## Document Revision Log

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<th>Revision</th>
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<tr>
<td>Draft</td>
<td>5/18/2017</td>
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<td>Addressed James Hanley and David Berry’s comments.</td>
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Approval Sheet

Environmental Services Assistance Team (ESAT) Team Manager:

Signature/Date
Mark McDaniel

ESAT Field Task Manager:

Signature/Date
Steve Auer

United States Environmental Protection Agency (EPA) Remedial Project Manager:

Signature/Date
James Hanley

EPA Region 8 Delegated Quality Assurance Approving Official:

Signature/Date
David Berry

EPA Task Order Project Officer (TOPO):

Signature/Date
Nicole Marotta

ESAT Quality Assurance Coordinator:

Signature/Date
Bill Fear
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Abbreviations and Acronym List

%R    Percent Recovery
BERA  Baseline Ecological Risk Assessment
CA    Corrective Action
CDPHE Colorado Department of Public Health and Environment
CLP   Contract Laboratory Program
CFR   Code of Federal Regulations
COPC  Contaminant of Potential Concern
CPR   Cardiopulmonary Resuscitation
DO    Dissolved Oxygen
DQA   Data Quality Assessment
DQO   Data Quality Objective
EDD   Electronic Data Deliverable
EPA   United States Environmental Protection Agency
ESAT  Environmental Services Assistance Team
GPS   Global Positioning System
HDPE  High-Density Polyethylene
LIMS  Laboratory Information Management System
LCS   Laboratory Control Spike
MDL   Method Detection Limit
MS/MSD Matrix Spike/Matrix Spike Duplicate
OSHA  Occupational Safety and Health Administration
PE    Performance Evaluation
PQL   Practical Quantitation Limit
PSQ   Principal Study Question
QA    Quality Assurance
QAO   Quality Assurance Officer
QAPP  Quality Assurance Project Plan
QC    Quality Control
QMP   Quality Management Plan
RI/FS Remedial Investigation/Feasibility Study
ROD   Record of Decision
RPD   Relative Percent Difference
RPM   Remedial Project Manager
SAP   Sampling and Analysis Plan
SAR   Sampling Activities Report
SI    Site Inspection
SOP   Standard Operating Procedure
TOPO  Task Order Project Officer
USFS  United States Forest Service
A.3 Distribution List

The following is a distribution list of personnel who will receive an electronic copy of the Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) for the 2017 sampling events at the Standard Mine Superfund Site. The SAP/QAPP with original signatures will be placed in the Superfund administrative record. Agency and contractor affiliations are also listed for each individual.

James Hanley  EPA Remedial Project Manager
Christina Progess  EPA Remedial Project Manager (alternate)
Andrew Todd  EPA
Nicole Marotta  EPA
David Berry  EPA
Ross Davis  Colorado Department of Public Health and Environment (CDPHE)
Mark McDaniel  ESAT Team Manager
Steven Auer  ESAT Field Task Manager
### A.4 Project/Task Organization

The following is a list of the federal project personnel involved in the field sampling and chemical analyses processes, their respective agencies or contract affiliations, and general responsibilities.

<table>
<thead>
<tr>
<th>Managers</th>
<th>Organization</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>James Hanley</td>
<td>EPA</td>
<td>Remedial Project Manager (RPM); Project oversight/management and document review,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>document control, data quality assessment (DQA), and data usability and limitations</td>
</tr>
<tr>
<td>Andrew Todd</td>
<td>EPA</td>
<td>RPM designee</td>
</tr>
<tr>
<td>Nicole Marotta</td>
<td>EPA</td>
<td>ESAT Task Order Project Officer (TOPO)</td>
</tr>
<tr>
<td>Don Goodrich</td>
<td>EPA</td>
<td>ESAT TOPO; Data Validation</td>
</tr>
<tr>
<td>John Wieber</td>
<td>EPA</td>
<td>ESAT TOPO</td>
</tr>
<tr>
<td>Jeff Mosal</td>
<td>EPA</td>
<td>Data Management</td>
</tr>
<tr>
<td>Ross Davis</td>
<td>CDPHE</td>
<td>CDPHE Project Manager</td>
</tr>
<tr>
<td>Mark McDaniel</td>
<td>ESAT</td>
<td>ESAT Team Manager, staff oversight and document review</td>
</tr>
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<table>
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<tr>
<th>Field Team</th>
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<tbody>
<tr>
<td>Kelsey Bartling</td>
<td>ESAT</td>
<td>Sample collection and field documentation</td>
</tr>
<tr>
<td>Emily Yadacus</td>
<td>ESAT</td>
<td>Sample collection and field documentation</td>
</tr>
<tr>
<td>Ryan Monahan</td>
<td>ESAT</td>
<td>Sample collection and field documentation</td>
</tr>
<tr>
<td>Leslie Christner</td>
<td>ESAT</td>
<td>Sample collection and field documentation</td>
</tr>
<tr>
<td>Steven Auer</td>
<td>ESAT</td>
<td>SAP development and maintenance of the official, approved SAP/QAPP, sample collection, field documentation, Field Task Lead, ESAT Field Quality Assurance, Health and Safety Officer, report review, ensures field and laboratory procedures comply with this SAP/QAPP</td>
</tr>
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<table>
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<tr>
<th>Laboratory Group</th>
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<tbody>
<tr>
<td>Scott VanOvermeiren</td>
<td>ESAT</td>
<td>Sample analysis and analytical report preparation</td>
</tr>
<tr>
<td>Scott Walker</td>
<td>ESAT</td>
<td>Sample analysis, analytical report preparation, report review, ESAT laboratory Quality Assurance management</td>
</tr>
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<tr>
<th>QA Team</th>
<th>Organization</th>
<th>Responsibilities</th>
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<tbody>
<tr>
<td>David Berry</td>
<td>EPA</td>
<td>Delegated Quality Assurance Approving Official</td>
</tr>
<tr>
<td>Bill Fear</td>
<td>ESAT</td>
<td>ESAT Quality Assurance Coordinator</td>
</tr>
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A.5 Problem Definition

A.5.1 Introduction

This document serves as the SAP and QAPP for sampling events to be conducted in 2017, at the Standard Mine Superfund Site (the Site) located near the town of Crested Butte, Colorado. Sampling is being performed in order to monitor water quality following the installation of the source control remedies. The activities described in this SAP/QAPP consist of collecting surface water samples, stream flow data, real-time water quality measurements (pH, conductivity, dissolved oxygen [DO], and temperature), global positioning system (GPS) coordinates of the sampling locations, and photo-documentation of sampling activities. The data obtained from these investigations will be used in accordance with the provisions outlined in the data quality objectives (DQOs) and applicable standard operating procedures (SOPs).

A.5.2 Background

The Standard Mine was a part of the Ruby Mining District located in Gunnison County, Colorado. Mining activity at this location started around 1874, with the most significant operations beginning in 1931. Lead, zinc, silver, and gold were extracted until 1966 when the mine was abandoned. The Site is situated at about 11,000 feet above mean sea level and includes multiple levels, a repository, and a borrow area.

In 1999, a Site Inspection (SI) was conducted at the Ruby Mining District to assess the environmental conditions during the high-flow and low-flow regimes. The SI showed high levels of multiple metals in the surface waters from Coal Creek and its tributaries.

Several sampling events were conducted at the site in 2005 and 2006 to evaluate temporal and geospatial changes in stream contaminant levels, evaluate previously unidentified watershed influences, measure biological tissue contaminant levels, evaluate the existing macroinvertebrate assemblages, and evaluate toxicity to benthic and aquatic organisms. These data were used in a Human Health Risk Assessment and Baseline Ecological Risk Assessment (BERA).

The United States Environmental Protection Agency (EPA) conducted non-time-critical removal actions in 2006 and 2007, which included constructing a mine-waste repository on United States Forest Service (USFS) land, removing the tailings impoundment and waste rock from levels 1, 2, and 3 at the Site to the repository, and implementing Site stabilization and drainage control measures. Preliminary remediation activities took place in the fall of 2006 to drain and cover the surface impoundment, remove a dilapidated mill, remove the remaining railroad infrastructure, and divert Elk Creek to the western side of the Site in an effort to reduced inputs from the adit drainage.

In 2007, the remedial program installed a passive treatment bioreactor as part of a pilot study to determine the effectiveness of this technology at remediating acid mine drainage from the Level 1 Adit. More sampling occurred in 2008 to establish post-removal baseline Site conditions, provide data to develop a Site-wide biomonitoring program, and help evaluate the feasibility of passive and active treatment alternatives for adit discharges at the Site (ESAT, 2009).
Sampling of the aquatic habitats continued for the next several years in support of the Remedial Investigation/Feasibility Study (RI/FS). Activities included collecting surface water, sediment, and macroinvertebrate (assemblage assessment) samples, and toxicity testing.

The CDPHE and the USFS completed the Site’s final RI/FS Report in May 2010. The FS report contains a detailed analysis of remediation alternatives for various Site components.

EPA, USFS and CDPHE signed a Record of Decision (ROD) in 2011 (EPA, 2011). The ROD includes a two phase remedy (Phase 1 source control and Phase 2 water treatment). As part of phase 1, a flow-through bulkhead was installed in the Fall of 2016.

A.6 Project/Task Description

The purpose of this SAP/QAPP is to describe the sampling activities to be conducted during high-flow, the week of June 19, 2017, and low-flow, the week of September, 18 2017 and to identify DQOs that will support baseline and long-term monitoring activities. The data will be used to determine the spatial and temporal distribution of contamination and to provide baseline water conditions after the installation of the bulkhead. Surface water sampling for total recoverable metals, dissolved metals, and alkalinity and anions will occur at a subset of historical sampling locations. Figure A.6-1 shows the 12 anticipated surface water sampling locations for the 2017 field season.

The objectives of the sampling events are to monitor site-related contamination in aquatic systems under high- and low-flow conditions and to evaluate the extent of surface water contamination within the watershed. Data generated from these sampling events will be used in accordance with the provisions outlined in the DQOs discussed below. The following data will be collected during the 2017 sampling events:

- Real-time field water quality measurements: pH, conductivity, DO, and temperature
- Stream flow measurements using Sontek® Flow Tracker™ flow meters or cutthroat flumes
- Surface water: total recoverable metals, dissolved metals and hardness (via calculation), alkalinity and anions
- Photolog: site photographs will be taken for all sampling locations and field activities

Data validation will be completed by February 2018, an interim sampling activities report (SAR) is anticipated to be completed between the June and September sampling events, and the annual SAR is anticipated to be completed by November 2018. Time constraints for collecting data are limited to daylight hours and acceptable weather conditions.

A.7 Quality Objectives and Criteria

This section discusses the DQO process and how it was applied to this study. Specific areas addressed include: the planning team and stakeholders, DQO content, and parameter metrics such as precision, accuracy, representativeness, completeness, comparability and sensitivity.

A.7.1 Planning Team and Stakeholders

The following subsection lists the members of the DQO planning team, primary decision makers, and parties who may be affected by the results of this study or who may use the data generated by the DQO process.
A.7.1 DQO Planning Team

Table A.7-1 includes the DQO planning team members, respective organizations, and role within that organization.

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Area of Technical Expertise</th>
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<tbody>
<tr>
<td>James Hanley</td>
<td>EPA Region 8</td>
<td>Remedial Project Manager (RPM)</td>
</tr>
<tr>
<td>Andrew Todd</td>
<td>EPA Region 8</td>
<td>Toxicologist</td>
</tr>
<tr>
<td>Nicole Marotta</td>
<td>EPA Region 8</td>
<td>ESAT TOPO</td>
</tr>
<tr>
<td>Steve Auer</td>
<td>ESAT Region 8</td>
<td>Field Task Lead</td>
</tr>
<tr>
<td>Jeff Mosal</td>
<td>EPA Region 8</td>
<td>Scribe Data Team Leader</td>
</tr>
<tr>
<td>Christine Vigil</td>
<td>EPA Region 8</td>
<td>Scribe Data Team Leader</td>
</tr>
</tbody>
</table>

A.7.1.2 Decision-Making Authority

The decision makers make the final decisions based on the recommendations of the DQO planning team. The EPA decision maker for this project is James Hanley, EPA Region 8 RPM for this site. His designee is Andrew Todd (EPA). Steven Auer (ESAT Region 8) is the decision maker for any health and safety decisions pertaining to the field sampling.

A.7.1.3 Stakeholders

Stakeholders are parties who may be affected by the results of the study and persons who may later use the data resulting from this DQO process. Table A.7-2 lists the impacted organizations and stakeholders, and the individuals representing those organizations.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Represented By</th>
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<tbody>
<tr>
<td>CDPHE</td>
<td>Ross Davis</td>
</tr>
<tr>
<td>USFS</td>
<td>Linda Lanham</td>
</tr>
<tr>
<td>Coal Creek Watershed Coalition</td>
<td>Zach Vaughter</td>
</tr>
<tr>
<td>CDPHE</td>
<td>Matt Alms</td>
</tr>
<tr>
<td>CDPHE</td>
<td>Holly Brown</td>
</tr>
<tr>
<td>CDPHE</td>
<td>Joni Nuttle</td>
</tr>
</tbody>
</table>

A.7.2 Data Quality Objectives

The DQO process specifies project decisions, the data quality required to support those decisions, specific data types needed, data collection requirements, and analytical techniques necessary to generate the specified data quality. The process also ensures that resources required to generate the data are justified. The DQO process consists of seven steps. The output from each step influences the choices to be made later in the process. These steps are as follows:

Step 1: State the problem
Step 2: Identify the goal of the study
Step 3: Identify information inputs
Step 4: Define the boundaries of the study  
Step 5: Develop the analytic approach  
Step 6: Specify performance or acceptance criteria  
Step 7: Develop the plan for obtaining data

The first six steps of the process consist of developing decision performance criteria that will be used to develop the data collection design. The final step of the process involves developing the data collection design based on the DQOs. The following sections briefly discuss these steps and their application to the project.

A.7.2.1 Step 1: State the Problem

Mine drainage from the various adits affects the water quality and ecological receptors in Elk Creek and Coal Creek, which serves as the source of drinking water for Crested Butte. Removal and remedial actions have been conducted and a flow-through bulkhead was installed in an effort to reduce the metals-loading into Elk Creek and subsequently Coal Creek. Further data is needed to determine the effectiveness of removal and remedial actions.

A.7.2.2 Step 2: Identify the Goals of the Study

The purpose of this step is to define the principle study questions (PSQs) that this study will attempt to resolve. The PSQs will help determine appropriate data inputs and potential alternative actions. Principle study questions can be used to develop decision statements when the potential alternative actions have been determined to resolve the problem. In situations where the outcomes may not lead to specific decisions or the information may be used to gain a greater understanding of existing data, estimation statements are more appropriate. Estimation statements are more applicable to the nature of the PSQs being investigated in these sampling efforts.

PSQ 1  What are the current contaminant levels found in surface water at the select sampling locations at the Site during high-flow and low-flow regimes?

Estimation Statements

PSQ 1:

What are the current contaminant levels found in surface water at the selected sampling locations at the Site during high-flow and low-flow regimes?

Results of this investigation will be used to establish a baseline for water quality improvements after construction of source controls and before a decision to close the bulkhead valve is taken. Additionally, data will be compared to Table III Metal Parameters Domestic Water Supply described in The Basic and Methodologies for Surface Water Regulation No. 31 (CDPHE Water Quality Control Commission, 2017)

A.7.2.3 Step 3: Identify Information Inputs

The purpose of this step is to identify the data required to answer the PSQs listed above and to determine which inputs require environmental measurements. The required data to answer the PSQs (generated as a part of the 2017 sampling effort) are as follows:
• Current surface water analytical data;
• Current stream flow data;
• Field water chemistry data (pH, DO, temperature, and conductivity); and
• Geospatial sample location data using GPS (where necessary).

Of the data identified, environmental measurements will be made during this study to evaluate field chemistry conditions and levels of contaminants of potential concern (COPCs) in surface water. Table A.7-3 summarizes the COPCs of the site, analytical methods, sample volumes, detection and reporting limits, holding times, and action limits. Tables A.7-4 and A.7-5 show the specific activities for each field event to be conducted in 2017.

A.7.2.4 Step 4: Define the Boundaries of the Study

The objective of this step is to define the spatial and temporal components of the study area. The scale of the decision making for the decision statement is defined by combining the population of interest with the spatial and temporal boundaries of the study area. Practical constraints that could interfere with sampling are also identified. Implementing this step helps ensure that the data are representative of the population.

A.7.2.4.1 Spatial Boundaries

The spatial boundaries identified for these investigations include the Standard Mine area, Coal Creek, and Elk Creek. Sampling locations are included in Figure A.6-1 and GPS coordinates are included in Table A.7-6.

A.7.2.4.2 Temporal Boundaries

In order to capture conditions representative of high- and low-flow regimes in the area, two data collection events will take place: June 2017 (high-flow) and September 2017 (low-flow). Flow rates at Elk-00 are anticipated to be greater than or equal to 20 cubic feet per second during the high-flow event and approximately two cubic feet per second during the low-flow event.

A.7.2.5 Step 5: Develop the Analytic Approach

Surface water analytical results, stream flow measurements, and field chemistry measurements from these events will be used to support a future ROD amendment. For this study, State of Colorado Numeric Water Quality Standards (March, 2017) will be compared with surface water analytical results. Table A.7-3 shows chronic toxicity water quality standards that have been calculated for average hardness values from previous sampling events.

A.7.2.6 Step 6: Specify Performance or Acceptance Criteria

The purpose of this step is to specify the tolerable limits of decision errors, which are used to establish performance goals for the data collection design, and discuss how decision errors will be addressed. For this project, the number of samples and sampling locations were based on previous investigations.

Sample collection processes will be consistent with established SOPs and quality assurance procedures to minimize the potential for false positive or false negative errors associated with field sampling. This effort includes consistency in the way data are collected in the field and laboratory, collecting duplicate samples (and subsequent analyses using relative percent difference [RPD] statistics), implementing a
decontamination procedure (which includes using disposable sampling equipment), and using field blanks.

Duplicate samples will be collected to determine sampling precision and the correlation between samples. According to the EPA *National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA, 2017), a control limit of 20% for water for the RPD shall be used for original and duplicate sample values that are greater than five times the contract required quantitation limit. These requirements are laboratory guidelines which may not apply to all field situations. RPD values will be calculated using the following equation:

\[
\text{RPD} = 100 \times \frac{\text{Sample Result} - \text{Duplicate Result}}{0.5 \times (\text{Sample Result} + \text{Duplicate Result})}
\]

For laboratory analysis of samples, quality assurance/quality control (QA/QC) steps (such as using laboratory controls, matrix spikes/matrix spike duplicates [MS/MSD], blanks, etc.) will be consistent with ESAT Region 8 requirements. Additionally, analytical results will undergo 10% data validation by a neutral third party.

**A.7.2.7 Step 7: Develop a Plan to Collect the Data**

A judgmental sampling design as described in *Guidance for Choosing a Sampling Design for Environmental Data Collection*, EPA QA/G-5S (December, 2002) will be used to help identify and verify the sources of COPCs. The COPCs were identified in previous studies and comparisons will be made from historical data obtained from the site and the results from the current collection efforts. Sampling locations for surface water were also identified from previous studies.

**A.7.2.8 Sampling Locations**

The sampling plan and location selection follow a judgmental design, as described in *Guidance for Choosing a Sampling Design for Environmental Data Collection*, EPA QA/G-5S (December, 2002), and is based on data needs identified in previous SAP’s. Sampling locations, descriptions, and sample activities that will take place are listed in Table A.7-4 through A.7-5. A map of the general study site and sampling locations is included as Figure A.6-1. The sampling location GPS coordinates will be obtained using Trimble GPS hand-held devices, if necessary. The parameters of interest and sample matrices are described in the DQO section of the documents.

**A.7.3 Criteria, Action Limits, and Laboratory Detection Limits**

Table A.7-3 provides the method detection limits (MDLs) and practical quantitation limits (PQLs). In most cases, the MDLs and PQLs fall well below the screening criteria, indicating that the analytical methods will be able to measure contaminant levels in the surface water samples with the required sensitivity.

**A.7.4 Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity**

A SAR will be generated after field activities have been conducted and results of sample analyses are considered final. The SAR will discuss all precision, accuracy, representativeness, completeness, comparability, and sensitivity parameter results from the data validation and overall usability of the data for project objectives, which include the following:

*Precision:*
Field duplicates: RPD criteria met?
Laboratory duplicates: RPD criteria met?
Method of standard dilution performed and criteria met?
MSDs: RPD criteria met? (if applicable)

**Accuracy:**
- MS/MSDs: percent recovery (%R) criteria met?
- Laboratory control sample (LCS)/LCS duplicates: %R criteria met?
- Initial and continuing calibration recoveries met?
- Interference check sample recoveries met?
- Inductively coupled plasma serial dilution recoveries met?

**Representativeness:**
- Sampling procedures and design: criteria met?
- Holding times and preservation: criteria met?
- Custody: all chain-of-custody forms complete and provided in data package?
- Blanks: contaminants present?

**Completeness:**
- The number of valid analytical results is comparable (90%) with the number determined necessary during establishment of DQOs.

**Comparability:**
- Data compares with similar analysis and data sets?
- Sample collection methods comparable to similar data sets?
- Laboratory analytical methods comparable to similar data sets?

**Sensitivity:**
- Method reporting limits met project objectives?

The data will be assessed for the following criteria:

- **Bias** – a systematic or persistent distortion of a measurement process that causes errors in one direction. The extent of bias will be determined by evaluating the laboratory initial calibration or continuing calibration verification, LCS and LCS duplicates, blank spikes, MS/MSD, and method blanks.
- **Sensitivity** – the ability to discriminate between small differences in analyte concentration is related to the rate of change in response when there is a small change in stimulus. Sensitivity is reflected in the calibration curve. MDLs of the field and laboratory methods are within the range of previous site sample detections.
- **Precision** – the measure of agreement among repeated measurements of the same sample location under identical, or substantially similar, conditions and which is expressed as the RPD between the sample pairs. An acceptable RPD for water samples is 20%, and 35% for soil and sediment samples (EPA, 2017).
• **Representativeness** – the measure of the degree to which data accurately and precisely represent a characteristic of population parameters, variations at a sampling point, process conditions, or environmental conditions.

• **Completeness** – a measure of the amount of valid data obtained from a measurement system. The actual percentage of completeness is less important than the effect of completeness on the data set. Completeness will be assessed by the total number of samples collected versus the amount planned.

• **Comparability** – the qualitative term that expresses the confidence that two data sets can contribute to common interpretation and analysis. Comparability is used to describe how well samples within a data set, as well as two independent data sets, are interchangeable.

Uncertainty of validated data will be evaluated to determine if the DQOs were met. In the event that the DQOs were not met, they will be reviewed to determine if they are achievable and may be revised if necessary. The data may also be further evaluated to determine the impact on the project. Data usability and limitations will be evaluated by the RPM.

### A.8 Special Training/Certifications

All field personnel will have completed the Occupational Safety and Health Administration (OSHA) 40-hour Health and Safety Course for Hazardous Waste Site Worker Training in accordance with Sections e and p of OSHA, Chapter 29 Code of Federal Regulations (CFR) Section 1910.120. Personnel will also maintain this certification with annual eight-hour Hazardous Waste Site Operations Refresher Training, as required by Sections e and q of OSHA, 29 CFR 1910.120.

All field staff will have completed the American Red Cross standard first aid and adult cardiopulmonary resuscitation (CPR) training and maintain this certification for adult CPR and standard first aid according to the requirements of each participating entity. The ESAT and EPA Health and Safety Managers ensure that all field staff members complete all the training requirements prescribed by OSHA.

TechLaw and each agency will provide training for their respective employees. The training documentation for ESAT personnel is stored in SharePoint, while training documentation for EPA personnel is maintained by the individual.

### A.9 Documentation and Records

Once finalized, a signed copy of this SAP/QAPP will be sent electronically to the individuals identified in Section A.3. Field water quality measurements will be recorded in an electronic data collection device (i.e. iPads), (or a field notebook in the event that the electronic data collection device is unavailable or not functioning properly) at the time of data collection. A photo log will be maintained in the electronic data collection device and will include a photo number, the location the photo was taken, and a description of the photo. A brief description of the stream flow measurements will also be recorded in the electronic data collection device. Flow measurement data will be stored in the individual Flow Tracker unit and downloaded within two weeks of collection. The data sheets from the flow data download will be printed and scanned copies will be included in the SAR. Electronic data collection device files, chain-of-custody forms, bench sheets, photographs, and other forms used for the site investigation will be stored at the Region 8 EPA Laboratory Suite A127 until relinquished to EPA in accordance with ESAT Region 8 contract requirements.
Electronic data collection devices, field log books and calibration log books will have the following entries for each sampling site when and where applicable:

- Date
- Time
- Sample location
- Sampler/Scribe
- Team members
- Weather conditions
- Water quality measurements
- Measurement/sample collection identification
- Measurement/sample collection method
- Equipment that was used to collect samples/measurements
- Camera and photo details to be used in the photolog
- Conditions that may adversely impact the quality of measurements/samples
- Maps/sketches if applicable

A brief description of the sampling location will be recorded in the electronic data collection device or field notebook when the collection device is unavailable. Information will consist of the site identification number, collection date, sampler identification, location, geographical observations (seeps, inflows, rocky outcroppings, etc.), sample matrix, access information, references to any photos taken, sketches, and any other pertinent information that will be useful to identify the sampling location in the future.

The documentation of the data evaluation efforts will be in the form of the worksheets prepared during validation. The SAR will be prepared to identify problems that may affect data usability or require that the data be qualified. The SAR will discuss all precision, accuracy, representativeness, completeness, comparability, and sensitivity parameter results from the data validation and overall usability of the data for project objectives.

The laboratory will submit to EPA a data report containing all analytical results for this sampling effort. The report will contain a case narrative that briefly describes the number of samples, analyses, and any analytical difficulties or QA/QC issues associated with the samples. The data report will also include signed chain-of-custody forms, analytical data, a QA/QC package, and raw data. Data will be loaded into Scribe for permanent storage or archiving. Additional reporting requirements are outlined in the ESAT laboratory contract and Quality Management Plan (QMP Final Revision 2).

Peer review of the data package, at a 100% frequency of reported versus raw data, will be performed by the analytical laboratory. The final report of the abbreviated data validation will be in a standard Contract Laboratory Program (CLP) format, including all laboratory and instrument QC results.

**B. DATA GENERATION AND ACQUISITION**

This section describes data generation and acquisition activities associated with these events, including process design, sampling and analytical methods, sample handling and custody, QC, equipment, and data use and management.
B.1 Sampling Process Design (Experimental Design)

The following subsections describe the sampling methods to collect and analyze surface water. Appendix A provides copies of the applicable SOPs outlining how field activities will be performed (including documentation protocols). Tables B.1-1 and B.1-2 provide the sampling checklist and field equipment checklist, respectively. Section A.7 provides the rationale for the sampling process outlined in this section.

Sampling will occur from downstream to upstream to avoid cross-contamination in accordance with Surface Water Sampling SOP FLD-01.00 (EPA, 2012).

The EPA RPM, or designee, will be responsible for directing corrective actions if problems are encountered in the field that would impact the way this SAP/QAPP is implemented, or if sampling locations are inaccessible. Andrew Todd is the EPA designee appointed for the studies. Any problems encountered, actions taken, or deviations from this SAP/QAPP will be documented in the electronic data collection device.

B.1.1 Surface Water Sampling

Surface water samples will be collected from 12 sampling locations in June and September 2017, from Coal Creek and Elk Creek. Tables A.7-4 and A.7-5 provide the name and a description of each of the surface water sampling locations. All samples will be preserved in the field, placed in a cooler with ice, and transported back to the EPA Region 8 Laboratory following chain-of-custody protocols.

B.1.3 Nature of Data Collected

As indicated in Section A.6, a variety of data will be collected during these events, some of which are critical to achieve the established DQOs and project objectives, and some of which are primarily for informational purposes or which will be used to supplement critical data. The following chart specifies each type:

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real-time water quality parameters (pH, temperature, conductivity, and DO)</td>
<td>Critical</td>
</tr>
<tr>
<td>Stream flow measurements</td>
<td>Critical</td>
</tr>
<tr>
<td>Surface water (analyzed for dissolved metals/hardness, total recoverable metals, and alkalinity/anions)</td>
<td>Critical</td>
</tr>
<tr>
<td>GPS coordinates</td>
<td>Critical</td>
</tr>
<tr>
<td>Photolog</td>
<td>Informational</td>
</tr>
<tr>
<td>General field observations noted in an electronic data collection device</td>
<td>Informational</td>
</tr>
</tbody>
</table>

B.1.4 Data Variability

To help assess data variability of field samples, field QC samples are collected. These field QC samples include blanks and duplicates. A field blank is collected at a frequency of one in twenty samples or one per day of sampling and a field duplicate is collected for one in every ten samples using the same procedures used to collect the samples.

The field blank is collected by pouring ultra-pure deionized water into the total 250 ml container, into the 250 ml filter apparatus for the dissolved sample and into the 500 ml alkalinity and anions container. Field blanks will be preserved using the same procedures as samples.
Field duplicates are used to evaluate precision in sampling, handling, shipping, storage, preparation, and analysis. A control limit of 20% for the RPD shall be used for original and field duplicate sample values that are greater than or equal to five times the PQL. The field blank results shall be free of contamination (detections less than the PQL). Any deviation from the control limits or variability will be evaluated and qualified at data validation and reconciled during data quality assessment and discussed in the data usability and limitations.

B.2 Sampling Methods

This section describes sampling methods, applicable SOPs, necessary equipment and support facilities that will be employed during these sampling events.

B.2.1 Equipment and Support Facilities

Specific field equipment necessary for execution of the SAP is included in Table B.1-2, no additional equipment or support facilities are needed in order to execute this event.

B.2.2 Sampling for Surface Water

Sampling protocols, sample containers, sample labeling and custody, field logbook checklist and overall field management requirements for collecting surface water grab samples are described in the Surface Water Sampling SOP FLD-01.00 (EPA, 2012), General Field Sampling Protocols SOP FLD-12.00 (EPA, 2012) and Sample Custody and Labeling SOP FLD-11.00 (EPA, 2012) (Appendix A).

The surface water samples will be collected as discrete samples from each sampling location. Table A.7-3 summarizes the required volumes needed for analysis as follows: 250 mL for total recoverable metals, 250 mL for dissolved metals, and 500 mL for alkalinity/anions. Sample bottles used for sample collection will be station dedicated, therefore, decontamination is not required. Water samples for dissolved metals analysis will be collected in a certified clean and triple rinsed 250 mL high density polyethylene (HDPE) bottle and then transferred and filtered through a Nalgene filter apparatus. The 250 mL HDPE transfer bottle will be refilled for total recoverable metal analysis. A triple rinsed, certified clean 500 mL HDPE bottle will be filled for alkalinity and anions analysis. After collection, the total recoverable metals and dissolved metals samples will be preserved with nitric acid. All samples will then be placed in a cooler with ice for transport to the laboratory.

The pH, conductivity, temperature, and DO measurements will be obtained on a real-time basis in the field. These field measurements will be taken at each sampling location using a water quality multi-meter according to the provisions outlined in the manufacturer’s instructions and SOP FQP-5005 R1 In-Situ Operation (EPA, 2016). In cases in which there is not enough water to submerge the probe, the sample cup will be filled with water from the station and readings will be collected soon thereafter. A note will be made in the electronic data collection device when this technique is used and DO and temperature will be provided as estimates.

Stream flow measurements will be collected at select surface water sampling locations. As a safety precaution, flow measurements will only be collected provided conditions are deemed safe based on observed stream conditions. The project manager or designee will be informed if conditions are too dangerous to collect stream flow data. Flow will be measured using a Flow Tracker® flow meter or prefabricated flumes, following the protocols outlined in the Flow Tracker Operation SOP FLD-08.00 (EPA, 2012).
B.3 Sample Handling and Custody

The sample designation will consist of a series of letters and numbers to indicate the creek name, the sampling location name, and the sample type. Tables A.7-4 and A.7-5 show the naming convention and the site descriptions. Surface water will be labeled as follows:

- **COAL-X** Coal Creek
- **ELK-X** Elk Creek
- **LX-X** Adit levels for Standard Mine
- **SW** surface water
- **TM** total recoverable metals
- **DM** dissolved metals
- **Alk/Anions** alkalinity and anions
- **Date** MM/DD/YYYY

All samples will be preserved in the field, placed in a cooler with ice, and transported back to the EPA Region 8 Laboratory following chain-of-custody protocols. The samples will be relinquished with completed and signed chain-of-custody forms to the sample custodian at the laboratory. Attachment A provides a blank chain-of-custody form. The sample custodian will inspect the coolers to make sure that the proper temperature was maintained, that the sample containers are intact and sealed, and that the number of samples in the coolers match up with the information provided in the chain-of-custody forms. All the samples will be stored in a walk-in cooler at the laboratory. An analytical chemist will log the samples in the Laboratory Information Management System (LIMS) upon receipt and will enter all analytical data into the Scribe database for permanent storage or archiving.

All field measurements and observations will be recorded in an electronic data collection device, a field notebook, or on appropriate data sheets by field personnel at the time they are performed in accordance with the CLP Program Guidance for Field Samplers (EPA, 2014). Electronic data collection devices will be used when available for all proposed sampling events. These devices will be used in accordance with Field Data Collection Using GPS and Collector for ArcGIS Field Quality Procedures-1 (EPA, 2017) and Survey123 for ArcGIS Field Quality Procedures (EPA, 2017). In the event of using a bound field notebook, the personnel doing the recording will initial and date all measurements, observations, and any other notations made. Corrections will be performed by drawing a single line through the error accompanied by the date and the initials of the person performing the correction, followed by the proper entry. Chain-of-custody forms will be filled out during the time of collection and will follow protocol provided in Sample Custody and Labeling, SOP FLD-11.00 (EPA, 2012).

B.3.1 Sample Preservation

Surface water samples collected for analysis of total recoverable metals and dissolved metals will be acidified in the field using ultra-pure nitric acid to a pH less than two. This will be accomplished by adding approximately 0.5 mL of nitric acid or emptying the entire contents of an ampoule into each sample container in accordance with SOP FLD-03.00 Sample Preservation (EPA, 2012). Used ampoules should be disposed of in the acid neutralization container. Samples collected for anions and alkalinity analysis will not be acidified but placed directly on ice after collection. All samples will be stored in coolers on ice for transport to the EPA Region 8 Laboratory in accordance with General Field Sampling Protocols SOP FLD-12.00 (EPA, 2012). The maximum holding time is 180 days for total recoverable and dissolved metals, 28 days for anions, and 14 days for alkalinity (see Table A.7-3).
B.4 Analytical Methods

Samples will be analyzed for total recoverable metals, dissolved metals, hardness (calculated from dissolved metals), alkalinity, and anions. Table A.7-3 includes the laboratory analytical instrumentation and methods to be used for sample analysis. Mercury analysis will be in accordance with EPA Determination of Mercury in Water by Cold Vapor Atomic Absorption Spectrometry (CVAA) (Method 245.1, Revision 3, 1994). Additionally, total recoverable and dissolved metals sample analysis will be in accordance with Method 200.7 Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry, Revision 4.4, May 1994, and Method 200.8 Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry, Revision 5.4, May 1994. Alkalinity sample analysis will be in accordance with Method 310.1 Alkalinity by Titration, 1978, and anions sample analysis will be in accordance with Method 300.0 Determination of Inorganic Anions by Ion Chromatography, Revision 2.1, August 1993. Laboratory QC and performance criteria for ESAT and EPA Region 8 are discussed in Section B.5. The sample selection for laboratory QC will be determined by the laboratory staff following the laboratory’s QMP located at the laboratory in Golden, Colorado.

Sample disposal of potentially hazardous waste will follow protocol defined in Laboratory Waste Management SOP 16-LAB-01.01 (EPA, 2016).

All surface water samples will be submitted for analysis to the EPA Region 8 Laboratory, ESAT Analytical Chemistry Department. Table A.7-3 provides the analytical protocols for the surface water analyses.

B.5 Quality Control

Tables B.5-1 and B.5-2 provide laboratory QC criteria. This information includes the QC checks, the run frequency, the acceptance criteria, and the corrective action (CA). In addition, Table B.5-2 provides the calculations used for generating QA/QC parameters. The sample selection for laboratory QC will be determined by the laboratory staff following the laboratory’s QMP located at the laboratory in Golden, Colorado.

The calibration procedures for the field measurements to be performed using the In-Situ Multi-Parameter Meter are detailed in the In-Situ Operation SOP FQP-5005 R1 (EPA, 2016). If other multi-probes are used for this sampling event, the field sampling team will calibrate the probe according to the manufacturer’s specifications listed in the owner’s manual. The SOPs and procedures appended to this document also detail the associated QA/QC criteria for the field analyses and equipment.

Field QC samples will be collected on the following basis:

- Filter/container/preservative blank – one blank per 20 samples collected or minimum of one field blank per day. The filter/container/preservative blank verifies the sample containers, the filters, and the preservative are contaminant free.
- Duplicates (collocated) – minimum of 1 duplicate per 10 samples collected

The collection of field QC samples will be recorded in the electronic data collection device. If control limits are exceeded they will be recorded in the SAR and the RPM will be notified of the findings.
B.6 Instrument/Equipment Testing, Inspection and Maintenance

The following chart includes the equipment that will be used during execution of this SAP that requires testing, inspection or maintenance.

<table>
<thead>
<tr>
<th>Equipment/Instrument</th>
<th>Requirement</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-parameter meter</td>
<td>Calibration, routine maintenance, scheduled service</td>
<td>In accordance with manufacturer’s specifications, user’s manual and applicable SOPs</td>
</tr>
<tr>
<td>Trimble®GeoXT™ GPS</td>
<td>Service</td>
<td>As needed depending on equipment performance</td>
</tr>
<tr>
<td>Sontek®FlowTracker™</td>
<td>Calibration, routine maintenance, scheduled service</td>
<td>In accordance with manufacturer’s specifications, user’s manual and applicable SOPs</td>
</tr>
<tr>
<td>Cutthroat flumes</td>
<td>Maintenance and service</td>
<td>As needed depending on equipment condition</td>
</tr>
<tr>
<td>Laboratory analytical</td>
<td>Calibration, routine maintenance, scheduled service</td>
<td>In accordance with manufacturer’s specifications, user’s manual and applicable SOPs</td>
</tr>
<tr>
<td>instrumentation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Periodic maintenance and servicing schedules as well as applicable testing criteria are included in the applicable user’s manuals and SOPs attached to this document. Note that most spare parts for each piece of equipment are kept at the EPA Region 8 Laboratory, including both parts for field equipment and also for laboratory instrumentation. Spare parts are routinely available and ordered during periodic maintenance activities to ensure they are on hand when needed. Service agreements are in place for all laboratory instrumentation to address equipment maintenance, service, parts, and repair needs as they arise. Equipment and instrument calibration requirements and frequencies are detailed in the applicable SOPs and user’s manuals attached to this document.

Field equipment will be inspected, tested, and routine maintenance performed prior to deployment in the field by contractor personnel knowledgeable of equipment operation and maintenance requirements at the EPA Region 8 Laboratory. Any equipment deficiencies and or maintenance requirements will be identified and mitigated (i.e., parts replaced, alternate equipment deployed, etc.). After mitigation, equipment will be re-inspected and the effectiveness of any repairs will be verified. Any repair or maintenance activities performed will be documented in the applicable equipment or instrument log book. Backup equipment will be deployed during these events in case of equipment or instrument failure in the field.

B.7 Instrument/Equipment Calibration and Frequency

As indicated in Section B.6, some laboratory instrumentation (analytical instrumentation) and field equipment (such as water quality meters and flow meters) will require periodic calibration to verify function. Calibration requirements, procedures, testing criteria and deficiency resolution procedures are included in applicable SOPs and user’s manuals, each of which are included in Appendix A of this document (for field equipment). SOPs and user’s manuals for laboratory analytical instrumentation are on file and readily available at the EPA Region 8 Laboratory. Any variations or inability to calibrate a piece of equipment or instrumentation will be noted in the relevant logbook, and appropriate mitigation procedures will be followed or replacement equipment will be obtained. Recalibration of any instrument
that requires mitigation of a deficiency will be performed prior to use or deployment and documented in the appropriate logbook.

B.8 Inspection/Acceptance for Supplies and Consumables

All supplies for this event will be purchased by EPA from approved vendors and stored in the field storage room (or adjacent storage rooms at the EPA Region 8 Laboratory). The week before a sampling event, an EPA or ESAT sampling team member will gather needed supplies and consumables, which will subsequently be verified by an EPA or ESAT team member. Supplies and consumables will be ordered, inspected upon receipt, accepted, tracked, and inventoried by EPA or ESAT personnel at the EPA Region 8 Laboratory. Acceptance of supplies and consumables will be determined by the requirements of the end user.

B.9 Use of Existing Data (Non-Direct Measurements)

Non-direct measurements were relied upon for preparation of project implementation. These measurements include previous sampling and analysis plans (EPA, 2016), historical data, and requirements listed in the current ROD.

B.10 Data Management

Specific management processes will be implemented for data collected during the following field activities: field equipment calibration and maintenance entries, electronic data, field logbook, data sheet entries, chain-of-custody forms, electronically entered or logged data (such as GPS locations, flow measurements, etc.), and analytical data.

Field equipment calibration and maintenance logs – all field equipment calibration and maintenance activities will be documented in a logbook dedicated to each piece of equipment. Logbook entries will be signed and dated by the individual performing calibration or maintenance, or the individual responsible for coordination (such as the field task lead) if equipment is shipped to a manufacturer for repair or maintenance. Field logbooks will be stored with the appropriate piece of equipment. When new logbooks are needed, the former logbook will be stored at the EPA Region 8 EPA Laboratory, Suite A127 until relinquished to EPA in accordance with ESAT Region 8 contract requirements.

Field logbook/datasheet entries – all field measurements and observations will be recorded in an electronic data collection device, bound notebook if collection device is unavailable, or on appropriate data sheets by field personnel at the time they are performed. In the event that an electronic data collection device is unavailable, the personnel doing the recording will initial and date each logbook. Corrections to logbook entries will be made by drawing a single line through the error accompanied by the date and the initials of the person performing the correction, followed by the proper entry. Upon return to the EPA Region 8 laboratory, in the event that electronic data collection devices were not used, all data hand-entered into field notebooks or datasheets will be transferred to electronic spreadsheets (such as Microsoft® Excel) by ESAT contract staff to prepare for uploading to a Scribe project (see Scribe project generation, below). ESAT field personnel will perform a 100% verification of spreadsheet entries against hand-entered field logbook or datasheet entries before uploading to Scribe. Original field notebooks and data sheets will be stored at the Region 8 EPA Laboratory, Suite A127 until relinquished to EPA in accordance with ESAT Region 8 contract requirements. Non-Scribe electronic files generated as a part of this process (i.e., spreadsheets) will be stored on the ESAT Region 8 contractor G drive.
Chain-of-custody forms – when possible, chain-of-custody forms will be generated prior to field activities using Scribe and will be filled out when samples are collected following the protocol outlined in Sample Custody and Labeling SOP FLD-11.00 (EPA, 2012). Otherwise, blank chain-of-custody forms will be used to collect sample information during field activities. Information entered on the forms during investigation activities will be entered into Scribe after returning to the EPA Region 8 Laboratory as a part of the Scribe upload process (see Scribe project generation, below). ESAT personnel will verify 100% of all data entered into Scribe against the chain-of-custody forms completed in the field. Hard copies of these forms will be stored at the EPA Region 8 Laboratory, Suite A127 until relinquished to EPA in accordance with ESAT Region 8 contract requirements.

Electronically entered or logged data – in some cases data may be recorded in the field directly on electronic field forms or using data loggers (such as GPS instrumentation or multi-probe data loggers). In these cases, upon return to the EPA Region 8 Laboratory, all electronic data logs will be downloaded directly to a spreadsheet (or alternate electronic media depending on specific instrument software requirements), verified against any hand-written documentation (such as field logs or field data sheets) and processed into an electronic form that can be uploaded directly to Scribe. Similarly, electronic field forms will be processed for upload to Scribe. Electronic field forms and data logs will be maintained on the ESAT Region 8 contractor G drive. In cases where information must be manually entered into Scribe, ESAT personnel will perform 100% verification between electronic documents, data logs, and data manually entered into Scribe.

Analytical Data – An analytical chemist will log all the samples into LIMS upon receipt at the EPA Region 8 Laboratory. All analytical results will be uploaded into LIMS in accordance with SOP 16-LAB-05.04, Sample Receipt, Custody, Storage and LIMS Data Entry (EPA, 2015). Peer review of the data package, at a 100% frequency of reported versus raw data, will be performed by the analytical laboratory before a final report is released. The final report will be in standard CLP format, including all laboratory and instrument QC results. The laboratory electronic data deliverable (EDD) will immediately be uploaded into a Scribe project for permanent electronic storage and archiving after the final report is generated. Hard copies of data reports (including bench sheets) will be stored at the EPA Region 8 Laboratory, Suite A127 until relinquished to EPA in accordance with ESAT Region 8 contract requirements.

Scribe project generation – As indicated above, all data generated as a part of field investigation activities will be uploaded into a Scribe project (or update to a Scribe project) and subsequently published to Scribe.net in accordance with the Data Management for Field Operations and Analytical Support SOP 16-DAT-01.00 (EPA, 2014). It is anticipated that data collected in the field may supersede existing or historical data that has already been published (such as GPS locations, etc.) for a specific site. Therefore, before data are published or updated to Scribe projects, ESAT personnel will perform a 100% verification of each Scribe project against data collected in the field (hand entered logbook data, electronic forms or data logs) prior to publishing the project on Scribe.net. Verified Scribe projects will be published within two weeks of delivery of analytical EDD, when possible. After the validation process, the validation qualifiers will be published in Scribe. In the event that conditions preclude publication within that time period, the EPA project manager will be immediately notified and an alternate publication date will be established.
C. ASSESSMENT AND OVERSIGHT

This section describes assessment and oversight associated with these events, including field sampling assessments, laboratory assessments, field corrective actions, and reports to management.

C.1 Assessment and Response Actions

C.1.1 Field Sampling Assessments

Assessment and oversight of field sampling activities and implementation of the SAP/QAPP will include the following:

- Oversight of field sampling activities
- Oversight of sample handling and chain of custody procedures

The following individuals or their designees are authorized to perform the assessments listed above:

- EPA RPM – James Hanley
- EPA TOPO – Nicole Marotta
- ESAT Field Task Lead – Steve Auer

Assessment of field activities may occur at any time and without prior notice, and will be documented in the electronic data collection device, as well as the SAR. Only authorized individuals may conduct the assessments and it is their role to issue any CA or response action to the situation. Minor problems will be addressed on-site prior to resuming work. Significant problems may result in a stop work order issued by the TOPO until the project manager or designee can resolve the problem.

C.1.2 Laboratory Assessments

System assessments of the designated laboratory may be performed by ESAT. The quality assurance officer (QAO), or a designee, may perform a laboratory inspection.

Routine assessments will be conducted at least once a year, in accordance with ESAT’s QMP. However, the frequency of the laboratory system assessments will also be based on the level of use and performance of individual designated laboratories. A member of the ESAT team will perform the assessment in accordance with the assessment checklist and TechLaw SOP 02-06-08. The checklist requires examining the laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, instrument operating records, etc. Routine assessments will also be performed before a laboratory is added to the approved laboratory list. Should one-time specialty analysis be requested, the need for on-site assessments will be evaluated and discussed with EPA before an audit.

Performance assessments will require preparing blind QC samples and submitting them, along with project samples to the laboratory for analysis. The analytical results of the QC sample analyses are evaluated by the QAO to ensure that the laboratory maintains acceptable QC performance. Performance assessments may be requested by ESAT or EPA. Performance evaluation (PE) samples will be prepared by and obtained from vendors. The QAO will designate whether a PE sample shall be submitted. PE samples should be submitted if a laboratory has not recently passed an outside PE sample, or as requested by EPA.
Response Actions

CAs may be required at two phases corresponding to the two activities of data generation: 1) field activities (data gathering phase); and 2) laboratory activities (data analysis phase). CAs required as a result of the data analysis phase are initiated by the TechLaw QAO when analytical data are found to be outside the limits of acceptability, as specified in the laboratory SOPs.

C.1.3 Field Corrective Actions

CAs required as a result of the field data collection phase are initiated by the ESAT field team leader as deemed necessary from log reports or field assessments. QC needs to be implemented both during the development of the SAP and during sampling activities to ensure CAs will not be required. CAs are initiated by ESAT if weaknesses or problems are uncovered as a result of field activities. CAs will depend on the nature or severity of the problem and the level at which the problem is detected, and may include, but shall not be limited to:

- Modifications to sampling procedures
- Recalibration (or replacement) of field instruments
- Additional training of field personnel
- Reassignment of staff personnel
- Resampling

C.2 Reports to Management

The results of all laboratory assessments will be submitted to the appropriate ESAT project manager, task order manager, and laboratory assistance team, as well as the EPA Contracting Officer Representative and EPA QA personnel, if requested. An external assessment of the designated laboratory may also be conducted by EPA, at the agency’s discretion. All reporting will follow guidelines established in the Quality Assurance Review Form.

D. DATA VALIDATION AND USABILITY

D.1 Data Review, Verification, and Validation

Abbreviated verification will be completed on ten percent of the analytical results for data that is electronically uploaded directly from the analytical instrumentation into the ESAT LIMS. This review will be performed to ensure that data was produced in accordance with procedures outlined in this project plan. The following elements will be reviewed for compliance as part of the abbreviated data validation:

- Holding times
- Calibration
- Blanks
- Spikes
- Duplicates
- LCSs
- Reporting limits
- Analyte quantification
Peer review of the data package, at a 100% frequency of reported versus raw data, will be performed by the analytical laboratory prior to releasing a final report.

Laboratory data validation and verification will begin at the sample log-in stage where a sample log-in technician or chemist will compare received samples against chain-of-custody forms and document sample condition (e.g., damage, cooler temperature). Validation and verification of data will be performed by QA/QC personnel following *EPA National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA, 2017) in order to determine if the DQOs were met. Sample data deemed outside the expected range will be investigated, communicated to the analytical chemistry staff, flagged (if needed) and potentially resampled to verify or discredit the data. Data that have proven to be incorrect may be flagged, further reviewed, or invalidated. The cause of incorrect data will be investigated and appropriate response actions will be taken, including communication of any issues to the user in the data report.

**D.2 Verification and Validation methods**

Analytical data will be validated for ten percent of the results by a third party contractor outside of TechLaw, Inc. The validation will include reviewing ten percent of the samples for 100% of the analytical analysis that was performed and reported. The following elements will be reviewed for compliance as part of the abbreviated data validation:

- Holding times
- Calibration
- Blanks
- Spikes
- Duplicates
- LCSs
- Reporting limits
- Analyte identification
- Analyte quantification
- Comparison of hardcopy results to electronic data deliverable

**D.3 Reconciliation with User Requirements**

If necessary, the analytical data will be qualified in order to convey the outcome of the data validation process to the end users to help them determine how the data may be applied in subsequent interpretations. The following definitions provide brief explanations of the national qualifiers assigned to results in the data review process. If additional qualifiers are needed, then a complete explanation of those other qualifiers will be included in the data review.

<table>
<thead>
<tr>
<th>Qualifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.</td>
</tr>
<tr>
<td>J</td>
<td>The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.</td>
</tr>
<tr>
<td>J+</td>
<td>The result is an estimated quantity, but the results may be biased high.</td>
</tr>
<tr>
<td>J-</td>
<td>The result is an estimated quantity, but the results may be biased low.</td>
</tr>
<tr>
<td>R</td>
<td>The data is unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be presented in the sample.</td>
</tr>
<tr>
<td>----</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>UJ</td>
<td>The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.</td>
</tr>
</tbody>
</table>

**D.4 Reconciliation with DQOs**

Information obtained from the field investigation will be evaluated through the data quality assessment (DQA) process to determine if the data are of adequate quality and quantity to support their intended use. The DQA process consists of five steps, summarized below (EPA, 2006):

1) **Review the project’s objectives and sampling design:** review the objectives defined during systematic planning to ensure they are still applicable. If objectives have not been deployed, articulate them before evaluating the data for the project objectives. Review the sampling design and data collection documentation for consistency with the project objectives, observing any potential discrepancies.

2) **Conduct a preliminary data review:** review QA reports (when possible) to validate data, calculate basic statistics, and generate graphs of the data. Use this information to learn about the structures of the data and identify patterns, relationships, or potential anomalies in it.

3) **Select the statistical method:** select the appropriate procedures for summarizing and analyzing the data based on the review of the performance and acceptance criteria associated with the project objectives, sampling design, and preliminary data review. Identify the key underlying assumptions associated with the statistical tests.

4) **Verify the assumptions of the statistical method:** evaluate whether the underlying assumptions hold, or whether departures are acceptable, given the actual data and other information about the study.

5) **Draw conclusion from the data:** perform the calculations necessary to draw reasonable conclusions from the data. If the design is to be used again, evaluate the performance of the sampling design.

Uncertainty of validated data will be evaluated by the RPM to determine if the DQOs were met. In the event that the DQOs were not met, they will be reviewed to determine if they are achievable and may be revised if necessary. The data may then be further evaluated to determine the impact to the project. Data usability and limitations will be evaluated and determined by the RPM.
REFERENCES

Documents:


United States Environmental Protection Agency. 2014. *Contract Laboratory Program Guidance for Field Samplers. (EPA 540-R-014-013)*


**Standard Operating Procedures:**

TechLaw. 2017. *Field Procedures - Analytical Support and Laboratory Selection*. SOP 02-06-08


United States Environmental Protection Agency. 2012. *Sample Preservation*. SOP FLD-03.00

United States Environmental Protection Agency. 2012. *Flow Tracker Operation*. SOP FLD-08.00


United States Environmental Protection Agency. 2015. *Sample Receipt, Custody, Storage and LIMS Data Entry*. SOP 16-LAB-05.04

United States Environmental Protection Agency. 2016. *In-Situ Operation*. SOP GQP-5005 R1

United States Environmental Protection Agency. 2016. *Laboratory Waste Management*. SOP 16-LAB-01.01


Tables
Table A.7-3  Water Contaminants of Concern, EPA Methods, Sampling Protocols, and Detection Limits

<table>
<thead>
<tr>
<th>Target Analytes</th>
<th>EPA Method</th>
<th>Instrument</th>
<th>Fraction Evaluated</th>
<th>Required Sample Volume (ml)</th>
<th>Preservation</th>
<th>Holding Time</th>
<th>Laboratory MDL (mg/L)</th>
<th>Laboratory MDL for water (mg/L)</th>
<th>CDPHE Surface Water Regulations for Chronic &amp; Acute Acidified / Alkaline pH (ug/L)</th>
<th>Estimated Chronic TBVs for Surface Water at Standard Mine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum (Al)</td>
<td>200.7</td>
<td>ICP-OE</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>20</td>
<td>5</td>
<td>87 µg/L *[ln(hardness)] +0.1158 (not exceed)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beryllium (Be)</td>
<td>200.7</td>
<td>ICP-OE</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>2</td>
<td>5</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>200.7</td>
<td>ICP-OE</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>100</td>
<td>250</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>200.7</td>
<td>ICP-OE</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>2</td>
<td>5</td>
<td>2 µg/L *[ln(hardness)] +0.5340</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>0.5</td>
<td>1</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>0.5</td>
<td>1</td>
<td>0.084 µg/L *[ln(hardness)] +0.0544</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>0.5</td>
<td>1</td>
<td>0.048 µg/L *[ln(hardness)] +0.0544</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selenium (Se)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>2</td>
<td>5</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver (Ag)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>0.5</td>
<td>1</td>
<td>1.72 µg/L *[ln(hardness)] +0.96</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vanadium (V)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>2</td>
<td>5</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>300.0</td>
<td>Ion Chromatography</td>
<td>N/A</td>
<td>250 ml</td>
<td>Acidified to 6°C ± 2°C</td>
<td>14 Days</td>
<td>5</td>
<td>5</td>
<td>0.1 µg/L</td>
<td>NA</td>
</tr>
<tr>
<td>Antimony (Sb)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>1</td>
<td>2</td>
<td>0.145732 ([ln(hardness)] +0.7372)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic (As)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>0.5</td>
<td>1</td>
<td>1.045732 ([ln(hardness)] +0.7372)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barium (Ba)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>0.5</td>
<td>1</td>
<td>0.688511214</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boron (B)</td>
<td>200.7</td>
<td>ICP-OE</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>2</td>
<td>5</td>
<td>0.9986 * e^[0.9094*[ln(hardness)] +0.6235]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>200.7</td>
<td>ICP-OE</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>200</td>
<td>500</td>
<td>0.100533939</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>0.5</td>
<td>1</td>
<td>0.048 µg/L *[ln(hardness)] +0.0544</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>200.7</td>
<td>ICP-OE</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>0.5</td>
<td>1</td>
<td>0.048 µg/L *[ln(hardness)] +0.0544</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>0.5</td>
<td>1</td>
<td>0.048 µg/L *[ln(hardness)] +0.0544</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>200.7</td>
<td>ICP-OE</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>100</td>
<td>250</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>0.5</td>
<td>1</td>
<td>0.145732 ([ln(hardness)] +0.7372)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>0.5</td>
<td>1</td>
<td>0.048 µg/L *[ln(hardness)] +0.0544</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selenium (Se)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>2</td>
<td>5</td>
<td>4.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver (Ag)</td>
<td>200.8</td>
<td>ICP-MS</td>
<td>TR &amp; Diss</td>
<td>Disc - 250ml TR - 250ml</td>
<td>0.5</td>
<td>1</td>
<td>1.72 µg/L *[ln(hardness)] +0.96</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Disc = Dissolved metal fraction, i.e. source water filtered through 0.45 µm filter prior to preservation (acidified). TR = Total recoverable metals, source water, acidified (preserved).

MDL: Method Detection Limit, statistically determined from the deviation in a series of seven low level (3-5x the anticipated MDL) analyses, treated exactly as unknown samples for PQL: Practical Quantitation Limit. MDL = 0.05 µg/L. For water:pH <2 the PQL is 0.2 µg/L.

(B) Cold Stream Tier I temperature criteria apply where cutthroat trout and brook trout are expected.

<table>
<thead>
<tr>
<th>Station Name</th>
<th>Site Description and Access Information</th>
<th>Field Measurements</th>
<th>Surface Water</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coal Creek</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COAL-10</td>
<td>Coal Creek upstream of keystone water treatment plant</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>COAL-20</td>
<td>Coal Creek approximately 50 yds upstream of Elk Creek confluence.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Adits</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1-1</td>
<td>Level 1 Adit aka SM-00 &amp; EC-MSTD1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>L1-2</td>
<td>Level 1 Sed. Pond outlet to Elk Creek</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>L2-1</td>
<td>Level 2 Adit aka EC-MUSTD1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>L2-2</td>
<td>Level 2 MW at station 4+50</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>L3-1</td>
<td>Level 3 Sed. pond outlet</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Elk Creek</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELK-00</td>
<td>Elk Creek at CO-12 crossing approximately 100 yds upstream of confluence with Coal Creek. There is an old flume in an old channel at this location. No water is going through flume.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>ELK-05</td>
<td>Elk Creek approximately 130 feet downstream of confluence of several seeps that feed Elk Creek from the eastern bank. There are rock outcrops located on the forest service road just upstream of the sampling location. Access on foot via forest service road that follows Elk Creek.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>ELK-08</td>
<td>Elk Creek downstream of Copley Lake outfall. Access on foot via forest service road that follows Elk Creek.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>ELK-10</td>
<td>Elk Creek approximately 30 meters below tailings impoundment. Sample further downstream if site is not well-mixed. Access via forest service road or Keystone Mine road.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>ELK-29</td>
<td>Elk Creek downstream of confluence of individual Elk Creek flows (tributaries near the headwaters). Elk Creek Upstream Level 1 sed. ponds</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Number of Samples</strong></td>
<td></td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Station Name</td>
<td>Site Description and Access Information</td>
<td>Field Measurements</td>
<td>Surface Water</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------</td>
<td>--------------------</td>
<td>---------------</td>
</tr>
<tr>
<td><strong>Coal Creek</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COAL-10</td>
<td>Coal Creek upstream of keystone water treatment plant</td>
<td>1 1 1 1</td>
<td></td>
</tr>
<tr>
<td>COAL-20</td>
<td>Coal Creek approximately 50 yds upstream of Elk Creek confluence.</td>
<td>1 1 1 1</td>
<td></td>
</tr>
<tr>
<td><strong>Adits</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1-1</td>
<td>Level 1 Adit aka SM-00 &amp; EC-MSTD1</td>
<td>1 1 1 1</td>
<td></td>
</tr>
<tr>
<td>L1-2</td>
<td>Level 1 Sed. Pond outlet to Elk Creek</td>
<td>1 1 1 1</td>
<td></td>
</tr>
<tr>
<td>L2-1</td>
<td>Level 2 Adit aka EC-MUSTD1</td>
<td>1 1 1 1</td>
<td></td>
</tr>
<tr>
<td>L2-2</td>
<td>Level 2 MW at station 4+50</td>
<td>1 1 1 1</td>
<td></td>
</tr>
<tr>
<td>L3-1</td>
<td>Level 3 Sed. pond outlet</td>
<td>1 1 1 1</td>
<td></td>
</tr>
<tr>
<td><strong>Elk Creek</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELK-00</td>
<td>Elk Creek at CO-12 crossing approximately 100 yds upstream of confluence with Coal Creek. There is an old flume in an old channel at this location. No water is going through flume.</td>
<td>1 1 1 1</td>
<td></td>
</tr>
<tr>
<td>ELK-05</td>
<td>Elk Creek approximately 130 feet downstream of confluence of several seeps that feed Elk Creek from the eastern bank. There are rock outcrops located on the forest service road just upstream of the sampling location. Access on foot via forest service road that follows Elk Creek.</td>
<td>1 1 1 1</td>
<td></td>
</tr>
<tr>
<td>ELK-08</td>
<td>Elk Creek downstream of Copley Lake outfall. Access on foot via forest service road that follows Elk Creek.</td>
<td>1 1 1 1</td>
<td></td>
</tr>
<tr>
<td>ELK-10</td>
<td>Elk Creek approximately 30 meters below tailings impoundment. Sample further downstream if site is not well-mixed. Access via forest service road or Keystone Mine road.</td>
<td>1 1 1 1</td>
<td></td>
</tr>
<tr>
<td>ELK-29</td>
<td>Elk Creek downstream of confluence of individual Elk Creek flows (tributaries near the headwaters): Elk Creek Upstream Level 1 sed. ponds.</td>
<td>1 1 1 1</td>
<td></td>
</tr>
<tr>
<td><strong>Total Number of Samples</strong></td>
<td></td>
<td>12 12 12 12</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Latitude</td>
<td>Longitude</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>--------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>COAL-10</td>
<td>38.866819</td>
<td>-107.023900</td>
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<tr>
<td>COAL-20</td>
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<td>-107.060535</td>
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</tr>
<tr>
<td>ELK-00</td>
<td>38.867065</td>
<td>-107.059728</td>
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</tr>
<tr>
<td>ELK-10</td>
<td>38.877964</td>
<td>-107.075224</td>
<td></td>
</tr>
<tr>
<td>L1-1</td>
<td>38.880118</td>
<td>-107.073696</td>
<td></td>
</tr>
<tr>
<td>L1-2</td>
<td>38.879365</td>
<td>-107.074008</td>
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</tr>
<tr>
<td>ELK-29</td>
<td>38.882021</td>
<td>-107.073106</td>
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</tr>
<tr>
<td>L2-1</td>
<td>38.881571</td>
<td>-107.071536</td>
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</tr>
<tr>
<td>L2-2</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>L3-1</td>
<td>38.879419</td>
<td>-107.073978</td>
<td></td>
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<tr>
<td>ELK-05</td>
<td>38.865294</td>
<td>-107.073958</td>
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</tr>
<tr>
<td>ELK-08</td>
<td>38.870654</td>
<td>-107.078708</td>
<td></td>
</tr>
</tbody>
</table>
Table B.1-1  Sampling Checklist

1. Make sure the necessary paperwork is in place for a field event: Approved LSR, SAP, and QAPP.

2. Coordinate sampling dates and times with members of the field team and talk with chemists involved in the project to see if your plans work for them. Coordinate sample delivery with outside laboratories.

3. Fill out the necessary paperwork: Comp Time forms and TAs if travel will be more than 50 miles from the laboratory. Be sure to have reservations made for airlines and hotels if necessary.

4. Make necessary arrangements with people outside of the Region VIII laboratory that are involved with the project. Arrange meeting times and places, vehicle needs, sampling teams, additional equipment needs, etc.

5. Inform any volunteers outside of the EPA laboratory group what will be involved with sampling - physical stressors, equipment to bring, lunch, water, etc.

6. Calibrate meters needed for fieldwork well-before leaving. Make sure:
   a. pH probes are filled.
   b. DO membranes are intact.
   c. Spare batteries, calibration logs, and pens are available for each meter.
   d. Replace pH and conductivity calibration standards with fresh solution.
   e. Condition new probes and replace damaged ones as needed. Buy new equipment from a scientific vendor if necessary.

7. Lay out needed sampling equipment in the field room (see attached list).

8. Check vehicles: fill with gas, top off windshield wiper fluid, equip with cell phones, walkie-talkies, and chargers.

9. Charge batteries for needed sampling equipment one or two nights before leaving: digital camera, hydrolab, GPS units, walkie-talkies, etc.

10. Pack vehicles the night before leaving. In the event of hot or cold weather, leave meters and deionized water in the field room and pack the day you leave.

11. In the event of a day-trip, calibrate meters the morning you leave.
## Field Equipment List

<table>
<thead>
<tr>
<th>Sample Containers:</th>
<th>Logbook</th>
<th>Summer Field Gear:</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 ml HDPE containers</td>
<td></td>
<td>Backpacks</td>
</tr>
<tr>
<td>Gallon cubitainers</td>
<td></td>
<td>Hiking Boots</td>
</tr>
<tr>
<td>VOA vials</td>
<td></td>
<td>Hat</td>
</tr>
<tr>
<td>Glass Amber (BNA, pest)</td>
<td></td>
<td>Gor-Tex Waders</td>
</tr>
<tr>
<td>1 oz plastic (sed. metals)</td>
<td></td>
<td>Wading Boots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rain Parka</td>
</tr>
<tr>
<td>Filter Apparatus:</td>
<td></td>
<td>Wool Socks</td>
</tr>
<tr>
<td>250 or 500 ml filters</td>
<td></td>
<td>Layered Clothing</td>
</tr>
<tr>
<td>Filter Stands</td>
<td></td>
<td>Sunscreen</td>
</tr>
<tr>
<td>Vacuum pump with spare</td>
<td></td>
<td>Chapstick</td>
</tr>
<tr>
<td>Prefilters</td>
<td></td>
<td>Bug Spray</td>
</tr>
<tr>
<td>Teflon Tweezers</td>
<td></td>
<td>Sun Glasses</td>
</tr>
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<td>HNO₃ - metals</td>
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<td>H₂SO₄ - nutrients</td>
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<td>Forms</td>
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<td>Picking forceps/brush</td>
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<td>Solinst depth meter w/battery</td>
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<tr>
<td>3 to 2 prong electrical converter</td>
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<td>Generator- gas, ext. chord</td>
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<tr>
<td>String or chord</td>
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<td>Long multimeter cable</td>
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<td>Misc:</td>
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<td>Battery charger</td>
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<td>Bucket</td>
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<td>DI rinse bottles</td>
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<td>Cell Phones w/ charger</td>
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<td>Walkie-Talkies w/batteries</td>
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<td>Vehicle log &amp; credit card</td>
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<td>DI rinse bottles</td>
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<td>Winter Field Gear:</td>
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<td>Shovel/Ice Breaker</td>
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<td>Neoprene Waders</td>
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<td>Sunglasses</td>
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<td>Water/Food</td>
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<td>Pocket Knife</td>
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<td>Field Meters (when not using multimeters):</td>
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<td>logbooks</td>
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<td>pH- buffers</td>
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<td>DO- Spare membranes filling</td>
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<td>0.035N Na Thio</td>
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<tr>
<td>Buret/Pipet</td>
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<td>Buret Holder</td>
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<td>Flask w/ stir bar</td>
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<td>Powder Pillows:</td>
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<td>MnSO₄</td>
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<tr>
<td>Alk Iodide-Azide</td>
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<td>Sulfamic Acid</td>
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<td>Conductivity- calibration stds</td>
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</table>

*Standard Mine Superfund Site – 201*
**QC Check I Symbol** | **Explanation** | **Run Frequency** | **Acceptance Criteria** | **Corrective Action**
---|---|---|---|---
Initial Calibration Verification (ICV) | Initial calibration verification (same source as calibration) | Beginning of run, to verify calibration | ICP-OE 95-105% ; ICPMS 90-110% | Terminate analysis, restandardize
Secondary Calibration Verification (SCV) | Certified standard or standard from a different lot/source than calibration standards | Verify at least once per quarter | 90-110% recovery (%R) of “true value” | Terminate analysis, restandardize
Continuing Calibration Verification (CCV) | Approximate mid-range standard made from working standards stock | Every 10 unknowns and at end of run | 90-110% “true” value | Re-analyze immediately (once). Then: Restart standardize and run all samples following last “acceptable” CCV. If recovery >110% and <120% and all associated samples (same analyte) show non-detected, no action required.
Spectral/Mass Interference Check for ICP-OE & ICP-MS (ICSA / ICSAB) | Analyze spectral interferents at high concentrations alone (ICSA) and with other target analytes (ICSAB) to evaluate the effect on analyte recovery | Once per analytical run, prior to sample analyses | ICSA: ± 20% ‘true value’ ICSAB: ± 20% ‘true value’ or < ±PQL whichever is greater | Evaluate the sample analyte levels. Rerun ICSA/AB or use an alternate wavelength. If interferent levels in the samples don’t approach ICSA interferent levels, no action is required. If necessary, recalculate IECs & rerun associated samples
Calibration Blanks, Initial & Continuing (ICB & CCB) | Blank with same reagents as working standards; i.e. zero point on curve | Beginning, end, and after each ICV/CCV during analytical run | ≤ ±PQL | Re-analyze immediately once. If still unacceptable, termninate analysis & restandardize. Rerun all samples analyzed after last “acceptable” blank. Evaluate interferent level(s) vs samples, use prof judgement for addit'l required sample reruns.
Preparation Blank (PB) | Digested or prepared blank processed identical to samples. Aliquot of clean water prepared using same reagents/volumes as unknown samples. | Once per preparation batch/per matrix, or at 5% frequency, whichever is greatest | ≤ ±PQL | PB > PQL: Redigest all samples >MDL and <10x PB value PB < -PQL: Re-calibrate and re-analyze all associated samples
Matrix Spike (MS) | Unknown sample (NOT a field blank) fortified at approximately 10-100x MDL for each target analyte. High concentration samples (spike ~25% sample target analyte concentration), no calculation is required | 1 per 10 unknowns per matrix, whichever is greatest (One PB Spike per PB) | Spike recovered at: 70-130% (ICP & MS) | Compose 1 post-digest spike (PS) and retest, note in the narrative. (Analyze original sample with PS) Evaluate duplicate reproducibility. Compare results to LFB/PBS for similar trends. If no similar trends observed, assume a matrix effect. Qualify co
Lab Fortified Blank (LFB or BS) | Spike of reagent blank at same level as MS (analyze/prep identical to samples) | Recommend: once/run | 85-115%R of expected (for target analytes) | Used for comparison to Matrix Spike. If MS/MSD in-control no corrective action necessary.
Standard Reference Material (SRM) Lab Control Sample (LCS) | For solid & liquid digested samples. A known of similar matrix prepared the same as unknown samples. | 1 per prep batch or one per matrix, whichever is greater. | Ae: 80-120%R of “true” published limits SRM varies by manufacturer default 80-120% | Recalibrate & reanalyze. If still unacceptable, check for corresponding high or low results in pre-digest spikes, if similar, redigest all associated samples
Serial Dilution (L.) | Sample analyzed at 5x the reported analysis. (for matrix effect evaluation) Applies to analytes >50x MDL (in the original analyzed solution) | 1 per 20 unknown | Diluted value 90-110% of original analysis. | Concentrations compared/reported from the analyzed solution only. Check IECs and re-analyze. May re-analyze both sample and ‘L’ at a higher dilution. Use professional judgement, and discuss outliers in the narrative.
Detection Limit Standard (CRLCRA) | Low level standard (:3-5x MDL concentration. Applies to all target analytes except Al, Ca, Fe, Mg, Na, & K | Once per analytical batch prior to unknowns | 50-150%R for Sb, Pb, and TI 70-130%R for other target analytes*. | 1. Rerun 2. If all associated samples >CCV for outlier analytic, no action required. 3. Correct instrument’s sens. problem or else need to restandardize and raise reporting limits *
Internal Standard (IS) | IS standard solution added to all samples, blanks, and standards. | All samples and standards corrected for IS response. | 60% - 125%R of IS associated with target analyte(s) for ICPMS | [IS recovery determined versus calibration blank response.]
ICP-OE IS | IS standard solution added to all samples, blanks, and standards. | All samples and standards corrected for IS response. | 80-120% for ICP-OE | Dilute sample by 2, re-analyze. Continue to dilute until IS %R acceptable.
### Table B.5-2: QA/QC Calculation Algorithms

<table>
<thead>
<tr>
<th>Statistical QC Parameter Evaluated</th>
<th>Acronym</th>
<th>Analyses Applied to</th>
<th>Calculation Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Recovery</td>
<td>%R</td>
<td>Spike recovery determinations</td>
<td>%R = (((Cₐ - Sₐ) ÷ Sₐ) x 100)</td>
</tr>
<tr>
<td>Percent Recovery</td>
<td>%R</td>
<td>ICV/CCV, ICSAB, LCS</td>
<td>%R = (Aₜ ÷ T) x100</td>
</tr>
<tr>
<td>Relative Percent Difference</td>
<td>RPD</td>
<td>Variance between duplicates</td>
<td>RPD = (((C - Cₖ) / ((C + Cₖ) ÷ 2)) x 100)</td>
</tr>
<tr>
<td>Percent Difference</td>
<td>%D</td>
<td>Serial dilution variance</td>
<td>%D = (((C - Cₘ) / C) x 100)</td>
</tr>
</tbody>
</table>

**Notes:**

- C = Sample extract concentration
- Cₐ = Sample extract, spiked concentration
- Sₐ = Spike amount added
- T = True (possibly certified) amount in standard solution
- Cₖ = Duplicate sample concentration
- Cₘ = Sample extract concentration, dilution factor corrected.
- Aₜ = Analyzed concentration for the known standard.

*Hardness = (Ca, mg/L)*2.497 + (Mg, mg/L)*4.118*
Figures
Figure A.6-1
Standard Mine
Surface Water
Sample Locations - 2017

Map Date: April 18, 2017

Data Sources:
Map Projection: UTM Zone 13N, WGS84, Meters

Note:
One site (L3-1) had no locational information at the time this map was produced.
Appendix A

Standard Operating Procedures
SOP Description

This Standard Operating Procedure (SOP) describes the process to be followed by TechLaw Holdings and Subsidiary Companies (TechLaw Holdings) staff when acquiring analytical support. All requests for analytical services are to be arranged through the Laboratory Assistance Team (LAT) Coordinator, or alternatively through a LAT member (see Attachment A for a list of approved LAT members). This SOP is to be followed by the TechLaw Holdings Project Manager (PM), or designee, when completing and submitting the Analytical Support Request Form (ASRF) (see Attachment B), and after the sampling event is completed by submitting copies of the chain-of-custody (COC) forms to the LAT and forwarding invoices to the project files. A LAT member checklist is provided in Attachment D, and a TechLaw Holdings Project Manager Checklist is provided in Attachment E.

This SOP is also to be followed by the LAT Coordinator and assigned LAT members when processing the ASRF, selecting a laboratory, and reviewing data packages and invoices.

General Procedures

Related SOPs

This SOP is to be used in conjunction with other applicable SOPs found in the following SOP categories:

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Category Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>General Procedures</td>
</tr>
<tr>
<td>02</td>
<td>Field Procedures</td>
</tr>
<tr>
<td>03</td>
<td>Field Documentation Procedures</td>
</tr>
<tr>
<td>04</td>
<td>Packaging and Shipping Procedures</td>
</tr>
<tr>
<td>05</td>
<td>Field Equipment Operation and Maintenance Procedures</td>
</tr>
</tbody>
</table>
Field Procedures – Page 2 of 7

Analytical Support and Laboratory Selection

Procedures for Submitting and Processing the Form

An analytical support request must be submitted to the assigned LAT member at least five business days prior to the sampling event to avoid additional charges for rush shipping of any necessary supplies. The request should be submitted as a completed ASRF (see Attachment B). Note that either this form or an email containing the same information will be considered an ASRF. If supplies are not required from the laboratory, the ASRF may be submitted three business days prior to the sampling event. If shorter turnaround time is required, every effort will be made by the LAT to process the request.

The assigned LAT member will ensure that all necessary information is included in the ASRF and make the necessary arrangements with the laboratory (e.g., request delivery of glassware or other sample collection media and equipment). The assigned LAT member will procure sample containers on an as-needed basis, as indicated on the ASRF.

Upon completion of the ASRF by the assigned LAT member, a copy is uploaded to the project folder under LAT on TechLaw Holdings’ SharePoint Site. All samples must be sent to a TechLaw Holdings-approved laboratory. The laboratory is selected on the ability to perform the requested analysis, availability of laboratory space, and analysis cost. The LAT member must send the winning bid to the TechLaw Holdings PM for approval prior to shipment of samples to the laboratory (approval can be received formally in writing or via e-mail). In cases of emergency responses or expedited requests for analytical services (e.g., within 24 hours), TechLaw Holdings PM approval will be obtained as soon as possible. This documented approval will be uploaded to the project folder under LAT on SharePoint. A Work Authorization
(Attachment C) is submitted to the selected laboratory by the assigned LAT member prior to sampling activities. The Work Authorization is also e-mailed to TechLaw Holdings contracting staff for generation of a purchase order (PO). A copy of the finalized Work Authorization is placed in the project folder under LAT on SharePoint.

In cases where the sampling work is in the initial stages of being bid, an ASRF is not required; however, the LAT member must make sure that all information required from the request for proposal (RFP) is obtained by the PM prior to providing costs (i.e., requirements for certifications, such as State, DoD, etc., as well as EDD requirements).

**Procedures for Completing the Form**

The ASRF (see Attachment B) must contain complete sampling and analytical information. This information shall include the following:

- Project number (billing code) and project manager name
- Site name and location
- Date(s) of sampling event
- Required turnaround time
- Type of data package (i.e., Level II, III or IV, requirements for summary forms)
- Special considerations, if any
- For the table: sample matrix, number of field samples, parameter (i.e., the appropriate analytical method numbers), required detection limits, and the numbers of quality control (QC) samples (i.e., field duplicates, trip blanks, field blanks, and matrix spike/matrix spike duplicates [MS/MSD]).

**Procedures for Changes**

If changes occur in the number of samples or type of sampling methods during the field activities, the project manager will notify the LAT member by email.
Procedures After Sampling Event Completion

COC Forms

Within one week of shipment of samples (within 24 hours ideally), the laboratory must send copies of all COC forms to the assigned LAT member. Scanned copies are acceptable. The LAT member should do a cursory review of the COC forms to ensure the information contained therein is consistent with the ASRF.

Data Package Review and Delivery

The laboratory sends all data packages directly to the assigned LAT member who performs a preliminary review to ensure that the laboratory has submitted the requested information. This review shall be performed within approximately 1 day of receipt. Each data package is evaluated by the assigned LAT member for the following criteria ONLY:

- Laboratory reports address methods specified on COCs
- Requested results present for all samples
- Appropriate level data package provided
- Data received within requested turnaround time

Upon completion of this review, the original data package is forwarded to the PM unless the PM specifically requests otherwise.

Invoices

The laboratory sends all invoices to the assigned LAT member. Upon receipt of the invoice, it is reviewed for agreement with the Work Authorization and project sampling documentation. Upon confirmation (within approximately 24 hours of receipt), the LAT member will forward the invoice to TechLaw Holdings Accounts Payable and send a copy to the TechLaw Holdings PM.
Communication with the Laboratories

A member of the LAT, preferably the assigned LAT member, is to participate in all communications with laboratories. This is to ensure that all procedures required under the laboratory agreements and the TechLaw Holdings Quality Management Plan (QMP) are met. The LAT member will notify the laboratory of any unusual situations, including the expected presence of high concentrations of contaminants at the site.

Obtaining New Laboratories

All samples must be sent to a TechLaw Holdings-approved laboratory. Names of approved laboratories may be obtained from the LAT Coordinator. Only senior members of the LAT, with the concurrence of the TechLaw Holdings Quality Assurance Director (QAD), may approve a new laboratory; this approval is conditional upon examination of laboratory-specific documentation. Necessary documentation consists of a laboratory quality assurance (QA) plan (must include a description and number of instruments, staff resumes and a summary of QA/QC procedures), current accreditation certification if routine analyses are being conducted (including updates when they become available), SOPs, method detection limits (MDLs), quantitation limits, proficiency examination (PE) sample results, and pricing.

An onsite laboratory audit may also be performed by the TechLaw Holdings LAT. A laboratory audit will be performed at the discretion of the LAT Coordinator and TechLaw Holdings QAD. The laboratory audit checklist is included as Attachment F to this SOP. Note that the laboratory audit checklist is based on International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) 17025, second edition, dated May 15, 2005.

After a laboratory has been approved by the LAT, a Laboratory Agreement shall be arranged by the TechLaw Holdings Contracts Administrator working in conjunction with the senior LAT member responsible for assessing the laboratory’s qualifications. Only after these procedures have been completed may a new laboratory be used for analytical services.

The laboratory list is reviewed and updated biennially. If a problem is encountered with an approved laboratory, its approval status will be reviewed at that time (i.e., more frequently). LAT laboratories are contacted to obtain any updated laboratory documentation and pricing during the biennial review.
Health and Safety

Not applicable

QA/QC

None at this time

Comments/Notes

Under no circumstances is it acceptable to provide the laboratory with the name, location or other identifying information for the site (this includes listing facility information on the COC). Facility initials, TechLaw Holdings project number, or other identifier should be used that will not reveal facility information to the laboratory, but will be evident to TechLaw Holdings employees involved with the project. If the laboratory becomes aware of the site name, the LAT member should inform the TechLaw Holdings Conflict of Interest (COI) Officer immediately. The COI Officer will ensure that the laboratory does not have a COI and will post documentation of this confirmation to the LAT project files on SharePoint.

The time required to arrange analytical services and process data packages and invoices will be charged to the appropriate project.

Attachments

Attachment A – Approved LAT Members

Attachment B – Analytical Support Request Form

Attachment C – Laboratory Work Authorization (generic)

Attachment D – LAT Member Checklist

Attachment E – TechLaw Holdings Project Manager Checklist

Attachment F – Laboratory Audit Checklist
References


TechLaw Holdings Approved LAT Members

**LAT Coordinator:** Jim Burden  
536 South Clark Street, Suite 734  
Chicago, IL 60605  
(312) 353-2964  
(312) 877-0048 (mobile)

**LAT Members:**

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<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
| Ms. Nikki Thomsen (Backup LAT Coordinator) | 600 12th Street., Suite 110, Golden, CO 80401 | (303) 552-5809  
(303) 746-7647 (mobile) |
| Ms. Rachel Ireland        | 7 Technology Drive, Unit 202, North Chelmsford, MA 01863 | (978) 275-9749  
(617) 283-1332 (mobile) |
| Mr. Eric Middleditch      | 600 12th Street., Suite 110, Golden, CO 80401 | (303) 586-4822  
(720) 364-7899 (mobile) |
| Mr. Bruce Fritz (TLI Solutions only) | 112 N. Rubey Drive, Suite 210, Golden, CO 80401 | (303) 416-6295  
(720) 292-0659 (mobile) |
| Mr. Gene Nance (START Region 3 only) | 5455 County Road 2, Chesapeake, OH 45619 | (740) 867-0968  
(304) 830-1442 (mobile) |
| Mr. Scott Walker (ESAT Region 8 only) | 16194 W. 45th Dr., Golden, CO 80403 | (303) 312-7726  
(303) 453-9018 (mobile) |
| Mr. Doug Kent (ESAT Region 8 only) | 16194 W. 45th Dr., Golden, CO 80403 | (303) 312-7725  
(303) 489-0793 (mobile) |
| Mr. Nathan DelHierro (ESAT Region 8 only) | 16194 W. 45th Dr., Golden, CO 80403 | (303) 312-7790  
(720) 695-6304 (mobile) |
If none of the above LAT Members are available, and an urgent laboratory need/data issue arises, please contact:

Mr. Bill Fear
600 12th Street, Suite 110
Golden, CO 80401
(303) 586-4572
(303) 204-4540 (mobile)

Mr. David Dobb
7411 Beach Drive East
Port Orchard, WA 98366
(360) 871-8750
(360) 337-0625 (mobile)

TechLaw Holdings COI Officer:  Ms. Judy Manley
14500 Avion Parkway, Suite 300
Chantilly, VA 20151
(703) 818-3233
(703) 209-5187 (mobile)
ANALYTICAL SUPPORT REQUEST FORM

Project Number (Bill Code): ____________________
TechLaw Holdings Project Manager: _________________
Site Name and Location: ______________________________________________
Site Code (identifier)*: ________________________________________________
*Site Code should not reveal the site name or location and will be the only identifier used in communication with the laboratory (including COCs) to prevent COI issues
Example: Site Name and Location: Buckeye Products in Adrian, Michigan
Site Code: BAM (used the first letter of facility name, city, and state)
Date(s) of Sampling Event: ____________________________________________
Glassware: Date Needed:  ____________________   Location:  _____________________________
Turnaround Time (circle one): Standard (21 days) / Rush-_____ days (extra charge)
Data Package: Level IV  (full "CLP-like")  /  Other (Level II or III)____________________
Electronic Date Deliverable?    Yes / No   Format (i.e., Excel):  _______________________
Special Considerations:
• Are any special certifications required?
• Are there minimum volume or filter requirements?
• Is there a specific QAPP requirement?
• Are high concentrations expected?
• Are verbal or preliminary results required?

PLEASE ATTACH A TABLE OF THE APPLICABLE SCREENING LEVELS FOR ALL COMPOUNDS TO BE ANALYZED. The LAT staff will use this information to verify that the laboratory reporting limits will meet the specified screening levels.

<table>
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<tr>
<th>Matrix 1</th>
<th>Number of field samples</th>
<th>Parameter (method #’s)2</th>
<th>Required Reporting Limits</th>
<th>Number of field duplicates</th>
<th>Number of trip blanks</th>
<th>Number of field blanks</th>
<th>Number MS/MSD</th>
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</table>

1 Be specific (i.e., surface H2O, liquid fuel, slag; not just solid/water).
2. Be specific; if split sampling, attach applicable MDLs, action levels, methodologies, etc., from facility work plan. For metals, please specify which compound list should be utilized: RCRA 8, priority pollutants, Target Analyte List.

Note: Target Analyte List compounds will be utilized, unless otherwise specified by the Project Manager.

TechLaw Holdings Project Manager Signature: _______________________ Date: ______________

LAT Signature: _______________________ Date: ______________
LABORATORY ANALYTICAL WORK AUTHORIZATION

Date:

To: Contact
   Laboratory
   Address
   Address
   Phone
   Email

From: [LAT Member], LAT Representative
   Address
   Address
   Phone
   Email

Re: EPA Prime Contract XXXXX
   TechLaw Holdings Laboratory Agreement
   Task Order Authorization Number: XXXX
   Site Code (identifier): XXX
   Project Code: [Insert billing code]

This document authorizes work on the subject Contract as outlined in the attached Scope of Work and Pricing quotation (Attachment A). The expenditure limits on the Contract are XXXXX for work performed through (insert date). If it is anticipated that these funding limitations will be exceeded in performance of this work, you must notify us in a timely manner. Failure to notify and negotiate additional funding will result in forfeiture of costs incurred in excess of the funding limitations. Invoices should be sent to the Laboratory Assistance Team (LAT) representative noted above.

Please acknowledge your acceptance of work by signing in the space provided on this Laboratory Analytical Work Authorization Form, and return the signed form to [TechLaw Holdings Contracting Staff (insert email address)] and [LAT Member (insert email address)]. By acceptance of this Work Authorization, the Laboratory confirms that: no known personal or organizational conflict of interest exists; best efforts will be employed to conduct the work specified to the satisfaction of TechLaw Holdings representatives; all terms and conditions of the Agreement
identified and the Scope of Work and Pricing document will be met in performance of the work specified herein.

**Authorized Signatures:**

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<thead>
<tr>
<th>TechLaw Holdings</th>
<th>Laboratory Name</th>
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<td>Name:</td>
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<td>Title:</td>
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LAT Member Checklist

1. If a TechLaw Holdings Project Manager (PM) contacts you regarding laboratory procurement, please ask them to fill out the Analytical Support Request Form (ASRF) in Attachment B of SOP 02-06-XX (current version) or send an email providing all information contained in this form, if they have not already done so. Upload completed form to the project file on SharePoint.
   a. Be sure to ask if there are any reporting limit requirements, and verify with the laboratory that they can achieve such requirements
2. Contact three TechLaw Holdings Approved Laboratories to obtain price quotes and to ensure they have capacity to analyze the samples within the requested turnaround time.
   a. If a specialized analysis is required and is not performed by a TechLaw Holdings Approved Laboratory, another laboratory may be used upon consultation with the LAT Coordinator.
3. Select the laboratory based on lowest pricing and ability to perform the requested analyses.
4. Send the winning laboratory bid to the TechLaw Holdings PM and request approval.
5. Upload TechLaw Holdings PM approval documentation to SharePoint.
6. Fill out the Work Authorization Form in Appendix C of SOP 02-06-XX (current version), convert it to a PDF file, and attach the analytical quote to end of the PDF. Submit the form to the selected laboratory via e-mail (copy TechLaw Holdings Contracting Staff). TechLaw Holdings Contracting Staff will email the LAT member the purchase order (PO) associated with the analytical request.
7. Check the appropriate laboratory folder under LAT on SharePoint to ensure we have the SOP for the methods requested for the project. If these are not available already on SharePoint, request a copy of the SOP from the lab and upload to the laboratory folder on SharePoint.
8. Create a folder for your project under LAT > Project Files.
9. Update the Project Tracking spreadsheet under LAT > Project Tracking and ensure justification for laboratory selection is included in the Comments column.
10. Upon submission to the laboratory, upload a copy of the Work Authorization Form (unsigned by lab) to LAT > Project Files > Project Name.
11. Once a signed copy of the Work Authorization Form is received from laboratory, upload to LAT > Project Files > Project Name.
12. Confirm with laboratory when/where to send bottleware.
13. Inform the laboratory when to expect samples (it is also a good idea to remind them one day before they will receive samples).
14. Ensure the laboratory submits a copy of the COC to you to confirm that samples submitted are consistent with the ASRF and for verification of invoicing/sample data.
15. Upon receipt of the analytical data, review for the following:
   a. Laboratory reports address methods specified on COCs
b. Requested results present for all samples submitted to the lab

c. Appropriate level data package provided

d. Data received within the requested turnaround time

e. Scan through the laboratory case narrative for any major issues that would result in rejection of data.

16. If the items above are acceptable, approve invoice by signing, dating, and adding the proper PO number (including line item number) and forward to TechLaw Holdings Accounts Payable at ap@techlawholdings.com (copy the TechLaw Holdings PM).

17. Ask the TechLaw Holdings PM where the data should be sent, and send it out as soon as possible. If electronic data is available, you may upload a copy to the project folder under LAT > Project Files.
TechLaw Holdings Project Manager Checklist for LAT

1. Fill out the Analytical Support Request Form (ASRF) in Attachment B of SOP 02-06-07 and send an email to the LAT providing all information contained in this form.
2. Notify LAT member of any changes in schedule/requirements as soon as possible.
3. Inform LAT member where to send data upon receipt.

LAT members will:
- Procure laboratories
- Order bottleware, preservatives, and laboratory-grade water for blanks (if requested to do so)
- Handle all communication with the laboratory
- Add another laboratory to the TechLaw Holdings Approved Lab List only if required by the project (i.e., 24-hour turnaround for an emergency response) and current approved laboratories cannot fulfill the project requirements. Note: Additional time will be required to obtain the necessary information and add the laboratory to the approved list.

LAT members do NOT:
- Verify reporting limits if no requirements have been provided by the TechLaw Holdings Project Manager
- Perform data validation (unless qualified and asked to do so)
- Coordinate a data validator (unless asked to do so and authorized hours are provided)
LABORATORY AUDIT CHECKLIST

Laboratory On-Site Visits
LABORATORY AUDIT CHECKLIST
Section A - Overview

There are several purposes for making on-site visits to analytical laboratories. The most common purposes are:

1. Prior to award of a contract or delivery of samples, a client visits the laboratory to verify that the laboratory has the capability to perform the needed work. The areas for which capability must be judged are:
   
   • Physical facility – adequate work space, adequate and appropriate air handling, adequate storage space.
   
   • Equipment – all equipment (instrumentation, reagents, glassware, etc.) needed to do the job at the needed frequency.
   
   • Personnel – trained, experienced personnel who meet the clients’ requirements.
   
   • Standard Operating Procedures (SOPs) – written procedures must be in place (and updated when changes to “modus operandi” are made) for all operations of the laboratory so that consistency and continuity are maintained where appropriate.
   
   • Quality Assurance (QA) Program – includes all aspects of EPA’s “Good Automated Laboratory Practices” (GALP) Guidance.
   
   • Appropriate evidentiary procedures, chain-of-custody (COC) documentation, and security systems must be in place.

2. Post contract award or after sample delivery by a client (at intervals determined appropriate by the client), the laboratory can be visited to verify that the capabilities evaluated in Number one (1) still exist, or improvements cited as needed or deficiencies cited as requiring correction in Number one (1) have occurred.

3. Problem resolution visits – When problems are noted by the client (e.g., performance evaluation samples not analyzed acceptably, lateness, non-compliance with contract requirements, etc.), laboratories can be visited to isolate problem areas and identify where corrective action must be taken by laboratory management.

4. Unannounced visits – To verify that the laboratory follows procedures and maintains systems per the client’s requirements, even when the client’s visit is not expected.

5. Unannounced visits – When there is reason to believe a laboratory may be involved in improper practices (e.g., data falsification/alteration), a client may want a “surprise” visit. This visit should focus an audit on the area perceived to be vulnerable.

6. Routine – Even when a laboratory is performing well, a client presence to show interest (and maybe a “pat on the back”) is important every other year if possible.
As we look at the cited purposes, we should take the opportunity to identify what we really need to do during an on-site visit to meet our needs. We should minimize the universe of possible targets for evaluation and focus on what is important.

We should recognize that the capability to meet our needs (produce our required product) may come in many forms, and a stereotyped approach on our part is unreasonable and unnecessary. If we accept this premise, we go a long way towards minimizing our efforts in auditing the laboratory and opening the door to innovation and creativity on the part of our laboratories that may save time and money and may produce a better product.

Since the first two types (and sometimes Number 6) of on-site visits are the most common and involve looking at the same things (which are primarily amenable to a checklist approach), the first effort at a new design of an on-site visit will consist of an appropriate checklist.

It is important to note that a checklist only meets part of our needs: one-on-one conversations with laboratory personnel who will perform our work should occur to make sure they understand our requirements, follow their SOPs, are properly trained, etc.

Proposed checklists for Evidentiary and Technical on-site visits (audits) are in the following sections of this Laboratory Audit Checklist. They are designed so one auditor can perform the full gamut of evaluation in one swing through a laboratory. The auditor should become familiar with the checklists prior to an audit so that all necessary checks can be made in one location in a laboratory at one time.

These checklists are not contract specific. They can be used for non-CLP and CLP because they do not demand conformance, only observance of what is in place. The auditor is responsible for determining if the laboratory appears to meet the requirements of the client (which in the case of CLP labs, is the SOW).

The auditor should only evaluate the laboratory according to the items that the client considers relevant to meet needs (for CLP contracts, this is all items). Judgment should be used when determining what items are relevant to meet needs.
LABORATORY AUDIT CHECKLIST
Section B - General

This section must be completed for every on-site laboratory audit

Laboratory Name: _____________________________________________
Address: ___________________________________________________

Date of on-site visit: ________________________________

General Information

1. Audit Staff
   Name: ____________________________
   Phone: ____________________________
   E-mail: ____________________________

2. Management Staff
   Name: ____________________________
   Title: ____________________________
   Phone: ____________________________
   E-mail: ____________________________

3. Quality Assurance Officer
   Name: ____________________________
   Phone: ____________________________
   E-mail: ____________________________

4. State the reason for the on-site visit (refer to Items 1-6 in Section A - Overview):

   ___________________________________________________________
   ___________________________________________________________
   ___________________________________________________________

5. Type of Evaluation
   Q Evidentiary  Q Organics  Q Inorganics  Q Asbestos

   Note: If you are performing an Evidentiary audit, do not complete the Organics, Inorganics or Asbestos checklists. If you are performing an Organics, Inorganics, and/or Asbestos audit, do not complete the Evidentiary checklist.
LABORATORY AUDIT CHECKLIST
Section C - Evidentiary Procedures Evaluation Checklist

Instructions: Complete this section for Evidentiary audits only. Do not complete this section if you are performing an Organics, Inorganics and/or Asbestos audit.

Place an "X" beside each checklist item that represents a nonconformity. Place a "C" beside each item on which you are commenting for other reasons. Record the item number and written nonconformity explanation and/or comment on the comment sheet(s) at the end of this section. Write "N/A" beside any item that is not applicable to the current audit. Write "OK" beside all other items you observed or verified as compliant.

Personnel Interviewed:

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<th>Title/Department</th>
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I. Sample Receipt

1. The laboratory has a designated sample custodian and alternate for each shift.
   - Names:
     - Sample Custodians
     - Alternates

2. SOPs for sample receipt are in place and readily available.

3. SOPs for sample receipt are followed by laboratory personnel.

4. The sample receipt area is secured against non-authorized personnel.

5. The sample custodian verifies the following:
   - Condition of shipping cooler
   - Presence or absence of custody seals
   - Condition of custody seals, when present
   - Custody seal numbers, when present
   - Presence or absence of COC records
   - Presence or absence of airbill stickers
   - Airbill or airbill sticker number
   - Presence or absence of sample tags
i. Sample tag numbers
j. Condition of sample containers
k. Discrepancies in any information recorded on COC records, client requests, airbills, sample containers, etc.
l. Documentation of hand deliveries
m. Problems encountered

Obtain examples of all forms used during sample receipt.

II. Sample Identification

6. The laboratory has a unique sample identification system (i.e., vs. using client sample ID numbers).

   a. The number is assigned upon receipt. If no, when?

   b. If yes, the numbers are cross referenced to client numbers in a log.

7. The system clearly applies to samples, extracts, digestates, etc.

8. SOPs are readily available for sample identification.

9. SOPs for sample identification are followed by laboratory personnel.

Obtain example of laboratory's sample ID system (e.g., example sample number with cross reference).

III. Sample Storage and Tracking

10. Sample (extracts, etc.) storage areas are secured and access to samples (extracts, etc.) is available only to authorized personnel.

11. Samples (extracts, etc.) are logged in/out of storage area(s) when accessed.

12. Samples (extracts, etc.) are tracked throughout analytical process (e.g., a traveler sheet).

13. SOPs for storage and tracking of samples (extracts, etc.) are readily available.

14. SOPs for storage and tracking are followed by laboratory personnel.

Obtain examples of all forms/documents used for storage and tracking records.

IV. Document Review

15. Evaluate documents with the following in mind:

   a. Activities (e.g., GC/MS-VOA, ICP-metals) are identified on all analysis documents.

   b. Titles are on all documents.

   c. Columns are labeled with headers.

   d. Reviewers' signatures are identified when applicable.

   e. The laboratory's name is on all documents.
f. All entries are fully dated (day, month, year).

g. Entries are signed by the person responsible for performing and recording activities.

h. All logbook and other document entries are in ink.

i. Error correction protocol is followed (single line through area to be corrected and corrector's initials - no "white out").

j. Pages in bound and unbound logbooks are sequentially numbered.

k. Logbook entries are in chronological order.

l. Inserted information taped into logbooks is signed and dated when activity is performed.

m. Unused portions of documents are lined out.

16. Documents provide a complete record of activities observed by the evaluator.

17. Instrument run logs are maintained to enable a reconstruction of the run sequence on an instrument.

18. Records of failed runs are maintained.

19. Disposal/depletion of samples (extracts, etc.) is documented.

20. For data transferred electronically within the laboratory, a hardcopy is printed and retained in a client/case file.

21. If data is transferred electronically, the following information recorded:
   a. Person responsible for electronic data transfer.
   b. Date of electronic transfer.
   c. Person to whom data was electronically transferred.
   d. Status of electronically transferred data (e.g., draft, final, etc.).
   e. Numerical identifier assigned to electronic data transfer.

22. SOPs are readily available for electronic data transfer.

23. SOPs are followed by laboratory personnel for electronic data transfer.

V. Confidential Information

24. If the laboratory receives confidential information/documents, there is a system set up to maintain that confidentiality, including for data generated on associated samples.

VI. Case (Client's Designated Group of Samples) File Organization and Assembly

Names:
Document Control Officer Alternate

25. Case documents are maintained in a secure area.

26. Shipments of deliverables to clients are documented.
27. The recipient is identified.
28. Deliverables are sealed with custody seals.
29. Custody seals are signed and dated.
30. The document control officer assembles and cross checks information to assure that data on each case file is consistent and complete.

VII. Security of the Facility

31. Visitors are required to sign in.
32. Visitors are required to display distinct badges/ID.
33. All doors to outside lock except to the reception area.
34. Access to laboratory and data reduction/report preparation areas is limited to authorized personnel.
## COMMENTS AND NONCONFORMITIES
### Section C - Evidentiary Procedures Evaluation Checklist

**Instructions:** Use this sheet to document comments or nonconformities. For each, identify the appropriate item number from the checklist. Identify comments with a "C" and nonconformities with an "X." If additional space is needed, make copies of this page (or use additional blank sheets).

<table>
<thead>
<tr>
<th>Item No.</th>
<th>C or X</th>
<th>Comments and/or Nonconformities</th>
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LABORATORY AUDIT CHECKLIST
Section D - Organics Technical Procedures Evaluation Checklist

Instructions: Place an "X" beside each checklist item that represents a nonconformity. Place a "C" beside each item on which you are commenting for other reasons. Record the item number and written nonconformity explanation and/or comment on the comment sheet(s) at the end of this section. Write "N/A" beside any item that is not applicable to the current audit. Write "OK" beside all other items you observed or verified as compliant.

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</table>

I. Sample Receipt

1. The laboratory has a designated sample custodian and alternate for each shift.

   Names:
   Sample Custodians  Alternates
   __________________________  __________________________
   __________________________  __________________________
   __________________________  __________________________

2. SOPs for sample receipt are in place and readily available.
3. SOPs for sample receipt are followed by laboratory personnel.
4. The sample receipt area is secured against non-authorized personnel.

5. The sample custodian verifies the following:
   a. Condition of shipping cooler
   b. Presence or absence of custody seals
   c. Condition of custody seals, when present
   d. Custody seal numbers, when present
   e. Presence or absence of COC records
   f. Presence or absence of airbill stickers
   g. Airbill or airbill sticker number
   h. Presence or absence of sample tags
   i. Sample tag numbers
   j. Condition of sample containers
k. Discrepancies in any information recorded on COC records, client requests, airbills, sample containers, etc.

l. Documentation of hand deliveries

m. Problems encountered

Obtain examples of all forms used during sample receipt.

II. Sample Identification

6. The laboratory has a unique sample identification system (i.e., vs. using client sample ID numbers).

   a. The number is assigned upon receipt. If no, when?

   b. If yes, the numbers are cross referenced to client numbers in a log.

7. The system clearly applies to samples, extracts, digestates, etc.

8. SOPs are readily available for sample identification.

9. SOPs for sample identification are followed by laboratory personnel.

Obtain example of laboratory's sample ID system (e.g., example sample number with cross reference).

III. Sample Storage and Tracking

10. Sample (extracts, etc.) storage areas are secured and access to samples (extracts, etc.) is available only to authorized personnel.

11. Samples (extracts, etc.) are logged in/out of storage area(s) when accessed.

12. Samples (extracts, etc.) are tracked throughout analytical process (e.g., a traveler sheet).

13. SOPs for storage and tracking of samples (extracts, etc.) are readily available.

14. SOPs for storage and tracking are followed by laboratory personnel.

Obtain examples of all forms/documents used for storage and tracking records.

IV. Sample Receipt and Storage Area

15. Sample shipping coolers are opened in a contamination-free area (e.g., fume hood or vented area).

16. Adequate facilities are provided for the cold storage of samples and unused samples for 60 days after data submission.

   a. The temperature of the cold storage is recorded daily in a logbook.

   b. Temperature excursions are noted and appropriate actions are taken when required.

17. Volatile samples are stored separately from semi-volatile samples and extracts.
18. Sample extracts are properly stored (2-6°C, separate) and easy to locate by reference to a logbook.

V. Sample Preparation Area

19. The laboratory is maintained in a clean and organized manner appropriate for trace level analyses (contamination free).

20. The laboratory appears to have adequate work space (6 linear feet of unencumbered bench top per analyst).

21. The laboratory benches are made of suitable chemically resistant materials.

22. Sufficient functional hoods are available.

23. Documented organic free water (for organics standards, blanks, dilutions) is available.

24. Analytical balances are located away from drafts and areas subject to rapid temperature changes.

25. Sample preparation SOPs are readily available.

26. Sample preparation SOPs are followed by laboratory personnel.

27. Glassware preparation/cleaning SOPs are readily available.

28. Glassware preparation/cleaning SOPs are followed by laboratory personnel.

29. All required sample preparation equipment is available.

a. Sonicator
   
   Make
   Model
   Backup (Y/N)

b. GPC
   
   Make
   Model
   Backup (Y/N)

c. GPC UV Detector
   
   Make
   Model

d. GPC logs indicate that corrective actions are taken when there is a problem with calibration.

e. The number of continuous liquid/liquid extractors: ____________
30. Analysts record bench data in a neat and accurate manner.
31. Analysts record the lot number of solvents, spiking solutions, etc. on bench sheets.
32. There is evidence of a secondary review of all documents and logbooks by someone other than the person generating the documents.
33. Review the following procedures for oven drying:
   a. Temperatures in the drying ovens are verified against NIST traceable thermometers.
   b. Ovens have temperature logbooks.
   c. "In" and "Out" drying times are recorded.

VI. Standards Preparation and Storage
34. SOPs for standards preparation are readily available.
35. SOPs for standards preparation are followed by laboratory personnel.
36. Reagent grade or higher purity chemicals are used to prepare standards.
37. Standards are properly labeled with concentrations, date of preparation, expiration date, and/or traceable reference code number.
38. Spiking/calibration standards preparation and tracking logbooks for:
   a. VOCs
   b. SVOCs
39. Logbook numbers and series of stock solutions and reagents are recorded.
40. For commercially prepared standard mixes, appropriate documentation is available (Manufacturer's Certificate of Analysis).

VII. Analytical Instrumentation and Analyses-Specific Items
List the following for each instrument:

<table>
<thead>
<tr>
<th>Type</th>
<th>ID Number</th>
<th>Manufacturer/Model</th>
<th>Software</th>
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</table>
41. The manufacturer's operating manuals are readily available.

42. The laboratory has service contracts for each instrument.

43. The laboratory has extensive replacement parts available.

44. A permanent service record is maintained for each instrument.

45. The laboratory uses a recent mass spectral library.

46. Magnetic tape storage of GC/MS electronic data:
   a. Raw data, including quantitative output files and libraries, are archived on magnetic tape.
   b. A log of raw data contents of tapes is maintained.

47. For VOA analyses:
   a. Equipment is available for heated purge and trap for low level soil analysis.
   b. VOA holding blanks results are available.

48. The instrument operator can show from the run log that corrective actions were taken for:
   a. Re-analysis when internal standard areas are out of control.
   b. Dilutions when calibration range is exceeded.
   c. Blanks when previous sample showed saturation.

49. SOPs for analyses and logbook completion are readily available.

50. SOPs for analyses and logbook completion are followed by laboratory personnel.

51. There is evidence of a secondary review of all documents and logbooks by someone other than the person generating the documents.

VIII. Data Handling and Review (GALP)

52. Data calculations are spot checked by a second person.

53. Records indicate appropriate corrective action when QC criteria are not met.

54. Supervisory personnel review the data and QC results prior to submission.

55. SOPs for data handling/review are readily available.

56. SOPs for data handling/review are followed by laboratory personnel.

57. Deliverables are checked for completeness and accuracy (hardcopy and electronic), including resubmittals.

58. The monthly data entry error rate is determined and recorded.

59. When changes to deliverables are required, the changes are properly documented (rationale, review, initials, etc.).

60. User manuals and operations/systems manuals are available.
61. A written software test and acceptance plan is available for installation of system changes.

IX. Quality Assurance Internal Inspections

62. There is an internal QA inspection procedure.

63. The QA Officer reports to senior management.

64. Corrective actions are documented.

65. Internal audits are performed.

List the types of internal audits


66. The following QA records are kept:

a. PE sample results

b. Records of recoveries (extractions, etc.)

c. Training/experience records of personnel

d. Method sensitivities

e. Control charts for QC purposes

f. Other ____________________________

67. A Quality Assurance Manual (or equivalent) is available.

68. The Quality Manual addresses the following:

a. Organization and philosophy

b. Facilities and equipment

c. Document control

d. Analytical methodology

e. Data generation

f. QA

g. QC

h. Corporate ethics policy

X. Standard Operating Procedures

69. In addition to the previously mentioned SOPs, the following SOPs are also available:

a. Calibration (balance)

b. Calibration (instruments)

c. Maintenance activities (for each system)

d. Data reduction procedures
e. Documentation policy/procedures
f. Data validation/self-inspection procedures

XI. Organization and Personnel Summary

70. Personnel assigned to this project have the appropriate educational background to accomplish the objectives of the program (see Key Personnel list below).

71. The laboratory is adequately staffed to meet project commitments in a timely manner.

72. All key personnel were present and available for the audit.

XII. Laboratory Capacity

73. The laboratory has sufficient analytical instrumentation to analyze the needed number of samples.

74. The laboratory has sufficient technical and administrative personnel to deliver the number of needed analyses.

75. The laboratory has an adequate sample and data tracking system to handle the needed number of analyses.

XIII. Key Personnel List (not previously identified)

Organics Supervisor
Name: ______________________
Generally requires Bachelor's degree in chemistry/science/engineering + 3 years organics experience, including 1 year supervisory experience.

Sample Preparation Laboratory Supervisor
Name: ______________________
Generally requires Bachelor's degree in chemistry/science/engineering + 3 years organics experience, including 1 year supervisory experience. Three additional years experience may substitute for education requirement.

GC/MS Operator
Name: ______________________
Generally requires Bachelor's degree in chemistry/science/engineering + 1 year GC/MS/DS experience or 3 years GC/MS/DS experience and GC/MS interpretation. Three additional years experience may substitute for education requirement.

GC/EC Operator
Name: ______________________
Generally requires Bachelor's degree in chemistry/science/engineering + 1 year GC/EC experience or 3 years GC/EC experience and GC/EC interpretation. Three additional years experience may substitute for education requirement.
Extraction Concentration Expert

Name: __________________________
Generally requires high school diploma and college level course in general chemistry + 1 year experience in extraction/concentration.

Backup Chemist (Technical Staff Redundancy)

Name: __________________________
Generally requires Bachelor's degree in chemistry/science/engineering + 1 year lab experience in GC/MS operation, MS interpretation, extraction, and pesticide analysis.
# COMMENTS AND NONCONFORMITIES

Section D - Organics Technical Procedures Evaluation Checklist

**Instructions:** Use this sheet to document comments or nonconformities. For each, identify the appropriate item number from the checklist. Identify comments with a "C" and nonconformities with an "X." If additional space is needed, make copies of this page (or use additional blank sheets).

<table>
<thead>
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<th>Item No.</th>
<th>C or X</th>
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## COMMENTS AND NONCONFORMITIES (Cont.)

Section D - Organics Technical Procedures Evaluation Checklist

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LABORATORY AUDIT CHECKLIST
Section E - Inorganics Technical Procedures Evaluation Checklist

Instructions: Place an "X" beside each checklist item that represents a nonconformity. Place a "C" beside each item on which you are commenting for other reasons. Record the item number and written nonconformity explanation and/or comment on the comment sheet(s) at the end of this section. Write "N/A" beside any item that is not applicable to the current audit. Write "OK" beside all other items you observed or verified as compliant.

Personnel Interviewed:

<table>
<thead>
<tr>
<th>Name</th>
<th>Title/Department</th>
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I. Sample Receipt

1. The laboratory has a designated sample custodian and alternate for each shift.

   Names:
   Sample Custodians          Alternates

   __________________________  __________________________

2. SOPs for sample receipt are in place and readily available.

3. SOPs for sample receipt are followed by laboratory personnel.

4. The sample receipt area is secured against non-authorized personnel.

5. The sample custodian verifies the following:
   a. Condition of shipping cooler
   b. Presence or absence of custody seals
   c. Condition of custody seals, when present
   d. Custody seal numbers, when present
   e. Presence or absence of COC records
   f. Presence or absence of airbill stickers
   g. Airbill or airbill sticker number
   h. Presence or absence of sample tags
   i. Sample tag numbers
   j. Condition of sample containers
k. Discrepancies in any information recorded on COC records, client requests, airbills, sample containers, etc.

l. Documentation of hand deliveries

m. Problems encountered

Obtain examples of all forms used during sample receipt.

II. Sample Identification

6. The laboratory has a unique sample identification system (i.e., vs. using client sample ID numbers).

   a. The number is assigned upon receipt. If no, when?

   b. If yes, the numbers are cross referenced to client numbers in a log.

7. The system clearly applies to samples, extracts, digestates, etc.

8. SOPs are readily available for sample identification.

9. SOPs for sample identification are followed by laboratory personnel.

Obtain example of laboratory's sample ID system (e.g., example sample number with cross reference).

III. Sample Storage and Tracking

10. Sample (extracts, etc.) storage areas are secured and access to samples (extracts, etc.) is available only to authorized personnel.

11. Samples (extracts, etc.) are logged in/out of storage area(s) when accessed.

12. Samples (extracts, etc.) are tracked throughout analytical process (e.g., a traveler sheet).

13. SOPs for storage and tracking of samples (extracts, etc.) are readily available.

14. SOPs for storage and tracking are followed by laboratory personnel.

Obtain examples of all forms/documents used for storage and tracking records.

IV. Sample Receipt and Storage Area

15. Sample shipping coolers are opened in a contamination-free area (e.g., fume hood or vented area).

16. Adequate facilities are provided for the cold storage of samples and unused samples for 60 days after data submission.

   a. The temperature of the cold storage is recorded daily in a logbook.

   b. Temperature excursions are noted and appropriate actions are taken when required.

17. The pH of the samples is recorded and available for data review.
V. Sample Preparation Area

18. The laboratory is maintained in a clean and organized manner appropriate for trace level analyses (contamination free).

19. The laboratory appears to have adequate work space (6 linear feet of unencumbered bench top per analyst).

20. The laboratory benches are made of suitable chemically resistant materials.

21. Sufficient functional hoods are available.

22. Documented organic free water (for organics standards, blanks, dilutions) is available.

23. Analytical balances are located away from drafts and areas subject to rapid temperature changes.

   a. Balances are checked routinely (e.g., before each weighing session) with the appropriate range of weights and the results are recorded in a permanent logbook.

   b. Routine weights are checked against Class S (or equivalent) weights at least once a month and the results are recorded in a permanent logbook.

   c. Balances have been calibrated within one year by a certified technician.

   d. Data generated from balances are electronically transferred or manually entered into LIMS.

24. Sample preparation SOPs are readily available.

25. Sample preparation SOPs are followed by laboratory personnel.

26. Glassware preparation/cleaning SOPs are readily available.

27. Glassware preparation/cleaning SOPs are followed by laboratory personnel.

28. If microwave digestion is used, adequate microwave ovens (programmable power setting up to 600 watts) are available.

29. Analysts record bench data in a neat and accurate manner.

30. Analysts record the lot number of solvents, spiking solutions, etc. on bench sheets.

31. There is evidence of a secondary review of all documents and logbooks by someone other than the person generating the documents.

32 Review the following procedures for oven drying:

   a. Temperatures in the drying ovens are verified against NIST traceable thermometers.

   b. Ovens have temperature logbooks.

   c. "In" and "Out" drying times are recorded.
VI. Standards Preparation and Storage

33. SOPs for standards preparation are readily available.

34. SOPs for standards preparation are followed by laboratory personnel.

35. Reagent grade or higher purity chemicals are used to prepare standards.

36. Standards are properly labeled with concentrations, date of preparation, expiration date, and/or traceable reference code number.

37. Spiking/calibration standards preparation and tracking logbooks for:

   a. Inorganics
   b. Pesticides

38. Logbook numbers and series of stock solutions and reagents are recorded.

39. For commercially prepared standard mixes, appropriate documentation is available (Manufacturer's Certificate of Analysis).

40. If the laboratory uses automatic pipets for preparing standards, they are routinely calibrated.

VII. Analytical Instrumentation and Analyses-Specific Items

List the following for each instrument:

<table>
<thead>
<tr>
<th>Type</th>
<th>ID Number</th>
<th>Manufacturer/Model</th>
<th>Software</th>
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41. The manufacturer's operating manuals are readily available.

42. The laboratory has service contracts for each instrument.

43. SOPs for analyses and logbook completion are readily available.

44. SOPs for analyses and logbook completion are followed by laboratory personnel.

45. Stock standards are current.

46. Calibration standards are made from a ready-made stock standard.
   Manufacturer: __________________________________________
47. Calibration standards are prepared at least monthly.

48. If any instrument has been modified, list which one and how:

49. Explain how calibration intensity and gains are kept:

50. A mass flow controller is used.

51. Interference correction is done automatically and interelement correction factors are determined on at least an annual basis.

52. A permanent service record is maintained for each instrument.

53. There is evidence of a secondary review of all documents and logbooks by someone other than the person generating the documents.

54. For AA Spectrometer, element-specific SOPs which list instrument conditions, background corrections, and required instrument sensitivity are readily available and followed.

55. An autosampler is used.

56. List EPA or instrument manufacturer's matrix modifiers used:

   As
   Pb
   Se
   Tl

57. For Mercury Analyzer - Cold Vapor AAs, an absorbance record is kept to monitor sensitivity.

58. For Cyanide Distillation Apparatus, there is a stock cyanide standard from a commercial source. If no, the standard is made from KCN salt. The standard is titrated.

59. For Cyanide Distillation Apparatus, the titrimetric manual or semi-automated colorimetric method is used. Method: ________________________________

60. For Cyanide Distillation Apparatus, the pH of the samples is recorded and available for review.

61. For Cyanide Distillation Apparatus, samples are checked for the presence of sulfide and chlorine.
VIII. **Data Handling and Review (GALP)**

62. Data calculations are spot checked by a second person.

63. Records indicate appropriate corrective action when QC criteria are not met.

64. Supervisory personnel review the data and QC results prior to submission.

65. SOPs for data handling/review are readily available.

66. SOPs for data handling/review are followed by laboratory personnel.

67. Deliverables are checked for completeness and accuracy (hardcopy and electronic), including resubmittals.

68. The monthly data entry error rate is determined and recorded.

69. When changes to deliverables are required, the changes are properly documented (rationale, review, initials, etc.).

70. User manuals and operations/systems manuals are available.

71. A written software test and acceptance plan is available for installation of system changes.

IX. **Quality Assurance Internal Inspections**

72. There is an internal QA inspection procedure.

73. The QA Officer reports to senior management.

74. Corrective actions are documented.

75. Internal audits are performed.

List the types of internal audits

<table>
<thead>
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<th>Type of Internal Audit</th>
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76. The following QA records are kept:

a. PE sample results

b. Records of recoveries (ex extractions, etc.)

c. Training/experience records of personnel

d. Method sensitivities

e. Control charts for QC purposes

f. Other ______________________________________

77. A Quality Assurance Manual (or equivalent) is available.

78. The Quality Manual addresses the following:
a. Organization and philosophy
b. Facilities and equipment
c. Document control
d. Analytical methodology
e. Data generation
f. QA
g. QC
h. Corporate ethics policy

X. Standard Operating Procedures

79. In addition to the previously mentioned SOPs, the following SOPs are also available:

   a. Calibration (balance)
   b. Calibration (instruments)
   c. Maintenance activities (for each system)
   d. Data reduction procedures
   e. Documentation policy/procedures
   f. Data validation/self-inspection procedures

XI. Organization and Personnel Summary

80. Personnel assigned to this project have the appropriate educational background to accomplish the objectives of the program (see Key Personnel list below).

81. The laboratory is adequately staffed to meet project commitments in a timely manner.

82. All key personnel were present and available for the audit.

XII. Laboratory Capacity

83. The laboratory has sufficient analytical instrumentation to analyze the needed number of samples.

84. The laboratory has sufficient technical and administrative personnel to deliver the number of needed analyses.

85. The laboratory has an adequate sample and data tracking system to handle the needed number of analyses.

XIII. Key Personnel List (not previously identified)

Inorganics Supervisor

Name: ________________________________

Generally requires a BS or BA in science and 1 year related experience, including 1 year supervisory experience.
ICP/ICP-MS Operator

Name: __________________________

Generally requires a BS or BA in science and 1 year ICP experience. Three additional years experience may substitute for education requirement.

Lachat Operator

Name: __________________________

Generally requires a BS or BA in science and 1 year Lachat experience. Three additional years experience may substitute for education requirement.

AA/Mercury Operator

Name: __________________________

Generally requires a BS or BA in science and 1 year experience for each of the following AA techniques: flame, graphite furnace, and cold vapor. Three additional years experience may substitute for education requirement.

Inorganic Sample Preparation Specialist

Name: __________________________

Generally requires high school diploma and college level course in general chemistry + 1 year experience in extraction/concentration. An additional 6 months experience with microwave digestion is required if microwave technique is used.

Wet Chemistry Analyst

Name: __________________________

Generally requires a BS or BA in science and 1 year experience. Three additional years experience may substitute for education requirement.
### COMMENTS AND NONCONFORMITIES

**Section E - Inorganics Technical Procedures Evaluation Checklist**

**Instructions:** Use this sheet to document comments or nonconformities. For each, identify the appropriate item number from the checklist. Identify comments with a "C" and nonconformities with an "X." If additional space is needed, make copies of this page (or use additional blank sheets).

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## COMMENTS AND NONCONFORMITIES (Cont.)

### Section E - Inorganics Technical Procedures Evaluation Checklist

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LABORATORY AUDIT CHECKLIST
Section F - Asbestos Technical Procedures Evaluation Checklist

Instructions: Place an "X" beside each checklist item that represents a nonconformity. Place a "C" beside each item on which you are commenting for other reasons. Record the item number and written nonconformity explanation and/or comment on the comment sheet(s) at the end of this section. Write "N/A" beside any item that is not applicable to the current audit. Write "OK" beside all other items you observed or verified as compliant.

Personnel Interviewed:

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<th>Name</th>
<th>Title/Department</th>
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I. Sample Receipt

1. The laboratory has a designated sample custodian and alternate for each shift.

   Names:
   Sample Custodians          Alternates
   ___________________________  ___________________________
   ___________________________  ___________________________
   ___________________________  ___________________________

2. SOPs for sample receipt are in place and readily available.

3. SOPs for sample receipt are followed by laboratory personnel.

4. The sample receipt area is secured against non-authorized personnel.

5. The sample custodian verifies the following:
   a. Condition of shipping package
   b. Presence or absence of custody seals
   c. Condition of custody seals, when present
   d. Custody seal numbers, when present
   e. Presence or absence of COC records
   f. Presence or absence of airbill stickers
   g. Airbill or airbill sticker number
   h. Presence or absence of sample tags/labels
   i. Sample tag/labels numbers
   j. Condition of sample containers
k. Discrepancies in any information recorded on COC records, client requests, airbills, sample containers, etc.

l. Documentation of hand deliveries

m. Problems encountered

**Obtain examples of all forms used during sample receipt.**

### II. Sample Identification

6. The laboratory has a unique sample identification system (i.e., vs. using client sample ID numbers).

   a. The number is assigned upon receipt. If no, when?

   b. If yes, the numbers are cross referenced to client numbers in a log.

7. The system applies to all asbestos samples, including QC, PE and round robin samples.

8. SOPs are readily available for sample identification.

9. SOPs for sample identification are followed by laboratory personnel.

**Obtain example of laboratory's sample ID system (e.g., example sample number with cross reference).**

### III. Sample Storage and Tracking

10. Sample storage areas are secured and access to samples is available only to authorized personnel.

11. Samples are logged in/out of storage area(s) when accessed.

12. Samples are tracked throughout analytical process (e.g., a traveler sheet).

13. SOPs for storage and tracking of samples are readily available.

14. SOPs for storage and tracking are followed by laboratory personnel.

**Obtain examples of all forms/documents used for storage and tracking records.**

### IV. Sample Receipt and Storage Area

15. Sample shipping packages are opened in a contamination-free area (e.g., fume hood or vented area).

16. Adequate facilities are provided for the storage of samples and unused samples for 6 months after data submission.

### V. Sample Preparation Area

17. The laboratory is maintained in a clean and organized manner appropriate for trace level analyses (contamination free).
18. The laboratory appears to have adequate work space (6 linear feet of unencumbered bench top per analyst).

19. The laboratory benches are made of suitable chemically resistant materials.

20. Sufficient functional HEPA-filtered hoods are available.

21. Analytical balances are located away from drafts and areas subject to rapid temperature changes.

   a. Balances are checked routinely (e.g., before each weighing session) with the appropriate range of weights and the results are recorded in a permanent logbook.

   b. Routine weights are checked against Class S (or equivalent) weights at least once a month and the results are recorded in a permanent logbook.

   c. Balances have been calibrated within one year by a certified technician.

   d. Data generated from balances are electronically transferred or manually entered into LIMS.

22. Sample preparation SOPs are readily available.

23. Sample preparation SOPs are followed by laboratory personnel.

24. SOPs for sample preparation area decontamination are readily available.

25. SOPs for sample preparation area decontamination are followed by laboratory personnel.

26. Analysts record bench data in a neat and accurate manner.

27. Analysts record ID numbers of equipment and materials used (e.g., microscope, RI liquids, etc.) on bench sheets.

28. There is evidence of a secondary review of all documents and logbooks by someone other than the person generating the documents.

29. Air flow through the HEPA-filtered hoods is checked on a routine basis and results are documented in a logbook.

30. RI liquids are calibrated on a routine basis and results are documented in a logbook.

31. The HEPA-filtered hoods used for sample preparation are checked for contamination each time samples are prepared and results are documented in a logbook.

32. Corrective action procedures are in place if contamination is detected.

VI. Analytical Instrumentation and Analyses-Specific Items

List the following for all instrumentation/equipment used:

<table>
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<tr>
<th>Type</th>
<th>ID Number</th>
<th>Manufacturer/Model</th>
<th>Software</th>
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Page F3 of F8
33. The manufacturer's operating manuals are readily available.

34. The laboratory has service contracts for each instrument.

35. The laboratory has extensive replacement parts available.

36. A permanent service record is maintained for each instrument.

37. SOPs for analyses and logbook completion are readily available.

38. SOPs for analyses and logbook completion are followed by laboratory personnel.

39. There is evidence of a secondary review of all documents and logbooks by someone other than the person generating the documents.

VII. Data Handling and Review (GALP)

40. Data calculations are spot checked by a second person.

41. Records indicate appropriate corrective action when QC criteria are not met.

42. Supervisory personnel review the data and QC results prior to submission.

43. SOPs for data handling/review are readily available.

44. SOPs for data handling/review are followed by laboratory personnel.

45. Deliverables are checked for completeness and accuracy (hardcopy and electronic), including resubmittals.

46. The monthly data entry error rate is determined and recorded.

47. When changes to deliverables are required, the changes are properly documented (rationale, review, initials, etc.).

48. User manuals and operations/systems manuals are available.

49. A written software test and acceptance plan is available for installation of system changes.

VIII. Quality Assurance Internal Inspections

50. There is an internal QA inspection procedure.

51. The QA Officer reports to senior management.
52. Corrective actions are documented.

53. Internal audits are performed.

List the types of internal audits

________________________________________________________________________
________________________________________________________________________
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54. The following QA records are kept:

   a. PE sample results
   b. Round robin/interlab results
   c. Reference standards results
   d. Training/experience records of personnel
   e. Method sensitivities
   f. Control charts for QC purposes
   g. Other ________________________________

55. A Quality Assurance Manual (or equivalent) is available.

56. The Quality Manual addresses the following:

   a. Organization and philosophy
   b. Facilities and equipment
   c. Document control
   d. Analytical methodology
   e. Data generation
   f. QA
   g. QC
   h. Corporate ethics policy

IX. **Standard Operating Procedures**

57. In addition to the previously mentioned SOPs, the following SOPs are also available:

   a. Calibration (balance)
   b. Calibration (instruments)
   c. Maintenance activities (for each system)
   d. Data reduction procedures
   e. Documentation policy/procedures
   f. Data validation/self-inspection procedures
X.  Organization and Personnel Summary

58. Personnel assigned to this project have the appropriate educational background to accomplish the objectives of the program (see Key Personnel list below).

59. The laboratory is adequately staffed to meet project commitments in a timely manner.

60. All key personnel were present and available for the audit.

XI. Laboratory Capacity

61. The laboratory has sufficient analytical instrumentation to analyze the needed number of samples.

62. The laboratory has sufficient technical and administrative personnel to deliver the number of needed analyses.

63. The laboratory has an adequate sample and data tracking system to handle the needed number of analyses.

XII. Key Personnel List (not previously identified)

TEM Supervisor

Name: ____________________________

Generally requires a BA or BS in science + 3 years TEM analysis experience. Requires knowledge of statistics and extensive familiarity with the silicate minerals, as well as the following methods: ISO 10312, AHERA, EPA 100.2, and ASTM D5755.

PLM Supervisor

Name: ____________________________

Generally requires a BA or BS in science + 3 years PLM analysis experience. Requires knowledge of statistics and extensive training in optical mineralogy.

PCM Supervisor

Name: ____________________________

Generally requires a BA or BS in science + 3 years PCM analysis experience.

TEM/PLM/PCM Analyst

Name: ____________________________

Generally requires a BA or BS in science; however, three additional years laboratory experience may substitute for education requirement.
## Comments and Nonconformities

**Section F - Asbestos Technical Procedures Evaluation Checklist**

**Instructions:** Use this sheet to document comments or nonconformities. For each, identify the appropriate item number from the checklist. Identify comments with a "C" and nonconformities with an "X." If additional space is needed, make copies of this page (or use additional blank sheets).

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<td>4/22/2016</td>
<td>Revised to apply to TechLaw Holdings and Subsidiary Companies.</td>
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<td>2/3/2017</td>
<td>Minor changes to LAT Members and Appendix D</td>
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Surface Water Sampling

APPROVED:

[Signature] 06/04/12
ESAT Region 8 QA Coordinator

[Signature] 6/6/12
ESAT Region 8 Team Manager

[Signature] 7/10/12
EPA Task Order Project Officer

[Signature] 6/18/12
ESAT Region 8 Task Lead

DCN: EP8-7-7061

This document has been prepared for the Environmental Protection Agency by the TechLaw, Inc. ESAT Region 8 Team and is intended to provide documentation of administrative, analytical and quality control procedures used in the daily performance of EPA and ESAT support services.
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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to guide field personnel on general surface water sampling procedures. Not all situations are accounted for; therefore site reconnaissance is a key factor in determining sampling techniques that may be utilized. Always consult the site-specific Sampling and Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) before deployment to a surface water sampling event.

2.0 SCOPE AND APPLICABILITY

This SOP is applicable to the collection of representative liquid samples from streams, rivers, lakes, ponds, lagoons, and surface impoundments utilizing direct method sampling procedures. This method may be varied or changed as required, dependent upon site conditions, equipment limitations or other procedural limitations. These are the preferred methodologies and should be implemented as closely as possible. Any deviations from these procedures should be discussed with site managers in order to confirm that data objectives are being met. All procedures employed should be documented and associated with the final report. Mention of trade names or commercial products does not constitute TechLaw, Inc. endorsement or recommendation for use.

This SOP is to be used in conjunction with other relevant and applicable documents which may include:

- Water Quality Measurement Procedures
- Sample Preservation Procedures
- Sediment Sampling Procedures
- Pore Water Sampling Procedures
- Field Sampling Procedures

The following documentation should be included to assist in preparing for and conducting surface water sampling activities:

- Health and Safety Plan (HASP)
- Sampling and Analysis Plan (SAP)
- Quality Assurance Project Plan (QAPP)
- Any other site-specific planning documents

3.0 SUMMARY OF METHOD

This SOP is intended to provide guidance on collection of surface water. Sampling situations vary widely, therefore, no universal sampling procedure can be recommended. However, sampling of aqueous liquids from the above mentioned sources is generally accomplished through use of the direct method technique (filling sample containers directly from the source) and transfer devices (collecting the sample with a container and then transferring to another container). This allows for the collection of representative samples of surface water from streams, creeks, rivers, lakes, ponds, and other impoundments. Note that for certain types of sampling, transfer devices are not appropriate. Volatile Organic Analysis and Semi-Volatile Organic Analysis samples should always be sampled directly if possible. Also, proper decontamination or conditioning of transfer devices must occur in order to avoid cross-contamination.
4.0 ACRONYMS AND DEFINITIONS

°C Degrees Celsius
COC Chain of Custody
EPA United States Environmental Protection Agency
ESAT Environmental Services Assistance Team
EDI Equal Discharge Increment
EWI Equal Width Increment
GPS Global Positioning System
HASP Health and Safety Plan
HAZWOPER Hazardous Waste Operations and Emergency Response
HDPE High Density Polyethylene
LDPE Low Density Polyethylene
mL Milliliter
OSHA Occupational Health and Safety Administration
SAP Sampling and Analysis Plan
SOP Standard Operating Procedure
QAPP Quality Assurance Project Plan
QA/QC Quality Assurance/Quality Control
VCF Ventrical at Centroid of Flow

Equal Discharge Increment (EDI): A surface water sampling strategy that requires isokintetic water sampling from locations in a moving body of water that have the same discharge rate.

Equal Width Increment (EWI): A surface water sampling strategy that requires isokinetic water sampling from established equidistant intervals in a moving body of water.

Global Positioning System (GPS): A geospatial referencing tool that is used for mapping and identification.

Sampling and Analysis Plan (SAP): A site-specific document that details events to take place in the field.

Standard Operating Procedure (SOP): A set of written instructions that document a routine or repetitive activity followed by an organization (EPA, 2007).

Quality Assurance Project Plan (QAPP): A site-specific document that specifies quality assurance activities and data quality objectives.

Ventrical at Centroid of Flow (VCF): A sampling strategy similar to EDI sampling where only one location along a transect is used to collected the isokinetic water sample.

5.0 HEALTH AND SAFETY

When working with potentially hazardous materials or in hazardous situations, personnel must understand and comply with the site-specific SAP/QAPP and HASP before the sampling event begins. More specifically, when sampling streams or surface impoundments containing known or suspected hazardous substances, adequate personal protective equipment such as nitrile gloves, safety glasses,
and waders are necessary to prevent contact with contaminants during sampling. When entering a stream, hazardous situations may exist requiring the use of adequate personal safety equipment including personal floatation devices and non-slip footwear. When conducting sampling from a boat in an impoundment or flowing waters, appropriate boating safety procedures should be followed.

6.0 CAUTIONS

Only collect surface water samples if it can be done so safely. Many unsafe conditions exist on streams, rivers, ponds, and other surface water impoundments. Consult the site HASP before performing any sample collection.

7.0 INTERFERENCES

There are three primary interferences or potential problems with surface water sampling. These include cross-contamination of samples, improper sample collection, and improper sample preservation.

1. Cross-contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Refer to the Sampling Equipment Decontamination SOP #FLD-02.00.

2. Improper sample collection can involve disturbance of the stream substrate and/or sampling in an obviously disturbed area. To minimize potential for unrepresentative samples, consider sampling from downstream to upstream to avoid sampling where the substrate has been disturbed. Site sampling often involves multiple sampling procedures being deployed simultaneously. Therefore, well-organized team member coordination is essential to prevent improper sample collection.

3. Sample preservation is a critical component of sample collection. If the wrong preservative is used, the sample must be re-collected if possible. Improperly preserved samples cannot be analyzed. Refer to the Sample Preservation SOP #FLD-03.00 for proper field sample preservation guidelines.

8.0 PERSONNEL QUALIFICATIONS

Any personnel who are involved with field sampling activities must be cleared for health and safety. Clearance includes medical monitoring, respirator fit testing, and Occupational Health and Safety Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) 40-hour training. Personnel who will be collecting surface water samples should familiarize themselves with this and other pertinent SOPs including: Sample Equipment Decontamination SOP #FLD-02.00; Sample Preservation SOP #FLD-03.00; Water Quality Measurements with the In-Situ® Multi-Parameter Meter SOP #FLD-09.00; Sample Custody and Labeling SOP #FLD-11.00; and General Field Sampling Protocols SOP #FLD-12.00.
9.0 EQUIPMENT AND SUPPLIES

Equipment needed for collection of surface water samples may include:

**HASp Required Gear** - personal floatation device, waders/gloves, proper footwear, safety glasses, insulating clothing for cold water, etc.

**Mapping & Location Tools** - GPS units, site/local area maps, compass, tape measure, survey stakes, pin flags, camera, 2-way radios

**Documentation Supplies** - field log book, field data sheet, Chains of Custody (COCs), labels, clear tape, pens, permanent marker, waterproof paper

**Sampling Tools** - plastic or other appropriate composition transfer device, bucket, rinse bottles, purified water, paper towels, filtering equipment, vacuum pump tool, vacuum pump stand, preservative, Ziploc™ plastic bags, cooler(s), ice, thermometer, preservative waste containment

**Sample Containers** - High-density polyethylene/Low Density Polyethylene (HDPE/LDPE) or other appropriate composition containers.

See Table 9.0-1 for a detailed list of surface water sampling equipment.

10.0 STANDARDS AND REAGENTS

Reagents will be utilized for preservation of samples and for decontamination of sampling equipment (refer to SOP’s #FLD-02.00 and #FLD-03.00). The preservatives required are specified by the analysis to be performed and will be specified in the SAP/QAPP but usually include nitric acid (Total Recoverable and Dissolved Metals samples) and phosphoric acid (Dissolved and Total Organic Carbon samples). Field sampling personnel should also be aware of any special sampling considerations, contamination issues, and sample compositing and mixing methods that could affect the sampling efforts. Appropriate regional guidance and procedures should be consulted for detailed sample collection, preservation, handling and storing, equipment decontamination, and Quality Assurance/Quality Control (QA/QC) procedures. Field sampling personnel should preserve and immediately cool all water samples to 4 degrees Celsius (°C) (±2°C) upon collection and samples should remain <6°C until the time of analysis (do not freeze water samples).

11.0 PROCEDURES

11.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods required, and the types and amounts of equipment and supplies needed. Use the site-specific SAP/QAPP for guidance to determine which kind of samples need to be collected.

2. Obtain the necessary sampling and monitoring equipment and ensure it is in working order.

3. Decontaminate equipment according to the procedures outlined in SOP #FLD-02.00, or use triple rinsed, dedicated disposable sample containers (non-filtering and not pre-
4. Prepare scheduling and coordinate with staff, clients, and regulatory agencies where appropriate. It is also important to obtain site access agreements if sampling is to occur on private property.

5. Perform a general site survey prior to site entry in accordance with the site-specific HASP.

6. Use stakes, flagging, GPS markers, or photos to identify and mark all sampling locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

Generally, factors to consider in the selection of a device for sampling liquids in streams, rivers, lakes, ponds, lagoons, and surface impoundments are:

   a. Can the sample be collected directly from the source? (i.e. is a transfer device needed for sample collection?)
   
   b. What is the desired depth at which you wish to collect the sample?
   
   c. What is the overall depth and flow direction of river or stream?
   
   d. What type of analysis will be run (total recoverable metals, dissolved metals, alkalinity and anions, etc.)?

11.2 Sample Container Composition

A sample container should be selected based on analysis to be performed. A triple rinse should be performed on any sample container being used for direct sample collection. Filtered sample bottles or pre-preserved bottles should never be rinsed first.

11.3 Sample Collection

1. Direct collection is the optimal procedure for sample collection. After rinsing, the sample should be collected in a well-mixed area, as close to the middle of the stream as possible, in-between the streambed and the surface. The sample should be capped immediately.

2. Preserve the sample if appropriate. Refer to the site-specific SAP and SOP #FLD-03.00 for correct methods. The sample should be clearly labeled (and bagged in order to keep samples from the same location together) before being placed in a cooler on ice.

3. Record all pertinent site data (usually date, time, pH, conductance, dissolved oxygen, temperature, site ID, and anomalies) in the field logbook, field data sheets and/or sample container labels.

4. Complete the COC record. Refer to SOP #FLD-11.00 for guidelines on sample
custody and labeling documentation.

5. Attach custody seals to cooler prior to shipment where applicable. Refer to SOP #FLD-11.00 for guidelines on sample custody and labeling.

6. If a non-direct method was used for sampling (i.e. a bucket from a bridge or a dip sampler), decontaminate or condition all sampling equipment prior to the collection of additional samples with that sampling device as required by SOP #FLD 02.00. Sections 11.3.4 and 11.3.5 describe a few of the non-direct sampling methods that may be useful in Region 8.

7. If sampling on private property, sample receipts will be provided to property owners for all samples taken and removed from the property.

### 11.3.1 Direct Method

For streams, rivers, and lakes, the direct method may be utilized to collect water samples from the surface directly into the sample container. For shallow stream stations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector. Samples should be collected prior to all other activities as specified in the SAP/QAPP to avoid disturbing the substrate. Rinse the sample container three times (unless it’s filtered or pre-preserved) with site water before procuring a sample. When using the direct method, do not use pre-preserved sample bottles as the collection method may dilute the concentration of preservative necessary for proper sample preservation.

### 11.3.2 Dip Sampling

Dip sampling is useful in situations where a sample is to be recovered from an outfall pipe or from a bridge where direct access is limited. The long handle or rope on such a device allows access from a discrete location. Sampling procedures are as follows:

1. Assemble the device in accordance with the manufacturer's instructions.
2. Extend the device to the sample location and collect the sample by dipping the sampler into the water at the sampling location.
3. Triple rinse the sampler with the site water
4. Retrieve the sampler and transfer the sample to the appropriate (triple rinsed) sample container

### 11.3.3 Synoptic Sampling

Synoptic sampling is a strategy used for evaluating a surge of water as it moves downstream. In general, the flow rate should be determined before executing a synoptic sampling event. Flow measurements are used to calculate when a surge of water will pass by a certain point or sample location. Floating visual objects may also be used to
accurately determine when a surge of water passes by a sampling location. The synoptic sampling strategy is useful in determining where contaminants may be entering a watershed through seeps, fens, or other inflows that may not be visible. Below is a general guideline on synoptic sampling:

- Identify sample locations
- Conduct flow measurements; or test a floating object (ping pong ball, tangerine, etc.) to see if it will float through to the last sampling location (some objects may get caught in eddies or shallow areas)
- Calculate when the surge of water will pass through each sampling location
- Position sampling personnel or equipment where a sample can be captured at the required time
- Process samples

11.3.4 Large Stream or River Sampling

There are several techniques for sampling large rivers or streams. The most commonly used are Equal-Width Increment (EWI) sampling, Equal Discharge Increment (EDI) sampling, Single Vertical at Centroid of Flow sampling (VCF), dip sampling (section 11.3.2), direct method sampling (section 11.3.1), discrete sampling, and pump sampling (USGS, 2006). Below is a brief description of the sampling methods that have not yet been mentioned in this document:

**EWI Method** – A stream cross-section is divided into equal width intervals, and samples are collected by lowering and raising a sampler through the water column at the center of each interval. This produces a discharge weighted sample that is proportional to stream flow. This method cannot be used if the stream flow is less than what is required to fill the sampler during the isokintetic (constant rate) motion.

**EDI Method** – The objective of this method is to obtain a discharge weighted sample that represents the entire flow through a cross-section by obtaining a series of samples. For this method, the flow in the cross-section must be divided into points of equal discharge. Equal volume and depth integrated samples are collected at the center of the equal discharge interval along the cross-section. Flow measurements or historical data is necessary to determine interval number (usually more than 4, but less than 20) and location. This method may also require additional personnel to sample a large cross-section. If conducted properly, both the EWI and EDI methods should produce identical results.

**VCF Method** – This method is a simple version of the EDI method, but only one sample is collected at flow center (usually a smaller river or stream). This is to be used if the sample location is known to be homogenous and is warranted by the sampling plan objectives. Flow data should be obtained to determine where the flow center is located.

11.3.5 Shallow Stream and Still Water Sampling
Shallow streams and still water such as a pond are common locations to sample in Region 8. Below are three methods (in addition to ones mentioned above) that may be required.

**Discrete (point) Sampling** – This method is achieved by lowering a sample container to a specific depth in a body of water then opening and closing the container to obtain the sample.

**Pump Sampling** – This method is used to collect single point samples using a suction-lift or submersible pump. These are not used for collecting isokinetic samples (EWI, EDI, or VCF). Using the pump method is limited by electrical needs in remote areas. Always consult the SAP for sampling objective requirements.

**Syringe Sampling** – A 50 mL syringe can be used to collect sample from very shallow locations to avoid contact with substrate.

### 12.0 DATA RECORDS AND MANAGEMENT

Once collected, samples are preserved, labeled, and stored for transport. A COC must accompany all samples during transport and transfer between entities. Sample labels should contain the following information:

- Site Identification
- Date sampled
- Sampler initials
- Time
- Analysis to be performed

### 13.0 QUALITY CONTROL AND ASSURANCE

1. The following general QA procedures apply:

2. All data must be documented on field data sheets or within site logbooks.

3. In general, concurrent (duplicate) sample collection at a frequency of 10% is required for most sampling activities. Blanks at a frequency of one per day are also generally required. Consult the corresponding SAP/QAPP for specific QA/QC sampling frequency. Below is a list of typical QA/QC sample types and the inaccuracy they are intended to detect:

   - **Field blank** – checks cross-contamination during sample collection, preservation, and shipment as well as in the laboratory.
   - **Equipment blank** – equipment contamination due to inadequate decontamination procedures
   - **Temperature blank** – provides an accurate temperature measurement of field samples upon arrival to the laboratory and establishes whether the temperature range has been maintained while in transit
   - **Trip blank** – checks contamination of samples during handling, storage, and shipment from the field to the laboratory; carried through the same sampling and handling
protocols as field samples and placed in the cooler for the duration of the trip.

- **MS/MSD** – checks accuracy and precision of organic or inorganic analyses in specific sample matrices. They are collected from areas know or suspected to be contaminated.
- **Sequential replicates** – samples are pulled one after another to detect variability among field activities (collection, preservation, handling, etc.)
- **Split samples** – division of one sample into two, then submitting for identical analysis in order to detect variability in the process from collection to analysis
- **Concurrent or collocated replicate samples** (often referred to as “duplicate” samples) – two samples collected at the same location at the same time, intended to detect variability inherent in collection, processing, and handling procedures; Relative percent difference is usually calculated from these samples.

4. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer unless otherwise specified in the work plan or SAP/QAPP. Equipment calibration activities must be conducted and documented prior to sampling and/or operation of equipment.

5. Document any deviations from SOPs, work plan, SAP/QAPP, etc.

14.0 REFERENCES


## Table 9.0-1 Surface Water Sampling Equipment

<table>
<thead>
<tr>
<th>Category</th>
<th>Item</th>
<th>Use</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health and Safety</td>
<td>Gloves</td>
<td>Protection from absorption of contaminants</td>
<td>Nitrile or neoprene are recommended</td>
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<tr>
<td>Health and Safety</td>
<td>Waders</td>
<td>Slipcontaminant protection, warmth</td>
<td>Any type are acceptable</td>
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<td>Health and Safety</td>
<td>Safety Glasses</td>
<td>Eye protection</td>
<td>Sunglasses for UV protection</td>
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<td>Health and Safety</td>
<td>Layered Clothing</td>
<td>Protection from hypothermia</td>
<td>Polyester base layers only</td>
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<td>Mapping/Location</td>
<td>GPS unit</td>
<td>Sample station locating</td>
<td>Pre-loaded with site locations</td>
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<td>Mapping/Location</td>
<td>Maps</td>
<td>Location identification</td>
<td>Most current information required</td>
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<tr>
<td>Mapping/Location</td>
<td>Two-way radios</td>
<td>Communication</td>
<td>Extra batteries or charger required</td>
</tr>
<tr>
<td>Documentation</td>
<td>Field Logbook</td>
<td>Site data and conditions documentation</td>
<td>Waterproof pages</td>
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<td>Documentation</td>
<td>Field Data Sheets (waterproof)</td>
<td>Marsh McBirney Flows</td>
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<td>Documentation</td>
<td>Chain of Custody</td>
<td>Sample handling/identification</td>
<td>Generated using Scribe</td>
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<tr>
<td>Documentation</td>
<td>Labels</td>
<td>Sample identification</td>
<td>Generated using Scribe</td>
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<td>Documentation</td>
<td>Clear tape &amp; Scissors</td>
<td>Label protection</td>
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<td>Sampling Tools</td>
<td>Bucket/Transfer Device</td>
<td>Sample transfer (if required)</td>
<td>Decontaminated between samples</td>
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<td>Sampling Tools</td>
<td>Vacuum Pump</td>
<td>Dissolved sample processing</td>
<td></td>
</tr>
<tr>
<td>Sampling Tools</td>
<td>Vacuum Stand</td>
<td>Dissolved sample processing</td>
<td></td>
</tr>
<tr>
<td>Sampling Tools</td>
<td>Ziploc baggies</td>
<td>Sample containment</td>
<td></td>
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<tr>
<td>Sampling Tools</td>
<td>Water Chemistry meters</td>
<td>In-situ water quality data gathering</td>
<td>Temp, pH, dissolved oxygen, conductivity</td>
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<td>Sampling Tools</td>
<td>Flow measurement equipment</td>
<td>Flow measurements</td>
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<tr>
<td>Sampling Tools</td>
<td>Cooler</td>
<td>Sample containment</td>
<td>Samples to be kept at 4°C</td>
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<td>250 ml HDPE/LDPE</td>
<td>Total recoverable metals samples</td>
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<td>Sampling Containers</td>
<td>250 ml HDPE/LDPE filtered bottles</td>
<td>Dissolved Metals/ DOC samples</td>
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<td>Sampling Containers</td>
<td>500 ml HDPE/LDPE</td>
<td>Alkalinity+Anions samples</td>
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<td>Sampling Containers</td>
<td>VOA Vials</td>
<td>Volatile and Semi-Volatile organics analysis</td>
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<td>Reagents</td>
<td>Nitric Acid(HNO3) ampules</td>
<td>For preserving metals samples</td>
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<tr>
<td>Reagents</td>
<td>Phosphoric Acid (H3PO4) ampules</td>
<td>For preserving DOC samples</td>
<td></td>
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<tr>
<td>Reagents</td>
<td>Hydrochloric (HCl) Acid</td>
<td>For preserving VOA samples</td>
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<td>Reagents</td>
<td>CaCO3 Acid waste Containment</td>
<td>Ampule/acid waste disposal</td>
<td>Usually in a 1 liter cubitainer</td>
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<td>Reagents</td>
<td>pH and Conductivity standards</td>
<td>Calibration of water quality equipment</td>
<td>Quantity for each day of sampling</td>
</tr>
</tbody>
</table>
Sample Preservation

APPROVED:

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ESAT Region 8 QA Coordinator
04/04/12
Date

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ESAT Region 8 Team Manager
6/6/12
Date

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Date

DCN: EP8-7-7061

This document has been prepared for the Environmental Protection Agency by the TechLaw, Inc. ESAT Region 8 Team and is intended to provide documentation of administrative, analytical and quality control procedures used in the daily performance of EPA and ESAT support services.
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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide a standard approach for Environmental Protection Agency (EPA) and Environmental Services Assistance Team (ESAT) Region 8 personnel to preserve samples during field activities.

2.0 SCOPE AND APPLICATION

This SOP is specifically intended for application by EPA and ESAT personnel who conduct sample preservation in field work activities.

3.0 SUMMARY OF METHOD

For purposes of this SOP, proper sample preservation techniques and methods are reviewed. This SOP is based on industry standard instructions.

4.0 ACRONYMS AND DEFINITIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>ESAT</td>
<td>Environmental Services Assistance Team</td>
</tr>
<tr>
<td>DOC</td>
<td>Dissolved Organic Carbon</td>
</tr>
<tr>
<td>HASP</td>
<td>Health and Safety Plan</td>
</tr>
<tr>
<td>HAZWOPER</td>
<td>Hazardous Waste Operations and Emergency Response</td>
</tr>
<tr>
<td>MSDS</td>
<td>Material Safety Data Sheet</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
<tr>
<td>QAPP</td>
<td>Quality Assurance Project Plan</td>
</tr>
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<td>Sampling Analysis Plan</td>
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<td>Standard Operating Procedure</td>
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<td>EPA</td>
<td>United States Environmental Protection Agency</td>
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<td>Volatile Organic Analytes</td>
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</table>

Ampule: A small sealed vial which is used to preserve a sample usually nitric, phosphoric, hydrochloric, or sulfuric acid.

Health and Safety Plan (HASP): A site-specific document that outlines potential site hazards and hazard mitigation practices.

Material Safety Data Sheets (MSDS): A form with data regarding the properties of a particular substance.

Personal Protective Equipment (PPE): Refers to protective clothing, helmets, goggles, or other garment designed to protect the wearer’s body from injury by blunt impacts, electrical hazards, heat, chemicals, and infection, for job-related occupational safety and health purposes.

Quality Assurance Project Plan (QAPP): A site-specific document that specifies quality assurance activities and data quality objectives.
**Sampling and Analysis Plan (SAP):** A site-specific document that specifies events to take place in the field.

**Standard Operating Procedure (SOP):** A set of written instructions that document a routine or repetitive activity followed by an organization (EPA, 2007).

### 5.0 HEALTH AND SAFETY

The procedures outlined in this SOP have general health and safety issues associated with it. This includes the use of proper PPE when conducting sample preservation. The most important health and safety items while preserving samples are latex gloves to prevent skin contact and safety eyewear to protect from splash hazards. Always refer to the applicable HASP and MSDS any time field work or preservation activities are conducted.

### 6.0 EQUIPMENT

- Acid Ampules
- PPE (gloves, eye protection, coveralls)
- First-Aid kit
- Disposal equipment (ampoule waste container, garbage bags)
- Sample Filter equipment

### 7.0 SAMPLE PRESERVATION

Complete and unequivocal preservation of samples with total stability of every constituent maintained, regardless of the nature of the sample, can never be achieved. At best, preservation techniques can only minimize the chemical and biological changes that inevitably continue after the sample is removed from the parent source. Proper preservation methods, such as pH control, chemical addition, filtration, and refrigeration are intended to retard biological and chemical effects, reduce volatility of constituents, and limit absorption effects.

Because of the potential vulnerability samples may have to a number of influences, it is best that sample analyses occur as soon as possible after collection. However, since the majority of sampling events do not have on-site mobile laboratories, and travel time from the field to the laboratory may be multiple days, it is critical that effective sample preservation techniques are employed to ensure sample integrity.

### 7.1 Chemical Influences on Samples

Chemical changes to samples may result when physical conditions alter the chemical structure of the constituents. Many of the chemical processes that occur once a sample is taken will ultimately depend on the type and amount of sample taken, the medium to which the sample is housed, and the storage and transportation environment for that particular sample. Examples of chemical effects to samples might include metal cations precipitating as hydroxides or forming complexes with other constituents; cations or anions changing valence states under certain reducing or oxidizing conditions; or other constituents dissolving or volatilizing with the passage of time. Metal cations may also adsorb onto surfaces (glass, plastic, quartz, etc.), such as, iron and lead.
7.2 Biological Influences on Samples

Biological changes may occur when a sample changes the valence of an element or a radical to a different valence. Soluble constituents may be converted to organically bound materials in cell structures, or cell lysis may result in release of cellular material into solution. Nitrogen and phosphorus cycles are examples of biological influence on sample composition.

7.3 Sample Types to Preserve

Sample preservation mainly pertains to water samples (surface water, groundwater, pore water), but other sample types that might require preservation include sediment, macroinvertebrates, or waste rock. For all non-water based samples, the basic practice of storing and transporting in coolers with ice will suffice for a preservation method. However, be sure to consult with the analyzing laboratory with regard to any specific preservation requirements (for both water and non-water samples) before going into the field.

8.0 PRESERVATION PROCEDURES AND TECHNIQUES

Samples collected in the field are generally preserved by chilling or chemical treatment. It is important that the sample crew be knowledgeable of the following before and during the field event:

1. The required sample-designation code for each sample.
2. The sample requirements for filtration, chilling and chemical treatment.
3. The holding time restrictions required by the analyzing laboratory.

8.1 Water Sample Preservation

There are a number of things to consider when preparing for a water sampling event. Before field deployment, be sure to have all the equipment and supplies necessary to collect, preserve, store, and transport your samples in the proper way.

8.2 Meet Sample Volume Requirements

Collecting sufficient sample volume is critical. There must be sufficient physical sample volume for the analysis of all required parameters and completion of all QC determinations. The type of analytical procedure(s) to be performed will often dictate the sample volume to collect. It is extremely important that samplers refer to their specific SAP and QAPP to identify and collect the correct sample volume during each sampling event. Once the sample volume requirement is understood, the appropriate container size can be chosen to accommodate the sample.

8.3 Proper Preservation for Water Sample

Whether the preservation method is chilling or chemical treatment, the preservation specifics will vary based on the analysis. The variability involved in sample preservation can best be understood in the Preservation Requirement Tables (section 8.5.1 – 8.5.4). In these tables, you
will see how different analyses (physical, metals, organics, inorganics or non-metallics), dictate a different set of preservation requirements.

8.4 Preservation Methods

Each preservation method has specific standard procedures that need to be followed when preserving a sample.

8.4.1 Chemical Treatment

Chemicals used for sample preservation will depend on the target analyte (see section 8.5.1 – 8.5.4). For purposes of EPA Region 8 sampling, nitric acid (HNO₃), sulfuric acid (H₂SO₄), hydrochloric acid (HCl), and phosphoric acid (H₃PO₄) are most commonly used. It is important to wear appropriate PPE when involved in any part of the sample preservation process, especially in the chemical treatment process. An MSDS should be available for all preservatives to be used on site.

Preservation chemicals may be in the form of bulk liquid or ampoules.

Common chemical preservation in EPA Region 8 water sampling:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Chemical Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total and Dissolved Metals</td>
<td>Nitric Acid (HNO₃)</td>
</tr>
<tr>
<td>Semi-Volatile Organics</td>
<td>Hydrochloric Acid (HCl)</td>
</tr>
<tr>
<td>Dissolved Organic Carbon (DOC)</td>
<td>Phosphoric Acid (H₃PO₄)</td>
</tr>
<tr>
<td>Nutrients</td>
<td>Sulfuric Acid (H₂SO₄)</td>
</tr>
</tbody>
</table>

8.4.2 Using Preservation Ampules

Preservation chemicals, such as nitric acid (HNO₃), hydrochloric acid (HCl), and phosphoric acid (H₃PO₄), can come in the form of ampoules. Ampoules are small plastic or glass containers that hold an exact amount of a chemical in a liquid form. They are designed to be used once per sample.

When preparing to treat a sample with a chemical from an ampoule, first break the tip of the ampoule with two hands (while wearing proper PPE), and pour the liquid into the sample bottle. When all liquid has been removed from the ampoule, place the broken components of the glass ampoule into a specifically designated and labeled acid neutralization container that has a secure screw top. It is acceptable for one acid waste container to be used to neutralize all acids.
8.4.3 Using Bulk Concentrated Acid

Preservation acid can also come in the form of bulk concentrated acid, typically at a concentration level of 70%. When using bulk concentrated acid, a disposable pipet may be used to extract the necessary quantity from the parent vessel to then be released in the water sample. The pipet may be used multiple times if the same chemical is being transferred. Never cross-contaminate pipets with different chemicals or different samples.

8.4.4 Chilling

Chilling samples is almost always a part of the sample preservation process. Once a sample is collected (and potentially treated with chemicals) it is to be immediately packed in ice or placed in a refrigerator and maintained at a temperature of 4 degrees Celsius or less, without freezing, until analyzed. To avoid problems that can result from sample expansion, allow sufficient headspace in the sample bottle before chilling it (An exception to this method includes Volatile Organic Analytes (VOA). In the case of VOAs, do not leave head space in the sample bottle). If using glass bottles, use foam sleeves to protect them. Another method that can be used to avoid the potential of melting ice water seeping into sample bottles is the use of plastic bags to contain the samples. This method doubles as a way to group subsamples from the same sample location.

8.5 Preservation Requirement Tables

Preservation requirements for physical, metals, organics, and inorganic sample types can be understood in the following tables.

### 8.5.1 Physical Preservation Requirements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Volume (ml)</th>
<th>Container</th>
<th>Preservative</th>
<th>Holding Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>50</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius</td>
<td>48 Hours</td>
</tr>
<tr>
<td>Conductance</td>
<td>100</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius</td>
<td>28 Days</td>
</tr>
<tr>
<td>Hardness</td>
<td>100</td>
<td>Plastic or Glass</td>
<td>HNO₃ – pH below 2</td>
<td>6 Months</td>
</tr>
<tr>
<td>Odor</td>
<td>200</td>
<td>Glass</td>
<td>Cool, 4 Degrees Celsius</td>
<td>24 Hours</td>
</tr>
<tr>
<td>pH</td>
<td>25</td>
<td>Plastic or Glass</td>
<td>None required</td>
<td>Analyze Immediately</td>
</tr>
<tr>
<td>Temperature</td>
<td>1000</td>
<td>Plastic or Glass</td>
<td>None required</td>
<td>Analyze Immediately</td>
</tr>
<tr>
<td>Turbidity</td>
<td>100</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius</td>
<td>48 Hours</td>
</tr>
</tbody>
</table>
### 8.5.2 Metals Preservation Requirements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Volume (ml)</th>
<th>Container</th>
<th>Preservative</th>
<th>Holding Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved</td>
<td>250</td>
<td>Plastic* or Glass</td>
<td>Filter on site. HNO₃ – pH below 2</td>
<td>6 Months</td>
</tr>
<tr>
<td>Suspended</td>
<td>250</td>
<td>Plastic* or Glass</td>
<td>Filter on site. HNO₃ – pH below 2</td>
<td>6 Months</td>
</tr>
<tr>
<td>Total</td>
<td>500</td>
<td>Plastic* or Glass</td>
<td>HNO₃ – pH below 2</td>
<td>6 months</td>
</tr>
<tr>
<td>Dissolved (Mercury)</td>
<td>250</td>
<td>Plastic* or Glass</td>
<td>Filter on site. HNO₃ – pH below 2</td>
<td>28 Days</td>
</tr>
<tr>
<td>Total (Mercury)</td>
<td>250</td>
<td>Plastic* or Glass</td>
<td>HNO₃ – pH below 2</td>
<td>28 Days</td>
</tr>
</tbody>
</table>

*Polyethylene with a polypropylene cap (no liner) is preferred.

### 8.5.3 Organics Preservation Requirements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Volume (ml)</th>
<th>Container</th>
<th>Preservative</th>
<th>Holding Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD</td>
<td>1000</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius</td>
<td>48 Hours</td>
</tr>
<tr>
<td>COD</td>
<td>50</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius. H₂SO₄ – pH below 2</td>
<td>28 Days</td>
</tr>
<tr>
<td>DOC</td>
<td>500</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius. Add H₃PO₄.</td>
<td>28 Days</td>
</tr>
<tr>
<td>Oil &amp; Grease</td>
<td>1000</td>
<td>Glass only</td>
<td>Cool, 4 Degrees Celsius. H₂SO₄ – pH below 2</td>
<td>28 Days</td>
</tr>
<tr>
<td>Phenolics</td>
<td>500</td>
<td>Glass only</td>
<td>Cool, 4 Degrees Celsius. HNO₃ – pH below 2.</td>
<td>28 Days</td>
</tr>
<tr>
<td>Semi-volatiles</td>
<td>1000</td>
<td>Glass only</td>
<td>Cool, 4 Degrees Celsius</td>
<td>7-14 Days</td>
</tr>
</tbody>
</table>

### 8.5.4 Inorganics & Non-Metallics Preservation Requirements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Volume (ml)</th>
<th>Container</th>
<th>Preservative</th>
<th>Holding Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidity</td>
<td>100</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius</td>
<td>14 Days</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>250</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius</td>
<td>14 Days</td>
</tr>
<tr>
<td>Bromide</td>
<td>100</td>
<td>Plastic or Glass</td>
<td>None required</td>
<td>28 Days</td>
</tr>
<tr>
<td>Chloride</td>
<td>250</td>
<td>Plastic or Glass</td>
<td>None required</td>
<td>28 Days</td>
</tr>
<tr>
<td>Cyanides</td>
<td>500</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius. NaOH – pH over 12. 0.6g</td>
<td>14 Days (24 Hours when</td>
</tr>
<tr>
<td>Substance</td>
<td>Quantity</td>
<td>Container Type</td>
<td>Storage Conditions</td>
<td>Preservation Conditions</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------</td>
<td>----------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Fluoride</td>
<td>250</td>
<td>Plastic or Glass</td>
<td>None required</td>
<td>28 Days</td>
</tr>
<tr>
<td>Iodide</td>
<td>100</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius</td>
<td>24 Hours</td>
</tr>
<tr>
<td>Nitrogen (Ammonia)</td>
<td>500</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius. $\text{H}_2\text{SO}_4$ – pH below 2</td>
<td>28 Days</td>
</tr>
<tr>
<td>Nitrate &amp; Nitrite</td>
<td>250</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius. $\text{H}_2\text{SO}_4$ – pH below 2</td>
<td>28 Days</td>
</tr>
<tr>
<td>Nitrate</td>
<td>250</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius</td>
<td>48 Hours</td>
</tr>
<tr>
<td>Nitrite</td>
<td>250</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius</td>
<td>48 Hours</td>
</tr>
<tr>
<td>Sulfate</td>
<td>250</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius</td>
<td>28 Days</td>
</tr>
<tr>
<td>Sulfide</td>
<td>250</td>
<td>Plastic or Glass</td>
<td>Cool, 4 Degrees Celsius. Add 2 ml Zinc Acetate plus NaOH – pH over 9.</td>
<td>7 Days</td>
</tr>
</tbody>
</table>

9.0 PERSONNEL QUALIFICATIONS

All personnel who participate in field activities are required to obtain clearance in three mandatory health and safety programs: medical monitoring, respirator fit testing, and OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) 40-hour training. It is important for field personnel to familiarize themselves with other applicable SOP’s such as Sampling Equipment Decontamination SOP FLD 02.00, Surface Water Sampling SOP FLD 01.00, Sample Custody and Labeling SOP FLD 11.00, and General Field Sampling Protocols SOP FLD 12.00. In addition, any personnel who will participate in sample preservation activities must read, understand, and sign the site-specific HASP and SAP/QAPP.

10.0 REFERENCES


FlowTracker® Operation

APPROVED:

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ESAT Region 8 QA Coordinator

04/04/12
Date

[Signature]
ESAT Region 8 Team Manager

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7/10/12
Date

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ESAT Region 8 Task Lead

6/8/12
Date

DCN: EP8-7-7061

This document has been prepared for the Environmental Protection Agency by the TechLaw, Inc. ESAT Region 8 Team and is intended to provide documentation of administrative, analytical and quality control procedures used in the daily performance of EPA and ESAT support services.
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1.1.1 Figure 1.0-1 Flow Tracker with 2D Probe

1.1.2 Figure 1.0-2 2D Side Looking FlowTracker Probe and Sampling Volume

1.1.3 Figure 1.0-3 FlowTracker Probe and Sampling Volume

3.4.1 View Data File (System Functions <1>)

3.4.2 Check Recorder Status (System Functions <2>)

3.4.3 Format Recorder (System Functions <3>)

3.4.4 Temperature Data (System Functions <4>)

3.4.5 Battery Data (System Functions <5>)

3.4.6 Raw Velocity Data (System Functions <6>)

3.4.7 Automatic QC Test (System Functions <7>)

3.4.8 Show System Configuration (System Functions <8>)

3.4.9 Set System Clock (System Functions <9>)

3.5 QC Menu

4.1 Basic FlowTracker Data Collection Process - Using the Keypad Interface

5.1.1 Table 1-1 Quality Control (QC) Parameters

5.1.2 Table 1-2 QC Warning Messages

5.2 Signal-to-Noise Ratio (SNR)

5.3 Standard Error of Velocity (σV)

5.4 Boundary Adjustment (Boundary QC)

5.5 Spike Filtering

5.6 Velocity Angle

5.7 Maximum Section Discharge

5.8 Maximum Depth Change

5.9 Maximum Location Change

6.0 BATTERY POWER

7.0 HEALTH AND SAFETY

8.0 REFERENCES
1.0 GETTING STARTED: OPERATIONAL OVERVIEW

1.1 System Components

1.1.1 Figure 1.0-1  Flow Tracker with 2D Probe

Figure 1.0-1 shows the FlowTracker with all major components labeled.

- **Probe** – The probe contains the acoustic elements used to measure velocity. See the *FlowTracker Principles of Operation* for more information.

- **Probe cable** – The probe is mounted from a 200-cm (80-in) flexible cable. The probe cable is custom built and highly noise-sensitive; it must never be modified.
• **Handheld controller** – The handheld controller contains the processing electronics, batteries, keypad, and liquid crystal display (LCD) screen. The controller is designed to withstand temporary submersion, but is not intended for underwater operation.

• **Keypad** – The FlowTracker keypad is designed for quick, efficient entry of data collection parameters and commands.

• **LCD screen** – The LCD screen displays instructions and real-time data.

• **External power/communication connector** – A waterproof connector on the bottom of the handheld controller connects to an external power/communication cable. This is used to download data from the FlowTracker to a personal computer (PC). During data collection, the connector is sealed with a dummy cap. **WHEN TRANSPORTING FLOWTRACKER, THIS SCREWCAP MUST BE UNSCREWED.**

1.1.2 Figure 1.0-2 2D Side Looking FlowTracker Probe and Sampling Volume
2.0 ACRONYMS AND DEFINITIONS

°C Degrees Celcius
°F Degrees Fahrenheit
%Q Section Discharge
σV Standard error of velocity
Bnd Boundary QC variable
cfs Cubic feet per second
cm centimeter
dB Decibel
EPA United States Environmental Protection Agency
ESAT Environmental Services Assistance Team
ft feet
ft/s feet per second
Hz Hertz
in inch
LCD Liquid Crystal Display
m meter
mA Milliampere
MB Megabyte
m/s Meters per Second
PC Personal Computer
ppt parts per thousand
QC Quality Control
SNR Signal-to-Noise Ratio

Averaging time: The time (in seconds) in which the FlowTracker records data at each measurement location. This is a United States Geological Survey specified value of 40 seconds (Blanchard, 2004).

External control: The FlowTracker can be controlled by an external computer using the RS232 serial interface. This is accessed from the external power/communication connector. External control is used to download data from the internal recorder to a PC for further analysis, display, and archiving.

Keypad interface: The FlowTracker is controlled from the keypad on the handheld controller. The LCD screen is used to display command options and real-time data.

Measurement location: At each measurement location, the FlowTracker records one second velocity data for the specified averaging time, location, and water depth parameters (to document the data set), and a variety of statistical and quality control data.

Ping: A single estimate of the 2D or 3D water velocity.

Ping rate: The number of pings per second (Hz). The FlowTracker ping rate is 10 Hz.
Quality control data: In addition to velocity, the FlowTracker records several quality control (QC) parameters. These include signal-to-noise ratio (SNR), standard error of velocity, boundary adjustment, the number of spikes filtered from data, and velocity angle.

Salinity: Water salinity (in ppt) is a user-supplied value that is used for sound speed calculations. Note: If using the system in salt water, a zinc anode should be installed on the probe for corrosion protection.

Sample: A sample refers to the mean of 10 pings to produce a measurement of the 2D or 3D water velocity. A sample includes velocity and signal strength data. The FlowTracker records one sample per second.

Signal strength: This refers to the strength of the reflected acoustic signal. It is a function of the acoustic conditions of the water – primarily the amount and type of suspended material (scatterers) present. This is most commonly accessed as a SNR.

Signal-to-noise ratio (SNR): SNR is the ratio of the received acoustic signal strength to the ambient noise level. It is expressed in logarithmic units (dB) and is the most important QC data for the FlowTracker.

Sound speed: Speed of sound in water (in m/s) is used to convert the Doppler shift to velocity.

Temperature: Water temperature (°C) is measured by the internal temperature sensor. Temperature is used for sound speed calculations.

3.0 USING THE KEYPAD INTERFACE, MENUS AND DISPLAY

This section describes FlowTracker’s keypad interface, its menus, and the LCD display.

3.1 On/Off Switch

The On/Off power button is in the upper left hand corner of the keypad.

- To turn the system on, hold the button for one second until the LCD screen turns on.
- To turn the system off, hold the button for four seconds until the LCD screen resets.
- The FlowTracker draws a small amount of current when off (< 1 mA). If the system is to be left idle for a long period (more than 1 month), remove the batteries to prevent unnecessary draining and potential battery leakage.

NOTE: It is important to always return to the Main Menu before turning the system off to ensure all data has been properly saved.
3.2 Keypad

3.2.1 Figure 2.2-1 – FlowTracker Keypad

The function of each key is described below. Many keys have multiple functions.

Keys are described starting at the top left, moving right and down by rows.

Numbers (0-9)
- These keys are used to enter the following information when prompted by the FlowTracker: Menu selections, filename and extension, station location, depth, and other information.

Letters (A-Z)
- These keys are used to enter text for the filename and for comments in the file.
- Text entry is done in the same manner as for mobile phones. For file names, the text entry assumes numbers first (i.e., for “C” press 2 button four times 2 – A – B – C); for all other text, it assumes letters first (i.e., for “C” press 2 button three times A – B – C).

NOTE: It is important to always return to the Main Menu before turning the system off to ensure all data has been properly saved.

Backlight
This key turns the LCD backlight on/off.
- If the backlight is already on, it turns the backlight off.
- The backlight will turn off automatically after 1 minute.
- Minimize backlight use to increase battery life (the backlight doubles power consumption).
Delete
This key deletes the last character when entering parameters and is used for deleting stations from a file.

Measure
This key starts a measurement.
- It works identically in both Discharge and General data collection modes.
- It is only active if the FlowTracker is displaying the current station information screen. It is not active when displaying data from a previous measurement.

Corr. Factor
This key is used to enter special correction factors.
- The correction factor is used only in the Discharge mode.
- The correction factor is only used for certain situations.

Next Station
This key is used to view the next station when scrolling through completed stations.
- It works identically in both Discharge and General data collection modes.
- It is not active during a measurement, or from the time Measure is used to start a station until the time the last measurement for that station is completed.
- In Discharge mode, stations are sorted/displayed by location (regardless of the order in which they were collected).
- In General mode, stations are displayed in the order they were collected.

Set Velocity
This key is used to enter a user-estimated velocity. It is active only in Discharge mode for stations using the Input V method.

Set Location
This key is used to set the measurement location.
- It sets the location value (Loc) in Discharge mode.
- It sets both the location 1 and location 2 values (L1/L2) in General mode.
- It can be used either for the current station (before the measurement) or to edit data from a previous station.

LEW/REW
This key is used to specify the starting or ending edge of water.
- It is used only in the Discharge mode.
- LEW means “Left Edge of Water” and REW means “Right Edge of Water.” Your position is based on your body orientation when facing downstream.
Prev. Station
This key is used to view the previous station when scrolling through completed stations.
• It is not active during a measurement, or from the time Measure is used to start a station until the time the last measurement for that station is complete.
• In Discharge mode, stations are sorted/displayed by location (regardless of the order in which they were collected).
• In Discharge data collection mode, it will scroll past station 1 to the starting edge and starting gauge information.

Set Measurement Depth
This key is used to set the measurement depth.
• It sets the measurement depth value (MDep).
• It can be used either for the current station (before the measurement) or to edit data from a previous measurement.

Set Depth
This key is used to set the water depth (Dep). It can be used either for the current station (before the measurement) or to edit data from a previous station.

Set Ice Depth
This key is used to set the ice depth.
• It is active only in Discharge mode.
• It sets the ice depth value (Idep) as measured from the water surface to the bottom of the ice.
• It can be used either for the current station (before the measurement) or to edit data from a previous station.

QC Menu
This key is used to access the QC Menu during data collection.
• It works identically in both Discharge and General data collection modes.
• The QC Menu includes the following functions:
  • Input supplemental data (gauge height, rated flow, and comments).
  • Accessing QC Settings and Discharge Settings.
  • Changing the averaging time for each measurement.
  • Display raw velocity data.
  • Run the automatic QC test.

Method –
This key sets the method used for calculating the mean velocity in discharge measurements.
• It is active only in Discharge mode.
• This key changes the method to the previous method in the list.
Method +
This key sets the method used for calculating the mean velocity in discharge measurements.
- It is active only in Discharge mode.
- This key changes the method to the next method in the list.

Abort
This key is used to stop data collection during a measurement.
- After pressing Abort, it can take 1-2 seconds to stop data collection.
- The FlowTracker will display a message saying that data collection was aborted and how much data were collected.
- You can accept the aborted measurement (using the mean values of the data that were collected) or repeat the measurement.

Calculate Disch.
This key tells the FlowTracker to perform the final discharge calculation.
- It is active only in Discharge mode.
- It is active only when all stations have been completed and the End Section key has been pressed to enter the ending edge information.
- It is active only when the ending edge screen is displayed.
- The system will display a series of discharge screens showing final discharge data.

End Section
This key is used to end a series of measurements. In General mode, it ends the series of measurements and displays the summary of all data collected.
- It is active only when the current station (not yet measured) is displayed.
- It takes a few seconds for the file to be closed before displaying the summary.
- In Discharge mode, this indicates that all stations have been collected.
- It ends the section and displays the ending edge screen. After this data has been entered, the final discharge calculation can be done.
- It is active only when the current station (not yet measured) is displayed.

ENTER
This key serves several functions and works identically in both Discharge and General data collection modes.
- It is used to complete the entry of any user parameter.
- It is used to toggle between multiple display screens when available.
- It is used to acknowledge a FlowTracker system message.

3.3 Main Menu
When turned on, the FlowTracker displays a wake up screen showing the firmware version and the date/time from the system clock (continually updating).

Example: FlowTracker 3.0 2006/06/01 08:10:25 Press Enter For Main Menu
Pressing **Enter** displays the **Main Menu**.

**Main Menu** 1: Setup Parameters 2: System Functions 3: Start Data Run

From the **Main Menu**, press the appropriate key to access the desired function.

Press 1 for the **Setup Parameters Menu**.

Press 2 for the **System Functions Menu**.

Press 3 to start a data run.

**NOTE:** It is important to always return to the **Main Menu** before turning the system off to ensure all data has been properly saved.

### 3.3.1 Setup Parameters Menu (Main Menu <1>)

Setup parameters determine how the FlowTracker collects data. This section describes each item in the **Setup Parameters Menu**.

1: Units English
2: Avg. Time (40)
3: Mode Discharge
   0=Exit or Enter=More
4: QC Settings
5: Discharge Settings
6: Salinity (0.00)
   0=Exit or Enter=More
7: Language English
8: No Correction
   0=Exit or Enter=More

The **Setup Parameters Menu** is shown above (three screens are needed to show all options). Press **Enter** to cycle through the screens. To change a setting, press the appropriate menu number.

### 3.3.2 Units System (Setup Parameters <1>)

The **Units** option defines the units system used for display and output data (set as **English**). The units system does not affect internal calculations or storage (internal units are metric).

To change the units system, press 1 from the **Setup Parameters Menu**, and then press 1 for **English** units.
3.3.3  Averaging Time (Setup Parameters <2>)

The **Avg Time** (averaging time) option specifies the amount of data (in seconds) to be collected at each measurement site. Averaging time is specified in 1-second intervals from 10 to 1000 seconds. Forty (40) seconds is the approved time.

To change the averaging time, press 2 from the **Setup Parameters Menu**.

3.3.4  Data Collection Mode (Setup Parameters <3>)

The **Mode** option determines the procedure when collecting a series of measurement stations.

To change the data collection mode, press 3 from the **Setup Parameters Menu**, and then press 1 for **Discharge** mode. In **Discharge** mode, a sequence of measurements is used to calculate river discharge (cfs).

3.3.5  QC Settings (Setup Parameters <4>)

The **QC Settings** menu sets universal QC criteria for **Discharge** mode.

To access the **QC Settings** menu, press 4 from the **Setup Parameters Menu**, and then:

- Press 1 to set the **SNR Threshold (>10dB)**
- Press 2 to set the **σV Threshold (<0.03 ft/s)**
- Press 3 to set the **Spike Threshold (<10%)**
- Press 4 to set **Max Velocity Angle (<20 degrees)**

3.3.6  Discharge Settings (Setup Parameters <5>)

The **Discharge Settings** menu specifies settings for the discharge calculations and the QC criteria used for **Discharge** measurements.

To access the **Discharge Settings** menu, press 5 from the **Setup Parameters Menu**. You can also access **Discharge Settings** by pressing 3 from the **QC Menu** (although options 1, 2, and 3 are not available when a data file is open).

- Press 1 to set the discharge **Equation**.
- Press 1 to select **Mid Section**. Selecting this option sets **Repeat Depth** and **Repeat Velocity** to **NO**.

The section discharge (%Q) displayed for each station can be calculated based on either the user-supplied **Rated** discharge or the total **Measured** discharge.

Select the desired reference, **Rated** or **Measured**.

The default is **Rated**. If no **Rated** value is specified, the **Measured** value is used.
• Press 8 to select the Methods Displayed.

The FlowTracker supports several methods to determine mean velocity. The method determines the number and location of velocity measurements.

Scroll through available methods using the Method+ and Method− keys.

• Press 1 to toggle 2-6-8 Methods (0.6, 0.2/0.8, 0.8/0.2, 0.2/.6/.8, 0.8/.6/.2) on/off.

3.3.7 Salinity (Setup Parameters <6>)

The Salinity option specifies the salinity value used to compute sound speed.

To change salinity, press 6 from the Setup Parameters Menu, and then enter the desired salinity value in ppt.

Sound speed is used in Doppler velocity calculations (see FlowTracker Principles of Operation for details).

Salinity is specified in parts per thousand (ppt). Fresh water has a salinity of 0; seawater typically has a salinity of about 35 ppt.

As a rule of thumb, a 12-ppt error in the value of salinity will result in a 1% error in sound speed, which results in a 2% error in velocity data.

Salinity should be specified as accurately as possible for each location.

NOTE: When using the FlowTracker in salt water, a sacrificial zinc anode should be installed on the probe for corrosion protection.

3.3.8 Language (Setup Parameters <7>)

The FlowTracker firmware can operate in five different languages. Keypad labels are changed for compatibility with each language; keypad overlays are available on request for each language (and are included with each system shipped outside the United States and Canada).

To change the language, press 7 from the Setup Parameters Menu, and then press 1 for English.

3.3.9 Mounting Correction (Setup Parameters <8>)

Mounting Correction specifies how to account for the device used to hold the FlowTracker in the water. The mount may have a small impact on velocity measurements. Specifying the proper mounting correction allows the FlowTracker to account for the effect of the mount.
To change the Mounting Type, press 8 from the Setup Parameters Menu:

- Press 1 for No Correction (the default setting).
- Press 2 for Custom. When prompted, enter a Mounting Correction for the mount being used.
- Contact SonTek for help in determining the appropriate Mounting Correction. The standard recommendation is 1.0%.

3.4 System Functions Menu (Main Menu <2>)

The System Functions Menu provides access to items that should be checked periodically but do not directly affect how data is collected. This section describes those items.

1: View Data File
2: Recorder Status
3: Format Recorder
4: Temperature Data
5: Battery Data
6: Raw Velocity Data
7: Auto QC Test
8: Show Config.
9: Set System Clock
0: Exit or Enter=More

Three screens are needed to show all items above. Press Enter to switch between screens. To change a setting, press the number shown.

3.4.1 View Data File (System Functions <1>)

The View Data File option allows you to view data files stored on the internal recorder.

To view a data file stored on the internal recorder, press 1 in the System Functions Menu.

The FlowTracker will display a menu of the files on the internal recorder. At most, three files are displayed on each screen.

- Use Enter to scroll through the entire recorder directory (three files at a time).
- Press 1, 2, or 3 to select the desired file.
- Press 0 to exit the View Data File option without loading a file.

After loading the file, the FlowTracker displays a summary of the data file.

- Press Enter to move between the different summary display screens.
- Press Previous Station from any file summary screen to view station data.
- Use Next Station and Previous Station to scroll through station data (no new measurements can be added). The same station display screens are available as
those used during data collection. Press Enter to scroll through the station data screens.

- Pressing **Next Station** from the last station returns you to the file summary screens.
- When done, press 0 to exit and return to the main menu. The 0 key is only active when the display is showing the summary data. If you have scrolled back to a previous station to view data, you will not be able to exit until you scroll forward to the summary data screen.

### 3.4.2 Check Recorder Status (System Functions <2>)

The **Recorder Status** option displays the number of files stored on the internal recorder and the number of files remaining.

To view the status of the recorder, press 2 from the **System Functions Menu**. Press any key to return to the main menu. The FlowTracker will have either a 2-MB or 4-MB recorder.

### 3.4.3 Format Recorder (System Functions <3>)

The **Format Recorder** option erases all data on the internal recorder.

To format the recorder, press 3 from the **System Functions Menu**.

The system will prompt you to enter 123 to confirm your decision to format (erase) the recorder. Entering any other value will abort the formatting process.

Be certain that all data has been downloaded before formatting the recorder; data cannot be recovered after the recorder is formatted.

Recorder formatting takes 20-60 seconds to complete.

### 3.4.4 Temperature Data (System Functions <4>)

The **Temperature Data** option displays the current temperature sensor data.

To view temperature data, press 4 from the **System Functions Menu**. Press any key to return to the main menu.

The temperature sensor is in the probe head and is accurate to +/- 0.1°C.

### 3.4.5 Battery Data (System Functions <5>)

The **Battery Data** option shows the current battery voltage and an estimate of remaining capacity.
To view battery data, press 5 from the System Functions Menu. Press any key to return to the main menu.

An estimate of remaining capacity (as a percent of total) is given for three battery types. The FlowTracker does not know what types of batteries are installed. Typical capacities:

- Alkaline: ≈25 hours
- NiMH: ≈15 hours
- NiCad: ≈7 hours

**Battery capacity estimates are based on voltage and are only approximate.**

*Cold weather can greatly affect battery voltage and capacity; always check battery voltage after the system has acclimated to outside temperatures.*

### 3.4.6 Raw Velocity Data (System Functions <6>)

The Raw Velocity Data option shows a continuous display of raw velocity and SNR data.

To display raw data, press 6 from the System Functions Menu.

- This can also be accessed by pressing 5 from the QC Menu.
- Press any key to exit the raw velocity display.
- This can be done as a quick test before data collection or to check stream conditions during data collection. Data displayed during this function are not recorded.
- Velocity and SNR data are updated once per second.
- Velocity data can be expected to show notable variations (most of which are real), and should be indicative of the general conditions in the water.
- SNR is primarily a function of the amount of particulate matter in the water. For good conditions, SNR should be at least 10 dB. The system can operate effectively with SNR as low as 2-3 dB, although the noise in individual velocity measurements will increase.

### 3.4.7 Automatic QC Test (System Functions <7>)

The Auto QC Test is an automated version of the BeamCheck software. This test can be run in three ways:

- When you are prompted to run this test at the start of each data file.
- When you press 7 from the System Functions menu.
- When you press 6 from the QC Menu.

Follow the instructions on the LCD. When the test is done and while a data file is open,
results are recorded with the file. Place the probe in moving water well away from any underwater obstacles. The FlowTracker collects data for about 30 seconds. The data are analyzed based on several criteria:

**Noise level**
- Measured electronics noise level is compared to reference data. Any significant deviation causes a warning.
- A large change in noise level may indicate damage to the probe.

**SNR**
- The SNR is checked as sufficient for reliable data collection.
- Each beam SNR is compared to be sure all beams perform equally.
- A warning is issued for low SNR or if beam SNR values differ.

**Peak shape**
- The shape of the sampling volume curve is compared to the expected shape. Any significant deviation causes a warning.
- This criterion can only be checked with sufficient SNR (> 7 dB).

**Peak location**
- The physical location of the sampling volume is compared to the expected location. Any significant deviation causes a warning.
- This criterion can only be checked for sufficient SNR (> 7 dB).
- If any warnings are issued, you are given the option to repeat the test.

It is recommended that the test be repeated at least once after you verify that the probe and sampling volume are well away from any underwater obstacles.

If multiple warnings are received, run *BeamCheck* from a PC to evaluate FlowTracker performance in more detail.

### 3.4.8 Show System Configuration (System Functions <8>)

The **Show Config** option displays basic system configuration information.

To display system configuration information, press 8 from the **System Functions Menu**. Press any key to return to the main menu. Displayed items include:

- Firmware version number
- Serial number
- Probe type

**Side XY 10cm** indicates a side-looking 2D probe.

### 3.4.9 Set System Clock (System Functions <9>)

The **Set System Clock** option displays the date and time (continually updated) from the FlowTracker’s internal clock.
To change the date/time, press 9 from the System Functions Menu, and then follow the menu options to change the date or time.

3.5 QC Menu

The QC Menu is accessed only during data collection by pressing the QC Menu key (in either Discharge or General mode). It provides access to several functions.

Input supplemental data

- Supplemental data is provided to allow you to further document that data set.
- Up to 20 different supplemental data records can be included with each file.
- Each record can include gauge height, rated flow, user comments, a time stamp, and a location stamp.

The time stamp and location stamp are automatically generated with any gauge height, rated flow, or comment entries, but can be edited. Data in all records can be viewed and modified following the on-screen instructions in the QC Menu.

- Modify QC Settings
- Modify Discharge Settings (Discharge mode only)
- Change the averaging time (Avg Time) used for each measurement
- Display Raw Velocity Data from the FlowTracker without recording to a file
- One possible use for this function is to use the FlowTracker to locate the bottom of a slush layer under ice
- Run and record an additional Auto QC Test

4.0 ESTABLISHING A FLOW DISCHARGE STATION

4.1 Basic FlowTracker Data Collection Process - Using the Keypad Interface

Pressing 3 from the main menu starts a data collection run. Press 1 to Name the data file. Enter the station ID using the keypad.

Find the previously established sample location and visually inspect the site for hazards both above and below the surface of the water. To minimize QC errors, spend time engineering the stream above your tag line by removing rocks, sticks, moss, and any other obstacles that may channelize water currents or cause back flow. Once you begin flow measurement, you may not move obstacles.

1. Stretch the tag line across the stream perpendicular to the stream flow.
2. The user proceeds through a series of measurement locations (a minimum of 20 stations and up to 100 stations can be recorded with each file).
3. At the start of data collection, you are prompted for a file name. Name this file for the Station Identification.
4. The operator will next be prompted to Run or Skip the Auto QC Test. The Auto QC Test is essentially a field version of BeamCheck but is particular to the present measurement environment. This information is stored with each discharge measurement file and is displayed on the discharge measurement summary.

5. It is a requirement of all United States Environmental Protection Agency (EPA) and Environmental Services Assistance Team (ESAT) personnel to conduct an Auto QC Test prior to each discharge measurement.

6. Press 1 to Run Test.

7. The FlowTracker will collect 20 pings and either report that “All Results are Good” or that the test completed with warnings.

8. If a warning exists, Press 1 to End Test or Press 2 to Repeat Test. If the test is being repeated, move to a different place in the cross section free of potential boundary interference.

9. At this point of the procedure you are prompted to enter the Starting Edge of the cross section to be measured and will soon be collecting velocity data.

10. Press LEW/REW (#4) to toggle between the edges, and set the starting edge. The Right or Left edge of water is determined by your body orientation when facing downstream.

11. Press Set Location to enter the distance on the tagline for the starting edge of water. Press Enter when finished. You will not take a measurement at the Starting Location.

12. Press Set Depth to enter the depth of water at the particular location on the tagline. Press Enter when finished.

13. Press Next Station (#2) to continue the measurement.

14. The following sequence will occur at each successive location of the cross section. Generally, 20 - 25 evenly-spaced observations per cross section are sufficient to define the natural variability of the channel.

15. Press Set Location to enter the location on the tagline of the velocity observation. Press Enter when finished. The default observation spacing is one foot. Each successive observation sends you to the next point on the tagline based on the spacing of previous observations.

16. Press Set Depth to enter the depth of water at the observation point. Press Enter when finished. Each successive observation copies the depth of the previous point.

17. Depending on the depth of water at the observation point, the measurement method may differ in order to calculate mean velocity. Depths below 2 feet will use the 6/10ths method (the default setup on the FlowTracker). If the depth is above 2 feet, the 2/10ths - 8/10ths method is used. To toggle between the various methods, press Method+.

18. It is possible to recover if you mistakenly press Measure with an incorrect parameter or Method. Press Abort to terminate the measurement (or let the measurement finish), and press 2 to repeat the measurement. Until one measurement is accepted at a station, you have the ability to change all parameters. After one measurement
has been accepted, **Method** can no longer be changed (although other parameters can still be changed).

19. Press **1** to **Accept** the data and move to the next station or location in the measurement series (e.g., advancing from the 2/10\textsuperscript{ths} to 8/10\textsuperscript{ths} observation depth).

20. Press **2** to **Repeat** the measurement, especially if QC issues arise. When a measurement is repeated, data are not lost. However, you will no longer be able to view the old data from the keypad interface. The old data are still recorded. Later, the data can be extracted in the raw data file (*.dat) and the measurement summary file (*.sum), but not in the discharge summary file (*.dis).

21. Once a station is completed, the FlowTracker displays the next station. Location, depth, and method data for new stations are predicted using previous stations. If a multiple measurement method was used (e.g., 2/10\textsuperscript{ths} and 8/10\textsuperscript{ths} water depth), the next station will use the same method in the opposite order (i.e., 8/10\textsuperscript{ths} then 2/10\textsuperscript{ths} depth).

22. Summary velocity and QC data are displayed at the end of each measurement. QC data is automatically reviewed. Values outside expected boundary limits generate a warning to the user. You are allowed to repeat individual measurements if desired.

23. You can scroll through previous stations to view data and edit station information.

24. When done, press **End Section**. For Discharge measurements, enter ending-edge information to be shown the final discharge data.

25. Press **Calculate Disch.** to finish the measurement. Press **Enter** to advance through the multiple screens. Any stations with a discharge greater than 10\% must be re-evaluated. Do not end section and return to add stations on both sides of the station with greater than 10\% discharge until all QC errors are satisfied.

**NOTE:** *It is important to always return to the Main Menu before turning the system off to ensure all data has been properly saved.*

### 5.0 EXPLANATION OF QC CRITERIA

#### 5.1 Accessing QC Criteria

All QC criteria can be modified or disabled. All discharge measurements for EPA and ESAT field events should conform to the following criteria and are entered as the defaults in the ESAT FlowTrackers. To access QC settings:

From the Main Menu, press 1 for Setup Parameters.

From Setup Parameters, select 4 for QC Settings.

- Select 1 to specify SNR Threshold.
- Select 2 to specify \(\sigma\)\textsubscript{V} Threshold.
- Select 3 to specify Spike Threshold.
- Select 4 to specify Max Velocity Angle.
From Setup Parameters, select 5 for Discharge Settings.

- Select 4 to specify Max Section Discharge.
- Select 5 to specify Max Depth Change.
- Select 6 to specify Max Location Change.

To disable any QC criteria, set that parameter to a value of 0.

### 5.1.1 Table 1-1 Quality Control (QC) Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Expected Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNR (§1.4.2)</td>
<td>SNR is the most important QC parameter. It measures the strength of the acoustic reflection from particles in the water. Without sufficient SNR, the FlowTracker cannot measure velocity.</td>
<td>Ideally &gt; 10 dB Minimum ≥ 4 dB</td>
</tr>
<tr>
<td>σV (§1.4.3)</td>
<td>σV (standard error of velocity) is a direct measure of the accuracy of velocity data. It includes the effects of turbulence in the river and instrument uncertainty.</td>
<td>Typically &lt; 0.01 m/s (0.03 ft/s). Higher in turbulent environment</td>
</tr>
<tr>
<td>Boundary QC (§1.4.4)</td>
<td>Boundary QC evaluates the measurement environment for interference from underwater obstacles. FAIR or POOR results may indicate significant interference from an underwater obstacle.</td>
<td>BEST or GOOD</td>
</tr>
<tr>
<td>Spikes (§1.4.5)</td>
<td>Spikes in FlowTracker velocity data are removed using a spike filter. Some spikes are common and no cause for concern. Too many spikes indicate a problem in the measurement environment (e.g., interference from underwater obstacles or highly aerated water).</td>
<td>Typically &lt; 5% of total samples. Should be &lt; 10% of total samples.</td>
</tr>
<tr>
<td>Angle (§1.4.6)</td>
<td>Angle is the direction of the measured velocity relative to the FlowTracker X-axis. Used for discharge measurements only. A good site should have small velocity angles. Large angles may be unavoidable at some sites.</td>
<td>Ideally &lt; 20°</td>
</tr>
<tr>
<td>%Q (§1.4.7)</td>
<td>%Q is the percentage of the total discharge in a single measurement station. Most agencies have criteria for the maximum %Q.</td>
<td>Typical criteria: Ideally &lt; 5% Maximum &lt; 10%</td>
</tr>
</tbody>
</table>
5.1.2 Table 1-2 QC Warning Messages

<table>
<thead>
<tr>
<th>Warning</th>
<th>QC Criteria</th>
<th>Description</th>
<th>Suggested Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low SNR (§1.4.2)</td>
<td>None</td>
<td>SNR &lt; 4 dB</td>
<td>Improve SNR (§8.6)</td>
</tr>
<tr>
<td>Beam SNR (§1.4.2)</td>
<td>SNR Threshold</td>
<td>Difference in SNR for any 2 beams is &gt; SNR Threshold.</td>
<td>Look for underwater obstacles; repeat measurement.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Check probe operation (§6.5).</td>
</tr>
<tr>
<td>SNR Variation</td>
<td>None</td>
<td>One-second SNR data varies more than expected during a measurement.</td>
<td>Look for underwater obstacles; repeat measurement.</td>
</tr>
<tr>
<td>(§1.4.2)</td>
<td></td>
<td></td>
<td>Look for environmental sources (e.g., aerated water).</td>
</tr>
<tr>
<td>SNR Change</td>
<td>SNR Threshold</td>
<td>SNR more than SNR Threshold different previous measurements; major change in measurement conditions.</td>
<td>Look for underwater obstacles or other changes in river condition. Repeated measurement.</td>
</tr>
<tr>
<td>(§1.4.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High oV</td>
<td>oV Threshold</td>
<td>oV &gt; oV Threshold: adjusted based on previous data and measured velocity.</td>
<td>Look for underwater obstacles or a change in conditions.</td>
</tr>
<tr>
<td>(§1.4.3)</td>
<td></td>
<td></td>
<td>Consider real turbulence levels in river. Repeat measurement.</td>
</tr>
<tr>
<td>Bad Boundary QC</td>
<td>None</td>
<td>Boundary QC is FAIR or POOR. Indicates possible interference from underwater obstacles.</td>
<td>Consider re-locating probe and repeating test. Measurement can proceed if results are consistent.</td>
</tr>
<tr>
<td>(§1.4.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Spikes</td>
<td>Spike Threshold</td>
<td>Spikes &gt; Spike Threshold percent of samples. May indicate poor measurement conditions.</td>
<td>Look for underwater obstacles or unusual conditions (e.g., aerated water). Repeat measurement.</td>
</tr>
<tr>
<td>(§1.4.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Angle</td>
<td>Max Velocity Angle</td>
<td>Angle &gt; Max Velocity Angle. May only indicate non-ideal measurement environment.</td>
<td>Consider if measured angle is realistic. Repeat measurement if needed.</td>
</tr>
<tr>
<td>(§1.4.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High %Q</td>
<td>Max Section Discharge</td>
<td>%Q &gt; Max Section Discharge. Station contains a large portion of the total discharge.</td>
<td>Consider adding more stations.</td>
</tr>
<tr>
<td>(§1.4.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspect Depth Value</td>
<td>Max Depth Change</td>
<td>Station depth differs from adjacent stations by more than Max Depth Change %. This may indicate a data entry problem.</td>
<td>Verify station depth value. Re-enter if needed.</td>
</tr>
<tr>
<td>(§1.4.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspect Location Value</td>
<td>Max Location Change</td>
<td>Spacing between stations has changed by more than Max Location Change %. This may indicate a data entry problem.</td>
<td>Verify station location value. Re-enter if needed.</td>
</tr>
<tr>
<td>(§1.4.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location Out of Order Location Outside Edge</td>
<td>None</td>
<td>Station location out of sequence or outside river edge. This may indicate a data entry problem.</td>
<td>Verify station location value. Re-enter if needed.</td>
</tr>
</tbody>
</table>

5.2 Signal-to-Noise Ratio (SNR)

SNR is a measure of the strength of the reflected acoustic signal relative to the ambient noise level of the FlowTracker. SNR is the most important QC data provided by the FlowTracker. An error may indicate interference from an underwater obstacle or a potential problem with the probe. At the first alert, repeat the measurement (perhaps after moving probe location). Some
errors are unavoidable. Field conditions, such as turbulent water, may affect SNR and are unavoidable.

- SNR is reported in logarithmic units (dB). It is recorded with each one-second velocity sample. Mean values are recorded for each measurement location.
- For the best operating conditions, SNR should be greater than 10 dB.
- The FlowTracker can operate reliably with SNR as low as 4 dB, although the noise in individual measurements will increase.
- The FlowTracker displays an alert at the end of a measurement if SNR of any beam is <4.0 dB. SNR data are displayed during the measurement and with the measurement summary. For 2D systems, if the SNR of either beam is low, this will affect all velocity data even if the other beam shows higher SNR values.

Low SNR indicates a lack of suspended material in the water. For clear water, seeding material can be introduced to increase SNR. Seeding is typically only required in large laboratory tanks. Most field applications have sufficient natural scattering material.

The SNR data shown during data collection is the mean of the primary receivers (depending on the operating mode of the FlowTracker – either General or Discharge). Individual receiver data can be accessed after downloading the data file to a PC.

If the problem persists, run BeamCheck from a PC to evaluate FlowTracker operation in more detail. When the variation of SNR during a measurement (as measured by the standard deviation SNR data) is greater than a fixed threshold of 5 dB:

- This may indicate interference from an underwater obstacle, a highly turbulent environment, or highly aerated water.
- At the first alert, repeat the measurement (perhaps after moving probe location).
- If the problem persists, evaluate the measurement environment. In some cases, large variations may be unavoidable and may not impact the quality of velocity data.

**SNR Threshold** is checked with each measurement and when the **End Section** key is pressed in **Discharge** mode.

- You are notified of any stations that exceed the above criteria.
- If desired, you can go back and delete suspect stations and repeat the measurements.

### 5.3 Standard Error of Velocity (σV)

Standard error of velocity (σV) is a direct measure of the accuracy of the mean velocity data.  

σV can be directly interpreted as the accuracy of the mean velocity.

σV is calculated by dividing the standard deviation of one-second samples by the square root of the number of samples.
\( \sigma V \) is normally dominated by real variations in the flow and will vary depending on the measurement environment. When \( \sigma V_x \) is greater than the standard error threshold for that measurement:

- This may indicate interference from an underwater obstacle, a highly turbulent environment, or highly aerated water.
- At the first alert, repeat the measurement (perhaps after moving probe location).
- If the problem persists, evaluate the measurement environment. In some cases, large variations may be unavoidable (e.g., in highly turbulent waters).

**\( \sigma V \) Threshold** is checked with each measurement and when the End Section key is pressed in Discharge mode.

- You are notified of any stations that exceed the above criteria.
- If desired, you can go back and delete suspect stations and repeat the measurements.

### 5.4 Boundary Adjustment (Boundary QC)

The FlowTracker has a potential for acoustic interference from underwater objects. The **Boundary QC** test looks for interference with underwater objects that are in or close to the FlowTracker sampling volume. The system tries to avoid this interference, but you must be aware of system limitations.

- Reflections can occur from the bottom, the water surface, or submerged objects (e.g., rocks).
- If the sampling volume is on top of or beyond an underwater object, velocity data will be meaningless.
- When working in very shallow water or near underwater obstacles (with the sampling volume within 15 cm (6 in) of the obstacle), acoustic reflections can potentially affect velocity data.
- At each measurement location, the FlowTracker looks for these conditions, and if necessary, adapts its operation to avoid interference.
- For most locations, any required changes do not affect system performance.
- In some environments, changes may result in a lower maximum velocity. The FlowTracker records any changes required to avoid acoustic interference. It reports this as **Boundary QC**. This value describes the effect (if any) of boundary adjustments on performance.

The **Boundary QC** variable (Bnd) can have the following values (0 and 1 are the most common).

**0 (BEST):** No boundary adjustments were necessary, or if necessary, they have minimal impact on system performance. Maximum velocity is at least 3.5 m/s (11 ft/s).

**1 (GOOD):** Minor boundary adjustments were necessary with moderate impact on system performance. Maximum velocity is at least 2.5 m/s (8 ft/s).
2 (FAIR): Larger boundary adjustments were necessary with notable impact on system performance. Maximum velocity is at least 1.2 m/s (4 ft/s).

3 (POOR): Major boundary adjustments were necessary with significant impact on system performance. Maximum velocity is less than 1.2 m/s (4 ft/s). The FlowTracker will still provide good performance for lower flows.

If the Boundary QC results are FAIR or POOR, this indicates possible interference, and the FlowTracker will issue an alert before the measurement is made. You are prompted to consider moving the probe to avoid this interference. If the probe is moved, repeat the boundary test prior to data collection. If repeated Boundary QC tests do not give improved results, you can proceed with the measurement but should carefully evaluate velocity data.

5.5 Spike Filtering

Spikes in velocity data occur with any acoustic Doppler velocity sensor such as the FlowTracker. Spikes may have a variety of causes – large particles, air bubbles, or acoustic anomalies.

- Velocity data from each FlowTracker measurement are evaluated to look for spikes.
- The number of spikes is displayed and recorded at the end of each measurement.
- The number of velocity spikes present in data is evaluated as follows.

The Spike Threshold (default 10%) is used as follows.

- If the number of spikes is a greater percentage of the total number of points than specified by the Spike Threshold, a warning is given.
- This may indicate interference from an underwater obstacle, a highly turbulent environment, or highly aerated water.
- At the first alert, repeat the measurement (perhaps after moving probe location).
- If the problem persists, evaluate the measurement environment. A large number of spikes may be unavoidable but may not overly impact the quality of velocity data.

Spike Threshold is checked with each measurement and when the End Section key is pressed in Discharge mode.

- You are notified of any stations that exceed the above criteria.
- If desired, you can go back and delete suspect stations and repeat the measurements.

5.6 Velocity Angle

In Discharge mode, an additional QC parameter is provided – velocity angle. Velocity angle is defined as the direction of flow relative to the upstream direction. The measured velocity angle is evaluated to ensure reliable data collection.

For an ideal discharge measurement site, flow should be perpendicular to the tag line used to define the cross section.
• The FlowTracker’s X-axis is always held perpendicular to the tag line.
• An angle of 0 degrees means flow direction is perpendicular to the tag line (as desired for an ideal measurement location).
• A good measurement site will typically show some flow variations but with all angles less than about 20-30 degrees.
• The Max Angle criterion (default 20º) is used as follows:
  • When measured angle is greater than Max Angle, a warning is given.
  • Evaluate the measurement site to verify the measured angle is reasonable.
  • Consider repeating the measurement if the angle does not appear reasonable (perhaps after moving probe location).

Max Angle is checked with each measurement and when the End Section key is pressed.

• You are notified of any stations that exceed the above criterion.
• If desired, you can go back and delete suspect stations and repeat the measurements.

5.7 Maximum Section Discharge

Most agencies monitoring discharge expect that no individual station should contain more than a certain percentage of the total discharge. The Max Sect. Q criterion (default 10%) alerts you if this standard is exceeded.

If the station discharge exceeds Max Sect. Q percent of the rated flow, a warning is issued, and you are prompted to consider adding another station on either side of the station in exceeding the 10% rule.

Max Sect. Q is also checked when the End Section key is pressed.

• You are warned if any station exceeds Max Sect. Q percent of total measured discharge.
• If warned, you must go back and add more stations!
• Add stations on each side of the station with the Maximum Section Discharge warning.

5.8 Maximum Depth Change

The Max Depth Change criterion (default 50%) is intended to avoid data entry errors. It is assumed that depth changes between stations will be gradual. If the entered depth is different from a reference by more than Max Depth Change (and at least 0.20 m; 0.66 ft), an alert is issued to be sure the depth was not incorrectly entered.

• If only the previous station is available, the newly entered depth is compared to the depth from the previous station.
• If depth data are available on both sides of this station, the newly entered depth is compared to an interpolated depth between the two adjacent stations.
• You are prompted to verify the depth value or re-enter the depth.
• This criterion can be adjusted or disabled by setting Max Depth Change to 0.

Max Depth Change is also checked when the End Section key is pressed. You are notified of any stations that exceed the Max Depth Change criterion and are given the option to review all stations and modify any incorrectly entered data.

5.9 Maximum Location Change

The Max Location Change criterion (default 100%) is intended to avoid data entry errors. It is assumed that the spacing of adjacent stations will be nearly constant across the river. If spacing between stations has changed by more than Max Location Change, an alert is issued to be sure the location was not incorrectly entered.

• A 100% Max Location Change means the new station spacing is more than two times the previous station spacing. Any time a station location is changed, the location is compared to adjacent value(s) to see if the station is out of order. Collecting an out-of-order station is allowed. However, when an out-of-order station is entered, we verify the location value since the station is sorted into the correct place within the stream.

Any time a station location is changed, the location is compared to the starting edge location. If the new location is outside the starting edge, a warning is given.

6.0 BATTERY POWER

The FlowTracker uses eight AA batteries (alkaline, NiMH, or NiCad).

<table>
<thead>
<tr>
<th>Battery Type</th>
<th>Voltage</th>
<th>Operating Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaline</td>
<td>12.0 V</td>
<td>25 hours</td>
</tr>
<tr>
<td>NiMH (rechargeable)</td>
<td>10.2 V</td>
<td>15 hours</td>
</tr>
<tr>
<td>NiCad (rechargeable)</td>
<td>10.0 V</td>
<td>7 hours</td>
</tr>
</tbody>
</table>

To check FlowTracker battery level and estimated battery capacity:

• Press 5 from the System Functions Menu. Battery life estimates are at approximately 20°C (70°F). Cold weather greatly reduces battery capacity. Check battery capacity with the system acclimated to the outside temperature.

The batteries are accessed from the back of the FlowTracker handheld controller (Figure 1.0-1). To change the batteries, use the following steps:

• Turn the system off.
• Remove the six screws holding the battery compartment lid to the main housing.
• Remove the old batteries from the battery holder.
• Install the new batteries matching the orientation shown on the battery holder.
• Do not mix old and new batteries.
• Do not mix different types of batteries.
• Secure the battery compartment lid using the six screws.
• Turn the system on and check the battery voltage level to ensure proper installation.

To avoid draining batteries when system is not in use, always turn the system off before storing the system.

If the system will not be used for more than one month, remove the batteries

7.0 HEALTH AND SAFETY

When working in potentially hazardous situations, personnel must understand and comply with the site-
specific Sampling and Analysis Plan/Quality Assurance Project Plan and Health and Safety Plan before
the sampling event begins. More specifically, when entering a stream, hazardous situations exist that
warrant the person performing the measurements wear adequate safety equipment, including a personal
floatation device and waders with slip-resistant footwear.

8.0 REFERENCES


Discharge, Version 1.0. Washington State Department of Ecology, Olympia, WA.SOP Number

Software Version 2.10 featuring SmartQC. P/N 6054-60050—B.

featuring SmartQC. P/N 6054-60051—B.


SonTek/YSI, Inc., 2006. SonTek FlowTracker, version 2.11[program]. San Diego, California.
SonTek/YSI, Inc.
Sample Custody and Labeling

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DCN: EP8-7-7061

This document has been prepared for the Environmental Protection Agency by the TechLaw, Inc. ESAT Region 8 Team and is intended to provide documentation of administrative, analytical and quality control procedures used in the daily performance of EPA and ESAT support services.
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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to assist field personnel in developing proper sample custody and sample identification methods for the collection of environmental samples. This includes the use of chain of custody (COC) forms and labels for samples collected in the field. These procedures are critical in ensuring the integrity of environmental samples.

2.0 SCOPE AND APPLICABILITY

To ensure the integrity of a sample collected in the field or generated in a laboratory setting, documentation is needed to chronicle all sample handling for collection or creation through analysis and/or disposal. Any sample that is collected in the field or generated in a laboratory setting will require that records are kept as it transfers from various entities. This is the basis for generation of a COC. Uniquely, labeling samples with information, such as sample location, date, time, preservation method, and analytical requirements, keeps samples organized. A COC is initiated for each sample, either at the time of sample collection or generation or as part of preparation for a sampling event. This SOP will cover the best practices for sample custody and the method of COC and label generation.

3.0 SUMMARY OF METHOD

Once a sample is collected, several steps need to be taken to ensure the required information is collected and maintained as it is transferred from the point of collection to the laboratory. If sample nomenclature and location is known before a field event, a COC will be generated before deployment into the field. When generating the COC, it is important to know the analytical fate of samples required for each sample location (e.g. total recoverable metal, dissolved metals, etc.). This information can be found in the site-specific Sampling and Analysis Plan (SAP) and other sampling event planning documents. Some software programs (e.g. Scribe) that generate COCs also have the ability to generate labels. Scribe is the Laboratory Information Management System (LIMS) used by the lab. It is important to keep in mind that it is not mandatory to generate COCs and labels before a sampling event, but it is preferred. If it is not known where samples will be collected or the nomenclature of the sites is unclear, sample containers can be labeled with permanent marker with tape placed over it, and a blank COC can be filled out at the time of sample collection. Once the method of custody is established, a specific person, known as the sample custodian, is then responsible for maintaining the integrity of the samples as they move from and within various locations.

4.0 ACRONYMS AND DEFINITIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLP</td>
<td>Contract Lab Program</td>
</tr>
<tr>
<td>COC</td>
<td>Chain of Custody</td>
</tr>
<tr>
<td>EPA</td>
<td>United States Environmental Protection Agency</td>
</tr>
<tr>
<td>ERT</td>
<td>Environmental Response Team</td>
</tr>
<tr>
<td>ID</td>
<td>Identification</td>
</tr>
<tr>
<td>LIMS</td>
<td>Laboratory Information Management System</td>
</tr>
<tr>
<td>QAPP</td>
<td>Quality Assurance Project Plan</td>
</tr>
<tr>
<td>SAP</td>
<td>Sampling and Analysis Plan</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
</tbody>
</table>
5.0 HEALTH AND SAFETY

There are no specific health and safety hazards associated with sample custody and labeling, but these activities sometimes take place on-site during a sampling event. It is important for field personnel to familiarize themselves with the site-specific Health and Safety Plan before deployment to a site. In terms of personal interaction with the sample throughout the process of sample custody, there exists the possibility that the samples can leak. It is important to be aware of such hazards, especially when interacting with samples that are highly contaminated.

6.0 CAUTIONS

Samples sometimes require specific storage and maintenance, such as temperature preservation requirements. Proper storage of samples is critical in maintaining their integrity. Labeling is also critical in the process of sample custody. Samples usually are labeled with a series of letters and numbers that correspond to a site location, which sometimes are very similar to each other. Sample nomenclature will be designated in the approved SAP and will be followed in the field. Once a COC or label is generated, it is very important to have it reviewed for quality assurance purposes. Sample label and COC review is necessary to ensure that they match site documents.

7.0 INTERFERENCES

Once a COC and group of labels are reviewed and deployed, it is critical that the proper label ends up on the correct sample container. There will be more than one subsample collected at the majority of sampling locations in the region. This means that sample numbers can be very close in nomenclature, which puts more emphasis on attention to detail when labeling the sample containers. If the wrong label is attached to a sample, it may result in improper preservation, improper analysis, or rejection by the analytical laboratory.

8.0 PERSONNEL QUALIFICATIONS

It is critical that field personnel have proper clearance and health and safety training. Anyone who performs sample custody activities should also familiarize themselves the site-specific SAP and Quality Assurance Project Plan (QAPP), as well as with applicable SOPs: Surface Water Sampling SOP FLD 1.00, Groundwater Sampling SOP FLD 04.00, Soil Sampling SOP FLD 5.00, Pore Water Sampling SOP FLD 10.00, and Shallow Stream Sediment Sampling SOP FLD 06.00.
9.0 EQUIPMENT AND SUPPLIES

Below is a list of equipment and supplies required for COC activities (refer to the site specific SAP for additional items that maybe needed:

- Scribe software
- A SAP that details sample locations and analytical requirements
- Printer (that accepts corresponding labels)
- Blank COC pages in case of unexpected opportunistic sampling
- Permanent marker for preliminary labeling
- Clear tape for label protection from moisture
- Printable labels
- Field Logbook

10.0 STANDARDS AND REAGENTS

There are no standards or reagents associated with this SOP.

11.0 PROCEDURES

The following sections outline the general procedures for sample custody and labeling, filling out COCs with the proper information, and relinquishing samples. See Attachment A for an example of a blank COC and Attachment B for an example of a sample label.

11.1 Generating a Blank COC and Sample Labels

There are several types of data management software that can be used to generate COCs and labels. Scribe is used at the EPA Region 8 laboratory. Some training is required before an individual can use Scribe; however, once the basics of Scribe are understood, it can be used to generate COCs and labels for any type of sample or analysis. A COC that is generated prior to deployment should have the following information:

- Site Identification
- Analysis to be performed
- Preservation
- Tag Identification

The following information should not be filled out until sampling occurs:

- Date
- Time
- Sampler identification
- Comments describing anomalies

Labels can be produced with the same information found in the COCs.
11.2 Populating COC Fields and Affixing Labels

Sample containers should always be marked with a permanent marker with the site identification (ID), time of collection, analysis to be performed, date, and sampler initials prior to sample collection. Once samples have been collected, and a safe place to fill out COC and labels is established, field personnel should fill out the pre-populated COCs and labels with information such as date, time of collection, sampler initials, and comments. It is imperative that the information written on the sample container in permanent marker is the same information on the sample labels and the COC. The same information should also be recorded in a site-dedicated field logbook.

Once the labels have been verified to have the correct information, they should be affixed to the sample containers. Always be sure to double check that the proper label is placed on the corresponding sample container by cross-referencing it with the markings. Once the label is affixed to the sample container, place clear packing tape over the label and wrap completely around the container. This will prevent moisture from dissolving the label adhesive and blurring the writing. It also prevents holes, knicks, or tears from rendering the label unreadable.

11.3 Review/Custody Transfer

Once sample information is written on the COC and labels, and the label IDs have been verified against the permanent marker ID on the container, they are then ready for transfer of custody. Whether the samples are going to the EPA Region 8 lab or a Contract Lab Program (CLP) laboratory partner, the samples must be properly shipped at the required temperature (4°C for water and sediment samples) and done so in a way that containers are not compromised. In order to not compromise the integrity of the samples, the handler needs to make sure the cooler or other transporting vessel is not dropped, exposed to moisture or extreme weather, or in any other way disturbed. A signed copy of the COC intended for the receiving laboratory (samples IDs and event information should not be viewable to the lab) must be included in the shipping container. If samples are returning to the Region 8 Laboratory, they should be properly stored on ice in the field until delivered to the lab. To protect against sample contamination, place the ice in the coolers in plastic bags. When at the lab, samples should be placed in the walk-in coolers located in the sample receiving room. A signed copy of the COC is given to the sample receiving coordinator. In order to ensure samples are transferred to the correct party with the appropriate information and communication, a mutual signing of the COC by the sampler or transport agency and the sample coordinator can be arranged.

12.0 DATA RECORDS AND MANAGEMENT

As mentioned earlier, a COC should have information such as site ID, sample location, sample time, sample date, sampler initials, analytical requirements, sample matrix, preservative type, and a comments field. A sample label should have information such as sample location, time, date, matrix, preservative, and sampler initials. Any other field observations that require an explanation should be noted in the field forms or site-dedicated field notebook. Data such as sample ID, time, date, field parameters, (pH, temperature, conductivity, and dissolved oxygen) and sampler initials will eventually be entered into Scribe.
13.0 QUALITY CONTROL AND ASSURANCE

Proper sample custody and labeling requires a number of quality control and assurance steps. A COC generated in Scribe should always be crossed-checked by another person with the sample list found in the SAP. Completed COCs and labels should also be compared for accuracy before being relinquished to the receiving analytical laboratory. Any incorrect information on a COC or label may cause the lab to reject the shipment.

14.0 REFERENCES


15.0 ATTACHMENTS

**Attachment A: Example Chain of Custody Form**

```
<table>
<thead>
<tr>
<th>Sample #</th>
<th>Tag</th>
<th>Location</th>
<th>Sub Location</th>
<th>Sample Type</th>
<th>Collection</th>
<th>Matrix</th>
<th>Analyses</th>
<th>Preservation</th>
<th>Sample Date</th>
<th>Sample Time</th>
<th>Sampler</th>
<th>Remarks</th>
</tr>
</thead>
</table>
```

Relinquished By (DATE): _____________

Relinquished By: _____________

Received By (DATE/TIME): _____________

Received By: _____________

Cooler Temp: _____________

ICE: Y N

pH: Y N

Cust. Seals: Y N

COC/Labels Agree: Y N

Containers Intact: Y N
Attachment B: Example Sample Label

Sample # 082X-127    Sampler:
Tag: A
Date:    Sample Time:
Location: Dup-05    Samp_Depth:
Analyses: Total Recoverable Metals
Preservation: TR_Plastic Baggie
General Field Sampling Protocols

APPROVED:

[Signature]
ESAT Region 8 QA Coordinator

[Signature]
ESAT Region 8 Team Manager

[Signature]
EPA Task Order Project Officer

[Signature]
ESAT Region 8 Task Lead

04/04/12  Date
6/6/12  Date
7/10/12  Date
2/8/12  Date

DCN: EP8-7-7051

This document has been prepared for the Environmental Protection Agency by the TechLaw, Inc. ESAT Region 8 Team and is intended to provide documentation of administrative, analytical and quality control procedures used in the daily performance of EPA and ESAT support services.
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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide general field sampling guidelines that will assist Environmental Protection Agency (EPA) and Environmental Services Assistance Team (ESAT) personnel in choosing sampling strategies, location, and frequency for proper assessment of site characteristics. This SOP is applicable to all field activities that involve sampling.

2.0 SCOPE AND APPLICABILITY

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

3.0 SUMMARY OF METHOD

Sampling is the selection of a representative portion of a larger population, area or body. Through examination of a sample, the characteristics of the larger entity from which the sample was drawn can be inferred. In this manner, sampling can be a valuable tool for determining the presence, type, and extent of contamination by hazardous substances in the environment. The sampling design is a fundamental part of data collection for scientifically based decision making. A well-developed sampling design plays a critical role in ensuring that data are sufficient to draw the conclusions needed. The goals of a sampling design can vary widely. Typical objectives of a sampling design for environmental data collection are:

- To support a decision about whether contamination levels exceed a threshold of unacceptable risk
- To determine whether certain characteristics of two populations differ by some amount
- To estimate the mean characteristics of a population or the proportion of a population that has certain characteristics of interest
- To identify the location of “hot spots” (areas having high levels of contamination) or plume delineation
- To characterize the nature and extent of contamination at a site
- To monitor trends in environmental conditions or indicators of health

A well-planned sampling design is intended to ensure that resulting data are adequately representative of the target population and defensible for their intended use. Representativeness may be considered as the measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Throughout the sampling design process, the efficient use of time, money, and human resources are critical considerations. A good design should meet the needs of the study with a minimum expenditure of resources. If resources

4.0 ACRONYMS AND DEFINITIONS

- EPA: United States Environmental Protection Agency
- ESAT: Environmental Services Assistance Team
- DOT: Department of Transportation
HAZWOPER  Hazardous Waste Operations and Emergency Response
IATA  International Air Transport Association
MI  Multi-increment
OSHA  Occupational Safety and Health Administration
QA  Quality Assurance
QAPP  Quality Assurance Project Plan
QC  Quality Control
SAP  Sampling and Analysis Plan
SOP  Standard Operating Procedure

Occupational Safety and Health Administration (OSHA): A regulatory agency that governs health and safety standards in the United States.

Standard Operating Procedure (SOP): A set of written instructions that document a routine or repetitive activity followed by an organization (EPA, 2007).

Quality Assurance Project Plan (QAPP): A site-specific document that specifies quality assurance activities and data quality objectives.

5.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA) and corporate health and safety procedures. Always review the site Health and Safety Plan (HASP) before beginning work at any site.

6.0 CAUTIONS

In general, health and safety of field team members and sample/data integrity are the two main concerns during a field sampling event. Field personnel must understand sampling procedures and be familiar with health and safety protocols before deployment to a site. Always consult the HASP before entering a site.

7.0 INTERFERENCES

The nature of the object or materials being sampled may be challenging to characterize. If a material is homogeneous, it will generally have a uniform composition throughout. In this case, any sample increment can be considered representative of the material. On the other hand, heterogeneous samples present problems to the sampler because of spatial and temporal changes in the material. Samples of hazardous materials may pose a safety threat to both field and laboratory personnel. Proper health and safety precautions should be implemented when handling this type of sample. Environmental conditions, weather conditions, or non-target chemicals may cause problems and/or interferences when performing sampling activities or when sampling for a specific parameter. Refer to the specific SOPs for sampling techniques.

8.0 PERSONNEL QUALIFICATIONS

All personnel who participate in field activities are required to obtain clearance in three mandatory health and safety programs: medical monitoring, respirator fit testing, and OSHA Hazardous Waste Operations
and Emergency Response (HAZWOPER) 40-hour training. In addition, any personnel who will participate in sampling activities must read, understand, and sign the site-specific HASP and associated Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP).

9.0 EQUIPMENT AND SUPPLIES

The equipment required to collect samples must be determined on a site-specific basis. Due to the wide variety of sampling equipment available, refer to the specific SOPs for sampling techniques which include lists of the equipment required for sampling.

10.0 STANDARDS AND REAGENTS

Reagents may be utilized for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed. Decontamination solutions are specified in the Sampling Equipment Decontamination SOP FLD 02.00.

11.0 PROCEDURES

11.1 Types of Samples

In relation to the media to be sampled, two basic types of samples can be considered: the environmental sample and the hazardous sample.

Environmental samples are those collected from streams, ponds, lakes, wells, and are off-site samples that are not expected to be contaminated with high levels of hazardous materials. They usually do not require the special handling procedures typically used for concentrated wastes. However, in certain instances, environmental samples can contain elevated concentrations of pollutants and in such cases would have to be handled as hazardous samples.

Hazardous or concentrated samples are those collected from drums, tanks, lagoons, pits, waste piles, fresh spills, or areas previously identified as contaminated, and require special handling procedures because of their potential toxicity or hazard. These samples can be further subdivided based on their degree of hazard; however, care should be taken when handling and shipping any wastes believed to be concentrated regardless of the degree. The importance of making the distinction between environmental and hazardous samples is two-fold:

1. Personnel safety requirements: Any sample thought to contain enough hazardous materials to pose a safety threat should be designated as hazardous and handled in a manner which ensures the safety of both field and laboratory personnel. Personnel handling potentially hazardous substances should always wear proper Personal Protective Equipment.

2. Transportation requirements: Hazardous samples must be packaged, labeled, and shipped according to the International Air Transport Association (IATA) Dangerous Goods Regulations or Department of Transportation (DOT) regulations and U.S. EPA guidelines.
11.2 Sample Collection Techniques

In general, two basic types of sample collection techniques are recognized, both of which can be used for either environmental or hazardous samples.

**Grab (Discrete) Samples**

A grab sample is defined as a discrete aliquot representative of a specific location at a given point in time. The sample is collected all at once at one particular point in the sample medium. The representativeness of such samples is defined by the nature of the materials being sampled. In general, as sources vary over time and distance, the representativeness of grab samples will decrease.

**Composite (Multi-Increment) Samples**

Multi-increment (MI) or composite sampling is a structured sampling protocol that reduces data variability and increases sample representativeness. The objective of MI sampling is to obtain a single sample for analysis that has a mean analyte concentration representative of the decision unit. The decision unit size is site-specific and represents the smallest area on which to base a decision or conclusion. Samples are collected from multiple locations within the decision unit and composited so the samples are spatially representative of the decision unit. The decision unit must be defined so that the results are relevant to explicitly articulated sampling objectives. Note that establishment of decision units is necessary to develop any effective sampling approach, whether using MI or discrete sampling.

The MI sampling strategy improves the reliability and defensibility of sampling data by reducing their variability compared to conventional discrete sampling strategies. The data distribution for MI replicate samples tends to be normally distributed, as contrasted to the positively skewed distribution seen with discrete samples. Fewer non-detect results can be expected using MI, thus mitigating problems caused by using censored data sets and lessening the chance of missing significant contamination. In addition, levels of statistical confidence and decision uncertainty that would require a large number

11.3 Types of Sampling Strategies

It is important to select an appropriate sampling approach for accurate characterization of site conditions. Prior to undertaking any sampling program, it is necessary to establish appropriate measurement and system Data Quality Objectives. Refer to the U.S. Environmental Protection Agency (EPA) Soil Sampling Quality Assurance User's Guide (listed in Section 14.0 References) for guidance in establishing Data Quality Objectives, statistical sampling methodologies and protocols for each of the sampling approaches. Each approach is defined below.

**Judgmental or Biased Sampling**

Judgmental or Biased sampling is used primarily for documenting an observed release to the groundwater, surface water, air or soil exposure pathways. This form of sampling is based on the subjective selection of sampling locations where contamination is most likely to occur. Locations are based on relative historical site information and on-site investigation (site walk-over) where contamination is most likely to occur.
There is no randomization associated with this sampling approach because samples are primarily collected at areas of suspected highest contaminant concentrations. Any statistical calculations based on the results of this sampling technique will be biased.

**Random Sampling**

Random sampling, used for the characterization of a heterogeneous non-stratified waste, involves arbitrary collection of samples within a defined area. This method is most effective and accurate if the chemical heterogeneity of the waste remains constant from batch to batch. The easiest method for Random Sampling is to divide the area for sampling into an imaginary grid, assign a series of numbers to the units of the grid, and select the numbers or units to be sampled through the use of a random-numbers table which can be found in the text of any basic statistics book. Note that haphazardly selecting sample numbers or units is not a suitable substitute for a randomly selected sample.

**Stratified Random Sampling**

Stratified random sampling, used for the characterization of a heterogeneous stratified waste, involves arbitrary collection of samples within a defined area and strata. This method is most effective and accurate if the chemical heterogeneity of the waste remains constant from batch to batch. The easiest method for stratified random sampling is to divide the area for sampling into an imaginary grid, assign a series of numbers to the units of the grid, and select the numbers or units to be sampled through the use of a random-numbers table which can be found in the text of any basic statistics book. A random sample is then collected from each strata at the selected numbers or units on the grid. Note that haphazardly selecting sample numbers or units is not a suitable substitute for a randomly selected sample.

**Systematic Grid Sampling**

Systematic grid sampling involves dividing the area of concern into smaller sampling areas using a square or triangular grid. Samples are then collected from the intersection of the grid lines or nodes. The origin and direction for placement of the grid should be selected by using an initial random point. The distance between nodes is dependent upon the size of the site or area of concern and the number of samples to be collected. Generally, a larger distance is used for a large area of concern.

**Systematic Random Sampling**

Systematic random sampling involves dividing the area of concern into smaller sampling areas. Samples are collected within each individual grid cell using random selection procedures.

**Search Sampling**

Search sampling utilizes a systematic grid or systematic random sampling approach to define areas where contaminants exceed clean-up criteria. The distance between the grid lines and number of samples to be collected are dependent upon the acceptable level of error (i.e., the chance of missing a hot spot). This sampling approach requires that assumptions be made regarding the size, shape, and depth of hot spots.

**Transect Sampling**

Transect sampling involves establishing one or more transect lines, parallel or non-parallel, across the area of concern. If the lines are parallel, this sampling approach is similar to systematic grid sampling. The advantage of transect sampling over systematic grid sampling is
the relative ease of establishing and relocating transect lines versus an entire grid. Samples are collected at regular intervals along the transect line at the surface and/or at a specified depth(s). The distance between the sample locations is determined by the length of the line and the number of samples to be collected.

11.4 Quality Assurance Project Plans (QAPP)

A Quality Assurance Project Plan (EPA, 2006) is required when it becomes evident that a field investigation is necessary. It should be initiated in conjunction with, or immediately following, notification of the field investigation. This plan should be clear and concise and should detail the following basic components, with regard to sampling activities:

- Objective and purpose of the investigation
- Basis upon which data will be evaluated
- Information known about the site including location, type and size of the facility, and length of operations/abandonment
- Type and volume of contaminated material, contaminants of concern (including concentration), and basis of the information/data
- Technical approach including media/matrix to be sampled, sampling equipment to be used, sample equipment decontamination (if necessary), sampling design and rationale, and SOPs or description of the procedure to be implemented
- Project management and reporting, schedule, project organization and responsibilities, manpower and cost projections, and required deliverables
- QA objectives and protocols including tables summarizing field sampling and QA/QC analysis and objectives

Note that this list of QAPP components is not all-inclusive and that additional element(s) may be added or altered depending on the specific requirements of the field investigation. It should also be recognized that although a detailed QAPP is quite important, it may be impractical in some instances. Emergency responses and accidental spills are prime examples of such instances where time might prohibit the development of site-specific QAPPs prior to field activities. In such cases, investigators would have to rely on general guidelines and personal judgment, and the sampling or response plans might simply be a strategy based on preliminary information and finalized on site. In any event, a plan of action should be developed, no matter how concise or informal, to aid investigators in maintaining a logical and consistent order to the implementation of their task.

11.5 Legal Implications

The data derived from sampling activities are often introduced as critical evidence during litigation of a hazardous waste site cleanup. Legal issues in which sampling data are important may include cleanup cost recovery, identification of pollution sources and responsible parties, and technical validation of remedial design methodologies. Because of the potential for involvement in legal actions, strict adherence to technical and administrative SOPs is essential during both the development and implementation of sampling activities.
Technically valid sampling begins with thorough planning and continues through the sample collection and analytical procedures. Administrative requirements involve thorough, accurate documentation of all sampling activities. Documentation requirements include maintenance of a chain of custody, as well as accurate records of field activities and analytical instructions. Failure to observe these procedures fully and consistently may result in data that are questionable, invalid and non-defensible in court, and the consequent loss of enforcement proceedings.

12.0 DATA RECORDS AND MANAGEMENT

There are many data parameters and custody records that require attention to detail. Refer to the specific SOPs for data management activities that are associated with sampling techniques.

13.0 QUALITY CONTROL/QUALITY ASSURANCE (QC/QA)

Refer to the specific SOPs for the type and frequency of QA/QC samples to be analyzed, the acceptance criteria for the QA/QC samples, and any other QA/QC activities which are associated with sampling techniques.

14.0 REFERENCES


EPA Guidance on Choosing a Sampling Design for Environmental Data Collection (QA/G-5S). December, 2002
This document was prepared by the ESAT Region 8 Team and is intended to provide documentation of administrative, analytical and quality control procedures used in the daily performance of ESAT support services. This is a controlled document and may only be provided to a third party, such as consultants or other government agencies, at the direction of EPA and if all said third party recipients agree that the contents of this document remain confidential. If the document is provided as a controlled document, the user agrees to surrender the document upon request of EPA or ESAT Region 8. If the document is provided as an uncontrolled document, the user understands that subsequent revisions may not be provided.
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1.0 **SOP Description**

The purpose of this standard operating procedure (SOP) is to provide a consistent format for all Region 8 Environmental Services Assistance Team (ESAT) data management personnel who perform uploads to Scribe and management of associated databases and reports.

This SOP is applicable to all ESAT personnel who prepare, process, review, and load analytical data into the Scribe database for the Field Operations Group and the Analytical Support and Data Validation Group.

2.0 **Abbreviations and Acronyms**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>EDD</td>
<td>Electronic Data Deliverable</td>
</tr>
<tr>
<td>ERT</td>
<td>Environmental Response Team</td>
</tr>
<tr>
<td>ESAT</td>
<td>Environmental Services and Assistance Team</td>
</tr>
<tr>
<td>LIMS</td>
<td>Laboratory Information Management System</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
<tr>
<td>TDF</td>
<td>Technical Direction Form</td>
</tr>
<tr>
<td>TO</td>
<td>Task Order</td>
</tr>
<tr>
<td>USEPA</td>
<td>United States Environmental Protection Agency</td>
</tr>
</tbody>
</table>

3.0 **Health and Safety**

All office-related safety precautions must be followed. Consideration is given to ergonomics for staff members using a keyboard and sitting in front of a computer terminal for extended periods of time and all other work conditions where ergonomics may be an issue.

4.0 **Equipment and Supplies**

Standard office supplies are required for this SOP, such as a personal computer and central filing system. Specific equipment and supplies are listed below:

- Internet connection and access to the ESAT network drive
- Access to Scribe and the Scribe databases associated with Technical Direction Forms (TDFs) issued by the client
- Login capabilities to the Scribe.NET website
- Microsoft Office software applications
- External hard drive containing the appropriate databases for upload

5.0 **General Procedures**

ESAT personnel are responsible for acquiring, compiling, reviewing, and loading analytical data into the appropriate Scribe database associated with a specific TDF. Electronic Data Deliverables (EDDs) are posted to the network drive from the Laboratory Information Management System (LIMS) on or before the EDD due date.

5.1 Review, Obtain, and Prepare EDDs to be uploaded to Scribe

The analysts and/or Data Package Coordinator posts EDDs to the appropriate Task Order (TO) and project folder on the network drive upon completion. Prior to uploading or publishing a project to Scribe, review the LIMS Tracking spreadsheet to ensure that the
Data Package Coordinator has completed assembly and finalization of the current Sample Event(s) (Figure 5.2). EDDs that are complete and ready for upload are listed in the LIMS Tracking spreadsheet (located on the network drive), and will be signed off in the “Gen By” (generated by) column (Figure 5.1). EDDs that have been published will contain a date in the “Published” column (Figure 5.1).

Note: TO Numbers and TDFs are not permanent, and are subject to change based on the contract year, as well as the type and number of sample events.

- Review the "Gen By" and "Published" columns. If the Data Package Coordinator's initials are listed in the "Gen by" column, but a date is not included in the "Published" column, that sampling event is ready for uploading to the database.

Figure 5.1 LIMS Tracking Spreadsheet Example
- Navigate to the TO and Projects to be uploaded
- Select the .xlsx EDD files, and within the same folder, convert them to .csv format for uploading to Scribe
- Repeat with all other EDDs noted from the LIMS Tracking spreadsheet

Figure 5.2 Example of Sample Event Folder from the Network Drive
5.2 Scribe Data Load

Each TO project/TDF has its own database. Several separate sample events may occur under each project and will be managed according to the associated TO and project.

- Access the external hard drive containing the appropriate TO databases
- Open the Scribe Database Program
- Select "File" from the menu then "New Project"
- Select "Open Project" in the "New Project Wizard" dialogue box (this will open a Windows Explorer window from which to choose the appropriate folder pathway and database file)

Figure 5.3 Scribe Database "Open Project"
• Navigate to the current TO and Project to be uploaded

Note: Databases for the current TO are stored on an external hard drive as shown in Figure 5.4, but the external storage location, pathways, and TO numbers are subject to change.

Figure 5.4 Scribe Database Project Pathway
• Select “Yes” in the "Load this Project" dialogue box

**Figure 5.5  Scribe Database Load Project**
- Select "File -> Import -> Custom Import"
- Select "No" in the resulting "Backup Now?" dialogue box

**Figure 5.6 Scribe "File/Import/Custom Import"**
- Select "Lab Results" from the drop down arrow list in the Data Category field
- Select the correct EDD using the "browse" button above the Import Data File field

*Note: EDDs will be obtained from the folders located on the network drive pathways discussed in Section 5.1.*

- Select "ESAT Lab Results Script" for the "Script Name" field
- Select the Master Scribe template using the "browse" button above the Scribe Template field; this template is located on the external drive in Scribe Databases/Master
- Select "Next"

**Figure 5.7 Scribe "Import Data Wizard"**
• Review the field mapping dialogue box to ensure that all fields match up with Scribe requirements

Note: The fields in blue bolded text are required fields. The remaining fields (listed below the blue bolded font) may not match exactly in name. Ensure that they match in type and meaning regardless of the slight differences in names and case. In addition, not all "Import Fields" fields will be present for "Scribe Fields".

• Select "Next"

Figure 5.8 Scribe "Map Data to Import"
• Review the total in the "Lab Results # Records:" field

• Ensure that the total number of records in the "Lab Results # Records" field matches the total in the EDD

Note: The Excel formatted EDD can be opened and reviewed to verify that the total number of samples to be imported matches the number of samples contained in the EDD.

• Select the blue bolded "Import Errors file" link to obtain a list of errors if the import is unsuccessful (list will open in Excel format)

Figure 5.9 Scribe "Data to be Imported" Import Errors
• Review the error report, open the appropriate EDD, and correct the errors. As shown in the example report below, the “Reporting Units” field has a numerical value, which is incorrect. Because this is a text field, the necessary correction would be to insert the appropriate unit text, which for this EDD would be ug/L.

Note: The example below contains one of the common types of errors that may occur. That is, one that is correctable within the EDD itself and by the Scribe uploader. However, this is not the only possible error type. If a more complex error occurs, one that cannot be corrected within the EDD, an ESAT analyst may need to be contacted for assistance and the error may need to be corrected at an earlier point in the process.

Errors within the Scribe program itself are essentially non-existent for the Analytical Support Group and Field Operations databases. If an upload error occurs, it is generally caused by incorrect selections of either the database script or the Scribe Master template. In those cases, return to the import screen and ensure that all scripts and templates selected are correct. If the database still shows errors that are not correctable in the EDD, the error(s) may be Scribe-related. If an error occurs that cannot be corrected within the EDD, or by correcting possible upload procedure errors, contact the Environmental Response Team (ERT) Software Support department for assistance. ERT can be contacted by email: ertsupport@epa.gov or by phone: 800-999-6990.

Figure 5.10  Scribe Example of Import Errors File
- Select "Next" once the errors have been corrected and continue the import process.

**Figure 5.11  Scribe Corrected "Data to be Imported"**
- Select the "Add New Records" box
- Select "Import"
- Move the "Finished!" dialogue box away from the center portion of the "Import Data Wizard" dialogue box so that the "LabResults Records Added" total can be viewed
- Ensure that the "LabResults Records Added" is the same as the total in the "Data to be Imported" dialogue box (Figure 5.11)
- Select "Yes" if more EDDs for the same TO and Project will be loaded
- Select "No" if complete

Figure 5.12   Scribe "Import More Data?"
• Continue with all completed EDDs (those noted as ready to upload in the LIMS Tracking spreadsheet)

5.3 Publish Databases in Scribe

Once all EDD uploads for a specific project are loaded to Scribe, the project can be published to Scribe.NET.

• Navigate to the LIMS Tracking spreadsheet on the network drive as described in Section 5.1 and shown in Figure 5.1
• Open the LIMS Tracking spreadsheet
• Follow the steps for opening a specific database as shown in Section 5.2, Figure 5.3, Figure 5.4, and Figure 5.5
• Select "File -> Scribe.net -> Publish"

**Figure 5.13** Scribe "File/Scribe.NET/Publish"
- Select "Next" on the Scribe.NET Publisher Wizard dialogue box

**Figure 5.14  "Scribe.NET Publisher Wizard"**
• Select "USEPA Region 8" from the dropdown list on the resulting dialogue box; leave the password field as is
• Select "Publish"

**Figure 5.15  Scribe Publish Dropdown**
• Select "OK" in the "Finished! Project Published to Scribe.NET!" dialogue box

• **Figure 5.16 Scribe.NET "Project Published"**
• Move completed and published project folders to the correct TO subfolder titled "Final Folder" (located on the network drive, as described in Section 5.1)
• Open the LIMS Tracking spreadsheet and record the Publish date (date format defaults to spreadsheet formatting) for each Sample Event completed
• Continue with remaining TO Sample Events

Figure 5.17 LIMS Tracking Spreadsheet Input Published Date

6.0 Data Records and Management

The Data Package Coordinator will combine documents contained within each specific TO and Project folder and create and assemble the final Data Package for submittal to the client. Both the Excel and .csv versions of the EDD, as well as the data package and other associated documents, will be located in the appropriate TO Project file and Sample Event folder as shown in Figure 5.3.

7.0 Quality Control and Assurance

This SOP meets all the requirements of the ESAT Quality Management Plan.
8.0 References

ESAT Region 8, SOP,16-QAQ-03.00, Document Control, effective November 11, 2013.

ESAT Region 8, Quality Management Plan, version 7, effective June 2013.


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<th>Status(^1) (I, R, C)</th>
<th>Effective Date</th>
<th>Changes Made</th>
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<tr>
<td>0</td>
<td>I</td>
<td>03/12/14</td>
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\(^1\) Status: I = Initial, R = Revision, or C = Cancelled
16-LAB-05.04

Sample Receipt, Custody, Storage, and LIMS Data Entry

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Date:  10/14/15

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1.0 **SOP Description**

The purpose of this standard operating procedure (SOP) is to establish a safe, traceable, and consistent laboratory process for receiving, tracking, and storage of Environmental Services Assistant Team (ESAT) samples at the United States Environmental Protection Agency (EPA) Region 8 Laboratory. These may include surface waters, ground waters, soils, sediments, biological materials, and proficiency testing (PT) samples.

This SOP specifies the requirements for project definition, sample receipt, control, and record keeping by ESAT. The following objectives are defined in detail within this document:

1.1 EPA Project Definition – Prior to accepting client samples at the laboratory, an agreement between the EPA Task Order Project Officer (TOPO) and ESAT must be set forth in a Technical Direction Form (TDF), which details the required analytical methods, target analytes, approximate quantity of samples, receipt date, analytical quality control (QC) procedures, and data deliverables.

1.2 ESAT Project Definition – Following receipt of the TDF, ESAT personnel will create a project in the Laboratory Information Management System (LIMS) that defines the requirements detailed in the TDF.

*Note: ESAT does not receive a TDF for PT samples; however, ESAT will still create a project in LIMS that defines the requirements of the PT provider and the National Environmental Laboratory Accreditation Conference (NELAC).*

1.3 Sample Integrity Inspection

- Samples listed on the chain of custody (COC) are compared to the actual samples received in order to identify any discrepancies
- Samples and shipping coolers are inspected for leakage or breakage
- Temperature of the samples is recorded
- Sample preservation is verified
- Any breach of the sample integrity will be noted and become a part of the project record
- A copy of the *Sample Receipt Form* – TLF-51.XX (current version) will be completed, which documents all of the parameters taken and anomalies, if any.

1.4 COC Verification

- The COC establishes a traceable, legal record of the possession of the samples from sampling through analysis
- Laboratory personnel compares the sample identification as listed on the COC to the identification on the samples
- Identify any sample requiring analyses with short holding times and notify laboratory personnel of the sample arrival
- Note any and all discrepancies on the *Sample Receipt Form*, which become part of the project record
- Maintain sample custody by storing the samples in a locked cooler
- Track movement of the samples in and out of the cooler in a logbook

1.5 LIMS Sample Login – After completing sample receipt procedures, the samples are logged into the LIMS by utilizing the ESAT project definition and either an electronic XML
file or by hand entering sample information and any noted discrepancies from the Sample Receipt Form.

2.0 Acronyms

- °C: Degrees Celsius
- CHP: Chemical Hygiene Plan
- COC: Chain of Custody
- EDD: Electronic Data Deliverable
- EPA: United States Environmental Protection Agency
- ESAT: Environmental Services Assistance Team
- HSO: Health and Safety Officer
- ID: Identification
- IR: Infrared
- LIMS: Laboratory Information Management System
- NELAC: National Environmental Laboratory Accreditation Conference
- PPE: Personal Protective Equipment
- PT: Proficiency Testing
- QA: Quality Assurance
- QAO: Quality Assurance Officer
- QC: Quality Control
- SOP: Standard Operating Procedure
- TDF: Technical Direction Form
- TO: Task Order
- TOPO: Task Order Project Officer

3.0 Health and Safety

3.1 The person receiving the samples ensures that the sample login area is clean and free of any potential contaminants prior to working in the area.

3.2 Proper personal protective equipment (PPE) is required for sample receipt, including a minimum of gloves, eye protection, and lab coat.

3.3 Leaking containers can pose a health risk due to the possible presence of acids and other toxic components making inhalation of toxic vapors a potential hazard.

- All coolers should be opened in a room with adequate ventilation
- If broken sample containers are present, additional PPE and engineering controls (e.g., chemical fume hood) may be required. If the use of spill cleanup material is necessary, the proper method of cleanup and disposal must be followed. Refer to the EPA Region 8 HSP-001, Chemical Hygiene Plan (CHP), current version.
- Assistance from the ESAT or EPA Health and Safety Officer (HSO) for proper handling and disposal procedures may be required

3.4 Sample receipt personnel must be familiar with the location of additional safety equipment.

- Spill and neutralizer equipment are available in the sample receipt area
- The eye wash station and safety shower in the sample receiving area should be verified as unobstructed prior to unpacking the samples
4.0 Equipment and Supplies

- Calibrated and certified thermometers – Thermometers used for measuring sample storage cooler temperatures are calibrated annually under the supervision of the EPA laboratory Quality Assurance Officer (QAO) using a certified thermometer. An infrared (IR) temperature indicator is maintained and used by ESAT personnel for recording the temperature of the samples upon arrival.
- Wide-range pH paper (non-bleeding)
- Waste container (properly labeled according to the CHP)
- Promium ELEMENT LIMS for sample tracking and reporting
- Laboratory chemical fume hood for opening sample coolers
- Refrigerated and secured sample storage cooler

5.0 Personnel Qualifications and Responsibilities

5.1 ESAT Personnel

- The receiving and checking of incoming samples must be performed by an ESAT team member trained in the proper performance of this SOP
- The sample receiver must be familiar with interpreting COC documentation, performing pH determinations, and maintaining custody of samples
- Personnel receiving samples should have a baseline physical examination performed prior to receiving samples
- Some lifting of 30-50 pound coolers/containers may be required

5.2 EPA Personnel

- EPA personnel will periodically move coolers containing ESAT samples into the ESAT sample storage cooler
- EPA personnel will notify ESAT team members of the arrival of the samples

6.0 Cooler Receipt and Acceptance

6.1 Sample Integrity Inspection

6.1.1 Generally, samples are received through the main entrance of the laboratory via FedEx or delivery from the sampling contractor. Note the method of delivery on the Sample Receipt Form. This is indicated in the project later when the samples are logged into the LIMS.

6.1.2 Retrieve a sample cart, and move the coolers to the sample receipt area (E-115).

6.1.3 Examine the shipping coolers for any damage or leaks, and note their presence for inclusion into the project folder.

6.1.4 Open the cooler(s) while the cooler is located under the exhaust hood in the sample receipt area.

6.1.5 Remove the COC from the cooler.

6.1.6 On each page of the COC, sign the “Received” section and record the date and time of receipt.

Note: Whenever possible, the sampler or customer should be present during the transition of the samples into ESAT custody, including opening of the coolers and cross-checking of information.
6.1.7 Unpack the cooler, and use the COC to organize the samples on the work table in the sample receipt area.

- If any issues with sample integrity are observed (e.g., damage to the sample container, contamination, etc.), the analyst should note on the Sample Receipt Form and in the case narrative of the data package so that data users are aware that the sample may have been compromised.
- Any correspondence with and direction received from the TOPO regarding a compromised sample should be received in writing via email, and that email should be included in the data package.

6.1.8 Temporarily place the ice or baggies filled with ice in the deep sink under the exhaust hood.

6.1.9 Using the IR thermometer, measure the temperature of the first unpacked sample. This temperature is recorded on the Sample Receipt Form and in LIMS.

6.1.10 Inspect each sample container for damage or leaking, and note any circumstance for inclusion in the project folder.

6.1.11 Verify the preservation of any samples that are indicated on the COC as having been preserved to a specific pH. Note the lot number(s) of the pH strips on the Sample Receipt Form.

6.1.12 Place a drop or two of sample on the pH indicator strip using a disposable pipet and compare strip to color scale that is provided on pH strip package to obtain sample pH.

6.1.13 If the sample is properly preserved, no further action is required.

6.1.14 Recap the sample container and proceed with the login procedure (see Section 7.0).

6.1.15 Improperly preserved samples must be preserved before placing into the storage cooler. Carefully note on the Sample Receipt Form which samples were not properly preserved.

6.2 COC Verification

6.2.1 The samples should be accompanied by a COC, sample identification (ID) tags, and custody seals.

- All information required on the forms and tags must be properly completed and legible.
- The sample ID tag information must be verified against the corresponding sample information provided on the COC.

6.2.2 In the case of COC discrepancies, the sample ID tag will be assumed as the true information, and the discrepancies must be clearly noted on the Sample Receipt Form and on the COC with the login personnel’s initials and date.

- All COC discrepancies should be discussed in the Sample Receipt Form of the data package.
- If a COC discrepancy requires contact with the TOPO, this should also be discussed in the case narrative of the data package. If COC discrepancies are resolved verbally with the TOPO, an email should be sent to confirm the reconciliation of discrepancies, and a copy of the email should be included in the data package with the COC.

6.2.3 If the documentation is incomplete, the ESAT Contract Project Manager and TOPO must be notified of the discrepancy. The TOPO will decide if the process will continue.

6.2.4 After each sample is unpacked from the shipping container and the sampling information is verified, it is segregated into various storage trays by analytical method.

6.2.5 The trays are labeled with a tag in a plastic shield with the following information:
project name, LIMS number, TDF number, due date, and requested analysis.

6.2.6 The labeled trays are then placed in walk-in cooler “A” and secured by locking the cooler with the provided padlock.

6.2.7 The trays are removed by the analyst prior to analysis. The analyst records the removal of the samples from the cooler in the logbook in the sample receipt area.

6.2.8 Empty the plastic bags filled with ice that were placed in the sink, and put the empty bags into the provided waste container in the sample receipt area.

7.0 Project Creation and Sample Entry in LIMS

7.1 Project Creation in LIMS

- Open the LIMS software
- In the Project Management dropdown menu, select “Projects”
- Highlight a similar project. Be sure to check that it has the required test codes.
- Select the “Copy” option
- Double click the “Superfund” client option
- Rename the project in the dialog window
- From the new project screen select “Edit”
- Put the TDF number in both the “Project Number” and “PO number” fields
- Select the “Project Manager” from the drop down menu
- Check that the default Electronic Data Deliverable (EDD) is “StdESATExl_rev1.exe”
- Enter the appropriate project name in the comments field
- If the test codes for the new project need to be changed, double click on “Test Codes” and select the correct test codes for the project from the drop down menu
- Save the project

7.2 Work Order Creation in LIMS

- From the “Sample Control” menu, select “Work Order”
- Select “Import” and select the file location of the XML/Scribe file from the drop down menu
- Click the “Import” button
- From the “Analysis” tab, match the appropriate test codes
- From the “Matrices” tab, match the sample preservatives
- From the “Container” tab, select “Default”
- Click “Done” and the new work order screen will appear

7.3 Work Order Information Editing

- Select the work order from the dropdown menu and click “Edit”
- Select the project from the drop down menu in the top right corner
- The Project number and the PO number should match the TDF for the project
- In the “Submitted By” window, select the appropriate sampler from the drop down menu
- In the “SDG Identifier” window, type in the TDF number
- In the “Shipped By” window, select either “Walk-in” or “FedEx” from the drop down menu. If shipping was by Fed Ex, enter the tracking number in that window.
- Select the turn around time to calculate the appropriate due date for the project
- Check the appropriate “Condition” boxes for the samples received
- Ensure the Analysis Test Codes are accurate and add/delete as needed
7.4 Editing Samples in the Work Order

- Click on the “Samples” tab and “Edit”
- Verify that the sample name, container, location, and comment (EPA Tag #) are correct
- In the “Report Matrix” drop down window, select the one listed on the COC
- In the “Sample Type” drop down window, select “Field Sample”
- In the “Sampled By” drop down window, select the one listed on the COC
- In the “Work Analysis” windows, the test codes may or may not be applied. If more tests are needed, click the “Work Analysis” tab to see all of the available test codes.
- Repeat sample entry/editing for all samples in the project
- Save the work order, and click the printer icon to print the sample information

7.5 Project Folder Creation

7.5.1 Master Project Folder
- Label a new folder with the work order number, project name, TDF number, and due date
- Place the original COC, TDF, and the shipping label in this folder
- Place the LIMS printout of the samples entered in this folder
- Place any E-mail or other documents pertaining to the project in this folder
- All analytical data will be placed in this folder until final report generation

7.5.2 Analytical Folder
- On the LIMS computer, go to “Explore”
- Go to the “X” drive and click on “Metals_Data_Files”
- Select the appropriate year
- Go to “File”, “New”, “Folder”
- Name the new folder using the following format: Work Order_TDF Project Name (e.g., C606006_SC010 CalGulch June Monthly)
- Repeat the file creation sequence in “WetChem_Data_Files” if the project requires this type of analysis

7.5.3 Reporting Folder
- On an ESAT computer (not the LIMS computer), navigate to the appropriate Task Order (TO) folder on the network drive
- Click on “Analytical Reports” and then “Final Reports”
- Go to “File”, “New”, “Folder”
- Name the folder using the same convention as the Analytical Folder (Section 7.5.2)

8.0 Data and Records Management

- The sample checkout logbook is maintained by ESAT quality assurance (QA)/ QC personnel
- Completed logbooks are archived and new ones provided when necessary
- EPA QA/QC personnel verify thermometer calibration and log cooler temperatures daily
- COC records, LIMS reports, and all other correspondence become part of the ESAT retained records data file
- All custody records and entries in the sample checkout logbook will be recorded in blue or black indelible ink
- When an entry error occurs, the author will draw a single line through the error, initial and
date, and record the correct information. If the space is too small for further legible entries, either the next line will be used or the correction must be footnoted to ensure legibility of the correct entry.

- Internal audits will be conducted periodically by the ESAT QAO or designee to verify the procedures outlined in this SOP are being performed.
- Refrigerated cooler temperatures are checked and recorded daily according to EPA Region 8 SOP EQOP-805, *Monitoring Refrigerator and Cooler Temperatures*, current version.

9.0 Waste Minimization

- The analyzed samples are separated for consolidation and disposal. Refer to ESAT SOP 16-LAB-01.XX, *Collection, Analysis and Disposal of Laboratory Waste*, current version.
- Plastic sample tag holders are reused, as are the washable trays, coolers, and carts. Sample containers are not reused due to high possibility of cross contamination.
- In order to minimize contamination of large volumes of liquids, compatible samples marked for disposal will be consolidated without further dilution.
- Field coolers and some packing materials (e.g., foam, bubble wrap) can be cleaned, dried, and reused.

10.0 References

- EPA Region 8 Laboratory HSP-001, *Chemical Hygiene Plan*, current revision
- EPA Region 8 Laboratory SOP EQOP-805, *Monitoring Refrigerator and Cooler Temperatures*, current revision
- EPA Region 8 Laboratory SOP GENLP-808, *Sample Receipt and Custody*, current revision
- ESAT Region 8 SOP 16-LAB-01.XX, *Collection, Analysis and Disposal of Laboratory Waste*, current revision
- ESAT Region 8 Health and Safety Plan, current revision
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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to document standard practices in the use of the In-Situ® multi-parameter water quality meter. For optimal performance, refer to the In-Situ® Multi-Parameter Troll® 9500 Operator’s Manual and the Rugged Reader® Operator’s Manual (Attachments 1 & 2).

2.0 APPLICABILITY/SCOPE

This SOP is applicable only for In-Situ® water quality meters. Water quality parameters of interest for purposes of this SOP include pH, dissolved oxygen (DO), specific conductance, turbidity, and temperature readings.

3.0 SUMMARY OF METHOD/PROCEDURE

Water quality measurements are a critical component of field sampling activities. Water quality meters are versatile tools for various measurements of water quality. For field sampling purposes, water quality meters are calibrated on site before use to account for barometric pressure. The main parameters for surface water quality are pH, DO, specific conductance, and temperature. These parameters are built in to the In-Situ® Rugged Reader® Troll® device and its Pocket Situ 4 Software. Once calibrated, sampling teams have up to 24 hours to record water quality readings if barometric pressure conditions remain constant (see Section 10.2). Water quality data is recorded in a site-dedicated field logbook.

4.0 PERSONNEL QUALIFICATIONS & RESPONSIBILITIES

Any personnel involved with field sampling activities must be cleared for participation by their organization’s health and safety program plan. Personnel who will be collecting surface water quality data must be familiar with this and any other relevant SOPs, including the Sample Equipment Decontamination SOP FQP-5002, Sample Preservation SOP FQP-5000, and Sample Custody and Labeling SOP FQP-5001.
5.0 DEFINITIONS/ACRONYMS

mg/L milligram/liter
mL milliliter
μS/cm microsiemens/centimeter
DI Deionized
DO Dissolved Oxygen
EPA United States Environmental Protection Agency
GPS Global Positioning System
HASP Health and Safety Plan
PPE Personal Protective Equipment
RDO Rugged Dissolved Oxygen sensor
SAP/QAPP Sampling and Analysis Plan/Quality Assurance Project Plan
SOP Standard Operating Procedure

Health and Safety Plan (HASP): A site-specific plan that outlines safety hazards and hazard mitigation practices.

Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP): Site-specific documents that outline sampling and data quality objectives for a field sampling project.

Standard Operating Procedure (SOP): A set of written instructions that document a routine or repetitive activity followed by an organization (EPA, 2007).

6.0 EQUIPMENT & SUPPLIES

Equipment needed for collection of surface water quality data may include:

Water quality collection device – Multi-parameter Troll® 9550 and the Rugged-Reader®

General Maintenance Kit - Spare D cell batteries (for sonde and Rugged Dissolved Oxygen sensor [RDO] calibration chamber), cotton swabs, mild detergent, silicon lubricant, O-rings (sensor and sonde size), spare RDO cap, reference electrode filling solution, spare Teflon reference junction, pH storage solution, small bottle brush and DI water.

Personal protective equipment (PPE) – personal floatation device, waders, gloves, proper footwear, safety glasses, insulating clothing for cold water, etc.
Mapping and location tools – Global Positioning System (GPS) units, site and local area maps, compass, tape measure, survey stakes, pin flags, camera, two-way radios

Documentation – field logbook or field data sheet(s)

Calibration standards – see Section 7.0, Reagents and Standards

7.0 REAGENTS & STANDARDS

Certified standards are required for calibration of the RuggedReader® In-Situ® water quality multi-parameter meter. pH calibration can be done at one to three points using buffer solutions at pH 4, 7, or 10. Specific conductance is calibrated with one point, usually at 1000 µS/cm. In addition to certified standards, it is best practice to also have spent standard, referred to as rinse, to use as probe conditioner in order to equilibrate the sensor. Refer to the Sampling Equipment Decontamination SOP FQP-5002 for decontamination guidelines.

8.0 HEALTH & SAFETY CONSIDERATIONS

When working with potentially hazardous materials or in hazardous situations, personnel must understand and comply with the site-specific Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) and Health and Safety Plan (HASP) before the sampling event begins. When taking water quality readings in streams or surface impoundments containing known or suspected hazardous substances, adequate PPE such as nitrile gloves, safety glasses, and waders are necessary to prevent exposure. If entering a stream, safety equipment (including a personal floatation device and non-slip footwear) should be worn in addition to general PPE. When taking measurements from a vessel in an impoundment or flowing waters, appropriate safety procedures and practices should be followed.

9.0 INTERFERENCES

Improper calibration of the instrument can lead to erroneous readings or equipment malfunction. For each calibration standard, be sure to condition the instrument or probe with a rinse of the appropriate standard before calibration. Additionally, the handheld Rugged Reader® unit should be fully charged before deployment to the field. If the unit fails to recognize the probe, make sure to check the batteries located in the upper part of
the probe, just below the interface cable connection. Note that batteries do not operate optimally in cold weather conditions.

10.0 PROCEDURAL STEPS/EQUIPMENT OPERATION

Commonly used procedures for the use of the Rugged Reader® In-Situ® water quality meter are provided in the following sections. Note that this equipment has many other functions, but only the most frequently used procedures for surface water sampling activities will be discussed. For further information on potential uses and capabilities, consult the Rugged Reader® and Troll® 9550 Operations Manuals (Attachments 1 & 2).

10.1. Pre-Deployment Activities

Before field deployment, it is important to check the equipment for functionality. The batteries to the Rugged Reader® should be charged at least 24 hours prior to use. The Troll® 9500 requires two D-cell batteries. Calibration frequency varies between sensor types on the multi-parameter meter and environmental conditions. Sensors should, at a minimum, be calibrated under the following circumstances:

- Each day prior to field sampling.
- When fouling of the sensors or sensor drift is suspected.
- When replacing sensor components such as the RDO cap, pH Teflon junction, or pH electrolyte. Only the altered sensor needs to be recalibrated.
- Any time the performance of the sensors may have been compromised.
- When site conditions (pH or specific conductance) are outside calibration range.

Additionally, consult the calibration frequency requirements mandated by sampling event protocols or project data quality objectives. It is recommended that water quality sensors be stored, calibrated, and maintained in accordance with the In-Situ® Multi-parameter Troll® 9500 operations manual. Sufficient time for thermal stabilization of standards to ambient conditions should be considered before calibration. To reduce the time for stabilization, all calibration standards and the In-Situ® equipment should be stored at the same temperature before starting calibration.

10.2. Field Water Quality Measurements – Data Collection
Once calibration (see Section 11.0 for calibration instructions) is complete, the user will be returned to the parameters screen.

1. To begin collecting water quality data, tap the **Parameters** icon once, then the **Profiler** option once. The next screen will ask the user to assign a test name. Enable the keyboard icon on the bottom of the screen and type in the Location ID for the site that is to be sampled. Once finished entering the Test Name, tap **OK**.
2. The screen will then display temperature, pH, specific conductance, DO, and barometric pressure data. Tap the icon on the bottom right of the screen that says **Continuous**. Allow several minutes for the readings to stabilize.
   - Note: make sure the readings are within a certain range of expectation.
   - Refer to previous readings at the site in the logbook, if available, to verify correct data ranges.
3. Once the readings have stabilized, tap the icon **Stop Log**. Before exiting out of the screen, record the readings in a project dedicated field logbook. Data should be recorded in the following units for each parameter: pH = standard units; DO = mg/L; specific conductance = μS/cm; and temperature = °C.
4. Once the data has been recorded in the logbook, tap the icon **close** on the bottom right of the screen. To begin collecting data at a different site, repeat these exact steps found here in this section.

### 10.3. Computer Hardware and Software

The In-Situ® Rugged Reader® and Multi-parameter Troll 9500 have many applications that will not be discussed in this document. For instructions on special uses of equipment software and hardware, see the Rugged Reader® Operator’s Manual and the Multi-Parameter Troll 9500 Operator’s Manual (attached in Section 17.0).

### 10.4. Troubleshooting

When problems are noted during the calibration procedure, check the following:

1. Make sure the parameter shown on the screen is the same parameter to which the unit is being calibrated.
2. Make sure the proper standard is being used for its corresponding calibration value (i.e. make sure not to calibrate specific conductance with a pH standard).
3. Verify that the standards used have not been contaminated.
4. Make sure the equipment and solutions are at the correct temperature for the calibration being performed.
5. Be sure to fill the calibration cup according to directions in the Troll® 9550 operations manual.
6. Make sure the pH reference electrode was filled with the proper pH filling solution.
7. Check the multi-probe housing and sensors for physical damage (cracked or bent electrodes) and fouling (tarnished, soiled, color change, or otherwise coated electrodes).
8. Check the multi-probe battery status. Recharge the unit if there are only one or two bars showing in the battery icon in the opening screen. There is also a battery voltage indicator under the parameters screen in the Pocket-Situ 4 software. If the Troll® 9550 batteries are running low, quit the Pocket Situ 4 software and replace the D-cell batteries.
9. The software will notify the user when the DO sensor cap is due to expire. Do not wait for the sensor to expire before replacing it.
10. If the above troubleshooting tips and maintenance procedures do not solve the problem, contact In-situ® technical support at 1-970-498-1500 or toll free at 1-800-466-1500 (Option 3).

10.5 Data Acquisition, Calculations, and Data Reduction

Data collection procedures are outlined in Section 10.2. Data collected with the In-situ is automatically adjusted for temperature and pressure during the calibration process.

10.6 Data Review and Acceptance

Data collected either by hand or logged internally by the Rugged Reader® handheld device should be reviewed by the personnel who collected it before submittal or archiving. Suspect data should be flagged.

11.0 CALIBRATION – FIELD WATER QUALITY MEASUREMENTS

Many sampling sites in EPA Region 8 are located at various elevations with differing barometric pressures, and as a result, re-calibration of the water quality sensors will occur at a greater frequency than manufacturer recommendations. Upon arrival on a site, it is recommended that a 500mL bottle of tap water be used to begin aeration of the optical DO sensor. Specific conductance and pH calibration can occur while the water aerates. In general, most mine effluent sites have pH values between 4.0 and 7.0. Therefore, only a 2-point calibration with 4.0 and 7.0 pH buffer solutions is necessary. If deployed to a site where pH values are completely unknown, perform a 3-point calibration (adding the 10.0
calibration). Below are calibration procedures for pH, specific conductance, and DO measurements.

### 11.1. pH Calibration

Connect the Troll® 9500 to the Rugged Reader® with the interface cable and power on the unit. From the starting screen, tap **Start** (located on the upper right corner of the screen) with the stylus. The Start menu is the main access point to all programs, files, and settings loaded on the Rugged Reader®. If this is the first time the Troll® 9500 is connected to the Rugged Reader®, follow the instructions for using the Connection Wizard in the Rugged Reader® Operator’s Manual (for subsequent uses, tap on the COM1-19200 line in the navigation window). If the Troll® 9500 is not recognized in the navigation window you may have to “find” the device. Do this by tapping the COM port (labeled as COM1-19200) and then tap **Find** located in the lower right hand corner. The information for the Troll® 9500 should appear in the Rugged Reader® navigation screen. If there is no connection to the Troll® 9500, check cable connections and battery status. Once the Troll® 9500 connection appears as a line in the navigation window, tap to open the **Parameters** option. Tap this twice in order to bring up the sensors that are currently connected to the probe (this should always be pH, specific conductance, DO, temperature, and barometric pressure). From this menu, tap **pH**. Three options will appear at the bottom of the screen, select **Calibrate**.

#### 1. This will bring up the calibration setup menu. Select number of calibration points desired (usually 2). Make sure the fields are populated with the desired calibration values. Select **Next**.

#### 2. Start the pH calibration with the lowest standard. Use the pH 4.0 buffer rinse to condition the sensor, empty the cup, and then place certified pH 4.0 buffers in the calibration cup up to the fill level line. Press **Run**.

#### 3. The sensors will take a few moments to stabilize for temperature and pH. Once stabilized, the screen will immediately prompt for the next standard. Follow the same procedure by first conditioning the sensor with the pH buffer rinse, then fill the calibration cup with the certified buffer. Press **Run** again.

#### 4. Once the final calibration has stabilized, the user will be given the option to view the calibration report. Click **Yes** to view the report and record the final calibration results in the instrument-dedicated calibration logbook. Click the “x” in the top right hand corner to
close the report screen and return to the menu screen. Record the pH buffer lot number and expiration date in the instruments calibration book.

11.2. **Specific Conductance Calibration**

To calibrate for specific conductance, select the **Conductivity** option from the parameters menu by tapping it once, then select **Calibrate** by tapping it once. This will bring up the calibration setup menu.

1. This menu allows the user to select the standard intended for use. If the standard being used does not appear as one of the options, select **other** and input the desired standard. Tap **Next**.
2. Condition the sensors by saturating with specific conductance rinse of similar concentration, and then fill the calibration cup with the certified standard. Make sure to fill the cup all the way to the fill line.
3. Once the calibration is stabilized, the user is given the option to view the calibration reports. Select **Yes** and record the new calibration results in the instrument-dedicated calibration logbook. Click the “x” in the top right hand corner to close the report screen and return to the menu screen. Record the conductivity standard lot number and expiration date in the logbook.

11.3. **Dissolved Oxygen Calibration**

Finally, the optical DO sensor should be calibrated. If the other parameters were calibrated first, there should have been sufficient time to saturate a 500 mL wide-mouth container of tap water with oxygen (10-15 minutes). Remove the aeration device before calibration. From the parameters menu, tap once on the **Rugged Dissolved Oxygen** icon, then once again on the calibration option at the bottom of the screen.

1. The first screen allows the user to edit the barometric setting. Select **Yes**.
2. The next screen will give the user options as to how the barometric setting should be calculated into the DO calibration. Select the **Use Vented Cable** option, and then tap **OK**.
3. The following screen gives the user the choice of: 1) restoring default settings and calibrating, 2) restoring defaults and not calibrating, and 3) calibration only. Select the **Calibrate Only** option, and then tap **Next**.

4. Place the DO probe in the saturated tap water, then tap the **Run** button. The sensor will take a few moments to equilibrate for temperature and DO.

5. Once stabilized, the unit will prompt for a zero oxygen calibration. To skip this, simply tap the **Next** button. To finish the calibration, tap the **Finish** button.

6. The user will be given the option to see the calibration reports. Select **Yes** and record the calibration information in the instrument dedicated logbook. Click the “x” in the top right hand corner to close the report screen and return to the menu screen.

12.0 MAINTENANCE

Proper maintenance of the RuggedReader® and Troll® 9500 can assist in reliable data collection and longevity of the equipment. Below are some of the key components of basic care for the In-Situ instruments.

12.1. RuggedReader® Maintenance

12.1.1. Storage

*Short Term Storage (less than two weeks):*

1. Back up any logged data onto a desktop computer or other external storage device.
2. If possible, store device indoors to protect from large temperature fluctuations.
3. Suspend the device by pressing the power button briefly and releasing.
4. Leave the battery pack in the device.

*Long Term Storage (greater than two weeks):*

1. Back up any logged data onto a desktop computer or other external storage device.
2. Close all programs that may be running on the device.
3. Charge the battery to full capacity.
4. Press the power button until the power menu appears, then select “power off”.
5. Store the handheld unit in a dry, safe place.

12.1.2. Cleaning

*Touchscreen:*

1. Suspend the device using the power button.
2. Apply mild cleaning solution such as window cleaner or another all-purpose cleaner to a microfiber cloth and gently apply to touchscreen. Do not use tissues or paper towels to clean touchscreen.

3. Rinse screen with water and use microfiber cloth to dry. The device can now be turned back on.

**Case and Communications Module Cleaning:**

1. Use mild cleaning solution and a soft toothbrush to clean dirty areas.
2. Rinse with water, and use microfiber cloth to blot dry.

Never attempt to make repairs on this device. Doing so will void the manufacturer’s warranty. For a more comprehensive care instructions, see Attachment 1, *RuggedReader Operator’s Manual.*

### 12.2. Troll® 9500 Maintenance

The Troll® 9500 comes with several items that are necessary for proper storage and maintenance such as dust caps, desiccant caps, replacement o-rings, and vacuum grease. Components such as o-rings should be checked before every use to prevent damage caused by moisture getting into unwanted areas. Below are basic guidelines for care of the Troll® 9500. For more comprehensive care instructions, see Attachment 2, *Multi-Parameter Troll® 9500 Operators Manual.*

#### 12.2.1. Storage

1. The Troll® 9500 should be stored in a clean, dry place. Use the red dust caps to cover the cable ends to protect them.
2. Store in an area that is safe from mechanical shocks and temperature extremes.
3. For long-term storage of sensors, a pH 4.0 buffer and potassium chloride solution is used to prevent corrosion and crystal build up. Tap water can be used as a temporary storage solution.
4. Sensors can also be stored by placing them in their original packaging. Remember to place plugs in the dry sensor ports

#### 12.2.2. Cleaning/O-ring replacement

1. Damaged or compromised (tears, cracks, excessive dirt, splits, desiccated) O-rings should be immediately replaced.
2. Remove all pieces of the O-ring and clean the affected surfaces. Apply the supplied O-ring grease to the surfaces and new O-rings, and re-assemble.
3. The body and sensors should be thoroughly rinsed and wiped with lint-free wipes. If a more
detailed decontamination is necessary, consult SOP FQP-5002 Sample Equipment Decontamination for further instructions.

13.0 WASTE MANAGEMENT & POLLUTION PREVENTION

Used calibration standards should be properly contained and brought back to the facility that it originated from. Consult the chemical hygiene plan for proper disposal. Never discard parts or batteries from the In-Situ into regular municipal waste. Broken pieces of equipment should be returned to the manufacturer, batteries should always be recycled.

14.0 DATA & RECORDS MANAGEMENT

All data and measurements must be recorded in the site-dedicated field logbooks. This data will be entered into a spreadsheet and published in Scribe. Any recording errors should be struck out with a single line through the incorrect value, initialed by the recorder, and then re-recorded with the correct value. All calibration or repair data should be recorded in the equipment-dedicated field logbook. For each calibration the following data should be recorded:

- Date
- Time
- Location or Project
- Person performing the calibration
- Results for each parameter calibrated
- Standard and Buffer information (manufacture, lot number, and expiration date)

All data logged in the Rugged Reader® unit during collection should be transferred to a computer as soon as possible. To do this, the computer must have the ActiveSync® and Win-Situ 4® software installed, which can be found on the in-situ website (www.in-situ.com). Once the software is installed, connect the Rugged Reader® to the computer using the supplied USB cord and follow the on-screen instructions to sync the Rugged Reader® to the computer. After the Rugged Reader® has finished syncing, open Win-Situ 4®. Each site location will have its own file which is organized by Troll® unit number. To export each file into excel go to the file menu and select Export to Excel. These files should be included as attachments in reports summarizing field activities.

15.0 QUALITY CONTROL & QUALITY ASSURANCE
Personnel who use these instruments will calibrate the In-situ® each day before use and will perform maintenance procedures as needed. If personnel feel uncertain about the quality of measurement data in the field, performance of the instrument will be checked using a known calibration standard or buffer. Corrective actions will be determined on a case-by-case basis with all circumstances being considered. Data will be flagged as needed in the final data package.

16.0 REFERENCES


17.0 ATTACHMENTS


This document was prepared by the ESAT Region 8 Team and is intended to provide documentation of administrative, analytical and quality control procedures used in the daily performance of ESAT support services. This is a controlled document and may only be provided to a third party, such as consultants or other government agencies, at the direction of EPA and if all said third party recipients agree that the contents of this document remain confidential. If the document is provided as a controlled document the user agrees to surrender the document upon request of EPA or ESAT Region 8. If the document is provided as an uncontrolled document, the user understands that subsequent revisions may not be provided.
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1.0 SOP Description

This standard operating procedure (SOP) describes the procedures for safely collecting, storing, analyzing, and disposing of laboratory waste. This SOP is applicable to the following aqueous waste streams: acidic instrument waste, acidic reagents (except standards), sample digestates, and samples preserved for analysis with acid. This SOP is also applicable to solid wastes such as soils, vegetation and biota samples.

Aqueous samples, digestates, reagents, and some instrument wastes contain small amounts of mineral acids. The presence of these acids causes the pH of the waste to be below 2, and hence, be defined as hazardous. In addition, these wastes may contain metal concentrations which exceed discharge standards.

Solid wastes may contain metal concentrations which exceed disposal standards. This waste must be properly labeled, contained, and stored in accordance with all state and federal regulations. This SOP includes the initiation of satellite waste containers, documentation accompanying the waste, and procedures for placing the waste in the designated waste storage area.

2.0 Acronyms and Definitions

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>CHP</td>
<td>Chemical Hygiene Plan</td>
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<tr>
<td>EPA</td>
<td>United States Environmental Protection Agency</td>
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<tr>
<td>ESAT</td>
<td>Environmental Services Assistance Team</td>
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<tr>
<td>GHS</td>
<td>Globally Harmonized System for Classification and Labeling of Chemicals</td>
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<td>HASP</td>
<td>Health and Safety Plan</td>
</tr>
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<td>HSO</td>
<td>Health and Safety Officer</td>
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<tr>
<td>HWTS</td>
<td>Hazardous Waste Tracking System</td>
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<tr>
<td>LIMS</td>
<td>Laboratory Information Management System</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
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<tr>
<td>SHEMP</td>
<td>Safety, Health and Environmental Management Program</td>
</tr>
<tr>
<td>Satellite Waste Container</td>
<td>A container used to collect waste during generation (see 40 CFR 261.31)</td>
</tr>
<tr>
<td>Secondary Containment</td>
<td>A second level of containment ensuring no release if the initial containment fails</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
<tr>
<td>WCO</td>
<td>Waste Control Officer</td>
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3.0 Health and Safety

Follow general laboratory health and safety policies and regulations in the current versions of the Environmental Services Assistance Team (ESAT) Health and Safety Plan (HASP) and the United States Environmental Protection Agency (EPA) Region 8 Chemical Hygiene Plan (CHP) when handling wastes. The use of laboratory equipment and chemicals exposes the analyst to several potential hazards. Good laboratory practices should be followed at all times.

Solutions classified as aqueous corrosive wastes normally contain percentage levels of mineral acids and can contain certain inorganic elements known to be hazardous. Avoid contact with water or wastewater samples. Personal protective equipment (PPE), such as gloves, protective eye wear and laboratory coats, should be worn at all times when handling samples, reagents, or when in the vicinity of others handling these items.
Satellite waste containers must always be tightly capped when not in use. Satellite waste containers can weigh in excess of 50 pounds and should be lifted carefully.

When in doubt as to the proper procedure to follow, contact the EPA Health and Safety Officer (HSO) for guidance. Personnel should minimize exposure to potential health hazards through the use of engineering and administrative controls, work practice procedures, and proper PPE.

4.0 Personnel Qualifications

Personnel responsibilities for hazardous waste management at the EPA Region 8 laboratory are described in the Introduction/Executive Summary of the Safety, Health and Environmental Management Program (SHEMP) Manual (Section 2.2 Hazardous Waste Management).

Federal and state regulations require that employees who handle hazardous waste be provided with initial and annual training. Initial orientation and on-the-job training are provided to new ESAT employees within their first month of employment, and refresher training is provided on an annual basis thereafter. This training is designed to keep employees familiar with waste handling procedures in place at the Region 8 laboratory, along with applicable regulations. Training completion will be enforced by the supervisor and documented for each individual by the HSO.

5.0 Equipment and Supplies

The EPA Waste Control Officer (WCO) will ensure that a supply of appropriate waste containers and labels are available for use. The WCO is responsible for maintaining control of all documentation of waste disposal.

Waste containers must be able to be tightly capped, and both the container and the secondary containment must be chemically resistant to corrosive materials.

6.0 General Procedures

6.1 Satellite Waste Container Preparation

6.1.1 Labeling the Waste Container

The waste container will be properly labeled as appropriate. A waste container ID is assigned to the container by the person who initiates the container's designation. The container ID must be written on the container with a permanent marker in a location that is easily seen.

The format for the container ID is “YYMMDD-XXXX- #” where “XXXX” is the laboratory room number and “#” is the sequential number of the container generated on that particular day.

Affix an appropriate red and white hazardous label for containers used for suspected or known hazardous materials on the waste container. Affix the proper Globally Harmonized System for Classification and Labeling of Chemicals (GHS) label for hazard communication warning of the presence of corrosives (pH<2) when the contents to be added to the container are known to be acidic.

6.1.2 Waste Container Inventory Log

The waste container inventory log must be initiated and placed next to the
container. The hazardous waste container inventory log is either attached or located in the near vicinity of the waste container, and lists the accumulated waste maintained by the generator(s).

The waste inventory log must include the container ID number and its date, description and amount of waste added, date of the addition, and the name of the person making each addition.

**Note:** The waste inventory log serves two important purposes. It guards against addition of incompatible chemicals to the container mix, and it allows packers to determine the correct classification of the waste for transport and disposal.

### 6.2 Waste Collection and Analysis

#### 6.2.1 Waste Collection

Waste must be collected as near as possible to the point of generation and have secondary containment.

Containers must be kept closed except when waste is being added. When a container of waste is approximately 85% full, the waste inventory sheet must be signed, dated and entered into the inventory system by the WCO.

Waste containers that are full or otherwise ready for disposal will be transported to the F wing where the wastes are segregated by waste categories.

Each unit will be labeled with the start of accumulation date and, as appropriate, a “hazardous waste” or “non-hazardous waste” label.

#### 6.2.2 Waste Analysis

**Aqueous Waste**

Aqueous waste containers must be sub-sampled. The waste inventory sheet must be filled out and transported to the waste storage area within 24 hours and must be clearly labeled as “Awaiting Analysis.”

Analysis of each aqueous waste container must be completed within 10 days. The results are then entered into the waste inventory sheet.

**Solid Waste**

Solid wastes designated for disposal are collected in an approved container.

In lieu of analyzing the solids, the data collected during the analysis of the samples is used to indicate the level, if any, of metals concentration in the solid waste. In general, segregating the solids into Laboratory Information Management System (LIMS) Work Order-specific groups will make calculating the metals concentration less complicated.

A copy of the completed solid waste inventory sheet, along with the raw data, is provided to the WCO, and the original is attached to the waste container.
6.3 Waste Minimization

Metals laden waste volumes are minimized by the use of a dedicated waste receptacle in which no other laboratory waste is placed.

Waste concentrations are minimized by judicious use of metals standard solutions and materials. In addition, ESAT chemists work with field personnel to reduce the amount of excess sample collected.

7.0 Data and Records Management

Waste is tracked through the use of container labels, waste container logs, an in-house tracking system, physical inventories, hazardous waste shipping manifests, and certificates of disposal.

Data from waste container sheets for wastes generated in the laboratory is entered into the Hazardous Waste Tracking System (HWTS) by the WCO at the time of transport to the F-wing.

8.0 References

EPA Region 8, Chemical Hygiene Plan, current version
EPA Region 8, Health and Safety Plan, current version
EPA Region 8, Waste Management SOP, current version
## Document Change History

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\(^1\) Status: I = Initial, R = Revision, or C = Cancelled
U.S. EPA Region 8
Field Data Collection Using GPS and Collector for ArcGIS

Region 8 Ecosystems Protection and Remediation
Program Support
Data Systems Unit
GIS

Version 1.0
March 21, 2017

Document Revision History
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Contacts

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1.0 PURPOSE
The purpose of this Standard Operating Procedure (SOP) is to provide personnel a standard approach for the use of a Global Positioning System (GPS) for data collection during field activities.

2.0 APPLICABILITY/SCOPE
This SOP is specifically intended for personnel who conduct field work using ESRI’s Collector for ArcGIS on an Apple iPad coupled with a Trimble R1 GNSS GPS receiver.

3.0 SUMMARY OF METHOD/PROCEDURE
This SOP covers the use of Collector for ArcGIS on an Apple iPad coupled with a Trimble R1 GNSS GPS receiver for field data collection. This SOP is based on Esri’s (manufacturers’) instructions. Using Collector on an iPad requires preparing map layers in an office setting and downloading those maps to the iPad when connected to WiFi or Cellular signal. Prior to entering the field, users should login to the maps on the iPad while connected to WiFi or Cellular signal to avoid the possible disruption of WiFi or Cellular service in the field.

4.0 PERSONNEL QUALIFICATIONS & RESPONSIBILITIES
Personnel who will be collecting data with the specified equipment should practice with the equipment before use. Additionally, personnel who conduct fieldwork should familiarize themselves with the standard health and safety practices associated with the particular field event they are participating in.

5.0 ACRONYMS/DEFINITIONS
EPA United States Environmental Protection Agency
GIS Geographic Information System
GNSS Global Navigation Satellite System
GPS Global Positioning System
HASP Health and Safety Plan
SDE Spatial Data Engine
SOP Standard Operating Procedure
Geographic Information System (GIS): A system of hardware and software used for storage, retrieval, mapping, and analysis of geographic data.

Global Positioning System (GPS): A navigational system involving satellites and computers that can determine the latitude and longitude of a receiver on Earth by computing the time difference for signals from different satellites to reach the receiver.

Collector for ArcGIS: Software used on mobile devices that captures and stores locational data and attributes of features collected in the field.

Trimble: A private GPS Company that provides hardware, software, and technical support, including the R1 GNSS GPS units and the Trimble GNSS Status application.

6.0 EQUIPMENT & SUPPLIES

- Trimble R1 GNSS GPS unit and accessories.
- Apple iPad and accessories.
- Computer and/or external hard drive and accessories.

7.0 HEALTH & SAFETY CONSIDERATIONS

There are no health and safety issues requiring mention in this SOP; however, refer to the applicable site-specific Health and Safety Plan (HASP) any time field work is conducted.

8.0 PROCEDURAL STEPS/EQUIPMENT OPERATION

8.1 Establishing Bluetooth connection between the iPad and the Trimble R1 GNSS Receiver.

To establish a Bluetooth connection between the iPad and the Trimble R1 GNSS receiver, open the iPad’s Settings App and tap on “Bluetooth” to enable a Bluetooth connection. Follow the printed Trimble instructions for enabling a Bluetooth connection for the Trimble R1 GNSS receiver that accompanied the GPS unit. Once enabled, the device will be listed in the “My Devices” window.

Figure 1: Establishing a Bluetooth connection on an iPad
As shown in Figure 2, open the Trimble R1 GNSS Utility application to view satellite constellation and reported accuracy. It is recommended that you give the receiver 5-10 minutes on initial start up to lock in signals from satellites. To assist in locking onto satellites it is recommended that the user maintain an unobstructed view of the southern sky. Once a connection is established, the user can open the Collector for ArcGIS application.
8.2 Collector for ArcGIS Application

To open the Collector for ArcGIS application, you begin by tapping on the Collector App icon on the home screen. Opening the application requires signing into the EPA GeoPlatform Online when connected to WiFi or Cellular signal. Using the application is restricted to EPA and ESAT personnel only due to Collector’s reliance on the EPA Single Sign-on.

In order to sign into the EPA GeoPlatform Online, choose the first option, “ArcGIS Online” (see Figure 4) and choose to Sign in with an “Enterprise Account.” Then enter “epa” to complete the url as epa.maps.arcgis.com. Sign into EPA GeoPlatform Online “Using Your ArcGIS Account.” Use the device ID and Password specific to the iPad you are using.
Figure 4: Collector for ArcGIS sign in to EPA GeoPlatform Online
Once Collector for ArcGIS is opened, choose the appropriate map project. The Cloud icon with up and down arrows indicate that a map is stored on the device and is available for use in the field without WiFi or Cell service; see Figure 5.

Figure 5: Map project thumbnail indicating downloaded on device

Open the map on the iPad by touching the thumbnail. The map will center to you current position by tapping the icon 🪴.

8.3 Settings in Collector for ArcGIS

Before beginning field collection, you must ensure that the appropriate settings have been applied. On the “Maps” screen in Collector, tap on the Action icon and choose “Settings.” Under “Location” click “Provider” and confirm the Trimble Unit that you have connected to with Bluetooth is listed and checked. Then set the height above ground to where you will be carrying the unit (example: 1 meter) by clicking the “information” icon.

8.4 Capturing New Features with Collector

When you are ready to collect a new feature, click on the “+”, plus symbol that brings up a form that can be filled out; see Figure 6. Your GPS location will be logged by Collector via the Bluetooth connection to the Trimble R1 GNSS receiver. For point locations, the GPS coordinates will be logged and your Latitude and Longitude will be reported at the top of the form. For line and polygons, you must press “Start Streaming” before walking the line or polygon feature. You can press “End Streaming” to finish collecting the feature.

Figure 6: New feature form for Collector for ArcGIS
8.5 Updating Existing Features with Collector

Field personnel have the ability to make updates to locations that have been pre-loaded to the Collector for ArcGIS application. This may occur when changes to the location (Latitude and Longitude), changes to attributes, or collecting new pictures are necessary. When updating an existing feature, tap the feature on the map to bring up the item details. Select the Action icon and select “Edit.” Fill out the form as necessary. When finished, click the “Update” button located in the top right of the screen; see Figures 7 and 8.
Figure 7: Pop Up showing details for a selected map feature.
8.6 Syncing Field Collection Data from the iPad.

Once collection is completed and you are in an area with WiFi and connected to the internet, sync the map by returning to the “Maps” page and pressing the Sync button, see icon below. It is recommended that this is completed nightly and is the responsibility of the Field Data Collector. This action will load the field data to the EPA Geoplatform, where the GIS team can then manage the data.

9.0 NAVIGATION

Navigating using Collector of ArcGIS occurs by selecting the sample location in the map and tapping on the action button and select “Directions to here.” Routing information will be created based on the current location of the sampler.

10.0 CALIBRATION
There is no calibration requirement associated with this SOP.

11.0 MAINTENANCE

GPS maintenance must be performed by qualified GIS staff during the offseason as appropriate. This process involves firmware updates that are published by Apple and Esri. Hardware updates include visual and physical checks and the replacement of equipment as needed. Please report any equipment issues to the GIS team as soon as they are discovered.

12.0 WASTE MANAGEMENT & POLLUTION PREVENTION

Use of the GPS produces no waste. There are no waste management requirements associated with this SOP.

13.0 DATA & RECORDS MANAGEMENT

Once field data is synced, the remaining data and records management must be handled by qualified GIS staff. Any and all work related to data and records management should be processed and stored on the appropriate network location. After a field event, the File GeoDatabase (.gdb) and Comma Separated Values file (.csv) are downloaded from the EPA Geoplatform and archived at the appropriate network location. Attribute values from the data collection event are to be forwarded to a data manager for processing and upload to the appropriate data management system. Any new sample locations, updates to current sample locations, or features collected are then added to the Regional GIS enterprise geodatabase and made available to Regional staff.

14.0 QUALITY CONTROL & QUALITY ASSURANCE

All data received by GIS staff from field personnel are reviewed under Regional GIS guidelines. Data received is reviewed for positional error using spot checking and review of field notes. Attribute information is reviewed for misspellings, inaccuracies, and operator error before being published. All data processing performed by a GIS staff member must be reviewed by another staff member to assure quality control.

15.0 REFERENCES

Link to the Trimble R1 GNSS Manual.
Quick Start Guide

Trimble R1
GNSS RECEIVER

⚠️ CAUTION: Please read the full user guide including all safety warnings, before operating this product.

PDF

Transforming the Way the World Works.

Trimble®
CHARGING AND OPERATION

1. Charge battery

2. Turn on

   1. Hold Power button
      - LED = 
      - LED = 

   2. When LEDs = 
      release Power button.
      After a few seconds,
      - LED = ... ... ...

3. Bluetooth connection

   1. Place the R1 GNSS receiver in pairing mode:
      hold Power button for 5 seconds
      until LED = 

   2. Pair the receiver with your device:
      - For Windows® 7 and 8.x,
        Windows Embedded Handheld 6.5,
        and Android® 4.1.x and later,
        connect using Trimble field software,
        or use the Trimble GNSS Status utility.
      - For iOS, use Settings > Bluetooth®.

LED INFORMATION AND POWER OFF

Bluetooth / GNSS LED (●●)

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Turn off

1. Hold Power button
   (●●) LED = ⚫
   ¬¬LED = ⚫

2. When (●●) LED = Off and ¬¬ LED = ⚫, release Power button.

If not connected via USB, both LEDs = Off; if connected, ¬¬ LED = ⚫, LED = current charging state.
Download Trimble GNSS Status utility

If you are not using Trimble field software, use the Trimble GNSS Status utility to configure the receiver for use with applications that accept NMEA messages. Download from:

- Windows, Windows Embedded Handheld: www.trimble.com
- Android: Google Play store
- iOS: iTunes

Made for
- iPhone 6 Plus, iPhone 6
- iPhone 5s, iPhone 5c, iPhone 5
- iPad Air, iPad Air 2
- iPad mini with Retina display
- iPad (4th generation)
- iPad mini

"Made for iPhone," and "Made for iPad" mean that an electronic accessory has been designed to connect specifically to iPhone or iPad, respectively, and has been certified by the developer to meet Apple performance standards. Apple is not responsible for the operation of this device or its compliance with safety and regulatory standards. Please note that the use of this accessory with iPhone or iPad may affect wireless performance.

iPad, iPhone and Retina are trademarks of Apple Inc., registered in the U.S. and other countries. iPad Air, iPad Air 2 and iPad mini are trademarks of Apple Inc.

Trimble Support

http://www.trimble.com/locator/locator.aspx

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U.S. EPA Region 8
Survey123 for ArcGIS

Region 8 Ecosystems Protection and Remediation

Program Support

Data Systems Unit

GIS

Version 1.0

March 21, 2017
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<td>Ryan Bahnfleth</td>
<td>1.0</td>
<td>Final</td>
</tr>
</tbody>
</table>

Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Role/Org</th>
<th>Telephone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>
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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide a standard approach for personnel to use a Global Positioning System (GPS) and the Survey123 application during field activities.

2.0 APPLICABILITY/SCOPE

This SOP is specifically intended for application by personnel who conduct field work using Survey123 for ArcGIS on an Apple iPad coupled with a Trimble R1 GNSS GPS receiver.

3.0 SUMMARY OF METHOD/PROCEDURE

This SOP covers the use of Survey123 for ArcGIS on an Apple iPad coupled with a Trimble R1 GNSS GPS receiver for field data collection. This SOP is based on Esri’s (manufacturers’) instructions.

4.0 PERSONNEL QUALIFICATIONS & RESPONSIBILITIES

Personnel who will be collecting data with the specified equipment should practice with the equipment before use. Additionally, personnel who conduct fieldwork should familiarize themselves with the standard health and safety practices associated with remedial clean-up operations.

5.0 ACRONYMS/DEFINITIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA</td>
<td>United States Environmental Protection Agency</td>
</tr>
<tr>
<td>ESAT</td>
<td>Environmental Services Assistance Team</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>HASP</td>
<td>Health and Safety Plan</td>
</tr>
<tr>
<td>SDE</td>
<td>Spatial Data Enterprise</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
</tbody>
</table>

**Geographic Information System (GIS):** A system of hardware and software used for storage, retrieval, mapping, and analysis of geographic data.

**Global Positioning System (GPS):** A navigational system involving satellites and computers that can determine the latitude and longitude of a receiver on Earth by computing the time difference for signals from different satellites to reach the receiver.
Survey123: Software used on iPad units that captures and stores spatial data and attributes of a sample location collected in the field.

Trimble: A private GPS Company that provides equipment and technical support, including the R1 GNSS GPS units and the Trimble GNSS Status application.

6.0 EQUIPMENT & SUPPLIES

- Trimble R1 GNSS GPS unit and accessories
- Apple iPad and accessories
- LTI TruPulse™ 360 Laser RangeFinder
- TruPulse™ 200B/36B Cheat Notes card
- Tape measure
- Flags
- Computer and/or external hard drive and accessories

7.0 HEALTH & SAFETY CONSIDERATIONS

Refer the applicable site-specific Health and Safety Plan (HASP) any time field work is conducted.

8.0 PROCEDURAL STEPS/EQUIPMENT OPERATION

8.1 Connecting the iPad to the Trimble GNSS Status app

To establish a Bluetooth connection between the iPad and the Trimble R1 GNSS receiver, open the iPad’s Settings App and tap on “Bluetooth” to enable a Bluetooth connection. Follow the printed Trimble instructions for enabling a Bluetooth connection for the Trimble R1 GNSS receiver that accompanied the GPS unit. Once enabled, the device will be listed in the “My Devices” window.
As shown in Figure 2, open the Trimble R1 GNSS Utility application to view satellite constellation and reported accuracy. It is recommended that you give the receiver 5-10 minutes on initial start up to lock in signals from satellites. To assist in locking onto satellites it is recommended that the user maintain an unobstructed view of the southern sky. Once a connection is established, you may now open the Survey123 application.
8.2 Survey123 for ArcGIS Application

Begin by tapping on the Survey123 Application icon

Sign in by tapping on the upper right-hand corner of the screen and choose Sign in.

Choose to Sign in with your EPA Enterprise Account

Type EPA to complete the url as epa.maps.arcgis.com
Sign in using Your ArcGIS Account. Use the device ID and Password specific to the iPad you are using.

After completing the Sign in, choose the project that you will be working on by tapping on the right hand corner and selecting Download Surveys. A list of surveys will appear, choose the appropriate survey for your field work and tap the following icon.

Once the Survey has downloaded tap on the survey and choose collect at the bottom of the screen.

Fill out the survey starting from the top to the bottom paying special attention to required fields which have a red asterisks *. Once your survey is completed, tap on the check mark to close that survey. Choose the Send Later option when in the field. When you have finished with collection for the day and you are in an area with WiFi and connected to the internet, send the completed surveys by returning to the Survey123 home page and pressing the Send Surveys Now option.

8.3 List of Fields to be Completed

<table>
<thead>
<tr>
<th>Sample Area</th>
<th>Area of Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location ID</td>
<td>Sample Location unique identifier</td>
</tr>
<tr>
<td>Metals Analyses 1</td>
<td>Fill out each entry with separate Metals Analyses to obtain unique Sample # in report.</td>
</tr>
<tr>
<td>Sample ID 1</td>
<td>Unique sample number for reporting in Scribe</td>
</tr>
<tr>
<td>Field</td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
</tr>
<tr>
<td>Metals Analyses 2</td>
<td>Fill out each entry with separate Metals Analyses to obtain unique Sample # in report.</td>
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<tr>
<td>Sample ID 2</td>
<td>Unique sample number for reporting in Scribe</td>
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<tr>
<td>Metals Analyses 3</td>
<td>Fill out each entry with separate Metals Analyses to obtain unique Sample # in report.</td>
</tr>
<tr>
<td>Sample ID 3</td>
<td>Unique sample number for reporting in Scribe</td>
</tr>
<tr>
<td>Sample Collection Type</td>
<td>Type of sample being collected. Select the appropriate radio button</td>
</tr>
<tr>
<td>Sample Matrix</td>
<td>Sample matrix to be collected</td>
</tr>
<tr>
<td>Date</td>
<td>Current date</td>
</tr>
<tr>
<td>Time</td>
<td>Current time</td>
</tr>
<tr>
<td>Environmental Conditions</td>
<td>Weather description, physical description of site, note anything that would adversely impact quality of measurement/sample</td>
</tr>
<tr>
<td>Form Author's Name</td>
<td>Who is completing this form?</td>
</tr>
<tr>
<td>Field Sampler's Name</td>
<td>Who is collecting the samples?</td>
</tr>
<tr>
<td>Water Quality Probe Barcode</td>
<td>Scan the Barcodes for this equipment</td>
</tr>
<tr>
<td>Flow Measurement Barcode</td>
<td>Scan the Barcodes for this equipment</td>
</tr>
<tr>
<td>TRM Bottle Lot Number</td>
<td>Scan the Barcode for this bottle</td>
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<tr>
<td>DM Bottle Lot Number</td>
<td>Scan the Barcode for this bottle</td>
</tr>
<tr>
<td>Alk/Anion Bottle Lot Number</td>
<td>Scan the Barcode for this bottle</td>
</tr>
<tr>
<td>Extra Field Equipment</td>
<td>Scan the Barcode</td>
</tr>
<tr>
<td>pH</td>
<td>ph reading as a number within the pH scale</td>
</tr>
<tr>
<td>Temperature</td>
<td>Degrees Celcius</td>
</tr>
<tr>
<td>Conductivity</td>
<td>Reading in µS/cm</td>
</tr>
</tbody>
</table>
## Dissolved Oxygen

Reading in mg/L

## ORP

Reading in mV

## Flow Measurement

CFS or flume measurements. Not a required field

## Remarks

Any further remarks concerning the sample location

## Location

GPS reading of current location

## Take Picture Upstream

Collect pictures upstream.

## Take Picture Downstream

Collect pictures downstream.

## Supplemental Picture

Include supplemental pictures as needed

## Author's Signature

Sign this form to testify that all is truthful

### 9.0 CALIBRATION

There is no calibration requirement associated with this SOP.

### 10.0 MAINTENANCE

GPS maintenance must be performed by qualified GIS staff during the offseason as appropriate. This process involves firmware updates that are published by Apple and Esri. Hardware updates include visual and physical checks and the replacement of equipment as needed. Please report any equipment issues to the GIS team as soon as they are discovered.

### 11.0 WASTE MANAGEMENT & POLLUTION PREVENTION

Use of the GPS produces no waste. There are no waste management requirements associated with this SOP.

### 12.0 DATA & RECORDS MANAGEMENT

All data and records management must be handled by qualified GIS staff. Any and all work related to data and records management should be processed under the Regional S: drive, also known as the “SAN.” After a field event, the File GeoDatabase (.gdb) and Comma Separated Values file (.csv) are downloaded from the GeoPortal and are
archived on the SAN. Attribute values from the data collection event are to be forwarded to a data manager for processing and upload to Scribe. Pictures are to be stored in accordance to the Site specific Data Management Plan. Any new sample locations, updates to current sample locations, or features collected are then added to the Regional GIS Spatial Data Enterprise (SDE) and made available to Regional staff.

13.0 QUALITY CONTROL & QUALITY ASSURANCE

All data received by GIS staff from field personnel are reviewed under Regional GIS guidelines. Data received is reviewed for positional error using spot checking and review of field notes. Attribute information is reviewed for misspellings, inaccuracies, and operator error before being published. All data processing performed by a GIS staff member must be reviewed by another qualified staff member to assure quality control.

14.0 REFERENCES

Attachment A

Blank Chain of Custody Form
<table>
<thead>
<tr>
<th>Location</th>
<th>Sub_Location</th>
<th>Sample Type</th>
<th>Collection</th>
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<th>Analyses</th>
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<th>Sample Time</th>
<th>Sampler</th>
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</table>

**Relinquished by (Organization and Signature)**

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Received by (Organization and Signature)</th>
<th>Date/Time</th>
</tr>
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