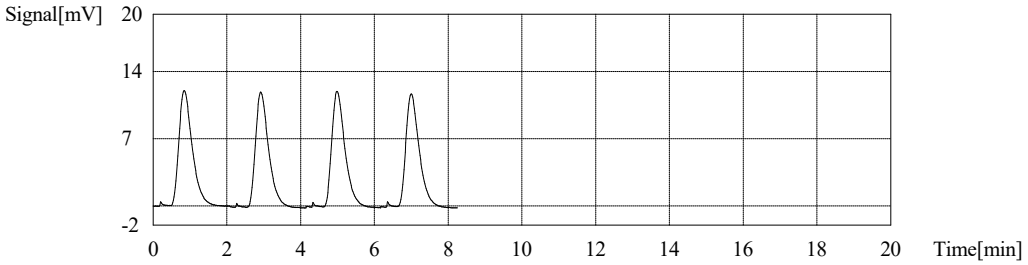
Type	Anal.	Manual Dilution	Result
Unknown	TC	1.000	TC:6.304mg/L

1. Det

Anal.: TC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	29.71	6.315mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 1:59:19 AM
2	29.53	6.277mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:01:37 AM
3	29.89	6.354mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:03:52 AM
4	29.49	6.269mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:06:11 AM

Mean Area 29.66
Mean Conc. 6.304mg/L



Sample

Sample Name: 680-232058-b-3
Sample ID: TC Curve
Origin: TCCURVE.cal
Status Completed
Chk. Result

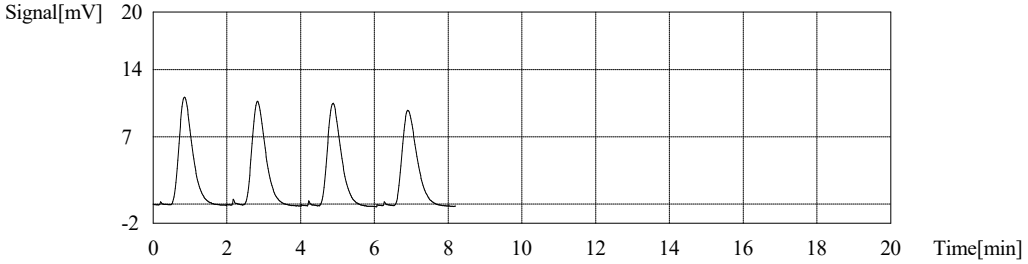
Type	Anal.	Manual Dilution	Result
Unknown	TC	1.000	TC:5.905mg/L

1. Det

Anal.: TC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	28.45	6.047mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:10:49 AM
2	27.49	5.843mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:13:05 AM
3	27.62	5.871mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:15:23 AM
4	27.56	5.858mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:17:46 AM

Mean Area 27.78
Mean Conc. 5.905mg/L



Sample

Sample Name: CCV
Sample ID: TC Curve
Origin: TCCURVE.cal
Status Completed
Chk. Result

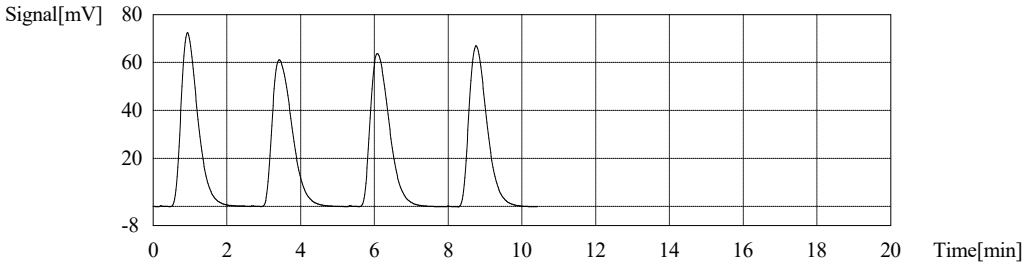
Type	Anal.	Manual Dilution	Result
Unknown	TC	1.000	TC:48.34mg/L

1. Det

Anal.: TC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	227.6	48.38mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:23:00 AM
2	227.5	48.36mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:25:53 AM
3	227.6	48.38mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:28:47 AM
4	226.9	48.23mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:31:38 AM

Mean Area 227.4
Mean Conc. 48.34mg/L



Sample

Sample Name: CCB
Sample ID: TC Curve
Origin: TCCURVE.cal
Status Completed
Chk. Result

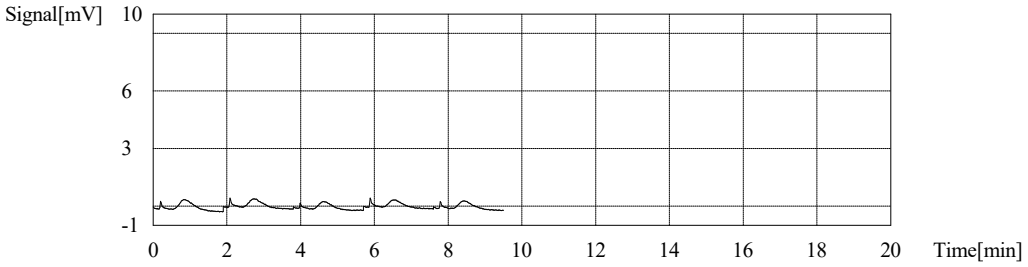
Type	Anal.	Manual Dilution	Result
Unknown	TC	1.000	TC:0.2146mg/L

1. Det

Anal.: TC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.298	0.2759mg/L	50uL	1.000	E	TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:36:26 AM
2	1.093	0.2323mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:38:36 AM
3	0.9194	0.1954mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:40:44 AM
4	0.9652	0.2052mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:42:52 AM
5	1.060	0.2253mg/L	50uL	1.000		TCCURVE.2023_02_16_16_18_03.cal	3/19/2023 2:45:00 AM

Mean Area 1.009
Mean Conc. 0.2146mg/L



Instr.Information

Instrument Options	TOC/ASI/IC Unit/
Catalyst	Regular Sensitivity

Sample

Sample Name:	H2S04 DI
Sample ID:	Untitled
Origin:	TOCCurve.cal
Status	Completed
Chk. Result	

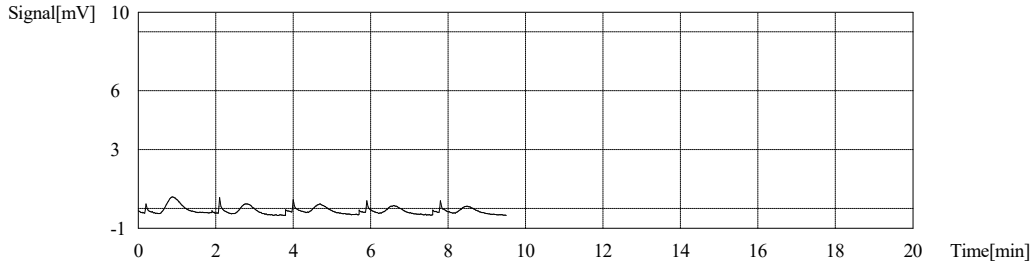
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2424mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	2.144	0.4534mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:29:26 AM
2	1.327	0.2806mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:31:39 AM
3	1.134	0.2398mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:33:50 AM
4	1.079	0.2282mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:36:02 AM
5	1.045	0.2210mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:38:14 AM

Mean Area	1.146
Mean Conc.	0.2424mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

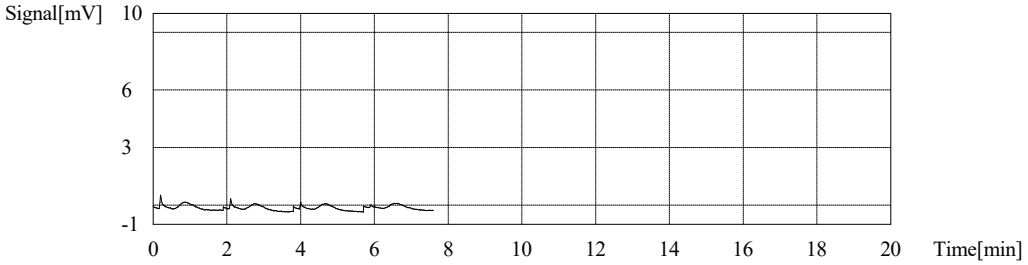
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1716mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.8973	0.1897mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:45:57 AM
2	0.7919	0.1675mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:48:08 AM
3	0.7407	0.1566mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:50:19 AM
4	0.8169	0.1727mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:52:31 AM

Mean Area 0.8117
Mean Conc. 0.1716mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

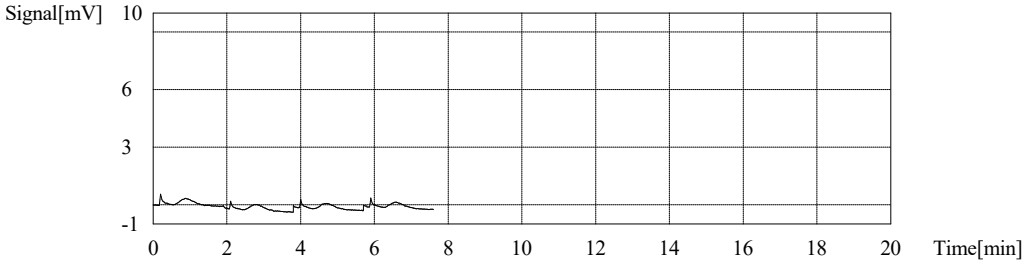
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1550mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.7917	0.1674mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:00:03 PM
2	0.7149	0.1512mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:02:10 PM
3	0.7488	0.1583mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:04:22 PM
4	0.6774	0.1432mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:06:31 PM

Mean Area 0.7332
Mean Conc. 0.1550mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

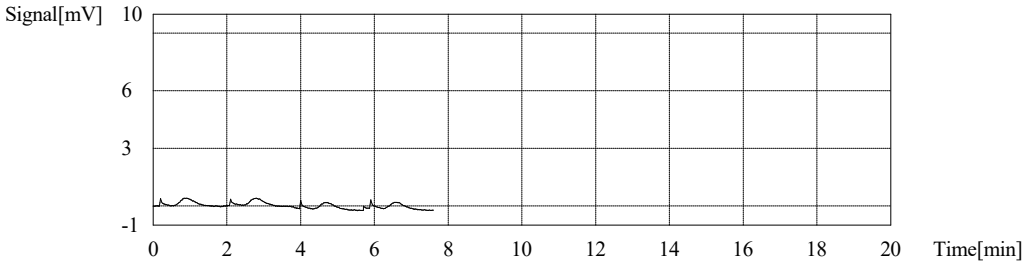
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2043mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.052	0.2225mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:14:03 PM
2	1.003	0.2121mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:16:09 PM
3	0.9495	0.2008mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:18:16 PM
4	0.8598	0.1818mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:20:26 PM

Mean Area 0.9661
Mean Conc. 0.2043mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

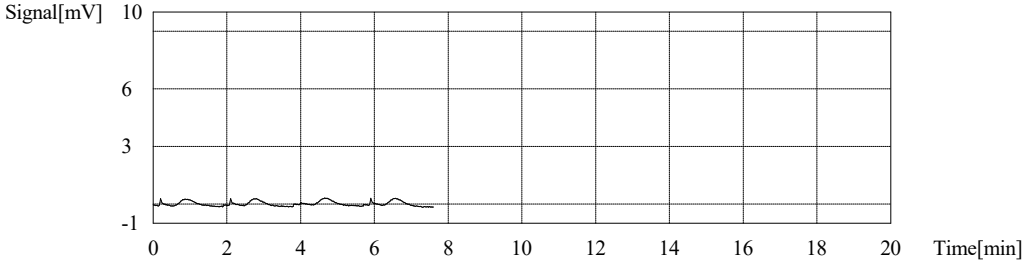
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1954mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.9161	0.1937mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:27:57 PM
2	0.8869	0.1875mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:30:07 PM
3	0.9170	0.1939mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:32:17 PM
4	0.9757	0.2063mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:34:29 PM

Mean Area 0.9239
Mean Conc. 0.1954mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

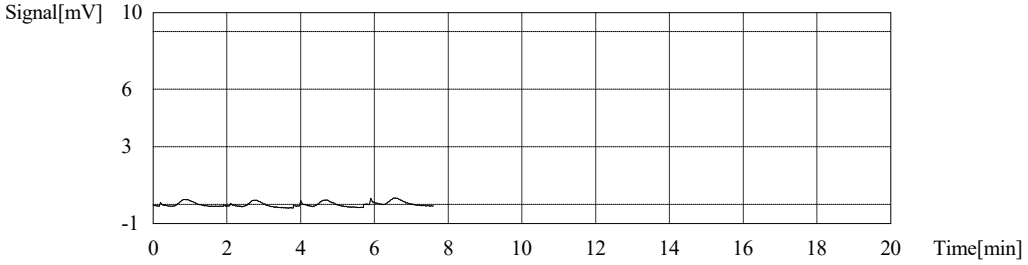
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1901mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.9672	0.2045mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:42:00 PM
2	0.8537	0.1805mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:44:14 PM
3	0.8820	0.1865mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:46:24 PM
4	0.8930	0.1888mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:48:35 PM

Mean Area 0.8990
Mean Conc. 0.1901mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

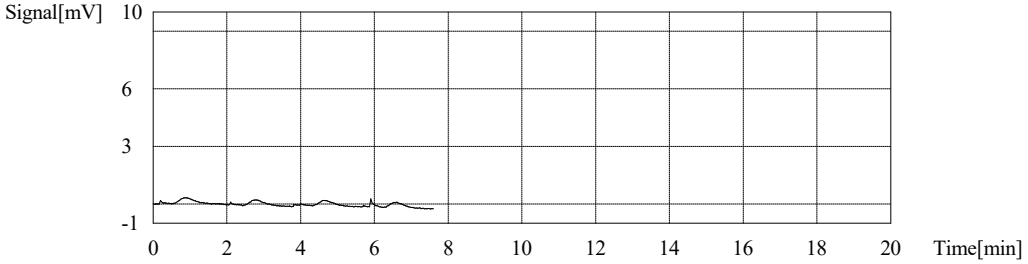
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1593mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.7552	0.1597mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:56:06 PM
2	0.8347	0.1765mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:58:13 PM
3	0.7170	0.1516mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:00:25 PM
4	0.7063	0.1494mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:02:35 PM

Mean Area 0.7533
Mean Conc. 0.1593mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

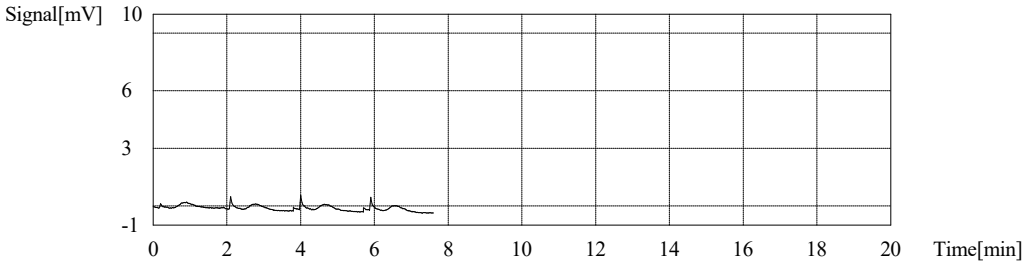
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1529mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.7407	0.1566mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:10:06 PM
2	0.7170	0.1516mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:12:18 PM
3	0.6922	0.1464mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:14:29 PM
4	0.7421	0.1569mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:16:40 PM

Mean Area 0.7230
Mean Conc. 0.1529mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

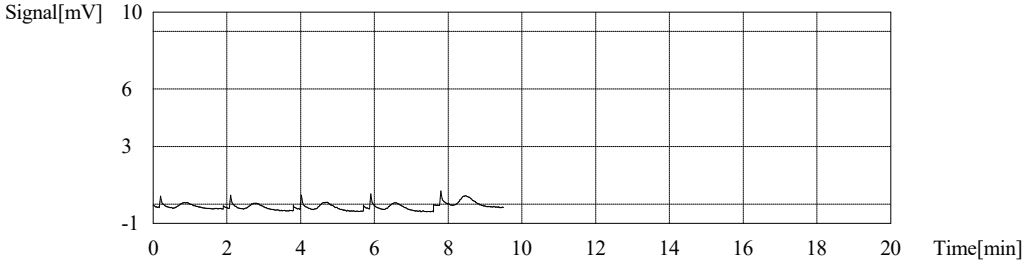
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1805mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.7181	0.1518mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:24:11 PM
2	0.8389	0.1774mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:26:22 PM
3	0.9491	0.2007mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:28:33 PM
4	0.9090	0.1922mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:30:43 PM
5	1.291	0.2730mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:32:55 PM

Mean Area 0.8538
Mean Conc. 0.1805mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

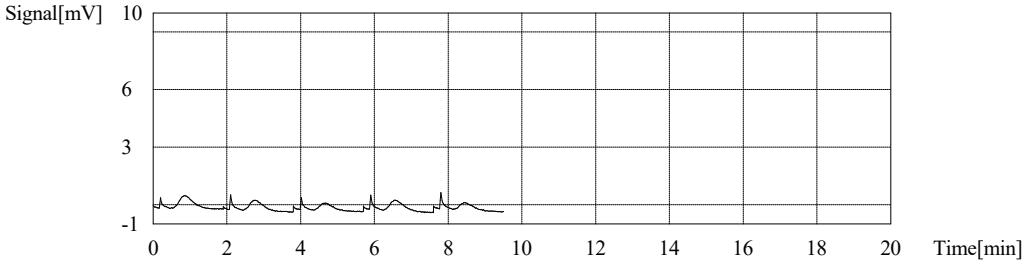
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2288mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.713	0.3622mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:40:39 PM
2	1.258	0.2660mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:42:52 PM
3	0.8894	0.1881mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:45:03 PM
4	1.333	0.2819mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:47:12 PM
5	0.8477	0.1793mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:49:22 PM

Mean Area 1.082
Mean Conc. 0.2288mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

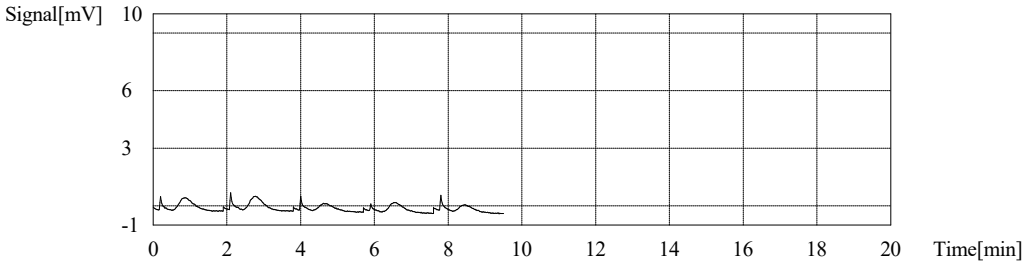
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.3024mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.718	0.3633mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:57:06 PM
2	1.731	0.3660mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:59:18 PM
3	0.9661	0.2043mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:01:28 PM
4	1.306	0.2762mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:03:38 PM
5	0.8299	0.1755mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:05:49 PM

Mean Area 1.430
Mean Conc. 0.3024mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

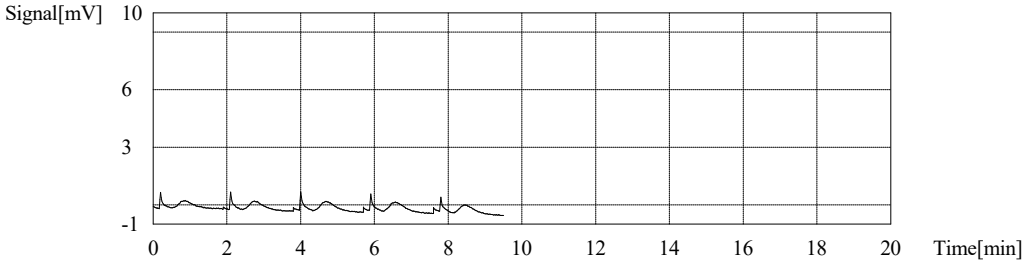
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2553mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.9815	0.2075mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:13:33 PM
2	1.084	0.2292mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:15:45 PM
3	1.283	0.2713mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:17:57 PM
4	1.307	0.2764mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:20:08 PM
5	1.155	0.2442mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:22:19 PM

Mean Area 1.207
Mean Conc. 0.2553mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

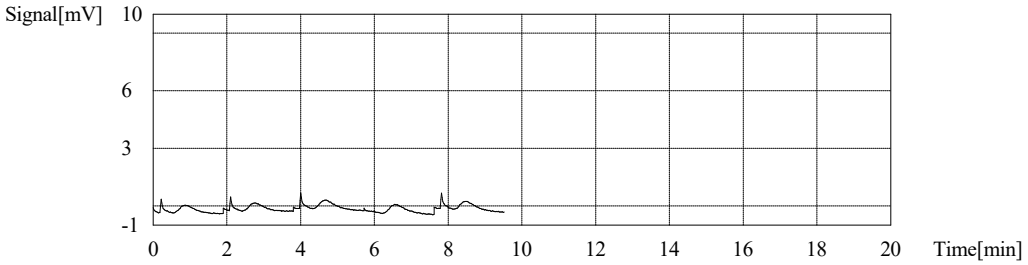
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2426mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.092	0.2309mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:30:05 PM
2	1.049	0.2218mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:32:15 PM
3	1.292	0.2732mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:34:27 PM
4	1.410	0.2982mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:36:38 PM
5	1.157	0.2447mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:38:49 PM

Mean Area 1.148
Mean Conc. 0.2426mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

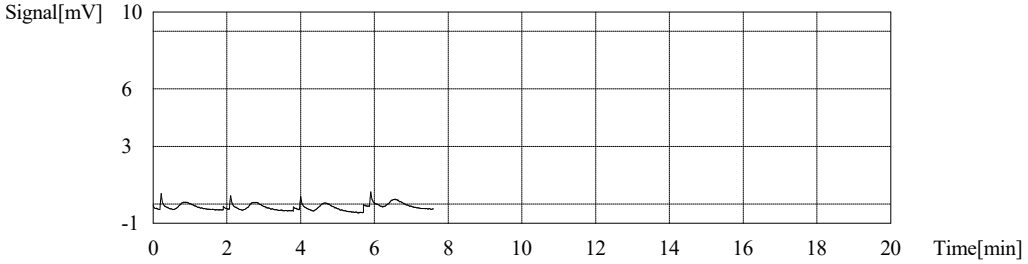
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2208mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.9461	0.2001mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:46:32 PM
2	1.076	0.2275mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:48:44 PM
3	1.117	0.2362mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:50:56 PM
4	1.038	0.2195mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:53:07 PM

Mean Area 1.044
Mean Conc. 0.2208mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

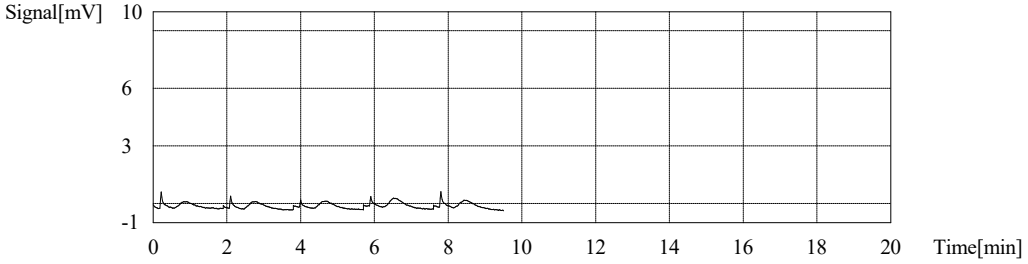
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2088mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.8411	0.1779mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:00:37 PM
2	0.9770	0.2066mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:02:50 PM
3	1.043	0.2206mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:05:03 PM
4	1.257	0.2658mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:07:14 PM
5	1.088	0.2301mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:09:25 PM

Mean Area 0.9873
Mean Conc. 0.2088mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

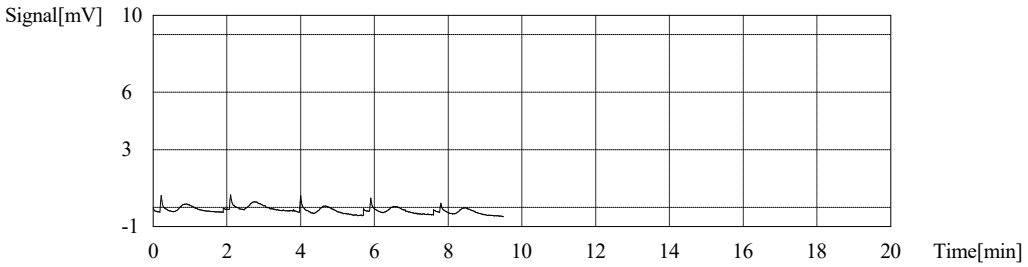
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2127mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.041	0.2201mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:17:08 PM
2	1.032	0.2182mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:19:21 PM
3	1.111	0.2349mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:21:32 PM
4	0.8389	0.1774mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:23:43 PM
5	0.8198	0.1734mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:25:56 PM

Mean Area 1.006
Mean Conc. 0.2127mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

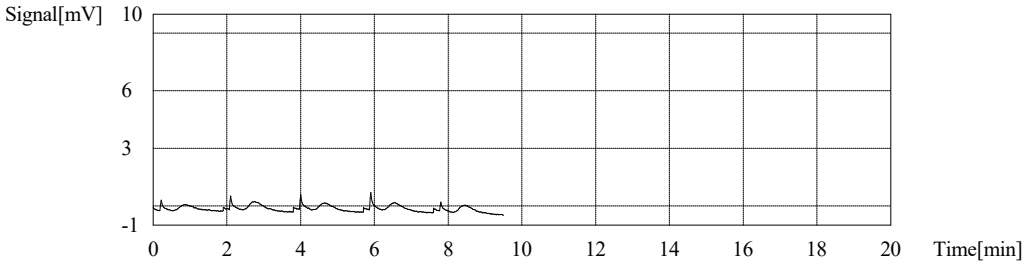
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1887mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.7485	0.1583mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:33:39 PM
2	1.204	0.2546mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:35:52 PM
3	0.9263	0.1959mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:38:03 PM
4	0.9602	0.2030mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:40:14 PM
5	0.9345	0.1976mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:42:27 PM

Mean Area 0.8924
Mean Conc. 0.1887mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

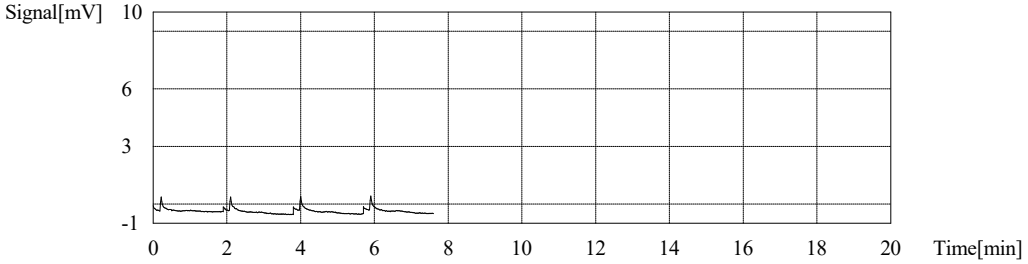
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.000mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:50:10 PM
2	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:52:22 PM
3	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:54:34 PM
4	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:56:46 PM

Mean Area 0.000
Mean Conc. 0.000mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

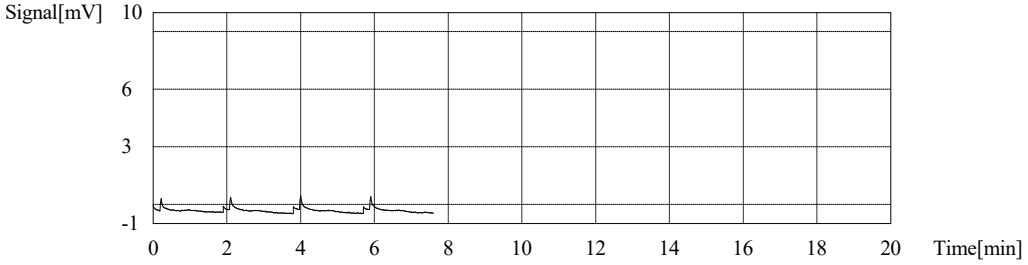
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.000mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 4:04:16 PM
2	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 4:06:27 PM
3	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 4:08:40 PM
4	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 4:10:53 PM

Mean Area 0.000
Mean Conc. 0.000mg/L



Cal. Curve

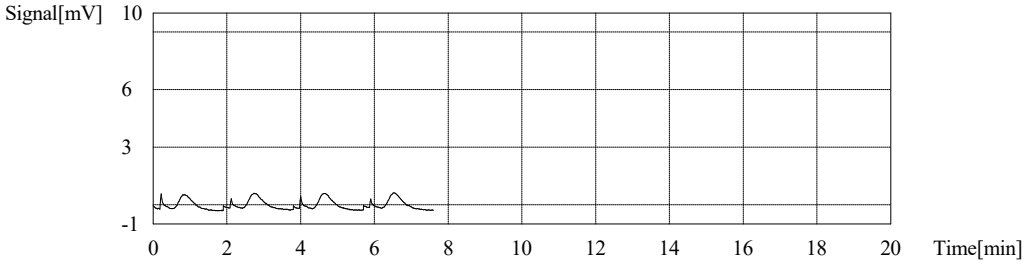
Sample Name: TC Curve
Sample ID: TC Curve
Cal. Curve: TCCURVE.2023_02_16_16_18_03.cal
Status Completed

Type	Anal.
Standard	TC

Conc: 0.000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	1.942	50uL	1.000	*******		2/16/2023 4:22:23 PM
2	2.011	50uL	1.000	*******		2/16/2023 4:24:31 PM
3	1.980	50uL	1.000	*******		2/16/2023 4:26:38 PM
4	2.022	50uL	1.000	*******		2/16/2023 4:28:48 PM

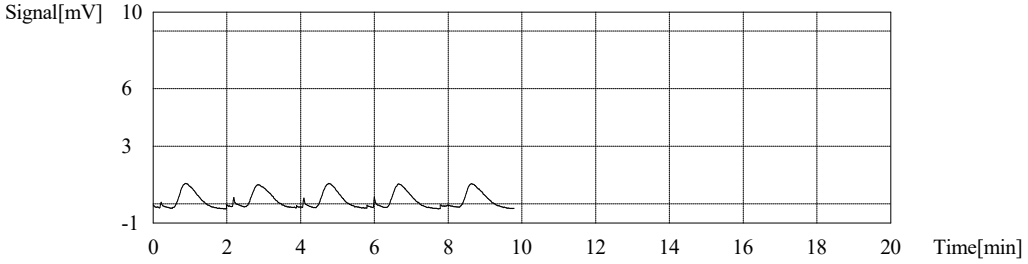
Acid Add. 0.000%
Mean Area 1.989



Conc: 0.5000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	4.166	50uL	1.000	*******		2/16/2023 4:33:25 PM
2	3.858	50uL	1.000	*******	E	2/16/2023 4:35:32 PM
3	3.959	50uL	1.000	*******		2/16/2023 4:37:41 PM
4	4.022	50uL	1.000	*******		2/16/2023 4:39:54 PM
5	4.098	50uL	1.000	*******		2/16/2023 4:42:09 PM

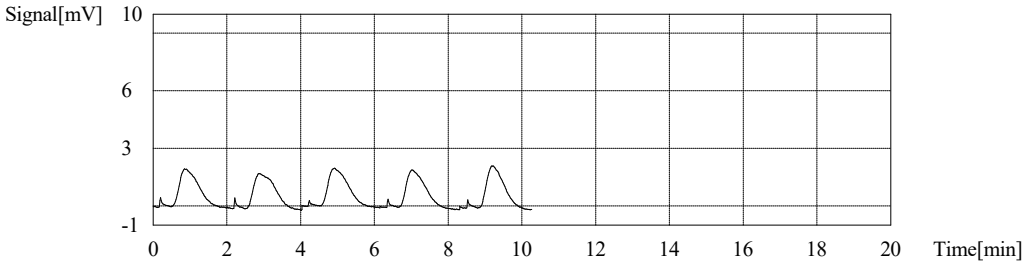
Acid Add. 0.000%
Mean Area 4.061



Conc: 1.000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	7.038	50uL	1.000	*******		2/16/2023 4:46:44 PM
2	7.372	50uL	1.000	*******		2/16/2023 4:48:58 PM
3	7.199	50uL	1.000	*******		2/16/2023 4:51:18 PM
4	6.888	50uL	1.000	*******	E	2/16/2023 4:53:41 PM
5	7.165	50uL	1.000	*******		2/16/2023 4:55:51 PM

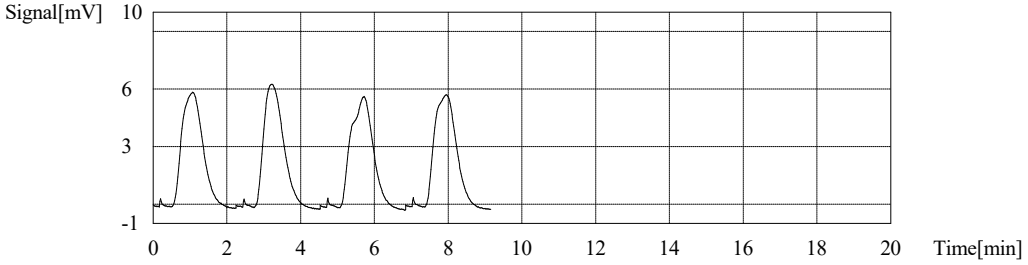
Acid Add. 0.000%
Mean Area 7.194



Conc: 5.000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	23.57	50uL	1.000	*******		2/16/2023 5:00:39 PM
2	23.88	50uL	1.000	*******		2/16/2023 5:03:09 PM
3	24.20	50uL	1.000	*******		2/16/2023 5:05:41 PM
4	24.33	50uL	1.000	*******		2/16/2023 5:08:15 PM

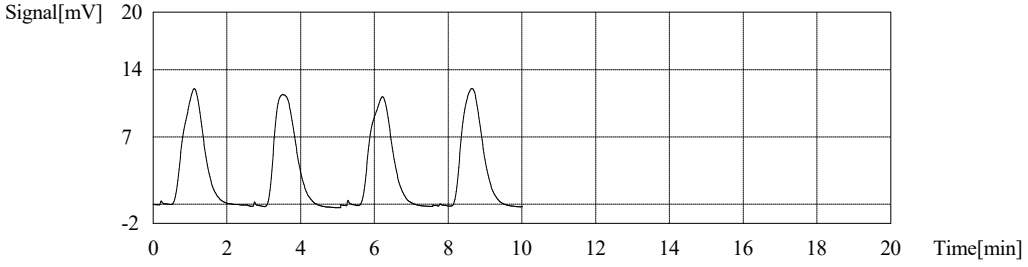
Acid Add. 0.000%
Mean Area 24.00



Conc: 10.00mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	46.08	50uL	1.000	*******		2/16/2023 5:13:26 PM
2	46.65	50uL	1.000	*******		2/16/2023 5:16:11 PM
3	46.13	50uL	1.000	*******		2/16/2023 5:18:56 PM
4	47.31	50uL	1.000	*******		2/16/2023 5:21:35 PM

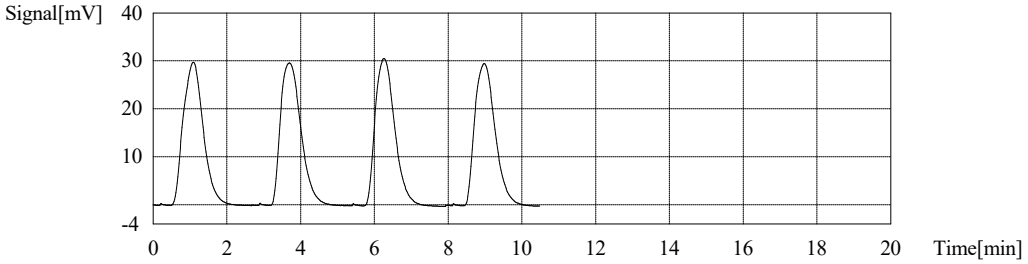
Acid Add. 0.000%
Mean Area 46.54



Conc: 25.00mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	112.7	50uL	1.000	*******		2/16/2023 5:26:54 PM
2	114.3	50uL	1.000	*******		2/16/2023 5:29:41 PM
3	113.3	50uL	1.000	*******		2/16/2023 5:32:36 PM
4	113.6	50uL	1.000	*******		2/16/2023 5:35:24 PM

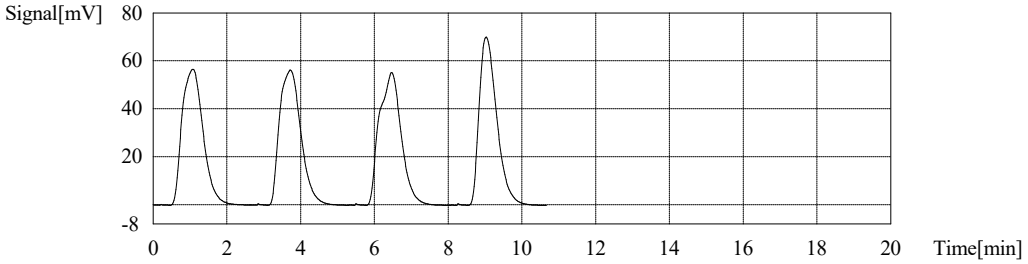
Acid Add. 0.000%
Mean Area 113.5



Conc: 50.00mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	225.0	50uL	1.000	*******		2/16/2023 5:40:40 PM
2	226.6	50uL	1.000	*******		2/16/2023 5:43:35 PM
3	228.3	50uL	1.000	*******		2/16/2023 5:46:34 PM
4	232.7	50uL	1.000	*******		2/16/2023 5:49:23 PM

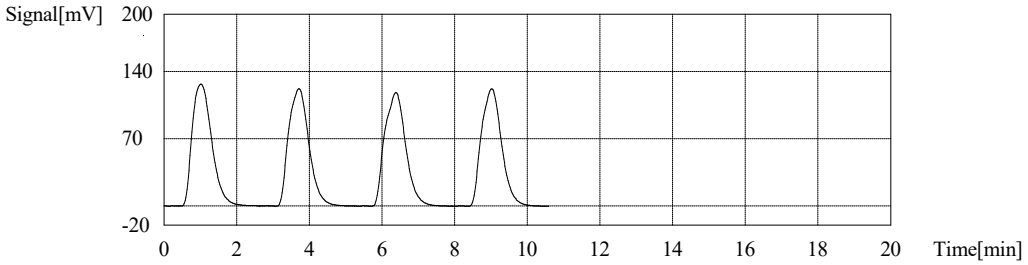
Acid Add. 0.000%
Mean Area 228.2



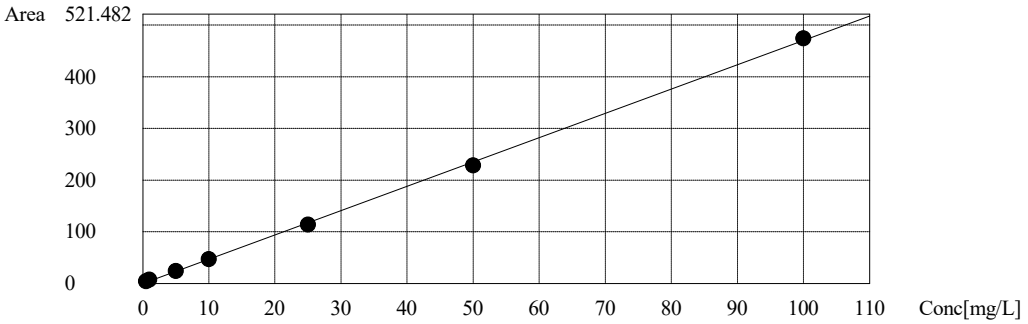
Conc: 100.0mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	474.9	50uL	1.000	*******		2/16/2023 5:54:38 PM
2	473.9	50uL	1.000	*******		2/16/2023 5:57:31 PM
3	474.5	50uL	1.000	*******		2/16/2023 6:00:25 PM
4	473.0	50uL	1.000	*******		2/16/2023 6:03:20 PM

Acid Add.	0.000%
Mean Area	474.1



Slope:	4.704
Intercept	0.000
r^2	0.9995
r	0.9998
RSE(%)	35.4
Zero Shift	Yes



Sample

Sample Name:	H2S04 DI
Sample ID:	Untitled
Origin:	TOCCurve.cal
Status	Completed
Chk. Result	

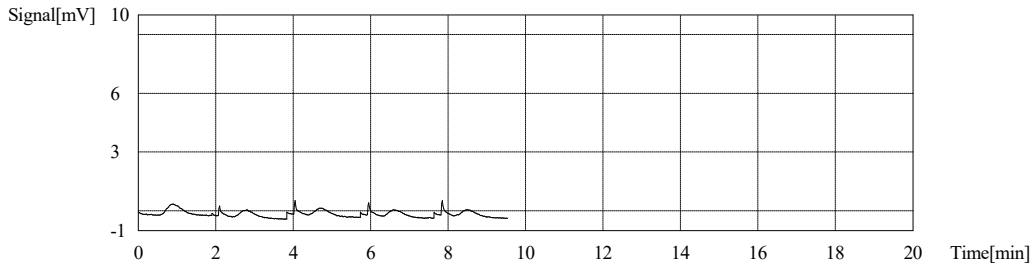
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1844mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.488	0.3146mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:10:51 PM
2	0.9389	0.1985mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:13:05 PM
3	0.9204	0.1946mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:15:16 PM
4	0.8717	0.1843mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:17:28 PM
5	0.7577	0.1602mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:19:40 PM

Mean Area 0.8722
Mean Conc. 0.1844mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

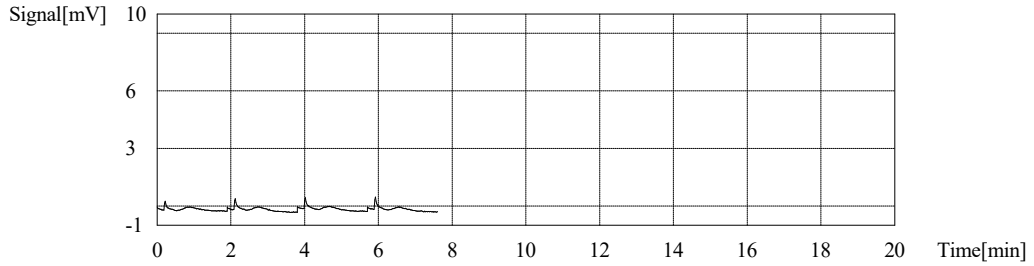
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.08468mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.4676	0.09888mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:27:24 PM
2	0.3892	0.08230mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:29:35 PM
3	0.3671	0.07763mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:31:47 PM
4	0.3779	0.07991mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:33:59 PM

Mean Area 0.4004
Mean Conc. 0.08468mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

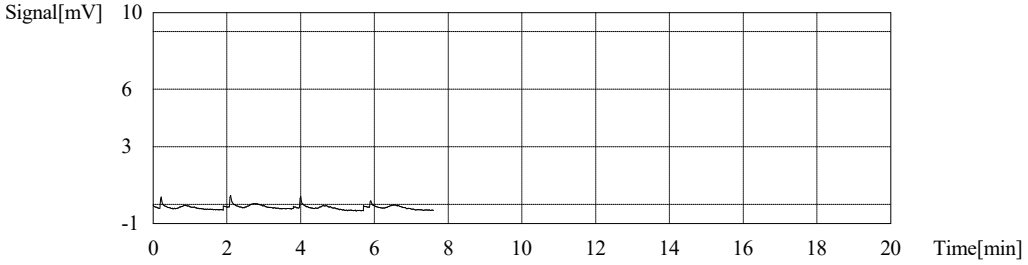
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.09013mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.3753	0.07936mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:41:30 PM
2	0.5369	0.1135mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:43:40 PM
3	0.3554	0.07515mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:45:50 PM
4	0.4373	0.09247mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:48:01 PM

Mean Area 0.4262
Mean Conc. 0.09013mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

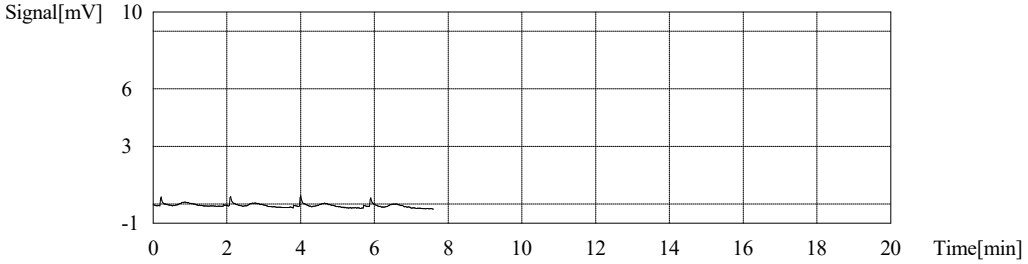
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.08579mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.4321	0.09137mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:55:32 PM
2	0.3494	0.07388mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:57:45 PM
3	0.4292	0.09076mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:59:56 PM
4	0.4122	0.08716mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:02:07 PM

Mean Area 0.4057
Mean Conc. 0.08579mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

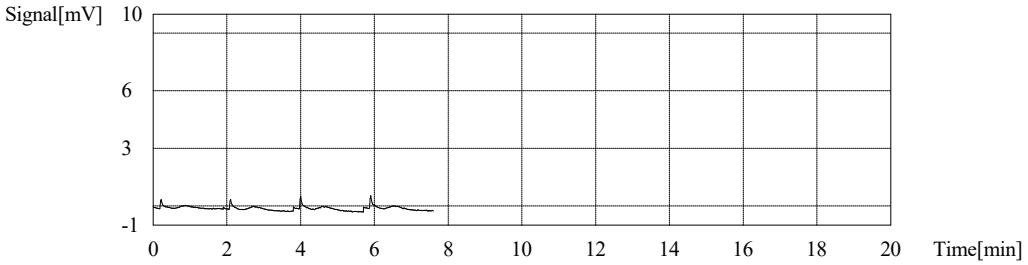
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.08044mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.3430	0.07253mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:09:38 PM
2	0.4093	0.08655mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:11:51 PM
3	0.3866	0.08175mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:14:02 PM
4	0.3828	0.08095mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:16:14 PM

Mean Area 0.3804
Mean Conc. 0.08044mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

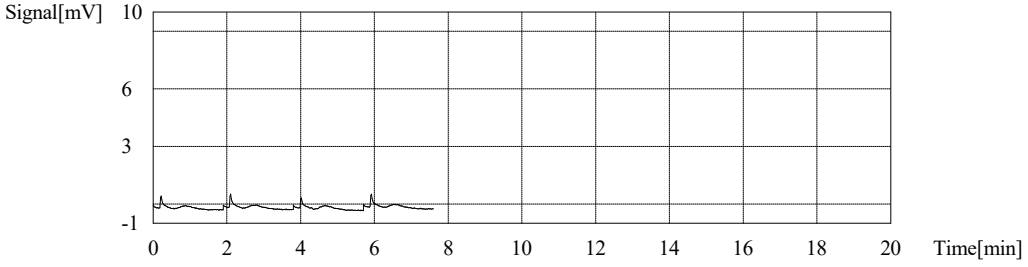
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.08284mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.3959	0.08372mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:23:45 PM
2	0.4387	0.09277mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:25:57 PM
3	0.3911	0.08270mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:28:07 PM
4	0.3414	0.07219mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:30:17 PM

Mean Area 0.3918
Mean Conc. 0.08284mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

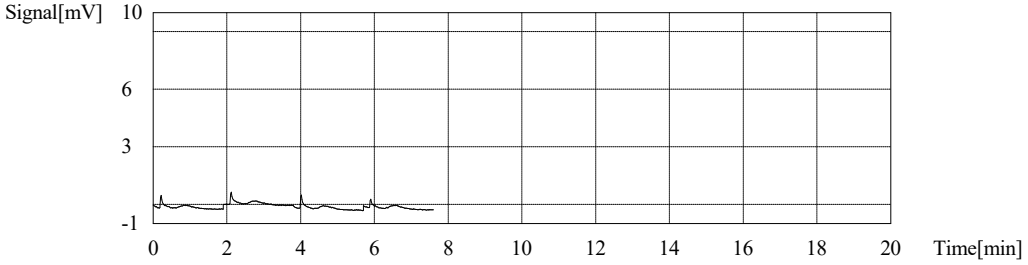
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.07270mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.3292	0.06961mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:37:48 PM
2	0.3642	0.07701mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:39:58 PM
3	0.2864	0.06056mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:42:06 PM
4	0.3955	0.08363mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:44:19 PM

Mean Area 0.3438
Mean Conc. 0.07270mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

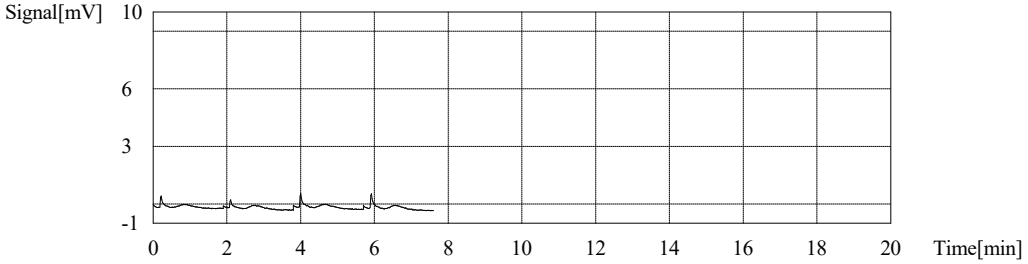
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.08823mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.3981	0.08418mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:51:50 PM
2	0.4035	0.08532mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:54:02 PM
3	0.4260	0.09008mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:56:13 PM
4	0.4414	0.09334mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:58:23 PM

Mean Area 0.4173
Mean Conc. 0.08823mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

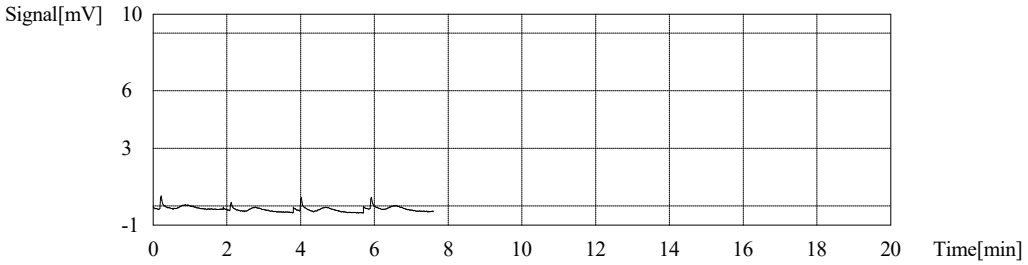
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1071mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.5083	0.1075mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:05:54 PM
2	0.4565	0.09653mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:08:06 PM
3	0.5362	0.1134mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:10:16 PM
4	0.5247	0.1110mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:12:26 PM

Mean Area 0.5064
Mean Conc. 0.1071mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

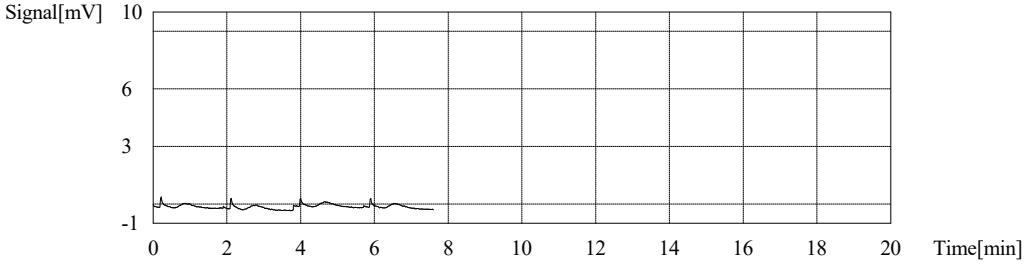
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1221mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.5821	0.1231mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:19:57 PM
2	0.5369	0.1135mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:22:08 PM
3	0.6574	0.1390mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:24:19 PM
4	0.5329	0.1127mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:26:29 PM

Mean Area 0.5773
Mean Conc. 0.1221mg/L



Cal. Curve

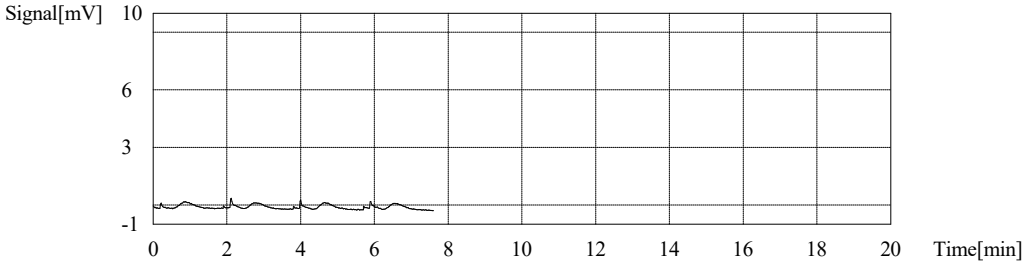
Sample Name: TOC CURVE
Sample ID: Untitled
Cal. Curve: TOCCurve.2023_02_16_20_26_29.cal
Status Completed

Type	Anal.
Standard	NPOC

Conc: 0.000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	0.7940	50uL	1.000	*******		2/16/2023 8:35:16 PM
2	0.7958	50uL	1.000	*******		2/16/2023 8:37:25 PM
3	0.8753	50uL	1.000	*******		2/16/2023 8:39:33 PM
4	0.7986	50uL	1.000	*******		2/16/2023 8:41:42 PM

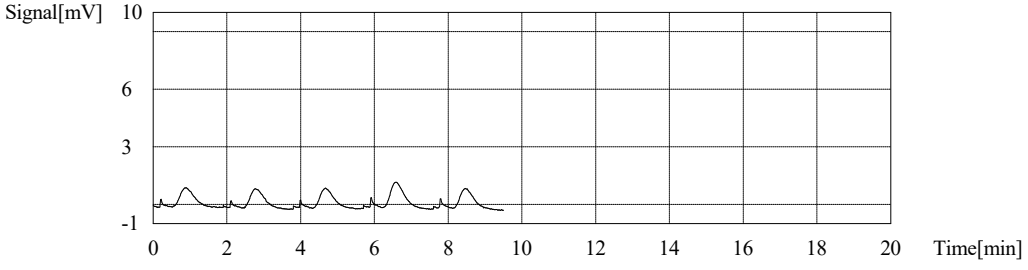
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 0.8159



Conc: 0.5000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	2.677	50uL	1.000	*******		2/16/2023 8:50:29 PM
2	2.663	50uL	1.000	*******		2/16/2023 8:52:38 PM
3	2.677	50uL	1.000	*******		2/16/2023 8:54:46 PM
4	3.471	50uL	1.000	*******	E	2/16/2023 8:56:54 PM
5	2.757	50uL	1.000	*******		2/16/2023 8:59:02 PM

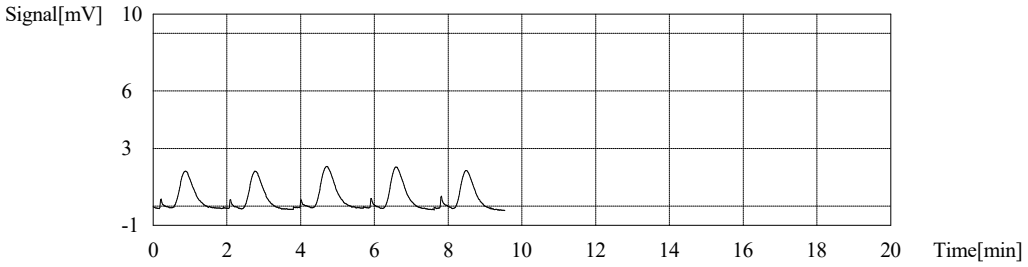
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 2.693



Conc: 1.000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	4.812	50uL	1.000	*******		2/16/2023 9:07:44 PM
2	5.032	50uL	1.000	*******		2/16/2023 9:09:54 PM
3	5.840	50uL	1.000	*******	E	2/16/2023 9:12:03 PM
4	5.736	50uL	1.000	*******		2/16/2023 9:14:13 PM
5	5.117	50uL	1.000	*******		2/16/2023 9:16:22 PM

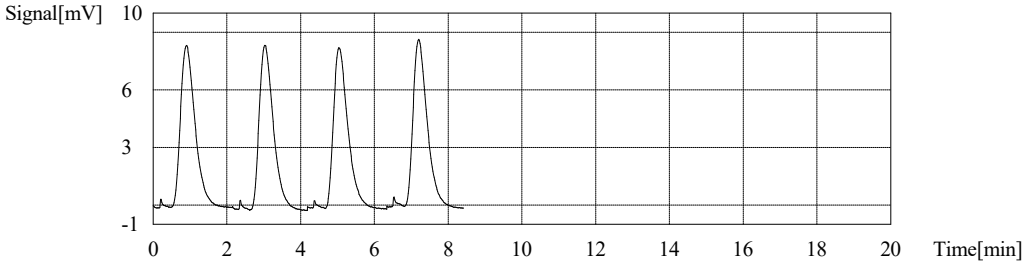
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 5.174



Conc: 5.000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	23.05	50uL	1.000	*******		2/16/2023 9:25:19 PM
2	22.78	50uL	1.000	*******		2/16/2023 9:27:36 PM
3	22.47	50uL	1.000	*******		2/16/2023 9:30:00 PM
4	22.91	50uL	1.000	*******		2/16/2023 9:32:19 PM

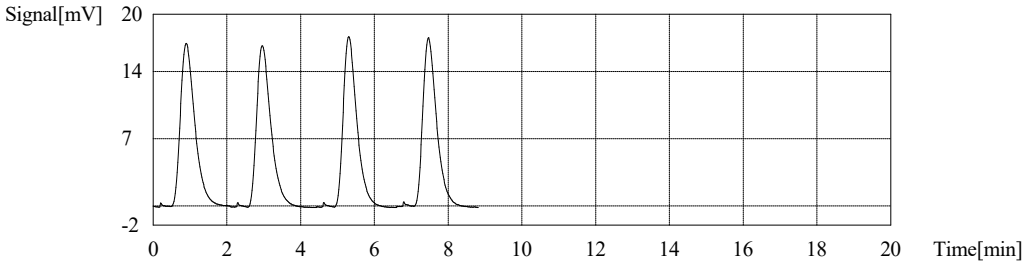
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 22.80



Conc: 10.00mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	46.02	50uL	1.000	*******		2/16/2023 9:41:17 PM
2	45.18	50uL	1.000	*******		2/16/2023 9:43:53 PM
3	45.36	50uL	1.000	*******		2/16/2023 9:46:17 PM
4	45.04	50uL	1.000	*******		2/16/2023 9:48:45 PM

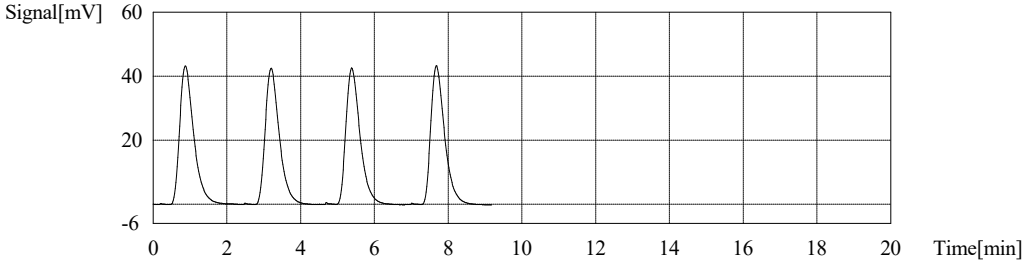
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 45.40



Conc: 25.00mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	114.4	50uL	1.000	*******		2/16/2023 9:57:55 PM
2	112.6	50uL	1.000	*******		2/16/2023 10:00:23 PM
3	113.3	50uL	1.000	*******		2/16/2023 10:02:57 PM
4	112.7	50uL	1.000	*******		2/16/2023 10:05:34 PM

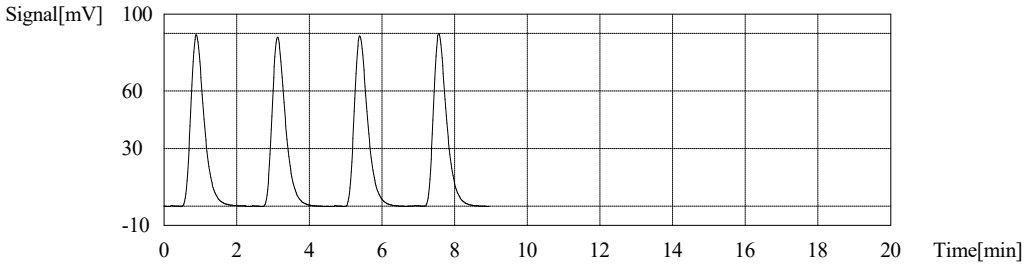
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 113.3



Conc: 50.00mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	225.9	50uL	1.000	*******		2/16/2023 10:14:42 PM
2	223.0	50uL	1.000	*******		2/16/2023 10:17:12 PM
3	225.2	50uL	1.000	*******		2/16/2023 10:19:39 PM
4	224.5	50uL	1.000	*******		2/16/2023 10:22:09 PM

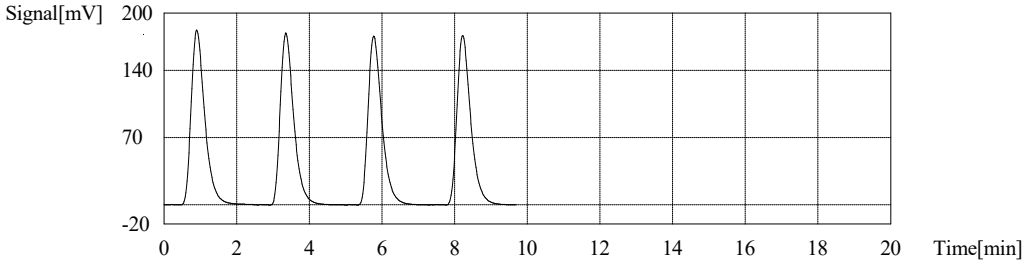
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 224.7



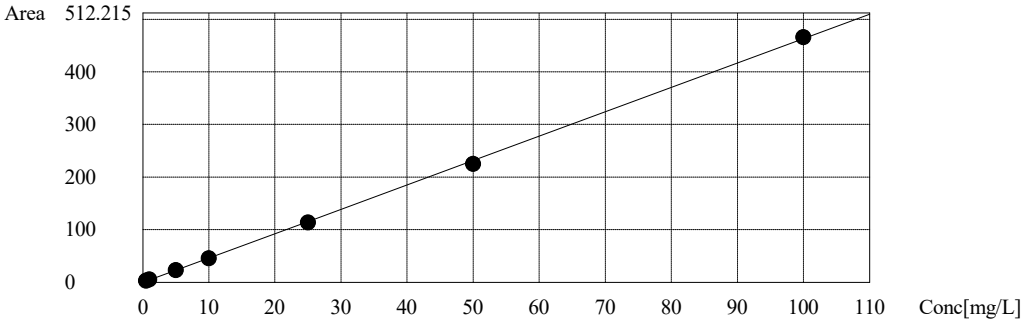
Conc: 100.0mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	472.7	50uL	1.000	*******		2/16/2023 10:31:29 PM
2	461.6	50uL	1.000	*******		2/16/2023 10:34:10 PM
3	463.5	50uL	1.000	*******		2/16/2023 10:36:50 PM
4	464.8	50uL	1.000	*******		2/16/2023 10:39:28 PM

Acid Add.	0.000%
Sparge Gas Flow	80mL/min
Sp. Time	180.0sec
Mean Area	465.7



Slope:	4.635
Intercept	0.000
r^2	0.9997
r	0.9998
RSE(%)	8.6
Zero Shift	Yes



Instr.Information

Instrument Options	TOC/ASI/IC Unit/
Catalyst	Regular Sensitivity

Sample

Sample Name:	BICARB/CARB
Sample ID:	Untitled
Origin:	TOCCurve.cal
Status	Completed
Chk. Result	

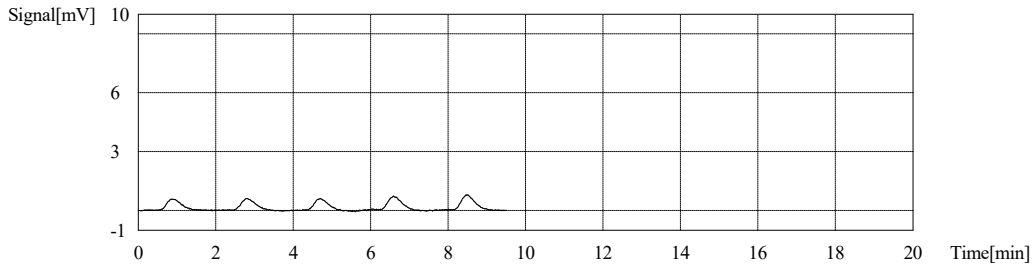
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.3470mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.457	0.3143mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:07:40 PM
2	1.598	0.3447mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:09:47 PM
3	1.522	0.3284mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:11:54 PM
4	1.951	0.4209mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:14:01 PM
5	1.857	0.4006mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:16:09 PM

Mean Area	1.609
Mean Conc.	0.3470mg/L



Sample

Sample Name: CCV
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

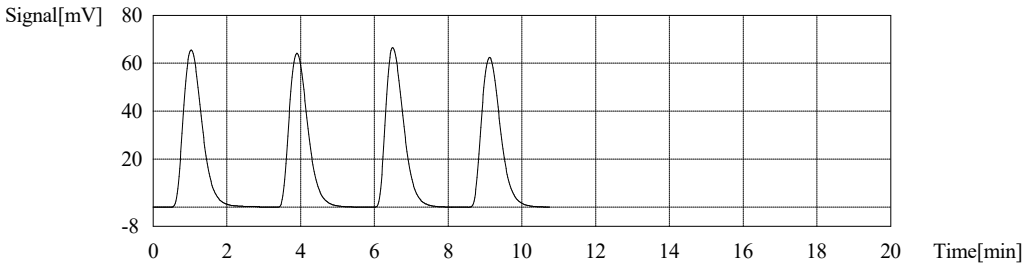
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:48.55mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	230.8	49.79mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:25:50 PM
2	224.4	48.41mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:28:42 PM
3	223.3	48.17mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:31:29 PM
4	221.7	47.83mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:34:22 PM

Mean Area 225.1
Mean Conc. 48.55mg/L



Sample

Sample Name: CCB
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

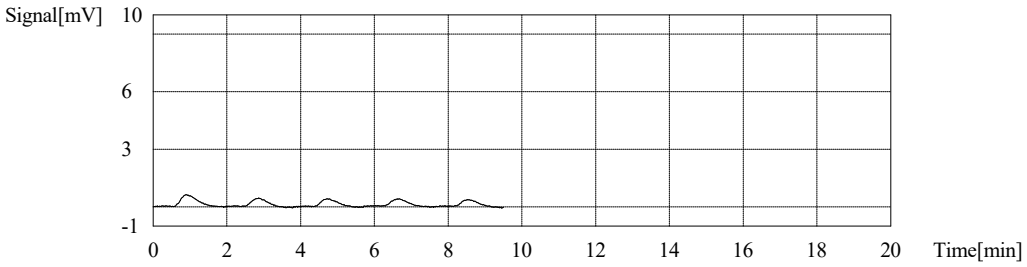
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2500mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.811	0.3907mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:43:08 PM
2	1.244	0.2684mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:45:15 PM
3	1.209	0.2608mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:47:24 PM
4	1.129	0.2436mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:49:32 PM
5	1.053	0.2272mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 8:51:39 PM

Mean Area 1.159
Mean Conc. 0.2500mg/L



Sample

Sample Name: LCS
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

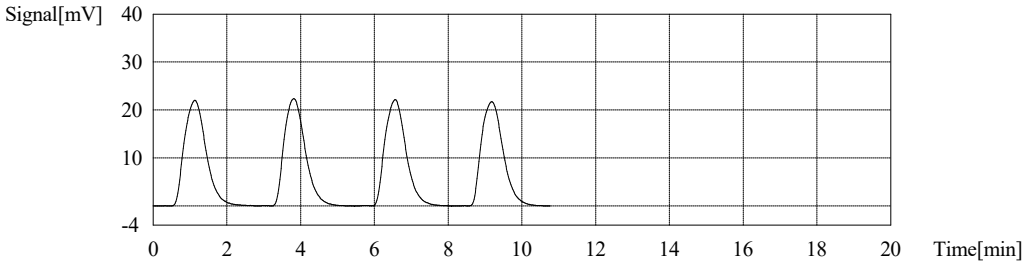
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:19.05mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	89.39	19.28mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:01:10 PM
2	88.14	19.02mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:04:08 PM
3	87.08	18.79mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:06:59 PM
4	88.55	19.10mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:09:53 PM

Mean Area 88.29
Mean Conc. 19.05mg/L



Sample

Sample Name: LCSD
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

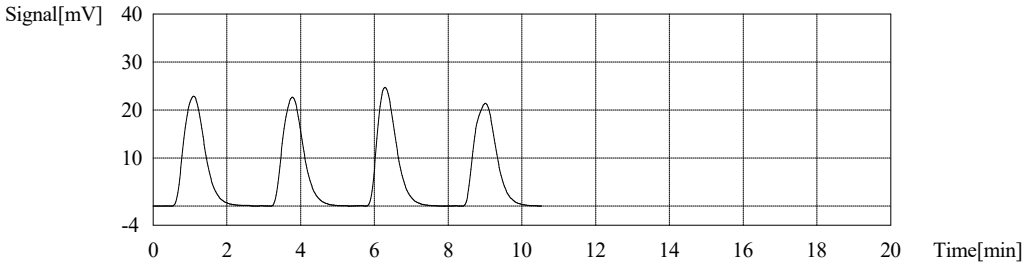
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:19.06mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	89.27	19.26mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:18:20 PM
2	87.51	18.88mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:21:11 PM
3	88.07	19.00mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:24:00 PM
4	88.53	19.10mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:26:52 PM

Mean Area 88.34
Mean Conc. 19.06mg/L



Sample

Sample Name: LLCS
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

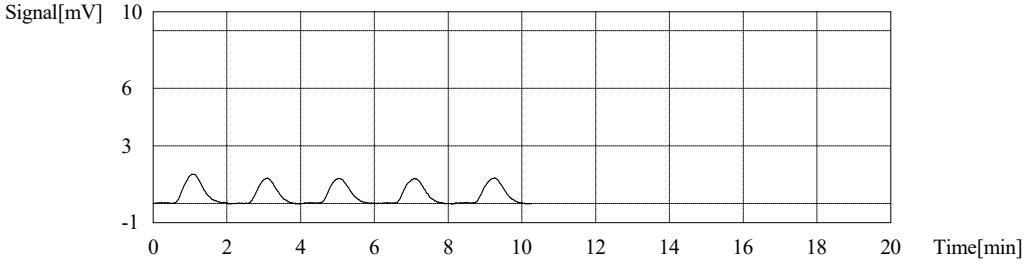
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:1.023mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	5.304	1.144mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:35:45 PM
2	4.640	1.001mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:37:56 PM
3	4.685	1.011mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:40:11 PM
4	4.768	1.029mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:42:31 PM
5	4.873	1.051mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:44:51 PM

Mean Area 4.742
Mean Conc. 1.023mg/L



Sample

Sample Name: 680-232120-b-1
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

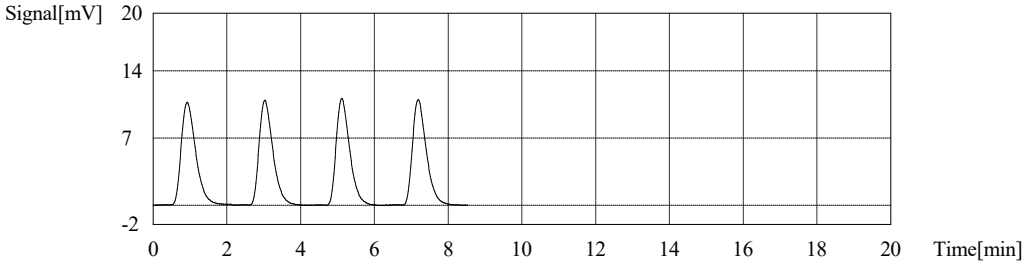
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:6.152mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	28.96	6.248mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:53:46 PM
2	28.29	6.103mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:56:06 PM
3	28.20	6.084mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 9:58:23 PM
4	28.61	6.172mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:00:51 PM

Mean Area 28.52
Mean Conc. 6.152mg/L



Sample

Sample Name: 680-232120-b-2
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

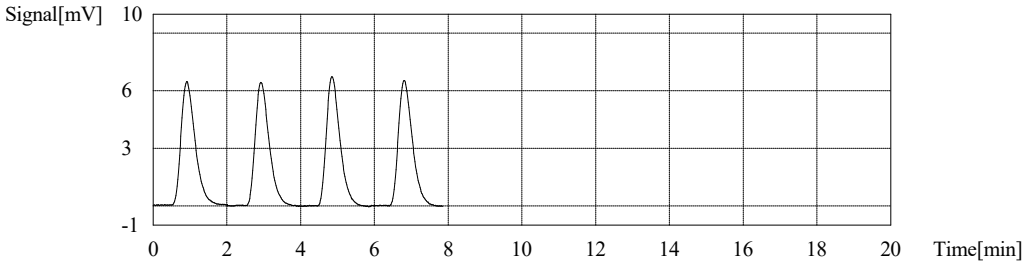
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:3.667mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	16.85	3.635mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:09:44 PM
2	16.80	3.624mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:11:53 PM
3	17.25	3.721mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:14:03 PM
4	17.09	3.687mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:16:14 PM

Mean Area 17.00
Mean Conc. 3.667mg/L



Sample

Sample Name: 680-232120-b-2 MS
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

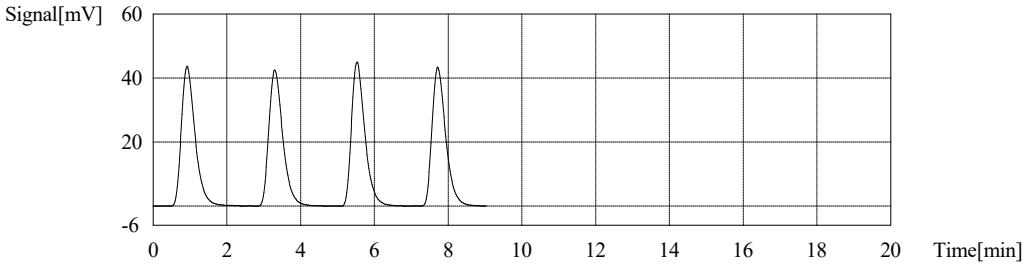
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:24.12mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	111.8	24.12mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:25:28 PM
2	111.3	24.01mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:28:00 PM
3	112.9	24.36mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:30:23 PM
4	111.3	24.01mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:32:50 PM

Mean Area 111.8
Mean Conc. 24.12mg/L



Sample

Sample Name: 680-232120-b-2 MSD
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

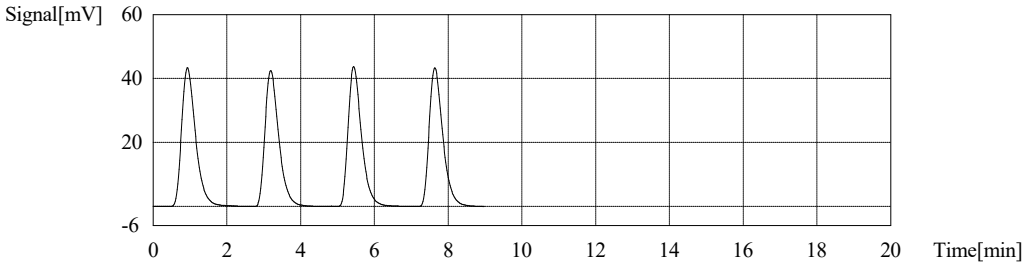
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:23.96mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	113.2	24.42mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:40:53 PM
2	110.2	23.77mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:43:23 PM
3	109.8	23.69mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:45:48 PM
4	111.1	23.97mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:48:16 PM

Mean Area 111.1
Mean Conc. 23.96mg/L



Sample

Sample Name: 680-232120-b-3
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

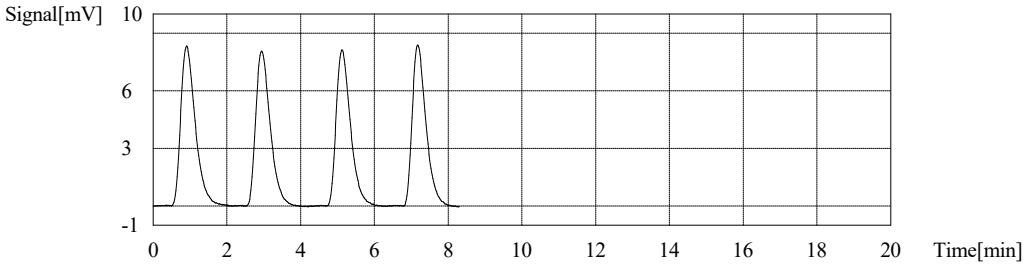
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:4.775mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	22.60	4.876mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:57:10 PM
2	22.17	4.783mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 10:59:36 PM
3	21.95	4.735mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:01:54 PM
4	21.82	4.707mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:04:07 PM

Mean Area 22.13
Mean Conc. 4.775mg/L



Sample

Sample Name: 680-232120-b-4
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

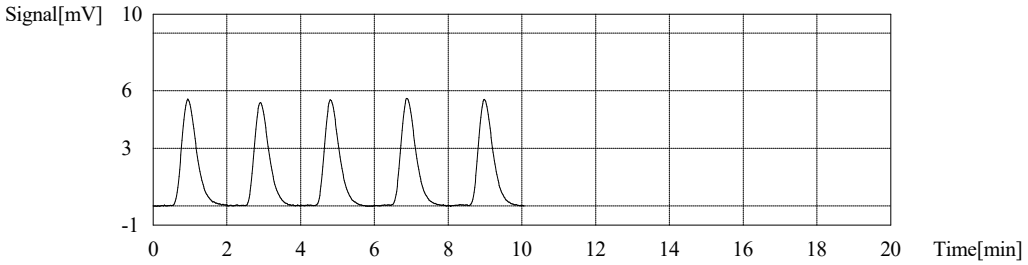
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:3.286mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	15.43	3.329mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:12:59 PM
2	14.64	3.158mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:15:08 PM
3	15.14	3.266mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:17:24 PM
4	15.36	3.314mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:19:44 PM
5	15.00	3.236mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:21:57 PM

Mean Area 15.23
Mean Conc. 3.286mg/L



Sample

Sample Name: 680-232120-b-5
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

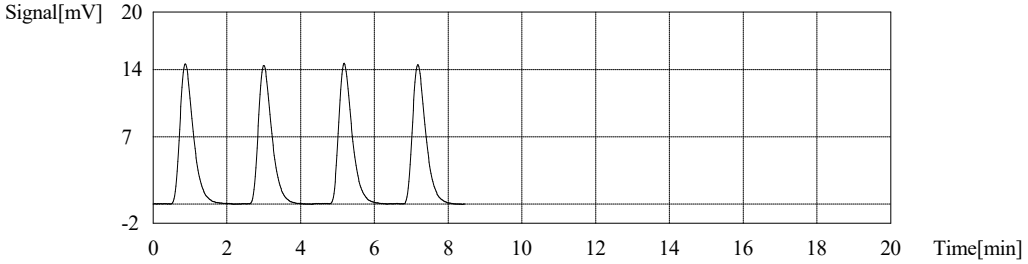
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:7.887mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	36.64	7.905mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:30:52 PM
2	36.65	7.907mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:33:16 PM
3	36.52	7.879mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:35:29 PM
4	36.42	7.857mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:37:50 PM

Mean Area 36.56
Mean Conc. 7.887mg/L



Sample

Sample Name: 680-232120-b-6
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

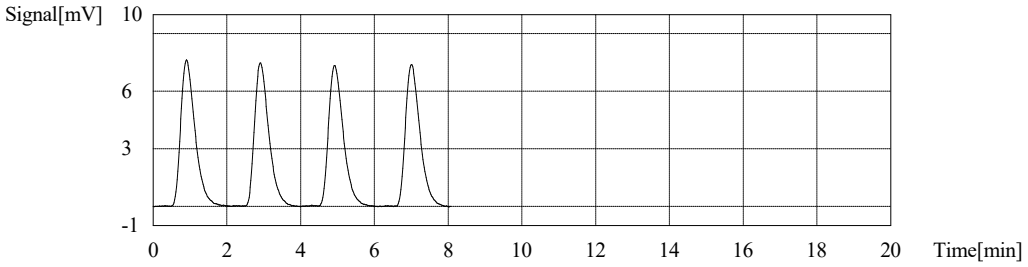
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:4.369mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	20.44	4.410mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:46:42 PM
2	20.01	4.317mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:48:55 PM
3	20.25	4.369mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:51:14 PM
4	20.30	4.379mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/21/2023 11:53:27 PM

Mean Area 20.25
Mean Conc. 4.369mg/L



Sample

Sample Name: 680-232120-c-7
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

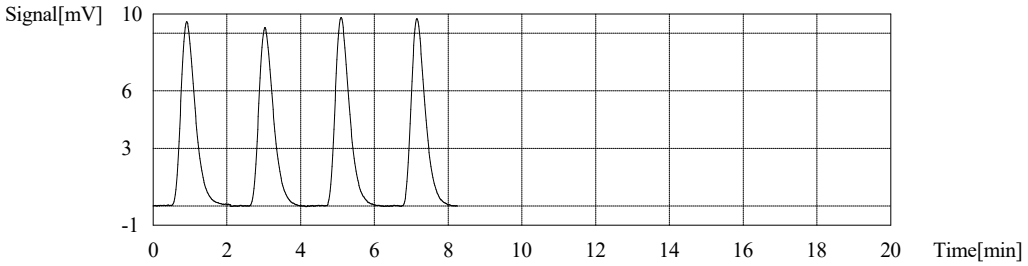
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:5.556mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	25.71	5.547mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:02:26 AM
2	25.42	5.484mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:04:46 AM
3	26.16	5.644mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:07:04 AM
4	25.73	5.551mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:09:18 AM

Mean Area 25.76
Mean Conc. 5.556mg/L



Sample

Sample Name: 680-232120-b-8
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

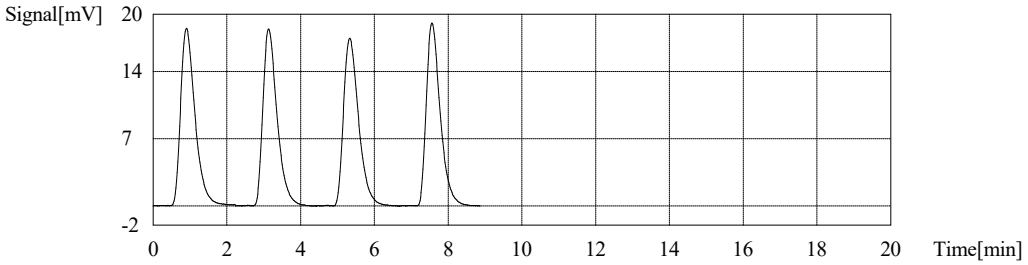
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:10.68mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	49.68	10.72mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:18:25 AM
2	48.99	10.57mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:20:51 AM
3	49.37	10.65mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:23:20 AM
4	50.07	10.80mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:25:46 AM

Mean Area 49.53
Mean Conc. 10.68mg/L



Sample

Sample Name: CCV
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

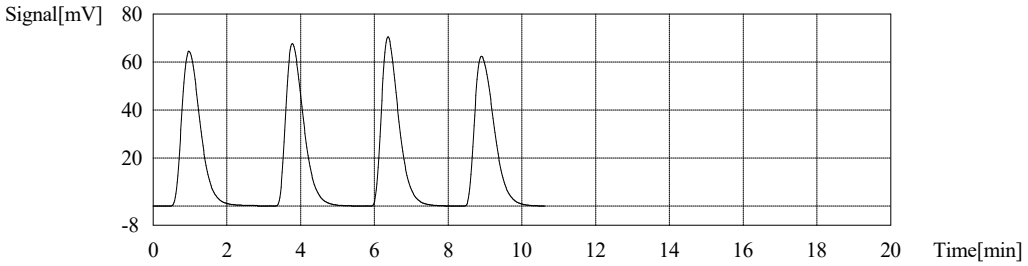
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:48.83mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	224.0	48.33mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:35:38 AM
2	225.6	48.67mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:38:28 AM
3	227.8	49.14mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:41:14 AM
4	228.0	49.19mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:44:08 AM

Mean Area 226.4
Mean Conc. 48.83mg/L



Sample

Sample Name: CCB
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

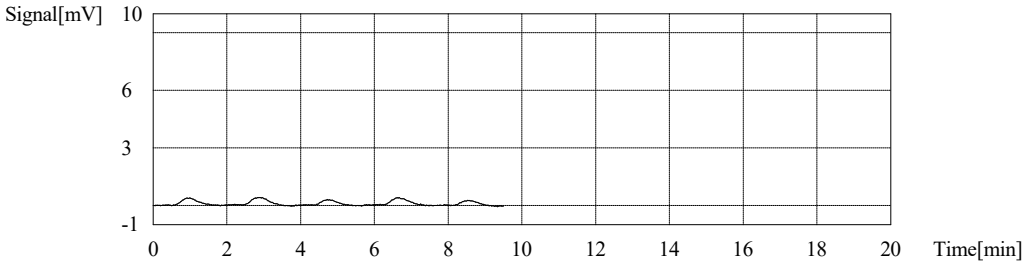
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2137mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.101	0.2375mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:52:55 AM
2	1.349	0.2910mg/L	50uL	1.000	E	TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:55:03 AM
3	0.7964	0.1718mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:57:11 AM
4	1.154	0.2490mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 12:59:19 AM
5	0.9109	0.1965mg/L	50uL	1.000		TOCCurve.2023_02_16_20_26_29.cal	3/22/2023 1:01:27 AM

Mean Area 0.9906
Mean Conc. 0.2137mg/L



Instr.Information

Instrument Options	TOC/ASI/IC Unit/
Catalyst	Regular Sensitivity

Sample

Sample Name:	H2S04 DI
Sample ID:	Untitled
Origin:	TOCCurve.cal
Status	Completed
Chk. Result	

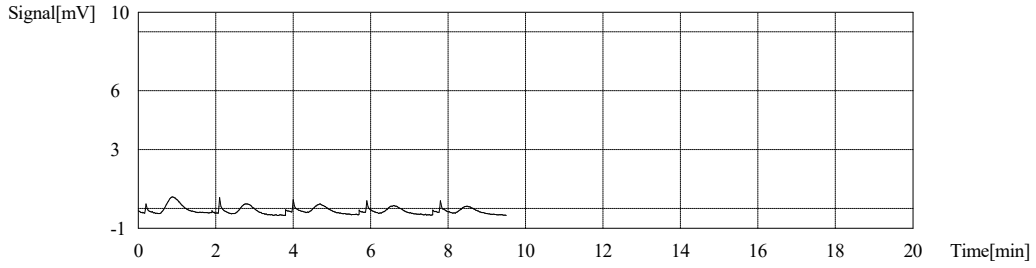
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2424mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	2.144	0.4534mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:29:26 AM
2	1.327	0.2806mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:31:39 AM
3	1.134	0.2398mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:33:50 AM
4	1.079	0.2282mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:36:02 AM
5	1.045	0.2210mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:38:14 AM

Mean Area	1.146
Mean Conc.	0.2424mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

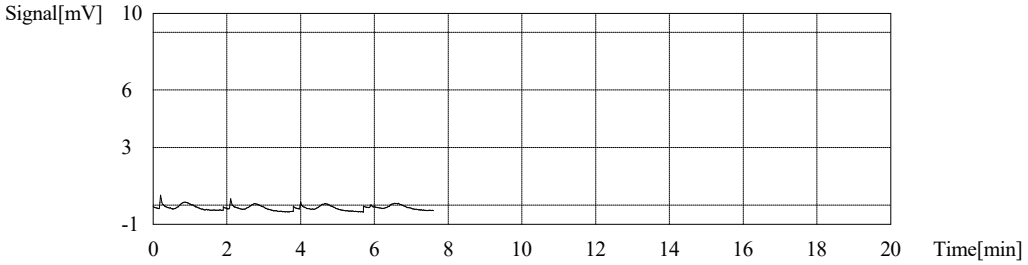
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1716mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.8973	0.1897mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:45:57 AM
2	0.7919	0.1675mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:48:08 AM
3	0.7407	0.1566mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:50:19 AM
4	0.8169	0.1727mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 11:52:31 AM

Mean Area 0.8117
Mean Conc. 0.1716mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

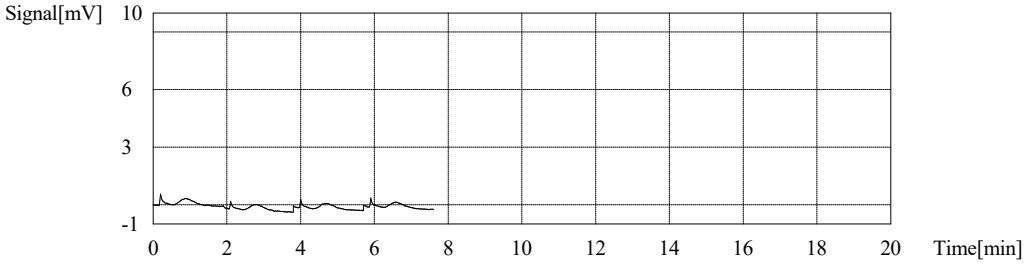
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1550mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.7917	0.1674mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:00:03 PM
2	0.7149	0.1512mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:02:10 PM
3	0.7488	0.1583mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:04:22 PM
4	0.6774	0.1432mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:06:31 PM

Mean Area 0.7332
Mean Conc. 0.1550mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

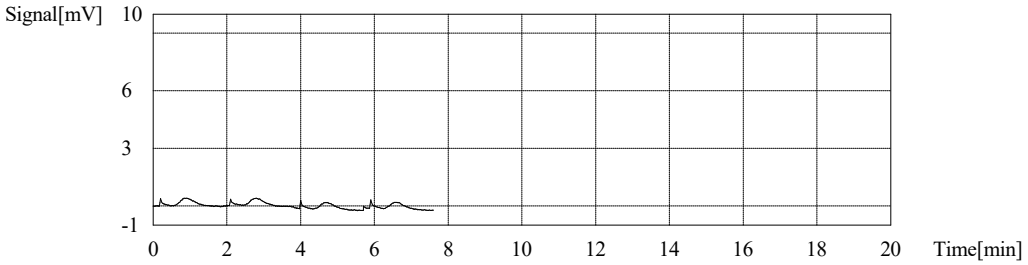
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2043mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.052	0.2225mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:14:03 PM
2	1.003	0.2121mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:16:09 PM
3	0.9495	0.2008mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:18:16 PM
4	0.8598	0.1818mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:20:26 PM

Mean Area 0.9661
Mean Conc. 0.2043mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

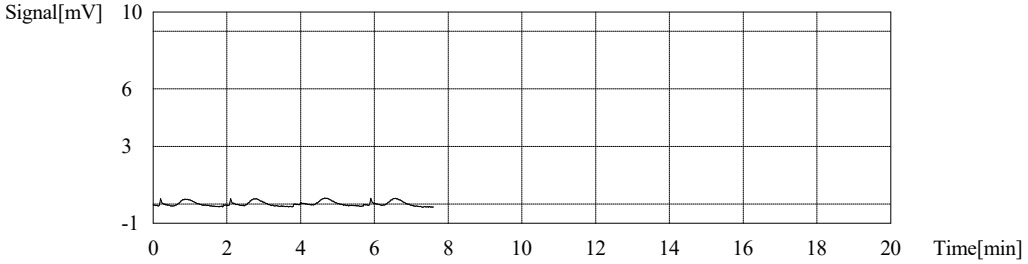
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1954mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.9161	0.1937mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:27:57 PM
2	0.8869	0.1875mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:30:07 PM
3	0.9170	0.1939mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:32:17 PM
4	0.9757	0.2063mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:34:29 PM

Mean Area 0.9239
Mean Conc. 0.1954mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

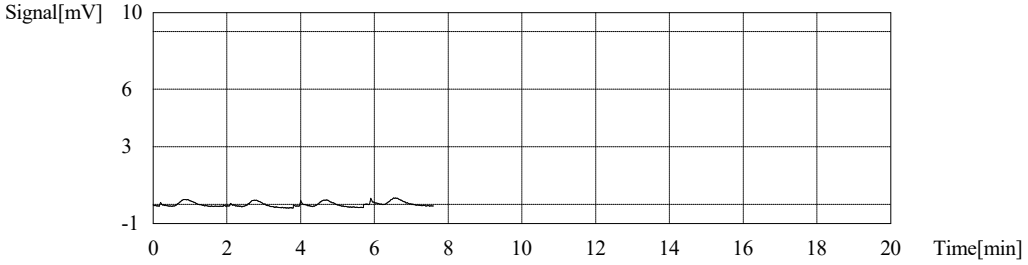
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1901mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.9672	0.2045mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:42:00 PM
2	0.8537	0.1805mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:44:14 PM
3	0.8820	0.1865mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:46:24 PM
4	0.8930	0.1888mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:48:35 PM

Mean Area 0.8990
Mean Conc. 0.1901mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

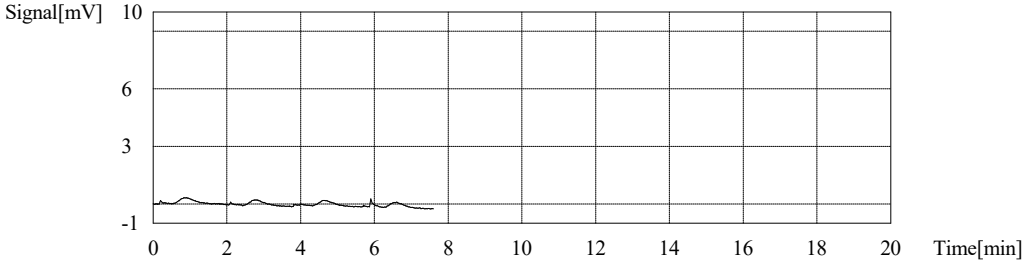
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1593mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.7552	0.1597mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:56:06 PM
2	0.8347	0.1765mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 12:58:13 PM
3	0.7170	0.1516mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:00:25 PM
4	0.7063	0.1494mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:02:35 PM

Mean Area 0.7533
Mean Conc. 0.1593mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

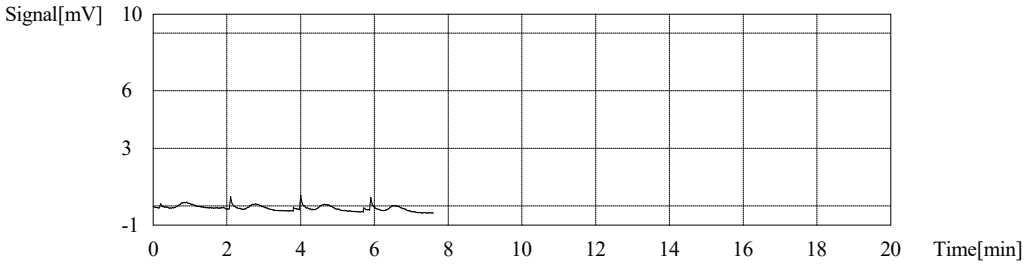
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1529mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.7407	0.1566mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:10:06 PM
2	0.7170	0.1516mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:12:18 PM
3	0.6922	0.1464mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:14:29 PM
4	0.7421	0.1569mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:16:40 PM

Mean Area 0.7230
Mean Conc. 0.1529mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

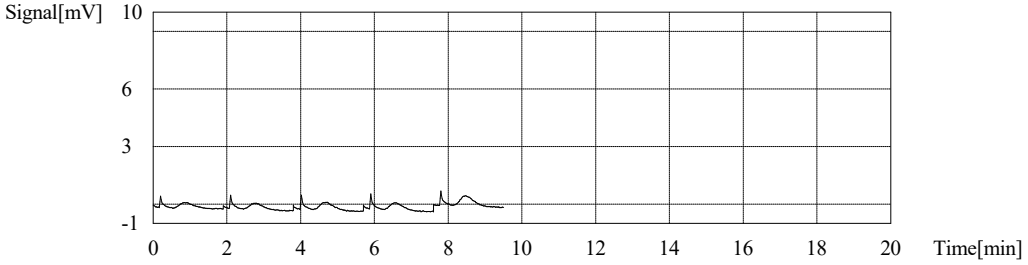
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1805mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.7181	0.1518mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:24:11 PM
2	0.8389	0.1774mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:26:22 PM
3	0.9491	0.2007mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:28:33 PM
4	0.9090	0.1922mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:30:43 PM
5	1.291	0.2730mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:32:55 PM

Mean Area 0.8538
Mean Conc. 0.1805mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

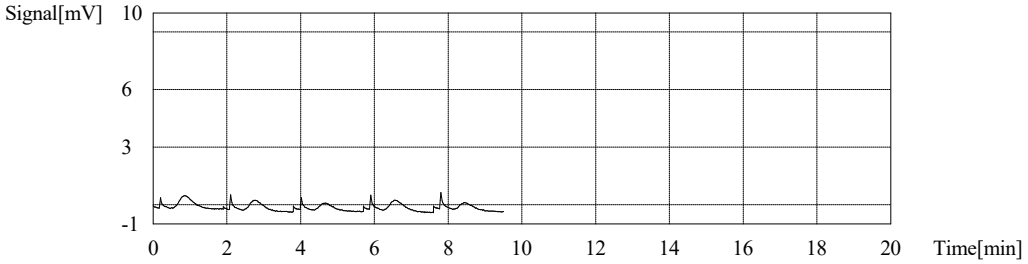
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2288mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.713	0.3622mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:40:39 PM
2	1.258	0.2660mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:42:52 PM
3	0.8894	0.1881mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:45:03 PM
4	1.333	0.2819mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:47:12 PM
5	0.8477	0.1793mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:49:22 PM

Mean Area 1.082
Mean Conc. 0.2288mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

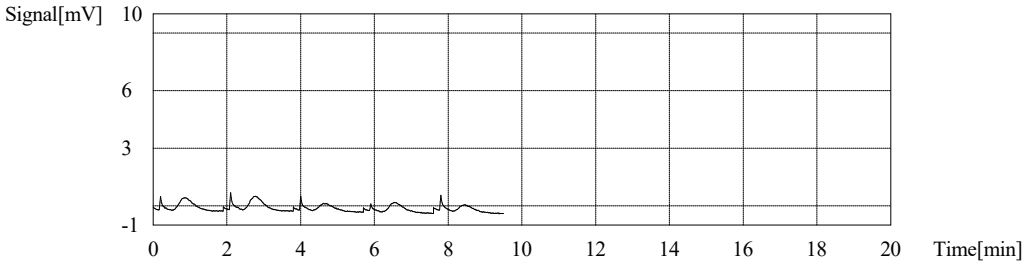
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.3024mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.718	0.3633mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:57:06 PM
2	1.731	0.3660mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 1:59:18 PM
3	0.9661	0.2043mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:01:28 PM
4	1.306	0.2762mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:03:38 PM
5	0.8299	0.1755mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:05:49 PM

Mean Area 1.430
Mean Conc. 0.3024mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

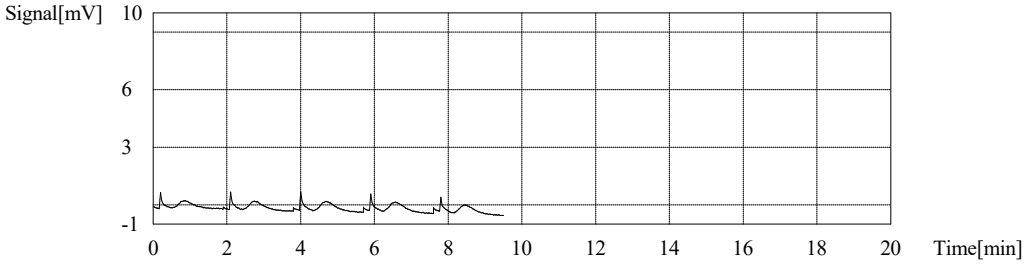
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2553mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.9815	0.2075mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:13:33 PM
2	1.084	0.2292mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:15:45 PM
3	1.283	0.2713mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:17:57 PM
4	1.307	0.2764mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:20:08 PM
5	1.155	0.2442mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:22:19 PM

Mean Area 1.207
Mean Conc. 0.2553mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

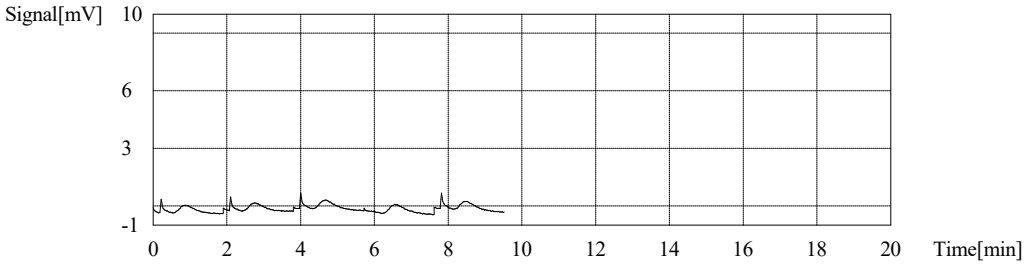
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2426mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.092	0.2309mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:30:05 PM
2	1.049	0.2218mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:32:15 PM
3	1.292	0.2732mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:34:27 PM
4	1.410	0.2982mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:36:38 PM
5	1.157	0.2447mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:38:49 PM

Mean Area 1.148
Mean Conc. 0.2426mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

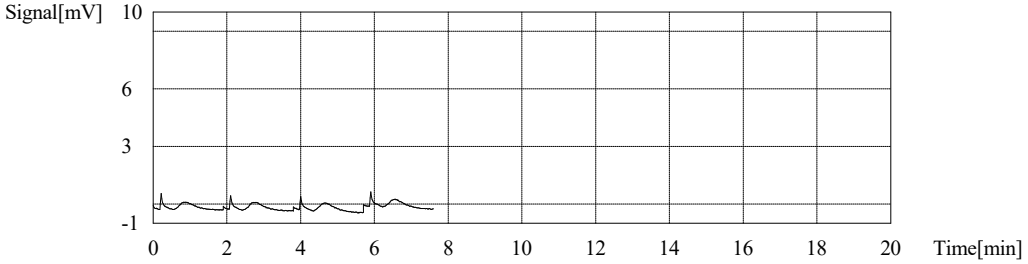
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2208mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.9461	0.2001mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:46:32 PM
2	1.076	0.2275mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:48:44 PM
3	1.117	0.2362mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:50:56 PM
4	1.038	0.2195mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 2:53:07 PM

Mean Area 1.044
Mean Conc. 0.2208mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

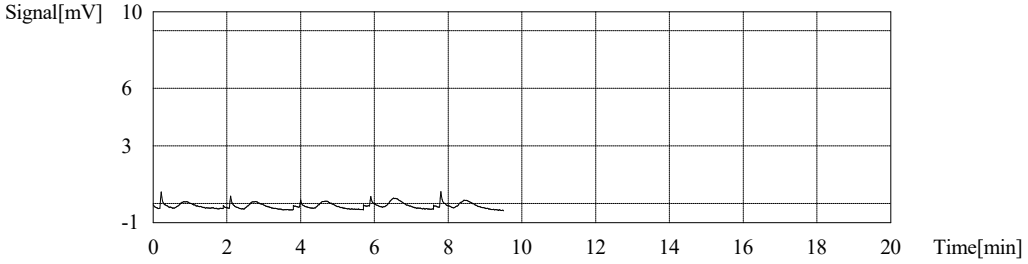
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2088mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.8411	0.1779mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:00:37 PM
2	0.9770	0.2066mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:02:50 PM
3	1.043	0.2206mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:05:03 PM
4	1.257	0.2658mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:07:14 PM
5	1.088	0.2301mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:09:25 PM

Mean Area 0.9873
Mean Conc. 0.2088mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

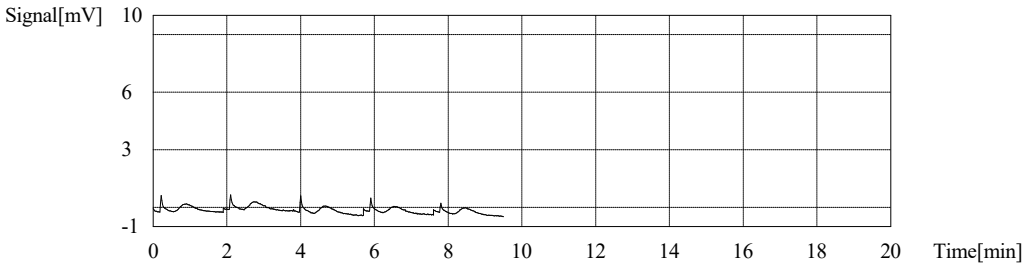
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.2127mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.041	0.2201mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:17:08 PM
2	1.032	0.2182mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:19:21 PM
3	1.111	0.2349mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:21:32 PM
4	0.8389	0.1774mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:23:43 PM
5	0.8198	0.1734mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:25:56 PM

Mean Area 1.006
Mean Conc. 0.2127mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

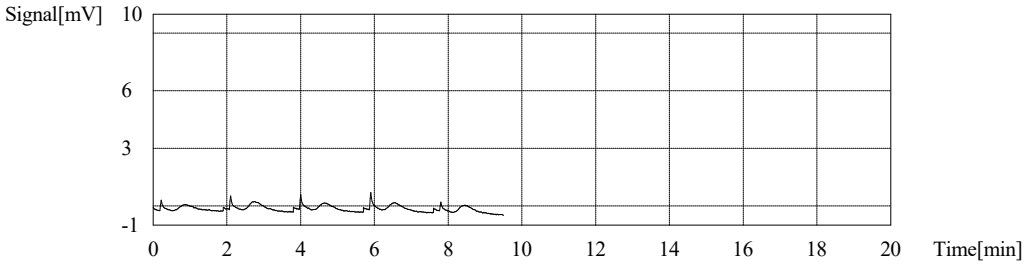
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1887mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.7485	0.1583mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:33:39 PM
2	1.204	0.2546mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:35:52 PM
3	0.9263	0.1959mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:38:03 PM
4	0.9602	0.2030mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:40:14 PM
5	0.9345	0.1976mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:42:27 PM

Mean Area 0.8924
Mean Conc. 0.1887mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

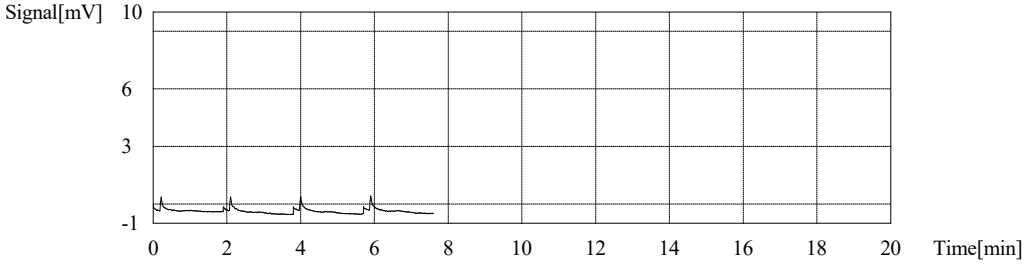
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.000mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:50:10 PM
2	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:52:22 PM
3	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:54:34 PM
4	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 3:56:46 PM

Mean Area 0.000
Mean Conc. 0.000mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

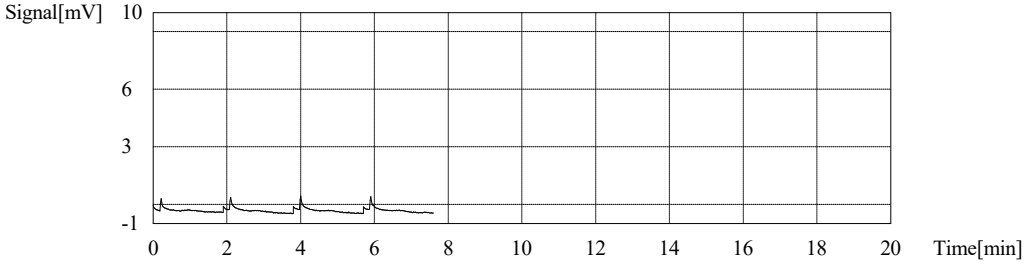
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.000mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 4:04:16 PM
2	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 4:06:27 PM
3	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 4:08:40 PM
4	0.000	0.000mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 4:10:53 PM

Mean Area 0.000
Mean Conc. 0.000mg/L



Cal. Curve

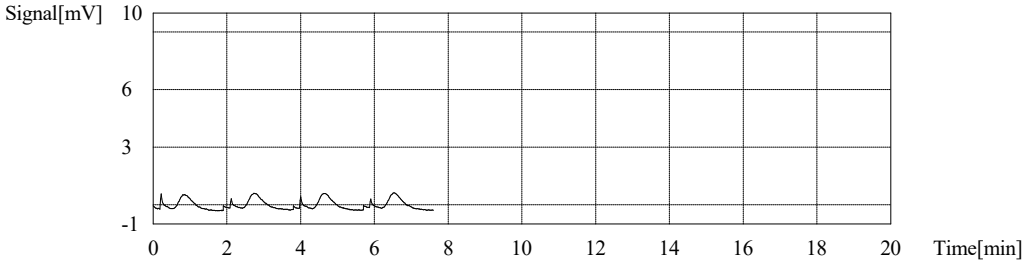
Sample Name: TC Curve
Sample ID: TC Curve
Cal. Curve: TCCURVE.2023_02_16_16_18_03.cal
Status Completed

Type	Anal.
Standard	TC

Conc: 0.000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	1.942	50uL	1.000	*******		2/16/2023 4:22:23 PM
2	2.011	50uL	1.000	*******		2/16/2023 4:24:31 PM
3	1.980	50uL	1.000	*******		2/16/2023 4:26:38 PM
4	2.022	50uL	1.000	*******		2/16/2023 4:28:48 PM

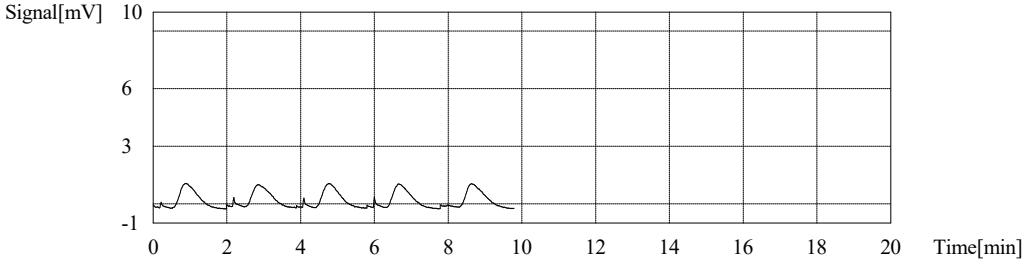
Acid Add. 0.000%
Mean Area 1.989



Conc: 0.5000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	4.166	50uL	1.000	*******		2/16/2023 4:33:25 PM
2	3.858	50uL	1.000	*******	E	2/16/2023 4:35:32 PM
3	3.959	50uL	1.000	*******		2/16/2023 4:37:41 PM
4	4.022	50uL	1.000	*******		2/16/2023 4:39:54 PM
5	4.098	50uL	1.000	*******		2/16/2023 4:42:09 PM

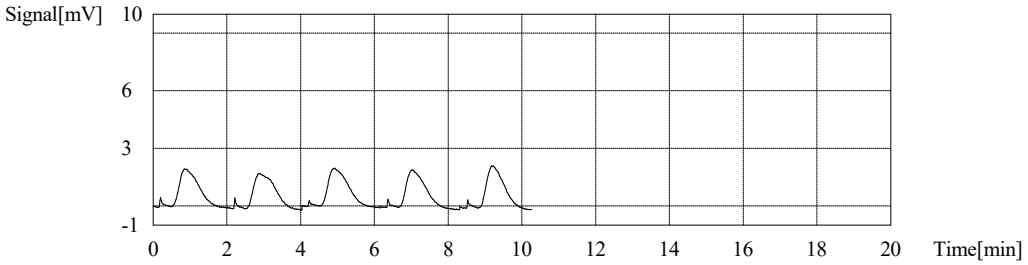
Acid Add. 0.000%
Mean Area 4.061



Conc: 1.000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	7.038	50uL	1.000	*******		2/16/2023 4:46:44 PM
2	7.372	50uL	1.000	*******		2/16/2023 4:48:58 PM
3	7.199	50uL	1.000	*******		2/16/2023 4:51:18 PM
4	6.888	50uL	1.000	*******	E	2/16/2023 4:53:41 PM
5	7.165	50uL	1.000	*******		2/16/2023 4:55:51 PM

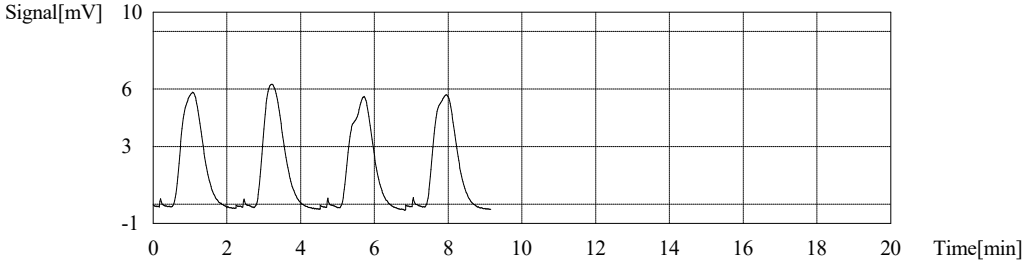
Acid Add. 0.000%
Mean Area 7.194



Conc: 5.000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	23.57	50uL	1.000	*******		2/16/2023 5:00:39 PM
2	23.88	50uL	1.000	*******		2/16/2023 5:03:09 PM
3	24.20	50uL	1.000	*******		2/16/2023 5:05:41 PM
4	24.33	50uL	1.000	*******		2/16/2023 5:08:15 PM

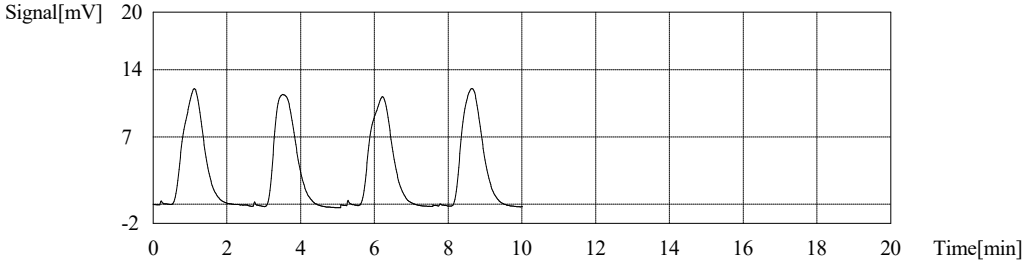
Acid Add. 0.000%
Mean Area 24.00



Conc: 10.00mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	46.08	50uL	1.000	*******		2/16/2023 5:13:26 PM
2	46.65	50uL	1.000	*******		2/16/2023 5:16:11 PM
3	46.13	50uL	1.000	*******		2/16/2023 5:18:56 PM
4	47.31	50uL	1.000	*******		2/16/2023 5:21:35 PM

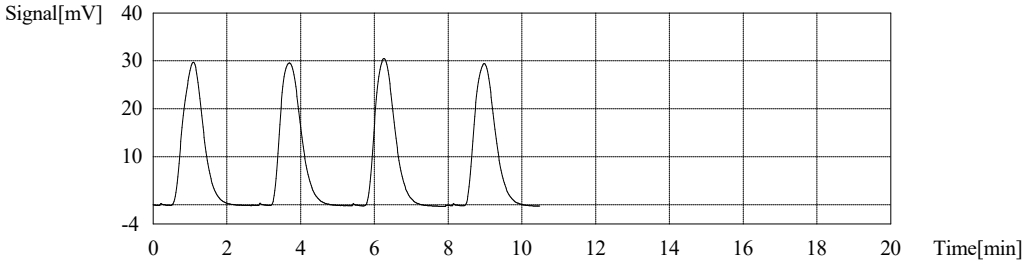
Acid Add. 0.000%
Mean Area 46.54



Conc: 25.00mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	112.7	50uL	1.000	*******		2/16/2023 5:26:54 PM
2	114.3	50uL	1.000	*******		2/16/2023 5:29:41 PM
3	113.3	50uL	1.000	*******		2/16/2023 5:32:36 PM
4	113.6	50uL	1.000	*******		2/16/2023 5:35:24 PM

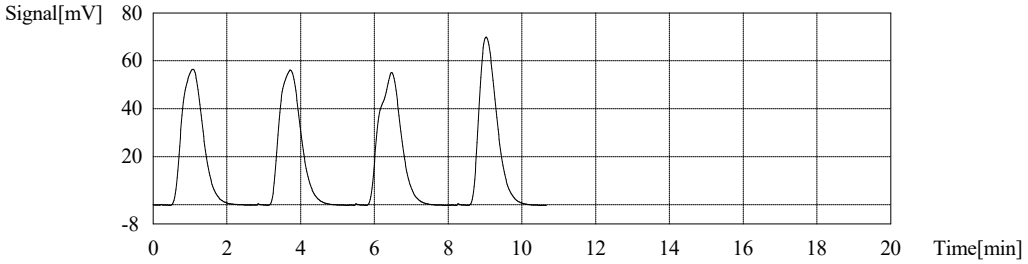
Acid Add. 0.000%
Mean Area 113.5



Conc: 50.00mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	225.0	50uL	1.000	*******		2/16/2023 5:40:40 PM
2	226.6	50uL	1.000	*******		2/16/2023 5:43:35 PM
3	228.3	50uL	1.000	*******		2/16/2023 5:46:34 PM
4	232.7	50uL	1.000	*******		2/16/2023 5:49:23 PM

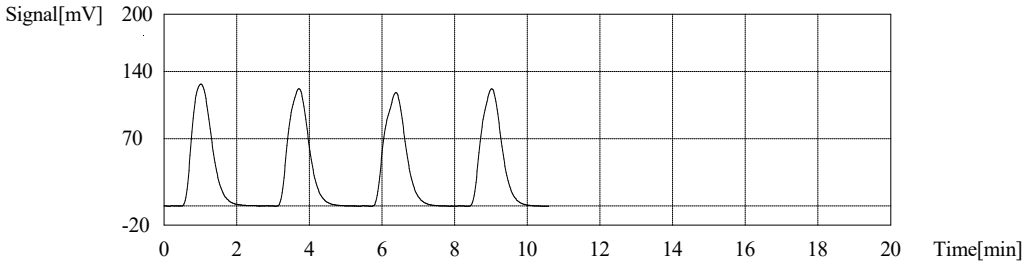
Acid Add. 0.000%
Mean Area 228.2



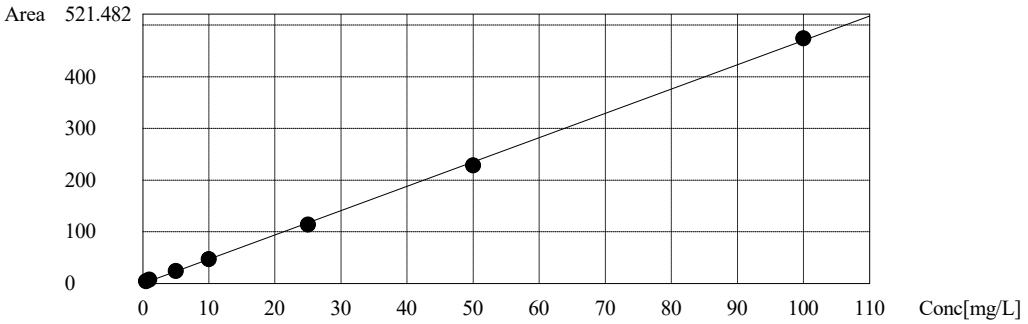
Conc: 100.0mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	474.9	50uL	1.000	*******		2/16/2023 5:54:38 PM
2	473.9	50uL	1.000	*******		2/16/2023 5:57:31 PM
3	474.5	50uL	1.000	*******		2/16/2023 6:00:25 PM
4	473.0	50uL	1.000	*******		2/16/2023 6:03:20 PM

Acid Add.	0.000%
Mean Area	474.1



Slope:	4.704
Intercept	0.000
r^2	0.9995
r	0.9998
RSE(%)	35.4
Zero Shift	Yes



Sample

Sample Name:	H2S04 DI
Sample ID:	Untitled
Origin:	TOCCurve.cal
Status	Completed
Chk. Result	

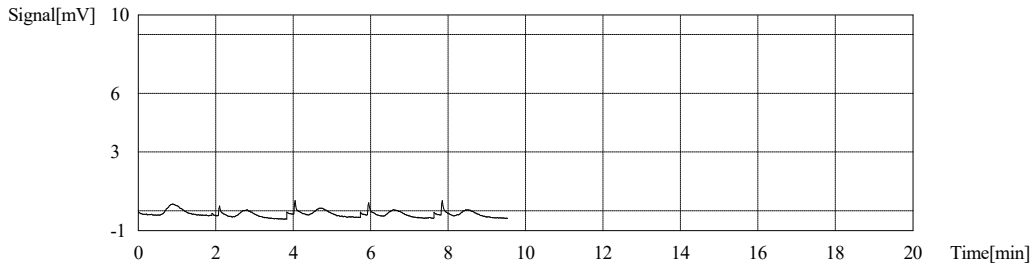
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1844mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	1.488	0.3146mg/L	50uL	1.000	E	TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:10:51 PM
2	0.9389	0.1985mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:13:05 PM
3	0.9204	0.1946mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:15:16 PM
4	0.8717	0.1843mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:17:28 PM
5	0.7577	0.1602mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:19:40 PM

Mean Area 0.8722
Mean Conc. 0.1844mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

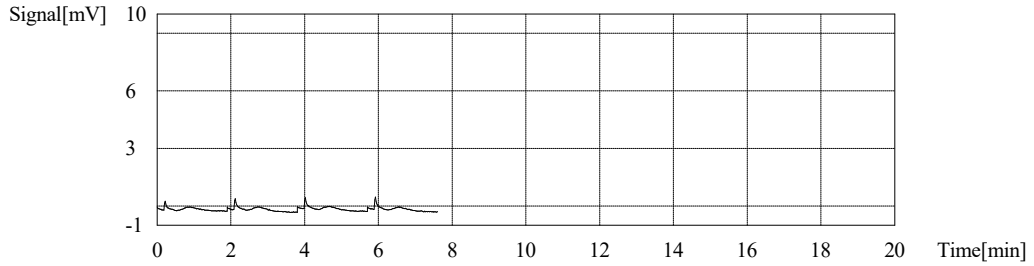
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.08468mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.4676	0.09888mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:27:24 PM
2	0.3892	0.08230mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:29:35 PM
3	0.3671	0.07763mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:31:47 PM
4	0.3779	0.07991mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:33:59 PM

Mean Area 0.4004
Mean Conc. 0.08468mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

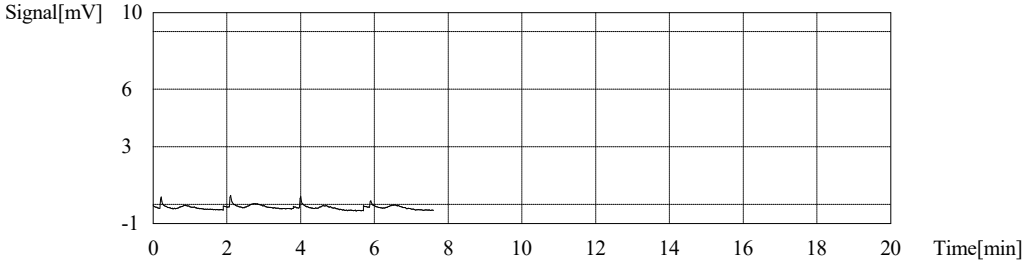
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.09013mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.3753	0.07936mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:41:30 PM
2	0.5369	0.1135mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:43:40 PM
3	0.3554	0.07515mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:45:50 PM
4	0.4373	0.09247mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:48:01 PM

Mean Area 0.4262
Mean Conc. 0.09013mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

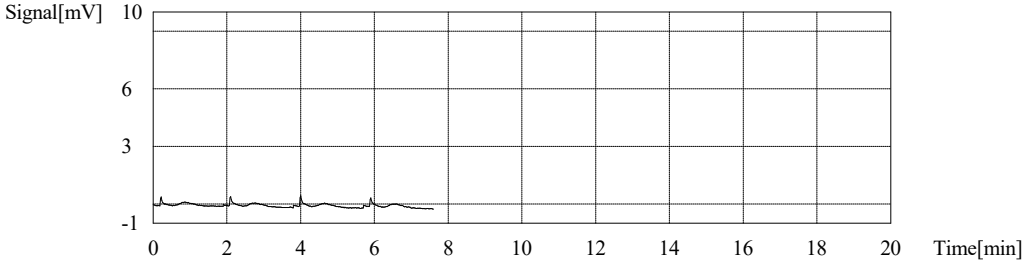
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.08579mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.4321	0.09137mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:55:32 PM
2	0.3494	0.07388mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:57:45 PM
3	0.4292	0.09076mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 6:59:56 PM
4	0.4122	0.08716mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:02:07 PM

Mean Area 0.4057
Mean Conc. 0.08579mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

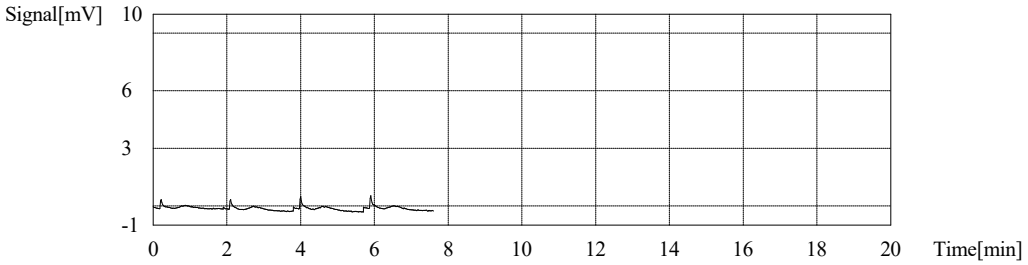
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.08044mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.3430	0.07253mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:09:38 PM
2	0.4093	0.08655mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:11:51 PM
3	0.3866	0.08175mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:14:02 PM
4	0.3828	0.08095mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:16:14 PM

Mean Area 0.3804
Mean Conc. 0.08044mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

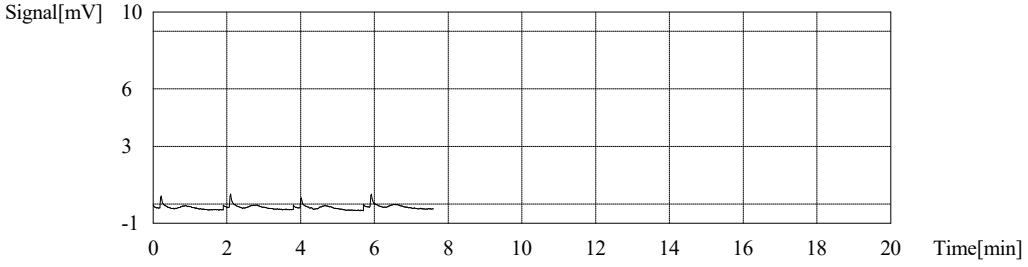
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.08284mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.3959	0.08372mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:23:45 PM
2	0.4387	0.09277mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:25:57 PM
3	0.3911	0.08270mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:28:07 PM
4	0.3414	0.07219mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:30:17 PM

Mean Area 0.3918
Mean Conc. 0.08284mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

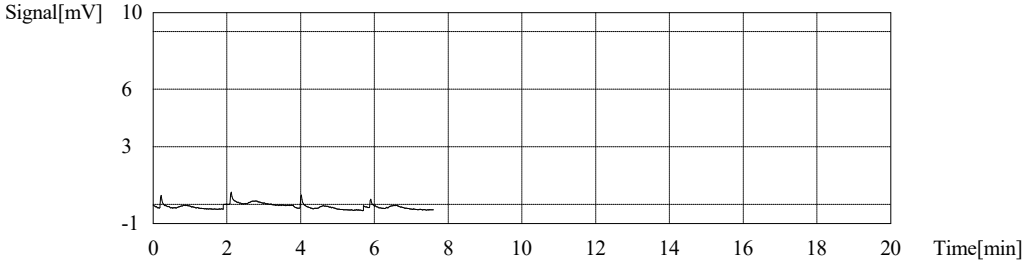
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.07270mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.3292	0.06961mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:37:48 PM
2	0.3642	0.07701mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:39:58 PM
3	0.2864	0.06056mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:42:06 PM
4	0.3955	0.08363mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:44:19 PM

Mean Area 0.3438
Mean Conc. 0.07270mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

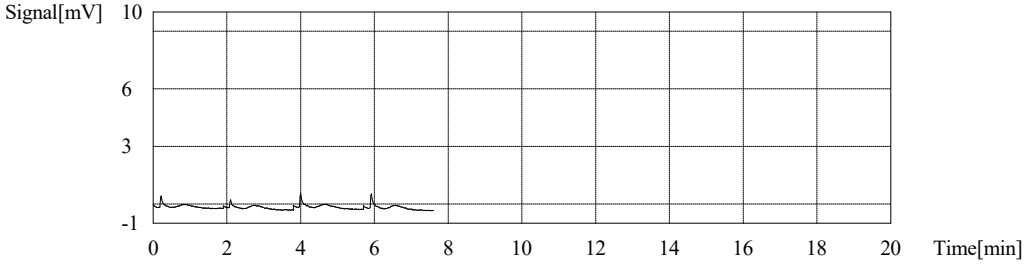
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.08823mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.3981	0.08418mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:51:50 PM
2	0.4035	0.08532mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:54:02 PM
3	0.4260	0.09008mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:56:13 PM
4	0.4414	0.09334mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 7:58:23 PM

Mean Area 0.4173
Mean Conc. 0.08823mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

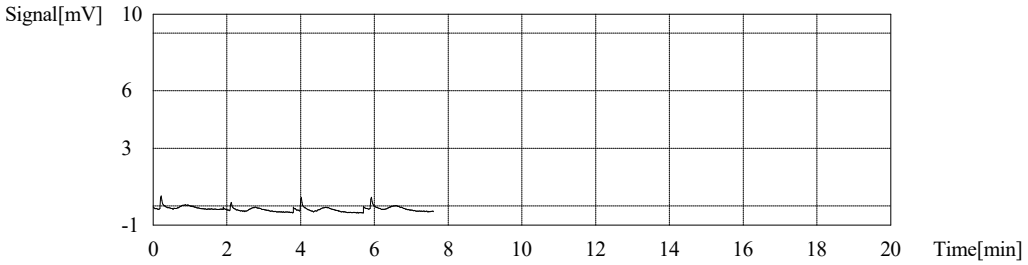
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1071mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.5083	0.1075mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:05:54 PM
2	0.4565	0.09653mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:08:06 PM
3	0.5362	0.1134mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:10:16 PM
4	0.5247	0.1110mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:12:26 PM

Mean Area 0.5064
Mean Conc. 0.1071mg/L



Sample

Sample Name: H2S04 DI
Sample ID: Untitled
Origin: TOCCurve.cal
Status Completed
Chk. Result

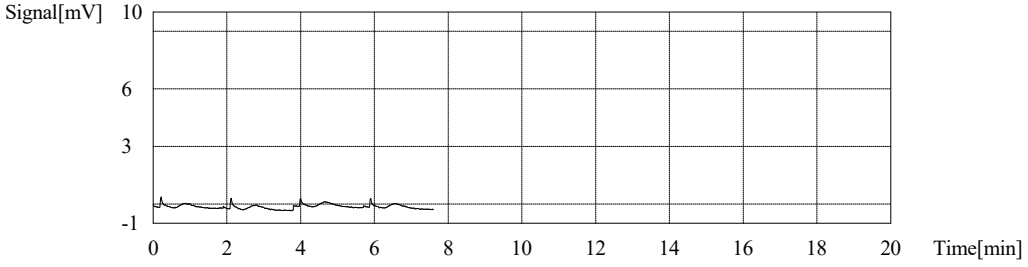
Type	Anal.	Manual Dilution	Result
Unknown	NPOC	1.000	NPOC:0.1221mg/L

1. Det

Anal.: NPOC

No.	Area	Conc.	Inj. Vol.	Aut. Dil.	Ex.	Cal. Curve	Date / Time
1	0.5821	0.1231mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:19:57 PM
2	0.5369	0.1135mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:22:08 PM
3	0.6574	0.1390mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:24:19 PM
4	0.5329	0.1127mg/L	50uL	1.000		TOCCurve.2023_02_15_19_37_27.cal	2/16/2023 8:26:29 PM

Mean Area 0.5773
Mean Conc. 0.1221mg/L



Cal. Curve

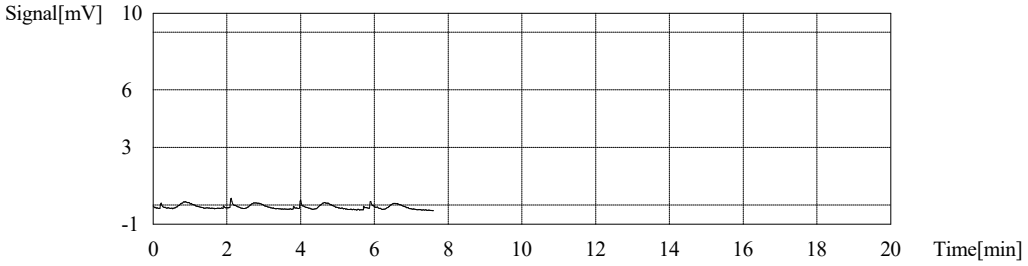
Sample Name: TOC CURVE
Sample ID: Untitled
Cal. Curve: TOCCurve.2023_02_16_20_26_29.cal
Status Completed

Type	Anal.
Standard	NPOC

Conc: 0.000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	0.7940	50uL	1.000	*******		2/16/2023 8:35:16 PM
2	0.7958	50uL	1.000	*******		2/16/2023 8:37:25 PM
3	0.8753	50uL	1.000	*******		2/16/2023 8:39:33 PM
4	0.7986	50uL	1.000	*******		2/16/2023 8:41:42 PM

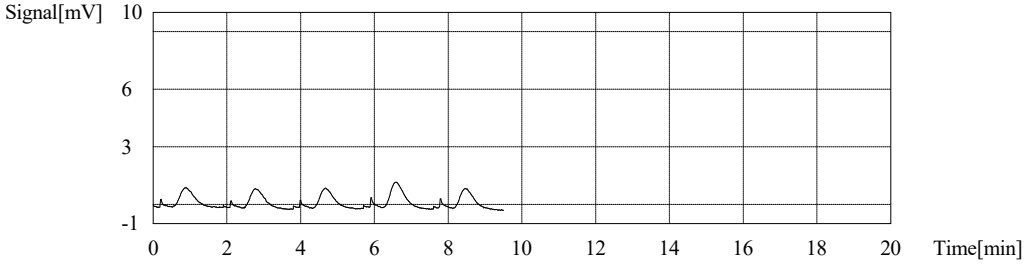
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 0.8159



Conc: 0.5000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	2.677	50uL	1.000	*******		2/16/2023 8:50:29 PM
2	2.663	50uL	1.000	*******		2/16/2023 8:52:38 PM
3	2.677	50uL	1.000	*******		2/16/2023 8:54:46 PM
4	3.471	50uL	1.000	*******	E	2/16/2023 8:56:54 PM
5	2.757	50uL	1.000	*******		2/16/2023 8:59:02 PM

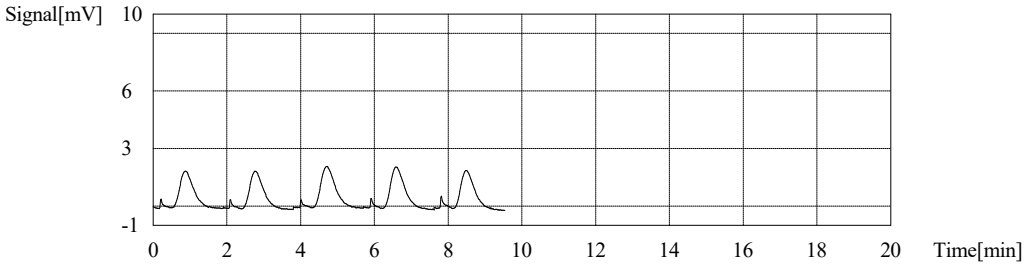
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 2.693



Conc: 1.000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	4.812	50uL	1.000	*******		2/16/2023 9:07:44 PM
2	5.032	50uL	1.000	*******		2/16/2023 9:09:54 PM
3	5.840	50uL	1.000	*******	E	2/16/2023 9:12:03 PM
4	5.736	50uL	1.000	*******		2/16/2023 9:14:13 PM
5	5.117	50uL	1.000	*******		2/16/2023 9:16:22 PM

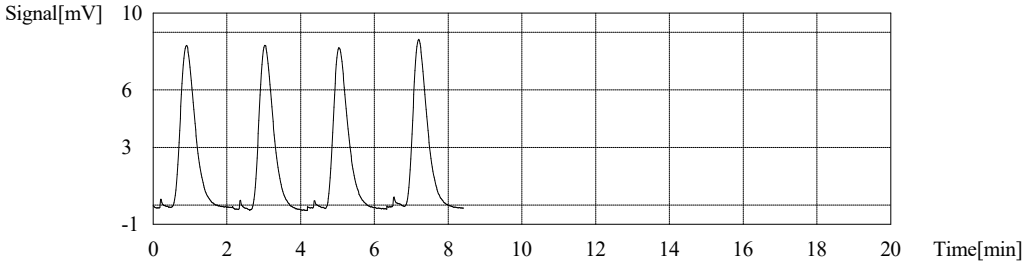
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 5.174



Conc: 5.000mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	23.05	50uL	1.000	*******		2/16/2023 9:25:19 PM
2	22.78	50uL	1.000	*******		2/16/2023 9:27:36 PM
3	22.47	50uL	1.000	*******		2/16/2023 9:30:00 PM
4	22.91	50uL	1.000	*******		2/16/2023 9:32:19 PM

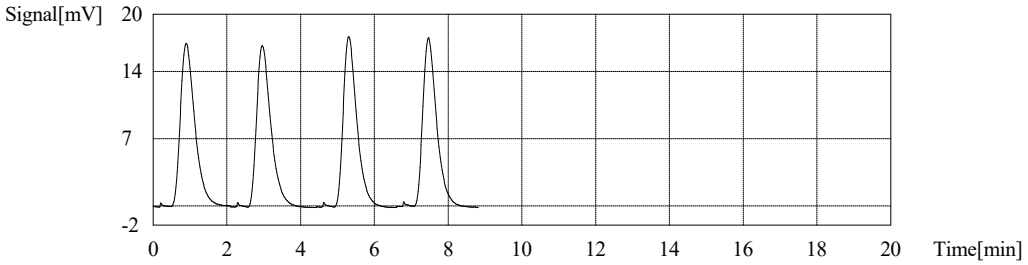
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 22.80



Conc: 10.00mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	46.02	50uL	1.000	*******		2/16/2023 9:41:17 PM
2	45.18	50uL	1.000	*******		2/16/2023 9:43:53 PM
3	45.36	50uL	1.000	*******		2/16/2023 9:46:17 PM
4	45.04	50uL	1.000	*******		2/16/2023 9:48:45 PM

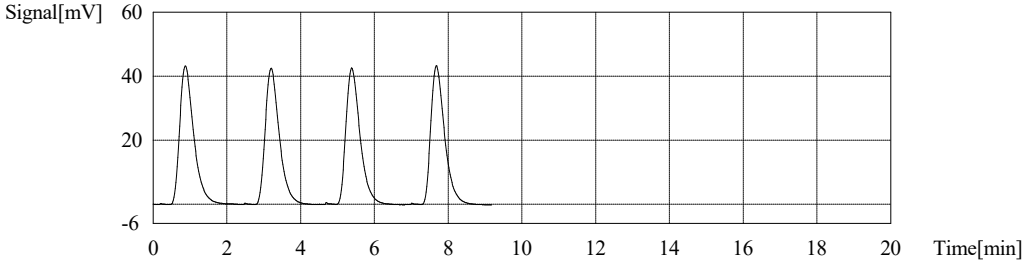
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 45.40



Conc: 25.00mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	114.4	50uL	1.000	*******		2/16/2023 9:57:55 PM
2	112.6	50uL	1.000	*******		2/16/2023 10:00:23 PM
3	113.3	50uL	1.000	*******		2/16/2023 10:02:57 PM
4	112.7	50uL	1.000	*******		2/16/2023 10:05:34 PM

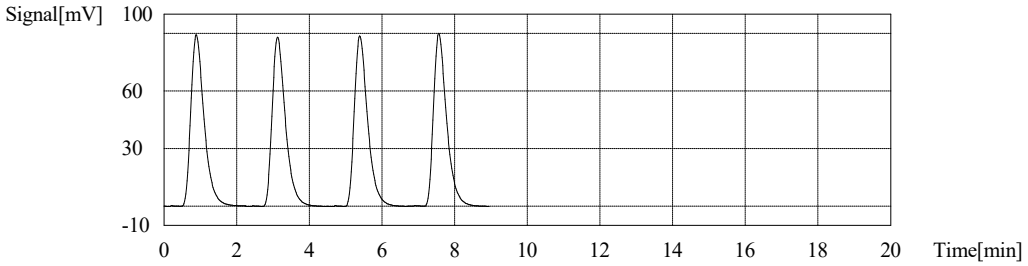
Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 113.3



Conc: 50.00mg/L

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	225.9	50uL	1.000	*******		2/16/2023 10:14:42 PM
2	223.0	50uL	1.000	*******		2/16/2023 10:17:12 PM
3	225.2	50uL	1.000	*******		2/16/2023 10:19:39 PM
4	224.5	50uL	1.000	*******		2/16/2023 10:22:09 PM

Acid Add. 0.000%
Sparge Gas Flow 80mL/min
Sp. Time 180.0sec
Mean Area 224.7



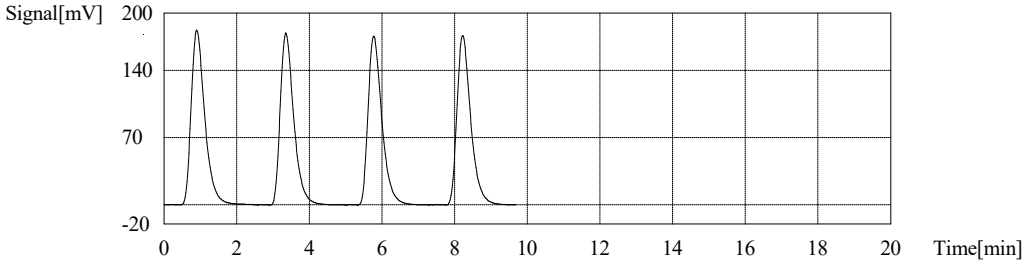
Conc: 100.0mg/L

TOC-Control L Report

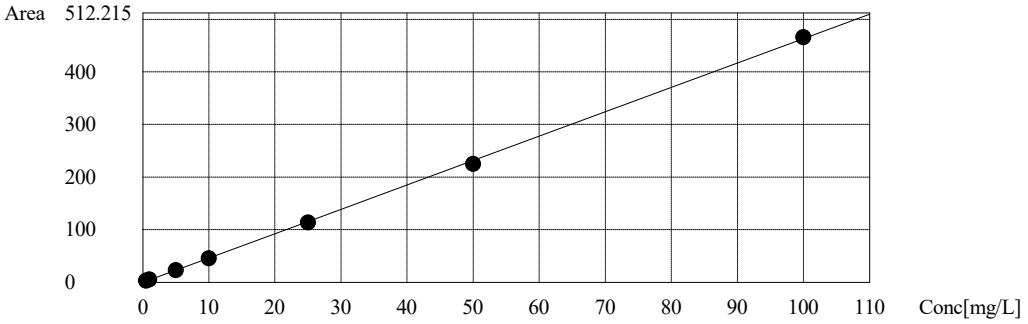
9060_TOC_TC_ICAL2022_02_16_001_TOC7.tlx

No.	Area	Inj. Vol.	Aut. Dil.	Rem.	Ex.	Date / Time
1	472.7	50uL	1.000	*******		2/16/2023 10:31:29 PM
2	461.6	50uL	1.000	*******		2/16/2023 10:34:10 PM
3	463.5	50uL	1.000	*******		2/16/2023 10:36:50 PM
4	464.8	50uL	1.000	*******		2/16/2023 10:39:28 PM

Acid Add.	0.000%
Sparge Gas Flow	80mL/min
Sp. Time	180.0sec
Mean Area	465.7



Slope:	4.635
Intercept	0.000
r^2	0.9997
r	0.9998
RSE(%)	8.6
Zero Shift	Yes



Shipping and Receiving Documents

Eurofins Savannah

Katahdin ANALYTICAL SERVICES

Sub-contract Laboratory Chain of Custody

Client:	Contact:	Email:	Phone #:
Katahdin Analytical Services	Heather Manz	hmanz@katahdinlab.com	(207) 874-2400

Address:	City:	State:	Zip:	Project Name:
600 Technology Way	Scarborough	Maine	04074	Fort Jackson

KAS WO #:	Quote #:	Purchase Order #:	TAT:
SQ1201		SQ 1201	2 week

Verbal TAT: N/A

RPT Level: 4 | Reporting Format: DOD | EDD: EQUIS EQEDD

Sample ID:	Collect Date/Time:	Matrix:	No. of Containers	Pres.	MS/MSD Dup.	Analysis: DOC 9060 Filtered? (Y) / N	Analysis: Alkalinity 2320B Filtered? Y / N	~~Analysis:~~ Filtered? Y / N
SWDUP	08-MAR-23 00:00	AQ	3	yes see Below	No	✓	✓	
JACKSON-SWMC3-DC-01	08-MAR-23 14:00	AQ	7		yes	✓	✓	
JACKSON-SWMC2-DC-01	08-MAR-23 11:30	AQ	3		No	✓	✓	
JACKSON-SWJC1-DC-01	08-MAR-23 13:30	AQ	3			✓	✓	
JACKSON-SWMC1-DC-01	08-MAR-23 11:50	AQ	3			✓	✓	
JACKSON-SWCC3-DC-01	08-MAR-23 14:15	AQ	3			✓	✓	
JACKSON-SWCC4-DC-01	08-MAR-23 09:40	AQ	3			✓	✓	
JACKSON-SWCC2-DC-01	08-MAR-23 10:00	AQ	3	✓	✓	✓	✓	
[redacted]								
[redacted]								
[redacted]								
[redacted]								

Relinquished By:	Date/Time:	Received By:
	3/15/23 1000	TA 3-16-23 1000

Comments:

DOC preservative H_2SO_4

Alkalinity unpreserved

Same project as 680-230049

0.7/0.7

680-232120 Chain of Custody

Login Sample Receipt Checklist

Client: Katahdin Analytical Services

Job Number: 680-232120-1

Login Number: 232120
List Number: 1
Creator: Sims, Robert D

List Source: Eurofins Savannah

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

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Appendix E: Data Validation Summaries

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DATA VALIDATION REPORT

Operational Range Assessments
Fort Jackson
March 2023 Sampling

SDGs: SQ1188 and SQ1201

Katahdin Analytical Services, Eurofins Lancaster Laboratories Environment Testing, LLC, Eurofins Savannah, and Eurofins Denver

Prepared by

ENVIRONMENTAL DATA SERVICES, LTD.

Prepared for

EA Engineering, Science, and Technology, Inc.

Report Released 4/19/2023

5 Brilliant Avenue, Pittsburgh, PA 15215
412.408.3288 I www.eds-pa.com

ENVIRONMENTAL DATA SERVICES, LTD.

EXECUTIVE NARRATIVE

Sample Delivery Group: SQ1188
Laboratory: Katahdin Analytical Services
Site: Fort Jackson
Sampling dates: 3/8/2023
Number of Samples: 8
Test Method: SW-846 8330
Analysis: Explosives

Quality Assurance Project Plan: Draft Contract Quality Assurance Project Plan FY20 Update Operational Range Assessments, FY18-22 Army Operational Range Assessment Cycle, Multiple Sites for Active Army and Army Reserve, April 2020 (QAPP).

Validation Guidelines: United States Environmental Protection Agency (USEPA) Contract Laboratory Program National Functional Guidelines for Organic Superfund Methods Data Review, EPA-540-R-2017-002. Office of Superfund Remediation and Technology Innovation, January 2017; Department of Defense General Data Validation Guidelines, February 2018; and USEPA SW-846 Test Method 8330B: Nitroaromatics, Nitroamines, and Nitrate Esters by High Performance Liquid Chromatography (HPLC), Revision 2, October 2006.

Client Sample ID	Laboratory Sample Identification	Matrix	Validation Stage
JACKSON-SDCC3-DC-01	SQ1188-1	sediment	S2BVM
JACKSON-SDCC2-DC-01	SQ1188-3	sediment	S2BVM
JACKSON-SDMC3-DC-01	SQ1188-5	sediment	S2BVM
JACKSON-SDMC1-DC-01	SQ1188-7	sediment	S2BVM
JACKSON-SDCC4-DC-01	SQ1188-9	sediment	S2BVM
JACKSON-SDJC1-DC-01	SQ1188-11	sediment	S2BVM
JACKSON-SDMC2-DC-01	SQ1188-13	sediment	S2BVM
SDDUP	SQ1188-15	sediment	S2BVM

Table 1 provides a summary of the major and minor data quality issues applied to this data set. All data are acceptable except those results which have been qualified with “X”, rejected. Data validation qualifiers along with associated descriptions are provided in Table 2. All data qualification related to this group of samples is detailed on the attached sheets.

All data users should note two facts. First, an "X" flag means that the associated value is unusable due to significant quality control (QC) problems, the data is invalid and provides no information as to whether the compound is present or not. "X" values should not appear on any data tables even as a last resort. Second, no analyte concentration, even if it passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data, but any value potentially contains error.

DATA ASSESSMENT

1. NARRATIVE AND COMPLETENESS REVIEW

The case narrative was reviewed, and the data package was checked for completeness. No discrepancies were noted.

2. SAMPLE DELIVERY AND CONDITION

The samples arrived at the laboratory in acceptable condition.

Proper custody was documented.

3. HOLDING TIME

The amount of an analyte in a sample can change with time due to chemical instability, degradation, volatilization, etc. If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J". The non-detect results will be flagged as not detected at an estimated quantitation limit, "UJ", unless the holding time is grossly exceeded (by more than two times the holding time specified), in which case non-detect results are flagged X, rejected. Qualifications were applied to the samples and analytes as shown below.

No problems were found with this criterion.

4. CALIBRATION

Satisfactory instrument calibration is established to ensure that the instrument is capable of producing acceptable quantitative data. An initial calibration demonstrates that the instrument is capable of giving acceptable performance at the beginning of an experimental sequence. The continuing calibration checks document that the instrument is giving satisfactory daily performance.

Percent Relative Standard Deviation and Percent Difference

Percent relative standard deviation (%RSD) is calculated from the initial calibration and is used to indicate the stability of the specific compound response factor over increasing concentration. Percent difference (%D) compares the response factor of the continuing calibration check to the mean response factor (RRF) from the initial calibration. Percent difference is a measure of the instrument's daily performance. If %RSD exceeds limits outlined in validation guidance (20%), qualify all associated positive results "J". If the %D exceeds a limit of 20% for any analyte, qualify all associated positive results "J" and non-detects "UJ". If %RSD and %D grossly exceed QC criteria, non-detect data may be qualified X.

The %RSD values for the target analytes were within quality control limits in all cases.

Continuing calibration verifications (CCV) were analyzed at the proper frequencies, and all observed %D values for those associated with reported results for the samples in this sample delivery group (SDG) met quality control criteria for the compounds reported with the following exceptions.

The observed %D values for tetryl in two CCVs on the primary column on instrument HPLC02 were outside of acceptance limits. All samples in this SDG are associated with the non-compliant CCVs. The results reported for tetryl were non-detected, therefore, have been qualified "UJ" on this basis.

5. BLANK CONTAMINATION

Quality assurance (QA) blanks (i.e. method, trip, field, or rinse blanks) are prepared to identify any contamination which may have been introduced into the samples during sample preparation or field activity. Method blanks measure laboratory contamination. Trip blanks, field, equipment, and rinse blanks measure cross-contamination of samples during field operations. When an equipment blank, trip blank, or lab blank has an analyte detection greater than the analyte method detection limit (MDL), then all associated field samples are flagged according to validation guidance.

A) Method blank contamination:

No problems were found for this criterion.

B) Field/Equipment blank contamination:

No sample was submitted as an equipment blank in association with the samples in this SDG.

6. SURROGATES/SYSTEM MONITORING COMPOUNDS

All samples are spiked with surrogate/system monitoring compounds (SMC) prior to sample preparation to evaluate overall laboratory performance and efficiency of the analytical technique. If the measured surrogate/SMC concentrations were outside contract specifications, qualifications were applied to the samples and analytes as shown below. All surrogates should meet the laboratory advisory limits.

No problems were found with this criterion with the following exceptions.

The surrogate recovery observed during the analysis of sample JACKSON-SDMC1-DC-01 was less than the lowest acceptance limit. Potential low bias is indicated. The results reported for target analytes in the impacted sample were all non-detect and have been qualified "UJ" on this basis.

7. COMPOUND QUANTIFICATION

Target compound result quantitation was not reviewed at the Stage 2B level.

Manual integrations were not reviewed at the Stage 2B level.

8. COMPOUND IDENTIFICATION

Explosives Fraction

The retention times (RTs) of reported compounds must fall within the calculated retention time windows for the two chromatographic columns. The %D of the positive results obtained on the two GC columns should be less than or equal to 25%.
Retention Time

No problems were found for this criterion.

Percent Difference

The concentration of reported compounds from the two chromatographic columns must have a relative percent difference RPD of less than 40% as stated in the project QAPP.

No problems were found for this criterion.

9. MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Matrix spike/matrix spike duplicate (MS/MSD) data is generated to determine the long-term precision and accuracy of the analytical method in various matrices. The MS/MSD data may be used in conjunction with other quality control criteria for additional qualification of data. The spiking compound recoveries should meet the limits outlined in the Department of Defense Quality Systems Manual Version 5.1. Further, per the QAPP the reproducibility as demonstrated by relative percent difference (RPD) for the pair must be less than 20%.

Sample JACKSON-SDMC3-DC-01 was submitted for MS/MSD evaluation in association with this SDG. Upon evaluation all precision and accuracy indictors were favorable.

10. FIELD DUPLICATES

Field duplicates may be taken and analyzed as an indication of overall precision. Per the project QAPP, a control limit of 35% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values greater than or equal to five times (5x) the LOQ. A control limit of the +/- the LOQ shall be used if either the sample or duplicate value is less than 5x the LOQ. For field duplicate analyses that do not meet the technical criteria, the action is applied to only the field sample and it's duplicate.

Samples JACKSON-SDMC3-DC-01 and SDDUP were submitted as a field duplicate pair in association with this SDG. Adequate field precision was demonstrated.

11. LABORATORY CONTROL SAMPLES

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation. Aqueous/water, soil/sediment, wipe, and filter LCSs shall be analyzed for each analyte utilizing the same sample preparations, analytical methods, and quality assurance/quality control (QA/QC) procedures as employed for the samples. All LCS percent recoveries must fall within control limits identified in the Department of Defense Quality Systems Manual Version 5.1. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion requiring qualification of sample results.

12. OTHER PROBLEMS

None.

13. DILUTIONS, RE-EXTRACTIONS & REANALYSIS

Samples may be re-analyzed for dilution, re-extraction and for other QC reasons. In such cases, the best result values are used.

No dilution, re-extraction, or other re-analysis was performed on the samples in association with this SDG.

Table 1 Major and Minor Findings

	Were acceptance criteria met?		
	Yes	No	
Explosives		Major	Minor
Sample Preservation	x		
Holding Time	x		
Percent Relative Standard Deviation and Percent Difference			x
Method Blank	x		
Equipment/Field Blank	NA		
Surrogates/System Monitoring Compounds			x
Compound Quantification	NA		
Compound Identification – Explosives	NA		
Matrix Spike/Matrix Spike Duplicate	x		
Field Duplicate	x		
Laboratory Control Samples	x		
Other Quality Control Data out of Specification	x		

Major = Major data quality issue identified resulting in rejection of data.
Minor = Minor data quality issue identified resulting in the qualification of data. Data qualification should be used to inform the data users of data limitations.
NA = Not applicable

Table 2 Data Validation Qualifiers

Data Qualifier	Definition
U	The analyte was analyzed for but was not detected above the level of the reported sample quantitation limit.
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result is an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
X	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

ENVIRONMENTAL DATA SERVICES, LTD.

EXECUTIVE NARRATIVE

Sample Delivery Group: SQ1188
Laboratory: Katahdin Analytical Services
Site: Fort Jackson
Sampling dates: 3/8/2023
Number of Samples: 8
Test Method: SW-846 6010
Analysis: Sediment: Simultaneously Extracted Metals (SEM)
Cadmium, Copper, Lead, Nickel, Silver, Zinc.

Quality Assurance Project Plan: Final Site-Specific Quality Assurance Project Plan Operational Range Assessments, FY18-22 Army Operational Range Assessment Cycle, Peason Ridge, Louisiana, August 2021 (QAPP).

Validation Guidelines: United States Department of Defense, Quality Systems Manual, Rev. 5.1 2017, and United States Environmental Protection Agency (USEPA) Contract Laboratory National Functional Guidelines for Superfund Inorganic Methods Data Review, (USEPA 2017) and United States Department of Defense (DOD) Environmental Data Quality Workgroup (EDQW), November 2019, General Data Validation Guidelines.

Client Sample Identification	Laboratory Sample Identification	Matrix	Validation Stage
JACKSON-SDCC3-DC-01	SQ1188-002	sediment	S2BVM
JACKSON-SDCC2-DC-01	SQ1188-004	sediment	S2BVM
JACKSON-SDMC3-DC-01	SQ1188-006	sediment	S2BVM
JACKSON-SDMC1-DC-01	SQ1188-008	sediment	S2BVM
JACKSON-SDCC4-DC-01	SQ1188-010	sediment	S2BVM
JACKSON-SDJC1-DC-01	SQ1188-012	sediment	S2BVM
JACKSON-SDMC2-DC-01	SQ1188-014	sediment	S2BVM
SDDUP	SQ1188-016	sediment	S2BVM

Table 1 provides a summary of the major and minor data quality issues identified in this data set. All data are acceptable except those results which have been qualified with “X”, rejected. Data validation qualifiers along with associated descriptions are provided in Table 2. All data qualification related to this group of samples is detailed on the attached sheets.

All data users should note two facts. First, an "X" flag means that the associated value is unusable due to significant quality control (QC) problems, the data is invalid and provides no information as to whether the compound is present or not. "X" values should not appear on any data tables even as a last resort. Second, no analyte concentration, even if it passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data, but any value potentially contains error.

DATA ASSESSMENT

1. NARRATIVE AND COMPLETENESS REVIEW:

The case narrative was reviewed, and the data package was checked for completeness. No discrepancies were noted.

2. SAMPLE DELIVERY AND CONDITION:

The samples arrived at the laboratory in acceptable condition. Proper custody was documented.

3. HOLDING TIME:

The amount of an analyte in a sample can change with time due to chemical instability, degradation, volatilization, etc. If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J". The non-detects will be flagged as not detected at an estimated quantitation limit, "UJ", unless the holding time is grossly exceeded (by more than two times the holding time specified), in which case non-detect results are flagged " ", rejected. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

4. CALIBRATION:

Method requirements for satisfactory instrument calibration are established to ensure that the instrument can produce acceptable quantitative data. Initial calibration verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibration verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis.

Initial and Continuing Calibration Verification:

Immediately after each system has been calibrated, the accuracy of the initial calibration must be verified and documented for each target analyte by the analysis of an ICV solution(s). The CCV standard shall be analyzed at a frequency of one for every 10 field samples analyzed during an analytical run, at the beginning of the run, and again after the last analytical sample. The percent recovery acceptable limits for ICV/CCV are 90 – 110% for metals. The percent recovery acceptable limits for the Contract Required Detection Limit (CRDL) standard for metals are 80-120%. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

5. BLANK CONTAMINATION:

Quality assurance blanks, i.e., instrument, preparation, field, or rinse blanks are prepared to identify any contamination which may have been introduced into the samples during sample preparation or field activity. Calibration blanks (ICB and CCB) are used to ensure a stable instrument baseline before and during the analysis of analytical samples. Preparation blanks measure laboratory contamination. Field blanks or lab blanks should not have an analyte detection greater than ½ the analyte Limit of Quantitation (LOQ), or one tenth the concentration of associated samples. However, any positive blank result is assessed against all associated field sample results per validation guidance and data are flagged accordingly. Qualifications were applied to the samples and analytes as shown below.

A) Method blank contamination:

No problems were found for this criterion with the following exceptions. Cadmium and zinc were positively identified in the method blank associated with all samples in this sample delivery group (SDG). Positive sample results for the impacted analytes have been evaluated and qualified per validation guidance on this basis.

B) Instrument blank contamination:

No problems were found for this criterion with the following exceptions.

Zinc and cadmium were positively detected in several calibration blanks. All samples are associated. Positive sample results for the impacted analytes have been evaluated and qualified per validation guidance on this basis.

C) Field /Equipment blank contamination:

No samples were submitted as a field/equipment blank associated with the samples in this SDG.

6. INTERFERENCE CHECK SAMPLE:

The Interference Check Sample (ICS) verifies the analytical instrument's ability to overcome interferences typical of those found in samples. The laboratory analyzed and reported ICS results for all elements being reported from the analytical run and for all interferents (target and non-target) for these reported elements. The ICS consists of two solutions: Solution A and Solution AB. Solution A consists of the interferents, and Solution AB consists of the analytes mixed with the interferents. Results for the analysis of ICS Solution must fall within the control limits of ± 20% or ±CRQL (whichever is greater) of the true value for the analytes and interferents included in the solution. If results that are greater than or equal to the level of detection (LOD) are observed for analytes that are not present in the ICS solution, the possibility of false positives exists. If negative results are observed for analytes that are not present in the ICS solution, and their absolute value is greater than or equal to the LOD, the possibility of false negatives in the samples exists. In general, sample data can be accepted if the concentrations of Al, Ca, Fe, and Mg in the sample are found to be less than or equal to their respective concentrations in the ICS. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

7. LABORATORY CONTROL SAMPLE:

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis. Aqueous/water and soil/sediment LCSs shall be analyzed for each analyte utilizing the same sample preparations, analytical methods, and quality assurance/quality control procedures as employed for the samples. Per the QAPP all LCS percent recoveries must fall within the limits specified in the US DOD Quality Systems Manual 5.1. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

8. MATRIX SPIKE/MATRIX SPIKE DUPLICATE/LABORATORY DUPLICATE:

The matrix spike/matrix spike duplicate (MS/MSD) sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. The matrix spike percent recoveries and relative percent difference (RPD) values must fall within the control limits established in the QAPP. However, spike recovery limits do not apply when the sample concentration is greater than or equal to four times the spike added.

Sample JACKSON-SDMC1-DC-01 was submitted for MS/MSD and/or laboratory duplicate evaluations in association with the samples in this SDG. Upon evaluation, all precision and accuracy indicators were favorable.

9. SERIAL DILUTION:

The serial dilution determines whether significant physical or chemical interferences exist due to sample matrix. If the analyte concentration is sufficiently high (concentration in the original sample is greater than 50 times the LOQ), the percent difference between the original determination and the serial dilution analysis (a five-fold dilution) after correction for dilution shall be less than 10. For a serial dilution analysis that does not meet the technical criteria, the action was applied to only the field sample used to prepare the serial dilution sample.

Serial dilution analysis was performed on sample JACKSON-SDMC1-DC-01 in association with the samples in this SDG. No problems were found for this criterion.

10. FIELD DUPLICATES:

Field duplicates may be taken and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision. A control limit of 35% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values greater than or equal to five times (5x) the LOQ. A control limit of two times the LOQ shall be used if either the sample or duplicate value is less than 5x the LOQ. For field duplicate analyses that do not meet the technical criteria, the action was applied to only the field sample and its duplicate.

Samples JACKSON-SDMC3-DC-01 and SDDUP were submitted as a field duplicate pair in association with this SDG. Adequate field precision was demonstrated.

11. ANALYTE QUANTIFICATION AND REPORTED DETECTION LIMITS:

Analyte quantitation was not verified as part of the Level 2B data validation.

Reported detection limits were evaluated for all samples in the delivery group. In all cases the Limit of Quantitation (LOQ) specified in the QAPP for the analytes reported have been achieved.

12. SYSTEM PERFORMANCE:

None.

Table 1 Major and Minor Findings

	Were acceptance criteria met?		
	Yes	No	
SEM		**Major**	**Minor**
Holding Time	X		
Initial and Continuing Calibration Verification	X		
Initial and Continuing Calibration Blanks			X
Method Blank			X
Field or Rinse Blank	NA		
Interference Check Standards	X		
Matrix Spike/Matrix Spike Duplicate	X		
Laboratory Control Sample	X		
ICP Serial Dilution	X		
Field Duplicate	X		

Major = Major data quality issue identified resulting in rejection of data.
Minor = Minor data quality issue identified resulting in the qualification of data. Data qualification should be used to inform the data users of data limitations.
NA = Not applicable

Table 2 Data Validation Qualifiers

Data Qualifier	Definition
U	The analyte was not detected and was reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been “tentatively identified” or “presumptively” as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

ENVIRONMENTAL DATA SERVICES, LTD.

EXECUTIVE NARRATIVE

Sample Delivery Group: SQ1188
Laboratory: Katahdin Analytical Services
Site: Fort Jackson
Sampling dates: 3/8/2023
Number of Samples: 8
Test Method: SW-846 6020
Analysis: Antimony, Copper, Lead, and Zinc

Quality Assurance Project Plan: Draft Contract Quality Assurance Project Plan FY20 Update Operational Range Assessments, FY18-22 Army Operational Range Assessment Cycle, Multiple Sites for Active Army and Army Reserve, April 2020 (QAPP).

Validation Guidelines: United States Department of Defense, Quality Systems Manual, Rev. 5.1 2017, and United States Environmental Protection Agency (USEPA) Contract Laboratory National Functional Guidelines for Superfund Inorganic Methods Data Review, (USEPA 2017) and United States Department of Defense (DOD) Environmental Data Quality Workgroup (EDQW), November 2019, General Data Validation Guidelines.

Client Sample Identification	Laboratory Sample Identification	Matrix	Validation Stage
JACKSON-SDCC3-DC-01	SQ1188-001	sediment	S2BVM
JACKSON-SDCC2-DC-01	SQ1188-003	sediment	S2BVM
JACKSON-SDMC3-DC-01	SQ1188-005	sediment	S2BVM
JACKSON-SDMC1-DC-01	SQ1188-007	sediment	S2BVM
JACKSON-SDCC4-DC-01	SQ1188-009	sediment	S2BVM
JACKSON-SDJC1-DC-01	SQ1188-011	sediment	S2BVM
JACKSON-SDMC2-DC-01	SQ1188-013	sediment	S2BVM
SDDUP	SQ1188-015	sediment	S2BVM

Table 1 provides a summary of the major and minor data quality issues identified in this data set. All data are acceptable except those results which have been qualified with “X”, rejected. Data validation qualifiers along with associated descriptions are provided in Table 2. All data qualification related to this group of samples is detailed on the attached sheets.

All data users should note two facts. First, an "X" flag means that the associated value is unusable due to significant quality control (QC) problems, the data is invalid and provides no information as to whether the compound is present or not. "X" values should not appear on any data tables even as a last resort. Second, no analyte concentration, even if it passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data, but any value potentially contains error.

DATA ASSESSMENT

1. NARRATIVE AND COMPLETENESS REVIEW:

The case narrative was reviewed, and the data package was checked for completeness. No discrepancies were noted.

2. SAMPLE DELIVERY AND CONDITION:

The samples arrived at the laboratory in acceptable condition. Proper custody was documented.

3. HOLDING TIME:

The amount of an analyte in a sample can change with time due to chemical instability, degradation, volatilization, etc. If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J". The non-detects will be flagged as not detected at an estimated quantitation limit, "UJ", unless the holding time is grossly exceeded (by more than two times the holding time specified), in which case non-detect results are flagged "X", rejected. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

4. INSTRUMENT TUNE ANALYSIS:

The Inductively Coupled Plasma/Mass Spectrometer (ICP/MS) must be tuned on a daily basis prior to calibration. The ICP/MS tune serves as an initial demonstration of instrument stability and precision.

Instrument tunes were verified and found to have been performed daily prior to each instrument calibration. Further, the percent relative standard deviation observed for the instrumental scans for each isotope were less than or equal to five percent in all cases.

5. CALIBRATION:

Method requirements for satisfactory instrument calibration are established to ensure that the instrument can produce acceptable quantitative data. Initial calibration verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibration verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis.

Initial and Continuing Calibration Verification:

Immediately after each system has been calibrated, the accuracy of the initial calibration must be verified and documented for each target analyte by the analysis of an ICV solution(s). The CCV standard shall be analyzed at a frequency of one for every 10 field samples analyzed during an analytical run, at the beginning of the run, and again after the last analytical sample. The percent recovery acceptable limits for ICV/CCV are 90 – 110% for metals. The percent recovery acceptable limits for the Contract Required Detection Limit (CRDL) standard for metals are 80-120%. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

6. BLANK CONTAMINATION:

Quality assurance blanks, i.e., instrument, preparation, field, or rinse blanks are prepared to identify any contamination which may have been introduced into the samples during sample preparation or field activity. Calibration blanks (ICB and CCB) are used to ensure a stable instrument baseline before and during the analysis of analytical samples. Preparation blanks measure laboratory contamination. Field blanks or lab blanks should not have an analyte detection greater than ½ the analyte Limit of Quantitation (LOQ), or one tenth the concentration of associated samples. However, any positive blank result is assessed against all associated field sample results per validation guidance and data are flagged accordingly. Qualifications were applied to the samples and analytes as shown below.

A) Method blank contamination:

Copper, lead and zinc were positively identified in the method blank associated with the samples listed below in this sample delivery group (SDG).

JACKSON-SDCC3-DC-01	*JACKSON-SDMC3-DC-01*	*JACKSON-SDCC4-DC-01*
JACKSON-SDCC2-DC-01	*JACKSON-SDMC1-DC-01*	*SDDUP*

Positive sample results for copper, lead, and zinc have been evaluated and qualified per validation guidance on this basis as appropriate.

Lead and zinc were positively detected in the method blank associated with samples JACKSON-SDJC1-DC-01 and JACKSON-SDMC2-DC-01. Positive sample results for lead and zinc have been evaluated and qualified per validation guidance on this basis as appropriate.

B) Instrument blank contamination:

No problems were found for this criterion requiring result qualification on this basis.

C) Field /Equipment blank contamination:

No sample was submitted as a field/equipment blank in association with this sample SDG.

7. INTERFERENCE CHECK SAMPLE:

The Interference Check Sample (ICS) verifies the analytical instrument's ability to overcome interferences typical of those found in samples. The laboratory analyzed and reported ICS results for all elements being reported from the analytical run and for all interferents (target and non-target) for these reported elements. The ICS consists of two solutions: Solution A and Solution AB. Solution A consists of the interferents, and Solution AB consists of the analytes mixed with the interferents. Results for the analysis of ICS Solution must fall within the control limits of ± 20% or ±CRQL (whichever is greater) of the true value for the analytes and interferents included in the solution. If results that are greater than or equal to the limit of detection (LOD) are observed for analytes that are not present in the ICS solution, the possibility of false positives exists. If negative results are observed for analytes that are not present in the ICS solution, and their absolute value is greater than or equal to the LOD, the possibility of false negatives in the samples exists. In general, sample data can be accepted if the concentrations of Al, Ca, Fe, and Mg in the sample are found to be less than or equal to their respective concentrations in the ICS. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

8. LABORATORY CONTROL SAMPLE:

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis. Aqueous/water and soil/sediment LCSs shall be analyzed for each analyte utilizing the same sample preparations, analytical methods, and quality assurance/quality control procedures as employed for the samples. Per the QAPP all LCS percent recoveries must fall within the limits specified in the US DOD Quality Systems Manual 5.1. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

9. MATRIX SPIKE/MATRIX SPIKE DUPLICATE:

The matrix spike/matrix spike duplicate (MS/MSD) sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. The matrix spike percent recoveries and relative percent difference (RPD) values must fall within the control limits established in the QAPP. However, spike recovery limits do not apply when the sample concentration is greater than or equal to four times the spike added.

Sample JACKSON-SDMC3-DC-01 was submitted for MS/MSD and/or laboratory duplicate evaluations in association with this SDG. Upon evaluation all precision and accuracy indicators were favorable with the following exception. Both MS and MSD recoveries observed for antimony were lower than the lowest acceptance limit. The antimony result reported in the parent sample has been qualified "J" estimated on this basis.

10. SERIAL DILUTION:

The serial dilution determines whether significant physical or chemical interferences exist due to sample matrix. If the analyte concentration is sufficiently high (concentration in the original sample is greater than 50 times the detection limit), the percent difference between the original determination and the serial dilution analysis (a five-fold dilution) after correction for dilution shall be less than 10. For a serial dilution analysis that does not meet the technical criteria, the action was applied to only the field sample used to prepare the serial dilution sample.

Sample JACKSON-SDMC3-DC-01 was submitted for serial dilution analysis. No problems were found for this criterion.

11. INTERNAL STANDARDS PERFORMANCE:

Internal standards were added to all sample and quality assurance evaluation digestates prior to analysis to monitor analytical performance and sample matrix effects.

All samples and associated quality assurance analyses had internal standard percent recoveries within validation acceptance criteria of 30-120%.

12. FIELD DUPLICATES:

Field duplicates may be taken and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision. A control limit of 35% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values greater than or equal to five times (5x) the LOQ. A control limit of two times the LOQ shall be used if either the sample or duplicate value is less than 5x the LOQ. For field duplicate analyses that do not meet the technical criteria, the action was applied to only the field sample and it's duplicate.

Samples JACKSON-SDMC3-DC-01 and SDDUP were submitted as a field duplicate pair. Adequate field precision was demonstrated.

13. ANALYTE QUANTIFICATION AND REPORTED DETECTION LIMITS:

Analyte quantitation was not verified as part of the Level 2B data validation.

Reported detection limits were evaluated for all samples in the delivery group. In all cases the Limit of Quantitation (LOQ) specified in the QAPP for the analytes reported have been achieved.

14. SYSTEM PERFORMANCE:

No other problems were found.

Table 1 Major and Minor Findings

	Were acceptance criteria met?		
	Yes	No	
Metals		**Major**	**Minor**
Holding Time	X		
Instrument Tune Analysis	X		
Initial and Continuing Calibration Verification	X		
Initial and Continuing Calibration Blanks	X		
Method Blank			X
Field or Rinse Blank	NA		
Interference Check Standards	X		
Matrix Spike/Matrix Spike Duplicate			X
Laboratory Control Sample	X		
ICP Serial Dilution	X		
Internal Standard Performance	X		
Field Duplicate	X		

Major = Major data quality issue identified resulting in rejection of data.
Minor = Minor data quality issue identified resulting in the qualification of data. Data qualification should be used to inform the data users of data limitations.
NA = Not applicable

Table 2 Data Validation Qualifiers

Data Qualifier	Definition
U	The analyte was not detected and was reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been “tentatively identified” or “presumptively” as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

ENVIRONMENTAL DATA SERVICES, LTD.

EXECUTIVE NARRATIVE

Sample Delivery Group: SQ1188
Laboratory: Katahdin Analytical Services and Eurofins Lancaster Laboratories Environment Testing, LLC
Site: Fort Jackson
Sampling dates: 03/08/2023
Number of Samples: 8
Test Method: USEPA 821/R-91-100 and Llyod Kahn
Analysis: Acid Volatile Sulfide (AVS) and Total Organic Carbon (TOC)

Quality Assurance Project Plan: Draft Contract Quality Assurance Project Plan FY20 Update Operational Range Assessments, FY18-22 Army Operational Range Assessment Cycle, Multiple Sites for Active Army and Army Reserve, April 2020 (QAPP).

Validation Guidelines: United States Department of Defense, Quality Systems Manual, Rev. 5.1 2017, and United States Environmental Protection Agency (USEPA) Contract Laboratory National Functional Guidelines for Superfund Inorganic Methods Data Review, (USEPA 2017) and United States Department of Defense (DOD) Environmental Data Quality Workgroup (EDQW), November 2019, General Data Validation Guidelines.

Client Sample Identification	Laboratory Sample Identification	Matrix	Validation Stage
JACKSON-SDCC3-DC-01	SQ1188-2 / 410-119054-1	sediment	S2BVM
JACKSON-SDCC2-DC-01	SQ1188-4/ 410-119054-2	sediment	S2BVM
JACKSON-SDMC3-DC-01	SQ1188-6/ 410-119054-3	sediment	S2BVM
JACKSON-SDMC1-DC-01	SQ1188-8/ 410-119054-4	sediment	S2BVM
JACKSON-SDCC4-DC-01	SQ1188-10/ 410-119054-5	sediment	S2BVM
JACKSON-SDJC1-DC-01	SQ1188-12/ 410-119054-6	sediment	S2BVM
JACKSON-SDMC2-DC-01	SQ1188-14/ 410-119054-7	sediment	S2BVM
SDDUP	SQ1188-16/ 410-119054-8	sediment	S2BVM

Table 1 provides a summary of the major and minor data quality issues identified in this data set. All data are acceptable except those results which have been qualified with “X”, rejected. Data validation qualifiers along with associated descriptions are provided in Table 2. All data qualification related to this group of samples is detailed on the attached sheets.

All data users should note two facts. First, an "X" flag means that the associated value is unusable due to significant quality control (QC) problems, the data is invalid and provides no information as to whether the compound is present or not. "X" values should not appear on any data tables even as a last resort. Second, no analyte concentration, even if it passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data, but any value potentially contains error.

DATA ASSESSMENT

1. NARRATIVE AND COMPLETENESS REVIEW:

The case narrative was reviewed, and the data package was checked for completeness. No discrepancies were noted.

2. SAMPLE DELIVERY AND CONDITION:

The samples arrived at the laboratory in acceptable condition. Proper custody was documented.

3. HOLDING TIME:

The amount of an analyte in a sample can change with time due to chemical instability, degradation, volatilization, etc. If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J" or "UJ" as appropriate. When holding times are exceeded by more than twice the time specified, the non-detects will be flagged as unusable, "X". Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

4. CALIBRATION:

Method requirements for satisfactory instrument or procedural calibration are established to ensure that the instrument can produce acceptable quantitative data. Initial calibration verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibration verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis. Immediately after each system has been calibrated, the accuracy of the initial calibration must be verified and documented for each target analyte by the analysis of an ICV solution(s). The CCV standard shall be analyzed at a frequency of every 10 samples. The percent relative standard deviation (%RSD) should be less than 20% or the correlation coefficient greater than 0.995. Qualifications were applied to the samples and analytes as shown below.

Calibrations were performed at the appropriate frequency and resulted in %RSD and correlation coefficient values within guidance in all cases. Further, all ICV and CCV evaluations were within acceptance criteria with the following exception. Multiple continuing calibrations associated with all samples in this sample delivery group (SDG) were outside acceptance limits for TOC. The positive sample results for the impacted analyte have been qualified estimated "J" on this basis.

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5. BLANK CONTAMINATION:

Quality assurance blanks, i.e., instrument, preparation, field, or rinse blanks are prepared to identify any contamination which may have been introduced into the samples during sample preparation or field activity. Calibration blanks (ICB and CCB) are used to ensure a stable instrument baseline before and during the analysis of analytical samples. Preparation blanks measure laboratory contamination. Field blanks or lab blanks should not have an analyte detection greater than ½ the analyte Limit of Quantitation (LOQ), or one tenth the concentration of associated samples. However, any positive blank result is assessed against all associated field sample results per validation guidance and data are flagged accordingly. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

6. LABORATORY CONTROL SAMPLE:

The Laboratory Control Sample (LCS) serves to monitor the overall performance of each step during the analysis. Aqueous/water and soil/sediment LCSs shall be analyzed for each analyte utilizing the same sample preparations, analytical methods, and quality assurance/quality control procedures as employed for the samples. All LCS percent recoveries must fall within the control limits of 85-115% for total organic carbon. All LCS percent recoveries must fall within the laboratory control limits for acid volatile sulfide. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion with the following exception. The LCS samples associated with all samples in this SDG were higher than the highest acceptance limit for TOC. The positive sample results for the impacted analyte have been qualified estimated "J" on this basis.

7. MATRIX SPIKE/MATRIX SPIKE DUPLICATE:

The matrix spike/matrix spike duplicate (MS/MSD) sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. The spike percent recovery must fall within the established QAPP acceptance limits, with a relative percent difference between the two of less than 20%. However, spike recovery limits do not apply when the sample concentration is greater than or equal to four times the spike added. For a spike analysis that does not meet the technical criteria, the action was applied to all samples in the preparation batch.

Sample JACKSON-SDMC3-DC-01 was submitted for MS/MSD pair evaluation in association with this SDG for TOC. Upon evaluation, all precision and accuracy indicators were favorable.

Sample SDDUP was submitted for MS/matrix duplicate (MD) pair evaluation in association with this SDG for AVS. Upon evaluation, all precision and accuracy indicators were favorable with the following exception. The observed percent recovery in the MS was lower than the lowest acceptance limit for AVS. The non-detected sample result for the impacted analyte has been qualified estimated "UJ" on this basis.

8. FIELD DUPLICATES:

Field duplicates may be taken and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision. A control limit of 35% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values greater than or equal to five times the LOQ. A control limit of two times the LOQ shall be used if either the sample or duplicate value is less than five times the LOQ. For field duplicate analyses that do not meet the technical criteria, the action was applied to only the field sample and its duplicate.

Samples JACKSON-SDMC3-DC-01 and SDDUP were submitted as a field duplicate pair in association with this SDG. Upon evaluation, adequate field precision was demonstrated.

9. OTHER PROBLEMS:

None.

Table 1 Major and Minor Findings

	Were acceptance criteria met?		
	Yes	No	
Acid Volatile Sulfide		Major	Minor
Sample Preservation	x		
Holding Time	x		
Initial Calibration	x		
Continuing Calibration	x		
Method Blank	x		
Continuing Calibration Blank	x		
Field Blank	NA		
Matrix Spike / Matrix Duplicate			x
Laboratory Control Sample	x		
Field Duplicate	x		
	Were acceptance criteria met?		
	Yes	**No**	
TOC Organic Carbon		**Major**	**Minor**
Sample Preservation	x		
Holding Time	x		
Initial Calibration	x		
Continuing Calibration			x
Method Blank	x		
Continuing Calibration Blank	x		
Field Blank	NA		
Matrix Spike / Matrix Duplicate	x		
Laboratory Control Sample			x
Field Duplicate	x		

Major = Major data quality issue identified resulting in rejection of data.
Minor = Minor data quality issue identified resulting in the qualification of data. Data qualification should be used to inform the data users of data limitations.
NA = Not applicable

Table 2 Data Validation Qualifiers

Data Qualifier	Definition
U	The analyte was not detected and was reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been “tentatively identified” or “presumptively” as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

ENVIRONMENTAL DATA SERVICES, LTD.

EXECUTIVE NARRATIVE

Sample Delivery Group: SQ1201
Laboratory: Katahdin Analytical Services
Site: Fort Jackson
Sampling dates: 3/8/2023
Number of Samples: 9
Test Method: SW-846 8330
Analysis: Explosives

Quality Assurance Project Plan: Draft Contract Quality Assurance Project Plan FY20 Update Operational Range Assessments, FY18-22 Army Operational Range Assessment Cycle, Multiple Sites for Active Army and Army Reserve, April 2020 (QAPP).

Validation Guidelines: United States Environmental Protection Agency (USEPA) Contract Laboratory Program National Functional Guidelines for Organic Superfund Methods Data Review, EPA-540-R-2017-002. Office of Superfund Remediation and Technology Innovation, January 2017; Department of Defense General Data Validation Guidelines, February 2018; and USEPA SW-846 Test Method 8330B: Nitroaromatics, Nitroamines, and Nitrate Esters by High Performance Liquid Chromatography (HPLC), Revision 2, October 2006.

Client Sample ID	Laboratory Sample Identification	Matrix	Validation Stage
SWDUP	SQ1201-1	surface water	S2BVM
JACKSON-SWMC3-DC-01	SQ1201-2	surface water	S2BVM
JACKSON-SWMC2-DC-01	SQ1201-3	surface water	S2BVM
JACKSON-SWJC1-DC-01	SQ1201-4	surface water	S2BVM
JACKSON-SWMC1-DC-01	SQ1201-5	surface water	S2BVM
JACKSON-SWCC3-DC-01	SQ1201-6	surface water	S2BVM
JACKSON-SWCC4-DC-01	SQ1201-7	surface water	S2BVM
JACKSON-EB-01	SQ1201-9	equipment blank	S2BVM
JACKSON-CB-01	SQ1201-10	container blank	S2BVM

Table 1 provides a summary of the major and minor data quality issues applied to this data set. All data are acceptable except those results which have been qualified with “X”, rejected. Data validation qualifiers along with associated descriptions are provided in Table 2. All data qualification related to this group of samples is detailed on the attached sheets.

All data users should note two facts. First, an "X" flag means that the associated value is unusable due to significant quality control (QC) problems, the data is invalid and provides no information as to whether the compound is present or not. "X" values should not appear on any data tables even as a last resort. Second, no analyte concentration, even if it passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data, but any value potentially contains error.

DATA ASSESSMENT

1. NARRATIVE AND COMPLETENESS REVIEW

The case narrative was reviewed, and the data package was checked for completeness. No discrepancies were noted.

2. SAMPLE DELIVERY AND CONDITION

The samples arrived at the laboratory in acceptable condition.

Proper custody was documented.

3. HOLDING TIME

The amount of an analyte in a sample can change with time due to chemical instability, degradation, volatilization, etc. If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J". The non-detect results will be flagged as not detected at an estimated quantitation limit, "UJ", unless the holding time is grossly exceeded (by more than two times the holding time specified), in which case non-detect results are flagged X, rejected. Qualifications were applied to the samples and analytes as shown below.

No problems were found with this criterion.

4. CALIBRATION

Satisfactory instrument calibration is established to ensure that the instrument is capable of producing acceptable quantitative data. An initial calibration demonstrates that the instrument is capable of giving acceptable performance at the beginning of an experimental sequence. The continuing calibration checks document that the instrument is giving satisfactory daily performance.

Percent Relative Standard Deviation and Percent Difference

Percent relative standard deviation (%RSD) is calculated from the initial calibration and is used to indicate the stability of the specific compound response factor over increasing concentration. Percent difference (%D) compares the response factor of the continuing calibration check to the mean response factor (RRF) from the initial calibration. Percent difference is a measure of the instrument's daily performance. If %RSD exceeds limits outlined in validation guidance (20%), qualify all associated positive results "J". If the %D exceeds a limit of 20% for any analyte, qualify all associated positive results "J" and non-detects "UJ". If %RSD and %D grossly exceed QC criteria, non-detect data may be qualified X.

The %RSD values for the target analytes were within quality control limits in all cases.

Continuing calibration verifications (CCV) were analyzed at the proper frequencies, and all observed %D values for those associated with reported results for the samples in this SDG met quality control criteria for the compounds reported.

5. BLANK CONTAMINATION

Quality assurance (QA) blanks (i.e. method, trip, field, or rinse blanks) are prepared to identify any contamination which may have been introduced into the samples during sample preparation or field activity. Method blanks measure laboratory contamination. Trip blanks, field, equipment, and rinse blanks measure cross-contamination of samples during field operations. When an equipment blank, trip blank, or lab blank has an analyte detection greater than the analyte method detection limit (MDL), then all associated field samples are flagged according to validation guidance.

A) Method blank contamination:

No problems were found for this criterion.

B) Field/Equipment blank contamination:

Samples JACKSON-EB-01 and JACKSON-CB-01 were submitted as equipment/container blanks in association with the samples in this sample delivery group (SDG). No problems were found for this criterion.

6. SURROGATES/SYSTEM MONITORING COMPOUNDS

All samples are spiked with surrogate/system monitoring compounds (SMC) prior to sample preparation to evaluate overall laboratory performance and efficiency of the analytical technique. If the measured surrogate/SMC concentrations were outside contract specifications, qualifications were applied to the samples and analytes as shown below. All surrogates should meet the laboratory advisory limits.

No problems were found with this criterion with the following exceptions.

The surrogate recovery observed during the analysis of sample JACKSON-SWJC1-DC-01 was lower than the lowest acceptance limit. Potential low bias is indicated. The results reported for target analytes in the impacted sample were all non-detect and have been qualified "UJ" on this basis.

7. COMPOUND QUANTIFICATION

Target compound result quantitation was not reviewed at the Stage 2B level.

Manual integrations were not reviewed at the Stage 2B level.

8. COMPOUND IDENTIFICATION

Explosives Fraction

The retention times (RTs) of reported compounds must fall within the calculated retention time windows for the two chromatographic columns. The %D of the positive results obtained on the two GC columns should be less than or equal to 25%.

Retention Time

No problems were found for this criterion.

Percent Difference

The concentration of reported compounds from the two chromatographic columns must have a relative percent difference RPD of less than 40% as stated in the project QAPP.

No problems were found for this criterion.

9. MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Matrix spike/matrix spike duplicate (MS/MSD) data is generated to determine the long-term precision and accuracy of the analytical method in various matrices. The MS/MSD data may be used in conjunction with other quality control criteria for additional qualification of data. The spiking compound recoveries should meet the limits outlined in the Department of Defense Quality Systems Manual Version 5.1. Further, per the QAPP the reproducibility as demonstrated by relative percent difference (RPD) for the pair must be less than 20%.

Sample JACKSON-SWMC3-DC-01 was submitted as an MS/MSD pair in association with this SDG. Upon evaluation all precision and accuracy indictors were favorable or did not require qualification of sample results.

10. FIELD DUPLICATES

Field duplicates may be taken and analyzed as an indication of overall precision. Per the project QAPP, a control limit of 35% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values greater than or equal to five times (5x) the LOQ. A control limit of the +/- the LOQ shall be used if either the sample or duplicate value is less than 5x the LOQ. For field duplicate analyses that do not meet the technical criteria, the action is applied to only the field sample and it's duplicate.

Samples JACKSON-SWMC3-DC-01 and SWDUP were submitted as a field duplicate pair in association with this SDG. Adequate field precision was demonstrated.

11. LABORATORY CONTROL SAMPLES

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation. Aqueous/water, soil/sediment, wipe, and filter LCSs shall be analyzed for each analyte utilizing the same sample preparations, analytical methods, and quality assurance/quality control (QA/QC) procedures as employed for the samples. All LCS percent recoveries must fall within control limits identified in the Department of Defense Quality Systems Manual Version 5.1. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion requiring qualification of sample results.

12. OTHER PROBLEMS

None.

13. DILUTIONS, RE-EXTRACTIONS & REANALYSIS

Samples may be re-analyzed for dilution, re-extraction and for other QC reasons. In such cases, the best result values are used.

No dilution, re-extraction, or other re-analysis was performed on the samples in association with this SDG.

Table 1 Major and Minor Findings

	Were acceptance criteria met?		
	Yes	No	
Explosives		Major	Minor
Sample Preservation	x		
Holding Time	x		
Percent Relative Standard Deviation and Percent Difference	x		
Method Blank	x		
Equipment/Field Blank	x		
Surrogates/System Monitoring Compounds			x
Compound Quantification	NA		
Compound Identification – Explosives	NA		
Matrix Spike/Matrix Spike Duplicate	x		
Field Duplicate	x		
Laboratory Control Samples	x		
Other Quality Control Data out of Specification	x		

Major = Major data quality issue identified resulting in rejection of data.
Minor = Minor data quality issue identified resulting in the qualification of data. Data qualification should be used to inform the data users of data limitations.
NA = Not applicable

Table 2 Data Validation Qualifiers

Data Qualifier	Definition
U	The analyte was analyzed for but was not detected above the level of the reported sample quantitation limit.
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result is an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
X	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

ENVIRONMENTAL DATA SERVICES, LTD.

EXECUTIVE NARRATIVE

Sample Delivery Group: SQ0201
Laboratory: Katahdin Analytical Services
Site: Fort Jackson
Sampling dates: 3/8/2023
Number of Samples: 8
Test Method: SW-846 6010
Analysis: Calcium, Magnesium, Potassium, and Sodium

Quality Assurance Project Plan: Draft Contract Quality Assurance Project Plan FY20 Update Operational Range Assessments, FY18-22 Army Operational Range Assessment Cycle, Multiple Sites for Active Army and Army Reserve, April 2020 (QAPP).

Validation Guidelines: United States Department of Defense, Quality Systems Manual, Rev. 5.1 2017, and United States Environmental Protection Agency (USEPA) Contract Laboratory National Functional Guidelines for Superfund Inorganic Methods Data Review, (USEPA 2017) and United States Department of Defense (DOD) Environmental Data Quality Workgroup (EDQW), November 2019, General Data Validation Guidelines.

Client Sample Identification	Laboratory Sample Identification	Matrix	Validation Stage
SWDUP	SQ1201-001	Surface water	S2BVM
JACKSON-SWMC3-DC-01	SQ1201-002	Surface water	S2BVM
JACKSON-SWMC2-DC-01	SQ1201-003	Surface water	S2BVM
JACKSON-SWJC1-DC-01	SQ1201-004	Surface water	S2BVM
JACKSON-SWMC1-DC-01	SQ1201-005	Surface water	S2BVM
JACKSON-SWCC3-DC-01	SQ1201-006	Surface water	S2BVM
JACKSON-SWCC4-DC-01	SQ1201-007	Surface water	S2BVM
JACKSON-SWCC2-DC-01	SQ1201-008	Surface water	S2BVM

Table 1 provides a summary of the major and minor data quality issues identified in this data set. All data are acceptable except those results which have been qualified with “X”, rejected. Data validation qualifiers along with associated descriptions are provided in Table 2. All data qualification related to this group of samples is detailed on the attached sheets.

All data users should note two facts. First, an "X" flag means that the associated value is unusable due to significant quality control (QC) problems, the data is invalid and provides no information as to whether the compound is present or not. "X" values should not appear on any data tables even as a last resort. Second, no analyte concentration, even if it passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data, but any value potentially contains error.

DATA ASSESSMENT

1. NARRATIVE AND COMPLETENESS REVIEW:

The case narrative was reviewed, and the data package was checked for completeness. No discrepancies were noted.

2. SAMPLE DELIVERY AND CONDITION:

The samples arrived at the laboratory in acceptable condition. Proper custody was documented.

3. HOLDING TIME:

The amount of an analyte in a sample can change with time due to chemical instability, degradation, volatilization, etc. If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J". The non-detects will be flagged as not detected at an estimated quantitation limit, "UJ", unless the holding time is grossly exceeded (by more than two times the holding time specified), in which case non-detect results are flagged "X", rejected. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

4. CALIBRATION:

Method requirements for satisfactory instrument calibration are established to ensure that the instrument can produce acceptable quantitative data. Initial calibration verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibration verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis.

Initial and Continuing Calibration Verification:

Immediately after each system has been calibrated, the accuracy of the initial calibration must be verified and documented for each target analyte by the analysis of an ICV solution(s). The CCV standard shall be analyzed at a frequency of one for every 10 field samples analyzed during an analytical run, at the beginning of the run, and again after the last analytical sample. The percent recovery acceptable limits for ICV/CCV are 90 – 110% for metals. The percent recovery acceptable limits for the Contract Required Detection Limit (CRDL) standard for metals are 80-120%. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

5. BLANK CONTAMINATION:

Quality assurance blanks, i.e., instrument, preparation, field, or rinse blanks are prepared to identify any contamination which may have been introduced into the samples during sample preparation or field activity. Calibration blanks (ICB and CCB) are used to ensure a stable instrument baseline before and during the analysis of analytical samples. Preparation blanks measure laboratory contamination. Field blanks or lab blanks should not have an analyte detection greater than ½ the analyte Limit of Quantitation (LOQ), or one tenth the concentration of associated samples. However, any positive blank result is assessed against all associated field sample results per validation guidance and data are flagged accordingly. Qualifications were applied to the samples and analytes as shown below.

A) Method blank contamination:

No problems were found for this criterion with the following exceptions.

Potassium was positively detected in the method blank associated with all samples in this sample delivery group (SDG). Positive sample results for the impacted analyte have been evaluated and qualified per validation guidance as appropriate on this basis.

B) Instrument blank contamination:

No problems requiring result qualification were found for this criterion.

C) Field /Equipment blank contamination:

No samples were submitted as a field/equipment blank associated with the samples in this SDG.

6. INTERFERENCE CHECK SAMPLE:

The Interference Check Sample (ICS) verifies the analytical instrument's ability to overcome interferences typical of those found in samples. The laboratory analyzed and reported ICS results for all elements being reported from the analytical run and for all interferents (target and non-target) for these reported elements. The ICS consists of two solutions: Solution A and Solution AB. Solution A consists of the interferents, and Solution AB consists of the analytes mixed with the interferents. Results for the analysis of ICS Solution must fall within the control limits of ± 20% or ±CRQL (whichever is greater) of the true value for the analytes and interferents included in the solution. If results that are greater than or equal to the level of detection (LOD) are observed for analytes that are not present in the ICS solution, the possibility of false positives exists. If negative results are observed for analytes that are not present in the ICS solution, and their absolute value is greater than or equal to the LOD, the possibility of false negatives in the samples exists. In general, sample data can be accepted if the concentrations of Al, Ca, Fe, and Mg in the sample are found to be less than or equal to their respective concentrations in the ICS. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

7. LABORATORY CONTROL SAMPLE:

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis. Aqueous/water and soil/sediment LCSs shall be analyzed for each analyte utilizing the same sample preparations, analytical methods, and quality assurance/quality control procedures as employed for the samples. Per the QAPP all LCS percent recoveries must fall within the limits specified in the US DOD Quality Systems Manual 5.1. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

8. MATRIX SPIKE/MATRIX SPIKE DUPLICATE/LABORATORY DUPLICATE:

The matrix spike/matrix spike duplicate (MS/MSD) sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. The matrix spike percent recoveries and relative percent difference (RPD) values must fall within the control limits established in the QAPP. However, spike recovery limits do not apply when the sample concentration is greater than or equal to four times the spike added.

Sample JACKSON-SWMC3-DC-01 was submitted for MS/MSD and/or laboratory duplicate evaluations in association with the samples in this SDG. Upon evaluation all precision and accuracy indicators were favorable.

9. SERIAL DILUTION:

The serial dilution determines whether significant physical or chemical interferences exist due to sample matrix. If the analyte concentration is sufficiently high (concentration in the original sample is greater than 50 times the LOQ), the percent difference between the original determination and the serial dilution analysis (a five-fold dilution) after correction for dilution shall be less than 10. For a serial dilution analysis that does not meet the technical criteria, the action was applied to only the field sample used to prepare the serial dilution sample.

Sample JACKSON-SWMC3-DC-01 was submitted for serial dilution analysis in association with all samples in this SDG. No problems were found for this criterion.

10. FIELD DUPLICATES:

Field duplicates may be taken and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision. A control limit of 35% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values greater than or equal to five times (5x) the LOQ. A control limit of two times the LOQ shall be used if either the sample or duplicate value is less than 5x the LOQ. For field duplicate analyses that do not meet the technical criteria, the action was applied to only the field sample and its duplicate.

Samples JACKSON-SWMC3-DC-01 and SWDUP were submitted as a field duplicate pair. Adequate field precision was demonstrated.

11. ANALYTE QUANTIFICATION AND REPORTED DETECTION LIMITS:

Analyte quantitation was not verified as part of the Level 2B data validation.

Reported detection limits were evaluated for all samples in the delivery group. In all cases the Limit of Quantitation (LOQ) specified in the QAPP for the analytes reported have been achieved.

12. SYSTEM PERFORMANCE:

None.

Table 1 Major and Minor Findings

	Were acceptance criteria met?		
	Yes	No	
Metals		**Major**	**Minor**
Holding Time	X		
Initial and Continuing Calibration Verification	X		
Initial and Continuing Calibration Blanks	X		
Method Blank			X
Field or Rinse Blank	X		
Interference Check Standards	X		
Matrix Spike/Matrix Spike Duplicate	X		
Laboratory Control Sample	X		
ICP Serial Dilution	X		
Field Duplicate	X		

Major = Major data quality issue identified resulting in rejection of data.
Minor = Minor data quality issue identified resulting in the qualification of data. Data qualification should be used to inform the data users of data limitations.
NA = Not applicable

Table 2 Data Validation Qualifiers

Data Qualifier	Definition
U	The analyte was not detected and was reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been “tentatively identified” or “presumptively” as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

ENVIRONMENTAL DATA SERVICES, LTD.

EXECUTIVE NARRATIVE

Sample Delivery Group: SQ1201
Laboratory: Katahdin Analytical Services
Site: Fort Jackson
Sampling dates: 3/8/2023
Number of Samples: 10
Test Method: SW-846 6020; SM 2340B
Analysis: Dissolved Antimony, Copper, Lead, Zinc, Calcium, and Magnesium; Hardness

Quality Assurance Project Plan: Draft Contract Quality Assurance Project Plan FY20 Update Operational Range Assessments, FY18-22 Army Operational Range Assessment Cycle, Multiple Sites for Active Army and Army Reserve, April 2020 (QAPP).

Validation Guidelines: United States Department of Defense, Quality Systems Manual, Rev. 5.1 2017, and United States Environmental Protection Agency (USEPA) Contract Laboratory National Functional Guidelines for Superfund Inorganic Methods Data Review, (USEPA 2017) and United States Department of Defense (DOD) Environmental Data Quality Workgroup (EDQW), November 2019, General Data Validation Guidelines.

Client Sample Identification	Laboratory Sample Identification	Matrix	Validation Stage
JACKSON-EB-01	SQ1201-009	equipment blank	S2BVM
JACKSON-CB-01	SQ1201-010	container blank	S2BVM
SWDUP	SQ1201-011	Surface water	S2BVM
JACKSON-SWMC3-DC-01	SQ1201-012	Surface water	S2BVM
JACKSON-SWMC2-DC-01	SQ1201-013	Surface water	S2BVM
JACKSON-SWJC1-DC-01	SQ1201-014	Surface water	S2BVM
JACKSON-SWMC1-DC-01	SQ1201-015	Surface water	S2BVM
JACKSON-SWCC3-DC-01	SQ1201-016	Surface water	S2BVM
JACKSON-SWCC4-DC-01	SQ1201-017	Surface water	S2BVM
JACKSON-SWCC2-DC-01	SQ1201-018	Surface water	S2BVM

Table 1 provides a summary of the major and minor data quality issues identified in this data set. All data are acceptable except those results which have been qualified with “X”, rejected. Data validation qualifiers along with associated descriptions are provided in Table 2. All data qualification related to this group of samples is detailed on the attached sheets.

All data users should note two facts. First, an "X" flag means that the associated value is unusable due to significant quality control (QC) problems, the data is invalid and provides no information as to whether the compound is present or not. "X" values should not appear on any data tables even as a last resort. Second, no analyte concentration, even if it passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data, but any value potentially contains error.

DATA ASSESSMENT

1. NARRATIVE AND COMPLETENESS REVIEW:

The case narrative was reviewed, and the data package was checked for completeness. No discrepancies were noted.

2. SAMPLE DELIVERY AND CONDITION:

The samples arrived at the laboratory in acceptable condition. Proper custody was documented.

3. HOLDING TIME:

The amount of an analyte in a sample can change with time due to chemical instability, degradation, volatilization, etc. If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J". The non-detects will be flagged as not detected at an estimated quantitation limit, "UJ", unless the holding time is grossly exceeded (by more than two times the holding time specified), in which case non-detect results are flagged "X", rejected. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

4. INSTRUMENT TUNE ANALYSIS:

The Inductively Coupled Plasma/Mass Spectrometer (ICP/MS) must be tuned on a daily basis prior to calibration. The ICP/MS tune serves as an initial demonstration of instrument stability and precision.

Instrument tunes were verified and found to have been performed daily prior to each instrument calibration. Further, the percent relative standard deviation observed for the instrumental scans for each isotope were less than or equal to five percent in all cases.

5. CALIBRATION:

Method requirements for satisfactory instrument calibration are established to ensure that the instrument can produce acceptable quantitative data. Initial calibration verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibration verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis.

Initial and Continuing Calibration Verification:

Immediately after each system has been calibrated, the accuracy of the initial calibration must be verified and documented for each target analyte by the analysis of an ICV solution(s). The CCV standard shall be analyzed at a frequency of one for every 10 field samples analyzed during an analytical run, at the beginning of the run, and again after the last analytical sample. The percent recovery acceptable limits for ICV/CCV are 90 – 110% for metals. The percent recovery acceptable limits for the Contract Required Detection Limit (CRDL) standard for metals are 80-120%. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion with the following exception. A CCV recovery for magnesium was greater than the upper acceptance limit. Samples JACKSON-CB-01 AND JACKSON-EB-01 were associated with the noncompliant CCV. The positive dissolved magnesium results reported for the impacted samples have been qualified "J+" on this basis.

6. BLANK CONTAMINATION:

Quality assurance blanks, i.e., instrument, preparation, field, or rinse blanks are prepared to identify any contamination which may have been introduced into the samples during sample preparation or field activity. Calibration blanks (ICB and CCB) are used to ensure a stable instrument baseline before and during the analysis of analytical samples. Preparation blanks measure laboratory contamination. Field blanks or lab blanks should not have an analyte detection greater than ½ the analyte Limit of Quantitation (LOQ), or one tenth the concentration of associated samples. However, any positive blank result is assessed against all associated field sample results per validation guidance and data are flagged accordingly. Qualifications were applied to the samples and analytes as shown below.

A) Method blank contamination:

The analytes listed in the table below were positively identified in the method blank associated with all samples in this sample delivery group (SDG). Positive sample results for the impacted analytes have been evaluated and qualified per validation guidance on this basis.

antimony	*calcium*	*copper*
magnesium	*zinc*	

B) Instrument blank contamination:

No problems requiring result qualification were found for this criterion.

C) Field /Equipment blank contamination:

Samples JACKSON-EB-01 and JACKSON-CB-01 were submitted as field and container blanks in association with the samples in this SDG. The analytes listed in the table below were positively identified in one or both blanks. Positive results reported for impacted analytes have been evaluated and qualified per validation guidance as appropriate on this basis.

antimony	*calcium*	*copper*
magnesium	*zinc*	*hardness*

7. INTERFERENCE CHECK SAMPLE:

The Interference Check Sample (ICS) verifies the analytical instrument's ability to overcome interferences typical of those found in samples. The laboratory analyzed and reported ICS results for all elements being reported from the analytical run and for all interferents (target and non-target) for these reported elements. The ICS consists of two solutions: Solution A and Solution AB. Solution A consists of the interferents, and Solution AB consists of the analytes mixed with the interferents. Results for the analysis of ICS Solution must fall within the control limits of ± 20% or ±CRQL (whichever is greater) of the true value for the analytes and interferents included in the solution. If results that are greater than or equal to the limit of detection (LOD) are observed for analytes that are not present in the ICS solution, the possibility of false positives exists. If negative results are observed for analytes that are not present in the ICS solution, and their absolute value is greater than or equal to the LOD, the possibility of false negatives in the samples exists. In general, sample data can be accepted if the concentrations of Al, Ca, Fe, and Mg in the sample are found to be less than or equal to their respective concentrations in the ICS. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

8. LABORATORY CONTROL SAMPLE:

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis. Aqueous/water and soil/sediment LCSs shall be analyzed for each analyte utilizing the same sample preparations, analytical methods, and quality assurance/quality control procedures as employed for the samples. Per the QAPP all LCS percent recoveries must fall within the limits specified in the US DOD Quality Systems Manual 5.1. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

9. MATRIX SPIKE/MATRIX SPIKE DUPLICATE:

The matrix spike/matrix spike duplicate (MS/MSD) sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. The matrix spike percent recoveries and relative percent difference (RPD) values must fall within the control limits established in the QAPP. However, spike recovery limits do not apply when the sample concentration is greater than or equal to four times the spike added.

Sample JACKSON-SWMC3-DC-01 was submitted for MS/MSD and/or laboratory duplicate evaluations in association with this SDG. Upon evaluation all precision and accuracy indicators were favorable.

10. SERIAL DILUTION:

The serial dilution determines whether significant physical or chemical interferences exist due to sample matrix. If the analyte concentration is sufficiently high (concentration in the original sample is greater than 50 times the detection limit), the percent difference between the original determination and the serial dilution analysis (a five-fold dilution) after correction for dilution shall be less than 10. For a serial dilution analysis that does not meet the technical criteria, the action was applied to only the field sample used to prepare the serial dilution sample.

Sample JACKSON-SWMC3-DC-01 was submitted for serial dilution analysis. No problems were found for this criterion.

11. INTERNAL STANDARDS PERFORMANCE:

Internal standards were added to all sample and quality assurance evaluation digestates prior to analysis to monitor analytical performance and sample matrix effects.

All samples and associated quality assurance analyses had internal standard percent recoveries within validation acceptance criteria of 30-120%.

12. FIELD DUPLICATES:

Field duplicates may be taken and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision. A control limit of 35% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values greater than or equal to five times (5x) the LOQ. A control limit of two times the LOQ shall be used if either the sample or duplicate value is less than 5x the LOQ. For field duplicate analyses that do not meet the technical criteria, the action was applied to only the field sample and it's duplicate.

Samples JACKSON-SWMC3-DC-01 and SWDUP were submitted as a field duplicate pair. Adequate field precision was demonstrated.

13. ANALYTE QUANTIFICATION AND REPORTED DETECTION LIMITS:

Analyte quantitation was not verified as part of the Level 2B data validation.

Reported detection limits were evaluated for all samples in the delivery group. In all cases the Limit of Quantitation (LOQ) specified in the QAPP for the analytes reported have been achieved.

14. SYSTEM PERFORMANCE:

No other problems were found.

Table 1 Major and Minor Findings

	Were acceptance criteria met?		
	Yes	No	
Metals		**Major**	**Minor**
Holding Time	X		
Instrument Tune Analysis	X		
Initial and Continuing Calibration Verification			X
Initial and Continuing Calibration Blanks	X		
Method Blank			X
Field or Rinse Blank			X
Interference Check Standards	X		
Matrix Spike/Matrix Spike Duplicate	X		
Laboratory Control Sample	X		
ICP Serial Dilution	X		
Internal Standard Performance	X		
Field Duplicate	X		

Major = Major data quality issue identified resulting in rejection of data.
Minor = Minor data quality issue identified resulting in the qualification of data. Data qualification should be used to inform the data users of data limitations.
NA = Not applicable

Table 2 Data Validation Qualifiers

Data Qualifier	Definition
U	The analyte was not detected and was reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been “tentatively identified” or “presumptively” as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

ENVIRONMENTAL DATA SERVICES, LTD.

EXECUTIVE NARRATIVE

Sample Delivery Group: SQ1201
Laboratory: Katahdin Analytical Services and Eurofins Savannah
Site: Fort Jackson
Sampling dates: 03/08/2023
Number of Samples: 8
Test Method: SW-846 9060A; USEPA 300.0; and SM2320B
Analysis: Dissolved Organic Carbon (DOC), Chloride and Sulfate, and Alkalinity

Quality Assurance Project Plan: Draft Contract Quality Assurance Project Plan FY20 Update Operational Range Assessments, FY18-22 Army Operational Range Assessment Cycle, Multiple Sites for Active Army and Army Reserve, April 2020 (QAPP).

Validation Guidelines: United States Department of Defense, Quality Systems Manual, Rev. 5.1 2017, and United States Environmental Protection Agency (USEPA) Contract Laboratory National Functional Guidelines for Superfund Inorganic Methods Data Review, (USEPA 2017) and United States Department of Defense (DOD) Environmental Data Quality Workgroup (EDQW), November 2019, General Data Validation Guidelines.

Client Sample Identification	Laboratory Sample Identification	Matrix	Validation Stage
SWDUP-03082023	SQ1201-1/ 680-232120-1	surface water	S2BVM
JACKSON-SWMC3-DC-01	SQ1201-2/ 680-232120-2	surface water	S2BVM
JACKSON-SWMC2-DC-01	SQ1201-3/ 680-232120-3	surface water	S2BVM
JACKSON-SWJC1-DC-01	SQ1201-4/ 680-232120-4	surface water	S2BVM
JACKSON-SWMC1-DC-01	SQ1201-5/ 680-232120-5	surface water	S2BVM
JACKSON-SWCC3-DC-01	SQ1201-6/ 680-232120-6	surface water	S2BVM
JACKSON-SWCC4-DC-01	SQ1201-7/ 680-232120-7	surface water	S2BVM
JACKSON-SWCC2-DC-01	SQ1201-8/ 680-232120-8	surface water	S2BVM

Table 1 provides a summary of the major and minor data quality issues identified in this data set. All data are acceptable except those results which have been qualified with “X”, rejected. Data validation qualifiers along with associated descriptions are provided in Table 2. All data qualification related to this group of samples is detailed on the attached sheets.

All data users should note two facts. First, an "X" flag means that the associated value is unusable due to significant quality control (QC) problems, the data is invalid and provides no information as to whether the compound is present or not. "X" values should not appear on any data tables even as a last resort. Second, no analyte concentration, even if it passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data, but any value potentially contains error.

DATA ASSESSMENT

1. NARRATIVE AND COMPLETENESS REVIEW:

The case narrative was reviewed, and the data package was checked for completeness. No discrepancies were noted.

2. SAMPLE DELIVERY AND CONDITION:

The samples arrived at the laboratory in acceptable condition. Proper custody was documented.

3. HOLDING TIME:

The amount of an analyte in a sample can change with time due to chemical instability, degradation, volatilization, etc. If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J" or "UJ" as appropriate. When holding times are exceeded by more than twice the time specified, the non-detects will be flagged as unusable, "X". Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion with the following exception. Sample JACKSON-SWCC2-DC-01 was analyzed by the house laboratory 2 days outside of the 14-day holding time for alkalinity due to a receiving error at the subcontract laboratory. The non detected sample result for the impacted analyte has been qualified estimated "UJ" on this basis.

4. CALIBRATION:

Method requirements for satisfactory instrument or procedural calibration are established to ensure that the instrument can produce acceptable quantitative data. Initial calibration verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibration verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis.

Immediately after each system has been calibrated, the accuracy of the initial calibration must be verified and documented for each target analyte by the analysis of an ICV solution(s). The CCV standard shall be analyzed at a frequency of every 10 samples. The percent relative standard deviation (%RSD) should be less than 20% or the correlation coefficient greater than 0.995. Qualifications were applied to the samples and analytes as shown below.

Calibrations were performed at the appropriate frequency and resulted in %RSD and correlation coefficient values within guidance in all cases. Further, all ICV and CCV evaluations were within acceptance criteria.

Note: No calibration summaries were available for review for the alkalinity method. Therefore, this criterion was not assessed for alkalinity. The validator used the method blank and LCS data provided to assess accuracy.

5. BLANK CONTAMINATION:

Quality assurance blanks, i.e., instrument, preparation, field, or rinse blanks are prepared to identify any contamination which may have been introduced into the samples during sample preparation or field activity. Calibration blanks (ICB and CCB) are used to ensure a stable instrument baseline before and during the analysis of analytical samples. Preparation blanks measure laboratory contamination. Field blanks or lab blanks should not have an analyte detection greater than ½ the analyte Limit of Quantitation (LOQ), or one tenth the concentration of associated samples. However, any positive blank result is assessed against all associated field sample results per validation guidance and data are flagged accordingly. Qualifications were applied to the samples and analytes as shown below.

No problems requiring result qualification were found for this criterion.

6. LABORATORY CONTROL SAMPLE:

The Laboratory Control Sample (LCS) serves to monitor the overall performance of each step during the analysis. Aqueous/water and soil/sediment LCSs shall be analyzed for each analyte utilizing the same sample preparations, analytical methods, and quality assurance/quality control procedures as employed for the samples. All LCS percent recoveries must fall within the control limits of 80-120% for dissolved organic carbon and 90-110% for chloride and sulfate. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

7. MATRIX SPIKE/MATRIX SPIKE DUPLICATE:

The matrix spike/matrix spike duplicate (MS/MSD) sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. The spike percent recovery must fall within the established QAPP acceptance limits of 75-125%, with a relative percent difference between the two of less than 20% for dissolved organic carbon. The spike percent recovery must fall within the established QAPP acceptance limits of 80-120%, with a relative percent difference between the two of less than 15% for chloride and sulfate. However, spike recovery limits do not apply when the sample concentration is greater than or equal to four times the spike added.

Sample JACKSON-SWMC3-DC-01 was submitted for MS/MSD analyses for DOC, chloride, and sulfate in association with this SDG. Upon evaluation all precision and accuracy indicators were acceptable.

8. FIELD DUPLICATES:

Field duplicates may be taken and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision. A control limit of 35% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values greater than or equal to five times the LOQ. A control limit of two times the LOQ shall be used if either the sample or duplicate value is less than five times the LOQ. For field duplicate analyses that do not meet the technical criteria, the action was applied to only the field sample and its duplicate.

Samples JACKSON-SWMC3-DC-01 and SWDUP were submitted as a field duplicate pair in association with this SDG. Adequate field precision was demonstrated with the exception of DOC. Results reported for the impacted analyte in the parent and field duplicate samples have been qualified "J" estimated on this basis.

9. OTHER PROBLEMS:

No problems were found for this criterion.

Table 1 Major and Minor Findings

	Were acceptance criteria met?		
	Yes	No	
Dissolved Organic Carbon		Major	Minor
Holding Time	x		
Initial Calibration	x		
Continuing Calibration	x		
Method Blank	x		
Continuing Calibration Blank	x		
Field Blank	NA		
Matrix Spike / Matrix Duplicate	x		
Laboratory Control Sample	x		
Field Duplicate			x
	Were acceptance criteria met?		
	Yes	No	
Chloride		Major	Minor
Holding Time	x		
Initial Calibration	x		
Continuing Calibration	x		
Method Blank	x		
Continuing Calibration Blank	x		
Field Blank	NA		
Matrix Spike / Matrix Duplicate	x		
Laboratory Control Sample	x		
Field Duplicate	x		
	Were acceptance criteria met?		
	Yes	No	
Sulfate		Major	Minor
Holding Time	x		
Initial Calibration	x		
Continuing Calibration	x		
Method Blank	x		
Continuing Calibration Blank	x		
Field Blank	NA		
Matrix Spike / Matrix Duplicate	x		
Laboratory Control Sample	x		
Field Duplicate	x		
	Were acceptance criteria met?		
	Yes	No	
Alkalinity		Major	Minor
Holding Time			x
Initial Calibration	NA		
Continuing Calibration	NA		
Method Blank	x		
Continuing Calibration Blank	x		
Field Blank	NA		
Matrix Spike / Matrix Duplicate	x		
Laboratory Control Sample	x		
Field Duplicate	x		

Major = Major data quality issue identified resulting in rejection of data.
Minor = Minor data quality issue identified resulting in the qualification of data. Data qualification should be used to inform the data users of data limitations.
NA = Not applicable

Table 2 Data Validation Qualifiers

Data Qualifier	Definition
U	The analyte was not detected and was reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been “tentatively identified” or “presumptively” as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

ENVIRONMENTAL DATA SERVICES, LTD.

EXECUTIVE NARRATIVE

Sample Delivery Group: SQ1201
Laboratory: Eurofins Denver
Site: Fort Jackson
Sampling dates: 3/8/2023
Number of Samples: 10
Test Method: SW-846 6860
Analysis: Perchlorate

Quality Assurance Project Plan: Draft Contract Quality Assurance Project Plan FY20 Update Operational Range Assessments, FY18-22 Army Operational Range Assessment Cycle, Multiple Sites for Active Army and Army Reserve, April 2020 (QAPP).

Validation Guidelines: United States Environmental Protection Agency (USEPA) Contract Laboratory Program National Functional Guidelines for Organic Superfund Methods Data Review, EPA-540-R-2017-002. Office of Superfund Remediation and Technology Innovation, January 2017, Department of Defense General Data Validation Guidelines, February 2018.

Client Sample ID	Laboratory Sample Identification	Matrix	Validation Stage
SWDUP	280-173651-1	surface water	S4VM
JACKSON-SWMC3-DC-01	280-173651-2	surface water	S2BVM
JACKSON-SWMC2-DC-01	280-173651-3	surface water	S2BVM
JACKSON-SWJC1-DC-01	280-173651-4	surface water	S2BVM
JACKSON-SWMC1-DC-01	280-173651-5	surface water	S2BVM
JACKSON-SWCC3-DC-01	280-173651-6	surface water	S2BVM
JACKSON-SWCC4-DC-01	280-173651-7	surface water	S2BVM
JACKSON-SWCC2-DC-01	280-173651-8	surface water	S2BVM
JACKSON-EB-01	280-173651-9	equipment blank	S2BVM
JACKSON-CB-01	280-173651-10	container blank	S2BVM

Table 1 provides a summary of the major and minor data quality issues applied to this data set. All data are acceptable except those results which have been qualified with “X”, rejected. Data validation qualifiers along with associated descriptions are provided in Table 2. All data qualification related to this group of samples is detailed on the attached sheets.

All data users should note two facts. First, an "X" flag means that the associated value is unusable due to significant quality control (QC) problems, the data is invalid and provides no information as to whether the compound is present or not. "X" values should not appear on any data tables even as a last resort. Second, no analyte concentration, even if it passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data, but any value potentially contains error.

DATA ASSESSMENT

1. NARRATIVE AND COMPLETENESS REVIEW:

The case narrative was reviewed, and the data package was checked for completeness. No discrepancies were noted.

2. SAMPLE DELIVERY AND CONDITION:

The samples arrived at the laboratory in acceptable condition. Proper custody was documented.

3. HOLDING TIME:

The amount of an analyte in a sample can change with time due to chemical instability, degradation, volatilization, etc. If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J". The non-detect results will be flagged as not detected at an estimated quantitation limit, "UJ", unless the holding time is grossly exceeded (by more than two times the holding time specified), in which case non-detect results are flagged "R", rejected. Qualifications were applied to the samples and analytes as shown below.

All sample analyses were within the validation guidance.

4. CALIBRATION:

Satisfactory instrument calibration is established to ensure that the instrument can produce acceptable quantitative data. An initial calibration demonstrates that the instrument can give acceptable performance at the beginning of an experimental sequence. The continuing calibration checks document that the instrument is giving satisfactory daily performance.

Mass calibration:

The instrument must have a valid mass calibration prior to any sample analysis.

No problems were found for this criterion.

Percent Relative Standard Deviation and Percent Difference:

Percent relative standard deviation (%RSD) is calculated for the initial calibration and is used to indicate the stability of the specific compound response factor over increasing concentration. Percent difference (%D) compares the response factor of the continuing calibration check to the mean RRF from the initial calibration.

Percent RSD must be equal to or less than maximum %RSD of 15 for all target analytes. In cases where linear and non-linear regressions are used, coefficients of determination must be greater than 0.990. For the opening or closing continuing calibration verification (CCV) the %D must be within maximum %D limits of +/- 15% for all target compounds. A value outside of these limits indicates potential detection and quantitation errors. If the %RSD exceeds quality control criteria, detects may be qualified as "J" and professional judgment is used to qualify non-detects. If the %D exceeds quality control criteria, the positive results are flagged as estimated, "J" and non-detects are flagged "UJ". Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

5. INTERFERENCE CHECK SAMPLES:

Interference check samples (ICS) must be analyzed with every group of twenty samples and at least once daily. The observed concentration of the ICS must be within +/- 20% of its true value.

No problems were found for this criterion.

6. BLANK CONTAMINATION:

Quality assurance (QA) blanks, i.e., method, trip, field, or rinse blanks are prepared to identify any contamination which may have been introduced into the samples during sample preparation or field activity. Method blanks measure laboratory contamination. Field and rinse blanks measure cross-contamination of samples during field operations. Qualifications were applied to the samples and analytes as shown below.

A) Method blank contamination:

No problems were found for this criterion.

B) Instrument blank contamination:

No problems were found for this criterion.

C) Field/Equipment blank contamination:

Samples JACKSON-CB-01 and JACKSON-EB-01 were submitted as container/equipment blanks in association with the samples in this sample delivery group (SDG). No problems were found for this criterion.

7. COMPOUND IDENTIFICATION AND QUANTIFICATION:

Compound Identification

The compounds are identified on the ion chromatograph/mass spectrometer (IC/MS) by using the analytes relative retention time (RRT) and ion spectra. For the results to be a positive hit the sample peak must be within ±0.06 RRT units of the standard compound. Also, the ratio of ions 99 to 101 specifically must be within 2.3 to 3.7. In the cases where there is not an adequate ion spectrum match, the laboratory may have provided false positive identifications.

Target compound identifications were reviewed for samples validated at the Stage 4 level. No anomalies were identified.

Compound Quantification

Target compound result quantitation was reviewed for all samples validated at the Stage 4 level. No anomalies were identified.

8. MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY:

Matrix spike/matrix spike duplicate (MS/MSD) data is generated to determine the long-term precision and accuracy of the analytical method in various matrices. The MS/MSD data may be used in conjunction with other quality control criteria for additional qualification of data.

Sample JACKSON-SWMC3-DC-01 was submitted for MS/MSD evaluation in association with this SDG. Upon evaluation all precision and accuracy indicators were favorable.

9. INTERNAL STANDARDS PERFORMANCE:

Internal standard performance criteria are meant to ensure that the ion chromatograph/mass spectrometer (IC/MS) sensitivity and response are stable during every experimental run.

The internal standard area count must not vary by more than a factor of two from the associated continuing calibration standard. The retention time of the internal standard must not vary by more than ±30 seconds from the associated continuing calibration standard. The area count must be within a (50-150%) range of the associated standard. If the area count is greater than 200%, non-detected results are not qualified and positive results are flagged as estimated "J-". If the area count is less than 50%, positive results are flagged as estimated "J+" and non-detected results are flagged "UJ". If the area count is less than 20%, positive results are flagged as estimated "J+" and non-detected results will be classified as unusable "R". Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

10. FIELD DUPLICATES:

Field duplicates may be taken and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision. A control limit of 35% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values greater than or equal to five times the LOQ in the case of solid samples. A control limit of 20% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values greater than or equal to five times the LOQ in the case of liquid samples. A control limit of two times the LOQ shall be used if either the sample or duplicate value is less than five times the LOQ. For field duplicate analyses that do not meet the technical criteria, the action was applied to only the field sample and its duplicate.

Samples JACKSON-SWMC3-DC-01 and SWDUP were submitted as a field duplicate pair in association with this SDG. Adequate field precision was demonstrated.

11. LABORATORY CONTROL SAMPLES:

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation. Aqueous/water, soil/sediment, wipe, and filter LCSs shall be analyzed for each analyte utilizing the same sample preparations, analytical methods, and quality assurance/quality control (QA/QC) procedures as employed for the samples. All LCS percent recoveries must fall within the project specific control limits or Department of Defense QSM 5.1. Qualifications were applied to the samples and analytes as shown below.

No problems were found for this criterion.

12. DILUTIONS, RE-EXTRACTIONS & REANALYSIS:

Samples may be re-analyzed for dilution, re-extraction and for other QC reasons. In such cases, the best result values are used.

No dilutions, re-extractions or reanalysis were provided for review.

13. SYSTEM PERFORMANCE:

No other problems were found with system performance.

Table 1 Major and Minor Findings

	Were acceptance criteria met?		
	Yes	No	
Perchlorate		Major	Minor
Holding Time	x		
Calibration	x		
Percent Relative Standard Deviation and Percent Deviation	x		
Interference Check Samples	x		
Internal Standards	x		
Method Blank	x		
Instrument Blank	x		
Equipment/Control Blank	x		
Matrix Spike/Matrix Spike Duplicate	x		
Internal Standards	x		
Field Duplicate	x		
Laboratory Control Samples	x		
Other Quality Control Data out of Specification	x		

Major = Major data quality issue identified resulting in rejection of data.
Minor = Minor data quality issue identified resulting in the qualification of data. Data qualification should be used to inform the data users of data limitations.
NA = Not applicable

Table 2 Data Validation Qualifiers

Data Qualifier	Definition
U	The analyte was not detected and was reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been “tentatively identified” or “presumptively” as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

Calculation Documentation

Field Duplicate Calculations

Parameters	Original Sample	Duplicate Sample	RPD	LOQ	Flag
	JACKSON-SDMC3-DC-01	SDDUP			
ACID VOLATILE SULFIDE			#DIV/0!	0.14	
TOTAL SOLIDS	74	74	0.00	1	
LEAD	0.0286	0.0244	15.85	0.00063	
NICKEL	0.00134	0.00112	17.89	0.0044	
SILVER			#DIV/0!	0.0024	
CADMIUM	0.000178	0.000196	9.63	0.0012	
COPPER	0.00595	0.00481	21.19	0.01	
ZINC	0.0289	0.0256	12.11	0.0081	
ANTIMONY	0.08	0.069	14.77	0.11	
COPPER	1.18	0.79	39.59	0.33	ok
ZINC	4.11	3.19	25.21	1.1	
LEAD	7.84	5.69	31.78	0.11	
2,4,6-TRINITROTOLUENE			#DIV/0!	130	
2,4-DINITROTOLUENE			#DIV/0!	130	
RDX			#DIV/0!	130	
4-Amino-2,6-dinitrotoluene			#DIV/0!	130	
HMX			#DIV/0!	130	
2-Amino-4,6-dinitrotoluene			#DIV/0!	130	
TETRYL			#DIV/0!	130	
NITROGLYCERIN			#DIV/0!	1000	
2,6-DINITROTOLUENE			#DIV/0!	130	
2-NITROTOLUENE			#DIV/0!	130	
NITROBENZENE			#DIV/0!	130	
3-NITROTOLUENE			#DIV/0!	130	
1,3,5-TRINITROBENZENE			#DIV/0!	130	
1,3-DINITROBENZENE			#DIV/0!	130	
4-NITROTOLUENE			#DIV/0!	130	
Total Organic Carbon	6550	5760	12.84	397	

Field Duplicate Calculations

Parameters	Original Sample	Duplicate Sample	RPD	LOQ	Flag
	JACKSON-SWMC3-DC-01	SWDUP			
SULFATE	0.67	0.64	4.58	1	
CHLORIDE	3.6	3.6	0.00	2	
HARDNESS, DISSOLVED	6310	6390	1.26	650	
MAGNESIUM	693	700	1.01	100	
SODIUM	2970	2980	0.34	1000	
POTASSIUM	457	529	14.60	1000	
CALCIUM	1280	1290	0.78	100	
LEAD	2.18		200.00	1	ok, diff <2X LOQ
D ANTIMONY	0.34	0.27	22.95	1	
D COPPER	1.8	0.69	89.16	3	ok, diff <2X LOQ
D MAGNESIUM	731	737	0.82	100	
D ZINC	7		200.00	10	ok, diff <2X LOQ
D CALCIUM	1320	1340	1.50	100	
2,4,6-TRINITROTOLUENE			#DIV/0!	0.25	
2,4-DINITROTOLUENE			#DIV/0!	0.25	
RDX			#DIV/0!	0.25	
4-Amino-2,6-dinitrotoluene			#DIV/0!	0.25	
HMX			#DIV/0!	0.25	
2-Amino-4,6-dinitrotoluene			#DIV/0!	0.25	
TETRYL			#DIV/0!	0.25	
NITROGLYCERIN			#DIV/0!	4	
2,6-DINITROTOLUENE			#DIV/0!	0.25	
2-NITROTOLUENE			#DIV/0!	0.25	
NITROBENZENE			#DIV/0!	0.25	
3-NITROTOLUENE			#DIV/0!	0.25	
1,3,5-TRINITROBENZENE			#DIV/0!	0.25	
1,3-DINITROBENZENE			#DIV/0!	0.25	
4-NITROTOLUENE			#DIV/0!	0.25	
4-NITROTOLUENE			#DIV/0!		
Dissolved Organic Carbon-DISS	3.7	6.2	50.51	1.0	parent < 5X LOQ but >
DOC Result 1-DISS	3.6	6.1	51.55	1.0	parent < 5X LOQ but >
DOC Result 2-DISS	3.6	6.1	51.55	1.0	parent < 5X LOQ but >
DOC Result 3-DISS	3.7	6.2	50.51	1.0	parent < 5X LOQ but >
DOC Result 4-DISS	3.7	6.2	50.51	1.0	parent < 5X LOQ but >
Alkalinity	11		200.00	5.0	ok, < LOQ
Perchlorate	0.028	0.044	44.44	0.20	ok, <LOQ

Internal Standard Initial Calibration and Calculation Worksheet

Lab: Eurofins Denver
Method: 6850
Instrument: LC_LCMS10
Curve Date: 3/21/2023
Compound: Perchlorate
Internal Standard: Perchlorate-18O

Initial Calibration Model Worksheet

Compound Area Ax	ISTD Area Ais	Compound Conc Cx	ISTD Conc Cis	Y-Values Ax/Ais	X-Values Cx/Cis	X^2 $(Cx/Cis)^2$	RF (Ax*Cis)/(Ais*Cx)
2594	10723	100	816	0.241909913	0.12254902	0.015018262	1.9740
3340	10611	200	816	0.314767694	0.245098039	0.060073049	1.2843
8550	10210	400	816	0.8374143	0.490196078	0.240292195	1.7083
18468	10179	1000	816	1.814323607	1.225490196	1.501826221	1.4805
36750	9826	2000	816	3.740077346	2.450980392	6.007304883	1.5260
74048	9696	4000	816	7.636963696	4.901960784	24.02921953	1.5579
177575	9498	10000	816	18.69604127	12.25490196	150.1826221	1.5256
352293	8990	20000	816	39.18720801	24.50980392	600.7304883	1.5988
SUM OF EACH COLUMN :				72.4687	46.20098039	782.7668445	12.6554

CALIBRATION MODELS:

Average Response Factor:
Cx = Ax*Cis/Ais/RF

Average RF	1.582	AVERAGE(RF)
RSD	12.5%	STDEV(RF)/(AveRF)

Linear Regression:

y = mx + b
Cx = (((Ax/Ais)-b)/m)*Cis

Weighting	Equal	1/X	$1/X^2$	Equation
Slope (m)	1.58744	1.56727	1.50798	SLOPE(RatioY,RatioX)
Intercept (b)	-0.07934	0.00740	0.037369	INTERCEPT(RatioY,RatioX)
CC (R)	0.99978	0.99948	0.99174	CORREL(RatioY,RatioX)
COD (R^2)	0.99956	0.99895	0.98356	POWER(R,2)

Quadratic Regression:

$y = ax^2 + bx + c$
Cx=(SQRT(b^2-(4*a*(c-(Ax/Ais))))-b)/(2*a)*Cis

Weighting	Equal	1/X	$1/X^2$	Equation
x^2 Coefficient (a)	0.00511	0.00465	-0.01090	LINEST(RatioY,RatioX:RatioX^2,1,1)
x Coefficient (b)	1.46941	1.48040	1.76355	INDEX(LINEST(RatioY,RatioX:RatioX^2,1,1),1,2)
Intercept (c)	0.07221	0.03950	-0.04363	INDEX(LINEST(RatioY,RatioX:RatioX^2,1,1),1,3)
COD (R^2)	0.99992			INDEX(LINEST(RatioY,RatioX:RatioX^2,1,1),3,1)

Sample Concentration Calculations

Sample ID	File ID	Compound Response Ax	ISTD Response Ais	ISTD Conc Cis	Ave RF On-column Conc	Linear Cal On-column Conc Equal Weighting	Linear Cal On-column Conc 1/X Weighting	Linear Cal On-column Conc $1/X^2$ Weighting	Quadratic Cal On-column Conc Equal Weighting	Quadratic Cal On-column Conc 1/X Weighting	Quadratic Cal On-column Conc	Reported on column
Equations:					Ax*Cis/Ais/RF	((Ax/Ais-b)/m)*Cis			(SQRT(b^2-(4*a*(c-(Ax/Ais))))-b)/(2*a)*Cis			
ICV	LC1023C21036.d	36562	9685	816	1947.311	1981.322	1961.660	2022.579	2038.584	2043.021	1791.240	1947.3
CCV	LC1023C22066.d	40424	11108	816	1877.191	1911.445	1890.884	1949.021	1964.362	1969.231	1726.620	1877.2
LCS	LC1023C22070.d	4252	11133	816	197.009	237.107	194.996	186.448	171.865	188.610	197.200	197
MS	LC1023C22076.d	4807	10958	816	226.281	266.278	224.541	217.156	203.328	219.840	223.541	226.3
MSD	LC1023C22077.d	4713	11197	816	217.120	257.149	215.295	207.546	193.482	210.068	215.296	217.1
280-173651-1	LC1023C22074.d	906	10652	816	43.873	84.505	40.429	25.804	7.130	25.107	59.568	43.9

Data Validation Worksheet

DATA VALIDATION EXPLOSIVES USEPA 8330B

QSM 5.1 Reference

Validator: LL 4/18/23

Reviewer: GAP 4/19/2023

Project: Fort Jackson

SDG: SQ1188 (full explosives list)

LAB: Katahdin Analytical Services

Samples Collected: 3/8/23

Preservation: Cooler temp < 6 degrees C ok

SAMPLE RECEIPT AND CASE NARRATIVE REVIEW

- ✓ Traffic reports, chain-of-custody forms or SDG narrative do not indicate any problems with sample receipt, condition of the samples, analytical problems or special circumstances affecting the quality of the data.

All ok

HOLDING TIMES

- ✓ Water and waste samples must be properly preserved (cooled to 4° +/- 2°), and nitro substituted aromatics and amines analysis must be extracted within 7 days of the date of collection. Extracts must be analyzed within 40 days of the date of extraction.
- ✓ Solid samples must be properly preserved (cooled to 4° +/- 2°), and nitro substituted aromatics and amines analysis must be extracted within 14 days of the date of collection. Extracts must be analyzed within 40 days of the date of extraction.

Water Samples ext. 7 days analyzed within 40

Collected: 3/8
Extracted: 3/16
Analyzed: 3/23

SURROGATES

- ✓ The laboratory must evaluate the surrogate data from individual samples versus the surrogate control limits developed by the laboratory. Method 8000C, Sec 9.0 details evaluating surrogate data and updating surrogate limits. If laboratory established recovery limits are not established, use surrogate recovery between 70 - 130% for all samples, including MS, MSDs, LCSs, and all blanks.

QSM Limits 78-119

JACKSON-SDMC1-DC-01 ↓ Q UJ all targets SQ1188-7

✓ Surrogate retention times (RT) must be within the windows established during the initial 5-point analysis.

LABORATORY CONTROL SAMPLE

✓ LCS prepared, extracted, analyzed, and reported once for every 20 field samples of a similar matrix, per SDG. Raw data and percent recoveries present for all Laboratory Control samples as required by Method 8000C (section 9.5).

✓ Laboratory Control Samples were analyzed for all the nitroaromatics and nitroamines analytes that the samples are analyzed for.

✓ Did laboratory calculate in-house performance criteria for LCS recoveries according to Method 8000C section 9.7, and were recoveries met? If in house LCS recoveries performance criteria were not generated, the laboratory should use 70 - 130% criteria, and was this criterion met?

NA QSM limits are used all criteria are met.

LCS WG333925-2 Tetryl ↑ all ND no Q

MS/MSD

JACKSON-SDMC3-DC-01 SQ1188-5

	MS	MSD	RPD
All	ok	ok	out

✓ The Matrix Spike Samples were spiked and analyzed for all the nitroaromatics and nitroamines analytes that the samples are analyzed for (Same analytes as LCS).

✓ QSM 5.1 limits are used for %R all criteria are met. Exceptions if any are above
✓ Per QAPP RPD < 20% all met

BLANKS

- ✓ Frequency of Analysis: reagent blank has been analyzed for every 20 (or less) samples of similar matrix or concentration or each extraction batch.

  Method Blank:

  WG333925-1 all ND

- ✓ The chromatographic performance (baseline stability) for each instrument is acceptable for nitroaromatics and nitroamines.

- ✓ Method/instrument/reagent/cleanup blanks do not have positive results for nitroaromatics or nitroamines.

  Note when necessary, the contaminant concentration in these blanks are multiplied by the sample Dilution Factor and corrected for % moisture when necessary.

  ✓ Field/rinse blanks are not positive nitroaromatics or nitroamines.
  sample was submitted as field/equipment blanks in association with the surface water or sediment samples in this sample delivery group (SDG).

  none

  NOTE: All field blank results associated to a particular group of samples (may exceed one per case or one per day) may be used to qualify data. Blanks may not be qualified because of contamination in another blank. Field blanks must be qualified for surrogate, or calibration QC problems.

  NOTE: If gross blank contamination exists (e.g., saturated peaks, hump-o-grams, junk peaks), all affected positive compounds in the associated samples should be qualified as unusable "R", due to interference. Non-detected pesticide target compounds do not require qualification unless the contamination is so high that it interferes with the analyses of non-detected compounds.

  ✓ Field/rinse/equipment blanks are not associated with every sample.

  ACTION: For low level samples, note in data assessment that there is no associated field/rinse/ equipment blank. Exception: samples taken from a drinking water tap do not have associated field blanks.

ICAL

✓ Data summary forms (containing calibration factors or response factors) for the initial 5 pt. calibration and daily calibration verification standards are present and complete for each column and each analytical sequence.

NOTE: External standard calibration procedures are used (Method 8000C (section 11.4.2), therefore calibration factors must be used.

ALL SAMPLES WERE INITIALLY ANALYZED ON THE PRIMARY PHENOMENEX COLUMN

INST HPLC02 PHENOMENEX
ICAL 3/15 all samples all ok
ICV 3/15 WG333590-8 all ok

INST HPLC04 ACCLAIM E2
N/A

✓ No transcription/calculation errors between raw data and data summary forms.

✓ Standard retention time (RT) windows for each nitroaromatics and nitroamine peak of interest are presented on modified CLP summary forms.

No retention time windows were provided

ACTION: If any data are missing, or it cannot be determined how RT windows were calculated, call the lab for explanation/resubmittals. Note any problems in the data assessment.

NOTE: Retention time windows for all nitroaromatics and nitroamines are established using retention times from three calibration standards analyzed during the entire analytical sequence (Method 8000C section 11.6).

✓ All standard retention times in each level of the initial 5 pt. calibrations for nitroaromatics and nitroamines fall within the windows established during the initial calibration sequence

✓ Linearity criteria for the initial calibration standards has been satisfied for both columns. (% RSD for the calibration factors (CFs)must be < 20.0% or coeff of determination >0.990 for all analytes)

CCAL

✓ Calibration verification/continuing calibration standard contain the nitroaromatics or nitroamines peaks of interest, analyzed on each working day, prior to sample analyses.

✓ Calibration verification/continuing calibration standard been analyzed after every 10 samples and at the end of each analytical sequence

✓ Percent difference (%D) between the Calibration Factor (CF) of the peaks used to identify the nitroaromatics and nitroamines in the CCV and the CF from these peaks in the initial calibration do not exceed 20%.

✓ Continuing calibration blank or PIBLK been analyzed after every 10 samples and at the end of each analytical sequence not detected above MDL for all targets.

No CCBs or PIBLKs were analyzed

INST HPLC02 PHENOMENEX

CCV	3/23	WG334249-1	all ok
		Tetryl out	Q UJ
	3/23	WG334249-2	all ok
		Tetryl out	Q UJ

INST HPLC04 ACCLAIM E2
N/A

All ok unless noted above

✓ New 5 pt. initial calibration curve been generated for those nitroaromatics and nitroamines analytes which failed in the calibration verification/continuing calibration standard (8000C, section 11.7.3), and all samples which followed the out-of-control calibration verification/standard continuing calibration standard.

✓ Retention time (RT) windows have been properly calculated for each analyte of interest (Method 8000C, section 11.6), using RTs from the associated calibration verification/continuing standard.

✓ All standard retention times for each calibration verification/continuing calibration standard fall within the windows established during the initial calibration sequence.

✓ All standard retention times for each mid-concentration standard (analyzed after

every 10 samples) fall within the daily RT windows.

✓ No transcription/calculation errors between raw data and data summary forms (initial calibration summaries, calibration verification summaries, analytical sequence summaries. ok

ACTION: If large errors exist, call lab for explanation/resubmittal, make necessary corrections and note error in the data assessment.

%RPD BETWEEN DUAL COL RESULTS

✓ CLP Form X or equivalent, showing retention time data for positive results on the two HPLC columns, been completed for every sample in which a nitroaromatics or nitramines was Detected.

✓ Retention times (RT) of sample compounds within the established RT windows for both columns/analyses.

ACTION: Qualify as unusable (R) all positive results which were not confirmed by second HPLC column analysis. Also qualify "R", unusable, all positive results not within RT windows unless associated standard compounds are similarly biased. The reviewer should use professional judgement to assign an appropriate quantitation limit.

✓ Check chromatograms for false negatives, especially if RT windows on each column were established differently.

No false negatives.

ACTION: Use professional judgement to decide if the compound should be reported. If there is reason to believe that peaks outside retention RT windows should be reported, make corrections to data summary forms (Form I) and note in data assessment.

✓ Percent difference (%D) calculated for the positive sample results on the two HPLC columns<40.0%.

Exceptions:

None

NOTE: The method requires quantitation from one column. The second column is to confirm the presence of an analyte. It is the reviewer's responsibility to verify from the project plan what the lab was required to report. If the lab was required to report concentrations from both columns, continue with validation for % Difference. If

required, but not reported, either contact the lab for results or calculate the concentrations from the calibration. If not required, skip this section. Document actions in Data Assessment.

ACTION: If the reviewer finds neither column shows interference for the positive hits, the data should be qualified as follows:

% Difference Qualifier
0-40% none
41-70% "J"
71-100% "NJ"
101-200% (No Interference) "R"
101-200% (Interference detected) "NJ"
>50% (Analyte value is <CRQL) "U"
>200% R

Note: The lower of the two values is reported on Form I. If using professional judgement, the reviewer determines that the higher result was more acceptable, the reviewer should replace the value and indicate the reason for the change in the data assessment.

FIELD DUPLICATES

No QAPP RPD +/- 20% for FDs water used RPD +/- 35% for FDs solid used

JACKSON-SDMC3-DC-01 and SDDUP all ok

SEM Sediments

Validated by: **DM**

Validated on: **4/19/2023**

Reviewed by: DLW 4/19/23

SDG: **SQ1188** Analytes: **Cadmium, Copper, Lead, Nickel, Silver, Zinc**

Temp. (0-6 degrees C) **Yes**

Preservation Holding Time –

Date collected : **3/8/2023**

pH < 2 **yes**

6 months HT **yes**

Calibration- IQC24A

Instrument: **THERMO ICAP 6500**

Date: **03/24/2023**

Blank and 1 Standard **yes**

PQL or CRQL Std. (80-120%) **Ok**

Initial Calib Verif. ICV (90-110) %R **Ok**

Continuing Calib. Verif. CCV (90-110) %R **Ok**

Initial Calib Blank ICB (ND or U) All Yes

Continuing Calib. Blank CCB (ND or U) No

Frequency every ten samples Yes

Cadmium, Copper, Lead, Nickel, Silver, Zinc

ICV (15:10) ok

ICB (15:14) ok

CCV (15:49) ok

CCB (15:53) Cd 0.144J sample 2 <10x flag U, Zn 0.451J all >10x no Q

Assoc samples 2, 4, 6, 8

CCV (16:39) ok

CCB (16:44) Cd 0.105J converts to .000025623 Um/g sample 2 <10x flag U

CCV (16:48) ok

CCB (16:52)

CCV (17:30) ok

CCB (17:35) Cd 0.124J samples 10, 12, 14, 16 flag U, Zn 0.551J all >10x no Q

Assoc samples 10, 12, 14, 16

Blanks: (Remember never qualify a blank for a blank and always use highest blank value)

Method Blank (ND or U) (3P)

Cadmium, Copper, Lead, Nickel, Silver, Zinc

PBSQC21ICS2

Cadium 0.000017 use 10x rule, previosuly qualified for calibration blank

Zinc 0.0126B FLAG ALL SAMPLES U

Field Blanks/Equipment Blanks/Rinse Blanks (ND or U)

None

Interference Check Sample (ICS) (4)

ICSA (+/- LOD or 80-120 %R) yes

ICSAB (+/- LOD or 80-

120 %R) yes

Instrument: ICAP 6500

Date: 3/21/22

OK

Laboratory Control Sample (LCS) USE QSM

Cadmium, Copper, Lead, Nickel, Silver, Zinc

LCSOQC21ICS2

QSM Liquid NA

QSM Solid ok

Duplicates: 1 in 20

Yes/No No

If yes Does RPD or relative percent difference meet QSM 20%.

Matrix Spike (MS) (only if sample concentration is less than 4x spike added)

Cadmium, Copper, Lead, Nickel, Silver, Zinc

Yes/No Yes

If yes, sample name: JACKSON-SDMC1-DC-01

%R solid QSM see chart below

%R liquid QSM NA

	MS %R	MSD %R	RPD	PDS	FLAG
Lead	77.7↓	ok	ok	ok	inconclusive no Q
Silver	80↓	ok	ok	ok	inconclusive no Q

Matrix Spike Duplicate (MSD)

Yes/No Yes

If yes, sample name: JACKSON-SDMC1-DC-01

%R solid QSM see chart above

%R liquid QSM NA

%RPD < 20 see chart above

Serial Dilution

Yes/No Yes

If yes, sample name: JACKSON-SDMC1-DC-01

%D < 10% (only if undiluted result is > 50x LOQ) All those >10% are less than 50x LOQ. No Q

Field Duplicates (FIELD DUPS QAPP +/- 35% RPD) **Use calculation sheet and EDD**

≤ 35% RPD, for results greater than five times the QL

List Field Duplicates:

JACKSON-SDMC3-DC-01 **SDDUP all ok**

Precision acceptable (Y/N) **See worksheet**

QAPP reporting limits met: Look in QAPP WS# 15 PQL column

Yes/No: **Yes**

ICPMS

Validated by: DM

Validated on: 4/19/23

Reviewed by: DLW 4/19/23

SDG: SQ1188 Analytes: Sb, Cu, Pb, Zn

Temp. (0-6 degrees C) Yes

Preservation Holding Time –

Date collected : 3/8/23

pH < 2 NA

6 months HT yes

Tune Analysis-

Was tune performed at instrument daily set up (yes/no) Yes

Resolution within 0.1 amu Yes

%RSD < 5% Yes

All Ok

Calibration- **lqc21a**

Instrument: THERMO ICAP 6500

Date: 3/21/23

Blank and 1 Standard yes

PQL or CRQL Std. (80-120%) Yes

Initial Calib Verif. ICV (90-110) %R Yes

Continuing Calib. Verif. CCV (90-110) %R Yes

Initial Calib Blank ICB (ND or U) No

Continuing Calib. Blank CCB (ND or U) No

Frequency every ten samples Yes

Sb, Cu, Zn

PQL

ICV 3/21/23 (15:17)

ICB 3/21/23 (15:26) ok

CCV (17:32) ok

CCB (17:41) ok

CCV (18:48) ok

CCB (18:57) ok

CCV (20:01) ok

CCB (20:11) ok

CCV (21:07) ok

CCB (21:16) ok

CCV (22:17) ok

CCB (22:27) ok

Calibration-**LQC24A**

Instrument: AGILENT 7800 ICP-MS

Date: 3/24/23

Blank and 1 Standard yes

PQL or CRQL Std. (80-120%) Yes

Initial Calib Verif. ICV (90-110) %R Yes

Continuing Calib. Verif. CCV (90-110) %R Yes

Initial Calib Blank ICB (ND or U) No

Continuing Calib. Blank CCB (ND or U) No

Frequency every ten samples Yes

Pb only

PQL

ICV 3/24/23

ICB 3/24/23

CCV (20:41) ok

CCB (20:51) Pb 0.029J all >10x no Q

CCV (21:58) ok

CCB (22:07) Pb 0.018J all >10x no Q

CCV (23:12) ok

CCB (23:21) Pb 0.010J all >10x no Q

Calibration-**LQC28E**

Instrument: AGILENT 7800 ICP-MS

Date: 3/28/23

Blank and 1 Standard yes

PQL or CRQL Std. (80-120%) Yes

Initial Calib Verif. ICV (90-110) %R Yes

Continuing Calib. Verif. CCV (90-110) %R Yes

Initial Calib Blank ICB (ND or U) No

Continuing Calib. Blank CCB (ND or U) No

Frequency every ten samples Yes

Zn only

PQL

ICV 3/28/23 (16:12)

ICB 3/28/23 (16:21)

CCV (17:20) ok

CCB (17:28) ok

CCV (18:30) ok

CCB (18:39) ok

Blanks: (Remember never qualify a blank for a blank and always use highest blank value) (3P)

Method Blank (ND or U) No

PBSQC14IMS2

COPPER 0.077J FLAG SAMPLE 1 U

ZINC 0.3J sample 1 FLAG U

LEAD 0.066B all >10x no Q

Assoc samples 1, 3, 5, 7, 9, 15

PBSQC16IMS1

LEAD 0.016J ALL >10X NO Q

ZINC 0.7 B FLAG ALL SAMPLES U

Assoc samples 11, 13

Field Blanks/Equipment Blanks/Rinse Blanks (ND or U)

None

Interference Check Sample (ICS)

ICSA (+/- LOD or 80-120 %R) yes

ICSAB (+/- LOD or 80-120 %R) yes

Instrument: AGILENT 7500 ICP-MS

Date: 3/24/23, 3/28/23

Ok

Laboratory Control Sample (LCS) USE QSM

LC2OQC14IMS2

LCSOQC14IMS2

LCSOQC16IMS1

QSM Liquid NA

QSM Solid ok

Duplicates: 1 in 20

Yes/No No

If yes Does RPD or relative percent difference meet QSM 20%.

Table 20. Spike Sample Actions for ICP-MS Analysis

Criteria	Action	
	Detect	Non-detect
Matrix Spike %R < 30% Post-digestion spike %R < 75%	J-	R
Matrix Spike %R < 30% Post-digestion spike %R ≥ 75%	J	UJ
Matrix Spike %R 30-74% Post-digestion spike %R < 75%	J-	UJ
Matrix Spike %R 30-74% Post-digestion spike %R ≥ 75%	J	UJ
Matrix Spike %R > 125% Post-digestion spike %R > 125%	J+	No qualification
Matrix Spike %R > 125% Post-digestion spike %R ≤ 125%	J	No qualification
Matrix Spike %R < 30% No post-digestion spike performed	J-	R
Matrix Spike %R 30-74% No post-digestion spike performed	J-	UJ
Matrix Spike %R 75-125% No post-digestion spike is required	No qualification	No qualification
Matrix Spike %R > 125% No post-digestion spike performed	J+	No qualification

NOTE: The above control limits are **method requirements** for spike samples, regardless of the sample matrix type. However, it should be noted that laboratory variability arising from the sub-sampling of non-homogenous soil samples is a common occurrence. Therefore, for **technical review purposes only**, EPA Regional policy or project DQOs may allow the use of less restrictive criteria (e.g., 10 %R and 150 %R for the lower and upper limits) to be assessed against spike and post-digestion spike soil samples.

Matrix Spike (MS) (only if sample concentration is less than 4x spike added)

Yes/No Yes

If yes, sample name: JACKSON-SDMC3-DC-01P

%R solid QSM see chart below

%R liquid QSM NA

Only positives for RPD get qualified

	MS	MSD	PDS	RPD	Parent Q
Sb	↓	↓	**Ok**	**Out**	J
Pb	Ok	Ok	**Ok**	**Ok**	
Cu	Ok	Ok	**Ok**	**Out**	
Zn	Ok	Ok	**Ok**	**Out**	

Matrix Spike Duplicate (MSD)

Yes/No Yes

If yes, sample name:

%R solid QSM see chart above

%R liquid QSM NA

%RPD < 20 see chart above

Serial Dilution

Yes/No Yes

If yes, sample name: JACKSON-SDMC3-DC-01

%D < 10% (only if undiluted result is > 50x IDL) All those >10% are less than 50x LOQ. No Q

Internal Standards (IS)

Present (Y/N) Y

Per QAPP: IS intensity within 30-120% of intensity of the IS in the ICAL (Y/N) Y

Field Duplicates (FIELD DUPS Fort Polk QAPP +/- 35% RPD) Use calculation sheet and EDD

List Field Duplicates:

JACKSON-SDMC3-DC-01 and SDDUP all ok

Precision acceptable (Y/N) Y See calc spreadsheet

QAPP reporting limits met: Look in QAPP WS# 15 PQL column

Yes/No: Yes

Worksheet #15
Reference Limits and Evaluation Table 15-8

Matrix: Sediment
Analytical Group: Metals and SEM/AVS
Concentration Level: Low

Metals

Analyte	CAS Number	PAL (mg/kg)(a)	PQL (mg/kg)(c)	Achievable Laboratory Limits (mg/kg)		
				LOD	LOQ	DL
Antimony	7440-36-0	2	0.2	0.05	0.10	0.020
Copper	7440-50-8	31.6	3.16	0.20	0.30	0.071
Lead	7439-92-1	35.8	3.58	0.050	0.10	0.0070
Zinc	7440-66-6	121	12.1	0.80	1.0	0.13

SEM/AVS(b)

Analyte	CAS Number	PAL (µmol/g)(a)	PQL (µmol/g)(c)	Achievable Laboratory Limits (µmol/g)		
				LOD	LOQ	DL
Acid Volatile Sulfide	NA	NA	0.038	0.076	0.038	0.10
Antimony	7440-36-0	NA	0.00019	0.00082	0.00019	0.00131
Cadmium	7440-43-9	NA	0.000014	0.00053	0.000014	0.00089
Chromium	7440-47-3	NA	0.00017	0.001539	0.00017	0.00385
Copper	7440-50-8	NA	0.00073	0.003147	0.00073	0.007868
Lead	7439-92-1	NA	0.00015	0.000386	0.00015	0.000483
Mercury	7439-97-6	NA	0.000016	0.000018	0.000016	0.000020
Nickel	7440-02-0	NA	0.00022	0.001363	0.00022	0.00341
Silver	7440-22-4	NA	0.00010	0.000742	0.00010	0.00185
Zinc	7440-66-6	NA	0.0011	0.00306	0.0011	0.00612

(a) PALs refer to the lower of the US EPA Region 4 Freshwater Sediment Screening Values (2015) and the US EPA Region 3 Freshwater Sediment Screening Benchmarks (BTAG) (August 2006). Any applicable state standards may supersede the values shown and will be presented in the SSQAPP.
(b) Analytes with NA for PAL have PQL set at the Achievable Laboratory LOQ.
(c) PQLs are set to one-tenth the PAL, if achievable. If not achievable, the PQLs are set to at least one-third the PAL. Analytes shaded under PQLs are not achievable at three times less than the PAL.

Notes:
µg/L = Microgram(s) per liter
µmol/g = Micromole(s) per gram
AVS = Acid volatile sulfides
CAS = Chemical Abstracts Service
DL = Detection Limit
LOD = Limit of Detection
LOQ = Limit of Quantitation
mg/kg = Milligram(s) per kilogram
NA = Not applicable
PAL = Project Action Limit
PQL = Project Quantitation Limit
SEM = Simultaneously extracted metals

AVS Validation Checklist

USED QSM 5.1

Site:	Fort Jackson
Laboratory:	Katahdin Analytical Services
SDG:	SQ1188
Data Validator:	PMH
Validation Date:	4/18/2023
Reviewer:	DLW
Review Date:	4/19/2023
Method:	AVS USEPA 821/R-91-100

Date Collected:	3/8/2023
Date of Analysis:	3/21/2023

Data Completeness and Deliverables

Have any missing deliverable been recieved and added to the data package?
ACTION: Call lab for explanation/resubmittal of any missing deliverables. If the lab cannot probive them, note the effect on review of the data in the non-compliance section of the data assessment narrative.

☐ Yes ☑ No

Notes and validation action:

Custody Documents and Narratives

Are chains of custody present and complete for all samples?

☑ Yes ☐ No

ACTION: Contract lab for replacement of missing documents.

Do chains of custody or lab narratives indicate any problems with sample receipt, condition of samples, analytical problems or special notations affecting the quality of the data?

☑ Yes ☐ No

Notes and validation action:

Temperature:

Sample coolers received @ 4 +/- 2 ℃ ?

☑ Yes ☐ No

Preservation: No indication of head space in sample receipt documentation or case narrative?

☑ Yes ☐ No

ACTION: Samples improperly preserved shall be noted in the data validation report. Professional judgement may result in the results of an analysis of an improperly preserved sample by the laboratory being qualified as estimated "J" or "UJ".

ACTION: If samples were not iced upon receipt, flag all positive results as estimated, an all non-detects “UJ”.

Notes on validation:

Holding Time

Does the holding time exceed 14 days to extraction? 40 days to analysis?

☐ Yes ☑ No

ACTION: If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J" or “UJ” as appropriate. When holding times are exceeded by more than twice the time specified, the non-detects will be flagged as unusable, "R”.

Notes and validation action:

Calibration Verification

Are raw data and summary sheets present for both inital and continuing calibrations? ☑ Yes ☐ No

At least 5 standards and a blank?

Correlation coeff > 0.995?

Are the %D values between 85-115%?
Per QAPP: ICV/CCV 80-120%

ACTION: If the ICV or CCV fail - if possible, indicate bias in the validation report and qualify affected data

Notes and validation action:

ICAL 3/21/2023	corr coeff OK
ICV	ok
CCV	ok
CCB	ok
samples 2,4,6,8,10,12	
CCV	ok
CCB	ok
samples 14,16	
CCV	ok
CCB	ok

Blanks

Has a method blank analysis been reported per twenty samples of a similar matrix or concentration level, and for each extraction batch? ☑ Yes ☐ No

Upon examination of laboratory and field blank data, do any blanks contain positive results? ☐ Yes ☑ No
ACTION: If yes, qualify associated results as follows: If the sample result is greater than the laboratory reporting limit but less than 5 times the blank concentration, flag sample result as non-detect ("U"). If the sample result is reported as detected at a concentration less than the reporting limit and less than 5 times the blank concentration, qualify the sample result as non-detectable at the laboratory reporting limit. For aqueous blanks applied to soil/sediment samples, compare the sample result to the equivalent concentration of the blank.

Are there field/rinse/equipment blanks associated with every sample? ☐ Yes ☑ No

Notes and validation action:

blank	positives	Flag	assocated samples
WG334165	ND		

Matrix Spike

Is a matrix spike/matrix spike duplicate summary present? ☑ Yes ☐ No

ACTION: If any matrix spike data are missing, call the lab for explanation/re-submittal. If information is not available, document the effect in narrative notes.

Notes and validation action: sample run as MS/DU pair ☑ Yes ☐ No

Sample	MS %R	MSD %R	RPD	Flag	
SQ1188-8	42%↓	n/a	n/a	sample result ND, Q UJ	SDDUP

Laboratory Duplicate

Is a laboratory duplicate summary present? ☑ Yes ☐ No

Are the RPDs within the control limit or +/- 20%? ☑ Yes ☐ No

Notes and validation action:

Sample	RPD
SQ1188-8	ok

Laboratory Control Sample

Were LCS samples evaluated with each batch of 20 samples or less and were observed percent recoveries within the laboratory defined limits?
Used lab limits used 50-120%

☑ Yes ☐ No

Notes and validation action:

LCS or LCSD	%R	Flag	Associated samples:
WG334165-2	ok		

Field Duplicates

Were field duplicates submitted for AVS analysis?

ACTION: For field duplicate analyses that do not meet the technical criteria, apply action to only the parent sample and its duplicate.

☑ Yes ☐ No

Notes and validation action:

JACKSON-SDMC3-DC-01 and SDDUP

all ok see FD worksheet

Review Level

Is a level 4 review required for this project?

☐ Yes ☑ No

List samples reviewed and bold samples used for calculations:
Level 2B for this SDG

As part of the data validation process, the following validation qualifiers and their meanings will be used:

"U" - Non-Detect – The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

"J" - Estimated Value – The analyte was positively identified; but the associated numerical value is the approximate concentration of the analyte in the sample.

"NJ" - The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

"UJ" - Estimated Non-Detect – The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

"X" - The sample results are rejected. Due to significant QA/QC problems the analysis is invalid and provides no information as to whether the analyte is present or not. Once the data are flagged with "X", any further review or consideration is unnecessary.

If no determination of the overall bias of a result qualified as estimated can be made, the result will be flagged with "J". If the data reviewer can determine the overall bias for sample data qualified as estimated, the data reviewer will qualify the sampl e result as either an estimated minimum value (JL) or an estimated maximum value (JH).

TOC Validation Checklist

Site:	Fort Jackson
Laboratory:	Eurofins Lancaster Laboratories Environment Testing, LLC
SDG:	410-119054-1
Data Validator:	PMH
Validation Date:	4/18/2023
Reviewer:	DLW
Review Date:	4/19/2023
Method:	TOC Lloyd Kahn

Date Collected:	3/8/2023
Date of Analysis:	3/22/2023

Data Completeness and Deliverables

Have any missing deliverable been recieved and added to the data package?
ACTION: Call lab for explanation/resubmittal of any missing deliverables. If the lab cannot probive them, note the effect on review of the data in the non-compliance section of the data assessment narrative.

☐ Yes ☑ No

Notes and validation action:

Custody Documents and Narratives

Are chains of custody present and complete for all samples?

☑ Yes ☐ No

ACTION: Contract lab for replacement of missing documents.

Do chains of custody or lab narratives indicate any problems with sample receipt, condition of samples, analytical problems or special notations affecting the quality of the data?

☐ Yes ☑ No

Notes and validation action:

Temperature:

Sample coolers received @ 0-6 ℃ ?

☑ Yes ☐ No

Preservation:

Sulfuric or hydrochloric acid pH of 2?

☐ Yes ☑ No

ACTION: Samples improperly preserved shall be noted in the data validation report. Professional judgement may result in the results of an analysis of an improperly preserved sample by the laboratory being qualified as estimated "J" or "UJ".

ACTION: If samples were not iced upon receipt, flag all positive results as estimated, an all non-detects “UJ”.

Notes and validation action: samples sediments no pres.

Holding Time

Does the holding time exceed 28 days?

☐ Yes ☑ No

ACTION: If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J" or “UJ” as appropriate. When holding times are exceeded by more than twice the time specified, the non-detects will be flagged as unusable, "R”.

Notes and validation action: HT ok

Calibration Verification

Are raw data and summary sheets present for both inital and continuing calibrations? ☑ Yes ☐ No

At least 3 standards and a blank?

Correlation coeff > 0.995?

Are the %D values between 90-110%? No see below

QAPP ICV /CCV 80-120%

ACTION: If the ICV or CCV fail - if possible, indicate bias in the validation report and qualify affected data. 75-89% - J/UJ; 111-125% - J; 75-89%; <75% use professional judgement.

Notes and validation action:

		Associated samples	
INST: 11082			
ICAL 3/7/2023	corr. coeff ok		
Run Date: 3/22/2023			
CCV 410-356521/1 1 13:14 X	ok		
CCB 410-356521/2 1 13:19 X	ok		
CCV 410-356521/13 1 14:21 X	79%↓	samples 3,1,4,5,6,7,8	all samples detected, all samples impacted, (
CCB 410-356521/14 1 14:33 X	ok		
CCV 410-356521/25 1 15:17 X	134%↑	samples 1,4,5,6,7,8	
CCB 410-356521/26 1 15:23 X	ok		
CCV 410-356521/37 1 16:09 X	128%↑	sample 2	
CCB 410-356521/38 1 16:14 X	ok		
CCV 410-356521/41 1 16:25 X	ok		
CCB 410-356521/42 1 16:28 X	ok		

Blanks

Has a method blank analysis been reported per twenty samples of a similar matrix or concentration level, and for each extraction batch? ☑ Yes ☐ No

Upon examination of laboratory and field blank data, do any blanks contain positive results? ☐ Yes ☑ No
ACTION: If yes, qualify associated results as follows: If the sample result is greater than the laboratory reporting limit but less than 5 times the blank concentration, flag sample result as non-detect ("U"). If the sample result is reported as detected at a concentration less than the reporting limit and less than 5 times the blank concentration, qualify the sample result as non-detectable at the laboratory reporting limit. For aqueous blanks applied to soil/sediment samples, compare the sample result to the equivalent concentration of the blank.

Are there field/rinse/equipment blanks associated with every sample? ☐ Yes ☑ No

Notes and validation action: MB result summary in data package does not have U qualifier even though it was not detected. EDD shows U qualifier.

blank	positives	Flag	assocated samples
MB 410-356521/4	ND	none	samples 1,3,4,5,6,7,8
MB 410-356521/32	ND	none	sample 2

Matrix Spike

Is a matrix spike/matrix spike duplicate summary present? ☐ Yes ☑ No

ACTION: If any matrix spike data are missing, call the lab for explanation/re-submittal. If information is not available, document the effect in narrative notes.

Are all matrix spike and/or matrix spike duplicate %Rs or RPDs within acceptance range? ☐ Yes ☐ No

Per QAPP: 80-120% TOC
75-125% DOC

Notes and validation action:

Sample	MS %R	MSD %R	RPD	Flag
410-119054-3 JACKSON-SDMC3-DC-01	ok	ok	ok	none

Laboratory Duplicate

Is a laboratory duplicate summary present? ☐ Yes ☑ No

Are the RPDs within the control limit or +/- 20%? ☐ Yes ☑ No

Notes and validation action:

none

Laboratory Control Sample

Were LCS samples evaluated with each batch of 20 samples or less and were observed percent recoveries within the laboratory defined limits?

Per QAPP: 85-115% TOC
80-120% DOC

☐ Yes ☑ No

Notes and validation action:

LCS or LCSD	%R	Flag	Associated samples:
LCS 410-356521/3	116%↑	samples detect, Q J	samples 1,3,4,5,6,7,8
LCS 410-356521/31	125%↑	samples detect, Q J	sample 2

Field Duplicates

Were field duplicates submitted for TOC analysis?

ACTION: For field duplicate analyses that do not meet the technical criteria, apply action to only the parent sample and its duplicate.

☑ Yes ☐ No

Notes and validation action:

JACKSON-SDMC3-DC-01 and SDDUP

all ok see FD worksheet

Review Level

Is a level 4 review required for this project?

☐ Yes ☑ No

List samples reviewed and bold samples used for calculations:
level 2B for this SDG

As part of the data validation process, the following validation qualifiers and their meanings will be used:

“U” - Non-Detect – The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

“J” - Estimated Value – The analyte was positively identified; but the associated numerical value is the approximate concentration of the analyte in the sample.

“NJ” - The analysis indicates the presence of an analyte that has been “tentatively identified” and the associated numerical value represents its approximate concentration.

“UJ” - Estimated Non-Detect – The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

“X” - The sample results are rejected. Due to significant QA/QC problems the analysis is invalid and provides no information as to whether the analyte is present or not. Once the data are flagged with “X”, any further review or consideration is unnecessary.

If no determination of the overall bias of a result qualified as estimated can be made, the result will be flagged with “J”. If the data reviewer can determine the overall bias for sample data qualified as estimated, the data reviewer will qualify the sample result as either an estimated minimum value (JL) or an estimated maximum value (JH).

DATA VALIDATION EXPLOSIVES USEPA 8330B

QSM 5.1 Reference

Validator: LL 4/19/23

Reviewer: GAP 4/19/2023

Project: Fort Jackson

SDG: SQ1201 (full explosives list)

LAB: Katahdin Analytical Services

Samples Collected: 3/8/23

Preservation: Cooler temp < 6 degrees C ok

SAMPLE RECEIPT AND CASE NARRATIVE REVIEW

- ✓ Traffic reports, chain-of-custody forms or SDG narrative do not indicate any problems with sample receipt, condition of the samples, analytical problems or special circumstances affecting the quality of the data.

All ok

HOLDING TIMES

- ✓ Water and waste samples must be properly preserved (cooled to 4° +/- 2°), and nitro substituted aromatics and amines analysis must be extracted within 7 days of the date of collection. Extracts must be analyzed within 40 days of the date of extraction.
- ✓ Solid samples must be properly preserved (cooled to 4° +/- 2°), and nitro substituted aromatics and amines analysis must be extracted within 14 days of the date of collection. Extracts must be analyzed within 40 days of the date of extraction.

Water Samples ext. 7 days analyzed within 40

Collected: 3/8
Extracted: 3/14
Analyzed: 3/17

SURROGATES

- ✓ The laboratory must evaluate the surrogate data from individual samples versus the surrogate control limits developed by the laboratory. Method 8000C, Sec 9.0 details evaluating surrogate data and updating surrogate limits. If laboratory established recovery limits are not established, use surrogate recovery between 70 - 130% for all samples, including MS, MSDs, LCSs, and all blanks.

QSM Limits 78-119 solid, 83-119 aqueous

JACKSON-SWJC1-DC-01	↓	Q UJ	all targets	SQ1201-4

- ✓ Surrogate retention times (RT) must be within the windows established during the initial 5-point analysis.

LABORATORY CONTROL SAMPLE

- ✓ LCS prepared, extracted, analyzed, and reported once for every 20 field samples of a similar matrix, per SDG. Raw data and percent recoveries present for all Laboratory Control samples as required by Method 8000C (section 9.5).

- ✓ Laboratory Control Samples were analyzed for all the nitroaromatics and nitroamines analytes that the samples are analyzed for.

- ✓ Did laboratory calculate in-house performance criteria for LCS recoveries according to Method 8000C section 9.7, and were recoveries met? If in house LCS recoveries performance criteria were not generated, the laboratory should use 70 - 130% criteria, and was this criterion met?

NA QSM limits are used all criteria are met.

LCS	WG333823-2	Tetryl	↑	all ND no Q

MS/MSD

JACKSON-SWMC3-DC-01			SQ1201-2	
	MS	MSD	RPD	
Tetryl	↑	↑	ok	ND no Q

- ✓ The Matrix Spike Samples were spiked and analyzed for all the nitroaromatics and nitroamines analytes that the samples are analyzed for (Same analytes as LCS).

- ✓ QSM 5.1 limits are used for %R all criteria are met. Exceptions if any are above
- ✓ Per QAPP RPD < 20% all met

BLANKS

- ✓ Frequency of Analysis: reagent blank has been analyzed for every 20 (or less) samples of similar matrix or concentration or each extraction batch.

  Method Blank:

  WG333823-1 all ND

- ✓ The chromatographic performance (baseline stability) for each instrument is acceptable for nitroaromatics and nitroamines.

- ✓ Method/instrument/reagent/cleanup blanks do not have positive results for nitroaromatics or nitroamines.

  Note when necessary, the contaminant concentration in these blanks are multiplied by the sample Dilution Factor and corrected for % moisture when necessary.

  ✓ Field/rinse blanks are not positive nitroaromatics or nitroamines.
  sample was submitted as field/equipment blanks in association with the surface water or sediment samples in this sample delivery group (SDG).

  JACKSON-EB-01 All ND
  JACKSON-CB-01 All ND

  NOTE: All field blank results associated to a particular group of samples (may exceed one per case or one per day) may be used to qualify data. Blanks may not be qualified because of contamination in another blank. Field blanks must be qualified for surrogate, or calibration QC problems.

  NOTE: If gross blank contamination exists (e.g., saturated peaks, hump-o-grams, junk peaks), all affected positive compounds in the associated samples should be qualified as unusable "R", due to interference. Non-detected pesticide target compounds do not require qualification unless the contamination is so high that it interferes with the analyses of non-detected compounds.

  ✓ Field/rinse/equipment blanks are not associated with every sample.

  ACTION: For low level samples, note in data assessment that there is no associated field/rinse/ equipment blank. Exception: samples taken from a drinking water tap do not have associated field blanks.

ICAL

✓ Data summary forms (containing calibration factors or response factors) for the initial 5 pt. calibration and daily calibration verification standards are present and complete for each column and each analytical sequence.

NOTE: External standard calibration procedures are used (Method 8000C (section 11.4.2), therefore calibration factors must be used.

ALL SAMPLES WERE INITIALLY ANALYZED ON THE PRIMARY PHENOMENEX COLUMN

INST HPLC02 PHENOMENEX
ICAL 3/15 all ok
ICV 3/15 WG333590-8 all ok

ICAL 3/21 all ok
ICV 3/21 WG334216-8 all ok

INST HPLC04 ACCLAIM E2
N/A

✓ No transcription/calculation errors between raw data and data summary forms.

✓ Standard retention time (RT) windows for each nitroaromatics and nitroamine peak of interest are presented on modified CLP summary forms.

No retention time windows were provided

ACTION: If any data are missing, or it cannot be determined how RT windows were calculated, call the lab for explanation/resubmittals. Note any problems in the data assessment.

NOTE: Retention time windows for all nitroaromatics and nitroamines are established using retention times from three calibration standards analyzed during the entire analytical sequence (Method 8000C section 11.6).

✓ All standard retention times in each level of the initial 5 pt. calibrations for nitroaromatics and nitroamines fall within the windows established during the initial calibration sequence

✓ Linearity criteria for the initial calibration standards has been satisfied for both columns.

(% RSD for the calibration factors (CFs)must be < 20.0% or coeff of determination >0.990 for all analytes)

CCAL

✓ Calibration verification/continuing calibration standard contain the nitroaromatics or nitroamines peaks of interest, analyzed on each working day, prior to sample analyses.

✓ Calibration verification/continuing calibration standard been analyzed after every 10 samples and at the end of each analytical sequence

✓ Percent difference (%D) between the Calibration Factor (CF) of the peaks used to identify the nitroaromatics and nitroamines in the CCV and the CF from these peaks in the initial calibration do not exceed 20%.

✓ Continuing calibration blank or PIBLK been analyzed after every 10 samples and at the end of each analytical sequence not detected above MDL for all targets.

No CCBs or PIBLKs were analyzed

INST HPLC02 PHENOMENEX
CCV 3/17 WG333979-1
3/17 WG333979-2
3/18 WG333979-3
3/22 WG334216-9

INST HPLC04 ACCLAIM E2
N/A

All ok unless noted above

✓ New 5 pt. initial calibration curve been generated for those nitroaromatics and nitroamines analytes which failed in the calibration verification/continuing calibration standard (8000C, section 11.7.3), and all samples which followed the out-of-control calibration verification/standard continuing calibration standard.

✓ Retention time (RT) windows have been properly calculated for each analyte of interest (Method 8000C, section 11.6), using RTs from the associated calibration verification/continuing standard.

✓ All standard retention times for each calibration verification/continuing calibration standard fall within the windows established during the initial calibration sequence.

✓ All standard retention times for each mid-concentration standard (analyzed after every 10 samples) fall within the daily RT windows.

✓ No transcription/calculation errors between raw data and data summary forms (initial calibration summaries, calibration verification summaries, analytical sequence summaries.

ACTION: If large errors exist, call lab for explanation/resubmittal, make necessary corrections and note error in the data assessment.

%RPD BETWEEN DUAL COL RESULTS

✓ CLP Form X or equivalent, showing retention time data for positive results on the two HPLC columns, been completed for every sample in which a nitroaromatics or nitramines was Detected.

✓ Retention times (RT) of sample compounds within the established RT windows for both columns/analyses.

ACTION: Qualify as unusable (R) all positive results which were not confirmed by second HPLC column analysis. Also qualify "R", unusable, all positive results not within RT windows unless associated standard compounds are similarly biased. The reviewer should use professional judgement to assign an appropriate quantitation limit.

✓ Check chromatograms for false negatives, especially if RT windows on each column were established differently.

No false negatives.

ACTION: Use professional judgement to decide if the compound should be reported. If there is reason to believe that peaks outside retention RT windows should be reported, make corrections to data summary forms (Form I) and note in data assessment.

✓ Percent difference (%D) calculated for the positive sample results on the two HPLC columns<40.0%.

Exceptions:

None

NOTE: The method requires quantitation from one column. The second column is to confirm the presence of an analyte. It is the reviewer's responsibility to verify from the project plan what the lab was required to report. If the lab was required to report concentrations from both columns, continue with validation for % Difference. If required, but not reported, either contact the lab for results or calculate the concentrations from the calibration. If not required, skip this section. Document actions in Data Assessment.

ACTION: If the reviewer finds neither column shows interference for the positive hits, the data should be qualified as follows:

% Difference Qualifier
0-40% none
41-70% "J"
71-100% "NJ"
101-200% (No Interference) "R"
101-200% (Interference detected) "NJ"
>50% (Analyte value is <CRQL) "U"
>200% R

Note: The lower of the two values is reported on Form I. If using professional judgement, the reviewer determines that the higher result was more acceptable, the reviewer should replace the value and indicate the reason for the change in the data assessment.

FIELD DUPLICATES

No QAPP RPD +/- 20% for FDs water used RPD +/- 35% for FDs solid used

JACKSON-SWMC3-DC-01 and SWDUP all ok

Validated by: **GAP**

Validated on: **4/18/2023**

Reviewed by: LL 4/19/23

SDG: **SQ0201** Analytes: **Ca, Mg, K, Na**

Temp. (0-6 degrees C) **Yes**

Preservation Holding Time –

Date collected : **3/8/2023**

pH < 2 **yes**

6 months HT **yes**

Calibration- IQC17A

Instrument: **THERMO ICAP 6500**

Date: **3/17/2023**

Blank and 1 Standard **yes**

PQL or CRQL Std. (80-120%) **Ok**

Initial Calib Verif. ICV (90-110) %R **Ok**

Continuing Calib. Verif. CCV (90-110) %R **Ok**

Initial Calib Blank ICB (ND or U) All Yes

Continuing Calib. Blank CCB (ND or U) No

Frequency every ten samples Yes

Mg, Na

ICV (16:17)

ICB (16:21)

CCV (20:21)

CCB (20:25) Mg 3.176 J ug/L all results >10x no action

Na 137.3 J ug/L>10x no action

Samples 1 and 2

CCV (21:13)

CCB (21:17) Mg 3.981 J ug/L all results >10x no action

Na 24.450 J ug/L results >10x no action

Samples 3-8

CCV (22:03)

CCB (22:08) Mg 5.099 J ug/L all results >10x no action

Calibration- IQC20A

Instrument: **THERMO ICAP 6500**

Date: **3/20/2023**

Blank and 1 Standard **yes**

PQL or CRQL Std. (80-120%) **Ok**

Initial Calib Verif. ICV (90-110) %R **Ok**

Continuing Calib. Verif. CCV (90-110) %R **Ok**

Initial Calib Blank ICB (ND or U) All Yes

Continuing Calib. Blank CCB (ND or U) No

Frequency every ten samples Yes

Ca, K

ICV (16:37)

ICB (16:42)

CCV (17:17)

CCB (17:21) K 102.4 J higher in MB see below

Samples 1 (Ca only) and 2

CCV (18:09)

CCB (18:18)

Samples 3(Ca only), 4-8

CCV (19:01)

CCB (19:05)

Calibration- IQC21A

Instrument: **THERMO ICAP 6500**

Date: **3/20/2023**

Blank and 1 Standard **yes**

PQL or CRQL Std. (80-120%) **Ok**

Initial Calib Verif. ICV (90-110) %R **Ok**

Continuing Calib. Verif. CCV (90-110) %R **Ok**

Initial Calib Blank ICB (ND or U) All Yes

Continuing Calib. Blank CCB (ND or U) No

Frequency every ten samples Yes

K

ICV (16:35)

ICB (16:43)

CCV (17:14)

CCB (17:19)

Samples 1 and 3

CCV (18:06)

CCB (18:10)

Blanks: (Remember never qualify a blank for a blank and always use highest blank value)

Method Blank (ND or U) (3P)

QC16ICW1

Potassium 110 J RESULTS <RL; Q U AT RL

Field Blanks/Equipment Blanks/Rinse Blanks (ND or U)

None

Interference Check Sample (ICS) (4)

ICSA (+/- LOD or 80-120 %R) yes

ICSAB (+/- LOD or 80-

120 %R) yes

Instrument: ICAP 6500

Date: 3/17/23; 3/20/23; 3/21/23

OK

Laboratory Control Sample (LCS) USE QSM

QC16ICW1

QSM Liquid ok

QSM Solid NA

Duplicates: 1 in 20

Yes/No No

If yes Does RPD or relative percent difference meet QSM 20%. yes

---

Matrix Spike (MS) (only if sample concentration is less than 4x spike added)

Yes/No Yes

If yes, sample name: JACKSON-SWMC3-DC-01

%R solid QSM see chart below

%R liquid QSM NA

	MS %R	MSD %R	RPD	PDS	FLAG

All ok

Matrix Spike Duplicate (MSD)

Yes/No Yes

If yes, sample name: JACKSON-SWMC3-DC-01

%R solid QSM see chart above

%R liquid QSM NA

%RPD < 20 see chart above

Serial Dilution

Yes/No Yes

If yes, sample name: JACKSON-SWMC3-DC-01

%D < 10% (only if undiluted result is > 50x LOQ) All those >10% are less than 50x LOQ. No Q

Field Duplicates (FIELD DUPS QAPP +/- 35% RPD) **Use calculation sheet and EDD**

≤ 35% RPD, for results greater than five times the QL

List Field Duplicates:

JACKSON-SWMC3-DC-01 and SWDUP **all ok**

Precision acceptable (Y/N) **See worksheet**

QAPP reporting limits met: Look in QAPP WS# 15 PQL column

Yes/No: **Yes**

ICPMS

Validated by: GAP

Validated on: 4/18/23

Reviewed by: LL 4/19/23

SDG: SQ1201 Analytes: Sb, Cu, Pb, Zn; Ca and Mg for hardness

Temp. (0-6 degrees C) Yes

Preservation Holding Time –

Date collected : 3/8/23

pH < 2 NA

6 months HT yes

Tune Analysis-

Was tune performed at instrument daily set up (yes/no) Yes

Resolution within 0.1 amu Yes

%RSD < 5% Yes

All Ok

Calibration- LQC23C

Instrument: AGILENT 7800 ICP-MS

Date: 3/23/23

Blank and 1 Standard yes

PQL or CRQL Std. (80-120%) Yes

Initial Calib Verif. ICV (90-110) %R Yes

Continuing Calib. Verif. CCV (90-110) %R Yes

Initial Calib Blank ICB (ND or U) No

Continuing Calib. Blank CCB (ND or U) No

Frequency every ten samples Yes

Sb, Cu, Pb

PQL

ICV 3/23/23 (18:35)

ICB 3/23/23 (18:44) Pb 0.011 J ug/L ALL RESULTS >10X; NO ACTION

CCV (20:14)

CCB (20:23) Pb 0.014 J ug/L ALL RESULTS >10X; NO ACTION

Samples 9-12

CCV (21:26)

CCB (21:35) Pb 0.011 J ug/L ALL RESULTS >10X; NO ACTION

Samples 13-18

CCV (22:35)

CCB (22:46) Pb 0.005 J ug/L ALL RESULTS >10X; NO ACTION

Calibration- LQC24A

Instrument: AGILENT 7800 ICP-MS

Date: 3/24/23

Blank and 1 Standard yes

PQL or CRQL Std. (80-120%) Yes

Initial Calib Verif. ICV (90-110) %R Yes

Continuing Calib. Verif. CCV (90-110) %R Yes

Initial Calib Blank ICB (ND or U) No

Continuing Calib. Blank CCB (ND or U) No

Frequency every ten samples Yes

Mg

PQL

ICV 3/24/23 (16:38)

ICB 3/24/23 (16:47) Mg 2.632 J ug/L

CCV (18:21)

CCB (18:30) Mg 12.790 ug/L HIGHEST IN MB SEE BELOW

Samples 11-12

CCV (18:32)

CCB (19:42) Mg 3.594 J ug/L HIGHEST IN MB SEE BELOW

Samples 13-18

CCV (20:41)

CCB (20:51) Mg 5.771 J ug/L HIGHEST IN MB SEE BELOW

Calibration- LQC28E

Instrument: AGILENT 7800 ICP-MS

Date: 3/28/23

Blank and 1 Standard yes

PQL or CRQL Std. (80-120%) Yes

Initial Calib Verif. ICV (90-110) %R Yes

Continuing Calib. Verif. CCV (90-110) %R Yes

Initial Calib Blank ICB (ND or U) No

Continuing Calib. Blank CCB (ND or U) No

Frequency every ten samples Yes

Ca, Zn

PQL

ICV 3/28/23 (16:12)

ICB 3/28/23 (16:21)

CCV (22:00)

CCB (22:08)

Samples 9-11

CCV (23:07)

CCB (23:15)

Samples 12-17 Ca NOT REPORTED

CCV (00:12) Ca 112.2%

CCB (00:20) Ca 32.856 ug/L HIGHEST IN MB SEE BELOW

Calibration- LQC29A

Instrument: AGILENT 7800 ICP-MS

Date: 3/29/23

Blank and 1 Standard yes

PQL or CRQL Std. (80-120%) Yes

Initial Calib Verif. ICV (90-110) %R Yes

Continuing Calib. Verif. CCV (90-110) %R Yes

Initial Calib Blank ICB (ND or U) No

Continuing Calib. Blank CCB (ND or U) No

Frequency every ten samples Yes

Ca

PQL

ICV 3/28/23 (19:02)

ICB 3/28/23 (19:11)

CCV (22:47)

CCB (22:56)

Samples 12

CCV (23:55)

CCB (00:04)

Samples 13-18

CCV (00:45)

CCB (00:55)

Calibration- LQC30A

Instrument: AGILENT 7800 ICP-MS

Date: 3/30/23

Blank and 1 Standard yes

PQL or CRQL Std. (80-120%) Yes

Initial Calib Verif. ICV (90-110) %R Yes

Continuing Calib. Verif. CCV (90-110) %R Yes

Initial Calib Blank ICB (ND or U) No

Continuing Calib. Blank CCB (ND or U) No

Frequency every ten samples Yes

Mg

PQL

ICV 3/30/23 (16:58)

ICB 3/30/23 (17:04) Mg 5.319 J ug/L HIGHEST IN MB SEE BELOW

CCV (22:39)

CCB (22:46) Mg 4.745 J HIGHEST IN MB SEE BELOW

Samples 9,10 JACKSON-CB-01 AND JACKSON-EB-01

CCV (23:46) Mg 112% J+

CCB (23:54) Mg 5.545 J HIGHEST IN MB SEE BELOW

Blanks: (Remember never qualify a blank for a blank and always use highest blank value) (3P)

Method Blank (ND or U) No

PBWQC21IMW2

Sb 0.11 J highest in EB

Ca 41 J

Cu 1.4 J **ALL <RL; Q U AT RL**

Mg 35 J **RESULTS<RL; Q U AT RL RESULT <10X U AT SAMPLE RESULT**

Zn 4.2 J

Field Blanks/Equipment Blanks/Rinse Blanks (ND or U)

JACKSON-EB-01

D Sb 0.12 J ug/L RESULTS <RL; Q U AT RL

D Ca 83 J RESULTS<RL; Q U AT RL RESULT <10X U AT SAMPLE RESULT

D Cu 0.20 J

D Mg 12 J

D Zn 5.7 J RESULTS <RL; Q U AT RL

Hardness 260 J RESULT <10X U AT SAMPLE RESULT

JACKSON-CB-01

D Sb 0.095 J ug/L highest in EB

D Ca 52 J

D Cu 0.43 J

D Mg 8.8 J

Hardness 170 J

Interference Check Sample (ICS)

ICSA (+/- LOD or 80-120 %R) yes

ICSAB (+/- LOD or 80-120 %R) yes

Instrument: AGILENT 7500 ICP-MS

Date: 3/23/23 ; 3/24/2023 ; 3/28/2023 ; 3/29/2023 ; 3/30/2023

Ok

Laboratory Control Sample (LCS) USE QSM

LCSWQC21IMW2

QSM Liquid ok

QSM Solid NA

Duplicates: 1 in 20

Yes/No No

If yes Does RPD or relative percent difference meet QSM 20%.

Table 20. Spike Sample Actions for ICP-MS Analysis

Criteria	Action	
	Detect	Non-detect
Matrix Spike %R < 30% Post-digestion spike %R < 75%	J-	R
Matrix Spike %R < 30% Post-digestion spike %R ≥ 75%	J	UJ
Matrix Spike %R 30-74% Post-digestion spike %R < 75%	J-	UJ
Matrix Spike %R 30-74% Post-digestion spike %R ≥ 75%	J	UJ
Matrix Spike %R > 125% Post-digestion spike %R > 125%	J+	No qualification
Matrix Spike %R > 125% Post-digestion spike %R ≤ 125%	J	No qualification
Matrix Spike %R < 30% No post-digestion spike performed	J-	R
Matrix Spike %R 30-74% No post-digestion spike performed	J-	UJ
Matrix Spike %R 75-125% No post-digestion spike is required	No qualification	No qualification
Matrix Spike %R > 125% No post-digestion spike performed	J+	No qualification

NOTE: The above control limits are **method requirements** for spike samples, regardless of the sample matrix type. However, it should be noted that laboratory variability arising from the sub-sampling of non-homogenous soil samples is a common occurrence. Therefore, for **technical review purposes only**, EPA Regional policy or project DQOs may allow the use of less restrictive criteria (e.g., 10 %R and 150 %R for the lower and upper limits) to be assessed against spike and post-digestion spike soil samples.

Matrix Spike (MS) (only if sample concentration is less than 4x spike added)

Yes/No Yes

If yes, sample name: JACKSON-SWMC3-DC-01

%R solid QSM see chart below

%R liquid QSM NA

Only positives for RPD get qualified

	MS	MSD	PDS	RPD	Parent Q

ALL OK

Matrix Spike Duplicate (MSD)

Yes/No Yes

If yes, sample name: JACKSON-SWMC3-DC-01

%R solid QSM see chart above

%R liquid QSM NA

%RPD < 20 see chart above

Serial Dilution

Yes/No Yes

If yes, sample name: JACKSON-SWMC3-DC-01 all ok

%D < 10% (only if undiluted result is > 50x IDL) All those >10% are less than 50x LOQ. No Q

Internal Standards (IS)

Present (Y/N) Y

Per QAPP: IS intensity within 30-120% of intensity of the IS in the ICAL (Y/N) Y

Field Duplicates (FIELD DUPS Fort Polk QAPP +/- 35% RPD) Use calculation sheet and EDD

List Field Duplicates:

JACKSON-SWMC3-DC-01 and SWDUP all ok

Precision acceptable (Y/N) Y See calc spreadsheet

QAPP reporting limits met: Look in QAPP WS# 15 PQL column

Yes/No: Yes

Worksheet #15
Reference Limits and Evaluation Table 15-8

Matrix: Sediment
Analytical Group: Metals and SEM/AVS
Concentration Level: Low

Metals

Analyte	CAS Number	PAL (mg/kg) [a]	PQL (mg/kg) [c]	Achievable Laboratory Limits (mg/kg)		
				LOD	LOQ	DL
Antimony	7440-36-0	2	0.2	0.05	0.10	0.020
Copper	7440-50-8	31.6	3.16	0.20	0.30	0.071
Lead	7439-92-1	35.8	3.58	0.050	0.10	0.0070
Zinc	7440-66-6	121	12.1	0.80	1.0	0.13

SEM/AVS[b]

Analyte	CAS Number	PAL (µmol/g) [a]	PQL (µmol/g) [c]	Achievable Laboratory Limits (µmol/g)		
				LOD	LOQ	DL
Acid Volatile Sulfide	NA	NA	0.038	0.076	0.038	0.10
Antimony	7440-36-0	NA	0.00019	0.00082	0.00019	0.00131
Cadmium	7440-43-9	NA	0.000014	0.00053	0.000014	0.00089
Chromium	7440-47-3	NA	0.00017	0.001539	0.00017	0.00385
Copper	7440-50-8	NA	0.00073	0.003147	0.00073	0.007868
Lead	7439-92-1	NA	0.00015	0.000386	0.00015	0.000483
Mercury	7439-97-6	NA	0.000016	0.000018	0.000016	0.000020
Nickel	7440-02-0	NA	0.00022	0.001363	0.00022	0.00341
Silver	7440-22-4	NA	0.00010	0.000742	0.00010	0.00185
Zinc	7440-66-6	NA	0.0011	0.00306	0.0011	0.00612

(a) PALs refer to the lower of the US EPA Region 4 Freshwater Sediment Screening Values (2015) and the US EPA Region 3 Freshwater Sediment Screening Benchmarks (BTAG) (August 2006). Any applicable state standards may supersede the values shown and will be presented in the SSQAPP.
(b) Analytes with NA for PAL have PQL set at the Achievable Laboratory LOQ.
(c) PQLs are set to one-tenth the PAL, if achievable. If not achievable, the PQLs are set to at least one-third the PAL. Analytes shaded under PQLs are not achievable at three times less than the PAL.

Notes:
µg/L = Microgram(s) per liter.
µmol/g = Micromole(s) per gram.
AVS = Acid volatile sulfides.
CAS = Chemical Abstracts Service.
DL = Detection Limit.
LOD = Limit of Detection.
LOQ = Limit of Quantitation.
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
PAL = Project Action Limit.
PQL = Project Quantitation Limit.
SEM = Simultaneously extracted metals.

Alkalinity Validation Checklist

Site:	Fort Jackson
Laboratory:	Katahdin Analytical Services and Eurofins Savannah
SDG:	SQ1201/ 680-232120-1
Data Validator:	PMH
Validation Date:	4/19/2023
Reviewer:	DM
Review Date:	4/19/2023
Method:	SM 2320B

Date Collected:	3/8/2023
Date of Analysis:	3/22/2023
	3/24/2023

Data Completeness and Deliverables

Have any missing deliverable been recieved and added to the data package?
ACTION: Call lab for explanation/resubmittal of any missing deliverables. If the lab cannot probive them, note the effect on review of the data in the non-compliance section of the data assessment narrative.

☐ Yes ☑ No

Notes and validation action:

Custody Documents and Narratives

Are chains of custody present and complete for all samples?

ACTION: Contract lab for replacement of missing documents.

☑ Yes ☐ No

Do chains of custody or lab narratives indicate any problems with sample receipt, condition of samples, analytical problems or special notations affecting the quality of the data?

☑ Yes ☐ No

Notes and validation action: Sample SQ1201-8 (JACKSON-SWCC2-DC-01)was not received by the sub lab for alkalinity and was 2 days outside of hold time by the time it was analyzed in house. All other samples were received and analyzed by Eurofins Savannah within hold.

Temperature:

Sample coolers received @ 0-6 ℃ ?

☐ Yes ☑ No

Preservation:

none required

☑ Yes ☐ No

ACTION: Samples improperly preserved shall be noted in the data validation report. Professional judgement may result in the results of an analysis of an improperly preserved sample by the laboratory being qualified as estimated "J" or "UJ".

ACTION: If samples were not iced upon receipt, flag all positive results as estimated, an all non-detects "UJ".

Notes and validation action:

Holding Time

Does the holding time exceed 14 days?

☑ Yes ☐ No

ACTION: If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J" or "UJ" as appropriate. When holding times are exceeded by more than twice the time specified, the non-detects will be flagged as unusable, "R".

Notes and validation action: Sample SQ1201-8 (JACKSON-SWCC2-DC-01) was analyzed 2 days outside of hold due to receiving error at the sub lab. The sample result was ND, Q UJ

Calibration Verification

Are raw data and summary sheets present for both inital and continuing calibrations? ☐ Yes ☑ No

At least 7 standards and a blank?

Correlation coeff > 0.995?

Are the %D values between 90-110%? ☑ Yes ☐ No

Notes and validation action: ICAL date/ time and slope present from Katahdin and Eurofins Savannah. # of standards and corr coeff not confirmed; all CCV %D acceptable at Katahdin. Insufficient CCV data submitted from Eurofins Savannah, could not evaluate.

Blanks

Has a method blank analysis been reported per twenty samples of a similar matrix or concentration level, and for each extraction batch? ☑ Yes ☐ No

Upon examination of laboratory and field blank data, do any blanks contain positive results? ☑ Yes ☐ No
ACTION: If yes, qualify associated results as follows: If the sample result is greater than the laboratory reporting limit but less than 5 times the blank concentration, flag sample result as non-detect ("U"). If the sample result is reported as detected at a concentration less than the reporting limit and less than 5 times the blank concentration, qualify the sample result as non-detectable at the laboratory reporting limit. For aqueous blanks applied to soil/sediment samples, compare the sample result to the equivalent concentration of the blank.

Are there field/rinse/equipment blanks associated with every sample? ☐ Yes ☑ No

Notes and validation action:

blank	positives	Flag	associated samples
MB 680-769235/4	ND		samples 1-7
WG334311	2.4 J	sample result ND, no Q	sample 8

all provided CCBs ND

Matrix Spike

Is a matrix spike/matrix spike duplicate summary present?

☐ Yes ☑ No

ACTION: If any matrix spike data are missing, call the lab for explanation/re-submittal. If information is not available, document the effect in narrative notes.

Are all matrix spike and/or matrix spike duplicate %Rs or RPDs within acceptance range? 75-125%?

☐ Yes ☐ No

Notes and validation action:

Sample	MS %R	MSD %R	RPD	Flag
None				

Laboratory Duplicate

Is a laboratory duplicate summary present?

☐ Yes ☑ No

Are the RPDs within the control limit?
Per QAPP RPD ≤ 20%

☐ Yes ☐ No

Notes and validation action:

None

Laboratory Control Sample

Were LCS samples evaluated with each batch of 20 samples or less and were observed percent recoveries within the laboratory defined limits? 80-120% ?

☑ Yes ☐ No

Notes and validation action:

LCS or LCSD	80-120	Flag	Associated samples:	
LCS WG334311-2	ok		sample 8	
LCSD WG334311-3	ok		sample 8	RPD ok
LCS 680-769235/6	ok		samples 1-7	

Field Duplicates

Were field duplicates submitted for alkalinity analysis?

ACTION: For field duplicate analyses that do not meet the technical criteria, apply action to only the parent sample and its duplicate.

☑ Yes ☐ No

Notes and validation action:
JACKSON-SWMC3-DC-01 and SWDUP; all ok see FD worksheet

Review Level

☐ Yes ☑ No

List samples reviewed and bold samples used for calculations:
this SDG Level 2B

As part of the data validation process, the following validation qualifiers and their meanings will be used:

“U” - Non-Detect – The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

“J” - Estimated Value – The analyte was positively identified; but the associated numerical value is the approximate concentration of the analyte in the sample.

“NJ” - The analysis indicates the presence of an analyte that has been “tentatively identified” and the associated numerical value represents its approximate concentration.

“UJ” - Estimated Non-Detect – The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

“X” - The sample results are rejected. Due to significant QA/QC problems the analysis is invalid and provides no information as to whether the analyte is present or not. Once the data are flagged with “X”, any further review or consideration is unnecessary.

If no determination of the overall bias of a result qualified as estimated can be made, the result will be flagged with “J”. If the data reviewer can determine the overall bias for sample data qualified as estimated, the data reviewer will qualify the sample result as either an estimated minimum value (JL) or an estimated maximum value (JH).

Anions Validation Checklist

Site:	Fort Jackson
Laboratory:	Katahdin Analytical Services
SDG:	SQ1201
Data Validator:	PMH
Validation Date:	4/19/2023
Reviewer:	DM
Review Date:	4/19/2023
Anion:	Chloride and Sulfate
Method:	EPA 300.0

Date Collected:	3/8/2023
Date of Analysis:	3/20/2023
# of solid samples	0
# of liquid samples	8

Data Completeness and Deliverables

Have any missing deliverable been recieved and added to the data package?

☐ Yes ☑ No

ACTION: Call lab for explanation/resubmittal of any missing deliverables. If the lab cannot probive them, note the effect on review of the data in the non-compliance section of the data assessment narrative.

Notes and validation action:

Custody Documents and Narratives

Are chains of custody present and complete for all samples?

☑ Yes ☐ No

ACTION: Contract lab for replacement of missing documents.

Do chains of custody or lab narratives indicate any problems with sample receipt, condition of samples, analytical problems or special notations affecting the quality of the data?

☐ Yes ☑ No

ACTION: If samples were not iced upon receipt, flag all positive results as estimated, an all non-detects “UJ”.

Notes and validation action:

Temperature:

Sample coolers received @ 0-6 ℃ ?

Preservation: none required

ACTION: Samples improperly preserved shall be noted in the data validation report. Professional judgement may result in the results of an analysis of an improperly preserved sample by the laboratory being qualified as estimated "J" or "UJ".

☑ Yes ☐ No

☐ Yes ☐ No

Notes and validation action:

Holding Time

Does the holding time exceed 28 days?
(nitrate, nitrite and phosphate - 48 hours per method 9056)
ACTION: If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J" or “UJ” as appropriate. When holding times are exceeded by more than twice the time specified, the non-detects will be flagged as unusable, "R”.

☐ Yes ☑ No

Notes and validation action:

Initial/Continuing Calibration Verification

Are raw data and summary sheets present for both inital and continuing calibrations?

☑ Yes ☐ No

All ICV and CCVs performed initially and evry ten samples thereafter?

At least 3 standards and a calibration blank?

☑ Yes ☐ No

Correlation coeff > 0.99?

Per QAPP: R must be >0.995

☑ Yes ☐ No

All ICV and CCV % recoveries between 90-110%?
ACTION: If the ICV or CCV fail - if possible, indicate bias in the validation report and qualify affected data. 75-89% - J/UJ; 111-125% - J; 75-89%; <75% use professional judgement.

☑ Yes ☐ No

Notes and validation action:
INST: ICS-2100
ICAL 02/09/2023 Cl and SO4 RSDs ok
Run sequence 3/20/2023
CCV1 ok
CCB2 ok
CCV13 ok ALL
CCB14 ok
CCV24 ok
CCB25 ok

Preparation blanks/ICB/CCB

Preparation blanks present for each prep batch not to exceed 20 samples? **ACTION:** If no list impacted samples.	☑ Yes	☐ No
Preparation blanks < Method Detection Limit? **ACTION:** If no, list impacted samples below.	☐ Yes	☑ No
Preparation blanks < Negative Reporting Limit? **ACTION:** If yes, list impacted samples below.	☐ Yes	☑ No
ALL ICB and CCBs performed initially and every ten samples thereafter? **ACTION:** If no, list impacted samples below.	☑ Yes	☐ No
All ICB and CCBs < Method Detection Limit? **ACTION:** If no, list impacted samples below.	☑ Yes	☐ No
All ICB and CCBs < Negative Reporting Limit? **ACTION:** If yes, list impacted samples below.	☐ Yes	☑ No

Notes and validation action:
all ok see above

Blanks

Has a method blank analysis been reported per twenty samples of a similar matrix or concentration level, and for each extraction batch?

☑ Yes ☐ No

Upon examination of laboratory and field blank data, do any blanks contain positive results?
ACTION: If yes, qualify associated results as follows:

☑ Yes ☐ No

If the blank is > the reporting limit then:
If the sample result is greater than the laboratory reporting limit but less than 10 times the blank concentration, flag sample result as non-detect ("U").
or
If the sample result is reported as detected at a concentration less than the reporting limit, qualify the sample result as non-detectable at the laboratory reporting limit.

If the blank is < the reporting limit then:
If the sample result is reported as detected at a concentration less than the reporting limit, qualify the sample result as non-detectable at the laboratory reporting limit.

For aqueous blanks applied to soil/sediment samples, compare the sample result to the equivalent concentration of the blank.

☐ Yes ☐ No

Notes and validation action:

blank	positives	Flag	associated samples
Chloride and Sulfate:			
WG334130	ND		all
WG331472	ND		all

Matrix Spike

Is a matrix spike/matrix spike duplicate summary present?

☑ Yes ☐ No

ACTION: If any matrix spike data are missing, call the lab for explanation/re-submittal. If information is not available, document the effect in narrative notes.

Are all matrix spike and/or matrix spike duplicate %Rs or RPDs within acceptance range?
Per QAPP: MS/MSD %R 80-120%; RPD < 15%

☐ Yes ☑ No

ACTION: If the spike recovery is greater than 125% or less than 75% and the sample results are greater than the IDL, qualify "J". If the spike recovery is within range of 30-74% and the sample results are less than the IDL, qualify the data for these samples as non-detected and estimated "UJ". If spike recovery results are less than 30% and the sample results are less than the IDL, qualify the data for these samples as unusable "R".

Notes and validation action:

Sample	MS %R	MSD %R	RPD	Flag	
Chloride and Sulfate:					
SQ1201-2	ok	ok	ok	none	JACKSON-SWMC3-DC-01

Laboratory Duplicate

Is a laboratory duplicate summary present for each prep batch not to exceed 20 samples?

☐ Yes ☑ No

Are the RPDs within the control limit or +/- 20%?

☐ Yes ☐ No

ACTION: If duplicate analytical results for a particular analyte are outside the appropriate control windows, qualify the results for that analyte in all associated samples of the same sample matrix as estimated "J". Non-detects are not qualified.

Notes and validation action: none

Laboratory Control Sample

Were LCS samples evaluated with each batch of 20 samples or less and were observed percent recoveries within the laboratory defined limits of (80-120%)?

☑ Yes ☐ No

ACTION: If LCS %R fall outside the control limits, qualify all sample results greater than the IDL as estimated "J". If the LCS results exceed the control limits, and the sample results are less than the IDL, the results are acceptable. If the LCS results are lower than the control limits, then qualify all sample results less than the IDL as estimated "UJ".

Per QAPP: LCS %R 90-110

Notes and validation action:

LCS or LCSD	%R	Flag	Associated samples:
Chloride and Sulfate:			
WG334130-2	ok		

Field Duplicates

Were field duplicates submitted for anion analysis?

☑ Yes ☐ No

ACTION: For field duplicate analyses that do not meet the technical criteria, apply action to only the parent sample and its duplicate.

Notes and validation action:

JACKSON-SWMC3-DC-01 and SWDUP

all ok see FD worksheet

Were all sample results lower than the highest calibration standard? **ACTION:** If no, list impacted samples below.	☑ Yes	☐ No

Notes and validation action:

Review Level ***Is a level 4 review required for this project?***	☐ Yes	☑ No

List samples reviewed and bold samples used for calculations:
this SDG Level 2B

As part of the data validation process, the following validation qualifiers and their meanings will be used:

“U” - Non-Detect – The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

“J” - Estimated Value – The analyte was positively identified; but the associated numerical value is the approximate concentration of the analyte in the sample.

“NJ” - The analysis indicates the presence of an analyte that has been “tentatively identified” and the associated numerical value represents its approximate concentration.

“UJ” - Estimated Non-Detect – The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

“X” - The sample results are rejected. Due to significant QA/QC problems the analysis is invalid and provides no information as to whether the analyte is present or not. Once the data are flagged with “X”, any further review or consideration is unnecessary.

If no determination of the overall bias of a result qualified as estimated can be made, the result will be flagged with “J”. If the data reviewer can determine the overall bias for sample data qualified as estimated, the data reviewer will qualify the sample result as either an estimated minimum value (JL) or an estimated maximum value (JH).

DOC Validation Checklist

Site:	Fort Jackson
Laboratory:	Eurofins Savannah
SDG:	680-230049-1 (sub from SQ1201)
Data Validator:	PMH
Validation Date:	4/19/2023
Reviewer:	DM
Review Date:	4/19/2023
Method:	DOC

Date Collected:	3/8/2023
Date of Analysis:	3/22/2023

Data Completeness and Deliverables

Have any missing deliverable been recieved and added to the data package?
ACTION: Call lab for explanation/resubmittal of any missing deliverables. If the lab cannot probive them, note the effect on review of the data in the non-compliance section of the data assessment narrative.

☐ Yes ☑ No

Notes and validation action:

Custody Documents and Narratives

Are chains of custody present and complete for all samples?

☑ Yes ☐ No

ACTION: Contract lab for replacement of missing documents.

Do chains of custody or lab narratives indicate any problems with sample receipt, condition of samples, analytical problems or special notations affecting the quality of the data?

☐ Yes ☑ No

Notes and validation action:

Temperature:

Sample coolers received @ 0-6 ℃ ?

☑ Yes ☐ No

Preservation:

Sulfuric or hydrochloric acid pH of 2?

☑ Yes ☐ No

ACTION: Samples improperly preserved shall be noted in the data validation report. Professional judgement may result in the results of an analysis of an improperly preserved sample by the laboratory being qualified as estimated "J" or "UJ".

ACTION: If samples were not iced upon receipt, flag all positive results as estimated, an all non-detects “UJ”.

Notes and validation action:

Holding Time

Does the holding time exceed 28 days?

☐ Yes ☑ No

ACTION: If the specified holding time is exceeded, the data may not be valid. Those analytes detected in the samples whose holding time has been exceeded will be qualified as estimated, "J" or “UJ” as appropriate. When holding times are exceeded by more than twice the time specified, the non-detects will be flagged as unusable, "R”.

Notes and validation action:

Calibration Verification

Are raw data and summary sheets present for both inital and continuing calibrations?

At least 3 standards and a blank?

Correlation coeff > 0.995?

Are the %D values between 90-110%?

Per QAPP: ICV/CCV 80-120%

☑ Yes ☐ No

ACTION: If the ICV or CCV fail - if possible, indicate bias in the validation report and qualify affected data. 75-89% - J/UJ; 111-125% - J; 75-89%; <75% use professional judgement.

Notes and validation action:

INST: TOC7

ICAL 02/16/2022	corr coeff OK
ICV 680-768365/14-A 1 14:33	ok
ICB 680-768365/15-A 1 14:52	ok
CCV 680-768986/2 1 20:25	ok
CCV 680-768986/17 1 00:35	ok
CCB 680-768986/18 1 00:52	ok

Blanks

Has a method blank analysis been reported per twenty samples of a similar matrix or concentration level, and for each extraction batch? ☑ Yes ☐ No

Upon examination of laboratory and field blank data, do any blanks contain positive results? ☐ Yes ☑ No

ACTION: If yes, qualify associated results as follows: If the sample result is greater than the laboratory reporting limit but less than 5 times the blank concentration, flag sample result as non-detect ("U"). If the sample result is reported as detected at a concentration less than the reporting limit and less than 5 times the blank concentration, qualify the sample result as non-detectable at the laboratory reporting limit. For aqueous blanks applied to soil/sediment samples, compare the sample result to the equivalent concentration of the blank.

Are there field/rinse/equipment blanks associated with every sample? ☐ Yes ☑ No

Notes and validation action:

blank	positives	Flag	assocated samples
DOC:			
MB 680-768986/3	ND		all

Matrix Spike

Is a matrix spike/matrix spike duplicate summary present? ☑ Yes ☐ No

ACTION: If any matrix spike data are missing, call the lab for explanation/re-submittal. If information is not available, document the effect in narrative notes.

Are all matrix spike and/or matrix spike duplicate %Rs or RPDs within acceptance range? ☐ Yes ☑ No

Per QAPP: MS/MSD %R 75-125%

Notes and validation action: MS/MSD recoveries extremely high, spiking error suspected, lab suspected interference

Sample	MS %R	MSD %R	RPD		Flag	
DOC:						
680-232120-2	ok	ok	ok	none		JACKSON-SWMC3-DC-01

Laboratory Duplicate

Is a laboratory duplicate summary present? ☐ Yes ☑ No

Are the RPDs within the control limit or +/- 20%? ☐ Yes ☐ No

Notes and validation action: none

Laboratory Control Sample

Were LCS samples evaluated with each batch of 20 samples or less and were observed percent recoveries within the laboratory defined limits? ☑ Yes ☐ No

Per QAPP: LCS %R 80-120%

Notes and validation action:

LCS or LCSD	%R	Flag	Associated samples:
LCS 680-768986/4	ok		

Field Duplicates

Were field duplicates submitted for DOC analysis? ☑ Yes ☐ No

ACTION: For field duplicate analyses that do not meet the technical criteria, apply action to only the parent sample and its duplicate.

Notes and validation action:

JACKSON-SWMC3-DC-01 and SWDUP

see FD worksheet DOC out all 4 reps Q J

Review Level

Is a level 4 review required for this project? ☐ Yes ☑ No

List samples reviewed and bold samples used for calculations:
this SDG Level 2B

As part of the data validation process, the following validation qualifiers and their meanings will be used:

“U” - Non-Detect – The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

“J” - Estimated Value – The analyte was positively identified; but the associated numerical value is the approximate concentration of the analyte in the sample.

“NJ” - The analysis indicates the presence of an analyte that has been “tentatively identified” and the associated numerical value represents its approximate concentration.

“UJ” - Estimated Non-Detect – The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

“X” - The sample results are rejected. Due to significant QA/QC problems the analysis is invalid and provides no information as to whether the analyte is present or not. Once the data are flagged with “X”, any further review or consideration is unnecessary.

If no determination of the overall bias of a result qualified as estimated can be made, the result will be flagged with “J”. If the data reviewer can determine the overall bias for sample data qualified as estimated, the data reviewer will qualify the sample result as either an estimated minimum value (JL) or an estimated maximum value (JH).

DATA VALIDATION PERCHLORATE USEPA 6860

QSM 5.1 Reference

Validator: LL 4/18/2023

Reviewer: GAP 4/19/2023

Site: Fort Jackson

SDG: SQ1201

LAB: Eurofins Denver

Samples Collected: 3/8/2023

Preservation: Cooler temp < 6 degrees C

SAMPLE RECEIPT AND CASE NARRATIVE REVIEW

- ✓ Traffic reports, chain-of-custody forms or SDG narrative do not indicate any problems with sample receipt, condition of the samples, analytical problems or special circumstances affecting the quality of the data. ok

HOLDING TIMES

- ✓ Water and solid samples must be properly preserved (cooled to 4° +/- 2°), all analyses performed within 28 days of collection.
  Collected: 3/8
  Analyzed: 3/22

INTERNAL STANDARDS

- ✓ Addition of 18O-labeled perchlorate to every sample, batch QC sample, standard, instrument blank, and Method Blank. Measured 18O IS area within ± 50% of the value from the average of the IS area counts of the ICAL. Ok

Level 4 only

- ✓ RRT of the perchlorate ion must be 1.0 ± 2% (0.98 – 1.02). ok

LABORATORY CONTROL SAMPLE

- ✓ LCS prepared, extracted, analyzed, and reported once for every 20 field samples of a similar matrix, per SDG. Raw data and percent recoveries present for all Laboratory Control samples as required by Method 8000C (section 9.5).

- ✓ Laboratory Control Samples were analyzed for all the analytes that the samples are analyzed for.

- ✓ Did laboratory calculate in-house performance criteria for LCS recoveries according to Method 8000C section 9.7, and were recoveries met? If in house LCS recoveries performance criteria were not generated, the laboratory should use 70 - 130% criteria, and was this criteria met?
  QSM 5.1 limits are used all criteria are met. (84-121) solid (84-119) liquid

  LCS 280-606020/56 ok

MS/MSD

JACKSON-SWMC3-DC-01 280-173651-2 All ok

- ✓ QSM 5.1 limits are used for %R all criteria are met. (84-121) solid (84-119) liquid
- ✓ Per QSM 5.1 RPD < 15% all met

BLANKS

- ✓ Frequency of Analysis: reagent blank has been analyzed for every 20 (or less) samples of similar matrix or concentration or each extraction batch.

  MB 280-606020/55 ND
  CCBs all ND

  Equipment & Control Blanks
  JACKSON-CB-01 ND
  JACKSON-EB-01 ND

Level 4 only

- ✓ The chromatographic performance (baseline stability) for each instrument is acceptable.

- ✓ Method/instrument/reagent/cleanup blanks do not have positive results.

  Note when necessary, the contaminant concentration in these blanks are multiplied by the sample Dilution Factor and corrected for % moisture when necessary.

  - ✓ Field/rinse blanks are not positive.

  NOTE: All field blank results associated to a particular group of samples (may exceed one per case or one per day) may be used to qualify data. Blanks may not be qualified because of contamination in another blank. Field blanks must be qualified for surrogate, or calibration QC problems.

NOTE: If gross blank contamination exists(e.g., saturated peaks, hump-o-grams, junk peaks), all affected positive compounds in the associated samples should be qualified as unusable "R", due to interference. Non-detected pesticide target compounds do not require qualification unless the contamination is so high that it interferes with the analyses of non-detected compounds.

✓ Field/rinse/equipment blanks are associated with every sample.

ACTION: For low level samples, note in data assessment that there is no associated field/rinse/ equipment blank. Exception: samples taken from a drinking water tap do not have associated field blanks.

ICAL

✓ Data summary forms (containing calibration factors or response factors) for the initial 5 pt. calibration and daily calibration verification standards are present and complete for each analytical sequence.

✓ No transcription/calculation errors between raw data and data summary forms. Level 4 only

✓ Linearity criteria for the initial calibration standards has been satisfied.
(% RSD for the calibration factors (CFs)must be < 15.0% or coeff of determination >0.990 for all analytes)

INST: LC_LCMS10
STD00100 280-605949/3 IC 03/21/2023 14:11 1 LC1023C21027.d

CCAL

✓ Calibration verification/continuing calibration standard contain the perchlorate peaks of interest, analyzed on each working day, prior to sample analyses.

✓ Calibration verification/continuing calibration standard been analyzed after every 10 samples and at the end of each analytical sequence

✓ Percent difference (%D) between the Calibration Factor (CF) of the peaks used to identify the compounds in the CCV and the CF from these peaks in the initial calibration **do not exceed 15%.**

✓ New 5 pt. initial calibration curve been generated for those analytes which failed in the calibration verification/continuing calibration standard (8000C, section 11.7.3), and all samples which followed the out-of-control calibration verification/standard continuing calibration standard.

✓ No transcription/calculation errors between raw data and data summary forms (initial calibration summaries, calibration verification summaries, analytical sequence summaries. Level 4 only

ACTION: If large errors exist, call lab for explanation/resubmittal, make necessary corrections and note error in the data assessment.

ICB 280-605949/11 03/21/2023 14:55 1 LC1023C21035.d
ICV 280-605949/12 03/21/2023 15:00 1 LC1023C21036.d
DLCK 280-605949/13 03/21/2023 15:06 1 LC1023C21037.d

CCV 280-606020/52 03/22/2023 16:23 1 LC1023C22066.d
CCVL 280-606020/53 03/22/2023 16:28 1 LC1023C22067.d
CCB 280-606020/54 03/22/2023 16:33 1 LC1023C22068.d

CCV 280-606020/65 03/22/2023 17:32 1 LC1023C22079.d
CCVL 280-606020/66 03/22/2023 17:38 1 LC1023C22080.d
CCB 280-606020/67 03/22/2023 17:43 1 LC1023C22081.d

CCV 280-606020/78 03/22/2023 18:42 1 LC1023C22092.d
CCVL 280-606020/79 03/22/2023 18:48 1 LC1023C22093.d
CCB 280-606020/80 03/22/2023 18:53 1 LC1023C22094.d

All ok

Ratio 35Cl/37Cl

Level 4 only

✓ Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85 depending on which ions are quantitated.

Must fall within 2.3 to 3.8.

✓ Retention times (RT) of sample compounds within the established RT.

Interference Check Sample (ICS)

✓ One ICS is prepared with every batch of 20 samples and must undergo the same preparation and pretreatment steps as the samples in the batch.

✓ Perchlorate concentration must be **within ± 20% of** its true value.

INF 280-606020/57 ok

FIELD DUPLICATES

No QAPP RPD +/- 20% for FDs water used RPD +/- 35% for FDs solid used

(See calculation worksheet)

JACKSON-SWMC3-DC-01 and SWDUP Ok

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Appendix F: Analytical Data Tables

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Location ID Sample Name Parent Sample ID Sample Date			SWCC2-DC-01 JACKSON-SWCC2-DC-01 3/8/2023		SWCC3-DC-01 JACKSON-SWCC3-DC-01 3/8/2023		SWCC4-DC-01 JACKSON-SWCC4-DC-01 3/8/2023		SWJC1-DC-01 JACKSON-SWJC1-DC-01 3/8/2023		SWMC1-DC-01 JACKSON-SWMC1-DC-01 3/8/2023		SWMC2-DC-01 JACKSON-SWMC2-DC-01 3/8/2023		SWMC3-DC-01 JACKSON-SWMC3-DC-01 3/8/2023	SWMC3-DC-01 SWDUP JACKSON-SWMC3-DC-01 3/8/2023
Analyte	**Unit**	**PAL[a]**	**Reference**	**PAL[a]**		**PAL[a]**		**PAL[a]**		**PAL[a]**		**PAL[a]**		**PAL[a]**		
Dissolved Metals (SW6020A)																
Antimony	µg/L	30	< 0.5 U	30	< 0.5 U	30	< 0.5 U	30	< 0.5 U	30	< 0.5 U	30	< 0.5 U	30	< 0.5 U	< 0.5 U
Copper[b]	µg/L	0.28	< 2.0 U	0.28	< 2.0 U	0.32	< 2.0 U	0.28	< 2.0 U	0.36	< 2.0 U	1	< 2.0 U	0.84	< 2.0 U	< 2.0 U
Lead[b]	µg/L	0.02	0.853 J	0.02	0.34 J	0.02	0.26 J	0.02	< 0.5 U	0.03	< 0.5 U	0.12	3.25	0.1	2.18	< 0.5 U
Zinc[b]	µg/L	3.7	< 8.0 U	3.7	< 8.0 U	4.3	< 8.0 U	3.7	< 8.0 U	4.8	< 8.0 U	13.6	< 8.0 U	11.4	< 8.0 U	< 8.0 U
Water Hardness (SM2340B)																
Hardness, total	mg/L	NSL	1.7	NSL	1.74	NSL	1.97	NSL	1.66	NSL	2.32	NSL	7.77	NSL	6.31	6.39
Explosives (SW8330B)																
1,3,5-Trinitrobenzene	µg/L	11	--	11	< 0.12 U	11	< 0.12 U	11	< 0.12 UJ	11	< 0.12 U	11	< 0.12 U	11	< 0.12 U	< 0.12 U
1,3-Dinitrobenzene	µg/L	22	--	22	< 0.12 U	22	< 0.12 U	22	< 0.12 UJ	22	< 0.12 U	22	< 0.12 U	22	< 0.12 U	< 0.12 U
2,4,6-Trinitrotoluene	µg/L	13	--	13	< 0.12 U	13	< 0.12 U	13	< 0.12 UJ	13	< 0.12 U	13	< 0.12 U	13	< 0.12 U	< 0.12 U
2,4-Dinitrotoluene	µg/L	44	--	44	< 0.12 U	44	< 0.12 U	44	< 0.12 UJ	44	< 0.12 U	44	< 0.12 U	44	< 0.12 U	< 0.12 U
2,6-Dinitrotoluene	µg/L	81	--	81	< 0.12 U	81	< 0.12 U	81	< 0.12 UJ	81	< 0.12 U	81	< 0.12 U	81	< 0.12 U	< 0.12 U
2-Amino-4,6-dinitrotoluene	µg/L	18	--	18	< 0.12 U	18	< 0.12 U	18	< 0.12 UJ	18	< 0.12 U	18	< 0.12 U	18	< 0.12 U	< 0.12 U
2-Nitrotoluene	µg/L	71	--	71	< 0.12 U	71	< 0.12 U	71	< 0.12 UJ	71	< 0.12 U	71	< 0.12 U	71	< 0.12 U	< 0.12 U
3-Nitrotoluene	µg/L	42	--	42	< 0.12 U	42	< 0.12 U	42	< 0.12 UJ	42	< 0.12 U	42	< 0.12 U	42	< 0.12 U	< 0.12 U
4-Amino-2,6-dinitrotoluene	µg/L	11	--	11	< 0.12 U	11	< 0.12 U	11	< 0.12 UJ	11	< 0.12 U	11	< 0.12 U	11	< 0.12 U	< 0.12 U
4-Nitrotoluene	µg/L	46	--	46	< 0.12 U	46	< 0.12 U	46	< 0.12 UJ	46	< 0.12 U	46	< 0.12 U	46	< 0.12 U	< 0.12 U
HMX	µg/L	150	--	150	< 0.12 U	150	< 0.12 U	150	< 0.12 UJ	150	< 0.12 U	150	< 0.12 U	150	< 0.12 U	< 0.12 U
Nitrobenzene	µg/L	230	--	230	< 0.12 U	230	< 0.12 U	230	< 0.12 UJ	230	< 0.12 U	230	< 0.12 U	230	< 0.12 U	< 0.12 U
Nitroglycerin	µg/L	18	--	18	< 2 U	18	< 2 U	18	< 2 UL	18	< 2 U	18	< 2 U	18	< 2 U	< 2 U
RDX	µg/L	79	--	79	< 0.12 U	79	< 0.12 U	79	< 0.12 UJ	79	< 0.12 U	79	< 0.12 U	79	< 0.12 U	< 0.12 U
Tetryl	µg/L	NSL	--	NSL	< 0.12 U	NSL	< 0.12 U	NSL	< 0.12 UJ	NSL	< 0.12 U	NSL	< 0.12 U	NSL	< 0.12 U	< 0.12 U
Perchlorate (SW6850)																
Perchlorate	µg/L	15	< 0.10 U	15	0.019 J	15	0.015 J	15	< 0.10 U	15	< 0.10 U	15	0.023 J	15	0.028 J	0.044 J

Notes.
(a) PALs refer to South Carolina Water Classifications & Standards Regulations (R.61-68) Freshwater Criterion (2020). The PAL for Antimony refers to US EPA National Recommended Water Quality Criteria.
(a) PALs for explosives refer to the lower of the US EPA Region 4 Freshwater Screening Values (2018) and the US EPA Region 3 Freshwater Screening Benchmarks (BTAG) (July 2006).
(a) PAL for perchlorate refer to US EPA National Primary Drinking Water Regulations, Maximum Contaminant Levels (MCL).
(b) Screening level provided based on hardness value found at each location.
PAL = Project Action Limit.
NSL = No screening level available.
µg/L = Microgram(s) per liter.
mg/L = Milligram(s) per liter.
J = Estimated value. The analyte was detected in the sample at a concentration less than the Limit of Quantitation (LOQ), but above the Method Detection Limit (MDL).
U = Analyte was not detected above the specified level. This level may be the Limit of Quantitation (LOQ), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client.
Results exceeding PAL are shaded gray.

			Location ID	SWCC2-DC-01	SWCC3-DC-01	SWCC4-DC-01	SWJC1-DC-01	SWMC1-DC-01	SWMC2-DC-01	SWMC3-DC-01	SWMC3-DC-01
			Sample Name	JACKSON-SDCC2-DC-01	JACKSON-SDCC3-DC-01	JACKSON-SDCC4-DC-01	JACKSON-SDJC1-DC-01	JACKSON-SDMC1-DC-01	JACKSON-SDMC2-DC-01	JACKSON-SDMC3-DC-01	SDDUP JACKSON-SDMC3-DC-01
			Parent Sample ID								
			Sample Date	3/8/2023	3/8/2023	3/8/2023	3/8/2023	3/8/2023	3/8/2023	3/8/2023	3/8/2023
Analyte	**PAL[a]**	**Unit**		**Reference**							
Metals (SW6020A)											
Antimony	2	mg/kg		0.15 J	0.025 J	0.02 J	0.023 J	0.14 J	0.025 J	0.08 J	0.069 J
Copper	31.6	mg/kg		21.6	< 0.18 U	1.42	0.4	4.81	0.32	1.18	0.79
Lead	35.8	mg/kg		33.3	1.78	0.815	0.747	7.01	1.48	7.84	5.69
Zinc	121	mg/kg		8.5	< 0.71 U	1.5	< 0.88 U	4.66	< 0.85 U	4.11	3.19
Explosives (SW8330B)											
1,3,5-Trinitrobenzene	0.015-1.5	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
1,3-Dinitrobenzene	0.04-4	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
2,4,6-Trinitrotoluene	0.027-2.7	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
2,4-Dinitrotoluene	0.0416	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
2,6-Dinitrotoluene	0.296	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
2-Amino-4,6-dinitrotoluene	0.047	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
2-Nitrotoluene	0.207	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
3-Nitrotoluene	0.145	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
4-Amino-2,6-dinitrotoluene	0.028	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
4-Nitrotoluene	0.145	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
HMX	0.108-10.8	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
Nitrobenzene	0.407	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
Nitroglycerin	0.01	mg/kg		< 1.7 U	< 0.46 U	< 0.44 U	< 0.46 U	< 0.67 UJ	< 0.45 U	< 0.52 U	< 0.52 U
RDX	0.013-1.3	mg/kg		< 0.22 U	< 0.057 U	< 0.055 U	< 0.057 U	< 0.083 UJ	< 0.056 U	< 0.065 U	< 0.065 U
Tetryl	53.4	mg/kg		< 0.22 UJ	< 0.057 UJ	< 0.055 UJ	< 0.057 UJ	< 0.083 UJ	< 0.056 UJ	< 0.065 UJ	< 0.065 UJ
Simultaneously Extracted Metals/Acid Volatile Sulfide (SEM/AVS)											
Acid Volatile Sulfide	NSL	µmol/g		< 0.34 U	< 0.1 U	< 0.095 U	< 0.095 U	< 0.14 UJ	< 0.091 U	< 0.1 U	< 0.1 U
Simultaneously Extracted Metals (SEM)	NSL	µmol/g		0.31225	0.0057	0.00325	0.00541	0.033262	0.001101	0.036068	0.03033
ΣSEM/AVS [(1)]	1	ratio		0.92	0.06	0.03	0.06	0.24	0.01	0.36	0.30
ΣSEM-AVS/foc [(1)]	130	ratio		-0.13	-34.93	-101.38	-79.99	-2.55	-167.41	-9.76	-12.10
TOC (Lloyd Kahn)											
Total Organic Carbon	NSL	mg/kg		220000 J	2700 J	905 J	1120 J	41800 J	537 J	6550 J	5760 J

Notes.

(a) PALs refer to the lower of the US EPA Region 4 Freshwater Sediment Screening Values (2018) and the US EPA Region 3 Freshwater Sediment Screening Benchmarks (BTAG) (August 2006)

(a) PALs for explosives refer to the lower of the US EPA Region 4 Freshwater Sediment Screening Values (2018) and the US EPA Region 3 Freshwater Sediment Screening Benchmarks (BTAG) (August 2006).
PAL = Project Action Limit.
NSL = No screening level available.
µmol/g = Micromole(s) per gram.
mg/kg = Milligram(s) per kilogram.
J = Estimated value. The analyte was detected in the sample at a concentration less than the Limit of Quantitation (LOQ), but above the Method Detection Limit (MDL).

U = Analyte was not detected above the specified level. This level may be the Limit of Quantitation (LOQ), the Limit of Detection (LOD) or Method Detection Limit
(MDL) as required by the client.
Results exceeding PAL are shaded gray.

FINAL
CAMP McCRADY, SC
MULTI-PURPOSE MACHINE GUN (MPMG) RANGE
MEC SURVEY REPORT
PROJECT NO. 450377

Prepared by:

United States Army Engineering and Support Center, Huntsville

March 26, 2013

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ACRONYM LIST

AOI – Area(s) of Interest
APP – Accident Prevention Plan
CD – Cultural Debris
CEHNC – Corps of Engineers, Huntsville Center
DA – Department of the Army
DMM – Discarded Military Munitions
GIS – Geographical Information System
GPS – Global Positioning System
HE – High Explosive
IGE – Independent Government Estimate
MD – Munitions Debris
MEC – Munitions and Explosives of Concern
MIMID – Miniature Mine Detector
MPMG – Multi-Purpose Machine Gun
OE – Ordnance and Explosives
OESS – Ordnance and Explosives Safety Specialist
PDA – Personal Digital Assistant
ROM – Rough Order of Magnitude
RRD – Range Related Debris
RTLP – Range and Training Lands Program
UXO – Unexploded Ordnance

1.0 GENERAL DISCUSSIONS

1.1 INTRODUCTION

1.1.1 In an effort to support the Sustainable Range Program (SRP), the Ordnance and Explosives (OE) Directorate Corps of Engineers Huntsville Center (CEHNC) conducted a Munitions and Explosives of Concern (MEC) reconnaissance survey on the proposed Multi-Purpose Machine Gun (MPMG) Range at Camp McCrady, SC. The survey served to gather information that determines the location, extent and quantity of surface MEC and estimates the extent and quantity of subsurface MEC on the area of interest (AOI) for the planned RTLP project. This report will recommend response actions based on observations and data collected.

1.2 PROJECT OBJECTIVES

1.2.1 The objectives of the ordnance survey are as follows:

1) Gather sufficient data to adequately characterize the nature of MEC at the AOI designated by Camp McCrady;
2) Categorize AOI into a low, medium or high risk area(s) by determining the potential that individuals performing work on the site will encounter MEC;
3) Gather sufficient data in order to define clearance footprints;
4) Gather sufficient data to produce rough order of magnitude (ROM) estimate for MEC response action activities.

1.3 SCOPE OF MEC RECON SURVEY

1.3.1 CEHNC mobilized one 2-person team to traverse the AOI at the MPMG Range. The site was overlain with transects and uploaded to a Thales Mobile Mapper (TMM) personal digital assistant (PDA) with an integrated global positioning system (GPS) to guide the teams throughout the surveys. The transect path is designed to provide a uniform site coverage which will demonstrate meaningful site models. The uploaded transect paths were followed throughout the survey. The transect paths can be viewed in Appendix A maps.

1.3.2 During fieldwork, the team photographed significant munitions related items, terrain, vegetation, quality control functions and other pertinent visual opportunities that would aid in the understanding of the potential for explosive hazards at the site. All site photos can be viewed in Appendix B.

1.3.3 Historical documentation is sought for each site that is slated for a MEC recon survey. No site historical information was recovered. Appendix C has been left as a place holder in the event that historical information is revealed during the project.

1.3.4 Data quality is the most essential element of the MEC recon survey. A functionality test strip was swept twice daily to insure proper equipment function, battery strength, data quality and proper techniques are being applied by the operators. The test strip is established prior to

fieldwork. A MEC simulant was swept in the morning and at the end of the day. The QC log can be viewed in Appendix D.

1.3.5 The survey was an instrument assisted qualitative and quantitative reconnaissance that logged items encountered on the surface as well as quantities of detected subsurface anomalies. Items logged may include unexploded ordnance (UXO), munitions debris (MD), discarded military munitions (DMM), Range Related Debris (RRD), berms, craters, targets and any other notable ordnance related features. Complete definitions of munitions related terms can be found in Appendix E. The survey enables the CEHNC GIS team to generate quantitative and qualitative site models that display MEC related characteristics of the site, improves the accuracy of a MEC response action government estimate and provides data to MEC contractors for accurate response action proposals.

1.3.6 The actual field data collected is weighted heavily in the conclusions and recommendations of the MEC survey. Constant vigilance is imperative to collecting reliable data. The two primary factors that decrease the accuracy of MEC surveys are vegetation and speed of collection. No vegetation removal is executed prior to MEC surveys. Also, many miles of transect must be traversed to cover the large range areas in a small amount of time. A balance of walking pace and adequate detection sweeping must be negotiated by the detection equipment operator. 8.5 miles of transect was covered in order to attain the necessary site coverage. 253 data points were collected. The OESS, using an analog magnetometer, swept a one meter wide swath and reported the counts to the data collector every 50 meters. The surface count encompassed a three meter wide swath. All counts were inventoried every 50 meters. The data collector kept the team on the projected path and informed the OESS when the next point had been reached. The field team leader monitors detection quality being achieved. If quality issues are observed, the field team leader is responsible for correcting the problem. The collection data can be viewed in Appendix F.

1.4 TECHNICAL APPROACH

1.4.1 The CEHNC team developed a survey coverage strategy using Geographical Information System (GIS) files. The CEHNC team created an addendum to the programmatic work plan (PWP) to meet the data quality objectives of the project.

1.4.2 Camp McCrady provided GIS data and/or information necessary to locate and development a comprehensive plan that would guide the recon team throughout the survey. The CEHNC GIS team created an overlay of transects for the survey team to follow while in the field.

1.4.3 A test plot was implemented at the site. A simulant was utilized at the test plot to verify equipment function. Coordinates were taken of the item for documentation. The test plot is a quality control (QC) matrix utilized to demonstrate proper function of the detection equipment and competence of the detection equipment operators. A Schiebel Miniature Mine Detector (MIMID) Electromagnetic (EM) all metals detector was used for quantitative subsurface anomaly counts. Detection of the simulants was verified each day at the site before and after survey activities.

1.4.4 The CEHNC GIS technician uploaded data files to the TMM to provide guidance in the field. While in the field the GIS technician guided the team as close to the proposed transects as possible. The team logged all surface and subsurface contacts at the end of a 50 meter increment along the transect. Data collection points were established every 50 meters along the transect for the entire survey route.

1.4.5 One 2-man survey team followed the planned transects, logged observed surface UXO, DMM, MD, and CD, recorded physical features that would indicate MEC related activity, terrain, geology, targets and logged the number of subsurface ferrous anomalies detected. The team progressed along the projected transects with the OE safety specialist (OESS) in the lead. His primary mission was to cover a one meter wide strip with the MIMID and note the number of subsurface anomalies detected, count notable surface items and ensure any surface UXO on the path was avoided by the team. The TMM operator followed entering all ordnance related observations. The OESS covered a minimum one meter wide swath for subsurface contacts. An effective 3 meter wide swath was covered for visual identification of surface items. All munitions related items were logged at the data collection points.

1.5 SITE LOCATION

Camp McCrady is the National Guard contingent located on Fort Jackson, SC. The site is located at Range 24 on the west side of the East Impact Area.

1.6 SITE DESCRIPTION

The MPMG is approximately 166 acres in surface area. The terrain is flat to rolling with a few abrupt changes in elevations. The vegetation is primarily wooded with oaks. The soil is very sandy.

1.7 MEC RELATED SITE HISTORY

The site is within the current delineated impact area. An active range exists to the north which the footprint overlaps down range. Numerous ordnance appears to have been used on the current range. Historic range fans for 105mm and 155mm Howitzer are displayed in the 2005 historical review previously conducted by Malcolm Pirnie. The historical review can be view in Appendix C. The historical range fans were geo-referenced and overlaid with the range footprint. The overlaid footprint can be viewed in Appendix A Figure 7.

1.8 PERSONNEL

1.8.1 Project Manager

Ken Hewitt is the project manager and is responsible for execution of all aspects of the MEC survey.

1.8.2 Technical Manager

Jason Burcham is the technical manager and is responsible for all technical issues that affect project implementation, quality, and feasibility.

1.8.3 GIS Analyst Team

Dustin Ray is the GIS specialist and is responsible for project GIS deliverables.

1.8.4 OE Safety Specialist

Michael Slovak was the OESS during field work. He was responsible for the safety of the team in the field, identification of ordnance, the abbreviated accident prevention plan (APP), assist in quality control, operation of detection equipment, and reporting MEC related data to the data collector.

1.8.5 Field Team Leader

Jason Burcham was the field team leader. He was responsible for creation and adherence to the project work plan and work plan addendum, adequate collection of data at the sites, quality control, field coordination with range control, and development of the MEC survey report.

1.8.6 Camp McCrady POC

Major Moyer was the primary points of contact (POC) during the survey.

2.0 TECHNICAL DISCUSSION

2.1 INITIAL COORDINATION - The team arrived at Fort Jackson range control at 0700 on Sunday November 11, 2012. The survey team was given clearance to occupy then proceeded to the site. The team surveyed transects until coverage was complete. The project progressed as follows in Table 1.

2.2 FIELDWORK PROGRESSION - Fieldwork progressed very efficiently throughout the survey. The team completed the site within schedule and collected the data needed for analysis of the site. The time spent performing fieldwork on the site can be viewed in Table 1.

TABLE 1
Fieldwork Progression

Site	Date	Type of Investigation	Begin	End	Complete
MPMG	**11/11/12**	**Survey**	**0730**	**1730**	**No**
MPMG	**11/12/12**	**Survey**	**0730**	**1430**	**Yes**

2.3 TEST PLOT - An area offsite was swept by an OESS and determined free of subsurface anomalies. An ordnance simulant item was placed on the surface and swept in order to fulfill the QC matrix for equipment function and operator competence. The test plot was swept at the beginning and end of fieldwork each day. The coordinates of each offsite location are provided in Table 2. A Schiebel MIMID was tested at the beginning and end of field activities at the site. It underwent and passed all functionality checks. Detection was observed and noted. Detection devices were inspected for any damage that may impair its functionality.

TABLE 2
Simulant Locations

AOI	Simulant	Depth	Coordinates, WGS84 UTM Zone 17N (X,Y)
MPMG	MEC Simulant	0	513152, 3764582

2.4 FIELD ACTIVITIES
One 2-person team traversed the site on November 11-12, 2012. A test strip was created offsite for equipment functionality checks. After functionality checks were complete, the survey commenced. The team traversed separate transects delineated north-south across the site. The transects were spaced 100 meters apart across the 166 acre site. The effective coverage was 262 acres due to transects that exceeded the limits of the MPMG footprint. See Figure 2 of Appendix A for a graphic representation of site coverage. The MEC survey team proceeded with the OESS sweeping a one meter wide swath with a Schiebel MIMID on high setting. Metallic subsurface anomalies in the path were counted and logged at predetermined data collection points (Every 50m). The data collector guided the team between data points. The team counted surface items and the OESS identified munitions related items. UXO, MD, RRD and CD were logged during the survey. Old hard targets were observed on the site. High quantities of ordnance is present on the northern portion of the site (See Appendix A).

2.5 SUMMARY OF FINDINGS – 4093 MD items were observed which consisted of HE fragments, 81mm Illumination Mortars, 105mm TP Projectiles. Two MEC items were observed which consisted of a 75mm HE Projectile and a 90mm HEAT Projectile. Several targets exist as well as high quantities of small arms bullets/debris.

TABLE 3
Summary of Findings

Site	MEC Observed	RRD Observed	MD Observed	MEC Response Needed
MPMG	2	456	4093	Yes

3.0 MAP REFERENCES, ARCHIVAL REFERENCES AND DISCUSSIONS

3.1 Overall MPMG Location - The location is displayed in Figure 1, Appendix A, Overall Location Map. The site is located at Range 24 west of the impact area. Figure 1 provides a visual reference of the site in relation to the installation.

3.2 MPMG Recon Survey Coverage - The proposed coverage of the site is generated at the CEHNC prior to fieldwork. The coverage is an unbiased uniform coverage of the site. Actual survey coverage may vary in the field due to installation instructions, dangerous terrain features, and/or field revision based MEC encountered. Typically the survey coverage delineated in the office is followed in the field to the greatest extent practical. The proposed coverage thoroughly covered the boundaries of the MPMG Range. The MPMG Range Site coverage can be viewed in appendix A, Figure 2.

3.3 Subsurface Contact Distribution
Subsurface anomalies were observed at the site. A Schiebel MIMID EM analog metal detector was used to gather subsurface quantitative data. All metallic anomalies are detectable by the instrument. The subsurface contacts indicate subsurface metallic densities. Anomaly densities

were developed to demonstrate the subsurface metallic characteristics of the sites. The densities reported are typically lower than the anomaly densities that will be encountered during a removal action. The subsurface density contours can be viewed in Appendix A, figure, 3.

3.4 Surface Density
Metallic surface items were logged during the recon. The surface density map demonstrates quantitative metallic surface characteristics of the site. The densities reported are typically lower than the anomaly densities that will be encountered during a removal action. The surface density maps can be viewed in Appendix A, figure 4.

3.5 Munitions Item Map
A munitions related surface item map was created to demonstrate significant findings of the reconnaissance survey. The item map can be viewed in Appendix A, figure 5.

3.6 Risk of Encountering MEC - A map that demonstrates areas of high, medium, and/or low risk of encountering MEC has been created based on the data collected. The map does not denote the hazard severity of the items encountered, but the probability of encountering explosive hazards throughout the AOI based on all known information. The map can be viewed in Appendix A, Figure 6.

3.7 Historic Analysis – A historical analysis was completed from a 2005 historical review report produced by Malcolm Pirnie. The historic map pertaining to the project site was geo-referenced and overlain onto the MPMG footprint. The map can be viewed in Appendix A Figure 7. The historical report can be viewed in Appendix C. Figure 4-9 in the report was overlain onto the footprint.

3.8 Data Tables - The determinations made in this report rely heavily upon the field data collected while traversing the site. Constant vigilance and awareness of the munitions related site characteristics must be maintained at all times in order to collect reliable data. At each data point a thorough data collection checklist is evaluated to determine munitions related quantitative and qualitative characteristics of the segment that was traversed. Typical data collection point spacing is approximately 50 meters. This regimen of data collection was performed 253 times at the MPMG. The data collection tables can be viewed in Appendix F.

4.0 MEC SURVEY CONCLUSIONS

Two MEC items were discovered during the survey. Evidence of MEC related site use exists throughout a large portion of the site. Numerous HE fragments were observed. The site exhibits areas with low, medium and high probability of encountering explosive hazards. Figure 6, Appendix A conveys the risk of encountering MEC probability map.

5.0 MEC SURVEY RECOMMENDATIONS

A subsurface clearance is recommended in the medium and high risk areas. Standby construction support is recommended in the low risk areas.

This report accurately depicts the survey team's evaluation of the extent of UXO contamination at the site but likely underreports the nature of contamination. The actual conditions experienced during a removal action will differ significantly from the conditions reported herein for a number of reasons. For example, the site was not cleared of vegetation prior to the survey; therefore this hampered the survey efforts which most likely resulted in an under reporting of surface and sub-surface anomaly density. Also, the speed at which the surveyor moved across the site and the fact that no QA followed will inherently result in an underestimation of the anomalies to be encountered in an actual removal action. Also an anomaly as reported herein is an area which demonstrates elevated geophysical instrument response and not the number of metallic items to be encountered at the site. Given that removal teams often define an anomaly as a metallic item as opposed to an anomalous area it is certain that the anomaly density reported by removal teams will exceed the anomaly density reported herein. The type of geophysical instrument and settings used by removal teams will certainly differ from those used by the survey team thereby creating differences between reported and actual number of geophysical anomalies at the site. The survey transect spacing is relatively wide compared to the small size of the construction features (targets, road corridors, etc) and it is likely that the survey missed high anomaly density areas that may be part of the clearance area. These and other factors will cause the report to underestimate the conditions at the site. The use of the data provided as the basis of estimate requires an experienced understanding of how the data of this type is collected, analyzed, interpreted, and presented and requires an understanding of the limitations of the data provided by assessments of this type. Therefore this information shall not be used by bidders in preparation of their pricing proposals. Bidders who do utilize this information shall accept full and sole responsibility for identifying and considering all factors that may affect the cost to execute the work use the data presented herein at their own risk.

APPENDIX A
SITE MAPS

APPENDIX B
PHOTOGRAPHS

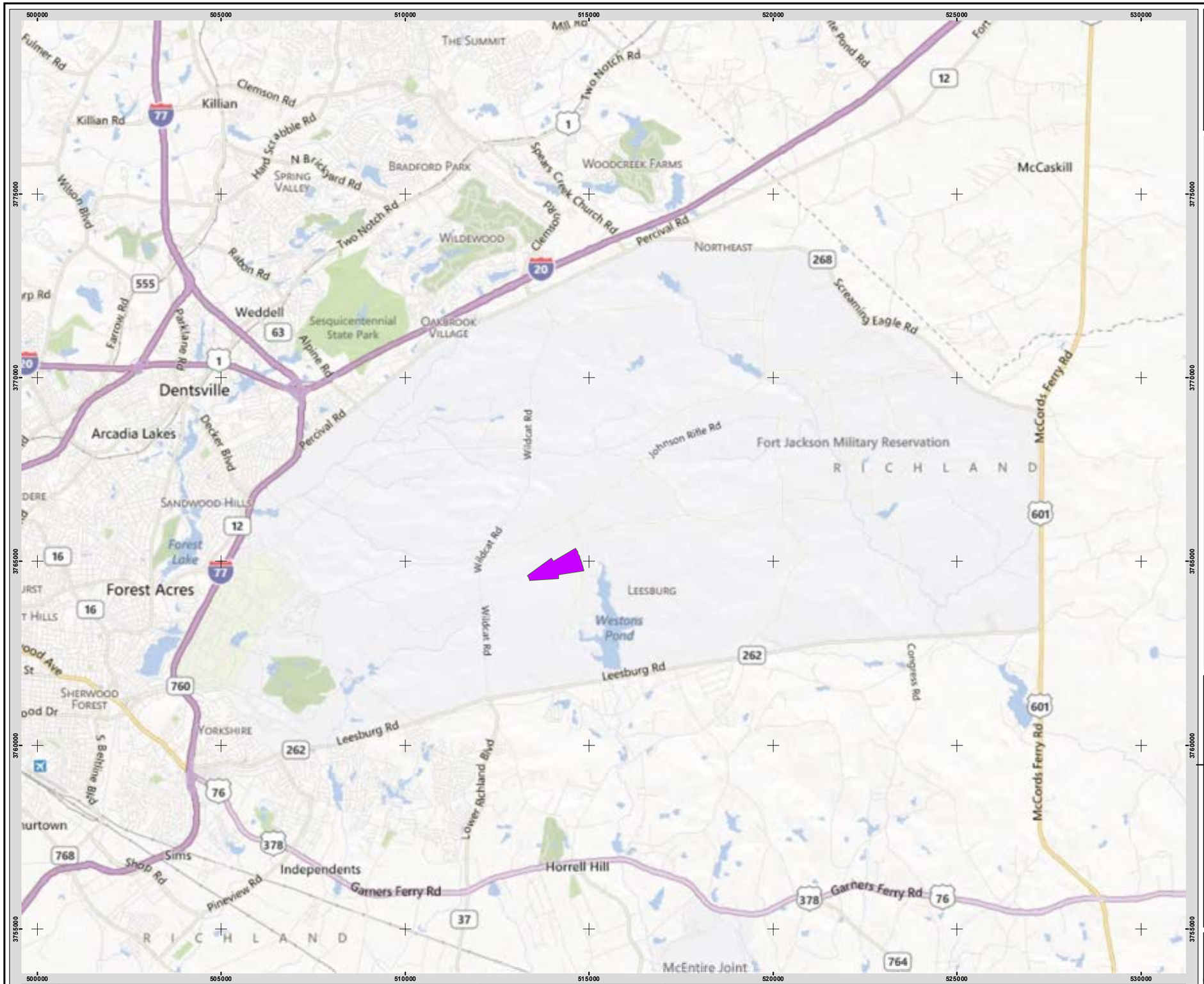
APPENDIX C
HISTORICAL DOCUMENTATION & PREVIOUS INVESTIGATIONS

APPENDIX D
QC LOG

APPENDIX E
Munitions Related Terms

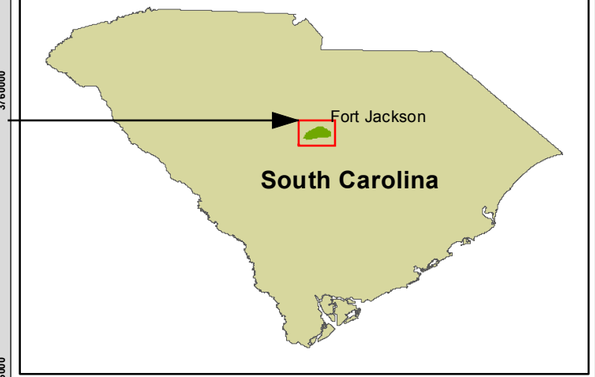
APPENDIX F
DATA TABLES

Figure 1
Overall Location
MPMG
Fort Jackson/Camp McCrady, SC



Legend

Project Location



0 1 2 3 4 5
Miles

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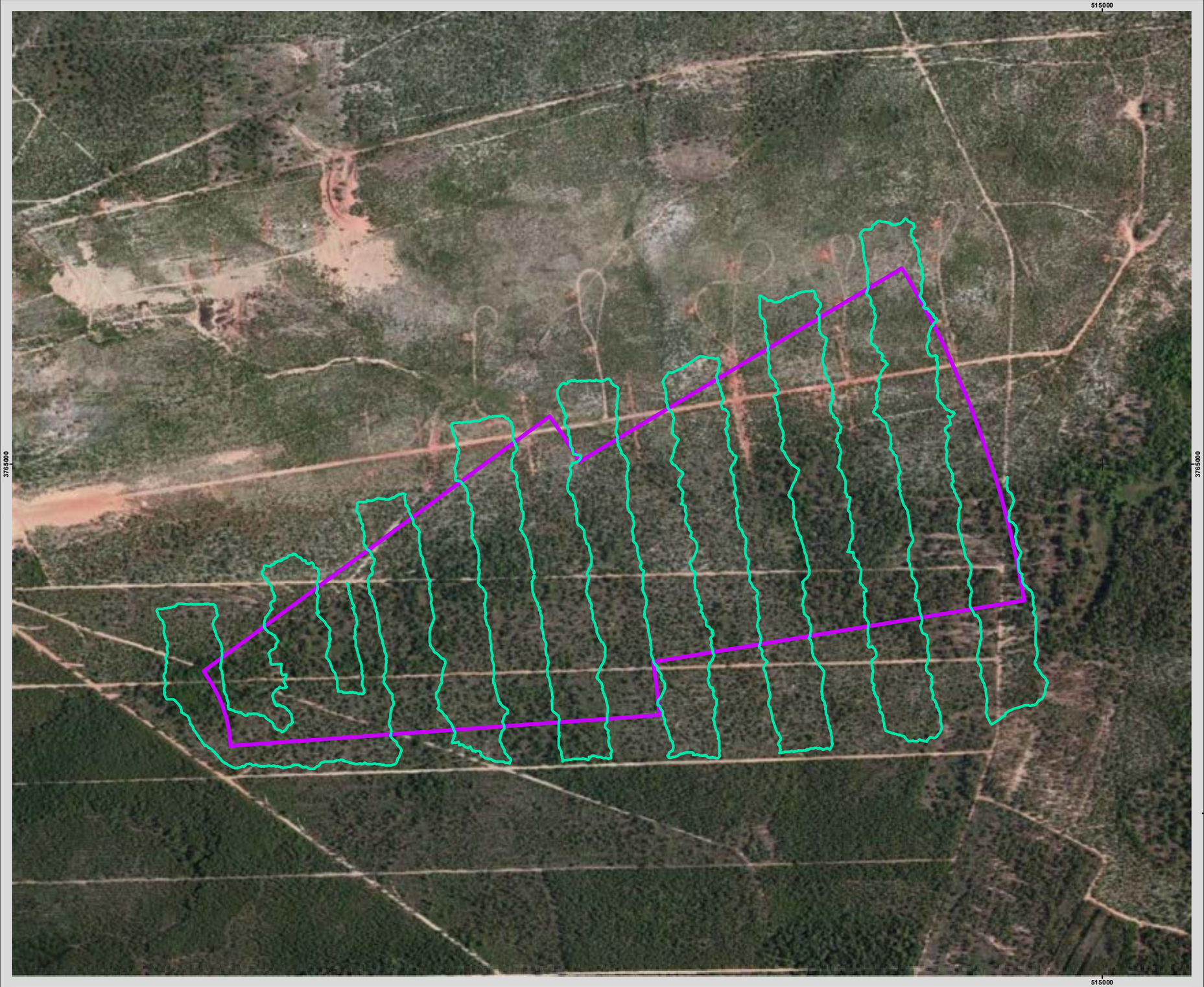
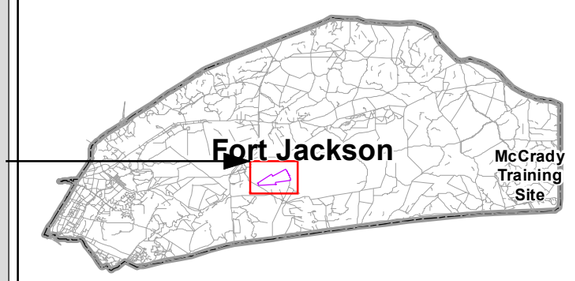
Figure 2
Recon Survey Coverage
MPMG
Camp McCrady/Fort Jackson, SC



Legend

- Proposed MPMG Boundary (166 Acres)
- Walked Path (8.5 Miles)



0 500 1,000 1,500 2,000
Feet

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	Coordinate System: WGS84 UTM Zone 17N, Meters

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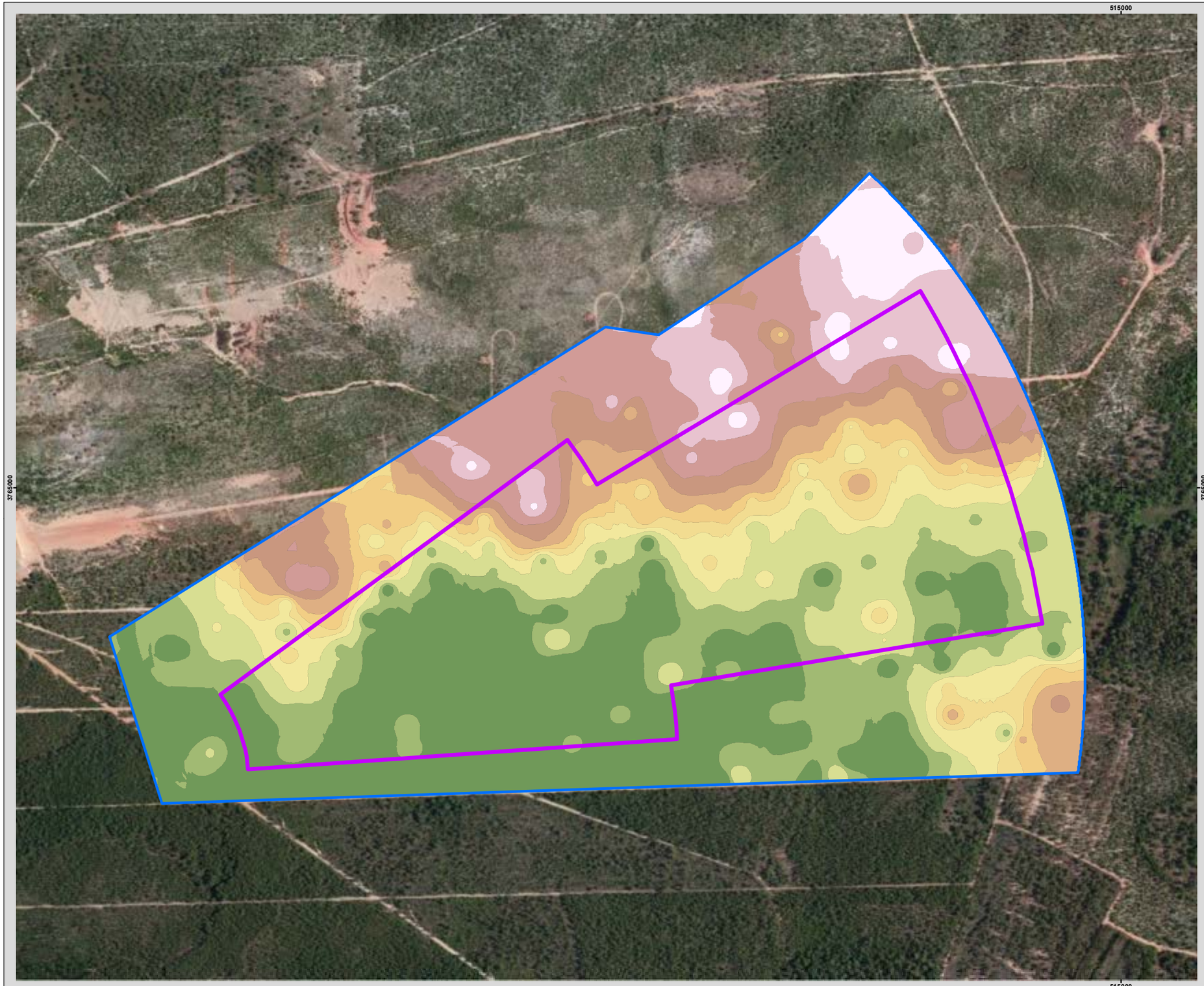
Figure 3
Subsurface Density
MPMG
Camp McCrady/Fort Jackson, SC



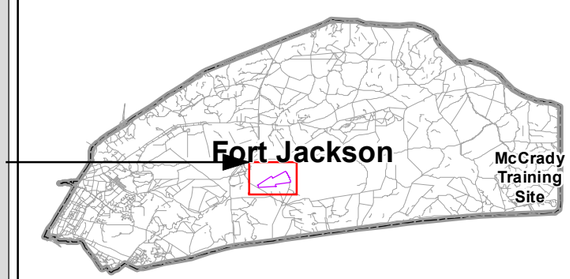
Legend

- Proposed MPMG Boundary (166 Acres)
- Analysis Boundary (325.9 Acres)

Subsurface Density

Density per Acre (Acres)

- 0 - 50 (86.4)
- 50 - 100 (43.5)
- 100 - 200 (41.4)
- 200 - 300 (21.0)
- 300 - 400 (15.8)
- 400 - 500 (13.4)
- 500 - 750 (19.7)
- 750 - 1000 (17.4)
- 1000 - 1500 (35.8)
- 1500 - 2000 (21.3)
- 2000 - 2630 (10.1)



0 500 1,000 1,500 2,000
Feet

Author: GDW	Date Saved: 1/11/2013 8:59:19 AM
Imagery: (c) 2010 Microsoft Corporation and its data suppliers	Coordinate System: WGS84 UTM Zone 17N, Meters

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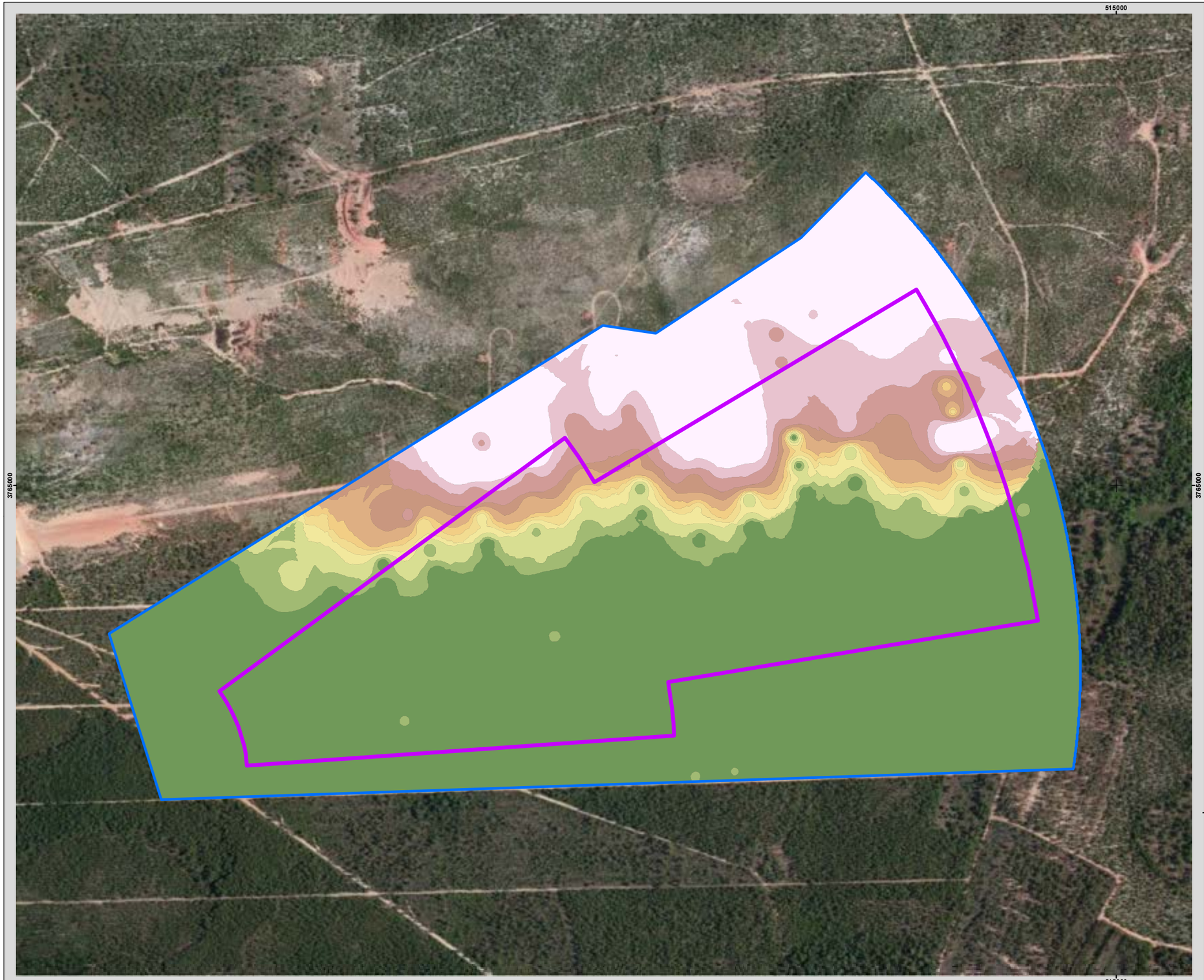
Figure 4
Surface Density
MPMG
Camp McCrady/Fort Jackson, SC



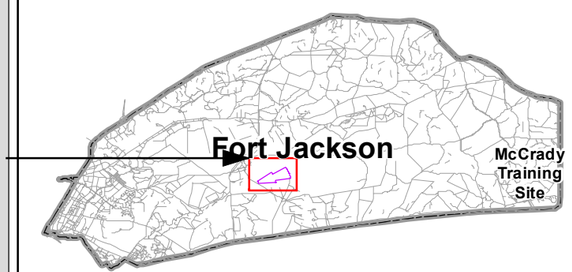
Legend

- Proposed MPMG Boundary (166 Acres)
- Analysis Boundary (325.9 Acres)

Surface Density

Density per Acre (Acres)

- 0 - 50 (189.5)
- 50 - 100 (12.3)
- 100 - 200 (10.4)
- 200 - 300 (5.5)
- 300 - 400 (4.3)
- 400 - 500 (3.6)
- 500 - 750 (8.3)
- 750 - 1000 (8.0)
- 1000 - 1500 (13.1)
- 1500 - 2000 (20.9)
- 2000 - 6183 (49.8)



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Imagery: (c) 2010 Microsoft Corporation and its data suppliers | Coordinate System: WGS84 UTM Zone 17N, Meters

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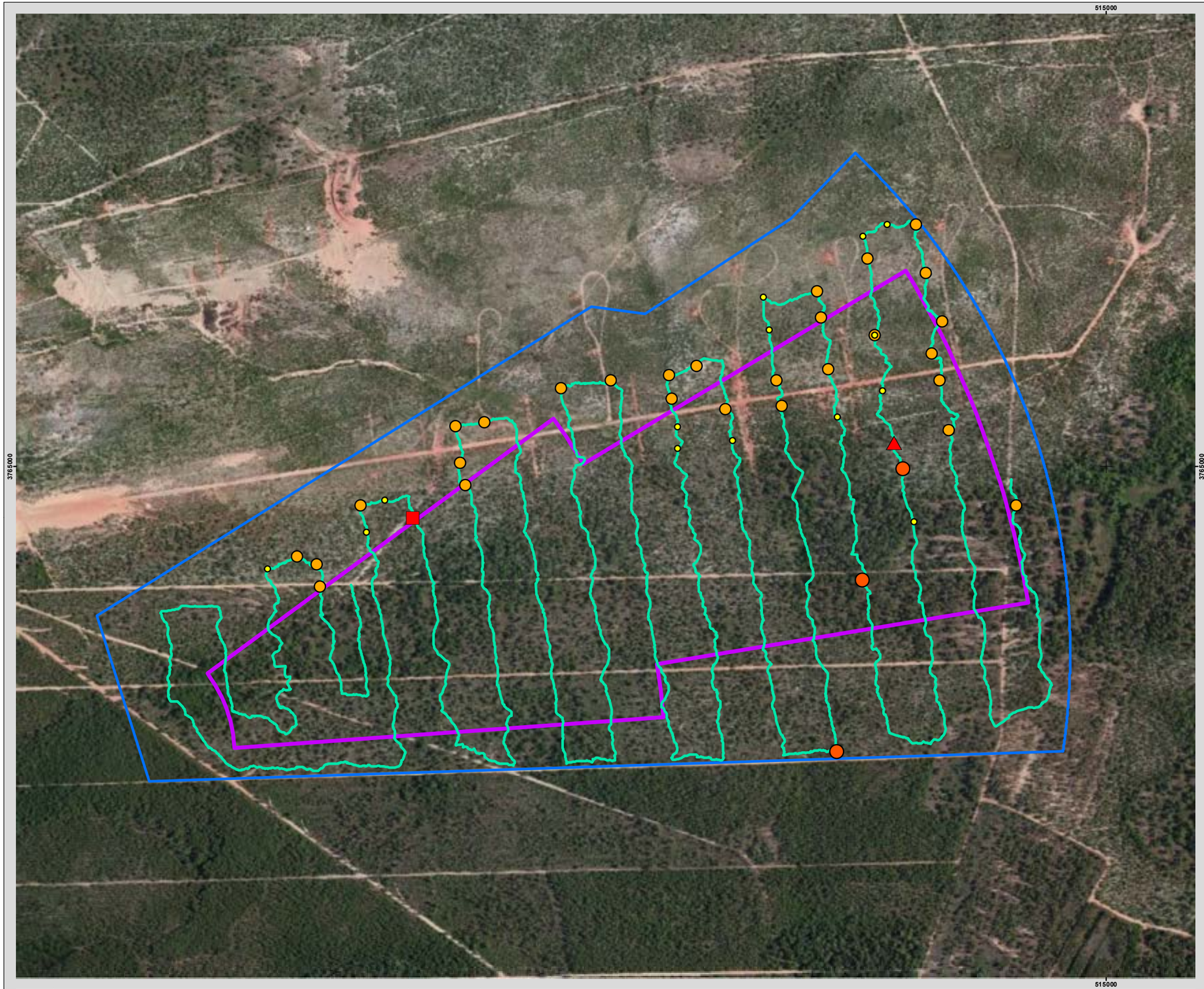
Figure 5
Munitions Discoveries
MPMG
Camp McCrady/Fort Jackson, SC



Legend

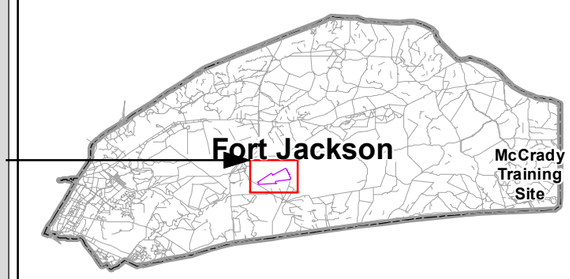
- Proposed MPMG Boundary (166 Acres)
- Analysis Boundary (325.9 Acres)
- Walked Path (8.5 Miles)

Significant MEC Items Found

- 75mm HE
- 90mm HE

Other Significant MD

- Light Frag
- Medium Frag
- Heavy Frag



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Coordinate System: WGS84 UTM Zone 17N, Meters

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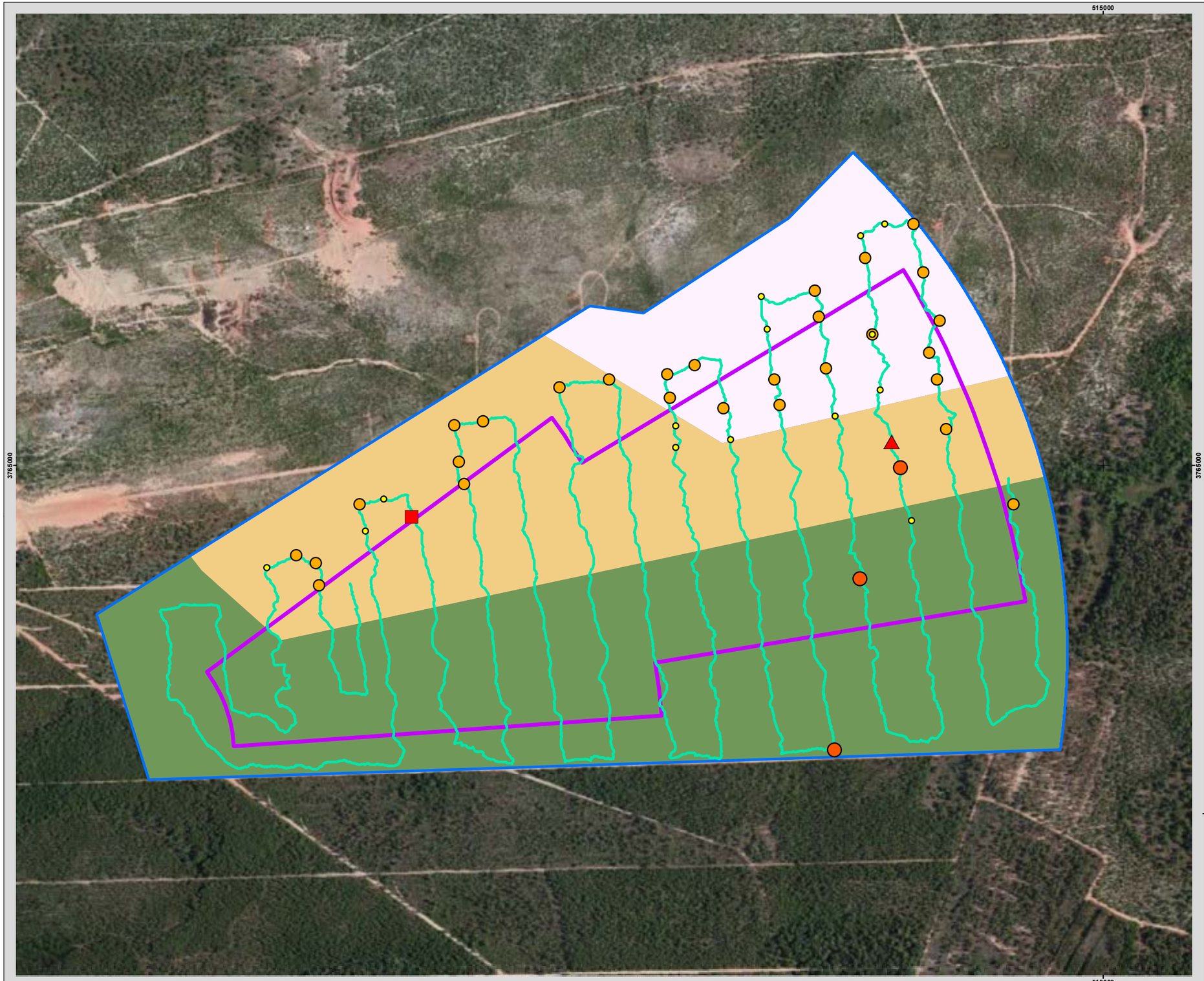
Figure 6
Risk of Encountering MEC
MPMG
Camp McCrady/Fort Jackson, SC



Legend

- Proposed MPMG Boundary (166 Acres)
- Analysis Boundary (325.9 Acres)
- Walked Path (8.5 Miles)

Significant MEC Items Found

- 75mm HE
- 90mm HE

Other Significant MD

- Light Frag
- Medium Frag
- Heavy Frag

Risk Area (Acres)

- High Risk (57.2)
- Medium Risk (104.6)
- Low Risk (164)

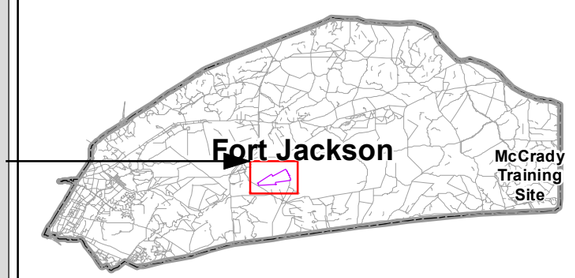


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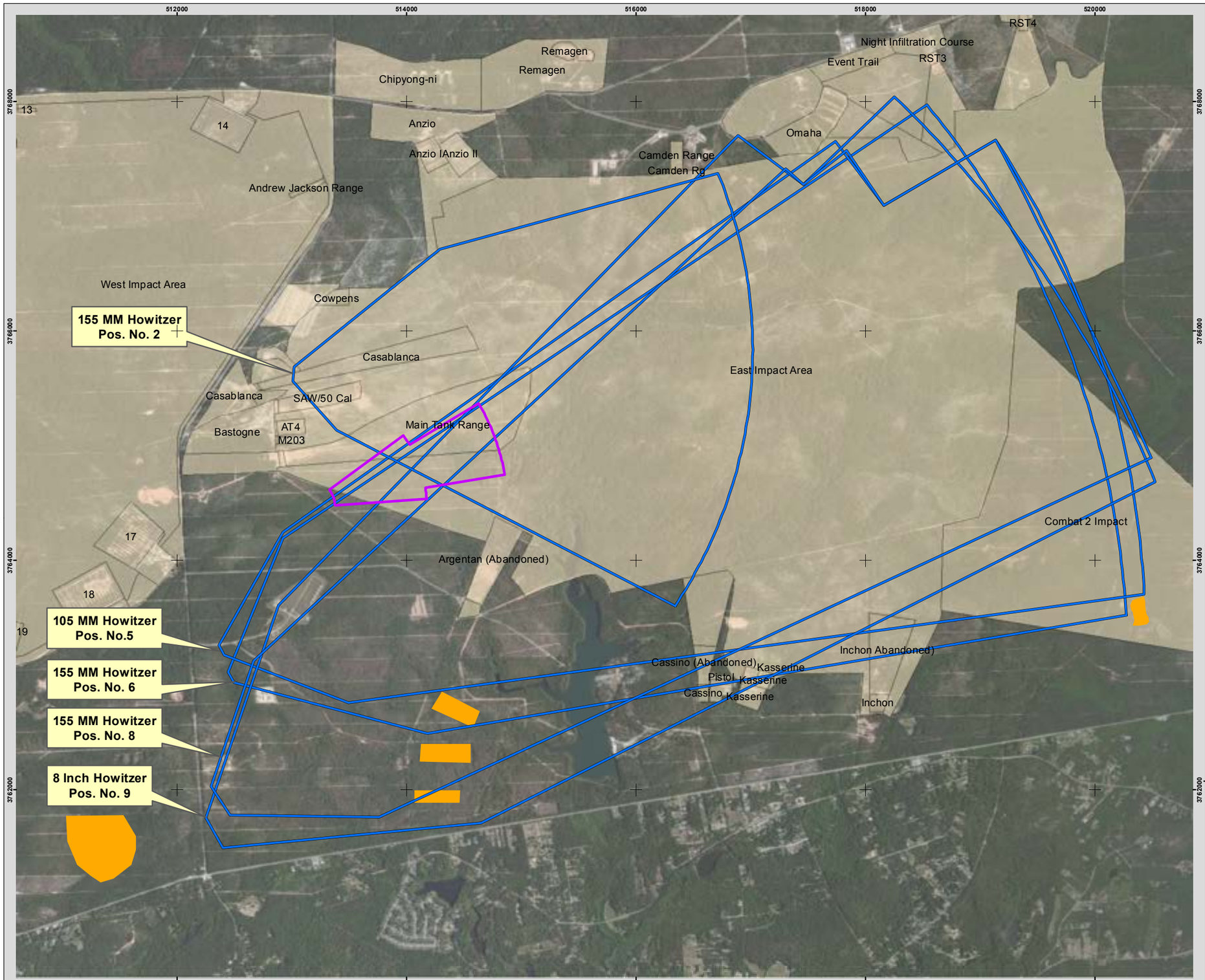
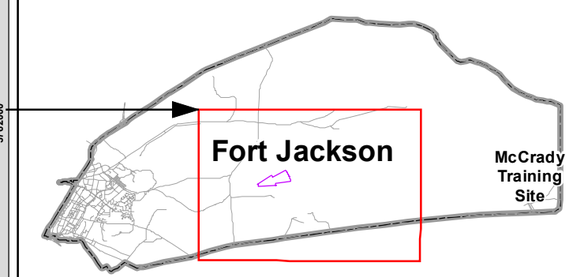
Figure 7
Historical/Active Ranges
MPMG
Camp McCrady/Fort Jackson, SC



Legend

- Proposed MPMG Boundary (166 Acres)
- Howitzer Ranges
- Suspected Dudded Ranges
- Military Live Fire Area



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FINAL
HISTORICAL RECORDS REVIEW
FORT JACKSON
COLUMBIA, SOUTH CAROLINA

MARCH 2005

Prepared for:

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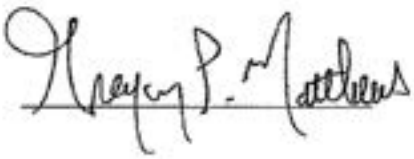
FINAL

HISTORICAL RECORDS REVIEW
FORT JACKSON
COLUMBIA, SOUTH CAROLINA

DoD Contract Number: DACW41-02-D-0003

Reviewed and Approved by:



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Malcolm Pirnie, Inc. prepared this report at the direction of the U.S. Army Corps of Engineers (USACE). This document should be used only with the approval of the USACE. This report is based, in part, on information provided in other documents and is subject to the limitations and qualifications presented in the referenced documents.

MARCH 2005

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TABLE OF ACRONYMS

Acronym	Definition
AEC	Army Environmental Center
Army	United States Army
ARS	Advance Range Survey
As	Arsenic
ASR	Archives Search Report
bgs	Below Ground Surface
CA	Corrective Action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CS	Confirmatory Sampling
CSM	Conceptual Site Model
CTT	Closed, Transferring, and Transferred
Cu	Copper
DERP	Defense Environmental Restoration Program
DMM	Discarded Military Munitions
DNT	Dinitrocellulose
DoD	Department of Defense
EOD	Explosive Ordnance Disposal
Fe	Iron
FJFC	Fort Jackson Flight Club

TABLE OF ACRONYMS

Acronym	Definition
Frag	Fragmentation
FUDS	Formerly Used Defense Site
FY	Fiscal Year
HE	High Explosive
HRR	Historical Records Review
ICRMP	Integrated Cultural Resources Management Plan
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
LAW	Light Anti-tank Weapon
MC	Munitions Constituents
MD	Maryland
MEC	Munitions and Explosives of Concern
Mg	Magnesium
mm	Millimeter
MMRP	Military Munitions Response Program
MRS	Munitions Response Site
MWR	Morale, Welfare, and Recreation
NARA	National Archives and Records Administration
NFA	No Further Action
No.	Number

TABLE OF ACRONYMS

Acronym	Definition
NR	Number
NRHP	National Registry of Historic Places
PA	Preliminary Assessment
Pb	Lead
PIRS	Project Information Retrieval System
RAC	Risk Assessment Code
R/C	Radio-controlled
RCRA	Resource Conservation and Recovery Act
RDX	Cyclotrimethylenetrinitramine
RFA	RCRA Facility Assessment
RFI	Request for Information
RG	Record Group
RI	Remedial Investigation
RMIS	Restoration Management Information System
SARA	Superfund Amendment and Reauthorization Act
Sb	Antimony
SC	South Carolina
SI	Site Inspection
Sn	Tin
Sr	Strontium

TABLE OF ACRONYMS

Acronym	Definition
SSG	Staff Sergeant
SWMU	Solid Waste Management Unit
TNT	Trinitrotoluene
TRADOC	U.S. Army Training and Doctrine Command
U.S.	United States
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
UXO	Unexploded Ordnance
VA	Virginia
WAA	War Assets Administration
WP	White Phosphorus
Zn	Zinc
°F	Degrees Fahrenheit

GLOSSARY OF TERMS

Closed Range – A military range that has been taken out of service as a range and that either has been put to new uses that are incompatible with range activities or is not considered by the military to be a potential range area. A closed range is still under the control of a Department of Defense (DoD) component.

Defense Site – All locations that are or were owned by, leased to, or otherwise possessed or used by the DoD. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used or was permitted for the treatment or disposal of military munitions.

Discarded Military Munitions (DMM) – Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations.

Explosive Ordnance Disposal (EOD) – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded explosive ordnance. It may also include explosive ordnance that has become hazardous by damage or deterioration.

Explosives Safety – A condition where operational capability and readiness, personnel, property, and the environment are protected from the unacceptable effects of an ammunition or explosives mishap.

Formerly Used Defense Site (FUDS) – A DoD program that focuses on compliance and cleanup efforts at sites that were formerly used by the DoD. A FUDS property is eligible for the Military Munitions Response Program if the release occurred prior to October 17, 1986;

the property was transferred from DoD control prior to October 17, 1986; and the property or project meets other FUDS eligibility criteria.

Military Munitions – All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the Department of Defense, the U.S. Coast Guard, the U.S. Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives, and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components of the above. The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, other than non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 have been completed.

Munitions and Explosives of Concern (MEC) – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means unexploded ordnance, DMM, or munitions constituents (e.g., Trinitrotoluene [TNT], Cyclotrimethylenetrinitramine [RDX]) present in high enough concentrations to pose an explosive hazard.

Munitions Constituents (MC) – Any materials originating from unexploded ordnance, DMM, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions.

Operational Range – A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities or, although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities.

Other than Operational Range – Encompasses closed, transferred, and transferring ranges.

Range – A designated land or water area set aside, managed, and used for range activities of the DoD. Ranges include firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access and exclusionary areas, and airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration.

Transferred Range – A range that is no longer under military control and had been leased by the DoD, transferred, or returned from the DoD to another entity, including federal entities. This includes a military range that is no longer under military control, but that was used under the terms of an executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager. Additionally, property that was previously used by the military as a range, but did not have a formal use agreement, also qualifies as a transferred range.

Transferring Range – A range that is proposed to be leased, transferred, or returned from the DoD to another entity, including federal entities. This includes a military range that was used under the terms of a withdrawal, executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager or property owner. An active range will not be considered a transferring range until the transfer is imminent (generally defined as the transfer date is within 12 months and a receiving entity has been notified).

Unexploded Ordnance (UXO) – Military munitions that have been primed, fused, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and remain unexploded either by malfunction, design, or any other cause.

1 INTRODUCTION

The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address DoD sites with unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) located on current and former military installations. Properties classified as operational military ranges, permitted munitions disposal facilities or operating munitions storage facilities are not eligible for the MMRP, nor are sites that had releases after September 30, 2002. The United States (U.S.) Army's (Army) inventory of closed, transferring, and transferred (CTT) military ranges and defense with UXO, DMM, or MC has identified sites eligible for action under the MMRP. Ten closed ranges (also referred to as sites) were identified during the inventory at Fort Jackson, located in the City of Columbia, Richland County, South Carolina (SC). A Site Inspection (SI) is currently ongoing at these sites. This report presents the results of the SI Historical Records Review (HRR).

The DoD is currently establishing policy and guidance for munitions response actions under the MMRP. However, key program drivers developed to date conclude that munitions response actions will be conducted under the process outlined in the National Contingency Plan (40 Code of Federal Regulations 300) as authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 United States Code (U.S.C.) 9605, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), Pub. L. 99-499 (hereinafter CERCLA). While it is the DoD's goal to address MMRP sites under the CERCLA, the Army recognizes that some installations (including Fort Jackson) will need to address these sites under the Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) program.

The Final Phase 3 CTT Range Inventory Report (CTT Range Inventory) for Fort Jackson, dated June 2003, marked the completion of the Preliminary Assessment (PA) phase of work under CERCLA and the RCRA Facility Assessment (RFA) phase of work under the RCRA CA program. The next step in the process is the SI (CERCLA terminology), which

corresponds with the Confirmatory Sampling (CS)/RCRA Facility Investigation (RFI) Phase I under RCRA. The work at Fort Jackson will be implemented under the MMRP SI program, which utilizes CERCLA terminology for programmatic documents. As such, the documents developed for the Fort Jackson MMRP SI, including the HRR, will use CERCLA terminology. It is understood that the following RCRA CA program terminology is implied:

Table 1-1: CERCLA and RCRA Terminology

CERCLA	RCRA
Preliminary Assessment (PA)	RCRA Facility Assessment (RFA)
Site Inspection (SI)	Confirmatory Sampling (CS)/RCRA Facility Investigation (RFI) Phase I
Remedial Investigation (RI)	RFI

1.1 PURPOSE/SCOPE

The purpose of the Site Inspection HRR is to perform a limited-scope records search to document historical and other known information for MMRP sites at Fort Jackson, to supplement the CTT Range Inventory information, and to facilitate decisions on what information is needed to determine the next steps in the CERCLA/RCRA process. The SI is part of the CERCLA process and will be conducted following completion of the HRR report. As noted in the previous section, the SI corresponds with the CS/RFI Phase I.

1.2 PROJECT DRIVERS

The regulatory structure for managing MMRP sites at Fort Jackson is guided by a mixture of federal, state, and local laws, as well as DoD and Army regulations and guidance. The picture is further complicated by debates at the national level between the DoD and the United States Environmental Protection Agency over key issues that include uncertainty of the final structure of the MMRP. However, key legislative and administrative precedents to date will undoubtedly influence the final regulatory framework for the MMRP. The key legislative, administrative, and historic precedents include the following:

Defense Environmental Restoration Program (DERP) Management Guidance (September 2001)

The DERP Management Guidance establishes a MMRP element for UXO, DMM, and MC defense sites. The history of DERP dates back to the SARA of 1986. The scope of the DERP is defined in 10 U.S.C. §2701(b), which states that the:

> Goals of the program shall include the following: … (1) The identification, investigation, research and development, and cleanup of contamination from hazardous substances, pollutants, and contaminants. (2) Correction of other environmental damage (such as detection and disposal of unexploded ordnance) which creates an imminent and substantial endangerment to the public health or welfare or to the environment.

National Defense Authorization Act (Fiscal Year [FY] 02) (Sections 311-312)

Sections 311-312 of the National Defense Authorization Act of FY02 reinforced the DoD's 2001 DERP Management Guidance by tasking the DoD to develop and maintain an inventory of defense sites that are known or suspected to UXO, DMM, or MC. Section 311 requires the DoD to develop a protocol for prioritizing defense sites for response activities in consultation with the states and Tribes. Section 312 requires the DoD to create a separate program element to ensure that the DoD can identify and track munitions response funding.

The September 2001 Management Guidance for the DERP and the Defense Authorization Act FY02, described above, established the MMRP. The DERP and the MMRP provide guidance and methods for conducting a baseline inventory of defense sites containing, or potentially containing, UXO, DMM, or MC.

1.3 BACKGROUND

As stated above, the CTT Range Inventory for Fort Jackson is considered to mark the completion of the PA phase of work under the CERCLA. The SI is the next phase in the CERCLA process and will complete the PA/SI requirements for the MMRP sites. As noted in the beginning of this section, the HRR uses CERCLA terminology. It is understood that RCRA CA program terminology is implied. The following paragraphs summarize the results

of the CTT Range Inventory at Fort Jackson and present the primary goals of performing a SI.

1.3.1 Inventory

The Army Range Inventory program was conducted in three phases. The first phase (Phase 1) involved a data call issued through the Army Environmental Center (AEC) requesting general information about ranges on various installations under each U.S. Army Major Command. The Phase 1 Inventory was conducted using a questionnaire called the Advance Range Survey (ARS). The ARS allowed the Army to meet the short-term data goal of supporting the DoD preparation of Senate Report 106-50.

Mr. James Wyatt, Range Officer, completed the ARS Phase 1 Inventory survey for Fort Jackson in November 2000. Three records for CTT ranges at Fort Jackson were found in the database. The CTT ranges listed in the ARS included the Old Hand Grenade Range #3, Old Small Arms Range #3, and a World War II Rifle Range Complex #6, all of which were considered closed. The Fort Jackson ARS data was submitted to AEC and compiled into a master database of Army installations.

The ARS allowed the Army to meet its short-term needs; however, the Army's long-term needs required a more detailed inventory of its ranges that was not achievable based on the information in the ARS. For management and budgetary reasons, the Army divided the detailed follow-up inventory into two phases. The Phase 2 Inventory addressed operational ranges, while Phase 3 covered CTT ranges and sites with UXO, DMM, or MC. During the Fort Jackson Phase 2 Inventory, completed in the winter of 2000, 44,028 acres were classified as operational range areas. The results were documented in a range inventory binder that was submitted to Fort Jackson and its major command, the U.S. Army Training and Doctrine Command (TRADOC).

The Phase 3 Inventory was completed for Fort Jackson in June 2003. Ten closed ranges were identified at Fort Jackson. Additional information regarding the results of the Phase 3 CTT Range Inventory is discussed in Sections 2.2 and 3.3.

1.3.2 Site Inspection

The primary goal of the MMRP SI is to collect information necessary to make one or more of the following decisions: 1) determine whether a RI/Feasibility Study is required at a site; 2) determine whether an immediate response is needed; or 3) determine whether the site qualifies for no further action (NFA). The installation-wide SI at Fort Jackson will address both munitions and explosives of concern (MEC), which include UXO and DMM, and MC issues for the MMRP sites. The secondary goals of the SI are to include collecting data to prepare better Cost to Complete estimates and site prioritization for the MMRP sites.

1.4 REPORT ORGANIZATION

This HRR has the following sections:

- Section 1 – Introduction
- Section 2 – Site Description
- Section 3 – Data Collection and Document Review Process
- Section 4 – Summary of Findings
- Section 5 – Conceptual Site Model (CSM)
- Section 6 – Conclusions

The following supporting information and analyses are appended to this HRR:

- Archives Searched/Data Sources (Appendix A)
- Archive Documents (Appendix B)
- Interview Records (Appendix C)
- Munitions Technical Data Sheets (Appendix D)

2 SITE DESCRIPTION

2.1 INSTALLATION DESCRIPTION

Fort Jackson (also referred to as the "installation") is located in the eastern section of Columbia, SC, in Richland County near the center of the state. The inset on Map 2-1 shows the location of the installation within SC. The installation occupies approximately 52,000 acres, which includes a cantonment area, training and maneuver areas, live fire zones, and impact areas. The cantonment area, which contains the majority of the facility housing, administrative buildings, and industrial operations, is located in the southwestern portion of the installation. Recreational areas at Fort Jackson include the Fort Jackson Flight Club (FJFC) (a radio-controlled [R/C] airplane field) and the Weston Lake Recreation Area. The remainder of the installation, which is primarily undeveloped and consists of moderate to dense pine woodlands, is used for military training.

Fort Jackson was originally established in 1917 (referred to as Camp Jackson at that time) as an infantry training center. For a brief period of time (1921-1925), the installation was inactive. From 1925 to 1939, it was controlled by SC and used as an encampment and training area for National Guard troops. In 1939, the facility was transferred to the Federal Government, designated as Fort Jackson, and re-established as an infantry training center. The current and primary mission of Fort Jackson is to train initial entry recruits for duty as soldiers for Army units. To support this mission, Fort Jackson currently houses Army training brigades and serves as a reception station that processes newly inducted and prior service personnel forwarded to the installation from recruiting and induction stations.

2.2 MMRP SITE DESCRIPTIONS

Ten MMRP sites were identified at Fort Jackson during the CTT Range Inventory. These sites included the following:

- 1000-Yard Range
- 600-Yard Range

- Andrew Jackson Range
- FJFC
- Hand Grenade Court Number No. 2
- Live Hand Grenade Court 2
- Machine Gun Range
- Mortar Range
- Rifle Grenade Range Number NR 2
- Submachine Gun Area

The site locations are illustrated on Map 2-1, and the sites are discussed in detail in Section 3.3. The information obtained and descriptions of these sites that resulted from the CTT Range Inventory are presented in the following paragraphs:

1000-Yard Range: The 1000-Yard Range (Army Environmental Database-Restoration [AEDB-R] Site ID: FTJA-001-R-01) was a former rifle range located in the current cantonment area near Washington Road and Ivy Road (more accurately described as near Hartsville Guards Road and Chesnut Road). The approximately seven-acre range was listed on a 1919 map adjacent to the 600-Yard Range (also included in the CTT Range Inventory). The range was used from 1918 to 1920. Documentation indicated that the 1000-Yard Range included intermediate targets and was used as a 100-, 200-, 300-, 600-, and 1000-yard range. Today, the area is adjacent to base housing, streets, and a school. However, the area where the former 1000-Yard Range was located and the immediate area surrounding the range are undeveloped. During the CTT Range Inventory, the Range Control Officer and the data collection team visited the area where the ranges were located. Signs of a former rifle range were not observed. The team did not locate records of UXO sightings, incidents, or clearances related to the 1000-Yard Range.

600-Yard Range: The 600-Yard Range (AEDB-R Site ID: FTJA-002-R-01) was a former rifle range located directly adjacent to and south of the 1000-Yard Range in the cantonment area near Hartsville Guards Road and Chesnut Road. The 19-acre range was listed on a 1919 map. The range had a series of targets located at 100, 200, 300, 500 and 600 yards. The dates of use (1918 to 1920) of the 600-Yard Range are assumed to be identical to the dates for the 1000-Yard Range. Today, the area is adjacent to base housing, streets, and a school. However, the area where the former 600-Yard Range was located and the immediate area surrounding the range are undeveloped. During the CTT Range Inventory, the Range Control Officer and the data collection team visited the area surrounding the former rifle range and did not observe signs of the former rifle range. The team did not locate records of UXO sightings, incidents, or clearances related to the 600-Yard Range.

Andrew Jackson Range: The Andrew Jackson Range (AEDB-R Site ID: FTJA-003-R-01) is currently a morale, welfare, and recreation (MWR) area used for recreational small arms target practice. The range is open to the military, dependents, and civilian employees and is managed by the MWR program at Fort Jackson. The range is located just off of Wildcat Road within the current boundaries of the West Impact Area. The range area consists of approximately 15 acres. The recreational pistol range was established in the early to mid 1980s. The area was formerly part of the surface danger zone for the M-1 Transition Range NR 3, which was shown on several maps from the 1940s. The area was also in the buffer of several overlapping range fans (small arms ranges) from the 1950s. For the CTT Range Inventory, the area was identified as a closed range because it was not operational and had a former range use.

FJFC: The FJFC (AEDB-R Site ID: FTJA-004-R-01) was an approximately 54-acre area located east of Wildcat Road just north of Shenandoah Road. The area was used as a machine gun range in the 1950s, 1960s, and 1970s. The FJFC land consists of a flat, cleared, level area surrounded by forest and grassland. The flat, cleared portion of the site has been used as an airstrip for R/C small recreational type model aircraft since the late 1980s. The improvements to the site for the airstrip include a gravel parking area, sun shade, a picnic area, a grounds maintenance storage building, and a set of bleachers for spectators to watch

the R/C model plane operations. The area was considered a closed range for the purposes of the inventory because it was not operational and had a former range use.

Hand Grenade Court No. 2: The Hand Grenade Court No. 2 (AEDB-R Site ID: FTJA-005-R-01) was located in the northern part of the Weston Lake Area southwest of the Mortar Range. The period of use (1944 to 1950) and types of grenades reported for the inventory are approximate. Using a conservative approach, it was assumed for the CTT Range Inventory that live, as well as practice, grenades may have been used on the range. It is important to note that the team did not locate records of UXO sightings, incidents, or clearances related to the Hand Grenade Court No. 2. The three-acre area shown on Map 2-1 is a 100-meter by 100-meter square representing the approximate size and location of the former hand grenade impact area. The range is closed. It lies within the boundary of the Weston Lake Area. The area adjacent to Weston Lake is used for camping, picnics, and other recreational activities. However, the former hand grenade court has not been improved with recreational facilities (e.g., camp sites, trails, etc.) and is in a remote location not easily accessible by people using the Weston Lake Area recreational facilities.

Live Hand Grenade Court 2: The Live Hand Grenade Court 2 (AEDB-R Site ID: FTJA-006-R-01) was listed on a 1949 map of Fort Jackson. The approximate period of use for this range was 1940 to 1950. The period of use and types of grenades reported for the inventory were approximated based upon maps reviewed and the history of the installation. It was assumed that live, as well as practice, grenades may have been used on the range. The team did not locate records of UXO sightings, incidents, or clearances related to the former Live Hand Grenade Court 2. The range is closed. The three-acre area shown on the Map 2-1 is a 100-meter by 100-meter square representing the approximate size and location of the former hand grenade impact area. The area is close to the Pierce Terrace base housing complex, which is located just off of Chesnut Road. The immediate area of the former hand grenade range is undeveloped. This area was also used for field fortification training in the 1970s and 1980s.

Machine Gun Range: The Machine Gun Range (AEDB-R Site ID: FTJA-007-R-01) was in the current cantonment area near Hartsville Guards Road and Chesnut Road. The former three-acre range was just south of the 1000-Yard Range and the 600-Yard Range. It is also assumed that this range was used only between 1918 and 1920. Today, the area is adjacent to base housing, streets, and a school. However, the area where the former machine gun range was located and the immediate area surrounding the range are undeveloped. The Range Control Officer and the data collection team visited the area surrounding the former range and did not observe signs of the former range.

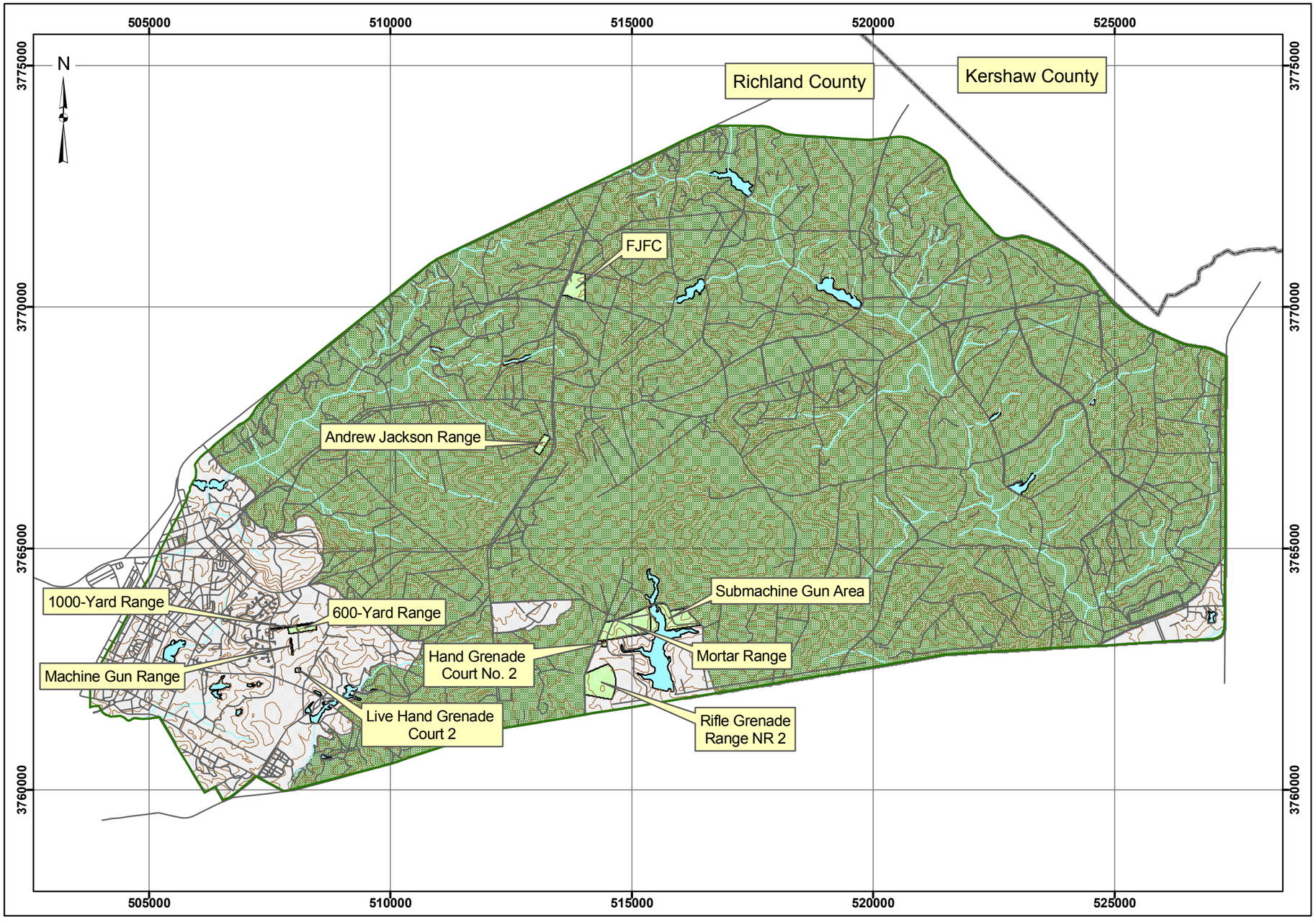
Mortar Range: The Mortar Range (AEDB-R Site ID: FTJA-008-R-01) was located in the northern section of the Weston Lake Area, with the Hand Grenade Court Number No. 2 to the southwest and the Submachine Gun Area to the east. The approximately 112-acre area was once part of a buffer for a mortar range in the 1940s. In addition, in 1969, other ranges overlapped the area, including 105-millimeter (mm), 155-mm, and 8-inch Howitzer ranges. The Submachine Gun Area also overlapped the area. The range is closed and is now part of the Weston Lake Area. However, the Mortar Range area has not been improved by recreational facilities (e.g., camp sites, trails, etc.) and is located about 1/4 mile north of the main recreation facilities at the Weston Lake Area. The team did not locate records of UXO sightings, incidents, or clearances related to the Mortar Range.

Rifle Grenade Range NR 2: The Rifle Grenade Range NR 2 (AEDB-R Site ID: FTJA-009-R-01) was estimated to be used from the 1940s through the 1960s. The range was used for firing rifle grenades and was also listed on a 1993 map reviewed at the installation with the hand written title "Explosive Ordnance Impact Areas". The map depicted several different explosive ordnance impact areas on Fort Jackson that were drawn in by hand. The range is closed and is now part of the Weston Lake Area. The 90-acre area has not been improved with recreational facilities (e.g., camp sites, trails, etc.) and is located approximately 1/2 mile west of the main recreation facilities of the Weston Lake Area. A dirt road runs close to the site (Washington Light Infantry Road), which is accessible by vehicle from the installation, but not from the Weston Lake Area. There is the potential that practice and live high explosive (HE) rifle grenades were fired on the former Rifle Grenade

Range NR 2. In 1969, the area appeared to be in the buffer areas for 155-mm and 8-inch Howitzer ranges. The impact area associated with the artillery ranges was not located in close proximity to the 90-acre Rifle Grenade Range NR 2 area.

Submachine Gun Area: The Submachine Gun Area (AEDB-R Site ID: FTJA-010-R-01) was located in the northern part of the Weston Lake Area extending into the East Impact Area. The area reported in the inventory occupied 101 acres and consisted of three separate ranges listed on a 1949 map of Fort Jackson. The three ranges included the Dismounted Submachine Gun No. 1 Range, the Moving Vehicle Submachine Gun Range, and the Dismounted Submachine Gun No. 2 Range. All three ranges were adjacent to each other, and their range fans overlapped. The ranges were situated so that the direction of fire was to the north into the East Impact Area. The Submachine Gun Area is closed and is now part of the Weston Lake Area. However, the range area has not been improved by recreational facilities (e.g., camp sites, trails, etc.) and is located approximately 1/4 mile north of the main recreation facilities at the Weston Lake Area. The team did not locate records of UXO sightings, incidents, or clearances related to the range.

Historical Records Review
Fort Jackson, SC



Map 2-1
Range Inventory Data

Legend

- Installation Boundary
- Roads
- Counties
- Contours
- Streams
- Waterbodies

CTT Range Area (Range Inventory)

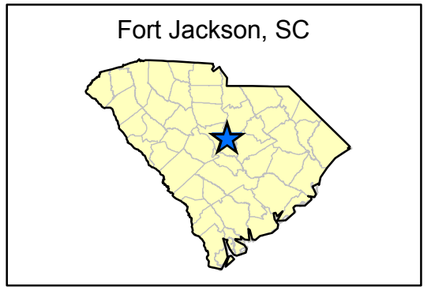
- Operational Ranges
- Closed
- Transferring
- Transferred
- Non Range, Non UXO-DMM-MC Area

0 1 2 3 Miles

Data Source: Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005



3 DATA COLLECTION AND DOCUMENT REVIEW PROCESS

Five primary sources of information were researched as part of the data collection effort for the HRR. The types of data included:

1) National and regional archives record group (RG) search
2) Installation site visits
3) Review of existing Archives Search Reports (ASRs) and administrative records for adjacent Formerly Used Defense Sites (FUDS) associated with Fort Jackson
4) Interviews
5) Review of the CTT Range Inventory and backup data

3.1 DATA COLLECTION METHODS

3.1.1 National and Regional Archives

Relevant archival record repositories and RGs were selected based on guidance set forth in the *Technical/Regulatory Guideline for Munitions Response Historical Records Review,* prepared by the Interstate Technology & Regulatory Council Unexploded Ordnance Team and based on the process developed by the U.S. Army Corps of Engineers (USACE) for performing ASRs (guidance provided at http://www.mvs.usace.army.mil/engr/ed-p/asr.htm). Only the record repositories that have historically proved to be most useful were searched. The archival repositories and RGs that were searched for this HRR are listed below. The archival data reviewed are presented by RG and source in Appendix A.

- National Archives, National Archives & Records Administration (NARA), College Park, Maryland (MD)
    - RG 18: Army Air Forces
    - RG 51: Bureau of Budget
    - RG 71: Bureau of Yards and Docks
    - RG 77: Chief of Engineers

  - RG 92: Quartermaster General
  - RG 111: Office of the Chief Signal Officer
  - RG 114: Natural Resources Conservation Service
  - RG 145: Agricultural Stabilization and Conservation Service
  - RG 156: Office of Chief of Ordnance
  - RG 168: National Guard Bureau
  - RG 270: War Assets Administration (WAA), Real Property Disposal Files
  - RG 319: Army Staff
  - RG 337: Headquarters, Army Ground Forces
  - RG 338: U.S. Army Commands
  - RG 373: Defense Intelligence Agency
  - RG 393: U.S. Army Continental Commands, 1821-1920
  - RG 394: U.S. Army Continental Commands, 1920-1942
  - RG 407: Adjutant General

- Library of Congress Prints & Photographs Division

- Library of Congress Geography and Map Division

- Library of Congress Main Reading Room

- Library of Congress Manuscript Division

- Regional Archives, NARA Southeast Region, East Point (Atlanta), Georgia

  - RG 77: Chief of Engineers
  - RG 156: Office of Chief of Ordnance
  - RG 270: WAA, Real Property Disposal Files

3.1.2 Web Search

In addition to the data sources listed above, Malcolm Pirnie also conducted research on the Internet to supplement the archival data and information received from the installation. The

list below presents the web sites that were searched for information on Fort Jackson. The search was conducted on June 28, 2004 and June 30, 2004. Information collected from the web search is presented in Section 3.2.

- Department of Defense Archives, http://www.defenselink.mil/pubs/archive.html
- DoD Explosives Safety Board, http://www.ddesb.pentagon.mil/
- National Imagery and Mapping Agency, Bethesda, MD, http://www.nima.mil/
- U.S. Army Center of Military History, Fort McNair, Washington, District of Columbia, http://www.army.mil/cmh-pg/
- USACE Office of History, Alexandria, Virginia (VA), http://www.hq.usace.army.mil/history/
- USACE Topographic Engineering Center, Alexandria, VA, http://www.tec.army.mil/
- U.S. Army Technical Center for Explosives Safety, McAlester, Oklahoma, http://mcalestr-www.army.mil/
- U.S. Army Test and Evaluation Command, http://www.atec.army.mil/
- Environmental Restoration Information System Database Queries, https://aerp.apgea.army.mil/pls/aerp/aecportal.home
- U.S. Army Training Center, Fort Jackson, SC, http://www.jackson.army.mil/Area/aboutFtJ.htm
- U. S. Army Training Center, Fort Jackson, SC, http://one-six-one.fifthinfantrydivision.com/161pg141b.htm
- U.S. Army Training Center, Fort Jackson, SC, http://www.jackson.army.mil/Area/FtJHis.htm
- Global Security, http://www.globalsecurity.org/military/facility/fort-jackson.htm
- Project Information Retrieval System (PIRS), https://fudspirs.mvr.usace.army.mil/Login.cfm

3.1.3 Site Visit

An initial site visit to Fort Jackson was conducted on May 4 and 5, 2004, by Malcolm Pirnie team members Ms. Susan Burtnett, Ms. Leigh Blake, and Mr. Jonathan Sperka. Ms. Burtnett, Ms. Blake, and Mr. Dan Hains conducted a follow-up site visit on June 16 through 18, 2004. Additional data was reviewed during a third site visit conducted by Ms. Burtnett and Ms. Blake on July 7 and 8, 2004. The site visits were conducted to review relevant installation records to complete the HRR and to develop the CSMs for the Fort Jackson sites. While on-site, Ms. Burtnett and Ms. Blake reviewed environmental reports and documents for Fort Jackson at the Environmental/Natural Resources Office, Fort Jackson Museum, and Range Control. Interviews with relevant personnel were also conducted. A summary of the applicable information collected during the site visit is presented in Sections 3.2.1 through 3.2.4. Results of the interviews are presented in Section 3.2.5.

3.1.4 Existing ASR and FUDS Information Review

Malcolm Pirnie obtained a copy of the *Archives Search Report, Findings for the Former Pontiac Precision Bombing Range. May 1995. U.S. Army Corps of Engineers, Rock Island District and U.S. Army Defense Ammunition Center and School* and other FUDS related documents for the Pontiac Precision Bombing Range (I04SC003701) from the PIRS website referenced in Section 3.1.2. Malcolm Pirnie also obtained a copy of the *Archives Search Report, Findings for Columbia Army Air Base and Associated Sites. June 1994. U.S. Army Corps of Engineers, Huntsville District* and other FUDS related documents for the Columbia Army Air Base (I04SC044503) and Lake Murray Bombing Ranges (I04SC004001) from the PIRS website. Although the documents were prepared for the FUDS properties located outside of Fort Jackson, the documents were reviewed for information relating to Fort Jackson training activities. These documents provided no relevant information on munitions use at Fort Jackson.

3.2 ARCHIVAL/HISTORICAL AND OTHER RECORDS COLLECTED

The following subsections present the data collected from the various sources outlined in Section 3.1. Although additional records may have been reviewed from the sources presented above, the records listed in this section represent the data that was determined to be applicable to the development of the HRR and CSMs for Fort Jackson.

3.2.1 Documents/Reports

The following table is a list of documents that provided relevant information for the former range and training areas within Fort Jackson.

Table 3-1: Summary of Documents and Relevant Information.

Document Name	General History	General Installation Information	Munitions Use	MC
Confirmatory Sampling Report for Solid Waste Management Units 5, 11, 18, 19, 24, 27, 29, 31, 32, 33, 34, 35, 38, 39, 40 and Area of Concern C, Ft. Jackson, South Carolina. Ecology and Environment, Inc. July 1997.	X	X		
Soil Background Study Report for the Fort Jackson Military Installation, Columbia, South Carolina. Ecology and Environment, Inc. January 2001.	X			
Supplemental Confirmatory Sampling Report for Solid Waste Management Units 5, 11, 29, 33, 34, 38 and Area of Concern C, Fort Jackson, South Carolina. Ecology and Environment, Inc. April 2001.		X		
Fort Jackson, South Carolina Integrated Cultural Resources Management Plan (ICRMP). United States Army Environmental Center. June 2000, Revised April 2002.	X	X		
Revised Final Phase II RCRA Facility Investigation Report for Wonsan (SWMU 12) and Inchon (SWMU 17) Explosive Ordnance Disposal Sites, Fort Jackson, South Carolina. U.S. Army Corps of Engineers Savannah District. March 2003.		X		

Document Name	General History	General Installation Information	Munitions Use	MC
Final U.S. Army Closed, Transferring and Transferred Range/Site Inventory for Fort Jackson, SC. Malcolm Pirnie, Inc. June 2003.	X	X	X	X
Phase 2 RCRA Facility Investigations Report for Solid Waste Management Unit 23, Fort Jackson, South Carolina. Ecology and Environment, Inc. July 2003.	X	X		
RCRA Facility Investigation SWMU 1, Fort Jackson, Phase II RFI Report. CH2MHill. March 2004.	X	X		
Integrated Natural Resources Management Plan and Environmental Assessment 2004-2008. Gene Stout and Associates. April 2004.	X	X		
Fort Jackson Range Architectural Inventory. Construction Engineering Research Laboratory. April 2004.	X			
The Cold War in South Carolina, 1945-1991 – An Inventory of Department of Defense Cold War Era Cultural and Historical Resources in the State of South Carolina – Second Interim Report. U.S. Army Environmental Legacy Program.	X			

3.2.2 Archival Records

3.2.2.1 Correspondence (Historical)

The following correspondence was obtained from the National Archives. Copies have been included in Appendix B.

- Correspondence regarding Small Arms Firing Manual, September 18, 1917
- Correspondence regarding Small Arms Target Ranges for Divisional Training, October 11, 1917
- Correspondence regarding Depopulation of Area Beyond Target Range, December 17, 1917

- Correspondence regarding Completion Report of Camp Jackson, Constructing Quartermaster, Camp Jackson, January 17, 1918

- Correspondence regarding Final Report of Plans and Descriptions of Camp and Camp Utilities, January 19, 1918

- Correspondence regarding Report on Small Arms Range, Camp Jackson, F. H. French, Brigadier General, July 23, 1918

- Correspondence regarding Firing on Machine Gun Range, Thomas Ryan, 2nd Lieutenant, F.A., September 23, 1918

- Memorandum regarding General Completion Report on North Camp Jackson as abandoned February 28, 1919, H. J. MacDonald, Captain, Quartermaster Corps, Constructing Quartermaster, February 28, 1919

- Correspondence regarding Daily Bulletin No. 32, February 11, 1920

- Correspondence regarding Daily Bulletin No. 39, February 19, 1920

- Correspondence regarding Daily Bulletin No. 42, February 24, 1920

- Correspondence regarding Daily Bulletin No. 47, March 3, 1920

- Correspondence regarding Daily Bulletin No. 77, April 15, 1920

- Correspondence regarding Daily Bulletin No. 96, May 10, 1920

- Correspondence regarding Daily Bulletin No. 105, May 22, 1920

- Correspondence regarding Answers to Questionnaire, Harry R. Lee, Colonel, Infantry, Commanding, June 29, 1920

- Correspondence regarding Rifle Range, Maurice E. Barker, Captain, C.A.C., June 25, 1923

- Correspondence regarding Rifle Range, Maurice E. Barker, Captain, C.A.C., June 25, 1923

- Memorandum to the Assistant Chief of Staff, C. M. Roberts, Ordnance Officer, August 1, 1923

- Correspondence regarding Construction of Training Aids, R. W. Strickland, 1st Lieutenant, A.G.D., Assistant Adjutant General, February 24, 1941

- Memorandum regarding Training Facilities, February 24, 1941
- Correspondence regarding General Orders Number 36, F. V. M. Dyer, Lieutenant Colonel, Infantry, Adjutant, June 11, 1941
- Memorandum regarding Platoon Combat Firing Proficiency Tests, Training Memorandum Number 33, F. R. Keeler, Lieutenant Colonel, Adjutant General's Department, May 26, 1942
- Correspondence regarding Training Aids, J. V. V. Shufelt, Colonel, General Staff Corps, Director, Operations and Training Division, October 5, 1942
- Correspondence regarding Post Range Regulations, General Orders Number 63, A. T. Murphey, Colonel, F.A., Adjutant, December 3, 1942
- Correspondence regarding Moving Vehicle Range, Stuart Lewis, Lieutenant Colonel, G.S.C., Chief, Training Branch, December 10, 1942
- Correspondence regarding Safety Limits of Ranges, Headquarters Army Ground Forces, Army War College, December 15, 1942
- Correspondence regarding Post Range Regulations, General Orders Number 25, A. T. Murphey, Colonel, F.A., Adjutant, July 8, 1943
- Correspondence regarding Post Range Regulations, General Orders Number 18, Joseph P. O'Hara, Major, A.U.S., Adjutant, March 16, 1944
- Report regarding Analysis of Fort Jackson, SC, Post War Utilization Studies, September 1945
- Correspondence regarding Estimate of Funds, Lynden R. Anderson, Major, Ordnance Department, Assistant S-4, February 18, 1947
- Correspondence regarding Construction of Ranges, John R. Lucas, Captain, Infantry Range Officer, April 25, 1947
- Correspondence regarding Historical Report and 1949 Fort Jackson Range Regulations, G. H. Decker, Major General, Commanding, June 17, 1949
- Memorandum regarding 1950 Fort Jackson Range Regulations, F. J. Reese, Lieutenant Colonel, A.G.D., Adjutant, April 15, 1950
- Correspondence regarding Training Report, 31st Infantry Division, Lother B. Sibert, Lieutenant Colonel, G.S.C., April 10, 1951

- Correspondence regarding Supply Status, 31st Infantry Division, Clifford P. Morrison, Lieutenant Colonel, G.S.C., 10 April 1951

3.2.3 Maps/Drawings

The following maps and drawings were obtained from the National Archives:

- Cantonment Realty Company, July 18, 1917
- General Layout, Camp Jackson, Columbia, SC, September 1917
- Location Map, Camp Jackson, Columbia, SC, 1918
- Key Map of Property, Camp Jackson, SC, June 1918
- Special Military Map, Camp Jackson, SC, 1920
- Jackson National Forest, SC, December 1926
- Annex No. 1 Firing Ranges, 1946

The following maps and drawings were obtained from Fort Jackson:

- General Map, Camp Jackson, SC, March 1919
- Fort Jackson and Vicinity, 1949
- Location Map, Fort Jackson, SC, 1952
- Training Facilities Map, February 17, 1955
- Training Facilities Map NR 2, January 3, 1956
- Basic Information for Master Plan: Range and Training Areas Map, Fort Jackson, SC, June 1957
- Master Plan, Fort Jackson, SC, August 1969
- Forestry Field Map, Fort Jackson, SC, May 1993
- DLE-PSESD Installation Field Map, Fort Jackson, SC, September 2000
- DLE-ENRD Installation Field Map of Fort Jackson, SC, July 2001

- Military Installation Map, Fort Jackson, SC, May 2003

3.2.4 Photographs/Aerial Photographs

a) Photographs

The following photographs were obtained from the National Archives:

- Salerno Range, Fort Jackson, SC, October 25, 1965
- Saint Lo, Fort Jackson, SC, October 25, 1965
- Combat Support Training, Fort Jackson, SC, September 15, 1969

b) Aerial Photographs

The following aerial photographs were obtained from the National Archives:

- RG145 SC302, 1938
- RG145 SC307, 1939
- RG145 SC313, 1939
- RG145 4583, June 1943

The following aerial photographs were obtained from Fort Jackson:

- 93 VV 11PTV M348 311RW, October 3, 1947
- 129 VV 11PTV M384 311RW, October 3, 1947
- 131 VV 11PTU M384 311RW, October 3, 1947
- 134 VV HPTV M348 311RW, October 3, 1947
- ATA-2P-42, March 1955
- ATA-2P-46, March 1955
- ATA-5AA-192-L, 1959
- ATA-5AA-197-L, 1959

- ATA-5AA-22-R, 1959
- ATA-1GG-39, February 1966
- ATA-1GG-43, February 1966
- ATA-1MM-165, November 1970
- ATA-1MM-199, November 1970
- ATA-1MM-265, November 1970
- ATA-1MM-193, December 1970
- ATA-1MM-198, December 1970

3.2.5 Interviews

The following interviews were conducted to collect information for the HRR. Interview records from these interviews are included in Appendix C.

Fort Jackson Environmental Department – The data collection team interviewed Mr. Lahiri Estaba, the Installation Restoration Program (IRP) Manager, on June 16, 2004, while at the installation for the site visit. Mr. Estaba is an on-site contractor and has worked at Fort Jackson for over nine years. Mr. Estaba is responsible for the installation's RCRA permit and Solid Waste Management Units (SWMUs) that are undergoing corrective action. He was familiar with the locations of the IRP sites and their soil and groundwater data, and provided information regarding those sites in relation to nearby MMRP sites. This information has been incorporated into site descriptions in this report. Information is also shown on Map 3-1, included at the end of Section 3. The IRP sites that were discussed included SWMU 1, SWMU 17, SWMU 21, and SWMU 34. In addition, the installation has completed surface and near-surface soil background studies. Mr. Estaba provided the data collection team with copies of these reports.

The data collection team also interviewed Mr. James McCracken, the installation's National Environmental Policy Act Coordinator, on June 18, 2004, while at the installation for the

site visit. Mr. McCracken has been at the installation for more than 15 years and provided historical information regarding the MMRP sites. Additional range uses in the cantonment area were discussed, including the numerous small arms ranges used over the years. He noted that the FJFC was also used as a 40-mm practice grenade range. Mr. McCracken was also familiar with the hand and rifle grenade range use near the Weston Lake Recreation Area. Mr. McCracken provided a copy of an historical installation map showing the cantonment area (Cantonment Area, Ft. Jackson, SC, Sheet 1 of 3, September 1945 Army Map, SVC War Department).

Fort Jackson Range Control – The data collection team interviewed Mr. Wyatt, the Range Officer, on June 18 and July 8, 2004, while at the installation for the site visit. Mr. Wyatt provided maps and documents regarding the MMRP ranges. The team discussed the historical range uses and range locations in the cantonment area. Mr. Wyatt noted that the area where the Live Hand Grenade Court 2 was depicted on maps had been extensively disturbed during the 1970s and 1980s when the area was used for field fortification training. Mr. Wyatt also discussed the hand grenade and rifle grenade ranges near Weston Lake. He agreed that the locations of the sites vary on different installation maps and that it appeared both hand grenade and rifle grenade use may have occurred at the Hand Grenade Court No. 2 and the Rifle Grenade Range NR 2. Mr. Wyatt provided copies of relevant documents, maps, and range fans sketches for the team's use.

The data collection team interviewed Staff Sergeant (SSG) Mark Wood on June 17, 2004, while at the installation for the site visit. SSG Wood escorted Malcolm Pirnie personnel to the FJFC Range and the Hand Grenade Court No. 2 and Rifle Grenade Range NR 2 Ranges located in the Weston Lake Area. SSG Wood provided a general description of the current uses in the vicinity of the closed ranges. SSG Wood could not provide much historical information on the ranges because he had only been stationed at Fort Jackson for three years.

Fort Jackson Forestry Office – The data collection team interviewed Mr. John Maitland, the Lead Forester, on June 16, 2004, while at the installation for the site visit. Mr. Maitland was familiar with the ranges, especially the Hand Grenade Court No. 2 and Rifle Grenade NR 2 Range near the Weston Lake Area. He noted that there were inconsistencies in how these ranges were shown on installation maps over the years. Mr. Maitland is responsible for managing the forestry resources at the installation. As such, he has been at the sites for logging purposes. Recently, longleaf pines have been planted adjacent to the FJFC. Logging has taken place at the rifle and hand grenade ranges near Weston Lake. Mr. Maitland noted that these areas have been surface cleared. He also provided aerial photographs of the installation for review. Relevant sections of the aerials were copied while at the installation, and they served as a primary source of site-specific information for the HRR.

Fort Jackson Engineering Office - The data collection team interviewed Mr. James Murphy, Engineering Technician, on July 28, 2004 via telephone. Mr. Murphy was contacted about the June 1, 1957 Basic Information for Master Plan, Range and Training Areas Map that he provided to us during the CTT Range Inventory data collection. The map legend was faded in several areas, and information was needed for the HRR. Mr. Murphy referred the team to the Fort Jackson Museum for a copy of the map.

Fort Jackson Museum – The data collection team interviewed Ms. Bessie Williams and Mr. Fred DeMag. Both were helpful in identifying historical maps showing the ranges.

Fort Jackson Real Property Office - The data collection team interviewed Mr. Thomas Peel, the Real Property Officer, on July 28, 2004 via telephone about real property records for range use and closure dates. Mr. Peel stated that the team would need to speak to Mr. Wyatt of Range Control for information. He stated that he does not receive information on range use, but noted that there have been no property boundary changes associated within the team's areas of interest.

Fort Jackson Wildlife Office - The data collection team interviewed Mr. Mark Dutton, the Natural Resource Specialist, on June 16, 2004, while at the installation for the site visit. Mr. Dutton provided maps showing cultural resource sites near the MMRP ranges. Other than a cemetery located north of the Hand Grenade Court No. 2 and Rifle Grenade Range NR 2 near Weston Lake, no cultural resources were identified in the other than operational areas.

3.3 PHASE 3 ARMY RANGE INVENTORY RESULTS

The purpose of the *Closed, Transferring, and Transferred Range/Site Inventory Report for Fort Jackson, South Carolina,* Malcolm Pirnie, June 2003, was to identify CTT ranges that are not within the operational training areas at Fort Jackson. The specific requirements of this investigation included: mapping CTT ranges and sites with UXO, DMM, or MC; collecting and preparing the data for inclusion in the Army Range Inventory Database; conducting an assessment of explosive safety risk using the Risk Assessment Code (RAC) on each CTT range or site; and determining which sites potentially qualify for the MMRP.

The CTT Range Inventory identified ten closed ranges totaling 407 acres within the installation's boundaries. The ranges and associate acreage are identified as follows: 1000-Yard Range (seven acres), 600-Yard Range (19 acres), Andrew Jackson Range (15 acres), FJFC (54 acres), Hand Grenade Court No. 2 (three acres), Live Hand Grenade Court 2 (three acres), Machine Gun Range (three acres), Mortar Range (112 acres), Rifle Grenade Range NR 2 (90 acres), and Submachine Gun Area (101 acres). The inventory summaries for these ranges are presented in Section 2.2.

The RAC process required the completion of a worksheet that consisted of a series of questions regarding each CTT range or site. Based on the results of the worksheet, a relative score (RAC score) for each area was assigned. The RAC score is an estimate of the relative explosives safety risk, which was reported as a number from one (high explosives safety risk) to five (negligible explosives safety risk). The RAC scores for the ranges/sites evaluated during the CTT Range Inventory are summarized in Table 3-2. The RAC scores

were developed based on the findings during the CTT Range Inventory and do not reflect new or additional information regarding these ranges/sites obtained during the HRR.

Table 3-2: CTT Range Inventory Range/Site RAC Scores

Range/Site Name	Munitions Type	RAC Score
1000-Yard Range	Small arms	5
600-Yard Range	Small arms	5
Andrew Jackson Range	Small arms	5
FJFC	Small arms	5
Hand Grenade Court No. 2	MEC	2
Live Hand Grenade Court 2	MEC	3
Machine Gun Range	Small arms	5
Mortar Range	MEC	2
Rifle Grenade Range NR 2	MEC	2
Submachine Gun Area	Small arms	5

3.4 SUMMARY OF OTHER PREVIOUS INVESTIGATIONS

Based on the data repositories reviewed for the HRR, the following previous investigations were identified which contained information pertaining to munitions use and/or relevant environmental data at Fort Jackson.

Confirmatory Sampling Report for Solid Waste Management Units 5, 11, 18, 19, 24, 27, 29, 31, 32, 33, 34, 35, 38, 39, 40 and Area of Concern C, Ft. Jackson, South Carolina - July 1997

This report describes CS investigations performed at 14 SWMUs and one area of concern. The report was written to meet the requirements of Fort Jackson's RCRA permit issued in October 1991. The report provides an historical overview of Fort Jackson and describes its environmental setting. The majority of the SWMUs evaluated in this report are in the

cantonment area, including SWMU 34, which is located near MMRP sites/ranges in the cantonment area.

SWMU 34 is the former location of a 30-foot by 30-foot concrete wash pad and a 400-gallon capacity oil/water separator that received vehicle wash water containing oil and grease. This unit is located on the eastern side of the cantonment area north of Semmes Road and approximately 250 feet northwest of the sanitary landfill. This area is in close proximity to the Transition Range located in the cantonment area, which is discussed in Sections 4 and 5 of this HRR. No significant contamination was found at SWMU 34. Some metals were present at concentrations that slightly exceeded the maximum background levels measured at Fort Jackson.

Supplemental Confirmatory Sampling Report for Solid Waste Management Units 5, 11, 29, 33, 34, 38 and Area of Concern C - April 2001

The results of this supplemental investigation combined with the results of the previous CS efforts performed in July 1997 (discussed above) were used to decide if further actions were needed at any of these sites. With respect to SWMU 34, the supplemental CS was conducted to determine if contamination was present in this area that was associated with high Organic Vapor Analyzer readings recorded during the 1995 CS investigation. This supplementary CS recommended NFA at SWMU 34. This report also provided limited historical information on Fort Jackson.

Soil Background Study Report for the Fort Jackson Military Installation Columbia, South Carolina - January 2001

This report presents the procedures, methodologies, and data from the Background Soil Study for the Fort Jackson Military Installation. The objective of this study was to develop comprehensive data sets characterizing levels of metals in the soil at Fort Jackson. The report concluded the following:

1. Sample depth (at least within a range significant for risk analysis) does not appear to be a meaningful discriminator of background soil concentrations.

2. Sample location (undeveloped versus developed) and soil type, or some combinations thereof, do appear to be discriminators for background soil concentrations.
3. Three sets of background soils are needed for Fort Jackson: sandy soils of developed areas, sandy soils of the undeveloped areas, and clayey soils combining both areas.

This report also provided a brief background and history of Fort Jackson, as well as an environmental sampling history.

Integrated Cultural Resources Management Plan (ICRMP*)* - June 2000, Revised April 2002

This report was written to meet the legal compliance requirements of federal historic preservation laws and regulations. The ICRMP establishes priorities for the identification of and standards for the evaluation of historic properties on Fort Jackson and provides a schedule designed to accomplish program objectives during a five–year period. The vast majority of land on Fort Jackson has been inventoried for cultural resources and historic properties. The ICRMP reported that a total of 662 archaeological sites have been identified at Fort Jackson to date. With the exception of 11 cemeteries recorded as archaeological sites, these resources require no further management consideration. Twelve sites are considered eligible for the National Registry of Historic Places (NRHP). Ninety-six sites have been recommended as potentially eligible for the NRHP. These resources must be preserved in place until their exact NRHP status is determined. There are no eligible or potentially eligible NRHP sites located on the sites being evaluated as part of the MMRP.

The ICRMP reported that one federally listed animal species exists on Fort Jackson: the Red-cockaded Woodpecker. The bird nests in aging pines, lives in family groups and inhabits park-like territories or clusters of 1,500-foot radii. There are 13 active clusters and 39 inactive clusters on the Fort Jackson installation. This population is routinely monitored, and the surrounding forest is managed to encourage survival of the groups. One cluster is located within close proximity to the Weston Lake Area, including the Rifle Grenade Range NR 2.

Revised Final Phase II RFI Report for Wonsan (SWMU 12) and Inchon (SWMU 17) Explosive Ordnance Disposal Sites - March 2003

The purpose of this report was to present the additional information collected during the 1999 and 2000 Phase II RFI activities, incorporate the new data, and perform an updated human health and ecological risk assessment of the two EOD sites, Wonsan (SWMU 12) and Inchon (SWMU 17). The Submachine Gun Range and the Mortar Range, which are being evaluated in the MMRP, are located in the Weston Lake Area. SWMU 17 is located approximately one and one-half miles east of Weston Lake. This report was helpful in providing general information about the Weston Lake Area. This document also reported that two federal and/or state listed threatened and endangered species are present at Fort Jackson: the Rough-leaved Loosestrife and the Red-cockaded Woodpecker.

Final U.S. Army Closed, Transferring and Transferred Range/Site Inventory for Fort Jackson, SC - June 2003

The objective of this report was to present the CTT Range Inventory for Fort Jackson. In preparation of this report, historical research was conducted to identify CTT ranges and sites subject to the inventory and their locations, periods of use, and associated types of UXO, DMM, or MC. This report contains a historical background of Fort Jackson and installation summary and is discussed further in Section 3.3.

RCRA Facility Investigation SWMU 1 Phase II RFI Report - March 2004

SWMU 1, also known as the former Sanitary Landfill No. 3, is closed and is located north of Semmes Road and east of Chesnut Road within the cantonment area. SWMU 1 is also located within the Transition Range's safety/buffer area. Phase II sampling for SWMU 1 was completed in 2003; data sets collected during the Phase I and Phase II efforts were combined to complete the RFI. This document reported that ten compounds (chromium, dieldrin, acetone, methylene choride, benzo(a)anthracene, 2,4-Dinitrotoluene, n-nitroso-di-n-propylene, 4-Chloro-3-methylphenol, 4-Nitrophenol, and pentachlorophenol) were present in soil samples at concentrations that exceeded their respective site-specific screening levels. However, these chemicals were considered not to represent a significant threat to shallow

groundwater. Therefore, further investigation to evaluate the potential for migration to groundwater was not recommended.

2004-2008 Integrated Natural Resources Management Plan (INRMP) and Environmental Assessment – April 2004

The purpose of the INRMP is to guide the implementation of the natural resources program for Fort Jackson from 2004 to 2008. The program is designed to conserve Fort Jackson's land and natural resources and helps to ensure compliance with environmental laws and regulations. The INRMP helps to endure the maintenance of quality training lands to accomplish Fort Jackson's critical military mission on a sustained basis and to ensure that natural resources conservation measures and Army military mission activities are integrated and consistent with federal stewardship requirements. The INRMP provided thorough descriptions with respect to Fort Jackson's historical background, cultural resources, physical environmental setting, biological resources, and natural resources. The INRMP is referenced throughout this HRR.

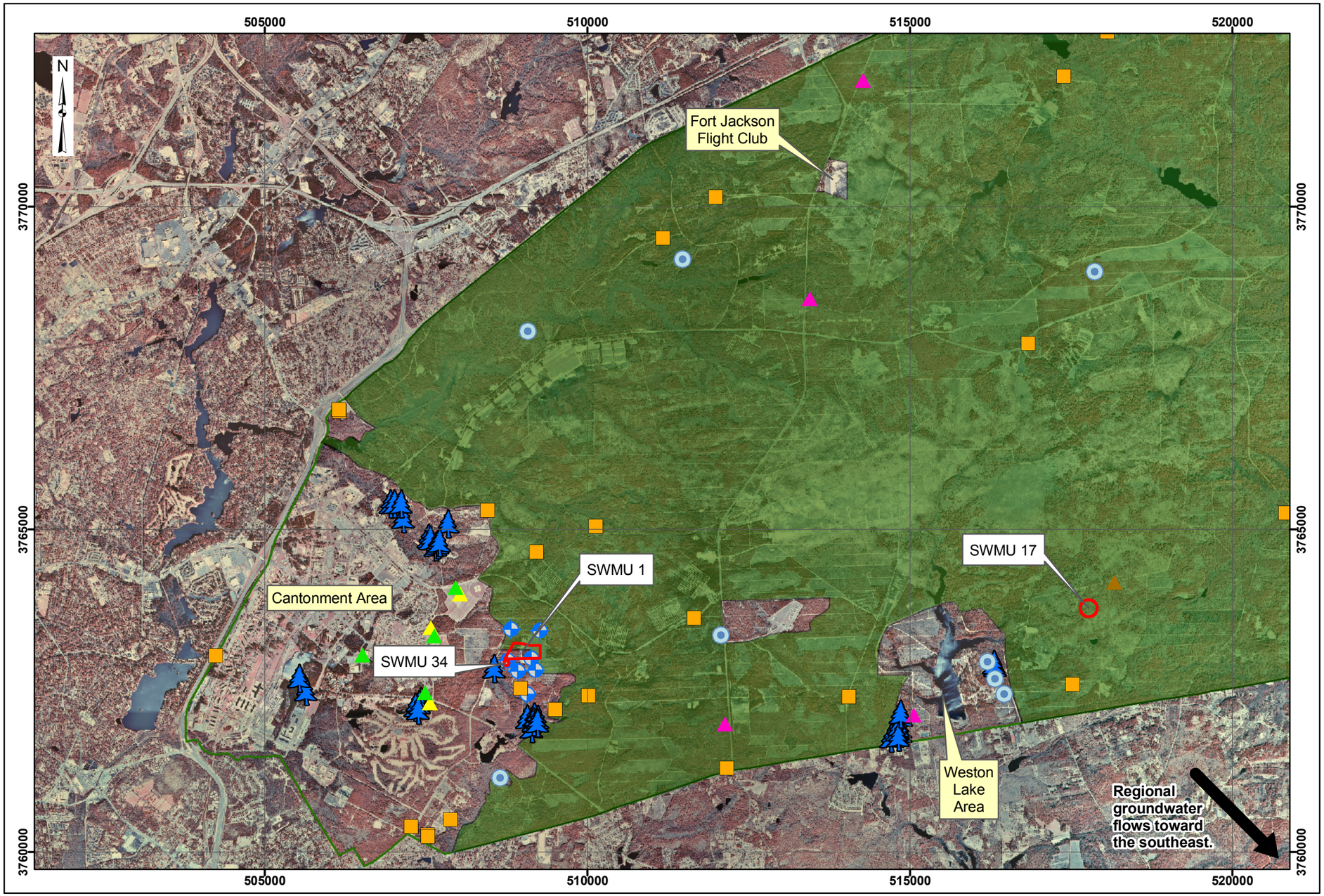
Fort Jackson Range Architectural Inventory Construction Engineering Research Laboratory, April 2004

This document is an Historic American Buildings Level IV Survey prepared to determine eligibility for inclusion on the NRHP for the following buildings and landscapes: 41 ranges, three bivouac regions, and 29 buildings in the Fort Jackson cantonment area and two structures neither on the ranges nor in the cantonment area. This report concluded that none of the ranges, buildings, or landscape elements evaluated in this report at Fort Jackson are eligible for the NRHP under any of the National Register Criterions. Other than the Andrew Jackson Range, none of the MMRP sites were discussed in this report. However, the report did include maps showing ranges and range fans for the installation for 1946 and 1949. These maps were utilized as source data for the HRR.

The Cold War in South Carolina, 1945-1991 – An Inventory of Department of Defense Cold War Era Cultural and Historical Resources in the State of South Carolina – Second Interim Report U.S. Army Environmental Legacy Program

This report provided a detailed chronological historical background of events and activities conducted at Fort Jackson from 1917 through 1992. Pertinent information from this report has been incorporated into the HRR.

Historical Records Review
Fort Jackson, SC



Map 3-1
Relevant IRP Data

Legend

- Installation Boundary
- Operational Range Area
- Solid Waste Management Units
- Cemetery

Endangered Species

- Red-cockaded Woodpecker Habitat

Wells

- Drinking Water Wells
- Monitoring Wells

Sampling Locations

- Soil Boring Location
- 1995 Background Surface Soil Sample Location
- 2000 Developed Area Background Soil Sample Location
- 2000 Undeveloped Area Background Soil Sample Location

0 0.5 1 1.5 2 Miles

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1999
Fort Jackson South, SC, 1999
Messers Pond, SC, 1999
Congaree, SC, 1999
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

4 SUMMARY OF FINDINGS

4.1 IN DEPTH CHRONOLOGICAL HISTORY OF INSTALLATION

The installation dates back to 1917 when it was first opened as Camp Jackson. Camp Jackson was originally constructed on a 1,200-acre tract of land donated to the Federal Government by the citizens of the City of Columbia. In addition to the 1,200 acres donated by the City of Columbia, the Army purchased additional land bringing the total area of Camp Jackson to 22,000 acres. By 1918, approximately 45,000 military personnel were actively training at the installation, which was named in honor of Major General Andrew Jackson (seventh President of the U.S.). Camp Jackson remained active until July 27, 1921, when it was abandoned.

A wrecking company was called in to dismantle the camp after it was abandoned. The wrecking company was still at work tearing out sewer and water lines when, in 1925, the War Department decided to use the post again as a training camp for the SC National Guard. From 1925 to 1939, the facility was controlled by the state and was used as an encampment area for National Guard troops.

In 1939, the demands of war brought the area again under federal control. The facility was designated as Fort Jackson and was organized as an infantry training center. In 1940, the installation was enlarged, by land purchase, to 52,000 acres. During that time, four firing ranges and more than 100 miles of road were constructed. In 1946, Fort Jackson became an Army replacement training center when Camp McClellan was closed. During the 1950s, Fort Jackson served as an active duty headquarters for Alabama and Mississippi National Guard units and was occupied by various infantry divisions.

In 1968, the installation area was annexed into the City of Columbia. It was re-designated as an Army training center in 1973. The current and primary mission of Fort Jackson is to train initial entry recruits for duty as soldiers for Army units. Throughout the years, the

installation has grown to its current size of 52,000 acres. A chronological list of significant historical events is provided in Table 4-1.

Table 4-1: Timeline of Significant Events

Time Period	Significant Events
1900-1920	• 1917: Installation first opened as Camp Jackson. • 1918: Approximately 45,000 military personnel were training at the installation.
1920-1940	• 1921: Camp Jackson was abandoned. • 1925 - 1939: Installation was controlled by the state and used as an encampment for National Guard troops. • 1939: Installation was designated as Fort Jackson and was organized as the infantry training center.
1940-1950	• 1946: Fort Jackson became an Army replacement training center.
1950-1960	• 1950s: Fort Jackson served as an active duty headquarters for Alabama and Mississippi National Guard units.
1960-present	• 1968: Installation area was annexed into the City of Columbia. • 1973: Fort Jackson was re-designated as an Army training center.

4.2 MMRP SITE FINDINGS

Information not previously identified regarding the cantonment area, FJFC, and the Weston Lake Area sites was obtained through the research performed for this HRR. This information resulted in modifications to the original MMRP site descriptions and boundaries formulated during the CTT Range Inventory, which are presented in Section 2.2. The locations of the cantonment area, FJFC, and Weston Lake Area are shown on Map 4-1.

Based on the information obtained during the HRR, additional MMRP sites were identified within the cantonment area. These sites, as well as the sites identified during the CTT Range Inventory, are discussed in Section 4.2.1. Additional munitions types, including MEC, were identified for the FJFC. The westernmost portion of the FJFC was determined to have had no historical range use, thereby reducing the total acreage for the FJFC. Details regarding these findings are included in Section 4.2.2. Additional munitions types and acreage changes were identified for the Weston Lake Area sites. This information is provided in Section 4.2.3.

The CTT Range Inventory listed the Andrew Jackson Range as one of the ten MMRP sites. The Andrew Jackson Range was originally a military small arms range that had been closed. The site has been turned over to the Fort Jackson MWR Department for operation as a recreational small arms shooting range. Because of its current activity and the ongoing releases that have occurred there after September 30, 2002, it was determined that this site is not eligible for evaluation as part of the Fort Jackson SI.

4.2.1 Cantonment Area Ranges/Sites

The cantonment area, which is located in the western portion of Fort Jackson, contains three MMRP sites. Four ranges (i.e., the 1000-Yard, 600-Yard, Machine Gun, and Live Hand Grenade Court No. 2 ranges) were discussed in the CTT Range Inventory. Thirteen additional sites were identified during the preparation of the HRR. Due to a change of the operational range boundary, seven of these sites were determined to not be eligible for evaluation as part of the Fort Jackson SI. Map 4-2 shows the cantonment area range details.

For the purposes of this report, the cantonment area MMRP sites have been combined into the following range groups: Camp Jackson Ranges, Small Arms Ranges East of Chesnut Road, and Live Hand Grenade Court 2. The findings and modifications with respect to each site identified in the CTT Range Inventory, as well as the additional sites identified in the HRR, are presented in the following subsections. Map 4-3, included at the end of Section 4, shows the differences in the CTT Range Inventory and HRR range locations. Map 4-4, also included at the end of Section 4, highlights the cantonment area MMRP sites.

4.2.1.1 Camp Jackson Ranges

The Camp Jackson Ranges occupy 81 acres and include the following five small arms ranges: 1000-Yard Range, 600-Yard Range, 300-Yard Range, Machine Gun Range, and Pistol Range. The 1000-Yard, 600-Yard, and Machine Gun Ranges were identified in the CTT Range Inventory, whereas the 300-Yard and Pistol Range were identified in the HRR.

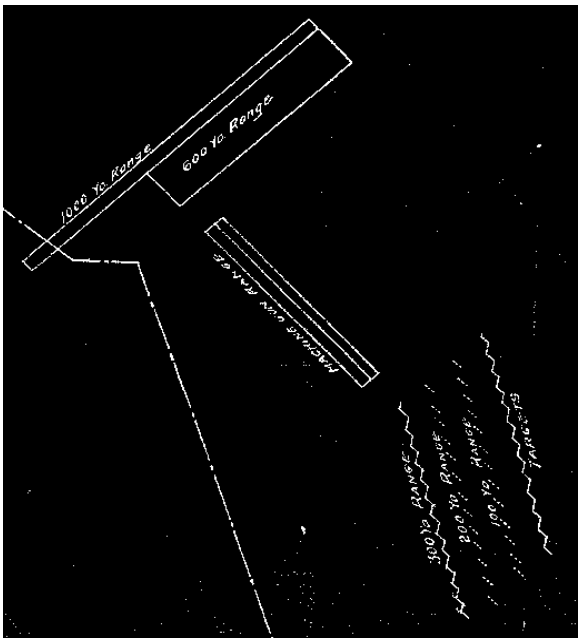


Figure 4-1: 1918 Location Map

The CTT Range Inventory reported that Camp Jackson had five rifle ranges in 1918, including 100-, 200-, 300-, 600-, and 1000-yard ranges. Based on information obtained during the CTT Range Inventory, these five ranges appeared to be located in a single range complex, with the 600-Yard and 1000-Yard Ranges located adjacent to each other and the 100-, 200-, and 300-yard ranges co-located within the 600-Yard Range boundary. During the HRR, a 1918 map (Figure 4-1) was obtained from the National Archives that showed the 300-Yard Range south of the 1000-Yard and 600-Yard Ranges. The 300-Yard Range included the 100- and 200-yard ranges. The 1918 map also depicts the Machine Gun Range. The Pistol Range is shown on a 1920 map. The Camp Jackson Ranges were used from 1918 through 1920 for small arms training.

1000-Yard Range

The 1000-Yard Range is described in the CTT Range Inventory as a former rifle range located near Washington Road and Ivy Road. During the research for this HRR, information was obtained that more accurately described the location and layout of the 1000-Yard Range. Based on review of historical maps, the 1000-Yard Range was located in the eastern portion of the cantonment area, just east of Chesnut Road and south of Hartsville Guards Road. This location is north of the 600-Yard Range and the Machine Gun Range, as identified in the CTT Range Inventory.

Historical correspondence indicated that construction of the 1000-Yard Range began in 1917, with the first operational use in early 1918. According to July 23, 1918 correspondence, the 1000-Yard Range had six targets located at 800 and 1000 yards. Based on historical documentation (i.e., letters, memorandums, and maps) the direction of fire was from west to east. Maps for Fort Jackson from 1918 (Figure 4-1) and 1919 depict the outline and configuration of the 1000-Yard Range. The 1920 Special Military Map depicts multiple gun emplacements, one of which is located in the general area of the 1000-Yard Range. Three ground targets and what appear to be two berms are also located in this area. Based on the range features shown on the 1920 map, the location of the 1000-Yard Range appears to be slightly north of where the CTT Range Inventory identified this range. Map 4-3 shows the CTT Range Inventory location of this range, as well as the revised location as determined by this HRR. The December 1926 Jackson National Forest Map does not depict the 1000-Yard Range. Based on the history of Fort Jackson, world events (e.g., end of World War I), and the documents and maps reviewed, it appears the range was used between 1918 and 1920.

600-Yard Range

The 600-Yard Range is described in the CTT Range Inventory as a former rifle range. As with the 1000-Yard Range, information was obtained during the HRR that more accurately described the location and layout of the 600-Yard Range. The range is located east of Chesnut Road and south of Hartsville Guards Road in the eastern portion of the cantonment

area. This location is south of the 1000-Yard Range and north of the Machine Gun Range, as identified in the CTT Range Inventory.

Historical correspondence indicates construction of the 600-Yard Range began in 1917, with the first operational use in early 1918. According to July 23, 1918 correspondence, the 600-Yard Range had a series of 200 targets located at 100, 200, and 300 yards (listed as short range targets) and 34 targets located at 500 and 600 yards (listed as mid range targets). The direction of fire was from west to east. Maps for Fort Jackson from 1918 (Figure 4-1) and 1919 depict the outline and configuration of the 600-Yard Range. The 1920 Special Military Map shows gun emplacements located in the general area of the 600-Yard Range. Three ground targets and what appear to be two berms located in the direction of fire are visible. Based on the locations of the gun emplacements, targets, and berms, the location of the 600-Yard Range appears to be slightly north of where the CTT Range Inventory identified this range.

Map 4-3 shows the CTT Range Inventory location of this range, as well as the revised location as determined by this HRR. The December 1926 Jackson National Forest Map does not depict the 600-Yard Range. Based on the history of Fort Jackson, world events (e.g., end of World War I), and the documents and maps reviewed, the range was used between 1918 and 1920.

300-Yard Range

The 300-Yard Range was a rifle range located south of the Machine Gun Range and north of the Live Hand Grenade Court 2. The 300-Yard Range included 100-, 200-, and 300-yard ranges. The 300-Yard Range is first shown on the June 1918 map and then again on the 1920 Special Military Map. The December 1926 Jackson National Forest Map is the last map to depict the 300-Yard Range.

A Completion Report of Camp Jackson, dated January 17, 1918, noted that the 300-Yard Range was located east of the cantonment area on a strip of land 13,200 feet wide and

42,000 feet long. A portion of this land, which was part of the 22,000 acres comprising Camp Jackson, was used for small arms training. The land configuration at the 300-Yard Range would not permit shooting directly from the firing trench to the target trench without danger of the bullets passing over the property line. Therefore, trenches were constructed in echelon (see Figure 4-1) to take advantage of the ridges/hills that were not parallel to the property line. This allowed for an easterly firing direction. The 50th Anniversary History 1917-1967 for Fort Jackson, prepared by the U.S. Army Training Center, includes a picture of the 300-Yard Range taken between 1917 and 1918. The picture shows the echelon configuration of the range, with target trenches and berms in the background (Figure 4-2).

Figure 4-2: 300-Yard Range

An October 11, 1917 Army memorandum written by the Adjutant General indicated that the 300-Yard Range was used for pistol firing. Camp Jackson's daily bulletins dated May 10 and 22, 1920 also indicated that there was pistol firing, confirming pistol use at the 300-Yard Range. An aerial photograph from 1959 (Figure 4-3) shows the remains of the 300-Yard Range echelon target area. Based on historical documents and correspondence, the 300-Yard Range was used from 1918 through 1920 by the Army and from 1920 through at least 1926 by SC National Guard troops.

Figure 4-3: 1959 Aerial Photograph

Machine Gun Range

The Machine Gun Range is described as a 1000-inch range. During the research for this HRR, information was obtained that more accurately described the location of the Machine Gun Range as east of Chesnut Road and south of Hampton Parkway in the eastern portion of the cantonment area. This location is south of the 1000- and 600-Yard Ranges, as identified in the CTT Range Inventory.

The Machine Gun Range is shown on the 1918 Location Map (Figure 4-1), the June 1918 map, the March 1919 General Map, and the 1920 Special Military Map. Historical correspondence indicates the construction of the Machine Gun Range began in 1917, with the first operational use in early 1918. According to July 23, 1918 correspondence, the Machine Gun Range had a series of 72 targets located on carriages that would be drawn on tracks toward the machine gun firing line during training exercises. The 50th Anniversary History 1917-1967 for Fort Jackson includes a picture of the Machine Gun Range taken between 1917 and 1918 (Figure 4-4). The direction of fire, as confirmed by historical documentation (i.e., letter, memorandums, and maps), was from west to east. The Machine Gun Range is not depicted on the December 1926 Jackson National Forest Map. Based on the history of Fort Jackson, world events (e.g., end of World War I), and the documents and maps reviewed, the range was used between 1918 and 1920.

Figure 4-4: Machine Gun Range

According to the *AR 750-10 Range Regulations for Firing Ammunition in Time of Peace,* typically light and/or heavy machine guns may have been used on 1000-inch rolling target machine gun ranges. The firing line was positioned 1000 inches in front of the targets. Probable ammunition used at the machine gun range includes 0.30-caliber, M1/5, (500-yard maximum range); 0.30-caliber, M2/3, (450-yard maximum range); and 0.50-caliber (7,500-yard maximum range).

Pistol Range

Evidence of this range was found on the 1920 Special Military Map. Gun emplacements (i.e., the firing point) were shown west of the Machine Gun Range. A backstop berm, which appears to be adjacent to a target area, is located north of the Machine Gun Range. Based on the configuration shown on the 1920 map, the direction of fire was northeast across the northernmost portion of the Machine Gun Range. A portion of the 1920 Special Military Map depicting the Pistol Range is shown in Figure 4-5. Because the range is only depicted on the 1920 map, it was likely constructed and used between 1919 and 1920.

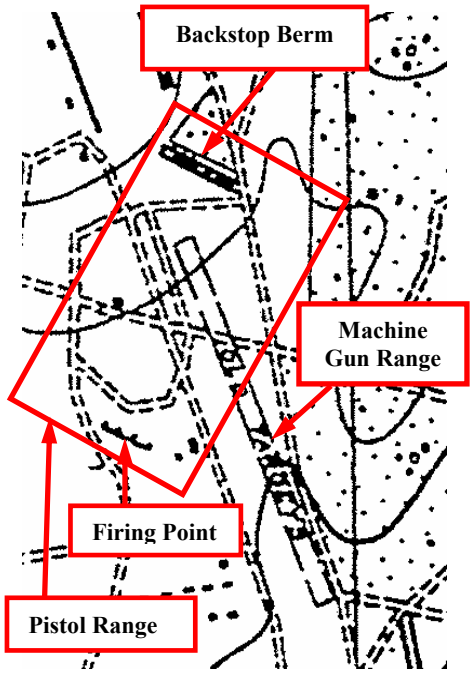


Figure 4-5: 1920 Special Military Map

Table 4-2, on the following page, summarizes historical use and overlapping range information for the Camp Jackson Ranges.

Table 4-2: Camp Jackson Ranges Historical Use Summary

MMRP Ranges/Sites	1918 Map	1919 Map	1920 Map	1926 Map	Historical Use	Overlapping Ranges
Camp Jackson Ranges						
1000-Yard Range	X	X			Small arms	Transition Range
600-Yard Range	X	X			Small arms	Transition Range
300-Yard Range	X		X	X	Small arms	Transition Range, Live Hand Grenade Court 2, Pistol Range NR 2
Machine Gun Range	X	X	X		Small arms	Pistol Range, Transition Range, Pistol Range NR 2
Pistol Range			X		Small arms	Machine Gun Range, Transition Range, Pistol Range NR 2

4.2.1.2 Small Arms Ranges East of Chesnut Road

The Small Arms East of Chesnut Road include the following four ranges: Transition Range; 1000-Inch Range Nos. 14, 15, 16; Pistol Range NR 2; and the Landscape Target Range. These ranges, which comprise 546 acres, were discovered as a result of the research performed for this HRR. These ranges were generally used during time period of 1946 to 1970 and are discussed below.

Transition Range

The Transition Range was located east of Chesnut Road, north of Semmes Road, and south of Red Diamond and Hartsville Guards Roads. The firing direction was from west to east. The Transition Range and its associated range fan overlapped the majority of the CTT-identified cantonment area ranges (i.e., the 1000-Yard Range, 600-Yard Range, Machine Gun Range, and Live Hand Grenade Court 2). Additionally, the Transition Range and its associated range fan overlapped portions of the following HRR-identified ranges: the 300-Yard Range; Pistol Range; Pistol Range NR 2; 1000-Inch Range Nos. 14, 15, 16; and the Landscape Target Range.

Correspondence regarding range construction, dated April 25, 1947, indicates that the Transition Range originally was to consist of 11 lanes with the firing line located on the western portion of the range. This correspondence also states that range construction was to be completed by June 23, 1947. Range Regulations, dated May 24, 1949, indicate that there were 15 firing lines at that time. Targets were located at the following distances: six lanes had targets at 200, 300, and 500 yards; four lanes targets at 250, 300, 350, 400, 450, and 500 yards; one lane had targets at 100 yards; and four lanes had targets from five to 70 yards. The type of weapon fired at this range was identified in the Range Regulations as the M1 .30 Caliber Rifle.

The Transition Range, which is shown on both the 1946 and 1949 maps, was extended south to encompass the Live Hand Grenade Court 2 sometime between 1946 and 1949 (this coincides with the increase in firing lanes from 11 to 15 described in the historical correspondence). The 1946 map shows the Live Hand Grenade Court 2 located just south of the southwestern corner of the Transition Range, where as the 1949 map (Figure 4-6) shows the Live Hand Grenade Court 2 located within the southwestern corner of the Transition Range. A 1952 Location Map shows the Transition Range firing line (identified on the map as M-1 Trans #1 Range), but does not include the range fan. The 1955 Training Facilities Map and the 1956 Training Facilities Map NR 2 also shows the Transition Range.

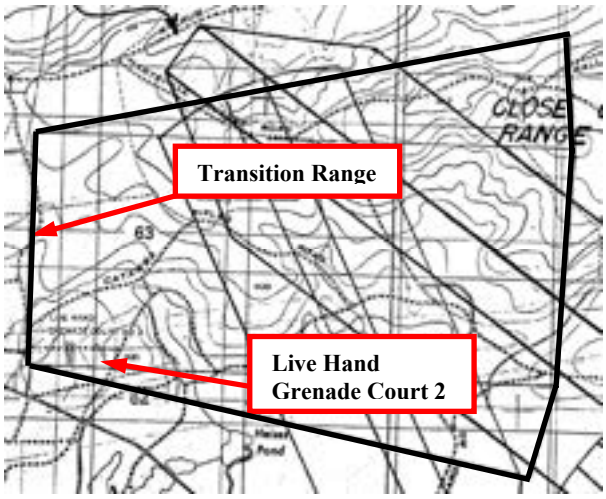


Figure 4-6: 1949 Fort Jackson and Vicinity Map

A Fort Jackson Basic Information Range Training Area Map, dated June 1, 1957, does not show the Transition Range. However, this map does show a Platoon Tactical Training Area (identified on the map as No. 309), Night Compass Course (No. 306), and Flame Thrower Area (No. 305) located just east of Chesnut Road where the westernmost portion of the

Transition Range was located. These three areas are only identified on the 1957 map (see Figure 4-7). Based on the historical correspondence and maps reviewed for the HRR, the period of use for the Transition Range was from 1947 to 1956.

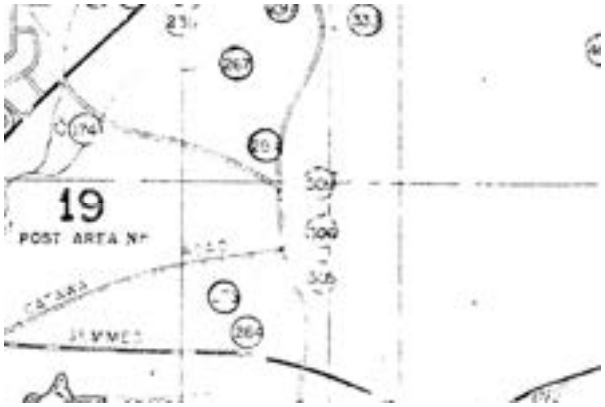


Figure 4-7: 1957 Basic Information Map

The *AR 750-10, Range Regulations for Firing Ammunition in Time of Peace* and *TM 9-855, Targets, Target Material, and Training Course Lay-outs* describe four general types of transition ranges used during the 1940s and 1950s. The first type of transition range was set up with firing lanes that had a single firing point and pop-up targets set at 200, 300, and 500 yards; each firing lane was approximately 60 yards wide. The second type of transition range was set up with firing lanes that had a single firing point and six stationary targets placed at random distances ranging from 200 to 500 yards; each firing lane was approximately 50 yards wide. The third type of transition range was set up without a limit of advance. This type of range consisted of up to ten firing lanes (each approximately 20 yards wide) that offered unique firing positions (i.e., fox holes, logs, etc.) and personnel transitioned along the firing line shooting from the various positions. Targets were placed at random distances out to 500 yards. The fourth type of transition range was set up with a limit of advance (typically no farther than 90 yards down range). This range utilized firing lanes in which personnel transitioned down-range while engaging pop-up targets positioned at various locations. Each lane was approximately 25 yards wide with earthen berms constructed between the firing lanes. Based on the historical documents reviewed, it appears that the Transition Range included a combination of these types of transition ranges.

1000-Inch Range Nos. 14, 15, 16

The 1000-Inch Range Nos. 14, 15, 16 is shown on the 1949, 1955, and 1956 maps. The 1949 map shows the 1000-Inch Range Nos. 14, 15, 16 located southeast of Golden Arrow Road and along the northeast side of Hartsville Guards Road, except for a small portion on the southwest side of Hartsville Guards Road. The firing point is located northeast of Hartsville Guards Road, with the direction of fire to the southeast. With the exception of a small area near the southern portion of the firing line, this range is overlapped by the Transition Range. When comparing the 1949 and 1956 maps, it was noted that the location of this range was shifted slightly to the south in the 1956 map. Map 4-2 illustrates the portion of this range that lies within the cantonment area.

Pistol Range NR 2

The Pistol Range NR 2 is shown on the 1952, 1955, and 1956 maps. This range is located east of Chesnut Road within the area identified as the Transition Range on the 1949 map. An aerial photograph from 1959 (Figure 4-8) shows the Pistol Range NR 2. Five berms that run in an east/west direction are visible in the photograph. These berms divided the range into separate firing areas. The firing points were located on the west side of the range with a target area located on the east side. A backstop berm located east of the firing lanes is also visible in the photograph. The Transition Range located north of the Pistol Range NR 2 is also visible in this aerial photograph.

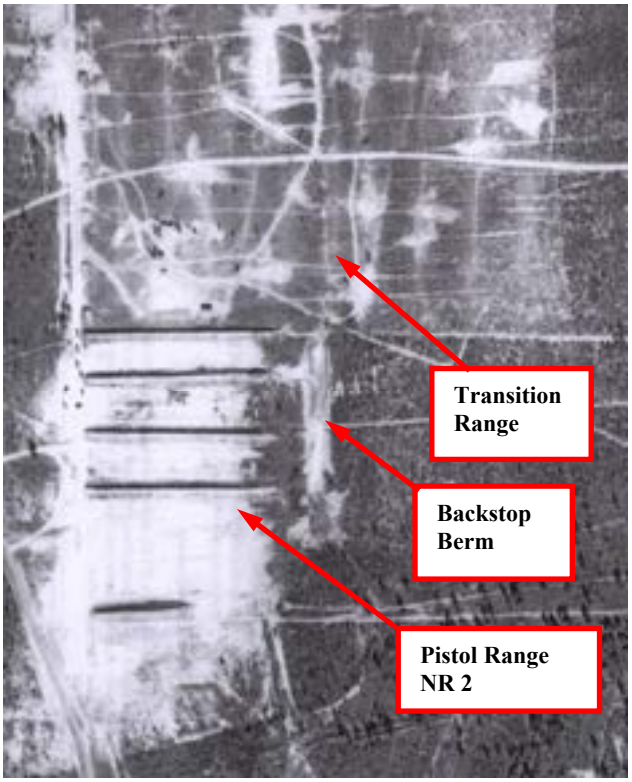


Figure 4-8: 1959 Aerial Photograph

Landscape Target Range

The Landscape Target Range is shown on the 1946 and 1949 maps. The maps show this range located south of Hartsville Guards Road, with a portion of the fan extending north across Hartsville Guards Road (Figure 4-9). The firing line was located southeast of the cantonment area, with the direction of fire to the northwest. The range fan extended northwest into the cantonment area. The Transition Range and 1000-Inch Range Nos. 14, 15, 16 overlap the portion of the Landscape Target Range that is located within the other than operational area.

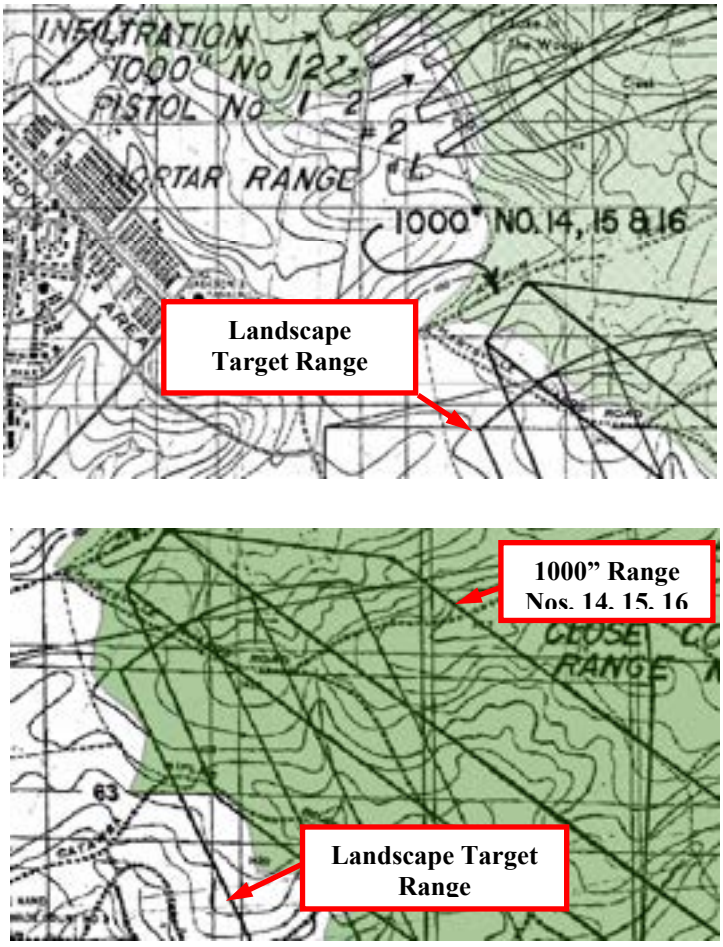


Figure 4-9: 1949 Fort Jackson and Vicinity Map with CTT Operational Boundary and Revised Operational Boundary

Based on information provided in the *AR 750-10, Range Regulations for Firing Ammunition in Time of Peace* and *TM 9-855, Targets, Target Material, and Training Course Lay-outs*, landscape targets were used for rifle practice on this type of 1000-inch range. The target set consisted of five black and white paper landscape targets that together made a panoramic picture of a landscape. The size of the panoramic picture was such that the features were recognizable at a distance of 1000 inches. Typically, .22 caliber weapons were fired at a Landscape Range and .30 caliber weapons were fired at a 1000-inch range.

Table 4-3 on the following page summarizes the historical use and overlapping range information for the Small Arms Ranges East of Chesnut Road.

Table 4-3: Small Arms Ranges East of Chesnut Road Historical Use Summary

MMRP Ranges/Sites	1946 Map	1949 Map	1952 Map	1955 Map	1956 Map	Historical Use	Overlapping Ranges
Small Arms Ranges East of Chesnut Road							
Transition Range	X	X	X	X	X	Small arms	300-Yard Range, Pistol Range, Pistol Range NR 2, 1000-Inch Range Nos. 14, 15, 16, Landscape Target Range, Live Hand Grenade Court 2
1000-Inch Range Nos. 14, 15, 16		X		X	X	Small arms	Transition Range, Pistol Range NR 2, Landscape Target Range
Pistol Range NR 2			X	X	X	Small arms	Transition Range, Machine Gun Range, 300-Yard Range, Live Hand Grenade Court 2, 1000-Inch Range Nos. 14, 15, 16, Landscape Target Range
Landscape Target Range	X	X				Small arms	Transition Range, 1000-Inch Range Nos. 14, 15, 16, Pistol Range NR 2

4.2.1.3 Live Hand Grenade Court 2

The three-acre Live Hand Grenade Court 2 is described in the CTT Range Inventory as a former hand grenade training range. The Live Hand Grenade Court 2 is located east of Chesnut Road and north of Semmes Road in the eastern portion of the cantonment area. This range is located southwest of the Machine Gun Range as identified in the CTT Range Inventory. According to the CTT Range Inventory, the approximate period of use of the Live Hand Grenade Court 2 was from 1940 to 1950. Practice, as well as live, grenades may have been used on the range. The Live Hand Grenade Court 2 was first depicted on the Annex No. 1 Firing Ranges Map dated 1946 and last depicted on the Fort Jackson and Vicinity Map dated 1949 (see Figure 4-6). During the 1970s and 1980s, the area where the Live Hand Grenade Court 2 was located was used for field fortification training.

Based on descriptions included in the *AR 750-10, Range Regulations for Firing Ammunition in Time of Peace* and *TM 9-855, Targets, Target Material, and Training Course Lay-outs*, a typical live hand grenade court used during the 1940s consisted of a trench with targets and an impact area approximately 25 yards to the front of the throwing line. Targets consisted of a circular outline, a crater, and/or a foxhole. A danger area of approximately 600 feet would have been established around the entire range. The 1949 map shows several parallel lines running north to south that may indicate throwing lines and trenches. Based on the orientation of these lines, grenades were most likely thrown to the east and/or west.

Table 4-4 summarizes historical use and overlapping range information for the Live Hand Grenade Court 2.

Table 4-4: Live Hand Grenade Court 2 Historical Use Summary

MMRP Ranges/Sites	1946 Map	1949 Map	1952 Map	1955 Map	1956 Map	Historical Use	Overlapping Ranges
Live Hand Grenade Court 2	X	X				Practice/live grenade training	300-Yard Range, Transition Range, Pistol Range NR 2

4.2.1.4 Ranges North of Hampton Parkway

The Ranges North of Hampton Parkway (which are northeast of Golden Arrow Road) include the following seven ranges: 1000-Inch Range No. 11, 1000-Inch Range No. 12, Pistol Range No. 1, Pistol Range No. 2, Mortar Range NR 1, Mortar Range NR 2, and the Infiltration Course. Several of these ranges can be seen in Figure 4-9. According to the operational range boundary used for the CTT Range Inventory, small portions of these ranges are located within the other than operational range area. These ranges, which comprise 32 acres, were identified as a result of the research performed for this HRR. These ranges were generally used during the time period of 1946 to 1957. During review of the draft HRR, additional mapping sources were identified that more accurately identified the operational range boundary. Based on this revised boundary, the Ranges North of Hampton Parkway are located within the operational range area and are not eligible for evaluation as part of the Fort Jackson SI. Details regarding these ranges are provided in the following paragraphs for informational purposes only.

1000-Inch No. 11

This small arms range was shown on the 1949, 1952, 1955, and 1956 maps. The 1000-Inch No. 11 Range is shown within the operational area on the 1949 map; however, the remainder of the maps show small portions of this range (near the firing points) located within the other than operational area. The direction of fire for this range was to the northeast.

1000-Inch No. 12

Small portions of this small arms range (near the firing points) were shown to be located within the other than operational area on the following maps: 1949, 1952, 1955, and 1956. The direction of fire was to the northeast.

Pistol Range No. 1

Small portions of this small arms range (near the firing points) were shown to be located within the other than operational area on the following maps: 1949, 1955, 1957, and 1969.

It is noted that this range was not shown on the 1956 map. The direction of fire was to the northeast.

Pistol Range No. 2

Small portions of this small arms range (near the firing points) were shown to be located within the other than operational area on the 1949 map. The 1946 map shows a range similar in size and location to the Pistol Range No. 2; however, it is only labeled as "Pistol". The direction of fire for the Pistol Range No. 2 was to the northeast.

Mortar Range NR 1

This range was shown on the 1949, 1952, 1955, and 1956 maps. Small portions of the Mortar Range NR 1 (near the firing line) are shown within the other than operational area on the 1949, 1955, and 1956 maps. Information on the Mortar Range NR 1, including firing line location and type of munition fired (i.e., 4.2-inch mortar), were described the April 15, 1950 Range Regulations. The range regulations indicate that the 4.2-inch mortar had a maximum range of 1,800 yards. The direction of fire for the Mortar Range NR 1 was to the northeast.

Mortar Range NR 2

Small portions of this range (near the firing line) were shown to be located within the other than operational area on the following maps: 1949, 1955, and 1956. The Mortar Range NR 2 was located south of, and overlapped portions of, Mortar Range NR 1. The direction of fire for this range was also to the northeast.

Infiltration Course

This range is shown on the following maps: 1949, 1952, 1955, 1956, 1957, and 1969. The entire Infiltration Course is shown within the operational area on the 1949 map; however, the remainder of the maps show small portions of the range (mainly near the firing points and the area of the range where the course would have been set up) located within the other than operational area. The direction of fire for the range was to the northeast. The 1957 map also

lists an Infiltration Course No. 2, with a location immediately south of the Infiltration Course. Since the 1957 map is the only reference for the Infiltration Course No. 2 and it is located immediately south of the Infiltration Course, this range is grouped together with the Infiltration Course.

According to the *AR 750-10, Range Regulations for Firing Ammunition in Time of Peace* and TM *9-855, Targets, Target Material, and Training Course Lay-outs*, an infiltration course was set up in a level area with logs and small mounds of dirt for personnel to roll over. The ground would have contained shell holes, trenches, slit trenches, wire entanglements, stumps, sparse brush, and other obstacles. Machine guns were typically fired from fixed platforms at the front of the range and reduced charges of explosives were placed in craters throughout the course to create realistic conditions during training.

Table 4-5 summarizes the historical use and overlapping range information for the Ranges North of Hampton Parkway.

Table 4-5: Ranges North of Hampton Parkway Historical Use Summary

MMRP Ranges/Sites	1946 Map	1949 Map	1952 Map	1955 Map	1956 Map	1957 Map	1969 Map	Historical Use	Overlapping Ranges
Ranges North of Hampton Parkway									
1000-Inch No. 11		X	X	X	X			Small arms	Ranges North of Hampton Parkway
1000-Inch No. 12		X	X	X	X			Small arms	Ranges North of Hampton Parkway
Pistol Range No. 1		X		X		X	X	Small arms	Ranges North of Hampton Parkway
Pistol Range No. 2	X	X						Small arms	Ranges North of Hampton Parkway
Mortar Range NR 1		X	X	X	X			Mortar	Ranges North of Hampton Parkway

MMRP Ranges/Sites	1946 Map	1949 Map	1952 Map	1955 Map	1956 Map	1957 Map	1969 Map	Historical Use	Overlapping Ranges
Mortar Range NR 2		X		X	X			Mortar	Ranges North of Hampton Parkway
Infiltration Course		X	X	X	X	X	X	Small arms Explosives	Ranges North of Hampton Parkway

Table 4-6 provides a summary of the historical time-line analysis for the ranges located in the cantonment area based on the maps reviewed.

Table 4-6: Cantonment Area Map Summary

Date of Map	Map Title	Map Observations
1918-1926	1918 Location Map 1918 Key Map of Property 1919 General Map 1920 Special Military Map 1926 National Forest Map	The ranges observed during this time frame include the following: 1000-, 600-, and 300-Yard Ranges, Machine Gun Range, and the Pistol Range. The 1000- and 600-Yard Ranges are only shown on the 1918 and 1919 maps. The Pistol Range is only shown on the 1920 map.
1946-1957	1946 Annex No. 1 Map 1949 Fort Jackson and Vicinity Map 1952 Location Map 1955 Training Facilities Map 1956 Training Facilities Map NR 2 1957 Master Plan Map	The ranges observed during this time frame include the following: Live Hand Grenade Court 2, Transition Range, 1000-Inch Range Nos. 14, 15, 16, and the Ranges North Hampton Parkway. The 1946 and 1949 maps depict the Live Hand Grenade Court 2 and the Transition Range. The Transition Range was extended to the south to encompass the Live Hand Grenade Court 2 between 1946 and 1949. The Ranges North of Hampton Parkway include the following: 1000-Inch No. 11 and 12 Ranges, Infiltration Course, Pistol Ranges No. 1 and 2, and the Mortar Ranges NR 1 and NR 2.
1969	1969 Master Plan	This map shows three range fans overlapping the other than operational area: the Pistol No. 1 Range, the South Carolina Range, and an unlabeled/unidentified range fan. In each case, only small portions of each range fan overlap the other than operational area, and these areas are included in other ranges/range fans previously identified in the maps reviewed above.

4.2.2 Fort Jackson Flight Club

The FJFC is a 54-acre area located east of Wildcat Road just north of Shenandoah Road. The western portion of the FJFC has been improved for recreational R/C model airplane use. Data obtained during the CTT Range Inventory indicated that the FJFC area was used as a machine gun range from 1955 to 1979. Information not previously identified regarding the FJFC area was obtained through the research performed for this HRR. Based on the data reviewed, the area on the western-most portion of the FJFC did not have a historical range use. As such, the MMRP sites do not include this area. The FJFC MMRP sites include the FJFC Salerno Ranges (15 acres) and the FJFC Small Arms Ranges (27 acres). Map 4-5 and Map 4-6 at the end of this section show the revised HRR site boundary, as well as the various ranges/range fans that overlap the FJFC. Map 4-7 shows the FJFC MMRP sites.

Since no evidence of range activity is indicated on the 1946 Annex No. 1 Firing Ranges Map, it was assumed that range activities were initiated at the FJFC area in the time period between 1946 and 1949. The 1949 Fort Jackson and Vicinity Map depicts two ranges that overlap the FJFC. The Field Firing Machine Gun range and safety fan are oriented to the southeast and cover the majority of the northern and eastern portions of the FJFC. The safety fan for the Close Combat No. 2 range extends into the southeastern corner of the FJFC, as shown on Figure 4-10. The machine gun range is labeled on the 1952 Fort Jackson Location Map as MG Field Firing #1 (Figure 4-11) and is in the same general location as shown on the 1949 map.

Figure 4-10: 1949 Fort Jackson and Vicinity Map with FJFC Overlay

Figure 4-11: 1952 Fort Jackson Location Map with FJFC Overlay

Based on the maps reviewed, the machine gun range usage continued through 1955 and 1956. However, the range fan is significantly larger as depicted on the 1955 and 1956 Training Facilities Maps when compared with that on the 1949 and 1952 maps. The 1955 and 1956 (Figure 4-12) maps both show the presence of an unlabeled smaller range located within the Machine Gun Field Firing Range NR 1. The range fan shape indicates that it may have also been used as a machine gun range.

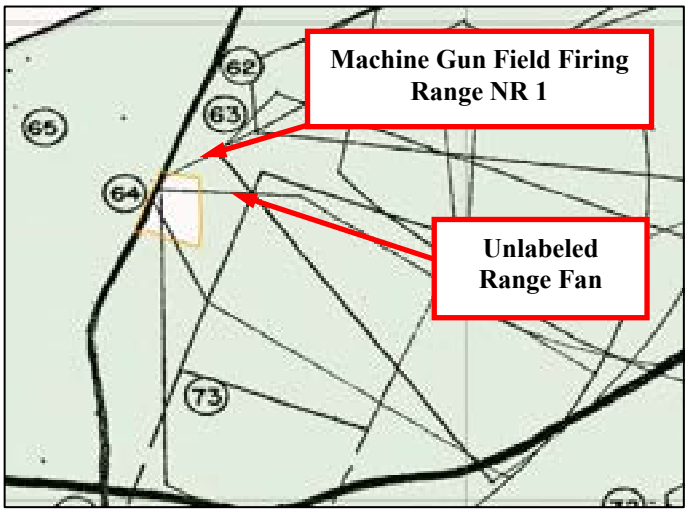


Figure 4-12: 1956 Training Facilities Map with FJFC Overlay

The 1957 map identifies a Technique of Rifle Fire w/ Distrib. and an M-1 Night Firing range that overlap the FJFC. The Technique of Rifle Fire w/ Distrib. range fan covers the northern and eastern portions of the FJFC. The M-1 Night Firing range covers the southern and eastern portions of the FJFC. The 1969 Master Plan Map (Figure 4-13) shows three range fans intersecting the FJFC. The two northern-most range fans are labeled Technique of Rifle Fire Range Salerno and the southern-most range fan is labeled Night Fire and Vision Range Saint Lo. The 1969 map uses the terms "Salerno" and "Saint Lo" for the first time to identify the ranges overlapping the FJFC.

Figure 4-13: 1969 Master Plan Map with FJFC Overlay

Information from a notebook located in the Range Control Office provided additional information on the usage of the Salerno and Saint Lo ranges during the 1960s and 1970s. A

sketch labeled Salerno Demonstration Overlay shows the relative location of four ranges: an M-60 machine gun range, an M-79 grenade launcher range, an M-72 Light Anti-tank Weapon (LAW) rocket launcher range, and an M18A1 mine range. A table attached to the sketch lists ammunition used at the Salerno range as of two dates. The January 3, 1964 entry lists .30-caliber and 7.62-mm ammunition. The April 9, 1970 entry lists LAW rockets, 40-mm grenades, and anti-personnel mines. This table also provides ammunition information for the Saint Lo range, with a January 3, 1964 entry indicating the use of .30-caliber and 7.62-mm ammunition. A historical photograph obtained from the National Archives depicts Army personnel training at an M-60 machine gun range (Figure 4-14). Fort Jackson personnel indicated that use of the Salerno and Saint Lo ranges ceased in 1973 and that the FJFC was established after 1982.

Figure 4-14: Firing at the M-60 range in 1969

The 1993 Forestry Field Map shows the presence of an "M79+40mm" rifle grenade range located in the northeastern-most portion of the FJFC. This location is shaded and labeled in the legend as "previous duds believed to have been cleared".

Aerial photographs from 1949 through 1970 were reviewed for evidence of training in the FJFC area. Disturbed areas were first visible on the 1955 aerial photograph. These areas were identified on other aerial photographs reviewed that were dated through 1970. The most evident land disturbance was shown in the 1955 aerial photograph (Figure 4-15).

Figure 4-15: Ranges Shown on 1959 Aerial Photograph

Table 4-7 below summarizes the historical time-line analysis of former range activities at the FJFC based on the maps reviewed.

Table 4-7: FJFC Map Summaries

Date of Map	Map Title	Map Observations
1946	Annex No. 1 Firing Ranges Map	No training was evident at the FJFC area.
1949	Fort Jackson and Vicinity Map	The Field Firing Machine Gun range and safety fan cover the majority of the northern and eastern portions of the FJFC. The Close Combat Range No. 2 safety fan extends into the southeastern corner of the FJFC.
1952	Location Map	The MG Field Firing #1 range location coincides with the Field Firing Machine Gun range shown on the 1949 map.
1955	Training Facilities Map	The Machine Gun Field Firing No. 1 range covers the majority of the FJFC. A smaller unlabeled range fan extends across the central portion of the FJFC.
1956	Training Facilities Map NR 2	The Machine Gun Field Firing Range NR 1 intersects the majority of the FJFC (same as 1955 map). The smaller unlabeled range fan shown on the 1955 map is also shown on the 1956 map.
1957	Basic Information for Master Plan Map	The Technique of Rifle Fire w/ Distrib. range fan covers the northern and eastern portions of the FJFC. The M-1 Night Firing range overlaps the Technique of Rifle Fire w/ Distrib. range and covers the southern and eastern portions of the FJFC. The Technique of Rifle Fire w/ Distrib. range is to the north of the M-1 Night Firing range and has a wider fan.
1969	Master Plan Map	Three range fans are shown that intersect the FJFC. The two northern range fans are labeled Technique of Rifle Fire Range Salerno. The southern-most range fan is labeled Night Fire and Vision Range Saint Lo.
1993	Forestry Field Map	A shaded area in the northeastern portion of the FJFC is labeled “M79+40mm”. The legend identifies this area as “previous duds believed to have been cleared”.

4.2.3 Weston Lake Area Ranges/Sites

The Weston Lake Area, located in the south-central portion of the installation, contains four closed ranges that were identified in the CTT Range Inventory (i.e., the Mortar Range, Hand Grenade Court No. 2, Rifle Grenade Range NR 2, and Submachine Gun Area). Due to a change of the operational range boundary, two of these sites (Hand Grenade Court No. 2 and Rifle Grenade Range NR 2) were determined to not be eligible for evaluation as part of the Fort Jackson SI. The findings and modifications based on information obtained during the HRR, including additional munitions types identified and acreage changes, are presented in the following subsections. Map 4-8 shows the Weston Lake Area range details. Map 4-10 shows the differences in the CTT Range Inventory and HRR range locations. Map 4-11 shows the Weston Lake Area MMRP sites.

4.2.3.1 Mortar Range

The 306-acre Mortar Range is located in the northern section of the Weston Lake Area, north of the Hand Grenade Court No. 2 and west of the Submachine Gun Area. According to the CTT Range Inventory, this area (identified as Mortar Range No. 8) was a buffer (safety) area for a mortar range that was used in the 1940s. The CTT Range Inventory also indicated that other ranges overlapped this area, including 8-inch, 105-mm, and 155-mm Howitzer ranges. The Submachine Gun Area also overlapped the Mortar Range. For acreage reporting purposes, the CTT Range Inventory depicted the Mortar Range and the Submachine Gun Area as a contiguous area divided in half, with the west side designated as the Mortar Range (112 acres) and the east side designated the as Submachine Gun Area (101 acres). However, based on the 1955 and 1956 Training Facilities Maps, the Mortar Range actually covers both the Mortar Range and most of the Submachine Gun Area reported in the CTT Range Inventory. For the HRR, the MMRP site boundary and acreage associated with the Mortar Range was increased to encompass the entire portion of the Mortar Range in the other than operational area, where as the Submachine Gun Area was decreased to include only the area not overlapped by the Mortar Range.

The 1952 Fort Jackson Location Map shows an area labeled "MTR #8" approximately 0.3 mile west of Washington Light Infantry Road. It is assumed that this is the location of the firing points, which are in an operational area. The 1955 and 1956 Training Facilities Maps show the Mortar Range No. 8 in the same location and oriented from west to east. Additionally, the 1955 map indicates the mortar range had 12 firing points. Both training maps depict a larger range fan almost directly overlapping Mortar Range No. 8. This fan is not labeled on either map and has not been identified on other maps reviewed. The majority of the 306 acres associated with the Mortar Range identified during this HRR consist of the portion of Mortar Range No. 8 that falls within the other than operational area at the Weston Lake Area. The remainder of the former Mortar Range No. 8, including the impact area, falls within the operational area. Mortar Range No. 8 was not identified on maps prior to 1952.

The 1955 Training Facilities Map shows two additional mortar range fans, Mortar Range No. 7 and Mortar Range No. 5A, overlapping the Mortar Range. Only the farthest extents away from the firing points of these two mortar range fans overlap the Mortar Range. The 1956 Training Facilities Map shows the same overlapping range fans; however, they are not labeled. The relationship of the three mortar range fans is depicted in Figure 4-16.

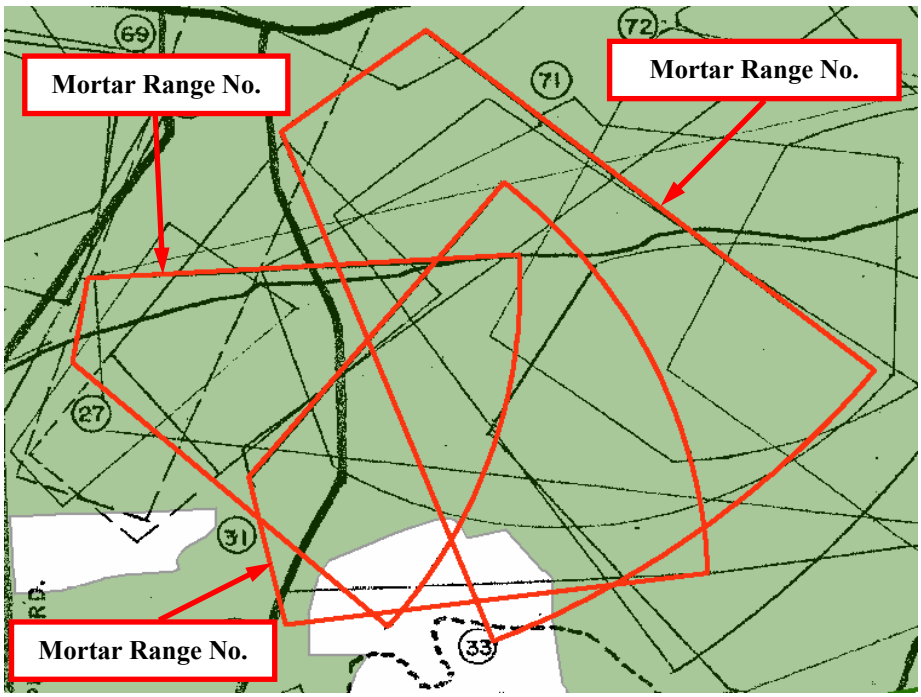


Figure 4-16: 1956 Training Facilities Map with Weston Lake Area Overlay

The 1957 Basic Information Map shows a mortar training area south of the eastern portion of the Mortar Range. However, no associated range fan was identified. The 1957 map also shows the Machine Gun Field Firing Range No. 1 and Machine Gun Field Firing Range No. 2 overlapping the eastern portion of the Mortar Range. These two ranges originate southeast of the Mortar Range, and only the surface danger zones associated with these ranges overlap the Mortar Range.

The 1969 Master Plan Map shows several range fans that overlap the Mortar Range. These range fans are identified as follows: 105-mm Howitzer Position No. 5; 155-mm Howitzer Position No. 2; 155-mm Howitzer Position No. 6; 155-mm Howitzer Position No. 8; and 8-inch Howitzer Position No. 9. These range fans originate from the west and overlap the entire Mortar Range. Map 4-9 shows the Howitzer range fan configurations. According to installation personnel, even though the Howitzer range fans overlap the Mortar Range, Howitzer-associated MEC are not likely to be found on the Mortar Range or other Weston Lake Area ranges because the firing points and impact areas of the Howitzer ranges were not located on or near the Weston Lake Area ranges. Review of the 1950 Fort Jackson Range Regulations and associated map overlays indicated that the Howitzer firing positions were located west of Washington Light Infantry Road and the impact area was northeast of the Weston Lake Area. Based on historical research, Howitzer ranges were operated by range personnel so that gun crews could restrict the gun's elevation and select the amount of propellant charge to control the downrange distance and hit the targets/impact areas. Short rounds are not anticipated at the Howitzer ranges based on the standard operating procedures. Because neither the firing points nor the impact areas for the Howitzer ranges lie in the other than operational range areas, these ranges were not evaluated under this HRR.

The 1969 map also shows the Machine Gun Field Fire No. 1, Cassino Range that originates from the south and overlaps the eastern portion of the Mortar Range. The Rifle Squad in Technique of Rifle Fire Range RSTT No. 1 originates from the north and overlaps the northeastern portion of the Mortar Range. Five additional range fans overlap the eastern

portion of the Mortar Range; however, these range fans are not labeled. No other maps reviewed show these unlabeled range fans.

The 1949 Fort Jackson and Vicinity Map does not show the Mortar Range; however, it does show the Dismounted Submachine Gun Range Nos. 1 and 2 fans and the farthest extent of the Close Combat Range No. 1 fan overlapping the Mortar Range. Neither the Mortar Range nor the Close Combat Range No. 1 appears on the 1946 Annex No. 1 Firing Ranges Map. This indicates that the Mortar Range was used in the 1950's rather than the 1940s as indicated in the CTT Range Inventory.

Aerial photographs from 1949 through 1970 were reviewed for evidence of mortar training in the Weston Lake Area. The portion of the Mortar Range in the other than operational area associated with the Weston Lake Area includes the safety fan, but not the firing points or impact areas of the Mortar Range. Evidence of mortar training in the Weston Lake Area was not observed in the aerial photographs, as expected based on the area being within the safety fan. Review of historical correspondence dating back to 1941 indicates that the Weston Lake (historically Weston Pond) Area was designated as off-limits for training. Based on the historical correspondence, the area surrounding Weston Lake has been used for recreational purposes since the 1940s.

4.2.3.2 Hand Grenade Court No. 2

The 18-acre Hand Grenade Court No. 2 is located in the northern portion of the Weston Lake Area, south of the Mortar Range. The CTT Range Inventory estimated that the period of use for this range was from 1944 to 1950. The acreage associated with the Hand Grenade Court No. 2 in the CTT Range Inventory was three acres. Based on additional information obtained during the research conducted for the HRR, the acreage associated with hand grenade training was increased to 18 acres. During review of the draft HRR, additional mapping sources were identified that more accurately identified the operational range boundary. Based on this revised boundary, the Hand Grenade Court No. 2 is located within the operational range area and is not eligible for evaluation as part of the Fort Jackson SI.

The following information obtained during the HRR is included for informational purposes only.

The Hand Grenade Court No. 2 is labeled on the 1952 Fort Jackson Location Map and is shown approximately 0.6 mile south of the Mortar Range No. 8. The location of Hand Grenade Court No. 2 appears to be just on the west side of Washington Light Infantry Road, which is an operational area. No associated range fan is shown on the 1952 map. Based on the review of historical documents and aerial photographs, it appears that hand grenade training occurred on both sides of Washington Light Infantry Road. However, research performed for this HRR focused only on the other than operational area, which is east of Washington Light Infantry Road.

The 1955 Training Facilities Map shows the location of the Hand Grenade Court No. 2 with an associated range fan on the east side of Washington Light Infantry Road (Figure 4-17). The 1956 Training Facilities Map only shows the reference number associated with the Hand Grenade Court No. 2, but does not show the range location.

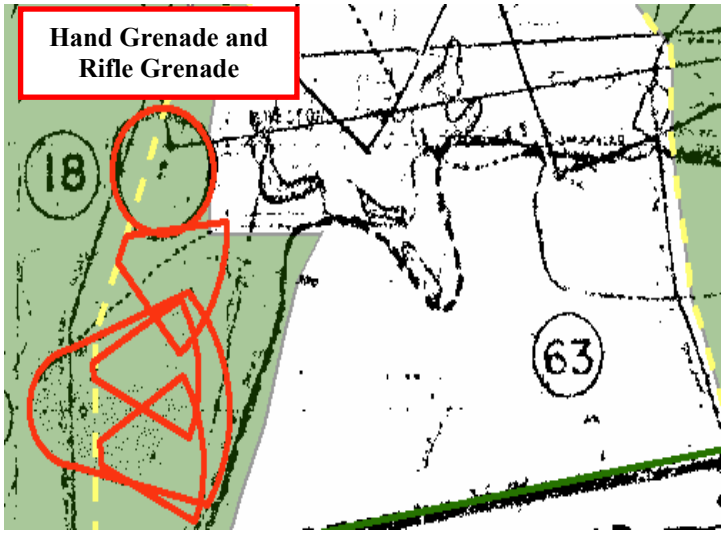


Figure 4-17: 1955 Training Facilities Map

An aerial photograph dated October 3, 1947 shows the land disturbed along the east side of Washington Light Infantry Road where rifle grenade and hand grenade training activities are assumed to have occurred. Aerial photography from March 29, 1955 shows a closer view of the same disturbed areas. A 1959 aerial photograph shows a firing line and a disturbed area that appears to be a hand grenade pit (impact area). The portion of this aerial photograph showing the Hand Grenade Court No. 2 is included as Figure 4-18. The aerial photograph confirms the use of the areas east and west of Washington Light Infantry Road for training purposes. Based on the maps and aerial photographs reviewed, it is assumed that both rifle grenades and hand grenades were used at this site.

Figure 4-18: Hand Grenade Court No. 2 shown on 1959 Aerial Photograph

4.2.3.3 Rifle Grenade Range NR 2

The 109-acre Rifle Grenade Range NR 2 is located in the southwestern portion of the Weston Lake Area. According to the CTT Range Inventory, this range was located south of the Hand Grenade Court No. 2 and was shown on several maps from the 1940s through the 1960s as a rifle grenade range. The Hand Grenade Court No. 2 is located in the northern portion of the Weston Lake Area, south of the Mortar Range. The CTT Range Inventory estimated that the period of use for the Rifle Grenade Range NR 2 was from 1944 to 1950. The acreage associated with the Rifle Grenade Range NR 2 in the CTT Range Inventory was 90 acres. Based on additional information obtained during the HRR, the acreage was increased to 109 acres to include the additional areas identified that were used in conjunction with the range. During review of the draft HRR, additional mapping sources were identified that more accurately identified the operational range boundary. Based on this revised boundary, the Rifle Grenade Range NR 2 is located within the operational range area and is not eligible

for evaluation as part of the Fort Jackson SI. The following information obtained during the HRR is included for informational purposes only.

The 1949 Fort Jackson and Vicinity Map shows three range fans identified as Hand Grenade & Rifle Grenade No. 2 (Figure 4-19). The ranges are oriented in an easterly/southeasterly direction and are located on the east side of Washington Light Infantry Road. These ranges are not shown on the 1946 Annex No. 1 Firing Ranges Map.

Figure 4-19: 1949 Fort Jackson and Vicinity Map

The Rifle Grenade Range NR 2 is shown on the 1952 Fort Jackson Location Map in approximately the same location as the 1949 map. However, the 1952 map depicts the range fan originating on the west side of Washington Light Infantry Road and extending across the road to the east. The 1955 and 1956 Training Facilities Maps also show the location of the Rifle Grenade Range NR 2 with the range fan originating on the west side of Washington Light Infantry Road. Based on review of historical maps, it appears that the administrative area of the range may have been located on the west side of Washington Light Infantry Road. This would indicate that the firing points were located on the east side of the road. The 1952, 1955, and 1956 maps show the majority of the range fan extending east of Washington Light Infantry Road. These maps do not show other ranges or range fans overlapping the Rifle Grenade Range NR 2.

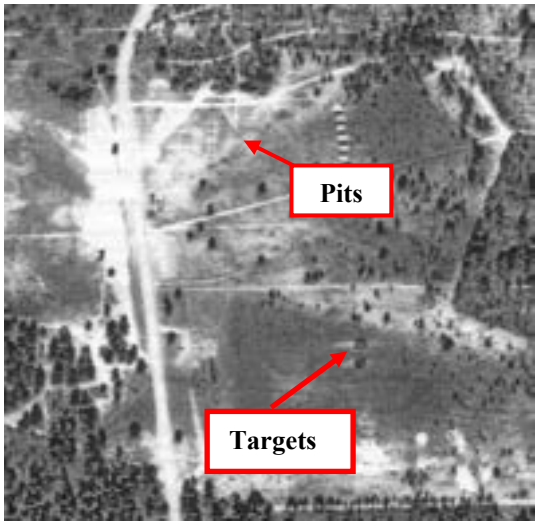


Figure 4-20: Rifle Grenade Range NR 2 shown on 1959 Aerial Photograph

Based on review of aerial photographs, two distinct training areas on the east side of the road are evident, just before the Washington Light Infantry Road turns to the northeast. Range use is visible on the east side of the road in the 1959 aerial photograph (Figure 4-20). Hand grenade pits and rifle grenade targets are visible in the photograph. Based on the information obtained for the HRR, it is assumed that both rifle and hand grenades were used at this site. The Rifle Grenade Range NR 2 is also identified on a 1993 Forestry Field Map as a "Known Dud Area".

4.2.3.4 Submachine Gun Area

The 17-acre Submachine Gun Area is located in the northern part of the Weston Lake Area. According to the CTT Range Inventory, this area is made up of three separate ranges, including the Dismounted Submachine Gun No. 1, the Moving Vehicle Submachine Gun, and the Dismounted Submachine Gun No. 2 ranges. These range fans overlap, with the direction of fire to the north/northwest into the East Impact Area. As discussed in the Mortar Range section above, the CTT Range Inventory depicted the Mortar Range and the Submachine Gun Area as a contiguous area divided in half, with the west side designated the Mortar Range (112 acres) and the east side designated the Submachine Gun Area (101 acres). However, based on the 1955 and 1956 Training Facilities Maps, the Mortar Range actually covers both the Mortar Range and the Submachine Gun Area reported in the CTT Range Inventory.

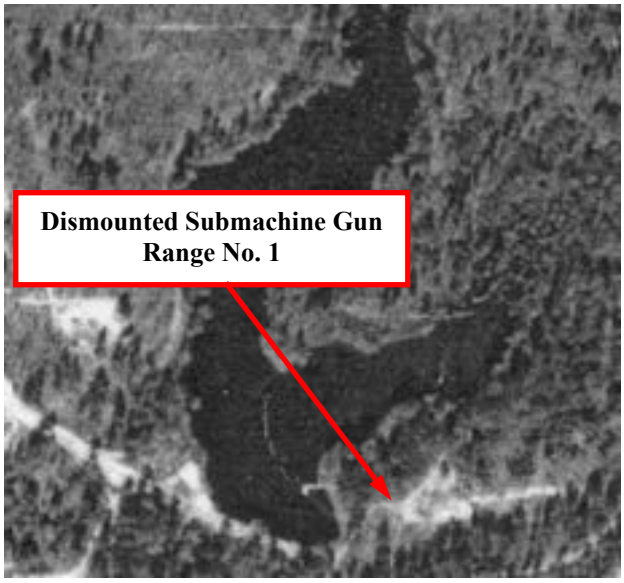


Figure 4-21: 1966 Aerial Photograph of Dismounted Submachine Gun Area

For the HRR, the Submachine Gun Area site boundary and acreage were reduced to include only the area not overlapped by the Mortar Range. As such, the acreage for the Submachine Gun Area was reduced from 101 acres to 17 acres. This area is shown on the 1966 aerial photograph included as Figure 4-21. For the HRR, aerial photography from 1949 to 1970 was also reviewed. The aerial photographs show that the Dismounted Submachine Gun Range firing points and target areas were located on a finger of land adjacent to Weston Pond. During the 1970s, the Weston Ponds were expanded to form Weston Lake. The firing points and target areas for this site are currently located on the shoreline of Weston Lake.

The 1946 Annex No. 1 Firing Ranges Map shows the Dismounted Submachine Gun No. 1 range with what appears to be firing points at three locations (two points at each of the three locations). The Dismounted Submachine Gun No. 2 range is located east of the Dismounted Submachine Gun No. 1 range and also has the same range layout. The Moving Vehicle Submachine Gun range is located between the Dismounted Submachine Gun No. 1 and No. 2 ranges. The Dismounted Submachine Gun No. 2 and the Moving Vehicle Submachine Gun range firing points are located in the operational area. However, the range fans extend into the other than operational area. According to the map, the direction of fire for all three ranges was north/northwest with the range fans covering an area from west of Washington Light Infantry Road to east of Timmonsville Guard Road.

The 1949 Fort Jackson and Vicinity Map shows the same general locations of the Dismounted Submachine Gun Nos. 1 and 2 and Moving Vehicle Submachine Gun ranges as the 1946 map; however, the range fans on the 1949 map are positioned slightly farther southwest. Additionally, the 1949 map shows the farthest extent of the Close Combat Range No. 1 fan overlapping the Submachine Gun Area.

The 1950 Fort Jackson Range Regulations include information regarding the Dismounted Submachine Gun No. 1 range. The 1949 map shows the range location, safety fan, and danger area, as described in these range regulations. Figure 4-22 shows a schematic for the range that was included in the range regulations. The range regulations state that there were three firing points located on this range. The regulations also note the type of weapons fired at the range included the M3A1 .45 caliber submachine gun and the Thompson M1928A1 .45 caliber submachine gun.

The 1957 Basic Information Map shows the Machine Gun Field Firing Range No. 1 and Machine Gun Field Firing Range No. 2 overlapping the Submachine Gun Area. Both of these ranges originate southeast of the Submachine Gun Area. The 1957 map does not show the Dismounted Submachine Gun Nos. 1 and 2 or the Moving Vehicle Submachine Gun ranges. This indicates that the ranges were no longer being used in 1957.

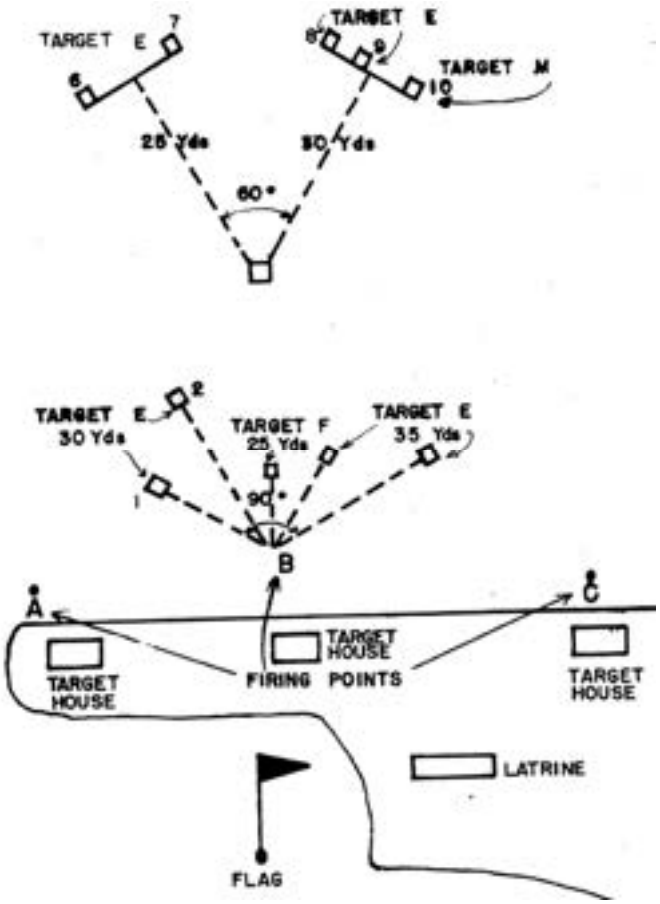


Figure 4-22: Dismounted Submachine Gun Range No. 1 Schematic Diagram

Table 4-8 summarizes the historical use and overlapping range information obtained for the Weston Lake Area ranges.

Table 4-8: Weston Lake Area Ranges Historical Use Summary

MMRP Ranges/Sites	1946 Map	1949 Map	1952 Map	1955 Map	1956 Map	1957 Map	Historical Use	Overlapping Ranges
Weston Lake Area								
Mortar Range			X	X	X		Mortar training	Submachine Gun Area, Hand Grenade Court No. 2, Howitzer Safety Fans
Hand Grenade Court No. 2		X	X	X	X		Hand/rifle grenade training	Mortar Range, Howitzer Safety Fans
Rifle Grenade Range NR 2		X	X	X	X		Hand/rifle grenade training	Howitzer Safety Fans
Submachine Gun Area	X	X					Small arms	Mortar Range, Howitzer Safety Fans

Table 4-9 provides a summary of the time-line analysis and map observations made for the Weston Lake Area ranges that are discussed in the previous sections.

Table 4-9: Weston Lake Area Map Summaries

Time Frame	Map Titles	Map Observations
1918-1926	1918 Location Map 1918 Key Map of Property 1919 General Map 1920 Special Military Map 1926 National Forest Map	No information on the Weston Lake Area MMRP sites was located on the 1918-1926 maps reviewed. In the Weston Lake Area, the installation boundary during 1918-1926 was approximately 5,000 feet north of the present boundary, so many of these locations would have been outside Camp Jackson and would not have had range use.

Time Frame	Map Titles	Map Observations
1946-1957	1946 Annex No. 1 Map 1949 Fort Jackson and Vicinity Map 1952 Location Map 1955 Training Facilities Map 1956 Training Facilities Map NR 2 1957 Basic Information Map	The ranges observed during this time frame include the following: Mortar Range No. 8, Mortar Range No. 7, Mortar Range No. 5A, Close Combat Range No. 1, Dismounted Submachine Gun No. 1, Dismounted Submachine Gun No. 2, Moving Vehicle Machine Gun, Rifle Grenade Range NR 2, Machine Gun Field Firing Range No. 1, and Machine Gun Field Firing Range No. 2.
1969	1969 Master Plan Map	The 1969 map does not show any of the areas identified as MMRP sites. However, the following 11 overlapping fans were identified: 105-mm Howitzer Position No. 5, 155-mm Howitzer Position No. 2, 155-mm Howitzer Position No. 6, 155-mm Howitzer Position No. 8, and 8-inch Howitzer Position No. 9, Machine Gun Field Fire No. 1 (Cassino Range), Rifle Squad in Technique of Rifle Fire Range RSTT No. 1, and five unlabeled range fans.

4.3 POTENTIAL MEC AND MC

Table 4-10 on the following page presents the potential MEC and the associated MC that are expected to be found at the Cantonment Area, FJFC, and Weston Lake Area ranges. The table includes information for each Munitions Response Site (MRS) and the associated sub areas. This information is based on the findings of the research conducted for the HRR.

Table 4-10: Summary of Potential MEC and MC

MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
***Camp Jackson Ranges* (includes 1000-Yard Range, 600-Yard Range, 300-Yard Range, Machine Gun Range, and Pistol Range)**	Firing Points/Lines Target Areas Overlapping Range Fans: Small Arms Ranges East of Chesnut Road (Transition No. 1, M-1 Transition only), and Live Hand Grenade Court 2 (overlaps the 300-Yard Range only)NR1, and Pistol Range NR2	.30-/.45-/.50-caliber	Munitions firing, potentially from the following guns: Springfield Model 1903, M1909 Revolver (.45 Colt caliber), M1917 Revolver, Enfield M1917 Rifle, Browning .30 caliber M1917 Machine Gun, Mk 2 .50 Machine Gun	None (small arms use only)	Black powder (potassium nitrate, sulfur, and charcoal) Smokeless powder (nitrocellulose, dinitrocellulose [DNT], dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Lead (Pb), Antimony (Sb), Arsenic (As), Copper (Cu), Tin (Sn), Zinc (Zn), Iron (Fe), Strontium (Sr), Magnesium (Mg), and lead styphnate/lead azide

MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
Live Hand Grenade Court 2	Impact Area Overlapping Range Fans: Camp Jackson Ranges (300-Yard Range only) and Small Arms Ranges East of Chesnut Road	Hand grenades: MK2 Fragmentation (Frag), MK II Practice, M26/61 Frag, M30/62 Practice, M48E1 Smoke, M69 Practice, M18 Smoke, M26A2 Frag, M57 Frag, M34 Smoke, M59/68 Frag	Munitions firing (throwing)	Non-functioned grenades/fuzes	Black powder (potassium nitrate, sulfur, and charcoal) Smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Composition B TNT Octol RDX White Phosphorous (WP)

MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
Small Arms Ranges East of Chesnut Road **(Includes Transition Range, Pistol Range NR 2, Landscape Target Range, and 1000-Inch Range Nos. 14, 15, 16)**	Firing Points/Lines Target Areas Overlapping Range Fans: Camp Jackson Ranges and Live Hand Grenade Court 2	.30-caliber .45-/.22-caliber	Munitions firing, potentially from the following guns: Springfield Model 1903, M1909 Revolver (Colt .45 caliber), M1917 Revolver, Enfield M1917 Rifle, M-1 Garand Rifle, M-1 Carbine, M1911 and M19111A1 .45-caliber pistol	None (small arms use only)	Black powder (potassium nitrate, sulfur, and charcoal) Smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide

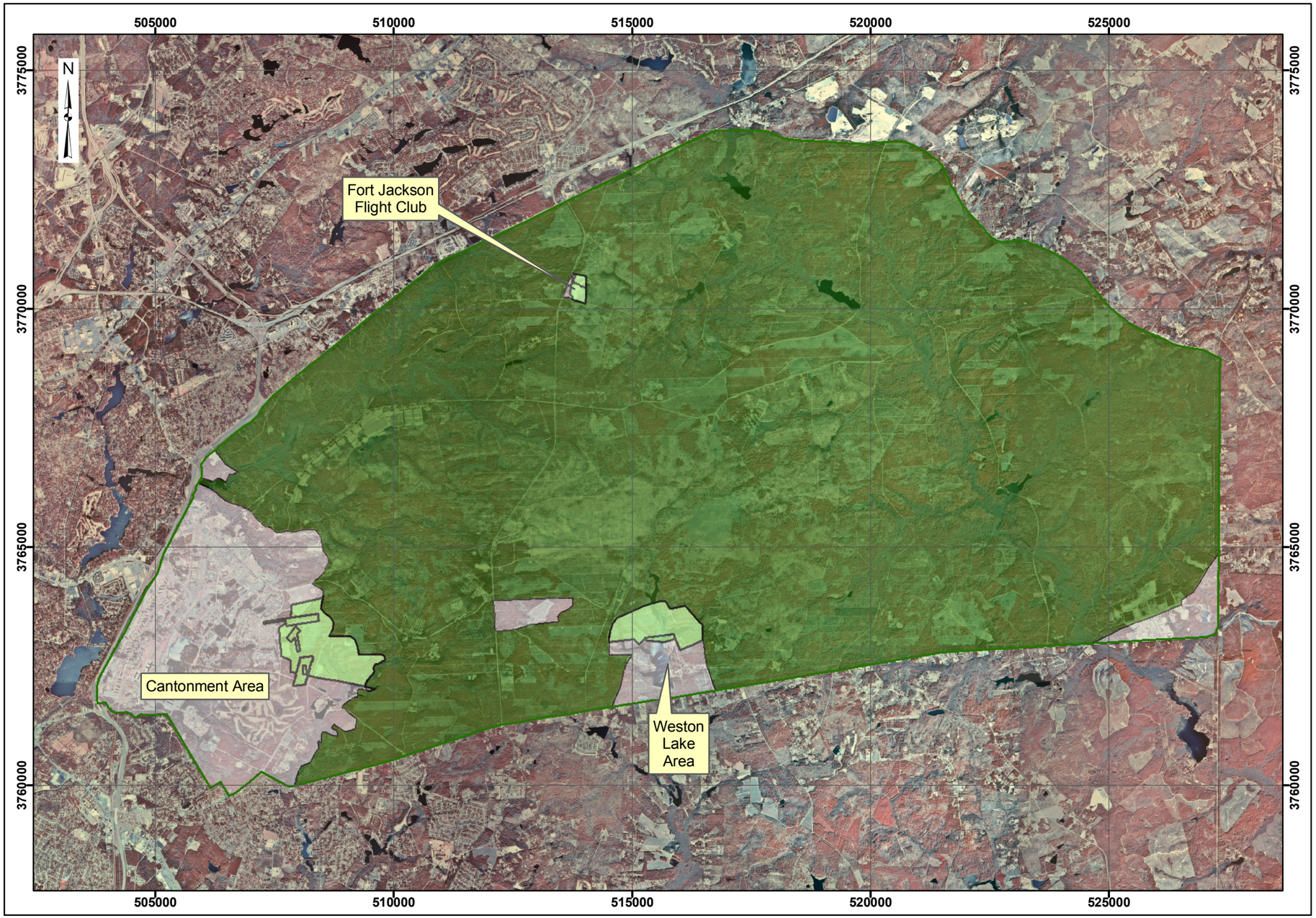
MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
FJFC Salerno Ranges	Firing lines and impact areas for the Salerno Ranges (M-72, M-79, and M18A1) Overlapping Range Area for the Field Firing Machine Gun Range NR 1, Technique of Rifle Fire Range, Night Fire and Vision Range (Saint Lo), and Salerno Range (M-60 only)	66-mm rockets, rocket grenades, 40-mm grenades, 35-mm sub-caliber rockets, M18A1 anti-personnel mines, practice grenades 30-/.50-caliber, 7.62-mm, 5.56-mm	M79 Grenade Launcher, M72 LAW, 3.5-in Rocket Launcher, M18A1 Claymore Mine Browning .30 M1917 Machine Gun, Mk 2 .50 Machine Gun M-60 Machine Gun Springfield Model 1903, Enfield M1917 Rifle, M-1 Garand Rifle, M-1 Carbine, M14 Rifle, M16 Rifle	Non-functioned ordnance, including rockets, rocket grenades, and anti-personnel mines (refer to potential munitions)	Composition B TNT Octol RDX WP C-4 Smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide

MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
FJFC Small Arms Ranges	Firing lines and target areas for the Field Firing Machine Gun Range NR 1, Technique of Rifle Fire Range, Night Fire and Vision Range (Saint Lo), and Salerno Range (M-60 only) Overlapping Range Area: Close Combat No. 2 Range	30-/.50-caliber, 7.62-mm, 5.56-mm	Browning .30 M1917 Machine Gun, Mk 2 .50 Machine Gun M-60 Machine Gun Springfield Model 1903, Enfield M1917 Rifle, M-1 Garand Rifle, M-1 Carbine, M14 Rifle, M16 Rifle	None (small arms use only)	Smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide

MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
Mortar Range	Area between the firing points and targets (safety fan) Overlapping Range Fan Area: Submachine Gun Area, Artillery Range Safety Fans, Close Combat Range, Machine Gun Ranges, Rifle Range, Hand Grenade Court No. 2	3-in stokes, 4.2-in stokes, 60-mm, and 81-mm mortar rounds .30-/.45-/.50-caliber, live and practice grenades	Mortar and Munitions firing	Non-functioned ordnance, including mortar shells and grenades	Black powder (potassium nitrate, sulfur, and charcoal) Smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide RDX Octol Illumination Mix (flare) Composition B TNT WP

MRS	Sub Area	Potential Munitions	Primary Release Mechanism	Potential MEC	Potential MC
Submachine Gun Area	Firing points and safety fan Overlapping Range Fan Area: Artillery Range Safety Fans	.45-caliber submachine gun ammunition	Munitions firing, potentially from the following guns: M1A1 Thompson, M1928 Thompson, M3, M3A1 (grease gun)	None (small arms use only)	Black powder (potassium nitrate, sulfur, and charcoal) Smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine) Double based propellant (nitrocellulose and nitroglycerin) Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide

Historical Records Review
Fort Jackson, SC



Map 4-1
Area Location Map

Legend

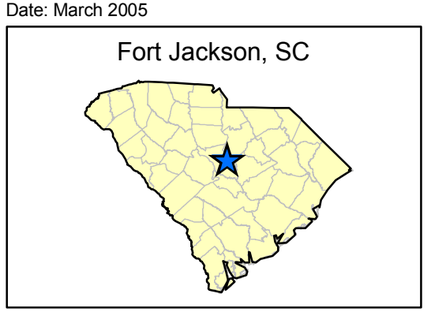
- Installation Boundary
- Operational Range Area
- MMRP Sites
- Fort Jackson Non-Range Property

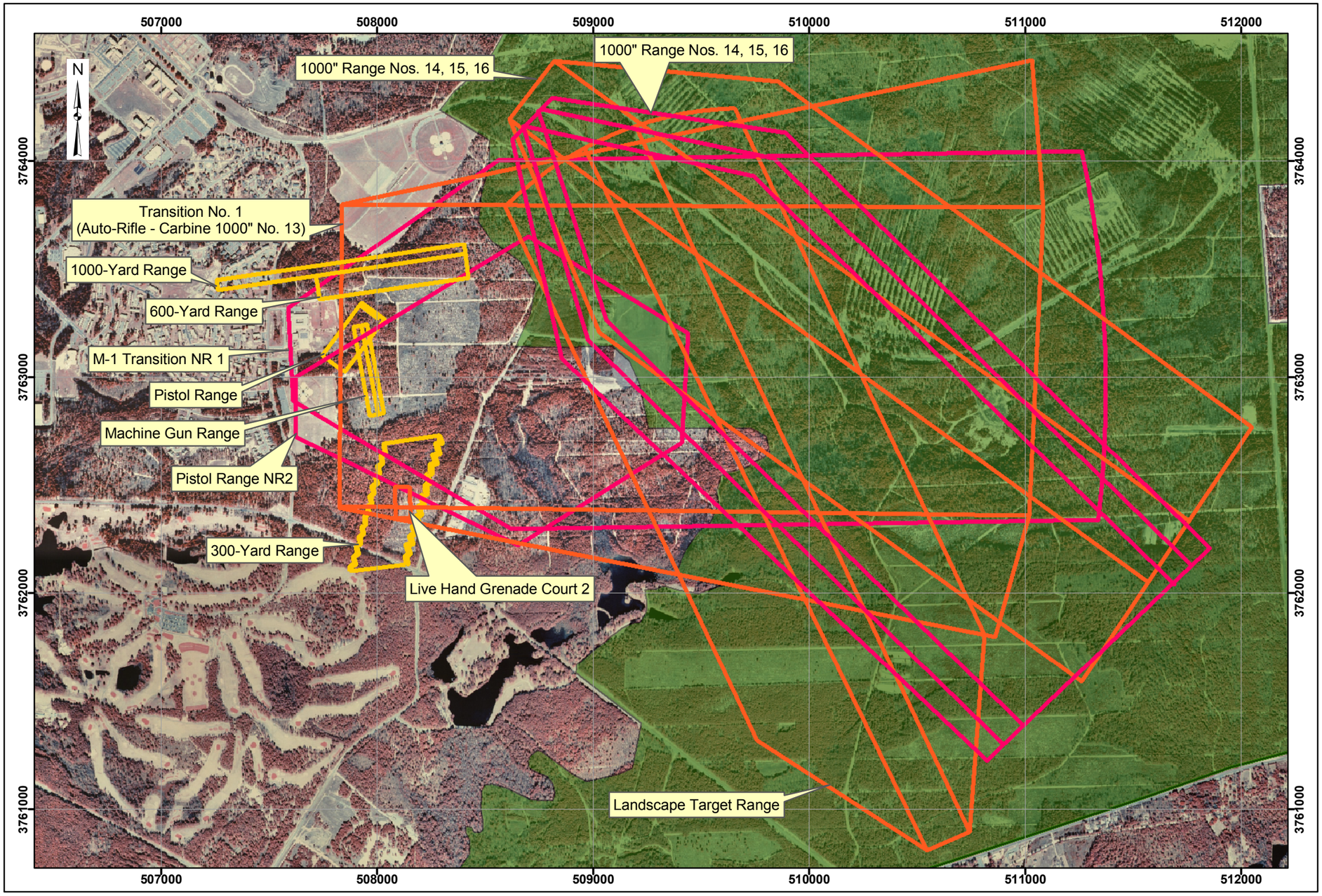
0 1 2 3 Miles

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1997
Fort Jackson South, SC, 1982
Messers Pond, SC, 1995
Congaree, SC, 1987
Leesburg, SC, 1995
Eastover, SC, 1982
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005





Historical Records Review
Fort Jackson, SC

MALCOLM PIRNIE

Map 4-2
Cantonment Area:
Range Details

Legend

- Installation Boundary
- Operational Range Area

Historical Ranges

Source Document

- 1920 Map
- 1949 Map
- 1956 Map

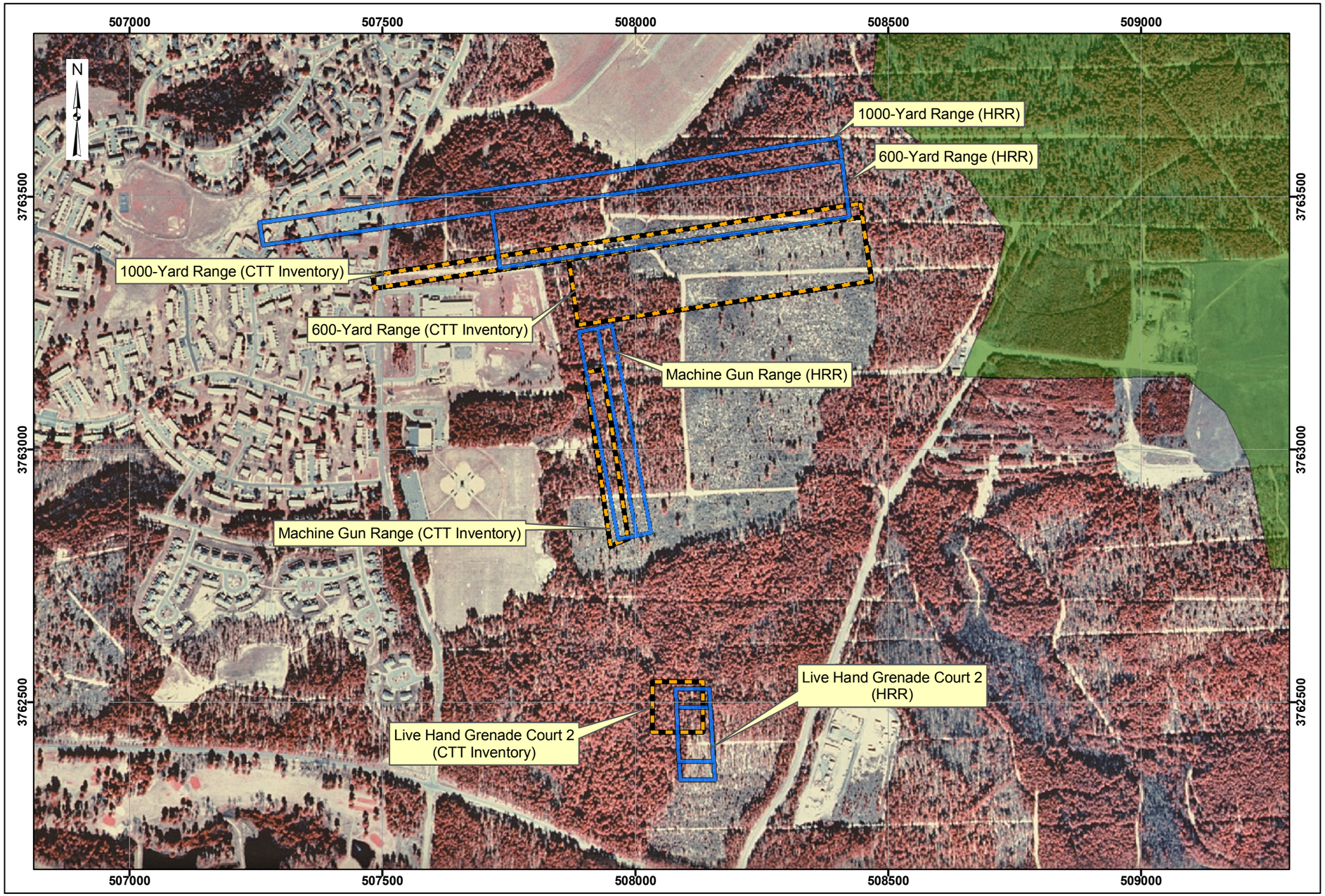
0 250 500 750 1,000 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1996
Fort Jackson South, SC, 1996
Congaree, SC, 1996
Messers Pond, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

Historical Records Review
Fort Jackson, SC



Map 4-3
Cantonment Area:
CTT Range Inventory as compared to
Historical Records Review (HRR)

Legend

- Operational Range Area
- Range Boundary (CTT Range Inventory)
- Range Boundary (HRR)

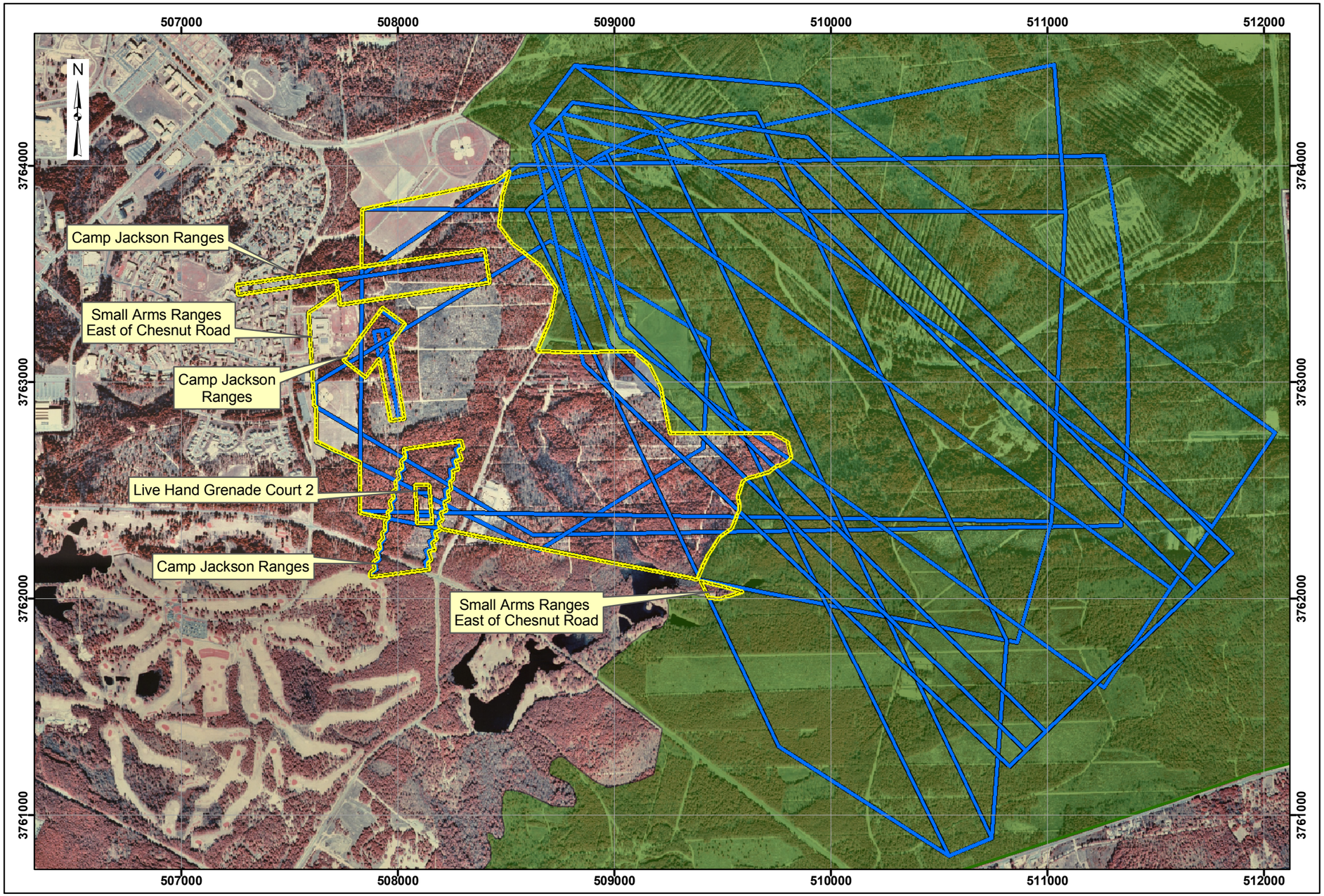
0 100 200 300 400 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

Historical Records Review
Fort Jackson, SC



Map 4-4
Cantonment Area:
MMRP Sites

Legend

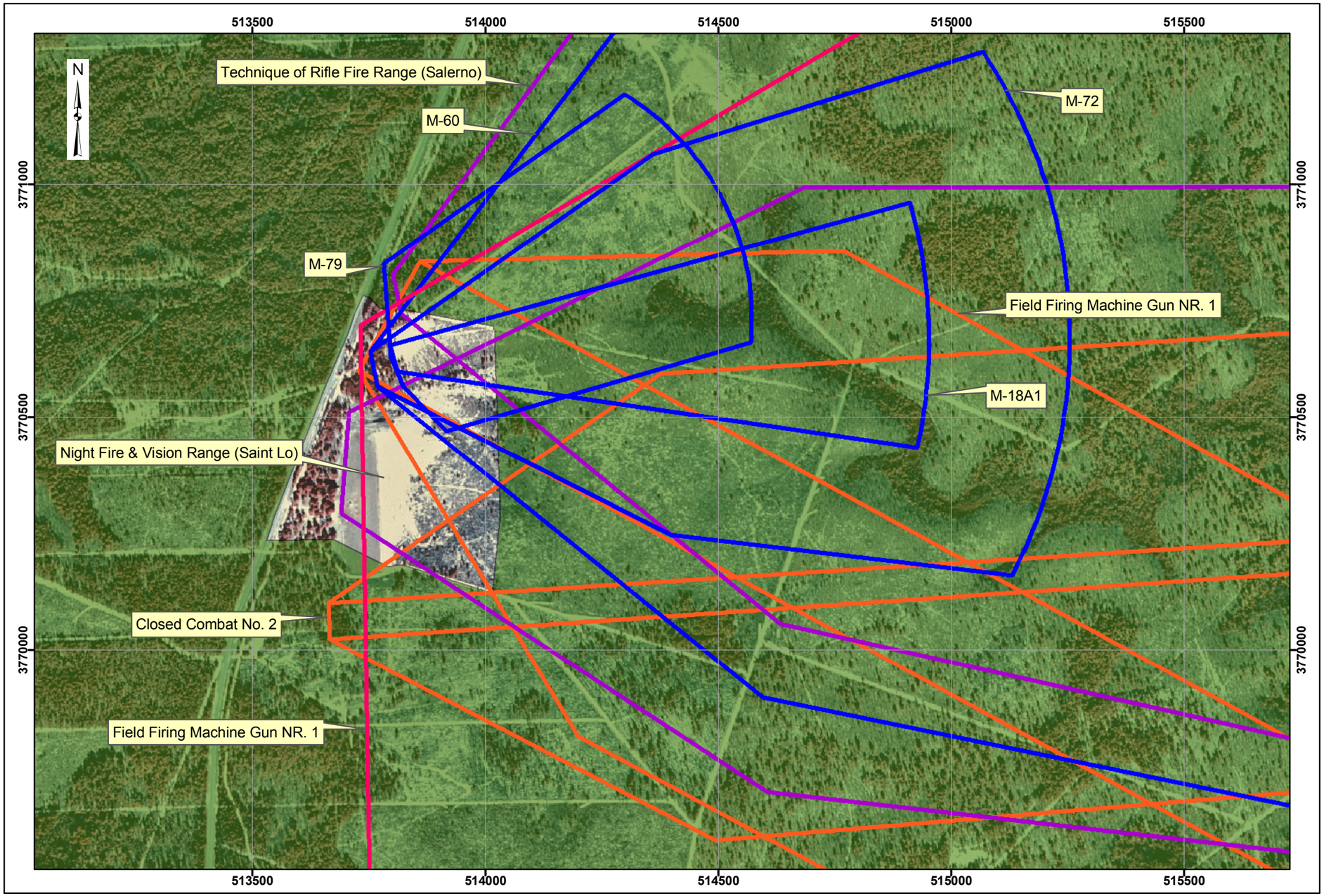
- Installation Boundary
- Operational Range Area
- MMRP Sites
- Historical Ranges

0 250 500 750 1,000 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1996
Fort Jackson South, SC, 1996
Messers Pond, SC, 1996
Congaree, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005



Historical Records Review
Fort Jackson, SC

MALCOLM PIRNIE

Map 4-5
Fort Jackson Flight Club:
Range Details

Legend

Operational Range Area

Historical Ranges

Source Document

- 1949 Map
- 1956 Map
- 1969 Map
- Salerno Demonstration Overlay

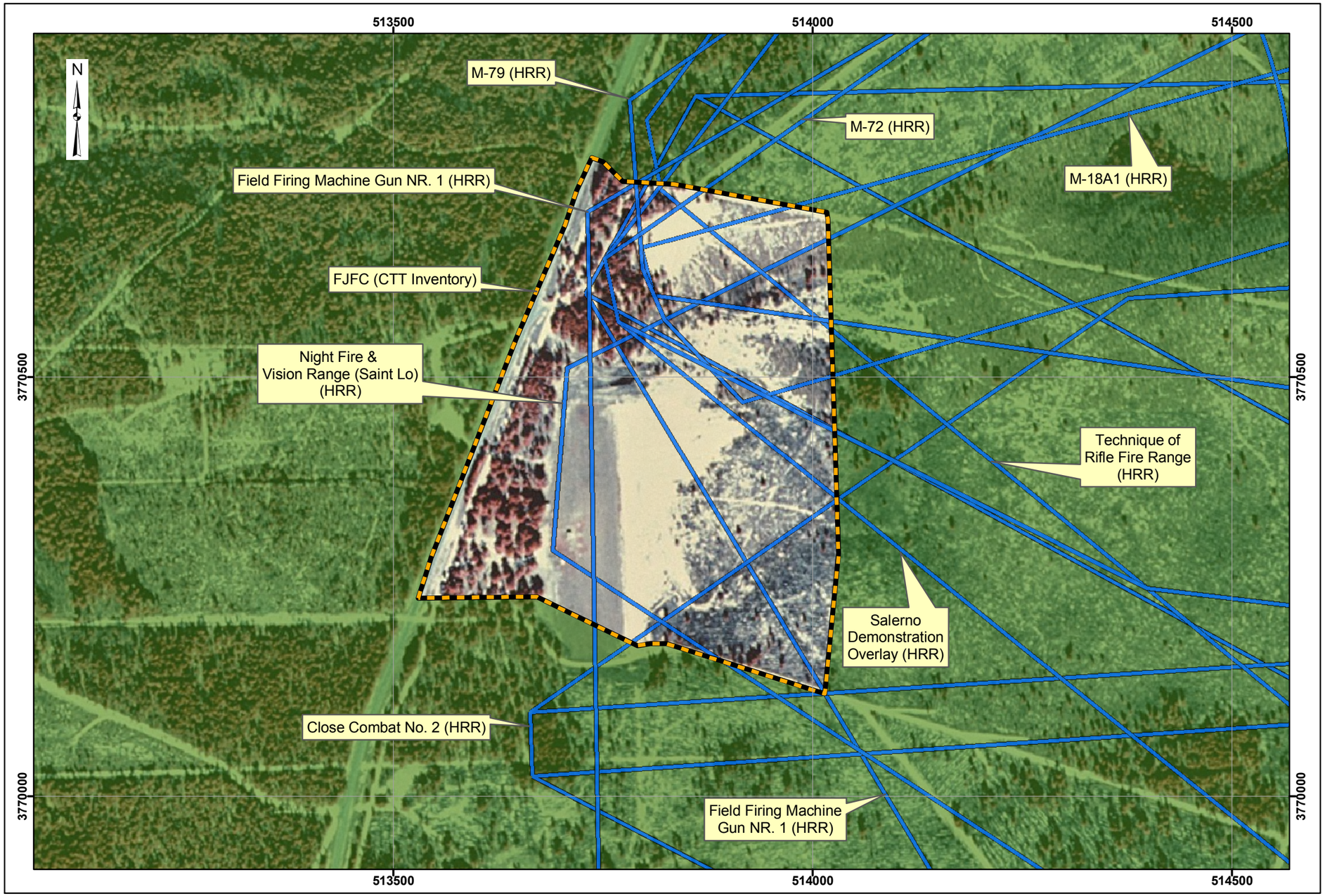
0 100 200 300 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

Historical Records Review
Fort Jackson, SC



MALCOLM PIRNIE

Map 4-6
Fort Jackson Flight Club:
CTT Range Inventory as compared to Historical Records Review (HRR)

Legend

- Operational Range Area
- Range Boundary (CTT Range Inventory)
- Range Boundary (HRR)

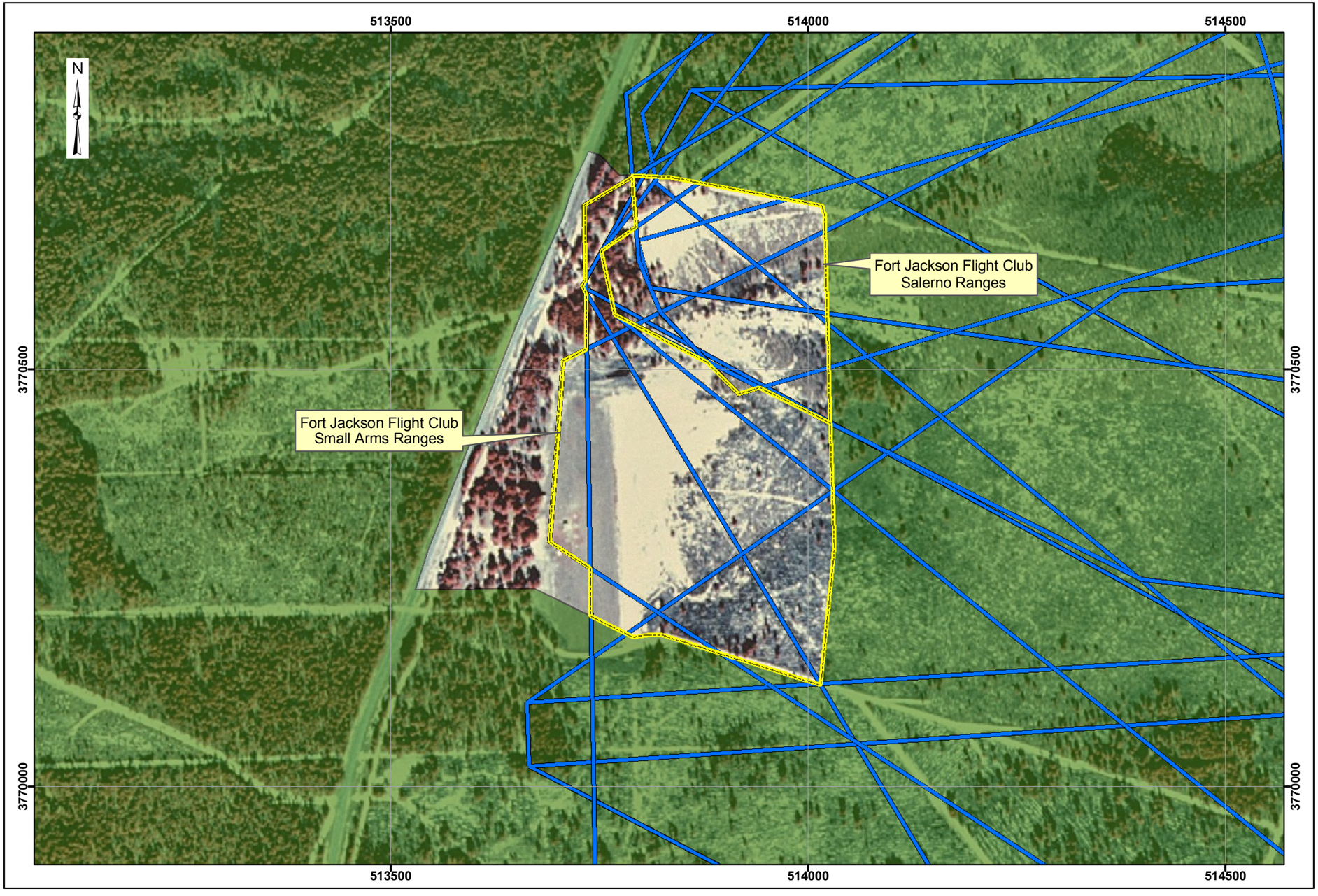
0 100 200 300 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

Historical Records Review
Fort Jackson, SC



Map 4-7
Fort Jackson Flight Club:
MMRP Sites

Legend

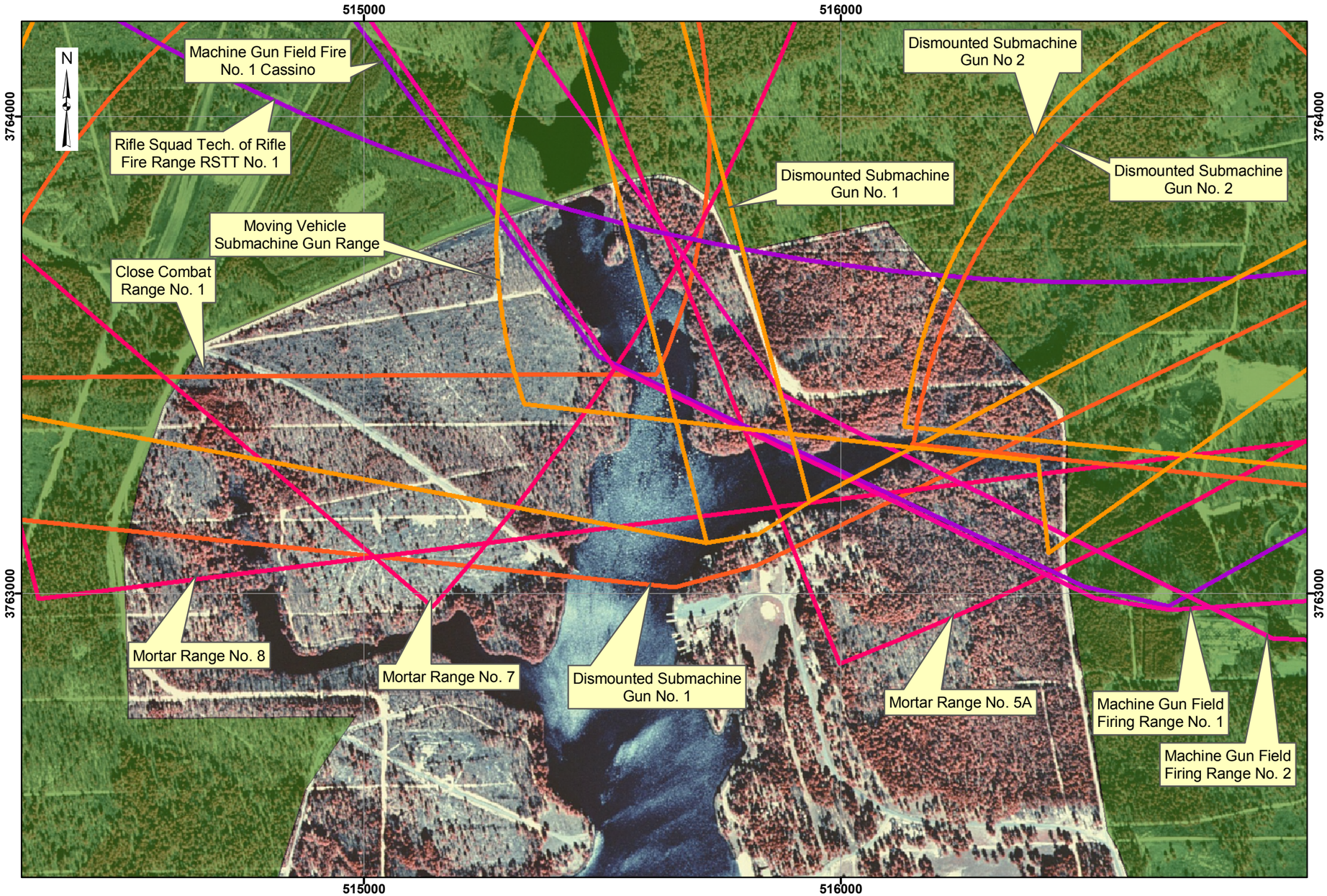
- Operational Range Area
- MMRP Sites
- Historical Ranges

0 100 200 300 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005



Historical Records Review
Fort Jackson, SC

MALCOLM PIRNIE

Map 4-8
Weston Lake Area:
Range Details

Legend

Operational Range Area

Historical Ranges

Source Document

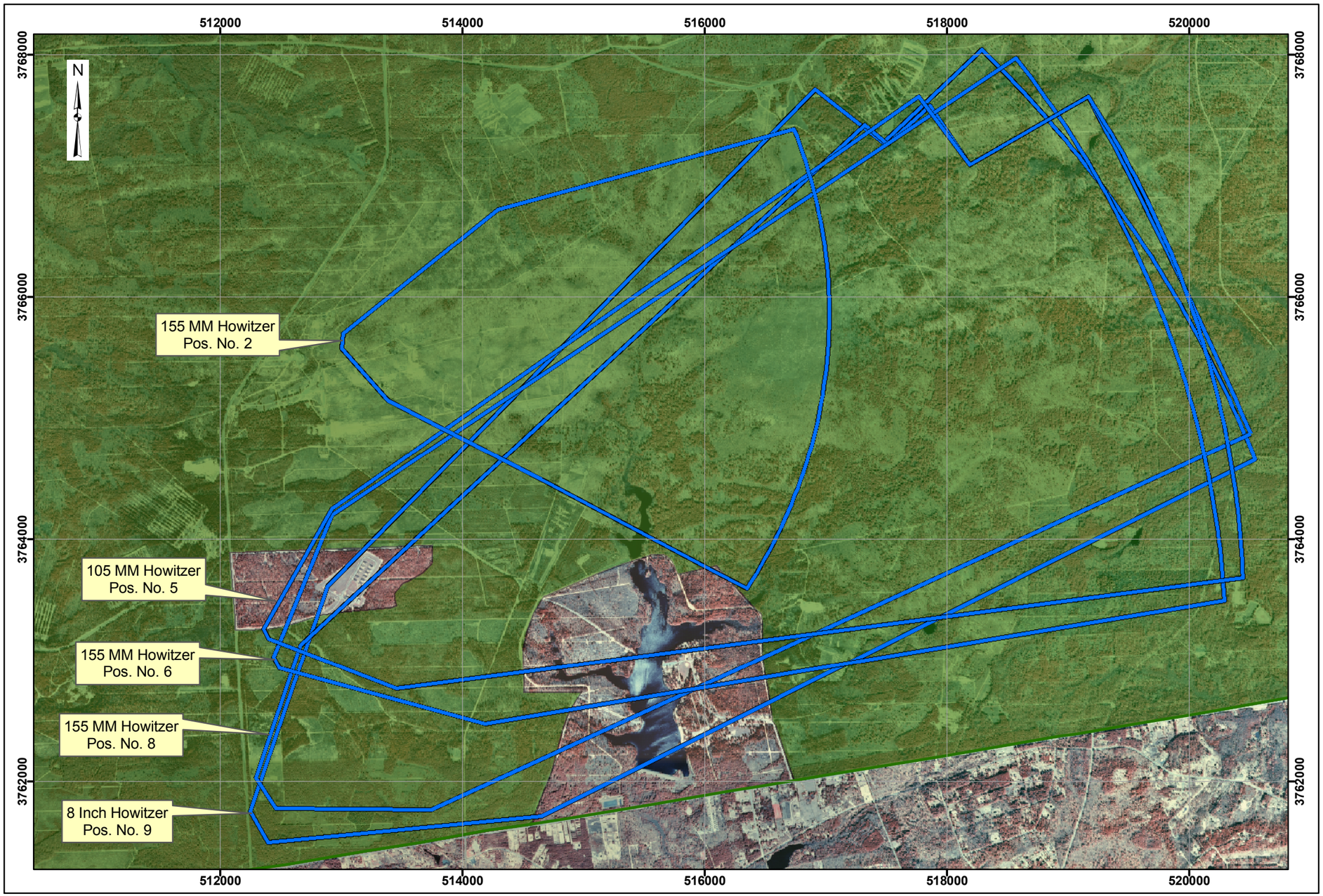
- 1946 Map
- 1949 Map
- 1956 Map
- 1957 Map
- 1969 Map

0 100 200 300 400 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Congaree, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005



Historical Records Review
Fort Jackson, SC

MALCOLM PIRNIE

Map 4-9
Weston Lake Area:
Howitzer Range Details

Legend

- Installation Boundary
- Operational Range Area

Historical Ranges

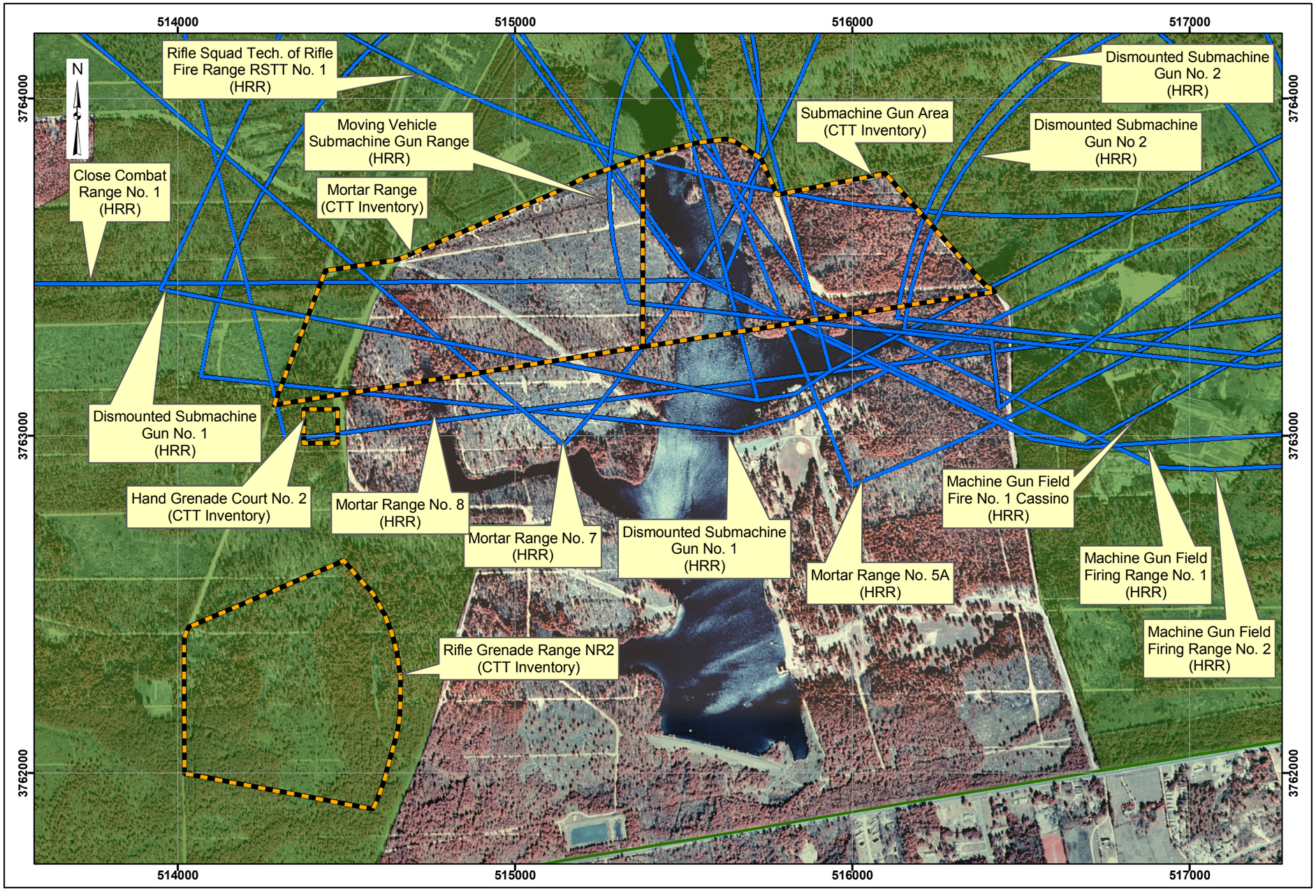
- Howitzer Ranges

0 500 1,000 1,500 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Fort Jackson North, SC, 1996
Congaree, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005



Historical Records Review
Fort Jackson, SC

MALCOLM PIRNIE

Map 4-10
Weston Lake Area:
CTT Range Inventory as compared to Historical Records Review (HRR)

Legend

- Installation Boundary
- Operational Range Area
- Range Boundary (CTT Range Inventory)
- Range Boundary (HRR)

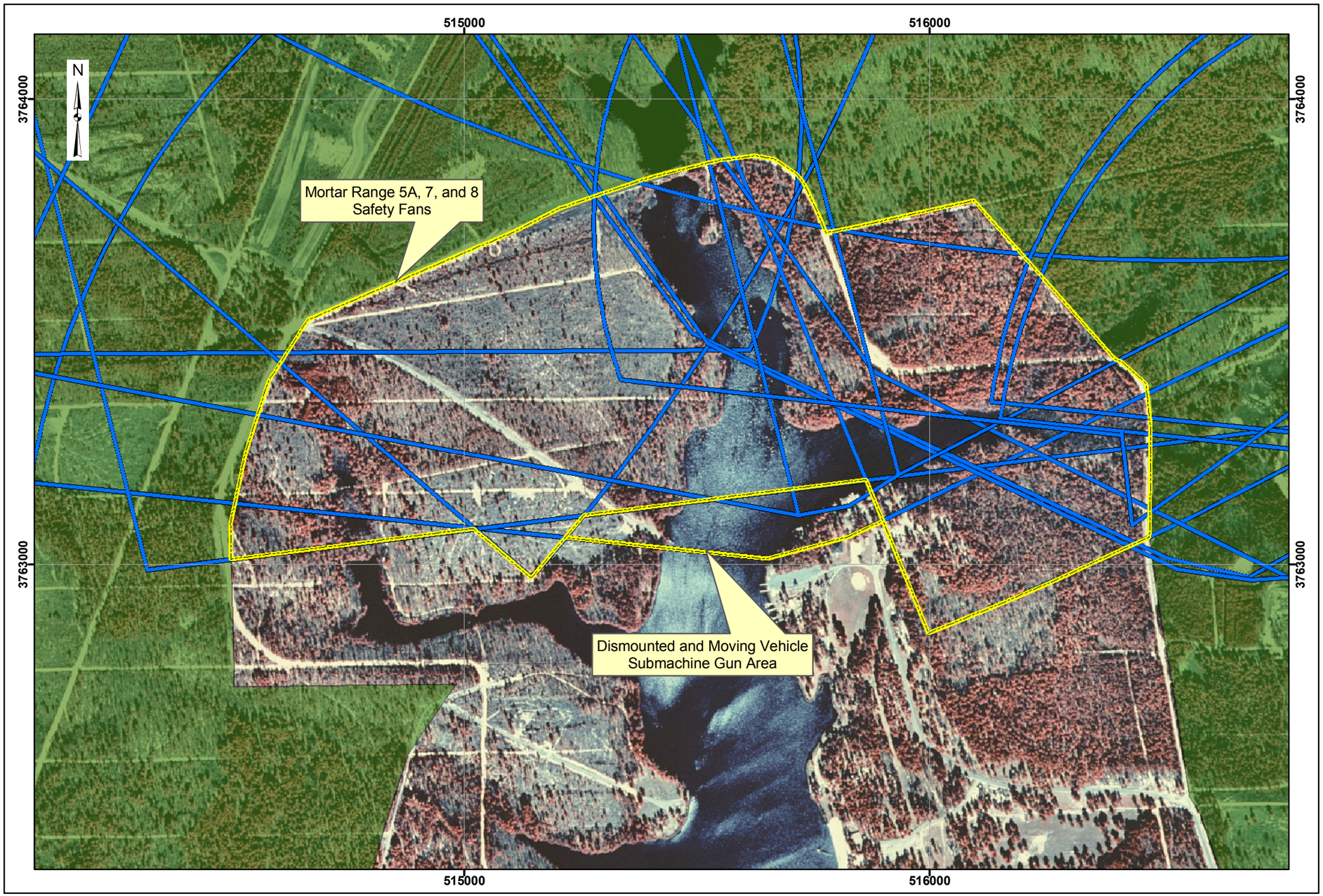
0 200 400 600 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Congaree, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

Historical Records Review
Fort Jackson, SC



Map 4-11
Weston Lake Area:
MMRP Sites

Legend

- Operational Range Area
- MMRP Sites
- Historical Ranges

0 100 200 300 400 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Congaree, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

5 CONCEPTUAL SITE MODEL

5.1 CANTONMENT AREA RANGES/SITES

5.1.1 MMRP Site Profile

5.1.1.1 Area and Layout

The cantonment area is located on the western portion of the installation. A total of 10 ranges located within the cantonment area are evaluated in this HRR. Four of these ranges were identified in the CTT Range Inventory (1000- and 600-Yard Ranges, Machine Gun Range, and the Live Hand Grenade Court 2). Six additional ranges were identified during the preparation of this HRR. Based on geographical location and period of use, the cantonment area ranges have been grouped into the following three MMRP sites: Camp Jackson Ranges, Small Arms Ranges East of Chesnut Road, and the Live Hand Grenade Court 2.

The Camp Jackson Ranges comprise 81 acres and consist of the 1000-Yard Range, 600-Yard Range, 300-Yard Range, Machine Gun Range, and Pistol Range. The Small Arms Ranges East of Chesnut Road occupy 546 acres and consist of the Transition Range; 1000-Inch Range Nos. 14, 15, 16; Pistol Range NR 2; and the Landscape Target Range. The Live Hand Grenade Court No. 2 covers 3 acres.

Geographical features of the Camp Jackson Ranges are as follows:

- The 1000-Yard Range is located just northeast of the center of the cantonment area in between Hartsville Guards Road and Semmes Road. The 1000-Yard Range is long, narrow, and rectangular-shaped and runs in an east-west direction.

- The 600-Yard Range is located immediately south of the 1000-Yard Range. The 600-Yard Range is also rectangular in shape, but is not as narrow as the 1000-Yard Range. The long axis of the range is also oriented in an east-west direction.

- The 300-Yard Range is located on the eastern portion of the cantonment area, south of the 1000- and 600-Yard Ranges and east of the Machine Gun Range. The 300-Yard Range is generally trapezoidal in shape and is oriented in a general north-south direction.

- The Machine Gun Range is located south of the 1000- and 600-Yard Ranges and east of Chesnut Road. The Machine Gun Range has a narrow rectangular shape and is oriented with its long axis in a north-south direction.

- The Pistol Range is located east of Chesnut Road. The range is rectangular in shape and is generally orientated in a southwest-northeast direction.

The Camp Jackson Ranges cover 81 acres in the cantonment area. All of the Camp Jackson Ranges were used for small arms training. They are not all contiguous. The 1000- and 600-Yard Ranges are contiguous, and the Pistol Range and Machine Gun Range overlap.

Geographical features of the Small Arms Ranges East of Chesnut Road are as follows:

- The Transition Range is located east of Chesnut Road between Hartsville Guards Road and Semmes Road. This range is generally rectangular in shape and overlaps the majority of the 1000-Inch Range Nos. 14, 15, 16. The Transition Range is oriented in an east-west direction.

- The 1000-Inch Range Nos. 14, 15, 16 is located southeast of Golden Arrow Road and along the northeast side of Hartsville Guards Road. The range is generally rectangular in shape, with its range fan directed to the southeast.

- The Pistol Range NR 2 is located southwest of the Machine Gun Range. The range is generally rectangular in shape, with its range fan directed to the east.

- The Landscape Target Range is located near the southeastern portion of the cantonment area. The firing direction for this range is northwesterly, and the

Transition Range overlaps the portions of the Landscape Target Range's fan that fall within the other than operational area.

The Small Arms Ranges East of Chesnut Road cover approximately 546 acres in the cantonment area.

The Live Hand Grenade Court 2 consists of approximately three acres and is located south of the Machine Gun Range. Based on historical maps, the throwing lines and trenches were oriented north and south with grenades most likely thrown east and west. The Live Hand Grenade Court 2 represents the approximate size and location of the former hand grenade court throwing lines and impact areas.

5.1.1.2 Structures

Base housing exists on the western-most portion of the 1000-Yard Range. The remaining area of the former 1000-Yard Range, the 600-Yard Range, the 300-Yard Range, and the Live Hand Grenade Court 2 and their immediate surrounding areas are undeveloped. The former Machine Gun and Pistol Ranges are located just west of a school; however, the area of the Machine Gun Range is undeveloped. The southwestern portion of the Pistol Range appears to overlap portions of the schoolyard. The majority of the Transition Range and the 1000-Inch Range Nos. 14, 15, 16 are undeveloped; however, it appears that a recreational area, which consists of a baseball field, football field, and a youth sports center, is located near the western portion of the former Transition Range. A school is located north of the recreational area and could also be located on portions of the former Transition Range.

5.1.1.3 Utilities

A school, base housing, and Chesnut Road are located in close proximity to the western boundaries of the following former ranges: 1000- and 600-Yard Ranges, Pistol Range, Machine Gun Range, Transition Range, and Pistol Range NR 2. The 1000-Yard Range has power lines on portions of it. The school area (which contains overhead electrical lines) and associated recreational area may also be located on portions of the former Transition Range.

Additionally, the Live Hand Grenade Court 2 area is located off of Chesnut Road, which is close to the Pierce Terrace base housing complex. There is potential that underground utilities could exist on range areas that are located in close proximity to cantonment facilities. It has not been determined whether there are utilities located in the area of the 1000-Inch Range Nos. 14, 15, 16.

5.1.1.4 Boundaries

Table 5-1 displays the boundaries of the MMRP sites in the cantonment area.

Table 5-1: Cantonment MMRP Site Boundaries

MMRP Site	Range	Western Boundary	Eastern Boundary	Northern Boundary	Southern Boundary
Camp Jackson Ranges	1000-Yard Range	Undeveloped land	Undeveloped land	Undeveloped land	School, recreational facility, 600-Yard Range
	600-Yard Range	Undeveloped land	Undeveloped land	School, recreational facility, 1000-Yard Range	Undeveloped land
	300-Yard Range	Undeveloped land	Undeveloped land	Undeveloped land	Undeveloped land
	Machine Gun Range	Undeveloped land	Undeveloped land	Undeveloped land	Undeveloped land
	Pistol Range	Undeveloped land	Undeveloped land	Undeveloped land	Undeveloped land
Live Hand Grenade Court 2		Undeveloped land	Undeveloped land	Undeveloped land	Undeveloped land
Small Arms Ranges East of Chesnut Road	Pistol Range NR 2	Undeveloped land	Chesnut Road	Undeveloped land	Undeveloped land
	1000-Inch Range Nos. 14,15,16	Undeveloped land	Undeveloped land	Undeveloped land	Undeveloped land
	Transition Range	School, recreational facility, Chesnut Road, and base housing	Undeveloped land	Undeveloped land	Undeveloped land
	Landscape Target Range	Undeveloped land	Undeveloped land	Undeveloped land	Just north of installation boundary

5.1.1.5 Security

The cantonment area MMRP sites are located within the boundaries of the Fort Jackson installation. The majority of the cantonment area has been enclosed by security fencing and access is controlled at guarded gates. Outside the fenced area, access is limited by gates and/or roadblocks on all roads leading into the installation. Access to the installation is restricted to Army personnel, authorized civilian personnel, contractors, and visitors. Security personnel routinely patrol the cantonment area by vehicle. The individual ranges within the cantonment area ranges are not fenced.

5.1.2 Physical Profile

5.1.2.1 Climate

Fort Jackson is in a humid continental area. Predominant climatic factors are the installation's location in the lower latitudes and its proximity to the Appalachian Mountains to the west, which block the approach of unseasonable cold weather in winter. This southern temperate region can experience temperatures ranging from below freezing to greater than 100 degrees Fahrenheit (ºF); however, there is a relatively narrow annual temperature range, from a mean daily temperature of 81ºF in July to 44ºF in January.

The Bermuda high, a semi-permanent high pressure cell centered in the Atlantic Ocean, dominates summer weather. The influx of warm moist air from the south causes days to be hot and humid. The average high temperature in July, the hottest month of the year, is 91ºF. Temperatures greater than 90ºF are experienced an average of 66 days per year. Winters are generally mild, and January, the coldest month, has an average daily minimum temperature of about 32ºF. Temperatures below freezing are experienced an average of 61 days a year. The frost-free growing season is about 190 days, with the first frost occurring in late October and the last frost usually occurring in mid-April.

The average annual precipitation is 46 inches, with summer rains constituting 39% of annual rainfall. Average monthly rainfall for July and August is five to six inches. Minimum

amounts of rainfall occur during October and November, when monthly averages are about three inches. About every five years an ice storm occurs, severe enough to cause some timber damage. Every few years a tropical storm will cause heavy rains for two or three days. In extremely rare instances, storm winds will come inland far enough to cause damage, such as occurred during Hurricane Hugo in 1989.

5.1.2.2 Geology

Fort Jackson is on the northwestern edge of the Atlantic Coastal Plain Province, a region of low to moderate relief and gently rolling plains, known as the Sand Hills. The Fall Line, a zone that marks the boundary between younger, softer sediments of the Province and ancient, crystalline rocks of the Piedmont Province, lies about four miles west of the cantonment area.

The principal geologic formation in the Sand Hills is the Tuscaloosa Formation, which consists of marine deposits of light-colored sands and kaolin clays. Most soils at Fort Jackson are formed from sediment of the Tuscaloosa Formation. A layer of Quaternary sand terrace overlies the Tuscaloosa Formation, which`, and arkosic sands. It lies unconformably on the peneplained surface of crystalline rocks.

5.1.2.3 Topography

Gently to moderately rolling, moderately dissected high plains occupy most of Fort Jackson. Flat to gently rolling low plains characterize the extreme western portion of the installation, including a major portion of the cantonment area and the alluvial plains occupied by southwesterly flowing Gills and Mill creeks. Local relief around the valley of Gills Creek and its tributaries is generally less than 60 feet. Slopes are predominately between zero and three percent on the alluvial plains, and slopes in the cantonment area are predominately between three and eight percent.

5.1.2.4 Soil

Soils at Fort Jackson range from nearly level to strongly sloping, characteristic of the Sand Hills. Principal soil map units occurring on Fort Jackson are the Lakeland, Vaucluse-Ailey-Pelion, and Pelion-Johnston-Valcluse. The installation also has Blanton soil series and

various soil-urban land complexes. These soils are typically well drained on high plains and side slopes and poorly drained in valleys. Surface soil layers in the Sand Hills are usually sandy with predominantly loamy subsoil.

Within the cantonment area, facilities are developed on moderately well drained, fine sands, silts, and clays, which are part of various soil-urban land complexes. Pelion urban land complex is the major soil series within the cantonment. Pelion soils occur on side slopes of ridges, with typical slopes of two to 15%. Pelion soils are loamy sands, very strongly acidic with moderately slow permeability.

5.1.2.5 Hydrogeology

Groundwater is generally plentiful at Fort Jackson. The Tuscaloosa Formation, of Upper Cretaceous age, underlies Fort Jackson and is the primary source of groundwater in the area. Small quantities of groundwater may be available in alluvial deposits along major streams.

The Tuscaloosa Formation is at the surface over most of Fort Jackson. This formation lies unconformably on a peneplained surface of older, crystalline rocks. The formation consists of interbedded, generally unconsolidated, fine to coarse sand and clay, causing groundwater to occur under both unconfined and confined (i.e., artesian) conditions. Groundwater occurs under water table conditions in the upper part of the zone of saturation. At a depth of about 99-251 feet, permeable sand zones are frequently overlain by less permeable clay zones, and the groundwater exists under artesian conditions.

Groundwater in the Fort Jackson area is suitable for human consumption; water quality is considered excellent. Total dissolved solids are generally less than 50 milligrams per liter. Water standards are occasionally exceeded by slight concentrations of iron and manganese. Fort Jackson is not located within a recharge area for the sole-source aquifer. A figure from a 1997 environmental sampling report shows an active water supply well located southwest of Heise Pond and south of Semmes Road. This well is located south of the Live Hand Grenade Court No. 2 and the Transition Range. This figure also shows three active water

supply wells located just east of Weston Lake and a water supply well located in the vicinity of the FJFC.

5.1.2.6 Hydrology

Five separate watersheds receive surface water runoff from the Fort Jackson installation. These watersheds are drained by Wildcat, Gills, Colonels, Mill, and Cedar Creeks. Wildcat Creek drains most of the cantonment area of Fort Jackson and flows west, where it enters the Gills Creek drainage area just below Lake Katherine. The Gills Creek drainage area is the second largest drainage area of the installation and is in the extreme northwest corner of Fort Jackson. This creek flows south along the installation's western boundary and enters the southeast-flowing Congaree River south of Columbia. Colonels Creek is the installation's largest drainage basin and drains the entire eastern one third of Fort Jackson. Colonels Creek flows southeast and off-post, eventually discharging into the Wateree River, a tributary of the Congaree River. Mill Creek drains the southwestern portion of the installation, flows off-post, and eventually discharges into the Congaree River. Cedar Creek drains an area along the installation's southern boundary. Drainage from this area flows southward, off-post, and also eventually discharges into the Congaree River

5.1.2.7 Vegetation

The area of Fort Jackson encompasses a wide variety of vegetative site conditions ranging from bottomland hardwood communities to xeric longleaf pine communities. In general, Fort Jackson can be classified into five primary terrestrial vegetative types: pine, pine/upland hardwood, upland hardwood, bottomland hardwood, and open field. There are no grassland areas on Fort Jackson, except for a small amount in the cantonment area and alongside roads.

Vegetation on Fort Jackson is diverse and abundant. Field investigations and surveys have identified over 750 species of flora on the installation. There are no farmlands within the installation boundary. Forest cover is the principal vegetative type and may be grouped into eight major forest types: Natural Pine, Pine Plantation, Pine-Scrub Oak, Pine-Hardwood, Scrub Oak, Upland Hardwood, Bottomland Hardwood, and Hardwood-Pine.

5.1.3 Land Use and Exposure Profile

5.1.3.1 Current Land Use / Activities

The former ranges within the cantonment area consist of undeveloped forested land. Fort Jackson manages the facilities forest resources with annual timber harvests. Timber located on some of the former ranges may be cut during the annual harvest. A school and its associated recreational facilities are located within the western portion of the Transition Range.

5.1.3.2 Current Human Receptors

With the exception of the western portion of the former Transition Range, which is occupied by a school and associated recreational area, the majority of the areas within the cantonment ranges are undeveloped woodland and largely inaccessible by vehicle. Human receptors are limited to authorized installation personnel, contractors, visitors, and trespassers. School children, teachers, and school officials would be the human receptors for the areas of the western portion of the Transition Range.

5.1.3.3 Potential Future Land Use

Currently there are no plans to develop the former cantonment area ranges. Potential land use will continue to be consistent with forest management (i.e., timber harvesting).

5.1.3.4 Potential Future Human Receptors

Potential future human receptors would be limited to current use receptors, to include authorized installation personnel, contractors, visitors, and trespassers.

5.1.3.5 Zoning/Land Use Restrictions

The majority of the MMRP site land areas have a land use class of Cantonment Open Space. Some ranges, located immediately east of Chesnut Road, overlap other land use classifications. The Transition Range, the Pistol Range, and the 600-Yard Range slightly overlap a Community Facility land use class, and the western portion of the Machine Gun

Range overlaps a Housing land use class. No zoning or land use restrictions have been identified for the land areas of the ranges located in the Cantonment Open Space land use class.

5.1.3.6 Beneficial Resources

As stated previously, the area of Fort Jackson encompasses a wide variety of vegetative site conditions ranging from bottomland hardwood communities to xeric longleaf pine communities. Natural Pine and planted pine are the most important forest types on the installation, which include all pine stands regardless of species. Timber is harvested annually at Fort Jackson. The annual harvest of timber products on Fort Jackson consists of sales ranging in size from 200 to 4,000 cords.

According to the Revised Final Phase II RFI Report for the Wonsan (SWMU 12) and Inchon (SWMU 17) Explosive Ordnance Disposal Sites, a variety of mammals and birds are likely to find suitable habitat on Fort Jackson, particularly in the adult, select cut, long-leaf pine forests adjacent to the active impact areas or within the adjacent scrub-brush habitat present on the active impact and ranges. It is noted that the SWMU 12 and SWMU 17 sites are located just east of the Weston Lake Area. This document also reported that a total of 78 federal and/or state listed threatened and endangered species have been identified within Richland County. However, only three species are present at Fort Jackson: the Rough-leaved Loosestrife, Smooth Coneflower, and the Red-cockaded Woodpecker. None of these species have been identified within the cantonment area.

Additionally, groundwater is generally plentiful at Fort Jackson. The Tuscaloosa Formation, of Upper Cretaceous age, underlies Fort Jackson and is the primary source of groundwater in the area. The Tuscaloosa Formation is at the surface over most of Fort Jackson. Groundwater in the Fort Jackson area is suitable for human consumption; water quality is considered excellent. However, according to a 2003 Phase II RFI report, groundwater is not used as a potable water source at Fort Jackson. Potable water is provided to Fort Jackson by the City of Columbia.

The following discussion pertains to Fort Jackson's cultural resources. According to the INRMP, Fort Jackson has completed a number of cultural resource surveys inventorying and documenting archaeological and historical resources. About 81% of Fort Jackson has been surveyed for archaeological resources. Known NRHP eligible or potentially eligible archaeological sites have occurred in fairly discrete clusters. Remaining portions of Fort Jackson that have not been examined are located in the main cantonment area and impact areas in outlying portions of the installation. The un-surveyed portion of the main cantonment area is expected to contain archaeological resource sites, some of which may be eligible for the NRHP. However, a letter from the South Carolina State Historic Preservation Office indicated that disturbed portions of the main cantonment area do not require survey (Cantonment Area, Fort Jackson, Richland County, South Carolina, letter from the State Historic Preservation Office dated December 15, 1993).

A total of 662 archaeological sites had been identified within Fort Jackson. Most have been preliminarily determined to be ineligible for the NRHP. With exception of the 11 cemeteries recorded as archaeological sites, these resources require no further management consideration. Twelve sites are considered eligible for the NRHP. NRHP-eligible resources must be preserved in place or subjected to appropriate data recovery investigations to prevent the loss of the significant information that is present. The remaining 96 sites have been determined to be potentially eligible for the NRHP. These sites contain components of the different cultural periods identified at Fort Jackson. These resources must be preserved in place until their eligibility for listing has been determined.

Numerous surveys have reviewed the historic qualities of the 1,700 structures at Fort Jackson, most of which have been built in the last 35 years. A review of all existing and demolished structures and all previous historic structure surveys concluded that only three structures were recommended as eligible for listing in the NRHP. One of these structures was subsequently mitigated and demolished. Remaining properties exhibited little integrity and are not considered NRHP-eligible (Panamerican Consultants, Inc., 1997).

Cemeteries are associated with families, churches, or communities that were present on installation lands prior to their acquisition by the Army. Cemeteries on Fort Jackson are enclosed by fences and maintained by the Army. None of Fort Jackson's cemeteries are considered eligible for NRHP inclusion, but all are protected. For management purposes, all cemeteries are treated in the same manner as NRHP-eligible cultural resources.

Fort Jackson has no properties listed on the NRHP, no identified access routes to or sites of religious or ceremonial rites of American Indians, no properties listed as National Historic Landmarks, and no properties listed on the World Heritage List. There may be properties potentially eligible for listing on the NRHP. There are 12 archaeological sites eligible for listing on the NRHP and 96 that are potentially eligible. Two structures remain eligible for the NRHP.

5.1.3.7 Demographics

Based on figures from the 2000 U.S. Census, the population of Richland County (in 2000) was 320,677. The population of the City of Columbia, Richland's largest city, was 116,278. With respect to Fort Jackson, soldiers, civilians, retirees, and family members make up the Fort Jackson community, which continues to grow. The installation instructs an average of 35,000 soldiers in basic and advanced training each year. An additional 19,000 attend courses at the Soldier Support Institute, Chaplain Center & School, and Drill Sergeant School. Fort Jackson employs 3,900 civilians and provides services for more than 100,000 retirees and their family members.

5.1.4 Ecological Profile

5.1.4.1 Habitat Type

According to the INRMP, forest cover is the principal vegetative type on Fort Jackson. The forest types are described in Section 5.1.2.7. Forest management has the most impact on wildlife management on Fort Jackson. Silvicultural treatments modify the landscape and associated wildlife habitats. To ensure silvicultural practices are performed in a manner that positively affects wildlife, all prescriptions are forwarded through the Wildlife Office for

review and comment. Most prescriptions result in beneficial impacts to many wildlife species, but some species may be negatively impacted by the operations in the short term. The only featured species designated for forested habitats is the Red-cockaded Woodpecker.

5.1.4.2 Degree of Disturbance

Disturbance of flora and fauna within the former ranges of the cantonment area is expected to be low to moderate during annual timber harvests.

5.1.4.3 Ecological Receptors

According to the June 2000 ICRMP, compiled by Mr. Jack Wynn (Heritage Program Manager for the Chattahoochee-Oconee National Forests) and Mr. Michael Harmon (Assistant Forest Archaeologist for the National Forests in North Carolina), only one federally listed endangered animal species exists on Fort Jackson: the Red-cockaded Woodpecker (*Piciodes borealis*). The bird nests in aging (greater than 70 year old) pines, lives in family groups or clans, and inhabits park-like territories or clusters of 1,500 radii. There are about 13 active clusters and 39 inactive ones on the installation. This population is routinely monitored, and the surrounding forest managed to encourage the survival of the groups. None of the bird nests or clusters are within the cantonment area ranges discussed in this section.

There are four candidate species for listing as threatened or endangered. They are Southeastern myotis (*Myotiss austroriparius*), Rafinesques's big-eared bat (*Plecotus rrafinequii*), Loggerhead shrike (*Lanius Ludovicianus*), and Bachman's sparrow (*Aimphila aestivalis*). They may be listed later if their populations drop. There are also two federally endangered plant species, rough-leaved loosestrife (*Lysimachia asperulaefolia*) and smooth coneflower (*Echnata laevigata*). Two candidate plants for listing are also found on the installation. They are the crested fringed orchid (*Pteroglossaspis ecristata*) and Piedmont milfoil (*Myriophyllulm laxum*). Endangered species monitoring plans have been prepared for listed species and are consulted prior to any activities that might cause disruptions.

According to the INRMP, the rough-leaved loosestrife is found on the eastern edge of the East (artillery) Impact Area. The smooth coneflower has been documented adjacent to Statue of Liberty Road in Training Area 29B. Neither of the endangered plant species is located within the cantonment area.

5.1.5 Munitions/Release Profile

5.1.5.1 Munitions Types and Release Mechanisms

Table 5-2 presents a summary of the types of munitions that were either identified during the limited visual survey or are expected to exist at the former cantonment area ranges based on information collected for this HRR. The mechanisms by which the munitions were released into the environment are also presented in this table. The typical release mechanisms for the former ranges are intentional activities, such as firing into a target area, and unintentional activities, such as rounds fired falling outside the target area or rounds discarded for various reasons at the firing point. It is noted that the majority of the ranges within the cantonment area were generally used for small arms training. Map 5-1, located at the end of Section 5, shows the horizontal extent of MEC for the cantonment area ranges. Only one range, the Live Hand Grenade Court 2, has the potential for MEC. As such, the primary concern for the cantonment ranges would be associated with MC.

Table 5-2: Summary of Potential Munition Types - Cantonment Area

MMRP Site	Potential Munitions	Primary Release Mechanism
Camp Jackson Ranges	.30-/.45-/.50-caliber	Munitions firing, potentially from the following weapons: Springfield Model 1903, M1909 Revolver, M1917 Revolver, Enfield M1917 Rifle, Browning .30 caliber M1917 Machine Gun, M2 .50-caliber Machine Gun
Live Hand Grenade Court 2	Hand grenades: MK 2 Frag, MK II Practice, M26/61 Frag, M30/62 Practice, M48E1 Smoke, M69 Practice, M18 Smoke, M26A2 Frag, M57 Frag, M34 Smoke, M59/58 Frag	Munitions firing (throwing) - hand grenades

MMRP Site	Potential Munitions	Primary Release Mechanism
Small Arms Ranges East of Chesnut Road	.22-/.30-/.45- caliber	Munitions firing, potentially from the following guns: Springfield Model 1903, M1909 Revolver, M1917 Revolver Enfield M1917 Rifle, M-1 Garand Rifle, M-1 Carbine, M1911 and M19111A1 Pistol

5.1.5.2 Maximum Probable Penetration Depth

The ranges located south of Hartsville Guards Road (the Camp Jackson Ranges, Live Hand Grenade Court 2, and Small Arms Ranges East of Chesnut Road) consist of nine small arms ranges and one hand grenade range. Small arms and hand grenades do not have an associated penetration depth. These and other MC components (such as spent shell casings and residual black or smokeless powder constituents) are expected to have been directly deposited on the soils surface.

5.1.5.3 MEC Density

MEC presence in the ranges located south of Hartsville Guards Road, with the exception of the Live Hand Grenade Court 2, is not anticipated because these ranges were used for small arms training. There is potential for MEC presence in the area of the Live Hand Grenade Court 2.

5.1.5.4 MEC Scrap/Fragments

No MEC scrap or fragments were identified at the Live Hand Grenade Court 2; however, a visual reconnaissance of the entire area was not performed for this HRR.

5.1.5.5 Associated Munitions Constituents

As noted in Table 4-10, the MC associated with the cantonment area ranges include the following: black powder (potassium nitrate, sulfur, and charcoal), smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine), double based propellant (nitrocellulose and nitroglycerin), Pb, Sb, As, Cu, Zn, Fe, Mg, lead styphnate/lead azide, RDX, and WP.

5.1.5.6 Transport Mechanisms / Migration Routes

The primary transport mechanisms identified for the former cantonment area ranges include the following:

Erosion: The majority of the cantonment areas are heavily vegetated. Thunderstorms often cause local flooding during the summer months; therefore, erosion could be a factor in transporting and migrating MC contaminated soil.

Soil Disturbance: Any surface or subsurface soil disturbance can cause both the transport and migration of MEC and MC. Surface and subsurface disturbances can lead to transport and migration of MC from one environmental media to another (soil to surface or groundwater or both) through surface water runoff and erosion. Since there is potential for timber harvesting to occur in some of the cantonment areas, the potential for soil disturbance exists.

Infiltration: Based on the generally sandy soils located within the cantonment area, the potential for MC to migrate from one environmental media to another (surface to subsurface soil to groundwater) through infiltration exists.

5.1.6 Pathway Analysis

5.1.6.1 MEC

A MEC pathway analysis was prepared for the Live Hand Grenade Court No. 2 (Figure 5-1). The Live Hand Grenade Court No. 2 is located east of Chesnut Road within the southwestern portion of the Transition Range. Since there is no penetration depth associated with hand grenades, MEC in the subsurface is not anticipated. The primary exposure pathway for human and ecological receptors is handle/tread underfoot of surface MEC. The potential for complete pathways exists between surface MEC and all receptors for the Live Hand Grenade Court No. 2.

5.1.6.2 MC

Due to the numerous ranges located within the cantonment area, similar ranges were grouped together to minimize the number of MC pathway analyses models. A pathway analysis figure was created for the Live Hand Grenade Court 2, Camp Jackson Ranges, and the Small Arms Ranges East of Chestnut Road. In summary, the following MC pathway analyses were prepared:

- Live Hand Grenade Court 2 (Figure 5-2)
- Camp Jackson Ranges - 1000-Yard, 600-Yard, 300-Yard, Machine Gun, and Pistol Ranges (Figure 5-3)
- Small Arms Ranges East of Chesnut Road – Transition Range, 1000-Inch Range Nos. 14, 15, 16, Pistol NR 2, and Landscape Target Ranges (Figure 5-4)

The three MC pathway analyses for the cantonment area ranges each show a potentially complete pathway for biota for the vegetation exposure route. Biota is the only receptor expected to ingest vegetation at the sites. Crops are not grown, and domestic animals are not raised on these sites. Biota has potentially complete pathways for contact with MC impacted vegetation. All other pathways for vegetation in the food chain are expected to be incomplete.

The pathways between game/fish/prey and authorized installation personnel, contractors, and visitors are incomplete because hunting is not permitted in the cantonment area and there are no water bodies overlapped by any HRR-identified ranges. Biota has potentially complete pathways through the potential ingestion of prey that may have fed on contaminated vegetation in these areas.

Potentially complete pathways for ingestion and dermal contact exist between surface water/sediment and all receptors at these sites because there is potential for erosion to enable the migration of MC to the water bodies located at the southern portion of the cantonment area; Heises Pond and Twin Lakes.

The groundwater exposure routes are expected to be potentially complete pathways for all potential receptors since there is an active water supply well located south of Semmes Road in the southern portion of the cantonment area. However, the City of Columbia supplies Fort Jackson with potable water.

Potentially complete pathways for all exposure routes for both surface and subsurface soil exist for all receptors. Since access to and activities in these areas are not restricted, the potential for soil disturbance to occur exists. Also, the subsurface pathways would be potentially complete for biota because they may nest or burrow in these areas.

Figure 5-1: MEC Exposure Pathway Analysis - Live Hand Grenade Court 2

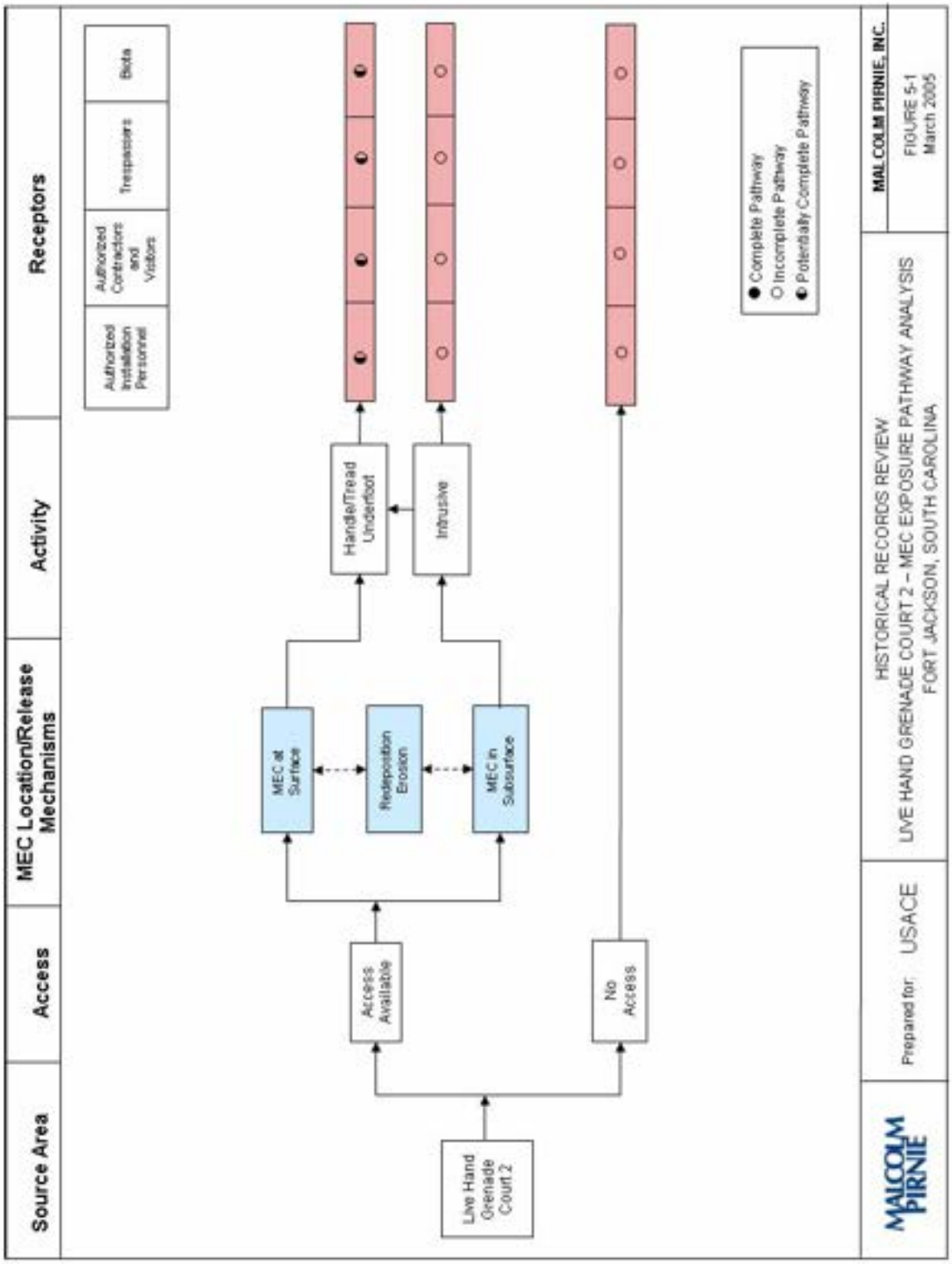


Figure 5-2: MC Exposure Pathway Analysis - Live Hand Grenade Court 2

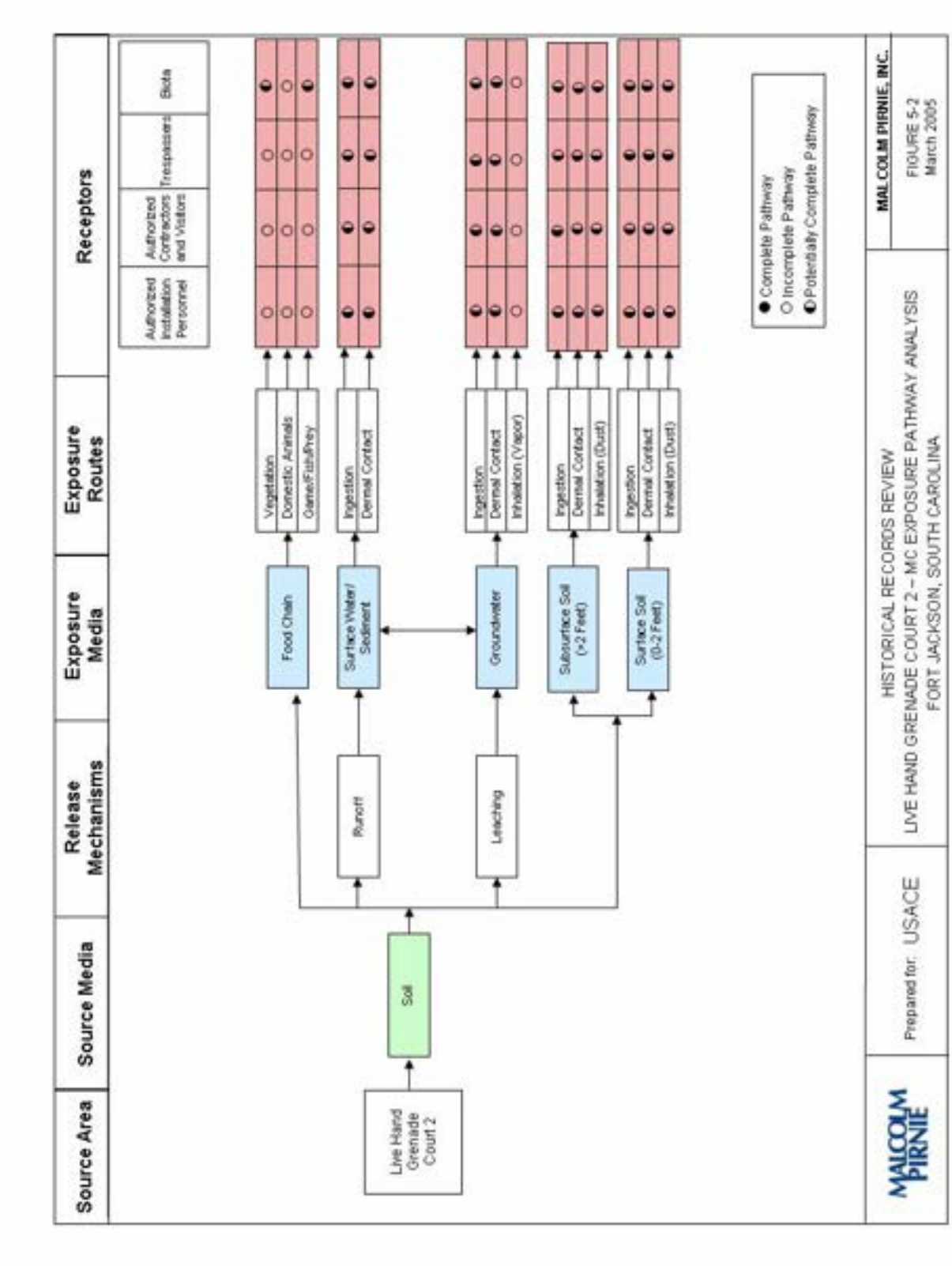


Figure 5-3: MC Exposure Pathway Analysis – Camp Jackson Ranges

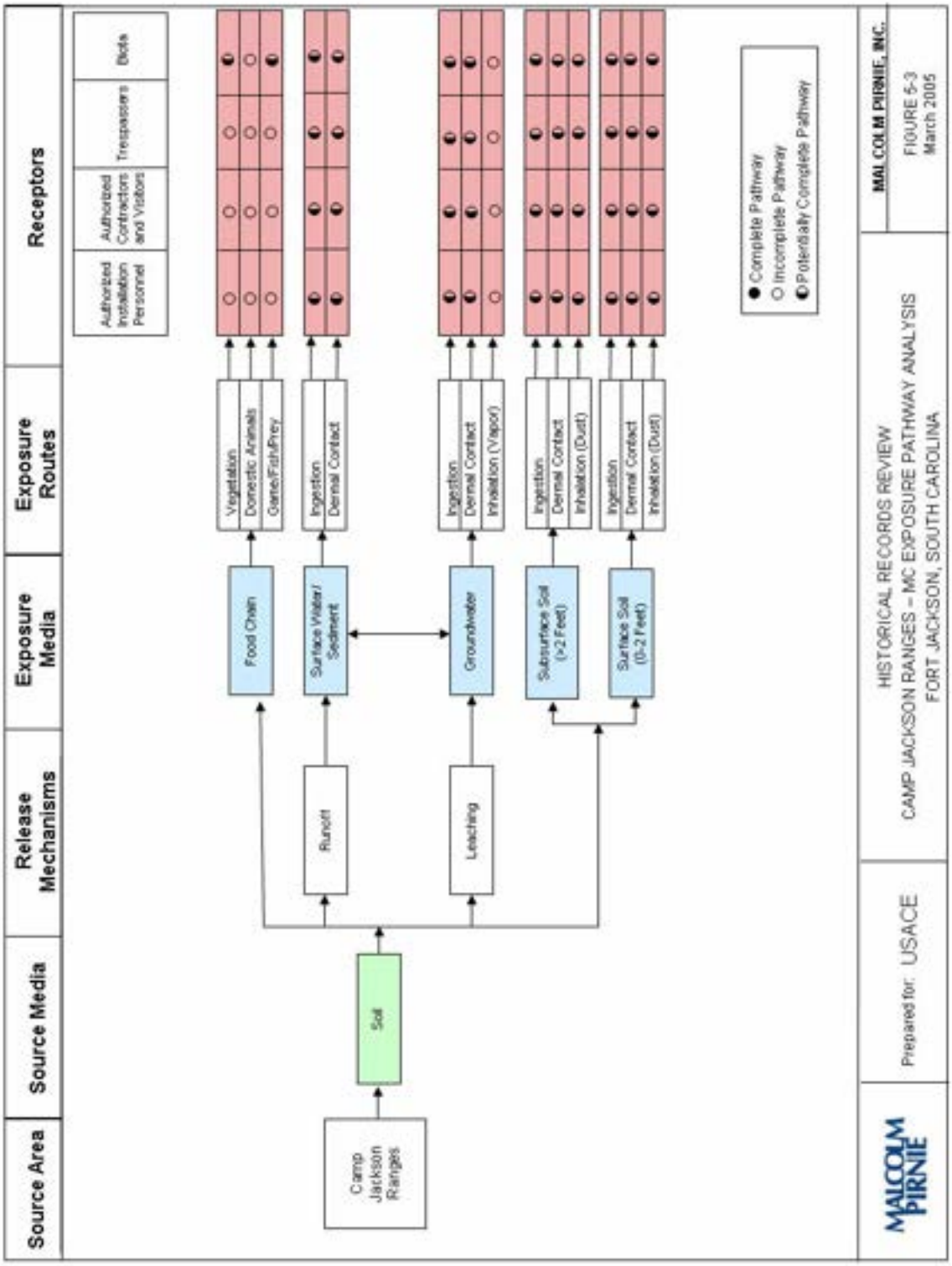
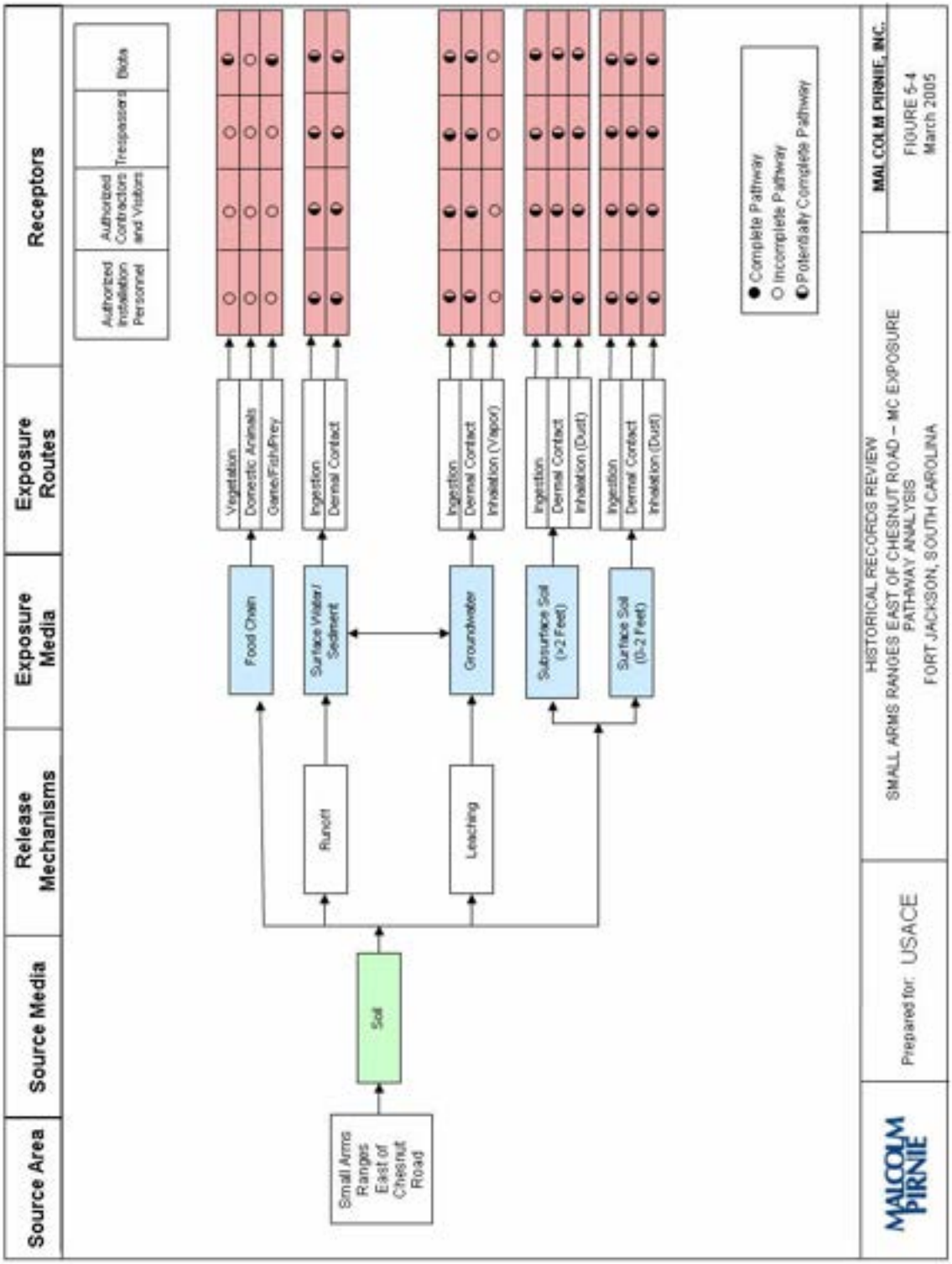


Figure 5-4: MC Exposure Pathway Analysis - Small Arms East of Chesnut Road



5.2 FORT JACKSON FLIGHT CLUB

5.2.1 MMRP Site Profile

5.2.1.1 Area and Layout

The FJFC is an approximately 54-acre area located east of Wildcat Road just north of Dixie Road, near the northwestern portion of the installation. The FJFC is quasi-rectangular in shape with a wider base than top. The westernmost portion of the FJFC did not have a historical range use. As such, the MMRP site acreage for the FJFC is 42 acres. This area has been divided into two MMRP sites: FJFC Salerno Ranges (which includes 15 acres that had MEC use) and FJFC Small Arms Ranges (which includes 27 acres).

5.2.1.2 Structures

The FJFC area contains a flat, clear, and level area surrounded by forest and grassland. The flat cleared portion of the site has been used by the Fort Jackson model airplane club as an airstrip for small recreational type R/C model aircraft. The improvements to the site include a level area for use as an airstrip, a gravel parking area, sun shelter and bleachers for spectators, a covered picnic area, and a storage building for maintenance equipment. No other structures are associated with this site.

5.2.1.3 Utilities

The only utilities associated with this area are electric lines running to street security lights.

5.2.1.4 Boundaries

The FJFC is bounded to the north and east by forest and grassland, to the south by Dixie Road, and to the west by Wildcat Road.

5.2.1.5 Security

The FJFC area is located within the boundaries of the Fort Jackson installation. Access to the installation is limited by gates and/or roadblocks on all roads leading into the installation.

Access to the installation is restricted to Army personnel, authorized civilian personnel, contractors and visitors. Security personnel routinely patrol the FJFC area by vehicle. The FJFC does not have separate fencing.

5.2.2 Physical Profile

5.2.2.1 Climate

Climate is general installation information and is presented in Section 5.1.2.1.

5.2.2.2 Geology

Geology is general installation information and is presented in Section 5.1.2.2. No specific geologic information for FJFC was available.

5.2.2.3 Topography

The FJFC is located at an elevation of approximately 400 feet above mean sea level. Topography within the FJFC is generally flat and slopes towards the east.

5.2.2.4 Soil

According to Figure 3.2.4 - Fort Jackson soils contained in the INRMP, the soil type located within the FJFC consists of Lakeland sand. Lakeland sand is a deep, excessively drained gentle sloping soil on convex ridge tops in the Sand Hills. The surface layer (three inches) consists of dark gray sand; the subsurface (107 inches) consists of yellow or brown sand. It has medium potential for urban development, primarily due to low water capacity. Lakeland sand is a predominant soil type found at Fort Jackson.

5.2.2.5 Hydrogeology

Hydrogeology is general installation information and is presented in Section 5.1.2.5.

5.2.2.6 Hydrology

Hydrology is general installation information and is presented in Section 5.1.2.6.

5.2.2.7 Vegetation

According to Figure 3.3.1.1 - Forest Types of Fort Jackson contained in the INRMP, the predominant forest types located within the FJFC are natural pine and scrub oak.

5.2.3 Land Use and Exposure Profile

5.2.3.1 Current Land Use

The flat cleared portion of the site has been used by the FJFC as an airstrip for R/C model aircraft since the late 1980s. There is a picnic area associated with the flying field.

5.2.3.2 Current Human Receptors

Current potential receptors of any MEC or MC present on the former FJFC include R/C aircraft operators (authorized visitors), authorized Fort Jackson personnel, authorized contractors, and trespassers.

5.2.3.3 Current Land Uses/Activities

Current activities include those associated with R/C aircraft recreational operations. Also, routine maintenance is performed on the airstrip, picnic, and spectator areas. Much of the FJFC area is undeveloped.

5.2.3.4 Potential Future Land Use

No changes to the current land use are planned for this area. Fort Jackson may increase the size of maintained area for the benefit of the FJFC.

5.2.3.5 Potential Future Human Receptors

The future human receptors are expected to remain the same as the current human receptors. There is no anticipated change in future site usage.

5.2.3.6 Zoning/Land Use Restrictions

No zoning or land use restrictions have been identified for this site.

5.2.3.7 Beneficial Resources

Beneficial factors for the Fort Jackson installation have been identified in Section 5.1.3.6. Additionally, slash pine has been planted in the former target/downrange hazard area. The slash pine, when mature, will provide beneficial habitat for the Red-cockaded Woodpecker, as well as a beneficial timber product.

5.2.3.8 Demographics

The demographics for the area of the installation are presented in Section 5.1.3.7.

5.2.4 Ecological Profile

5.2.4.1 Habitat Type

The habitat types are similar across the installation and are described in Section 5.1.4.1. Forest cover is the principal vegetative type on Fort Jackson. The primary forest cover type within the FJFC is slash pine and scrub oak; therefore, the habitat type would only be for small mammals (e.g., mice squirrels) and birds. The FJFC site contains maintained grass, sandy areas, and some planted slash pine forest that could provide a habitat for the Red-cockaded Woodpecker.

5.2.4.2 Degree of Disturbance

Minimal to moderate disturbance of flora and fauna species located in the FJFC area is expected due to the operation of R/C model aircraft and routine site maintenance.

5.2.4.3 Ecological Receptors

Potential rare, threatened, or endangered species and species of interest near and on Fort Jackson are discussed in Section 5.1.4.3. It is not likely that any of the species discussed in Section 5.1.4.3 would currently be found in the immediate area of the FJFC. However, it is possible that the slash pine forest will provide a future habitat for the Red-cockaded Woodpecker.

5.2.5 Munitions/Release Profile

5.2.5.1 Munitions Types and Release Mechanisms

Table 5-2 presents a summary of the types of munitions that would be expected based on information collected for this HRR. The mechanisms by which the munitions were released into the environment are also presented in this table. The typical release mechanisms for the former FJFC ranges are intentional activities, such as firing into a target area, and unintentional activities, such as rounds fired falling outside the target area or rounds discarded for various reasons at the firing point.

Table 5-3: Summary of Potential Munitions Types – FJFC

MMRP Site	Potential Munitions	Primary Release Mechanism
FJFC Salerno Ranges	40-mm grenades, Rocket grenades, 66-mm rockets, 35-mm sub-caliber rockets, 3.5-in rockets, M18A1 Anti-Personnel Mine, Practice grenades	Munitions firing, potentially from the following weapons: M79 Grenade Launcher M72 LAW 3.5-in Rocket Launcher M18A1 Anti-Personnel Mine
FJFC Small Arms Ranges	.30-/.50-caliber, 7.62-mm, 5.56-mm	Munitions firing, potentially from the following weapons: Browning .30 M1917 Machine Gun M2 .50 Machine Gun M-60 Machine Gun Springfield Model 1903 Enfield M1917 Rifle M-1 Garand Rifle M-1 Carbine

5.2.5.2 Maximum Probability Penetration Depth

MEC that may be present at the FJFC Salerno Ranges site include 66-mm LAW rockets and 40-mm rifle grenades. The expected depth of penetration in sand for the 66-mm rocket is 10.8 inches below ground surface (bgs), and the expected depth of penetration in sand for the 40-mm grenade is 2.4 inches bgs.

Small arms and hand grenades do not have an associated penetration depth. These and other MC components (such as spent shell casings and residual black powder components and wastes) are expected to have been directly deposited on the ground surface.

5.2.5.3 MEC Density

The greatest density of MEC is expected to be located in the northeast corner of the FJFC Salerno Ranges, since this area is most likely where the Salerno Demonstration M79 rifle grenade range and M72 LAW rocket launcher firing lines were located. The range for the 40-mm grenade was approximately 50 to 400 meters; therefore, the impact zone of the M79 rifle grenade range is within the current borders of the FJFC Salerno Ranges site. The effective range for the M72 LAW rocket is 170 to 220 meters, and its maximum range is 1000 meters; therefore, the impact zone of the M72 LAW is also expected to fall within the FJFC Salerno Ranges site.

5.2.5.4 MEC Scrap/Fragments

The majority of the MEC scrap/fragments are expected to have been deposited as a result of activities associated with the Salerno Demonstration Range, specifically, the M72 and M79 ranges. During the visual survey conducted at the FJFC on June 17, 2004, MEC including 40-mm grenades and 35-mm sub-caliber rockets were observed at the FJFC Salerno Ranges site.

5.2.5.5 Associated Munitions Constituents

As noted in Table 4-2, MC associated with the ranges formerly overlapping the FJFC include black powder (potassium nitrate, sulfur, and charcoal), smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine), double based propellant (nitrocellulose and nitroglycerin), Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide. No soil or groundwater samples have been analyzed for explosives within the FJFC; therefore, it is not known whether explosives are present at the FJFC site.

The primary MC of concern associated with the FJFC Small Arms Ranges is Pb. Other MC of concern that may be included in trace amounts are: Sb and Sn, which increase the hardness of bullets; As present in Pb; Cu present in the bullet core alloy; Cu and Zn present in the jacket alloy; Fe from the tips of penetrator rounds; Cu, Zn, Sr, and Mg present in tracer munitions; and lead styphnate/lead azide in the primer mixture.

5.2.5.6 Transport Mechanisms / Migration Routes

The primary transport mechanisms identified for the FJFC site include the following:

Erosion: Since thunderstorms are common during the summer months, erosion could be a factor in exposing buried MEC and in transporting and migrating MC contaminated soil to surface water bodies. Since the topography at the FJFC slopes to the east, it is expected that erosional migration of MEC and/or MC would be in the down slope direction.

Soil Disturbance: Surface and subsurface disturbances can lead to transport and migration of MC from one environmental media to another (soil to surface or groundwater or both) through surface water runoff and erosion. Known soil disturbance activities at the FJFC include land clearing and pine tree planting.

Infiltration: Since much of the FJFC is composed of sand, the potential for MC to migrate from one environmental media to another (surface to subsurface soil to groundwater) through infiltration exists.

5.2.6 Pathway Analysis

5.2.6.1 MEC

The MEC pathway analysis was prepared for the FJFC Salerno Ranges (Figure 5-5). The primary exposure pathway for human and ecological receptors is handle/tread underfoot of surface MEC. The potential for complete pathways exist between surface MEC and all receptors. The potential for complete pathways exist between subsurface MEC and

authorized installation personnel, contractors, and biota. Timber harvesting/planting in this area could lead to contact with subsurface MEC, and biota may nest or burrow in this area causing potential contact with subsurface MEC, as well.

5.2.6.2 MC

MC pathway analyses were prepared for the FJFC Salerno Ranges (Figure 5-6) and the FJFC Small Arms Ranges (Figure 5-7). These MC pathway analyses show a potentially complete pathway for biota for the vegetation exposure route. Biota is expected to ingest vegetation at the site and have a potentially complete pathway for vegetation in the food chain. All other pathways for vegetation in the food chain are expected to be incomplete. Crops are not grown on the site, and domestic animals are not raised on the site; therefore, no complete pathways exist for this exposure route. A potentially complete pathway through the game/fish prey exposure route exists only for biota.

Potentially complete pathways for ingestion and dermal contact exist between surface water/sediment and all receptors expected at the site. The groundwater exposure routes are expected to be potentially complete pathways for all potential receptors since there is an active water supply well located in close proximity to the FJFC.

Potentially complete pathways for all exposure routes for both surface and subsurface soil exist for all receptors. Since access and activities at the FJFC are not restricted, the potential for soil disturbance to occur exists. The subsurface pathway would also be potentially complete for biota because they may nest or burrow at the site.

Figure 5-5: MEC Exposure Pathway Analysis – FJFC Salerno Ranges

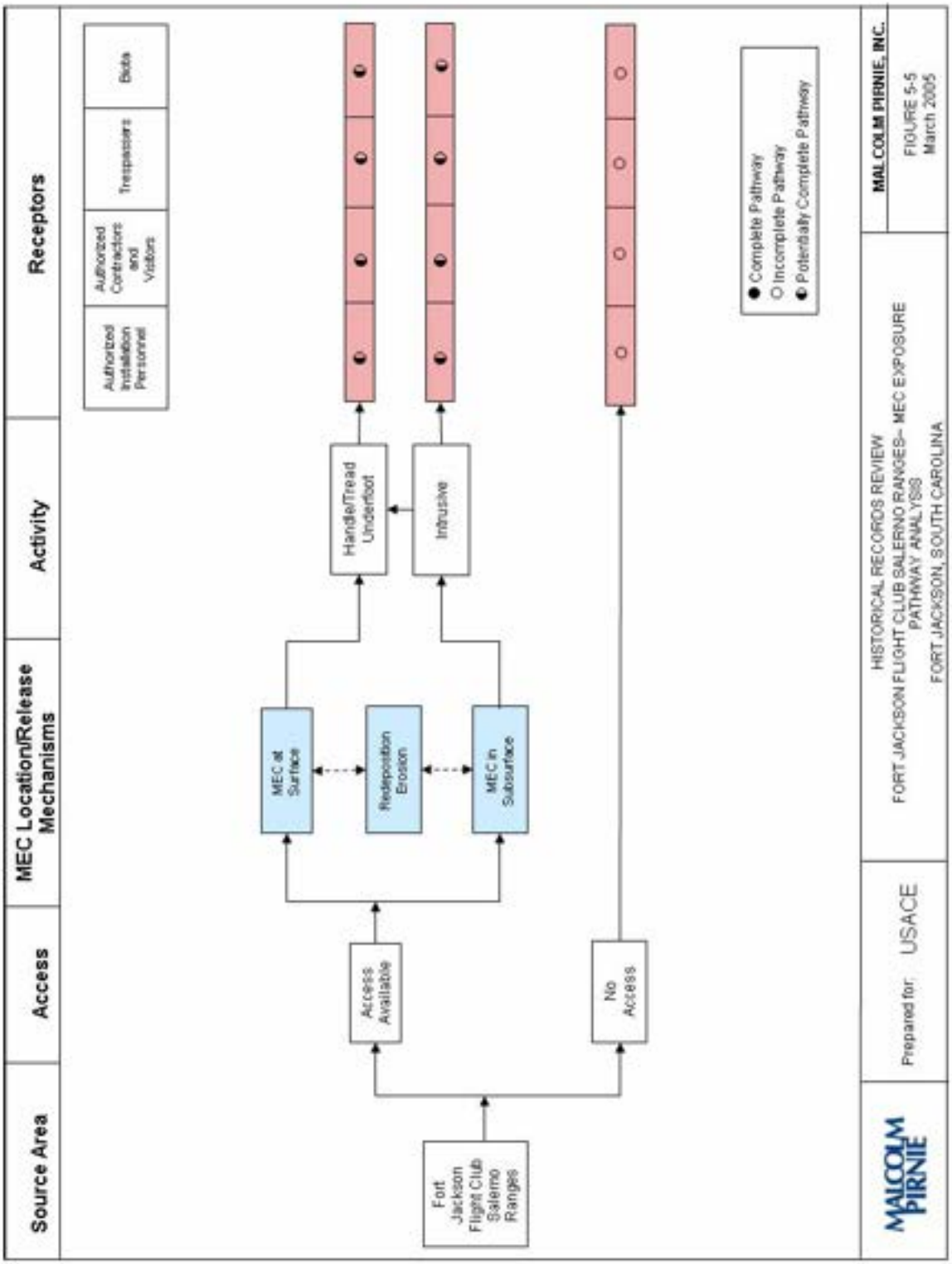


Figure 5-6: MC Exposure Pathway Analysis – FJFC Salerno Ranges

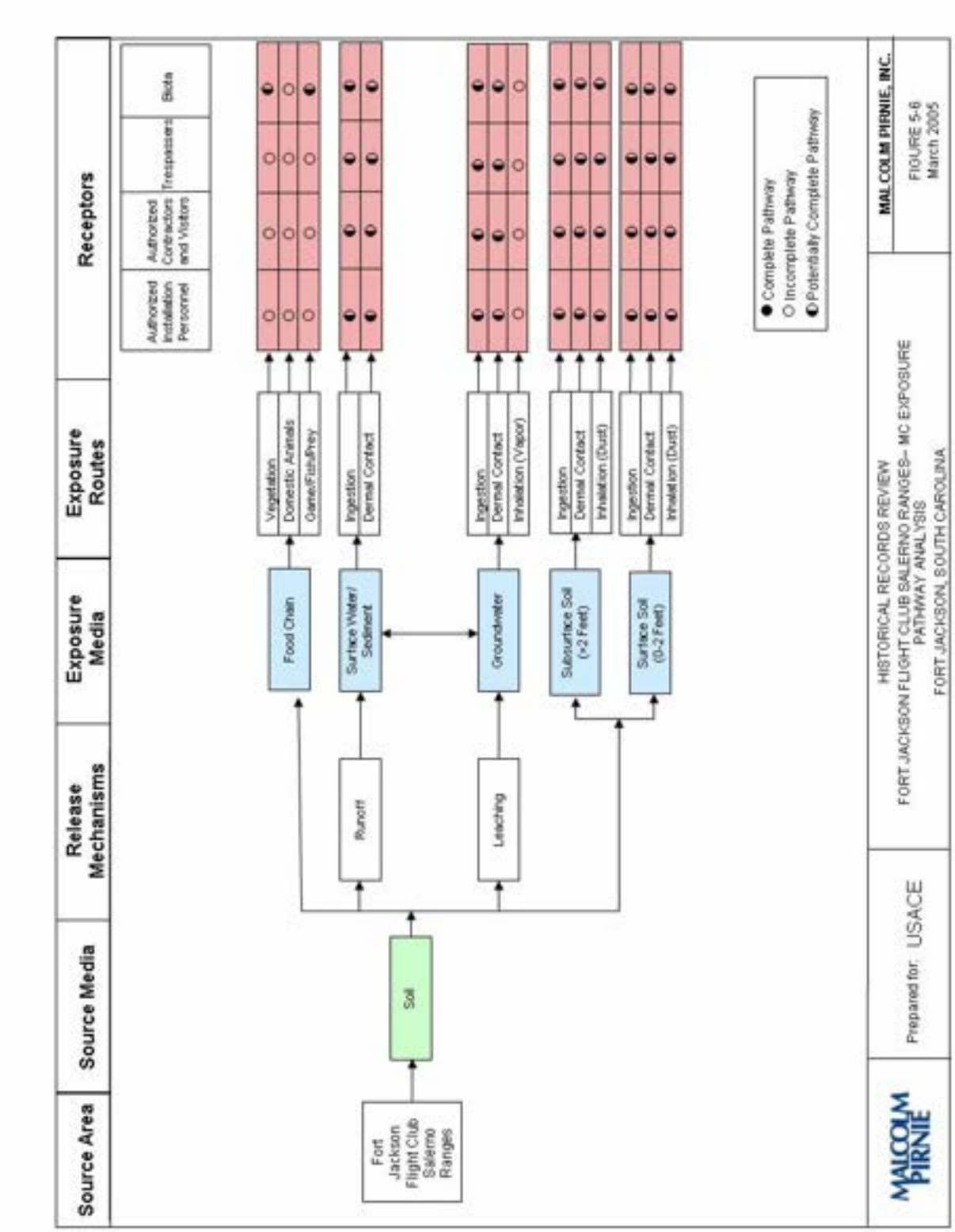
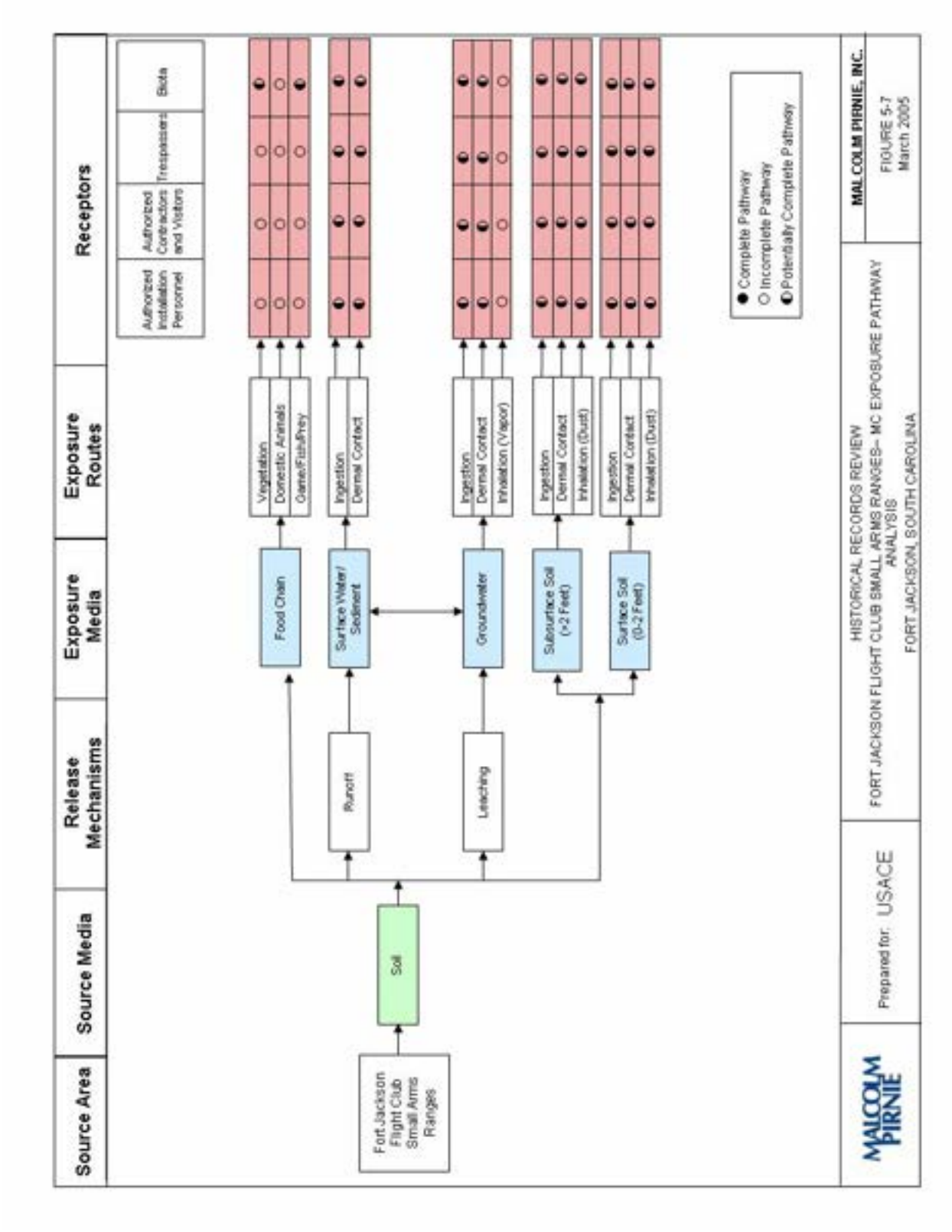


Figure 5-7: MC Exposure Pathway Analysis – FJFC Small Arms Ranges



5.3 WESTON LAKE AREA RANGES/SITES

5.3.1 MMRP Site Profile

5.3.1.1 Area and Layout

The Weston Lake Area is located on the southern, central portion of the installation. A total of two sites are located in this area. Geographical features of these sites are briefly described below:

- The Mortar Range (more specifically Mortar Range 5A, 7, and 8 Safety Fans) consists of a 306-acre area that is located in the northern section of the Weston Lake Area. The other than operational portion of the Mortar Range is somewhat trapezoidal in shape and includes the portion of the Submachine Gun Area that is overlapped by the Mortar Range.

- The Submachine Gun Area (more specifically the Dismounted and Moving Vehicle Submachine Gun Area) consists of an approximate 17-acre area located on the northern portion of the Weston Lake Area. The other than operational portion of the Submachine Gun Area is somewhat trapezoidal in shape. The 17-acre area includes only the portion of the Submachine Gun Area not overlapped by the Mortar Range.

5.3.1.2 Structures

The Mortar Range is located about 1/4 mile north of the main recreation facilities of the Weston Lake Area; however, it has not been directly improved by recreational facilities (e.g., camp sites or trails). There are no structures located at the Mortar Range. Portions of the Dismounted Submachine Gun No. 1 Range, the Moving Vehicle Submachine Gun Range, and the Dismounted Submachine Gun No. 2 Range extend across the eastern half of the Mortar Range.

The Submachine Gun Area primarily includes the firing points and target areas of the Dismounted Submachine Gun No. 1 Range. This area has been developed for recreational purposes and currently includes a picnic area, rental cabins, and a small boat launch area.

5.3.1.3 Utilities

There are no utilities located on the Mortar Range. However, the Submachine Gun Area has both overhead and buried utilities for the recreational area.

5.3.1.4 Boundaries

The Mortar Range is bounded to the north, west and east by undeveloped land and to the south by Weston Lake Area.

The Submachine Gun Area is bounded to the north and west by Weston Lake. Recreational facilities are located to the south and east.

5.3.1.5 Security

The Weston Lake Area is located within the boundaries of the Fort Jackson installation. Access to the installation is limited by gates and/or roadblocks on all roads leading into the installation. Access to the installation is restricted to Army personnel, authorized civilian personnel, contractors, and visitors. The Weston Lake Area MMRP sites are located within the Weston Lake Area. The individual sites within the Weston Lake Area are not fenced. However, the Mortar Range has not been directly improved with recreational facilities (e.g., camp sites, trails) and is in a remote location not easily accessible by visitors using the Weston Lake Area. Recreational facilities have been constructed at the Submachine Gun Area.

5.3.2 Physical Profile

5.3.2.1 Climate

Climate is general installation information and is presented in Section 5.1.2.1.

5.3.2.2 Geology

Geology is general installation information and is presented in Section 5.1.2.2.

5.3.2.3 Topography

General topographical information on the installation is given in Section 5.1.2.3.

5.3.2.4 Soil

General soil information for the Fort Jackson Installation is given in Section 5.1.2.4. According to Figure 3.2.4 - Fort Jackson Soils contained in the INRMP, the soil types located within the Mortar Range and Submachine Gun Area consist of Lakeland, Ailey, and Vauclose soils.

5.3.2.5 Hydrogeology

Hydrogeology is general installation information and is presented in Section 5.1.2.5.

5.3.2.6 Hydrology

Hydrology is general installation information and is presented in Section 5.1.2.6.

5.3.2.7 Vegetation

According to Figure 3.3.1.1 - Forest Types of Fort Jackson contained in the INRMP, the predominant forest type located within the Mortar Range is pine plantation. The Pine Plantation forest type is made up mostly of planted longleaf pine and slash pine (*Pinus elliottii*), which is not native to Fort Jackson.

According to Figure 3.3.1.1 discussed above, the predominant forest type located within the Submachine Gun Area is natural pine and pine hardwood. Natural pine includes all natural pine strands. In pine hardwood stands, hardwoods must constitute 21-49% of the overstory basal area, while the remainder is pine of any species.

5.3.3 Land Use and Exposure Profile

5.3.3.1 Current Land Use

The two Weston Lake Area MMRP sites are located in the Weston Lake Area, which is used by the general public for camping, picnics, and other recreational activities. However, the Mortar Range has not been directly improved with recreational facilities (e.g., camp sites) and is in a remote location not easily accessible by visitors using the Weston Lake Area. Recreational facilities have been constructed at the Submachine Gun Area.

5.3.3.2 Current Human Receptors

Current potential receptors of MEC or MC present on the Weston Lake Area ranges include authorized installation personnel, contractors, and visitors, as well as trespassers.

5.3.3.3 Current Land Uses/Activities

Current activities include recreational activities such as camping, swimming, fishing, biking, and hiking. However, the Mortar Range is in a remote location not easily accessible or frequented by visitors using the Weston Lake Area.

5.3.3.4 Potential Future Land Use

No changes to the current land use are planned for this area.

5.3.3.5 Potential Future Human Receptors

The future human receptors are expected to remain the same as the current human receptors. There is no anticipated change in access to the sites.

5.3.3.6 Zoning/Land Use Restrictions

No zoning or land use restrictions are present for this area.

5.3.3.7 Beneficial Resources

Fort Jackson encompasses a wide variety of vegetative site conditions, ranging from bottomland hardwood communities to xeric longleaf pine communities as noted in Section 5.1.3.6. The most predominant forest types on the ranges located within the Weston Lake Area are natural pine and pine plantation. Timber is harvested annually at Fort Jackson, and these ranges may provide a percentage of the annually harvested timber.

It is noted that the SWMU 12 and SWMU 17 sites are located just east of the Weston Lake Area. Additionally, the Red-cockaded Woodpecker is the only endangered animal species identified on the reservation. The Weston Lake Area includes habitat associated with the Red-cockaded Woodpecker. Informational signs (Figure 5-8) are located throughout the Weston Lake Area cautioning people of the potential presence of this endangered species.

Figure 5-8: Red-cockaded Woodpecker Habitat Sign

5.3.3.8 Demographics

The demographics for the area of the installation are presented in Section 5.1.3.7.

5.3.4 Ecological Profile

5.3.4.1 Habitat Type

The habitat types are general across the installation and are described in Section 5.1.4.1. Forest cover is the principal vegetative type on Fort Jackson. The most predominant forest types on the ranges located within the Weston Lake Area are natural pine and pine plantation; therefore, the habitat type would be for small mammals (e.g., mice and squirrels) and birds.

5.3.4.2 Degree of Disturbance

Disturbance of flora and fauna species located in the Weston Lake Area is expected to be moderate during annual timber harvests.

5.3.4.3 Ecological Receptors

Potential rare, threatened, or endangered species and species of interest near and on the Fort Jackson installation are discussed in Section 5.1.4.3. As stated previously, the Red-cockaded Woodpecker is the only endangered animal species identified on the reservation. Habitat exists within the Weston Lake Area.

5.3.5 Munitions/Release Profile

5.3.5.1 Munitions Types and Release Mechanisms

Table 5-3 presents a summary of the types of munitions that were either identified during the limited visual survey conducted at the Weston Lake Area sites or that would be expected based on information collected for this HRR. The mechanisms by which the munitions were released into the environment are presented in this table. The typical release mechanisms for the MMRP sites located in the Weston Lake Area include intentional activities, such as firing into a target area, and unintentional activities, such as rounds fired falling outside the target area or rounds discarded for various reasons at the firing point. It is important to note that in areas that were used for small arms training (i.e., the Submachine Gun Area), MEC are not expected, and the primary concern would be associated with MC.

Table 5-4: Summary of Potential Munition Types - Weston Lake Area

MMRP Site	Potential Munitions	Primary Release Mechanism
Mortar Range	60-mm, 81-mm, 3-in, 4.2-in mortar rounds .30-/.45-/.50-caliber, Live and practice grenades	Munitions firing, potentially from the following weapons: 60-mm, 81-mm, 3-in, 4.2-in mortar systems Overlapping Range Fan(s) weapons: M1A1 Thompson, M1928 Thompson, M3 and M3A1 (Grease) Submachine Gun .30-caliber machine gun .50-caliber machine gun M-1 rifle
Submachine Gun Area	.45-caliber	M1A1 Thompson, M1928 Thompson, M3 and M3A1 (Grease) Submachine Gun

5.3.5.2 Maximum Probability Penetration Depth

The expected depths for the various MEC items associated with the Weston Lake Area MMRP sites are presented in Table 5-5. These expected depths include values for sand, loam, and clay and were obtained from EM 1110-1-4009 Ordnance and Explosives Response, prepared by the USACE. These penetration depths are estimated on a worst-case scenario that assumes that the impact is perpendicular to ground surface and that the ordnance item does not deform upon impact. Small arms do not have an associated penetration depth. These and other MC components (such as spent shell casings and residual

black powder components and wastes) are expected to have been directly deposited on the ground surface.

Table 5-5: Summary of Expected MEC Penetration Depths

Ordnance Item/Weapon	Depth of Penetration (inches bgs)		
	Sand	Loam	Clay
60-mm mortar	13.2	18	27.6
81-mm mortar	32.4	42	64.8
4.2-in mortar	49.2	64.8	99.6

5.3.5.3 MEC Density

MEC presence in the Mortar Range, which includes three mortar range safety fans, is unknown. The other than operational area associated with the Mortar Range (i.e., safety fans) is undeveloped. As mentioned previously, five Howitzer range safety fans, two machine gun range safety fans, one rifle range, the Submachine Gun Area, and five unidentified range fans overlap the Mortar Range. Based on the number of overlapping fans, this area has the potential for MEC presence associated the Mortar Range and possibly from other overlapping ranges. However, MEC presence is expected to be minimal since the other than operational area associated with the Mortar Range lies within the safety fans (not within the direct line of fire) of the mortar ranges and overlapping ranges.

5.3.5.4 MEC Scrap/Fragments

During the June 17, 2004 site walk, MEC scrap and fragments were not observed at the Weston Lake Area MMRP Sites.

5.3.5.5 Associated Munitions Constituents

As noted in Table 4-3, MC associated with the Weston Lake Area MMRP sites include the following: black powder (potassium nitrate, sulfur, and charcoal), RDX, WP, illumination mix, smokeless powder (nitrocellulose, DNT, dibutylphalate, and diphenylamine), double

based propellant (nitrocellulose and nitroglycerin), Composition B, TNT, Octol, Pb, Sb, As, Cu, Sn, Zn, Fe, Sr, Mg, and lead styphnate/lead azide.

5.3.5.6 Transport Mechanisms / Migration Routes

The primary transport mechanisms identified for the Weston Lake Area MMRP sites include the following:

Erosion: Since thunderstorms are common during the summer months, erosion could be a factor in exposing buried MEC and in transporting and migrating MC contaminated soil to surface water bodies such as Weston Lake, located south of the Mortar Range/Submachine Gun Area.

Soil Disturbance: Since timber harvesting and recreational activities occur in this area, the potential for soil disturbance to occur exists. Any surface or subsurface soil disturbance can cause both the transport and migration of MEC and MC. Surface and subsurface disturbances can lead to transport and migration of MC from one environmental media to another (soil to surface or groundwater or both) through surface water runoff and erosion.

Infiltration: Based on the generally sandy soils located within the Weston Lake Area, the potential for MC to migrate from one environmental media to another (surface to subsurface soil to groundwater) through infiltration exists.

5.3.6 Pathway Analysis

5.3.6.1 MEC

The MEC pathway analysis was prepared for the Mortar Range (Figure 5-9). The primary exposure pathway for human and ecological receptors is handle/tread underfoot of surface MEC. The potential for complete pathways exists between surface MEC and all receptors. Since there is no penetration depth associated with hand grenades, MEC in the subsurface is not anticipated. The potential for complete pathways exists between subsurface MEC and

authorized installation personnel, contractors, and biota for the Mortar Range. Timber harvesting in this area could lead to contact with subsurface MEC, and biota may nest or burrow in these areas causing potential contact with subsurface MEC, as well.

5.3.6.2 MC

MC pathway analyses were prepared for the Mortar Range (Figure 5-10) and the Submachine Gun Area (Figure 5-11). The MC pathway analyses displayed show potentially complete pathways for biota for the vegetation exposure route. Biota is expected to ingest vegetation at the Weston Lake Area MMRP sites and have potentially complete pathways for vegetation in the food chain. All other pathways for vegetation in the food chain are expected to be incomplete. Crops are not grown on the sites, and domestic animals are not raised on the sites; therefore, no complete pathways exist for this exposure route. All receptors, except contractors, have potentially complete pathways through the game/fish prey exposure route. This is because the Weston Lake Area offers fishing for authorized installation personnel and their visitors.

Potentially complete pathways for ingestion and dermal contact exist between surface water/sediment and all receptors expected at the sites. The groundwater exposure routes are expected to be partially complete pathways for all potential receptors since there are three active water supply wells located just east of Weston Lake.

Potentially complete pathways for all exposure routes for both surface and subsurface soil exist for all receptors. Since access to and activities in these areas are not restricted, the potential for soil disturbance to occur exists. Also, the subsurface pathways would be potentially complete for biota because they may nest or burrow in these areas.

Figure 5-9: MEC Exposure Pathway Analysis - Mortar Range

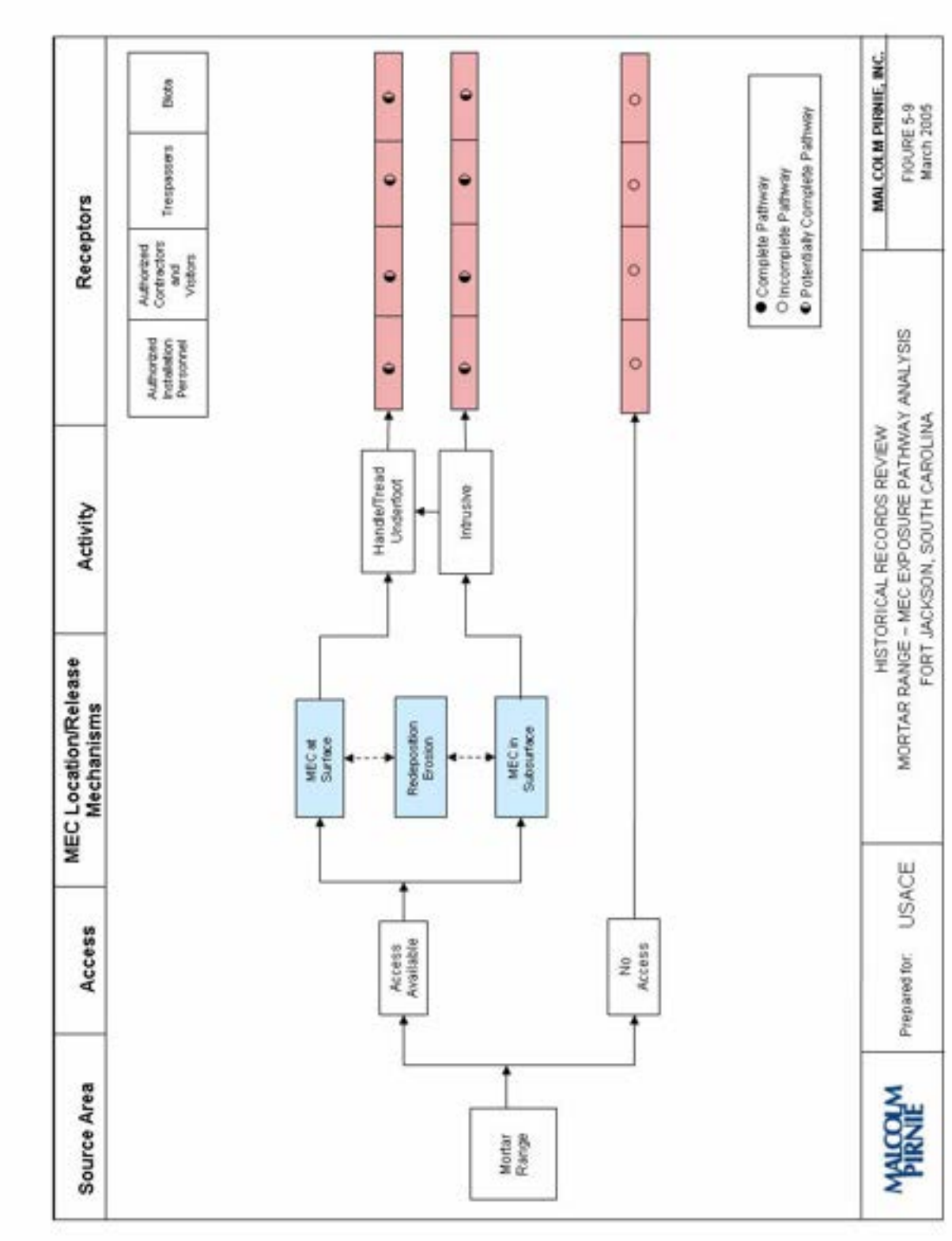


Figure 5-10: MC Exposure Pathway Analysis - Mortar Range

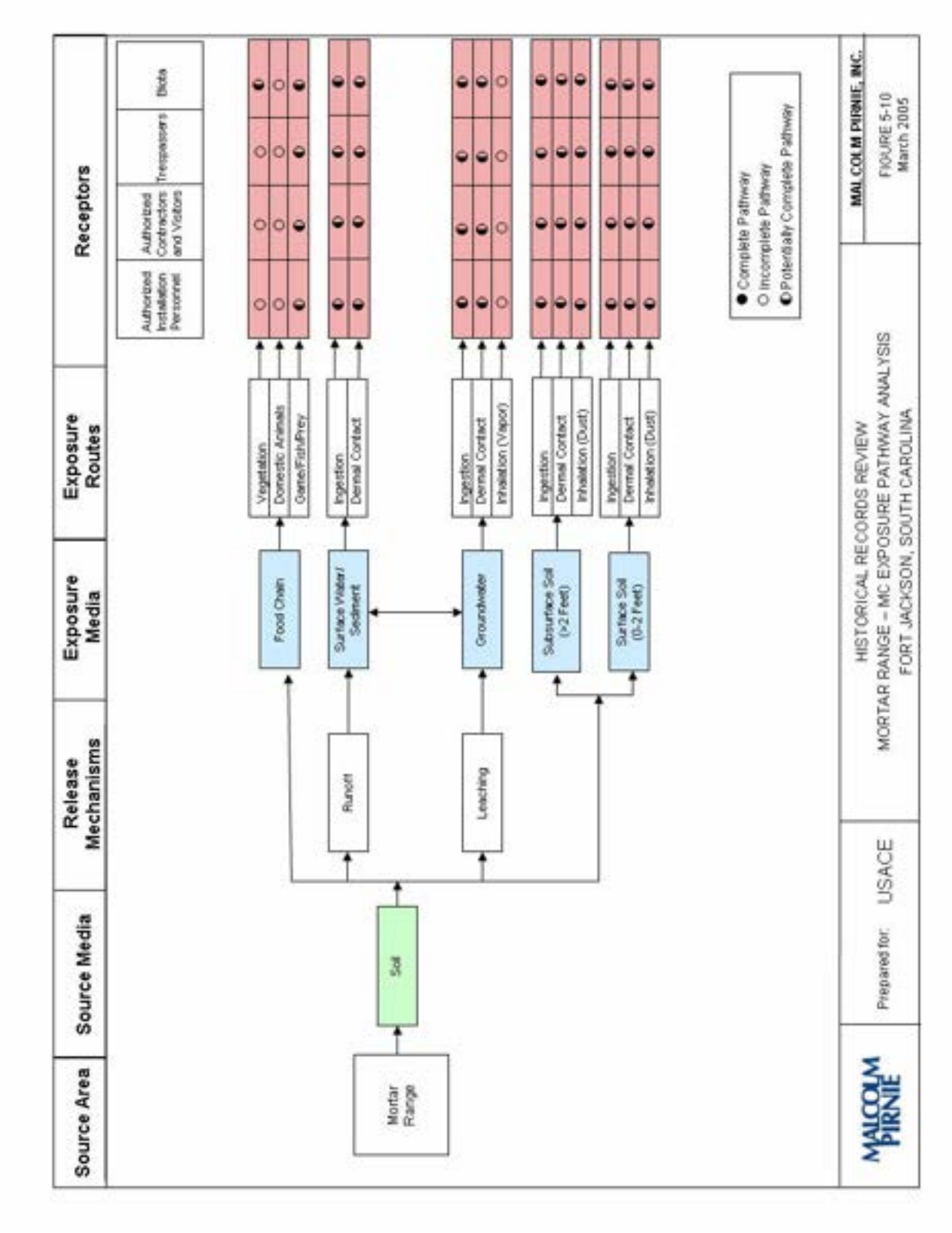
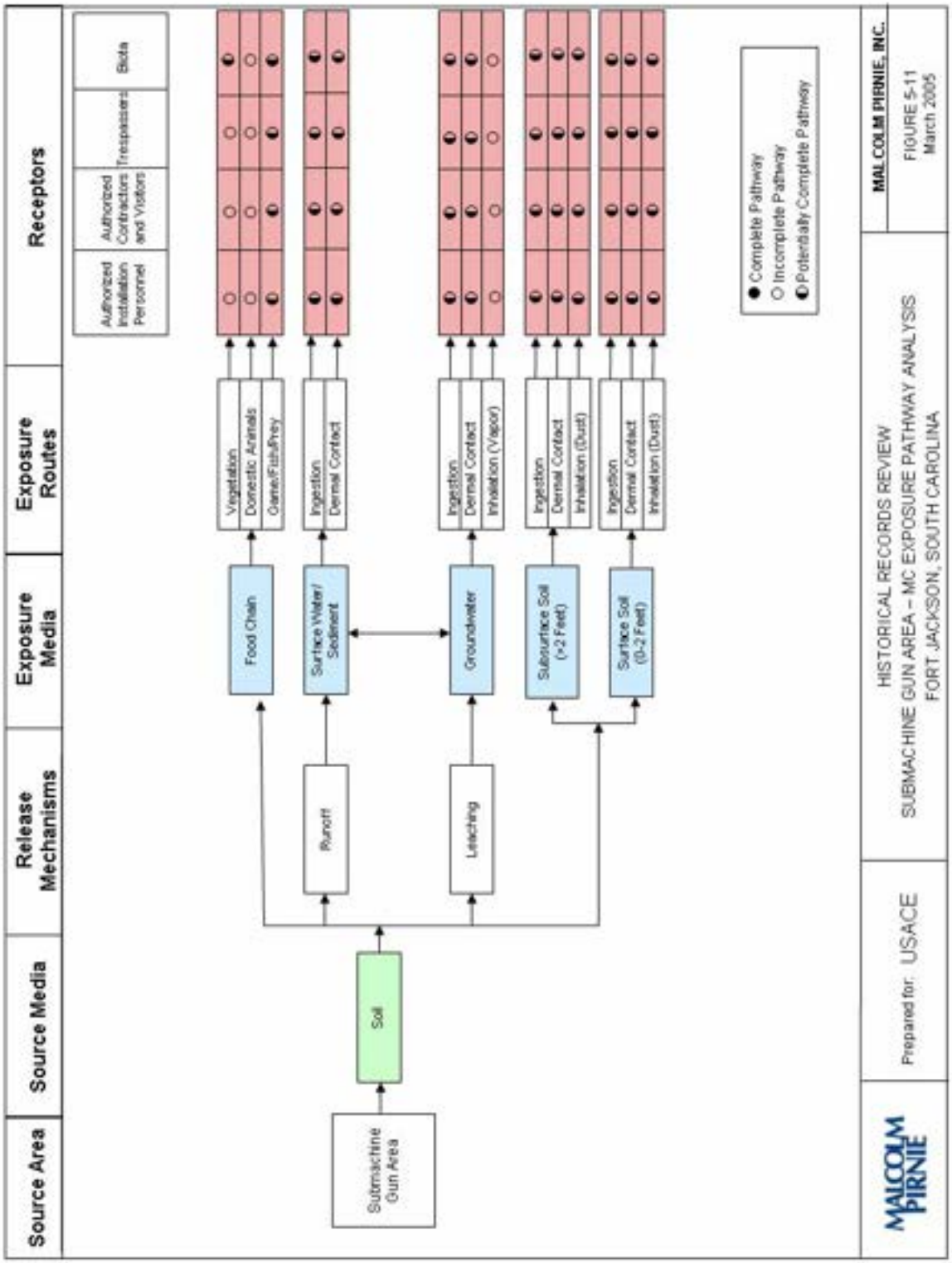
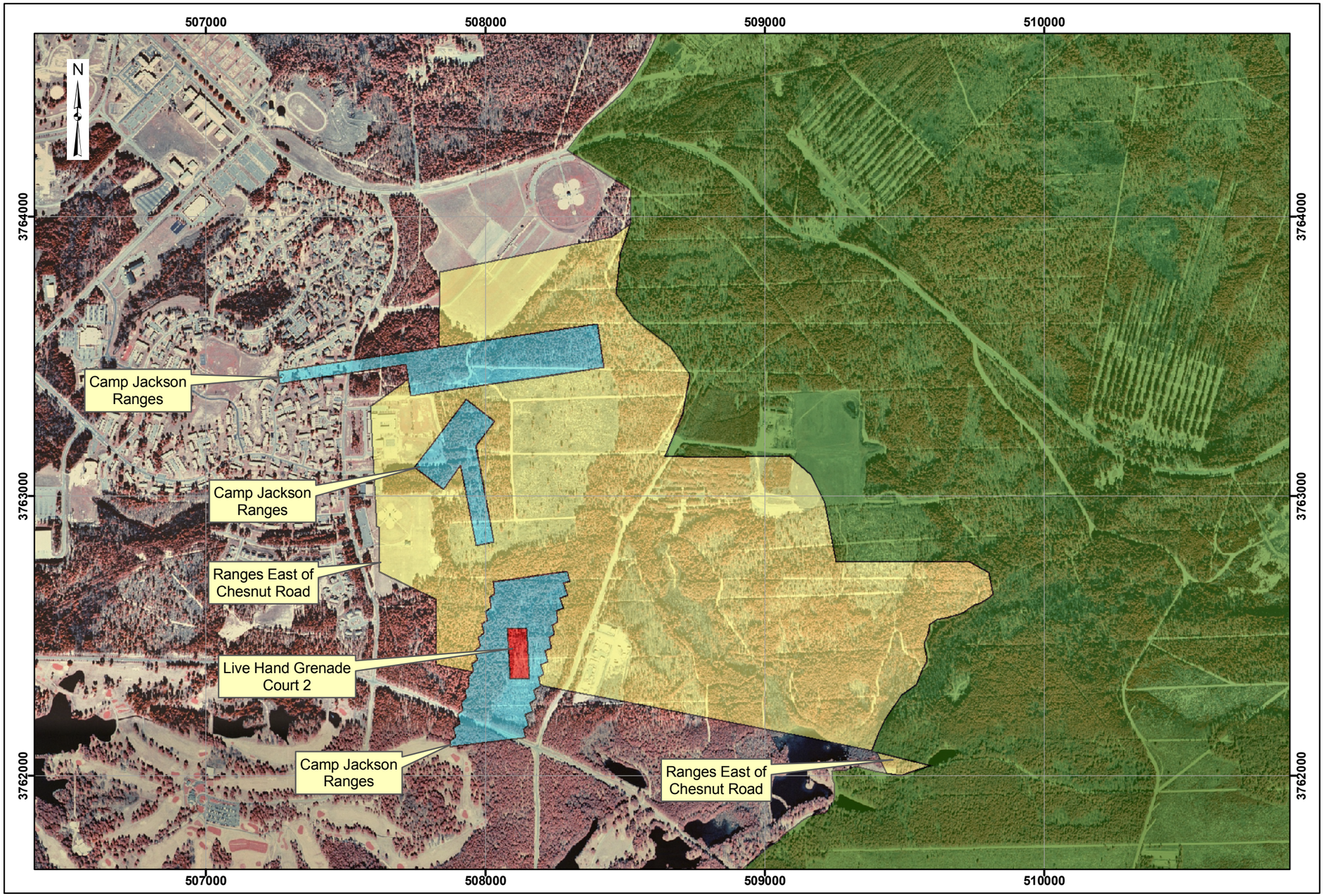


Figure 5-11: MC Exposure Pathway Analysis - Submachine Gun Area



Historical Records Review
Fort Jackson, SC



Map 5-1
Cantonment Area:
Horizontal Extent of MEC

Legend

- Installation Boundary
- Operational Range Area
- MEC Areas

MMRP Site

- Camp Jackson Ranges
- Live Hand Grenade Court 2
- Small Arms Ranges East of Chesnut Road

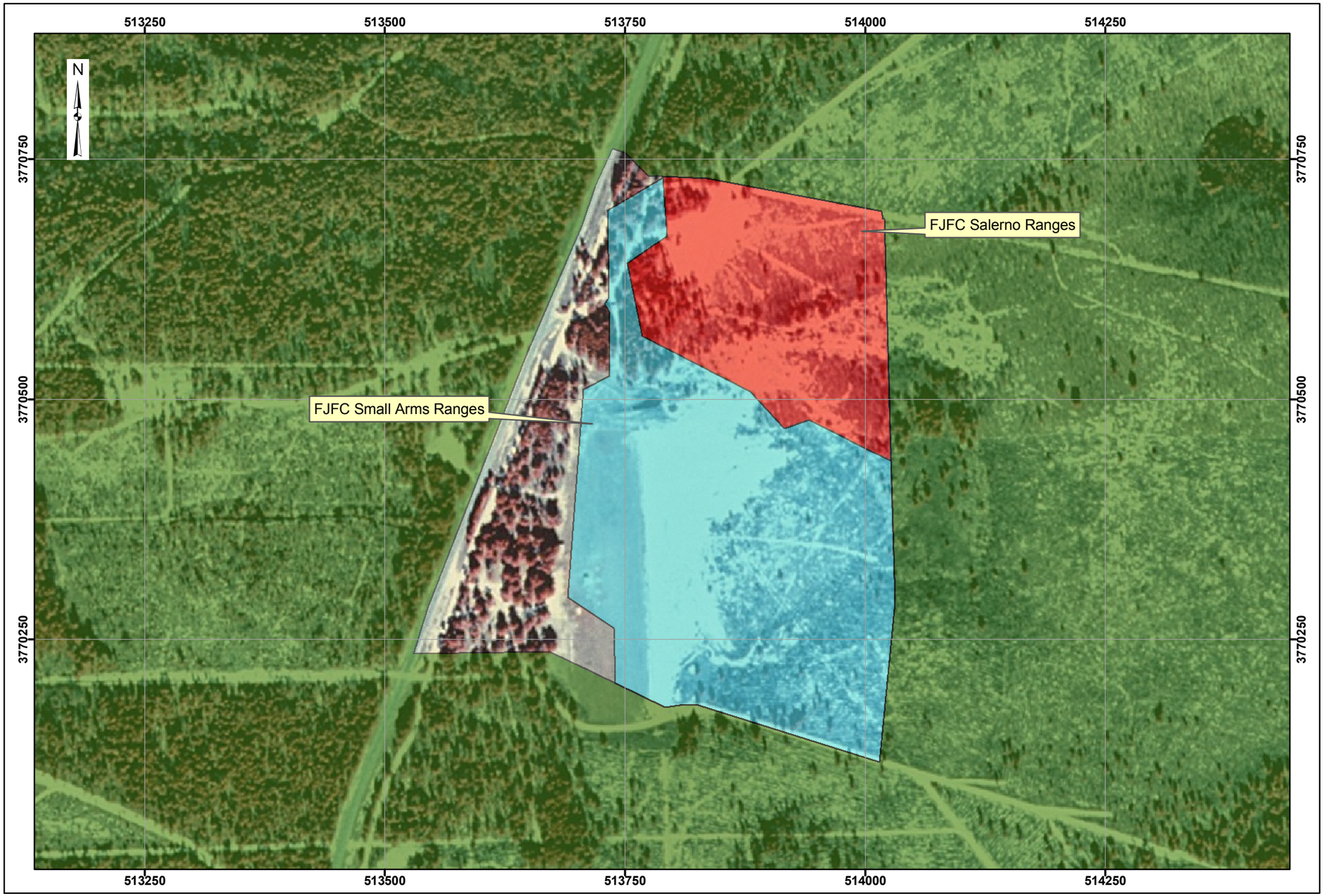
0 200 400 600 800 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Fort Jackson North, SC, 1996
Fort Jackson South, SC, 1996
Congaree, SC, 1996
Messers Pond, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

Historical Records Review
Fort Jackson, SC



Map 5-2
Fort Jackson Flight Club:
Horizontal Extent of MEC

Legend

- Operational Range Area
- MEC Areas

MMRP Site

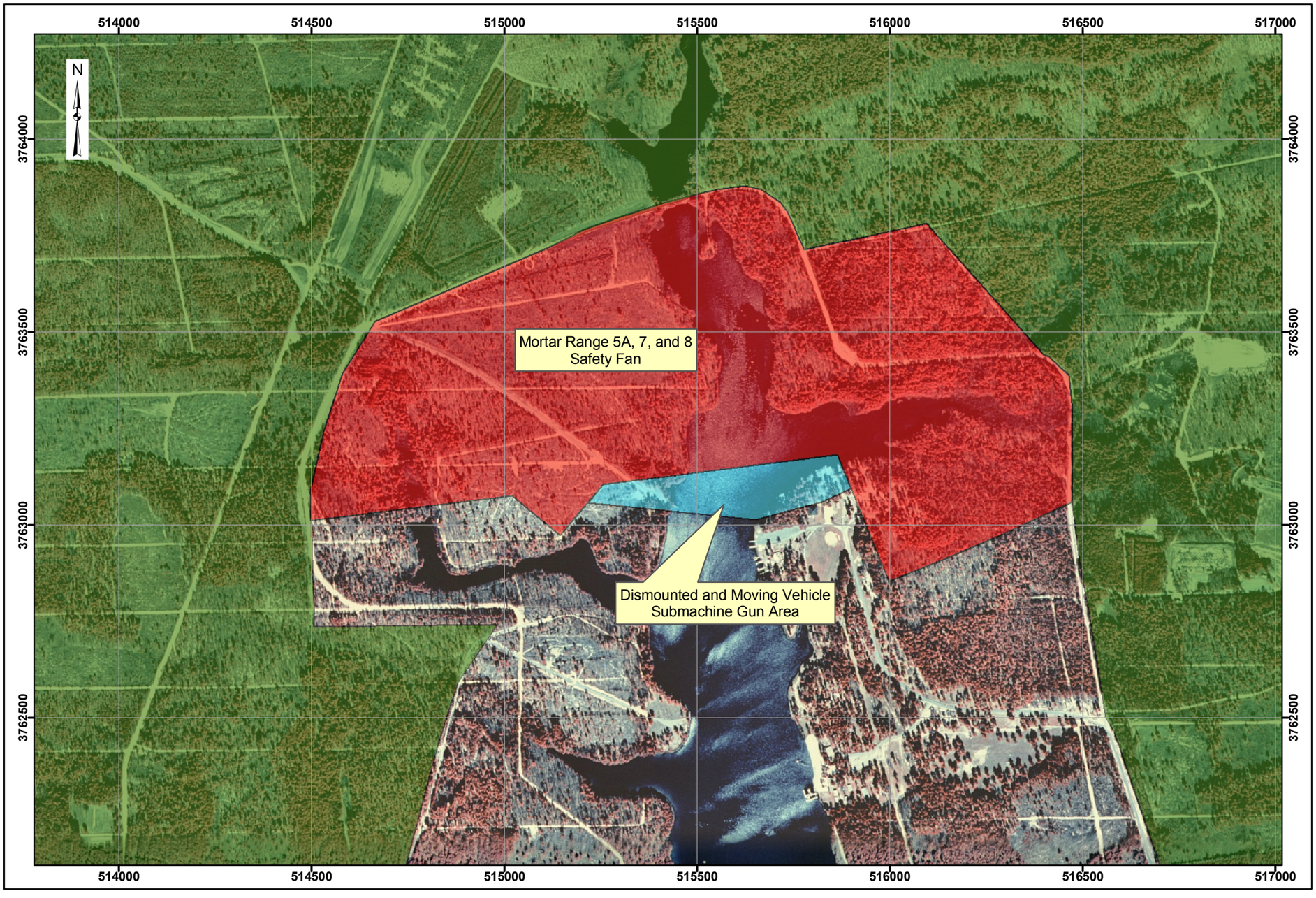
- FJFC Saint Lo Range
- FJFC Salerno Ranges

0 50 100 150 200 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005



Historical Records Review
Fort Jackson, SC

Map 5-3
Weston Lake Area:
Horizontal Extent of MEC

Legend

- Operational Range Area
- MEC Areas

MMRP Site

- Submachine Gun Area
- Mortar Range Area

0 100 200 300 400 Meters

Data Source: Richland County,
Digital Orthophoto Quadrangle
Messers Pond, SC, SC, 1996
Congaree, SC, 1996
Fort Jackson, SC, GIS Data

Coordinate System: UTM Zone 17N
Datum: NAD 1983
Units: Meters

Contract: DACA31-00-D-0043
Edition: Final Historical Records Review
Date: March 2005

6 CONCLUSIONS

The following conclusions for the cantonment area, FJFC, and Weston Lake Area MMRP sites were made based on the information reviewed for this HRR.

6.1.1 Cantonment Area Ranges/Sites

The CTT Range Inventory identified four ranges in the cantonment area: the 1000-Yard Range, 600-Yard-Range, Machine Gun Range, and Live Hand Grenade Court 2. Based on maps and aerial photographs reviewed during the preparation of the HRR, the locations of the 1000-Yard Range and the 600-Yard Range were adjusted slightly to the north. The information reviewed for the HRR also revealed the following newly identified ranges:

- 300-Yard Range
- Pistol Range
- Transition Range
- Pistol Range NR 2
- Landscape Target Range
- 1000-Inch Range Nos. 14, 15, 16

In addition, seven other ranges were identified in the area north of Hampton Parkway (Ranges North of Hampton Parkway). Based on changes to the operational range boundary during the HRR review process, these ranges were determined not to be eligible for inclusion in the Fort Jackson SI because they are located in the operational range area.

The CTT Range Inventory listed the Andrew Jackson Range as one of the ten MMRP sites. The Andrew Jackson Range was originally a military small arms range that had been closed. The site has been turned over to the Fort Jackson MWR Department for operation as a recreational small arms shooting range. Because of its current activity and the ongoing

releases that have occurred after September 30, 2002, it was determined that this site is not eligible for evaluation as part of the Fort Jackson SI.

Based on the HRR conclusions, three MMRP Sites are located in the cantonment area. The ranges identified in the cantonment area have been grouped by period of use, type of use, and location to form these MMRP Sites. Although some of these ranges overlap, the range acreages are only counted for the MMRP Site in which they are grouped. A brief discussion of each MMRP Site follows:

The Camp Jackson Ranges include the 1000-Yard Range, 600-Yard Range, Machine Gun Range, 300-Yard Range, and the Pistol Range. These ranges cover an area of 81 acres and were used for small arms training from 1918 through 1920. As such, no MEC and only limited MC are anticipated at the Camp Jackson Ranges.

The Small Arms Ranges East of Chesnut Road include the Transition Range, Pistol Range NR 2, Landscape Target Range, and 1000-Inch Range Nos. 14, 15, 16. These ranges were used for small arms training in the 1940s through the 1970s. As such, no MEC and only limited MC are anticipated at these ranges.

The Live Hand Grenade Court 2 includes a three acre area that overlaps the 300-Yard Range. Acreage for this area has only been included for the Live Hand Grenade Court 2. This range only appears on the 1946 and 1949 source maps. Based on the historical maps, the range was used in the 1940s and possibly the 1950s. The Live Hand Grenade Court 2 is the only range with MEC potential; however, this area has been disturbed by field fortification training (e.g., trenching and using the area to teach fortification techniques) and forestry activities. MEC, if present, would be limited.

Table 6-1, on the following page, provides a summary of the cantonment area MMRP sites an associated sub areas (ranges).

Table 6-1: MMRP Site and Associated Sub Areas Conclusion Summary for Cantonment Area Ranges/Sites

Area	Size	Description
Camp Jackson Ranges 1000-Yard Range 600-Yard Range 300-Yard Range Machine Gun Range Pistol Range	81 acres	Small arms only
Small Arms Ranges East of Chesnut Road Transition Range 1000-Inch Range Nos. 14, 15, 16 Pistol Range NR 2 Landscape Target Range	546 acres	Small arms only
Live Hand Grenade Court 2	3 acres	MEC - Hand grenades

6.1.2 Fort Jackson Flight Club

Additional munitions types at the FJFC were identified during the research for this HRR. Historical maps revealed several overlapping range fans with associated munitions other than small arms. Both firing points/lines and target areas exist within the FJFC. The additional munitions types are associated with the following ranges: an M18AI anti-personnel mine range, an M-79 grenade launcher range, and an M-72 LAW rocket launcher range. During the visual survey conducted at the FJFC on June 17, 2004, possible MEC including 40-mm grenades and 35-mm sub-caliber rockets were observed. Review of HRR information also identified an area at the FJFC that is not overlapped by ranges/range fans. As such, the acreage for the FJFC was revised to only include the 42-area of the FJFC that has had range use. Based on range use, MEC may be anticipated in the northern portion of the FJFC; however, the southern portion of the range was used only for small arms training. As such, the FJFC has been split into two sites: FJFC Salerno Ranges and FJFC Small Arms Ranges. Table 6-2 provides a summary for the FJFC.

Table 6-2: MMRP Site Conclusion Summary for FJFC Ranges/Sites

Site Name	Size	Description
FJFC Salerno Ranges	15 acres	MEC - Rockets Rifle grenades Grenades Claymore mines
FJFC Small Arms Ranges	27 acres	Small arms

6.1.3 Weston Lake Area Ranges/Sites

The CTT Range Inventory identified four ranges in the Weston Lake Area: the Mortar Range, Hand Grenade Court No. 2, the Rifle Grenade Range NR 2, and the Submachine Gun Area. Based on maps and aerial photographs reviewed during the preparation of the HRR, the locations of these ranges were adjusted from the CTT Range Inventory to better represent the areas where the range use occurred. Based on changes to the operational range boundary during the HRR review process, the Hand Grenade Court No. 2 and the Rifle Grenade Range NR 2 were determined not to be eligible for inclusion in the Fort Jackson SI because they are located in the operational range area.

Based on the HRR conclusions, two MMRP Sites are located in the Weston Lake Area: the Mortar Range 5A, 7, and 8 Safety Fans (i.e., the Mortar Range in the CTT Range Inventory) and the Dismounted and Moving Vehicle Submachine Gun Area (i.e., the Submachine Gun Area in the CTT Range Inventory). The ranges have been grouped by period of use, type of use, and location to form these MMRP Sites.

For acreage reporting purposes, the CTT Range Inventory depicted the Mortar Range and the Submachine Gun Area as a contiguous area divided into the Mortar Range (western half) and the Submachine Gun Area (eastern half). However, based on the 1955 and 1956 Training Facilities Maps, the Mortar Range actually covers both the Mortar Range and the Submachine Gun Area reported in the CTT Range Inventory. For the HRR, the Dismounted and Moving Vehicle Submachine Gun Area was changed to include only the area not overlapped by the Mortar Range 5A, 7, and 8 Safety Fans (i.e., the acreage was changed

from 101 acres to 17 acres). The Mortar Range 5A, 7, and 8 Safety Fans acreage was increased from 112 acres to 306 acres to encompass the entire area that was associated in the past with mortar range use. The Mortar Range 5A, 7, and 8 Safety Fans is the only site with a potential for MEC based on historical range use. Table 6-3 provides a summary of the Weston Lake Area MMRP sites.

Table 6-3: MMRP Site Conclusion Summary for the Weston Lake Area Ranges/Sites

Site Name	Size	Description
Mortar Range	306 acres	MEC - Mortars Small arms
Submachine Gun Area	17 acres	Small arms only

Table 6-4, on the following page, summarizes the site identification number changes from the CTT Range Inventory through completion of this HRR. This information clarifies the AEDB-R Site Identification changes that resulted from the HRR conclusions.

Table 6-4: AEDB-R Site Identification Changes

MMRP Site (CTT Range Inventory)		MMRP Site (HRR)	
AEDB-R Site ID	Site Name	AEDB-R Site ID	Site Name
FTJA-001-R-01	1000-Yard Range	FTJA-001-R-01	Camp Jackson Ranges
FTJA-002-R-01	600-Yard Range	FTJA-002-R-01	Small Arms Ranges East of Chesnut Road
FTJA-003-R-01	Andrew Jackson Range	FTJA-003-R-01	Live Hand Grenade Court 2
FTJA-004-R-01	Fort Jackson Flight Club	FTJA-004-R-01	Fort Jackson Flight Club Salerno Ranges
FTJA-005-R-01	Hand Grenade Court No. 2	FTJA-005-R-01	Fort Jackson Flight Club Small Arms Ranges
FTJA-006-R-01	Live Hand Grenade 2	FTJA-006-R-01	Mortar Range 5A, 7, and 8 Safety Fans
FTJA-007-R-01	Machine Gun Range	FTJA-007-R-01	Dismounted and Moving Vehicle Submachine Gun Area
FTJA-008-R-01	Mortar Range	FTJA-008-R-01	Not used
FTJA-009-R-01	Rifle Grenade Range NR 2	FTJA-009-R-01	Not used
FTJA-010-R-01	Submachine Gun Area	FTJA-010-R-01	Not used

Appendix A: Archives Searched/Data Sources

ARCHIVE RESOURCES

The archival data reviewed for this HRR are presented by RG and source below. Items indicated with an asterisk (*) are items that provided useful information and are included in Appendix B.

National Archives, NARA, College Park, MD

RG 18, Army Air Forces

- Box 78, Central Decimal Files (Bulky), 1942-1944
    1. Aerial Photograph. Fort Jackson and Vicinity, SC, N3357-W8046*

- Box 116, Central Decimal Files, 1917-1938
    1. Memorandum. Subject: Progress made at Firing Central Fields, From W. P. Jernigan, Major, JMANA, 1 October 1918

- Box 2835, Central Decimal Files, 1917-1938
    1. Map. Location Map, Camp Jackson, Columbia, SC, 1918*

RG 51, Bureau of Budget

- Box 164, Entry 149-B (UD), War Project Unit, Inspection Reports
    1. Map. Columbia Army Air Base and Vicinity, Columbia, SC*

RG 77, Chief of Engineering

- Aerial Photograph
    1. Dents, SC, N3400-W8052.5/7.5, AMS, V046A*
    2. Messers Pond, SC, N3400-W8045/7.5, AMS, V046A*

- Maps (Topographic)
    1. Messers Pond, SC, N300-W8045/7.5, AMS, V846*

- Box 47, Entry 391, Construction Completion Reports, 1917-1943
    1. Memorandum. Subject: Completion Report of Fort Jackson, SC, From Steward A. Marshall, Jr., Major, Corps of Engineers, Area Engineer, Constructing Quartermaster, 16 December 1941

- Box 101, Entry 393, History Record of Buildings
    1. Memorandum. Subject: Post War Utilization Studies, From War Department, Office of the Chief of Engineers, Fort Jackson, SC, September 1945*

- Box 140, Entry 391, Construction Completion Reports, 1917-1943
    1. Memorandum. Subject: Completion Report of Camp Jackson, From Construction Quartermaster, Camp Jackson, 17 January 1918*

RG 92, Quartermaster General

- Box 18-52, Entry 1998, Real Estate Records, 1917-1922
    1. Photograph. Miniature Range Building, Camp Jackson, SC

- Box 52, Entry 1998, Real Estate Records, 1917-1922
    1. Photograph. General Layout, Camp Jackson, SC, October 1917
    2. Map. Key Map of Property, Camp Jackson, SC, June 1918*

- Box 117, Entry 1998, Real Estate Records, 1917-1922
    1. Correspondence. From Matthew R. Beals, 2 January 1918
    2. Map. Cantonment Realty Company, 18 July 1917*

- Box 118, Entry 1998, Real Estate Records, 1917-1922
    1. Memorandum. Subject: Claim of C. M. Dempsey, From C.F. Von Dem Bussche, Major QMD Chief, Real Estate Division, 1 September 1920

- Box 119, Entry 1998, Real Estate Records, 1917-1922
    1. Correspondence. Subject: Lease, From North Carolina Security Company, 1 July 1918
    2. Correspondence. Subject: Property Offer, From P.H. Norcross, Acquisition Agent, 4 June 1919
    3. Correspondence. From Edwin Bell, Lieut. Colonel, Infantry, 28 November 1919
    4. Correspondence. From Edwin Bell, Lieut. Colonel, Infantry, 24 March 1920
    5. Correspondence. From O.M. Marshburn, Executive Officer, Fiscal Branch, 17 June 1920
    6. Correspondence. From War Department Claims Board, Appraisal Section, 13 April 1921

- Box 120, Entry 1998, Real Estate Records, 1917-1922
    1. Correspondence. From Edwin Bell, Lieut. Colonel, Infantry, 5 December 1919
    2. Correspondence. From Edwin Bell, Lieut. Colonel, Infantry, 17 April 1920
    3. Correspondence. Subject: Submitting a claim against US Government, From L. W. Cass, Lieut. Colonel, U.S.A. Acting Chairman, 13 April 1921

- Box 136, Entry 1974-A, Completion Reports, 1917-1919
    1. Map. General Layout, Camp Jackson, Columbia, SC, September 1917*
    2. Memorandum. Subject: Completion Report of Camp Jackson, From Constructing Quartermaster, Camp Jackson, 17 January 1918*
    3. Correspondence. Subject: Final Report: Plans and Descriptions of Camp and Camp Utilities, Camp Jackson, SC, 19 January 1918*
    4. Map. Location Map, Camp Jackson, Columbia, SC*

- Box 209, Entry 1974-A, Completion Reports, 1917-1919
    1. Memorandum. Subject: General Completion Report on North Camp Jackson as abandoned 28 February 1919, From H. J. MacDonald, Captain, Q. M. Corps, Constructing Quartermaster, 28 February 1919*

- Box 720
    1. Correspondence. Subject: Government lands, From DuPont B. Lyon, Acting Division Adjutant, 12 May 1921

RG 111, Office of the Chief Signal Officer

- Box 54
    1. Photographs. Drill Sergeant signals all clear as Fort Jackson Basic Trainees prepare to fire M-16's from kneeling position, 20 January 1963, Sergeant Wesley Forman acts as gunner on a 4.3 inch mortar in an arms demonstration at the Bastogne Range, Fort Jackson, SC, 22 January 1963
    2. Photographs. An Advanced Infantry Trainee is instructed in the proper handling and firing of the flame thrower at Fort Jackson's Biak Range, 23 April 1963, Private B. W. Roland fires a short burst of ammo from the M-60 automatic weapon during Advanced Infantry Training at the Cassino Range, Fort Jackson, SC, 6 January 1963, Advanced Infantry Trainees practice the proper firing techniques of the M-60 machine gun under the careful supervisor of a range safety officer at Fort Jackson's Cassino Range, 17 April 1963, Mortarmen zero in their weapons during class, 20 January 1963

- Box 72
    1. Photograph. Aerial view of the football and baseball parks at the U.S. Army Training Center, Infantry, Fort Jackson, SC, 21 May 1956
    2. Photograph. Aerial view of Fort Jackson, SC, 31 May 1956
    3. Photograph. Aerial view of Headquarters, U.S. Army Training Center, Infantry, Fort Jackson, SC, 31 May 1956
    4. Photograph. Tank Hill and area overlooking the area of the 1st and 2nd Training Regiments, Fort Jackson, SC, 31 May 1956
    5. Photograph. Aerial view of Gate #1 Main Entrance to Fort Jackson, U.S. Army Training Center, Infantry, Fort Jackson, SC, 31 May 1956

- Box 100
    1. Photographs. Crew members getting ready to launch a radio controlled airplane target OQ-2A from catapult at the anti-aircraft range, The radio controlled airplane target OQ-2A taking off from catapult, 1 December 1943

- Box 108
    1. Photograph. Drill Sergeant John R. Corkin helps a Basic Combat Trainee get into the proper position to fire, Fort Jackson, SC, 8 October 1964

2. Photographs. Front view firing position of the M-60 Machine Gun, Privates Coatney and Brown prepare to fire the 106 Recoilless Rifle, 15 September, 1969*
3. Photograph. Basic Combat Trainee fires his M-14 rifle down range as he is scored by another trainee, Ft. Jackson, SC, 8 October 1964

- Box 137
  1. Photographs. Aerial view of Signal Battalion lined up for command field inspection, Aerial view of the 59th Signal Battalion lined up for command field inspection, 15 February 1943

- Box 155
  1. Photographs. Firing line at .45 Caliber Pistol Range, 23 April 1943, Major Irving B. Tietze at observation post conducting firing, 28 April 1943

- Box 165
  1. Photographs. Life of 18-19 year old soldier, Fort Jackson, SC, April 1943

- Box 167
  1. Photographs. Sgt. Ramsey demonstrates how one can overcome two in a bayonet duel, 15 October 1943

- Box 180
  1. Photographs. Aerial view of the central area of Fort Jackson showing the post and Division Headquarters, 4 April 1950

- Box 212
  1. Photographs. Pvt. Otis C. Dobbins, Co. H, 28th Inf. Regiment is shown at Station #9 of the new Proficiency Range that was recently put in effect in Fort Jackson, SC, 25 June 1951

- Box 283
  1. Photographs. Lt. Col. C. T. Gilbreath, Major J. G. Mann, Lt. Col. Kenneth N. Vickery, and Major R. A. Banister firing .45 caliber pistols at Fort Jackson's Leesburg Pistol Range #3, Brothers Lt. Col. John P. Booker and Lt. Col. L. R. Booker checking targets on Leesburg Pistol Range #3, 11 August 1954

- Box 290
  1. Photographs. Aerial view of Fort Jackson Post Aviation Section and Headquarters area, 4 June 1956

- Box 323
  1. Photographs. The effectiveness of a new concept of Army rifle training is being carefully watched at Fort Jackson, SC by officials of the experimental system called "Trainfire," 20 October 1955
  2. Photographs. Maj. Gen. Armistead D. Mead, Chief of Infantry, Continental Army Command, Fort Monroe, and Lt. Col. James H. Ritts, Special Project Officer,

Trainfire, observe firing under the Army's experimental rifle marksmanship project "Trainfire," during Gen. Mead's inspection of the project at Fort Jackson, 15 November 1956

- Box 380
    1. Photographs. 12th Battalion, Third Training Regiment firing the M-94 Rifle from the standing position at Fort Jackson, SC, 28 March 1963

- Box 389
    1. Photographs. Expert infantry badge candidate removing mine from danger area, 5 March 1965
    2. Photographs. Lieutenant Colonel Musa Eltassan firing the M79 Grenade Launcher at the Taejon Range, Argentina Superior School of War officers visiting Fort Jackson, 5 November 1962

- Box 390
    1. Photographs. Station #5 of the Hand Grenade Range and the practice live bay on the Hand Grenade Range at Fort Jackson, SC, 25 March 1965
    2. Photographs. The ready line of the live bay area of the Hand Grenade Range and Station #5 of the Hand Grenade Range at Fort Jackson, SC, 25 March 1965
    3. Photographs. Station #4 of the Hand Grenade Range at Fort Jackson, SC, 25 March 1965
    4. Photographs. Control tower for the live bay area of the Hand Grenade Range, Live bay area of the Hand Grenade Range, Fort Jackson, SC, 25 March 1965
    5. Photographs. The grenade sump of a live bay on the Hand Grenade Range, Live bays on the Hand Grenade Range, Fort Jackson, SC, 25 March 1965

- Box 396
    1. Photograph. Salerno Range, Fort Jackson, SC, 25 October 1965*
    2. Photograph. Field Firing Range at Fort Jackson, SC, 25 October 1965
    3. Photographs. 25 Meter Range, Target Detection Range, Fort Jackson, SC, 25 October 1965
    4. Photographs. Metz Range, Saint Lo, Salerno Range, Fort Jackson, SC, 25 October 1965*
    5. Photographs. Metz Range, Saint Lo, Fort Jackson, SC, 25 October 1965*
    6. Photograph. 25 Meter Range, Fort Jackson, SC, 25 October 1965
    7. Photograph. Target Detection Range, Fort Jackson, SC, 25 October 1965

- Box 397
    1. Photographs. Aerial view of Tactical Training Range #3, New Rifle Squad Tactical Training Range Complex at Wildcat and Dixie Roads, Aerial view of Tactical Training Range #4, New Rifle Squad Tactical Training Range Complex At Wildcat and Dixie Roads, 19 October 1965
    2. Photographs. Aerial view of Tactical Training Range #1, New Rifle Squad Tactical Training Range Complex at Wildcat and Dixie Roads, Aerial view of

Tactical Training Range #2, New Rifle Squad Tactical Training Range Complex at Wildcat and Dixie Roads, 19 October 1965

RG 156, Office of Chief Ordnance

- Box 818, Entry 368, Real Property Disposal Files, Account 53A592
    1. Correspondence. Subject: Extract Requisitions, From Roger Taylor, Colonel Ordnance Department, Commanding, 8 January 1940

RG 270, WAA, Real Property Disposal Files

- Box 240
    1. Map. Fort Jackson and Vicinity, SC, N3357.9-W8041.7/8.9 x 18.9*

RG 337, Headquarters Army Ground Forces

- Box 23, Entry 51-A, Subject File, 1941-1950
    1. Correspondence. Subject: Estimate of Funds, From Lynden R. Anderson, Major, Ordnance Department, Asst S-4, 18 February 1947*

- Box 31, Entry 108 (UD), AGG and AFF Installations
    1. Correspondence. From James E. Bowen Jr., Captain, 20th Infantry, Adjutant, 12 March 1940
    2. Correspondence. From F. V. M. Dyer, Lieutenant Colonel, Infantry, Adjutant, 11 June 1941*
    3. Correspondence. Subject: Post Range Regulations, General Orders Number 63, From A. T. Murphey, Colonel, FA, Adj., 3 December 1942*
    4. Correspondence. Subject: Post Range Regulations, General Orders Number 25, From A. T. Murphey, Colonel, FA, Adj., 8 July 1943*
    5. Correspondence. From A. T. Murphey, Colonel, FA, 20 July 1943
    6. Correspondence. Subject: Post Range Regulations, General Orders Number 18, From Joseph P. O'Hara, Major, AUS, Adjutant, 16 March 1944*
    7. Correspondence. Subject: Danger Area for Aircraft, From Joseph P. O'Hara, Major, AUS, Adjutant, 23 March 1945

- Box 34, Entry 108 (UD), AGG and AFF Installations
    1. Correspondence. Subject: Historical report regarding 1949 Range Regulations, From G.H. Decker, Major General, Commanding, 17 June 17 1949*
    2. Memorandum. Subject: 1950 Fort Jackson Range Regulations, From F. J. Reese, Lt. Colonel, AGD, Adjutant, 15 April 1950*
    3. Map. Fort Jackson and Vicinity, SC, N3357.9-W8041.7/8.9x18.9*

- Box 37, Entry 1, Inspection Reports, 1951
    1. Correspondence. Subject: Inspection Third Army, From Michael Dopudja, 1st Lt. G3 (83), 1951

2. Correspondence. Subject: Training Report, 31st Infantry Division, From Lother B. Sibert, Lt. Colonel, GSC, 10 April 1951*
3. Correspondence. Subject: Supply Status, 31st Infantry Division, From Clifford P. Morrison, Lt. Colonel, GSC, 10 April 1951*
4. Correspondence. Subject: Brief of Report on Third Army Command Inspection of 31st Infantry Division, Fort Jackson, SC, 14 June 1951
5. Memorandum for Chief of Army Field Forces. Subject: Report of Staff Visit to Fort Jackson, SC, From T. M. Ariail, Lt. Col. G.S., 23 October 1951
6. Disposition Form. Subject: Report of OCAFF Participation in 3rd Army Inspection of Units at Fort Jackson, SC, From Charles B. Smith, Lt. Colonel, Inspector of Infantry Section, 23 October 1951
7. Memorandum for Chief of Army Field Forces. Subject: Report of Staff Visit to Fort Jackson, SC, From T. M. Ariail, Lt. Colonel, GS, 23 October 1951
8. Correspondence. Subject: Report of Annual Inspection of Fort Jackson and Semi-annual Inspection of the 8th Infantry Division, Fort Jackson, SC, From C. B. Herndon, Colonel, GS, 5 November 1951

- Box 57, Entry 57, General Headquarters, General Correspondence, 1940-1942
    1. Memorandum for General McNair. Subject: Report of Inspection of National Guard Divisions inducted into Federal Service, From M. W. Clark, Lt. Colonel, Infantry, 11 October 1940

- Box 58, Entry 57, General Correspondence, 1940-1942
    1. Correspondence from Walter C. Short, Major General, U.S. Army, Commanding, 22 November 1940
    2. Memorandum for Chief of Staff. Subject: Inspection Trip to Fort Jackson, SC, From C. H. Gerhardt, Lt. Colonel, G.S.C., 1 February 1941

- Box 60, Entry 1, Inspection Reports
    1. Memorandum for Chief of Army Field Forces. Subject: Report of Routine Inspection of 31st Infantry Divisions, From F. W. Milburn, Lieutenant General, Chief Inspector, 23 January 1952
    2. Correspondence. Subject: Report of Semi-annual Inspection of the 8th Infantry Division, Fort Jackson, SC, From M. J. Lucree, Lt. Colonel, GS, 7 May 1952
    3. Memorandum for Chief of Army Field Forces. Subject: Report of Inspection of 108th Infantry Division, From Reserve Corps, 15 August 1952
    4. Correspondence. Subject: Data Sheet for Inspectors and Visiting Staff Officers, From Inspection Secretariat Office, 24 September 1952
    5. Memorandum for Chief of Army Field Forces. Subject: Report of Observation of Semi-Annual Inspection of 8th Infantry Division, From Third Army Inspection Team, 24 September 1952
    6. Correspondence. Subject: Report of Semi-annual Inspection of the 8th Infantry Division and Annual Command Inspection of Fort Jackson, From Headquarters Third Army, Fort McPherson, Georgia, 1 October 1952

- Box 78, Entry 1, AFF, Inspection Reports
    1. Memorandum for Chief of Army Field Forces. Subject: Report of Staff Visit to the 108th Infantry Division, North and South Carolina (USAR) and ORC in Field Training at Fort Jackson, SC, From Donald M. Macwillie, Colonel, GS, 9 September 1953
    2. Correspondence. Subject: Report of Semi-annual Inspection of the 8th Infantry Division (Training) and Annual Command Inspection of Fort Jackson (Post), 25 September 1953

- Box 178, Entry 30, Inspection Reports, 1942-1944
    1. Memorandum for Training. Subject: Movement of Division to the Field, From M. McClure, Colonel GSC, Chief of Staff, 14 July 1943
    2. Memorandum for the Assistant Chief of Staff. Subject: Observation During Visit to Camp Gordon, Camp Jackson, and Camp Butner, 20-21 July 1943, From E. H. J. Carns, Lt. Colonel, Calvary, 24 July 1943
    3. Memorandum for the Assistant Chief of Staff. Subject: Visit to Camp Gordon, Camp Jackson and Camp Butner, 20-22 July 1943, From L. L. Williams, Colonel, GSC, 26 July 1943
    4. Memorandum for the Chief of Staff. Subject: Visit to Camp Gordon, Fort Jackson, and Camp Butner, 20-22 July 1943, From W. B. Forse, Colonel, Infantry, 27 July 1943

- Box 1122, Entry 55, General Correspondence, 1942-1948
    1. Correspondence. Subject: Layout Plans and Cost Estimate for Ranges, From Ezra S. Settle, Lt. Col. Inf. Executive, 5 April 1943
    2. Correspondence. Subject: Training Aids, From J. V. V. Shufelt, Colonel, General Staff Corps, Director, Operations and Training Division, 5 October 1942*
    3. Correspondence. Subject: Moving Vehicle Range, From Stuart Lewis, Lt. Col., G. S. C., Chief, Training Branch, 10 December 1942*
    4. Correspondence. Subject: Safety Limits of Ranges, Headquarters Army Ground Forces, Army War College, 15 December 1942*

- Box 1123, Entry 55, General Correspondence, 1942-1948
    1. Correspondence. Subject: Construction of Ranges, From John R. Lucas, Captain, Infantry Range Officer, 25 April 1947*

RG 338, U.S. Army Commands

- Box 488, Entry 37042, Unit Records
    1. Correspondence. Subject: Danger Area at Small Arms Range, From W. H. Gill, Colonel, General Staff Corps, Chief of Staff, 2 May 1941

- Box 489, Entry 37042, Unit Records
    1. Memorandum. Subject: Training Memorandum, From M. J. Conway, Major, Adjutant General, 28 August 1940

2. Memorandum. Subject: Memorandum for Training, From M. J. Conway, Lt. Colonel, Adjutant General, 7 March 1941
3. Memorandum. Subject: Training Memorandum, From M. J. Conway, Lt. Colonel, Adjutant General, 28 May 1941
4. Memorandum. Subject: Master Schedule, 1 June 1941 to 27 December 1941
5. Memorandum. Subject: Training Memorandum, From F. R. Keeler, Lt. Col., Adjutant General, 24 March 1942
6. Memorandum. Subject: Training Memorandum, From A. B. Wood, Acting Adjutant General, 28 March 1942
7. Memorandum. Subject: Training Memorandum Number 33, From F. R. Keeler, Lt. Colonel, Adjutant General's Department, 26 May 1942*
8. Memorandum. Subject: Training Program, From F. R. Keeler, Lt. Colonel, Adjutant General, 29 June 1942
9. Memorandum. Subject: Training Memorandum, From F. R. Keeler, Lt. Colonel, Adjutant General, 13 July 1942

RG 393, U.S. Army Continental Commands, 1821-1920

- Box 13, Part V, Camp Jackson
    1. Correspondence. Subject: General Conditions, Camp Jackson, SC, From Commanding General, 4 November 1920

- Box 14, Part V, Camp Jackson
    1. Correspondence. Subject: Activities of Utilities for Month of September 1918, September 1918
    2. Correspondence. Subject: Report of Activities of the Utilities for the Month of December 1918, From George Peterson, Major, Quartermaster Corps, 20 January 1919
    3. Correspondence. Subject: Letter from Chief Clerk to Camp Jackson, Commanding Officer, Camp Jackson, 15 August 1919

- Box 16, Part V, Camp Jackson
    1. Correspondence. Subject: Report on Artillery Range at Camp Jackson, From Andrew Mosses, Commanding Officer, 156th Artillery Brigade, 26 March 1918
    2. Correspondence. Subject: Gas Training, From Frederick Swanson, Chief Gas Officer, July 1918

- Box 23, Part V, Camp Jackson
    1. Correspondence from Thos. D. Osborne, Colonel 59th F.A., Commandant, 11 October 1919

- Box 24, Part V, Camp Jackson
    1. Correspondence. Subject: Camp on Ancrum Ferry Road, From Geo. L. Peterson, Major, Q. M. C., Utilities Officer, 11 September 1918
    2. Correspondence. Subject: Guard for Small Arms Target Range, From A.C. Marsh, Capt. Ord. Dept., 27 January 1919

3. Correspondence. Subject: Answers to Questionnaire, From Harry R. Lee, Colonel, Infantry, Commanding, 29 June 1920*
4. Memorandum. Subject: Memorandum for Publication, From Robert McCleave, Executive Officer, 23 March 1921
5. Correspondence. Subject: Use of Target Range, From C. J. Symmonds, Chief of Staff, 2 September 1921
6. Correspondence. Subject: Correspondence, From Dupont B. Lyon, Acting Camp Adjutant, 21 September 1921
7. Correspondence. Subject: Letter, From W. T. Derieux, Secretary, Missions Commission to Quartermaster, Camp Jackson, SC, 27 October 1921

- Box 25, Part V, Camp Jackson
  1. Correspondence. Subject: Marking boundaries of target range, From Major, Division of Judge Advocate, 16 March 1918
  2. Correspondence. Subject: Safety of Artillery Range, From Andrew Moses, Colonel, Commanding, 19 March 1918
  3. Memorandum. Subject: Assignments made for drill and training purposes, From W. L. Luhn, Lieut. Colonel, Infantry, Adjutant, 18 June 1918
  4. Correspondence. Subject: Report on Small Arms Range, Camp Jackson, From F.H. French, Brigadier General, Commanding, 23 July 1918*
  5. Memorandum. From W. L. Luhn, Lieut. Col., Infantry, Acting Executive Officer, 27 August 1918
  6. Correspondence. Subject: Firing on Machine Gun Range, From Thomas Ryan, 2nd Lt., 23 September 1918*

- Box 26, Part V, Camp Jackson
  1. Correspondence. Subject: Condition of Fence, From Andrew Hero Jr., Colonel, Coast Artillery Corps, Commanding, 21 July 1921
  2. Correspondence. Subject: Recommendation for Change in Artillery Range, From Land Acquisition Agent, 26 June 1919

- Box 27, Part V, Camp Jackson
  1. Correspondence. Subject: Target Range Telephone System, From L. S. Carson, Assistant Adjutant, 9 May 1921

- Box 28, Part V, Camp Jackson
  1. Correspondence. Subject: Lease for Artillery Range, Camp Jackson, From W. P. Dewall, Major General, August 1917
  2. Correspondence. Subject: Condemnation of Land for Artillery and Rifle Ranges, From Department Commander, Southeastern Department, 14 September 1917
  3. Correspondence. Subject: Small Arms Target Range for Divisional Training, 11 October 1917*
  4. Correspondence. Subject: Depopulation of Area Beyond Target Range, 17 December 1917*
  5. Correspondence. Subject: Recommendation for Change in Artillery Range, From Camp Jackson, Land Acquisition Agent, 14 June 1919

6. Correspondence. Subject: Camp Jackson, From James E. Manierre, Major, Camp Adjutant, Not dated

- Box 30, Part V, Camp Jackson
    1. Correspondence. Subject: Condemnation of Land for Use as Target Range, From Brigadier General, 8 September 1917
    2. Correspondence. Subject: Small Arms Firing Manual, From Roger H. Williams, 18 September 1917*
    3. Correspondence. Subject: Camp Jackson, From W. L. Luhn, Lieut. Col., Infantry, Adjutant, 28 June 1918
    4. Correspondence. Subject: Daily Bulletin No. 32, 11 February 1920*
    5. Correspondence. Subject: Daily Bulletin No. 39, 19 February 1920*
    6. Correspondence. Subject: Daily Bulletin No. 42, 24 February 1920*
    7. Correspondence. Subject: Daily Bulletin No. 47, 3 March 1920*
    8. Correspondence. Subject: Daily Bulletin No. 77, 15 April 1920*
    9. Correspondence. Subject: Daily Bulletin No. 92, 3 May 1920
    10. Correspondence. Subject: Daily Bulletin No. 96, 10 May 1920*
    11. Correspondence. Subject: Daily Bulletin No. 105, 22 May 1920*
    12. Correspondence. Subject: Daily Bulletin No. 174, 1 September 1920
    13. Correspondence. Subject: Daily Bulletin No. 185, 17 September 1920

- Box 31, Part V, Camp Jackson
    1. Correspondence. Subject: Camp Jackson, From Herman Erlenkotter, Major, FA, NA, Adjutant, 19 July 1918

- Box 32, Part V, Camp Jackson
    1. Correspondence. Subject: Men to Fire on Target Range, From B.W. Brooks, C.O., 28 April 1921

RG 394, U.S. Army Continental Commands, 1920-1942

- Box 1, Entry 470, General Orders
    1. Correspondence. Subject: Camp Jackson, From Dupont B. Lyon, Acting Camp Adjutant, 14 February 1921
    2. Correspondence. Subject: General Orders No. 52, From Dupont B. Lyon, Acting Camp Adjutant, 24 March 1921
    3. Correspondence. Subject: Camp Jackson, From Dupont B. Lyon, Acting Camp Adjutant, 25 April 1921

- Box 234, Entry 123, 4th Corps Area
    1. Correspondence. Subject: Rifle Range, From Maurice E. Barker, Captain, CAC, 25 June 1923*
    2. Memorandum to the Assistant Chief of Staff. From C. M. Roberts, Ordnance Officer, 3 August 1923*
    3. Correspondence. Subject: Clearing on Camp Jackson Military Reservation for Field Artillery Fire, From Jas. C. Dozier, 24 May 1937

RG 407, Adjutant General

- Box 370, General Correspondence, 1946-1958
    1. Correspondence. Subject: Complaint Concerning Waste of Ammunition at Fort Jackson, SC, 28 July 1958
- Box 1065, Entry 37-A, Central Decimal Files, 1917-1925
    1. Correspondence. Subject: Report on Small Arms Range, From F. H. French, Brigadier General, Commanding, 23 July 1918*

- Box 1191, Entry 37-A, Project Files, 1917-1925
    1. Correspondence. Subject: Camp Jackson, From Clark S. Smith, 21 January 1922
    2. Correspondence. Subject: Report of Director of Small Arms Firing, R.O.T.C. Camp, From James A. Lynch, Colonel, Infantry Camp, 25 August 1920

- Box 2865, Entry 37, Central Files, 1926-1939
    1. Correspondence. Subject: Camp Jackson, From F. C. Reilly, Lt. Colonel, Adjutant, General's Department, 28 March 1934

- Box 2867, Entry 37, Central Files, 1926-1939
    1. Memorandum. Subject: Camp Jackson National Forest, From War Department, General Staff, 11 April 1928
    2. Map. Jackson National Forest, SC*
    3. Map. Special Military Map, Camp Jackson, SC*

- Box 2868, Entry 37, Central Files, 1926-1939
    1. Correspondence. Subject: Camp Jackson, From Jas. C. Dozier, Adjutant General, 1 April 1927
    2. Memorandum to Colonel Dunn and Major Cron. Subject: Camp Jackson National Forest, From U.S. Department of Agriculture, Forest Service, Eastern District, 9 April 1928
    3. Memorandum. Subject: Jackson National Forest, From J. M. Dunn, Lieut. Colonel, General Staff, 24 April 1928

- Box 3964, AAG, Entry 363-A, Decimal File, 1940-1945
    1. Correspondence. Subject: Construction of Training Aids, From R. W. Strickland, 1st Lieut., Assistant Adjutant General, 24 February 1941*
    2. Memorandum. Subject: Training Facilities, 24 February 1941*

- Box 4440, Entry 363, Unclassified Project Decimal Files, 1940-1945
    1. Correspondence. Subject: Request for Permission to have Marine Corps Officers inspect Rifle Range, Fort Jackson, SC, From E.A. Ostermann, 29 July 1941
    2. Correspondence. Subject: Fort Jackson, From C. H. Day, Capt., 4th F. A., Acting Assistant Adjutant General, 3 July 1940
    3. Correspondence. Subject: Fort Jackson, From Steward A. Marshall, Jr., Captain, Quartermaster Corps, Constructing Quartermaster, 25 October 1941

4. Correspondence. Subject: Fort Jackson, From Signal Corps, U.S. Army, War Department Message Center, 10 September 1940

Library of Congress, Prints and Photographs Division, Washington, D.C.

Aerial Photographs:

1. Camden No. 22, Fort Jackson and Vicinity, N3400-W8048/6, AMS V046M
2. Camden No. 23, Fort Jackson and Vicinity, N3400-W8042/6, AMS V046M
3. Fort Jackson North, SC, Sheet 4852 III SW, Second Edition, N3400-W8052.5/7.5, Series V046A*
4. Fort Jackson North, SC, Series V046A, Sheet 4852 III SW, Edition 3-AMS*
5. Messers Pond, SC, Series V064A, Sheet 4852 III SE, N3400-W8045/7.5*
6. Leesburg, SC, Fort Jackson and Vicinity, N3400-W8037.5/7.5, AMS V046A

Library of Congress, Geography and Map Division, Washington, D.C.

Maps (Topographic):

1. Fort Jackson North Quadrangle, SC, Richland County, SW/4 Killian 15' Quadrangle, N 3400-W8052.5/7.5*
2. Fort Jackson North Quadrangle, SC, Richland County, 34080-A8-TF-024*
3. Fort Jackson South Quadrangle, SC, Richland County, NW/4 Hopkins 15' Quadrangle
4. Hagood, SC, AMS, V746, N3400-W8030/15
5. Hagood, SC, Series V746, Sheet 4852 II, Edition 3-AMS
6. Hagood, SC, Series V746, Sheet 4852 II, Edition 4-AMS
7. Hagood, SC, Series V746, Sheet 4852 II, Edition 5-TCP
8. Hagood, SC, Series V746, Sheet 4852 II, Edition 7-DMATC
9. Killian, SC, Series V742, Sheet 4852 III, Edition 4-AMS*
10. Killian, SC, Series V746, Sheet 4852 III, Edition 5-TPC*
11. Killian, SC, Series V746, Sheet 4852 III, Edition 7-DMATC*
12. Leesburg Quadrangle, SC, N3400-W8037.5/7.5, SW/4 Hagood 15' Quadrangle
13. Messers Pond, SC, Series V846, Sheet 4852 III SE, N3400-W8045/7.5*
14. Messers Pond Quadrangle, SC, SE/4 Killian 15' Quadrangle, N3400-W8045/7.5*
15. Messers Pond Quadrangle, SC, AMS 4852 III SE, Series V846, N3400-W8045/7.5*

Regional Archives, NARA Southeast Region (Atlanta), East Point, Georgia

RG-77, Chief of Engineers

- Maps
    1. MIL Construction Drawings, 1950-1956, Tube 13, NARA-Atlanta

RG-156, Office of Chief of Ordnance

- Box 24, Real Property Disposal Files, Account 53A592
    1. Correspondence. Subject: Disposal Plan, From Lillian S. Boswell, Realty Specialist, 9 November 1964

RG 270, WAA, Real Property Disposal Files

- Box 24, Account 52A592
    1. Correspondence. Subject: Certificate of Clearance, From Joseph A. Bocelato, Captain, Corps of Engineers, 30 August 1950
    2. Memorandum. Subject: Fort Jackson Military Reservation, 24 May 1951
    3. Memorandum. Subject: Fort Jackson Military Reservation, Richland County, SC, D-SC-403, From Administrator, General Service Administration, 27 June 1951
    4. Correspondence. Subject: Quitclaim Deed, From Lloyd Gensel, Deputy Regional Director, Public Building Service, General Services Administration, 18 July 1951
    5. Correspondence. Subject: Quitclaim Deed, From Robert V. Christie, Regional Director, 10 March 1964
    6. Memorandum. Appraisal Report from District Engineer, U.S. Army Engineering District, Savannah, GA, 29 September 1964

- Box 177
    1. Correspondence. Subject: Request for approval of salvaging and dismantling the materials of all Theatre of Operation Type Construction on the Main Post, From H.W. Ehrgott, Colonel, Corps of Engineers Chief, Repairs and Utilities Division, 5 December 1946

Appendix B: Archive Documents

REPRODUCED AT THE NATIONAL ARCHIVE

Sept 18, 1917

BULLETIN, No. 12.

HEADQUARTERS 81ST DIVISION
CAMP JACKSON, COLUMBIA, S. C.

September 18, 1917.

The following proposed changes, Small Arms Firing Manual, are published for the information and guidance of this command:

"SMALL ARMS FIRING MANUAL.

CHANGES No. —.

WAR DEPARTMENT,
WASHINGTON, *August —, 1917.*

The following is added to Appendix II, Small Arms Firing Manual, 1913:

C. *Special Course when time or facilities for regular courses are not available.*

This course will be prescribed for the quick training of troops in rifle practice, when time or facilities for the regular courses are not available.

Success cannot be expected, nor can proficiency in rifle practice be attained by a company in this course, unless it has been thoroughly instructed, and each man should satisfactorily pass the prescribed tests before he fires a shot on the range. Without this thorough preliminary course, and satisfactorily passing these tests, it is a waste of ammunition to let the soldier fire ball cartridges on the range.

The soldier is first given a thorough course of preliminary practice as outlined in paragraphs 1 to 70, inclusive. He is then before being allowed to fire a shot on the target range, given the following tests:

Test I.

Nomenclature of the rifle in so far as is necessary for its efficient care and use.

Test II.

Assembling and dissembling of the rifle in so far as is necessary for its efficient care and use.

Test III.

Care of rifle.

Test IV.

Sight-setting: Normal and peep, with and without

Major Roger H. Williams
Inf.

RG 393, Army Cont Cmds, 1821-1920
Part V, Bulletins & Memoranda
Box 30

deflection. Maximum time limit of 10 seconds in each of not less than 5 consecutive trials.

Test V.

Firing Positions:

(a) Standing,
(b) Kneeling,
(c) Sitting,
(d) Prone,
(e) From parapet, wall top, or other under-rifle rest.
(f) From vertical edge of wall, door, window, tree, or similar position.

Test VI.

Loading from belt, pockets fastened, with a clip of dummy cartridges, in position.

Standing, Kneeling, Sitting, Prone — Maximum time limit of 10 seconds each in best 5 out of 7 consecutive trials.

Test VII.

Sighting: With rifle in sighting rest.

(Third sighting exercise, Par. 27.)

Normal Sight, Peep Sight — Proficiency required in 3 consecutive triangles of sighting with each. Distance 20 feet; no side of triangle to exceed 1-2 inch.

Test VIII.

Aiming combined with trigger squeeze.

Test by means of:

(a) Target machine,
(b) Aiming Rod device,
(c) Belgian aiming device, or
(d) Perforated bullseye over instructor's eye.

(Methods used to be noted by abbreviations M., R., B. and P., respectively.)

(a) Standing,
(b) Kneeling,
(c) Sitting, and
(d) Prone.

Test IX.

Rapid Loading, aiming and firing: Load from belt and simulate fire with two clips of dummy cartridges. Tested by means of:

(a) Aiming rod device, or
(b) Belgian aiming device, or
(c) Perforated bullseye over instructor's eye.

(Method used to be noted by abbreviations R., B. and P., respectively.)

In positions:

Standing,
Kneeling,
Sitting, and
Prone.

Time of each:

1 minute,
1 minute, 10 seconds,
1 minute, 10 seconds, and
1 minute, 20 seconds, respectively.

Test X.

Flinching:

In prone position. The rifle will be so manipulated by the instructor that the man under test does not know whether or not it is loaded. Service ammunition to be used.

Known Distance Practice.

An annual allowance of 150 rounds per man is authorized for Known Distance Practice, which includes Short Range Practice, Midrange Practice and Practice with Telescopic Sights.

Short Range Practice.

All firing from a typical trench, bayonet fixed except as noted, rifle resting on parapet.

REPRODUCED AT THE NATIONAL ARCHIVES

Instruction.

Table 1.—Slow Fire.

Range Yards	Time	Shots	Target	Position and Type of Trench	Sight
100	No Limit	10	A-4	Prone	Leaf
200	" "	10	A-4	Standing	5 leaf and 5 battle sight
300	" "	15	A-4	Standing	10 leaf and 5 battle sight.

(a) One-half of firing with leaf sight at this range will be with bayonet not fixed.

105 points out of possible 175 in slow fire at bullseye target necessary to advance to slow fire at figure target.

Table 2.—Slow Fire.

Range Yards	Time	Shots	Target	Position and Type of Trench	Sight
100	No Limit	5	Head	Prone	Leaf
200	" "	5	F	Standing	"
300	" "	5	F	"	"

9 hits out of possible 15 required to advance to rapid fire.

Table 3.—Rapid Fire.

Range Yards	Time	Shots	Target	Position and Type of Trench	Sight
100	One Minute	10-20 (b)	Head	Prone	Leaf
200	" "	10	F	Standing	"
300	" "	10	F	"	"

18 hits out of possible 40 required to advance to Record Practice.

Soldiers who fail to make the necessary points to advance are given further instruction practice to the limit of the ammunition allowance.

Record.

Table 4.—Rapid Fire.

Range Yards	Time	Shots	Target	Position and Type of Trench	Sight
100	One Minute	10-20 (b)	Head	Prone	Leaf
200	" "	10	F	Standing	"
300	" "	10	F	Standing	"

(b) At this range the soldier must fire 10 rounds; he may fire as many more as he can up to 20 rounds and receive credit for every hit he makes. Soldier is penalized 1 point for each round less than ten that he does not fire.

Total shots—130.

Mid Range Practice.

For all men who have made 25 hits or more in Record Practice.

Table 5.—Slow Fire.

Range	Time	Target	Shots	Position
500	No Limit	B	10	Prone
600	" "	B	10	Prone

Every effort will be made to teach the men the effect of wind, light and temperature, and the value of small changes in elevation and windage.

No report of this firing will be required, although a record of it will be kept in each company.

Practice With Telescopic Sights.

After Mid Range Practice has been completed, the four best enlisted shots of the company will fire as prescribed in Par. 117.

Combat Practice.

Combat Practice, individual and collective, will be fired by an organization after the completion of the Known Distance Practice.

REPRODUCED AT THE NATIONAL ARCHIVES

REPRODUCED AT THE NATIONAL ARCHIVES

An annual allowance of 50 rounds of ammunition per man, to be expended under the direction of the regimental commander, is authorized for this practice.

Targets.

Target A-4 is the A target, as described in Par. 258, cut down to 4 feet square. The rapid fire is conducted as at present prescribed under Procedure Rapid Fire, page 71, with the exception that at all ranges the soldier assumes the firing position before the command "Ready" is given.

The Head Target is the top of the E Target cut off 12 inches from the top. (C. S. A. F. M. No—, Aug.—, 1917.) (353.1, A. G. O.)

BY ORDER OF THE SECRETARY OF WAR:

TASKER H. BLISS,
Major General, Acting Chief of Staff.

OFFICIAL:
H. P. McCAIN,
Adjutant General.

Copy of O. O. File R-300. 8-4.
MG
CM"

BY COMMAND OF BRIGADIER GENERAL BARTH:

C. D. ROBERTS,
Lieut. Col., Inf., N. A.,
Chief of Staff.

OFFICIAL:
ADNA R. CHAFFEE,
Major, Inf., N. A.,
Division Adjutant.

Ed. Camp Jackson, Oct. 16, 1917.

684-Target Ranges.

[illegible]
[illegible], S.C.

October 11, 1917.

Department Commander.

Commanding General, Camp Jackson, Columbia, S.C.

Small Arms Target Ranges for Divisional Training Camps.

1. With reference to the circular letter (copy herewith) from the Adjutant General of the Army, [illegible], [illegible] 2nd, 1917, to the Commanding Generals of the several camps in reference to the above, information is requested as to the progress made in the selection of a suitable Rifle Range for Camp Jackson, Columbia, S.C.

[illegible]/[illegible]

[illegible]
Major General, U.S.A.

ADJUTANT GENERAL
In Absence of Department Commander.

1st Ind. CDS-C

HQ., 81st Div., Camp Jackson, S.C., October 17, 1917.—To Commanding General, Southeastern Department, Charleston, S. C.

1. A suitable small-arms range adjacent to this camp has been selected and surveyed and work of clearing has begun. Target material is either on hand or en route and the range will be ready for use before the troops are prepared to use it.

2. The range lies adjacent to the cantonment site, about a mile and a half east of the nearest barracks, and is part of the large tract, a three year lease hold of which is to be obtained under authority of the War Department, by condemnation proceedings. The U. S. Attorney is now engaged in the preliminary work of instituting legal proceedings, but the property owners of the tracts on which the range, proper, is situated have given their consent to the use of the land; and work was begun without waiting for the actual institution of condemnation proceedings.

3. The range will have 200 targets for 300-yard rifle practice, [illegible] machine-gun targets, 34 600-yard targets, and 6 1000-yard targets. All can be used simultaneously. Any part of the 300-yard range can be used for pistol targets and in addition good sites for pistol practice are available nearer camp.

FILE CANTONMENT RECORD

RG 393, US Army Cont. Cmds, 1821-1920
Part V, Camp Jackson
Gen corr, 1917-20
30X 28

4. The State has a 24 target 600-yard range at Styx, S. C., but it is fourteen miles from camp and not available for practice by this command, unless a camp were to be established there.

Major General, U. S. A.,
Commanding.

1 incl.

REPRODUCED AT THE NATIONAL ARCHIVES

REPRODUCED AT THE NATIONAL ARCHIVES

Dec. 17, 1917

684 - Target Ranges

HEADQUARTERS 306th ENGINEERS
CAMP JACKSON, COLUMBIA, SOUTH CAROLINA.
December 17th, 1917.

FROM: The Division Engineer, 81st Division.

TO: The Commanding General, 81st Division.

SUBJECT: Depopulation of area beyond target range.

1. In view of the fact that it is expected to begin target practice on the small arms range about January 1st, 1918, it is recommended that steps be taken for the removal of all inhabitants in the tract to the east of the range for a distance of three miles, and to post danger signals and signs on all roads leading in behind the butts for the same distance to the eastward.

Colonel Engineers N. A.

FILE

RG 393, Army Cont. Cmds, 1821-1920
Part II, Camp Jackson
Gen corr, 1917-20
Box 28

REPRODUCED AT THE NATIONAL ARCHIVES

Undated (ca. Dec 1917)

684 - Target Ranges.

ARC/O'N.

684 - Target Ranges

Acting Chief of Staff

Brigade Commanders and Commanding Officer 306th Engineers.

Small Arms Target Range.

1. The Commanding General desires that you be informed that the small arms target range will be ready for use on the 1st. of January. The Range Officer will assign on the 300 yards range, 24 targets to each infantry regiment, to the 316th Field Artillery, and 306th Engineers for purposes of instruction. The 316th Field Artillery will be grouped with the 161st. Inf. Brigade and its small arms practice carried on under the general supervision of the Commanding General of that Brigade. The Range Officer will apportion targets on the 600 and 100 yardsranges in such a manner as future developments may indicate best.

2. The Commanding General desires that the first week on the range be devoted to the instruction of officers. Brigade Commanders and Commanding Officer, 306th Engineers, will make necessary arrangements for systematic instruction. The known distance course for all men now in the command will be completed on or before the 7th of February, 1918, leaving the range free after that date for the instruction of men who may have joined in the interim.

3. Attention is invited to paragraph 4, G.O. 42, December 8th, these Headquarters, which gives the schedule of gas instruction for the command.

4. It has been stated that battery harness will not be available for National Army divisions before the first of March. We have applied by telegraph for harness for one battery, which there seems to be a probability of our receiving in the near future.

5. Infantry field equipment is not yet in sight. Bayonets for Enfield rifles will be available.

6. With the above considerations as to equipment for instructions and allotment of time for gas instruction and small arms practice, the Commanding General desires that you submit your programme for the month of January not later than the 25th instant, for approval.

Major, Inf., N.A.

FILE

Copy sent:
C.O. 306 Eng.
C.O. 161st Inf. Brig.
C.O. 162nd " "
C.O. 186th " " X
C.O. 156th " "

CANTONMENT RECORD

RG 393, Army Cont Cmds, 1821-1920
Part V, Camp Jackson
Gen corr, 1917-20
Box 28

January 19, 1918

COMPLETION REPORT

OF

CAMP JACKSON

Columbia, S. C.

William Couper, Major, Q.M., U.S.R.,

Constructing Quartermaster.

****

DECLASSIFIED
Authority NND 803038
By CO NARA Date 8-5-04

RG 77 Chief of Eng.
E. 391 Construction Completion Reports, 1917-43
Box 140

CONSTRUCTING QUARTERMASTER

CAMP JACKSON

Columbia, S. C.

January 17, 1918.

From: Constructing Quartermaster, Camp Jackson.
To: Officer in Charge of Cantonment Construction,
Washington, D. C.
-Completion Report-

1. In accordance with your letter of November 2nd, requesting report of operations during the construction of this cantonment, file 600.914 CR-C (General), the following is submitted:
We have the following recommendations to make for consideration in case additional cantonments are constructed:

2. TIMEKEEPING: The practice employed at this cantonment of having the Government keep the time is not in my opinion a proper one to use in future work. The principal objection to it is that the contractor loses a certain control over his men. I believe that the actual disadvantage of this system more than outweighs the slight additional cost of having the contractor keep his own time and having a smaller Government force check it. I consider the practice of having booths for checking the men in and out essential.

3. PAYROLL SIGNATURES: I respectfully call attention to the practice of requiring signatures on pay rolls. With laborers this resolves itself into a farce, as practically none of them sign their names, and in view of the fact that the making a mark is a prefunctory practice, I believe that in the interest of efficiency the requirement should be abolished, and the signatures omitted. This is the practice which practically all large contracting firms have adopted.

4. COMMISSARY: I believe more efficient results will be obtained by compelling the contractor to sublet his commissary so that he may be able to devote his entire time to the actual performance of the work. The practice of running the commissary for profit has become so general that it is difficult for contractors to form the idea that the commissary on these emergency projects should be run on a cost basis.

5. SECRET SERVICE AGENTS: Secret service agents should be assigned to each project, as soon as actual construction commences. We worked here several months without one and the work done by the agent after he arrived showed that his services were necessary.

6. NEWSPAPER ADVERTISMENTS: Contractors in signing the contracts should be given to understand that no newspaper advertisements shall be placed in localities where other emergency work is being performed. The same applies to solicitation of labor from other Government projects. We have had a great deal of difficulty from that source at this cantonment due to the fact that wages paid elsewhere have been very much higher and that distance does not prevent the men from going to a new job in view of the fact that their transportation is refunded.

DECLASSIFIED
Authority NND 803038
By CO NARA Date 3-24-04

2.00 and $3.00, the original being delivered to the employee and the duplicate being held by the time-keeper's office. In order to have a signed evidence of payment (although the payment was only in the nature of a commissary ticket) in case the employee made no more time than he used up in Commissary credit the checks were designed to show the signature of the employee to whom they were issued.

A form, Requisition for refund of Transportation, was used in cases where transportation was refunded employees who had been on the work one continuous week or more.

Two forms were used in conjunction in cases where there were complaints of shortage, in time.

Other forms used were: A card record of the monthly foreman,

An outside time checkers report, was used in a bound book of 100 pages each. The outside checking department also kept a complete check on livestock and equipment, same being reported on a separate form. This department also checked teams, reporting same on "Team report".

A Report of Discharge Checks issued for the information of the Superintendents, and showing the total number of discharge checks issued daily.

74. The property on which the rifle range is located is situated east of the Cantonment. It is a strip of land 13200 feet wide; it averages about 42000 feet in length, and contains 13093.81 acres. It is rolling sand hill country covered principally with scrub oak, of the black jack variety, interspersed with a few pine trees, and is very sparsely settled. This land was largely acquired by condemnation proceedings. In laying out the 300 yard rifle range it was found that the lay of the land would not permit of shooting directly from the firing trench to target trench without danger of the bullets going over the property line, and so in order to take advantage of the ridges, which do not lie parallel to the property line, it was necessary to construct the trenches in echelon. This required slightly more trenching work but formed a layout which was so much more practical that it was decided to do the work, and it was all completed prior to January 1st. The method used in constructing the trenches has already been described in Paragraph 6.

75. All of the field engineering at this Cantonment was handled by the Field Engineer, Mr. James E. Gibbons, and the Engineering and Inspecting force was recruited from all over the East. By forming our own engineering organization, we avoided the payment of any engineering fees excepting the salaries of the men themselves. The only exception to this was the contract with the Supervising Engineer, Mr. P. H. Norcross, who was paid on contract a salary of $7500, plus his expenses, for designing the sewer system, water system, etc.

76. Two of the Commissioned Officers mentioned in Paragraph 3, Captains Frisbe and Holmar, not being up to the Standard, were released about August 4th and were sent to other Camps. Captain Moore, who had been in charge of the property account, was ordered away for similar duty elsewhere, we were sorry to lose his services. The other three officers stayed on the job until its completion and formed a very well-balanced staff-- Capt. Crunden having charge of Administration, Capt. MacDonald supervising the building operations, fire protection and equipment installations, and Capt. Dinkins having charge of transportation. The faithfulness and ability of these men are largely responsible for the completion of the work.

77. In appendix B we have shown rates of pay of the various classes of labor employed at Camp Jackson.

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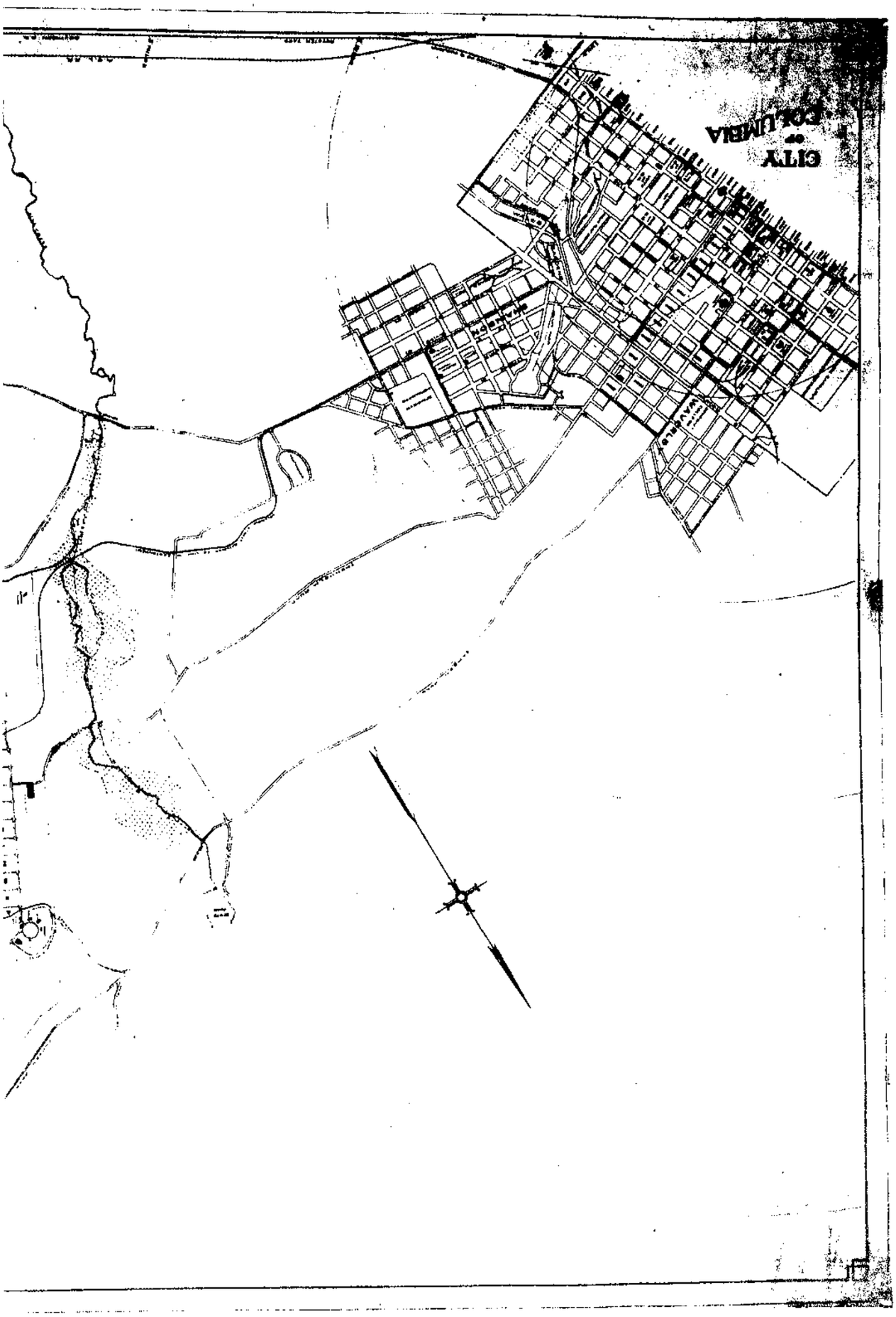
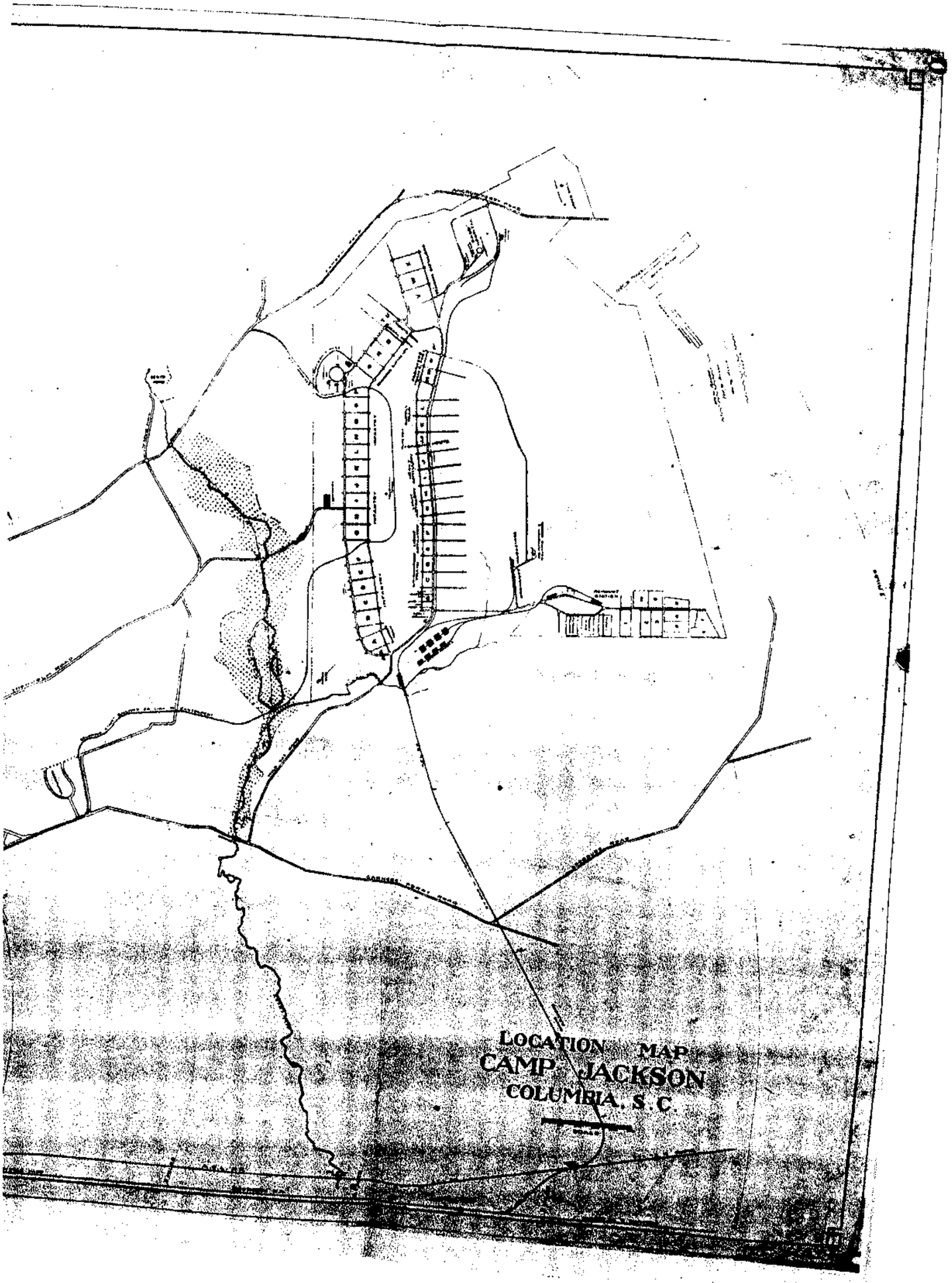
Authority NND 803038
By CORA Date 3-24-04

DECLASSIFIED
NND 803028
Authority
By CO NARA Date 3-4-04





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Authority NND 803038
By CR NARA Date 3-24-04

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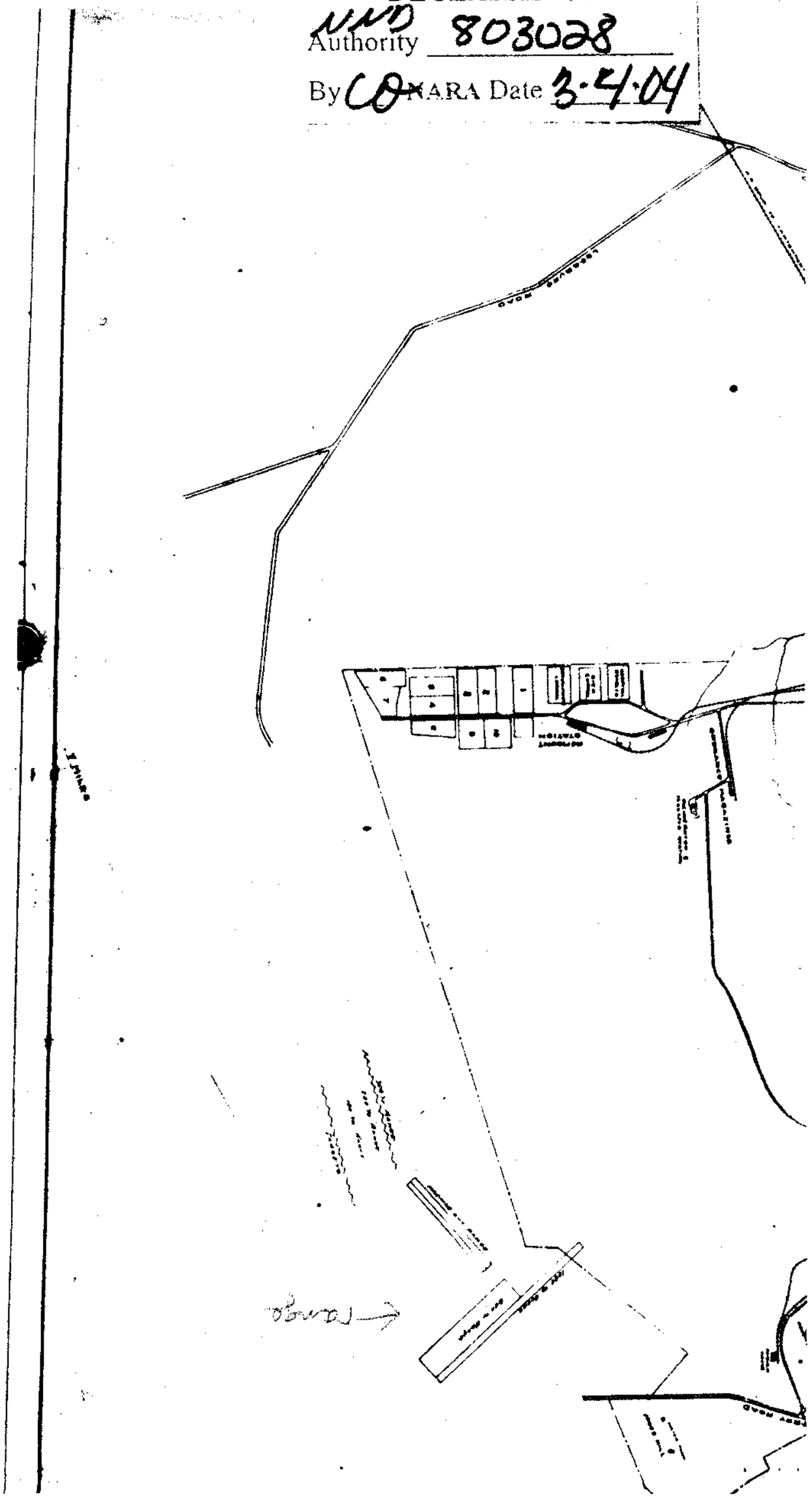
DECLASSIFIED
Authority NND 803028
By CO NARA Date 3-4-04



January 19 1918

FINAL REPORT

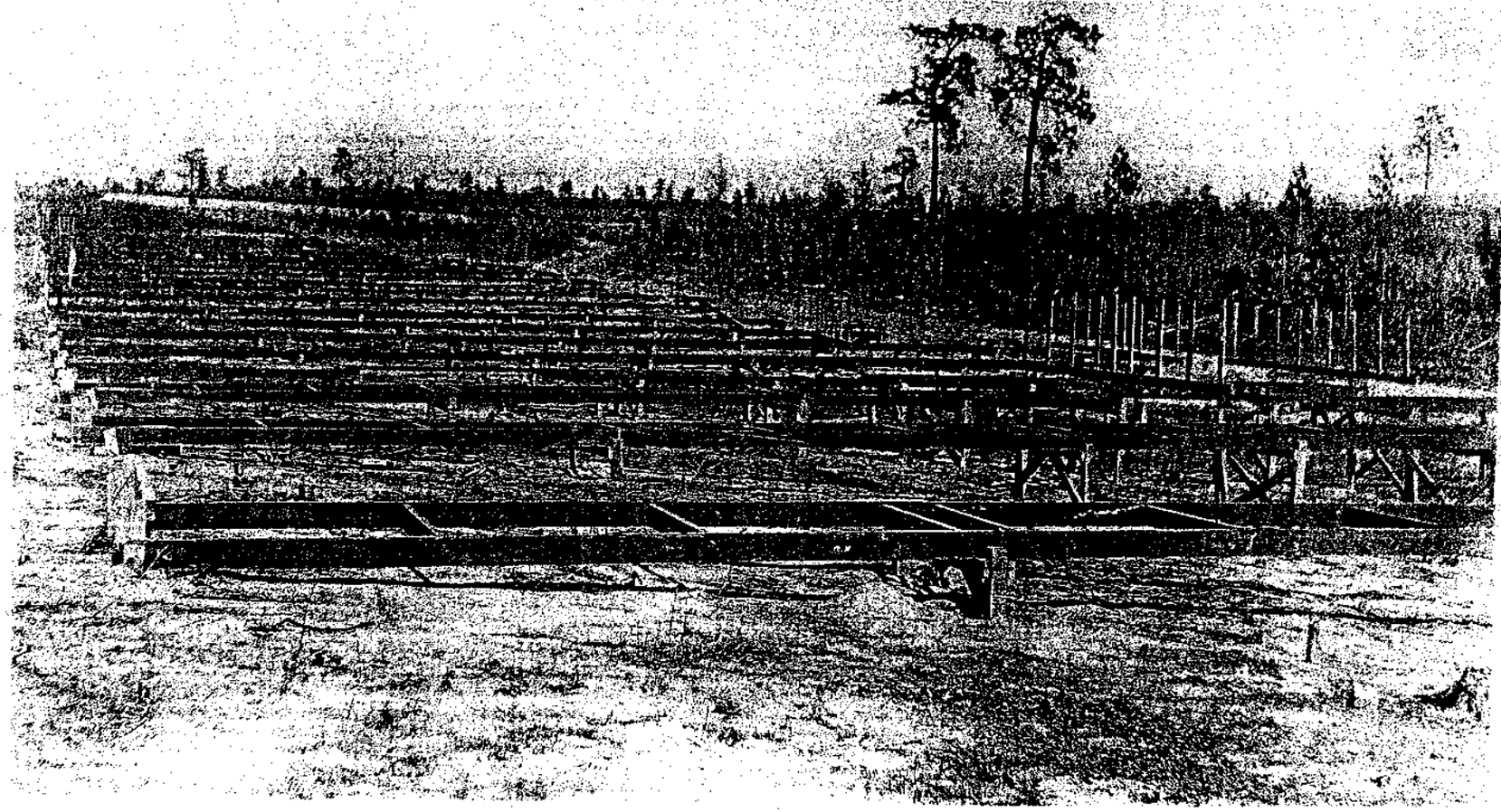
Plans and Descriptionof Camp and Camp Utilities

CAMP JACKSON? S. C.

Jan. 19, 1918.

RG 92. Quartermaster Gen'l
E. 97A A. Completion Repts, 1917-1919
Box 36

MACHINE GUN RANGE.



RIMLA RANGE.

July 23, 1918

No. 614 Camp Jackson

(Misc. Div.)

THE ADJUTANT GENERAL'S OFFICE

RECORD OF COMMUNICATION RECEIVED

From: C. G. Camp Jackson by letter *Dated:* July 23, 1918.

To: The Adjutant General *Rec'd A. G. O.* July 30, 1918.

Subject: Report on Small Arms Range, Camp Jackson, South Carolina.

Form No. 624, A. G. O.
Ed. Mar. 2-18—300,000.
6 8—4598

RG 407, AG, Entry 37A
Central Decimal Files 1917-25
Box 1065

HEADQUARTERS, CAMP JACKSON,

Columbia, S. C.,

614 (C) Misc. Div. July 23, 1918.

From: The Commanding General.

To: The Adjutant General of the Army, Washington, D. C.

Subject: Report on Small Arms Range, Camp Jackson, S. C.

1. Pursuant to instructions in letter from the Adjutant General's Office, War Department, Washington, D.C., July 13, 1918, the following report is submitted:

(a) There is one rifle range, four miles from the center of camp, with targets as follows: Short range (100, 200 and 300 yards), two hundred (200) targets. Mid range (500 and 600 yards) thirty-four (34) targets. Long range (800 and 1000 yards) six (6) targets.

(b) There is no pistol range. The short range for rifle firing can be used for pistol range by trimming paper targets to fit 4 x 4 foot frames.

(c) There are two machine gun ranges (1000 inch ranges) right in camp. One on the east side and one on the west side of Camp. These are small ranges and were used for the training of officers. One machine gun range (1000 inch range) of seventy-two (72) targets, on tracks, four miles from the center of camp.

(d) There are three Combat firing ranges for small arms and machine guns. Combat range No. 1 is four miles from center of camp. Combat Ranges Nos. 2 and 3 are five miles from center of Camp.

(e) Artillery range of 14000 by 6000 yards four miles from center of Camp with sufficient capacity for training one Brigade of Field Artillery.

2. The facilities are sufficient for the training of a division. The ranges reported upon were used by the 81st Division and were considered ample.

3. A map is submitted herewith showing location of ranges.

A. G. O. AUG 7 1918

Left with Secy G.S. & M.P.D.

F.H.FRENCH,
Brigadier General, U.S.A.,
Commanding.

WLL/jem

File

A. G.

RECEIVED
JUL 30

REPRODUCED AT THE NATIONAL ARCHIVES

July 13, 1918.

From: The Adjutant General of the Army.

To: The Commanding Officers of all Regular Army, National Guard, and National Army Camps and Cantonments.

Subject: Small Arms Ranges at Divisional Camps and Cantonments.

The Secretary of War directs that a report be submitted as to the facilities available at your camp for the instruction of troops in small arms and machine gun firing covering:

(a) Rifle ranges, distance and number of targets.
(b) Pistol ranges, number of targets.
(c) Machine gun ranges (1000 inch ranges), number.
(d) Combat firing ranges for small arms and machine guns.
(e) Artillery ranges.

The report should show the distance of the ranges from the center of the camp or garrison, and whether or not the facilities are sufficient for the training of a division. If possible, a map should be submitted. If the facilities of any class are not sufficient the report should show what measures are necessary in order to secure them.

Adjutant General.

REPRODUCED AT THE NATIONAL ARCHIVES

Sept 23, 1918

MACHINE GUN SCHOOL
10th REGIMENT, F. A. R. D.
Camp Jackson, S. C.

September 23, 1918.

From: Senior Instructor, Machine Gun School.

To: Camp Executive Officer, F.A.R.D., Camp Jackson, S. C.

Subject: Firing on Machine Gun Range.

1. Firing will take place from the old rifle butts to the southwest of the position now occupied by the incoming cavalry brigade. Firing will commence on Tuesday morning, September 24, 1918 and continue through Wednesday.

2. The positions will be at the south end of the rifle butt. The fire direction will be about 220 mills north of east, parallel with the southern mark of the butts as shown on the map made by the 306th Engineers.

Thomas C. Ryan
2nd Lt. F.A.

RG 393, Army Cont. Cards, 1821-1920
Part II, Camp Jackson
Gen corr, 1917-20
Box 25

GENERAL COMPLETION REPORT

ON

NORTH CAMP JACKSON

AS ABANDONED OF FEBRUARY 28, 1919.

H. J. Macdonald
CAPTAIN, Q. M. CORPS,
CONSTRUCTING QUARTERMASTER.

RG 92. Quartermaster Gen'l
E. 1974-A. Completion Rept's 19-[illegible]
P. [illegible]

THE CONTRACT

The contract is the ordinary Government form for emergency work which in this case constituted the construction of an Artillery Cantonment near Camp Jackson, S. C. to be known as North Camp Jackson.

The contract was made and concluded the 2nd day of September, 1918, by and between the HARDAWAY CONTRACTING COMPANY, Columbus, Georgia, represented by B. H. Hardaway, it's President, party of the first part, hereinafter called "The Contractor", and the UNITED STATES OF AMERICA, by R. C. Marshall, Jr., Brigadier General, U. S. Army, acting by the authority of the Secretary of War, party of the second part, hereinafter known as "Contracting Officer."

On September 6th, 1918, in accordance with the approval of the Assistant Secretary of War under date of August 21st, 1918, authority was given the Constructing Quartermaster, North Camp Jackson, to proceed with the construction of a Field Artillery Cantonment.

The amount approved for this construction was Nine Million Dollars ($9,000,000).

The authorization number for the construction of the above named Artillery Cantonment was Project Number 6015-1.

THE PROJECT

LOCATION

Attached find Appendix "C" showing location of North Camp Jackson with respect to Camp Jackson and the City of Columbia, S. C. As is shown on this Appendix you will note that the two camps proper are distant by about two miles and North Camp Jackson is distant from Columbia by about seven miles.

The main highway connecting the City of Columbia and North Camp Jackson is known as the Two Notch Road or the highway connecting the City of Columbia and the City of Camden, S. C. Dents Pond, popular for its bathing, is located equidistant from the two sites. The main road to Camp comes off said Two Notch Road at what is known as Dents Station on the Sea Board Air Line Railway.

The site for the Artillery Camp was picked so that its drill ground lies on a very long high ridge forming the divide between two creeks - Jackson Creek being on the western side of the Camp and Gill Creek on the eastern side, both of which flow into the above spoken of Dents Pond.

The Constructing Quartermaster upon arrival on the site August 26th, 1918, found that about six hundred and eleven (611) acres, more or less, of the wood land had been cleared off by the forces of the Harry F. Hann Contracting Company who was the contractor on some improvements made at Camp Jackson and who anticipated the con-

tract for the construction of North Camp Jackson.

On September 4th, 1918, the work of clearing was turned over to the Contractor, The Hardaway Contracting Company, who finished same. Construction equipment and teams were requisitioned at once and on the above date construction had begun on a temporary spur track from the Sea Board Air Line Railroad serving the Camp.

RESERVATION AND BOUNDRIES

Attached find Appendix "D" showing the boundries of the reservation and the acreage contained in same. The letters shown on this plan refer to detailed plans which are shown on an attached Appendix lettered "D-1". Blue prints or original plans are on file in the office of the C.Q.M., Camp Jackson.

The parcel lettered "A" or the original Camp Jackson area contained eleven hundred and ninety two (1192) acres, Parcel "B" contains fifteen hundred and forty five (1545) acres, Parcel "F" the tract covered by North Camp Jackson contains five thousand seven hundred and sixty five (5765) acres. The total acquisition constitutes approximately thirty six thousand two hundred and forty five (36,245) acres, more or less.

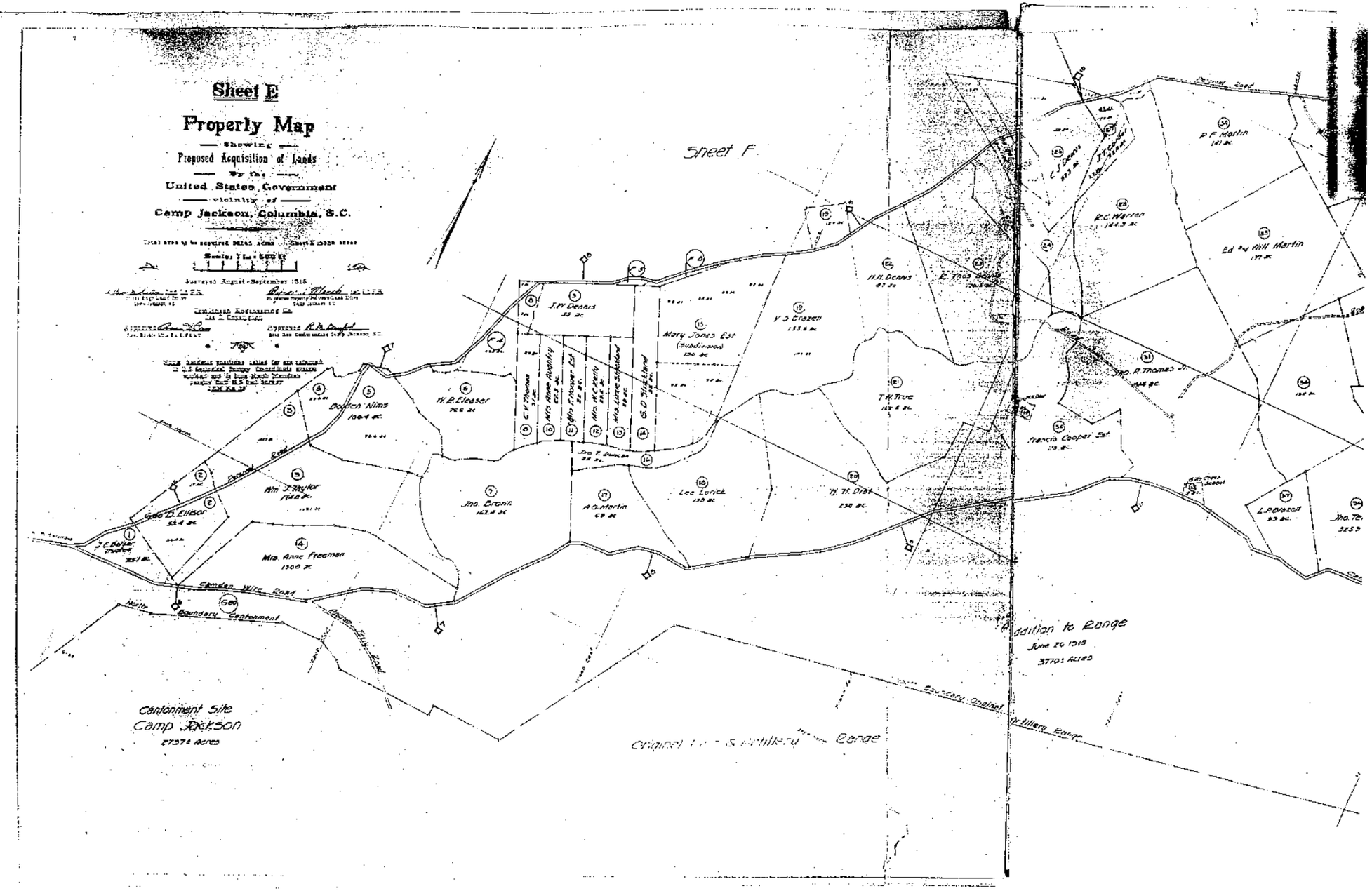
8

RAILROADS

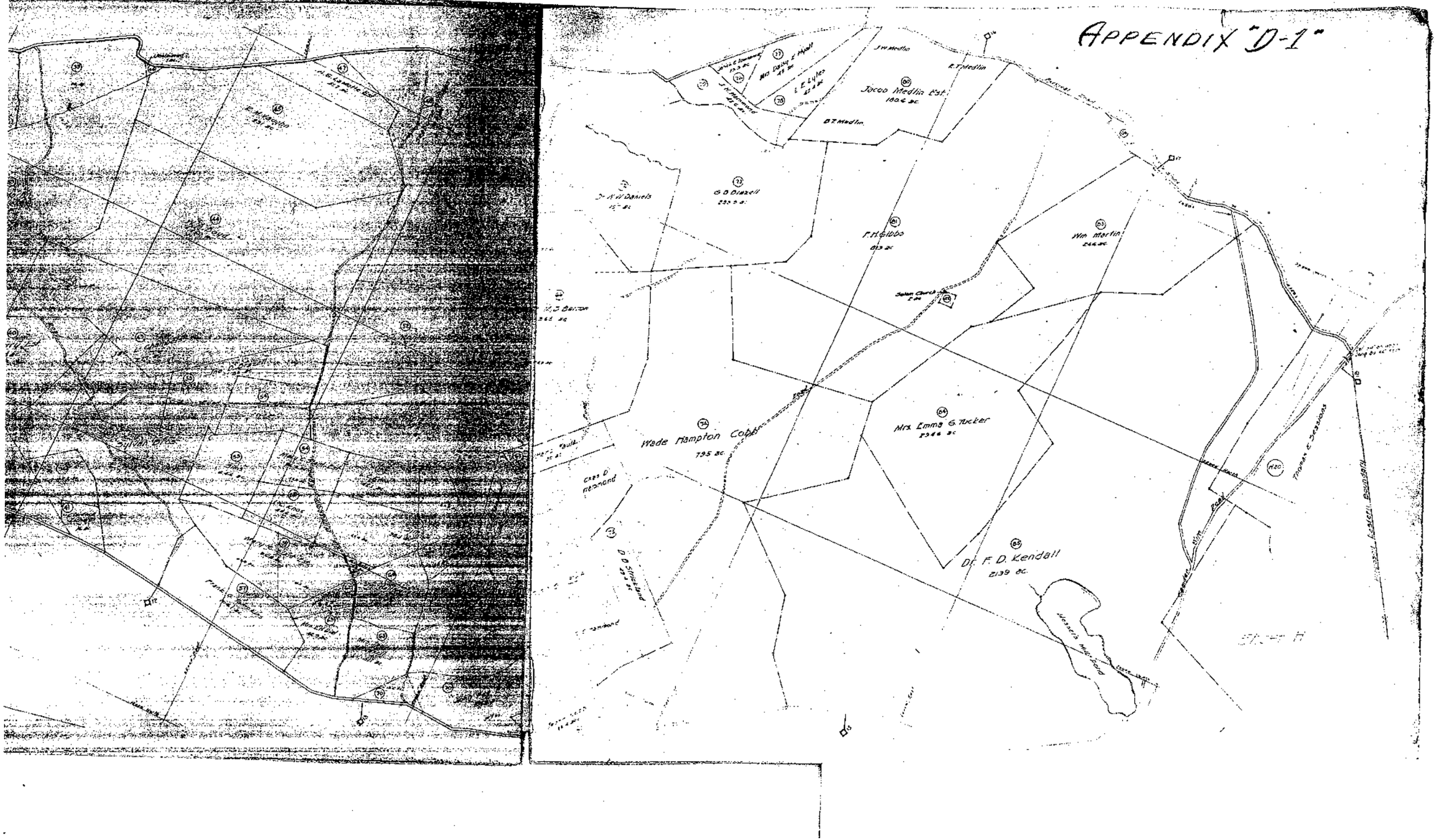
Attached find Appendix "J" showing railroad layout. The main line of the Sea Board Air Line Railroad forms the western boundary of the reservation. This being the only common carrier in the vicinity it was readily found necessary to construct a spur for the purpose of distributing the construction material in the construction area. The Supervising Engineer had already begun a location for this spur which in the opinion of the Constructing Quartermaster, was much larger and more expensive than was necessary. The second day on the site, the Constructing Quartermaster and a party reconnoitered and finally selected a location which proved to be at least a mile shorter and far less expensive. Three days later construction was begun on same and by September 16th, 1918, accommodation for 100 cars was made.

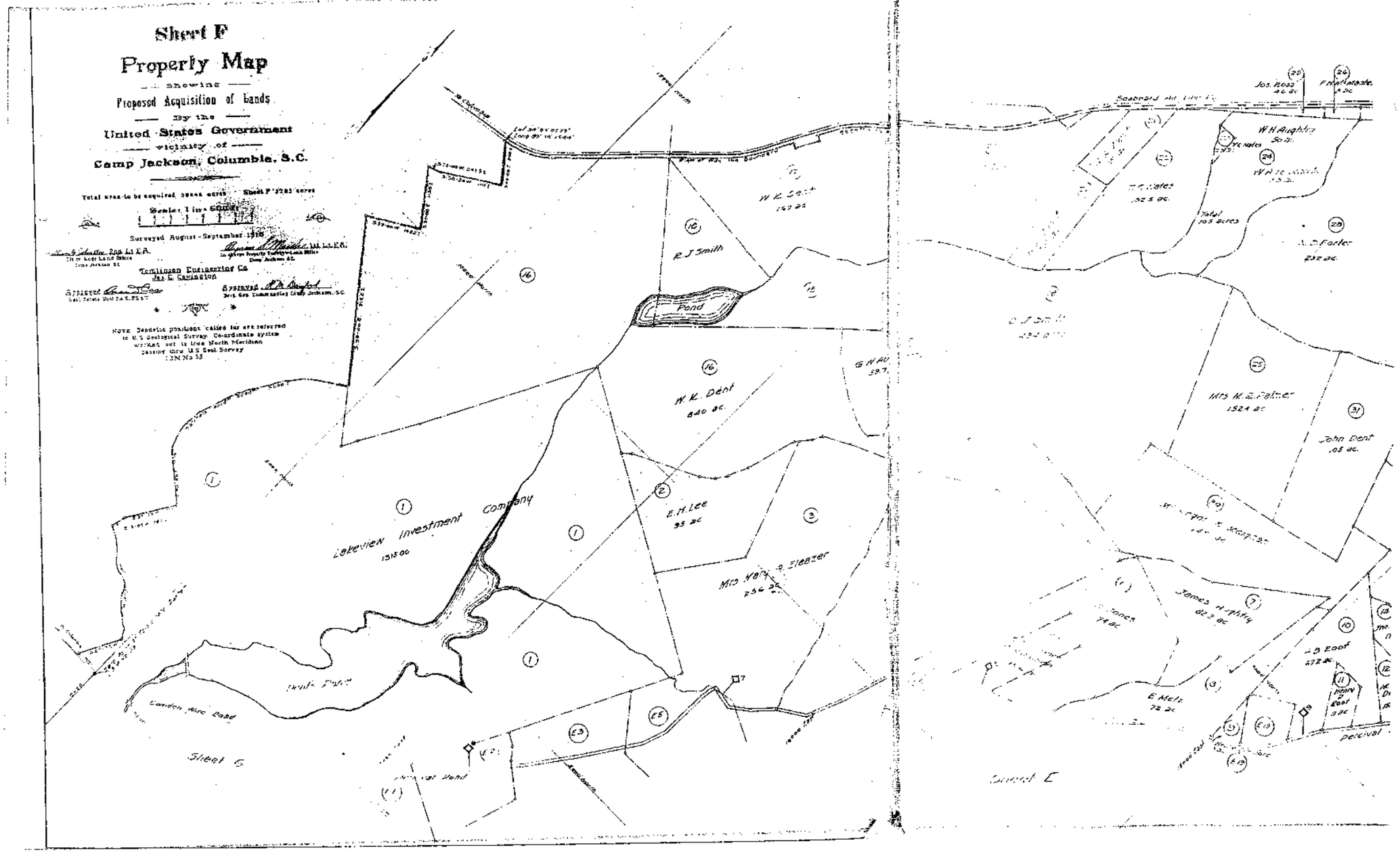
The only difficulty encountered was a swamp over which was built a fourteen foot (14') trestle about 400' long, a photograph of which is attached. This is known as the trestle crossing Jackson Creek. This temporary line is shown on Appendix "J". It was built on the shortest course (with a maximum allowable grade of 2%) to the drill grounds; thence down drill grounds giving as near as possible equal distribution of material to all construction. This constituted a length of 13786 lin. feet of which about 5300 lin. feet was used as permanent line, about 1500' being used in connection with track serving Quartermaster's

Original Rte. of Artillery
Bridge

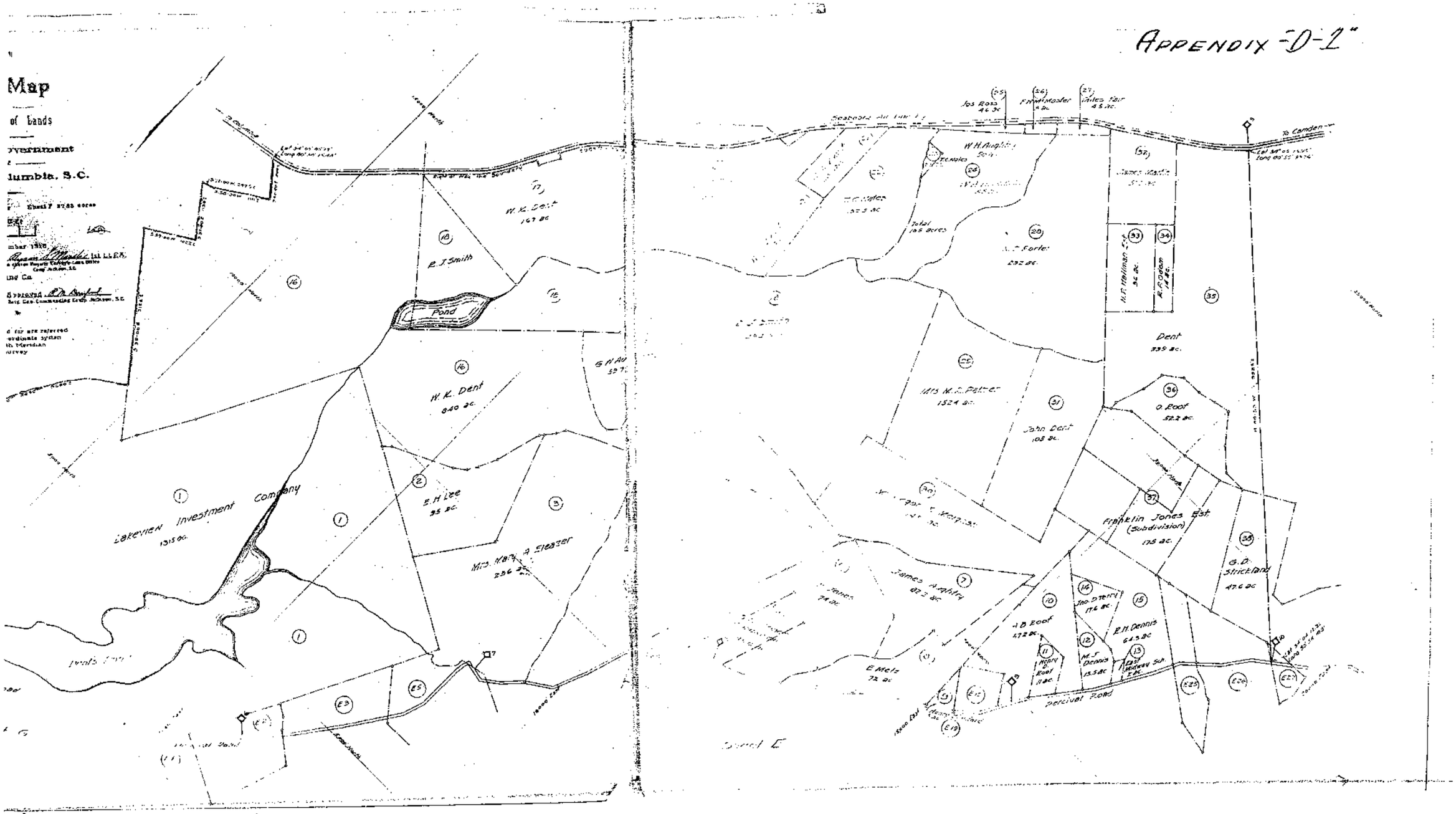

Sheet E
Property Map
Showing
Proposed Acquisition of Lands
By the
United States Government
vicinity of
Camp Jackson, Columbia, S.C.
Surveyed August-September 1918
Sheet F
Cantonment Site
Camp Jackson
2737± Acres
Addition to Range
June 20 1918
3770± Acres
Camden Wire Road
North Boundary Cantonment
Boundary Original Artillery Range
Mrs. Anne Freeman
Jno. Bronn
A.O. Martin
Lee Lorick
Mary Jones Est
(Subdivision)
Dodden Nims
W.R. Eleaser
J.W. Dennis
Y.S. Brazell
T.W. True
H.H. Dennis
R.C. Warren
P.F. Martin
Ed & Will Martin
Francis Cooper Est
L.P. Blazell
Jno. P. Thomas Jr.
Wm. J. Taylor
Geo. D. Ellison
J.E. Balser Trustee
Jno. T. Duncan
G.D. Strickland
Mrs. W.C. Kelly
Mrs. Lizzie Strickland
Mrs. Anne Aughtry
C.V. Thomas

APPENDIX "D-1"

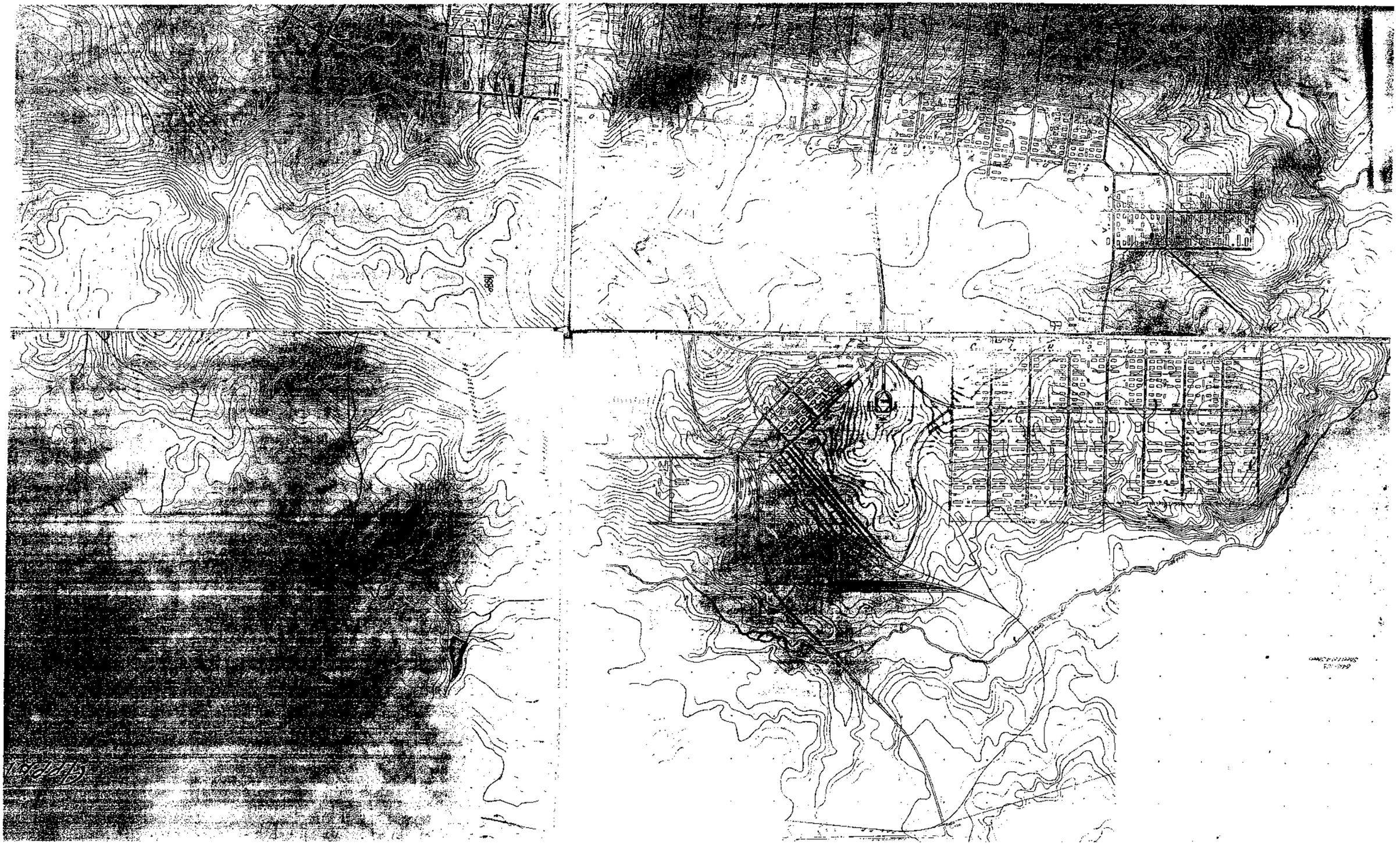

Jacob Medlin Est.
180.6 ac.
J.W. Medlin
B.T. Medlin
B.T. Medlin
G.D. Blazell
F.H. Gibbs
Wm. Martin
Wade Hampton Cobb
795 ac.
Mrs. Emma G. Tucker
Dr. F.D. Kendall
2139 ac.
Thomas E. Dickson
Sutton Creek
Cross Roads
Cross Roads
Cross Roads

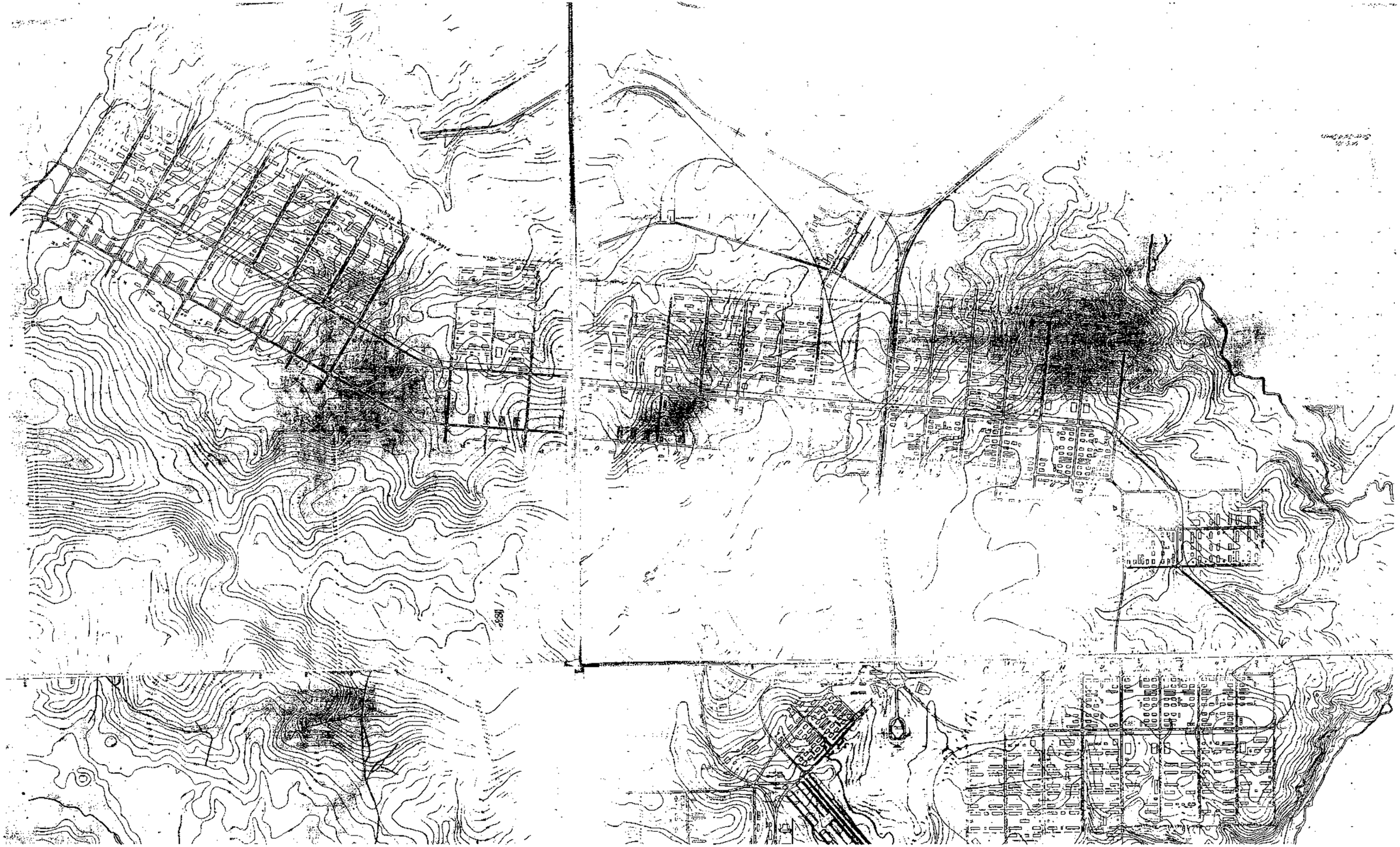

Sheet F
Property Map
showing
Proposed Acquisition of Lands
By the
United States Government
vicinity of
Camp Jackson, Columbia, S.C.
Total area to be acquired 3000 acres
Scale: 1 in = 600 ft
Surveyed August - September 1918
Tomlinson Engineering Co
Jas. E. Covington
Approved
Approved
Note Geodetic positions called for are referred to U.S. Geological Survey. Coordinate system worked out to true North Meridian passing thru U.S. Geol. Survey
Lakeview Investment Company
1315 ac
Pond
R. J. Smith
W. K. Dent
840 ac.
E. H. Lee
95 ac
Mrs Mary A. Eleazer
256 ac
Camden Wire Road
Sheet G
Sheet E
W. H. Aughtry
Total
105 acres
Mrs M. E. Palmer
1524 ac
John Dent
105 ac.
James Aughtry
E. Metz
72 ac
Percival

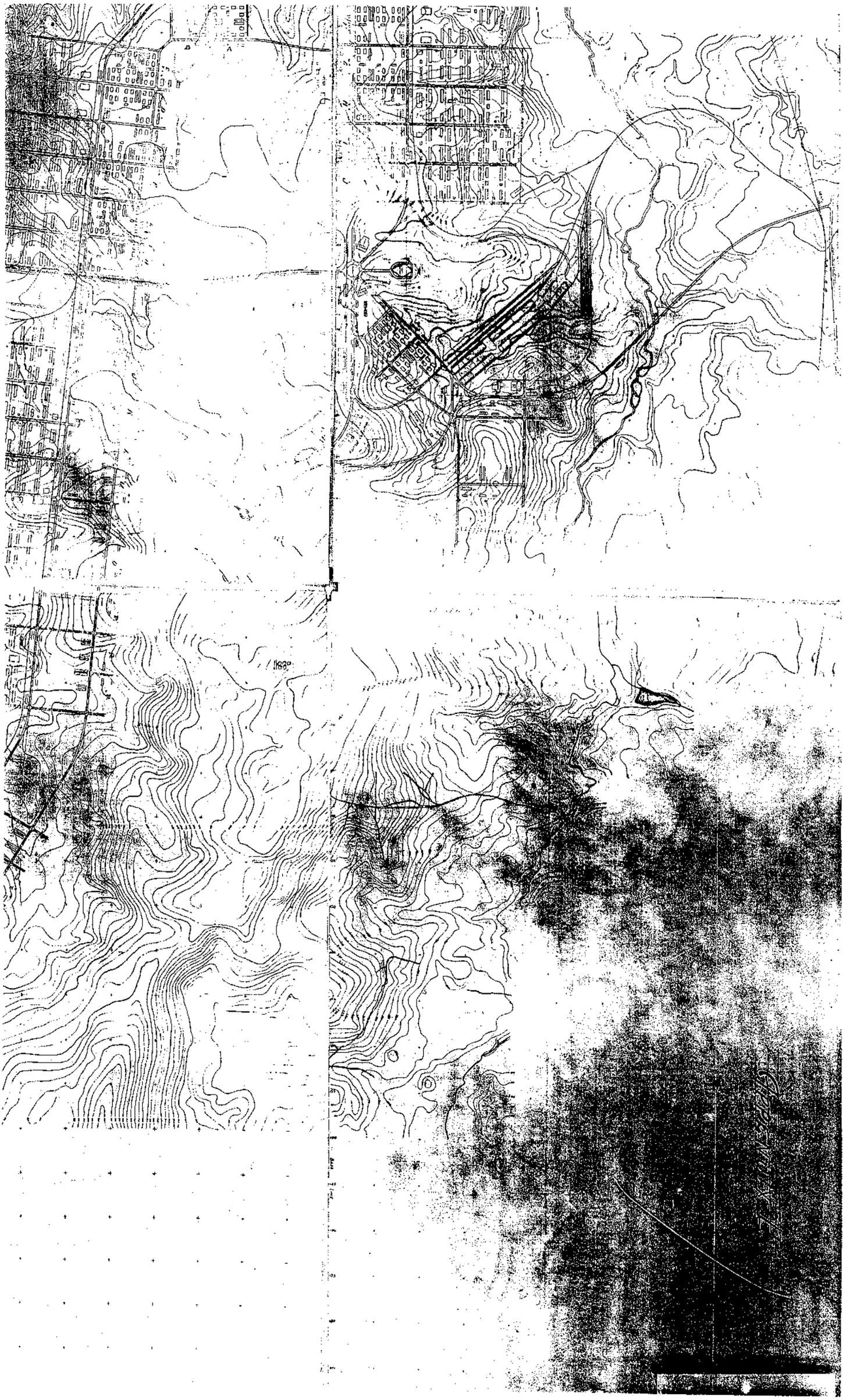
APPENDIX "D-1"



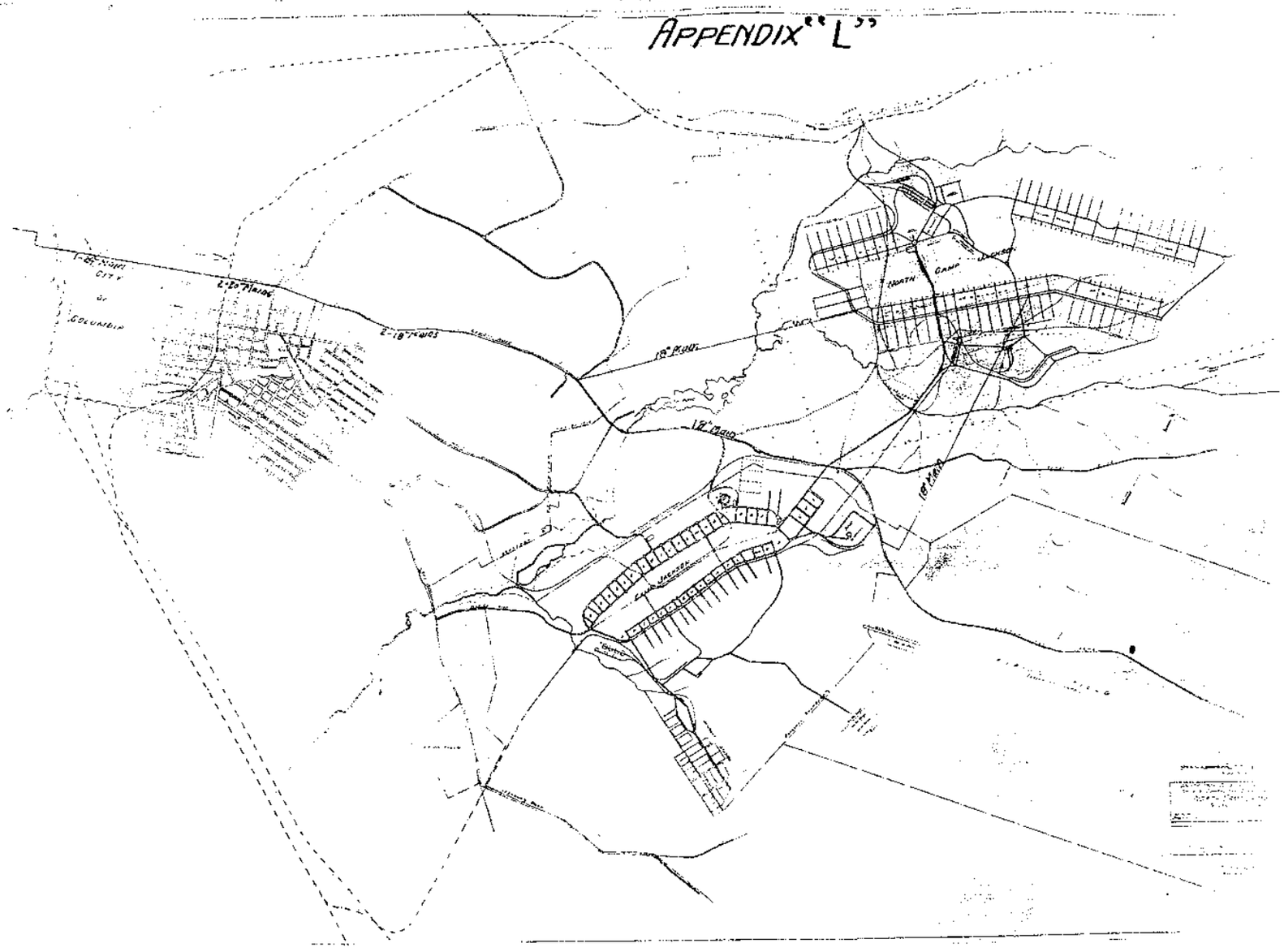
Map
of Lands
overnment
lumbia, S.C.
Lakeview Investment Company
1315 ac.
W. K. Dent
840 ac.
R. J. Smith
Pond
E. H. Lee
35 ac.
Mrs. Mary A. Eleazer
236 ac.
W. H. Aughtry
Total
165 acres
Mrs. M. R. Pelzer
1524 ac.
John Dent
105 ac.
Dent
339 ac.
O. Roof
52.2 ac.
Franklin Jones Est.
(Subdivision)
175 ac.
G. D. Strickland
47.6 ac.
James Aughtry
82.3 ac.
E. Metz
72 ac.
A. B. Roof
57.2 ac.
R. H. Dennis
64.3 ac.
M. J. Dennis
15.5 ac.
Percival Road
To Camden







APPENDIX "L"



HEADQUARTERS CAMP JACKSON,
Columbia, S. C.

DAILY BULLETIN NO. 32.

Wednesday, February 11, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE:- Organization commanders will be held responsible for the compliance by all members of their commands with all orders published in this Bulletin.

1. CAUTION! ! FIRING ON TARGET RANGE!

1. ON FRIDAY, FEBRUARY 13TH, FROM 8:00 TO 11:00 A. M., THERE WILL BE COMBAT FIRING EXERCISES ON THE SMALL ARMS TARGET RANGE, TWO MILES EAST OF CAMP. THE DIRECTION OF FIRE WILL BE FROM WEST TO EAST. ORGANIZATION COMMANDERS WILL CAUTION THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THAT DATE.

2. ECONOMIC USE OF LONG-DISTANCE PHONE CALLS.

1. In placing Long Distance Telephone Calls, the following instructions will govern:-

2. Unless it is especially desired to speak to some particular party at the other end, officers will not place a "Person to Person Call" but will place a"STATION TO STATION CALL" in the following manner:-

"Captain Jones, 123, Camp Jackson calling the Zone Supply Office (not officer) at Atlanta". Upon being questioned by Long Distance whom you wish to converse with, the reply will be "ANYBODY" and NOT "anybody who can talk business" or similar phrase.

3. The following form will be used only when it is necessary to converse with some particular person:-

"Captain Jones, 123, Camp Jackson calling Captain Smith, Zone Supply Office, Atlanta".

For this person to person service a higher rate is charged.

3. KAHN TAILORING COMPANY. BRANCH DISCONTINUED.

1. The Agency of the Kahn Tailoring Company which has been maintained at the Central Camp Exchange has been discontinued.

over.

REPRODUCED AT THE NATIONAL ARCHIVES

HEADQUARTERS CAMP JACKSON,
Columbia, S. C.

DAILY BULLETIN NO. 39

Thursday, February 19, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE:- Organization commanders will be held responsible for the compliance by all members of their commands with all orders published in this Bulletin.

1. ENLISTED MEN TO REPORT AT CAMP HEADQUARTERS.

1. Organization commanders will send all Enlisted Men of their units, who have served at Camp Jackson less than three months and who are not enrolled in any School to Camp Headquarters on TUESDAY, FEBRUARY 24TH, at 1:15 P.M., where they will be reported to the Director of Schools.

2. CAUTION! FIRING ON TARGET RANGE.

1. ON FRIDAY, FEBRUARY 20TH, from 8:00 TO 11:00 A.M. THERE WILL BE COMBAT FIRING EXERCISES ON THE SMALL ARMS TARGET RANGE, TWO MILES EAST OF CAMP. THE DIRECTION OF FIRE WILL BE FROM WEST TO EAST. ORGANIZATION COMMANDERS WILL CAUTION THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THAT DATE.

3. POST EXCHANGE MONTHLY INVENTORY AND CREDIT NOTES.

1. The inventory of the Post Exchange will be made on the 25th of the month, except that when that date falls on Sunday, inventory will be made on the following day.

2. Credit Notes may be issued to enlisted men by Company, Battery and Separate Detachment Commanders on any day of the month but the required report of such issue will be made to the Exchange Officer on the 25th of each month. Notes issued between the 25th and last day of the month will be reported on the 25th of the following month.

3. Special care will be exercised by above mentioned commanders to see that the correct amount of notes issued is reported in order to expedite the checking and cancelling of these notes on pay day.

4. Instructions contained in paragraph 2 of Daily Bulletin No. 12, these Headquarters, January 16, 1920, in conflict with the above are rescinded.

BY COMMAND OF MAJOR GENERAL READ:

W. D. BEACH,
Col., Cav., U.S.A.
Executive Officer.

OFFICIAL:
JAMES E. MANIERRE,
Major, A.G.D., U.S.A.
Camp Adjutant.

HEADQUARTERS CAMP JACKSON,
Columbia, S. C.

DAILY
BULLETIN
NO. 42.

Tuesday, February 24, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE:- Organization commanders will be held responsible for the compliance by all members of their command with all orders published in this Bulletin.

1. MEETING OF RANGE OFFICERS OF ALL ORGANIZATIONS.

1. A meeting is directed of the range officers of all organizations at the office of the Camp Signal Officer at 11:00 a. m. Wednesday, February 25, 1920.

2. Range Officers will find out from their organizations the number of men their organizations will have to fire on the range for 1920, the season to commence at an early date.

3. All range officers are advised of War Department letter of January 31, 1920 to Commanding General, Southeastern Department which states:-

"The Small Arms Firing Manual, 1913 1t 38mg revised.....Course "A" will be prescribed for all troops armed with the rifle as the principal weapon for offensive combat. This includes Infantry, Cavalry and Engineers. The Course provides for firing at 200, 300, 500 and 600 yards on Targets "A", "B", and "D".

Course "B" will be prescribed for all troops armed with the rifle as a weapon for defensive action only. This includes Motor Transport Companies, Balloon Companies, Headquarters Troops of Infantry Divisions, Coast Artillery Corps, and miscellaneous individuals armed with the rifle. This course provides for firing at 200 yards only on Target "A"."

4. Organizations of Camp enumerated to fire in this letter which have no range officer will send a representative to the meeting to act as such.

2. CAPTURED ENEMY MATERIAL.

1. Captured enemy material held by individuals or organizations in this camp which has not been reported to the Ordnance Department will be listed and the lists turned in to Camp Headquarters without delay.

(page one) over.

DIGITIZED AT THE NATIONAL ARCHIVES

HEADQUARTERS CAMP JACKSON
Columbia, S. C.

DAILY
BULLETIN
NO. 47.

Wednesday, March 3, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE: Organization commanders will be held responsible for the compliance by all members of their commands with all orders published in this Bulletin.

1. CAUTION! FIRING ON THE TARGET RANGE! ! !

ON FRIDAY, MARCH 5, 1920, FROM 8:00 TO 11:00 A. M. THERE WILL BE COMBAT FIRING EXERCISES ON THE SMALL ARMS TARGET RANGE, TWO MILES EAST OF CAMP. THE DIRECTION OF FIRE WILL BE FROM WEST TO EAST. ORGANIZATION COMMANDERS WILL CAUTION THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THAT DATE.

2. REPETITION OF WAR DEPARTMENT ORDERS REGARDING ARMY MUSICIANS.

1. Attention is again called to paragraph 261, A. R. It is reported that the provisions of the above regulation as to unlawful competition with local civilian musicians have been violated in specific instances since the publication of Paragraph 2, Daily Bulletin No. 43 these Headquarters.

2. Regimental commanders will take the action necessary to prevent their respective bands or any members thereof from furnishing music outside the limits of the reservation when the furnishing of such music places them in competition with local civilian musicians.

BY COMMAND OF MAJOR GENERAL READ:

W. D. BEACH,
Col., Cav., U.S.A.
Executive Officer.

OFFICIAL:
JAMES H. MANIERRE,
Major, A.G.D., U.S.A.
Camp Adjutant.

File
J.H.M.

HEADQUARTERS CAMP JACKSON,
Columbia, S. C.

DAILY BULLETIN NO. 77.

Thursday, April 15, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE:- Organization commanders will be held responsible for the compliance by all members of their commands with all orders published in this Bulletin.

1. CAUTION! FIRING ON THE TARGET RANGE.

1. THERE WILL BE FIRING ON THE SMALL ARMS TARGET RANGE SATURDAY, APRIL 17TH FROM 8:00 TO NOON. ORGANIZATION COMMANDERS WILL CAUTION MEMBERS OF THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THAT DATE.

2. REGARDING THE PURCHASE OF AUTOMOBILE EQUIPMENT.

1. Officers wishing to purchase automobile equipment from Motor Transport Corps at cost price will arrange to transact such business with the Motor Transport Supply Officer on WEDNESDAY mornings only, between the hours of 8:00 a. m. and 11:30 a. m. at the Motor Transport Corps Repair Shops. On account of the shortage of personnel no orders can be filled at times other than above mentioned.

3. NEW TELEPHONE DIRECTORIES.

1. All organizations and Seperate units will, upon receipt of New Telephone Directories, immediately destroy all old copies of both Camp and the City Directories.

4. LIST OF ENLISTED MEN TO BE SUBMITTED TO CAMP PERSONNEL ADJUTANT.

1. Regimental and sepamate unit commanders will submit to the Camp Personnel Adjutant not later than 5:00 p. m. April 16, 1920, a list of all enlisted men attached to their respective organizations in the following form:-

ENLISTED MEN ATTACHED TO_____

Rank	Name	Ser.No.	Ord. Corps or Branch of Service	Enlisted under Sec. V. Bull.22 W.D.1918 (Yes or No.)	Eligible for Furl. to Reserve by June 30 1920. (If No, so state. (If Yes give date of eligibility.)

Vacancies for N.C.O. by grades:-
Total vacancies (all ranks) in Organization:-

BY COMMAND OF MAJOR GENERAL READ:

OFFICIAL:

STEPHEN E. BULLOCK
Capt, F.A., U.S.A.
Acting Camp Adjutant.

W. D. BEACH,
Colonel Cav. U.S.A.
Executive Officer.

HEADQUARTERS CAMP JACKSON,
Columbia, S. C.

DAILY BULLETIN NO. 96.

Monday, May 10, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE: Organization commanders will be held responsible for the compliance by all members of their commands with all orders published in this Bulletin.

1. CAUTION! FIRING ON ARTILLERY RANGE!

THERE WILL BE SUB-CALIBER FIRING WITH 37MM GUNS ON THE ARTILLERY RANGE COMMENCING AT 9:00 A. M. TO LAST UNTIL 4:30 P. M. FROM MONDAY MAY 10TH TO FRIDAY 14TH, INCLUSIVE. THE DIRECTION OF THE FIRE WILL BE FROM WEST TO EAST ABOUT PARALLEL WITH THE ANGRUM FERRY ROAD AND TO THE NORTH OF IT. ORGANIZATION COMMANDERS WILL CAUTION THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THOSE DATES.

2. CAUTION! FIRING ON PISTOL RANGE!

1. THERE WILL BE FIRING ON THE PISTOL RANGE FROM 8:00 A.M. TO 5:00 P. M. EVERY DAY UNTIL MAY 19TH. THE DIRECTION OF THE FIRE WILL BE FROM WEST TO EAST. ORGANIZATION COMMANDERS WILL CAUTION THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THOSE DATES.

3. PRESENTATION OF CUP.

1. There will be a review of the 48th Infantry held on the 48th Infantry Drill Grounds at 5:30 P. M. TUESDAY, MAY 11TH. This ceremony will be modified as prescribed for the presentation of medals and will be for the purpose of presenting to the Headquarters Company, 48th Infantry, the Cup for best barracks and Mess room.

2. It is desired that as many members of the command as practicable be present to witness the ceremony.

Write report called for in Par 5 Date report and result.

L P K.

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HEADQUARTERS CAMP JACKSON,
Columbia, S. C.

DAILY BULLETIN NO. 105.

Saturday, May 22, 1920.

THE FOLLOWING IS PUBLISHED FOR THE INFORMATION AND GUIDANCE OF ALL CONCERNED. NOTE:- Organization commanders will be held responsible for the compliance by all members of their commands with all orders published in this Bulletin.

1. CAUTION! FIRING ON PISTOL RANGE! SUNDAY AFTERNOON.

1. The following men have been granted permission to practice pistol shooting on the Pistol Range, SUNDAY May 23, 1920 from 1:00 p. m.

Regt'l Sgt. Maj. C. Hundertmark, 48th Inf.
1st Sgt. Thomas Guillfoyle, Hdqrs. Co. 48th Inf.
Sgt. Arve B. Baker, Co. "G", 48th Inf.

2. The range officer will furnish the necessary ammunition and targets.

2. CAUTION! FIRING ON ARTILLERY RANGE! KEEP OUT OF THIS AREA!

1. THERE WILL BE SUB-CALIBER FIRING ON THE ARTILLERY RANGE WITH 37MM GUNS FROM 9:00 A. M. UNTIL 4:30 P. M. EVERY DAY FROM MONDAY MAY 24TH TO FRIDAY MAY 28TH. THE DIRECTION OF THE FIRE WILL BE FROM WEST TO EAST ABOUT PARALLEL WITH THE ANCRUM FERRY ROAD AND TO THE NORTH OF IT. ORGANIZATION COMMANDERS WILL CAUTION MEMBERS OF THEIR COMMANDS TO KEEP OUT OF THIS AREA ON THOSE DATES.

3. SCHOOL DUTIES MAY 24th & 25th.

1. School duties as outlined in Daily Bulletin No. 101, Paragraph 1, May 17, 1920, these Headquarters will be held on Monday and Tuesday, May 24th and 25th. The attendance of May 25th will be the last attendance of the year, excepting the Closing Exercises June 1st.

2. The Agricultural School and Animal Husbandry School will continue in operation.

BY COMMAND OF MAJOR GENERAL READ:

W. D. BEACH,
Colonel, Cavalry,
Executive Officer.

OFFICIAL:
J. R: BREWER,
Lt. Col., 46th Inf.
A. E. O. G-3

File

DISTRIBUTION: "A" "B" "C"

June 29, 1920

COPY

HEADQUARTERS CAMP JACKSON
COLUMBIA, S. C.

June 29, 1920.

FROM: Commanding Officer.

TO: Commanding General, Southeastern Department, Charleston, S. C.

SUBJECT: Answers to Questionnaire.

1. In compliance with paragraph 2, letter No. 600. 9- (Posts, Camps, and stations, S. E. Department) Headquarters, Southeastern Department, dated June 5, 1920, the following answers to the Questionnaire from the War Plans Division, General Staff, dated May 10th, 1920, is submitted:

1. Location and Area.

(a) Location

Camp Jackson is located approximately six (6) miles due east of Columbia, S.C.

(b) Area

21,946.6 Acres, or 34.29 square miles.

2. General characteristics of the reservation and surrounding territory in so far as these affect the training of troops. For training of what class of troops is reservation suitable - Infantry, cavalry, field artillery, coast artillery, engineers, tanks, etc.

(a) The country is rolling and covered with woods and undergrowth broken by many open spaces. There are many good camp sites and ample room for practice marches and maneuvers without danger of destruction to valuable crops or trespass on valuable farm land. There is an abundant supply of water for animals throughout the country roundabout. The topsoil is heavy sand; the subsoil is clay. There is little mud even during a rainy season as the water either drains off rapidly or is absorbed by the sandy soil. It is possible to drill troops within half an hour after a rain of twelve or more hours duration. The sand is but little shifted about by light winds and dust storms are infrequent. There are no prevailing high winds and no long seasons of rain.

RG 393 Army Cont. Cmds, 1821-1920
Part II, Camp Jackson
Gen Corr, 1917-1920
Box 24

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(b) The country is well suited for training of field artillery, infantry, engineers, and signal corps troops, there being suitable ground for unlimited target practice for these branches. For mounted troops the ground is easily gotten over but would prove heavy for drill ground work. Motorized heavy artillery finds considerable difficulty in moving heavy guns about, the ten-gun Holt tractors not having enough power to haul the guns, such as the 155 G.P.F. and the 8" Howitzer, where the sand is heavy. The same applies to tanks; the ground is favorable for the light tank but not for the others.

At present there is nt enough cleared ground in the vicinity of the barracks for dismounted and mounted drill. This defect can be remedied by clearing ground in close proximinity to the camp proper.

3. Amount and character of construction, capacity for troop shelter, permanent and temporary, for officers, enlisted men and animals. Show the data called for in this paragraph relative to permanent Construction listed separately from that pertaining to temporary Construction:

CONSTRUCTION

(a) Temporary Southern Army Cantonment:

Kind.	No.
Officers'	106
Barracks	358
Infirmaries	21
Mess and Kitchens	25
Administration	28
Offices	3
Guard Houses	19
Stable Guard	20
Bathhouses and Latrines	369
Stables	164
Storehouses	63
Sheds	96
Shops	25
Garages	6
Fire Stations	6
Heating Plants	3
Post Exchanges	18
Hospital Section	87
Theatre	1
Oil Filling Station	1
Laundry	1
Schools	7
Bakery	1
Septic Tank	1
Hotels	8
Stockade	1
Watch Towers	10

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(b)	Capacity men and Officers		47,860	
	Tent space for		22,000	
		Total	69,860	
	Capacity for Animals:			
	Camp Proper		8,320	
	Remount Area (Originally)		10,000	(now converted into Vocational Farm)
		Total	18,320	
(c)	Permanent Construction:			
	Grain Elevator	1		
	Magazines	4		
(d)	Hospital Capacity:			
	Beds	2,500		
	Personnel:			
	Nurses	200		
	Officers	200		
	Enlisted men	900		

4. Climatic conditions affecting training (number of outdoor working days by month for calendar year).

The annual rainfall is 45.7 inches. The mean temperature 65.4; lowest 24. In summer the temperature is at times so high that strenuous outdoor work is impracticable, but during the winter it is never too cold for such work. There are no prevailing high winds and no prolonged rainy season. For this reason, with the exception of a very few days in mid-summer, outdoor work can be carried on the entire year. Counting Sundays and holidays as working days the following working days by month can by counted on:

January - 31
February - 25 - 3 days of rain.
March - 31
April - 30
May - 25
June - 20 - 5 days of rain - 5 days of excessive heat.
July - 20 - 5 days of rain - 6 days of excessive heat.
August - 20 - 5 days of rain - 6 days of excessive heat.
September - 25 days
October - 31
November - 30
December - 31.

5. Communication within, to and from the area, including roads, railroads, trolley lines, telegraph, telephone, and available landing fields for airservice.

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Communications, etc.:

1. (Within Post Proper) Roads: Class A. - Concrete - 2.78 miles. Class A - Bituminous Macadam - 8.26 miles. Class C - Sand Clay - 6.62 miles. Total Class A Roads 10.98 miles. Total Class C Roads 6.62 miles.

1. (a) Within Reservation - Class C Roads - Sand Clay - 21.6 miles (exclusive of Post roads).

2. Miles of Railroad Track - 0.2 miles (This track is used jointly by the Atlantic Coast Line, Seaboard Air Line and Southern Railroads, operating through spur from Atlantic Coast Line Railroad).

3. Telegraphic Communications - Western Union and Postal Telegraph.

4. Telephone - Bell Long Distance and local to Columbia, S.C.

5. Current - Lighting, etc. Current is furnished by City of Columbia, S. C., through a 23,000 volt, 3 Phase Line, stepped down through transformers in Camp.

6. Water Supply - From mains from City Pumping Station.

Camp Storage Capacity is as follows: Concrete Reservoir of 1,300,000 gallons, 3 tanks of 200,000 gallons and 1 small tank of 50,000 gallons, giving a total storage capacity of 1, 950,000 gallons.

7. Communication with the Camp is effected by one well paved bituminous and concrete road and one sand-clay road and a trolley line leading directly from Columbia, S.C., to points east, north and south within the camp. There are three railroads leading to camp as follows: Atlantic Coast Line, Seaboard Air Line, and Southern, operating through joint spur as stated above.

8. Aviation Facilities - There is an aviation field, not owned by the Government, approximately two miles south of Camp, three fourths square mile in area. In addition there are several landing places scattered through-out Camp, large enough to accommodate at least two airplanes.

9. Existing target ranges for both infantry and artillery with possibilities of adaptation to musketry training (field firing) for infantry and service firing for field artillery.

(a) For small arms practice a complete range equipped with 65 targets, capable of expansion to 100 targets at all ranges with ideal spots adapted to musketry training. During the War there were 500 targets. Suitable ranges for the maximum number of troops that can be accommodated can be provided.

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(b) The Artillery range adjacent to and joining the Camp proper is approximately nine and one-half miles long and three and one-half miles wide, and affords facilities for every phase of artillery practice.

7. Additional tracts suitable for target ranges, infantry and field artillery, and their characteristics. Possibility of acquisition (a) for ordinary peace time training; (b) in an emergency requiring sudden expansion of peace time facilities. Distance from post and communications.

North of the Camden Road, immediately adjoining the present range and parallel thereto, is a large stretch of land similar in every respect to the present range, both as to size and characteristics, and suitable for infantry and field artillery target ranges.

POSSIBILITY OF ACQUISITION:

(a) For ordinary peace time training, -can be obtained only at exhorbitant cost.

(b) In an emergency requiring sudden expansion of peace time facilities - Can be obtained by lease, purchase of condemnation.

Distance from post and communications. - Tract is immediately adjoining present reservation on the North. Main road is the Camden Road running along the South side of the tract. This is an improved road at present in poor condition. Other roads throughout tract are merely trails, or unimproved roads.

8. Visitors Accommodations on reservation or in the immediate vicinity.

There are two large Y.W.C.A. houses in camp with limited facilities for the accomodation of visitors. There are also ten Y.M.C.A., two K. C., one Christian Science, and one Jewish Welfare buildings, with no sleeping quarters. There is one first class hotel in the City of Columbia, S. C., six miles distant and several second class hotels. All are expensive, generally crowded, and the service is poor. Accommodations with private families in Columbia are expensive and difficult to obtain.

9. Facilities for quartering families of troops on or near the reservation.

A number of families of Officers and enlisted men are at present occupying some of the temporary buildings not required for the use of the troops. Should these ever be required for troops there will be no accommodations in camp for families of troops.

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There are no other accommodations on the reservation, and in the city of Columbia accommodations are scarce and extremely expensive when obtainable.

10. Recreational facilities on or near the Reservation.

On the reservation there is one athletic field including a baseball diamond, one baseball field, one polo field, one large building, formerly belonging to the Y.M.C.A., suitable for a gymnasium, equipped with bowling alleys, but nothing else, and one Liberty Theatre, capacity 2200, in which moving pictures are shown and road shows presented. Six Service Clubs for enlisted men are in operation, and there is one Library.

Near the Reservation there is only the City of Columbia where the usual moving picture shows are in operation, and one public swimming pool on the outskirts of the city. The Y.W.C.A., the Y.M.C.A., the Knights of Columbus, and other fraternal organizations welcome enlisted men to their halls.

11. Formal capacity for training Purposes:

(a) Of Reservation Proper:
Officers and men in barracks - 47,860

Tent Space for	22,000
Total	69860

(b) Including adjacent ground now available for training purposes without cost to the Government.
None

12. Expansion Capacity:

(a) Including (11) above.

It is assumed that this question was intended to read, "Including (a) above". On this assumption, the numbers given in (a) above are considered to be the maximum capacity, viz., 69,860.

(b) Including ground in addition to (b) above that may be leased, purchased or condemned in the event of an emergency, using the ground formerly known as North Camp Jackson, just North and practically adjoining the Northwestern corner of the present reservation, which could be obtained through lease, purchase, and condemnation, in the event of an emergency the capacity could be expanded to 100,000 officers and men. Furthermore this tract lies adjacent to the main line of the Seaboard Air Line Railway.

13. A copy of each existing map of the reservation.
There are being forwarded under separate cover one blue print copy of each of twenty-four existing maps of the reservation.

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14. Any other information concerning the reservation which would be of interest in estimating its value as a training rendezvous for:

(a) The existing military establishment. Camp Jackson has ample facilities for housing and training at present 40,000 troops. Columbia, S. C., a town of 41,000, six miles distant, and connected with the Camp by a railroad spur, street car line, one macadam road in good condition, and one fair sand-clay road, is the junction point for three main southern railroads, viz., the Seaboard Air Line, the Atlantic Coast Line, and the Southern Railway. Training can be carried on outdoors practically the entire year round, due to the comparatively mild winter, and the absence of a prolonged rainy season. A noted winter resort, Camden, S. C., is thirty miles from Camp. Charleston, S. C., one of the most important ports of the South is only 128 miles distant.

Considerable repair work on the buildings would be necessary, however, for the carrying out of this project. Also, there would be no accommodation in camp for the families of officer and enlisted men with this number of troops, and the cost of rental of civilian quarters near the reservation would become prohibitive.

(b) A system of universal military training:

Owing to the number of railroads entering Columbia, S. C., and the excellent communication between the camp and the city, Camp Jackson with its present facilities would lend itself excellently to forming a part of such a training system.

(c) A mobilization and training of full man power of the nation (7,000,000 men program).

Owing to its location with reference to the three lines referred to, paragraph 14 (a) above, the ports of Charleston, S.C., and Savannah, Ga., and the possibilities of expansion of the present reservation, Camp Jackson, S.C., would form an important unit in the training and mobilization of the full man power of the nation. The possibilities of expansion are practically limited only by the capacity of the railroads for transportation of troops, material and supplies. The tracts referred to in preceding paragraphs as being available for are for the greater part uncultivated land and of small actual value, though held at a high price by the owners when the Government is in the market.

HARRY R. LEE,
COLONEL, INFANTRY,
Commanding.

MD:MP

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June 25, 1923

RECORD

RECORD

HEADQUARTERS EIGHTY-SECOND DIVISION
ORGANIZED RESERVES

OFFICE OF THE EXECUTIVE OFFICER
COAST ARTILLERY RESERVE COMPANIES

COLUMBIA, S. C.

MEB-RCM

JUL 17 1923

June 25, 1923.

Subject: Rifle Range.

To: C.O. IV Coast Artillery District.

1. It is recommended that a rifle Range for the use of Civilian Rifle Clubs and the instruction of citizens of military age, as outlined in paragraphs 1 and 2, Special Regulations No.109, W.D. 1920, be opened on the Military reservation at Camp Jackson, South Carolina.

2. If this range is opened I am willing to be appointed instructor in Rifle Marksmanship in addition to my other duties. This would include the care and responsibility for the government property involved. One enlisted assistant would be required.

3. It is recommended that this range be divided into two parts: viz, a small bore range and a service range. The small bore range should be constructed near the camp entrance and in close proximity to the car line. There is a suitable location available. This range could be constructed at a very reasonable cost. (About $100.00) There is a suitable range already constructed for service firing and a small expenditure would make this serviceable. This range is not easily accessable except by automobile, hence would not be used for small bore firing.

4. An initial issue of the following material would provide a working equipment; viz, 5 service rifles; 5 .22 caliber New Model Springfield Rifles; 1 Service Ramrod; 2 Ramrods for .22 caliber rifles; 5000 patches; 5000 rounds service ammunition; 25,000 rounds .22 long rifle cartridges; 1000 gallery targets; 200 targets A; 20,000 white pasters; 15,000 black pasters; cleaning material, preferable Hoppe's Nitro powder solvent; 200 yards of target cloth; suitable paste and gun oil. Considerable salvaged material could be used in this work.

5. In my opinion a large number of reserve officers would avail themselves of an opportunity to take this rifle instruction. There is a growing rifle club in Columbia that would expand to a considerable size. A general enthusiasm for shooting would be fostered and the army would secure much favorable comment as the result of such a range being established.

RECORD

RECORD

MAURICE E. BARKER,
Captain, C.A.C.

684 - Camp Jackson, S. C.

Benning, Ga. 1-6-22 10,000

RG 394, [illegible] Army [illegible] Mental [illegible]
E-123, 4th [illegible] Area, Adjtrs, [illegible]
Box 23[illegible]

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Hq. Fourth Coast Artillery District, Fort McPherson, Georgia, July 11, 1923 - To: Commanding Officer, Fourth Corps Area, Atlanta, Georgia.

1. Approved. I heartily approve of an increased interest among civilians in the matter of target practice. This is good and cheap propaganda. Gallery practice with modified Mausers was the greatest factor in stimulating German colonials and immigrants to foreign countries in maintaining their national spirit.

F.E. JOHNSTON,
Commanding.

2nd Ind. BB/M-jac.

HQ FOURTH CORPS AREA, Atlanta, Georgia, July 16, 1923 - To The Adjutant General of the State of South Carolina, Columbia, S. C.

For remark.

For the Corps Area Commander:

ROBT. WHITFIELD,
Assistant Adjutant.

1923

REPRODUCED AT THE NATIONAL ARCHIVES

August 1-3, 1923

State of South Carolina

ADJUTANT GENERAL'S OFFICE

Columbia

3rd Ind.

A.G.O., Columbia, S.C., August 1, 1923. To: Headquarters 4th Corps Area, The Corps Area Commander, Atlanta, Ga.

1. Returned, approved. I concur in the above indorsement.

2. The rifle range at Camp Jackson will be repaired in the near future and it will be the pleasure of the State of South Carolina to encourage and assist in every way possible and the use of the rifle range will be open at any specified time to the Civilian Club.

Robert U. Craig,
The Adjutant General.

REC/s

RG 394, U.S. Army Continental Commands
E. 123, 4th Corps Area, Hdqtrs. Corres, 1920-42
Box 234

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HEADQUARTERS I ARMY CORPS
~~HEADQUARTERS I CORPS~~
614 OFFICE OF THE CORPS COMMANDER HOC/lw
COLUMBIA, S. C.

February 24, 1941.

Subject: Construction of Training Aids.

To : Commanding General, First Army, Governors Island, New York.

1. Reference letter Headquarters First Army, file and subject as above, dated February 10, 1941, delays in the completion of range facilities have somewhat interfered with the progress of training. These delays, which have not been serious, were occasioned at Fort Jackson by the purchase of land, the time element incident to drawing of plans and specifications, and the letting of contracts.

2. Progress of Construction.

a. Fort Bragg, North Carolina

(1) 300-target Range:
(a) 70 completed by February 9th.
(b) 70 additional to be completed by March 1st.
(c) All to be completed by April 1st.

(2) 6 antitank sub-caliber ranges complete.
(3) 2 antiaircraft miniature ranges complete
(4) Moving target ranges, ample in operation.
(5) Sunken antitank ranges:
(a) 1 complete by March 15th.
(b) 2 additional to be completed by April 15th
(6) Infantry combat ranges one-third (1/3) complet by March 10th.
(7) Pistol range--200 complete by March 1st.

b. Fort Jackson, South Carolina.
(1) New ranges at Fort Jackson, South Carolina, will be in use about April 1, 1941, consisting of the following:

(a) 400-target Known-Distance Range.
(b) 8 - 1000" Moving Antitank.
(c) 4 - 1000" Antiaircraft.
(d) 200 - 1000" Bobbing Target.
(e) 20 sets, 1000" landscape.
(f) 200 pistol targets.

Incl. #4

REPRODUCED AT THE NATIONAL ARCHIVES

614 - Subject: Construction of Training Aids, Hq I Army Corps to Hq First Army, 2-24-41.

b. Fort Jackson, South Carolina (cont'd).

(2) Field Artillery.
(a) Artillery dugouts--bids to be opened February 28th.
(b) Range Telephone System--materials ordered and expected to arrive March 1st.

For the Commanding General:

RECEIVED - HQ FIRST ARMY (AGO) FEB 26 1941

Roy W. Strickland

R. W. STRICKLAND,
1st Lieut. A. G. D.,
Assistant Adjutant General

RECEIVED AT THE NATIONAL ARCHIVES

TRAINING FACILITIES

STATION	NATURE	WHEN REQUIRED	COMPLETE OR ESTIMATED DATE	ADEQUACY	REMARKS
I ARMY CORPS					
Fort Bragg, N.C.					
	Range, known distance	Current	April 1		25% complete Feby. 9th; 50% March 1st.
	Range, pistol	Current	March 1st		
	Range, combat	March	Not reported		33% complete March 1st.
	Range, anti-tank	Not reported	April 15		
	Range, anti-tank, sub-cal.	Current	Complete		
	Range, AA, miniature	Current	Complete		
Fort Jackson, S.C.					
	Range, known distance		April 1		
	Range, 1000"		April 1		
	Range, pistol		April 1		
	Range, telephone system		March 15		

Resume of report held in Hq 1st Army as of February 24, 1941.

Inc 1. #4

Inc 1. #4

June 11, 1941

HEADQUARTERS FORT JACKSON
Office of the Post Commander

Fort Jackson, S.C.
June 11, 1941.

GENERAL ORDERS)
:
NUMBER 36)

1. In order to efficiently maintain and operate the recreational center, Weston Pond - Forman Pond, this area is declared off-limits for all organizations and individuals of the command, except those specifically excepted by this headquarters.

2. The shaded portion of the attached sketch shows the delimited area.

For the Commanding Officer:

FRANK L. WHITTAKER,
Lieutenant Colonel, Cavalry,
Executive.

OFFICIAL:

F. V. M. DYER.
Lieutenant Colonel, Infantry.
Adjutant.

1 Incl.
Sketch

Distribution: "A"

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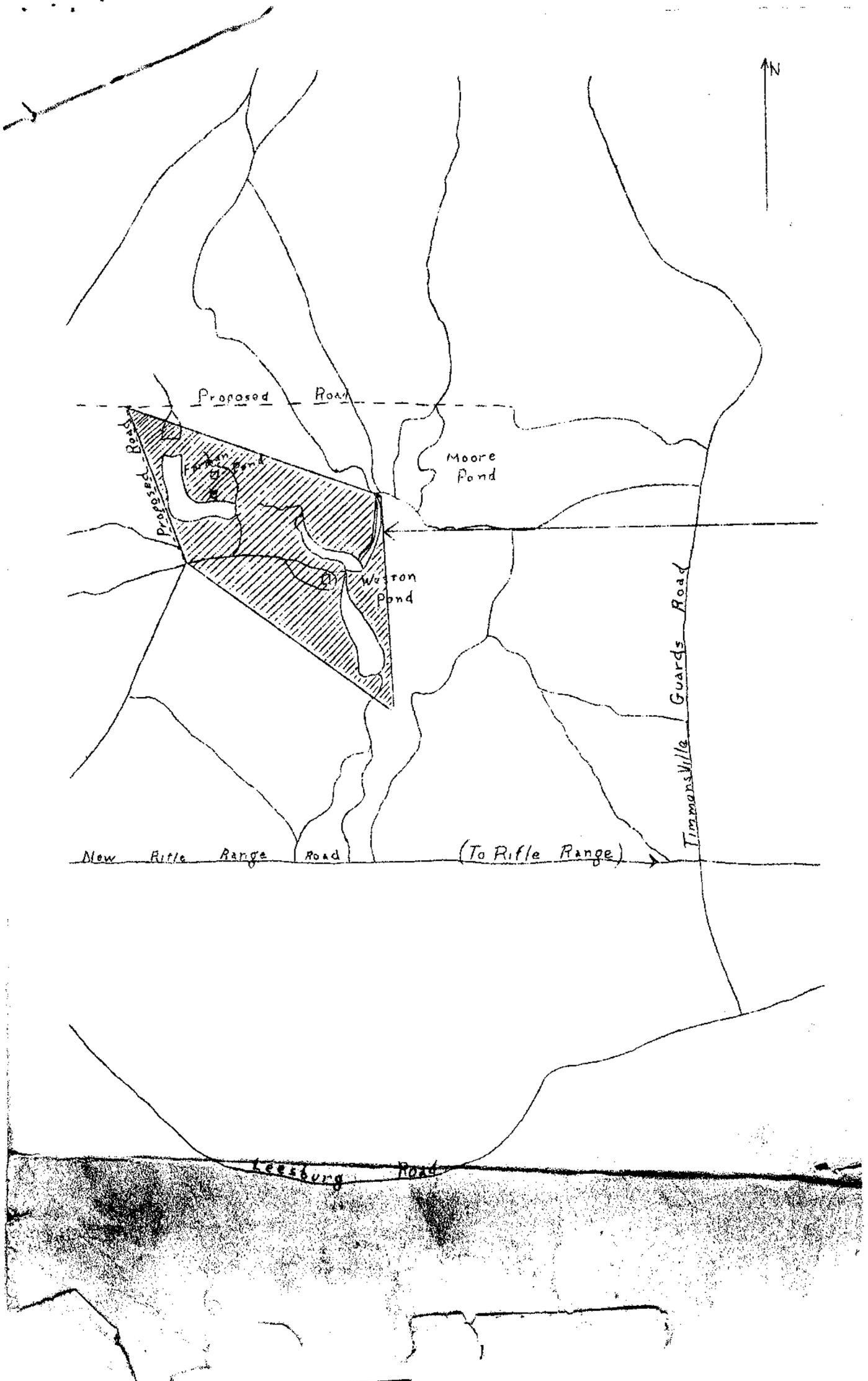
Authority NND 947030
By MD NARA Date 3/15/04

RG 337, Hq Army Ground Forces
E. 108 (A.D.) AGF + AFF Installs.
Box 31



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Authority NND 947030
By MD NARA Date 3/15/04

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May 26 1942

EWG

HEADQUARTERS 8TH MOTORIZED DIVISION
Fort Jackson, South Carolina

May 26, 1942

TRAINING MEMORANDUM
Number 33

PLATOON COMBAT FIRING PROFICIENCY TESTS

Reference: 1. Training Memorandum number 10, Hq I Army Corps, CS.
2. Ltr. GHQ, 353/652-6 (10-30-41), Oct 30, 1941, Subject "Post Maneuver Training".

1. The platoon Combat Firing Proficiency Tests as directed by reference 2, above will be held for the platoons of this division during the period May 28 - June 13 as follows:

a. May 28, 29, 30, June 1, 2, 3, - 13th Infantry.

b. June 8, 9, 10, 11, 12, 13, - 28th and 121st Infantry.

2. Assignment of Ranges.

a. 13th Infantry (except 81mm Mortar Platoons) - Combat Range #5.

b. 28th Infantry (except 81mm Mortar Platoons) - Combat Range #5.

c. 121st Infantry (except 81mm Mortar Platoons)- Combat Range #6.

d. 81mm Mortar Platoons, all Regt's - Mortar Range #1

3. Place.

a. Units firing on Combat Range No. 5, will report to the testing board at RJ Camden Rd. - Percival Rd.

b. Units firing on Combat Range No. 6, will report to the testing board of RJ Percival Rd. - Unimproved Rd. to Combat Range No. 6.

c. Units firing on Mortar Range No. 1, will be notified of the place to report.

4. Time.

a. Units firing on Combat Ranges No. 5 and 6,
The first platoon to be tested each day will report at 6:30 AM. Other platoons will follow at one hour intervals until eight (8) platoons have reported.

b. Mortar Platoons
Mortar platoons will be notified of the time to report.

RG 338. US Army Commands
E. 37042 Unit Recs
Box 489

Authority NND889540
By MNARA Date 2/21/04

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5. Ammunition.

Unit Commanders are responsible that sufficient ammunition is available at the place of reporting. See Annex No. 11 for instructions relative to issuing ammunition.

By command of Major General MARLEY:

GEORGE D. SHEA,
Colonel, General Staff Corps,
Chief of Staff.

OFFICIAL:

F. R. Keeler

F. R. KEELER,
Lieutenant Colonel, Adjutant General's Department
Adjutant General.

ANNEXES:

#1. Situation and requirements, Rifle Platoon.
#2. Situation and requirements, Cal. .30 M.G. Platoon
#3. Situation and requirements, Weapons Platoon, Rifle Co.
#4. Situation and requirements, 81mm Mortar Platoon
#5. Scenario of Problems.
#6. Umpire Check list, Rifle Platoon
#7. Umpire Check list, Cal. .30 M.G. Platoon
#8. Umpire Check list, Weapons Platoon, Rifle Co.
#9. Umpire Check list, 81mm Mortar Platoon
#10. Umpire Control Signals
#11. General Instructions.

Distribution
A & EB
25 copies to G-3

NOTE: Annexes issued to units and individuals concerned only.

Authority NND 883940
By MNARA Date 2/21/07

October 5, 1942

COPY

HEADQUARTERS FOURTH SERVICE COMMAND
Services of Supply
Office of the Commanding General DK:TMH:ctd

AG 614-General

Post Office Building
Atlanta, Georgia.

October 5, 1942.

SUBJECT: Training Aids

TO: Commanding General, Fort Jackson, South Carolina.

1. This headquarters has been requested by the Commanding General, 2nd Army, to install the following training aids at your station:

1 Sub-machine Gun Range.
1 Moving Vehicle Range.
1 Grenade Court (Live).

2. An estimate of cost for each installation, together with a map showing the proposed location of the training aid to be installed, will be submitted to this headquarters as soon as practicable.

3. A negative report is desired if any of the above facilities exist at present at your station.

For the Commanding General:

/s/ J. V. V. SHUFELT
J. V. V. SHUFELT,
Colonel, General Staff Corps,
Director, Operations and Training Division

COPY

RG 337, Hq. Army Ground Forces
E. 55, Gen'l. Cortes.
Box 1122

Authority NND 947010
By JA NARA Date 7/23/94

HEADQUARTERS FORT JACKSON
Office of the Commanding General

Fort Jackson, S.C.
December 3, 1942.

GENERAL ORDERS)
NUMBER 63

POST RANGE REGULATIONS

1. General Order #39, this Headquarters, dated June 24, 1941 is rescinded.

2. General Information.

   a. The purpose of these regulations is to govern the use of firing ranges and to prescribe safety precautions to be observed in service firing.

   b. All firing on the Reservation will be EAST of TELEPHONE ROAD as follows:

      (1) LEESBURG AREA: Small Arms firing will be conducted on the Leesburg Rifle Range.

      (2) ARTILLERY AREA: Artillery firing will be conducted in the area EAST of TELEPHONE ROAD exclusive of the Leesburg area. Infantry combat and Anti-Tank Ranges in the Artillery Area will be under control of the Artillery Area.

   c. When firing is in progress, signals will be displayed as follows:

      (1) LEESBURG RANGE: Red streamers on poles in rear of firing lines on ranges C-H-R.

      (2) ARTILLERY AREA: Red streamer on Tower Wichks Hill-(13.4-13.7) or Tower on Hill (15.7-21.2) depending on whether ANCRUM FERRY ROAD or OLD CAMDEN ROAD is closed to traffic. Red flags will also be displayed in vicinity of all firing points.

   d. Persons entering the reservation EAST of TELEPHONE ROAD will inform themselves as to the firing scheduled or in progress. The current days firing will be posted on maps located as follows:

      (1) Artillery Range Central. (C.R. Ancrum-Ferry and Telephone Roads).

      (2) Leesburg Range Central.

      (3) Office of the Post Range Officer, Post Headquarters.

      (4) See par. 12.

3. Range Control.

   a. The Post Range Officer will control the Range and will coordinate all firing on the Fort Jackson Reservation.

      (1) LEESBURG RANGE:

         a. The Assistant Post Range Officer at Leesburg will represent the Post Range Officer, with direct charge of all firing on Small Arms Ranges in the Leesburg Area. An organization firing on the Small Arms Ranges will appoint a Range Officer who will contact the Assistant Post Range Officer to arrange for targets and other materials, also for posting Range Guards.

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RG 337 Hq Army Ground Forces, E. 108 (U.S.), AGF - AFF Journals Box 31

(2) DIVISION ARTILLERY RANGE OFFICER.

a. The Divisions or similar units will detail one Field Artillery Officer as Assistant Range Officer for the period when the Artillery of the Division is firing on the Artillery Range. This officer will function as Assistant Post Range Officer with respect to Artillery firing of his Division. He will report to the Post Range Officer for instructions on the day when requests for Artillery Firing reach the Post Range Officer, and forty-eight (48) hours before each days firing.

4. Range Detachment.

a. A permanent detachment will operate under the orders of the Post Range Officer. The Range Detachment will operate the Post Range Communication System. It will establish sentinels, signs and road blocks as directed by the Range Officer and will keep range maps posted.

5. Governing Regulations.

a. The provisions of AR 750-10 will govern all firing. The provisions of appropriate Field Manuals will govern the firing of the particular weapon.

6. Range Telephone System:

a. Traffic diagram of the Range Telephone System is in the Office of the Post Range Officer.

b. Tapping of circuits on the Range Telephone System at other than installed terminal strips, or cutting or rearranging of any installed circuit, is forbidden.

c. Requests for special circuits will be submitted to Post Range Officer one (1) day in advance.

d. Damage to telephone cables or metallic circuits on Artillery Range will be reported to Artillery Range Central immediately; damage to installations on Leesburg Range to Leesburg Range Central.

e. Permanent pole lines of the range telephone system will not be used by troops.

f. All field wire will be disconnected at the conclusion of each day firing.

7. Assignment of Ranges.

a. The general assignment of the Small Arms Ranges and the Artillery Ranges will be announced by Post Headquarters.

(1) LEESBURG RANGE:

(a) The organization assigned the Leesburg Range will inform the Assistant Range Officer, Leesburg, of the calibers and ranges on which firing is to be conducted twenty-four (24) hours in advance, except in the case of 50 caliber Machine Gun, when forty-eight (48) hours notice will be required. (See Part II.)

(2) ARTILLERY AREA:

(a) In accordance with priorities prescribed by regulations and orders of these Headquarters, the Post Range Officer will assign firing areas, will prescribe the limitations on firing therein, the safety limits, and any other restrictions necessary for safety.

Authority NND 947630
By MD NARA Date 3/15/94

(b) When an organization has been assigned priority on the range, requests for firing areas approved by that Organization Headquarters will be acted on promptly in the order in which received, and the assignment made within twenty-four (24) hours after receipt of request. The Range Officer will approve requests as submitted, except where the limits of the requested area must be modified for safety reasons. In this event, the Range Officer will promptly confer with the organization Headquarters to arrange suitable modification.

(c) Units other than those normally assigned the Artillery Area, desiring to fire Special Problems will submit requests for firing areas to the Post Range Officer ten (10) days in advance of the proposed firing.

(d) 37-mm and 75-mm Anti-Tank Firing by units in areas involving both the Leesburg Area and the Artillery Area will be arranged by the Post Range Officer upon request.

(e) Sentinels for enclosing the danger area will be furnished by units conducting fire and will be posted by the Artillery Range Officer under the direction of the Post Range Officer.

8. Publication of Firing Memorandum:

a. A weekly Firing Memorandum is issued by Post Headquarters every Friday morning at 8:00 A.M. covering all firing for the succeeding week. Overlays will accompany requests for Artillery Ranges and will reach the Post Range Office in time to be checked and the information placed in the Firing Memorandum. It is necessary that this information be furnished the Post Range Officer. The Post Range Officer must know at all times what firing is being conducted, the position and danger areas.

b. The following form will be used to submit requests:

TO: POST RANGE OFFICER, HEADQUARTERS.

Request following Firing Memorandum:

(Signed by officer requesting Memorandum.)

(Submit only one copy)

FIRING MEMORANDUM NUMBER _____

DAY OF WEEK
DATE
HOURS OF FIRING
ORGANIZATION
CALIBER
AMMUNITION
TARGET AREA
OBSERVATION POST
GUN POSITION
RIGHT SECTOR LIMIT: GUN
LEFT SECTOR LIMIT: GUNS
MAXIMUM RANGE (YARDS)
DANGER LIMIT (YARDS)
RESPONSIBLE OFFICER
REMARKS

Authority NND 947030 By MD NARA Date 3/18/04

9. Duties of the Post Range Officer.

a. The Post Range Officer is responsible for the coordination of activities on the range and for the safety of the entire range.

b. When requests for firing positions are submitted, the Range Officer will adjust any conflicts as to areas, check safety provisions, and will issue a Firing Memorandum prescribing the safety limits for each position.

c. When request for an area is submitted, the Firing Memorandum will define the area assigned. The officer supervising the exercise will prescribe safety provisions for each position in compliance with paragraph 7, AR 750-10.

d. When required, in addition to the usual warning issue to personnel of the Post, announcement will be made in the daily papers.

e. The Post Range Officer is responsible for the posting of permanent signs on the reservation.

10. Duds:

a. The Post Ordnance Officer is charged with the destruction of "duds" on the Range.

b. "Duds" discovered on the Range will be marked by a stake and reported to the Post Range Officer. Reports will show type and caliber of each "dud" location by coordinates, and the name of any person familiar with its location. Artillery units conducting fire will report location of any suspected "duds" during the day's firing.

c. Officers in charge of Mortar Firing will police range for "duds" at the completion of firings and report the location of all duds to the Post Range Officer.

11. Permanent Installations:

a. Artillery firing will not be placed within 500 yards of permanent installations except dugouts.

b. All dugouts, except #5 dugout, are constructed to offer protection against caliber 105-mm and less. Dugout #5 offers protection against 37-mm and less.

c. Permanent roads, bridges and dams may be included in firing areas, but no adjustment will be made on such installations. Every precautions will be taken to prevent direct hits on such installations. Precautions will be taken to assure that firing will not endanger permanent telephone lines.

12. Danger Areas.

a. The size of the reservation and the nature of the terrain prevent the posting of guards to cover all approaches to danger areas. The danger areas will be marked by signs at points where sentinels are not posted. These signs will not be passed by personnel, except in the following cases:

(1) Personnel going to and from service firing on safe routes designated by the unit commander in charge of the firing.

(2) Officers and parties accompanied by an officer checking through the Range Central and signing the range book. In this case, the officer accepts responsibility for a complete knowledge of the danger areas and of all firing in progress.

Authority NND 947630 By MD NARA Date 3/15/04

13. Battery-Commander:

a. The Battery-Commander is responsible that:

(1) Safety precautions prescribed in AR 750-10 regarding handling of ammunition and service of the piece are complied with.

(2) A red flag is displayed in a conspicious place in the vicinity of the battery position during firing.

(3) That all personnel of the battery are properly instructed as to safety precautions in general, and in particular as to the location of adjacent gun positions and sector of fire.

(4) When the shell is fired other than with bore safe fuses, or fuses considered in the category of bore safe, all personnel within the danger limits are protected as prescribed in paragraph 14, AR 750-10.

(5) The Range Central is promptly notified on completion of firing.

(6) The area used will be policed at the end of practice.

14. Battery Executive:

a. The Battery Executive is responsible for safety of the personnel at the firing position, (AR 750-10). He will fire only when the safety officer indicates safe to fire.

15. Battery Safety Officer.

a. In all Artillery firing, the Battery Safety Officer will have no other duties. He will indicate safe to fire only when:

(1) The Range Officer indicates the range is clear.

(2) The Range visible to him is clear.

(3) The pieces are so laid as to fire inside the safety limits both for direction and for range as determined by the quadrant elevation corresponding to the maximum range designated in the Firing Memorandum.

PART II

SMALL ARMS RANGE, LEESBURG

16. General Information.

a. The duties of the Assistant Post Range Officer (SA) on the Leesburg Rifle Range, will be as follows:

(1) Maintain all ranges to insure proper operation.

(2) To furnish all target material the Table of Allowance provides.

(3) To turn over all camp property to Organization Range Officer, or Supply Officer.

(4) To see that the ranges are not abused and that all the Government property is taken care of and used properly.

(5) To ascertain that no changes are made in safety angles for any range.

(6) To allow no changes to be made by using troops in any of the ranges.

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(7) To permit the unauthorized use of weapons, [illegible] in weapons and ammunition not authorized for use on that particular range.

(8) Maintain and supervise the use of the camp and range utilities.

17. Duties of Organization (SA) Range Officer.

a. To take over the Leesburg Range and camping facilities, including all the property and return same at end of firing period to the Assistant Range Officer (SA) in good serviceable condition.

b. To assist all targets, quarters and facilities to the using troops.

c. To furnish guards and transportation and posting the necessary guard to keep the danger area clear of personnel during the hours of firing.

d. To act as representative for the using troops in which case all requests made by using troops will be made to him only.

e. Report to Post Range Officer any facilities assigned and not being used.

18. Location of Ranges:

a. Ranges are designated as follows from the most westerly range (A) through east to the most northerly range (Z)

(A) 100 Machine Targets, 30 caliber only

(B) 30 Pistol Target, 45 Caliber

(C) 1 AA Range, 22 Caliber

(D) 1 AA Range, 22 Caliber

(E) 100 Pistol Targets, 45 Caliber

(FG) 100 Rifle 200 yds., 30 Caliber

(HI) 100 Rifle 300 yds., 30 Caliber

(JK) 100 Rifle 300 yds., 30 Caliber

(LM) 100 Rifle 200 yds., 30 Caliber

(N) 4 sets Anti-Tank, 30 Caliber only.

(O) Trench Mortar.

(P) 100 Machine Gun, 30 Caliber and 50 caliber.
(NOTE: .50 caliber to be used only by arrangement with Post Range Officer.)

(Q) 35 Targets Pistol, 45 Caliber.

(R) 100 Target plain 1000", 30 Caliber

(S) 1 set AA Targets, 22 Caliber only.

(T) 1 set AA targets, 22 Caliber only.

(U) 8 sets of Landscape, 30 Caliber only.

(V) 25 Pistol Targets, 45 Caliber.

(W) 6 sets of Landscape, 22 Caliber only.

(X) 25 Pistol targets, 45 caliber.

(Y) 4 sets Anti-Tank, 22 Caliber.

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By MD NARA Date 3/18/09

(Z) 4 sets Sub-Machine Gun targets, 45 Caliber.

b. Each range is distinctly marked by a large conspicuous, designating letter. Also the type of ammunition to be used.

19. Control and Safety Regulations:

a. Guards will be posted under the supervision of the Organization Range Officer, so as to provide safety during the hours of firing, unless otherwise requested.

b. When all guards are posted, red streamers will be raised on poles in rear of Ranges C-H and R. No firing will be started until these streamers are raised. All firing will cease when streamers are lowered. A change in these streamers will be preceded by a long blast on the siren located at the water tank connected to tower. With no streamer raised, the blast will indicate that the streamer is to be flown. A series of blast on the siren, after firing has begun will indicate that all ranges will cease firing immediately.

c. Each range will be operated under the senior officer in charge. Where pits are provided, the pits will be under the supervision of an officer. Range procedure will be followed as specified in training manuals, for the arm being fired.

d. Prior to firing, the officer in charge of a range will notify the pit officer who will order the streamer on the target line to be raised when the pit is clear. Thereafter, no person will be allowed to stray from the pits, or leave the pits except by the authorized tunnels. Pit details will be instructed to operate and travel under the shelter.

e. An overlay will be furnished by Post Range Officer from time to time as to the location of the range guards. As the situation warrants, the location of these guards will change.

f. It will be the duty of the using troops to furnish one (1) non-commissioned officer and the guard for the range, and the duty of the organization (SA) Range Officer to ascertain that they are properly posted and instructed.

g. Ranges have been constructed to conform to Army Regulations for safety. Ranges will be used only for the purpose for which they were constructed (see paragraph 1). Special problems may be fired by arrangement with the Post Range Officer.

h. On all Combat Ranges and other Ranges beyond hearing distance of the siren at the water tank, the officer in charge of firing will communicate with the Leesburg Range Office to determine whether the Range Guards are posted and whether the Range is clear. At most of the Ranges telephone communication is established with the Range Detachment. The officer in charge of firing will notify the Leesburg Range Detachment Officer when firing is concluded each day.

i. The Officer in charge of firing will be responsible that the Range he uses is properly policed, targets are properly pasted or replaced for the next day, and any repairs that cannot be made on the "spot" will be reported to the Range Detachment at the conclusion of the day's firing.

j. Combat Ranges 1-2-3-4-5-6 are designed for firing Infantry Squad and Platoon Problems with Caliber 30, ball ammunition. The safety limits are marked and the Officer in Charge of Firing will see that all firing is within the Safety Limits.

These ranges will not be used for Training Areas or "Dry Run Exercises" except by permission of the Post Range Officer.

No changes in the Range Installations will be made by troops using the ranges. No other than caliber 30 ammunition will be fired on Combat Ranges except by permission of the Post Range Officer.

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20. Range Supplies and Property:

a. Ranges will be released to units when their authorized representatives have taken over the range property. This property will be maintained in good operating condition by the using unit. (Exception - broken targets, frames, etc., will be turned into the Post Range House for replacement.)

21. Communication:

a. Phones for ranges will be turned over with the range. Phones may be exchanged for repair at Post Range House.

22. Administration: - Camp Area.

a. Requests for use of the Camp Area on the Small Arms Range will be submitted to the Post Range Officer.

b. When the Camp Area is assigned to an organization, the Commanding Officer of that organization or an officer designated by him will contact the Assistant Range Officer at Leesburg and will sign for all property on Memo Receipt. Obtain from the Assistant Range Officer a proposed administrative order to the using troops covering the interior economy of the camp.

They will inspect the camp area noting any deficiencies.

c. Assignments in camp area, will be made by Commanding Officer of using troops, and administrative arrangement for the camp area, will be made under the control of the units using the area. Senior officer will command for coordination of installations.

d. Before departure, organization will:

(1) Fasten down sides of tents and loosen ropes.

(2) Stack all cots in mess halls for check.

(3) Scrub kitchen and mess halls.

(4) Clean ice box and leave open.

(5) Skim grease trap.

(6) Remove all garbage.

(7) Scrub bath house.

(8) Scrub latrines, sprinkle lime in pits, and leave covers closed.

(9) Burn out and clean all latrines.

(10) Police area.

(11) Clean incinerator and haul rubbish to dump.

(12) Return property to Assistant Range Officer and get Memo Receipt.

e. When the Post Exchange is in operation in the Camping Area the Senior Officer will issue orders regulating the hours and arranging for police and sanitary conditions. Post Exchange Officer should be informed of important changes or requests.

23. Facilities:

a. Each unit commander will notify the Organization Range Officer when he has facilities that are assigned to him and which he does not need.

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b. All requests for additional facilities should be made to the Organization Range Officer.

c. Available targets and ranges will be assigned by the Organization Range Officer.

d. The following equipment and facilities for each company or similar unit are available:

(1) Mess hall and kitchen.
(2) Pyramidal tents.
(3) Cots, canvas, folding.
(4) One (1) bath house to three (3) mess buildings.
(5) One (1) latrine, pit type.
(6) Screens or pyramidal tents, for latrines and bath houses.
(7) Ice Box.

e. The following equipment must be furnished by using troops.

(1) Field range.
(2) Cooking utensils.
(3) Mess kits, complete.
(4) Bedding.
(5) Ligh Bulbs.

f. Water facilities are very limited. Arrangements must be made within organizations to conserve all that is possible and alternate the use of it between the kitchen and bath houses when necessary. No water will be used for sprinkling streets.

24. Sanitation. The Commanding Officer of troops is responsible for sanitation and will appoint the senior medical officer as medical inspector for the camp and range.

25. Range Regulations, Anti-Tank Range.

Request will be made to Post Range Officer in same manner as for Artillery Range.

a. For the present time, only the following will be fired.
75mm sand loaded and armour piercing.
37mm armour piercing, sand loaded, and sub-caliber.
50 caliber Machine Gun.

b. The motor car and target car will be operated by personnel of the Range Detachment and under no circumstances by units firing. The car operator will set the car in motion and then report to officer in charge of firing that the range is clear and ready to be fired on.

c. A flag pole is available on the firing line. A red streamer will be flown when the Range is being fired on. No firing will be permitted unless the red streamer is being flown. It will be the duty of the officer in charge of firing to cause the streamer to be hoisted and lowered. Before the car operator goes forward, the order cease firing and lower the flag will be given. Upon return from target car the operator will report to officer in charge that range is clear and ready to be fired on. The officer in charge will order the flag to be hoisted and command begin firing.

d. The officer in charge of firing will furnish transportation for car operator to go to and from the target car to eliminate so much lost time when adjustments are to be made on car and target.

e. There is a white post at each end of the firing line. Pieces that are to be fired will take up positions between these posts.

f. Pieces that are merely for tracking purposes may be placed on an extension of the firing line.

g. There are two white poles 800 yds out with pieces of target cloth attached to the top which are to be used as right and left [illegible] markers respectively.

Authority NND 947630
By MD NARA Date 3/15/94

h. The car is able to operate at two speeds, slow speed which is 5-15 miles per hour. Fast speed is from 5-25 miles per hour. The car operator will set the car at either speed the officer in charge of firing so desires. No other speed will be used except the above listed, without permission of the Post Range Officer.

26. Range Fires:

a. The control of fires resulting from firing on the range is the responsibility of the Officer in Charge of Firing.

When a fire on the range is observed the Officer in Charge of Firing on that range will immediately contact the Post Range Officer or his Assistant to determine the danger area.

If the fire is located inside a danger area the Range Officer or the Assistant Range Officer will stop all firing in that area. The Officer in Charge of Firing will then proceed to extinguish the fire.

b. Unit Commanders in the vicinity of the fire will give assistance when called upon to do so.

c. There are tools available for fighting range fires at the Leesburg Range Headquarters Detachment.

d. During extremely dry weather when the danger of Range Fires is imminent Officers in Charge of Firing will inspect the impact areas of their ranges for fires at the conclusion of each days firing.

27. This General Order will be included in Post Regulations at a later date.

By command of Brigadier General BEEBE:

A. T. MURPHEY
Colonel, F.A.
Adjutant.

DISTRIBUTION: "A"

Authority NND 947030
By MD NARA Date 3/18/04

HQ, FT JACKSON, SC,
Dec 31 1942.

GENERAL ORDERS)

NUMBER 64)

REDESIGNATION OF UNITS.--1. Pursuant to instructions contained in letter AG 320.2 - Headquarters Fourth Service Command, Subject: "Consolidation and Redesignation of Detachments, Station Complement, Fourth Service Command", dated December 26, 1942, the following units of the Station Complement, this station, are redesignated as indicated, effective December 31, 1942.

Former Designation	New Designation
Service Detachment, Branch No. 1, Supply Division.	Section No. 1, Supply Detachment, Supply Division (with Chemical Warfare Service, Engineer, Ordnance, Quartermaster Corps and Signal Corps Sub-sections.)
*Service Detachment, Branch No. 2 Supply Division.	*Section No. 2, Supply Detachment, Supply Division.
*Service Detachment, DEML.	*Post Detachment.

2. The Arm or Service designation of enlisted personnel of Section No. 1, Supply Detachment, Supply Division, will be governed by the designation of the Section to which the individual is assigned to duty.

3. Final and initial rosters will be rendered on WD AGO Form No. 309 for the above redesignations, in compliance with Paragraphs 12 and 13, AR 345-900.

By command of Brigadier General REDHE:

A. T. MURPHEY,
Colonel, FA,
Adj.

* Negro personnel.

Amended by HQ 24 July 6, 1943

DISTRIBUTION "A"

Authority NND 947630
By MD NARA Date 3/15/94

December 10, 1942

AG 614 - General
(10-5-42)

8th Ind.

DK:SL:EMH:hwa

HEADQUARTERS FOURTH SERVICE COMMAND, Atlanta, Georgia; December 10, 1942
TO: Commanding General, Army Ground Forces, Washington, D. C.

1. The proposed layout for the moving vehicle range is considered satisfactory but attention is called to the following:

a. If 50 calibre ammunition is to be fired on this range, the danger area should be increased 1,000 yards to 3,600 yards.

b. If possible, more safety should be provided between this proposed range and the existing combat range #2. This may be accomplished by swinging the line of fire on the combat range to the east and/or moving the proposed vehicle range back closer to State Highway # 262.

2. Comment is requested as to number of installations of the types specified considered necessary for Fort Jackson; and as to estimated cost, which this Headquarters considers excessive.

For the Commanding General:

STUART LEWIS
Lt. Col., G. S. C.
Chief, Training Branch

4 Incls:
/1 Exhibit "A"-1
#2 " "A"-2
#3 " "A"-3
#4 " "C"

RG 337, Hq. Army Ground Forces -5-
E. 55, Gen'l. Corres.
Box 1122

340

Authority NND 947010
By JA NARA Date 7/23/14

December 15, 1942

32

HAWKINS:cjl
Ext.553
83665

684 - GNGCT/13428 (10-5-42) 9th Ind.

HEADQUARTERS ARMY GROUND FORCES, Army War College, Washington, D. C., To: Commanding General, Fourth Service Command, SOS, Atlanta, Georgia.

1. As long as sufficient land is available, it is not the policy of this headquarters to comment on the safety limits of ranges except insofar as it pertains to safety angles. It is believed that the depth of danger zones should be determined by the type of ammunition being used at the time.

2. It is considered necessary to have a total of the following type ranges at Fort Jackson in order to provide necessary training aids:

	Type	Number
a.	Live Grenade Courts	2
b.	Moving Vehicle Ranges	
	(1) MG (Page 100, FM 23-50)	1-(3 lanes)
	(2) Thompson Sub MG (Page 58, FM 23-40)	1
c.	Thompson Sub MG Range (dismounted)(Page 41, FM 23-40)	1-(12 firing points)

3. a. The construction of 2 a. above should be as simple as possible and should be independent of each other for operation.

b. Reference 2 b. (1) above, this range should provide three (3) adjacent lanes as indicated in FM reference. It is requested that this range be placed so that no other range lies within the area formed by drawing an angle of 45° to the outside of the two outside lanes. Obstacles on this range should be removable, so that firing may be conducted from either full track or wheeled vehicles.

c. Reference 2 b.(2) above and 2 c. above -- it is requested that the safety angle of 30° be used in this construction and that the twelve (12) firing points on the dismounted range be independent of each other.

4. There are no records available which would indicate the cost of the above construction but it is agreed that it should be as simple as possible.

For the COMMANDING GENERAL:

83665

Operations Division, AGF
12/15/42
Date

Incls - n/c

Basic: Ltr fr Hq Fourth Serv Comd, SOS, AG 614-General, October 5, 1942, Subject: Training Aids. To: CG, Ft. Jackson, South Carolina w/8 inds. and 4/incls. (Copy of basic in AG and G-3 files) - (Copy 8th Ind. in AG files)

RG 337, Hq. Army Ground Forces
E.55, Gen'l. Corres.
Box 1122

340

Authority NND 947010
By JA NARA Date 7/23/14

Memorandum for Record:

Basic fr Fourth Serv Comd requests CG, Ft. Jackson to submit plans for 1 sub-MG range, 1 Moving Vehicle Range, 1 Grenade Court (live). States CG, Second Army has requested installation of same.

1st Ind fr Hq., Ft. Jackson, SC, AG 614-General, Nov. 20, 1942 to CG, 4th Serv Comd submits detailed plans for the ranges in question. However, requests 4 grenade courts instead of 1, 5 moving vehicle ranges instead of 1.

2d Ind fr Hq, Fourth Serv Comd, AG 614-General,(10-5-42) dated Nov. 23, 1942 to CG, Ft. Jackson returns correspondence to Ft. Jackson requesting that safety angles and danger areas be checked.

3d Ind fr Hq Ft Jackson, AG 614-General (10-5-42) dated Nov. 25, 1942 to CG, 4th Serv Comd., returned correspondence with the requested corrections. Also states that full danger area is not shown because advantage is taken of a high hill to receive projectiles.

4th Ind fr Hq Fourth Serv Comd AG 614-General (10-5-42) dated Nov.27,1942 to CG, Ft. Jackson states that in order to comply with AR 750-10 it is desirable that danger areas be based on the maximum ranges for ammunition used.

5th Ind fr Hq Ft. Jackson, AG 614-General (10-5-42) dated Nov. 28, 1942 to Lt. Col. Chas D. Riley, Range Officer and President, Bd of Officers orders danger areas be provided as recorded above.

6th Ind. fr Office of the Range Officer, Ft Jackson, AG 614-General (10-5-42) dated Dec. 7, 1942 to CG, Ft Jackson states that danger areas have been surveyed as shown on exhibit.

7th Ind fr Hq Ft Jackson, AG 614-General dated Dec 7, 1942 to CG, 4th Serv Comd states that 4th Indorsement was complied with.

8th Ind fr Hq 4th Serv Comd, AG 614-General (10-5-42) dated Dec. 10,1942 to CG, AGF states that proposed layout is satisfactory. Invites attention to the fact that if .50 caliber ammunition is to be fired on this range, the danger area should be increased by 1000 yards. Request comment as to the number of installations of the type specified is considered necessary for Ft Jackson and as to the estimate cost which the 4th Serv Comd considers excessive.

This action outlines the ranges that are considered necessary for the proper training of the units stationed at Ft Jackson, taking into consideration the fact that it is contemplated that a cav mechanized regt will always be stationed at this post and that the post will be used by two divs. In this answer to the 4th Serv Comd reference is made to safety angle desired by the AGF. This has the concurrence of Maj. Coyle, Misc. Br. who is rewriting AR 750-10. The grouping of the moving ~~target~~ ranges has the concurrence of Col. Ennis, Tng Br. The number of ~~moving targets~~ needed is concurred in by Lt. Col. Carnes, Tng Br. The other numbers of ranges concerned has had the necessary concurrence of Tng Br.

340

Authority NND 947010
By JA NARA Date 7/23/94

Record

A COPY OF THIS GENERAL ORDER WILL BE INSERTED IN THE POST REGULATIONS AS APPENDIX "K".

HEADQUARTERS FORT JACKSON
Office of the Commanding General

Fort Jackson, S.C.
8 July 1943.

GENERAL ORDERS)
:
NUMBER 25)

POST RANGE REGULATIONS

1. General Order #63, this Headquarters, dated December 3, 1942 is recinded.

2. General Information:

a. The purpose of these regulations is to govern the use of firing ranges and to prescribe safety precautions to be observed in service firing.

b. All firing on the Reservation will be EAST OF TELEPHONE ROAD as follows:

(1) SMALL ARMS FIRING will be conducted on the Known Distance Ranges at Leesburg and other ranges especially constructed or designated for Small Arms Firing.

The following weapons will classify as Small Arms:

Pistol	Cal 50 Machine Guns
Carbine	37mm Guns
Rifle	60 & 81mm Mortars
Cal 30 Machine Gun	

(2) ARTILLERY FIRING will be conducted in the area EAST OF TELEPHONE ROAD exclusive of the Small Arms Ranges.

(3) HAND GRENADES: Live Hand Grenades will be discharged on Courts especially constructed for that purpose in the Training Areas.

(4) LARGE SIZE CANNON: By arrangements with the Post Range Officer 8 inch Cannon, or larger, may be fired from positions West of Telephone Road but the Impact Area must be to the East of Telephone Road.

c. When firing is in progress, signals will be displayed as follows:

(1) LEESBURG RANGE: Red Streamers on poles in rear of firing lines on Ranges C-H-R.

(2) ARTILLERY AREA: Red streamer on Tower Wiehrs Hill - (13.4-13.7) or Tower on Hill (15.7-21.2) depending on whether ANCRUM FERRY ROAD or OLD CAMDEN ROAD is closed to traffic. Red flags will also be displayed in vicinity of all firing points.

d. Persons entering the reservation EAST of TELEPHONE ROAD will inform themselves as to the firing scheduled or in progress. The current days firing will be posted on maps located as follows:

(1) Artillery Range Central. (C.R. Ancrum Ferry and Telephone Roads.)
(2) Leesburg Range Central.
(3) Office of the Post Range Officer, Post Headquarters.
(4) See par. 12.

3. Range Control:

a. The Post Range Officer will control the Range and will coordinate all firing on the Fort Jackson Reservation.

Authority NND 947620
By NARA Date 3/18/04

RG 337, Hq. Army Ground Force, E. 108 (U.S.) AGF + AFF Instruct. Box 31

(1) SMALL ARMS RANGES:

a. The Assistant Post Range Officer at Leesburg will represent the Post Range Officer, with direct cha ge of all firing on Small Arms Ranges in the Leesburg Area. An organization firing on the Small Arms Ranges will appoint a Range Officer who will contact the Assistant Post Range Officer to arrange for targets and other materials, also for posting Range Guards.

(2) DIVISION ARTILLERY RANGE OFFICER:

a. The Divisions or similiar units will detail one Field Artillery Officer as Assistant Range Officer for the period when the Artillery of the Division is firing on the Artillery Range. This officer will function as Assistant Post Range Officer with respect to Artillery firing of his Division. He will report to the Post Range Officer for instructions on the day when request for Artillery Firing reach the Post Range Officer, and forty-eight (48) hours before each days firing.

4. Range Detachment:

a. A permanent detachment will operate under the orders of the Post Range Officer. The Range Detachment will operate the Post Range Communicatio System. It will establish sentinels, signs and road blocks as directed by the Range Officer and will keep range maps posted.

5. Governing Regulations:

a. The provisions of AR 750-10 will govern all firing. The provisions of appropriate Field Manuals will govern the firing of the particular weapon.

6. Range Telephone System:

a. Traffic diagram of the Range Telephone System is in the Office of the Post Range Officer.

b. Tapping of circuits on the Range Telephone System at other than installed terminal strips, or cutting or rearranging of any installed circuit, is forbidden.

c. Requests for special circuits will be submitted to Post Range Officer one (1) day in advance.

d. Damage to telephone cables or metallic circuits on Artillery Range will be reported to Artillery Range Central immediately; damage to installations on Leesburg Range to Leesburg Range Central.

e. Permanent pole lines of the range telephone system will not be used by troops.

f. All field wire will be disconnected at the conclusion of each day firin

7. Assignment of Ranges:

a. The general assignment of the Small Arms Ranges and the Artillery Ranges will be announced by Post Headquarters.

(1) SMALL ARMS RANGE

a. The organization assigned a Small Arms Range will inform the Assistant Range Officer, Leesburg, of the calibers and ranges on which firing is to be conducted twenty-four (24) hours before firing is to begin.

Authority NND 947030
By MD NARA Date 3/15/04

(2) ARTILLERY AREA:

(a) In accordance with priorities prescribed by regulations and orders of this Headquarters, the Post Range Officer will assign firing areas, will prescribe the limitations on firing therein, the safety limits, and any other restrictions necessary for safety.

(b) When an organization has been assigned priority on the range, requests for firing areas approved by that Organization Headquarters will be acted on promptly in the order in which received, and the assignment made within twenty four (24) hours after receipt of request. The Range Officer will approve requests as submitted, except when the limits of the requested area must be modified for safety reasons. In the event, the Range Officer will promptly confer with the organization Headquarters to arrange suitable modification.

(c) Units other than those normally assigned the Artillery Area, desiring to fire Special Problems will submit requests for firing areas to the Post Range Officer ten (10 days in advance of the proposed firing.

(d) Firing at Moving Targets by units in areas involving both the Leesburg Area and the Artillery Area will be arranged by the Post Range Officer upon request.

(e) Sentinels for enclosing the danger area will be furnished by units conducting fire and will be posted by the Artillery Range Officer under the direction of the Post Range Officer.

8. Publication of Firing Memorandum:

a. A weekly Firing Memorandum is issued by Post Headquarters each Friday morning at 0800 covering all firing for the succeeding week. Overlays will accompany requests for Artillery Ranges and will reach the Post Range Officer in time to be checked and the information placed in the Firing Memorandum. It is necessary that this information be furnished the Post Range Officer. The Post Range Officer must know at all times what firing is being conducted, the position and danger area.

b. The following form will be used to submit requests:

TO: POST RANGE OFFICER HEADQUARTERS _____

Request following Firing Memorandum:

(Signed by officer requesting Memorandum

Submit only one copy

FIRING MEMORANDUM NUMBER _____

DAY OF WEEK
DATE
HOURS OF FIRING
ORGANIZATION
CALIBER
AMMUNITION
TARGET AREA
OBSERVATION POST
GUN POSITION
RIGHT SECTOR LIMIT: GUN
LEFT SECTOR LIMIT: GUN
MAXIMUM RANGE (YARDS)

Authority NND 947030 By MD NARA Date 3/15/04

9. Duties of the Post Range Officer.

a. The Post Range Officer is responsible for the coordination of activities on the range and for the safety of the entire range.

b. When requests for firing positions are submitted, the Range Officer will adjust any conflicts as to areas, check safety provisions, and will issue a Firing Memorandum prescribing the safety limits for each position.

c. When request for an area is submitted, the Firing Memorandum will define the area assigned. The officer supervising the exercise will prescribe safety provisions for each position in compliance with paragraph 7, AR 750-10.

d. When required, in addition to the usual warning issued to personnel of the Post, announcement will be made in the daily papers, and Daily Bulletins.

e. The Post Range Officer is responsible for the posting of permanent signs on the Reservation.

10. Duds:

a. The Post Ordnance Officer is charged with the destruction of "duds" on the Range.

b. "Duds" discovered on the Range will be marked by a stake and reported to the Post Range Officer. Reports will show type and caliber of each "dud" location by coordinates, and the name, organization, and telephone number of any person familiar with its location. Artillery units conducting fire will report location of any suspected "duds" during the day's firing.

c. Officers in charge of Mortar Firing will police range for "duds" at the completion of firings and report the location of all duds to the Post Range Officer.

11. Permanent Installations:

a. Artillery firing will not be placed within 500 yards of permanent installations except dugouts.

b. All dugouts, except #5, are constructed against caliber 105-mm and less. Dugout #5 offers protection against 37mm and less.

c. Permanent roads, bridges, mockups and dams may be included in firing areas, but no adjustment will be made on such installations. Every precaution will be taken to prevent direct hits on such installations. Precautions will be taken to assure that firing will not endanger permanent telephone lines.

12. Danger Areas:

a. The size of the reservation and the nature of the terrain prevents the posting of guards to cover all approaches to danger areas. The danger areas will be marked by signs at points where sentinels are not posted. These signs will not be passed by personnel, except in the following cases:

(1) Personnel going to and from service firing on safe routes designated by the unit commander in charge of the firing.

(2) Officers and parties accompanied by an officer checking through the Range Central and signing the range book. In this case, the officer accepts responsibility for a complete knowledge of the danger areas and of all firing in progress.

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By MD NARA Date 3/18/09

(1) Safety precautions prescribed in AR 750-10, regarding handling of ammunition and service of the piece are complied with.

(2) A red flag is displayed in a conspicious place in the vicinity of the battery position during firing.

(3) That all personnel of the battery are properly instructed as to safety precautions in general, and in particular as to the location of adjacent gun positions and sector of fire.

(4) When the shell is fired other than with bore safe fuses, or fuses considered in the category of bore safe, all personnel within the danger limits are protected as prescribed in paragraph 14, AR 750-10.

(5) The Range Central is promptly notified on completion of firing.

(6) The area used will be policed at the end of practice.

14. Battery Executive:

a. The Battery Executive is responsible for safety of personnel at the firing position, (AR 750-10). He will fire only when the safety officer indicates safe to fire.

15. Battery Safety Officer.

a. In all Artillery firing, the Battery Safety Officer will have no other duties. He will indicate safe to fire only when:

(1) The Range Officer indicates the range is clear.

(2) The Range visible to him is clear.

(3) The pieces are so laid as to fire inside the safety limits both for direction and for range as determined by the quadrant elevation corresponding to the maximum range designated in the Firing Memorandum.

PART II

SMALL ARMS RANGE

16. General Information:

a. The duties of the assistant Post Range Officer (SA) on the Leesburg Rifle Range, will be as follows:

(1) Maintain all ranges to insure proper operation.

(2) To furnish all target material the Table of Allowance provides.

(3) To turn over all camp property to Organization Range Officer, or Supply Officer.

(4) To see that the ranges are not abused and that all the Government property is taken care of and used properly.

(5) To ascertain that no changes are made in safety angles for any range.

(6) To allow no changes to be made by using troops in any of the ranges.

(7) To permit no unauthorized use of ranges, such as firing weapons and ammunition not authorized for use on that particular range.

(8) Maintain and supervise the use of the camp and range utilities.

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By MD NARA Date 3/18/04

17. Duties of Organization (SA) Range Officer.

a. To take over the assigned ranges and Camping Facilities, including all the property and return same at end of firing period to the Assistant Range Officer (SA) in good serviceable condition.

b. To assign all targets, quarters and facilities to the using troops.

c. To furnish guards and transportation for posting the necessary guard to keep the danger area clear of personnel during the hours of firing.

d. To act as representative for the using troops in which case all requests made by using troops will be made to him only.

e. Report to Post Range Officer any facilities assigned and not being used

18. SMALL ARMS RANGES:

a. Known Distance Ranges are designated as follows from the most westerly range (A) through east to the most northerly range (Y).

(A) 100 Machine Targets, 30 Caliber only.

(B) 30 Pistol Targets, 45 Caliber.

(C) 1 AA Range, 22 Caliber.

(D) 1 AA Range, 22 Caliber.

(E) 100 Pistol Targets, 45 Caliber.

(FG) 100 Rifle 200 yards, 30 Caliber

(HI) 100 Rifle 100-200 yards, and 300 yards, 30 Caliber.

(JK) 100 Rifle 100-200 yards, and 300 yards, 30 Caliber.

(LM) 100 Rifle 200 yard, 30 Caliber.

(N) 4 sets Anti-Tank, 30 Caliber only.

(P) 50 Rifle 100-200-300-500 yards, 30 Caliber.

(R) 100 Target plain 1000", 30 Caliber.

(S) 1 set AA Targets, 22 Caliber only.

(T) 1 set AA Targets, 22 Caliber only.

(U) 8 sets of Landscape, 30 caliber only.

(V) 25 Pistol Targets, 45 Caliber.

(W) 100 Machine Gun, 30 & 50 Caliber.

(X) 25 Pistol Targets, 45 Caliber.

(Y) 4 sets Anti-Tank, 22 Caliber.

b. Each range is distinctly marked by a large conspicious, designating letter. Also the type of ammunition to be used.

Archives NND 947030
By MD NARA Date 3/15/04

19. Control and Safety Regulations:

a. Guards will be posted under the supervision of the Organization Range Officer, so as to provide safety during the hours of firing, unless otherwise requested.

b. When all guards are posted, red streamers will be raised on poles in rear of Ranges C-H and R. No firing will be started until these streamers are raised. All firing will cease when streamers are lowered. A change in these streamers will be preceded by a long blast on the siren located at the water tank connected to tower. With no streamer raised, the blast will indicate that the streamer is to be flown. A series of blast on the siren, after firing has begun will indicate that all ranges will cease firing immediately.

c. Each range will be operated under the senior officer in charge. Where pits are provided, the pits will be under the supervision of an officer. Range procedure will be followed as specified in training manuals, for the arm being fired.

d. Prior to firing, the officer in charge of a range will notify the pit officer who will order the streamer on the target line to be raised when the pit is clear. Thereafter, no person will be allowed to stray from the pits, or leave the pits except by the authorized tunnels. Pit details will be instructed to operate and travel under the shelter.

e. An overlay will be furnished by Post Range Officer from time to time as to the location of the range guards. As the situation warrants, the location of these guards will change.

f. It will be the duty of the using troops to furnish one (1) non-commissioned officer and the guard for the range, and the duty of the organization (SA) Range Officer to ascertain that they are properly posted and instructed.

g. Ranges have been constructed to conform to Army Regulations for safety. Ranges will be used only for the purpose for which they were constructed (see paragraph 1). Special problems may be fired by arrangement with the Post Range Officer.

h. On all Combat Ranges and other Ranges beyond hearing distance of the siren at the water tank, the officer in charge of firing will communicate with the Leesburg Range Office to determine whether the Range Guards are posted and whether the range is clear. At most of the Ranges telephone communication is established with the Range Detachment. The officer in charge of firing will notify the Leesburg Range Detachment Officer when firing is concluded each day.

i. The Officer in charge of firing will be responsible that the Range he uses is properly policed, targets are properly posted or replaced for the next day, and any repairs that cannot be made on the "spot" will be reported to the Range Detachment at the conclusion of the day's firing.

j. Combat Ranges 1-2-3-4-5-6 are designed for firing Infantry Squad and Platoon Problems with Caliber .30, ball ammunition. The safety limits are marked and the Officer in Charge of Firing will see that all firing is within the Safety Limits.

These ranges will not be used for Training Areas or "Dry Run Exercises" except by permission of the Post Range Officer.

No changes in the Range Installations will be made by troops using the ranges. No other than caliber .30 ammunition will be fired on Combat Ranges except by permission of the Post Range Officer.

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By MD NARA Date 3/18/04

k. Woods Combat Course: The Officer in Charge of Firing will see that all possible precautions are taken to avoid accidents. Before giving the order to Commence Firing he will:

(1) Ascertain that the range guard is posted.

(2) That a Red Streamer is flying in the vicinity of the firing point.

(3) That only M-2 ammunition, or ammunition with a maximum range of 4000 yards is used.

(4) That all personnel operating the targets are in the pits and understanding the safety precautions.

(5) That all explosive charges placed to represent enemy fire and all "Booby Traps" are prepared and exploded under the supervision of an officer.

(6) That all troops are instructed in the safety angles of fire. The safety angle of fire is 35 degrees to the right and left of the long axis of the course.

(7) The right and left sides and the finishing end of the course are marked by a single strand of barb-wire.
The officer in charge of firing will see that all problems are conducted within this enclosure and that all troops who have completed an exercise have been moved to the Safety Zone before the beginning of an exercise.

(8) That all targets are repaired and that the Range is in operating condition at close of firing.

(9) That all personnel taking part in the exercise and all pit details wear the regulation steel helmet.

l. Infiltration Courses: The Officer in Charge of Firing will see that all possible precautions are taken to avoid accidents. Before giving the order to Commence Firing he will:

(1) Ascertain that the range guard is posted.

(2) That a Red Streamer is flying in the vicinity of the firing point.

(3) That Machine Guns have been properly laid and that the elevating and traversing stops are in their proper place to keep the fire at a minimum of 36 inches above the ground and within the bounds of the range.

(4) That only M-2 ammunition or ammunition with a maximum range of 4000 yards is used.

(5) That each gunner thoroughly understands the functions of the traversing and elevating safety stops.

(6) That an officer is on the control tower at all times during firing and that he has proper means for immediately communicating with the gunner.

(7) That all explosive charges placed to represent enemy fire, or "Booby Traps" be prepared and exploded under the supervision of an officer.

(8) That all personnel taking part in the exercise and all pit detail wear the regulation steel helmet.

m. Mock Village Course: The Officer in Charge of Firing will see that all possible precautions are taken to avoid accidents. Before giving the order to Commence Firing he will:

Authority NND 947030 By MD NARA Date 3/18/94

(1) Ascertain that the range guard is posted.

(2) That a Red Streamer is flying in the vicinity of the firing point.

(3) That only M-2 ammunition, or ammunition with a maximum range of 4000 yards is used.

(4) That all personnel operating the targets are in the pits and understand the safety precautions.

(5) That an officer is on the control tower at all times during firing and that he has proper means of communication with all the pits for which targets are operated.

(6) That all explosive charges placed to represent enemy fire and all "Booby Traps" are prepared and exploded under the supervision of an officer.

(7) That all troops are instructed in the safety angles of fire. The safety angle of fire is 90 degrees to the right and left of the center line of the street.

(8) That all targets are repaired and that the Range is in operating condition at close of firing.

(9) That all personnel taking part in the exercise and all pit details wear the regulation steel helmet.

n. Live Grenade Courts. The Officer in charge of Firing will:

(1) Take all possible precautions to insure the greatest amount of safety to personnel.

(2) See that all personnel not in trenches or behind masks are at least 250 yards from the impact area.

(3) That all personnel in the trenches and behind the mask wear the issue Steel Helmet.

(4) That a guard is posted to prevent anyone from approaching within 250 yards of the impact area.

(5) Designate an officer or Non-Commissioned Officer with the necessary assistants to check for "Duds."

(6) Upon completion of firing police the range and if any "Duds" are not exploded they will be marked and a guard posted over them until arrangements are completed for their destruction. (See par. 10)

(7) Before firing a Red Streamer will be displayed from a pole erected for that purpose in rear of the center mask. This streamer can be drawn from the [illegible] Officer. [illegible]

REFERENCES:
FM 23-30 - AR 750-10 - TM 9-1900- SNL-S-3.

o. Thompson Sub-Machine Gun Ranges, Dismounted: The officer in charge of firing will:

(1) Take all possible precautions to insure the greatest amount of safety to personnel.

(2) See that all personnel not participating in the firing remain in the area immediately in rear of the firing positions.

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(3) That only the marked routes of approach to ranges are used in getting into ranges.
(These ranges are close by other ranges and if other than marked roads are used men may wander into the danger area.)

(4) These ranges have three firing points on each range. If adjacent firing points are being used they will be used simultaneously. Men will advance from positions "A" to position "B" at a signal from the officer in charge of firing.

No scoring will be permitted when there is a man firing on an adjacent firing point.

(5) At the close of firing for the day targets and target material will be removed and placed in desiginated target house, the range will be thoroughly policed, any repairs that cannot be made will be reported to Assistant Range Officer - (Telephone Tie Line 12.)

o. Thompson Sub-Machine Gun Range, Mounted: The Officer in charge of firing will:

(1) Take all possible precautions to insure the greatest amount of safety to personnel.

(2) See that all personnel not participating in the firing remain in the area immediately in rear of the firing positions.

(3) That only the marked routes of approach to ranges are used in getting into ranges.
(These ranges are close by other ranges and if other than marked roads are used men may wander into danger area.)

(4) Vehicles will drive in the direction indicated by markers when firing.

(5) No one will be permitted on the course after firing begins until the vehicle doing the firing has completed the course and all weapons have been unloaded.

(6) At the close of firing for the day, targets and target materials will be removed and placed in dosignated target house, the range will be thoroughly policed, any repairs that cannot be made will be reported to Assistant Range Officer - (Telephone Tie Line 12.)

q. Anti-Tank Range: Request will be made to Post Range Officer in same manner as for Artillery Range.

(1) For the present time, only the following will be fired.

75mm send loaded and armour piercing.
37mm armour piercing, sand loaded, and sub-cal.
50 caliber Machine Gun.

(2) The motor car and target car will be operated by personnel of the Range Detachment and under no circumstances by units firing. The Car Operator will set the car in motion and then report to officer in charge of firing that the range is clear and ready to be fired on.

(3) A flag pole is available on the firing line. A red streamer will be flown when the Range is being fired

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on. No firing will be permitted unless the streamer is being flown. It will be the duty of the officer in charge of firing to cause the streamer to be hoisted and lowered. Before the car operator goes forward, the order cease firing and lower the flag will be given. Upon return from target car the operator will report to officer in charge that range is clear and ready to be fired on. The officer in charge will order the flag to be hoisted and command begin firing.

(4) The officer in charge of firing will furnish transportation for car operator to go to and from the target car to eliminate so much time when adjustments are to be made on car and target.

(5) There is a white post at each end of the firing line. Pieces that are to be fired will take up positions between these points.

(6) Pieces that are merely for tracking purposes may be placed on an extension of the firing line.

(7) There are two white poles 800 yards out with pieces of target cloth attached to the top which are to be used as right and left safety limits markers respectively.

(8) The car is able to operate at two speeds, slow speed which is 5-15 miles per hour. Fast speed is from 5-25 miles per hour. The car operator will set the car at either speed the officer in charge of firing so desires. No other speed will be used except the above listed, without permission of the Post Range Officer.

20. Range Supplies and Property:

a. Ranges will be released to units when their authorized representatives have taken over the range property. This property will be maintained in good operating condition by the using unit. (Exception - broken targets, frames, etc., will be turned into the Post Range House for replacement.)

21. Communication:

a. Phones for ranges will be turned over with the range. Phones may be exchanged for repair at Post Range House.

22. Administration: - Camp Area:

a. Requests for use of the Camp Area on the Small Arms Range will be submitted to the Post Range Officer.

b. When the Camp Area is assigned to an organization, the Commanding Officer of that organization or an officer designated by him will contact the Assistant Range Officer at Leesburg and will sign for all property on Memo Receipt. Obtain from the Assistant Range Officer a proposed administrative order to the using troops covering the interior economy of the camp.

c. Assignments in camp area, will be made by Commanding Officer of using troops, and administrative arrangement for the camp area. Senior officer will command for coordination of installations.

d. Before departure, organization will:

(1) Fasten down sides of tents and loosen ropes.

(2) Stack all cots in mess halls for check.

(3) Scrub kitchen and mess halls.

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(4) Clean i_ b_ and leave op

(5) Skim grease trap.

(6) Remove all garbage.

(7) Scrub Bath house.

(8) Scrub latrines, sprinkle lime in pits, and leave covers closed.

(9) Burn out and clean all latrines.

(10) Police area.

(11) Clean incinerator and haul rubbish to dump.

(12) Return property to Assistant Range Officer and get Memo Receipt.

e. When the Post Exchange is in operation in the Camping Area the Senior Officer will issue orders regulating the hours and arranging for police and sanitary conditions. Post Exchange Officer should be informed of important changes or requests.

23. Facilities:

a. Each unit commander will notify the Organization Range Officer when he has facilities that are assigned to him and which he does not need.

b. All requests for additional facilities should be made to the Organization Range Officer.

c. Available targets and ranges will be assigned by the Organization Range Officer.

d. The following equipment and facilities for each company or similar unit are available:

(1) Mess hall and kitchen.
(2) Pyramidal tents.
(3) Cots, canvas, folding.
(4) One (1) bath house to three (3) mess buildings.
(5) One (1) latrine, pit type.
(6) Screens or pyramidal tents, for latrines and bath houses.
(7) Ice Box.

e. The following equipment must be furnished by using troops.

(1) Field range.
(2) Cooking utensils.
(3) Mess Kits, Complete
(4) Bedding.
(5) Light Bulbs.

f. Water facilities are very limited. Arrangements must be made within organizations to conserve all that is possible and alternate the use of it between the kitchen and bath houses when necessary. No water will be used for sprinkling streets.

24. Sanitation: The Commanding Officer of troops is responsible for sanitation and will appoint the senior medical officer as medical inspector for the camp and range.

25. Range Fires:

a. The control of fires resulting from firing on the range is the responsibility of the Officer in Charge of Firing.

When a fire on the range is observed the Officer in charge of firing on that range will immediately contact the Post Range Officer or his assistant to determine the danger area.

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If the fire is located inside a danger area the Range Officer or the Assistant Range Officer will stop all firing in that area. The Officer in Charge of Firing will then proceed to extinguish the fire.

b. Unit Commanders in the vicinity of the fire will give assistance when called upon to do so.

c. There are tools available for fighting range fires at the Leesburg Range Headquarters Detachment.

d. During extremely dry weather when the danger of Range Fires is imminent Officers in Charge of Firing will inspect the impact areas of their ranges for fires at the conclusion of each day firing.

By command of Brig. Gen. BEEBE:

A. T. MURPHEY
Col, FA
Adj

DISTRIBUTION "A".

Authority NND 947030
By MD NARA Date 3/18/09

March 16, 1944

Extract

A COPY OF THIS GENERAL ORDER WILL BE INSERTED IN THE POST REGULATIONS AS APPENDIX "K".

ARMY SERVICE FORCES
Fourth Service Command
Fort Jackson, South Carolina

GENERAL ORDER)
NUMBER 18)

PART I

16 March 1944

POST RANGE REGULATIONS

1. General Order #25, this headquarters, dated 8 July 1943 and General Order #26, dated 20 July 1943, are rescinded.

2. GENERAL INFORMATION:

a. The purpose of these regulations is to govern the use of ranges and to prescribe safety precautions to be observed in service firing.

b. All firing on the reservation will be EAST OF TELEPHONE ROAD as follows:

(1) SMALL ARMS FIRING will be conducted on the Known Distance Ranges at Leesburg and other ranges especially constructed or designated for Small Arms Firing.

The following weapons will be classified as Small Arms:

Pistol	Cal 50 Machine Guns
Carbine	37mm Guns
Rifle	60 & 81mm Mortars
Cal 30 Machine Gun	

(2) ARTILLERY FIRING will be conducted in the area EAST OF TELEPHONE ROAD exclusive of the Small Arms Ranges.

(3) HAND GRENADES: Live hand grenades will be discharged on courts especially constructed for that purpose in the training areas.

(4) LARGE SIZE CANNON: By arrangements with the Post Range Officer, 8 inch Cannon, or larger, may be fired from positions West of Telephone Road, but the Impact Area must be to the East of Telephone Road.

c. When firing is in progress, signals will be displayed as follows:

(1) LEESBURG RANGE: Red streamers on poles in rear of firing lines on Ranges C-H-R.

(2) ARTILLERY AREA: Red streamer on Tower Wiehrs Hill (13.4-13.7) when firing on the southern part of artillery range.
Red streamers on North Tower (15.7-21.2) when firing on northern part of artillery range.

(3) ALL OTHER RANGES: Red streamer in vicinity of the firing points.

d. Persons entering the reservation EAST OF TELEPHONE ROAD will inform themselves as to the firing scheduled or in progress. The current days firing will be posted on maps located as follows:

(1) Artillery Range House. (C.R. Ancrum Ferry and Telephone Roads.)

(2) Leesburg Range Detachment.

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RG 337, Hq. Army Ground Forces
E. 108 (U.D.) AGF - AFF Instrs.
Box 51

(3) Office of the Post Range Officer.

(4) See paragraph 12.

3. RANGE CONTROL:

a. The Post Range Officer will control the range and will coordinate all firing on the Fort Jackson reservation.

(1) SMALL ARMS RANGES:

(a) The Assistant Post Range Officer at Leesburg will represent the Post Range Officer, with direct charge of all firing on Small Arms Ranges in the Leesburg area. An organization firing on the Small Arms Ranges will appoint a Range Officer to arrange for targets and other materials, also for posting Range Guards.

(2) ARTILLERY RANGE:

(a) The Battalion or similar units will detail one officer as Assistant Range Officer for the period when the battalion is firing on the artillery range. This officer will function as Assistant Post Range Officer with respect to artillery firing of his battalion. He will report to the Post Range Officer for instructions twenty-four (24) hours before each days firing.

4. RANGE DETACHMENT:

a. A permanent detachment will operate under the orders of the Post Range Officer. The Range Detachment will operate the Post Range Communications System. It will establish signs and road blocks as directed by the Range Officer and will keep range maps posted.

5. GOVERNING REGULATIONS:

a. The provisions of AR 750-10 will govern all firing. The provisions of appropriate Field Manuals will govern the firing of the particular weapons.

6. RANGE TELEPHONE SYSTEM:

a. Traffic diagram of the Range Telephone System is in the office of the Post Range Officer.

b. Tapping of circuits on the Range Telephone System at other than installed terminal strips, or cutting or rearranging of any installed circuit, is forbidden.

c. Requests for special circuits will be submitted to Post Range Officer one (1) day in advance.

d. Damage to telephone cables or metallic circuits on artillery range will be reported to Artillery Range Central immediately; damage to installations on Leesburg Range to Leesburg Range Office.

e. Permanent pole lines of the Range Telephone System will not be used by troops.

f. All field wire will be disconnected at the conclusion of each day firing.

7. ASSIGNMENT OF RANGES:

a. The general assignment of the Small Arms Ranges and the artillery ranges will be announced by Post Headquarters.

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(1) SMALL ARMS RANGES:

(a) Requests for ranges will be submitted to the Post Range Officer.

(b) The organization assigned a small arms range will inform the Assistant Range Officer, Leesburg, of the calibers and ranges on which firing is to be conducted twenty-four (24) hours before firing is to begin.

(c) If small arms ranges are to be used for any other purpose than that for which they were constructed, requests will show the type of firing to be conducted.

(2) ARTILLERY AREA:

(a) The Post Range Officer will assign firing areas, will prescribe the limitations on firing therein, the safety limits, and any other restrictions necessary for safety.

(b) Requests for artillery range will be submitted to the Post Range Officer and accompanied by an overlay giving the following information:

Organization
Date and day of week
Hours of firing
Caliber
Ammunition
Gun Position
Impact area
Safety limits
Observation posts.

(c) Units, other than those normally assigned the Artillery Area, desiring to fire special problems will submit requests for firing areas to the Post Range Officer ten (10) days in advance of the proposed firing.

(d) Sentinels for enclosing the danger area will be furnished by units conducting fire and will be posted by the unit Range Officer under the direction of the Post Range Officer.

8. PUBLICATION OF FIRING SCHEDULE:

A WEEKLY FIRING SCHEDULE IS ISSUED BY POST HEADQUARTERS EACH TUESDAY MORNING AT 0800 COVERING ALL FIRING FOR THE SUCCEEDING WEEK. ALL REQUESTS FOR FIRING MUST REACH THIS HEADQUARTERS BEFORE 0800 TUESDAY.

9. DUTIES OF THE POST RANGE OFFICER:

a. The Post Range Officer is responsible for the coordination of activities on the range and for the safety of the entire range.

b. When requests for firing positions are submitted, the Range Officer will adjust any conflicts as to areas, check safety provisions, and will issue a firing memorandum prescribing the safety limits for each position.

c. When request for an area is submitted, the firing memorandum will define the area assigned. The officer supervising the exercise will prescribe safety provisions for each position in compliance with AR 750-10.

d. When required, in addition to the usual warning issued to personnel of the Post, announcement will be made in the daily papers, and Daily Bulletin.

e. The Post Range Officer is responsible for the posting of permanent signs on the reservation.

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10. DUDS:

a. The Post Ordnance Officer is charged with the destruction of "duds" on the range.

b. "Duds" discovered on the range will be marked by stakes and reported to the Post Range Officer. Reports will show type of caliber of each "dud" location by coordinates, and the name, organization, and telephone number of any person familiar with its location. Artillery units conducting fire will report location of any suspected"duds" during the days firing.

c. Officers in charge of Mortar Firing will police range for "duds" at the completion of firing and report the locaion of all "duds" to the Post Range Officer. Officer in charge will sign certificate of clearance at Range Detachment Office regardless of whether there were any duds.

11. PERMANENT INSTALLATIONS:

a. Artillery firing will not be placed within 500 yards of permanent installations except dugouts.

b. All dugouts, except #5, are constructed against caliber 105-mm and less. Dugout #5 offers protection against 37mm and less.

c. Permanent roads, bridges, mockups, dams, and cemeteries, may be included in firing areas, but no adjustment will be made on such installations. Every precaution will be taken to prevent direct hits on such installations. Precautions will be taken to insure that firing will not endanger permanent telephone lines.

12. DANGER AREAS:

a. The size of the reservation and the nature of the terrain prevents the posting of guards to cover all approaches to danger areas. The danger areas will be marked by signs at points where sentinels are not posted. These signs will not be passed by personnel, except in the following cases:

(1) Personnel going to and from service firing on safe routes designated by the unit commander in charge of the firing.

(2) Officers, and parties accompanied by an officer, checking through the Range House and signing the range book. In this case, the officer accepts responsibility for a complete knowledge of the danger areas and of all firing in progress.

13. UNIT COMMANDER:

a. The Unit Commander is responsible that:

(1) Safety precautions prescribed in AR 750-10, regarding handling of ammunition and service of the piece are complied with.

(2) A red flag is displayed in a conspicious place in the vicinity of the battery position during firing.

(3) That all personnel of the battery are properly instructed as to safety precautions in general, and in particular as to the location of adjacent gun positions and sector of fire.

(4) When the shell is fired other than with bore safe fuses, or fuses considered in the category of bore safe, all personnel within the danger limits are protected as prescribed in paragraph 10, AR 750-10.

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(5) The Range Central is promptly notified on completion of firing.

(6) The area used will be policed at the end of practice and all excavations will be refilled.

(7) He will not fire until he has been informed by the Assistant Range Officer from his unit that the range is clear, and will cease firing when directed by the proper authority.

PART II

SMALL ARMS RANGE

14. GENERAL INFORMATION:

a. The duties of the assistant Post Range Officer (SA) on the Leesburg Rifle Range, will be as follows:

(1) Maintain all ranges to insure proper operation.

(2) To furnish all target material the Table of Allowance prescribes.

(3) To turn over camp property to Organization Range Officer or Supply Officer on memo receipt.

(4) To see that the ranges are not abused and that all Government property is taken care of and used properly.

(5) To ascertain that no changes are made in safety angles for any range.

(6) To allow no changes to be made by using troops in any of the ranges.

(7) To permit no unauthorized use of ranges, such as firing weapons and ammunition not authorized for use on that particular range.

(8) Maintain and supervise the use of the camp and range utilities.

15. DUTIES OF ORGANIZATION (SA) RANGE OFFICER:

a. To take over the assigned ranges and camp facilities, including all the property and return same at end of firing period to the Assistant Range Officer (SA) in good serviceable condition.

b. To assign all targets, quarters and facilities to the using troops.

c. To furnish guards and transportation for posting the necessary guard to keep the danger area clear of personnel during the hours of firing.

d. To act as representative for the using troops in which case all requests made by using troops will be made to him only.

e. Report to Post Range Officer any facilities assigned and not being used.

16. SMALL ARMS RANGES:

a. Known Distance Ranges are designated as follows from the most westerly range (A) through east to the most northerly range (Y).

(A) 100 Machine Targets, 30 Caliber only.

(B) 30 Pistol Targets, 45 Caliber.

(C) 1 AA Range, 22 Caliber.

(D) 1 AA Range, 22 Caliber.

(E) 100 Pistol Targets, 45 Caliber.

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(FG) 100 Rifle, 200 yards, 30 Caliber.

(HI) 100 Rifle, 100-200 and 300 yards, 30 Caliber.

(JK) 100 Rifle, 100-200 and 300 yards, 30 Caliber.

(LM) 100 Rifle, 200 yard, 30 Caliber.

(N) 4 sets Anti-Tank, 30 Caliber only.

(P) 50 Rifle, 100-200-300-500 yards, 30 Caliber.

(Q) Mortar 60 & 81mm.

(R) 100 Targets plain 1000", 30 Caliber.

(S) 1 set AA Targets, 200 Caliber only.

(T) 1 set AA Targets, 22 Caliber only.

(U) 8 sets of Landscape, 22 & 30 Caliber only.

(V) 25 Pistol Targets, 45 Caliber.

(W) 100 Machine Gun, 30 & 50 Caliber.

(X) 25 Pistol Targets, 45 Caliber.

(Y) 4 sets Anti-Tank, 22 Caliber.

b. Each range is distinctly marked by a large conspicious, designating letter. Also the type of ammunition to be used.

17. CONTROL AND SAFETY REGULATIONS:

a. Guards will be posted under the supervision of the Organization Range Officer, so as to provide safety during the hours of firing, unless otherwise requested.

b. When all guards are posted, red streamers will be raised on poles in rear of Ranges C-H and R. No firing will begin until these streamers are raised. All firing will cease when streamers are lowered. A change in these streamers will be preceded by a long blast on the siren located at the water tank connected to tower. With no streamer raised, the blast will indicate that the streamer is to be flown. A series of blast on the siren, after firing has begun will indicate that all ranges will cease firing immediately.

c. Each range will be operated under the senior officer in charge. Where pits are provided, the pits will be under the supervision of an officer. Range procedure will be followed as specified in training manuals, for the arm being fired.

d. Prior to firing, the officer in charge of a range will notify the pit officer who will order the streamer in pit to be raised when the pit is clear. Thereafter, no person will be allowed to stray from the pits, or leave the pits except by the authorized tunnels. Pit details will be instructed to operate and travel under the shelter.

e. An overlay will be furnished by Post Range Officer from time to time as to the location of the range guards. As the situation warrants, the location of these guards will change.

f. It will be the duty of the using troops to furnish one (1) non-commissioned officer and the guard for the range, and the duty of the organization (SA) Range Officer to ascertain that they are properly posted and instructed.

g. Ranges have been constructed to conform to Army Regulations for safety. Ranges will be used only for the purpose for which they were constructed (see paragraph 1). Special problems may be fired by arrangement with the Post Range Officer.

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h. On all Combat Ranges and other Ranges beyond hearing distance of the siren at the water tank, the officer in charge of firing will communicate with the Leesburg Range Office to determine whether the Range Guards are posted and whether the Range is clear. At most of the Ranges, telephone communication is established with the Range Detachment. The officer in charge of firing will notify the Leesburg Range Detachment Office when firing is concluded each day.

i. The officer in charge of firing will be responsible that the range he uses is properly policed, targets are properly posted and replaced for the next day, and any repairs that cannot be made on the "spot" will be reported to the Range Detachment at the conclusion of the day's firing.

j. Combat Ranges 1-2-3-4-5-6 are designed for firing Infantry Squad and Platoon Problems with Caliber .30, ball ammunition. The safety limits are marked and the officer in charge of firing will see that all firing is within the safety limits.

k. These ranges will not be used for training areas or "dry run exercises" except by permission of the Post Range Officer.

l. No changes in the range installations will be made by troops using the ranges. No other than caliber 30 ammunition will be fired on combat ranges except by permission of the Post Range Officer.

m. The officer in charge of firing will inspect all pits before firing begins and if any are found to be unsafe he will have the necessary corrections made.

18. CARBINE TRANSITION FIRING will be conducted on Combat Ranges 2 and 5. Before the firing begins the officer in charge of firing will inspect all pits and if any are found to be unsafe he will have the necessary corrections made.

19. WOODS COMBAT COURSE: The officer in charge of firing will see that all possible precautions are taken to avoid accidents. Before giving the order to commence firing he will:

a. Ascertain that the range guard is posted.

b. That a red streamer is flying in the vicinity of the firing point.

c. That only M-2 ammunition or ammunition with a maximum range of 4000 yards is used.

d. That all personnel operating the targets are in the pits and understand the safety precautions.

e. That all explosive charges placed to represent enemy fire and all "Booby Traps" are prepared and exploded under the supervision of an officer.

f. That all troops are instructed in the safety angles of fire. The safety angle of fire is 35 degrees to the right and left of the long axis of the course.

g. The right and left sides and the finishing end of the course are marked by a single strand of barb-wire.

The officer in charge of firing will see that all problems are conducted within this enclosure and that all troops who have completed an exercise have been moved to the safety zone before the beginning of an exercise.

h. That all targets are repaired and that the range is in operating condition at close of firing.

i. That all personnel taking part in the exercise and all pit details wear the regulation steel helmet.

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j. The officer in charge of firing will inspect all pits before firing begins and if any are found to be unsafe he will have the necessary corrections made.

20. INFILTRATION COURSES: The officer in charge of firing will see that all possible precautions are taken to avoid accidents. Before giving the order to commence firing he will:

a. Ascertain that the range guard is posted.

b. That a red streamer is flying in the vicinity of the firing point.

c. That machine guns have been properly laid and that the elevating and traversing stops are in their proper place to keep the fire at a minimum of 36 inches above the ground and within the bounds of the range.

d. That only M-2 ball ammunition or ammunition with a maximum range of 4000 yards is used. See par. 45d, AR 775-10, for regulations governing tracer ammunition.

e. That each gunner thoroughly understands the functions of the traversing and elevating safety stops.

f. That an officer is on the control tower at all times during firing and that he has proper means for immediately communicating with the gunner.

g. That all explosive charges placed to represent enemy fire, or "Booby Traps" be prepared and exploded under the supervision of an officer.

h. That all personnel taking part in the exercise and all pit detail wear the regulation steel helmet.

21. MOCK VILLAGE COURSE: The officer in charge of firing will see that all possible precautions are taken to avoid accidents. Before giving the order to commence firing he will:

a. Ascertain that the range guard is posted.

b. That a red streamer is flying in the vicinity of the firing point.

c. That only M-2 ammunition or ammunition with a maximum range of 4000 yards is used.

d. That all personnel operating the targets are in the pits and understand the safety precautions.

e. That an officer is on the control tower at all times during firing and that he has proper means of communication with all the pits from which targets are operated.

f. That all explosive charges placed to represent enemy fire and all "Booby Traps" are prepared and exploded under the supervision of an officer.

g. That all troops are instructed in the safety angles of fire. The safety angle of fire is 90 degrees to the right and left of the center line of the street.

h. That all targets are repaired and that the range is in operating condition at close of firing.

i. That all personnel taking part in the exercise and all pit details wear the regulation steel helmet.

j. That all pits be inspected before firing begins and if any are found to be unsafe he will have the necessary corrections made.

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22. LIVE GRENADE COURTS: The Officer in charge of firing will:

a. Take all possible precautions to insure the greatest amount of safety to personnel.

b. See that all personnel not in trenches or behind masks are at least 250 yards from the impact area.

c. That all personnel in the trenches or behind masks wear the issue steel helmet.

d. That a guard is posted to prevent anyone from approaching within 250 yards of the impact area.

e. Designate an officer or non-commissioned officer with the necessary assistants to check for "duds".

f. Upon completion of firing, police the range and if any "duds" are not exploded they will be marked and a guard posted over them until arrangements are completed for their destruction. (See par. 10).

g. Before firing, a red streamer will be displayed from a pole erected for that purpose in rear of the center mask. This streamer can be drawn from the Post Range Officer on memo receipt.

REFERENCES:
FM 23-30 - AR 750-10 - TM 9-1900 - SNL-S-3.

23. SUB-MACHINE GUN RANGES, DISMOUNTED: The officer in charge of firing will:

a. Take all possible precautions to insure the greatest amount of safety to personnel.

b. See that all personnel not participating in the firing remain in the area immediately in rear of the firing positions.

c. That only the marked routes of approach to ranges are used in getting into ranges. (These ranges are close by other ranges and if other than marked roads are used men may wander into the danger area.)

d. These ranges have three firing points on each range. If adjacent firing points are being used, they will be used simultaneously. Men will advance from positions "A" to position "B" at a signal from the officer in charge of firing.

No scoring will be permitted when there is a man firing on an adjacent firing point.

e. At the close of firing for the day, targets and target material will be removed and stored in designated target house, the range will be thoroughly policed and any repairs that cannot be made will be reported to Assistant Range Officer - (Telephone Tie Line 12.).

24. SUB-MACHINE GUN RANGE, MOVING VEHICLE: The officer in charge of firing will:

a. Take all possible precautions to insure the greatest amount of safety to personnel.

b. See that all personnel not participating in the firing remain in the area immediately in rear of the firing positions.

c. That only the marked routes of approach to ranges are used in getting into ranges. (These ranges are close by other ranges and if other than marked roads are used men may wander into danger area.)

d. Vehicles will drive in the direction indicated by markers when firing.

e. No one will be permitted on the course after firing begins until the vehicle carrying the firing has completed the course and all weapons have been unloaded.

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At the close of firing for the day targets and target materials will be removed and placed in designated target house, the range will be thoroughly policed, any repairs that cannot be made will be reported to Assistant Range Officer - (Telephone Tie Line 12.).

25. ANTI-TANK RANGE: Request will be made to Post Range Officer in same manner as for artillery range.

a. For the present time, only the following will be fired.

75mm sand loaded and armour piercing.
37mm armour piercing, (without windshields), sand loaded, and sub cal.
50 caliber machine gun.

b. The motor car and target car will be operated by personnel of the Range Detachment and under no circumstances by units firing. The car operator will set the car in motion and then report to officer in charge of firing that the range is clear and ready to be fired on.

c. A flag pole is available on the firing line. A red streamer will be flown when the range is being fired on. No firing will be permitted unless the red streamer is being flown. It will be the duty of the officer in charge of firing to cause the streamer to be hoisted and lowered. Before the car operator goes forward, the order cease firing and lower the flag will be given. Upon return from target car, the operator will report to officer in charge that range is clear and ready to be fired on. The officer in charge will order the flag to be hoisted and command begin firing.

d. The officer in charge of firing will furnish transportation for car operator to go to and from the target when adjustments are to be made on car and target.

e. There is a white post at each end of the firing line. Pieces that are to be fired will take up positions between these points.

f. Pieces that are merely for tracking purposes may be placed on an extension of the firing line.

g. There are two white poles 800 yards out with pieces of target cloth attached to the top which are to be used as right and left safety limits markers respectively.

h. The car is able to operate at two speeds, slow speed which is 5-15 miles per hour. Fast speed is from 5-25 miles per hour. The car operator will set the car at either speed the officer in charge of firing so desires. No other speed will be used except the above listed, without permission of the Post Range Officer.

26. TRANSITION RANGES: Before commencing to fire, the officer in charge of firing will inspect all pits and if any are found to be unsafe he will have the necessary corrections made.

27. RANGE SUPPLIES AND PROPERTY:

Ranges will be released to units when their authorized representatives have taken over the range property. This property will be maintained in good operating condition by the using unit. (Exception - broken targets, frames, etc., will be turned into the Range House for replacement.)

28. COMMUNICATION:

Phones for ranges will be drawn from the Assistant Range Officer. Phones may be exchanged for repair at Range Detachment.

29. CAMP AREA:

a. Requests for use of the Camp Area on the Small Arms Ranges will be submitted to the Post Range Officer.

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b. When the Camp Area is assigned to an organization, the Commanding Officer of that organization or an officer designated by him will contact the Assistant Range Officer at Leesburg and will sign for all property on memo receipt. Obtain from the Assistant Range Officer a proposed administrative order to the using troops covering the interior economy of the camp.

c. Assignments in camp area will be made by Commanding Officer of using troops, and administrative arrangement for the camp area. Senior officer will command for coordination of installations.

d. Before departure, organization will:

(1) Roll sides of tents and loosen ropes.

(2) Stack all cots in mess halls for check.

(3) Scrub kitchen and mess halls.

(4) Clean ice box and leave open.

(5) Clean electric refrigerator; leave closed and connected.

(6) Skim grease trap.

(7) Remove all garbage.

(8) Scrub bathhouse.

(9) Scrub latrines, sprinkle lime in pits, and leave covers closed.

(10) Police area.

(11) Clean incinerator and haul rubbish to dump.

(12) Return property to Assistant Range Officer and get memo receipt.

e. When the Post Exchange is in operation in the camping area, the senior officer will issue orders regulating the hours and arranging for police and sanitary conditions. Post Exchange Officer should be informed of important changes or requests.

30. FACILITIES:

a. The following equipment and facilities for each company or similar unit is available:

(1) Mess hall and kitchen.
(2) Pyramidal tents.
(3) Cots, canvas, folding.
(4) One (1) bathhouse to three (3) mess buildings.
(5) One (1) latrine, pit type.
(6) Ice box and electric refrigerator.

b. The following equipment must be furnished by using troops:

(1) Field range.
(2) Cooking utensils.
(3) Mess kits, complete.
(4) Bedding.
(5) O. D. Blankets.

c. Water facilities are very limited. Arrangements must be made within organizations to conserve all that is possible and alternate the use of it between the kitchen and bathhouses when necessary. No water will be used for sprinkling streets.

d. During freezing weather the commanding officer of troops occupying the camp area will take all precautions to protect exposed water pipes.

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By MD NARA Date 3/15/04

31. SANITATION: The commanding officer of troops is responsible for sanitation and will appoint the senior medical officer as medical inspector for the camp and range.

32. RANGE FIRES:

a. The control of fires resulting from firing on the range is the responsibility of the officer in charge of firing.

When a fire on the range is observed, the officer in charge of firing on that range will immediately contact the Post Range Officer or his Assistant to determine the danger area.

If the fire is located inside a danger area, the Range Officer or the Assistant Range Officer will stop all firing in that area. The officer in charge of firing will then proceed to extinguish the fire.

b. Unit commanders in the vicinity of the fire will give assistance when called upon to do so.

c. During extremely dry weather when the danger of range fires is imminent, officers in charge of firing will inspect the impact areas of their ranges at the conclusion of each days firing.

By command of Brigadier General RICHART:

JOSEPH P. O'HARA
Major, AUS
Adjutant

DISTRIBUTION "A"

Authority NND 947030
By MD NARA Date 3/18/04

WAR DEPARTMENT
OFFICE OF THE CHIEF OF ENGINEERS

FORT JACKSON, SOUTH CAROLINA

RESTRICTED

POST WAR UTILIZATION STUDIES

SEPT
1945

DECLASSIFIED
Authority NND 803038
By CAARA Date 3-5-04

ANALYSIS OF FORT JACKSON, SOUTH CAROLINA

GENERAL DESCRIPTION AND USE

Fort Jackson is located in the central part of South Carolina, 5 miles east of the city of Columbia (population 62,396). The reservation comprises an area of 60,217 acres of which 51,344 acres are Government-owned. From June 1940 to October 1944, a total of 8 Infantry Divisions received training for primary missions at this post. During the year 1942 the training of four Infantry Divisions was prosecuted at one time. Besides acting as a training post for infantry divisions, Fort Jackson has also been used for the training of miscellaneous tactical groups and service battalions.

REGIONAL FACTORS

Other nearby centers of population are: Sumter, 45 miles distant, (population 15,874), and Orangeburg, 50 miles distant (population 10,521). The proximity of Fort Jackson to the city of Columbia is very advantageous from the viewpoint of social outlets. The climate is moderate. The health of the troops is protected from mosquitoes by adequate drainage within the housing area, principal recreation areas, and for a one-mile strip surrounding these areas. Beyond the limits of the controlled area, mosquito breeding grounds are extensive and require the application of standard measures of malaria control. The area surrounding Fort Jackson is primarily an agricultural community.

POST DEVELOPMENT

In the cantonment area, based upon 80 square feet per man, there is available space for 19,714 men in mobilization type barracks. There have been housed 43,690 men in hutments and 2,198 in theater of operations type barracks. There are no permanent quarters. It would be desirable in the postwar period to convert the present hand fired space heaters and hot water heaters to automatic firing. Present housing conditions with respect to fire prevention are satisfactory.

The water supply system is constructed of permanent materials and is considered satisfactory for postwar use. The supply is from a dam on Gill Creek, treated in a water filtration plant, and is adequate and dependable.

The sewage disposal facilities are constructed of permanent materials and are considered very satisfactory and suitable for postwar use. Complete treatment is provided and therefore no nuisance is created.

Cold Storage facilities are adequate for postwar use.

The electric power is furnished by the South Carolina Gas and Electric Company. Service is excellent and supply adequate. No standby supply is provided. The last monthly billing of energy use was .7719 cents per KWH.

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By CB NARA Date 3-4-04

Fort Jackson, South Carolina

Rail service is furnished by the Atlantic Coast Lines, the Southern Railway and the Seaboard Air Lines over jointly operated tracks. Switching operations within the warehouse area are increased due to the fact that ten to twelve warehouses must be served by a single track. Three general supply depots are within 150 miles of the camp.

Highway access adequately serves Fort Jackson. The roads and drainage within the post are satisfactory for postwar use.

The total cost of Fort Jackson to the Government since July 1, 1940, including land and construction, has been approximately $31,078,000.

TRAINING FACILITIES

The general soil characteristic of the reservation is sand and sandy loam. Water is absorbed quickly and troops can drill a few minutes after a normal rainfall.

All training aids, except small arms ranges, are located within a maximum of thirty minutes' marching time of the housing area.

Small arms ranges are located sixteen miles from the housing area. A tent camp sufficient to accommodate 6,000 troops is located within an average marching time of thirty minutes of all small arms ranges. Troops using these ranges train progressively and usually remain at the tent camp until all small arms training is completed. No loss in training time is incurred by the location of the ranges.

The artillery ranges afford excellent ground observation of impact area in open ground. Maximum range is 18,000 yards.

The maneuver areas include well proportioned open and wooded areas and are very suitable for training. The wooded areas are accessible to all types of motor and tracked equipment.

Sufficient drill fields are located near small units and allow 60% of the troop strength to use the areas at any one time. A division review field is also available.

There are two air strips located on the reservation for the operation of L-2 (Artillery Liaison) Planes. Land is available for expansion of these strips. There are two Army airports in the vicinity. One is the Columbia Army Air Base, approximately 18 miles from the post having 3 - 5,000' runways evaluated for 30,000 pounds capacity operation, 40,000 pounds limited operation. The second airport is Congaree, approximately 10 miles from Fort Jackson, having 3 - 4,500' runways, evaluated for 40,000 pounds capacity operation, 74,000 pounds limited operation.

Engineering training is available for floating and fixed bridges.

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By CB NARA Date 8-24-04

Fort Jackson, South Carolina

Tank deployment training facilities are satisfactory.

CONCLUSION

From an engineering standpoint, Fort Jackson may be considered satisfactory for postwar retention except in the matter of housing. There is a discrepancy of 13,136 between the available space in mobilization type barracks and the proposed strength of 32,850. Based upon the assumptions given in the attached appendix, the cost of providing permanent quarters for the officer complement, quarters for the first three grades of W.C.S.'s, additional barracks, and remodeling the existing mobilization type barracks for postwar use would be in the neighborhood of $55,000,000.

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APPENDIX A

Assumptions on Basis of Which Estimated Costs Were Made

In the absence of determined policy as to types of construction to be used, ace allocation for different kinds of structures, method of housing married ficers and top-grade non-commissioned officers, etc., the following assumptions ve been used in preparing the housing costs given in the preceding conclusion:

(1) That Theater of Operations construction, hutments, and tents would be disposed of, that only permanent or mobilization-type construction would be retained, and that mobilization-type construction would be improved to supply facilities suitable for permanent occupancy.

(2) That all new construction with the exception of extensions or additions to existing mobilization-type construction would be of permanent construction.

(3) That station hospitals, being normally of mobilization-type construction or better, would not usually require more than nominal expenditure for conversion to permanent use. (Estimates do not include this conversion cost.)

(4) That officer strength at a given post is roughly 5% of the total complement assigned to the post.

(5) That all officers at regular army stations and all regular army cadre officers serving as trainers at other types of posts would be provided family housing.(This applies to married officers only.)

(6) That all trainee officers will be provided bachelors' officers quarters. (National Guard and Reserve Camps would have no family quarters.)

(7) That top three grades of non-commissioned officers to be housed in family quarters comprise 2.2% of the total complement assigned to the post.

(Above percentages are based roughly on the Table of Organization for an Infantry Division and check fairly closely with the actual conditions of housing at seven pre-war permanent posts.)

(8) That existing housing given in "War Department Owned, Sponsored, and Leased Facilities" would accommodate only 75% of rated capacity, since capacities given in this publication (30 June 1945) are based on 60 square feet per man, while allocation approved for planning is 80 square feet per enlisted man. (Costs of new permanent family housing takes into account existing permanent family housing as given in Historical Records.)

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By CB KARA Date 3-4-04

Based on the above assumptions and on the best available information, the following rough approximations of unit costs of housing were used:

(1) For remodeling mobilization type barracks and other related buildings, including necessary minimum improvements of roads, utilities, etc. . . . . $. 300.00 per S.M.

(2) For new permanent housing, replacing Theater of Operations structures, tents, and hutments, and including a proportional share of other facilities (buildings, utilities, etc.). . . . $ 2,000.00 per S.M.

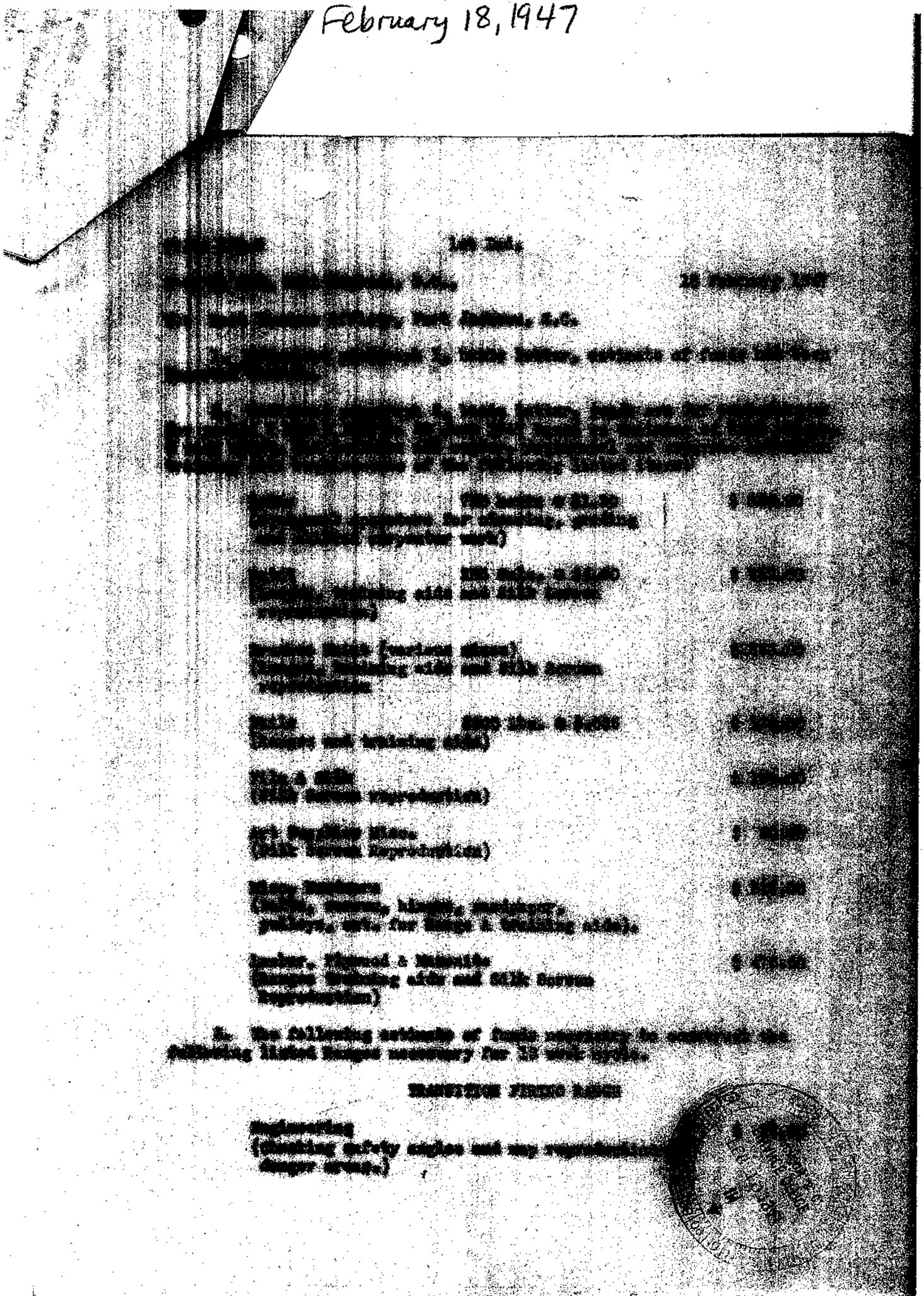
(3) For new permanent officers' family housing (field and company grades averaged), including roads, utilities and other necessary miscellaneous community facilities, such as schools, club, etc. . . . . $10,320.00 per Officer

(4) For new permanent apartment quarters for bachelor officers, including same as above . . . . . $ 3,000.00 per Officer

(5) For new permanent family quarters for Warrant officers and top-grade N.C.O.'s, including roads, utilities and other miscellaneous community facilities such as schools, club, etc.. . $14,770.00 per man

Authority NND 803038
By CORA Date 8-24-04

February 18, 1947



RG 337, Hq. Army Ground Forces
E. 51-A, Subject File, 1941-50
Box 23

Labor (Heavy equipment operators for clearing and grading.)	600 hours @ $1.20	$ 720.00
Lumber (Target frames, foxhole reveting and various Range fixtures.)		$ 420.00
Nails & Misc Hardware (Springs, pulleys, wire, Cable, pipe and ect. for 90 disappearing targets.)		$ 260.00
Concrete (Safety pits for target operators.)	100 Cubic yds.	$ 850.00
GRAND TOTAL		$5,538.00

FOR THE S-4:

LYNDEN R. ANDERSON
Major, Ord Dept
Asst S-4

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HEADQUARTERS
RANGE & TRAINING AIDS DIVISION
Fort Jackson, South Carolina

25 April 1947

SUBJECT: Construction of Ranges.

TO : Post Engineer, Fort Jackson, S.C.

1. Request the construction and rehabilitation of the following Ranges, to meet the training requirements set forth in the Military Training Program of Hq. Army Ground Forces, annex # 3 Sec. 2 Dated 1 Feb. 47, as follows.

2. Transition Range as in plan number OCE # 1600-200. This range is to consist of 6 #6 lanes, 4 #7 lanes, 1 #8 lane. The firing line is to be located at coordinates, 1008.40-1212.00, Map Ft. Jackson and Vicinity 1:25,000 compiled form reservation map Ft. Jackson, dated, 3 May 43.

3. Techinque of Fire Range, to be constructed in accordance with OCE plan # 1600-110, consisting of 4 panels, 5 targets per panel. The firing line to be located at coordinates, 1009.30-1214.60, Map Ft. Jackson and Vicinity S.C., 1:25,000 , Compiled from reservation map Ft. Jackson, dated, 3 May 43.

4. Field firing Range, to be constructed in accordance with OCE plan # 1600-140. Firing line to be located at coordinates 1009.35-1214.30. Map Fort Jackson and Vicinity S.C., 1:25,000, compiled from reservation map Ft. Jackson, dated 3 May 43.

5. Rehabilitation of existing hand grenade court located at coordinates 1008.35-1217.00. Map Fort Jackson and Vicinity S.C.,1:25,000, compiled from reservation map Fort Jackson, dated 3 May 43. Rehabilitation consists of replaceing sand bags, duck boards and other minor repairs.

6. Rifle Grenade Range, to be constructed in accordance with diagram, Figure 44, page 114, FM-23-30. To be located at coordinates, 1007.50-1216.50 Map Fort Jackson and Vicinity SC., 1:25,000, compiled from reservation map Ft. Jackson, dated, 3 May 43. Rocket Launcher Range can be combined in with the Rifle Grenade Range, with very little additional expense and materials.

7. It is necessary that the construction of these ranges be given top prority, as the 13 week Training cycle starts 5 May 47 and all ranges are used from the 5th. to the 8th. week of the Training cycle. Ranges must be completed prior to 23 June 47.

8. This request is based on the Training of approximately 10,000 troops.

JOHN R LUCAS
Captain, Infantry
Range Officer

RG 337 Hq. Army Ground Forces
E. 55, Box 1, Corr., 1942-48
E DX 1123

Authority NNDS 923194
By MW NARA Date

June 17, 1949

HEADQUARTERS
Fort Jackson, South Carolina

GNJDC 314.7

17 June 1949

SUBJECT: Historical Report

TO: Commanding General
Third Army
Fort McPherson, Georgia

In compliance with letter, Headquarters, Third Army, Subject and file as above, dated 28 April 1949, the attached historical report of Fort Jackson is submitted.

G. H. DECKER
Major General U. S. A.
Commanding

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Authority NND 997000
By CO NARA Date 3-22-04

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RG 337, Hq. Army Ground Forces
Entry 108 (UD)
AGF + AFF Installations
Box 34

HEADQUARTERS
Fort Jackson, South Carolina

GNJDT 300.8 24 May 1949

SUBJECT: Range Regulations

TO: See Distribution

RANGE REGULATIONS FORT JACKSON

1. These regulations will be considered to be organizational property of the unit concerned and will be turned over to successors as such. Individual sections of this publication will not be extracted for use in the field. This will not be interpreted to mean that the entire book may not be taken to the field for reference material.

2. In case of revision, each newly revised page will indicate, at the top, the page that it rescinds. Such changes will be posted and the old copies removed from the files.

3. All officers will read all pertinent sections of this publication prior to conducting range firing on any range.

4. Unit commanders are responsible that all range firing is conducted in compliance with the instructions set forth herein.

BY COMMAND OF MAJOR GENERAL DECKER:

M. BAILEY
Major AGD
Asst. Adjutant

Distribution:

6 ea. Co.	1 Ordnance Officer
3 ea. Bn.	1 QM Officer
10 ea. Rogt.	1 Medical Supply Officer
1 CG	1 TI&E Officer
1 Asst. CG	1 Bivouac Equip. Pool
1 Exec Officer	1 Weapons Pool
1 C of S	1 Chemical Officer
1 G-1	1 Chaplain
1 G-2	2 Safety Director
50 G-3	5 S.C. Military District
10 G-4	5 S.C. National Guard
4 AG	
1 Hq Comdt	
1 Ldrs Course	
1 Motor Officer	
1 Staff Surgeon	
1 Ord. Ammo. Officer	
1 Post Engineer	
1 Provost Marshal	
1 IG	
1 Engr Troop Supply	

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By CO NARA Date 3-22-04

RANGE REGULATIONS

Reference Copy

FORT JACKSON
SOUTH CAROLINA

JAN 16 1950

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Authority NND 947020
By CO NARA Date 3-22-04

HEADQUARTERS
Fort Jackson, South Carolina

11 April 1949

FORT JACKSON RANGE REGULATIONS

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Annex #3 - Schematic diagram of Rocket Launcher Range.
Annex #4 - Schematic diagram of Weapons Demonstration Range.
Annex #5 - Rifle Marksmanship Firing Course.
Annex #6 - Carbine Familiarization Course.
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Annex #9 - Overlay of Air to Ground Range (Limited Distribution).

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(1) The range is in proper mechanical condition for firing.

(2) The ambulance and qualified aid men are present.

(3) Range guards have been oriented and posted properly.

(4) The range has been scheduled and notice of firing placed in the Daily Bulletin.

(5) No situations have arisen that would make firing contrary to safety precautions.

7. During Use of Range by Using Units:

a. Range Supplies and Equipment: The Post Range Officer will furnish all requisite range supplies for specific ranges upon request for range supplies from the using unit.

b. On-the-spot Maintenance: The Post Range Officer will be responsible for continuous maintenance, during firing, of target frames, target devices and communication lines.

8. After Use of Range by Using Units:

a. Final Clearance: The Post Range Officer will be responsible for issuance of a written clearance of the range upon request by the using unit. Prior to the issuance of this clearance, he will personally, or by a commissioned officer or non-commissioned officer representative, ascertain that:

(1) The range proper is in an acceptable state of police.

(2) The condition of range facilities is the same as when accepted by the using unit.

(3) All non-expendable range supplies and equipment are turned in by the using unit and that expendable range supplies in excess of those used by the using unit are also turned in.

(4) The using unit has checked for range fires and duds.

b. Necessary Repair: The Post Range Officer will be responsible for making all necessary repairs. He will also be responsible for proper notification of the Post Engineer or Post Signal Officer for repairs of such nature as to require their aid.

Section III
Responsibilities of Officer in Charge of Firing

9. Before Using Range:

a. The Officer in Charge of Firing will be responsible for having personal knowledge of, and having the operation of ranges in compliance with, pertinent provisions of:

AR 750-10

Pertinent Technical Manuals and Field Manuals.

Chapter III below.

He will also be responsible for the dissemination of, and compliance with, the information contained in the pertinent provisions of the above references for all supervisory personnel.

b. The Officer in charge of firing will be responsible for notifying the Post Range Officer in the event firing is cancelled for any reason.

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(2) On The Firing Line:

(a) The organization of personnel on the firing line will be so arranged as to adapt the using unit to the course to be fired.

(b) The organization of personnel on the firing line will be so arranged as to make the most efficient use of the time allotted.

(c) An officer will be present on the firing line at all times.

(d) Safety precautions will be followed at all times, including the following:

1. Weapons will be pointed "down range".

2. Weapons will be cleared and placed in the "safe" firing position when not in operation.

3. "Cease firing" will be given at any time when a condition arises which in anyway precludes the continuation of safe firing.,

4. Firing, limited to designated firing lines or areas and between designated limiting points, will be observed at all times.

5. No one will move from the firing line in the direction of the impact area until all weapons have been cleared and placed in the "safe" firing position.

6. No firing will be conducted when the scarlet streamer is not displayed on the range pole.

7. In case of an accident, such as the bursting of a barrel, or permanent damage to the weapon, the weapon will be left in the position in which the accident occured and the Ordnance Officer, Ft Jackson, notified.

8. If any serious malfunction of Ordnance equipment occurs on the range, such equipment will be turned over promptly to the Ordnance Officer without effort to repair it.

(3) Pits (where applicable):

(a) Organization:

1. Scheduling personnel as target operators in pits should be so arranged as to not interfere, or to cause an unnecessary break in firing.

2. Personnel should be rotated as frequently as is consistent with the efficient operation of the range in the performance of duties as target operators in the pits.

(b) Safety:

1. Each pit will have a red flag, which flag is to be waved during firing, only when for some necessitous reason or emergency (except on the KD range), a target operator must have the firing line "cease fire" in order to emerge from pit.

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2. No target operator (s) will emerge from a pit or expose himself to fire until specific orders have been issued on the firing line to "cease fire" and "clear all weapons" and specific approval given to the target operator (s) to expose themselves.

3. The red flag will be exhibited from a prominent position in a pit during the entire time a target operator is exposed.

(4) Impact Area: Firing will be halted in the event:

(a) A range fire is detected on the range at any time. In which event the following procedure will be used:

1. Notify the Range Officer to obtain clearance to enter the impact area.

2. If the range fire is limited and clearance has been received extinguish fire with personnel and facilities available.

3. If the fire is large and clearance has been obtained or if possibility of its becoming large exists:

a. Use personnel and facilities available in attempt to prevent spread of fire, and if possible, extinguish it entirely.

b. Notify Post Range Officer that assistance will be required.

(5) Miscellaneous: All immediate repairs necessary will be reported to the Range Officer for action.

11. After Use of Range: The Officer-charge-of-firing will be responsible, upon completion of firing to:

a. Check for all range fires detected on the range, using the same procedure as in par 10 a (4) above, in the event one is discovered.

b. Check for, and report duds (where applicable) as follows:

(1) Appoint a limited number of responsible, experienced, non-commissioned officers to conduct a search for duds.

(2) Leave the suspected dud undisturbed.

(3) Mark the location by a dud marker (Note: Dud markers, 10" red discs with DUD marked in white letters, placed on 6 foot pole, are located in all target houses).

(4) Report the exact location by coordinates to the Post Ammunition Officer (tel 24). If Post Ammunition Officer indicates that he will investigate immediately, leave someone nearby to guide him to the exact location.

c. Police the entire range site for trash.

d. Conduct a search of all personnel for live ammunition.

e. Turn in all supplies, drawn specifically for range firing, to same agencies drawn from (See par 9 c, above).

f. Execute the following certificate (issued with all Ammunition) for all HE ammunition expended:

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By CO NARA Date 3-22-04

C E R T I F I C A T E

(Battery_____, _____, Field Artillery Bn.)

(Company_____, _____, Infantry)

_____
(Date)

I certify that the following information, concerning quantities of ammunition listed below is true and correct to the best of my knowledge and belief:

TYPE	ISSUED	EXPENDED	TURNED IN	DUDS	LOCATION OF DUDS

_____
(Signature)

_____
(Name Typed)

_____
(Rank and Organization)

g. Obtain a final clearance, in writing, from the Post Range Officer. This clearance will be maintained on file for a period of 2 months from the date of issuance.

h. Report to Post Range Officer all repairs needed.

i. Report the individual scores attained. The following extract from C1 to MR 775-10, dtd 23 Sept. 48 is quoted:

" 16. Records and Reports:

* * * * * *

c. Upon completion of the record practice or examination, score cards or a report from examining boards will be transferred to the Headquarters of the unit, where the order of classification will be published----------".

CHAPTER - III
Detailed Information and Responsibilities for Specific Ranges

SECTION I

Machine Gun Range #1

12. Description:

a. Location: (1007.7 - 1214.9) See Annex #1.

b. Telephone Numbers: Tie Line 14 Ring 1.

c. Number of Firing Points: 60

d. Type Weapon Fired: Machine Gun Cal..30, Light (M1919A4)
Machine Gun Cal..30, Heavy (M1917A1)

e. Course to be fired on range: A or B (modified to 500" range).

f. Distance from gun position to target: 500 inches.

g. Safety Limits: See Annex #1.

h. Danger Area: See Annex #1.

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i. Range Guard Positions: None necessary.

j. Available Range Facilities:

(1) Control Tower

(2) Covered Latrine

(3) Dry Firing Line with 60 Targets

(4) Mess Hall

(5) Scoring and Critique Tables

(6) Supply House

(7) Target House

k. Type Target: 500 inch Machine Gun.

13. Responsibilities of Post Range Officer:

a. Continuous responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in par 12 j, above.

b. Before Use of Range by Using Unit: The Post Range Officer is responsible for supplying using units with 500 inch Machine Gun targets and target frames.

14. Responsibilities of Officer-in-charge-of-firing:

a. Before Use of Range: The Officer-in-charge-of-firing will be responsible that:

(1) Both he and his supervisory personnel are thoroughly familiar with pars 110-122, FM 23-55, and AR 750-10.

(2) All firers have completed, as a minimum requirement, all mechanical training, gun drill and marksmanship, required by SOP 27 Hq 5th Inf Div. Requests for waiver of this prerequisite instruction will be submitted to this Headquarters ATTN: GNJDT, one week prior to actual firing.

(3) Prior to Firing:

(a) An officer will check headspace of each gun and make the proper adjustment.

(b) A cleaning rod and dry patch is run through the bore of each gun.

b. During Use of The Range:

(1) Operation of The Range:

(a) Behind the firing line (Opposite side of firing line from impact area): The Officer-in-charge-of-firing will be responsible that before removing a machine gun from its firing position, or from the firing line, each gun will be inspected, by an officer to see that it is unloaded. As part of this inspection, a cleaning rod will be passed completely through the barrel of each gun.

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(b) On The Firing Line:

1. The most efficient organization, for this range consists of a breakdown into 5 equal sized orders as outlined below:

1 Order	Gunner	Wet Line
1 Order	Asst Gunner	Wet Line
1 Order	Observer	Wet Line
1 Order	Gunner	Dry Line
1 Order	Asst Gunner	Dry Line

2. Safety Precautions: The Officer-in-charge-of-firing will be responsible for the accomplishment of the following safety precautions: Note: The "Safe firing position" referred to in par 10 a (2) (d) 2 "Safety Precautions" will be considered to have been attained for the machine gun when:

a. A cleaning rod has been passed completely through the barrel.

b. A clearing block has been placed in the receiver of the gun.

(c) A clearing block should be inserted in the receiver of each gun during the time it is not being used to fire an exercise.

(d) All decisions as to actions to be taken on stoppages will be made by an officer.

c. After Use of Range: The Officer-in-charge-of-firing will be responsible that all trash accumulated in the trash bin is burned in the metal receptacles provided for that purpose.

SECTION II

ROCKET LAUNCHER RANGE

15. Description:

a. Location: (1007.7 - 1216.4).

b. Telephone Number: Tie Line 15, Ring 3.

c. Number of Firing Points: 24

12 Practice Ammunition
12 Service Ammunition

d. Type of Weapon Fired: Rocket Launcher, 2.36 inch M9 and M9A1.

e. Distance from Gun Position to Target: 100 Yards.

f. Safety Limits: See Annex #1.

g. Danger Area: See Annex #1.

h. Range Gaurd Positions: None Necessary.

i. Available Range Facilities:

(1) Range House.

(2) Dry Firing Line with 12 Targets.

(3) Control Tower.

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f. After use of the range: The officer-in-charge-of-firing will be responsible that all trash has been policed.

SECTION IV

TRANSITION RANGE

21. Description:

a. Location (1008.7-1212.3)

b. Telephone Number - Tie Line 11.

c. Number of firing lanes: 15.

6 Lanes (1 through 6) - Table VI.
4 Lanes (7 through 10) - Table VII.
1 Lane (11) - Table VIII.
4 Lanes (12 through 15) - Table IX.

d. Course to be fired:

Table VI and VII - Par 69d FM 23-5
Table VIII - Par 69d FM 23-5, C2
Table IX - as follows:

PHASE LINES	TARGETS SINGLE	DOUBLE	TRIPLE	RANGE (YARDS)	SHOTS	TARGET	POSITION	SLING
2 - 3	2	1	0	5-70	4	E	Off Hand	None
3 - 4	0	1	2	5-70	8	E	Hip	None
4 - Final	2	3	0	5-70	8	E	Off Hand	None

(1) A single silhouette represents an enemy rifleman. A double silhouette represents an enemy automatic rifle team. A triple silhouette represents a machine gun.

(2) Targets will be exposed in sequence upon signal from the coach. Time of exposure of targets is as follows: (a) Single silhouettes, 3 Seconds. (b) Double silhouettes, 4 seconds. (c) Triple silhouettes, 5 seconds.

(3) Phase lines are placed after the 4th, 12th and 20th targets to assist in the enforcement of safety precautions.

e. Scoring and satisfactory scores:

TABLE	SCORING PROCEDURE	SATISFACTORY SCORES
Table VI & VII	Par 69e, (1) & (2), FM 23-5.	VII - 8
Table VIII	Par 69e (3), FM 23-5, C2	4
Table IX	1 for each target hit	8

f. Type of weapon fired: Rifle Cal .30, M1.

g. Distance from firing position to target:

Table VI - 200, 300, and 500 yards.

Table VII - 250, 300, 350, 400, 450 & 500 yards.

Table VIII - 100 yards.

Table IX - 5-70 yards.

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h. Safety Limits: See Annex #1

i. Danger Areas: See Annex #1

j. Range Guard Positions:

POSITION	DUTIES
1008.6-1211.2	- Block all traffic moving into transition range danger area.
1009.1-1213.4	- Block all traffic moving Southeast on Hartsville Guards Road and all other traffic seen moving into transition range danger area.
1009.6-1211.3	- Block all traffic moving North into the transition range danger area.
1013.3-1210.1	- Block all traffic moving North along Telephone Road.
1014.5-1217.6	- Block all traffic moving South along Telephone Road.

k. Available range facilities:

(1) 6 Control towers

(2) Latrines

(3) 3 Bleachers (Capacity 50 each).

(4) Target House

(5) Work Tables

(6) Communication Arrangement (See Annex #2).

22. Responsibilities of Post Range Officer:

a. Continuous responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in K above.

b. Before use of range by using unit: The Post Range Officer is responsible for supplying using units with a sufficient number of [illegible] silhouettes, including those colored Red [illegible] yard firing, and also a sufficient number of target staves for the entire period of firing.

23. Responsibilities of Post Signal Officer:

a. Before use of range by using unit: The Post Signal Officer (Tel 10) will be responsible, upon requests by Regimental S-3's to advise the units as to use of cable facilities and to restore inoperative cable facilities.

b. During use of range by using unit: The Post Signal Officer will be responsible, upon request of Regimental S-3's, for repairing broken wire communication facilities.

c. After use of range by using unit: The Post Signal Officer will be responsible, upon request by the Post Range Officer, to make any necessary repairs.

24. Responsibilities of Officer in Charge of Firing:

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a. Before Use of Range: The Officer in Charge of firing will be responsible that:

(1) Both he and supervisory personnel are thoroughly familiar with pars 34, 69d, e, f, g, 189-191b FM 23-5, C1 and 2, and AR 750-10, and SOP 24A.

(2) All firers have fired the rifle qualification Course "B" and also have received instruction in range estimation, assuming firing position and assault fire, required per SOP 24A, Hq 5th Inf Div. Requests for waiver of this prerequisite instruction will be submitted to this Hq, ATTN: GNJDT, one week prior to actual firing.

(3) Range Guards are posted in positions listed in 21 j above.

(4) When pits are filled with water they are bailed out prior to firing and that every third pit has a bucket available for any subsequent seepage into the pits.

(5) The first pit detail is familiarized with its duties and have at least one "dry run" prior to actual firing.

b. During use of Range: The Officer in charge of firing will be responsible for the overall operation of the range to include:

(1) Behind the firing line (opposite side of firing line from impact area).

(a) Only weapons that have been unloaded, locked, and have had a cleaning rod run through the bore, will be permitted to be removed from any firing point or firing line.

(b) Movement in rear of firing points by personnel undergoing this course, will be at a walk with rifles held at "Port Arms".

(2) On the firing line:

(a) Procedure for firing: As outlined in SOP 24A.

(b) Organization of firing line: As outlined in SOP 24A.

(d) Safety:

1. The safe firing position referred to in par 10 a (2) (d) 2, "Safety precautions" will be considered to have been attained when:

a. Rifle is locked.

b. Ammunition completely removed from rifle.

c. Bolt to rear.

d. A cleaning rod has been run through the bore of the rifle.

2. Safety Precautions: For Table IX.

The firer will be instructed prior to firing that targets are not more than 3 feet in size, targets will be on same level as ground, targets to front, right or left front only.

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The Coach Cadre [illegible] will:

Stay immediately in rear of firer.
Regulate speed of movement of firer.
Keep target operator well in rear of firer.
Determine that firer has unloaded his weapon before moving back to starting point.

(d) Communication: The firing point on each firing lane will maintain contact with the pits in its own lane by the use of field telephones.

(3) Pits:

(a) Organization: Pit details subsequent to the 1st order will be thoroughly instructed in their duties and also in safety precautions to be observed before being assigned to pits.

(b) Communication: Each lane within each of the 4 tables, will have its own integral communication net by which control will be exercised, as follows:

TABLE VI: The center pit at each of the three ranges (200, 300, 500 yds) will have a terminal for telephone communication to the firing point.

Communication between any of the three pits located at one of the three ranges may be established by use of whistles signals. Suggested signals are as follows:

"Attention" 4 short blasts

"Targets Up" 1 long blast

"Targets Down" 2 long blasts

"All Clear" 2 short blasts

TABLE VII: Each pit at each of the six different ranges (200, 250, 300, 350, 400, &450 yds) will have a terminal for telephone communications to the firing point.

TABLE VIII: The pit will have a terminal for telephone communication to the firing point.

(c) Scoring: Scoring will be accomplished by pit detail as follows:

TABLE VI: Flutter and lower target when hit then score.

TABLE VII: Same as above.

TABLE VIII: Score after command "Targets Down" is given.

TABLE IX: Not applicable (See par 21d & e, for scoring).

(d) Safety: See par 10 (2) (d) 2 "Safety".

c. After use of Range: The Officer in charge of firing will be responsible:

(1) That all trash accumulated in trash bins is burned.

(2) That new targets are fastened on all staves and then stored in target house for the use of the next unit.

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5. See that there are no burs on the rings of the grenade launcher, and that the rings are free from grit.

6. Inspect frequently the wing nut on the clamp of the launchers M1, M2, and M8 to insure that it is tight.

7. Never place a grenade on the launcher unless it is intended to fire it immediately. Never fire service ammunition or standard blank ammunition when grenade is on the launcher.

8. If the hand grenade with the grenade projection adapter should accidently become armed after the removal of the safety pin, unlock the weapon and fire immediately as the grenade will explode in 4 to 5 seconds. Care should be taken not to strike the lever after the safety pin is removed as such action may cause the lever to spring from the grenade and allow the fuze to function.

9. Do not drop a grenade after the safety pin has been removed.

10. In the event the rifle grenade cartridge M3 or carbine grenade cartridge M6 does not fire and there are no additional M3 or M6 cartridges available., lock the weapon, replace the grenade safety pin, and remove the grenade.

11. Do not recover or tamper with live grenades, once fired, that fail to fire.

c. After use of the Range:

(1) Execute a certificate for all HE ammunition expended (see par 11f for example of certificate).

(2) Police all trash

SECTION VIII

PISTOL RANGE

34 Description:

a. Location (1008.8-1214.9)

b. Telephone Number Tie Line 14 Ring 4

c. Number of Firing Points: 10

d. Type weapon fired: Automatic pistol, Cal..45 M1911 or M1911A1 Colt Revolver, cal..45 M1917.

e. Courses to be fired as prescribed in pars 87-90 FM 23-35

f. Distance from firing line to targets: 15 and 25 yards.

g. Safety Limits: See Annex #1.

h. Danger Area: See Annex #1.

i. Range guard positions: None.

j. Available Range facilities.

Target House
Latrine (to be used in conjunction with latrine on MG Range #2).
Pistol Butts

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35. Responsibilities of Post Range Officer:

a. Continuous responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in 34 j above.

b. Before use of range by using unit: The Post Range Officer is responsible for supplying using units with sufficient numbers of E&L type targets.

36. Responsibilities of officer in charge of firing:

a. Before use of range: The Officer in charge of firing will be responsible that:

(1) Both he and his supervisory personnel are throughly familiar with pars 13, 24, 25, 91, 96 FM 23-35 and AR 750-10.

(2) All firers have completed as a minimum requirement, all mechanical training and marksmanship training listed in FM 23-35. Requests for waiver of this instruction will be submitted to this headquarters ATTN: GNJDT one week prior to actual firing.

(3) All pistols have had safety devices tested per par 25.

All revolvers have had safety devices tested per par 64.

b. During use of range:

(1) Behind the firing line (opposite side of firing line from impact areas).

(a). Only weapons that have been unloaded, locked and have had a cleaning rod run through the bore will be permitted to be removed from the firing line.

(b). All weapons will be carried at the "Raise Pistol" position.

(2) On the firing line:

(a). Procedure for firing: As outlined in pars 94e FM 23-35.

(b). Organization: As outlined in par 94a and d FM 23-35.

(c). Safety: For pistol cal .45 M1911 or 1911A1.

1. When units carrying the pistol are first formed the officer or noncommissioned officer in charge causes the men to execute "Inspection Pistol".

2. The safe firing position referred to in par 10a (2) (d) 2. "Safety precautions" will be considered to have been attained when the weapon is unloaded, the magazine has been removed and the slide has been locked in the rearmost position with the slide stop.

3. Execute unload every time the pistol is picked up for any purpose. Never trust memory. Consider every pistol as loaded until it has been proven otherwise.

4. Always unload the pistol if it is to be left where someone else may handle it.

5. Always point the pistol up when snapping it after examination. Keep the hammer fully down when the pistol is not loaded.

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6. Never place the finger within the trigger guard until it is intended to fire or to snap for practice.

7. Never point the pistol at anyone.

8. Before loading the pistol, draw back the slide and look through the bore to see that it is free from obstruction.

9. On the range, do not insert a loaded magazine until the time for firing.

10. Never turn around at the firing point.

11. On the range, do not load the pistol with a cartridge in the chamber until immediate use is anticipated. If there is any delay, lock the pistol and only unlock it while extending the arm to fire. Do not lower the hammer on a loaded cartridge; the pistol is much safer cocked and locked.

12. In reducing a jam first remove the magazine.

13. To remove a cartridge not fired first remove the magazine and then extract the cartridge from the chamber by drawing back the slide.

For Revolver Cal..45:

14. The safe firing position referred to in par 10 a (2) (d) 2 "Safety precautions" will be considered to have been attained when the weapon is unloaded, the cylinder is opened and the safety has been placed in a safe position.

15. Execute unload every time the revolver is picked up for any purpose. Consider every revolver as loaded until proven otherwise.

16. Always unload the revolver if it is to be left where someone else may handle it.

17. Always point the revolver up when snapping it after examination. Keep the hammer fully down when the revolver is not loaded.

18. Never place the finger within the trigger guard until it is intended to fire or to snap for practice.

19. Never point the revolver at anyone. On the range do not snap for practice while standing back of the firing line.

20. Before loading, open the cylinder and look through the bore to see that it is free from obstruction.

21. Never turn around at the firing point.

23. On the range do not cock the revolver until immediate use is anticipated. If there is any delay, lower the hammer and recock it only when ready to fire.

24. If the revolver fails to fire, open the cylinder and unload if the hammer is down. If the hammer is cocked or partly cocked, a breakage has occurred. In this case hold the revolver at raise pistol and announce the fact to the officer in charge.

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25. To remove a cartridge not fired, open the cylinder and eject, first lowering the hammer if cocked.

(d) After Use of Range: The Officer in Charge of Firing will be responsible that all trash has been policed.

SECTION IX

ARTILLERY RANGE

37. Description:

a. Location: Gun Position (Center of Gun Position):

"A" - (1014.0-1211.3)
"B" - (1015.3-1214.8)
"C" - (1011.2-1210.4)

Impact Area (Center): (1019 - 1214)

b. Telephone Number: (Weir Tower) Tie Line 10.

c. Type Weapon Fired: 105mm and 155m Howitzer.

d. Safety Limits: See Annex #8.

e. Danger Area: See Annex #8.

f. Range Guard Positions: (See Annex #8)

For Impact Area: All road guards on the numbered road guard positions will prevent entry into the impact area.

When firing from gun position "A" the following additional guards will be posted in addition to impact area road guards: RG-A (1013.0-1210.0) allow only authorized traffic to proceed North along Telephone Road.

When firing from gun position "C" the following additional guard will be posted in addition to impact area road guards: RG-C (1011.2-1209.5) allow only authorized traffic to proceed North along Telephone Road.

When firing from gun position "B": Only impact area road guards will be posted.

38. Responsibilities of Officer in Charge of Firing:

a. Before Use of The Range: The Officer in Charge of Firing will be responsible that:

(1) Both he and his supervisory personnel are thoroughly familiar with Section I, Appendix I, FM 6-40 and FM 6-140, FM 6-75 (105mm Howitzer) FM 6-81 (155mm Howitzer) and AR 750-10.

(2) The following minimum number of personnel are designated:

1 Officer - Commanding Officer of Unit Firing.
1 Safety Officer at each Battery Position.
EM Range Guards as needed (See a.6. above).
1 EM Telephone Orderly.
2 EM First Aid Men.

(3) One (1) ambulance will be available during firing.

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(4) All firing personnel have completed training as outlined in FM 6-75 (for 105mm Howitzer) or FM 6-81 (for 155mm Howitzer).

(5) Post Range Guards (See Annex #8) at least thirty (30) minutes prior to scheduled firing time. Numbered range guards will be posted during all firing. Lettered range guards will be posted when corresponding lettered firing positions are being used.

(6) Instruct range guards as to their duties, i.e., allow no one to enter the impact area or gun position area without permission of the Range Officer or the Commanding Officer of unit firing.

(7) Raise the Red Flag, See Annex #8 , when range is clear for firing.

(8) Notify the Commanding Officer of unit firing when range is clear for firing.

(9) Entry into firing positions for the following gun positions will be as listed below;

"A" - From the South along Telephone Road.
"B" - From either of the following:

(a) From the North on the trail from Old Camden Road at coordinates (1015.4-1217.5).

(b) From the South on the Washington Light Infantry Road.

"C" - From the South along Hartsville Guards Road.

b. During Use of Range;

(1) The Officer in Charge of Firing will be in constant communication with the Observation Post (CO of Unit firing) and as near as practicable to his Range Guards.

(2) The Officer in Charge of Firing will be responsible that all safety requirements and precautions outlined in par 38 a (1) are complied with.

c. After Use of Range; The Officer in Charge of Firing will be responsible that;

(1) Range Guards are relieved.

(2) All trash has been policed.

(3) A certificate has been executed on all HE ammunition expended.

SECTION X

PISTOL RANGE "E"

39. Description;

a. Location; (1027.4-1212.5).

b. Telephone Number; Tie Line 14.

c. Number of Firing Points; 60.

d. Type Weapon Fired; Automatic Pistol Cal..45, M1911 or M1911A1, Colt Revolver, Cal..45, M1917.

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e. Courses to Be Fired: As prescribed in pars 87-90, FM 23-35.

f. Distances from Firing Points to Targets: 15 & 25 yards.

g. Safety Limits: See Annex #1.

h. Danger Area: See Annex #1.

i. Range Guard Positions: None.

j. Available Range Facilities:

Target House
Latrine
120 Pistol Rests

40. Responsibilities of Post Range Officer:

Same as outlined in par 35.

41. Responsibilities of Officer in Charge of Firing:

Same as outlined in par 36.

SECTION XI

MACHINE GUN RANGE #2

42. Description:

a. Location: (1009.1-1214.7).

b. Telephone Number: Tie Line 14, Ring 2.

c. Number of Firing Points: 60.

d. Type Weapon Fired: MG Cal..30, Light, M1919A4; MG Cal..30, Heavy, M1917A1.

e. Courses to be Fired: A or B (Modified to 500 inch Range).

f. Distance from Firing Point to Targets: 500 inches.

g. Safety Limits: (See Annex #1).

h. Danger Area: (See Annex #1).

i. Range Guard Positions: None.

j. Available Range Facilities:

(1) Control Tower.
(2) Covered Latrine.
(3) Dry Firing Line with 10 Targets.
(4) Mess Hall.
(5) Scoring and Critique Tables.
(6) Supply House.
(7) Target House.

k. Type Target: 500 inch Machine Gun.

43. Responsibilities of Post Range Officer: As outlined in par 13.

44. Responsibilities of Officer in Charge of Firing: As outlined in par 14.

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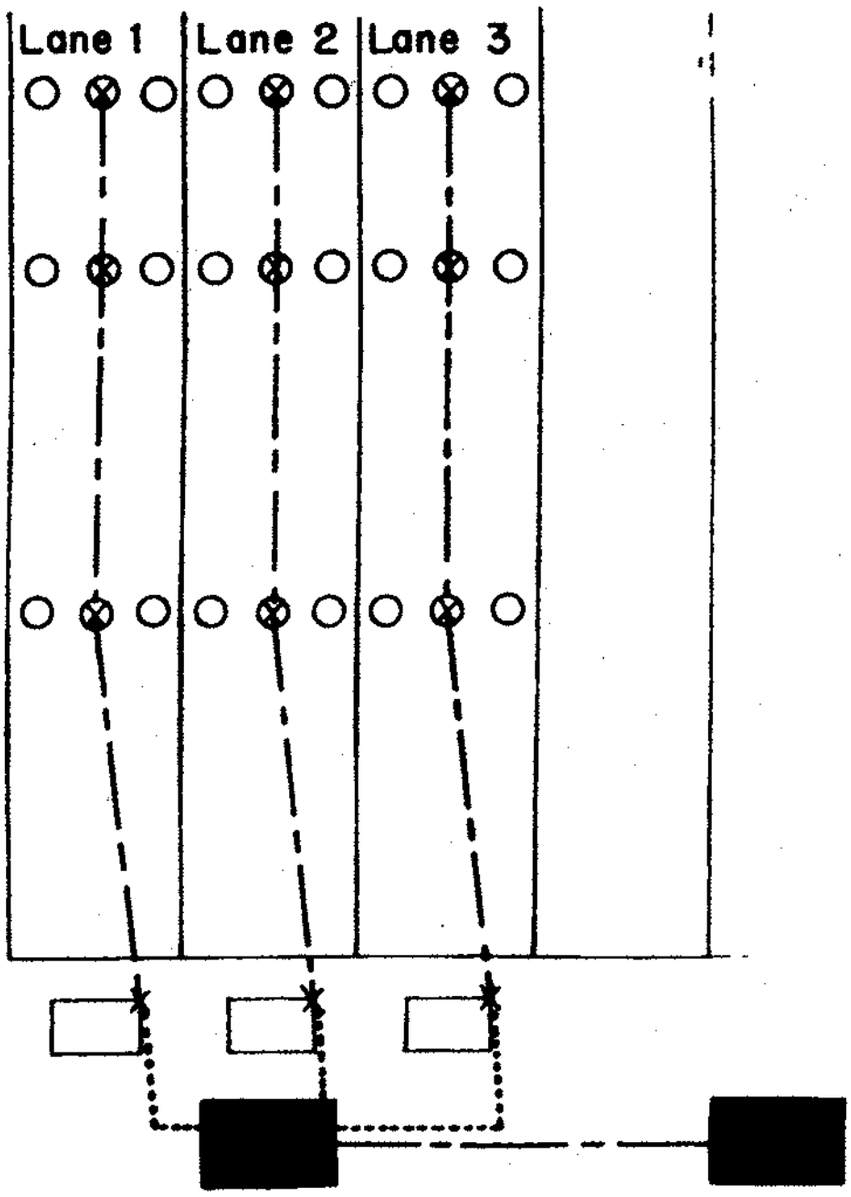

Schematic diagram of communication system for transition range.

-Legend-

X Terminals

—·— Cables

..... Field phone lines

O Pits

□ Firing points

■ Control towers

Annex 2

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ANNEX NO 5

US RIFLE CAL .30, M-1

INSTRUCTION PRACTICE

TABLE I - Slow Fire

Range (Yards)	TIME	SHOTS	TARGET	POSITION	SLING
200	No Limit	4	A	Prone (Sandbag Optional)	Loop
200	do	12	A	Prone	do
300	do	4	A	Prone (Sandbag Optional)	do
300	do	16	A	Prone	do
500	do	5	B	Prone (Sandbag Optional)	do

TABLE II - Slow Fire

Range (Yards)	TIME	SHOTS	TARGET	POSITION	SLING
200	No Limit	8	A	Sitting	Loop
200	do	8	A	Kneeling	do
200	do	8	A	Standing	Hasty
300	do	8	A	Sitting	Loop
300	do	8	A-	Kneeling	do

TABLE III - Sustained Fire

Range (Yards)	TIME (Seconds)	SHOTS	TARGET	POSITION	SLING
200*	27	3#	D	Kneeling or sitting from standing	Loop
200	51	9¢	D	Kneeling or Sitting from standing	do
300*	27	3#	D	Prone from standing	do
300	51	0¢	D	Prone from standing	do

*Fire Twice
#The rifle is to be loaded with one round initially and reloaded with a full clip, only two rounds of which are to be fired.
¢The rifle is to be loaded with one round initially and reloaded with a full clip.

ANNEX NO 5

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RECORD PRACTICE

TABLE IV - Slow Fire

Range (Yards)	Time	Shots	Target	Position	Sling
200	No Limit	6	A	Kneeling	Loop
200	do	6	A	Standing	Hasty
300	do	6	A	Prone	Loop
300	do	6	A	Sitting or squatting	do

TABLE V - Sustained Fire

Range (Yards)	Time (Seconds)	Shots	Target	Position	Sling
200	51	9*	D	Kneeling or Sitting from standing	Loop
300	51	9*	D	Prone from standing	do

*The rifle is to be loaded with one round initially and reloaded with a full clip.

Minimum Scores for Classification

Expert Rifleman - - - - - - - - - - - - - - 180
Sharpshooter - - - - - - - - - - - - - - - 165
Marksman - - - - - - - - - - - - - - - - - 140

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1950

Maj. O'Herrill
Ord. Adv.

File
Ar

FORT JACKSON 1950

RANGE REGULATIONS

FORT JACKSON
SOUTH CAROLINA

DECLASSIFIED
Authority NND 947030
By CB NARA Date 3-22-04

RG 337, Hq. Army Ground Forces
Entry 108 (U.D.)
AGF + AFF Installations
Box 34

HEADQUARTERS
Fort Jackson, South Carolina

GNJDT 300.8 15 April 1950

SUBJECT: Range Regulations

TO: See Distribution

RANGE REGULATIONS FORT JACKSON

1. These regulations will be treated as Memorandum Receipt property and will be turned in to Post Range Officer prior to the units departure from this Post. The Post Range Officer is designated as accountable officer for these regulations and is charged with distribution to units using the range facilities at this Post. Individual sections will not be removed from these regulations; the book will be maintained as bound.

2. In case of revision, each newly revised page will indicate, at the top, the page that it rescinds. Such changes will be posted and the old copies removed from the files.

3. All officers will familiarize themselves with all pertinent sections of these regulations prior to conducting range firing on any range.

4. Unit commanders are responsible that all range firing is conducted in compliance with the instructions set forth herein.

BY ORDER OF COLONEL REES:

F. J. REESE
Lt Col, AGD
Adjutant

Distribution:
1 Hq Third Army
6 Post Hq, Ft Jackson, SC
10 S-3, Fort Jackson, SC
100 Range Hq, Ft Jackson, SC
1 Post Engineer, Ft Jackson, SC
1 Post Signal Officer, Ft Jackson, SC
1 Post Property Officer, Ft Jackson, SC
1 S. C. Military District
5 51st N. G. Inf Div
5 48th N.G. Inf Div
5 30th N.G. Inf Div
2 S.C. Air N.G., Congaree Air Base, S. C.
2 Shaw Field, S.C.

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By CO NARA Date 3-22-04

HEADQUARTERS
Fort Jackson, South Carolina

15 April 1950

FORT JACKSON RANGE REGULATIONS

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a. All personnel of the company are notified of the Fire Alert status of the company.

b. All personnel (less not more than 15%) are immediately available to the company area at all times during the Fire Alert tour.

c. Not less than one (1) officer and four (4) non-commissioned officers are available on thirty (30) minutes notice for supervision in case of fire.

8. Instructions in case of fire:

a. In the event of a fire on the Fort Jackson reservation the Fire Alert Company will be alerted by the Fire Marshal. At the time of alerting, the Fire Marshal will furnish information to the Fire Alert Company as to the transportation being furnished to the Company.

b. The First Sergeant, (or the Charge of Quarters if after duty hours) will notify, by the most expeditious means, the Alert Officer and Non-commissioned Officers of the Alert, and will then proceed to form the company in readiness to move to the fire.

c. The Alert Officer, upon arrival in the company area will assume command of the company, and will hold the company in readiness pending instructions from the Fire Marshal. Troops will be issued any fire fighting equipment available in the company area such as picks, shovels, etc. Personnel will again be cautioned on the dangers of handling duds.

d. Once alerted and until released from alert, by the Fire Marshal, the Fire Alert Company will be under direct control of the Post Fire Marshal. The Post Fire Marshal will be responsible for the movement, and employment of this company in combating the fire.

e. At all times during the actual fighting of the fire, the Alert Officer and Non-commissioned Officers will be in the immediate vicinity of the men fighting the fire, and will exercise close supervision to prevent touching of duds by personnel.

SECTION III

AMMUNITION, EXPLOSIVES AND DUDS

9. Members of any command quartered in company or detachment areas will not have ammunition, grenades, shells, fuses, or any other explosive, live or otherwise, of any type, in their possession or secreted on the reservation. Such items may be in the possession of military personnel only when required in the performance of military duty. Unit Commanders will make frequent searches to insure compliance with the preceding regulation and will cause a search to be made of all EM after any use of ammunition or explosives.

10. Any enlisted man at this station who discovers the unauthorized presence of explosives referred to above will immediately report such to the unit commander. No one will molest, touch, or in any manner handle such explosives whenever found except as follows:

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a. When required in performance of military duty.

b. When small arms ammunition (caliber .22, .30, .45, and .50) is discovered, the finder will collect and carry same openly to unit commander for disposition.

11. No one will procure, secure or retain in their possession any explosive, dud of any type or any part thereof as a souvenir of for their own personal use, unless specifically authorized in writing by a commissioned officer to have such items.

12. Duds:

a. It is the responsibility of all unit commanders to orient their troops in the danger of handling duds. Specifically:

(1) Teach men the importance of leaving DUDS ALONE.

(2) "Policing the Area" does NOT mean picking up duds.

(3) HE impact areas are OFF LIMITS except as outlined in (4) and (5) below.

(4) The Officer-in-charge of firing will be responsible for appointing experienced non-commissioned officers from within his own unit to check the impact area for all duds upon completion of firing. The non-commissioned officers so appointed will be the sole persons from the firing unit authorized to enter the impact area from the time the firing unit has fired its first live round until it has been cleared by Range Headquarters.

(5) For Weapons Demonstration Range: The only authorized personnel to enter the impact area are demonstrators and non-commissioned officers appointed by Officer-in-charge of firing as in (4) above.

b. In the event a dud is found, the site will be marked and the Range Officer, Fort Jackson will be notified as follows:

(1) Location of Dud (coordinates if possible)

(2) Type of Dud

(3) Number of Duds

(4) Person making report (Name, rank and organization)

c. All ranges and impact areas will be "Off Limits" to all unauthorized personnel, ie., any personnel not firing on the range or not a member of the permanent Range Detachment.

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b. On-the-spot Maintenance: The Post Range Officer will be responsible for continuous maintenance, during firing, of target frames, target devices and communication lines.

17. After Use of Range by Using Units:

a. Final Clearance: The Post Range Officer will be responsible for issuance of a written clearance of the range upon request by the using unit. Prior to the issuance of this clearance, he will determine by inspection that:

(1) The range proper is in an acceptable state of police.

(2) The condition of range facilities is the same as when accepted by the using unit.

(3) All expendable and non-expendable range supplies and equipment are turned in by the using unit.

(4) The using unit has extinguished all range fires and has disposed of any known duds.

b. Necessary Repair: The Post Range Officer will be responsible for making all necessary repairs. He will be responsible for making the necessary work order requests to the Post Engineer or Post Signal Officer for repairs of such a nature as to require their aid.

SECTION III

Responsibilities of Officer-in-Charge of Firing

18. Before Using Range:

a. The Officer-in-Charge of firing will be responsible for the operation of ranges in compliance with pertinent provisions of:

SR 385-310-1
Pertinent Technical Manuals and Field Manuals
Chapter III below

He will also be responsible for the dissemination of the information contained in the pertinent provisions of the above references for all supervisory personnel.

b. The Officer-in-charge of firing will be responsible for notifying the Post Range Officer if, for any reason, firing is cancelled.

c. Safety Precautions: The Officer-in-charge of firing will be responsible that all personnel on the range have received a course of instruction in the weapon(s) to be fired and that they are familiar with:

(1) The safety features of the weapon(s) to be fired.

(2) The danger areas and safety limits.

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(2) On the Firing Line:

(a) The organization of personnel on the firing line will be so arranged as to adapt the using unit to the course to be fired.

(b) The organization of personnel on the firing line will be so arranged as to make the most efficient use of the time allotted.

(c) An officer will be present on the firing line at all times.

(d) Safety precautions will be followed at all times, including the following:

1. Weapons will be pointed "down range".

2. Weapons will be cleared and placed in the "safe" firing position when not in operation.

3. "Cease firing" will be given at any time when a condition arises which in anyway precludes the continuation of safe firing.

4. Firing, limited to designated firing lines or areas and between designated limiting points, will be observed at all times.

5. No one will move from the firing line in the direction of the impact area until all weapons have been cleared and placed in the "safe" firing position and then not until order to do so has been given by the Officer-in-charge of the firing line.

6. No firing will be conducted when the scarlet streamer is not displayed on the range pole.

7. In case of an accident, such as the bursting of a barrel, or permanent damage to the weapon, the weapon will be left in the position in which the accident occurred and the Ordnance Officer, Fort Jackson, notified.

8. If any serious malfunction of Ordnance equipment occurs on the range, such equipment will be turned over promptly to the Ordnance Officer without effort to repair it.

(3) Pits (where applicable):

(a) Organization:

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(5) Miscellaneous: All immediate repairs necessary will be reported to the Range Officer for action.

20. After Use of Range: The Officer-in-charge of firing will be responsible, upon completion of firing to:

a. Check for all range fires detected on the range, using the same procedure as in par 8 and 19 a (4) above, in the event one is discovered.

b. Check for, and report duds (where applicable) as follows:

(1) Appoint a limited number of responsible, experienced, non-commissioned officers to conduct a search for duds.

(2) Leave the suspected dud undisturbed.

(3) Mark the location by a dud marker (Note: Dud markers, 10" red discs with DUD marked in white letters, placed on 8 foot pole, are located in all target houses).

(4) Report the exact location by coordinates to the Post Range Officer. If Post Range Officer indicates that he will investigate immediately, leave someone nearby to guide him to the exact location.

c. Police the entire range site for trash and brass.

d. Conduct a search of all personnel for live ammunition.

e. Turn in all supplies, drawn specifically for range firing, to same agencies drawn from (See par 9 c, above).

f. Execute the following certificate (issued with all ammunition) for all HE ammunition expended:

C E R T I F I C A T E

(Battery_____, _____, Field Artillery Bn)

(Company_____, _____, Infantry)

_____
(Date)

I certify that the following information, concerning quantities of ammunition listed below, is true and correct to the best of my knowledge and belief:

TYPE	ISSUED	EXPENDED	TURNED IN	DUDS	LOCATION OF DUDS

_____
(Signature)

_____
(Name Typed)

_____
(Rank and Organization)

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10. Sand bag walls at least 20 inches thick or equivalent protection are provided for coaches, officer-in-charge of throwing, assistant instructors, or nonparticipants in instruction.

11. Practice hand grenades are practically free from hazard when properly used but they require the same degree of care in handling and operation as the standard live grenades.

12. The practice grenade may be thrown a safe distance by the average thrower, but personnel should take cover for the purpose of training. The steel helmet should be worn. Although there is practically no danger involved, personnel should remain at a safe distance.

13. Practice grenades that fail to function (duds) will not be recovered until at least 10 minutes have elapsed, and should be handled by experienced personnel.

c. After Use of the Range:

(1) Execute certificate for all HE Ammunition expended (See par 20 f) for example of certificate.

(2) Police all trash, dummy grenades, and all component parts of practice grenades.

d. Dummy Grenade Court: Dummy grenade court will be used to familiarize men with the throwing positions.

e. Rear Area Training Area: Rear Area training area is to be used for instruction in nomenclature and characteristics of grenades only. No demonstrations in throwing practice or live grenades will be conducted in this rear training area.

SECTION II

PISTOL RANGE # 1 AND PISTOL RANGE "E"

24. Description:

a. Location:

Pistol Range # 1 - (1008.8 - 1214.9)
Pistol Range "E" - (1027.4 - 1212.5)

b. Telephone Number:

Pistol Range # 1 - Tie Line 14, Ring 3
Pistol Range "E" - None

c. Number of Firing Points:

Pistol Range # 1 - 20. See Annex # 7
Pistol Range "E" - 60. See Annex # 8

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d. Type Weapon Fired: Automatic pistol, Cal. .45 M1911 or M1911A1
Colt Revolver, Cal. .45 M1917

e. Courses to be Fired: As prescribed in pars 87-90, FM 23-25

f. Distance from firing line to targets:

Pistol Range # 1 - 15, 25 & 50 yards
Pistol Range "E" - 15 & 25 yards

g. Safety Limits: See Annex # 1

h. Danger Area: See Annex # 1

i. Range guard positions: None

j. Available Range facilities:

Pistol Range # 1 - Target House
Latrine (to be used in conjunction with latrine on MG Range # 2).
Pistol Rests

Pistol Range "E" - Target House
Latrine
120 Pistol Rests

25. Responsibilities of Post Range Officer:

a. Continuous responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in 24j above.

b. Before use of range by using unit: The Post Range Officer is responsible for supplying using units with sufficient number of E&L type targets.

26. Responsibilities of Officer-in-charge of firing:

a. Before use of range: The Officer-in-charge of firing will be responsible that:

(1) Both he and his supervisory personnel are thoroughly familiar with pars 13, 24, 25, 91, 96 FM 23-35, SR 385-310-1, and par 1-20 of these range regulations.

(2) All firers have completed as a minimum requirement all mechanical training and marksmanship training listed in FM 23-35.

(3) All pistols have had safety devices tested per par 25 FM 23-35.

(4) All revolvers have had safety devices tested per par 64 FM 23-35.

b. During use of range:

(1) Behind the firing line (opposite side of firing line from impact areas).

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(a) Only weapons that have been unloaded, locked and cleared by the officer-in-charge of firing, will be permitted to be removed from the firing line.

(b) All weapons will be carried at the "Raise Pistol" position.

(2) On the firing line:

(a) Procedure for firing: As outlined par 94 e, FM 23-35.

(b) Organization: As outlined in par 94 a and d, FM 23-35.

(c) Safety: For pistol and revolver.

1. Execute unload every time the pistol or revolver is picked up for any purpose. Consider every revolver as loaded until proven otherwise.

2. Always unload the pistol or revolver if it is to be left where someone else may handle it.

3. Always point the pistol or revolver up when snapping it after examination. Keep the hammer fully down when the weapon is not loaded.

4. Never place the finger within the trigger guard until it is intended to fire or to snap for practice.

5. Never turn around at the firing point while you hold a pistol or revolver in your hand.

6. Never point the revolver or pistol at anyone. On the range do not snap for practice while standing back of the firing line.

For Pistol Cal. .45 M1911 or 1911A1 only

7. When units carrying the pistol are first formed, the officer or non-commissioned officer-in-charge causes the men to execute "Inspection Pistol".

8. The safe firing position referred to in par 19 a (2) (d) 2 "Safety precautions" will be considered to have been attained when the weapon is unloaded, the magazine has been removed and the slide has been locked in the [illegible] position with the slide stop.

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9. Before loading the pistol, draw back the slide and look through the bore to see that it is free from obstruction.

10. On the range do not insert a loaded magazine until the time for firing.

11. On the range do not load the pistol with a cartridge in the chamber until immediate use is anticipated. If there is any delay, lock the pistol and unlock it only while extending the arm to fire. Do not lower the hammer on a loaded cartridge; the pistol is much safer cocked and locked.

12. In reducing a jam, first remove the magazine.

13. To remove a cartridge not fired, first remove the magazine and then extract the cartridge from the chamber by drawing back the slide.

For Revolver Cal. .45

14. The safe firing position referred to in par 19 a (2) (d) 2 "Safety precautions" will be considered to have been attained when the weapon is unloaded, the cylinder is opened and the safety has been placed in a safe position.

15. Before loading, open the cylinder and look through the bore to see that it is free from obstruction.

16. On the range do not cock the revolver until immediate use is anticipated. If there is any delay, lower the hammer and recock it only when ready to fire.

17. If the revolver fails to fire, open the cylinder and unload if the hammer is down. If the hammer is cocked or partly cocked, a breakage has occurred. In this case hold the revolver at "Raise Pistol" and announce the fact to the officer-in-charge.

18. To remove a cartridge not fired, open the cylinder and eject, first lowering the hammer if cocked.

(d) After Use of Range: The Officer-in-charge of firing will be responsible that all trash has been policed and burned and that all brass has been collected and disposed of in accordance with par 108, AR 775-10.

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SECTION III

DISMOUNTED SUB-MACHINE GUN RANGE # 1

27. Description:

a. Location: (1017.4 - 1212.2) See Annex # 1.

b. Telephone Numbers: Tie Line 10 Ring 2.

c. Number of Firing Points: 3 (See Annex # 19).

d. Type Weapon Fired: Sub-Machine Gun M3A1 Cal. .45, Thompson Sub-Machine Gun Cal. .45 M1928A1

e. Course to be fired on range: See par 53-57 FM 23-40 and FM 23-41.

f. Safety Limits: See Annex # 1.

g. Danger Area: See Annex # 1.

h. Range Guard Positions:

(1) Position: Guard at junction of Timmonsville Guard Road and Range Road. Coordinates (1018.2 - 1211.4).

Instructions: Allow no travel to proceed North on Timmonsville Guard Road into impact area.

(2) Position: Guard at Weston Pond Road and Hwy # 262. Coordinates (1015.7 - 1210.4).

Instructions: To allow no traffic to proceed North on Weston Pond Road from Hwy # 262.

(3) Position: Guard at junction of Washington Light Infantry Road and Hwy # 262. Coordinates (1015.3 - 1210.4).

Instructions: To allow no traffic to proceed North on Washington Light Infantry Road from Hwy # 262.

i. Available Range Facilities:

(1) Covered Latrine

(2) 3 Target Houses

(3) Target frames, target assemblies and levers.

j. Type Target: E, F and Trapezoid.

28. Responsibilities of Post Range Officer:

a. Continuous responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in par 27 i, above.

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b. Before Use of Range by Using Unit: The Post Range Officer is responsible for supplying using units with targets listed in paragraph 27 j above, target frames and paste.

29. Responsibilities of Officer-in-charge of firing:

a. Before Use of Range: The Officer-in-charge of firing will be responsible that:

(1) Both he and his supervisory personnel are thoroughly familiar with par 53-57, FM 23-40, FM 23-41, SR 385-310-1 and par 1-20 of these range regulations.

(2) All firers have completed, as a minimum requirement, all mechanical training, gun drill and marksmanship required by FM 23-40 and FM 23-41.

(3) Prior to Firing:

(a) An officer will check each gun and make sure that each weapon is functioning properly.

(b) A cleaning rod and dry patch is run through the bore of each gun.

b. During Use of the Range:

(1) Operation of the Range:

(a) Behind the firing line (Opposite side of firing line from impact area): The Officer-in-charge of firing will be responsible that before removing a sub-machine gun from the firing points, or from the firing line, each gun will be inspected, by an officer to see that it is unloaded. As part of this inspection, a cleaning rod will be passed through the bore of each gun.

(b) On the Firing line:

1. Safety Precautions: The Officer-in-charge of firing will be responsible for the accomplishment of the following safety precautions: Note: The "Safe firing position" referred to in par 19 (2) (d) 2 "Safety Precautions" will be considered to have been attained for the sub-machine gun when:

a. The bolt has been opened.

b. A cleaning rod has been passed through the barrel.

(c) All decisions as to actions to be taken on stoppages will be made by an officer.

c. After Use of Range: The Officer-in-charge of firing will be responsible that all trash accumulated in the trash bin is burned in the metal receptacles provided for that purpose, that proper disposition has been made of all brass and that the targets have been prepared for use by the next unit.

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SECTION IV

Machine Gun Range # 1 and # 2

30. Description:

a. Location:

Range # 1 - (1008.1 - 1215.1). See Annex # 1
Range # 2 - (1009.1 - 1214.7).

b. Telephone Number:

Range # 1 - Tie Line 14, Ring 1.
Range # 2 - Tie Line 14, Ring 2.

c. Number of Firing Points:

Range # 1 - 60. See Annex # 5.
Range # 2 - 60. See Annex # 6.

d. Type Weapon Fired: Machine Gun Cal. .30, Light (M1919A4)
Machine Gun Cal. .30, Heavy (1917A1)

e. Course to be Fired: A or B.

f. Distance from gun position to target: 500 and 1000 inches.

g. Safety Limits: See Annex # 1.

h. Danger Area: See Annex # 1.

i. Range Guard Positions: None necessary.

j. Available Range Facilities:

(1) Control Tower
(2) Covered Latrine
(3) Dry Firing Line with 60 Targets
(4) Mess Hall
(5) Scoring and Critique Tables
(6) Supply House
(7) Target House

k. Type Target: 500 or 1000 inch Machine Gun.

31. Responsibilities of Post Range Officer:

a. Continuous Responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in par 30 j, above.

b. Before Use of Range by Using Unit: The Post Range Officer is responsible for supplying using units with 500 and 1000 inch Machine Gun targets and target frames.

32. Responsibilities of Officer-in-charge of firing:

a. Before Use of Range: The Officer-in-charge of firing will be responsible that:

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(1) Both he and his supervisory personnel are thoroughly familiar with pars 110-122, FM 23-55, SR 385-310-1 and par 1-20 of these range regulations.

(2) All firers have completed, as a minimum requirement, all mechanical training, gun drill and marksmanship required by FM 23-55.

(3) Prior to Firing:

(a) An officer will check headspace of each gun and make the proper adjustment.

(b) A cleaning rod and dry patch is run through the bore of each gun.

b. During Use of the Range:

(1) Operation of the Range:

(a) Behind the firing line (Opposite side of firing line from impact area): The Officer-in-charge of firing will be responsible that before removing a machine gun from its firing position, or from the firing line, each gun will be inspected, by an officer to see that it is unloaded. As part of this inspection, a cleaning rod will be passed through the bore of each gun.

(b) On the Firing Line:

1. The most efficient organization, for this range consists of a breakdown into 5 equal sized orders as outline below.

1 Order Gunner	Wet Line
1 Order Asst Gunner	Wet Line
1 Order Observer	Wet Line
1 Order Gunner	Dry Line
1 Order Asst Gunner	Dry Line

2. Safety Precautions: The Officer-in-charge of firing will be responsible for the accomplishment of the following safety precautions: Note: The "Safe firing position" referred to in par 19 a (2) (d) 2 "Safety Precautions" will be considered to have been attained for the machine gun when:

a. A cleaning rod has been passed through the bore.

b. A clearing block has been placed in the receiver of the gun.

(c) A clearing block should be inserted in the receiver of each gun during the time it is not being used to fire.

(d) All decisions as to actions to be taken on stoppages will be made by an officer.

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c. After Use of Range: The Officer-in-charge of firing will be responsible that all trash accumulated in the trash bin is burned in the metal receptacles provided for that purpose and that all brass has been collected and disposed of in accordance with par 108, AR 775-10.

SECTION V

.50 CAL. MACHINE GUN 1000" RANGE

33. Description:

a. Location: Center of Firing Line (1029.7 - 1216.3)

b. Telephone Number: TL 18 R 3

c. Number of Firing Points: 12

d. Type of Weapon: .50 Cal. Machine Gun, ground or vehicle mount

e. Safety Limits: See Annex # 1

f. Danger Areas: See Annex # 1

g. Range Guard Position:

(1) Position: Guard at junction of Pilgrim Church Road and Range Road. Coordinates (1029.7 - 1216.4)

(2) Instructions: To allow no traffic to proceed West on Pilgrim Church Road from Range Road

h. Available Range Facilities:

Target frames

34. Responsibilities of Post Range Officer:

a. Continuous Responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in par 33 h, above.

b. Before use of Range by Using Unit: The Post Range Officer is responsible for supplying using units with targets, target frames, and paste.

35. Responsibilities of Officer-in-charge of firing:

a. Before Use of Range: The Officer-in-charge of firing will be responsible that:

(1) Both he and his supervisory personnel are thoroughly familiar with safety regulations for weapon being fired, SR 385-310-1 and par 1-20 of these range regulations.

(2) All firers have completed, as a minimum requirement, all mechanical training, gun drill and marksmanship, required by FM 23-65.

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(2) On the firing line:

(a) Procedure for firing:

Rifle - as outlined in FM 23-5.
Carbine - as outlined in FM 23-7.
BAR - as outlined in FM 23-15.

(b) Organization of the firing line:

Rifle - as outlined in FM 23-5.
Carbine - as outlined in FM 23-7.
BAR - as outlined in FM 23-15.

(c) Safety:

1. The "Safe Firing Position" referred to in par 19 a (2) (d) 2 "Safety Precautions" will be considered to have been attained when:

Weapon is locked.
Ammunition is completely removed from the weapon.
Bolt is open.
A cleaning rod has been run through the bore of the weapon.

2. Weapons will be checked daily by an officer prior to firing to determine that chambers and bores are free from obstruction.

(d) Communication: Control of the pits will be maintained by telephone communication from the firing line.

All request for marking and disking targets will be transmitted via telephone.

(3) Pits:

(a) Personnel in the pit details will stay on the concrete walk between the target frames and the revetment at all times when firing is in progress.

c. After Use of the Range:

(1) Brass will be policed daily after the use of the range.

(2) All trash accumulated will be policed daily.

SECTION VII

RIFLE TRANSITION RANGE # 1

39. Description:

a. Location (1008.7 - 1212.3)

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b. Telephone Number - Tie Line 11.

c. Number of firing lanes: 15.

6 lanes (1 through 6) - Table VI.
4 lanes (7 through 10) - Table VII.
1 lane (11) - Table VIII.
4 lanes (12 through 15) - Table IX.

d. Course to be fired:

Table VI and VII - Par 69d FM 23-5
Table VIII - Par 69d FM 23-5, C2
Table IX - as follows:

PHASE LINES	TARGETS SINGLE	DOUBLE	TRIPLE	RANGE YARDS	SHOTS	TARGET	POSITION	SLING
2 - 3	2	1	0	5-70	4	E	Off Hand	None
3 - 4	0	1	2	5-70	8	E	Hip	None
4 - Final	2	3	0	5-70	8	E	Off Hand	None

(1) A single silhouette represents an enemy rifleman. A double silhouette represents an enemy automatic rifle team.
A triple silhouette represents a machine gun.

(2) Targets will be exposed in sequence upon signal from the coach. Time of exposure of targets is as follows: (a) Single silhouettes, 3 seconds. (b) Double silhouettes, 4 seconds. (c) Triple silhouettes, 5 seconds.

(3) Phase lines are placed after the 4th, 12th and 20th targets to assist in the enforcement of safety precautions.

e. Scoring and satisfactory scores:

TABLE	SCORING PROCEDURE	SATISFACTORY SCORES
Table VI & VII	Par 69e, (1) & (2), FM 23-5	VI not applicable VII - 8
Table VIII	Par 69e (3), FM 23-5 C2	1 - 4
Table IX	For each target hit - 1 Pt	8

f. Type of weapon fired: Rifle Cal. .30, M1.

g. Distance from firing position to target:

Table VI - 200, 300, and 500 yards.
Table VII - 250, 300, 350, 400, 450 and 500 yards.
Table VIII - 100 yards.

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h. Safety Limits: See Annex # 1

i. Danger Areas: See Annex # 1

j. Range Guard Positions:

(1) # 1 - Junction Ancrum Ferry Road and Hartsville Guard Road (1009.1 - 1213.4)

(a) Instructions:

1. Allow no one to enter Hartsville Guard Road.

2. Instruct all personnel travelling on Ancrum Ferry Road not to turn South between Range Road and Telephone Road.

(2) # 2 - Junction Ancrum Ferry Road and Telephone Road (1013.1 - 1214.3)

(a) Instructions:

1. Instruct personnel travelling on Telephone Road not to turn West between Ancrum Ferry Road and Hwy 262.

2. Instruct all personnel travelling on Ancrum Ferry Road not to turn South between Range Road and Telephone Road.

(3) # 3 - Junction Telephone Road and Hwy 262 (1013.3 - 1210.1)

(a) Instructions:

1. Instruct personnel travelling on Telephone Road not to turn West between Hwy 262 and Ancrum Ferry Road.

(4) # 4 - Junction Catawba Rifles and Range Road (1008.6 - 1211.7)

(a) Instructions:

1. Instruct personnel travelling on Range Road not to turn East between Catawba Rifles Road and Ancrum Ferry Road.

2. Allow no one to enter Catawba Rifles Road.

(5) # 5 - Junction Ancrum Ferry Road and Range Road (1008.3 - 1213.2)

(a) Instructions:

1. Instruct personnel travelling on Range Road not to turn East between Ancrum Ferry and Semmes Roads.

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(6) # 6 - Junction Semmes Road and Range Road (1008.6 - 1211.2)

(a) Instructions:

1. Instruct personnel travelling on Semmes Road not to turn North between Range Road and Telephone Road.

2. Instruct personnel travelling on Range Road not to turn East between Semmes Road and Anerum Ferry Road.

(7) # 7 - Junction Semmes Road and Hartsville Guard Road (1011.2 - 1209.3)

(a) Instructions:

1. Instruct personnel travelling on Semmes Road and Hwy 262 not to turn North between Range Road and Telephone Road, except that personnel may travel on Hartsville Guard Road not further than 1500 yards North of Hwy 262.

k. Available range facilities:

(1) 7 Control Towers
(2) 1 Latrine
(3) 1 Set of Bleachers
(4) 2 Target Houses
(5) Work Tables
(6) Mess Area
(7) Communication Arrangement (See Annex # 21).
(8) Table Model of Range

40. Responsibilities of Post Range Officer:

a. Continuous Responsibilities: The Post Range Officer is responsible for the maintenance of all range facilities mentioned in k (above).

b. Before Use of Range by Using Unit: The Post Range Officer is responsible for supplying using units with a sufficient number of type "E" Silhouettes, including those colored Red for 500 yard firing, and a sufficient number of target staves for the entire period of firing.

41. Responsibilities of Post Signal Officer:

a. Before Use of Range by Using Unit: The Post Range Officer will be responsible for instructing the Unit Range Officer in the use of permanent type telephone system. On request from the Post Range Officer, the Post Signal Officer will make the necessary repairs to these facilities.

42. Responsibilities of Officer-in-Charge of Firing:

a. Before Use of Range: The Officer-in-Charge of firing will be responsible that:

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(1) Both he and supervisory personnel are thoroughly familiar with pars 34, 69d, e, f, g, 189-191b FM 23-5, C1 and 2, and SR 385-310-1 and Annex # 24 as well as par 1-20 of these range regulations.

(2) All firers have fired the rifle qualification Course "B" and have received instruction in range estimation, assuming firing position and assault fire required by Annex 24.

(3) One day prior to firing the Unit Range Officer makes a check of the range facilities, supplies and communications to insure that the range is in proper condition for firing. Any deficiencies will be reported to the Post Range Officer promptly so that repairs can be made prior to firing.

(4) Range Guards are posted in psoitions listed in 39 j above.

(5) When pits are filled with water, they are bailed out prior to firing and that every third pit has a bucket available for any subsequent seepage into the pits.

(6) The pit details are familiarized with their duties and have at least one "dry run" prior to actual firing.

b. During Use of Range: The Officer-in-charge of firing will be responsible for the overall operation of the range to include:

(1) Behind the firing Line (Opposite side of firing line from impact area).

(a) Only weapons that have been unloaded, locked, and cleared by an officer will be permitted to be removed from any firing point or firing line.

(b) Movement in rear of firing points by personnel undergoing this course will be at a walk with rifles held at "Port Arms".

(c) Any minor repairs on table model targets and table 9 will be done by using unit.

(2) On the Firing Line:

(a) Procedure for firing: As outlined in Annex 24.

(b) Organization of firing line: As outlined in Annex 24.

(c) Safety:

1. The safe firing position referred to in par 19 a (2) (d) 2, "Safety precautions" will be considered to have been attained when:

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a. Rifle is locked.

b. Ammunition completely removed from rifle.

c. Bolt is open.

d. A cleaning rod has been run through the bore of the rifle.

2. Safety Precautions: For Table IX.
The firer will be instructed prior to firing that targets are not more than 3 feet in size, targets will be on same level as ground, targets to front, right or left front only.
The Coach Cadreman will;
Stay immediately in rear of firer.
Regulate speed of movement of firer.
Keep target operation well in rear of firer.
Determine that firer's weapon is unloaded and bolt is open before moving back to starting point.

(d) Communication: The firing point on each firing lane will maintain contact with the pits in its own lane by the use of field telephones.

(3) Pits:

(a) Organization: Pit details subsequent to the first order will be thoroughly instructed in their duties and in safety precautions to be observed while operating the pits.

(b) Communication: Each lane within each of the 4 tables will have its own integral communication met by which control will be exercised. as follows;

TABLE VI: The centerpit at each of the three ranges (200,300,500 yds) will have a terminal for telephone communication to the firing point.
Communication between any of the three pits located at one of the three ranges may be established by use of whistles signals.
Suggested signals are as follows:
"Attention" 4 short blasts
"Targets Up" 1 long blast
"Targets Down" 2 long blasts
"All Clear" 2 short blasts

TABLE VII: Each pit at each of the six different ranges (200,250, 300, 350, 400 & 450 yds) will have a terminal for telephone communications to the firing point.

TABLE VIII: The pit will have a terminal for telephone communication to the firing point.

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(c) Red silhouette targets used at 500 yds will be scored and pasted on the backside so as to not deface the red front.

(d) Scoring: Scoring will be accomplished by pit detail as follows.

TABLE VI: Flutter and lower target when hit, then score.
TABLE VII: Same as above.
TABLE VIII: Score after command "Targets Down" is given.
TABLE IX: Not applicable (see par 39 d & e, for scoring).

(e) Safety: See par 19 (2) (d) 2 "Safety".

c. After Use of Range: The Officer-in-Charge of firing will be responsible:

(1) That all trash accumulated in trash bins is burned.

(2) That new targets are fastened on all staves and then stored in target house for the use of the next unit.

SECTION VIII

RIFLE AND CARBINE TRANSITION RANGE # 1 AND # 2

43. Description:

a. Location:

(1) Range # 1 (1029.8 - 1216.6)
(2) Range # 2 (1028.2 - 1218.8)

b. Telephone Numbers:

(1) Range # 1 - TI 21 R1
(2) Range # 2 - TI 21 R2

c. Number of firing lanes:

(1) Range # 1: 10

6 lanes (1 thru 6) Table 6 - M-1
Table 4 - Carbine
4 lanes (7 thru 10) Table 7 - M-1
Table 5 - Carbine

(2) Range # 2: 6

4 lanes (1 thru 4) Table 6 - M-1
Table 4 - Carbine
2 lanes (5 thru 6) Table 7 - M-1
Table 4 - Carbine

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(5) Red flag is taken down upon completion of firing.

(6) All trash around gun position is policed upon completion of firing.

SECTION XIII

4.2 MORTAR RANGE # 1 AND # 2

57. Description:

a. Location:

(1) Range # 1 - Firing line coordinates (1009.4 - 1214.1) to (1009.3 - 1214.3)

(2) Range # 2 - Firing line coordinates (1022.45 - 1218.45) to (1022.20 - 1218.75)

(3) Impact Area - (See Annex # 1)

b. Telephone Number:

(1) Range # 1 - Tie line 14, Ring 4

(2) Range # 2 - None

c. Type of Weapon: 4.2" Chemical Mortar. (See FM 23-92 and TC 3 DA 28 Feb 50)

d. Maximum Range:

(1) Range # 1 - No weapon will be fired at a range greater than 1800 yards.

(2) Range # 2 - No weapon will be fired at a range greater than 2000 yards.

e. Targets: Natural terrain features. Drums and 6' x 6' target frames may be put out.

f. Observation Position:

(1) 4.2" Mortar Range # 1 - Control tower above firine line.

(2) 4.2" Mortar Range # 2 - Bunker # 17, coordinates (1022.4 - 1218.9).

g. Available facilities for 4.2" Mortar Range # 1:

Control tower
Stands capable of seating approx 1200
Latrine
Two target houses

h. Safety Limits: (See Annex # 1)

i. Danger Areas: (See Annex # 1)

j. Range Guard Positions:

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(1) 4.2" Mortar Range # 1: -

(a) # 1 - Junction Ancrum Ferry Road and Range Road (1009.1 - 1213.3).

1. Instructions:

a. Instruct personnel travelling on Ancrum Ferry Road not to turn North between Range Road and Telephone Road.

b. Instruct personnel travelling on Range Road not to turn East between Ancrum Ferry and Camden Roads.

(b) # 2 - Junction Ancrum Ferry and Telephone Roads (1013.1 - 1214.3).

1. Instructions:

a. Instruct personnel travelling on Ancrum Ferry Road not to turn North between Telephone Road and Range Road.

b. Instruct personnel travelling on Telephone Road not to turn West between Ancrum Ferry and Old Camden Roads.

(c) # 3 - Junction Old Camden Road and Telephone Road (1014.5 - 1217.5).

1. Instructions:

a. Instruct personnel travelling on Telephone Road not to turn West between Old Camden Road and Ancrum Ferry Road.

b. Instruct personnel travelling on Old Camden Road not to turn South between Telephone Road and Range Road.

(d) # 4 - Junction Old Camden Road and Range Road (1007.6 - 1215.1).

1. Instructions:

a. Instruct personnel travelling on Old Camden Road not to turn South between Range Road and Telephone Road.

b. Instruct personnel travelling on Range Road not to turn East between Old Camden Road and Ancrum Ferry Road except that personnel firing on ranges may enter those Ranges.

(2) 4.2" Mortar Range # 2: Five Range Guards will be posted at points indicated in Annex # 1 at 30 minutes prior to scheduled firing time.

(a) # 1 Guard will prevent any travel from going Northeast on Division Road.

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(b) # 2 Guard will prevent travel from going South on Colonel Creek Road into the impact area.

(c) # 3 Guard will prevent any travel from going on Messers Pond Road from turning South on the road into the impact area.

(d) # 4 Guard will prevent any traffic from going West on Division Road into the impact area.

(e) # 5 Guard will prevent any traffic on Chavers PondRoad from going West into the impact area.

The officer-in-charge of firing will make sure the temporary road block is in position at junction of highway # 262 and Colonel Creek Road, coordinates (1025.9 - 1211.8). The officer-in-charge of firing will be responsible that any additional range guards necessary to insure that safety measures are observed are posted on approaches into the danger area.

k. Safety: The provisions of SR 385-310-1 and FM 23-92 will govern all firing. In case of conflict, SR 385-310-1 will govern all firing.

58. Responsibilities of Officer-in-Charge of Firing:

a. In addition to his responsibility for the posting of necessary range guards, the officer-in-charge of firing will be responsible that:

(1) Range guards are instructed as to their duties, i.e., allow no one to enter the impact area or gun position area without permission of the range officer or the commanding officer of the unit firing.

(2) Both he and his supervisory personnel are thoroughly familiar with the provisions of SR 385-310-1, and par 1-20 of the Fort Jackson Range Regulations.

(3) Red flag is predominantly displayed in the vicinity of the gun positions when range is cleared for firing.

(4) The Commanding Officer of the unit firing is notified when range is cleared for firing.

(5) Range guards are relieved and red flag is taken down upon completion of firing.

(6) All trash around gun position is policed upon completion of firing.

b. The officer-in-charge of firing will be responsible for the control of fires and the protection of personnel against duds on the Mortar Range in accordance with par 8 Sec II and Sec III of Chapter I of these regulations.

(1) The officer-in-charge of firing will warn all personnel of the danger of "duds" in the area.

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(a) Duds discovered on the range will be plainly marked so they can be seen for a distance of 100 yards. These duds will not be moved or tampered with except by authorized personnel.

(b) The location of any duds will be reported to the Post Range Officer. Reports will show type, location and map coordinates and the name, rank, organization and telphone number of any person familiar with dud locations.

(2) The control of fires resulting from firing on the Mortar Range is the responsibility of the officer-in-charge of firing.

(a) When a fire on the Mortar Range is observed, the officer-in-charge of firing will immediately stop the firing and extinguish the fire.

(b) If the fire is located inside a danger area other than that of the Mortar Range, the officer-in-charge of firing will contact the Post Range Officer and report its location. The Post Range Officer will stop all firing in that area until the fire is extinguished.

(c) If a fire gets out of control of the using unit, the Post Range Officer and Post Engineer will be notified of that fact immediately.

(d) The officer-in-charge of firing will inspect the target area at the conclusion of each day's firing and extinguish all fires.

SECTION XIV

ROCKET LAUNCHER RANGE

59. Description:

a. Location: (1007.7 - 1216.4).

b. Telephone Number: Tie Line 15, Ring 3.

c. Number of Firing Points: 24

12 Practice Ammunition
12 Service Ammunition

d. Type of Weapon Fired: Rocket Launcher, 2.36 inch M9 and M9A1.

e. Distance from Gun Position to Target: 100 Yards.

f. Safety Limits: See Annex # 1.

g. Danger Area: See Annex # 1.

h. Rocket Launcher Range Guard Positions:

(1) # 1 - Boyden Arbor Road at (1007.0 - 1216.2)

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(2) Danger Area: See Annex 11

(3) Safety Limits: See Annex 11

f. Range Guards: Range guards will be posted at points indicated in Annex 11 at least 30 minutes prior to scheduled firing time. The Officer-in-charge of firing will be responsible that any additional range guards necessary to insure that safety measures are observed are posted on approaches into the danger area. If the Artillery Range is in use at the same time that the Tank Range is being used, guard positions # 1, 2 and 3 of the Tank Range are not necessary. Temporary road blocks will be picked up at the KD Range Detachment and placed into position as indicated on Annex 11.

g. Safety: The provisions of SR 385-310-1 and the provisions of the appropriate Field Manuals will govern all firing. In case of conflict, SR 385-310-1 will govern.

69. Responsibilities of the Officer-in-Charge of Firing:

a. In addition to his responsibility for the posting of necessary range guards, the Officer-in-charge of firing will be responsible that:

(1) Range guards are instructed as to their duties, i. e., allow no one to enter the impact area or gun position area without permission of the range officer or the commanding officer of the unit firing.

(2) Both he and his supervisory personnel are thoroughly familiar with the provisions of SR 385-310-1 and par 1-20 of the Fort Jackson Range Regulations.

(3) Red flag is predominantly displayed in the vicinity of the gun positions and Weir Tower when range is cleared for firing.

(4) The Commanding Officer of the unit firing is notified when range is cleared for firing.

(5) Temporary road blocks have been placed in position and that same are returned to the KD Range Detachment upon completion of firing.

(6) Range guards are relieved and red flag is taken down upon completion of firing.

(7) All trash around gun position is policed upon completion of firing.

SECTION XVIII

ARTILLERY RANGE

70. Description:

a. Location: Gun Position Area - See Annex 12
Impact Area - See Annex 12

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b. Telephone Number: (Weir Tower) Tie Line 10

c. Type Weapon Fired: 105mm and 155mm Howitzer and Rifles

d. Safety Limits: See Annex 12

e. Danger Area: See Annex 12

f. Range Guard Positions: See Annex 12

For Impact Area: All road guards on the numbered road guard positions will prevent entry into the impact area.

For Telephone Road: Two guards will be posted in addition to impact area road guards. RG-#2 (1013.0 - 1210.0) will allow only authorized traffic to proceed North along Telephone Road. RG-#11 (1011.2 - 1209.5) will allow only authorized traffic to proceed North along Telephone Road.

71. Responsibilities of Officer-in-charge of Firing:

a. Before Use of the Range: The Officer-in-charge of firing will be responsible that:

(1) Both he and his supervisory personnel are thoroughly familiar with Section 1, Appendix 1 FM 6-40 and FM 6-140, FM 6-75 (105mm Howitzer); FM 6-81 (155mm Howitzer); FM 6-90 plus C1 (155mm Gun); SR 385-310-1 and par 1-20 of these regulations.

(2) The following minimum number of personnel are designated:

1 Officer - Commanding Officer of Unit Firing.
1 Safety Officer at each Battery Position
EM Range Guards as needed (See par 68f above).
1 EM Telephone Orderly.
2 EM First Aid Men.

(3) One (1) ambulance will be available during firing.
(4) All firing personnel have completed training as outlined in FM 6-75 (for 105mm Howitzer) or FM 6-81 (for 155mm Howitzer) and FM 6-90 (for 155mm Gun).

(5) Three days prior to day of firing an overlay of the firing plan to include gun positions, proposed targets and type and number of weapons to be used will be sent to the Post Range Officer.

(6) Range Guards have been posted (See Annex 12).

(a) At least thirty (30) minutes prior to scheduled firing time. Numbered range guards will remain posted during all firing.

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(b) Instruct range guards as to their duties, i. e., allow no one to enter the impact area or gun position area without permission of the Range Officer or the Commanding Officer of unit firing.

(7) Temporary road blocks have been received from the KD Range Detachment Area and have been placed in position prior to firing as indicated on Annex 12.

(8) Raise the red flag on Weir Tower. (See Annex 12), when range is clear for firing.

(9) Notify the Commanding Officer of unit firing when range is clear for firing.

(10) Entry into firing positions area will be as listed below:

(a) From Hwy 262 North on Telephone Road.

(b) From Old Camden Road South on Telephone Road.

(c) East to West on Ancrum Ferry Road.

(11) Before moving personnel into impact area for setting up targets or before moving personnel up to observation posts, clearance will be made with Post Range Officer in order that firing on Tank Range can be halted until impact area of this range has been cleared of personnel.

b. During Use of Range:

(1) The Officer-in-charge of firing will be in constant communication with the Observation Post (CO of unit firing) and as near as practicable to his Range Guards.

(2) The Officer-in-charge of firing will be responsible that all safety requirements and precautions outlined in par 38 a (1) are complied with.

c. After Use of Range: The Officer-in-charge of firing will be responsible that:

(1) Range Guards are relieved and that temporary blocks have been returned.

(2) All trash has been policed.

(3) A certificate has been executed on all HE ammunition expended.

SECTION XIX

AIR-TO-GROUND RANGE REGULATIONS

72. The purpose of these regulations is to govern the use of the Air-to-Ground Range and to prescribe safety precautions to be observed in its use.

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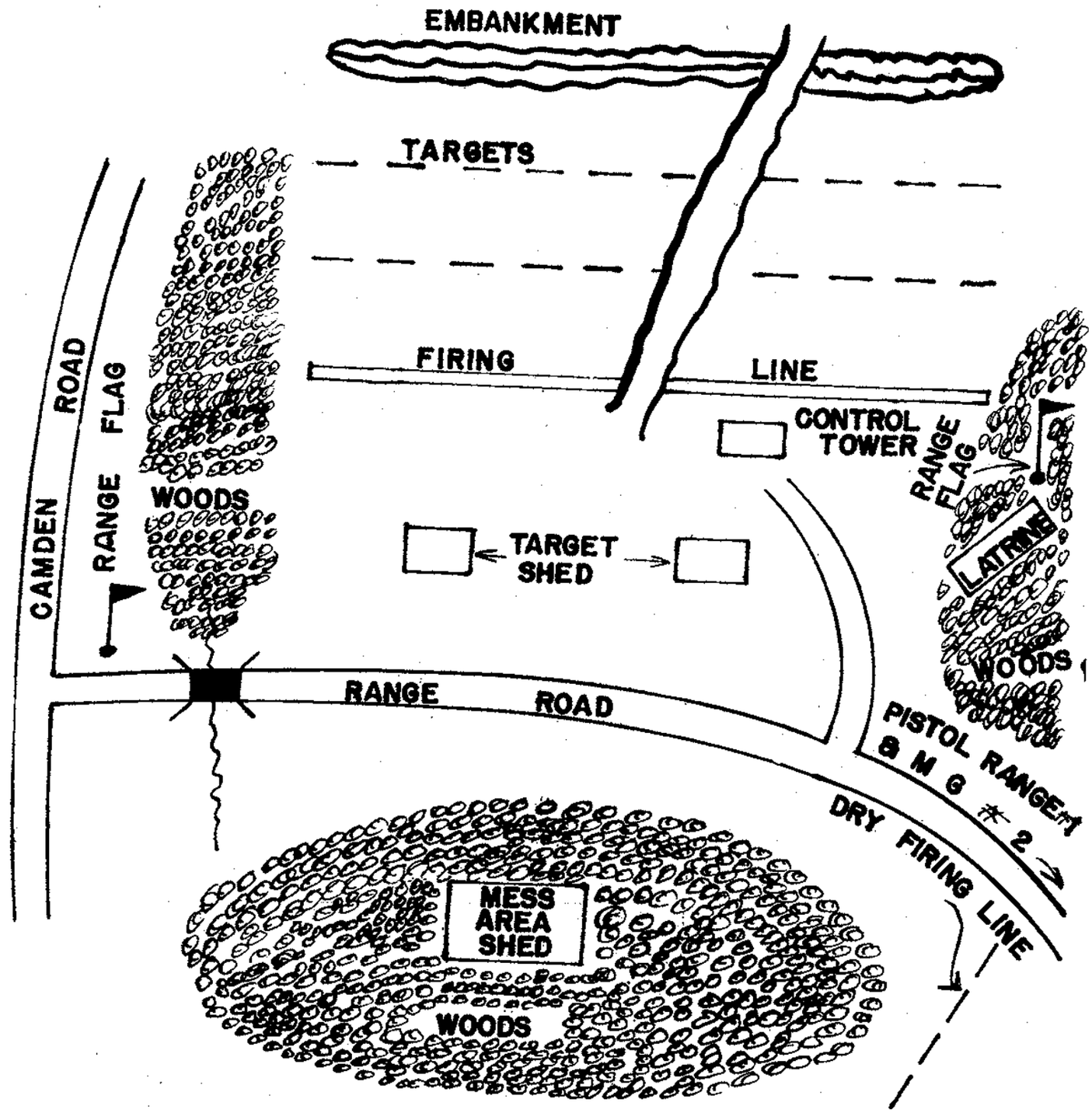

ANNEX # 5

SCHEMATIC DIAGRAM of MACHINE GUN RANGE # 1

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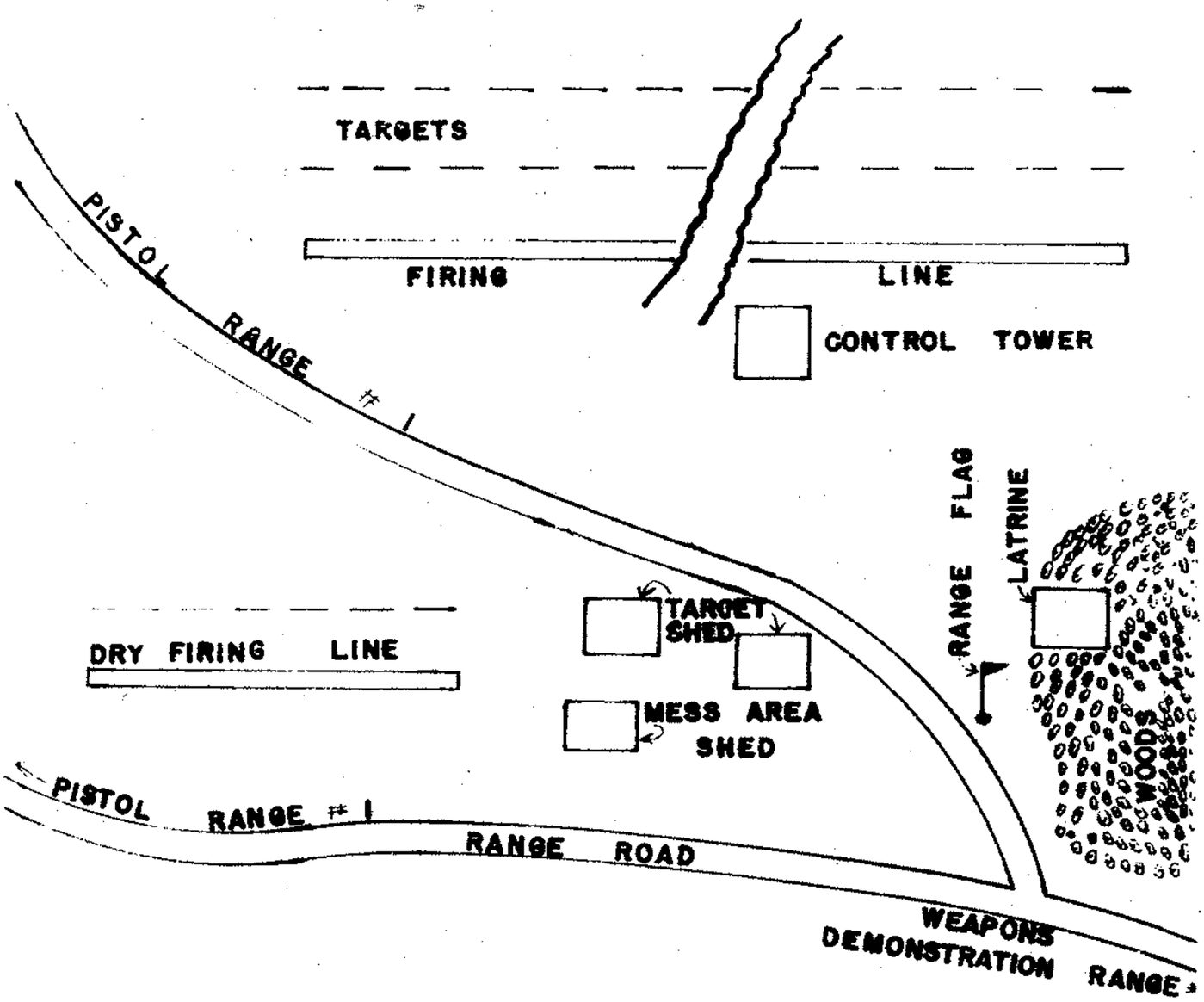
By CO NARA Date 3-22-04



ANNEX # 6

SCHEMATIC DIAGRAM of MACHINE GUN RANGE # 2

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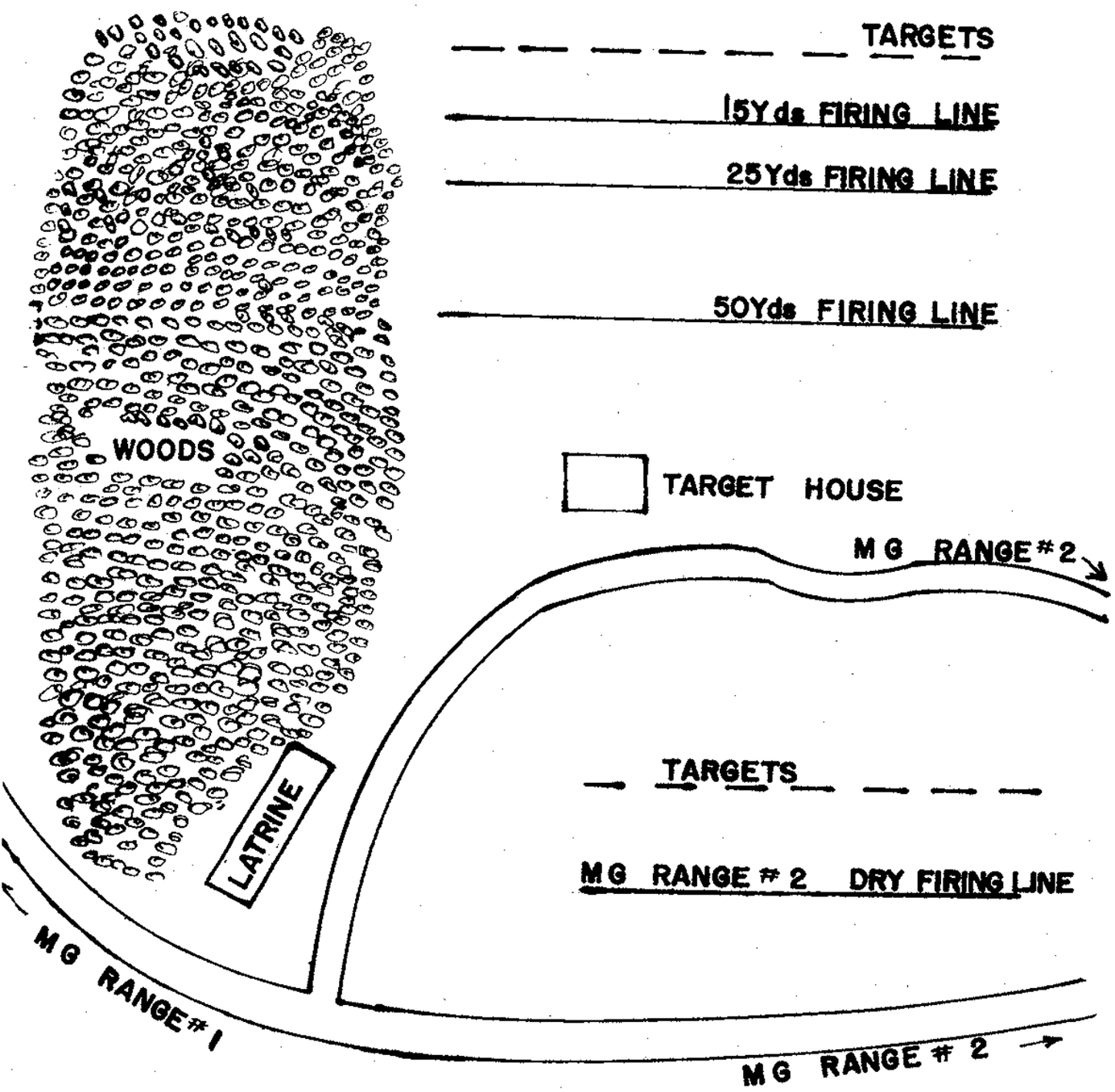

ANNEX # 7

SCHEMATIC DIAGRAM of PISTOL RANGE # 1

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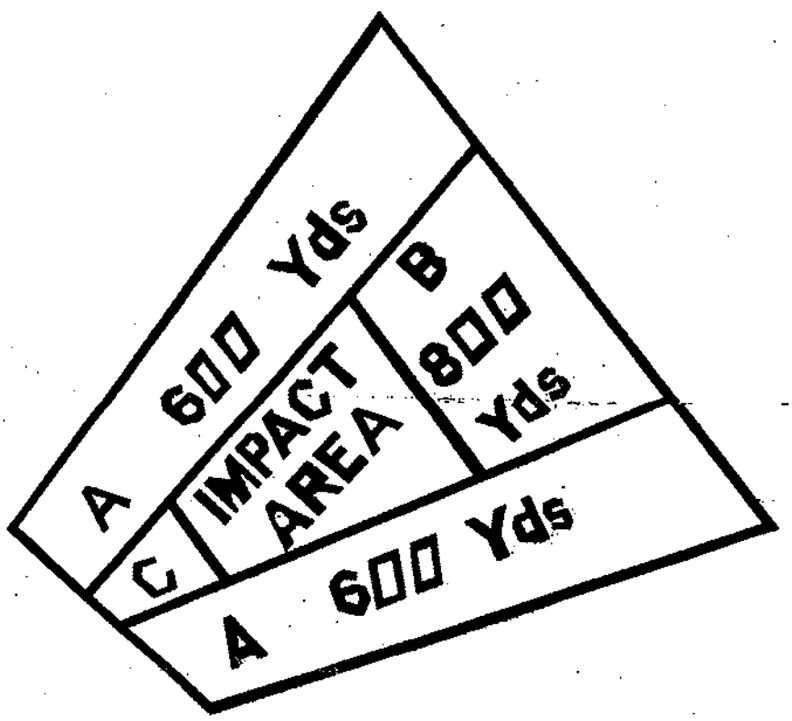
By CO NARA Date 3.22.04

OVERLAY SHOWING 4.2 MORTAR RANGE NO
MAP: FT. JACKSON & VICINITY
SCALE: 1/25,000



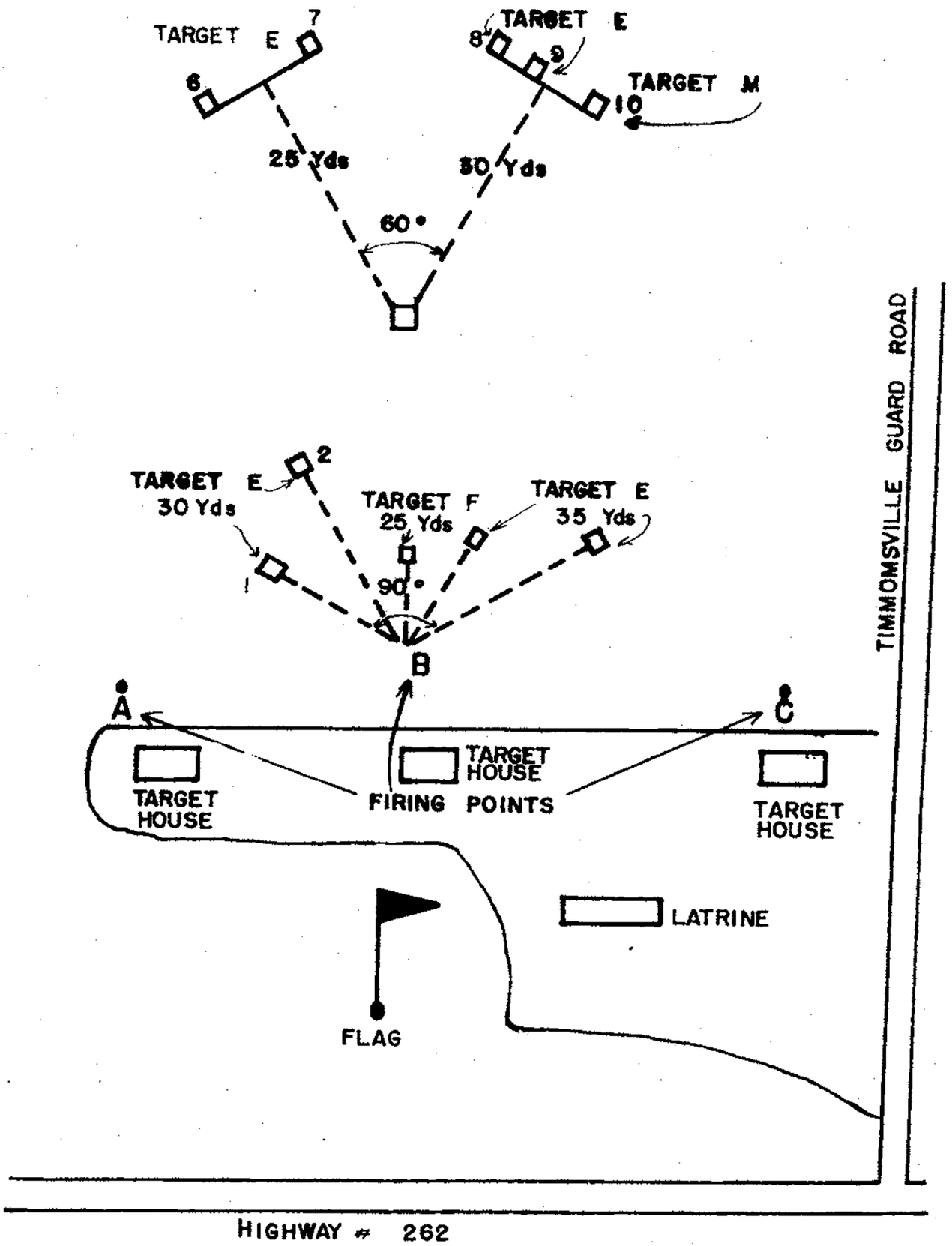
X4

X3

1013

1212

ANNEX # 10



ANNEX # 19

SCHEMATIC DIAGRAM of SUB MACHINE GUN # I

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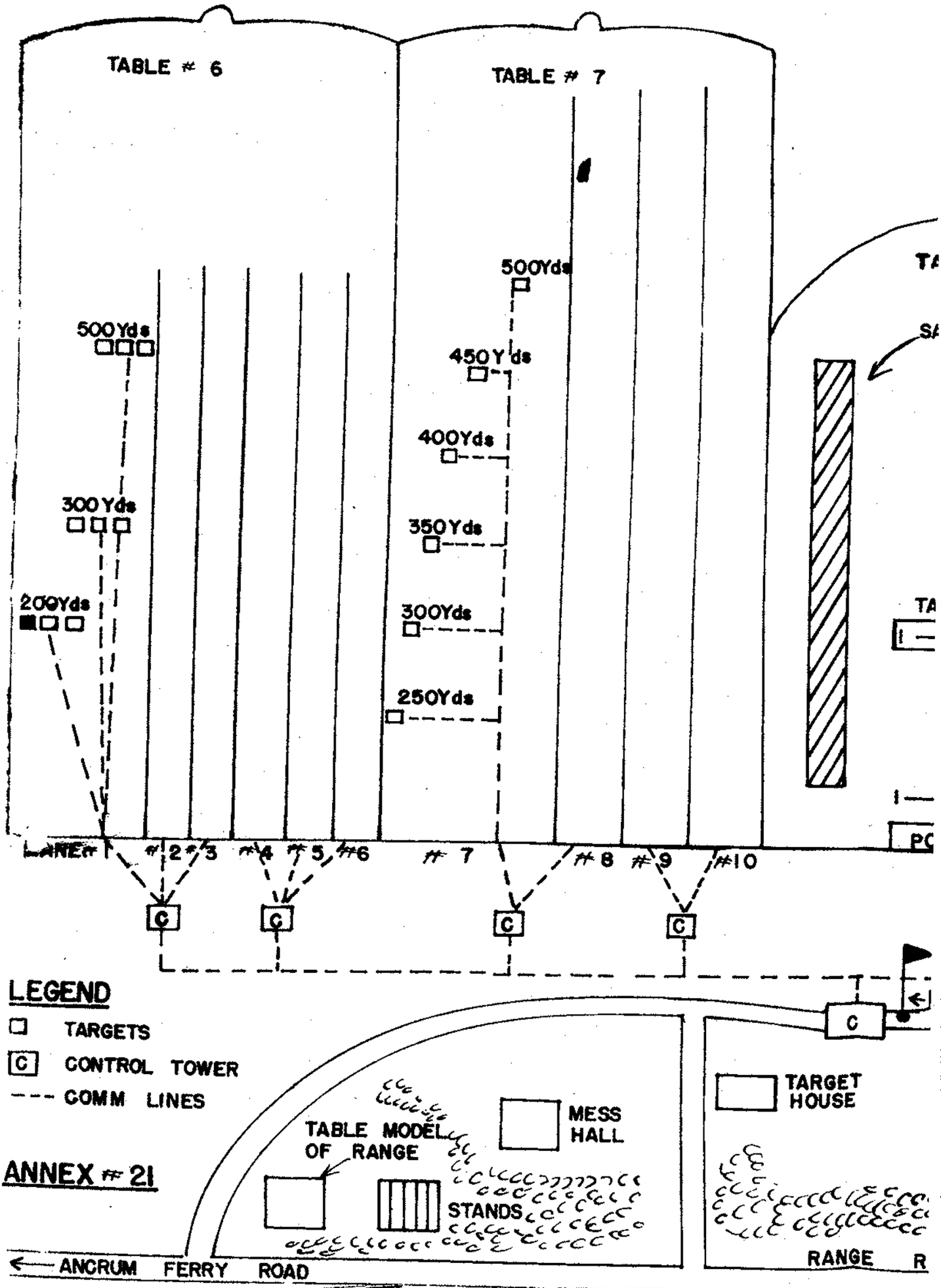
By NARA Date 3-22-04



ANNEX # 21

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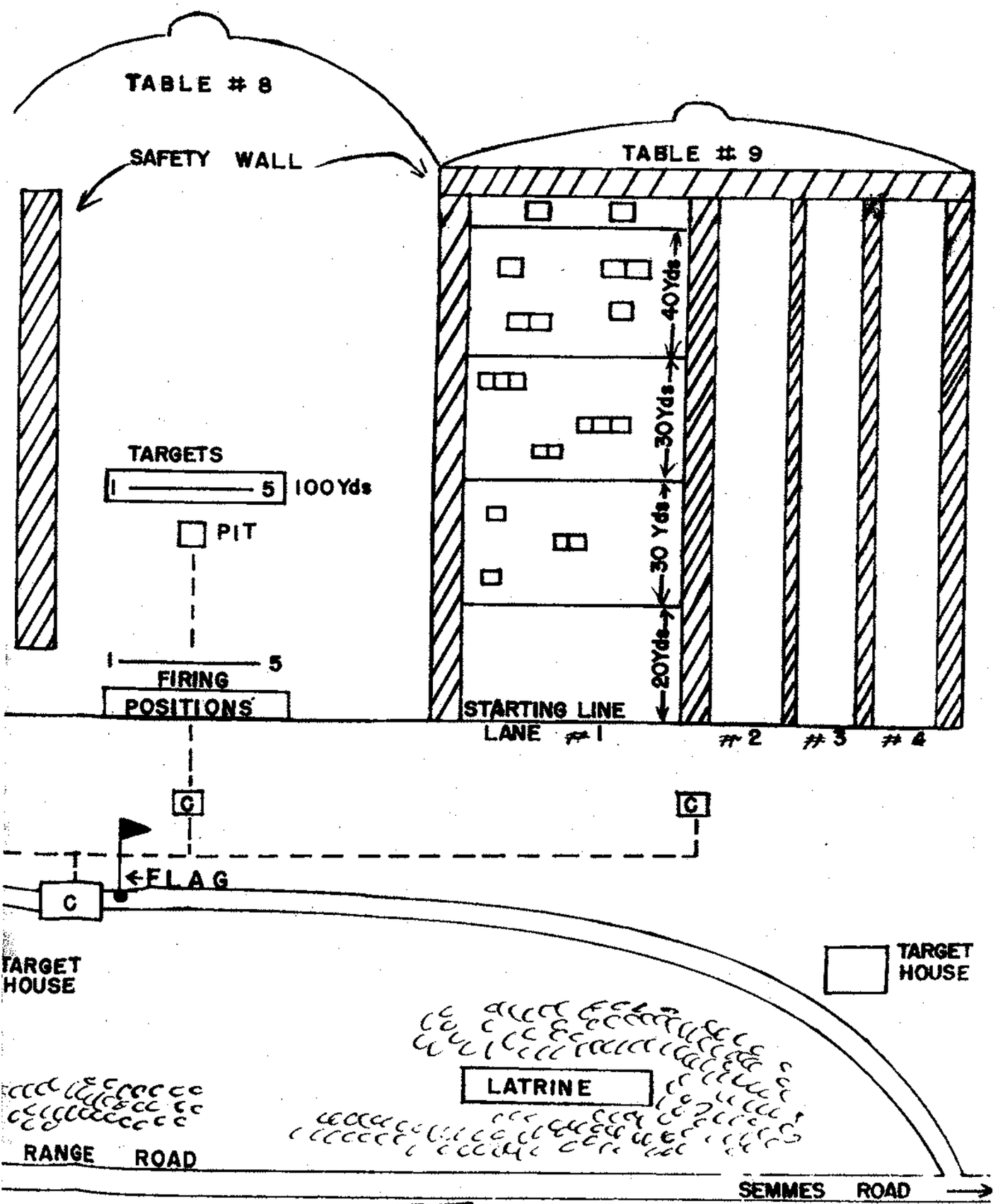
EMATIC DIAGRAM of RIFLE



RIFLE TR ANGE # 1

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By CO NARA Date 3.22.04

INSTRUCTIONS ON THE PROCEDURE

IN THE USE OF

RIFLE TRANSITION RANGE # 1 (12 Hrs)

1. OBJECTIVE:

a. To give the individual soldier practice in searching for targets, in estimating ranges, in setting his sights rapidly, and in firing an accurate shot quickly.

b. To emphasize the necessity for the continued application of the principles of rifle marksmanship in firing at field targets.

c. To give the individual soldier practice in assault firing.

2. TEXT REFERENCES:

FM 23-5, C1, 2 & 3
FM 23-7, C4
SR 385-310-1
ATP 21-1
Range Regulations, Fort Jackson

3. PROCEDURE:

a. Period 1 (2 Hours):

(1) Subject: Range Estimation.
(2) Text References: FM 23-5, pars 120-124.
(3) Equipment: Blackboard; Range Chart; Paper and pencil for each trainee; Chart - Factors effecting estimation by eye.
(4) Area: Range Estimation Course.
(5) Procedure: Explain the importance of estimating range accurately. Explain each of the methods employed in estimating ranges (Use of tracers, observation of fire, estimation by eye). Conduct the practical work exercises described in FM 23-5, par 124.

b. Period 2 (1 Hour):

(1) Subject: Setting Sights Rapidly; Stoppages; Immediate action.
(2) Text Reference: FM 23-5, pars 35-38, 66.
(3) Area: Out-of-doors.
(4) Procedure: Review sight setting and changes. Explain the importance of setting sights rapidly. Conduct practical exercises in setting sights rapidly. Review stoppages and immediate action.

c. Period 3 (1 Hour):

(1) Subject: Assuming Positions Rapidly; Assault Fire.
(2) Text References: FM 23-5, pars 65c, 138.
(3) Equipment: Type "E" and "F" silhouette targets. 2 EE8 telephones; Blackboard; whistles.
(4) Area: Out of Doors.
(5) Procedure: Review firing positions; Conduct explanation, demonstration and practical work in assuming positions rapidly. Conduct practical exercises requiring soldiers to estimate ranges, set sights, assume a firing position, and simulate firing at silhouette targets which are exposed for brief intervals. Explain, demonstrate, and conduct practical work in assault fire position procedure.

ANNEX #24

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By CO NARA Date 3.22.07

d. Period 4 (8 Hours):

(1) Subject: Transition Firing.
(2) Text References: FM 23-5, C1 and 2, pars 69d-g, 189, 191e.
(3) Personnel: Officer personnel requirements in sub par below are for ideal conditions. Minimum number for firing this range are:

Table VI and VII - 1 Officer
Table VIII - 1 Officer
Table IX - 1 Officer

(a) Table VI:
Officers: Two (2) Range Officers
Cadremen: Six (6) Asst Range Officers(Scorers)
Trainees: Fifty-four (54) Target Operators; two (2) ammunition bearers; one (1) Latrine Orderly; Six (6) Coaches

(b) Table VII:
Officers: Two (2) Range Officers
Cadremen: Four (4) Asst Range Officers
Trainees: Two (2) Target Operators; One (1) ammunition bearer; Four (4) Coaches

(c) Table VIII:
Officers: One (1) Range Officer
Cadremen: Four (4) Asst Range Officers
Trainees: Two (2) target operators; One (1) ammunition bearer; Four (4) Coaches

(d) Table IX:
Officers: One (1) Range Officer
Cadremen: Four (4) Asst Range Officers(Coaches)
Trainees: Four (4) target operators, One (1) ammunition bearer.

(e) Stations 1, 1A, 2 3, 4, 5, and 6:

One Orientation and Critique Non-commissioned officer for each station. Use table model of range.

(4) Equipment:

(a) Table VI; 72 targets
26 EE8 telephones
54 red flags
18 whistles
18 buckets suitable for bailing water.

(b) Table VII; 32 targets
27 telephones
2 whistles
24 red flags
8 buckets suitable for bailing water.

(c) Table VIII; 4 targets
2 telephones
1 red flag
1 bucket suitable for bailing water.

(d) Table IX; 1 red flag
16 clips adapted to hold 4 rounds.

(e) Station # 1 - Sight Blackening Equipment (Unit responsibility).
2 - Blackboards
3 - Blackboards
4 - Blackboards
5 - Blackboards and cleaning materials (Unit Responsibility)
1A - Clips of dummy ammunition.

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(5) Area: Transition Range.

(6) Procedure: (See Annex # 3).

For Firing Line and Stations in Rear of Firing Line:

(a) Pit detail and coaches will precede firing personnel to the range by 40 minutes.

(b) Equipment Area: Direct troops to remove and align packs and excess equipment. Direct firing personnel to Station # 1.

(c) Station # 1: Review Safety Regulations in general and those peculiar to the Transition Range (FM 23-5, par 191). Orient soldiers on the course to be fired. Direct twelve (12) trainees to Table VI (6 wet firing and six (6) dry firing).

(d) Table VI: Conduct firing of Table VI as prescribed in Annex # 1. Require the dry firers to follow the course simultaneously with the actual firers. Direct personnel to Station # 2. Present score sheets to Critique Officer.

(e) Station # 2: Critique Firing. Direct personnel who display noted deficiencies to Station # 1A for additional instructions. Orient personnel on Table VII. Direct personnel to Table VII. Present scorers with score sheets.

(f) Table VII: Conduct firihg of Table VII as prescribed in Annex # 1. Require dry dirers to fire the course simultaneously with the actual firers. Direct personnel to Station #3. Present score sheets to Critique Officer.

(g) Station #3: Critique Firing. Direct personnel who failed to qualify to Station # 1A for further instruction. Orient personnel on Table VIII. Direct personnel to Table VIII. Present scorers with score sheets.

(h) Table VIII: Conduct firing of Table VIII as prescribed in Annex # 1. Require firer to "stand fast" between shots. No dry firing will be done. Direct personnel to Station # 4. Present score sheets to Critique Officer.

(i) Station # 4: Critique firing. Direct personnel who failed to qualify to Station # 1A. Orient personnel on Table IX. Direct personnel to Table IX. Present scorer (coach) with score sheets.

(j) Table IX: Conduct firing of Table IX as prescribed in Annex #1, (also see Annex # 4). No dry firing will be done. Direct personnel to Station #5. Present score sheets to Critique Officer.

(k) Station # 5: Critique firing. Direct personnel who failed to qualify to Station # 1A. Inspect rifles and search men for live ammunition. Require men to clean rifles. Inspect rifles for cleanliness. Direct men to Station # 6.

(l) Station # 6: Orient men on duties of target operators or coaches. Relieve target operators or coaches of a complete lane when sufficient personnel arrives.

(m) Station # 1A: (This Station may be incorporated with Station # 1 if desired)
Concurrent instruction will be presented on: Rapid setting of sights. Assuming firing position quickly. Rapid loading. Immediate action. Firing from sitting and kneeling positions. Firing

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By CO NARA Date 3-22-01

from "off-hand" and "hip-firing" positions. Officer in charge of training will replace men in flow when he believes them able to qualify.

For Pits:

(n) Tables VI, VII and VIII:
The officer in charge of the control tower for each table will:

Supervise instruction of pit detail.
Supervise drawing of targets and red flags.
Demonstrate the operation of a pit to include target operation and communication.
Supervise the installation of the pit detail in their respective pits.
Conduct sufficient number of dry runs to insure both efficient and safe operation.

(o) Table IX - The range officer in charge of this Table will orient and supervise the operation of this detail. Upon completion of firing this exercise, and upon signal by the coach, the target operator will assist in scoring and pasting the hits with the coach.

4. MISCELLANEOUS:

a. Targets are fastened to staves and are operated by men protected in individual pits.

b. At firing points for Tables VI and VII, the following men are the only authorized personnel at each point.

1 Firer (Dry Run) 1 Firer (wet) 1 Telephone Operator
1 Coach (dry run) 1 Coach (wet) 1 Asst Range Officer

c. Coaches:

(1) The coaches in Tables VI and VII will set-off the sights of all men under their control sufficiently to require an adjustment. This adjustment will be accomplished by the firer after he has taken his firing position.
(2) The coach will enforce safety regulations.
(3) The coach will observe firing technique.
(4) The coach will note errors on the score sheet.
(5) The coach will observe dry firers (where applicable) and make any necessary corrections.

d. During Table VIII and IX, "Battle Sights" will be set and left there during the entire course.

e. Pits: Pits will not be used as latrines.
Pits will be policed at the completion of each day's firing.

f. Scores: Score sheets (See Annex #2) will be reproduced by units concerned.

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ANNEX # 1

TO

INSTRUCTION ON THE PROCEDURE IN
THE USE OF RIFLE TRANSITION RANGE # 1

1. Courses:

Table VI:

RANGE (YARDS)	TIME	SHOTS 1	TARGET 2	POSITION	SLING
200	60 Secs	5	3E	Kneeling or Sitting From Standing	Loop
300	60 Secs	5	3E	Prone from Standing	Loop
500	60 Secs	5	3E	Prone from Standing	Loop

1. The rifle is to be loaded with a partial clip containing five rounds.
2. Targets should be approximately five yards apart and as near the prescribed range as terrain permits.

Table VII:

RANGE 1 (YARDS)	TIME SECONDS	SHOTS 2	TARGET	POSITION	SLING
	120	10	6E	Prone from Standing	Loop

1. Two targets between ranges of 200 and 300 yards, two targets between 300 and 400 yards, and two between 400 and 500 yards. Each pair of targets will be staggered and separated in depth from 25 to 50 yards.
2. The rifle is to be loaded initially with a partial clip of two rounds and reloaded with a full clip.

TABLE VIII:

RANGE (Yards)	Time 1 Seconds	Shots 2	TARGET	POSITION	SLING
100	3 Secs per Round	5	E	Standing	None

1. Target will be exposed for 3 second period during which rifle will be brought to the shoulder and round fired.
2. Rifle is locked and loaded before start of exercise.
3. Rifle is held at the ready and brought to the shoulder for firing each round.

TABLE IX:

PHASE LINES	TARGETS SINGLE	DOUBLE	TRIPLE	RANGE (YARDS)	SHOTS	TARGET	POSITION	SLING
2-3	2	1	0	5-70	4	E	Off-hand	None
3-4	0	1	2	5-70	8	E	Hip	None
4-Final	2	3	0	5-70	8	E	Off-hand	None

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Annex 1 to Instruction on the Procedure in the Use of Rifle Transition Range # 1 (contd)

a. A single silhouette represents an enemy rifleman.
A double silhouette represents an enemy automatic rifle team.
A triple silhouette represents an enemy machine gun.

b. Targets will be exposed in sequence upon signal from the coach.
Time of exposure of targets is as follows: (a) Single silhouettes, 3 seconds. (b) Double silhouettes, 4 seconds. (c) Triple silhouettes, 5 seconds.

c. Phase lines are placed after the 4th, 12th, and 20th targets to assist in the enforcement of safety precautions. (See Annex # 1.)

d. Firer starts from the prone position, with rifle locked, 4 rounds in the rifle, and two, 8 round clips in his belt.

e. On signal from the range officer, the firer rises and moves down the lane on the alert. As targets are exposed the firer fires one round at each silhouette between phase lines two and three from the "Off Hand" position. He then reloads and fires from the "Hip" firing position at each silhouette between phase lines three and four. He reloads again and fires from the "Off Hand" position at each silhouette between the fourth and final base lines.

f. A coach accompanies each firer, to insure control, to assist the range officer and to critique the firer at the end of his firing.

g. Safety Precautions:
The firer will be instructed prior to firing that targets are not more than 3 feet high, targets will be on same level as ground, targets to front, right or left front only.

2. Scoring:

a. Table VI:
For each target hit . . . . . 1 Point
For each unexpended round if all targets are hit. . . . 1 Point

b. Table VII: For each target hit
Between 200 and 300 Yards . . . . . 1 Point
Between 300 and 400 Yards . . . . . 2 Points
Between 400 and 500 Yards . . . . . 3 Points
For each unexpended round if all targets are hit. . . 3 Points

c. Table VIII:
For each target hit . . . . . 1 Point

d. Table IX:
For each target hit . . . . . 1 Point
For each unexpended round if all targets are hit. . . . 1 Point

e. Satisfactory Scores:

Table	Satisfactory Score
VI	Not applicable
VII	8
VIII	4
IX	8

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Annex #2 to Instruction on the Procedure in the Use of Rifle Transition Range #1

SCORE SHEET

TRANSITION FIRING M-1

Name_____ Plat_____ Co_____ Bn_____ Regt_____

Date:_____

	TABLE VI	TABLE VII	TABLE VIII	TABLE IX
500 yds	1 1 1 (3)	3 3 (6)		
300 yds	1 1 1 (3)	2 2 (4)		
200 yds	1 1 1 (3)	1 1 (2)		
100 yds		1 1 1 1 1 (5)	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 (20	
	Add 1 point for each un-expended round if all targets are hit.	Add 1 point for each un-expended round if all targets are hit.	Add 1 point for each un-expended round if all targets are hit.	

COACH: CHECK ERRORS MADE

	TABLE VI	TABLE VII	TABLE VIII	TABLE IX
Sling				
Loading				
Positions				
Sight Aiming				
Trigger Squeeze				
Flinching				
Jerking				

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Annex # 2 to Instruction on the Procedure in the Use of Rifle Transition Range # 1 (contd)

	TABLE VI	TABLE VII	TABLE VIII	TABLE IX
Breathing	_____	_____	_____	_____
Rate of Fire	_____	_____	_____	_____

COACH _____

Asst Range Officer _____
(Initial)

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Annex # 3 to Instruction on the Procedure in the use of Rifle Transition Range # 1.

Annex # 3.

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Annex # 4 to Instruction on the Procedure in the use of Rifle Transition Range # 1.

NOTES:

1. As many lanes as local conditions permit may be used- average time per firer is 5 minutes.

2. Firer must be required to engage targets immediately after crossing each phase line.

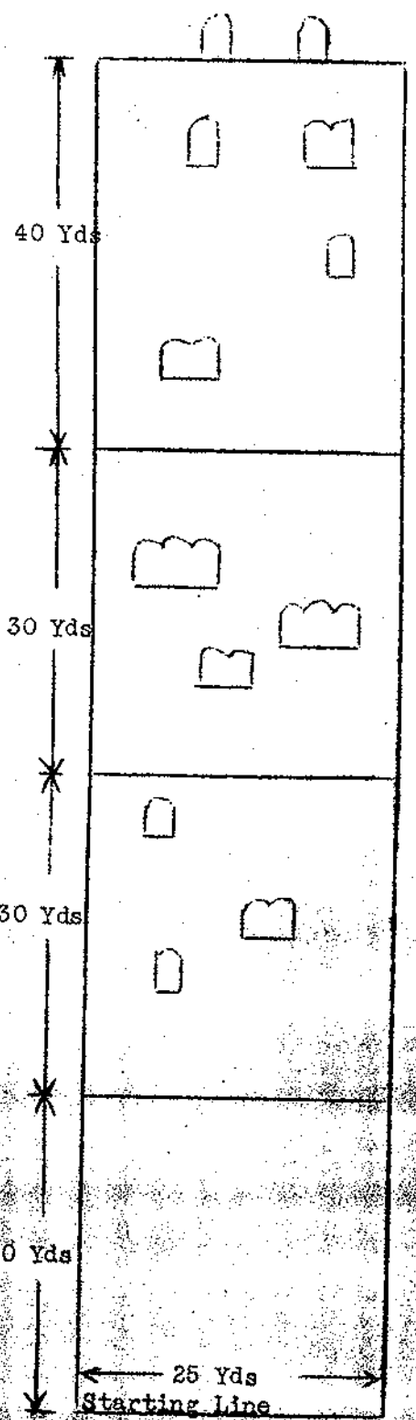

DIAGRAM FOR TABLE IX

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By CO NARA Date 3-22-04

April 10, 1951

HEADQUARTERS 31ST INFANTRY DIVISION
Office of The AC of S, G-2
Fort Jackson, S. C.

DDACB 10 April 1951

1. INTELLIGENCE TRAINING:

a. Twenty-One (21) officers and one hundred eight (108) enlisted men, division intelligence personnel, are currently attending Intelligence Courses at The Army General School, Fort Riley, Kansas and other service schools. Quotas have been approved for three (3) officers and fifty (50) enlisted men to attend intelligence courses at The Army General School commencing 25 April 1951.

b. All Division personnel are currently receiving Intelligence Training in accordance with appropriate ATP's.

c. A Division Intelligence School will be conducted during Unit Training Cycle, 11 June to 20 August 1951 inclusive.

2. AGGRESSOR:

a. Uniforms: There are approximately four hundred (400) AGGRESSOR Uniforms, complete with all accessories currently available for issue. Requisition for eleven hundred (1100) additional uniforms has been approved. 31st Division Quartermaster will coordinate issue of all AGGRESSOR Uniforms through the AC of S, G-2.

b. Simulation Equipment and Ammunition: Simulation Equipment and Ammunition have been requisitioned for use in AGGRESSOR Training.

c. AGGRESSOR Training:

(1) All AGGRESSOR training will be supervised and coordinated by AC of S, G-2.

(2) The AGGRESSOR Team from AGGRESSOR Headquarters, Fort Riley, Kansas, will present a demonstration for 31st Infantry Division 29 April - 5 May 1951 inclusive.

3. CLEARANCES:

Immediate Access clearances for access to TOP SECRET matter have been processed for the General Staff. Interim clearances for access to Secret matter have been processed for two hundred (200) officers and enlisted men of this division. Seven hundred eighty-five (785) Personal History Forms of division personnel have been processed to date. Cryptologic Clearance Requests have been processed for twenty-five (25) officers and enlisted men.

RG 337, Hq. Army Ground Force, Entry 1, Insp. Repts, 1951
BOX 37

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10 April 1951

4. MAPS:

a. A sufficient number of Topographic maps has been received and distributed.

b. Requisitions for Photo maps have been made. Third Army reports expected delivery date 15 April 1951.

Lother B. Sibert

LOTHER B. SIBERT
Lt. Col., GSC
AC of S, G-2

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By G NARA Date 2/23/07

CONDENSED TRAINING REPORT

1. Pre-cycle (cadre) training was completed on March 3rd and on March 5th this division started basic training with a strength of approximately 21,000; all fillers having been received in time to start on schedule. Training progressed according to Master Training Program for National Guard Divisions, dated October 1950, until 23 March, when we were directed to complete PCR qualifications in 14 weeks. A revised schedule was issued and all units are now in the 6th week of basic training.

2. FACTORS AFFECTING TRAINING:

a. SHORTAGE OF TRAINED PERSONNEL:

(1) As of 10 April 1951 this division had 416 officers and 660 enlisted men in attendance at service schools off the post. 385 enlisted men are attending schools on the post. It is believed the handicap created by this situation will be more than repaid when these school trained personnel return to the division.

b. INSUFFICIENT TRAINING AREAS:

(1) While much has been said about securing additional maneuver area the fact remains that we are reaching that stage of training where more maneuver area is required than is now available. The leasing of the proposed strip South of the reservation will remedy this situation.

c. FACILITIES:

(1) A definite shortage exists in transition ranges, close combat ranges and combat in cities courses. The division has initiated action to construct two additional close combat ranges with its own forces and thus solve one problem. By firing Saturdays and Sundays we can complete transition firing. But we cannot complete combat in cities fighting in the required time unless given priority on the course.

(2) There is a shortage of class room space, ordnance shop facilities and storage space.

(3) The original Field Artillery range was inadequate. Current negotiations with post may correct this situation.

(4) There is no range available for AAA firing, nor 90MM tank firing.

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HEADQUARTERS 31ST INFANTRY DIVISION
Office of AC of S, G-4
Fort Jackson, South Carolina

10 April 1951

SUBJECT: Supply Status, 31st Infantry Division

TO : Chief of Staff

1. One of the major problems is lack of Tactical Vehicles, especially for the 31st Division Artillery, in connection with Service Practice RSOP's being conducted. A letter has been written to the Commanding General, Ft. Jackson, South Carolina, in reference to this subject.

2. Division Artillery is authorized 100% TO&E on 155 and 105 Howitzers, which are on requisition, but is only authorized 30% on Prime Movers for said weapons. A letter was written to Commanding General, Ft. Jackson, requesting 100% TO&E for Tractors, high speed, 13 Ton M5A3, Prime Movers, also. Post has submitted requisitions on above basis.

3. Bayonets are issued on basis of one (1) per Rifle M-1 up to full TO&E strength, and one (1) per ten (10) men for balance of fillers. It is recommended that Bayonets be issued on the basis of one (1) per Rifle M-1 authorized. Knives, Bayonet M-4 are authorized on basis of one (1) per ten (10) Carbines. It is recommended that knives be issued on a basis of one (1) per Carbine.

4. Suspenders and Combat Packs are in short supply. General Sullivan called Army Field Forces to ascertain status of these items, during his visit with the 31st Division last week. General Sullivan indicated that these items would be available at an early date.

5. There has been a critical shortage of Combat Boots, but it is believed that each individual within the Division has at least one (1) pair of issue footwear. Said supply is improving gradually.

6. Steel Helmets were in short supply, but POst received 6,000 yesterday, which should practically complete requirements of the 31st Division.

7. The 31st Division is vitally in need of class room facilities. A letter has been written to Commanding General, Ft. Jackson, requesting ten (10) assembly tents be issued this Division for said purpose.

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8. As mentioned in Par 1, lack of vehicles within the Division is one of the shortages that affect training, but this Division has received copies of Shipping Documents, covering 132, 2½ Ton, 6x6, M-34 Trucks, and a copy of a telephone conversation which indicates an additional allotment of 238 Trucks.

9. With exception of aforementioned items, the supply status of the Division as a whole is satisfactory.

Clifford P. Morrison

CLIFFORD P MORRISON
Lt. Col. GSC
AC of S G-4

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By CPKARA Date 2/23/07

REDUCED TABLE OF ORGANIZATION

The 31st Division is organized under the reduced strength Table of Organization for an Infantry Division. This Division has approximately 50% overstrength in enlisted men. There are 416 officers away at Army Field Forces' Schools. It was determined that it would be far better to have the Division weak in the beginning and strong in the end as a policy, and therefore a determined effort was made to fill every available quota. Naturally with a reduced T/O strength in officers, further reduced by officers attending school, the problem of training has placed a tremendous burden on those officers remaining. They have accepted this challenge willingly.

It is recommended that an Infantry Division be allowed the full T/O strength in officers. The following list contains the minimum number of officers which should be restored to the T/O in the event the full T/O is not allowed:

Division Headquarters - 3 Capt. Assistants for the G-2 and G-3 Sections, 1 Lt. Postal Officer.

QM Co - 1 Lt. Platoon Leader.

Signal Co - 1 Lt.,Message Center.

Div. Arty. Hq. - 1 Capt. Liaison

AAA AW Bn Hq. - 1 Capt. Adjutant

AAA AW Btrys - 2 Lts. each

Engineer Bn. Hq. - 1 Capt. and 3 Lts. (Adjutant, Assistant S-2, Assistant S-4 Liaison Officer).

Engineer Co. - 1 Platoon Leader

155 MM FA Firing Btrys - 1 Lt. each.

105 MM FA Btrys - 1 Lt. each Firing Btry.

Infantry Bn. Hq. - 1 Capt. Adjutant and 1 Lt. Motor Officer.

Infantry Tank Co. - 2 Lts. Platoon Leaders.

Tank Bn. Hq. - 1 Capt. Adjutant

Tank Bn. Companies - 2 Platoon Leaders each.

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Appendix C: Interview Records

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	16 June 2004
Interview By:	Susan Burtnett/Leigh Blake
Person Interviewed:	Mark Dutton, Natural Resource Specialist Fort Jackson Wildlife Office

Discussion:

Mark Dutton provided information regarding cultural resources at Fort Jackson. He provided GIS maps showing archeological/cultural resource sites (both eligible and ineligible sites).

The maps showed cemeteries located at the installation. Other than a cemetery located north of the Hand Grenade Court No. 2 and the Rifle Grenade Range NR2 in the Weston Lake Area (on the east side of Washington Light Infantry Road), no cultural resources were identified in the other that operational areas evaluated as part of the HRR.

Duded areas were also shown on the maps. These areas are noted so the natural resource staff were aware of the areas at the installation where they are not allowed to enter due to the potential to encounter UXO.

In the Cantonment Area, the area adjacent to Chestnut Road was not surveyed because it was determined to be too disturbed to do a routine cultural resources survey. The forested areas in the Cantonment Area (i.e., the areas where the 600-Yard, 1000-Yard and Machine Gun Ranges and Live Hand Grenade Court 2 are located) have been surveyed. Mark noted that everything east of Chestnut Road has been surveyed, except for areas were structures have been constructed and an irregular shaped area south/southeast of Hilton Field that was shown as duded on an archeological inventory map dated 1990. (Note: this area is not shown as duded on any other maps reviewed.)

The majority of the area near and including Fort Jackson Flight Club (FJFC) was surveyed, with the exception of the duded area adjacent to and east of the FJFC. No potentially eligible or eligible sites were found (surveyed).

The Weston Lake Area, including the areas where the CTT sites (the Mortar Range, Submachine Gun Area, and Hand Grenade Court No 2) are located, has been surveyed. The only cultural resource site identified was the Brazelle cemetery located north of the Rifle Grenade Range NR2. The Rifle Grenade Range NR2 was not surveyed because it is shown as duded on installation maps. The installation maps actually show 3 separate duded areas identified as Rifle Grenade/Hand Grenade/Rifle Grenade in this area.

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	16 June 2004
Interview Made By:	Susan Burtnett/Leigh Blake
Person Interviewed:	Lahiri Estaba, IRP Manager Fort Jackson Environmental Department

Discussion:

Lahiri Estaba provided information regarding Fort Jackson's Installation Restoration Program (IRP) and the sites located near the MMRP ranges/sites where environmental investigations (soil/groundwater sampling) have been conducted. He also provided copies of relevant IRP documents for the team's use.

SWMU 1 (Sanitary Landfill No. 3) and SWMU 34 (Building 2183, Vehicle Wash Pad and Oil Water Separator) are located east/northeast of the Cantonment Area MMRP sites/ranges. In addition, background soil (surface and near-surface) samples were collected near this area. B-6 was obtained approximately ½ mile north of the 1000-Yard Range along Chestnut Road and B-5 was obtained approximately ½ mile south of the 1000-Yard Range.

There are no IRP sites near the FJFC (nothing within at least 5 miles).

SWMU 17 (Inchon OB/OD) is located approximately 5 miles east of the Mortar Range and Submachine Gun Area. Two phases of RFI have been completed and conditional approval has been received from the State. Mr. Estaba noted that the reports have good general soils and groundwater information.

SWMU 21 (Inactive Range 17 Landfill) is also located approximately 5 miles east of the Mortar Range and Submachine Gun Area. Groundwater monitoring has been conducted at this site.

There are no IRP sites west of Weston Lake (i.e., nothing near the Hand Grenade Court No. 2 and Rifle Grenade Range NR2).

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	June 16, 2004
Interview Made By:	Susan Burtnett/Leigh Blake
Person Interviewed:	John Maitland, Lead Forester Fort Jackson Forestry Office

Discussion:

Mr. Maitland was familiar with the areas where the MMRP sites/ranges are located, especially the sites west of the Weston Lake Area. He provided historical aerial photographs of the different sections of the installation where the MMRP sites/ranges are located (from the Forestry Office aerial photograph collection). During a follow-up site visit in July, relevant portions of the aerial photographs were copied and they served as a primary source of site-specific information for the HRR.

The area east/southeast of the Cantonment Area sites/ranges has been logged and replanted with pines at least once in the past.

Recently, slash pines have been planted at and east/southeast of the FJFC.

The sites/ranges located west of Weston Lake (the Hand Grenade Court No. 2 and Rifle Grenade Range NR2) have been surface cleared. Recently, the Rifle Grenade Range NR2 was logged (the area south of the cemetery was logged).

Mr. Maitland noted that there were inconsistencies in how the hand grenade and rifle grenade ranges are shown on the installation maps over the years. The team talked with him about the different ways the ranges are shown. The CTT Inventory identified one range (Rifle Grenade Range NR2), but the previous installation maps show three separate ranges in this area.

The CTT Inventory map shows the Hand Grenade Court No. 2 by Fire Break 12. Mr. Maitland did not remember anything in that area. He noted that is has been logged twice. Slash pine has been planted (Slash pine plantation in the 1970s) and the soil has been significantly disturbed down to at least one foot. This is also the case at the Rifle Grenade Range NR2 where logging has taken place.

Based on review of the aerials, it doesn't look like there was any range activity north of Fire Break 9. The area north of Fire Break 9 has been planted with slash pine, as well.

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	17 June 2004
Interview Made By:	Susan Burtnett/Leigh Blake
Person Interviewed:	SSGT Mark Wood Fort Jackson Range Control

Discussion:

SSGT Wood escorted the data collection team during a limited visual survey of several of the ranges. These included:

- Fort Jackson Flight Club (FJFC)
- Hand Grenade Court No. 2
- Rifle Grenade Range NR2

SSGT Wood provided general descriptions of current uses in the vicinity of these ranges. He noted that the FJFC is used by a club for flying remote controlled model airplanes. The area near the Rifle Grenade Range NR2 has Red Cockaded Woodpecker habitat. He did not have knowledge of historical range use since he has been at Fort Jackson for only the last 3 years.

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	18 June 2004
Interview By:	Susan Burtnett/Leigh Blake
Person Interviewed:	Jim McCracken, NEPA Coordinator Fort Jackson Environmental Department

Discussion:

Jim McCracken provided information regarding the past use of other than operational ranges in the Cantonment Area, the Fort Jackson Flight Club, and the Weston Lake Area.

Cantonment Area
The ranges used during the time period when the installation was Camp Jackson were discussed. These included the 1000-Yard, 600-Yard, 300-Yard, and Machine Gun Ranges. Mr. McCracken noted that the Baseball Field and Soccer Field were constructed in the area where these ranges were located in approximately 1980. The elementary school was constructed later.

Fort Jackson Flight Club (FJFC)
There were several ranges that existed in the area of the FJFC. In addition to the machine gun range, there was a 40mm range north of the area currently used by the FJFC.

Weston Lake Area
The Mortar Range, Submachine Gun Area, Rifle Grenade Range NR2, and Hand Grenade Court No. 2 were discussed. The team noted that the Rifle Grenade Range NR2 is shown differently depending on the map reviewed.

Mr. McCracken noted that there was a long wall located behind the commissary, behind the officer housing area, that he had been told may have been used as a range. Note: the team walked this area on a return site visit in July. The team walked along the wall and noted no bullet holes in the concrete or other visual signs of use as a range. The team did note that the area east of the wall was planted with bamboo at some time in the past. The bamboo plants were well established.

Mr. McCracken provided the data collection team with a map showing the Cantonment Area (Cantonment Area, Fort Jackson, SC, Sheet 1 of 3, September 1945, Army Map SVC, War Department). He also noted that an area located south of Hilton Field was shown on a 1990 map, but this area was not identified on any other maps.

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	18 June 2004
Interview By:	Susan Burtnett/Leigh Blake
Person Interviewed:	Jim Wyatt, Range Control Officer Fort Jackson Range Control

Discussion:

Mr. Wyatt provided maps and other documents (including range sketches) regarding the MMRP ranges/sites. The team discussed the historical range uses and range locations in the following areas:

Cantonment Area:
Mr. Wyatt noted that the area where the Live Hand Grenade Court 2 is located was used for Field Fortification training in the 1970s and 1980s. As such, the area has been significantly disturbed since its use as a hand grenade court.

The team discussed the 300-Yard Range that was identified on archival documents obtained as part of the HRR. Mr. Wyatt agreed that this appears to be an additional range used in the Cantonment Area in the early 1900s.

FJFC:
Mr. Wyatt provided information regarding use of this area as the Saint Lo Range and Salerno Range. The Saint Lo Range was used in 1965 as a combat indoctrination (C/I) range, not as a machine gun range. Later it was converted to the machine gun range. The Salerno Demonstration Range was depicted on a range sketch provided by Mr. Wyatt.

Weston Lake Area:
Mr. Wyatt agreed with the team that the Hand Grenade Court No. 2 and Rifle Grenade Range NR2 are inconsistently shown on installation maps. Review of historical maps and aerial photographs with Mr. Wyatt indicated that hand and rifle grenade use occurred east of Washington Light Infantry Road in the areas where these sites are located.

Historical photographs were reviewed by Mr. Wyatt. Mr. Wyatt noted that he was at Fort Jackson from 1956 – 1966.

He noted that in 1958 training at the installation was moved north so it was centrally located. Everything to the east was closed and the direction of fire was directed that way.

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	28 July 2004
Call Made By:	Leigh Blake
Person Called:	Jim Murphy (803) 751-5614 Fort Jackson Engineering Office

Discussion:

During a telephone conversation, Leigh Blake spoke to Jim Murphy about the 1957 Basic Information for Master Plan, Range, and Training Areas Map (June 1, 1957) that he provided to the team during the Phase 3 CTT Inventory data collection site visit. The map legend on the copy of the map that the data collection team had obtained is faded in several areas. We needed clarification on the missing information for the HRR. Mr. Murphy stated that he would look for the map to see if he could find a better copy.

Note: Ms. Blake followed up with a call to the Fort Jackson Museum (Ms. Bessie Williams and Mr. Fred DeMag) where she was able to obtain the missing information by telephone as museum personnel looked at the copy of the map and helped interpret/convey the missing information. Ms. Williams and Mr. DeMag were also helpful during the site visit in providing historical documents and maps for review while the team was at the Fort Jackson Museum.

Interview Record

Project:	Military Munitions Response Program - Site Inspection
Site:	Fort Jackson, SC
Contract No.:	DACW41-02-D-0003
Delivery Order:	DA02
Date:	30 July 2004
Call Made By:	Leigh Blake
Person Called:	Tom Peel (803) 751-7261 Fort Jackson Real Property Office

Discussion:

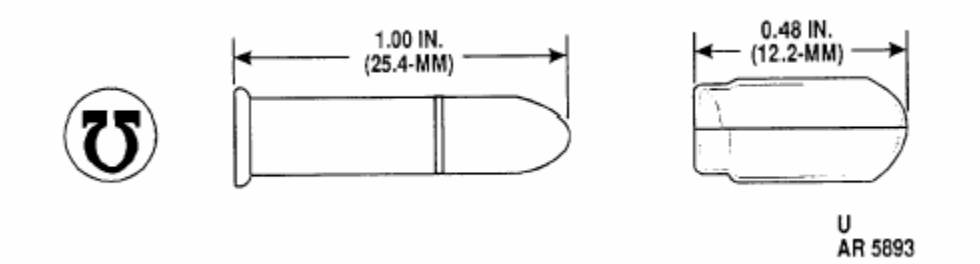
During a telephone conversation, Leigh Blake spoke to Tom Peel about Real Property records for range use and range closure dates. Mr. Peel stated that Leigh would need to speak with Jim Wyatt at Range Control for that information. He stated that he did not have information on ranges.

Mr. Peel noted that there have been no property boundary changes associated with the team's area of interest.

Appendix D: Munitions Technical Data Sheets

Ordnance Technical Data Sheet

.22 Caliber Small Arms



Nomenclature: .22 Caliber Small Arms Ammunition
Ordnance Family: Small Arms
DODIC: A086
Filler: None
Filler weight: None
Item weight: 416 g (416 grain)
Diameter: 5.58 mm (.22 in)
Length: 25.40 mm (1 in)

Usage: Sub-caliber Rifle M2A1; Caliber .22 Rifle; Remington Models 40X and M513T; Steven's Model 416-2; Winchester Models 52 and 75; Machine Gun Trainers M3 and M4; pistols for gallery practice and training purposes. The cartridge is intended for use against small game for survival purposes.

Description: BALL Cartridge. The cartridge is identified by a plain bullet tip.

Reference: Army Technical Manual, TM 43-0001-27

Ordnance Technical Data Sheet

U.S. Carbine Cartridge, .30 Caliber, Ball

Nomenclature: U.S. Carbine Cartridge, .30 Caliber, Ball
Ordnance Family: Small Arms
DODIC: Not Provided
Filler: None
Filler weight: None
Item Weight: Not Provided
Diameter: 7.62 mm (.30 in)
Length: 42.67 mm (1.68 in)

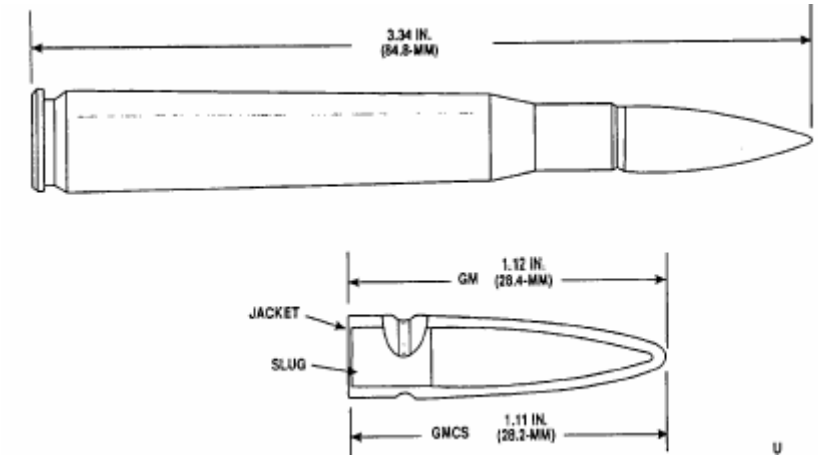
Usage: Standard general purpose small arms ammunition for the M-1 and M1A1 Carbine. The maximum range is 2,012 meters or 2,200 yards.

Description: BALL Cartridge. Ball ammunition is unpainted; tracer ammunition has the tip painted either orange or red.

Reference: Army Technical Manual, TM-9-1300-200.

Ordnance Technical Data Sheet

.30 Caliber Small Arms



Nomenclature:	.30 Caliber Small Arms Ammunition
Ordnance Family:	Small Arms
DODIC:	A212
Filler:	None
Filler weight:	None
Item weight:	26.96 g (416 grains)
Diameter:	7.62 mm (.30 in)
Length:	84.80 mm (3.34 in)

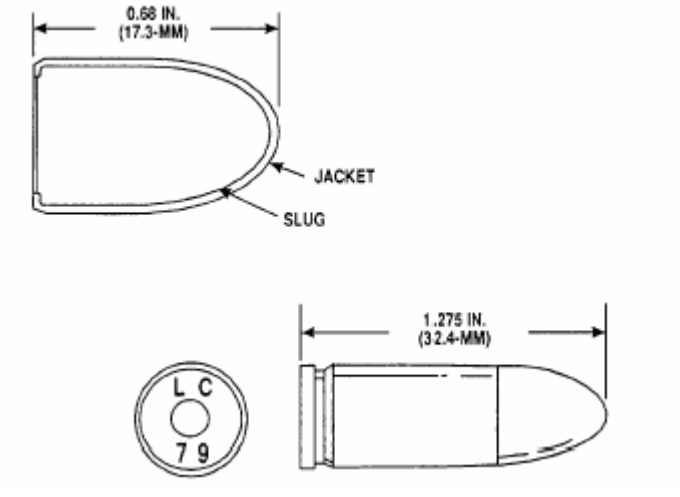
Usage: Machine Guns, Caliber .30, M37, M1919A4 and M1919A6; Rifle, Caliber .30, M1. The cartridge is intended for use against personnel or unarmored targets.

Description: BALL Cartridge. The cartridge is identified by a plain bullet tip.

Reference: Army Technical Manual, TM 43-0001-27

Ordnance Technical Data Sheet

Cartridge Ball .45 Caliber M1911



Nomenclature:	Cartridge Ball .45 Caliber M1911
Ordnance Family:	Small Arms
DODIC:	Not Provided
Filler:	None
Filler weight:	None
Item weight:	332 gr (11.32 oz)
Diameter:	11.43 mm (.45 in)
Length:	32.4 mm (1.275 in)

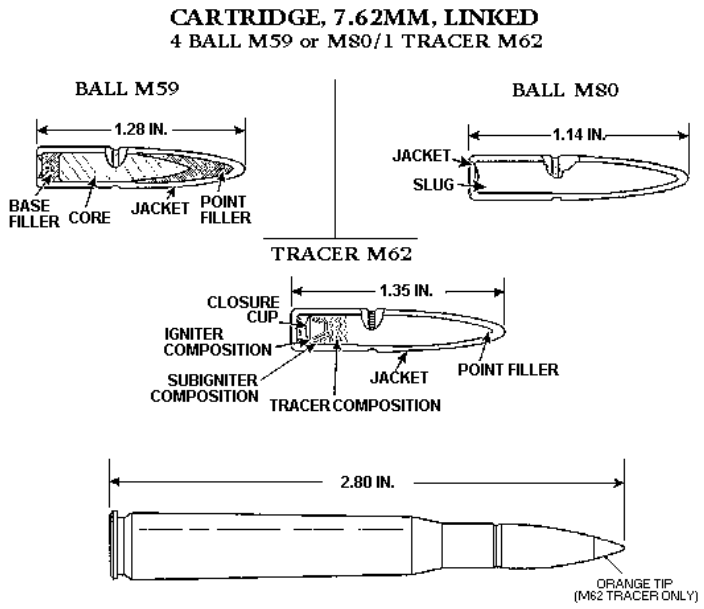
Usage: Submachine Gun, Caliber .45 M3A1; Pistol Caliber .45, M1911A1. The cartridge is intended for use against personnel.

Description: BALL Cartridge. The cartridge is identified by a plain bullet tip.

Reference: Army Technical Manual, TM-0001-27

Ordnance Technical Data Sheet

7.62MM Small Arms



Nomenclature:	7.62MM Small Arms Ammunition
Ordnance Family:	Small Arms
DODIC:	A138
Filler:	None
Filler weight:	None
Item weight:	376.5 g (13.2 oz)
Diameter:	7.62 mm (.3085 in)
Length:	71.12 mm (2.80in)

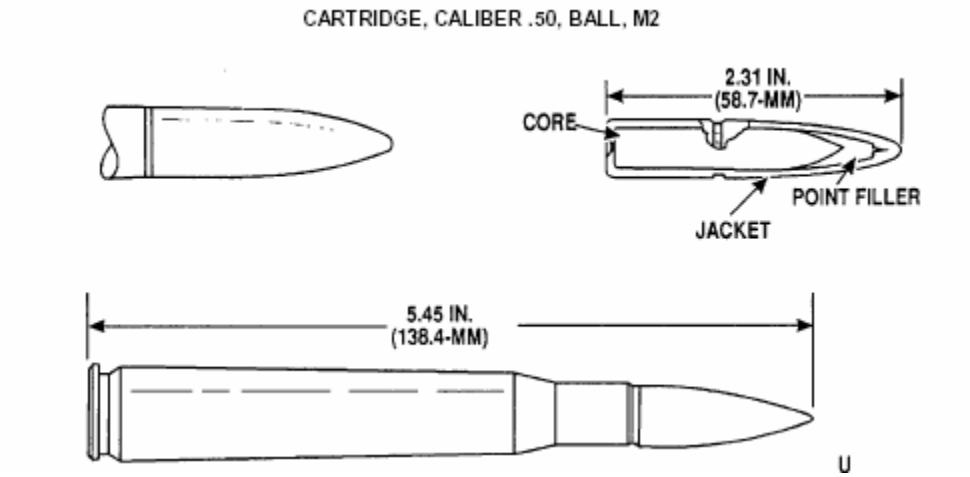
Usage: This cartridge is intended for use against personnel and unarmored targets.

Description: Full metal jacketed bullet and brass cartridge case. Center fired NATO standard small arms.

Reference: ORDATA Online; MIDAS; Army Technical Manual, TM-9-1306-200

Ordnance Technical Data Sheet

.50 Caliber Small Arms



Nomenclature:	.50 Caliber Small Arms Ammunition
Ordnance Family:	Small Arms
DODIC:	A552
Filler:	None
Filler weight:	None
Item weight:	117.50 g (.25 lb)
Diameter:	12.70 mm (.50 in)
Length:	138.40 mm (5.45 in)

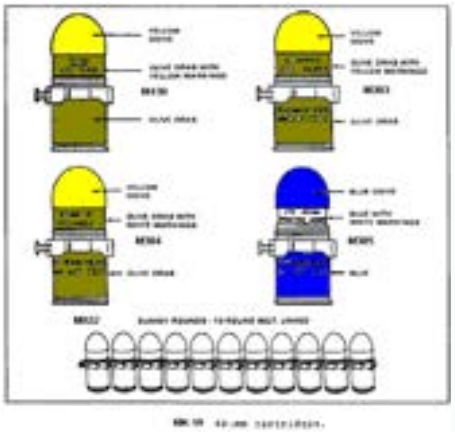
Usage: Machine Guns, Caliber .50, M2 and M85. The cartridge is intended for use against personnel or unarmored targets.

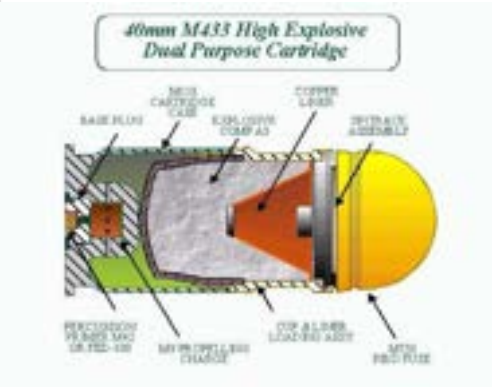
Description: BALL Cartridge. The cartridge is identified by a plain bullet tip.

Reference: Army Technical Manual, TM 43-0001-27

Ordnance Technical Data Sheet

40MM Grenade





Nomenclature: 40MM Grenade
Ordnance Family: Projectile
DODIC: B564
Filler: Explosive Composition A5
Filler weight: ± 57.00 g (2.011 oz)
Item weight: 340 g (11.99 oz)
Diameter: 40 mm (1.57 in)
Length: 79 mm (3.11 in)
Maximum Range: 400 m (437 yds)
Fuze: M550 (Impact Fuze)

Usage: Light Support Weapon. Providing capability for anti-personnel, anti-vehicle, anti-material, and training depending on type of round selected.

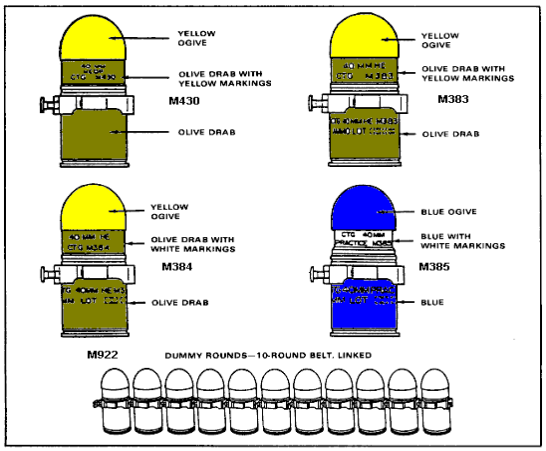
Description: The projectiles are olive drab with anodized gold ogives. The M383 has white markings; the M384 and M677 have yellow markings.

Filler Description: Composition A is a wax coated, granular explosive consisting of TDX and plasticizer wax. It is normally used as a bursting charge.

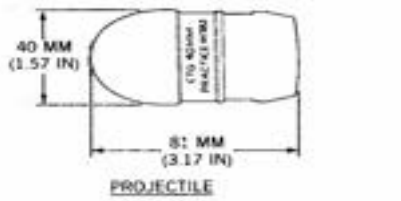
Reference: ORDATA Online

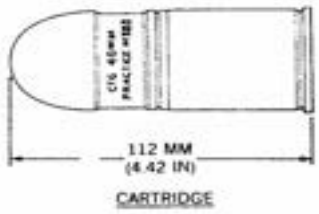
Ordnance Technical Data Sheet

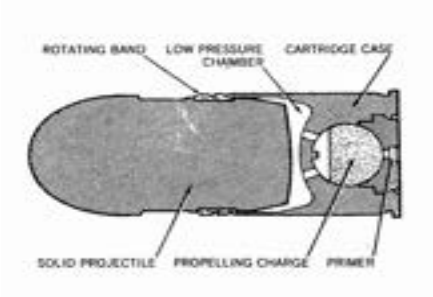
40MM Grenade Practice



MK-19 40-mm cartridges.







Nomenclature:	40MM Grenade Practice
Ordnance Family:	Projectile
DODIC:	B564
Filler:	None
Filler weight:	None
Item weight:	340 g (11.99 oz)
Diameter:	40 mm (1.57 in)
Length:	79 mm (3.11 in)
Range:	50 – 400 m (164 – 1312 ft)
Maximum Range:	400 m (437 yds)
Fuze:	None

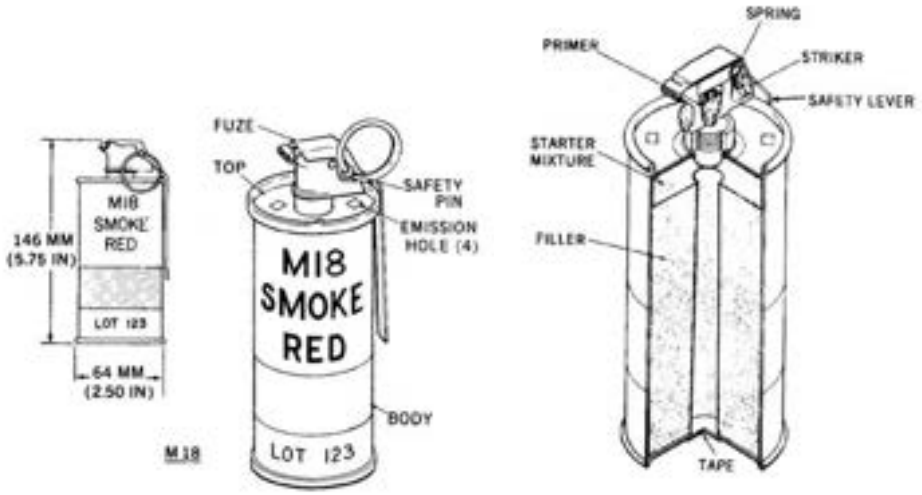
Usage: Light Support Weapon; In-service Training/Familiarization.

Description: The projectile is anodized blue with black markings.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Hand, Smoke, M18



Nomenclature:	U.S. Grenade, Hand, Smoke, M18
Ordnance Family:	Grenades
DODIC:	G955
Filler:	Smoke Mix, Colored
Filler weight:	326.03 g (11.5 oz)
Item weight:	539.00 g (19.01 oz)
Diameter:	64.00 mm (2.52 in)
Length:	146.00 mm (5.748 in)
Maximum Range:	Not Provided
Fuze:	Pyrotechnic, delay-igniting fuze (2 second delay)

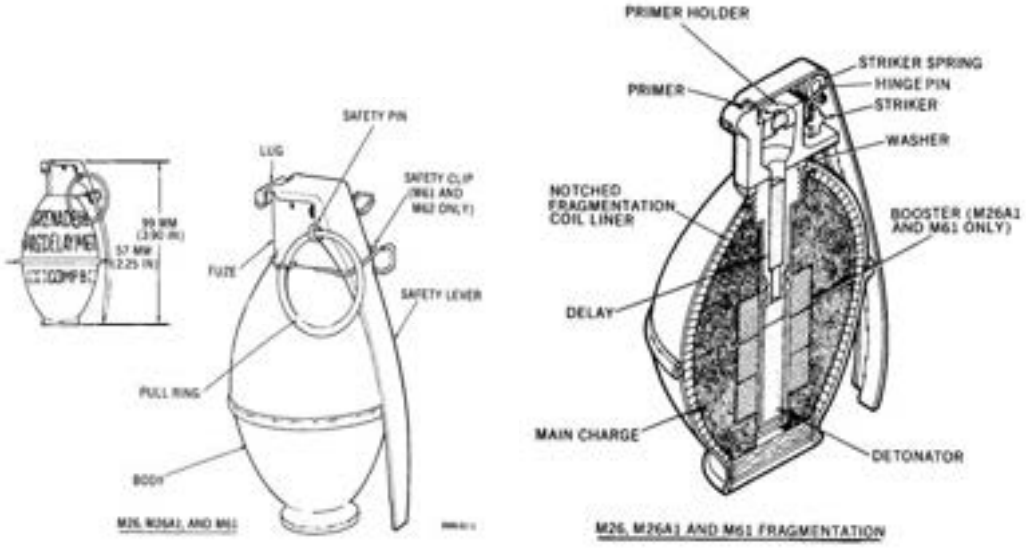
Usage: The M18 is a hand-thrown smoke grenade that emits red, yellow, or violet smoke for 50 to 90 seconds. The M18 may also emit green smoke. These grenades use a pyrotechnic, delay-igniting fuze that provides an approximate 2 second delay.

Description: The M18 grenade may be olive drab with a light green band around the lower body and nomenclature and smoke color stenciled in light green, or light green and stenciled with the color of the smoke. The top of the grenade is painted the color of the smoke.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Hand, Frag, M26, M26A1, M61



Nomenclature:	Hand Grenade, Frag, M26, M26A1, and M61
Ordnance Family:	Grenades
DODIC:	G890
Filler:	Composition B
Filler weight:	164.43 g (5.8 oz)
Item weight:	453.60 g (15.98 oz)
Diameter:	57.00 mm (2.52 in)
Length:	99.00 mm (3.187 in)
Maximum Range:	40.00 m (43.7 yds)
Fuze:	Powder train time delay

Usage: The M26, M26A1, and M61 are fragmentation (frag), antipersonnel, delay-detonating hand grenades that have a notched fragmentation coil liner.

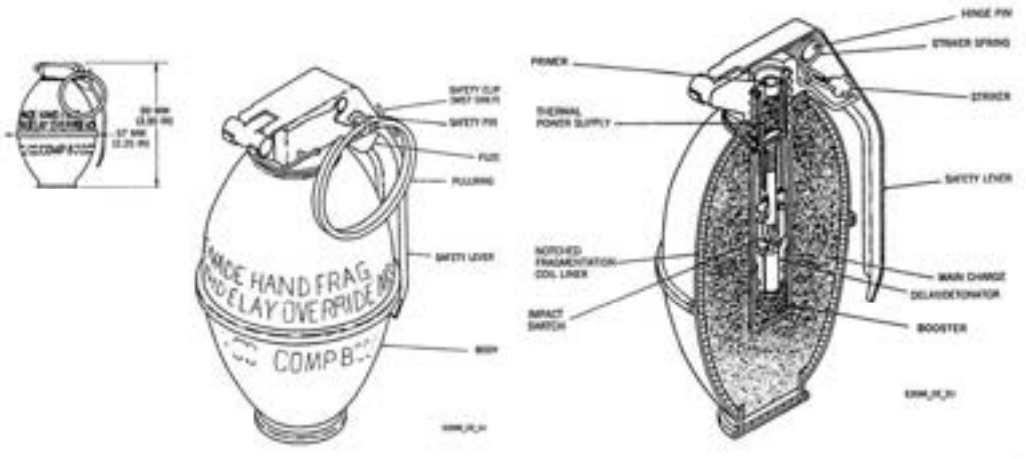
Description: The M26, M26A1, and M61 grenades are painted olive drab, with yellow markings stenciled on the body.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (trinitrotoluene) and RDX (cyclotrimethylenetrinitramine, cyclonite, and hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Hand, Frag, M26A2, M57



Nomenclature:	U.S. Grenade, Hand, Frag, M26A2 and M57
Ordnance Family:	Grenades
DODIC:	Not Provided
Filler:	Composition B
Filler weight:	155.93 g (5.5 oz)
Item weight:	454.00 g (16.01 oz)
Diameter:	57.00 mm (2.244 in)
Length:	99.00 mm (3.898 in)
Maximum Range:	40.00 mm (43.7 yds)
Fuze:	Powder Train Time-delay

Usage: These are fragmentation (frag), antipersonnel, delay-detonating, impact-actuated hand grenades that have a notched fragmentation coil liner.

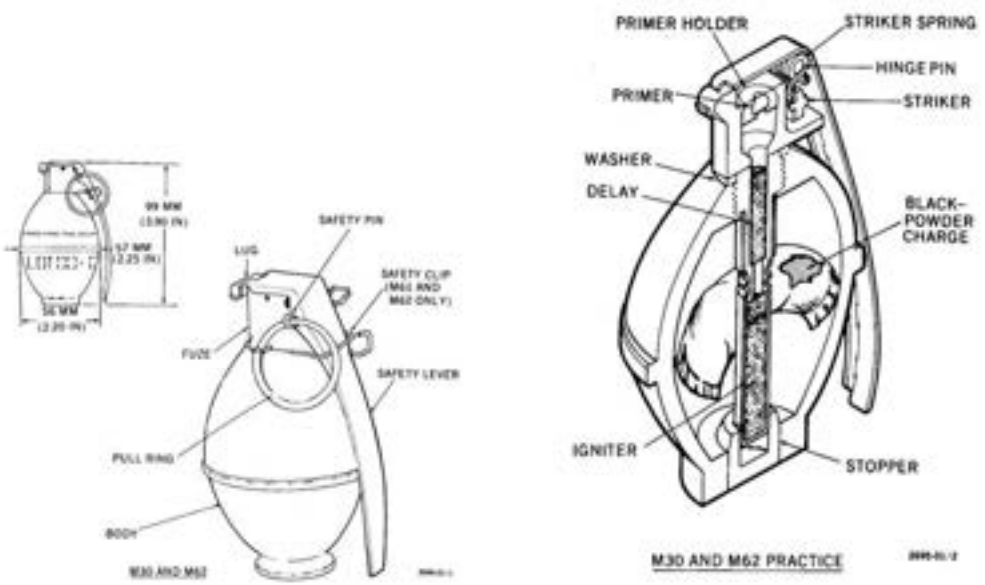
Description: The grenade is olive drab with markings stenciled in yellow. The safety lever is red. The word "IMPACT" is embossed on newer models and may or may not be stenciled in black on older models.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (trinitrotoluene) and RDX (cyclotrimethylenetrinitramine, cyclonite, and hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Practice, M30 and M62



Nomenclature:	U.S. Grenade, Practice, M30 and M62
Ordnance Family:	Grenades
DODIC:	G810
Filler:	Black Powder (Witness Charge Only)
Filler weight:	1.00 g (.03527 oz)
Item weight:	454.00 g (16.01 oz)
Diameter:	57.00 mm (2.244 in)
Length:	99.00 mm (3.898 in)
Maximum Range:	40.00 mm (43.7 yds)
Fuze:	Powder Train Time-delay

Usage: The M30 and M62 are standard, practice, delay-detonating hand grenades. The M30 is the practice version of the M26 and M26A1 grenades; the M62 is the practice version of the M61 grenade.

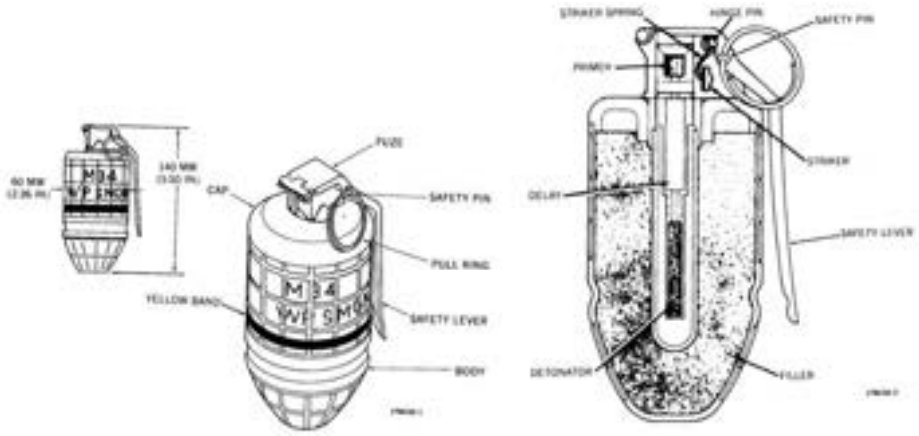
Description: The M30 and M62 grenades are blue, with a brown band around the body or neck. Markings, if any, are stenciled in white.

Filler (Witness Charge) Description: Black powder is a low explosive composed of potassium nitrate or sodium nitrate, charcoal, and sulfur. It is very sensitive to heat, friction, or spark. It was used in safety fuses and practice munitions. It is no longer used as a propellant or bursting charge.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Hand, Smoke, WP, M34



Nomenclature:	U.S. Grenade, Hand, Smoke, WP, M34
Ordnance Family:	Grenades
DODIC:	G937
Filler:	Smoke Mix (White Phosphorus)
Filler weight:	425.25 g (15 oz)
Item weight:	680.00 g (23.99 oz)
Diameter:	60.00 mm (2.362 in)
Length:	140.00 mm (5.512 in)
Maximum Range:	Not Provided
Fuze:	Powder Train Time-delay

Usage: This is a hand-thrown, bursting, smoke-producing grenade. It may also be launched by ground or by airborne grenade launchers.

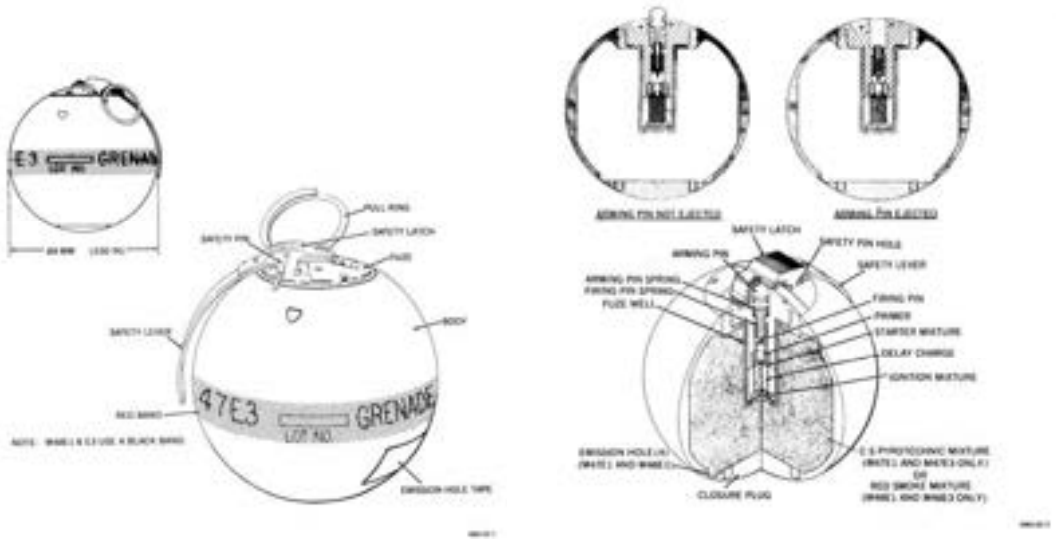
Description: The grenade is painted light green or gray, with one yellow band around the circumference. Nomenclature is stenciled in light red or yellow. The fuze is olive drab with black markings.

Filler Description: White phosphorus (WP) is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Hand, Red Smoke, M48E1 (Obsolete) and M48E3



Nomenclature:	U.S. Grenade, Hand, Red Smoke, M48E1 and M48E3
Ordnance Family:	Grenades
DODIC:	G932
Filler:	Smoke, Red/Pyrotechnic Mix
Filler weight:	142.00 g (5.009 oz)
Item weight:	390.00 g (13.76 oz)
Diameter:	89.00 mm (3.504 in)
Length:	Not provided
Maximum Range:	Not provided
Fuze:	Powder Train Time-delay

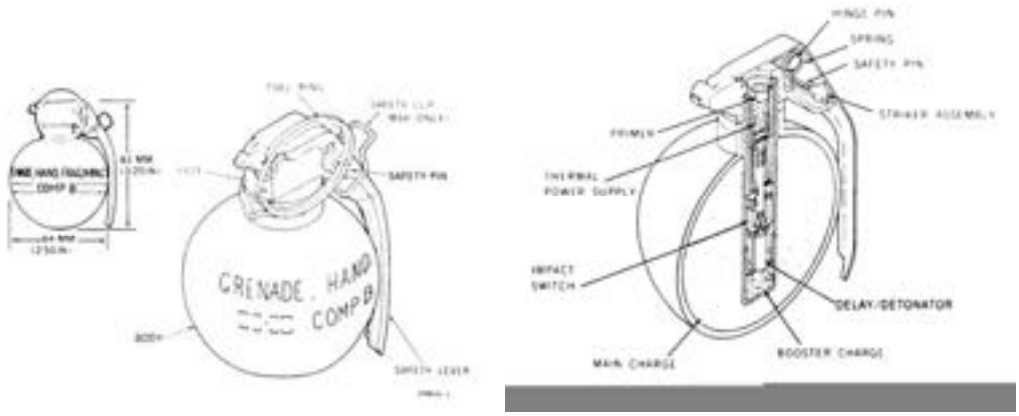
Usage: The M48E1 and M48E3 produce a red-smoke cloud used for training. These are the training grenades for the M47E1 and M47E3.

Description: The M48E1 and M48E3 are painted light green, with a black band and markings stenciled in black.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Hand, Frag, M59 and M68



Nomenclature:	U.S. Grenade, Hand, Frag, M59 and M68
Ordnance Family:	Grenades
DODIC:	G882
Filler:	Composition B
Filler weight:	198.45 g (7 oz)
Item weight:	397.00 g (14 oz)
Diameter:	64.00 mm (2.52 in)
Length:	81.00 mm (3.198 in)
Maximum Range:	Not Provided
Fuze:	Powder Train Time-delay

Usage: These are fragmentation (frag), antipersonnel, impact-activated hand grenades. They use the M217 fuze with a self-destruct delay-detonating feature.

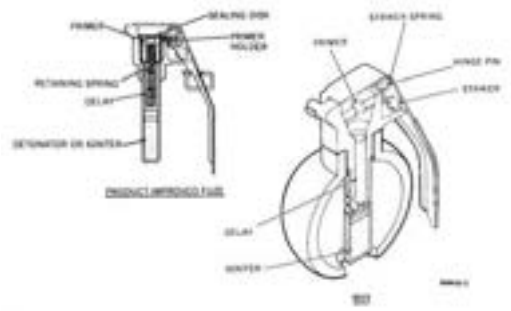
Description: The grenades are olive drab, with markings stenciled in yellow. The fuzes are olive drab with black stenciling.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (trinitrotoluene) and RDX (cyclotrimethylenetrinitramine, cyclonite, and hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenades, Hand, Practice, M69



Nomenclature: U.S. Grenades, Hand, Practice, M69
Ordnance Family: Grenades
DODIC: G918
Filler: None
Filler weight: None
Item weight: 397.00 g (13.37 oz)
Diameter: 64.00 mm (2.52 in)
Length: 90.00 mm (3.543 in)
Maximum Range: Not Provided
Fuze: Powder Train Time-delay

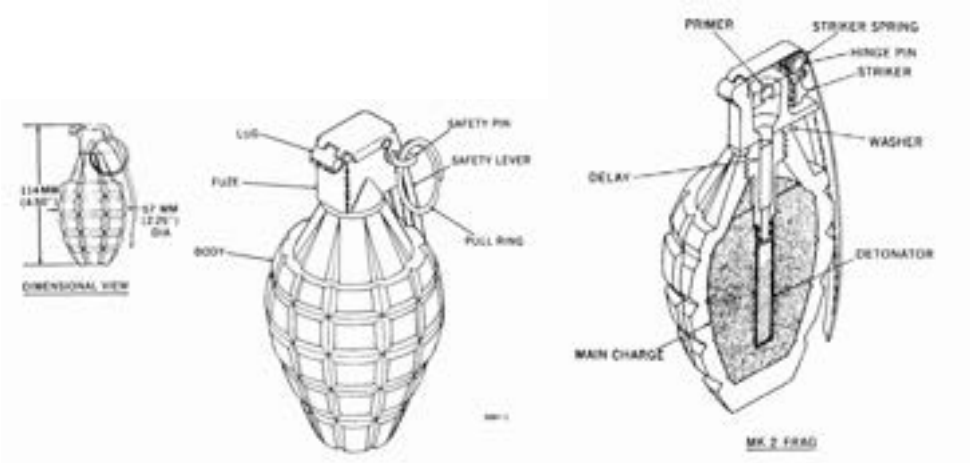
Usage: The M69 is a standard-delay practice version of the M33 and M67 grenades. The M33 and M67 are fragmentation (frag), antipersonnel (apers), delay-detonating hand grenades.

Description: The M69 is blue with a brown band around the body or neck.

Reference: ORDATA Online

Ordnance Technical Data Sheet

MK 2 Grenade, Hand, Antipersonnel



Nomenclature:	MK 2 Grenade, Hand, Antipersonnel
Ordnance Family:	Grenade
DODIC:	G890
Filler:	Flaked TNT
Filler weight:	± 56.70 g (2 oz)
Item weight:	589.68 g (1.3 lbs)
Diameter:	57.00 mm (2.244 in)
Length:	114.00 mm (4.88 in)
Maximum Range:	10.00 m (10.44 yds)
Fuze:	Not Provided

Usage: Fragmentation (frag), antipersonnel, delay-detonating hand grenade.

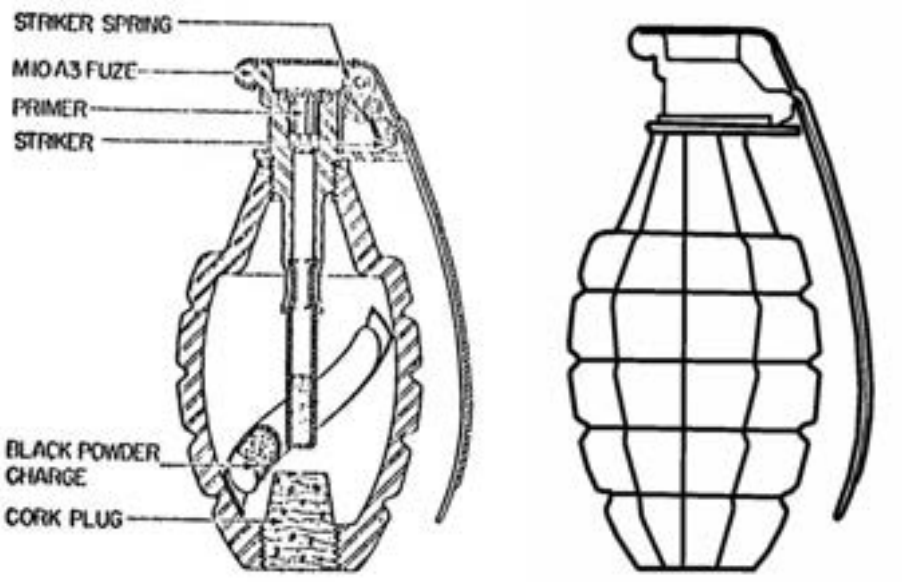
Description: The MK 2 grenade is painted olive drab, with a yellow band around the top of the fuze well. The grenade is referred to as the "Pineapple" because its shape and external serrations resemble a pineapple.

Filler Description: TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. In a refined form, it is one of the most stable high explosives. It is also used as a constituent of other explosives, including Amatol, Pentolite, Tetrytol, Tritonal, Picratol, and Composition B.

Reference: ORDATA Online, Army Field Manual FM 3-23.30

Ordnance Technical Data Sheet

U.S. Grenade, Practice, MK II (2)



Nomenclature:	U.S. Grenade, Practice, MK II (2)
Ordnance Family:	Grenades
DODIC:	G915
Filler:	Black Powder (Witness Charge Only)
Filler weight:	28.35 g (1 oz)
Item weight:	580.61 g (20.48 oz)
Diameter:	57.17 mm (2.25 in)
Length:	114.30 mm (4.5 in)
Maximum Range:	Not Provided
Fuze:	Powder Train Time-delay

Usage: This grenade consists of a fragmentation body with a filing hole in the base, an Igniting Fuze M206, a small charge of black powder, and a cork plug that is placed in the filling hole. Extra fuzes, charges, and plugs are supplied separately, so that the grenade body can be reused.

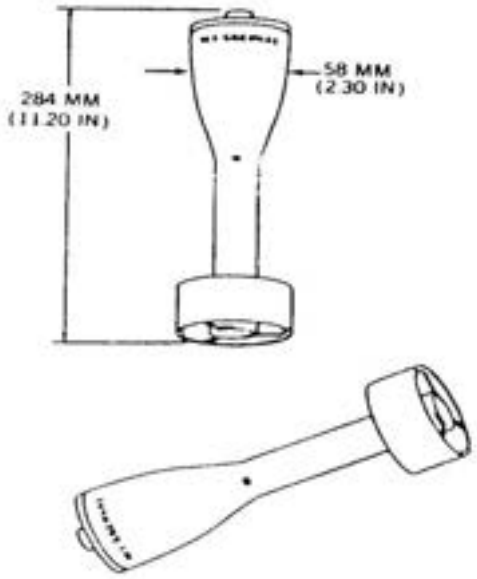
Description: The body is light blue.

Filler (Witness Charge) Description: Black powder is a low explosive composed of potassium nitrate or sodium nitrate, charcoal, and sulfur. It is very sensitive to heat, friction, or spark. It was used in safety fuses and practice munitions. It is no longer used as a propellant or bursting charge.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Rifle, M9



Nomenclature:	U.S. Grenade, Rifle, M9
Ordnance Family:	Grenades
DODIC:	Obsolete
Filler:	TNT
Filler weight:	113.40 g (4 oz)
Item weight:	557.00 g (19.68 oz)
Diameter:	58.00 mm (2.283 in)
Length:	284.00 mm (11.18 in)
Maximum Range:	Not Provided
Fuze:	Point-detonating Fuze

Usage: The M9 is an earlier model of the M9A1. It has the same tail assembly, but the head is acorn-shaped and equipped with a point-detonating fuze. The shrouded fin assembly aids in stabilization. It is slightly less sensitive than the M9A1. The safety pin of the M9 is located in the base of the grenade body instead of in the stabilizer tube. The pull ring is secured to the body with adhesive tape.

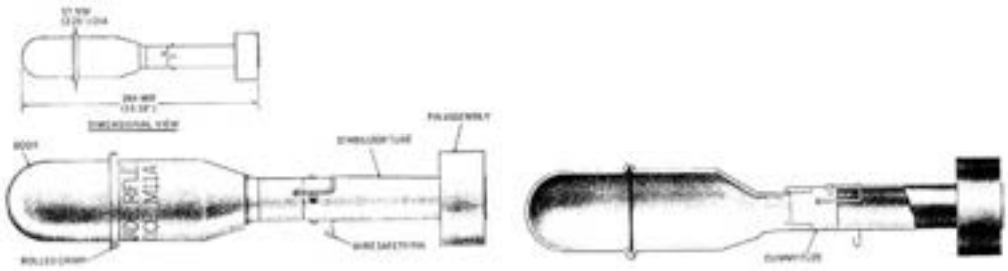
Description: The grenade is painted olive drab.

Filler (Main Charge) Description: TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. In a refined form, it is one of the most stable high explosives. It is also used as a constituent of other explosives, including Amatol, Pentolite, Tetrytol, Tritonal, Picratol, and Composition B.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Practice, Inert, M11 Series



Nomenclature: U.S. Grenade, Practice, Inert, M11 Series
Ordnance Family: Grenades
DODIC: G980
Filler: None
Filler weight: None
Item weight: 558.00 g (19.68 oz)
Diameter: 57.00 mm (2.244 in)
Length: 284.00 mm (11.18 in)
Maximum Range: Not Provided
Fuze: N/A

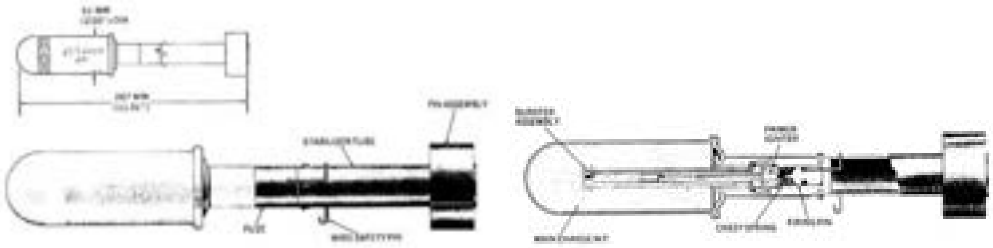
Usage: Rifle-projected grenades, except for the M11 Series, contain a simple impact inertia, base detonating fuze. The M11 Series practice grenade contains a dummy fuze that only has a safety pin hole.

Description: The grenades are painted blue or black, with white markings.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Rifle, Smoke, HC, M20



Nomenclature: U.S. Grenade, Rifle, Smoke, HC, M20
Ordnance Family: Grenades
DODIC: Not Provided (obsolete)
Filler: Smoke Mix, HC
Filler weight: 306.00 g (10.79 oz)
Item weight: 712.00 g (25.12 oz)
Diameter: 51.00 mm (2.008 in)
Length: 287.00 mm (4.3 in)
Maximum Range: Not Provided
Fuze: Impact Inertia, Base Detonating Fuze

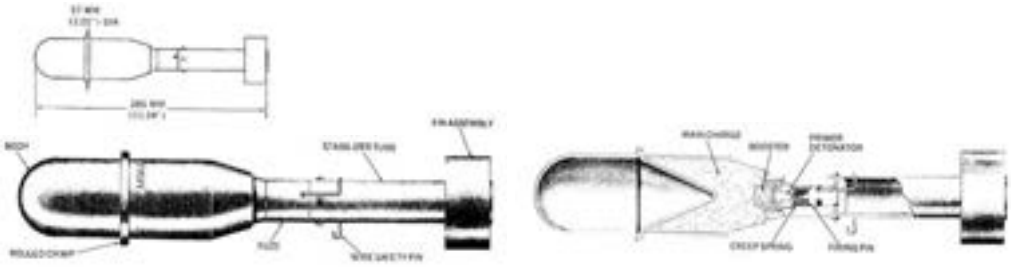
Usage: These are rifle-projected grenades that, except for the M11 series, contain a simple impact inertia, base detonating fuze.

Description: The painting and markings for each grenade are either light gray or light green with yellow markings.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Rifle, HEAT, M9A1 and M9A2



Nomenclature:	U.S. Grenade, Rifle, HEAT, M9A1 and M9A2
Ordnance Family:	Grenades
DODIC:	Not Provided (Obsolete)
Filler:	Pentolite
Filler weight:	113.40 g (4 oz)
Item weight:	558.00 g (1.23 lbs)
Diameter:	57.00 mm (2.244 in)
Length:	285.00 mm (11.22 in)
Maximum Range:	Not Provided
Fuze:	Impact Inertia, Base Detonating Fuze

Usage: These are rifle-projected High Explosive Anti-Tank (HEAT) rifle grenades that contain a simple impact inertia, base detonating fuze.

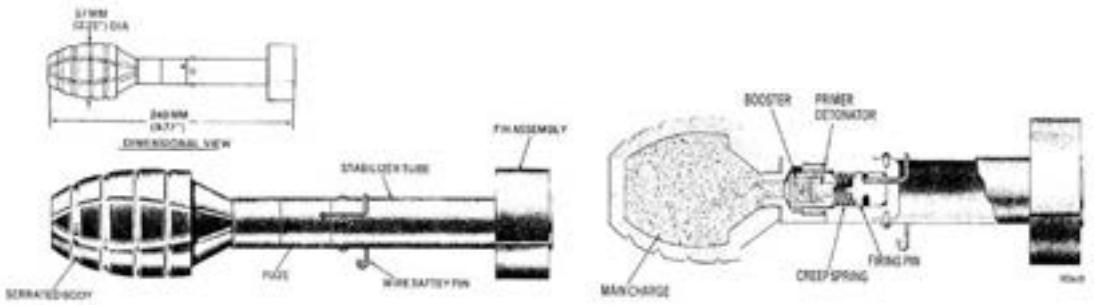
Description: The grenades are olive drab or black with yellow markings.

Filler (Main Charge) Description: Pentolite is composed of explosives, including TNT.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Rifle, Fragmentation, M17



Nomenclature:	U.S. Grenade, Rifle, Fragmentation, M17
Ordnance Family:	Grenades
DODIC:	Obsolete
Filler:	Flaked TNT
Filler weight:	22.00 g (.776 oz)
Item weight:	667.00 g (23.53 oz)
Diameter:	57.00 mm (2.244 in)
Length:	248.00 mm (9.764 in)
Maximum Range:	120 m (131 yds)
Fuze:	Impact Inertia, Base Detonating Fuze

Usage: These are rifle-projected grenades that contain a simple impact inertia, base detonating fuze.

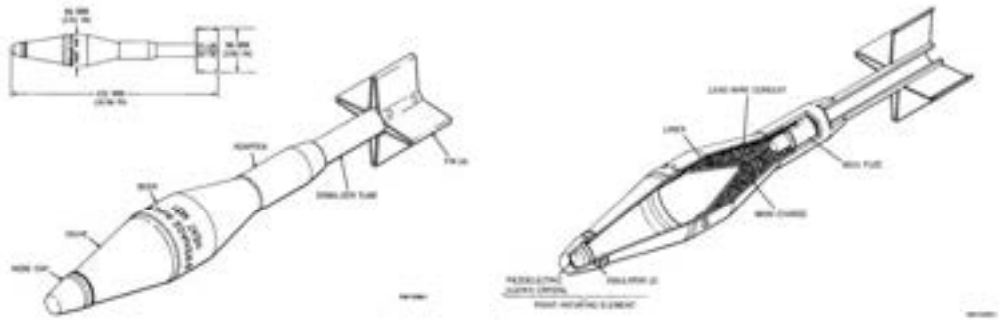
Description: The painting and markings for each grenade are olive drab, with yellow markings.

Filler (Main Charge) Description: TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. In a refined form, it is one of the most stable high explosives. It is also used as a constituent of other explosives, including Amatol, Pentolite, Tetrytol, Tritonal, Picratol, and Composition B.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Grenade, Rifle, HEAT, M31



Nomenclature:	U.S. Grenade, Rifle, HEAT, M31
Ordnance Family:	Grenades
DODIC:	G970
Filler:	Composition B
Filler weight:	280.67 g (9.9 oz)
Item weight:	708.00 g (24.97 oz)
Diameter:	66.00 mm (2.598 in)
Length:	431.00 mm (16.97 in)
Maximum Range:	200 m (218.7 yds)
Fuze:	Point-initiating Base-detonating Fuze, M211

Usage: This is a fin-stabilized high-explosive antitank rifle grenade that has an integral setback-armed, point-initiating base-detonating fuze (M211) that contains a piezoelectric crystal and an electric detonator.

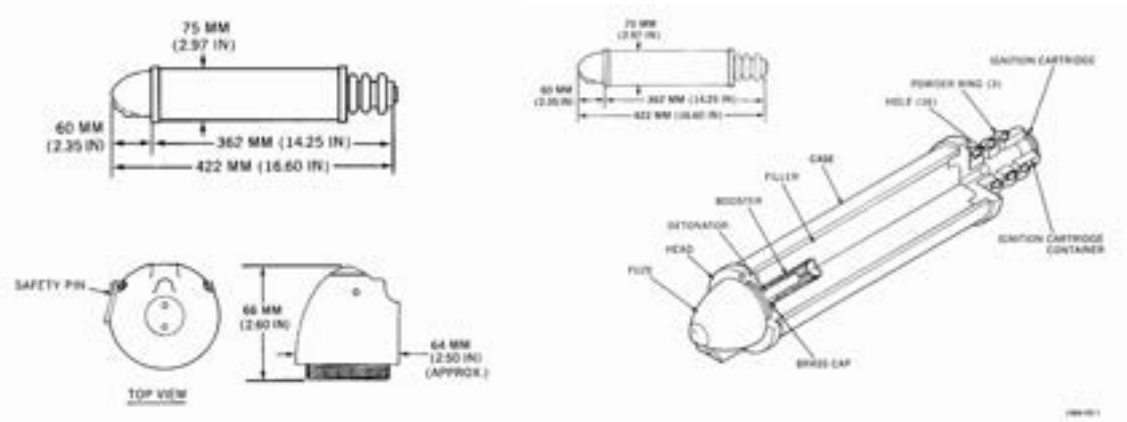
Description: The grenade is painted olive drab and the markings are in yellow. The practice version is painted blue with white markings.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (trinitrotoluene) and RDX (cyclotrimethylenetrinitramine, cyclonite, and hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

3-Inch Stokes Mortar



Nomenclature:	Mortar, 3-inch Stokes, WP, MK 1 and Practice MK 1
Ordnance Family:	Projectile
DODIC:	Not Provided (obsolete)
Filler:	White Phosphorus (plasticized)
Filler weight:	1.10 kg (2.425 lbs)
Item weight:	5.70 kg (12.57 lbs)
Diameter:	75 mm (2.953 in)
Length:	362 mm (14.25 in)
Maximum Range:	731 m (800 yds)
Fuze:	MK VI Setback-armed, Impact-inertia Fired, All-ways Acting

Usage: The Stokes is a mortar-fired, white phosphorus (WP), or practice cartridge. The WP cartridge is used for screening and against personnel.

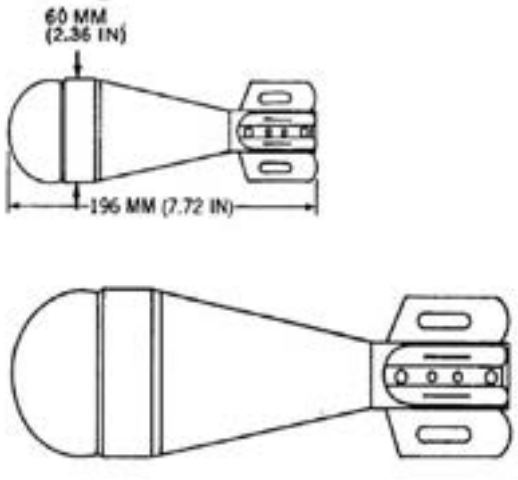
Description: The WP case is painted blue-gray with yellow stenciling; the practice case is painted dark blue with white stenciling. The heads of the cases are stamped with the name and mark number of the case, lot number of unfilled cases, inspector's stamp, and initials or symbol of the manufacturer of the metal parts. The cases are stenciled to show the caliber and type, mark number, filler, lot number, and the date and place loaded.

Filler Description: WP is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 60MM, Mortar, Drill, M69



Nomenclature: U.S. Projectile, 60MM, Mortar, Drill, M69
Ordnance Family: Projectile
DODIC: Not Provided
Filler: None
Filler weight: None
Item weight: 2.1 kg (4.63 lbs)
Diameter: 60.00 mm (2.36 in)
Length: 196.00 mm (7.27 in)
Maximum Range: 301.00 m (330 yds)
Fuze: None

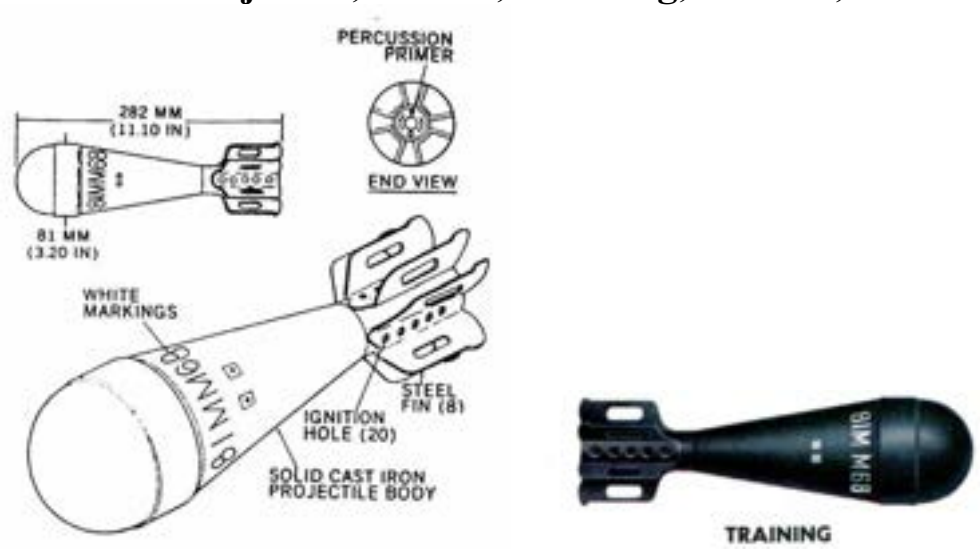
Usage: These projectiles are completely inert and simulate service projectiles for use in training, handling, loading, display, and instruction.

Description: Current projectiles are painted blue, earlier manufactured projectiles are painted black.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 81MM, Training, Mortar, M68



Nomenclature:	U.S. Projectile, 81MM, Training, Mortar, M68
Ordnance Family:	Projectiles
DODIC:	C228
Filler:	None
Filler weight:	None
Item weight:	4.89 kg (10.78 lbs)
Diameter:	81.00 mm (3.189 in)
Length:	282.00 mm (11.1 in)
Maximum Range:	301.00 m (330 yds)
Fuze:	None

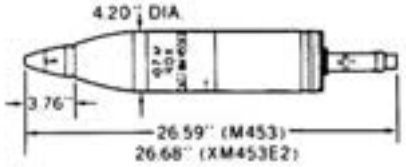
Usage: This is an Army, fin-stabilized, mortar-fired projectile used for training on the loading and firing of the mortar weapon system.

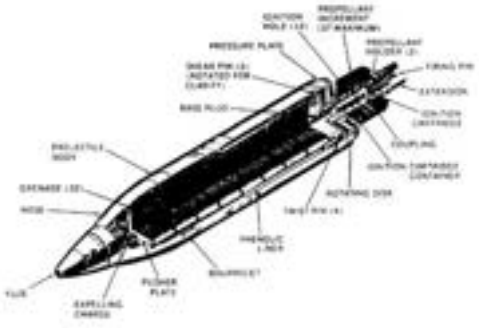
Description: Currently manufactured projectiles are painted blue, earlier manufactured projectiles are painted black.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 4.2-IN (107MM), HE, XM453E2 and M453





Nomenclature: 4.2 Inch (107MM), HE, XM453E2 and M453
Ordnance Family: Projectiles
DODIC: Not Provided
Filler: RDX
Filler weight: 680.40 g (1.5 lbs)
Item weight: 14.06 kg (31 lbs)
Diameter: 107.00 mm (4.2 in)
Length: 675.00 mm (26.57 in)
Maximum Range: Not Provided
Fuze: Mission Dependent

Usage: The general appearance, dimensions, and arrangement of the XM453E2 and M453 4.2-inch (107mm) HE cartridges are shown in the figure above. When the XM453E2 cartridge was type classified, it was designated M453.

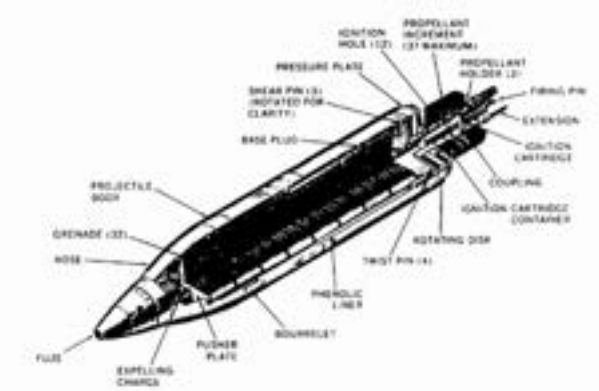
Description: The projectile is painted olive drab with markings stenciled in yellow. The identifying features of the cartridges are shown in the figure.

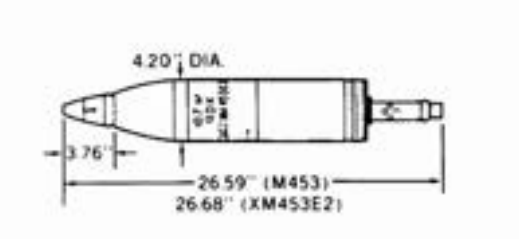
Filler Description: RDX is composed of Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen. It is very stable and is considered the most powerful and brisant of the military high explosives. Although rarely used alone, it is often used in/with other explosives. RDX forms the base for Composition A, B, and C; HBX; H-6; and Cyclotol.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 4.2-IN (107MM)





Nomenclature:	U.S. Cartridge, 4.2 Inch (107MM)
Ordnance Family:	Projectiles
DODIC:	Not Provided
Filler:	RDX
Filler weight:	680.40 g (1.5 lbs)
Item weight:	14.06 kg (31 lbs)
Diameter:	107.00 mm (4.2 in)
Length:	675.00 mm (26.57 in)
Maximum Range:	3,658 m (4,000 yds)
Fuze:	Mission Dependent

Usage: These are Army, spin-stabilized, mortar-fired, high explosive projectiles.

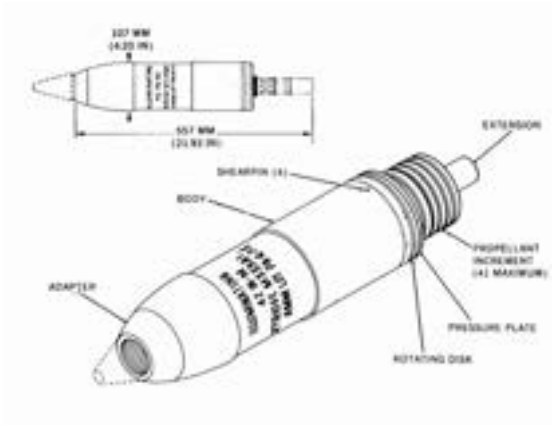
Description: The complete round consists of a projectile body, fuze, and tail assembly. The projectile body is painted olive drab with yellow markings.

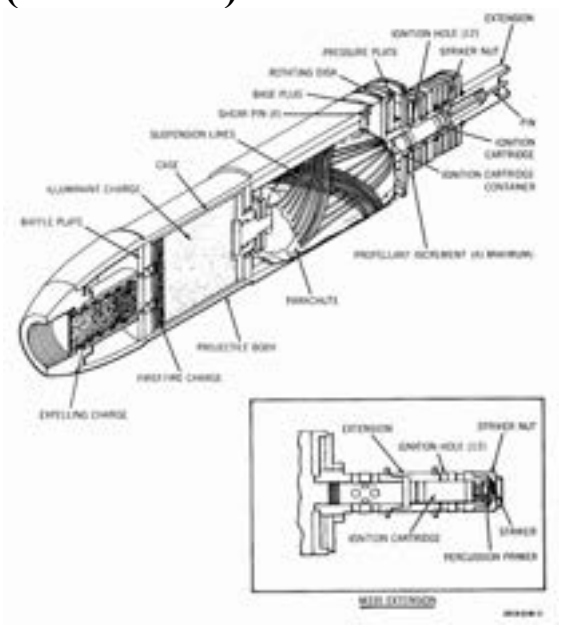
Filler Description: RDX is composed of Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen. It is very stable and is considered the most powerful and brisant of the military high explosives. Although rarely used alone, it is often used in/with other explosives. RDX forms the base for Composition A, B, and C; HBX; H-6; and Cyclotol.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 4.2-IN (107MM), Illuminating, M335, M335A1, and M335A2 (M335A1E1)





Nomenclature:	Stokes 4.2 inch (107mm) Mortar, Illuminating, M335
Ordnance Family:	Projectile
DODIC:	C706
Filler:	Illuminant Mix
Filler weight:	1.60 kg (3.527 lbs)
Item weight:	11.80 kg (26.01 lbs)
Diameter:	107.00 mm (4.213 in)
Length:	577.00 mm (21.93 in)
Maximum Range:	Not provided
Fuze:	Not provided

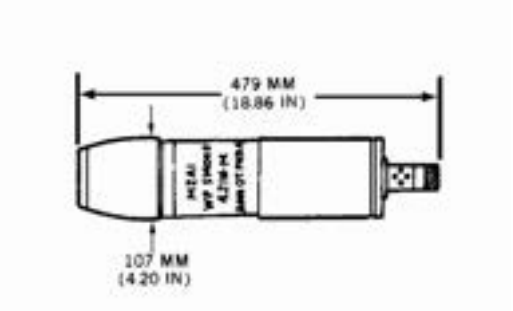
Usage: These are Army, spin-stabilized projectiles containing a base-ejected, parachute suspended illuminant charge. They are fired from mortars when illumination is required.

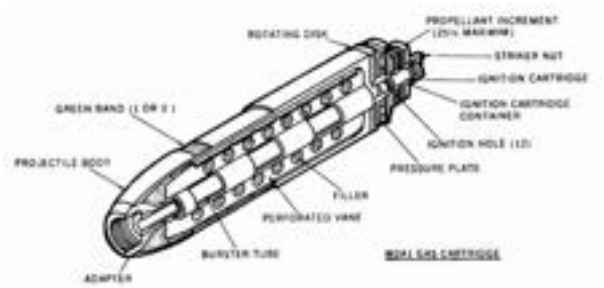
Description: Cartridges have either white projectile bodies with black identification markings or are painted gray with one white band and white identification markings.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 4.2-Inch (107MM), Smoke, WP, M2, M2A1





Nomenclature: Stokes 4.2-inch Mortar, Smoke (WP)
Ordnance Family: Projectile
DODIC: C708
Filler: Smoke Mix (White Phosphorus)
Filler weight: 3.40 kg (7.496 lbs)
Item weight: 11.30 kg (24.91 lbs)
Diameter: 107.00 mm (4.2 in)
Length: 479.00 mm (18.86 in)
Fuze: Not Provided

Usage: These are Army spin-stabilized projectiles fired from mortars to produce screening or spotting smoke and incendiary effects. The projectiles are filled with white phosphorus (WP), some obsolete M2-series smoke cartridges have a substitute filler of titanium tetrachloride (FM) or sulfur trioxide-chlorsulfonic acid (FS).

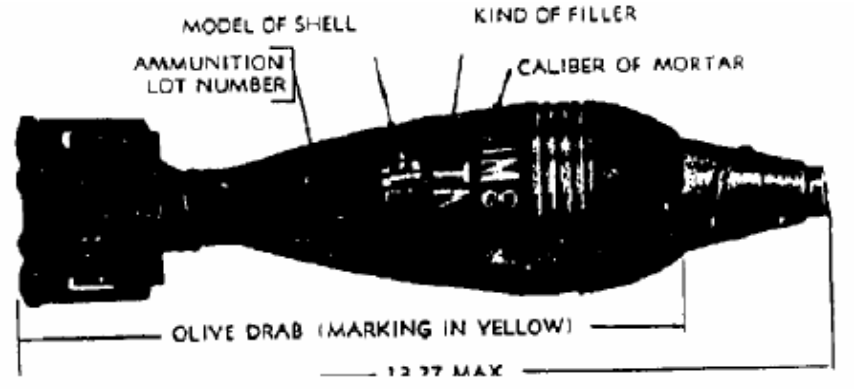
Description: Currently manufactured projectiles have light green projectile bodies with one yellow band and light red identification markings. Earlier manufactured projectiles have gray bodies with one yellow band and yellow markings.

Filler Description: WP is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 81MM, HE, M43A1



Nomenclature:	81MM, HE, Mortar
Ordnance Family:	Projectile
DODIC:	C225
Filler:	TNT
Filler weight:	553.39 kg (1.22 lbs)
Item weight:	3.20 kg (7.055 lbs)
Diameter:	81 mm (3.189 in)
Length:	337.06 mm (13.27 in)
Maximum Range:	2,400 m (2,625 yards)
Fragmentation Distance:	612.3 m (2,009 ft)
Fuze:	Various

Usage: The shell was originally adapted as the light shell for the 81mm mortar. It is designed for use against light targets, such as machine gun nests, barbed wire entanglements, and personnel in the open.

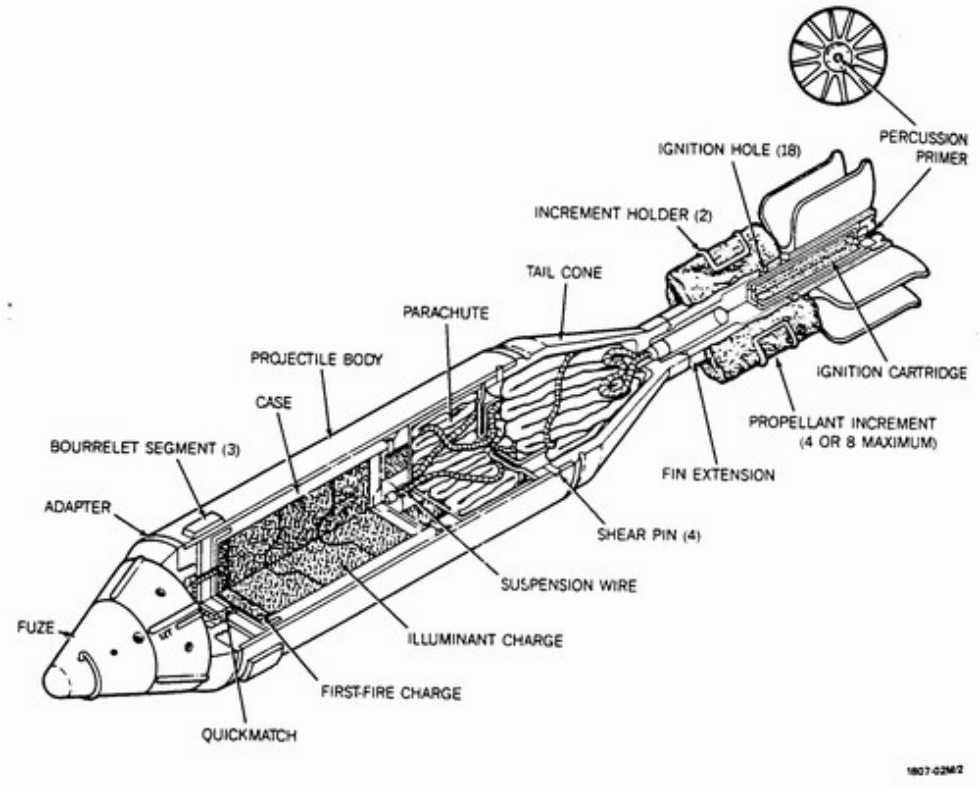
Description: The body is olive drab with yellow markings. The body, filler, adapter, and bakelite fuze well cup are exactly the same as in the M43. The fuze used is the Point-detonating Fuze M52, which has a super quick action. Due to the light weight and blunt nose of this shell, very little penetration can be obtained. This shell is designed to produce fragments as its primary function against personnel in the open and against barbed wire entanglements. Fragments to be effective must be above ground. A super quick fuze is used to burst the shell above ground. The body of the shell is constructed of forged steel.

Filler Description: TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. In a refined form, it is one of the most stable high explosives. It is also used as a constituent of other explosives, including Amatol, Pentolite, Tetrytol, Tritonal, Picratol, and Composition B.

Reference: ORDATA Online

Ordnance Technical Data Sheet

81MM Mortar



Nomenclature:	81MM (3.18in) Mortar
Ordnance Family:	Projectile
DODIC:	C225
Filler:	Round Dependent (Illuminant Charge)
Filler weight:	± 645.00 g
Item weight:	3.4 kg (7.5 lbs)
Diameter:	81 mm (3.189 in)
Length:	571.00 mm (23.20 in)
Maximum Range:	2,400 m (2,625 yds)
Fuze:	M935 Point Detonating Fuze or M734/734A1 Multi-Option Fuze

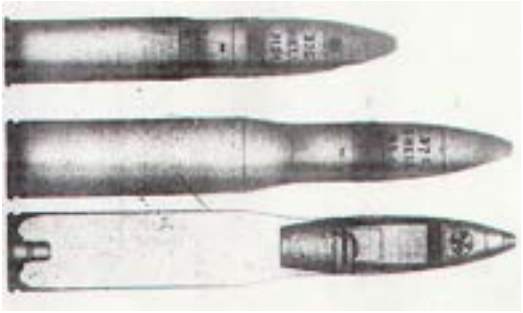
Usage: A Light Support Weapon that provides capability for high explosive, screening smoke, and illumination rounds delivered out to a maximum range of 2,400 m.

Description: The projectiles are painted white with stenciled black identification markings on the projectile bodies. Projectiles also may be gray with a white band and white markings.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 37MM, Gun, HE, M54A1



Nomenclature:	37MM Projectile, High Explosive
Ordnance Family:	Projectile
Filler:	Tetryl
Filler weight:	45.36 g (1.6 oz)
Item weight:	1.188 kg (2.62 lbs)
Diameter:	37.00 mm (1.457 in)
Length:	325.4 mm (12.81 in)
Maximum Range:	11,750 m (12,850 yds)
Fuze:	M56 Fuze

Usage: This general purpose projectile is used for blast and fragmentation effect against personnel, unarmored material targets, and aircraft. It has a substantial high explosive (HE) main charge. The projectile has a relatively thin to medium body-wall thickness. The fragmentation effect results from fracture of the body wall on detonation of the main charge.

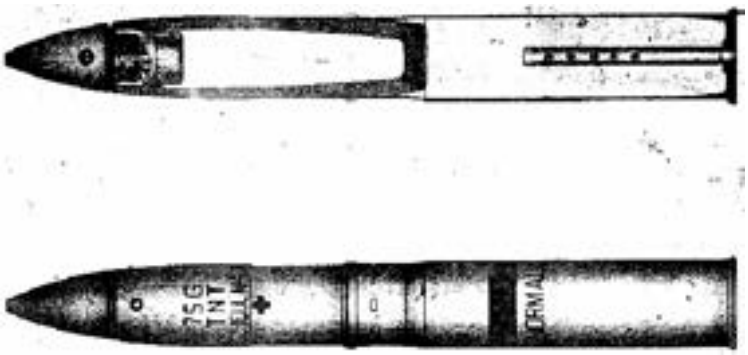
Description: The projectile may be fitted with a variety of fuzes for effective use in engaging different types of targets. The presence of the M56 Fuze identifies the round as an HE M54. The complete M54 round (HE shell) can be identified for the M1A2 Antiaircraft Gun by the extracting groove in the cartridge case.

Filler Description: Tetryl is composed of 2,4,6-Trinitrophenylmethylnitramine, N-methyl-N, 2,4,6-Tetranitroaniline, Tetralite, Tetrylite, and Pyronite. It is used extensively as a booster and main charge for small caliber projectiles. It is also used as the base charge in compound detonators. Tetryl is a finely divided crystalline powder that is colorless when freshly prepared and highly purified, rapidly acquires a yellow color when exposed to light, and turns gray when graphite is added as a lubricant during loading. Sensitivity is intermediate between TNT and PETN; it is more sensitive than Picric acid and can be detonated easier than TNT or Ammonium picrate. Tetryl is considered as sensitive as Mercury fulminate when finely divided and it will usually detonate when subjected to bullet impact. Tetryl is slightly hygroscopic, but not adversely affected by moisture.

Reference: ORDATA Online, MIDAS

Ordnance Technical Data Sheet

U.S. Projectile, 75MM, Gun, HE, M48



Nomenclature:	75MM Projectile, High Explosive		
Ordnance Family:	Projectile		
Filler:	TNT or Amatol		
Filler weight:	675.9 g (23.84 oz)		
Item weight:	8.274 kg (18.24 lbs)		
Diameter:	75.00 mm (2.953 in)		
Length:	596.4 mm (23.48 in)		
Maximum Range:	7,224 m (7,900 yds)		
Fragmentation Distance:	612.3 m (2,009 ft)	**Fuze:**	Varies

Usage: This is an Army gun-fired projectile that is nose fuzed only. It is painted green.

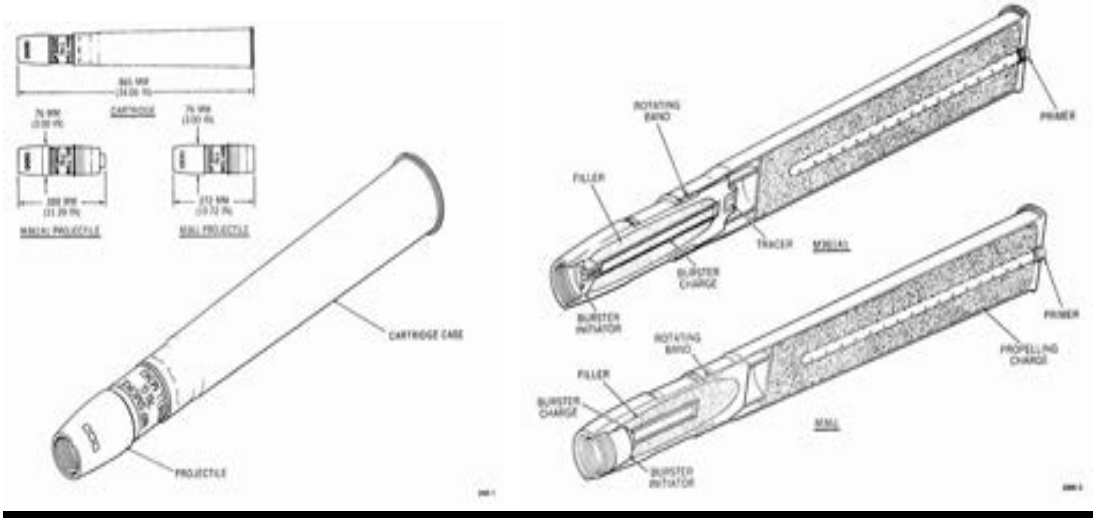
Description: Army HE projectiles are issued either with a nose fuze in place or with a removable lifting plug or closing plug that is replaced with a nose fuze before firing. Fuze types include ET, MT, MTSQ, PD, and PDSD. These projectiles do not have base fuzes.

Filler (Main Charge) Description: TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. In a refined form, it is one of the most stable high explosives. It is also used as a constituent of other explosives, including Amatol, Pentolite, Tetrytol, Tritonal, Picratol, and Composition B. Amatol is a main charge explosive employed by practically all foreign countries. It is used in the U.S. as a substitute explosive in 3-inch, 155mm, and larger shells. It is a mixture of Ammonium nitrate and TNT, with the percentage by weight of ammonium nitrate varying from 40 to 80 percent. It has a color of yellow to dark brown depending on the composition and purity of components. Amatol is less sensitive to detonation than TNT, but is readily detonated by mercury fulminate and other high explosives. It is very hygroscopic and, therefore, is usually protected by a sealing pour of TNT.

Reference: ORDATA Online, MIDAS

Ordnance Technical Data Sheet

U.S. Cartridge, 76MM, Smoke, WP, M361 (T140E2) and M361A1



Nomenclature:	76MM, Smoke (WP), M361
Ordnance Family:	Projectile
DODIC:	C128
Filler:	Smoke Mix (White Phosphorus)
Filler weight:	612.00 g (1.349 lbs)
Item weight:	6.00 kg (13.23 lbs)
Diameter:	76.00 mm (2.992 in)
Length:	272.00 mm (10.71 in)
Maximum Range:	Not Provided
Fuze:	Impact Fired

Usage: These are Army smoke projectiles used for spotting targets or screening; the projectiles also have a slight incendiary effect.

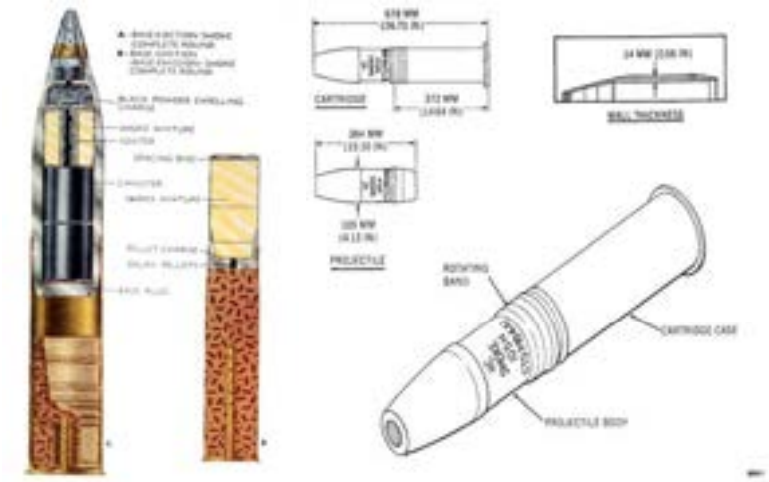
Description: Older projectiles are gray with a yellow band and yellow markings; newer projectiles are light green with a yellow band and red markings.

Filler Description: White phosphorus (WP) is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 105MM, HC and Colored Smoke, BE, M84 and M84A1



Nomenclature:	105MM, HC and Colored Smoke, BE, M84 and M84A1
Ordnance Family:	Projectile
DODIC:	C452
Filler:	Smoke Mix
Filler weight:	5.90 kg (13.01 lbs)
Item weight:	19.00 kg (41.89 lbs)
Diameter:	105.00 mm (4.123 in)
Length:	384.00 mm (15.12 in)
Maximum Range:	2,003 m (2,190 yds)
Fuze:	Mechanical Time Fuze

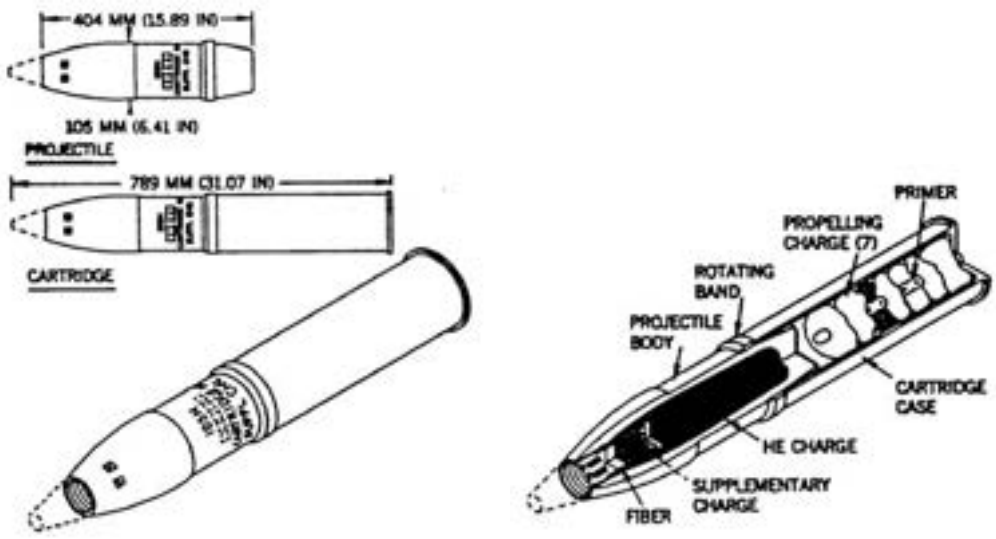
Usage: These are percussion-primed, semi-fixed Howitzer-fired cartridges with spin-stabilized, base-ejection smoke projectiles. They contain smoke canisters that emit either white, red, yellow, green, or violet smoke upon ejection. They are used for screening, spotting, or signaling purposes. The figure shows the appearance and dimensions of the M84A1 cartridge. The M84 and M84B1 cartridges are similar.

Description: Earlier manufactured projectiles are painted gray, with one yellow band and yellow-stenciled identification and manufacturing markings. Newer projectiles are painted light green, with black-stenciled identification and manufacturing markings. Older projectiles are marked with a row of squares whose color corresponds to the color of the smoke produced. Newer projectiles have either the letters HC, indicating that white smoke is produced, or a row of three letter C's in the color of the smoke produced. Brass cartridge cases are not painted. Steel cartridge cases are lacquered dark green or dark brown. White-stenciled identification and manufacturing markings are found on the base and on the lower portion of the cartridge case.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 105MM, HE, M1



Nomenclature:	U.S. Projectile, 105MM, HE, M1
Ordnance Family:	Projectiles
DODIC:	C430
Filler:	Composition B
Filler weight:	2.30 kg (5.071 lbs)
Item weight:	18.11 kg (39.9 lbs)
Diameter:	105.00 mm (4.134 in)
Length:	404.00 mm (15.91 in)
Maximum Range:	7,585 m (8,295 yds)
Fuze:	Not Provided

Usage: This is an Army, spin-stabilized, Howitzer-fired, high explosive projectile.

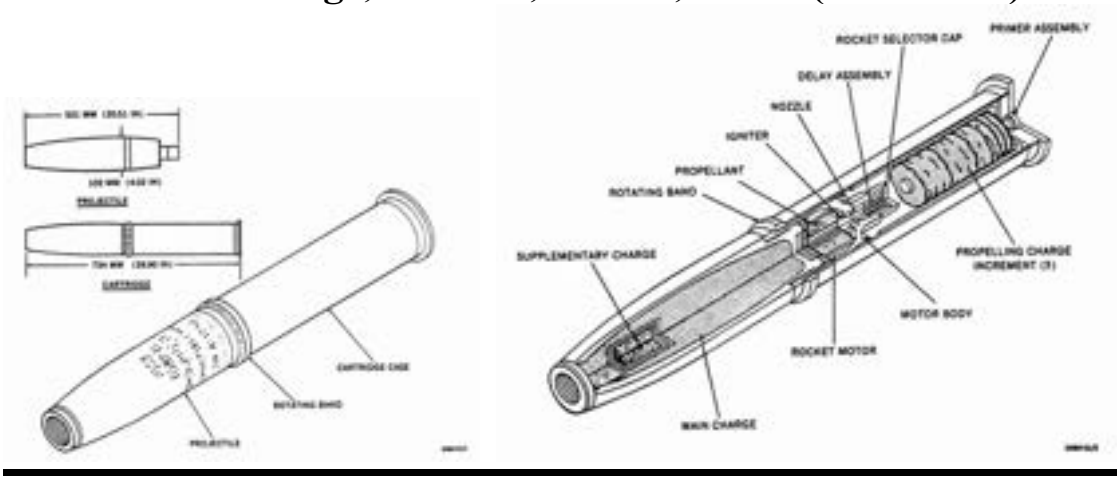
Description: The projectile is olive drab with yellow markings.

Filler (HE Charge) Description: Composition B consists of a mixture of TNT (Trinitrotoluene) and RDX (Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 105MM, HERA, M548 (XM548E1)



Nomenclature: 105MM, HERA, M548 (XM548E1)
Ordnance Family: Projectile
DODIC: C468
Filler: Composition B
Filler weight: 3.00 kg (6.614 lbs)
Item weight: 13.00 kg (28.66 lbs)
Diameter: 102.00 mm (4.16 in)
Length: 521.00 mm (20.51 in)
Maximum Range: 7,585 m (8,295 yds)
Fuze: Not Provided

Usage: This is a spin-stabilized, high-explosive rocket-assisted (HERA) semi-fixed cartridge with an extended-range capability. It is used against personnel and material.

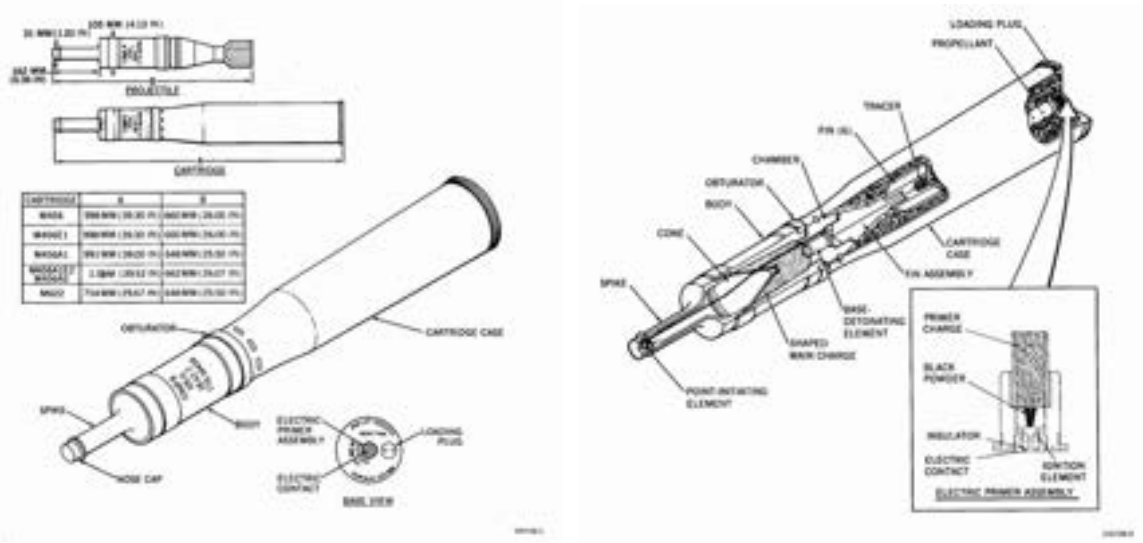
Description: The projectile is painted olive drab with markings stenciled in yellow. The cartridge case is unpainted with yellow markings.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (Trinitrotoluene) and RDX (Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Cartridge, 105MM, HEAT-T, M622 and M456A1



Nomenclature: 105MM, HEAT-T, M622 and M456A1
Ordnance Family: Projectile
DODIC: C508
Filler: Composition B
Filler weight: 1.00 kg (2.205)
Item weight: 10.00 kg (22.50)
Diameter: 105.00 mm (4.134 in)
Length: 648.00 mm (25.51 in)
Maximum Range: Not Provided
Fuze: M509 Series Impact Fuze

Usage: This is a fixed cartridge with a fin-stabilized high-explosive antitank with tracer (HEAT-T) projectile. The projectile incorporates a setback-armed, point-initiating base-detonating (PIBD) fuze containing a piezoelectric (Lucky) crystal and an electric detonator. The M509-series fuzes are impact fired.

Description: The projectiles are painted black or olive drab. The M622 markings are white. The M456A1 markings are yellow and white, with yellow bands on the spike.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (Trinitrotoluene) and RDX (Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 155MM (Howitzer), HE, M107

Nomenclature:	U.S. Projectile, 155MM (Howitzer), HE, M107
Ordnance Family:	Projectiles
DODIC:	D544
Filler:	TNT or Composition B
Filler weight:	6.99 kg (15.41 lbs)
Item weight:	42.91 kg (94.6 lbs)
Diameter:	155.00 mm (6.102 in)
Length:	605.00 mm (23.82 in)
Maximum Range:	18,100 m (19,795 yds)
Fuze:	Not Provided

Usage: This is an Army, spin-stabilized, Howitzer-fired, high explosive (HE) projectile.

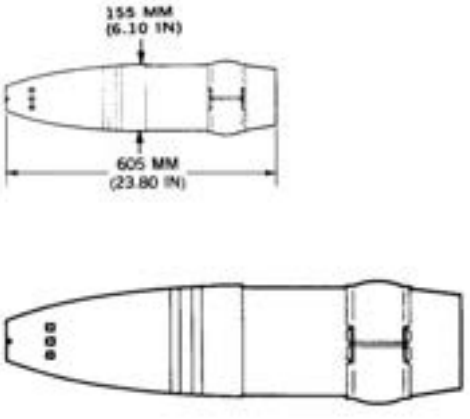
Description: The projectile is olive drab with yellow markings.

Filler Description: TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. In a refined form, it is one of the most stable high explosives. It is also used as a constituent of other explosives, including Amatol, Pentolite, Tetrytol, Tritonal, Picratol, and Composition B. Composition B consists of a mixture of TNT (Trinitrotoluene) and RDX (Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen). It is used as a buster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Projectile, 155MM (Gun), Smoke, WP, M104



Nomenclature:	U.S. Projectile, 155MM (Gun), Smoke, WP, M104
Ordnance Family:	Projectiles
DODIC:	D487
Filler:	Smoke Mix (White Phosphorous)
Filler weight:	7.10 kg (15.65 lbs)
Item weight:	44.00 kg (97 lbs)
Diameter:	155.00 mm (6.102 in)
Length:	605.00 mm (23.82 in)
Maximum Range:	24,000 m (26,685 yds)
Fuze:	Not Provided

Usage: This is an Army, spin-stabilized, separate-loaded, Howitzer-fired bursting smoke projectile used to screen or mark targets.

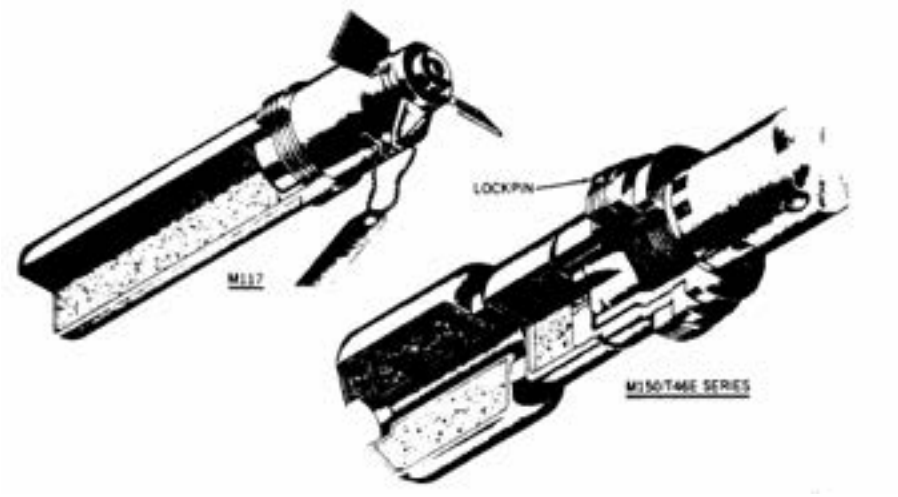
Description: The projectile is painted blue-gray with yellow stenciled markings and one 0.5-inch yellow band.

Filler Description: WP is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

Adapter Booster



Nomenclature: Adapter Booster
Ordnance Family: Misc.
DODIC: Not Provided
Filler: Tetryl
Filler weight: 196 g (6.9 oz)
Item weight: Not Available
Diameter: Varies
Length: 173 mm (6.8 in)

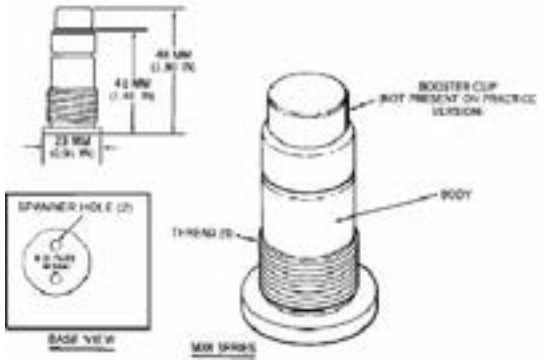
Usage: The adapter booster is a device fitted into the fuze well of a bomb that allows a fuze of smaller diameter to be used. Adapter boosters contain an explosive that transmits the firing train output of the fuze to the main explosive charge of the bomb. These devices can be used in projectiles, bombs, and rocket warheads.

Filler Description: Tetryl is composed of 2,4,6-Trinitrophenylmethylnitramine, N-methyl-N, 2,4,6-Tetranitroaniline, Tetralite, Tetrylite, and Pyronite. It is used extensively as a booster and main charge for small caliber projectiles. It is also used as the base charge in compound detonators. Tetryl is a finely divided crystalline powder that is colorless when freshly prepared and highly purified, rapidly acquires a yellow color when exposed to light, and turns gray when graphite is added as a lubricant during loading. Sensitivity is intermediate between TNT and PETN; it is more sensitive than Picric acid and can be detonated easier than TNT or Ammonium picrate. Tetryl is considered as sensitive as Mercury fulminate when finely divided and it will usually detonate when subjected to bullet impact. Tetryl is slightly hygroscopic, but not adversely affected by moisture.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Fuze, Projectile, BD, M38 and M38A1



Nomenclature:	Projectile Fuze
Ordnance Family:	Fuze
DODIC:	Not Provided
Filler:	Tetryl
Filler weight:	Less than 2 grams
Item weight:	Not Available
Diameter:	23 mm (0.91 in)
Length:	48 mm (1.90 in)
Fuze:	Various

Usage: These are setback-armed, impact-inertia-fired, non-delay, base-detonating fuzes. The fuzes are not painted and are marked on their bases with their nomenclatures. The bodies of the M38 series fuzes are brass.

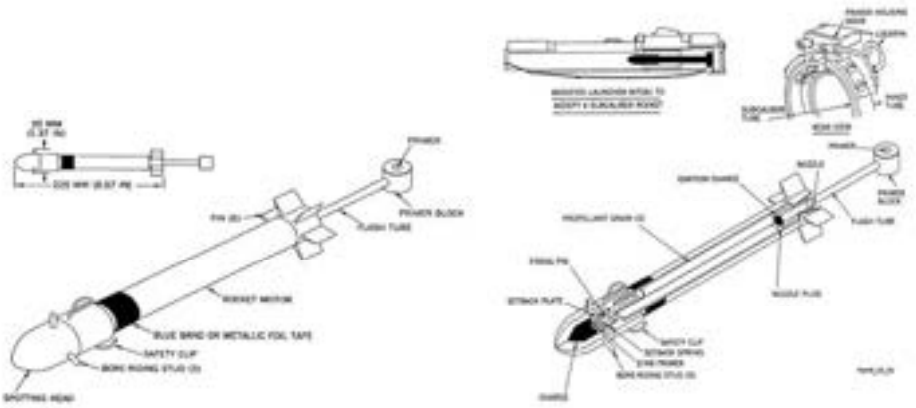
Description: On projectile firing, the setback drives the setback sleeve rearward, which forces the resistance ring rearward over the shoulder and into the groove around the base of the firing pin. The resistance ring locks the setback sleeve and firing pin together, with the tip of the firing pin protruding from the front of the sleeve. On projectile impact, inertia drives the firing pin and sleeve forward against the creep spring. The firing pin stabs the detonator, initiating the explosive train.

Filler Description: Tetryl is composed of 2,4,6-Trinitrophenylmethylnitramine, N-methyl-N, 2,4,6-Tetranitroaniline, Tetralite, Tetrylite, and Pyronite. It is used extensively as a booster and main charge for small caliber projectiles. It is also used as the base charge in compound detonators. Tetryl is a finely divided crystalline powder that is colorless when freshly prepared and highly purified, rapidly acquires a yellow color when exposed to light, and turns gray when graphite is added as a lubricant during loading. Sensitivity is intermediate between TNT and PETN; it is more sensitive than Picric acid and can be detonated easier than TNT or Ammonium picrate. Tetryl is considered as sensitive as Mercury fulminate when finely divided and it will usually detonate when subjected to bullet impact. Tetryl is slightly hygroscopic, but not adversely affected by moisture.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Rocket, 35MM, Sub-caliber, Practice, M73



Nomenclature: U.S. Rocket, 35MM, Sub-caliber, Practice, M73
Ordnance Family: Rocket
DODIC: H708
Filler: Smoke Mix (Witness Charge Only)
Filler weight: 10.00 g (.3527 oz)
Item weight: 145.00 g (5.115 oz)
Diameter: 35.00 mm (1.3878 in)
Length: 225.00 mm (8.858 in)
Maximum Range: 220 m (240.6 yds)
Fuze: Impact-inertia Fuze

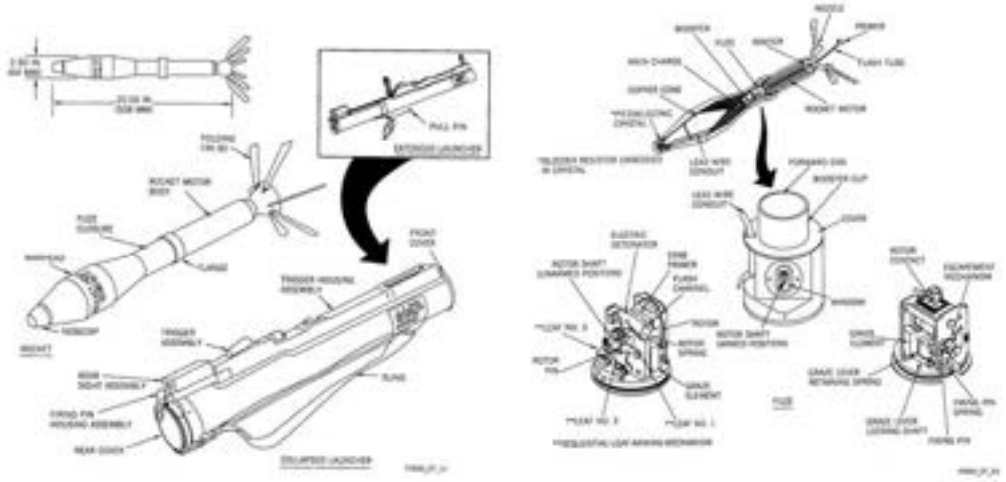
Usage: This is a sub-caliber practice rocket incorporating an integral, impact-inertia fuze. It is used for training and simulates the rocket for the light antitank weapon (LAW) system. The rocket is fired from a practice M190 launcher (a modified M72A1 LAW launcher). The figure shows the appearance and dimensions of the M73 practice rocket and M190 launcher.

Description: The spotting head and fins are painted black; the remainder of the rocket is olive drab. A blue band appears on the forward end of the rocket motor. On later production rockets, the spotting head is painted blue and the fins are painted brown. The rocket motor section is olive drab with white markings. A metallic foil covered tape is attached around the forward end of the rocket motor for weight adjustment.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Rocket, 66MM, Law, M72, M72A1, M72A2, and M72A3



Nomenclature:	66MM, Law, M72, M72A1, M72A2, and M72A3
Ordnance Family:	Rockets
DODIC:	B642
Filler:	Octol
Filler weight:	454.00 g (16.01 oz)
Item weight:	2.18 kg (4.806 lbs)
Diameter:	64.00 mm (2.52 in)
Length:	508.00 mm (20 in)
Maximum Range:	1,000 meters (3,300 feet)
Fuze:	M412 PIBD or M412A1

Usage: These are shoulder-fired, fin-stabilized, high-explosive light antitank weapons used primarily to penetrate armored targets. The rockets use an M54 rocket motor. The M72 uses an M18 warhead and an M412 point-initiating base-detonating (PIBD) fuze.

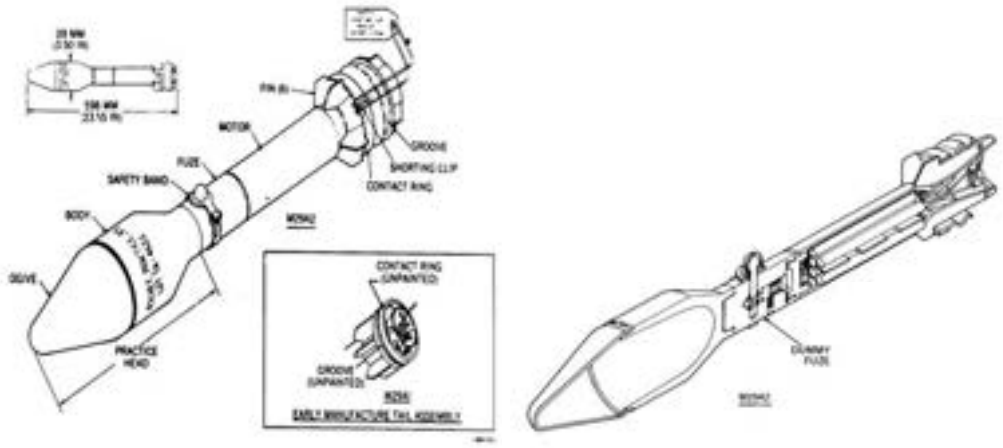
Description: The rocket launcher is painted olive drab with instruction labels on olive drab backgrounds with white printing. The manufacturing information is also printed in white. Launchers with limited light sights have a decal stating such and front sights coated with a yellow- or white-colored radioactive material at the 100- and 150-meter range markings and the remaining markings in red. Front sights not coated for night use will have all range markings in red. The rocket motor is brown and the warhead is black with yellow markings.

Filler (Main Charge) Description: Octol is a mixture of HMX (75%) and TNT (25%). HMX is a high melting explosive composed of Octogen and Cyclotetramethylene-tetranitramine. It is sensitive to high temperatures and is typically mixed with TNT in high blast explosives. TNT (2, 4, 6-trinitrotoluene), in a pure state, is crystalline and nearly white, resembling a light brown sugar. It is one of the most stable high explosives in refined form.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Rocket, 3.5-Inch, Practice, M29, M29A1, and M29A2



Nomenclature:	3.5-Inch, Practice, M29, M29A1, and M29A2
Ordnance Family:	Rockets
DODIC:	H601
Filler:	None
Filler weight:	None
Item weight:	3.90 kg (137.6 oz)
Diameter:	89.00 mm (3.5 in)
Length:	598.00 mm (23.54 in)
Fuze:	None

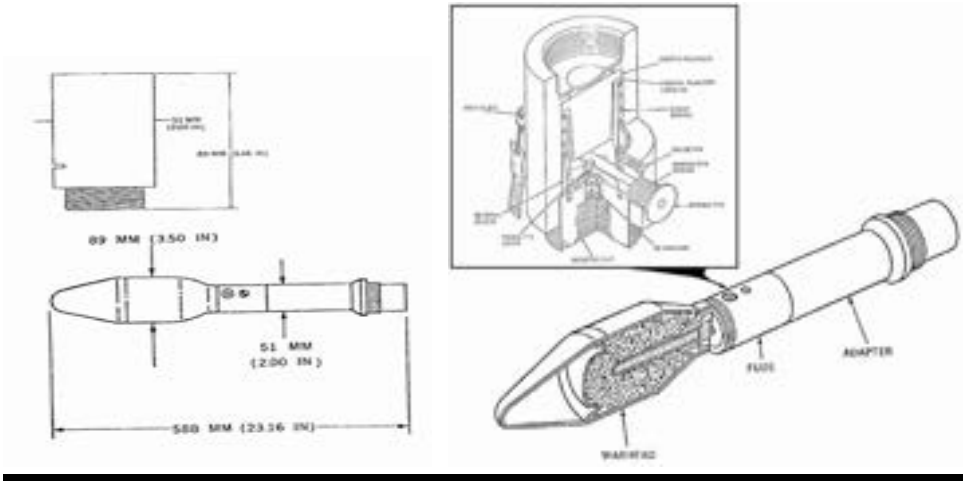
Usage: The M29-series rockets are inert and are used for training. The M29A2 rocket is modified for use in the M69 practice landmine system.

Description: The fuzes are painted olive drab or black and have the designation and loading information stamped on the body. The M29 warhead and rocket motor are blue. The M29A1 and M29A2 warheads are blue and the rocket motors are brown or olive drab with brown bands. The M29-series practice heads have white markings. The contact ring and groove, or notch, on the rockets are not painted.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Rocket Warhead, 3.5-Inch



Nomenclature: U.S. Rocket Warhead, 3.5-Inch Smoke, WP, Aircraft
Ordnance Family: Rockets
DODIC: Obsolete
Filler: Smoke Mix (White Phosphorus)
Filler weight: 1.00 kg (2.2 lbs)
Item weight: 4.90 kg (10.8 lbs)
Diameter: 89.00 mm (3.5 in)
Length: 588.00 mm (23.15 in)
Maximum Range: Not Provided
Fuze: M404A1 Base Detonating (BD)

Usage: This is a 3.5-inch white phosphorus (WP) filled rocket warhead. It uses the M404A1 (modified) fuze, which is a direct-arming, base-detonating (BD), non-delay fuze. The warhead and fuze are coupled to a 2.75-inch rocket motor by an adapter and are used against aircraft.

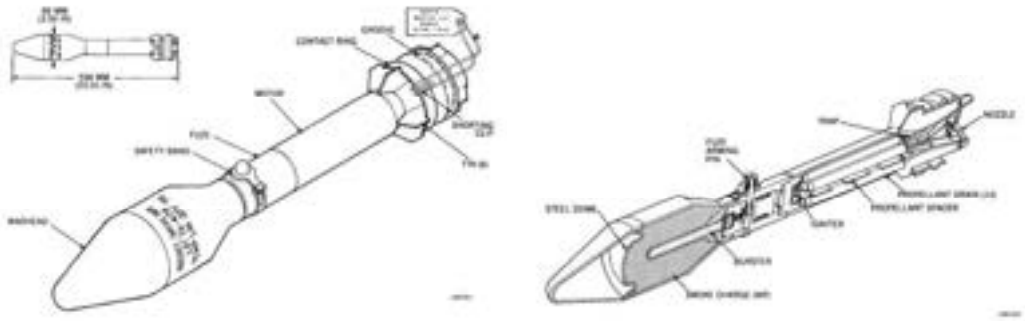
Description: The fuze is painted olive drab or black and has the designation and loading information stamped on the body. Older warheads are painted gray with yellow markings.

Filler Description: WP is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Rocket, 3.5-Inch, Smoke (WP), M30 (T127E3) and T127E2



Nomenclature: 3.5-Inch, Smoke (WP), M30 (T127E3) and T127E2
Ordnance Family: Rockets
DODIC: Not Provided
Filler: Smoke Mix (White Phosphorus)
Filler weight: 1.10 kg (2.425 lbs)
Item weight: 4.10 kg (9.039 lbs)
Diameter: 98.00 mm (3.5 in)
Length: 589.00 mm (23.54 in)
Maximum Range: Not Provided
Fuze: Impact, Base Detonating Fuze

Usage: These are 3.5-inch, ground-fired, fixed-fin, smoke (white phosphorus) rockets.

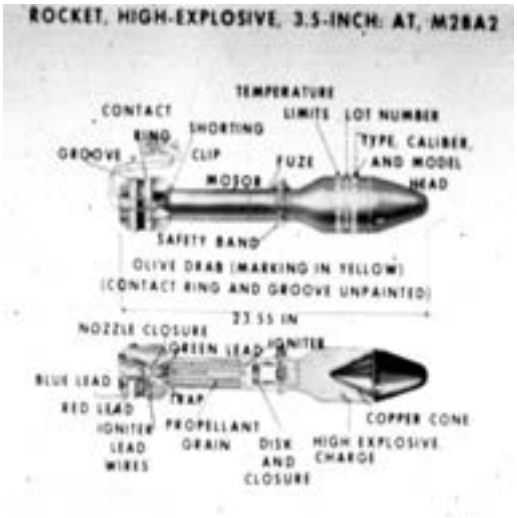
Description: The warheads are light green with light red markings and a light red band. Older warheads are painted gray with yellow markings. The rocket motor is brown or olive drab. The fuzes are painted olive drab or black and have the designation and loading information stamped on the body.

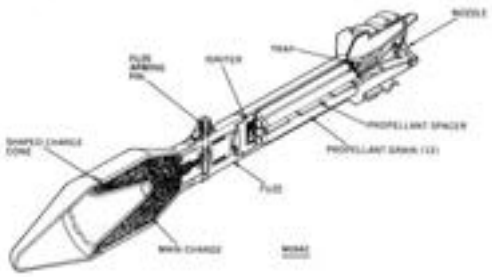
Filler (Smoke Charge) Description: White phosphorus (WP) is a white to light yellow, wax-like, luminous substance (phosphorescent in the dark). On ignition, it produces a yellow-white flame and dense white smoke. When dispersed by ammunition as small particles, it ignites spontaneously on exposure to air and continues to burn on contact with solid materials, even when embedded in human flesh. It is used in bursting-type projectiles, artillery and mortar shells, grenades, rockets, and bombs.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Rocket, 3.5-Inch, HEAT, M28 and M28A2





Nomenclature:	U.S. Rocket, 3.5-Inch, HEAT, M28 and M28A2
Ordnance Family:	Rockets
DODIC:	H600
Filler:	Composition B
Filler weight:	853.00 g (30.09 oz)
Item weight:	4.10 kg (9.039 lbs)
Diameter:	89.00 mm (3.5 in)
Length:	598.00 mm (23.54 in)
Maximum Range:	Not Provided
Fuze:	Setback-armed, Base-detonating (BD)

Usage: These are ground-fired, fixed-fin rockets that use setback-armed, base-detonating (BD), non-delay, impact-inertia-fired fuzes and a high-explosive antitank (HEAT) shaped-charge warhead. The fuzes are painted olive drab or black and have the designation and loading information stamped on the body.

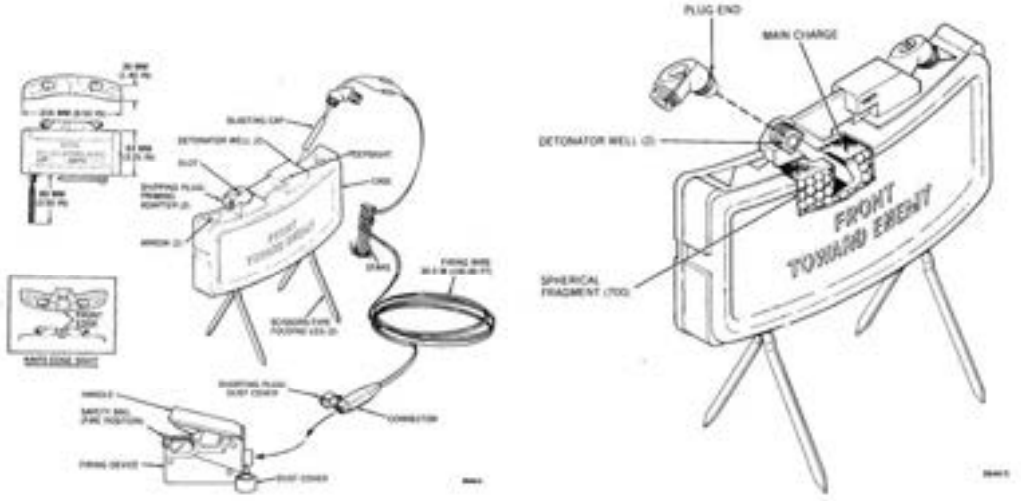
Description: The M28 warhead is olive drab with yellow markings; the M28A2 may have an olive drab or black warhead with yellow markings. Some M28A2 warheads with fuzes may be inert and painted blue. The rocket motor may be brown or olive drab with a brown band.

Filler (Main Charge) Description: Composition B consists of a mixture of TNT (Trinitrotoluene) and RDX (Cyclotrimethylenetrinitramine, Cyclonite, and Hexogen). It is used as a burster in Army projectiles, rockets, hand grenades, and landmines.

Reference: ORDATA Online

Ordnance Technical Data Sheet

U.S. Landmine, Apers, HE, M18A1 Claymore and Practice, M68



Nomenclature:	APERS, HE, M18A1 Claymore and Practice, M68
Ordnance Family:	Landmines
DODIC:	K143
Filler:	Composition C-4 (M18A1 only)
Filler weight:	680.00 g (23.99 oz)
Item weight:	1.60 kg (3.52 lbs)
Diameter:	216.00 mm (8.50 in)
Length:	83.00 mm (3.26 in)
Maximum Range:	Not Provided
Fuze:	Electric/non-electric command detonation

Usage: The M68 practice mine is similar to the M18A1 mine, except that the inert loaded M33 mine body replaces the high explosive loaded M18A1 mine body and the empty practice blasting cap M10 replaces the loaded blasting cap. The M18A1 is a directional, fragmentation, high explosive (HE), antipersonnel (apers) landmine that may be electrically or non-electrically initiated. It may be used as a controlled-fired mine in offensive or defensive situations.

Description: The M18A1 mine is olive drab.

Filler (Main Charge) Description: C-4 is a plastic demolition explosive consisting of RDX, other explosives, and plasticizers. C-4 can be molded by hand for demolition work and packed by hand into shape charge devices.

Reference: ORDATA Online

subEM	subMAG	surfHits	mppeh	fe	nonFe	uxo	dmm	md	rrd	cd	pntType	desc1	desc1CNT	desc2	desc2CNT	desc3	desc3CNT	desc4	desc4CNT	desc5	desc5CNT	desc6	desc6CNT	desc7	desc7CNT	desc8	desc8CNT	notes	POINT_X	POINT_Y
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0	start	514821.95	3764975.02
2	0	2	0	1	1	0	0	1	0	1	Recon Point	Medium Frag	1		0		0		0		0		0		0		0		514832.70	3764927.13
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514840.49	3764873.91
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514842.47	3764821.46
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514859.94	3764770.69
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514877.25	3764719.47
0	0	1	0	0	0	0	0	0	0	1	Recon Point		0		0		0		0		0		0		0		0		514872.55	3764676.21
6	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514875.94	3764625.56
12	0	1	0	0	0	0	0	1	0	0	Recon Point	Small Arm Projectile	1		0		0		0		0		0		0		0		514894.21	3764572.49
10	0	1	0	0	0	0	0	1	0	0	Recon Point	Small Arm Projectile	1		0		0		0		0		0		0		0		514839.32	3764547.13
7	0	2	0	0	0	0	0	1	1	0	Recon Point	Small Arm Projectile	1		0		0		0		0		0		0		0		514794.23	3764515.89
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514781.34	3764571.45
4	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514771.79	3764624.08
3	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514772.93	3764670.87
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514765.40	3764718.35
0	0	2	0	0	0	0	0	0	0	2	Recon Point		0		0		0		0		0		0		0		0		514756.44	3764767.76
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514752.78	3764816.26
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514734.80	3764867.65
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514736.13	3764919.75
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514722.18	3764965.17
3	0	2	0	0	0	0	0	2	0	0	Recon Point	81mm MOR Illum	1	105mm TP	1		0		0		0		0		0		0	pot uxo only fin showing	514710.48	3765014.15
5	0	4	0	0	0	0	0	4	0	0	Recon Point	Medium Frag	3	Small Arm F	1		0		0		0		0		0		0		514707.84	3765066.35
0	0	3	0	0	0	0	0	0	3	0	Target		0		0		0		0		0		0		0		0		514725.58	3765093.76
16	0	203	0	0	0	0	0	3	200	0	Recon Point	Target	3	25mm TP	1		0		0		0		0		0		0	120mm mortar	514700.38	3765112.87
14	0	12	0	0	0	0	0	12	0	0	Recon Point	105mm TP HEAT	5	Medium Fra	1	Small Arm F	5	25mm TP	1		0		0		0		0		514690.81	3765160.02
7	0	15	0	0	0	0	0	15	0	0	Recon Point	40mm GR TP	1	25mm TP	1	Medium Fra	2	Small Arm F	10	TP HEAT D	1		0		0		0		514675.63	3765209.84
40	0	102	0	0	0	0	0	102	0	0	Recon Point	Berm	1	Target	1	Small Arm F	100	Medium Fra	1	81mm MOR	1		0		0		0		514695.64	3765268.85
23	0	54	0	0	0	0	0	54	0	0	Recon Point	81mm MOR Illum	2	Small Arm F	50	40mm GR T	2		0		0		0		0		0		514665.50	3765307.11
20	0	101	0	0	0	0	0	101	0	0	Recon Point	Small Arm Projectile	100	Medium Fra	1		0		0		0		0		0		0		514664.21	3765358.88
23	0	102	0	0	0	0	0	102	0	0	Recon Point	Small Arm Projectile	100	81mm MOR	1	25mm TP	1		0		0		0		0		0		514651.80	3765409.30
25	0	102	0	0	0	0	0	102	0	0	Recon Point	Small Arm Projectile	100	81mm MOR	1	Medium Fra	1		0		0		0		0		0		514646.48	3765449.27
25	0	107	0	0	0	0	0	107	0	0	Recon Point	Light Frag	2	40mm GR T	1	81mm MOR	4	Small Arm F	100	81mm MOR	1		0		0		0	WP	514592.80	3765449.31
25	0	106	0	0	0	0	0	106	0	0	Recon Point	Light Frag	5	Small Arm F	100	TP HEAT D	1		0		0		0		0		0		514547.44	3765427.36
25	0	103	0	0	0	0	0	103	0	0	Recon Point	Small Arm Projectile	100	25mm TP	1	Medium Fra	2		0		0		0		0		0		514556.22	3765386.11
25	0	105	0	0	0	0	0	105	0	0	Recon Point	Small Arm Projectile	100	81mm MOR	5		0		0		0		0		0		0		514563.25	3765338.03
18	0	82	6	0	0	0	0	76	0	0	Recon Point	Small Arm Projectile	75	81mm MOR	1		0		0		0		0		0		0		514574.50	3765290.72
25	0	79	0	0	0	0	0	79	0	0	Recon Point	Small Arm Projectile	75	81mm MOR	1	Medium Fra	1	25mm TP	1	Light Frag	1		0		0		0		514569.45	3765243.86
12	0	79	0	0	0	0	0	79	0	0	Recon Point	Small Arm Projectile	75	81mm MOR	3	120mm TP	1		0		0		0		0		0		514589.74	3765194.51
7	0	55	0	0	0	0	0	55	0	0	Recon Point	Small Arm Projectile	50	Light Frag	1	TP HEAT D	3	25mm TP	1		0		0		0		0		514584.69	3765139.83
6	0	28	0	0	0	0	0	28	0	0	Recon Point	Small Arm Projectile	25	TP HEAT D	2	81mm MOR	1		0		0		0		0		0		514585.97	3765085.26
3	0	26	0	0	0	0	0	26	0	0	Recon Point	Small Arm Projectile	25	155mm TP	1		0		0		0		0		0		0		514606.53	3765046.94
0	0	0	0	0	0	0	0	0	0	0	UXO Item	75mm HE	1		0		0		0		0		0		0		0		514605.31	3765043.46
3	0	23	0	0	0	1	0	22	0	0	Recon Point	75mm HE	1	Heavy Frag	1	TP HEAT D	1	Small Arm F	20		0		0		0		0		514621.44	3764995.44
2	0	1	0	0	0	0	0	1	0	0	Recon Point	TP HEAT Debris	1		0		0		0		0		0		0		0		514626.43	3764937.51
1	0	2	0	0	0	0	0	2	0	0	Recon Point	Light Frag	1	Flare	1		0		0		0		0		0		0		514642.35	3764896.38
1	0	1	0	0	0	0	0	1	0	0	Recon Point	40mm GR TP	1		0		0		0		0		0		0		0		514639.12	3764844.37
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514642.12	3764799.38
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514657.86	3764749.96
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514662.09	3764691.13
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514675.29	3764650.50
4	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514682.95	3764603.02
7	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514691.98	3764552.44
3	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514700.02	3764505.20
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2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514557.62	3764735.59
5	0	1	0	0	0	0	0	1	0	0	Recon Point	Heavy Frag	1		0		0		0		0		0		0		0		514545.79	3764788.04
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514526.10	3764837.35
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514535.78	3764887.62
2	0	1	0	0	0	0	0	1	0	0	Recon Point	TP HEAT Debris	1		0		0		0		0		0		0		0		514527.27	3764937.39
4	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514517.77	3764977.70
9	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514509.19	3765032.86
3	0	3	0	0	0	0	0	3	0	0	Recon Point	Light Frag	1	TP HEAT D	2		0		0		0		0		0		0		514499.64	3765091.23
3	0	55	0	0	0	0	0	54	0	1	Recon Point	105mm TP HEAT	1	Small Arm F	50	40mm GR T	3		0		0		0		0		0		514497.39	3765132.61
9	0	67	0	0	0	0	0	67	0	0	Recon Point	Small Arm Projectile	50	40mm GR T	9	Penetrator D	1	Medium Fra	2	TP HEAT D	5		0		0		0		514483.39	3765180.21
18	0	57	0	0	0	0	0	57	0	0	Recon Point	Small Arm Projectile	50	40mm GR T	4	81mm MOR	2	152mm TP	1		0		0		0		0		514485.02	3765225.34
30	0	62	0	0	0	0	0	62	0	0	Recon Point	40mm GR TP	2	25mm TP	2	Small Arm F	50	81mm MOR	2	Medium Fra	5	TP HEAT D	1		0		0		514469.21	3765276.16
30	0	112	0	0	0	0	0	112	0	0	Recon Point	Small Arm Projectile	100	81mm MOR	5	Medium Fra	5	25mm TP	2		0		0		0		0		514462.65	3765325.31
20	0	79	0	0	0	0	0	79	0	0	Recon Point	Small Arm Projectile	75	81mm MOR	2	40mm GR T	1	25mm TP	1		0		0		0		0		514408.98	3765310.73
15	0	107	0	0	0	0	0	107	0	0	Recon Point	Small Arm Projectile	100	Light Frag	5	40mm GR T	1	81mm MOR	1		0		0		0		0		514362.79	3765314.84
7	0	56	0	0	0	0	0	56	0	0	Recon Point	Small Arm Projectile	50	Light Frag	2	40mm GR T	3	81mm MOR	1		0		0		0		0		514373.67	3765253.77
10	0	52	0	0	0	0	0	52	0	0	Recon Point	TP HEAT Debris	1	Small Arm F	50	81mm MOR	1		0		0		0		0		0		514377.51	3765204.74
15	0	57	0	0	0	0	0	56	1	0	Recon Point	Small Arm Projectile	50	Medium Fra	5	40mm GR T	1		0		0		0		0		0		514386.95	3765159.21
9	0	58	0	0	0	0	0	58	0	0	Recon Point	Small Arm Projectile	50	40mm GR T	5	81mm MOR	1	25mm TP	1	Medium Fra	1		0		0		0		514396.55	3765111.86
7	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514400.36	3765066.28
4	0	1	0	0	0	0	0	0	0	1	Recon Point		0		0		0		0		0		0		0		0		514415.38	3765007.04
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514424.29	3764965.23
2	0	1	0	0	0	0	0	1	0	0	Recon Point	TP HEAT Debris	1		0		0		0		0		0		0		0		514424.57	3764912.60
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514438.51	3764861.73

subEM	subMAG	surfHits	mppeh	fe	nonFe	uxo	dmm	md	rrd	cd	pntType	desc1	desc1CNT	desc2	desc2CNT	desc3	desc3CNT	desc4	desc4CNT	desc5	desc5CNT	desc6	desc6CNT	desc7	desc7CNT	desc8	desc8CNT	notes	POINT_X	POINT_Y
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514456.89	3764804.08
1	0	1	0	0	0	0	0	1	0	0	Recon Point	Flare	1		0		0		0		0		0		0		0		514447.30	3764760.36
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514453.61	3764711.74
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514459.93	3764662.03
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514478.65	3764618.65
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514478.24	3764572.31
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514489.79	3764517.31
0	0	1	0	0	0	0	0	1	0	0	Recon Point	Heavy Frag	1		0		0		0		0		0		0		0		514499.07	3764468.40
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514449.54	3764467.73
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514400.35	3764462.97
1	0	1	0	0	0	0	0	1	0	0	Recon Point	Small Arm Projectile	1		0		0		0		0		0		0		0		514389.93	3764509.62
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514377.98	3764558.06
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514373.38	3764606.87
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514365.19	3764655.10
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514357.68	3764703.02
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514355.52	3764746.66
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514341.12	3764799.90
3	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514337.17	3764853.03
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514321.34	3764893.84
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514319.36	3764952.65
4	0	2	0	0	0	0	0	2	0	0	Recon Point	25mm TP	1	TP HEAT D	1		0		0		0		0		0		0		514310.00	3764994.61
0	0	0	0	0	0	0	0	0	0	0	Target		0		0		0		0		0		0		0		0		514317.21	3765009.09
11	0	60	0	0	0	0	0	60	0	0	Recon Point	40mm GR TP	3	Light Frag	5	81mm MOR	1	Target	1	Small Arm F	50		0		0		0		514305.06	3765047.75
0	0	0	0	0	0	0	0	0	0	0	Target		0		0		0		0		0		0		0		0		514304.87	3765087.51
20	0	276	0	0	0	0	0	76	200	0	Recon Point	Medium Frag	10	40mm GR T	10	Fuze	1	Small Arm F	50	25mm TP	2	Target	2	Mover	1		0		514291.19	3765106.35
23	0	63	0	0	0	0	0	63	0	0	Recon Point	155mm TP	1	165mm TP	1	25mm TP	1	40mm GR T	10	Small Arm F	50		0		0		0		514286.10	3765144.76
14	0	79	0	0	0	0	0	79	0	0	Recon Point	Small Arm Projectile	75	81mm MOR	1	40mm GR T	3		0		0		0		0		0		514282.22	3765196.58
30	0	116	0	0	0	0	0	116	0	0	Recon Point	Small Arm Projectile	100	37mm TP	1	40mm GR T	5	Medium Fra	10		0		0		0		0		514237.30	3765185.94
21	0	119	0	0	0	0	0	119	0	0	Recon Point	57mm PRJ TP	2	40mm GR T	10	Small Arm F	100	25mm TP	2	Medium Fra	5	Fuze	0		0		0	M396A1, 51 series fuzeW	514186.82	3765169.02
14	0	111	0	0	0	0	0	111	0	0	Recon Point	Small Arm Projectile	100	Medium Fra	5	Fuze	1	40mm GR T	5		0		0		0		0		514192.12	3765125.46
22	0	116	0	0	0	0	0	116	0	0	Recon Point	Small Arm Projectile	100	TP HEAT D	3	40mm GR T	8	25mm TP	1	Light Frag	4		0		0		0		514202.25	3765073.26
16	0	63	0	0	0	0	0	63	0	0	Recon Point	Missile Debris	1	TP HEAT D	4	40mm GR T	3	25mm TP	2	Small Arm F	50	Light Frag	3		0		0	Dragon	514202.26	3765032.18
12	0	29	0	0	0	0	0	29	0	0	Recon Point	75mm Schrapnel	1	105mm TP	1	105mm TP	1	105mm BAS	1	Small Arm F	25		0		0		0		514221.34	3764983.71
6	0	12	0	0	0	0	0	12	0	0	Recon Point	81mm MOR Illum	2	Small Arm F	10		0		0		0		0		0		0		514217.44	3764924.87
3	0	1	0	0	0	0	0	1	0	0	Recon Point	105mm BASE EJC	1		0		0		0		0		0		0		0		514229.26	3764880.14
4	0	2	0	0	0	0	0	2	0	0	Recon Point	TP HEAT Debris	2		0		0		0		0		0		0		0		514243.26	3764834.05
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514241.98	3764795.93
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514253.77	3764734.83
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514274.75	3764685.13
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514269.33	3764629.67
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514270.93	3764584.43
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514276.98	3764528.27
1	0	1	0	0	0	0	0	0	0	1	Recon Point		0		0		0		0		0		0		0		0		514288.24	3764477.18
1	0	1	0	0	0	0	0	1	0	0	Recon Point	Fuze Component	1		0		0		0		0		0		0		0		514286.12	3764453.09
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514238.80	3764460.09
0	0	2	0	1	1	0	0	1	0	1	Recon Point	Wire	1		0		0		0		0		0		0		0		514191.24	3764453.44
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514184.78	3764526.01
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514182.15	3764572.40
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514167.78	3764626.67
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514157.90	3764675.90
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514147.29	3764720.83
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514144.49	3764781.15
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514138.00	3764818.09
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514125.15	3764873.22
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514116.14	3764921.21
6	0	1	0	0	0	0	0	1	0	0	Recon Point	TP HEAT Debris	1		0		0		0		0		0		0		0		514114.12	3764970.25
4	0	1	0	0	0	0	0	1	0	0	Recon Point	Berm	1	81mm MOR	1		0		0		0		0		0		0		514109.31	3765017.17
8	0	31	0	0	0	0	0	31	0	0	Recon Point	40mm GR TP	9	25mm TP	2	TP HEAT D	2	Small Arm F	20		0		0		0		0		514097.04	3765077.23
9	0	37	0	0	0	0	0	37	0	0	Recon Point	40mm GR TP	7	Small Arm F	30		0		0		0		0		0		0		514095.72	3765116.56
7	0	44	0	0	0	0	0	44	0	0	Recon Point	40mm GR TP	7	Small Arm F	30	Medium Fra	2	TP HEAT D	5		0		0		0		0		514078.47	3765159.95
20	0	110	0	0	0	0	0	110	0	0	Recon Point	Small Arm Projectile	100	TP HEAT D	5	40mm GR T	5		0		0		0		0		0		514030.71	3765155.41
11	0	62	0	0	0	0	0	62	0	0	Recon Point	Medium Frag	3	TP HEAT D	3	Small Arm F	50	40mm GR T	5	106mm HE	1		0		0		0		513986.04	3765145.44
12	0	52	0	0	0	0	0	52	0	0	Recon Point	40mm GR TP	12	Small Arm F	30	TP HEAT D	10		0		0		0		0		0		514001.29	3765088.22
7	0	52	0	0	0	0	0	52	0	0	Recon Point	40mm GR TP	25	Small Arm F	20	Discarded S	2	TP HEAT D	5		0		0		0		0		514009.56	3765039.60
0	0	0	0	0	0	0	0	0	0	0	Target		0		0		0		0		0		0		0		0	2 poles, tract trailer frame	514029.54	3765014.20
5	0	17	0	0	0	0	0	16	1	0	Recon Point	40mm GR TP	10	105mm TP	1	Small Arm F	5	Target	1		0		0		0		0		514008.70	3764993.16
6	0	5	0	0	0	0	0	5	0	0	Recon Point	40mm GR TP	5		0		0		0		0		0		0		0		514011.31	3764945.48
3	0	2	0	0	0	0	0	2	0	0	Recon Point	40mm GR TP	2		0		0		0		0		0		0		0		514020.39	3764897.99
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514042.93	3764850.74
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514038.89	3764791.57
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514044.91	3764748.13
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514057.62	3764696.18
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514074.23	3764649.94
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514058.72	3764602.93
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514079.96	3764553.14
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514080.15	3764503.73
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514085.68	3764452.38
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		514043.45	3764451.72
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513996.00	3764447.46
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513988.00	3764498.33
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513974.18	3764548.52
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513971.84	3764597.71
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513964.91	3764644.16

subEM	subMAG	surfHits	mppeh	fe	nonFe	uxo	dmm	md	rrd	cd	pntType	desc1	desc1CNT	desc2	desc2CNT	desc3	desc3CNT	desc4	desc4CNT	desc5	desc5CNT	desc6	desc6CNT	desc7	desc7CNT	desc8	desc8CNT	notes	POINT_X	POINT_Y
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513955.60	3764695.12
2	0	2	0	0	0	0	0	1	0	1	Recon Point	Discarded Sabot	1		0		0		0		0		0		0		0		513948.93	3764739.62
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513942.31	3764790.59
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513933.15	3764840.19
1	0	4	0	0	0	0	0	2	0	2	Recon Point	40mm GR TP	2		0		0		0		0		0		0		0		513919.97	3764887.31
11	0	3	0	0	0	0	0	3	0	0	Recon Point	Discarded Sabot	2	TP HEAT D	1		0		0		0		0		0		0		513915.64	3764940.23
26	0	18	0	0	0	0	0	18	0	0	Recon Point	40mm GR TP	5	Discarded S	1	Flare	2	Small Arm F	10		0		0		0		0		513903.12	3764989.11
23	0	50	0	0	0	0	0	50	0	0	Recon Point	40mm GR TP	20	Small Arm F	20	25mm TP	2	Discarded S	3	TP HEAT D	5		0		0		0		513908.02	3765038.49
14	0	137	0	0	0	0	0	137	0	0	Recon Point	Target	1	40mm GR T	31	Small Arm F	100	TP HEAT D	5		0		0		0		0		513894.35	3765083.41
15	0	135	0	0	0	0	0	135	0	0	Recon Point	Small Arm Projectile	100	40mm GR T	20	TP HEAT D	5	Medium Fra	10	Target	1		0		0		0		513842.36	3765081.32
15	0	55	0	0	0	0	0	55	0	0	Recon Point	Small Arm Projectile	25	40mm GR T	15	TP HEAT D	10	Medium Fra	5		0		0		0		0		513789.67	3765074.53
0	0	0	0	0	0	0	0	0	0	0	Target	Mover	1	Berm	1		0		0		0		0		0		0	old, saturated w ordnance	513759.65	3765029.88
36	0	250	0	0	0	0	0	200	50	0	Recon Point	40mm GR TP	100	Small Arm F	100	60mm MOR	1	Missile Debr	1	Medium Fra	10		0		0		0		513797.62	3765005.83
12	0	42	0	0	0	0	0	42	0	0	Recon Point	40mm GR TP	12	Small Arm F	20	TP HEAT D	5	Medium Fra	5		0		0		0		0		513807.63	3764964.02
4	0	8	0	0	0	0	0	8	0	0	Recon Point	40mm GR TP	3	Small Arm F	5		0		0		0		0		0		0		513825.41	3764915.21
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513827.92	3764865.42
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513839.58	3764821.15
0	0	1	0	0	0	0	0	1	0	0	Recon Point	TP HEAT Debris	1		0		0		0		0		0		0		0		513850.00	3764764.34
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513851.60	3764719.60
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513860.72	3764670.88
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513867.16	3764619.63
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513873.78	3764570.75
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513884.05	3764523.00
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513884.93	3764472.53
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513896.56	3764442.77
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513848.82	3764455.30
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513789.65	3764479.67
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513762.43	3764561.94
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513771.08	3764611.42
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513750.39	3764658.85
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513756.19	3764714.18
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513747.93	3764763.26
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513737.58	3764810.42
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513728.31	3764857.62
1	0	2	0	0	0	1	0	1	0	0	Recon Point	90mm HE	1	81mm MOR	1		0		0		0		0		0		0	M371A1, HEAT UXO AT Pt	513708.15	3764903.50
3	0	9	0	0	0	0	0	9	0	0	Recon Point	81mm MOR Illum	3	40mm GR T	3	TP HEAT D	3		0		0		0		0		0		513701.29	3764948.97
5	0	38	0	0	0	0	0	38	0	0	Recon Point	40mm GR TP	3	81mm MOR	1	Light Frag	4	Small Arm F	30		0		0		0		0		513657.79	3764935.83
6	0	32	0	0	0	0	0	32	0	0	Recon Point	40mm GR TP	8	Small Arm F	20	Medium Fra	3	Discarded S	1		0		0		0		0		513612.58	3764926.43
3	0	24	0	0	0	0	0	24	0	0	Recon Point	40mm GR TP	1	Small Arm F	20	Light Frag	2	Sub Calibre	1		0		0		0		0	35mm	513623.54	3764876.22
7	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513640.62	3764828.89
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513633.89	3764791.11
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513649.19	3764724.07
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513653.78	3764685.28
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513665.58	3764638.86
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513669.60	3764582.36
1	0	2	0	0	0	0	0	1	0	1	Recon Point	Flare	1		0		0		0		0		0		0		0		513674.05	3764537.54
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513680.67	3764486.46
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513679.38	3764438.88
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513635.74	3764441.28
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513586.75	3764448.07
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513539.49	3764438.05
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513493.10	3764439.68
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513435.49	3764436.93
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513390.37	3764434.61
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513329.83	3764476.25
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513284.91	3764537.02
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513254.77	3764574.38
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513259.62	3764632.30
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513256.16	3764675.32
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513239.63	3764728.49
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513290.83	3764740.62
3	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513348.20	3764738.06
2	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513347.16	3764687.63
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513362.24	3764638.89
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513364.50	3764589.85
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513376.78	3764543.80
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513433.80	3764532.23
1	0	1	0	0	0	0	0	0	0	1	Recon Point		0		0		0		0		0		0		0		0		513478.09	3764500.40
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513463.72	3764550.31
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513475.26	3764607.46
0	0	0	0	0	0	0	0	0	0	0	Other Item	Berm	0		0		0		0		0		0		0		0		513460.65	3764631.05
4	0	0	0	0	0	0	0	0	0	0	Recon Point	Berm	1		0		0		0		0		0		0		0		513465.16	3764668.61
4	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513440.56	3764707.50
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513459.16	3764755.64
3	0	3	0	0	0	0	0	3	0	0	Recon Point	Light Frag	3		0		0		0		0		0		0		0		513438.98	3764808.83
18	0	6	0	0	0	0	0	6	0	0	Recon Point	Medium Frag	5	Flare	1		0		0		0		0		0		0		513493.73	3764831.76
13	0	3	0	0	0	0	0	3	0	0	Recon Point	Discarded Sabot	1	Medium Fra	2		0		0		0		0		0		0		513530.48	3764817.30
7	0	1	0	0	0	0	0	1	0	0	Recon Point	Medium Frag	1		0		0		0		0		0		0		0		513537.13	3764775.05
6	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513537.63	3764723.80
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513562.49	3764673.59
1	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513563.20	3764626.17
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513579.42	3764577.27
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513625.08	3764574.26

subEM	subMAG	surfHits	mppeh	fe	nonFe	uxo	dmm	md	rrd	cd	pntType	desc1	desc1CNT	desc2	desc2CNT	desc3	desc3CNT	desc4	desc4CNT	desc5	desc5CNT	desc6	desc6CNT	desc7	desc7CNT	desc8	desc8CNT	notes	POINT_X	POINT_Y
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513619.18	3764623.20
0	0	1	0	0	0	0	0	0	0	1	Recon Point		0		0		0		0		0		0		0		0		513608.95	3764679.83
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513606.51	3764732.04
0	0	0	0	0	0	0	0	0	0	0	Recon Point		0		0		0		0		0		0		0		0		513594.82	3764778.32

90mm HEAT Projectile - UXO

Target Berm

81mm Mortar Probable Illumination – Probable MD

81mm Mortar TP - MD

Old HE Hard Target - RRD

Old HE Hard Target - RRD

Small Arms Debris – Abundant on North Side of Site - MD

105mm TP Projectile Debris - MD

75mm HE Projectile - UXO

105mm TP Projectile Debris - MD

Old HE Hard Target - RRD

Old Target Debris - RRD

Old Berm/Target

155mm TP Projectile - MD

165mm TP Projectile - MD

51 Series Fuze - MD

51 Series Fuze - MD

25mm TP Projectile - MD

Unknown Munitions Debris

Mortar Illumination – Probable MD

Target Stand

Old Mover Rails

Old Mover Car

60mm TP Mortar - MD

Appendix D

QC Log

Note Taker: Jason Burcham

11/11/12

0730 – Swept an area offsite and determined it free of subsurface anomalies. Placed a MEC simulant on the surface and swept the item with a Schiebel MIMID on high setting. The instrument produced an audible signal indicating a positive detect and proper function. Survey commenced

1700 – Re-swept test strip. The instrument produced an audible signal indicating a positive detect and proper function. Departed site.

11/12/12

0730 - Re-swept test strip. The instrument produced an audible signal indicating a positive detect and proper function. Survey commenced.

1430 - Re-swept test strip. The instrument produced an audible signal indicating a positive detect and proper function. Survey Complete.

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
INSTALLATIONS AND ENVIRONMENT
110 ARMY PENTAGON
WASHINGTON, DC 20310-0110

APR 2 1 2005

MEMORANDUM FOR THE ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT

SUBJECT: Munitions Response Terminology

1. This memorandum replaces my October 28, 2003 memorandum, subject: Definitions Related to Munitions Response Terms, and requests your office ensure that the enclosed terms and their definitions (Enclosure 1) are used, when appropriate, in correspondence (e.g., policies, guidance) and briefings concerning the Army's implementations of its Military Munitions Response Program (MMRP), Sustainable Range Management Program (SRMP) and, as appropriate, in other munitions-related matters.

2. In the past three years, the Department of Defense (DoD) has developed policies and guidance to implement its MMRP and SRMP. It has also worked to close a policy gap related to the management of material that may pose explosives hazards to DoD personnel and/or the public. During this period, DoD has been actively engaged, through the Munitions Response Committee (MRC), with the U.S. Environmental Protection Agency, Federal Land Managers, states, and with American Indians and Alaska Natives, to address issues related to the cleanup of munitions response sites.

3. To provide clarity and consistency in these efforts and in internal and external discussions, DoD has been working to establish and use common terms and definitions. The consistent use of accurate, descriptive terms, the definitions of which are commonly understood, is important to our dialogue with environmental regulators and safety officials, stakeholders, and the public.

4. Many of the terms that DoD has adopted for use in addressing munitions-related issues are now codified in Federal statute. On December 14, 2004, the Department of Defense Explosives Safety Board approved revisions to DoD 6055.9-STD, Ammunition and Explosives Safety Standards, using the enclosed terms.

5. The U.S. Army Technical Center for Explosives Safety, in coordination with other agencies, developed the enclosed matrix (Enclosure 2) to help the communities (e.g., operational, explosives safety, logistical, and cleanup) involved in addressing munitions-related operations to better understand how some of the new terms apply to actions they conduct.

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6. Use of this terminology does not imply any specific funding authority, nor does it alter the DERP Management Guidance's program eligibility criteria.

7. My staff point of contact is J. C. King at (703) 697-5564 or jc.king@us.army.mil.

Raymond J. Fatz
Deputy Assistant Secretary of the Army
(Environment, Safety and Occupational Health)
OASA(I&E)

Enclosures

cf:
G-3
G-4
DAIM-BD
SFIM-OP
SAGC
OTJAG-ELD
NGB
CEMP-R
USACE
AEC

Enclosure 1: Military Munitions-Related Terms and Definitions

Consolidated Definitions
Anomaly Avoidance. Techniques employed on property known or suspected to contain UXO, other munitions that may have experienced abnormal environments (e.g., DMM), munitions constituents in high enough concentrations to pose an explosive hazard, or CA, regardless of configuration, to avoid contact with potential surface or subsurface explosive or CA hazards, to allow entry to the area for the performance of required operations.
Chain of Custody. The activities and procedures taken throughout the inspection, re-inspection and documentation process to maintain positive control of MPPEH to ensure the veracity of the process used to determine the status of material as to its explosive hazard. This includes all such activities from the time of collection through final disposition.
Chemical Agent (CA). A chemical compound (to include experimental compounds) that, through its chemical properties produces lethal or other damaging effects on human beings, is intended for use in military operations to kill, seriously injure, or incapacitate persons through its physiological effects. Excluded are research, development, testing and evaluation (RDTE) solutions; riot control agents; chemical defoliants and herbicides; smoke and other obscuration materials; flame and incendiary materials; and industrial chemicals.
Chemical Agent (CA) Hazard. A condition where danger exists because CA is present in a concentration high enough to present potential unacceptable effects (e.g., death, injury, damage) to people, operational capability, or the environment.
Chemical Agent (CA) Safety. A condition where operational capability and readiness, people, property, and the environment are protected from the unacceptable effects or risks of a mishap involving chemical warfare material (CWM) and CA in other than munitions configurations.
Chemical Warfare Material (CWM). Items generally configured as a munition containing a chemical compound that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. CWM includes V- and G-series nerve agents or H-series (mustard) and L-series (lewisite) blister agents in other-than-munition configurations; and certain industrial chemicals (e.g., hydrogen cyanide (AC), cyanogen chloride (CK), or carbonyl dichloride (called phosgene or CG)) configured as a military munition. Due to their hazards, prevalence, and military-unique application, chemical agent identification sets (CAIS) are also considered CWM. CWM does not include: riot control devices; chemical defoliants and herbicides; industrial chemicals (e.g., AC, CK, or CG) not configured as a munition; smoke and other obscuration producing items; flame and incendiary producing items; or soil, water, debris or other media contaminated with low concentrations of chemical agents where no CA hazards exist.
Chemical Warfare Material (CWM) Response. Munitions responses and other responses to address the chemical safety; explosives safety, when applicable; human health; or environmental risks presented by CA-filled munitions and CA in other than munitions configurations. (See munitions response.)
Construction Support. Assistance provided by DoD EOD or UXO-qualified personnel and/or by personnel trained and qualified for operations involving CA, regardless of configuration, during intrusive construction activities on property known or suspected to contain UXO, other munitions that may have experienced abnormal environments (e.g., DMM), munitions constituents in high enough concentrations to pose an explosive hazard, or CA, regardless of configuration, to ensure the safety of personnel or resources from any potential explosive or CA hazards.
Cultural Debris. Debris found on operational ranges or munitions response sites, which may be removed to facilitate a range clearance or munitions response, that is not related to munitions or range operations. Such debris includes, but is not limited to: rebar, household items (refrigerators, washing machines, etc.), automobile parts and automobiles that were not associated with range targets, fence posts, and fence wire.
Defense Sites. Locations that are or were owned by, leased to, or otherwise possessed or used by the Department of Defense. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions. (10 U.S.C. 2710(e)(1))
Discarded Military Munitions (DMM). Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of, consistent with applicable environmental laws and regulations. (10 U.S.C. 2710(e)(2))
Disposal. End of life tasks or actions for residual materials resulting from demilitarization or disposition operations.
Disposition. The process of reusing, recycling, converting, redistributing, transferring, donating, selling, demilitarizing, treating, destroying, or fulfilling other life-cycle guidance, for DoD property.

Documentation of the Explosives Safety Status of Material. Documentation attesting that material: (1) does not present an explosive hazard and is consequently safe for unrestricted transfer within or release from DoD control, or (2) is MPPEH, with the known or suspected explosive hazards stated, that is only transferable or releasable to a qualified receiver. This documentation must be signed by a technically qualified individual with direct knowledge of: (1) the results of both the material's 100 percent inspection and 100 percent re-inspection or of the approved process used and the appropriate level of re-inspection, and (2) the veracity of the chain-of-custody for the material. This signature is followed by the signature of another technically qualified individual who inspects the material on a sampling basis (sampling procedures are determined by DoD entity that is inspecting the material).
Environmental Regulators and Safety Officials. Include, but may not be limited to environmental regulators, environmental coordinators or hazardous material coordinators, law enforcement officers, and safety personnel of the U.S. Environmental Protection Agency (USEPA), American Indians and Alaska Natives, other Federal Land Managers, and/or the States. When appropriate, public health officials of various agencies may also be involved.
Explosive Hazard. A condition where danger exists because explosives are present that may react (e.g., detonate, deflagrate) in a mishap with potential unacceptable effects (e.g., death, injury, damage) to people, property, operational capability, or the environment.
Explosive Ordnance Disposal (EOD). The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded ordnance and of other munitions that have become an imposing danger, for example, by damage or deterioration.
Explosive Ordnance Disposal (EOD) Personnel. Military personnel who have graduated from the Naval School, Explosive Ordnance Disposal; are assigned to a military unit with a Service-defined EOD mission; and meet Service and assigned unit requirements to perform EOD duties. EOD personnel have received specialized training to address explosive and certain CA hazards during both peacetime and wartime. EOD personnel are trained and equipped to perform Render Safe Procedures (RSP) on nuclear, biological, chemical, and conventional munitions, and on improvised explosive devices.
Explosive Ordnance Disposal (EOD) Unit. A military organization constituted by proper authority; manned with EOD personnel; outfitted with equipment required to perform EOD functions; and assigned an EOD mission.
Explosives or Munitions Emergency Response. All immediate response activities by an explosives and munitions emergency response specialist to control, mitigate, or eliminate the actual or potential threat encountered during an explosives or munitions emergency. An explosives or munitions emergency response may include in-place render-safe procedures, treatment or destruction of the explosives or munitions, and/or transporting those items to another location to be rendered safe, treated, or destroyed. Any reasonable delay in the completion of an explosives or munitions emergency response caused by a necessary, unforeseen, or uncontrollable circumstance will not terminate the explosives or munitions emergency. Explosives and munitions emergency responses can occur on either public or private lands and are not limited to responses at RCRA facilities. (Military Munitions Rule, 40 CFR 260.10)
Explosives Safety. A condition where operational capability and readiness, people, property, and the environment are protected from the unacceptable effects or risks of potential mishaps involving military munitions.
Interim Holding Facility (IHF). A temporary storage facility designed to hold recovered chemical warfare material (RCWM).
Land Use Controls (LUC). LUC are physical, legal, or administrative mechanisms that restrict the use of, or limit access to, real property, to manage risks to human health and the environment. Physical mechanisms encompass a variety of engineered remedies to contain or reduce contamination and/or physical barriers to limit access to real property, such as fences or signs.
Long-Term Management (LTMgt). The period of site management (including maintenance, monitoring, record keeping, 5-year reviews, etc.) initiated after response (removal or remedial) objectives have been met (i.e., after Response Complete).
Material Potentially Presenting an Explosive Hazard (MPPEH). Material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris); or material potentially containing a high enough concentration of explosives such that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization or disposal operations). Excluded from MPPEH are munitions within DoD's established munitions management system and other hazardous items that may present explosion hazards (e.g., gasoline cans, compressed gas cylinders) that are not munitions and are not intended for use as munitions.

Enclosure 1: Military Munitions-Related Terms and Definitions

Military Munitions. Military munitions means all ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the Department of Defense, the Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives, and chemical warfare agents; chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges; and devices and components thereof. The term does not include wholly inert items; improvised explosive devices; and nuclear weapons, nuclear devices, and nuclear components, other than nonnuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) have been completed. (10 U.S.C. 101(e)(4)(A) through (C))
Military Munitions Burial Site. A site, regardless of location, where military munitions or CA, regardless of configuration, were intentionally buried, with the intent to abandon or discard. This term includes burial sites used to dispose of military munitions or CA, regardless of configuration, in a manner consistent with applicable environmental laws and regulations or the national practice at the time of burial. It does not include sites where munitions were intentionally covered with earth during authorized destruction by detonation, or where in-situ capping is implemented as an engineered remedy under an authorized response action.
Minimum Separation Distance (MSD). MSD is the distance at which personnel in the open must be from an intentional or unintentional detonation.
Munition with the Greatest Fragmentation Distance (MGFD). The munition with the greatest fragment distance that is reasonably expected (based on research or characterization) to be encountered in any particular area.
Munitions and Explosives of Concern (MEC). This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) Unexploded ordnance (UXO), as defined in 10 U.S.C. 101(e)(5); (B) Discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2); or (C) Munitions constituents (e.g., TNT, RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.
Munitions Constituents (MC). Any materials originating from unexploded ordnance (UXO), discarded military munitions (DMM), or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. 2710(e)(3)).
Munitions Debris. Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.
Munitions Response. Response actions, including investigation, removal actions and remedial actions to address the explosives safety, human health, or environmental risks presented by unexploded ordnance (UXO), discarded military munitions (DMM), or munitions constituents (MC), or to support a determination that no removal or remedial action is required.
Munitions Response Area (MRA). Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. A munitions response area is comprised of one or more munitions response sites.
Munitions Response Site (MRS). A discrete location within an MRA that is known to require a munitions response.
Mutual Agreement. A meeting of the minds on a specific subject, and a manifestation of intent of the parties to do or refrain from doing some specific act or acts. Inherent in any mutual agreement or collaborative process are the acknowledgement of each member's role in the process and their differing views of their authorities. The mutual agreement process will provide a means of resolving differences without denying the parties an opportunity to exercise their respective authorities should mutual agreement fail to be achieved.
One Percent Lethality Distance. A distance calculated from a given CA Maximum Credible Event (MCE) and meteorological conditions (temperature, wind speed, Pasquill stability factor) and established as the distance at which dosage from that MCE agent release would be 150 mg-min/m^3 for H and HD agents, 75 mg-min/m^3 for HT agent, 150 mg-min/m^3 for Lewisite, 10 mg-min/m^3 for GB agent, 4.3 mg-min/m^3 for VX vapor, and 0.1 mg-min/m^3 for inhalation and deposition of liquid VX.

On-call Construction Support. Construction support provided, on an as needed basis, where the probability of encountering UXO, other munitions that may have experienced abnormal environments (e.g., DMM), munitions constituents in high enough concentrations to pose an explosive hazard, or CA, regardless of configuration, has been determined to be low. This support can respond from off-site when called, or be on-site and available to provide required construction support.
On-site Construction Support. Dedicated construction support, where the probability of encountering UXO, other munitions that may have experienced abnormal environments (e.g., DMM), munitions constituents in high enough concentrations to pose an explosive hazard, or CA, regardless of configuration, has been determined to be moderate to high.
On-the-Surface. A situation in which UXO, DMM or CA, regardless of configuration, are: (A) entirely or partially exposed above the ground surface (i.e., the top of the soil layer); or (B) entirely or partially exposed above the surface of a water body (e.g., because of tidal activity).
Open Burn (OB). An open-air combustion process by which excess, unserviceable, or obsolete munitions are destroyed to eliminate their inherent explosive hazards.
Open Detonation (OD). An open-air process used for the treatment of excess, unserviceable or obsolete munitions whereby an explosive donor charge initiates the munitions being treated.
Operational Range. A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities; or although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities. (10 U.S.C. 101(e)(3)(A) and (B)). Also includes "military range," "active range," and "inactive range" as those terms are defined in 40 CFR §266.201.
Primary Explosives. Primary explosives are highly sensitive compounds that are typically used in detonators and primers. A reaction is easily triggered by heat, spark, impact or friction. Examples of primary explosives are lead azide and mercury fulminate.
Public Access Exclusion Distance (PAED). The PAED is defined as longest distance of the hazardous fragment distance, inhabited building distance (IBD) for overpressure, or the One Percent Lethality Distance. For siting purposes, the PAED is analogous to the IBD for explosives; therefore, personnel not directly associated with the chemical operations are not to be allowed within the PAED.
Qualified Receiver. Entities that have personnel who are, or individuals who are, trained and experienced in the identification and safe handling of used and unused military munitions, and any known or potential explosive hazards that may be associated with the MPPEH they receive; and are licensed and permitted or otherwise qualified to receive, manage, and process MPPEH.
Range. A designated land or water area that is set aside, managed, and used for range activities of the Department of Defense. The term includes firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration. (10 U.S.C. 101(e)(1)(A) and (B))
Range activities. Research, development, testing, and evaluation of military munitions, other ordnance, and weapons systems; and the training of members of the armed forces in the use and handling of military munitions, other ordnance, and weapons systems. (10 U.S.C. 101(e)(2)(A) and (B))
Range Clearance. The destruction, or removal and proper disposition of used military munitions (e.g., unexploded ordnance (UXO) and munitions debris) and other range-related debris (e.g., target debris, military munitions packaging and crating material) to maintain or enhance operational range safety or prevent the accumulation of such material from impairing or preventing operational range use. "Range clearance" does not include removal, treatment, or remediation of chemical residues or munitions constituents from environmental media, nor actions to address discarded military munitions (e.g., burial pits) on operational ranges.
Range-Related Debris. Debris, other than munitions debris, collected from operational ranges or from former ranges (e.g., target debris, military munitions packaging and crating material).
Recovered Chemical Warfare Material (RCWM). CWM used for its intended purpose or previously disposed of as waste, which has been discovered during a CWM response or by chance (e.g., accidental discovery by a member of the public), that DoD has either secured in place or placed under DoD control, normally in a DDESB-approved storage location or interim holding facility, pending final disposition.

Render Safe Procedures (RSP). The portion of EOD procedures that involves the application of special disposal methods or tools to interrupt the functioning or otherwise defeat the firing train of UXO from triggering an unacceptable detonation.
Secondary Explosives. Secondary explosives are generally less sensitive to initiation than primary explosives and are typically used in booster and main charge applications. A severe shock is usually required to trigger a reaction. Examples are TNT, cyclo-1,3,5-trimethylene-2,4,6-trinitramine (RDX or cyclonite), HMX, and tetryl.
Small Arms Ammunition. Ammunition, without projectiles that contain explosives (other than tracers), that is .50 caliber or smaller, or for shotguns.
Team Separation Distance (TSD). The distance that munitions response teams must be separated from each other during munitions response activities involving intrusive operations.
Technical Escort Unit (TEU). A DoD organization manned with specially trained personnel that provide verification, sampling, detection, mitigation, render safe, decontamination, packaging, escort and remediation of chemical, biological and industrial devices or hazardous material.
Technology-aided Surface Removal. A removal of UXO, DMM or CWM on the surface (i.e., the top of the soil layer) only, in which the detection process is primarily performed visually, but is augmented by technology aids (e.g., hand-held magnetometers or metal detectors) because vegetation, the weathering of UXO, DMM or CWM, or other factors make visual detection difficult.
Time Critical Removal Action (TCRA). Removal actions where, based on the site evaluation, a determination is made that a removal is appropriate, and that less than 6 months exists before on-site removal activity must begin. (40 CFR 300.5)
Unexploded Ordnance (UXO). Military munitions that (A) have been primed, fuzed, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (C) remain unexploded whether by malfunction, design, or any other cause. (10 U.S.C. 101(e)(5)(A) through (C)))
UXO Technicians. Personnel who are qualified for and filling Department of Labor, Service Contract Act, Directory of Occupations, contractor positions of UXO Technician I, UXO Technician II, and UXO Technician III.
UXO-Qualified Personnel. Personnel who have performed successfully in military EOD positions, or are qualified to perform in the following Department of Labor, Service Contract Act, Directory of Occupations, contractor positions: UXO Technician II, UXO Technician III, UXO Safety Officer, UXO Quality Control Specialist, or Senior UXO Supervisor.
Venting. Exposing any internal cavities of MPPEH, to include training or practice munitions (e.g., concrete bombs), using DDESB- or DoD Component-approved procedures, to confirm that an explosive hazard is not present.

Military Munitions-Related Terms (1)
How do they apply to specific types of material?

Type of Material (These are only examples.)	What is it **BEFORE** it is inspected for explosives hazards? (2) What is it **BEFORE** it is inspected? (16)		What is it **AFTER** it is inspected for explosive hazards?					
			If it presents an explosive hazards?			If it does not present an explosive hazards?		
	MPPEH	Other	MEC			MC (5)	Munitions Debris	Other
			UXO	DMM (3)	MC (4)			
Used military munition, on a range, fired	X		X				X	
Unused military munition, on a range, apparently discarded	X			X			X	
Used military munition, in a burial pit, on an operational range or on former ranges	X		X (6)				X	
Unused military munition, in a burial pit on an operational range or on former ranges	X			X (6)			X	
Explosives in the soil	X				X (7)	X		
Refrigerator, nails, soft drink cans, old fence wire, etc.		(8)	NA	NA	NA			(8)
Used cartridge cases, from a range, with live unused munitions possibly mixed in	X			X			(9)	
Target from a range (other than small arms range)	X		(10)	(10)	(10)			(11)
Remnants of munitions from an operational range or former range	X		X (12)	X (12)	X (12)		X (13)	
Kicked out military munition from a former open burn or open detonation ground	X			X (14)			X	
Residual MC in a melt kettle of a former (closed) explosive cast loading building	X		(15)	(15)	X (15)	X		X (16)
Residual MC in a floor drain pipe from an explosives-laden wash water drain of a former (closed) explosives cast loading facility.	X		(15)	(15)	X (15)			X (16)
Residual MC in cracks in floor slab (and in soil underneath floor cracks) in a former explosives manufacturing building	X		(15)	(15)	X (15)	X		X (16)
Small arms bullets or lead particulates n the soil from small arms use at a former small arms range used only for firing small arms ammunition		X (17)	Not Applicable (17)			X		

Note: The examples in this table are not all inclusive. The numbers in the table refer to footnotes that are found on the next page. It is important to read the footnotes, as they provide additional information of importance to understanding.

Enclosure 2

Endnotes:

(1) DoD has been working to standardize terms related to military munitions.

(2) Before material that is considered MPPEH can be either transferred within or released from DoD, its explosives safety status must be determined (see definition--Documentation of the Explosives Safety Status of Material). The type material involved determines the type of inspection (e.g., visual examination, chemical analysis, X-ray) required. Personnel qualified to determine the status of the particular material being examined must perform required inspections. For example, EOD and UXO-qualified personnel may inspect UXO and DMM during a munitions response or during range clearance activities. A QASAS or certified Wage Grade ammunition operator may inspect steamed-out projectiles at a depot's steam-out operation. A laboratory technician may perform a chemical analysis of soil to determine the percent explosives in the soil.

(3) Munitions generally considered as DMM include: buried munitions; un-recovered kick outs from open detonations; munitions left behind or discarded accidentally during munitions-related activities; munitions intentionally disposed of without authorization during munitions-related activities. Munitions removed from storage for the purpose of disposal that are awaiting disposal are not DMM.

(4) This is MC that is both (a) an explosive; and (b) present in sufficient concentrations to present explosive hazards.

(5) This is MC that is either (a) not an explosive (e.g., lead, beryllium, and cadmium); or (b) an explosive not present in sufficient concentrations to present explosive hazards.

(6) Although military munitions in a burial pit will normally be DMM, some may be UXO. For explosives safety reasons, munitions in a burial pit should be approached as UXO until assessed by technically qualified personnel (e.g., EOD personnel, UXO-qualified personnel) and determined that they are not UXO or that they do not present explosive hazards similar to UXO.

(7) Explosive soil is typically found in sumps and settling lagoons for explosives-laden wastewater, and in and around drainage ditches and pipes that carry the wastewater to such sumps and lagoons.

(8) These items are cultural debris.

(9) After determination of their explosives safety status, used cartridge cases documented as safe would, after any demilitarization required to remove their military characteristics, be available for release from DoD. In addition to these DoD requirements, other regulatory criteria may apply.

(10) A target is a type of range-related debris. Although a target is not MEC, it may contain UXO, DMM, or MC. Prior to its release from DoD control, its explosives safety status must be documented.

(11) A target's explosives safety status must be documented and any demilitarization required to remove its military characteristics must be performed prior to its release from DoD control.
(12) UXO, DMM, or MC may be found on operationalranges and on former ranges (previously referred to as closed, transferring or transferred ranges). An inspection of the material will determine into which category this material falls. For example, if a projectile breaks apart on impact, one could find (a) a sheared-off fuze, which would be UXO or (b) explosive filler, which would be MC, that broke away from the projectile's open body. If during an open detonation of an unserviceable munition that is conducted on an operational range, the donor charge detonates, but the munition being destroyed breaks up, but does not detonate, the remnants of the munition would be DMM or, if explosive residue (e.g., clumps of TNT), MC.
(13) After determination of its explosives safety status, scrap metal from used munitions on a range that is documented as safe would, after any demilitarization required to remove its military characteristics, be available for release from DoD control. In additions to these DoD requirements, other regulatory criteria may apply.
(14) Prudent safety practice is to consider kick outs, which have experienced an unknown environment, to be equally dangerous and managed like UXO until technically qualified personnel assess and determine that they are not UXO or do not present explosive hazards similar to UXO.
(15) Of itself, such material (e.g., mettle kettle, drainpipes, floor slabs) do not present an explosive hazard and would not be classified as UXO, DMM or MC. However, residual MC (e.g., TNT, RDX, HMX) could remain in such material in high enough concentrations to present an explosive hazard.
(16) After determination of its explosives safety status, such material (e.g., mettle kettle, drainpipes, floor slabs) when documented as safe would be available for release from DoD control. In addition to this DoD requirement, other regulatory criteria may apply.
(17) At operational ranges or former ranges used exclusively for live fire of small arms ammunition, some unfired small arms ammunition may be found. Although this ammunition is considered DMM and would be MPPEH, it is not considered to present a significant explosive hazard.