

**Quality Assurance Project Plan
for
RCRA Subpart X Permit
OB/OD Area
at
Tooele Army Depot
Tooele, Utah**

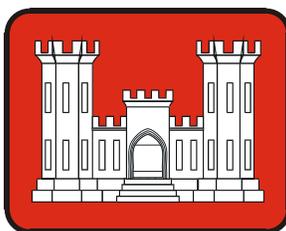
**Contract No. W91278-09-D-0040
Task Order No. 0003**

June 2010

Prepared for

**Tooele Army Depot (TEAD)
Under Contract to**

**U.S. Army Corps of Engineers
Mobile District**



prepared by

 Tetra Tech NUS, Inc.

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Prepared by

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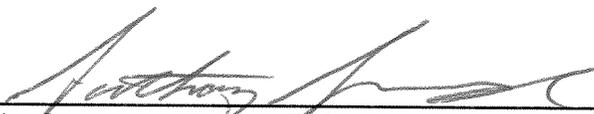

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ACRONYMS

%R	Percent Recovery
ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chain-of-Custody
COR	Contracting Officers Representative
DQO	Data Quality Objectives
EM	Engineering Manual
FOL	Field Operation Leader
FR	Federal Register
FSP	Field Sampling Plan
GIS	Geographic Information System
GPS	Global Positioning System
HPLC	High Performance Liquid Chromatography
HSO	Health & Safety Officer
IDW	Investigation Derived Waste
LIMS	Laboratory Information Management System
MDL	Mean Detection Limit
MD	Matrix Duplicate
MS	Matrix Spike
OB	Open Burning
OD	Open Detonation
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PDS	Post Digestion Samples
PM	Project Manager
PQL	Practical Quantitation Limits
PRG	Preliminary Remediation Goals

QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SOW	Statement of Work
SSHP	Site-specific Safety and Health Plan
TEAD	Tooele Army Depot
TtNUS	Tetra Tech NUS, Inc.
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

1.0 PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPP) outlines the organization, objectives, planned activities, and Quality Assurance/Quality Control (QA/QC) procedures associated with additional sampling and analysis investigation activities to be conducted at the Tooele Army Depot (TEAD) open burning (OB) and open detonation (OD) area located in Utah as discussed in the Sampling and Analysis Plan (SAP). The OB/OD area consists of three separate regulated units; the OB unit, the OD unit and the Static Fire unit. Protocols for sample collection, sample handling and storage, chain-of-custody, laboratory and field analyses, data validation, and reporting are also addressed.

This QAPP has been prepared by Tetra Tech NUS (TtNUS) on behalf of the U.S. Army Corps of Engineers (USACE) Mobile District. This task will be performed under Contract Number W91278-09-D-0040, Delivery Order Number 0003. The environmental sampling study will be conducted at the units in support of the Resource Conservation and Recovery Act (RCRA) Subpart X Permit. The main purpose of the study is to perform an investigation to obtain information to support the facility's Subpart X Permit. This QAPP was generated for and complies with applicable State of Utah and United States Environmental Protection Agency (USEPA) requirements, regulations, guidance, and technical standards.

This QAPP and other associated project documents, including the project-specific Field Sampling Plan (FSP) and Site-Specific Health and Safety Plan (SSHP), constitute the project planning documents for this investigation.

A project description is provided in Section 1 and Section 3 of the FSP.

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2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

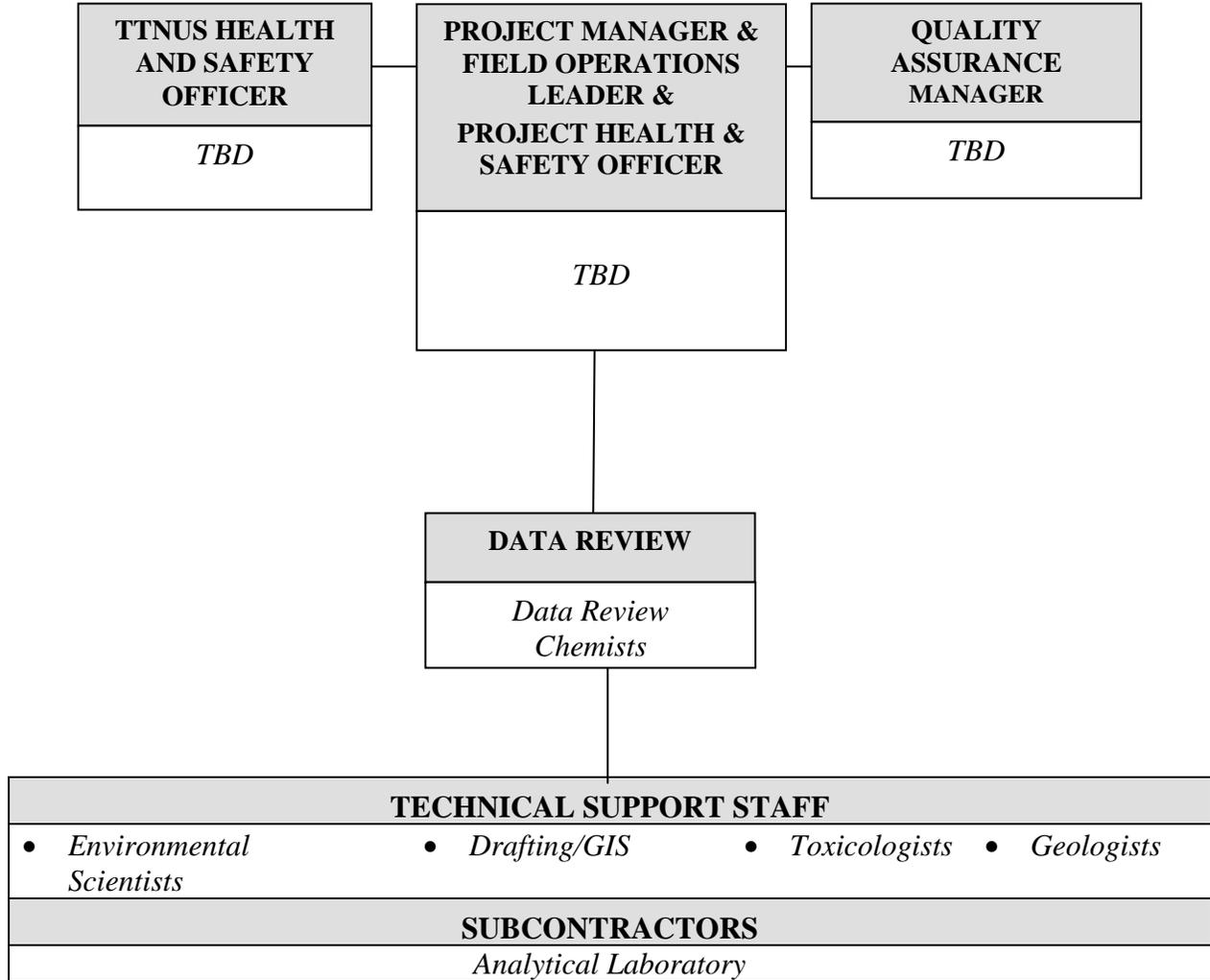
The project organization and responsibilities are detailed in this section. Figure 2-1 illustrates the project organization.

2.1 PROJECT MANAGEMENT

The Project Manager (PM) will be responsible for all contract negotiations with the Army and the subcontractors; will maintain client relationships; and will assume overall responsibility for staffing, maintenance of schedule, adherence to budget, and quality of technical work being performed. The PM will direct the development of the field program, evaluation of findings, determination of conclusions and recommendations, and preparation of the technical report. The PM is selected based on technical experience, project needs, and previous USACE contract management experience. Additional responsibilities include:

- Ensuring timely resolution of project-related technical, quality, safety, or waste management issues.
- Functioning as primary interface with the TEAD Site Manager, field and office personnel, and subcontractor points-of-contact.
- Monitoring and evaluating subcontractor laboratory performance.
- Coordinating and overseeing work performed by field and office technical staff (including data validation, statistical evaluations, and report preparation).
- Coordinating and overseeing maintenance of all project records.

**Figure 2-1
 Project Organization**



- Coordinating and overseeing review of project deliverables.
- Preparing and issuing final deliverables to the USACE.
- Approving the implementation of project corrective action.

2.1.1 Field Operations Leader and Project Health and Safety Officer

The Field Operations Leader (FOL) is responsible for coordinating all onsite personnel and for providing technical assistance, when required. The FOL, or designee, will coordinate and lead all sampling activities and will ensure the availability and maintenance of all sampling materials/equipment. The FOL is responsible for the completion of all sampling, field, and chain-of-custody (COC) documentation, and will assume custody of all samples and ensure the proper handling and shipping of samples. The FOL is an experienced environmental professional who will report directly to the PM. Specific FOL responsibilities include the following:

- Function as communications link between field staff members, the project QAM, the TEAD Site Manager and the PM.
- Oversee the mobilization and demobilization of all field equipment and subcontractors.
- Coordinate and manage the Field Technical Staff.
- Adhere to the work schedules provided by the PM.
- Be responsible for the maintenance of the site logbook, field logbook, and field recordkeeping.
- Initiate field task modification requests when necessary.

- Identify and resolve problems in the field; resolve difficulties in consultation with the TEAD; implement and document corrective action procedures, and provide communication between the field team and upper management.

The FOL will also serve as the project Health and Safety Officer (HSO), and is responsible for the following:

- Overseeing the development and review of the HASP.
- Implementing the HASP.
- Conducting Health and Safety audits.
- Preparing Health and Safety reports for management.

2.1.2 Project Quality Assurance Manager

The QA Manager will be responsible for performing any audits on the project and laboratory subcontractors. The QA Manager has the responsibility for the following specific activities:

- Developing, maintaining, and monitoring QA policies and procedures.
- Providing training to staff in QA/QC policies and procedures.
- Conducting systems and performance audits to monitor compliance with environmental regulations, contractual requirements, QAPP requirements, and corporate policies and procedures.
- Auditing project records.
- Monitoring subcontractor quality controls and records.

- Assisting in the development of corrective action plans; ensuring correction of nonconformances reported in internal or external audits.
- Overseeing the implementation of the QAPP.
- Overseeing and reviewing the development and revision of the QAPP.
- Overseeing the responsibilities of the Site QA/QC advisor.
- Preparing QA reports for management.

2.1.3 **Laboratory Responsibilities**

Subcontractor for this project will include a chemical laboratory. The subcontractor selection process consists of development of statements of work, identification of qualified laboratories, formal solicitation, bid evaluation, and award.

The subcontracted laboratory is responsible for analyzing all samples in accordance with the analytical methods and additional requirements specified in this QAPP. It also will be the analytical laboratory's responsibility to properly dispose of unused sample aliquots. Responsibilities of key laboratory personnel are outlined in the following paragraphs.

Laboratory Director

Responsibilities of the Laboratory Director include the following:

- Support the QA program within the laboratory.
- Provide management overview of both production and quality-related laboratory activities.

- Maintain adequate staffing to meet project analytical and quality objectives.
- Approve all laboratory Standard Operating Procedures (SOPs) and QA documents.
- Supervise in-house COC documentation.
- Oversee the preparation of and approve final analytical reports before submittal to the contractor.

Laboratory Project Manager

The Laboratory Project Manager will report directly to the PM and will:

- Ensure that method and project-specific requirements are properly communicated and understood by laboratory personnel.
- Ensure that all laboratory resources are available on an as-required basis.
- Monitor analytical and project QA requirements.
- Review data packages for completeness, clarity, and compliance with project requirements.
- Inform the PM of project status and any sample receipt or analytical problems.

Laboratory Quality Assurance Officer

The Laboratory Quality Assurance Officer (QAO) has the overall responsibility for data after it leaves the laboratory. The Laboratory QAO will be independent of the laboratory but will communicate data issues through the Laboratory Project Manager. In addition, the Laboratory QAO will:

- Oversee laboratory QA.
- Oversee QA/QC documentation.
- Conduct detailed data reviews.
- Determine whether to implement laboratory corrective actions, if required.
- Define appropriate laboratory QA procedures.
- Prepare laboratory SOPs.

Independent QA will be provided by the Laboratory Project Manager and QAO before release of all data.

Laboratory Sample Custodian

The Laboratory Sample Custodian will report to the Laboratory Director. Responsibilities of the Laboratory Sample Custodian include the following:

- Receive and inspect the incoming sample containers.
- Record the condition of the incoming sample containers.
- Sign appropriate documents.
- Verify COC.
- Notify laboratory manager and laboratory supervisor of sample receipt and inspection.
- Assign a unique identification number and customer number, and enter each into the sample receiving log.

- With the help of the laboratory manager, initiate transfer of the samples to appropriate lab sections.
- Control and monitor access/storage of samples and extracts.

Laboratory Technical Staff

The Laboratory Technical Staff will be responsible for sample analysis and identification of corrective actions. The staff will report directly to the Laboratory Director.

2.2 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATIONS

All field personnel will have appropriate training to conduct the field activities to which they are assigned. Additionally, each site worker will be required to have completed a 40-hour course in Health and Safety Training as described under Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(b)(4) as well as the requirements/training and certifications outlined in the Site-specific Health and Safety Plan (SSHP).

3.0 DATA QUALITY OBJECTIVES

3.1 BACKGROUND

Data quality objectives (DQOs) are requirements needed to support decisions relative to various stages of the project. The data needs associated with this project have been developed based upon evaluation of existing site data and subsequent risk assessment needs. A determination has been made as to what additional data are necessary to establish environmental conditions at the OB/OD area. Specific data needs include development of mean contaminant concentrations across the site and their potential for imparting public health risks and environmental impacts. The purpose of the environmental sampling study is to collect representative samples of surface soil that can be analyzed to identify the environmental condition of the units.

3.2 QA OBJECTIVES FOR CHEMICAL DATA MEASUREMENT

The quality of the laboratory data is assessed in terms of precision, accuracy, representativeness, comparability, and completeness. Definitions of these parameters and the applicable quality control procedures are given below.

Precision - Precision is a measure of the degree to which two or more measurements are in agreement and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions. A fundamental tenet of using precision measurements for QC is that precision will be bounded by known limits. Results outside these predetermined limits trigger corrective actions. Because of the inherent and unknown heterogeneity of soil samples, the precision of soil field duplicate samples will not be used for QC, but will be compared to laboratory precision estimates to gain a perspective on the natural heterogeneity of the soil.

Field precision is assessed by collecting and measuring field duplicates at a rate of 1 duplicate per 10 environmental samples submitted to the fixed-base laboratory. Acceptance

limits for field duplicate samples are 30% relative percent difference for aqueous matrices and 50% relative percent difference for solid matrices. This precision estimate encompasses the combined uncertainty associated with sample collection, homogenization, splitting, handling, laboratory and field storage, digestion or extraction, and analysis. In contrast, precision estimates obtained from analyzing duplicate laboratory samples incorporate only homogenization, subsampling, digestion or extraction, laboratory storage, and analysis uncertainties. Consequently, the field precision estimates (i.e., relative percent difference [RPD] values) should equal or exceed the laboratory precision estimates, on average, for each analyte. If field duplicate precision is significantly different from laboratory duplicate precision, the underlying cause will be investigated to determine whether the observed difference could be artifacts of sampling and analysis. Considerations given to this effort include:

- The scale of subsampling for laboratory precision estimates relative to the scale of field duplicate sample size.
- Analytical measurement precision.
- Precision for repeat analysis of the same solid laboratory control sample (LCS).
- Estimated environmental sample grain size relative to LCS grain size.
- Potential natural soil heterogeneity.

Laboratory precision QC samples (i.e., laboratory duplicates for inorganic chemicals and MSDs for organic chemicals) will be analyzed with a minimum frequency of 5 percent (i.e., 1 QC sample per 20 environmental samples). Laboratory precision is measured by comparing RPD values with precision control limits. Precision limits for matrix spike/matrix spike duplicate and laboratory duplicate samples are displayed in Table 3-1.

Table 3-1

**Aqueous and Solid Relative Percent Difference Quality Control Limits for
 Laboratory Control Samples, Matrix Spikes, and Laboratory Duplicates
 Tooele Army Depot, Tooele, Utah**

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PARAMETERS	Aqueous		Solid	
	MSD RPD	LABDUP RPD	MSD RPD	LABDUP RPD
EXPLOSIVES (NITROAROMATICS AND NITRAMINES)				
SW-846 METHOD 8330B				
Nitroglycerin	30	NA	50	NA
PETN	30	NA	50	NA
1,3,5-Trinitrobenzene	30	NA	50	NA
1,3-Dinitrobenzene	30	NA	50	NA
2,4,6-Trinitrotoluene (TNT)	30	NA	50	NA
2,4-Dinitrotoluene	30	NA	50	NA
2,6-Dinitrotoluene	30	NA	50	NA
2-Amino-4,6-dinitrotoluene	30	NA	50	NA
2-Nitrotoluene	30	NA	50	NA
3-Nitrotoluene	30	NA	50	NA
4-Amino-2,6-dinitrotoluene	30	NA	50	NA
4-Nitrotoluene	30	NA	50	NA
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	30	NA	50	NA
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	30	NA	50	NA
Nitrobenzene	30	NA	50	NA
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	30	NA	50	NA
TAL METALS				
SW-846 Method 6010B				
Aluminum	NA	20	NA	20
Antimony	NA	20	NA	20
Arsenic	NA	20	NA	20
Barium	NA	20	NA	20
Beryllium	NA	20	NA	20
Cadmium	NA	20	NA	20
Calcium	NA	20	NA	20
Chromium (total)	NA	20	NA	20
Cobalt	NA	20	NA	20
Copper	NA	20	NA	20
Iron	NA	20	NA	20
Lead	NA	20	NA	20
Magnesium	NA	20	NA	20
Manganese	NA	20	NA	20
Nickel	NA	20	NA	20
Potassium	NA	20	NA	20

Table 3-1

**Aqueous and Solid Relative Percent Difference Quality Control Limits for
Laboratory Control Samples, Matrix Spikes, and Laboratory Duplicates
Tooele Army Depot, Tooele, Utah
Page 2 of 3**

PARAMETERS	Aqueous		Solid	
	MSD RPD	LABDUP RPD	MSD RPD	LABDUP RPD
Selenium	NA	20	NA	20
Silver	NA	20	NA	20
Sodium	NA	20	NA	20
Thallium	NA	20	NA	20
Vanadium	NA	20	NA	20
Zinc	NA	20	NA	20
SW-846 7470A/7471A				
Mercury	20	NA	20	NA
Miscellaneous				
Perchlorate EPA Method 314.0 and SW-846 6850	15	NA	15	NA
Dioxin/Furans SW-846 8280A				
2,3,7,8-TCDD	30	NA	50	NA
1,2,3,7,8-PeCDD	30	NA	50	NA
1,2,3,6,7,8-HxCDD	30	NA	50	NA
1,2,3,4,7,8-HxCDD	30	NA	50	NA
1,2,3,7,8,9-HxCDD	30	NA	50	NA
1,2,3,4,7,8,9-HpCDD	30	NA	50	NA
OCDD	30	NA	50	NA
2,3,7,8-TCDF	30	NA	50	NA
1,2,3,7,8-PeCDF	30	NA	50	NA
2,3,4,7,8-PeCDF	30	NA	50	NA
1,2,3,6,7,8-HxCDF	30	NA	50	NA
1,2,3,7,8,9-HxCDF	30	NA	50	NA
1,2,3,4,7,8-HxCDF	30	NA	50	NA
1,2,3,4,6,7,8-HpCDF	30	NA	50	NA
OCDF	30	NA	50	NA
Total TCDD	30	NA	50	NA
Total PeCDD	30	NA	50	NA
Total HxCDD	30	NA	50	NA
Total HpCDD	30	NA	50	NA
Total TCDF	30	NA	50	NA
Total PeCDF	30	NA	50	NA
Total HxCDF	30	NA	50	NA
Total HpCDF	30	NA	50	NA
Total OCDD	30	NA	50	NA
Total OCDF	30	NA	50	NA

Table 3-1

**Aqueous and Solid Relative Percent Difference Quality Control Limits for
Laboratory Control Samples, Matrix Spikes, and Laboratory Duplicates
Tooele Army Depot, Tooele, Utah
Page 3 of 3**

- 1 Aqueous and solid percent recoveries are typical for these methods but the actual laboratory specific limits may vary. Quality Control (QC) limits may change prior to SWMU investigations as laboratory QC data is updated.
- 2 Analyte is not included in the spiking solution.

Accuracy - Accuracy is a measure of the closeness of the measured value to the true value. The accuracy of chemical test results is assessed by "spiking" samples with known standards (surrogate matrix spike) and establishing the average recovery. Accuracy measurements will be carried out in accordance with Contract Laboratory Program (CLP) Statement of Work (SOW) requirements for organic and inorganic analyses (USEPA CLP OLM04.3 and CLP ILM05.4, respectively) and at a minimum frequency of 1 in 10 samples per matrix analyzed (USEPA, 1991).

Accuracy requirements for field measurements are typically ensured through control over the sample collection and handling and through routine instrument calibration. Accuracy is also typically monitored through the use of blanks to detect cross-contamination and by monitoring adherence to procedures that prevent sample contamination or degradation. Accuracy also shall be assured qualitatively through adherence to all sample handling, preservation, and holding time requirements.

Accuracy in the laboratory is measured through the comparison of a spiked sample or LCS result to a known or calculated value and is expressed as a percent recovery (%R). It is also assessed by monitoring the analytical recovery of select surrogate compounds added to samples that are analyzed by organic chromatographic methods. MS and surrogate compound analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement. LCSs are used to assess the accuracy of laboratory operations with minimal sample matrix effects. Post Digestion spikes (PDSs) are used to assess the accuracy of the analytical measurement on the sample extract or digestate. The parameters to be included in spiking mixes and accuracy limits are presented by analytical fraction and matrix in Table 3-2. LCS and MS analyses are performed at a frequency no less than 1 per 20 associated samples of like matrix. Laboratory accuracy is assessed via comparison of calculated %R values to accuracy control limits.

Table 3-2

**Laboratory Control Sample and Matrix Spikes Recovery Quality
Control Limits for Aqueous and Solid Samples
Tooele Army Depot, Tooele, Utah
Page 1 of 3**

PARAMETERS	AQUEOUS ⁽¹⁾		SOLID ⁽¹⁾	
	LCS	MS	LCS	MS
	%R	%R	%R	%R

EXPLOSIVES (NITROAROMATICS AND NITRAMINES)

SW-846 METHOD 8330B

Nitroglycerin	60 - 120	50 - 140	55 - 125	50 - 140
PETN	60 - 120	50 - 140	55 - 125	50 - 140
1,3,5-Trinitrobenzene	60 - 120	50 - 140	55 - 125	50 - 140
1,3-Dinitrobenzene	60 - 120	50 - 140	55 - 125	50 - 140
2,4,6-Trinitrotoluene (TNT)	60 - 120	50 - 140	55 - 125	50 - 140
2,4-Dinitrotoluene	60 - 120	50 - 140	55 - 125	50 - 140
2,6-Dinitrotoluene	60 - 120	50 - 140	55 - 125	50 - 140
2-Amino-4,6-dinitrotoluene	60 - 120	50 - 140	55 - 125	50 - 140
2-Nitrotoluene	60 - 120	50 - 140	55 - 125	50 - 140
3-Nitrotoluene	60 - 120	50 - 140	55 - 125	50 - 140
4-Amino-2,6-dinitrotoluene	60 - 120	50 - 140	55 - 125	50 - 140
4-Nitrotoluene	60 - 120	50 - 140	55 - 125	50 - 140
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	60 - 120	50 - 140	55 - 125	50 - 140
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	60 - 120	50 - 140	55 - 125	50 - 140
Nitrobenzene	60 - 120	50 - 140	55 - 125	50 - 140
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	60 - 120	50 - 140	55 - 125	50 - 140

TAL METALS

SW-846 Method 6010B

Aluminum	80 - 120	75 - 125	80 - 120	75 - 125
Antimony	80 - 120	75 - 125	80 - 120	75 - 125
Arsenic	80 - 120	75 - 125	80 - 120	75 - 125
Barium	80 - 120	75 - 125	80 - 120	75 - 125
Beryllium	80 - 120	75 - 125	80 - 120	75 - 125
Cadmium	80 - 120	75 - 125	80 - 120	75 - 125
Calcium	80 - 120	75 - 125	80 - 120	75 - 125
Chromium (total)	80 - 120	75 - 125	80 - 120	75 - 125
Cobalt	80 - 120	75 - 125	80 - 120	75 - 125
Copper	80 - 120	75 - 125	80 - 120	75 - 125
Iron	80 - 120	75 - 125	80 - 120	75 - 125
Lead	80 - 120	75 - 125	80 - 120	75 - 125
Magnesium	80 - 120	75 - 125	80 - 120	75 - 125
Manganese	80 - 120	75 - 125	80 - 120	75 - 125
Nickel	80 - 120	75 - 125	80 - 120	75 - 125
Potassium	80 - 120	75 - 125	80 - 120	75 - 125

Table 3-2

**Laboratory Control Sample and Matrix Spikes Recovery Quality
Control Limits for Aqueous and Solid Samples
Tooele Army Depot, Tooele, Utah
Page 2 of 3**

PARAMETERS	AQUEOUS ⁽¹⁾		SOLID ⁽¹⁾	
	LCS	MS	LCS	MS
	%R	%R	%R	%R
Selenium	80 - 120	75 - 125	80 - 120	75 - 125
Silver	80 - 120	75 - 125	80 - 120	75 - 125
Sodium	80 - 120	75 - 125	80 - 120	75 - 125
Thallium	80 - 120	75 - 125	80 - 120	75 - 125
Vanadium	80 - 120	75 - 125	80 - 120	75 - 125
Zinc	80 - 120	75 - 125	80 - 120	75 - 125
SW-846 7470A/7471A				
Mercury	75 - 125	85 - 115	90 - 110	85 - 115
MISCELLANEOUS PARAMETERS				
Perchlorate EPA Method 314.0 and SW-846 6850	85 - 115	80 - 120	80 - 120	80 - 120
Dioxin/Furans SW-846 8280A				
2,3,7,8-TCDD	70 - 130	70 - 130	70 - 130	70 - 130
1,2,3,7,8-PeCDD	70 - 130	70 - 130	70 - 130	70 - 130
1,2,3,6,7,8-HxCDD	70 - 130	70 - 130	70 - 130	70 - 130
1,2,3,4,7,8-HxCDD	70 - 130	70 - 130	70 - 130	70 - 130
1,2,3,7,8,9-HxCDD	70 - 130	70 - 130	70 - 130	70 - 130
1,2,3,4,7,8,9-HpCDD	70 - 130	70 - 130	70 - 130	70 - 130
OCDD	70 - 130	70 - 130	70 - 130	70 - 130
2,3,7,8-TCDF	70 - 130	70 - 130	70 - 130	70 - 130
1,2,3,7,8-PeCDF	70 - 130	70 - 130	70 - 130	70 - 130
2,3,4,7,8-PeCDF	70 - 130	70 - 130	70 - 130	70 - 130
1,2,3,6,7,8-HxCDF	70 - 130	70 - 130	70 - 130	70 - 130
1,2,3,7,8,9-HxCDF	70 - 130	70 - 130	70 - 130	70 - 130
1,2,3,4,7,8-HxCDF	70 - 130	70 - 130	70 - 130	70 - 130
1,2,3,4,6,7,8-HpCDF	70 - 130	70 - 130	70 - 130	70 - 130
OCDF	70 - 130	70 - 130	70 - 130	70 - 130
Total TCDD	70 - 130	70 - 130	70 - 130	70 - 130
Total PeCDD	70 - 130	70 - 130	70 - 130	70 - 130
Total HxCDD	70 - 130	70 - 130	70 - 130	70 - 130
Total HpCDD	70 - 130	70 - 130	70 - 130	70 - 130
Total TCDF	70 - 130	70 - 130	70 - 130	70 - 130
Total PeCDF	70 - 130	70 - 130	70 - 130	70 - 130
Total HxCDF	70 - 130	70 - 130	70 - 130	70 - 130
Total HpCDF	70 - 130	70 - 130	70 - 130	70 - 130
Total OCDD	70 - 130	70 - 130	70 - 130	70 - 130
Total OCDF	70 - 130	70 - 130	70 - 130	70 - 130

Table 3-2

**Laboratory Control Sample and Matrix Spikes Recovery Quality
Control Limits for Aqueous and Solid Samples
Tooele Army Depot, Tooele, Utah
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NA = not applicable.

LCS = Laboratory control sample.

MS = Matrix spike.

- 1 Aqueous and solid percent recoveries are typical for these methods but the actual laboratory specific limits may vary. Quality Control (QC) limits may change prior to change prior to SWMU investigations as laboratory QC data is updated.
- 2 Analyte is not included in the spiking solution

Representativeness - Representativeness is an expression of the degree to which the data accurately and precisely represent a characteristic of a population or environmental condition existing at the site. Adherence to the project planning documents and use of standardized sampling, handling, preparation, analysis, and reporting procedures ensures that the final data accurately represent the desired populations.

To ensure representativeness of field data depends on the proper design of the sampling program and will be satisfied by ensuring that the project planning documents are followed and that proper sampling techniques are used.

Representativeness in the laboratory is ensured or evaluated by using the proper analytical procedures, meeting sample holding times, and analyzing and evaluating field duplicate samples relative to laboratory duplicates.

Comparability - Comparability is defined as the confidence with which one data set can be compared with another (e.g., between sampling points and between sampling events). Comparability is achieved by using standardized sampling and analysis methods and data reporting formats (including use of consistent units of measure), and by ensuring that reporting and detection limits are sufficiently low to satisfy project detection and quantitation criteria for the duration of the project.

Comparability depends on the proper design of the sampling program and will be satisfied by ensuring that the project planning documents are followed and that proper sampling techniques are used. The sample network and rationale for this investigation are addressed in Section 4.0 of the FSP.

Planned analytical data will be comparable when similar sampling and analytical methods are used and documented. Results will be reported in units that ensure comparability with previous data.

Completeness - Completeness is defined as the percentage of measurements made which are judged to be valid measurements. Results will be considered valid if all the precision,

accuracy, and representativeness objectives are met. The target completeness goal for this work is 90% (combined field and laboratory results) for a given analysis.

Chemical Analysis Methods

The applicable QC procedures and quantitation limits are dictated by the specific analytical methods employed. Analytical methods used to characterize soil quality are provided in Section 6.

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4.0 SAMPLING LOCATIONS AND PROCEDURES

Sampling locations, rationale, and procedures are discussed in Section 4 of the FSP.

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5.0 SAMPLE HANDLING, CUSTODY, PRESERVATION, AND HOLDING TIME REQUIREMENTS

This section outlines the procedures to be used for field documentation, sample labeling, sample preservation, and the maintenance of COC. In addition to these procedures, the laboratory contractor is required to obtain a Laboratory Information Management System (LIMS) tracking number from the USACE technical manager. The associated project LIMS number will be noted on all samples shipped to government QA laboratories, if required.

5.1 DAILY FIELD LOGBOOK AND SAMPLING POINT DOCUMENTATION

All information pertinent to field activities will be recorded in a daily field logbook. The logbook will be a bound book with consecutively numbered, water-resistant pages. Entries in the logbook will be made in indelible ink and will include, but not be limited to, the following items:

- Names and affiliations of field personnel and any persons contacted at the site;
- Date and time of arrival and departure;
- Documentation of the weather conditions and pertinent field conditions;
- Field equipment calibration data;
- General description of the day's activities;
- Location of sampling points;
- Date and time of sample and data collection;
- Sample ID numbers, volume, sampling method, containers, any sample manipulation (filtration, compositing), and preservation techniques;
- Description and number of shipping coolers packaged; and
- Name and address of all receiving laboratories.

The location of sampling points will be determined using a hand-held Global Positioning System (GPS). GPS files will be stored in the data logger and downloaded to a personal computer. Files will then be transferred to a Geographic Information System (GIS) database (ARC/INFO).

Sampling points will also be documented on film. When possible, photographs will include reference points to facilitate locating the sampling point at a later date. Developed photographs will be compared against the photographic log to confirm the log and match the photographs. For each photograph taken, the following information will be recorded in the field logbook:

- Name of site and photographer;
- Date and time;
- General direction faced and a description of the area photographed;
- Roll number and sequential number of the photograph; and
- Site map depicting areas photographed.

5.2 SAMPLE LABELING

A sample label will be prepared and affixed to each sample container. Sample containers/bottleware to support chemical analyses will be of ICHM series 300 cleanliness or equivalent. The label will contain the contractor name, project number, site name, sample number, date and time of collection, matrix, subsurface depth interval, analyses requested, sampler name, preservation type (if any), and sample type (discrete or composite). Labels will be filled out prior to sampling to facilitate placement of samples in a cooler as soon as possible. Each sample collected at TEAD will be assigned a unique sample tracking number. The sample tracking number will consist of a three-segment, alphanumeric code that identifies the sample medium, location, and depth (in the case of soil samples) or the sampling event (in the case of monitoring well samples). Any other pertinent information regarding sample identification will be recorded in the field logbooks.

The alphanumeric code to be used in the sample numbering system is explained in the following diagram and the subsequent definitions:

5.3 SAMPLE CHAIN-OF-CUSTODY

After recovery, each sample will be maintained in the sampler's custody until formally transferred to another party. Custody is defined as any one of the following:

- The sample is in plain view of the sampler.
- The sample is inside a cooler which is in plain view of the sampler.
- The sample is inside any locked space, such as a cooler, locker, car, or truck, to which the sampler has the only immediately available key.
- The sample is in a designated secure area.

For all samples recovered, a COC record will document the date and time of sample collection, a list of samples collected, and the sampler's name. Specifications for chemical analyses will also be documented on the custody record. All others who subsequently hold custody of the sample will sign, date, and note the time of receipt of the samples on the COC record.

5.4 SAMPLE SHIPMENT

The sample bottles to be sent to the laboratory will be packed in insulated coolers with the drain plug taped shut from the inside and outside. A large plastic bag will line the cooler and an inert packing material will be placed around the bottles to prevent breakage during shipment. Each sample bottle will be sealed in a separate plastic bag. The samples will be chilled to 4°C by placing ice packs or the equivalent on the sample bottles. A temperature blank will be placed in each cooler. The original plus one copy of the COC record will be taped to the inside lids of the shipping coolers in a plastic bag. To ensure that proper analysis of the samples is performed, an additional form supplementing the COC may be included, as required by the laboratory. This form will identify the samples by number, location, time collected, and desired analysis. The

sample shipping cooler will be secured using nylon strapping tape and at least two signed custody seals. The custody seals will be placed on the containers so that the containers cannot be opened without breaking the seals.

The type of shipment to be used will be dependent on the location of the laboratory in relation to TEAD. Expedient shipment will be used to ensure analyses within allowable holding times. After the laboratory has accepted the samples, the original COC record will be returned to the FOL via registered return receipt or common carrier. The air bill number or registered mail serial number will be noted on the COC record.

5.5 QA/QC REQUIREMENTS

If an error is made on original documentation (field logbooks, sample labels, or COC records), the person who made the entry is to cross out the error and enter the correct information. The incorrect information will not be obliterated. Any corrections will be initialed and dated.

5.6 SAMPLE CONTAINER, PRESERVATION, AND HOLDING TIME REQUIREMENTS

As part of the QA/QC program, established preservation and storage measures will be followed. Table 5-1 provides information on holding times, sample containers, and sample preservation requirements. All sample containers will be obtained directly from the laboratory. The split sample containers will be supplied by DSHW and the split samples will be analyzed by the State laboratory.

Table 5-1
Container, Preservation, and Holding Time Requirements

Analysis	Soil Sample Container	Water Sample Container	Holding Time	Preservative	Sample Handling
Metals	Wide-mouth glass jar with Teflon-lined lid or 1 kilogram capacity laboratory sample bag	500 mL Plastic	Analyze within 6 months, Mercury analyze within 28 days	none (soil) HNO ₃ to a pH<2 (water)	cool to 4° C (ice)
Energetics	Wide-mouth glass jar with Teflon-lined lid or 1 kilogram capacity laboratory sample bag	1 Liter amber glass	Extract 7 days (water)14 days (soil); Analyze within 40 days	none	cool to 4° C (ice)
Dioxin/ Furans	Wide-mouth amber glass jar with Teflon-lined lid or 1 kilogram capacity laboratory sample bag	4 Liter amber glass jar with Teflon-lined lid	Extract 30 days; Analyze within 45 days	none	cool to 4° C (ice)
Perchlorate	Wide-mouth amber glass jar with Teflon-lined lid or 1 kilogram capacity laboratory sample bag	500 mL Plastic	28 dyas to analysis	none	cool to 4° C (ice)

6.0 ANALYTICAL PROCEDURES

A USACE-approved Utah certified laboratory will be selected for the analytical program. Analytical methods used will follow Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, (EPA SW-846) and Methods for the Determination of Metals in Environmental Samples (EPA 600/4-91/010) (USEPA, 1986). Analytical methods used to characterize soil and groundwater quality will include the following:

Laboratory analysis will include:

- RCRA metals/EPA Method

- arsenic (6010B)
- barium (6010B)
- cadmium (6010B)
- chromium (6010B)
- lead (6010B)
- mercury (7470A aqueous, 7471A soil)
- selenium (6010B)
- silver (6010B)

- Other metals/EPA Method

- aluminum (6010B), 7/92
- beryllium (6010B)
- copper (6010B)
- iron (6010B)
- potassium (6010B)
- manganese (6010B)
- nickel (6010B)
- sodium (6010B)
- thallium (6010B)
- vanadium (6010B)
- zinc (6010B)

- Explosive compounds (EPA 8330B)

- Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
- Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
- 1,3,5-Trinitrobenzene (TNB)
- Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
- 1,3-Dinitrobenzene (DNB)
- 2,4,6-Trinitrotoluene (TNT)
- 2-Amino-4, 6-dinitrotoluene (2-AM-DNT)
- 4-Amino-2,6-dinitrotoluene (4-AM-DNT)
- 2-Nitrotoluene (2NT)
- 3-Nitrotoluene (3NT)
- 4-Nitrotoluene (4NT)
- Nitroglycerin (TNG)
- Pentaerythritol tetranitrate (PETN)

- Nitrobenzene (NB)
- 2,4-Dinitrotoluene (2,4-DNT)
- 2,6-Dinitrotoluene (2,6-DNT)

- Perchlorate (EPA 6850)

- Dioxins/Furans (EPA 8280A)-Only at background, burn pans, and static fire locations
 - 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD)
 - 1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin (PeCDD)
 - 1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin (HxCDD)
 - 1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin (HxCDD)
 - 1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin (HxCDD)
 - 1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin (HpCDD)
 - 1,2,3,4,5,6,7,8-Octachlorodibenzo-*p*-dioxin (OCDD)
 - 2,3,7,8-Tetrachlorodibenzofuran (TCDF)
 - 1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)
 - 2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)
 - 1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)
 - 1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)
 - 1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)
 - 2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)
 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)
 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)
 - 1,2,3,4,5,6,7,8-Octachlorodibenzofuran (OCDF)
 - Total TCDD
 - Total PeCDD
 - Total HxCDD
 - Total HpCDD
 - Total TCDF
 - Total PeCDF
 - Total HxCDF
 - Total HpCDF

6.1 METALS ANALYSIS BY INDUCTIVELY COUPLED PLASMA

Estimated practical quantitation limits (PQLs) using SW-846, as well as mean detection limits (MDLs) for the general laboratories, for soil and groundwater samples are shown below (EM 200-1-3, Table G-2). These values are compared to screening criteria.

Metals	Soils (mg/kg)			Groundwater (µg/L)		
	IDL ^(a)	PQLs ^(b)	Screening criteria ^(c)	IDL ^(a)	PQLs ^(b)	Screening criteria ^(c)
Aluminum	10	30	76,000	50	300	36000
Arsenic	0.6	1	0.39	3.0	10	0.045
Barium	1.0	0.5	5,400	5.0	5	2600
Beryllium	0.2	0.5	0.15	1.0	5	73
Cadmium	0.2	1	37	1.0	10	18
Chromium	0.4	1.5	30	2.0	15	11
Copper	1.0	2.5	3,100	5.0	25	1500
Iron	6	10	23,000	30	100	11000
Lead	0.3	0.5	400	1.5	5	15
Potassium	100	100	NA	0.50	1000	NA
Manganese	0.6	0.5	1,800	3.0	5	88
Mercury	0.013	0.04	23	0.08	0.2	11
Nickel	1.0	4	1,600	5.0	40	730
Selenium	0.6	1	390	3.0	10	180
Silver	0.2	1.5	390	1.0	15	180
Sodium	100	100	NA	0.50	1000	NA
Thallium	0.6	1.5	NA	3.0	10	NA
Vanadium	1.0	2.5	78	5.0	25	36
Zinc	1.0	2.5	23,000	5.0	25	11000

^a Instrument detection limits (IDLs) shown are a guide for an instrumental limit at the wavelengths recommended within the method.

^b PQLs determined for samples vary depending upon the sample matrix. USACE has established these levels as estimated PQLs (commensurate with SW-846).

^c U.S EPA Region 9 Preliminary Remediation Goals (PRGs) Table (Values for residential soil) 2004 and tap water.

^d Revised Interim Soil Lead Guidance for CERCLA and RCRA Corrective Action Facilities, Office of Solid Waste and Emergency Response (OSWER) Directive 9355.4-12, July 14, 1994.

NA = Not available

6.2 EXPLOSIVES ANALYSIS BY METHOD 8330B

The procedure for analysis of explosives in soil is SW-846 Method 8330B by high performance liquid chromatography (HPLC). The estimated SW-846 PQLs, as well as MDLs for general laboratories, using this method are shown below. These values are compared to screening criteria.

Explosives	SOIL (mg/kg)			GROUNDWATER (µg/L)		
	PQL	MDLs ^(a)	Screening criteria ^(b)	PQL	MDLs ^(a)	Screening criteria ^(b)
HMX	0.50	0.05	3,100	0.50	0.15	1800
RDX	0.50	0.05	4.4	0.50	0.15	0.61
TNB	0.25	0.02	1,800	0.20	0.1	1100
Tetryl	0.65	0.05	NA	0.20	0.1	360
DNB	0.25	0.02	6.1	0.20	0.1	3.6
TNT	0.25	0.03	16	0.20	0.1	2.2
NB	0.25	0.03	20	0.20	0.1	3.4
2,6 DNT	0.25	0.02	61	0.20	0.1	36
2,4 DNT	0.25	0.02	120	0.20	0.1	73
2-AM-DNT	0.25	0.03	12	0.20	0.1	7.3
4-AM-DNT	0.25	0.04	12	0.20	0.1	7.3
2NT	0.25	0.05	730	0.20	0.1	120
4NT	0.25	0.05	12	0.20	0.1	0.66
3NT	0.25	0.06	0.88	0.20	0.1	0.049
PETN ^c	2.5	0.43	NA	4	0.5	NA
TNG ^d	2.5	0.86	NA	4	0.5	NA

^a Guidance Method Limits; these values are laboratory-specific and will be established when the contract laboratory is procured.

^b U.S EPA Region 9 Preliminary Remediation Goals (PRGs) Table (Values for residential soil and tap water) 2004.

^c PETN is an add-on to Method 8330.

^d TNG is an add-on to Method 8330.

NA = Not available

6.3 PERCHLORATE ANALYSIS BY METHOD 6850

The procedure for analysis of perchlorate in soil and groundwater EPA Method 6850. The estimated PQLs, as well as MDLs for general laboratories, using this method are shown below. These values are compared to screening criteria.

	Soil			Groundwater		
	PQL ^(a)	MDLs ^(a)	Screening criteria ^(b)	PQL ^(a)	MDLs ^(a)	Screening criteria ^(b)
Perchlorate	10	1.1	7.8	0.2	0.066	3.6

^a Guidance Method Limits; these values are laboratory-specific and will be established when the contract laboratory is procured.

^b Advisory Level-to be determined prior to final approval of the QAPP.

NA = Not available

6.4 DIOXIN/FURANS ANALYSIS BY METHOD 8280A

The procedure for analysis of dioxins and furans in soil EPA Method 8280A. The estimated PQLs, as well as MDLs for general laboratories, using this method are shown below. These values are compared to screening criteria.

Dioxins/Furans	Soil (mg/kg)			Groundwater (ng/L)		
	PQL	MDLs ^(a)	Screening criteria ^(b)	PQL	MDLs ^(a)	Screening criteria ^(b)
TCDD	1	TBD	TBD	10	TBD	TBD
PeCDD	2.5	TBD	TBD	25	TBD	TBD
HxCDD (all)	2.5	TBD	TBD	25	TBD	TBD
HpCDD	2.5	TBD	TBD	25	TBD	TBD
OCDD	5	TBD	TBD	50	TBD	TBD
TCDF	1	TBD	TBD	10	TBD	TBD
PeCDF (all)	2.5	TBD	TBD	25	TBD	TBD
HxCDF (all)	2.5	TBD	TBD	25	TBD	TBD
HpCDF (all)	2.5	TBD	TBD	25	TBD	TBD
OCDF	5	TBD	TBD	50	TBD	TBD

^a Guidance Method Limits; these values are laboratory-specific and will be established when the contract laboratory is procured.

^b To be determined prior to final approval of the QAPP.

NA = Not available

7.0 CALIBRATION PROCEDURES AND FREQUENCY

7.1 ANALYTICAL SUPPORT AREAS

Standard/Reagent Preparation - All standards and standard solutions will be catalogued to identify the supplier, lot number, purity/concentration, receipt/preparation date, preparer's name, method of preparation, expiration date, and any other pertinent information. Stock and working standard solutions will be validated before use and checked regularly for signs of deterioration. Standard solutions will be properly stored and handled, and all containers will be labeled to identify the chemical(s), concentration, solvent, expiration date, initials of preparer, and date of preparation. Reagents will be examined for purity by subjecting an aliquot or subsample to the analytical method in which it will be used. The contract laboratory will not use a standard or reagent if its expiration date has passed. Complete documentation will be maintained for all standards and reagents used.

Balances - Analytical balances will be calibrated daily or before each use and will be calibrated by the manufacturer once annually. The daily calibration will be conducted using two Class "S" weights that bracket the expected balance use range. Balance calibrations will be documented in hardbound logbooks with prenumbered pages.

Refrigerators/Freezers - All refrigerator and freezer temperatures will be monitored daily and the internal minimum and maximum temperatures will be recorded at least once daily. Thermometers used (either continuous or minimum/maximum) for measurement of refrigerator and freezer temperatures will be calibrated at least annually. The expected temperature ranges will be posted on each unit in service and corrective actions established if necessary.

Water Supply System - The contract laboratory will maintain a water supply system which is capable of furnishing American Society of Testing and Materials Type II polished water to the analytical areas (ASTM 1) (ASTM, 2005). The water quality will be monitored and recorded on a regular basis.

7.2 LABORATORY INSTRUMENTS

All laboratory instruments will be calibrated with the appropriate standard solution. All reported analytes are to be bracketed by an established calibration curve. Because standard methods allow the lowest standard to be up to ten times the concentration of the MDL, any positive values below this low-level standard and above the project PQL would be classified as estimated. To avoid quantifications of data based on this requirement, the contract laboratory is required to analyze an additional low standard at or near the project PQL. Analytical guidelines and manufacturer specifications determine the frequency of laboratory instrument calibration necessary. All batches of samples analyzed will be bracketed by appropriate calibration verification standards. Corrective actions will be taken if the calibration checks do not meet established criteria. All corrective actions will be documented, summarized in the case narrative, and submitted with the analytical results.

8.0 INTERNAL QC CHECKS

The applicable QC procedures, quantitation limits, and frequency of QC samples taken are dictated by the specific analytical methods employed and requirements outlined in the Sampling and Analysis Plan (SAP). Acceptance criteria and/or target ranges for QC samples will, at a minimum, be equivalent to those specified within SW-846. Corrective actions will be initiated for data which vary from these target ranges. USACE will be informed of any implemented corrective actions and sent the affected data package. Corrective actions will be fully documented and summarized in the case narrative. The laboratory QC procedures will consist of at least the following items:

- Instrument calibration and standardization as defined in the EPA SW-846 manual for organic and inorganic analyses (EPA SW-846),
- Laboratory blank measurements at a minimum 5% or 1-per-20 frequency,
- Accuracy and precision measurements at a minimum 5% or 1-per-20 frequency, and
- Data reports including appropriate QA/QC documentation.

Clarifications of the internal laboratory QC requirements are summarized below.

Sample Batch - Uniquely identified samples will be extracted and analyzed in batches of no more than 20 samples each. Two types of batches will be identified: the preparation batch and the analytical batch. These batches are defined below.

The preparation batch consists of samples of similar matrix that are prepared together by the same person using the same equipment with the same method sequence and the same lots of reagents. Common manipulations of each sample within the same time period or in limited continuous sequential time periods will also be followed.

The analytical (or instrument) batch consists of samples that are analyzed together within the same analytical run sequence and within the same time period or continuous time periods. If an instrument is not in use for a period of time or is shut down (e.g., overnight), a new batch must be started. This restriction may be relaxed if the laboratory instrument is left operative but in stand-by mode, and all laboratory QC samples confirm that the instrument is performing within established control limits.

Batch QC - At least one method blank will be analyzed with each batch of samples processed to determine the acceptability of the data generated for the corresponding batch of samples. Blank acceptability will be based on SW-846 criteria, including consideration of the analytical techniques used, analytes reported, and quantitation limits required. If the blank fails to meet the acceptance criteria, the source of contamination will be investigated and appropriate corrective action will be implemented. Sample results will not be corrected for blank contamination.

Laboratory performance QC will be based on standard control matrices that are prepared separately from the standard solutions used in establishing the calibration curve. The QC data will be used to calculate precision and accuracy data and establish control limits. The results of the laboratory performance QC data, along with method blank data, will be used to assess daily laboratory performance.

The matrix-specific QC will analyze an actual environmental sample using methods such as matrix duplicates, surrogate compounds, matrix spikes, and matrix spike duplicates to determine precision and accuracy. Results of matrix-specific QC samples, along with method blank results, will be used to assess the effect of sample matrix and field conditions on analytical data.

9.0 CALCULATION OF DATA QUALITY INDICATORS

The quality of the laboratory data is assessed in terms of precision, accuracy, representativeness, comparability, and completeness. Definitions of these parameters and the applicable quality control procedures are given below.

9.1 PRECISION

Precision is a measure of the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average values. Analytical precision is measured through duplicate samples for inorganic analyses. Analytical precision is quantitatively expressed as the RPD between the MS/MSD or duplicates. Analytical precision measurements will be carried out at a minimum of 1 in 10 samples per matrix analyzed.

9.2 ACCURACY

Accuracy is a measure of the closeness of the measured value to the true value. The accuracy of chemical test results is assessed by "spiking" samples with known standards (surrogate matrix spike) and establishing the average recovery. Accuracy measurements will be carried out in accordance with CLP SOW requirements for organic and inorganic analyses (EPA CLP SOW) and at a minimum frequency of 1 in 10 samples per matrix analyzed.

9.3 REPRESENTATIVENESS

Representativeness is a measure of how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the matrix sampled. The sample plan design, sampling techniques, and sample handling protocols (e.g., storage, preservation, and transportation) have been developed to ensure representative samples.

9.4 COMPARABILITY

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The use of standard techniques for both sample collection and laboratory analysis should make data collected comparable to both internal and other data generated.

9.5 COMPLETENESS

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. Results will be considered valid if all the precision, accuracy, and representativeness objectives are met. The target completeness goal for this work is 90% for a given analysis.

9.6 METHOD DETECTION LIMIT

The MDL is defined as the minimum concentration of a substance that can be measured and reported. MDL studies will follow the procedures outlined in 40 CFR 136. MDL is normally calculated using data generated from reagent water. However, this would also apply if required to assess the detection limit associated with a specific project matrix.

10.0 CORRECTIVE ACTIONS

The contract laboratory's QA Plan will include corrective actions to be initiated when errors, deficiencies, or anomalous situations occur. Corrective actions are necessary under the following conditions: 1) any QC data are outside the acceptable ranges for precision and accuracy; 2) laboratory control samples contain contaminants above acceptable levels (acceptable laboratory blank contamination follows SW-846); 3) undesirable trends are detected in spike or surrogate recoveries or RPD between duplicates; 4) unusual changes in MDL are detected; 5) deficiencies are detected during internal or external QA audits or in the results of performance evaluation samples; 6) inquiries concerning data quality are received from USACE. Once problems are resolved, the corrective action procedure followed will be fully documented in the project records and summarized in the case narrative.

The following corrective actions and/or procedures will be used.

10.1 INCOMING SAMPLES

Problems noted during sample receipt will be documented on the cooler receipt form and USACE will be contacted immediately for problem resolution.

10.2 SAMPLE HOLDING TIMES

If samples exceed the appropriate method required holding time, USACE will be contacted immediately for problem resolution. The occurrences would also be documented in a report to the Utah Department of Environmental Quality (UDEQ).

10.3 INSTRUMENT CALIBRATION

Initial calibration requirements will be met before beginning sample analysis. In the event that a calibration does not meet method requirements, the calibration will be reviewed and rerun, and, if necessary, samples affected following the previous acceptable calibration check will be reanalyzed.

10.4 PRACTICAL QUANTITATION LIMITS

If difficulties arise in achieving the PQL due to a particular sample matrix, USACE will be notified for problem resolution. Any dilutions will be documented in the case narrative along with the revised PQLs for the analytes directly affected. Analytes detected above the MDL but below the PQL will be reported as estimated values.

10.5 METHOD QC

All method QC will meet the requirements specified within the analytical method. If method-required QC is not followed, all affected data will be reviewed. If no errors are found, the affected samples will be reanalyzed and/or re-extracted/redigested, and then reanalyzed within method QC holding times to verify the presence or absence of matrix effects. If matrix effects are confirmed, the corresponding data will be flagged using USACE flagging symbols and criteria in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review and USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA, 1999; USEPA, 2004). If matrix effects are not confirmed, the entire batch of samples may be reanalyzed and/or re-extracted/redigested and then reanalyzed at no cost to the government. If unusually difficult sample matrices are encountered, USACE will be notified to discuss possible corrective actions.

10.6 CALCULATION ERRORS

Reports will be reissued if calculation or reporting.

11.0 DATA REDUCTION, REVIEW, VALIDATION, AND REPORTING

To ensure the validity of reported data, all laboratory data generated will be internally reviewed prior to report generation. An independent validation of the data may also be required. The internal data review process will include data reduction, three levels of review/validation, and reporting. Each stage of the review process will be documented on a checklist form that is signed and dated by the reviewer.

11.1 DATA REDUCTION

Data reduction procedures are summarized and responsible personnel identified within the SAP. These procedures include statistical approaches used in data reduction.

11.2 DATA REVIEW

All data generated and reduced will follow well-documented laboratory protocols. Below is a summary of the three-level review process and data validation procedures to be used by the contract laboratory:

1) Level 1 Technical Data Review. Analysts will review their work based on review criteria established in each method and as stated in the laboratory's Quality Management Manual. The Level 1 review will ensure that the items in the following checklist are met:

- Sample preparation information is correct and complete.
- Analysis information is correct and complete.
- Appropriate SOPs have been followed.
- Analytical results are correct and complete.
- QC samples are within established control limits.
- Blanks and laboratory control samples are within appropriate QC limits.
- Special sample preparation and analytical requirements have been met.
- Documentation is complete (any anomalies have been documented and forms completed, holding times are documented, etc.).

All sample data obtained under this task will be reviewed against the quality control criteria stipulated in the specific analytical method. Chemical data will be reviewed with regard to the following, as appropriate to the particular analysis: holding times, instrument calibration, blanks, detection limits, duplicates and MS/MSD, accuracy and precision, and completeness.

EPA laboratory functional guidelines for evaluating organic and inorganic analysis and will also be used for evaluating data quality (EPA CLP 1,2). Data will be qualified by the laboratory in accordance with SW-846 laboratory data qualifier definitions for inorganic and organic data. False positives believed to be attributable to associated blank contamination will be flagged (qualified) and considered unacceptable data points. Likewise, any data rejected during the review process will be flagged and removed from use. Data which are flagged as estimated (J) are still considered suitable for use as indicators of the extent and magnitude of contamination.

2) Level 2 Technical Review. A supervisor or data review specialist will conduct an independent review of the data. The Level 2 review will ensure that the items in the following checklist are met:

- All appropriate laboratory SOPs have been followed.
- Calibration data are scientifically sound, appropriate to the method, and completely documented.
- QC samples are within established guidelines.
- Qualitative identification of sample components is correct.
- Quantitative results are correct and all calculations have been checked.
- Documentation is complete and accurate (any anomalies have been documented and forms completed, holding times are documented, etc.).
- Data are ready for incorporation into the final report.
- The data package is complete and ready for data archive.

The Level 2 review will include a review of all calibration data and QC sample results, and a review of at least 10% of the sample analytical results. If no problems are found in the

data package, the review is complete. If problems are found in the data package, an additional 10% of the sample results will be reviewed back to the sample preparation and analytical level sheets. This will be repeated until no errors are found in the set reviewed or all the sample data have been checked. All errors and correction will be documented.

3) Level 3 Administrative Data Review. The laboratory QA officer or program administrator will conduct the Level 3 review. This review will be similar to the Level 2 review and also include a total overview of the data package to ensure checklist items are met and the data package is consistent. All errors and corrections will be documented.

11.3 DATA VALIDATION

Data validation is the process (involving an independent party from the laboratory) of reviewing data provided by the laboratory to ensure specific criteria are met. These criteria are concerned with specifications that are not sample dependent; they specify performance requirements that should be fully under a laboratory's control. For organic data analyses, specific validation areas include blanks, performance evaluation standard materials, and instrument performance checks. For inorganic data analyses, specific validation areas include blanks, calibration standards, calibration verification standards, laboratory control standards and interference check standards.

Tetra Tech NUS, Inc. will use the following EPA guidelines to perform data validation: 1) USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, and 2) USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA, 1999; USEPA, 2004). The following table provides a listing of those items suggested for consideration during data validation:

Organic Data Validation Parameters:	Inorganic Data Validation Parameters:
Data Completeness	Data Completeness
Holding Times	Holding Times
GC/MS Tuning and System Performance	Calibration Verifications
Initial/Continuing Calibrations	Laboratory Blank Analyses
Laboratory Method & Field Quality Control Blank Results	ICP Interference Check Sample Results
Surrogate Spike Recoveries	Matrix Spike/Matrix Spike Duplicate Results
Blank Spike/Blank Spike Duplicate Results	ICP Serial Dilution Results
Matrix Spike/Matrix Spike Duplicate Results	Laboratory Control Sample Results
Internal Standard Performance	Sample Quantitation
Compound Identification	
Compound Quantitation	
Detection Limits	

Data validation for explosives compounds will follow the same validation protocols as those required for organic parameters.

11.4 DATA REPORTING

Hard-copy report deliverables for the analyses are to comply with the reporting requirements for EPA Level III data. The data reporting format used will consist of a data package that can be fully validated. This reporting format requires the full data package as defined by the USACE Functional Guidelines for Data Validation or EPA guidelines.

11.5 LABORATORY TURNAROUND TIME

The scheduled turnaround time (not the holding times) will be 28 calendar days for standard delivery from the time of sample receipt, unless an accelerated turnaround time is requested and agreed to.

12.0 PREVENTIVE MAINTENANCE

Measuring equipment used in environmental monitoring or analysis for the TEAD investigations shall be maintained in accordance with the manufacturers' operation and maintenance manuals. Equipment and instruments shall be calibrated in accordance with the procedures, and at the frequency, discussed in Calibration Procedures and Frequency Section. Preventive maintenance for field and laboratory equipment is discussed in the remainder of this section.

12.1 LABORATORY INSTRUMENT PREVENTIVE MAINTENANCE

Proper maintenance of laboratory instruments and equipment is essential. Depending on manufacturers' recommendations, maintenance intervals are established for each instrument. All instruments will be labeled with a model number and serial number, and a maintenance logbook will be maintained for each instrument. Personnel will be alert to the maintenance status of the equipment they are using at all times.

The use of manufacturer-recommended grades or better of supporting supplies and reagents is also a form of preventive maintenance. For example, gases used in the ICP instruments must be of sufficient grade to minimize fouling of the instrument. The routine use of other supporting supplies from reputable manufacturers will assist in averting unnecessary periods of instrument downtime. An inventory of critical spare parts will also be maintained by the laboratory to minimize instrument downtime.

12.1.1 Major Instruments

Table 12-1 provides a summary of typical preventive maintenance procedures for key analytical instruments and equipment associated with this project.

Table 12-1

Typical Preventive Maintenance for Analytical Instruments

Instrument	Preventive Maintenance	Maintenance Frequency
HPLC	Change filter frit in mixer.	As needed (when pressure builds).
	Change column pre-filter.	As needed (2-3 months).
	Rinse water pump with methanol, filter water, sonicate water intake filter frit.	Approximately weekly.
	Change pump seals.	As needed
ICP/AES	Service Intercooler.	Annually.
	Rinse and clean nebulizer cap and spray chamber.	Monthly or as needed.
	Clean torch, vacuum filters.	Bi-monthly.
	Profile instrument, examine autosampler tubing and replace as needed.	Daily.
	Empty rinse container, fill rinse water reservoir.	As needed
Mercury Analyzer	Check and replace pump tubing, check and replace membrane, check and clean windows.	As needed.

ICP AES= Inductively Coupled Plasma Atomic Emission Spectrophotometer

HPLC = High Performance Liquid Chromatography

Maintenance of key instruments is often covered under service contracts with external firms. These contracts provide for periodic routine maintenance to help guard against unexpected instrument downtime. The contracts also provide for quick response to unscheduled service calls when malfunctions are observed by the instrument operator.

12.1.2 Refrigerators/Ovens

The temperatures of refrigerators used for sample storage and drying ovens will be monitored a minimum of once daily. The acceptable range for refrigerator temperatures is $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Required temperatures of ovens will vary based on the analytical methods for which they are used. The temperatures will be recorded on temperature logs. The logs will contain the date, temperature, and initials of the person performing the check.

Maintenance of the logs is typically the responsibility of the sample custodian. However, assignment of responsibilities for temperature monitoring to specific personnel does not preclude the participation of other laboratory personnel. If unusual temperature fluctuations are noted, it is the responsibility of the observer to immediately notify the person in charge of the discrepancy before the condition of the samples is compromised.

Unstable or fluctuating temperatures may be indicative of malfunctions in the cooling or heating system. However, the instability may be from frequent opening of the door. Regardless of the cause, such an observation must be investigated, and modifications must be made to the refrigerators/ovens access procedures or repairs to equipment must be made to prevent jeopardizing the integrity of the samples.

12.2 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

All field equipment shall be inspected before use to ensure that necessary parts are available. Most equipment planned for use in this project is simple with few to no moving parts. Therefore, a visual inspection before use shall be sufficient to ensure that the equipment is

suitable for use. This visual inspection shall occur during mobilization and during each use by the person using the equipment.

Laboratory inspection and acceptance requirements must be outlined in the laboratory QA Plan and should include the following specifications for inspection and acceptance of supplies and consumables:

- Requirements to follow individual SOP specifications for grades of chemicals necessary to achieve acceptable analytical performance. SOPs are required to detail the necessary grade of chemicals, including compressed gases.
- Requirements to obtain primary chemical standards from reliable sources that use calibrated glassware in the preparation of the standards and to maintain all certificates supplied with the standards. Emphasis is on obtaining NIST-traceable standards where possible.
- Storage of chemical standards in accordance with applicable SOPs and in a manner that preserves their integrity.
- Routine monitoring of de-ionized water and solvents to ensure that analytical systems, samples, and standards are not contaminated.
- Requirements to record the date received and the date opened on each container of chemical used for analysis.

13.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits will be conducted periodically to ensure that work is being implemented in accordance with the approved project plans and in an overall satisfactory manner. Some examples of pertinent audits are:

- The FOL will supervise and check daily that the field observations are made accurately, equipment is thoroughly decontaminated, samples are collected and handled properly, and fieldwork is documented accurately and neatly.
- The PM will maintain contact with the FOL and Data Validation Manager to ensure that management of the acquired data proceeds in an organized and expeditious manner.

Details regarding additional audit responsibilities, frequency, and procedures are provided in the remainder of this section. Field performance and system audits are addressed in Section 13.1. Laboratory performance and system audits are addressed in Section 13.2. The information presented in Section 13.2 covers the fixed-based laboratory. However, USACE and USEPA may perform an audit of the mobile laboratory at their discretion.

13.1 FIELD PERFORMANCE AND SYSTEM AUDITS

This section presents the responsibilities, frequencies, and procedures associated with internal and external field performance and system audits.

13.1.1 Internal Field Audits

In addition to the daily checks performed by the FOL, the project QAO or designee may conduct an independent performance and system audit of field activities. If a formal field audit is conducted for this study, the project QAO (or designee) will be responsible for ensuring that sample collection, handling, and shipping protocols, as well as field documentation procedures,

are being performed in accordance with the approved project plans and SOPs. Details regarding potential field audits are described in the following subsections.

13.1.1.1 Internal Field Audit Frequency

A formal audit of the field sampling procedures may be conducted by the project QAO or designee in addition to the auditing that is an inherent part of the daily project activities. Individual projects are selected for audit by the project QAO without the involvement of the PM.

13.1.1.2 Internal Field Audit Procedure

Internal field audits will be conducted in accordance with the following procedure:

- Before an audit, the auditor will prepare a detailed checklist to be used as an auditing guide.
- Upon arrival at the audit location, the auditor shall conduct a pre-audit meeting with the responsible management of the organization or project to be reviewed.
- Field audits will include a review of required project documentation (logbooks, sample log sheets, etc.) and field operations (sample COC, sample handling, etc.) to evaluate completeness and compliance with applicable SOPs.
- The audit checklist will be used to record observations including any noted non-conformances.
- A formal post audit debriefing will be conducted, and potential immediate corrective actions will be discussed.
- The auditor will generate a formal audit report that will address corrective actions. The auditor will provide this report to the PM.

- The PM will ensure that all corrective actions are addressed and will provide written verification of corrective action implementation to the auditor.
- The auditor will manage corrective action verification and audit closure.
- The following audit records will be maintained by the project QAM:
 - Audit checklists
 - Audit reports
 - Response evaluations
 - Verification of corrective actions
 - Follow-up checklists and audit reports

13.1.2 External Field Audits

The State of Utah may conduct external field audits. External field audits may be conducted at any time during field activities at the discretion of the State of Utah. If an audit is to be conducted, scheduling should be coordinated through the project QAO to ensure that personnel and equipment are available as necessary. Personnel being audited may or may not be informed of the impending audit at the discretion and request of the auditing body. External audit procedures are at the discretion of the State of Utah.

13.2 LABORATORY PERFORMANCE AND SYSTEM AUDITS

This section presents the responsibilities, frequencies, and procedures associated with internal and external laboratory performance and system audits.

13.2.1 Internal Laboratory Audits

The QAO or appropriate designee of the subcontracted laboratory performs routine internal audits of the laboratory. The USACE, also conducts internal laboratory audits. The contractor holds no responsibility for such audits. It is the responsibility of USACE to ensure that the subcontracted laboratory complies with good laboratory practices and the general requirements of all analytical services provided by the laboratory. The frequency with which these internal audits are conducted as well as audit procedures are addressed in the following subsections.

13.2.1.1 Internal Laboratory Audit Frequency

Performance and system audits for the laboratory will be performed regularly by the subcontracted laboratory's QA staff in accordance with the laboratory QA Plan.

13.2.1.2 Internal Laboratory Audit Procedures

Internal system audits are conducted by the subcontracted laboratory in accordance with the laboratory QA Plan to detect any problems in sample flow, analytical procedures, or documentation and to ensure adherence to laboratory SOPs.

Internal USACE laboratory audit procedures, as performed by a USACE contractor, include a pre-screening process that requires review of the laboratory's QA Plan, analysis of performance evaluation (PE) samples, generation of data deliverables for those samples, an onsite technical systems audit of the laboratory, and satisfactory resolution of all deficiencies and findings.

13.2.2 External Laboratory Audits

The State of Utah may perform external audits at their discretion.

The subcontracted laboratory is also involved in various other external audits and performance evaluation studies throughout the year, as required, to maintain certifications and/or approvals by other regulatory agencies or programs.

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14.0 QC REPORTS TO MANAGEMENT

QC reports will be submitted by the laboratory to the contractor and USACE. These reports will include, at a minimum, an assessment of accuracy, precision, and completeness; performance and system audit results; and significant QA problems encountered.

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APPENDIX A
REFERENCES

REFERENCES

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APPENDIX B

LABORATORY CERTIFICATION LETTERS

(To Be Provided Later)