Quality Assurance Project Plan

Limited Site Investigation, Stimson Atlas Mill Property

3074 West Seltice Way, Coeur d'Alene, Idaho 83814

Tetra Tech Project #100-RED-T38956 / DEQ Task Order #28
Idaho DEQ EDMS Document No. 2019BBD35

June 5, 2019

TITLE & APPROVAL PAGE

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ACRONYMS / ABBREVIATIONS

Acronyms/Abbreviations	Definition
%	Percent
%R	Percent recovery
bgs	Below ground surface
CFR	Code of Federal Regulations
COI	Chemicals of Interest
DEQ	Idaho Department of Environmental Quality
DQOs	Data quality objectives
DU	Decision Unit
EPA	Environmental Protection Agency
FSP	Field sampling plan
g	Grams
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDTL	Initial Default Target Level
IDW	Investigation Derived Waste
ISM	Incremental Sampling Methodology
ITRC	Interstate Technology & Regulatory Council
LCS	Laboratory control sample
MDL	Method detection limit
mg/L	Milligrams per liter
mm	Millimeter
MS	Matrix spike
MSD	Matrix spike duplicate
OSHA	Occupational Safety and Health Administration
PARCC	Precision, accuracy, representativeness, comparability, and completeness
PM	Project manager
PPE	Personal protective equipment
PPM	Priority Pollutant Metal
PQL	Practical quantitation limit
QA	Quality assurance
QC	Quality control
QAM	Quality assurance manual
QAO	Quality assurance officer
QAPP	Quality assurance project plan

Acronyms/Abbreviations	Definition
QA/QC	Quality assurance/quality control
QMP	Quality management plan
RPD	Relative percent difference
RSL	Regional Screening Level
RUSL	Residential use screening level
SC	Specific conductivity
SOP	Standard operating procedure
SSHP	Site Safety & Health Plan
TO	Task Order
USGS	United States Geological Survey

1.0 DISTRIBUTION LIST

Table 1 lists the personnel and analytical laboratory contacts that will receive an electronic copy of the final, signed Quality Assurance Project Plan (QAPP). The distribution list consists of Idaho Department of Environmental Quality (DEQ), Tetra Tech, and laboratory personnel.

Table 1. Project QAPP Distribution List

Name	Project Affiliation	Organization and Location	Contact Number
Kiley Mulholland	Quality Assurance Manager	DEQ – State Office, Boise	208-373-0405
Eric Traynor	Program Manager	DEQ – State Office, Boise	208-373-0565
Steve Gill	Project Manager	DEQ – Coeur d'Alene Regional Office	208-666-0222
Derek Young, PG	Quality Assurance Officer	DEQ – State Office, Boise	208-373-0525
Jon Welge	Project Manager	Tetra Tech, Inc. – Spokane	509-344-0262
Suzy Cavanaugh, PG	Contract/Program Manager	Tetra Tech, Inc. – Boise	208-389-1030
Natalie Morrow	Quality Assurance Officer	Tetra Tech, Inc. – Missoula	406-543-3045
Ron Phillips	Project Geologist	Tetra Tech, Inc. – Boise	208-389-1030
Brian Ford	Laboratory Technical Services Representative	Pace National – Mt. Juliet TN	615-773-9747
Dianne Gardner	Laboratory Project Manager	SVL – Kellogg, ID	208-783-1288
J. R. Cantrall	Owner/Operator	Northern Lights Drilling LLC – Post Falls	208-818-5856

2.0 PROJECT / TASK ORGANIZATION

Table 2, below, presents key project personnel and their responsibilities. **Figure 1** provides a project organizational chart.

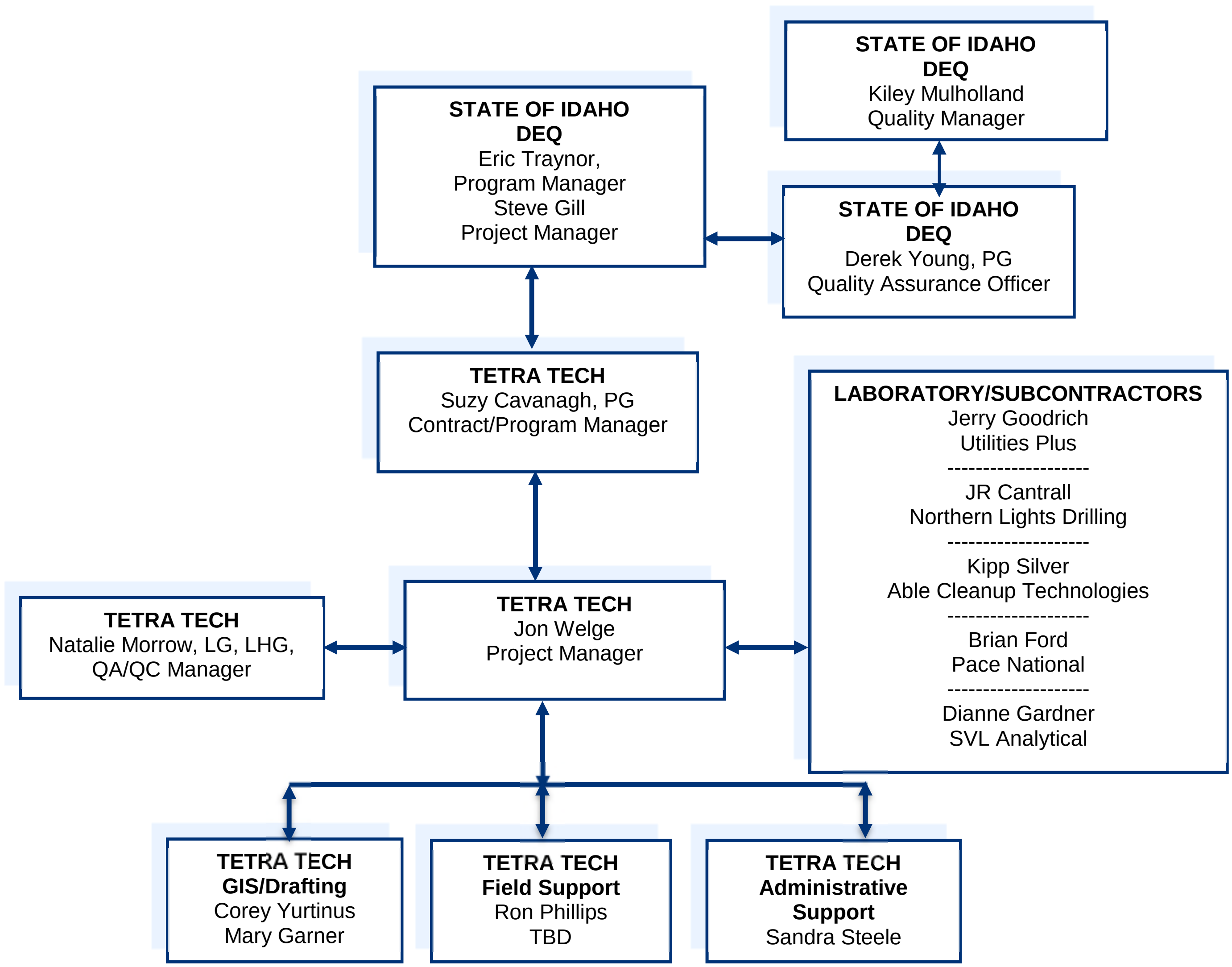
Table 2. Key Project Personnel & Responsibilities

Name	Project Title & Responsibility
Eric Traynor	**DEQ Program Manager** DEQ Brownfields Response Program Manager: Note: The following description is *not all inclusive*; see section 1.2.7 of the DEQ Quality Management Plan (QMP) (Idaho DEQ 2016) for a more detailed description. This person is the regional manager or State Office program manager for the project. Duties and responsibilities include: • Assists in the review of the QAPP and signs the final QAPP as an approver. • Confirms the project QAPP meets the needs of the program/region. • Ensures the QAPP is approved prior to the start of project work. • Ensures the program/regional procedures and policies referenced in the QAPP are current and approved for use. • Performs all duties and responsibilities as assigned in the project QAPP. • Selects and assigns a project quality assurance officer (QAO) who meets the criteria for independence defined in the DEQ QMP (see QAO duties below) and obtains approval for this selection from the DEQ quality manager.
Steve Gill	**DEQ Project Manager (PM)** The DEQ PM is responsible for the following. • Overall project planning and approval. • Reporting functions, project report/summary development, and documentation of all project activities in the EDMS and elsewhere as required by the project documents. • Ensuring all project work is conducted in accordance with the DEQ QMP and the approved project QAPP. • Ensuring that personnel assigned to this project are appropriately trained and qualified. • Performing periodic project reviews/audits in accordance with the DEQ QMP and provides data verification and validation per the project QAPP and associated field sampling plans. • As needed, provide reviews for project final reports. • Periodic review of the project QAPP over the project's duration and determine if revision is necessary. If the QAPP does require revision, the revised QAPP must be submitted for approval prior to implementation, per the DEQ QMP.

Name	Project Title & Responsibility
Derek Young, PG	**DEQ Project Quality Assurance Officer (QAO)** The DEQ QAO is responsible for the following. • Assisting in the development, review, and approval of the project QAPP, and project related documents. • Performing periodic project reviews/audits per the DEQ QMP and provide data verification and validation per the project QAPP. • As needed, perform reviews of project final reports. This individual has a direct line of communication to the DEQ Quality Assurance Director (QA Director) in project quality assurance matters. • Periodic review of the project QAPP to determine if revision is necessary. This process is designed to ensure that all DEQ QAPPs are approved, and issued, in accordance with the DEQ QMP. • The QAO shall not be the Project Technical Lead, the Project Manager, the Program Manager, or be otherwise assigned to the project data generation efforts. Neither the Project Manager nor the QAO may directly report to the other within the DEQ organizational structure. All assigned QAOs shall, prior to signing for the approval of any project QAPP, contact the DEQ QA Director to discuss the project. At that time, the DEQ QA Director shall also verify that the assigned QAO is on the authorized Project QAO list.
Jon Welge	**Tetra Tech Project Manager** Tetra Tech's PM is responsible for the following. • Overall project planning, document development and approval, scheduling field activities, data review, and verification, reporting functions, review project reports, and documentation of project activities under DEQ's direction. • Ensuring project work is conducted in accordance with the approved project QAPP. • Ensuring that personnel assigned to this project are appropriately trained and qualified, with the corresponding training records on file with Tetra Tech's human resources department. • Shall periodically review the project QAPP and determine if revision is necessary. If the QAPP does require revision, the revised QAPP must be submitted for DEQ's approval prior to implementation. • Disposal management of Investigation Derived Waste (IDW). • Project reporting. • Development of recommendations for remediation efforts or additional investigation at the site based on the field data.
Field Support	**Tetra Tech Field Staff (TBD)** • Scheduling and coordination with utility locate, laboratory, and drilling company. • Field oversite for soil sample collection and management. • Processing and shipping soil and rinsate water samples. • Field management of IDW.

<table>
<tr><th>Name</th><th>Project Title & Responsibility</th></tr>
<tr><td>JR Cantrall</td><td>Northern Lights Drilling
Drilling ISM and deep borings using direct-push technology.
A total of 210 one-foot borings proposed for ISM.
A total of up to 10 additional deeper borings proposed.</td></tr>
<tr><td>Natalie Morrow, LG., LHG</td><td>Tetra Tech Quality Assurance/Quality Control (QA/QC) Manager
Tetra Tech’s QA/QC Manager is responsible for the following.
Reviews the laboratory analytical data per EPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, dated January 13, 2009 (EPA 2009).
Shall not be the Tetra Tech PM, or otherwise be assigned to the project data generation efforts.
May be part of the review team for project final reports.</td></tr>
<tr><td>Brian Ford</td><td>Pace National Technical Services Representative (PAH Analysis)
The laboratory contact/manager issues the sample receipts, verifies analysis, and confirms the laboratory data review.</td></tr>
<tr><td>Dianne Gardner</td><td>SVL Analytical (Metals Analysis)
The laboratory contact/manager issues the sample receipts, verifies analysis, and confirms the laboratory data review</td></tr>
</table>

Figure 1. Project Organizational Chart



3.0 PROBLEM DEFINITION / BACKGROUND

This QAPP defines the required field and QA/QC procedures for this project under DEQ's **Task Order (TO) #28** of DEQ's Contract No. K158 with Tetra Tech. The Site is an approximate 47-acre area located at 3074 West Seltice Way in Coeur d'Alene, Idaho, see **Figure 2** in **Appendix A**. The Site includes ten (10) parcels of real estate with the following Kootenai County parcel numbers: 50N04W-10-2500, 0-6680-036-006-B, 0-6680-018-001-A, 0-6680-036-005-A, 0-6680-036-006-A, 0-6680-038-001-A, 50N04W-10-0750, 0-6680-018-001-B, 0-6680-037-000-A, and 50N04W-10-3200. It should be noted that task activities may not impact every parcel.

A lumber mill was constructed on the site in the early part of the twentieth century (Tetra Tech, 2017). A 1910 Sanborn Map shows the original north-south oriented shape of the mill. The majority of the mill structures were located on a western central portion of the subject property at that time. Railroad uses were noted onsite and nearby, as the subject property is positioned along an important historic railroad corridor. Other structures on site include dwellings, an oil house, and a wagon shed. The Northern Pacific railroad, the electric Spokane & Eastern Railway & Power Company railroad, Great Northern railroad, and the Chicago, Milwaukee, St. Paul & Pacific railroad are each onsite or nearby.

The early mill area was concentrated on a western-central portion of the subject property and railroad uses dominated the northern portion of the site. Subsequent early maps depict the mill operation expanding to include a planer building, shavings bins, sorting areas, a lunch room, a blacksmith, a boiler house, a refuse burner, an electric switch house, auto storage areas, a slash warehouse, lumber yards, and similar features.

The mill expanded through the years to the west when a large planer building was established in the 1940s, when the Atlas Building Center was constructed in the 1950s, and when the headquarters building was constructed in the 1960s on what is currently the north-adjoining property. The entire western portion of the site appears used to support mill structures from the 1950s and beyond.

During the 1950s and 1960s the northeast portion of the subject property was used for gravel extraction by the State of Idaho (highway district) to support local road construction projects such as Interstate 90. This resulted in the formation of pits on the northern central and northeastern portions of the site. The pits were eventually filled in during the 1980s and the northeastern portion of the site was used to store and load lumber. During mill closure operations in the 2000s the northeast corner of the site was used to stockpile soil and wood debris, resulting in a local feature called Mt. Heinke. The former log storage yard immediately west of Mt. Heinke was paved at some point. This area has recently been used as a loading area for trucks and for short-term materials storage supporting the recent reconstruction of Seltice Way to the north.

The southeastern portions of the site did not appear frequently used until the late 1960s and 1970s, after the web of railroads on that portion of the site and nearby had been removed. The southeastern portion of the site supported lumber storage from the 1970s through 2006.

Aerial photographs and building department records suggest most of the total of 27 structures at the mill site were demolished from 2006 to 2009. The concrete from many of these areas remains in piles on the western portion of the site. Top soil was removed from the western and eastern lower bench areas of the site at that time and deposited elsewhere, including at the northeast corner of the site (Mt. Heinke).

The southern boundary of the site rests along the Spokane River. Shoreline areas of the site have been flooded at least several times over the past 100 years. Historic mining operations along the Coeur d'Alene River to the northeast resulted in the release of metals-contaminated sediments to Lake Coeur d'Alene and to the Spokane River, the primary outlet of the lake.

Currently the site includes the large Mt. Heinke stockpile, a former truck scale area and paved log yard to the north, crushed concrete piles to the west in immediate vicinity of former mill structures, a berm and shore area along the Spokane River, and the eastern lower half of the property was recently covered by thousands of cubic yards of fill from nearby earthwork along Interstate 90. The quality of soil across the site and along the Spokane River remains unknown.

3.1 PROBLEM STATEMENT

TO #28 of Contract No. K158 authorizes an investigation to evaluate whether historic mill operations have resulted in impacts to near surface and subsurface soils that exceed regulatory action levels.

The Phase I ESA indicated that the site functioned as large lumber mill for over 100 years, where mill operations included multiple specific areas of use. The site was also crossed by four railroads and multiple spur lines (Tetra Tech, 2017). Railroad areas adjacent to the site have been investigated previously.

The northeastern portion of the subject site was used for stockpiling surface soil and woody debris that may have been affected by mill and nearby railroad operations. This large stockpile exists today (Mt. Heinke). This portion of the site is not part of this LSI.

The northern-central portion of the site, to the west of the Mt. Heinke stockpile, was a former log storage area. This area, known as *Decision Unit – North*, includes wood waste and unconsolidated fill overlain by asphalt. The quality of soil beneath asphalt in this area is unknown and may include elevated concentrations of polycyclic aromatic hydrocarbons (PAHs) and metals.

South of these two areas is a long low-elevation bench stretching generally east to west across the site. The western portion of this bench, known as *Decision Unit – West*, included numerous mill structures until these structures were removed in the mid-2000s. The eastern portion, known as *Decision Unit – East*, was primarily used as log storage by the mill. The topsoil was removed from across the western and eastern portions of the bench in the mid-2000s. Within the past year the eastern portion of this area received fill materials originating from a nearby Interstate 90 improvement project.

The quality of surface material across this entire area is currently unknown. The western portion may include elevated concentrations of PAHs and metals from prior mill operations. The eastern portion consists primarily of fill originating from beneath the interstate and may include elevated concentrations of metals.

The Shoreline Area is not a formalized decision unit as only grab and composite sampling is to be completed at the location. The Shoreline Area includes a long berm and shoreline fronting the Spokane River to the south. The Shoreline Area includes both berm soil and littoral sediments, where the sediment was deposited by the Spokane River through time. The quality of berm soil and littoral sediments is unknown and may include elevated concentrations of metals.

The rationale for collecting samples and for conducting certain analyses is further defined in Section 8.2.

3.2 INTENDED DATA USE

The purpose of this Limited Site Assessment (LSI) is to delineate the extent of Chemicals of Interest (COI) within three (3) Decision Units (DUs) and the Shoreline Area on the property. The specifics of the DUs are discussed in **Section 4.1**. The COIs for this project include Polynuclear Aromatic Hydrocarbons (PAHs), RCRA Metals 8 (Metals 8), and the specific metals lead, zinc, and cadmium (Metals 3). The PAHs to be evaluated include these 11 common **PAHs**: acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, naphthalene, and pyrene. **Metals 8** includes arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. **Metals 3** includes lead, zinc, and cadmium.

The results of the PAH analysis will be compared to the Residential Use Screening Levels (RUSLs) from DEQ's Risk Evaluation Manual for Petroleum Releases – August 2018 (also known as the PetroREM), which is a guidance document based upon Department of Environmental Quality Rules IDAPA 58.01.24, Standards and Procedures for Application of Risk Based Corrective Action at Petroleum Release Sites (the Rule). These are in **Appendix B**.

The results of the metals analysis will be compared to Regional Screening Levels (RSLs) from the U.S. Environmental Protection Agency (EPA) for Residential Soil (USEPA 2018a, 2018b).

Background and other levels of metals may also be considered when making the comparisons. Information from the USGS for Kootenai County and from the Washington State Department of Ecology (Ecology) will be used to estimate the natural background levels. The allowable concentrations for arsenic as documented by the Idaho Bureau of Community and Environmental Health will be considered (BCEH 2017). **Appendix B** provides a site-specific summary of laboratory detection limits and the USGS background values for the metals COI for this project.

It should be noted that not all areas of the site are being evaluated at this time and that further evaluation of specific areas of the site may be necessary after this analysis, and/or as necessary to support reuse.

4.0 PROJECT TASK / DESCRIPTION

4.1 PROJECT OVERVIEW

This QAPP was prepared based on the scope of work presented in **TO #28** of Contract No. K158. This LSI includes the following scope of work:

- Prepare this QAPP for DEQ approval;
- Prepare a site-specific safety and health plan (SSHP) to guide field activities of the investigation;
- Utility locates will initially be conducted through a public one-call locating service. A private utility locating company will be retained to further define the locations of utilities.
- Conduct soil sampling within three DUs and along the Shoreline Area of the Spokane River. The three DUs have been designated DU-WEST, DU-NORTH, and DU-EAST. Shoreline areas rest south of these DUs, and north of and proximal to the Spokane River. Descriptions of each sampling area and the general scope of soil sampling to occur are presented below.
    - **DU-WEST:** This DU represents the western proposed residential area on the site. Soil sub-samples will be collected from approximately ninety (90) shallow borings as part of an *Incremental Sampling Methodology* (ISM) characterization program. Using direct push drilling techniques, sub-samples will be collected from designated locations within the DU. This DU will be sampled in *triplicate* (x3) using ISM methods. A single soil sample comprised of sub-samples from approximately thirty (30) shallow (approximately 12" deep) borings will be collected, processed, and analyzed. This sample collection phase will be conducted three times across the DU to produce three ISM samples total (in triplicate) for statistical and QA/QC purposes. The methods for ISM will be guided by the Interstate Technology and Regulatory Council (ITRC) ISM guidance of 2012 (ITRC 2012). The three ISM samples collected will each be analyzed for metals and PAHs. Collecting and analyzing these samples assists in characterizing surface soils.
    - **DU-NORTH:** This DU represents the northern proposed residential area on the site. Soil samples will be collected from approximately thirty (30) shallow borings as part of the ISM soil sampling program. Using direct push drilling techniques, 30 sub-samples will be collected from designated locations in the DU and processed. The single ISM sample collected will be analyzed for metals and PAHs. Collecting and analyzing these samples assists in characterizing the soil below the asphalt in this area.
    - **DU-EAST:** This DU represents the eastern proposed residential area on the site. Soil sub-samples will be collected from approximately ninety (90) shallow borings as part of an *Incremental Sampling Methodology* (ISM) characterization program. Using direct push drilling techniques, sub-samples will be collected from designated locations within the DU. This DU will be sampled in *triplicate* (x3) using ISM methods. A single soil sample comprised of sub-samples from approximately thirty (30) shallow (approximately 12" deep) borings will be collected, processed, and analyzed. This sample collection phase will be conducted three times across the DU to produce three ISM samples total (in triplicate) for statistical and QA/QC purposes. The methods for ISM will be guided by the Interstate Technology and Regulatory Council (ITRC) ISM guidance of 2012 (ITRC 2012). The three ISM samples collected will each be analyzed for metals. Collecting and analyzing these samples assists in characterizing materials at the surface in this area.
    - **SHORELINE AREA:** This area represents the southern shoreline on the site that fronts the Spokane River to the south. Soil samples will be collected from approximately ten (10) direct-push borings advanced within the shoreline berm and from ten (10) hand-auger borings advanced at the river shoreline south of the berm. Two samples will be collected from each direct-push berm boring, including one composite sample from the upper three feet of each boring and a second composite sample from near the boring terminus, or an area where field instruments (an x-ray fluorescence or XRF analyzer may be used) and observations/experience suggests the possibility of elevated metals. The direct push borings will be advanced up to 18 feet or up to approximately four feet

below the 2,125-foot elevation above mean sea level (AMSL), whichever is less. The 2,125 elevation represents the ordinary high-water mark (OHWM) of the river and Lake Coeur d'Alene. Samples collected from borings will be submitted for Metals 8 analysis. A hand-auger or trowel sample will be collected along shoreline to the south of each berm boring and submitted for Metals 3 analysis. The upper boring samples characterize berm soil. The samples collected from borings at depth and laterally toward the river generally assist in characterizing river sediments. A total of 30 samples will be collected and analyzed, where the 20 berm samples will undergo analysis for Metals 8, and the 10 hand-auger samples will be analyzed for Metals 3.

Quality control (QC) samples will be collected during the investigation as described in **Sections 10** and **13** of this document. The soil samples collected will either be submitted to Pace National (formerly ESC Lab Sciences) in Mt. Juliet, Tennessee or to SVL Analytical in Kellogg, Idaho, or both when required. **Section 12** of this document states the analytical parameters and methods to be used.

The following sections detail the work to be performed. The work described is designed to meet project quality objectives (**Section 5**) and will be collected following the procedures and methods defined in **Sections 7** through **16** of this document.

4.2 PROJECT TIMETABLE

The estimated timeline for activities under this QAPP is shown in **Table 3**. The ultimate schedule will depend on final QAPP approval, subcontractor availability, weather, and laboratory analysis times.

Table 3. Tentative Project Timeline

Task	Tentative Timeline
Utility Locate	Week of June 17, 2019
Soil Sampling	Week of June 24, 2019
Pace National and SVL Analytical Reporting of Sample Analysis *(Up to 15-day standard turnaround time)*	Through July 12, 2019
Draft Report Submittal	August 9, 2019

5.0 QUALITY OBJECTIVES AND CRITERIA

Data quality objectives (DQOs) for this project were developed to help define the requirements to support the qualitative and quantitative design of the data collection effort. DQOs are also used to assess the adequacy of the data in relation to their intended use. The DQO process allows Tetra Tech to evaluate the level of data quality required for specific data collection activities.

The objective of QA/QC is to ensure that analytical results obtained by sample analyses are representative of actual chemical and physical composition of the soil. Field QA/QC will consist of following a standard protocol for field documentation; sample collection and handling of natural and QC samples.

5.1 PROBLEM STATEMENT

The potential exists for residual contamination in soil at the site based on historical land uses and recent import of fill. DEQ has therefore requested this LSI to evaluate the soil for appropriate COI including PAHs and selected metals, and with consideration to proposed future site uses. Results of sampling will be compared to applicable screening levels or background levels to evaluate the associated risk of any detected compounds.

5.2 DECISION STATEMENT

This investigation will involve collecting environmental data to characterize site conditions. Tetra Tech's activities will generate data that the DEQ will use to make decisions about the status of the site, based on the following decision statements.

- Are PAHs present in soil that exceed the RUSLs?
- Are metals present in soil that exceed the EPA RSLs or known background concentrations?
- Based on the analytical results, is additional investigation warranted to determine the extent and magnitude of impacts?

5.3 DECISION INPUTS

Information required to address the decision statements include the concentrations of PAHs and metals in soil. The concentration data collected and evaluated during this assessment will be compared to applicable screening levels. **Table 4**, below, presents the specific decision inputs for this investigation.

Table 4. Decision Inputs

Source Material	Data Parameters	Data Uses
Soil	PAHs	PAH concentrations will be compared to DEQ residential screening levels (Idaho DEQ, 2018) for soil including vapor intrusion, direct contact, and groundwater protection.
	Metals (RCRA 8 Metals and Metals 3)	Concentrations of metals will be compared to EPA RSLs for Residential Use summary table (TR=1E-6, HQ=1.0) (EPA, 2018) and to background and toxicity concentrations.

5.4 STUDY BOUNDARY

The lateral study area boundary for this project coincides with the combined borders of the three DUs and the Shoreline Area. These are shown on **Figure 3** in **Appendix A**. The vertical boundary is the base of each soil boring. For DU-North, DU-East, DU-West, the vertical boundary will be approximately 12 inches deep. For the Shoreline Area, the vertical boundary will be slightly deeper than the apparent elevation of native soils, but less than 18 feet.

5.5 DECISION RULE

Regulatory standards will be used to evaluate data collected during the assessment as follows:

- An initial comparison of concentrations of COI in soil will be made to evaluate which analytes, if any, exceed established regulatory standards.
- Based on the initial data, decisions will be made as to whether additional evaluation would be appropriate for the site.

Appendix B presents a list of analytical parameters, reporting limits, and screening levels.

5.6 TOLERABLE LIMITS OF DECISION ERRORS

Decision errors are incorrect conclusions about a site caused by using data that are not representative of site conditions because of sampling or analytical error. Limits on decision error are typically established to control the effect of sampling and measurement errors on decisions regarding a site, thereby reducing the likelihood that an incorrect decision is made. Decision errors fall into three categories; null hypothesis, false positive, and false negative.

For example, a null hypothesis for the site exists when soil is not found impacted by a COI above the IDEQ RUSL and where there are no QA/QC or statistical errors identified, but where obvious contaminated soil was missed through sampling (i.e. sampling is just not representative of site conditions). Conversely, a false-positive decision error would be one where soil is found through analysis to be impacted and require treatment, but where QAQC or other procedures identify errors leading to a biased-high analytical result (i.e. uncleaned sampling equipment leads to elevated concentrations in samples). A false negative decision error would be one that states the site does not require cleanup or treatment, but where QAQC or other procedures identify a likelihood of a biased-low analytical result (i.e. forgetting preservatives in sample containers that lead to a biased low analytical result).

This QAPP identifies specific field and laboratory methods that reduce sampling error. The total study error will be reduced by collecting an appropriate number of environmental samples deemed necessary that are intended to represent the range of concentrations present at the Site. The sampling program is designed to reduce sampling error by specifying an adequate number and distribution of samples to meet project objectives. The following sections discuss data accuracy, precision and measurement ranges. This information will be used during the data review and data validation process to evaluate precision, accuracy, representativeness, comparability, and completeness (PARCC). PARCC will be considered during data verification and validation (**Sections 21** and **22**). **Appendix B** provides the Pace National and SVL Analytical QA/QC limits that will be used for this project.

For evaluation purposes, the laboratory will analyze to its lowest practical quantitative limit (PQL) achievable and use only approved analytical methods. The PQL is the lowest standard on the calibration curve and the lowest level that the laboratory can reliably achieve within the established limits of precision and accuracy. The method detection limit (MDL) is the minimum concentration of a substance that can be analyzed with 99% confidence that the analyte concentration is greater than zero. Laboratory test results reported between the MDL and PQL will be identified by the analytical laboratory. The analytical methods were selected based on their need to provide detection limits less that their corresponding RUSLs and RSLs so that decisions regarding future use of the site can be determined.

5.6.1 Accuracy

Accuracy is a measure of the agreement between a “true” or reference value and the associated measured value. A sampling campaign may include spiked samples with a known matrix submitted blind to the laboratory or may rely on reported recoveries for laboratory control samples (LCS). The latter option will be used for this project. The recoveries of LCS, matrix spikes, and surrogate spikes will be used to evaluate the accuracy of the measurements. These recoveries are typically calculated as “percent recovery” (%R) represented by **Equation 1** and **Equation 2**.

Equation 1. Spiked Sample or LCS Percent Recovery

$$\%R = \frac{C_M}{C_T} \times 100$$

Where: C_M = measured spike/LCS concentration

C_T = true spike/LCS concentration

Equation 2. Matrix Spike and Surrogate Recoveries

$$\%R = \frac{(C_S - C_{US})}{C_T} \times 100$$

Where: C_S = measured concentration of spiked sample
C_{US} = measured concentration of unspiked sample
C_T = true concentration of spike added

Laboratory accuracy for each analysis is determined through statistical analysis of the laboratory equipment by the laboratory; the acceptable accuracy range for the laboratory equipment will be indicated in the laboratory sheets. Any outliers from the acceptable range in percent recovery, as determined by the laboratory, will be flagged by the laboratory.

5.6.2 Precision

Precision is a measure of agreement between two measurements of the same property under prescribed conditions. Sampling campaigns may include duplicate samples (field replicates or split samples; see **Section 13**) or may rely on LCS split sample results. The relative percent difference (RPD) of duplicate samples will be used to assess data precision. For laboratory duplicates, field duplicates, and matrix spike duplicates, **Equation 3** will be used to calculate RPD:

Equation 3. Relative Percent Difference (RPD)

$$RPD = \frac{|(C_1 - C_2)|}{(C_1 + C_2)/2} \times 100$$

Where: C_1 = concentration in first sample
C_2 = concentration in the second/duplicate sample

The above equation is valid when both C_1 and C_2 are equal to or greater than five times the laboratory reporting limit.

Precision will be based on field, LCS, and matrix spike duplicates. The maximum RPD allowed for this project is 50% for soil.

Appropriate measurement range is determined by reviewing results with comparison to the laboratory reporting levels (MDLs or PQLs).

5.6.3 Representativeness

Representativeness is the degree to which the sample data accurately and precisely represent site conditions. The representativeness criterion is best satisfied by confirming that sampling locations are properly selected, sample collection procedures are appropriate and consistently followed, a sufficient number of samples are collected, and analytical results meet data quality objectives. Representativeness is evaluated during data review, verification, validation, and reconciliation efforts by comparing the combination of data accuracy, precision, measurement range, and methods and assessing other potential sources of bias, including sample holding times, reported results of blank samples, and laboratory QA review.

5.6.4 Comparability

Comparability is the confidence with which one data set can be compared to another data set. Using standard sampling and analytical procedures will maximize comparability. To ensure data comparability, sample collection procedures will be consistently followed, the same analytical procedures will be used, and the same laboratories will be used to analyze the samples throughout this project (Pace National for PAHs and SVL Analytical for metals).

5.6.5 Completeness

Completeness is the percentage of valid data relative to the total possible data points. For a data set to be considered valid, it must meet all of the acceptance criteria, including accuracy and precision, and any other criteria specified by the analytical method used. The overall data quality objective for completeness for the sampling events conducted under this QAPP is 80%. If the sampling event does not meet the quality assurance goal of 80%, the data will be discussed with the program manager and a course of action agreed upon. Any required departure from this goal will be justified and explained in the project records in accordance with the QMP.

5.7 SAMPLING DESIGN

Sections 7 through **22** of this QAPP specify sampling-related protocols, analytical methods, data management, and review. Soil samples collected during the field effort will be analyzed as per analytical data support Level II. Level II refers to Standard EPA-approved methods of analysis. Level II will allow for Stage 2A data validation procedures, which includes a review of sample-related QC results as per EPA's Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA 2009). The data verification and validation will include a usability evaluation based on PARCC. Once collected, data review and data validation procedures will be implemented to evaluate whether the data achieves the DQOs.

6.0 SPECIAL TRAINING / CERTIFICATION

Tetra Tech staff receive initial 40-hour and annual 8-hour refresher training in Occupational Health and Safety Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) as per 40 Code of Federal Regulations (CFR) 1910.120. Most Tetra Tech personnel have also received HAZWOPER Supervisor Training and/or First Aid/CPR training. Personnel receive additional training, as needed, based on client requirements or the specific type of work to be performed. Personnel assigned to the project to conduct field activities will have the necessary education, on-the-job training, and field experience to conduct the work.

Personnel also participate in Tetra Tech's medical surveillance program. At a minimum, subcontractors on site must have similar training and surveillance. Field activities will be conducted and monitored by Tetra Tech.

7.0 DOCUMENTATION AND REPORTING

7.1 FIELD DOCUMENTATION

Tetra Tech field personnel will document all field activities in a field notebook and on field forms. Tetra Tech's Standard Operating Procedure (SOP) number 10 (**Appendix C**) will be used to guide documentation of field activities, including sampling. Field notebook entries will be written in ink and corrections or revisions made by lining through the original entry with a single line and initialing the changes. Field personnel will document the following in the field notebook, as applicable, for the field work:

- Project name and type of work;
- Date and time of starting work;
- Weather conditions;
- Names of field crew leader and team members;
- Equipment brand and model numbers;
- Description of site conditions and any unusual circumstances;
- Details of actual work effort, particularly any deviations from the field work plan or standard;
- Field observations;

- Calculations;
- Location of sample site, including map reference, if relevant;
- Names, date, and times of samples collected;
- Name, date and time of duplicate samples collected with reference to corresponding natural sample name;
- Name, date, and time of field blanks collected;
- Problems encountered or concerns identified;
- Project-related communications with site personnel, visitors, and other field personnel.

Tetra Tech will maintain original field records in hard copy and by scanning the records and storing them electronically in the project folders.

7.2 LABORATORY DOCUMENTATION

Laboratory reports will document the following:

- Sample identification;
- Laboratory batch or report number;
- Sampling date and time;
- Date/time received;
- Extraction date (if required);
- Analytical parameter;
- Analytical results with appropriate units of measure;
- Minimum Detection Limit and Practical Quantitation Limit;
- Analytical method;
- Sample non-conformance form (if necessary);
- Completed chain-of-custody;
- Laboratory QA/QC documentation; and
- Other documentation necessary to adhere to Stage 1 and Stage 2A criteria in **Sections 21** and **22**.

7.3 RECORDS

All documents, including this QAPP, the SSHP, analytical reports, field notebooks and forms, project reports, memoranda, and communications will be stored electronically in the project folder on Tetra Tech's server, which is backed up daily. Documents, as per DEQ requirements, will also be uploaded to DEQ's EDMS document management system where they will be maintained for at least three years.

8.0 SAMPLING PROCESS DESIGN

This section describes the data collection activities, assumptions, sample location selection, the number of sampling locations and the number of samples to be obtained, and the types of samples (grab or composite). The results of the sampling will be presented in a report prepared by Tetra Tech.

8.1 PRELIMINARY ACTIVITIES

Tetra Tech will coordinate with Pace National and SVL Analytical to obtain the proper sample containers, shipping containers, and chain-of-custody forms. The request for sampling supplies will be made at least 1 week in advance of the sampling event.

Tetra Tech will also gather and conduct an inspection of sampling/screening equipment and ancillary supplies that will be used in the field. This includes:

- Sample containers (proper amount and preservatives);
- Pin flags for marking sample locations;
- Screens and containers for homogenizing subsamples;
- GPS equipment;
- Decontamination supplies; and,
- Personal protective equipment (PPE).

Field personnel will ensure the equipment and supplies are clean and operational prior to taking it into the field. Equipment will be transported in such a manner as to maintain cleanliness to and from the site as well as between sample locations.

Tetra Tech will notify the one-call utility locating agency that covers Kootenai County (Pass Word, Inc, 800-428-4950) at least five days prior to field activities. The appropriate utility companies will mark the utilities at locations where the underground lines enter the Site. Utilities Plus, a private utility locating contractor, may be used to further define the locations of utilities depending of the results of the Pass Word survey.

8.2 RATIONALE FOR SELECTING SAMPLE SITES

Sample planning requires understanding the layout and possible contaminants associated with the former activities at the site. The site was used as a lumber mill since the early part of the twentieth century and up until 2006, when demolition began. Since then the site was bulldozed and fill has been provided. Thousands of cubic yards of fill have been spread across the eastern portion of the site from the local Interstate 90 construction project. A variety of specific uses are described in the Phase 1 ESA and summarized in **Section 3** above. Based on this conceptual understanding and the purposes of performing this LSI, the sampling process design includes dividing the area into three DUs and the Shoreline Area. **Figure 4** shows DU locations and sampling locations on site.

- **DU-WEST:** This DU represents the western proposed residential area on the site. It is an irregularly shaped area with approximate dimensions of 1,700 feet in an east-west direction and 700 feet in a north-south direction. It encompasses an area of approximately 20 acres. This area included many of the mill structures on the site. The area is being examined for the appropriateness of residential use.
- **DU-NORTH:** This DU represents the northern proposed residential area on the site. It is a roughly square shaped area with approximate dimensions of 450 feet in an east-west and 450 feet in a north-south direction. It encompasses an area of approximately 5 acres. This area was once a pit and later received fill and was used for log storage. It has since been capped with asphalt. The area is being examined for the appropriateness of residential use.
- **DU-EAST:** This DU represents the eastern proposed residential area on the site. It is an irregularly shaped area with approximate dimensions of 800 feet in an east-west direction and an average of 600 feet in a north-south direction. It encompasses an area of approximately 10 acres. This area was primarily unused until later when it became a log storage area. Fill from a nearby Interstate 90 construction project was recently spread across this area of the site. The area is being examined for the appropriateness of residential use.
- **SHORELINE AREA:** This area represents the Spokane River shoreline, along the southern border of the site. It is a linear, slightly arc-shaped area that is approximately 3,800 feet long resting proximal to the ordinary high-water mark of the Spokane River. Two distinct soil horizons are to be examined and include berm soils and river-associated sediments at depth. The berm soil content is unknown. Further,

contaminated sediments from historic sediment deposition may have come to rest in this area. The overall area is being examined to determine the best management practices and techniques for soils that may be disturbed or removed for shoreline modification and stabilization under an Army Corps of Engineers permit.

Additional areas of the site remain unsampled where there are no immediate plans for reuse, and where additional sampling may be completed later.

8.3 DECISION UNIT SAMPLE LOCATIONS

Sample collection locations within the three ISM DUs (DU-North, DU-West, and DU-East) have been selected using a systematic-random approach as described in Section 4.3.4.2 of the Interstate Technology & Regulatory Council's (ITRC) Incremental Sampling Methodology (ISM) guidance (ITRC, 2012). Each of the three ISM DUs were divided into a grid of 30 areas (boxes or cells) of roughly equal size, where soil will be collected from a point within each cell in the effort to generate a complete one or more 30-aloquot ISM samples.

To reduce bias, random sample positions or points were generated for each of the 30 cells in each ISM DU, thus completing the systematic-random approach. Each of the 30 cells in each ISM DU were subdivided into nine subsections or subcells. These nine subcells were designated with the numbers 1 through 9 beginning at the top left (northwest) corner and ending at the lower right (southeast) corner. The same numbering process for subcells was implemented across each of the 30-cell grids for the three DUs. For each of the 30 cells, a random number generator was then used to select which one of the nine subcells would be targeted for sampling. For example, if the generator chose no. 3 for a specific cell, then that subcell is selected for that cell. The same process was repeated for each cell. It should be noted that the approximate center of the selected subcell is where each subsample coordinate was plotted. Thus, across a typical DU, a total of 30 soil sample positions were systematically yet randomly generated and plotted, so that a complete ISM sample, consisting of soil from each of the 30-aloquots, could be collected.

The entire process was repeated twice more for each DU that includes triplicate sampling (in this case DU-West and DU East). For each cell, a second, third, or fourth, etc. random number was generated when any of the subcell locations were found duplicated or to have an obstacle such as a property boundary. This assures that random triplicate sampling occurs within three random locations in each of the 30 cells within each of the triplicate DUs.

Figure 4 shows the subsampling points across the three DUs, and **Figures 4a, 4b, and 4c** depict large-scale views of each DU and sampling points. The initial GPS positions are included in Appendix B.

The location of each of the 210 DU subsample locations will be loaded into a Mesa Juniper XT or a Galaxy Tab A GPS receiver. These units typically have an approximate three-meter accuracy. The field crew will mark each of the sample locations with a pin flag. The field crew will have the option of moving the sample location if an obstruction is present or the terrain/topography prevents safe access. If needed, the movement convention will be to move the sample location three feet to the west, then three feet to the south. A second alternate location, using the same method, can be identified when necessary. The field crew will record the GPS coordinates of these alternate locations.

8.4 GENERAL INCREMENTAL SAMPLING METHODOLOGY LOGISTICS

The sampling design for the three ISM DUs is summarized below. Further details can be found in **Section 10.2**:

- The field crew will collect one subsample from each of the thirty (30) selected locations within each DU (DU-West, DU-East, and DU-North). The process will be repeated twice more in DU-West and in DU-East so that samples in triplicate will be collected from each of those two DUs. **Table 5** discusses additional samples collected for QA purposes.
    - The field crew will have access to data sheets noting the GPS coordinates of the subsample locations for each DU.
    - At each subsample location, the field crew will advance the direct push probe to a depth of 12 inches and collect subsamples (sample increments) from the probe. The field crew will collect generally equal volumes of soil from each direct push soil core.
    - The field crew will process each soil core through a ¼-inch (6.35 millimeter [mm]) sieve to break up the consolidated pieces and remove larger debris. Additional sieving may be completed

depending upon soil type.

- Approximately one 8oz jar or cup of this soil, minus the larger debris, will be removed from the sieve and placed into a clean, dedicated laboratory-supplied plastic bucket for homogenization and eventual shipment to the lab.
- The lid will be placed on the bucket between sample locations.

- After each of the 30 increments have been collected and placed into the bucket, the soil will be homogenized within the bucket using a clean stainless-steel spoon. At this point, the total volume of the undivided sample is approximately 240oz, or about 11kg or 1.9 US gals.
- After homogenization, the soil will be dispensed upon a clean approximately three-foot square portion of six-mil poly plastic. A cone of soil will be created. A quarter of the cone will be segregated and a portion of soil from the cone will be placed into a 4oz sample jar for eventual PAH analysis. The jar will be appropriately labeled and placed on ice in a cooler. The remainder of the soil will be placed back into the sample bucket.
- The approximate 1.8-gallon remainder of ISM sample will be sealed in the bucket, labeled, and set aside for eventual hand-delivery to an analytical laboratory.
- The laboratory will complete additional ISM processing, including sieving the sample through a #80 (180 µm) sieve. The ISM process includes the diagram presented in **Appendix B**.
- This will make a total of seven samples (three from DU-West, three from DU-East, one from DU-North). Additional samples will be collected for QA purposes as described in **Section 13**.
    - The metals samples will be delivered to SVL Analytical where they will be dried, sieved and analyzed for the eight metals listed in **Section 3.2**, using EPA Methods 6010D and 7471.
    - The PAH samples will be sent to Pace National where they will be analyzed for the ten specific PAHs listed in **Section 3.2** using EPA Method 8270 SIM.

8.4.1 Field Logistics

This section describes the procedures the field sampling crew will use to collect the soil samples. The samples will be sent or delivered to Pace National and SVL Analytical with chain-of-custody documentation after all samples have been collected. **Section 10.0** lists the equipment necessary to perform the sampling activities.

PPE necessary to perform the field work for this project will be consistent with the requirements of the project-specific SSHP. This will include:

- Nitrile gloves
- Safety glasses
- Safety shoes meeting ANSI Standard
- A high-visibility vest or jacket
- Hearing protection when working near the direct push drill rig
- A hard hat when working near the direct push drill rig

QA/QC procedures as specified for sample collection will be followed by field personnel. The QA/QC procedures will be fulfilled by adhering to all requirements detailed in this QAPP and the soil sampling procedures described below. Such adherence will be demonstrated through appropriate documentation of sampling procedures within the field logbook. Field audits may also be part of QA/QC procedures.

The following provides basic field logistics that will be followed during this project:

- Ensure proper PPE is worn at all times according to the SSHP (**Appendix D**). Nitrile gloves will be donned when handling soil, sampling equipment, and sample bottles. Gloves will be replaced frequently, including immediately prior to sample collection.
- Maintain a stock of ice for preservation. Ice will be purchased at the beginning of each sampling day, then refreshed, as needed, throughout the day. Frozen conditions may negate the need to refresh ice.

- Collect samples as described in **Section 10** and as per laboratory and method requirements.
- Adhere waterproof labels to the sample container and write, in indelible ink, the sample name, date and time of sample collection, and the analyses requested and project name or number.
- Complete chain-of-custody forms in the field. Field personnel will also maintain custody of the samples and ensure proper storage and handling until transfer to the analytical laboratory or overnight courier.

Section 10 provides additional sample methodology and sample handling requirements.

9.0 INVESTIGATION DERIVED WASTE MANAGEMENT

IDW consists of any remaining soil cuttings and water from decontamination procedures. The following steps summarize the approach to managing and documenting the management of wastes:

1. Containerize the waste,
2. On-site treatment and disposal *or* transportation and off-site disposal, and
3. Documentation of waste determination, transportation, and disposal.

IDW is expected to include up to four 55-gallon drums of soil and one 55-gallon drum of decontamination/rinse water. Up to five (5) drums of IDW are anticipated. Characterization of the soil or liquid waste will rely on the analytical results from sampling; samples of the IDW will not be collected. This QAPP assumes these materials will be acceptable in a Subtitle D Landfill facility, and it is anticipated these materials may be appropriately stored on site pending the implementation of the IDW management plan.

9.1 GENERAL RESPONSIBILITIES

The field crew leader has the responsibility for ensuring that the field crew conducts field activities in accordance with the IDW management plan presented in this document. The field crew is responsible for implementing the IDW standard operating procedure and communicating any unusual or unplanned conditions to the field crew leader's attention.

9.2 IDW LABELING

Department of Transportation-approved containers (55 gallons steel drums) will be used to store IDW. The drums will be labeled as described below.

9.2.1 Label Information

Labels with adhesive backing will be placed on the drums. Each label will include the following information:

- Description of the waste (drill cuttings);
- Date when waste was first placed into the drum;
- Project name;
- DEQ Project Manager contact information.

This information will be written legibly with a permanent marker.

9.2.2 Label Placement

The labels will be placed on the drums where they can readily be viewed. For groups of drums located together, this means the labels will be facing outward from the rest of the group so that they are not obscured by the other drums.

9.3 IDW SITE ACCUMULATION

The Tetra Tech project manager, field crew, and subcontracted drillers will select staging locations for the drums that allow access during the investigation and when they are ready to be removed for disposal. The staging areas should also be in areas that do not readily allow public access.

IDW that is classified as nonhazardous or "characterization pending analysis" should be disposed of as soon as possible. Until disposal, such containers should be inventoried and stored securely. IDW that is classified as hazardous shall not be accumulated on site longer than 30 days after receipt of analytical results.

9.4 IDW DISPOSAL

As outlined in **Task Order #28**, Tetra Tech will contract with Able Cleanup Technologies to remove the waste from the site after the characterization is complete following the laboratory analysis. The DEQ or property owner will be responsible for signing manifests as the waste generator, if necessary.

9.5 FIELD AND PROJECT IDW DOCUMENTATION

Notes of IDW generation, storage, and labeling will be made in the project field notebook. This will include the number of drums filled (or partially filled), the storage location, and confirmation that the correct labeling was performed. Project file documentation will include the laboratory results, transporter information, date of disposal, and copies of manifests. A description of the disposal will be included in the site investigation report.

10.0 SAMPLING METHODS

This section describes the procedures and equipment used to obtain the samples for this project.

10.1 STANDARD OPERATING PROCEDURES

Tetra Tech will also follow the sampling methods described in this section and use the following Tetra Tech SOPs to guide field activities. **Appendix C** includes copies of the SOPs.

- SOP-09: Sample Packaging and Shipping;
- SOP-10: Field Forms;
- SOP-11: Equipment Decontamination;
- SOP-12: Sample Documentation;
- SOP-13: Quality Control Samples;
- SOP-48: Investigation-Derived Waste

Site activities and sampling details will be documented in the field notebook and on field forms (see **Section 7** and SOP-10, **Appendix C**).

Field personnel will don disposable nitrile gloves and safety glasses during all site sampling activities. Sample gloves will be changed frequently, especially when the gloves come into contact with equipment that has not been decontaminated, or if they become soiled. The SSHP (**Appendix D**) provides additional health and safety requirements for this project.

10.2 SOIL INVESTIGATION

This section describes the procedures the field team will use to obtain project samples. QA/QC procedures for sample collection will be followed by sampling personnel. The QA/QC procedures will be fulfilled by adhering to all requirements detailed in this QAPP and the soil sampling procedures described below.

10.2.1 Incremental Soil Sampling Methods

The sampling design uses an incremental sampling approach, consistent with the ITRC's ISM guidance document (ITRC 2012). The ISM strategy is a method to collect soil samples that are representative of an entire DU. Tetra Tech divided the Site into three ISM DUs (**Figure 4**). The field crew will collect 30 subsamples to complete one multi-increment sample for each DU. Furthermore, DU-West and DU-East will each be sampled in triplicate (see **Figures 4a, 4b, and 4c in Appendix A**). Therefore, a total of seven natural samples will be collected using this method. Additional samples will be collected for QA/QC purposes.

The ISM process for this project includes the following steps:

- The field crew will possess a GPS with 210 pre-programmed data points depicting each increment location for each of the DUs. The points will be grouped by DU and by sample (initial, duplicate, or triplicate). The field crew will also possess a physical copy of these data points as coordinates.
- At each DU the field crew will use pin flags to locate the positions of the 30 increments and proceed linearly by row to each increment location.
- At each increment location the direct push probe will be advanced to a depth of 12 inches in the effort to collect a core of soil from the probe.
- The drill crew will retrieve the core and give it to Tetra Tech for processing.
- The field crew will process each soil core through a ¼-inch (6.35 millimeter [mm]) sieve to break up the consolidated pieces and remove larger debris. A larger or smaller sieve may be implemented if necessary, depending upon the type of soil or material uncovered during sample collection.
- Approximately one 8oz jar or cup from each core will be retrieved from the sieve and placed into a dedicated, new, clean, and disposable plastic bucket. The bucket lid will be placed on the bucket after retrieval of the soil increment.
- The process will be completed until soil from each of the 30 increment locations has been acquired. The final amount of soil in the bucket should total 240oz, or about 11,000g, or 1.8 US gals.
- The soil will be homogenized within the bucket using a clean stainless-steel spoon. The homogenized soil in the bucket at this point is considered the complete soil sample.
- After homogenization, the soil from the bucket will be poured onto a clean three-foot by three-foot piece of polyethylene plastic about six-mil thick and a cone of soil will be created. A quarter of the cone will be separated and a clean 4oz sample jar will be filled for eventual PAH analysis. The jar will be appropriately labeled and placed on ice in a cooler for eventual shipment to Pace National of Mt. Juliet, Tennessee, where this portion of the sample will be analyzed for the ten specific PAHs listed in **Section 3.2** using EPA Method 8270 SIM.
- The remainder of ISM sample will then be placed back into the bucket and sealed, labeled, and set aside for eventual hand-delivery to SVL Laboratories (SVL) of Kellogg, Idaho. SVL will complete additional ISM processing and eventual metals analysis. Processing includes air drying, final sieving using a #80 (180 µm) sieve, and creation of a 2-D Japanese slab cake to create 10g aliquots. The laboratory ISM preparation process is shown as **Figure 5** located in **Appendix B**. SVL will then analyze the sample for the eight metals listed in **Section 3.2**, using EPA Methods 6010D and 7471.
- Sample labeling for DU samples will include the project name (SAM for Stimson-Atlas Mill), the specific DU (North, West, or East), and a number designating the single, double, or triple or triplicate of the sample within that DU (DU-West and DU-East will be sampled three times each). For example, the second sample from DU-East will be labeled **SAM-DU-East-2**. This should not be confused with the duplicate ISM sample collected for other QAQC purposes.
- Decontamination of sample collection tools will be completed after sampling each DU. One rinsate blank will be collected after sampling each DU to document the quality of decontamination procedures. A total of three rinsate blank samples will be collected during ISM sampling.
- This process will continue until the total of seven ISM samples are collected (three from DU-West, three

from DU-East, one from DU-North), plus the additional *field duplicate* sample for QA purposes, as described below and in **Section 13**.

QUALITY CONTROL: Quality control samples collected by field personnel from the DU investigations will include one field duplicate, one site-specific MS/MSD, one laboratory ISM-process duplicate, and three rinsate blanks. The date, time, QC sample name, and corresponding natural sample name, and DU sample number will be documented in the field notebook/field log. **Section 13** provides additional QC details.

- **Field Duplicate:** One field duplicate will be collected to represent the seven ISM samples. The field duplicate process for ISM sampling begins by collecting twice as much sample (16oz) from the one-foot boring during soil boring at each increment location. A second clean sample bucket will be used to hold the duplicate. Field duplicate results will be compared to the natural sample results. Field personnel will document the DU and sample where the duplicate sample was generated. The duplicate sample for metals and PAH analyses will be designated as **SAM-DU-SD-1**. The date, location, and time of collection will be included in the field notes.
- **Site-Specific MS/MSD:** An MS/MSD sample will be generated by the lab from an ISM sample. Field personnel will choose on the chain of custody form which ISM sample will undergo MS/MSD analysis. The MS/MSD sample will be used internally by the laboratory for QC analysis.
- **Laboratory (ISM-Process) Duplicate:** Field personnel will designate in the comments section of an ISM chain of custody form which ISM sample is required for QC analysis of the laboratory's ISM preparation process. This will inform of any bias that may have occurred during the laboratory's ISM sample preparation process.
- **Equipment Rinsate Blank:** Field personnel will collect three equipment rinsate blanks during ISM sampling. Tetra Tech will decontaminate field soil sampling equipment after sampling each DU and a rinsate blank will be collected after decontamination. The equipment rinsate blank will be labeled as to identify the corresponding soil sample that was completed prior to generating the rinsate blank (RB). For example, **SAM-DU-North-1-RB**, would be an equipment rinsate blank collected after the sample collection for DU-North-1 was finished. The rinsate blank will be collected by pouring distilled water over a piece of sampling equipment (sieve, measuring cup, etc.) that has been decontaminated, and collecting the water that drains off of the equipment into the appropriate laboratory containers. The samples will be analyzed for metals by SVL Analytical, and for PAHs by Pace National (when necessary). Analytical results for water will be examined for data quality purposes.

10.2.2 Discrete Sampling Method

Soil characterization sampling in the Shoreline Area will be completed using both the direct push drill rig and a hand-operated soil auger (hand auger) or stainless-steel trowel, as necessary. A total of ten (10) direct push borings will be advanced along the berm area of the shoreline, and ten (10) corresponding hand-auger type borings will be advanced along actual shoreline. Each sample location will be pre-programmed using a GPS and later recorded using a GPS. Two composite samples will be collected from each direct push boring, and one discrete or grab sample will be collected from each hand-auger location. A total of 30 samples will be collected from the Shoreline Area, not including QA/QC samples. The approximate boring locations, subject to access restrictions, are shown on **Figure 4**. Additional details are below.

Direct Push (Berm) Sampling:

Direct push borings advanced into the shoreline *berm* are meant to characterize berm soils in the upper soil horizons and river sediments at depth. Berm borings may extend up to 18 feet deep. The direct push drill rig will be used to bring cores of soil to the surface for examination and access by Tetra Tech. Soil borings will be logged in the field for lithology, staining, odors, debris, etc.

The direct push berm sampling for this project includes the following:

- Two composite samples, one upper and one lower, will be collected from each berm boring. An x-ray Fluorescence device (XRF) may be used to record the concentrations of metals identified during the soil boring activity.

- The composite samples from each boring will be obtained by placing the three feet of a soil core into a clean bucket, homogenizing the soil using a stainless-steel spoon, and collecting soil into one 4oz wide-mouth glass jar. The jar will be immediately labeled and placed on ice.
- Direct push samples from the shoreline berm will each be uniquely labeled. The sample nomenclature includes the location (SAM-Berm), the boring number (1-10), and numbers in parentheses designating the sample interval (i.e. 0 feet to 3 feet). For example, a composite sample of the upper three feet from Boring 2 would be labeled **<u>SAM-Berm-2 (0-3)</u>**. The deeper sample from that same boring may be labeled **<u>SAM-Berm-2 (8-11)</u>,** indicating the sample represents soils collected from an eight-foot to an 11-foot interval at depth.
- Soil samples collected from the shoreline berm will be packed and delivered to SVL for analysis of the eight metals listed in **Section 3.2**, using EPA Methods 6010D and 7471.
- The GPS position of each boring will be recorded.

<u>Hand-Auger (Shore) Sampling:</u>

Discrete dry sediment samples are meant to characterize littoral sediments associated with the Spokane River. Sediment will be collected using a hand auger or trowel from ten (10) locations along the shoreline. Each of the ten hand auger sample locations are proximal to a corresponding berm boring of the same number. Observations and soil or sediment lithology will be noted.

The hand-auger shoreline sampling for this project includes the following:

- At each shore sample location, soil from approximately 0-8" will be collected using a stainless-steel hand auger or trowel and placed in a wide-mouth glass jar.
- An XRF may be used to provide initial readings of metals concentrations in sediment.
- Discrete samples from the shoreline will each be uniquely labeled. The sample nomenclature includes the location (SAM-Shore), the sample number (1-10), and numbers in parentheses designating the approximate sample depth in feet (i.e. 0.5 feet, or 1 foot, or 2 feet, etc.). The first number of the sample nomenclature should correspond to the nearest direct push boring. For example, the shoreline sample that is near Boring 2 should be labeled **<u>SAM-Shore-2 (0.5)</u>**. Soil samples collected of shoreline sediments will be packed and delivered to SVL for analysis of the three metals listed in **Section 3.2**, using EPA Methods 6010D.
- The GPS position of the sample location will be recorded.

<u>QUALITY CONTROL.</u> Quality control samples collected by field personnel from the entire shoreline area (berm and shore areas) will include two field duplicates, two site-specific MS/MSD, and two rinsate blanks, where one rinsate blank includes direct-push equipment and the other includes hand-auger and/or trowel equipment. The date, time, QC sample name, and corresponding regular sample name, and borehole number will be documented in the field notebook/field log. **Section 13** provides additional QC details.

- **<u>Field Duplicates</u>:** The two field duplicate samples will be collected from the same borings or positions, and at the same depth or same location as the corresponding natural (or initial) soil samples. Field duplicate results will be compared to the natural sample results. Field personnel will document the borehole or locations and sample depths in which the duplicate sample(s) was collected. The soil duplicate samples will be designated as **<u>SAM-Berm-SD-1</u>** and **<u>SAM-Shore-SD-1</u>**, without other details. Field notes will be kept indicating each corresponding field duplicate. One of these two duplicates will represent the hand-auger/trowel set and the other will represent the direct-push set.
- **<u>Site-Specific MS/MSD</u>:** Field personnel will designate two soil samples that will undergo MS/MSD analysis, including one from the berm sample set and one from the shore sample set. Field personnel will designate which samples these are in the comments section of the accompanying chain of custody form. The MS/MSD sample results will be used internally by the laboratory for QC analysis.
- **<u>Equipment Rinsate Blank</u>:** Field personnel will collect two equipment rinsate blanks during shoreline berm and sediment sampling, where one rinsate blank will be collected during the sampling of each area (berm and shore). Field personnel will decontaminate equipment during sampling. A rinsate blank will be collected

after the collection of a sample or samples from a specific boring or location. Equipment rinsate blanks will be labeled as to identify the corresponding soil sample that was completed prior to generating the rinsate blank (RB). For example, **SAM-Berm-5 (8-11) RB,** would be an equipment rinsate blank collected after the sample collection at the deeper portion of Boring 5. The rinsate blank will be collected by pouring distilled water over a piece of sampling equipment (drill rod, trowel, etc.) that has been decontaminated, and collecting the water that drains off of the equipment into the appropriate laboratory containers. The samples will be analyzed for metals by SVL Analytical. Analytical results for water will be examined for data quality purposes.

10.2.3 Laboratory Analysis

Field personnel will ship the metals samples by overnight courier to SVL Analytical in Kellogg, Idaho. Alternatively, Tetra Tech personnel or a courier from SVL Analytical may drive the samples from the project site to the laboratory. The PAH samples will be shipped by overnight courier to Pace National, Mt Juliet, Tennessee. The soil samples will be analyzed for the parameters listed in **Table 5**, below.

Table 5. Soil Analytical Parameters & Designated Laboratory

Analytical Parameter	Analytical Method	# of Natural Samples	# of QC Samples	Analyzing Laboratory & Shipping Address
Metals (8)	6010D (7471 for Mercury)	**37 Natural** (1 from DU-North, 3 from DU-West, 3 from DU-East, 30 from Shoreline areas)	**3 Duplicate** (1 from a DU, 2 from Shoreline areas), **3 MS/MSD** (1 from a DU, 2 from Shoreline areas), **5 Rinsate Blanks** (1 from each DU, 2 from Shoreline areas)	SVL Analytical, 1 Government Gulch Rd, Kellogg, ID 83837
PAHs	8270C SIM	**4 Natural** (1 from DU-North, 3 from DU-West)	**1 Duplicate** (1 from a DU w/PAH), **1 MS/MSD** (1 from a DU), **2 Rinsate Blanks** (1 after each DU w/PAHs)	Pace National, 12065 Lebanon Rd, Mt Juliet, TN 37122

Section 12 provides additional analytical methods, preservation, holding times and sample container details. **Tables B-1** and **B-2** (**Appendix B**) provides a list of analytical parameters, reporting limits, and soil screening levels.

10.3 REPORTING

Tetra Tech will prepare a Draft Phase II Limited Site Investigation (LSI) Report that summarizes and interprets the investigation results. The report will include text, maps, figures, tables, data summaries, and interpretations such that an accurate summary of methodologies and findings are presented. Data will be compared with the screening levels and standards presented in **Appendix B**. Reporting will also include: a data review, data verification and validation – including completion of Level 2A data QC review. Photographs, field notes, and laboratory analytical data will be appended to the report. Tetra Tech shall incorporate DEQ's comments on the Draft Phase II Site Limited Investigation Report into the Final Phase II Limited Site Investigation Report. The final report will be submitted to DEQ in electronic Portable Document Format (.pdf) format.

Tetra Tech will follow the Green Remediation Objectives outlined in EPA Region 10 Clean and Green Policy (EPA, 2009) by implementing, where practical, the assessment and cleanup practices encouraged by the Policy and by the Green Remediation Fact Sheet for Best Management Practices for Site Investigation and Environmental Monitoring. The Phase II Limited Site Investigation report will include a section summarizing the Clean and Green practices utilized in the project.

11.0 SAMPLE HANDLING AND CUSTODY

Field personnel will collect soil samples in various containers as described in **Sections 10.2.1** and **10.2.2** above. The PAH samples will be stored in coolers containing ice for preservation. Ice will be replenished as needed during the investigation and prior to shipment to the laboratory. Field personnel will document all samples on laboratory chain-of-custody documents (SOP-12). The chain-of-custody will remain with the samples throughout storage and transportation. Field personnel will use SOP-9 as guidance for sample packing and shipping. Field personnel will ship the samples for priority delivery via overnight courier to the appropriate analytical laboratory. Field personnel will sign, date, and document the time on the chain-of-custody upon transfer of the samples to the courier.

12.0 ANALYTICAL METHODS

Table 6, below, lists the analytical method, container type, preservative and holding time applicable to the samples collected during this project.

Field personnel will order sample containers for PAHs, metals, discrete soil samples, and rinsate blank samples from the laboratories. Some sample containers will arrive from the laboratory with preservative already in them. Others may need to have the preservative added in the field. Field personnel will follow sample collection and preparation instructions provided by the laboratory.

Table 6. Analytical Method, Container, Preservative and Holding Times

Analytical Parameter	Analytical Method	Container Type	Preservative	Maximum Holding Time
SOIL				
PAHs (Pace National)	EPA Method 8270C SIM	4 oz glass jar	Chilled to ≤ 4 degrees C	14 days
Metals (discrete samples - SVL Analytical)	EPA Method 6010D; 7471 (Mercury)	4 oz glass jar	None	28 days
Metals (ISM samples - SVL Analytical)	EPA Method 6010D; 7471 (Mercury)	5-gallon sealable lab-cleaned bucket	None	28 days
WATER (Rinsate Blanks – QA/QC Only)				
PAHs (Pace National)	EPA Method 8270C SIM	2 x 40 milliliter glass vial	Chilled to ≤ 4 degrees C	7 days
Metals (SVL Analytical)	EPA Method 6010D; 7470 (Mercury)	250 milliliter glass	HNO_3, chilled to ≤ 4 degrees C	28 days

13.0 QUALITY CONTROL

13.1 FIELD QUALITY CONTROL

The project manager and field team leader will coordinate the field effort and be responsible for QA/QC for the project. The project manager will manage all data for the project once it has been collected. The data will be maintained in Tetra Tech's electronic project file on its server. The project manager and field team leader will be responsible for coordinating the project and ensure equipment is ready for use and jars/bottles have been ordered from the laboratory. The field team leader will be responsible for inspection of field equipment prior to use and periodically over the course of the project. Field personnel will collect QA/QC samples to evaluate precision, accuracy, representativeness, comparability, and completeness. Field personnel will use SOP-13 for guidance. Further information on project QA/QC is presented in **Section 22** and **Appendix E**.

QC samples will be collected for this project. **Table 10**, below, presents the number and type of QC samples. In addition to these, the analytical laboratory will analyze laboratory control samples, method blanks, matrix spike/matrix spike duplicates, and other QA/QC analyses as per method requirements to ensure data quality. Field personnel will utilize comment section on chain of custody forms to request which samples receive MS/MSD analysis.

Table 7. Field QC Sample Objectives

Sample Type	Media and COI	Purpose	Number of QC Samples	QA Objective
Field Duplicate	Soil / Metals	Measure analytical precision.	3 (1 from a DU, 2 from Shoreline areas)	50% RPD for soil
Field Duplicate	Soil / PAHs	Measure analytical precision.	1 (from a DU w/PAH analysis)	50% RPD for soil
MS/MSD (by lab)	Soil / Metals	Measure analytical precision.	3 (1 from a DU, 2 from Shoreline areas)	Within laboratory QC limits
MS/MSD (by lab)	Soil / PAHs	Measure analytical precision.	1 (from a DU w/PAH analysis)	Within laboratory QC limits
Equipment Rinsate Blank	Water / Metals	Assess for cross-contamination of sampling equipment.	5 (1 after each DU, 2 for Shoreline areas)	Target analytes not detected.
Equipment Rinsate Blank	Water / PAHs	Assess for cross-contamination of sampling equipment.	2 (1 from each DU w/PAH analysis)	Target analytes not detected.

Duplicates

Duplicate sampling involves collecting two samples, one “natural” sample and one “duplicate” sample. The samples are collected during the same sample event and at the same sample location. There are two types of duplicate samples, a “replicate” and a “split”. Replicate samples are collected one immediately after the other, separated only by the actual time required to fill the sample container. Split samples are those that are collected from the same initial volume of matrix.

The soil duplicate sample from the DU will be a split sample, where initial increments are sieved and then the remainder is split into two sample buckets. The berm soil duplicate from the Shoreline Area will be a split, as those samples are generally composites of the upper three or lower three feet from borings. The shore sediment samples will be replicates. The same number and type of bottles will be used for the duplicate sample as its associated natural sample, and the material sampled will be analyzed for the same analytical parameters. Field personnel will document which natural samples the duplicates are associated with in the field notebook. The duplicate samples will be submitted blind to the laboratory. Sample name designations are discussed in **Section 10.2.1** and **10.2.2.**

The collection dates for the duplicate samples will be recorded on the sample labels and chain of custody forms, but the sample collection times will not. Field personnel will document which natural sample each duplicate corresponds to in the field notebook.

Equipment Rinsate Blank

An equipment rinsate blank is a sample of blank matrix. The equipment rinsate blank will be collected using the source of deionized or distilled water that is used to decontaminate re-useable field equipment. Field personnel will collect the equipment rinsate blank in the field by pouring the deionized or distilled water directly from its original container over or through the decontaminated sampling equipment and into the laboratory sample container.

Other types of QA/QC samples, such as the ISM processing laboratory duplicate and MS/MSD analyses, will be requested by field personnel using the chain of custody form. Sample name designations are discussed in **Section 10.2.1** and **10.2.2**. Analytical results for water will be examined for data quality purposes.

13.2 LABORATORY QUALITY CONTROL

Pace National and SVL Analytical will perform laboratory QC as per the analytical method and their internal requirements. **Appendix F** provides QC manuals for Pace National (formerly ESC Lab Sciences) and SVL Analytical.

The frequency and type of QC performed by the laboratory is often driven by the analytical method being performed. Each laboratory will report the result of their QC efforts in a QC summary, as applicable, with each analytical laboratory report. The data is reviewed to evaluate if any shifts occurred and the laboratory looks at standard deviations to evaluate the level of fluctuation. The information is used, as needed to apply any corrections to the data.

Typical laboratory QC checks include internal check for sample analysis activities, duplicate samples and blanks. Standard laboratory QC are described below.

Laboratory Blanks

A laboratory blank (e.g., method blanks) is a sample of known matrix where the presence or absence of concentrations are known to be less than the laboratory minimum limit of detection (practical quantitation limit). The laboratory analyzes the blank to evaluate the accuracy of the analysis.

Laboratory Control Samples (LCSs)

LCSs are samples that contain a known concentration of analytes. The laboratory analyzes the samples to evaluate the overall method and laboratory performance and accuracy. The LCSs are prepared in the same manner and undergo the same procedures as the project samples. Analysis of a duplicate LCS is used to measure precision by calculating the RPD between the LCS and the duplicate.

Laboratory Duplicate Sample

A laboratory duplicate is a split collected by the laboratory from one of the project samples being analyzed. The laboratory analyzes the two samples and compares the results using the RPD. The duplicate samples are used to evaluate precision.

Matrix Spikes and Matrix Spike Duplicate

For a matrix spike (MS), the laboratory selects a sample from the batch and adds a known amount of target analyte to the sample before analysis to assess possible matrix interferences on the analysis. The laboratory will analyze a matrix spike duplicate (MSD) to calculate an RPD and evaluate precision. The laboratory will be provided with additional sample volume to use for MS and MSD analysis. No additional sample containers will need to be filled for this testing.

13.3 DATA ANALYSIS QUALITY CONTROL

Tetra Tech's field personnel, project manager and/or QA/QC manager will review the field notes and data collected during this project. DEQ's QAO may request a review of the data at any time during the project. Problems that arise and their corresponding corrective actions will be documented. All data will be reviewed, and analytical data evaluated through the data verification/validation process. Data qualifiers will be assigned to the data, as needed.

14.0 INSTRUMENT / EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

Field personnel will check the condition and operation of equipment that will be used in the field. The equipment will be maintained according to the manufacturer's guidelines and decontaminated prior to use at the site.

Laboratory instrument/equipment testing, inspection and maintenance will be performed and documented by the laboratory according to the laboratory's QAM, any method-specific requirements, and if/as required by the State of Idaho laboratory certification process. **Appendix F** includes the laboratory QC manuals.

15.0 INSTRUMENT / EQUIPMENT CALIBRATION AND FREQUENCY

The primary field instruments field personnel will use in this investigation will be surveying instruments, such as hand-held GPS units. Project specific calibration will not be needed. An XRF device may be employed during sampling of the Shoreline Area berm and shore. If employed, this instrument will undergo a standard calibration beforehand.

16.0 INSPECTION / ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Supplies and consumable items required for the sampling will be based on the work described in **Section 10**. Supplies and consumables will be purchased new and inspected prior to the field effort. Field personnel will obtain all sample bottles and buckets from the analytical laboratory. The bottles will be ordered at least one week prior to the field effort and the order checked for accuracy upon arrival.

17.0 NON-DIRECT MEASUREMENTS AND DATA ACQUISITION

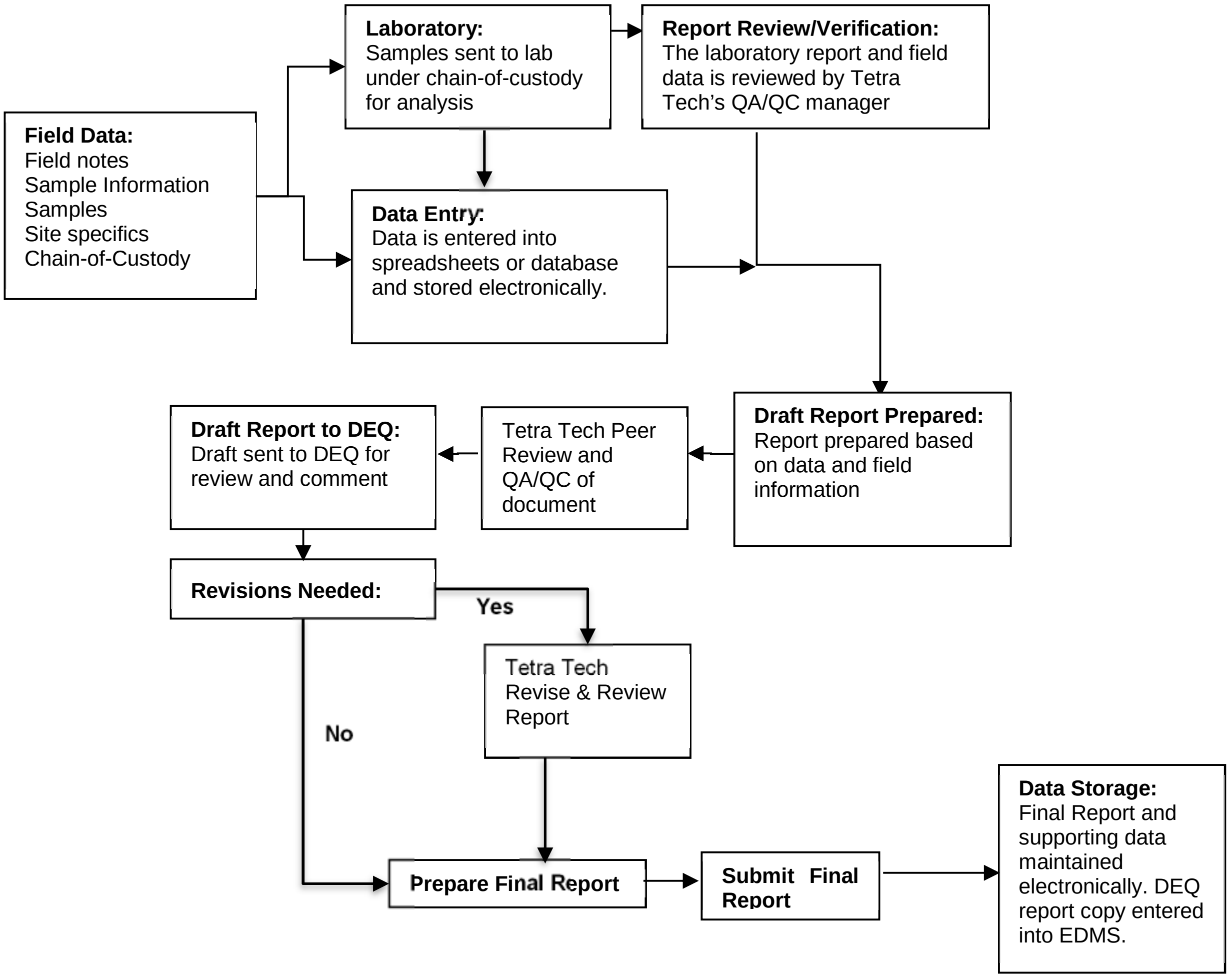
Project personnel may rely upon secondary data not directly measured or generated in this scope of work. This data may include on-line DEQ regulatory data, interviews with persons knowledgeable about the site, and other historical data. Specific non-direct measurements are not included in this QAPP.

18.0 DATA MANAGEMENT

Tetra Tech will maintain hard copies of field notebooks and field forms in a project folder. The field notebooks and forms will also be scanned and electronically kept in the project's electronic folder on Tetra Tech's server, which is backed up daily. Analytical data will be obtained from the laboratory in electronic format. The analytical reports will also be stored in the project folder on Tetra Tech's server as will all other project reports and documents. Field and laboratory data will also be uploaded to DEQ's EDMS system (**Figure 6,** next page).

Other data that may be used during this project include historic investigation and Phase 1 ESA reports. The existing documents will also be stored electronically in the project folder.

Figure 6. Data Flow Chart



19.0 ASSESSMENT AND RESPONSE ACTIONS

Tetra Tech's PM will be responsible for assessment and oversight of project activities. DEQ will be kept informed of project activities and progress throughout the duration of this project. Tetra Tech may conduct an internal audit of field procedures. If completed, the internal audit may include a review of procedures selected for the sampling program, a review of QA/QC samples required, and a review of training requirements. The laboratory is required to have written procedures addressing internal QA/QC as specified in the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Contract Laboratory Program (CLP) protocol.

Corrective actions will be taken promptly upon identification of potential problems with data acquisition or measurement. Field equipment malfunctions will be identified promptly and corrected by the field team leaders. Problems and their associated corrective actions will be documented in the field notes. Laboratory equipment malfunctions are handled according to EPA analytical method specifications. Laboratory QC samples (calibration samples, method blanks, matrix spike samples, laboratory control samples, and laboratory duplicates) will be handled according to EPA analytical method specifications. Laboratory corrective actions will be included on analytical laboratory reports.

20.0 REPORTS TO MANAGEMENT

Project and sample results for this project will be presented in the limited site investigation report. The report will document the sampling activities, laboratory analytical results, and a comparison of the analytical results to the Idaho DEQ or EPA Standards. The report will summarize the purpose, scope of work, field and analytical methods, and present tables of analytical results, and figures. The report will also include results of the data validation and verification, and data usability assessment, as well as findings and recommendations for additional work, as needed. The report will also discuss any deviations from this QAPP.

Tetra Tech will submit an electronic draft report to DEQ for review and incorporate DEQ comments into a final report. Tetra Tech will follow the Green Remediation Objectives outlined in USEPA Region 10 Clean and Green Policy by implementing, where practical, the assessment and cleanup practices encouraged by the Policy and by the Green Remediation Fact Sheet for Best Management Practices for Site Investigation and Environmental Monitoring. Tetra Tech will summarize in the ESA report the *Clean and Green* practices utilized in the project. The final report will be submitted in electronic PDF format.

21.0 DATA REVIEW, VERIFICATION, AND VALIDATION

Tetra Tech will conduct data review, verification, and validation on the field and laboratory data collected during this project.

21.1 DATA REVIEW

Data review will be conducted to ensure project data has been recorded, transmitted, and processed correctly. Data review will be performed by the project manager.

21.2 DATA VERIFICATION

Data verification will be performed after the data review to evaluate whether the data complies with the scope of work, investigation methods, DQOs and other requirements specified in the QAPP. The goal is to evaluate project performance against the requirements in the QAPP. The project manager will perform the verification.

21.3 DATA VALIDATION

Tetra Tech's QAO or other experienced data validator or subject matter expert will conduct the data validation of project analytical data. Data validation will be conducted to evaluate the quality of the project data relative to the end use. Validation is related to analyte- and sample-specific process that focuses on the project-specific data needs and documents any potentially unacceptable variances from the QAPP. Qualifiers will be assigned to project data during the validation process.

22.0 REVIEW, VERIFICATION, AND VALIDATION METHODS

This section describes the methods that will be used to review, verify, and validate the data. Data review, verification, and validation efforts are based on the analytical support determined to be necessary in the planning stages of the project. Tetra Tech personnel performing data verification and validation will use the following documents, as needed, for guidance during the effort:

- EPA QA/G-8 Guidance on Environmental Data Verification and Data Validation (EPA 2002)
- Appendix A of EPA's Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA 2009)
- National Functional Guidelines for Superfund Organic Methods Data Review (EPA 2016).

Deviations from the QAPP will be noted during the data review, verification, and validation process. Deviations will be identified in the project report along with an assessment of how the data may be affected.

22.1 DATA REVIEW

Tetra Tech's project manager will perform a review of data and information collected under this QAPP. Tetra Tech will use the data review checklist in **Appendix E**. The goal of the review will be to identify errors; evaluate completeness of all data collected, and how it was collected and handled; ensure that all non-direct measurement data was received; check for completeness of the data obtained and identify any deficiencies; review analytical laboratory documentation; and evaluate any programming or software related errors.

22.2 DATA VERIFICATION

Tetra Tech's project manager will use the data verification checklist in **Appendix E**. The review will generally consist of verifying that all data specified in the QAPP was collected; that the samples collected, handled, and analyzed according to the methods and procedures specified; field and laboratory supporting document is present and complete; data calculations use correct mathematical formulas, and numerical and modeling methods. The verification process will identify any deficiencies and limitations on the use of the data.

22.3 DATA VALIDATION

Tetra Tech's QAO or other designated data validator or subject matter expert will conduct the data validation using the data validation checklist in **Appendix E**. The goal of the validation effort is to evaluate whether the project data meets the needs of the user and associated decision makers. Validation will be completed on a minimum of 10% of all project data with a goal of 20%, except as noted below. Data validation will generally include:

- A 100% review of field QC sample results and assignment of data qualifiers, as needed.
- Review of analytical laboratory report and data, and assignment of data qualifiers, as needed.
- Evaluate data quality in relation to DQOs.
- Evaluate, where possible, reasons for any failure to meet methodical, procedural, or contractual requirements and the impact this may or may not have on the data.
- Assess adequacy of the data in relation to project DQOs and user requirements.
- As applicable, evaluate the extent of which any non-direct measurement data (existing data) and accompanying support information and documentation, meet the requirements of the data user.
- Evaluate limitations on the use of project data, as needed.

23.0 RECONCILIATION WITH USER REQUIREMENTS

Tetra Tech's project manager and/or QA/QC manager will assess whether the data is adequate to meet the project DQOs. The project report will include a list of any deviations from the QAPP and how the deviation may affect the data for use.

24.0 REFERENCES

Bureau of Community and Environmental Health (BCEH), 2017. Letter Health Consultation, BNSF Railway Corridor Site: Soil Arsenic, Coeur d'Alene, Idaho. By Morgan Willming, PhD. *Dated* October 11, 2017.

Idaho Department of Environmental Quality (DEQ), 2018. Idaho Risk Evaluation Manual for Petroleum Releases. *Dated* August 2018.

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Interstate Technology & Regulatory Council (ITRC), 2012. Incremental Sampling Methodology. *Dated* February 2012.

Tetra Tech, 2017. Phase I Environmental Site Assessment, Former Atlas-Stimson Mill Property, Coeur d'Alene, Idaho. *Dated* September 19, 2017.

U.S. Environmental Protection Agency (EPA), 2002. Guidance on Environmental Data Verification and Data Validation. EPA/240/R-02/004. *Dated* November, 2002.

U.S. EPA, 2009. Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use. EPA-540-R-08-005. *Dated* January 13, 2009.

U.S. EPA, 2016. National Functional Guidelines for Superfund Organic Methods Data Review. EPA-540-R-2016-002. *Dated* September, 2016.

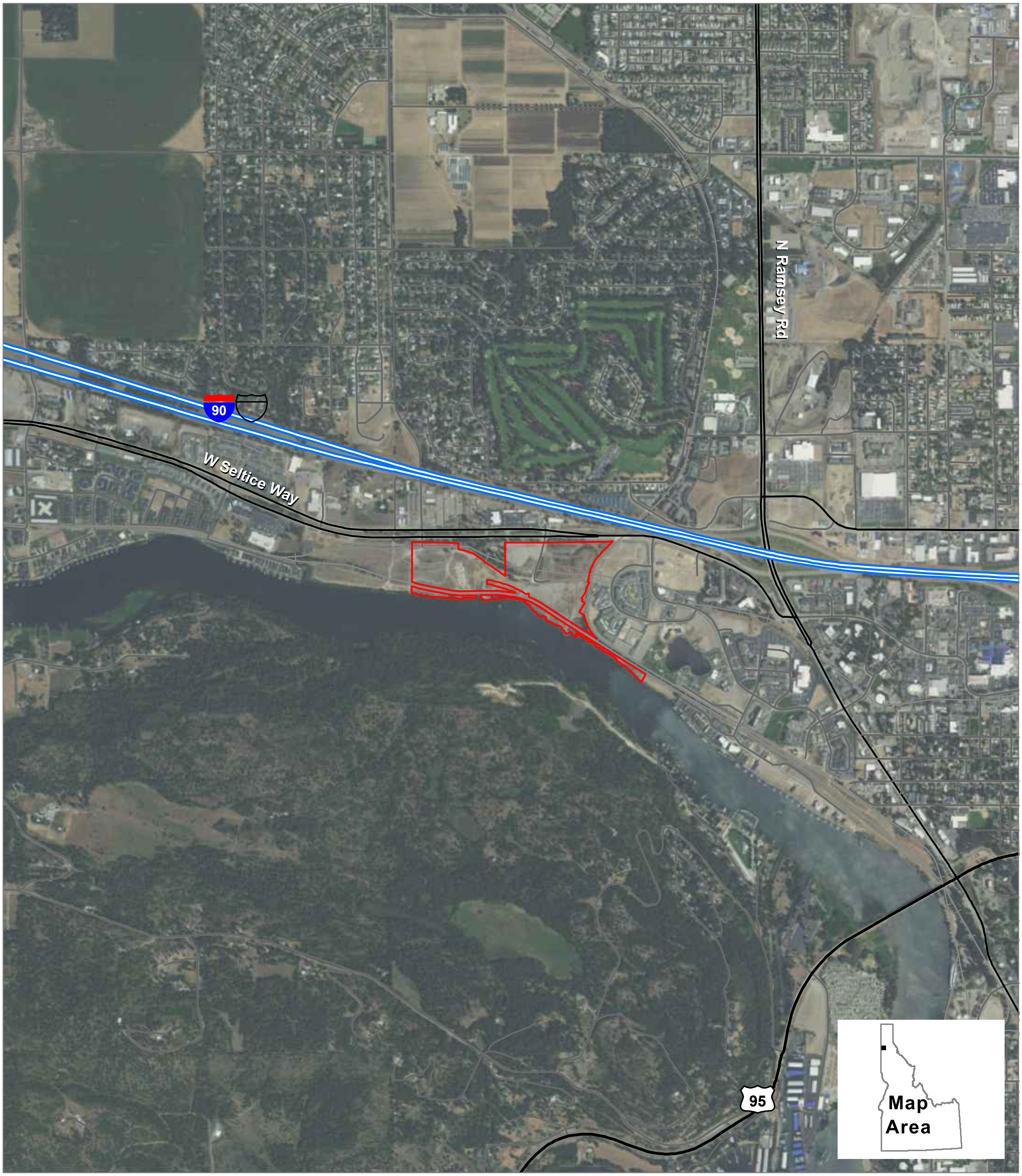
U.S. EPA, 2016. Green Remediation Best Management Practices: Site Investigation and Environmental Monitoring. EPA-542-F-16-002 *Dated* September 2016

U.S. EPA, 2018a. Regional Screening Level Table for Resident Soil. *Dated* November 2018.

U.S. EPA, 2018b. Regional Screening Level Table for Resident Soil to Groundwater. *Dated* November 2018.

Washington Department of Ecology (Ecology), 1994. Natural Background Soil Metals Concentrations in Washington State. Publication #94-115. *Dated* October 1994.

APPENDIX A – SITE MAPS



TETRA TECH

Site Location Map

N

0 2,000

Feet

Approximate Boundaries of the Subject Property

Stimson Site
Coeur d'Alene, ID
Figure 1

Source: ESRI
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0 300
Feet
N

Approximate Boundaries of the Subject Property
Contour Lines of the Subject Property

Source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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TETRA TECH

Site Map
Stimson Site
Coeur d'Alene, ID
Figure 2

0 300
Feet
N

Decision Unit
Shoreline Area

Source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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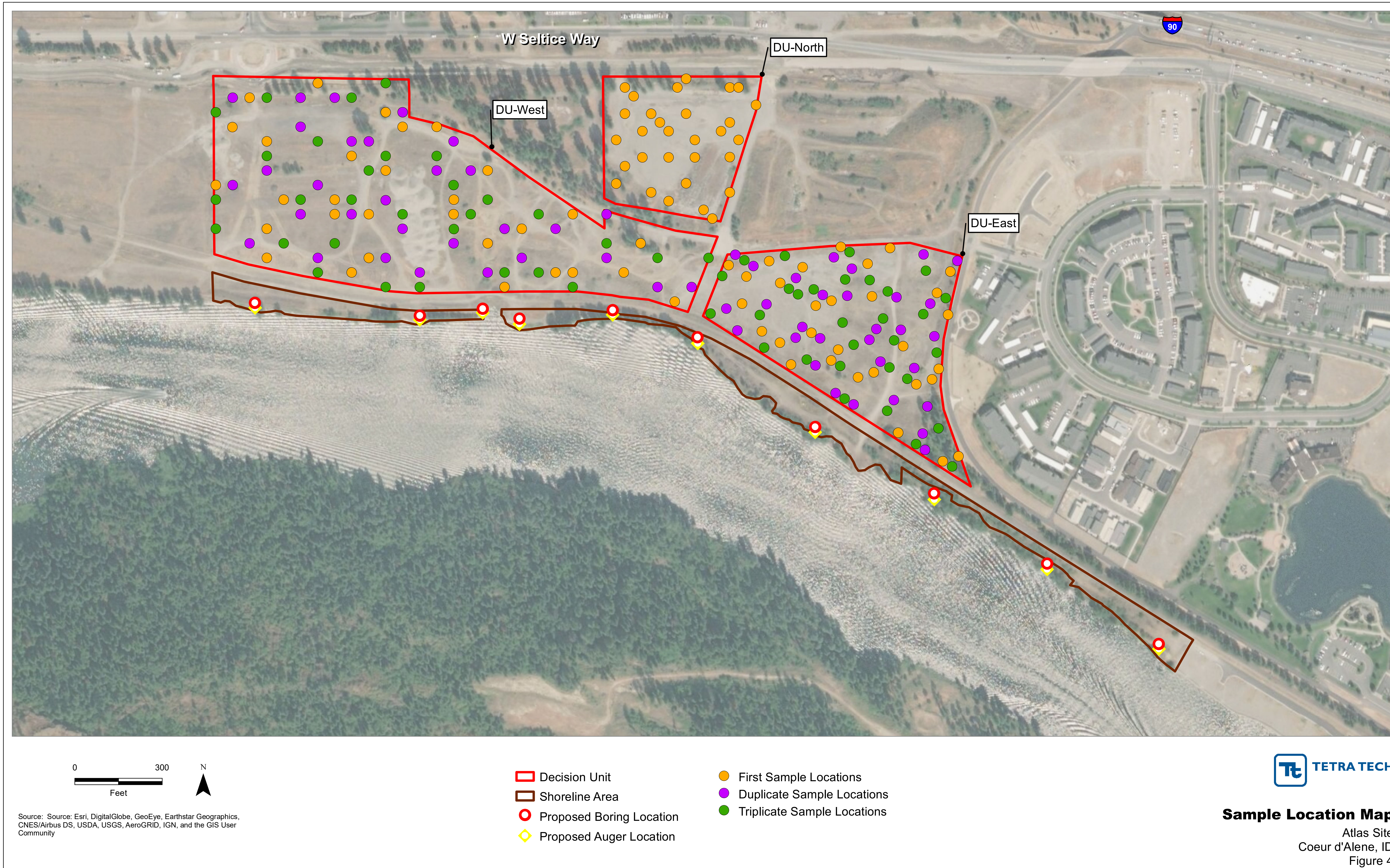
TETRA TECH

Site Map
Atlas Site
Coeur d'Alene, ID
Figure 3

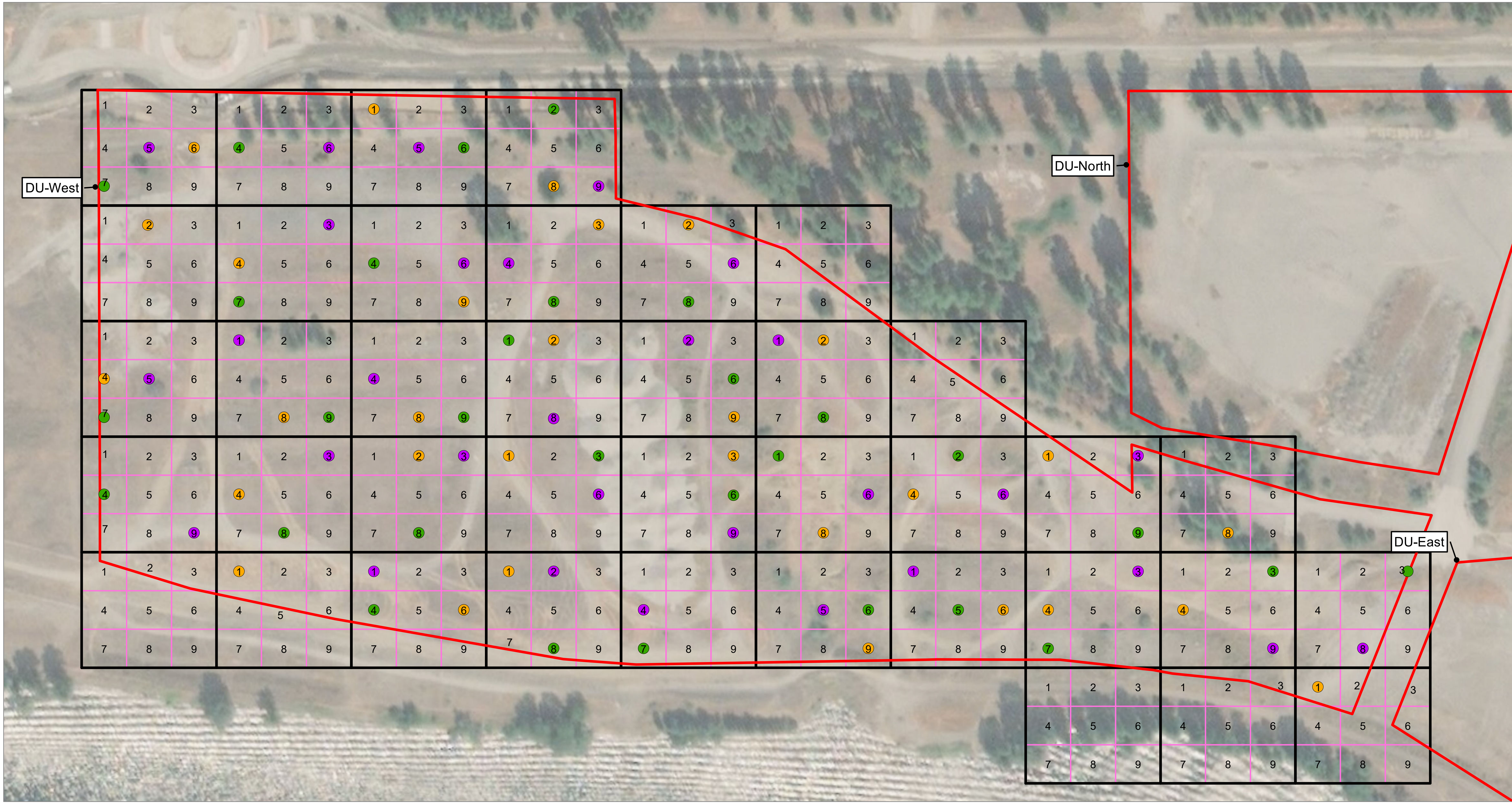


Sample Location Map

Atlas Site

Coeur d'Alene, ID

Figure 4



Decision Unit
DU Main Grid
DU Grid Cells

First Sample Locations
Duplicate Sample Locations
Triplicate Sample Locations

Source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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TETRA TECH

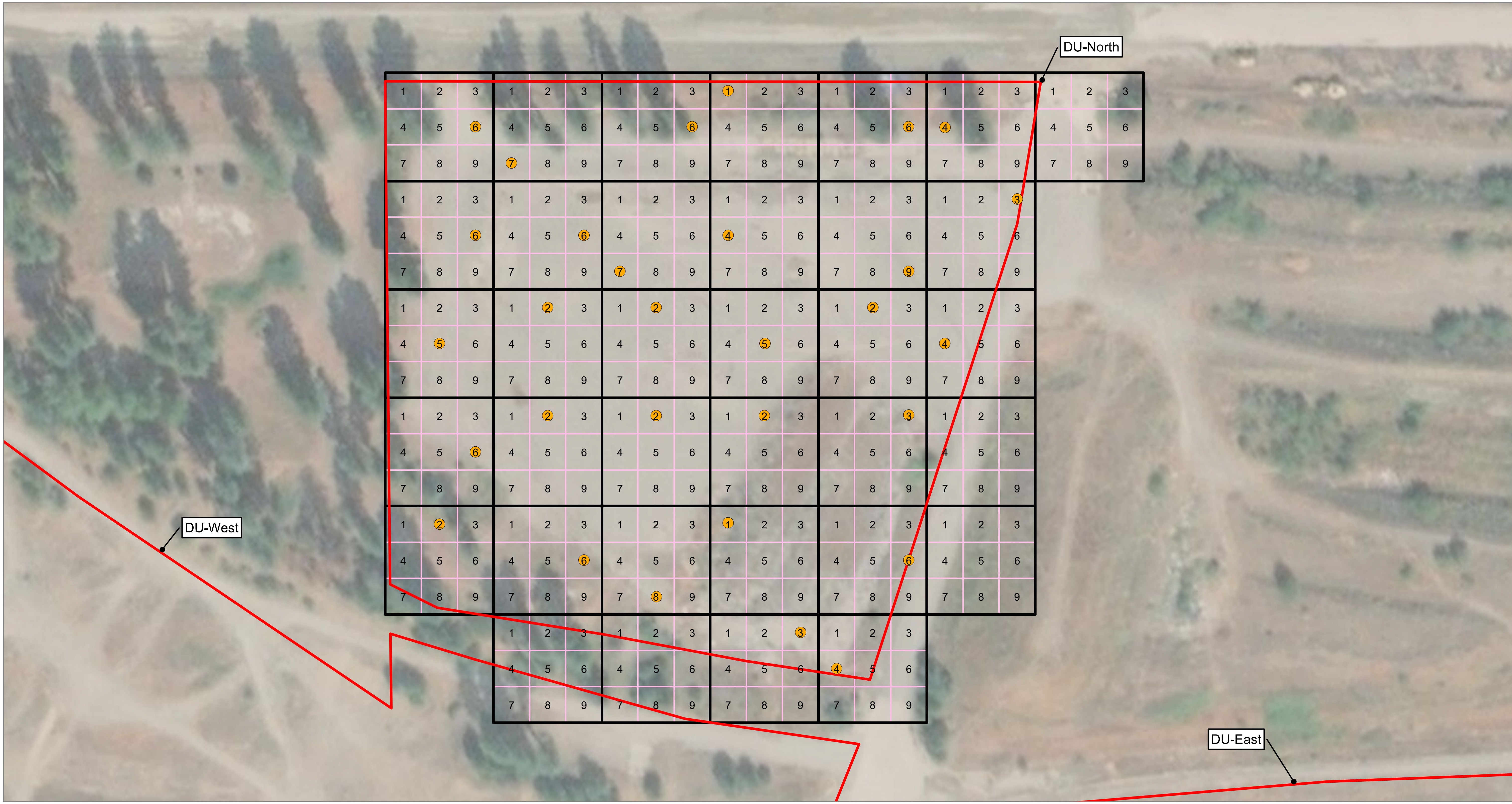
Sample Location Map

DU-West

Atlas Site

Coeur d'Alene, ID

Figure 4a



0 80
Feet
N

Source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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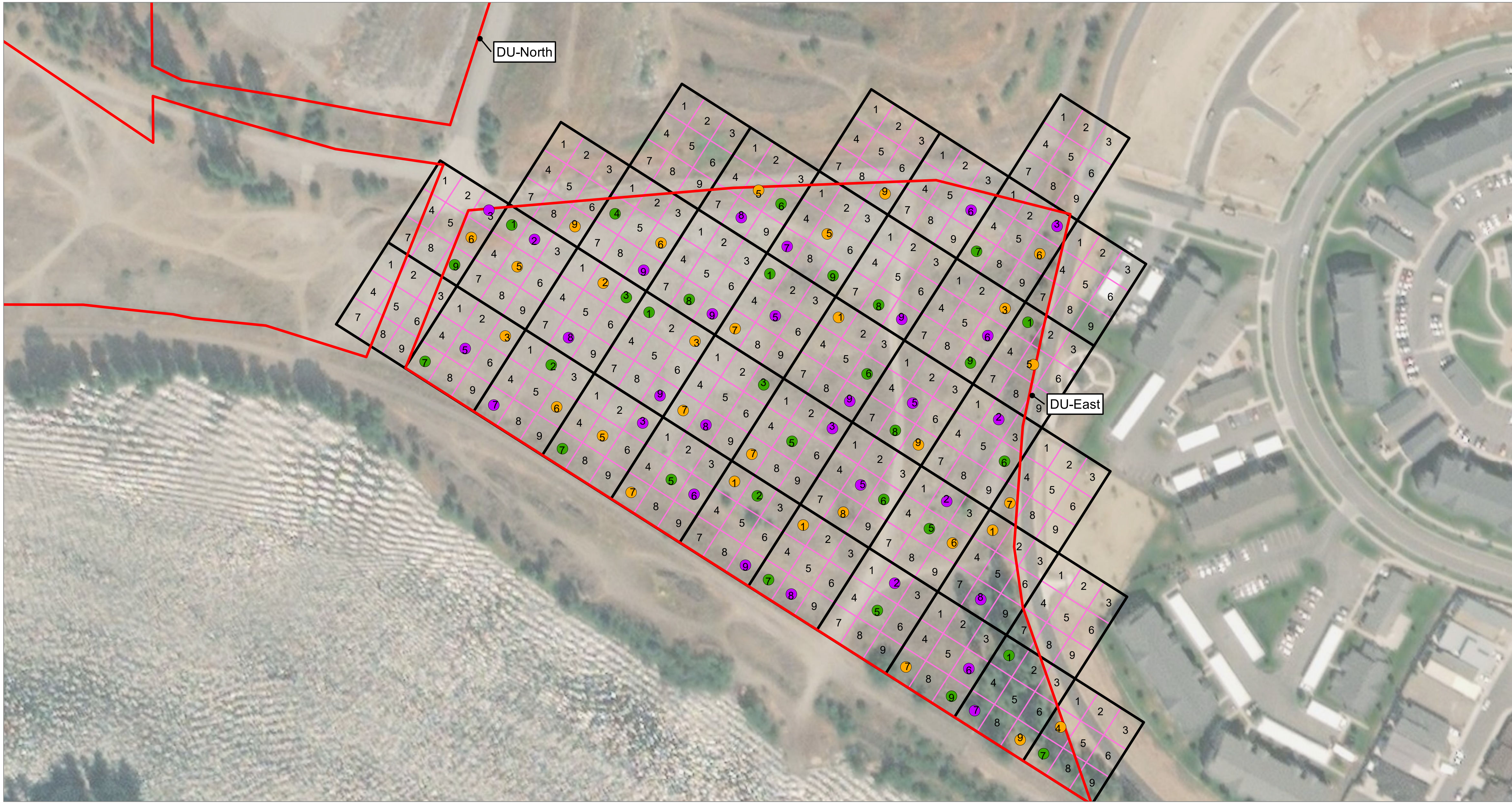
Decision Unit
DU Main Grid
DU Grid Cells
First Sample Location

TETRA TECH

Sample Location Map

DU-North

Atlas Site
Coeur d'Alene, ID
Figure 4b



0 150
Feet
N

Decision Unit
DU Main Grid
DU Grid Cells

First Sample Locations
Duplicate Sample Locations
Triplicate Sample Locations

Source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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TETRA TECH

Sample Location Map

DU-East

Atlas Site
Coeur d'Alene, ID
Figure 4C

APPENDIX B – SCREENING LEVELS, LAB DETECTION LIMITS, AND GPS DU POINTS

Samples received for ISM laboratory sample processing and analysis

↓

Sample Conditioning
Air Dry Bulk sample
Disaggregation if necessary

↓

Particle Size Selection
Sieve Bulk sample to -80

↓

Analytical Subsampling
Riffle Spit sample if required to fit on tray
2-D Japanese Slabcake on sample to 10 g ± 0.1 g

Procedure:

- Spread sample evenly on a tray with a resulting depth of no more than 1-2.5 cm.
- Divide surface into 30 sections.
- Using an appropriate scoop, collect a 0.33 g increment from each section, ensuring equal collection from both the top and bottom of the sample.
- Repeat collection for client specified duplicate.
- Repeat collection for % solids.

↓

RCRA 8 analysis
(1 g of sample per 6010C digestion)
(0.6 g of sample per 7471B digestion)

Quality Control Samples for 6010C and 7471B

- Method Blank
- Laboratory Control Sample
- Laboratory Duplicate Sample on replicate sample
- Matrix Spike and Matrix Spike Duplicate

Figure 5
SVL Analytical
ISM Process Flow Chart

TABLE B-1 **Summary of Screening Levels, Background Concentrations, and Laboratory Detection Limits, RCRA Metals 8** Concentrations are shown in mg/kg				
Metal	EPA Regional Screening Level for Soil[1]	Background	SVL Analytical MDL	SVL Analytical PQL
Arsenic (As)*	0.68	7.87[2]	2.50	2.50
Barium (Ba)	15,000	-	0.20	0.20
Cadmium (Cd)	71	1[3]	0.20	0.20
Total Chromium (Cr)	0.3	42[3]	0.60	0.60
Lead (Pb)	400	30.74[2]	0.75	0.75
Mercury (Hg)	11	0.07[3]	0.033	0.033
Selenium (Se)	390	0.208[2]	4.00	4.00
Silver (Ag)	390	-	0.50	0.50

(1)Regional Screening Level (Residential), from USEPA 2018

(2)Mean Concentration for Kootenai County, from USGS 2017 via website: https://www.epa.gov/superfund/usgs-background-soil-lead-survey-state-data#ID

(3)Natural Bkgrnd Soil Metals WA State, from WDOE 94-115 1994

Note *Arsenic levels may be as high as 25.6 mg/kg, which may be acceptable as per BCEH Health Consultation Letter 2017*

TABLE B-2 **Summary of Screening Levels and Laboatory Detection Limits, PAHs** Concentrations are shown in mg/kg			
PAH	IDEQ Soil Screening Level[1]	Pace MDL	Pace PQL
Acenaphthene	200	0.0006	0.006
Anthracene	3,200	0.0006	0.006
Benzo(a)anthracene	0.68	0.0006	0.006
Benzo(a)pyrene	0.14	0.0006	0.006
Benzo(b)fluoranthene	1.4	0.0006	0.006
Benzo(k)fluoranthene	14	0.0006	0.006
Chrysene	69	0.0006	0.006
Fluoranthene	1,400	0.0006	0.006
Fluorene	240	0.0006	0.006
Naphthalene	0.12	0.002	0.02
Pyrene	1,000	0.0006	0.006

(1)Screening Level Conc. for Soil, Table 2, from Idaho DEQ 2018

DU WEST

OID *	Shape *	Use	CellNumber	GridNumber	ORIG_FID	Latitude_DMS	Longitude_DMS
1	Point	Triplicate	7	1	48	47° 42' 0.339" N	116° 49' 42.341" W
2	Point	First	6	1	49	47° 42' 0.830" N	116° 49' 40.634" W
3	Point	Duplicate	5	1	50	47° 42' 0.831" N	116° 49' 41.486" W
4	Point	Triplicate	4	2	57	47° 42' 0.829" N	116° 49' 39.780" W
6	Point	Duplicate	6	2	59	47° 42' 0.826" N	116° 49' 38.074" W
7	Point	Triplicate	6	3	66	47° 42' 0.822" N	116° 49' 35.515" W
8	Point	First	1	3	67	47° 42' 1.318" N	116° 49' 37.219" W
9	Point	Duplicate	5	3	68	47° 42' 0.823" N	116° 49' 36.367" W
10	Point	Triplicate	2	4	75	47° 42' 1.313" N	116° 49' 33.806" W
11	Point	First	8	4	76	47° 42' 0.326" N	116° 49' 33.810" W
12	Point	Duplicate	9	4	77	47° 42' 0.325" N	116° 49' 32.957" W
14	Point	First	2	5	85	47° 41' 59.840" N	116° 49' 41.513" W
16	Point	Triplicate	7	6	93	47° 41' 58.854" N	116° 49' 39.787" W
17	Point	First	4	6	94	47° 41' 59.348" N	116° 49' 39.785" W
18	Point	Duplicate	3	6	95	47° 41' 59.839" N	116° 49' 38.078" W
19	Point	Triplicate	4	7	102	47° 41' 59.344" N	116° 49' 37.226" W
20	Point	First	9	7	103	47° 41' 58.848" N	116° 49' 35.521" W
21	Point	Duplicate	6	7	104	47° 41' 59.341" N	116° 49' 35.520" W
22	Point	Triplicate	8	8	111	47° 41' 58.845" N	116° 49' 33.815" W
24	Point	Duplicate	4	8	113	47° 41' 59.340" N	116° 49' 34.666" W
39	Point	Duplicate	9	8	158	47° 41' 55.893" N	116° 49' 40.650" W
91	Point	First	3	8	112	47° 41' 59.831" N	116° 49' 32.959" W
23	Point	First	2	9	112	47° 41' 59.828" N	116° 49' 31.252" W
56	Point	Triplicate	8	9	255	47° 41' 58.841" N	116° 49' 31.255" W
57	Point	Duplicate	6	9	257	47° 41' 59.333" N	116° 49' 30.401" W
25	Point	Triplicate	7	11	120	47° 41' 57.377" N	116° 49' 42.351" W
26	Point	First	4	11	121	47° 41' 57.871" N	116° 49' 42.349" W
27	Point	Duplicate	5	11	122	47° 41' 57.869" N	116° 49' 41.496" W
28	Point	Triplicate	9	12	129	47° 41' 57.371" N	116° 49' 38.086" W
29	Point	First	8	12	130	47° 41' 57.372" N	116° 49' 38.938" W
30	Point	Duplicate	1	12	131	47° 41' 58.360" N	116° 49' 39.788" W
31	Point	Triplicate	9	13	138	47° 41' 57.367" N	116° 49' 35.526" W
32	Point	First	8	13	139	47° 41' 57.368" N	116° 49' 36.379" W
33	Point	Duplicate	4	13	140	47° 41' 57.863" N	116° 49' 37.231" W
34	Point	Triplicate	1	14	147	47° 41' 58.353" N	116° 49' 34.670" W
35	Point	First	2	14	148	47° 41' 58.351" N	116° 49' 33.816" W
36	Point	Duplicate	8	14	149	47° 41' 57.348" N	116° 49' 33.821" W
58	Point	Triplicate	6	15	273	47° 41' 57.853" N	116° 49' 30.406" W
59	Point	First	9	15	274	47° 41' 57.364" N	116° 49' 30.397" W
60	Point	Duplicate	2	15	275	47° 41' 58.347" N	116° 49' 31.257" W
61	Point	Triplicate	8	16	282	47° 41' 57.356" N	116° 49' 28.701" W
62	Point	First	2	16	283	47° 41' 58.344" N	116° 49' 28.698" W
63	Point	Duplicate	1	16	284	47° 41' 58.345" N	116° 49' 29.551" W
37	Point	Triplicate	4	18	156	47° 41' 56.390" N	116° 49' 42.354" W
40	Point	Triplicate	8	19	165	47° 41' 55.891" N	116° 49' 38.943" W
41	Point	First	4	19	166	47° 41' 56.386" N	116° 49' 39.795" W

DU WEST

42	Point	Duplicate	3	19	167	47° 41' 56.877" N	116° 49' 38.087" W
43	Point	Triplicate	8	20	174	47° 41' 55.887" N	116° 49' 36.384" W
44	Point	First	2	20	175	47° 41' 56.874" N	116° 49' 36.381" W
45	Point	Duplicate	3	20	176	47° 41' 56.873" N	116° 49' 35.528" W
46	Point	Triplicate	3	21	183	47° 41' 56.869" N	116° 49' 32.969" W
47	Point	First	1	21	184	47° 41' 56.872" N	116° 49' 34.675" W
48	Point	Duplicate	6	21	185	47° 41' 56.375" N	116° 49' 32.970" W
64	Point	Triplicate	6	22	291	47° 41' 56.361" N	116° 49' 30.409" W
65	Point	First	3	22	292	47° 41' 56.865" N	116° 49' 30.409" W
66	Point	Duplicate	9	22	293	47° 41' 55.877" N	116° 49' 30.419" W
67	Point	Triplicate	1	23	300	47° 41' 56.864" N	116° 49' 29.556" W
68	Point	First	8	23	301	47° 41' 55.875" N	116° 49' 28.706" W
69	Point	Duplicate	6	23	302	47° 41' 56.368" N	116° 49' 27.852" W
76	Point	Triplicate	2	24	354	47° 41' 56.859" N	116° 49' 26.143" W
77	Point	First	4	24	355	47° 41' 56.366" N	116° 49' 26.998" W
78	Point	Duplicate	6	24	356	47° 41' 56.364" N	116° 49' 25.292" W
82	Point	Triplicate	9	25	381	47° 41' 55.866" N	116° 49' 22.735" W
83	Point	Duplicate	3	25	383	47° 41' 56.853" N	116° 49' 22.731" W
93	Point	First	1	25	355	47° 41' 56.856" N	116° 49' 24.437" W
94	Point	First	8	26	355	47° 41' 55.864" N	116° 49' 21.028" W
96	Point	First	1	28	165	47° 41' 55.398" N	116° 49' 39.798" W
51	Point	First	6	29	211	47° 41' 54.898" N	116° 49' 35.534" W
52	Point	Duplicate	1	29	212	47° 41' 55.395" N	116° 49' 37.239" W
97	Point	Triplicate	4	29	174	47° 41' 54.901" N	116° 49' 37.240" W
53	Point	Triplicate	8	30	219	47° 41' 54.402" N	116° 49' 33.829" W
54	Point	First	1	30	220	47° 41' 55.391" N	116° 49' 34.680" W
55	Point	Duplicate	2	30	221	47° 41' 55.389" N	116° 49' 33.826" W
70	Point	Triplicate	7	31	309	47° 41' 54.400" N	116° 49' 32.123" W
72	Point	Duplicate	4	31	311	47° 41' 54.893" N	116° 49' 32.122" W
73	Point	Triplicate	6	32	318	47° 41' 54.887" N	116° 49' 27.857" W
74	Point	First	9	32	319	47° 41' 54.393" N	116° 49' 27.858" W
75	Point	Duplicate	5	32	320	47° 41' 54.888" N	116° 49' 28.709" W
79	Point	Triplicate	5	33	363	47° 41' 54.884" N	116° 49' 26.150" W
80	Point	First	6	33	364	47° 41' 54.883" N	116° 49' 25.297" W
81	Point	Duplicate	1	33	365	47° 41' 55.379" N	116° 49' 27.002" W
84	Point	Triplicate	7	34	390	47° 41' 54.388" N	116° 49' 24.446" W
85	Point	First	4	34	391	47° 41' 54.881" N	116° 49' 24.444" W
86	Point	Duplicate	3	34	392	47° 41' 55.373" N	116° 49' 22.736" W
88	Point	Triplicate	3	35	417	47° 41' 55.369" N	116° 49' 20.177" W
89	Point	First	4	35	418	47° 41' 54.878" N	116° 49' 21.885" W
90	Point	Duplicate	9	35	419	47° 41' 54.381" N	116° 49' 20.180" W
99	Point	Duplicate	8	36	419	47° 41' 54.379" N	116° 49' 18.474" W
100	Point	Triplicate	3	36	417	47° 41' 55.365" N	116° 49' 17.618" W
101	Point	First	1	39	364	47° 41' 53.886" N	116° 49' 19.329" W

DU WEST - 90 POINTS TOTAL

DU NORTH

OID *	Shape *	Use	CellNumber	GridNumber	ORIG_FID	Latitude_DMS	Longitude_DMS
1	Point	First	3	1	42	47° 42' 1.153" N	116° 49' 21.804" W
2	Point	First	7	2	51	47° 42' 0.856" N	116° 49' 21.366" W
3	Point	First	6	3	60	47° 42' 1.149" N	116° 49' 19.171" W
4	Point	First	1	4	69	47° 42' 1.444" N	116° 49' 18.731" W
5	Point	First	6	5	78	47° 42' 1.145" N	116° 49' 16.542" W
6	Point	First	4	6	87	47° 42' 1.138" N	116° 49' 16.097" W
7	Point	First	6	8	114	47° 42' 0.264" N	116° 49' 21.807" W
8	Point	First	6	9	123	47° 42' 0.262" N	116° 49' 20.490" W
9	Point	First	7	10	132	47° 41' 59.965" N	116° 49' 20.053" W
10	Point	First	4	11	141	47° 42' 0.259" N	116° 49' 18.735" W
11	Point	First	9	12	150	47° 41' 59.960" N	116° 49' 16.543" W
12	Point	First	3	13	159	47° 42' 0.550" N	116° 49' 15.224" W
13	Point	First	5	14	168	47° 41' 59.376" N	116° 49' 22.248" W
14	Point	First	2	15	177	47° 41' 59.670" N	116° 49' 20.931" W
15	Point	First	2	16	186	47° 41' 59.668" N	116° 49' 19.615" W
16	Point	First	5	17	195	47° 41' 59.370" N	116° 49' 18.293" W
17	Point	First	2	18	204	47° 41' 59.665" N	116° 49' 16.982" W
18	Point	First	6	20	222	47° 41' 58.487" N	116° 49' 21.813" W
19	Point	First	2	21	231	47° 41' 58.782" N	116° 49' 20.934" W
20	Point	First	2	22	240	47° 41' 58.780" N	116° 49' 19.618" W
21	Point	First	2	23	249	47° 41' 58.778" N	116° 49' 18.302" W
22	Point	First	3	24	258	47° 41' 58.780" N	116° 49' 16.547" W
23	Point	First	2	26	276	47° 41' 57.895" N	116° 49' 22.253" W
24	Point	First	6	27	285	47° 41' 57.596" N	116° 49' 20.500" W
25	Point	First	8	28	294	47° 41' 57.294" N	116° 49' 19.617" W
26	Point	First	1	29	303	47° 41' 57.899" N	116° 49' 18.743" W
27	Point	First	6	30	312	47° 41' 57.590" N	116° 49' 16.551" W
30	Point	First	3	34	357	47° 41' 57.000" N	116° 49' 17.869" W
31	Point	First	4	19	204	47° 41' 59.367" N	116° 49' 16.106" W
32	Point	First	4	35	357	47° 41' 56.703" N	116° 49' 17.431" W

DU NORTH - 30 POINTS TOTAL

DU EAST

OID *	Shape *	Use	CellNumber	GridNumber	ORIG_FID	Latitude_DMS	Longitude_DMS
1	Point	First	3	2	56	47° 41' 53.817" N	116° 49' 15.952" W
2	Point	Duplicate	5	2	61	47° 41' 53.649" N	116° 49' 16.741" W
3	Point	Triplicate	7	2	64	47° 41' 53.482" N	116° 49' 17.530" W
4	Point	First	6	3	65	47° 41' 52.877" N	116° 49' 14.950" W
5	Point	Duplicate	7	3	70	47° 41' 52.902" N	116° 49' 16.187" W
6	Point	Triplicate	2	3	73	47° 41' 53.431" N	116° 49' 15.057" W
7	Point	First	5	4	74	47° 41' 52.491" N	116° 49' 14.054" W
8	Point	Duplicate	3	4	79	47° 41' 52.658" N	116° 49' 13.265" W
9	Point	Triplicate	7	4	82	47° 41' 52.323" N	116° 49' 14.843" W
10	Point	First	7	5	83	47° 41' 51.744" N	116° 49' 13.500" W
11	Point	Duplicate	6	5	88	47° 41' 51.718" N	116° 49' 12.263" W
12	Point	Triplicate	5	5	91	47° 41' 51.912" N	116° 49' 12.711" W
13	Point	First	1	6	92	47° 41' 51.886" N	116° 49' 11.474" W
14	Point	Duplicate	9	6	97	47° 41' 50.779" N	116° 49' 11.261" W
15	Point	Triplicate	2	6	100	47° 41' 51.693" N	116° 49' 11.026" W
16	Point	First	1	7	101	47° 41' 51.307" N	116° 49' 10.131" W
17	Point	Duplicate	8	7	106	47° 41' 50.392" N	116° 49' 10.365" W
18	Point	Triplicate	7	7	109	47° 41' 50.586" N	116° 49' 10.813" W
20	Point	Duplicate	2	8	115	47° 41' 50.535" N	116° 49' 8.339" W
21	Point	Triplicate	5	8	118	47° 41' 50.174" N	116° 49' 8.680" W
65	Point	First	9	8	272	47° 41' 48.462" N	116° 49' 5.887" W
67	Point	Duplicate	7	8	280	47° 41' 48.848" N	116° 49' 6.783" W
96	Point	Triplicate	1	8	<Null>	47° 41' 49.575" N	116° 49' 6.104" W
62	Point	First	7	9	263	47° 41' 49.427" N	116° 49' 8.126" W
63	Point	Duplicate	6	9	268	47° 41' 49.402" N	116° 49' 6.889" W
64	Point	Triplicate	9	9	271	47° 41' 49.041" N	116° 49' 7.230" W
71	Point	First	4	11	304	47° 41' 48.629" N	116° 49' 5.098" W
97	Point	Triplicate	7	11	<Null>	47° 41' 48.275" N	116° 49' 5.427" W
91	Point	First	6	12	128	47° 41' 55.117" N	116° 49' 16.614" W
92	Point	Duplicate	3	12	133	47° 41' 55.478" N	116° 49' 16.272" W
98	Point	Triplicate	9	12	<Null>	47° 41' 54.757" N	116° 49' 16.946" W
22	Point	First	5	13	128	47° 41' 54.731" N	116° 49' 15.718" W
23	Point	Duplicate	2	13	133	47° 41' 55.092" N	116° 49' 15.377" W
24	Point	Triplicate	1	13	136	47° 41' 55.285" N	116° 49' 15.825" W
25	Point	First	2	14	137	47° 41' 54.512" N	116° 49' 14.033" W
26	Point	Duplicate	8	14	142	47° 41' 53.791" N	116° 49' 14.716" W
27	Point	Triplicate	3	14	145	47° 41' 54.319" N	116° 49' 13.585" W
28	Point	First	3	15	146	47° 41' 53.740" N	116° 49' 12.242" W
29	Point	Duplicate	9	15	151	47° 41' 53.019" N	116° 49' 12.924" W
30	Point	Triplicate	1	15	154	47° 41' 54.126" N	116° 49' 13.138" W
31	Point	First	7	16	155	47° 41' 52.826" N	116° 49' 12.477" W
32	Point	Duplicate	8	16	160	47° 41' 52.633" N	116° 49' 12.029" W
33	Point	Triplicate	3	16	163	47° 41' 53.161" N	116° 49' 10.898" W
34	Point	First	7	17	164	47° 41' 52.246" N	116° 49' 11.133" W
35	Point	Duplicate	3	17	169	47° 41' 52.582" N	116° 49' 9.555" W
36	Point	Triplicate	5	17	172	47° 41' 52.414" N	116° 49' 10.344" W

DU EAST

37	Point	First	8	18	173	47° 41' 51.474" N	116° 49' 9.342" W
38	Point	Duplicate	5	18	178	47° 41' 51.835" N	116° 49' 9.001" W
39	Point	Triplicate	6	18	181	47° 41' 51.642" N	116° 49' 8.553" W
40	Point	First	6	19	182	47° 41' 51.062" N	116° 49' 7.209" W
41	Point	Duplicate	2	19	187	47° 41' 51.616" N	116° 49' 7.316" W
42	Point	Triplicate	5	19	190	47° 41' 51.256" N	116° 49' 7.657" W
68	Point	First	1	20	281	47° 41' 51.230" N	116° 49' 6.420" W
69	Point	Duplicate	8	20	286	47° 41' 50.316" N	116° 49' 6.655" W
43	Point	First	9	22	208	47° 41' 55.259" N	116° 49' 14.588" W
44	Point	First	6	23	209	47° 41' 55.040" N	116° 49' 12.903" W
45	Point	Duplicate	9	23	214	47° 41' 54.680" N	116° 49' 13.245" W
46	Point	Triplicate	4	23	217	47° 41' 55.427" N	116° 49' 13.799" W
48	Point	Duplicate	9	24	223	47° 41' 54.100" N	116° 49' 11.901" W
49	Point	Triplicate	8	24	226	47° 41' 54.294" N	116° 49' 12.349" W
50	Point	First	7	25	227	47° 41' 53.907" N	116° 49' 11.453" W
51	Point	Duplicate	5	25	232	47° 41' 54.075" N	116° 49' 10.664" W
52	Point	Triplicate	1	25	235	47° 41' 54.629" N	116° 49' 10.771" W
53	Point	First	1	26	236	47° 41' 54.050" N	116° 49' 9.427" W
54	Point	Duplicate	9	26	241	47° 41' 52.942" N	116° 49' 9.214" W
55	Point	Triplicate	6	26	244	47° 41' 53.303" N	116° 49' 8.873" W
56	Point	First	9	27	245	47° 41' 52.363" N	116° 49' 7.871" W
57	Point	Duplicate	5	27	250	47° 41' 52.917" N	116° 49' 7.977" W
58	Point	Triplicate	8	27	253	47° 41' 52.556" N	116° 49' 8.319" W
60	Point	Duplicate	2	28	259	47° 41' 52.698" N	116° 49' 6.293" W
61	Point	Triplicate	6	28	262	47° 41' 52.144" N	116° 49' 6.186" W
93	Point	First	7	29	254	47° 41' 51.591" N	116° 49' 6.079" W
72	Point	First	5	31	353	47° 41' 55.736" N	116° 49' 10.985" W
95	Point	Duplicate	8	31	<Null>	47° 41' 55.373" N	116° 49' 11.329" W
99	Point	Triplicate	6	31	<Null>	47° 41' 55.556" N	116° 49' 10.546" W
74	Point	First	5	32	362	47° 41' 55.157" N	116° 49' 9.641" W
75	Point	Duplicate	7	32	367	47° 41' 54.989" N	116° 49' 10.430" W
76	Point	Triplicate	9	32	370	47° 41' 54.603" N	116° 49' 9.534" W
78	Point	Duplicate	9	33	376	47° 41' 54.024" N	116° 49' 8.191" W
79	Point	Triplicate	8	33	379	47° 41' 54.217" N	116° 49' 8.639" W
80	Point	First	3	34	380	47° 41' 54.166" N	116° 49' 6.165" W
81	Point	Duplicate	6	34	385	47° 41' 53.805" N	116° 49' 6.506" W
82	Point	Triplicate	9	34	388	47° 41' 53.444" N	116° 49' 6.847" W
84	Point	First	5	35	394	47° 41' 53.419" N	116° 49' 5.611" W
100	Point	Triplicate	1	35	<Null>	47° 41' 53.983" N	116° 49' 5.718" W
94	Point	First	9	36	416	47° 41' 55.685" N	116° 49' 8.511" W
87	Point	Duplicate	6	37	424	47° 41' 55.466" N	116° 49' 6.826" W
88	Point	First	6	38	425	47° 41' 54.887" N	116° 49' 5.483" W
89	Point	Duplicate	3	38	430	47° 41' 55.248" N	116° 49' 5.141" W
101	Point	Triplicate	7	38	<Null>	47° 41' 54.920" N	116° 49' 6.719" W

DU EAST - 90 POINTS TOTAL

APPENDIX C – STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE

SAMPLE PACKAGING AND SHIPPING

All environmental samples collected should be packaged and shipped using the following procedures:

PACKAGING

1. Label all sample containers with indelible ink (on the side, not on the cap or lid). Place labeled sample bottles in a high quality cooler containing an adequate amount of ice and/or frozen blue ice (appropriate for the season), making sure the cooler drain plug is taped shut.

2. Place the samples in an upright position and wrap the samples with absorbent, cushioning material for stability during transport. Samples should not be loose; the cooler should be able to withstand rough handling during shipment without sample breakage.

3. Fill out the appropriate shipping forms, and place the paperwork in a ziploc bag and tape it to the inside lid of the shipping container. Shipping forms usually include: 1) a chain-of-custody form, documenting the samples included in the shipment; 2) an analysis request form, specifying the laboratory analyses for each sample. If more than one cooler is used per chain of custody, put a photocopy in the other coolers and mark them as a copy.

4. Close and seal the cooler using fiberglass strapping tape.

5. Secure the shipping label with address, phone number, and return address clearly visible.

SHIPPING HAZARDOUS MATERIALS/WASTE

Hazardous materials need to be shipped using procedures specified under Federal Law. Samples need to be shipped in ziploc bags or paint cans filled with vermiculite, depending on the level of hazard. Special package labeling may be needed. Consult the project manager for specific shipping procedures.

STANDARD OPERATING PROCEDURE

FIELD FORMS

All pertinent field investigations and sampling information shall be recorded on a field form or in a field notebook during each day of the field effort and at each sample site. The field crew leader shall be responsible for ensuring that sufficient detail is recorded on the field forms/field notebook. No general rules can specify the extent of information that must be entered on the field form or in the field book. However, field forms/field notebook shall contain sufficient information so that someone can reconstruct all field activity without relying on the memory of the field crew. All entries shall be made in indelible ink weather conditions permitting. Each day's or site's entries will be initialed and dated at the end by the author.

At a minimum, entries on the field form or in field notebook shall include:

- Date and time of starting work and weather conditions.
- Names of field crew leader and team members
- Project name and type
- Description of site conditions and any unusual circumstances.
- Location of sample site, including map reference, if relevant
- Equipment ID numbers
- Details of actual work effort, particularly any deviations from the field work plan or standard operating procedures
- Field observations
- Any field measurements made (e.g., pH)
- Names and times of samples collected
- Preservative(s) used

For surface water and groundwater sampling efforts, specific details for each sample should be recorded using Tetra Tech standardized field forms. Surface water and groundwater field forms contain fill-in-the-blank type information so that all pertinent information will be recorded. In addition to the items listed above, the following information is recorded on surface water and groundwater field forms during sampling efforts:

- Time and date samples were collected
- Number and type (natural, duplicate, QA/QC) of samples collected
- Preservative(s) used
- Analysis requested

- Sampling method, particularly deviations from standard operating procedures

Strict custody procedures shall be maintained with the field forms and field notebooks. Field forms/notebooks shall remain with the field team at all times, while being used in the field. Upon completion of the field effort, photocopies of the original field forms and notebooks will be made and used as working documents; original field forms/notebooks shall be filed in an appropriately secure manner.

STANDARD OPERATING PROCEDURE

EQUIPMENT DECONTAMINATION

The purpose of this section is to describe general decontamination procedures for field equipment in contact with mine/mill tailings, soil, or water. During field sampling activities, sampling equipment will become contaminated after it is used. Sampling equipment must be decontaminated between sample collection points if it is not disposable. Field personnel must wear disposable latex or vinyl gloves while decontaminating equipment at the project site. Change gloves between every sample. Every precaution must be taken by personnel to prevent contaminating themselves with the wash water and rinse water used in the decontamination process.

Table A-1 lists equipment and liquids necessary to decontaminate field equipment.

The following should be done in order to complete thorough decontamination:

1. Set up the decontamination zone upwind from the sampling area to reduce the chances of windborne contamination.

2. Visually inspect sampling equipment for contamination; use stiff brush to remove visible material.

3. The general decontamination sequence for field equipment includes: wash with Liquinox or an equivalent degreasing detergent; deionized water rinse; 10% dilute nitric acid rinse; deionized water rinse; rinse with sample water three times.

4. Rinse equipment with methanol in place of the nitric rinse if sampling for organic contamination. Follow with a deionized water rinse.

5. Decontaminated equipment that is to be used for sampling organics should be wrapped in aluminum foil if not used immediately.

6. Clean the outside of sample container after filling sample container.

Alternatively, field equipment can be decontaminated by steam cleaning, rinsing with 10% dilute nitric acid, and rinsing with deionized water.

All disposable items (e.g., paper towels, latex gloves) should be deposited into a garbage bag and disposed of in a proper manner. Contaminated wash water does not have to be collected, under most circumstances.

If vehicles used during sampling become contaminated, wash both inside and outside as necessary. Heavy equipment will be decontaminated by brushing loose soil from the equipment then steam cleaned.

EQUIPMENT LIST FOR DECONTAMINATION

- 5-gallon plastic tubs
- 5-gallon plastic water-container
- 5-gallon carboy DI water
- 1-gallon cube of 10% HNO_3 (metals sampling)
- 1-gallon container or spray bottle of 10% Methanol or pesticide grade acetone (for organics sampling)
- Liquinox (soap)
- Hard bristle brushes
- Garbage bags
- Latex gloves
- Squeeze bottles
- Paper Towels

STANDARD OPERATING PROCEDURE

SAMPLE DOCUMENTATION

Sample documentation is an important step to ensure the laboratory, project manager, and field personnel are informed on the status of field samples. Depending on the specifics required for each project, a number of forms will need to be filled out. Most sample documentation forms are preprinted carbonless triplicates, enabling copies to be filed or mailed from labs or offices. The forms will be completed by field personnel, who have custody of the samples. The office copy will be kept in the project file and subsequent copies sent to the laboratory, or other designated parties. The responsibility for the completion of these forms will be with each field crew leader. It is important the field crew leader is certain field personnel are familiar with the completion process for filling out forms, and the expected information is included.

Potential documents to be completed clearly in ink for each sample generated include:

- Field Form
- Chain-of-Custody
- Custody Seal

If working on Superfund activities, the following additional forms will also be prepared:

- EPA Sample Tags
- SAS Packing Lists
- Sample Identification Matrix Forms
- Organic Traffic Report (if applicable)
- Inorganic Traffic Report (if applicable)

STANDARD OPERATING PROCEDURE

QUALITY CONTROL (QC) SAMPLES

Quality Control (QC) samples are submitted along with natural samples to provide supporting laboratory data to validate laboratory results. QC samples typically are submitted blind, and do not have any unique identifying codes that would enable the lab or others to bias these samples in any way. Usually, the time or sampling location is modified in a way which will separate blank and standard samples from the rest of the sample train. QC samples are identified only on field forms and in field notebooks. The following codes are typically used:

N - Natural Sample	Soil, water, air, or other material from a field site
SP - Split Sample	A portion of a natural sample collected for independent analysis; used in calculating laboratory precision
D - Duplicate Sample	Two samples taken from the same media under similar conditions; also used to calculate laboratory precision
BB - Bottle Blank	Deionized water collected in sample bottle; used to detect contamination in sample containers
CCB - Cross Contamination Blank	Deionized water run through decontaminated equipment and analyzed for residual contamination
BFS - Blind Field Standard	Certified chemical constituent(s) of known concentration; used to determine laboratory accuracy
TB - Travel or Trip Blank	Inert material (deionized water or diatomaceous earth) included in sample cooler; sent by the lab, the sample is used to determine if contamination by volatiles is present during collection or shipping

In general, selected QC samples will be inserted into the sample train within a group of 10 to 20 samples. Unless otherwise specified, QC samples will be prepared in the field. Deionized water for bottle blanks and cross-contamination blanks will be collected from carboys and cubitainers used in the field. An exception to field preparation of QC samples is some blind field standards. Since the analytes in some blind field standards are to be mixed according to specific manufacturer's instructions, field conditions may not provide the needed laboratory atmosphere. This is especially true for volatile organic compounds, which need to be prepared just before analyzing. Under these circumstances, such blind field standards will be shipped to the laboratory for preparation, keeping the concentration or manufacturer's QC Lot Number as blind as possible.

The number and types of samples submitted for each group of natural samples will be determined by the project manager and others, including state or Federal agencies, and will be defined in the project work plan. Each field crew leader will be responsible for all QC samples prepared in the field.

Methods for computing data validation statements can be found in EPA documents or obtained from the laboratory.

STANDARD OPERATING PROCEDURE
INVESTIGATION DERIVED WASTE MANAGEMENT

Many sampling activities at environmental sites will generate materials that need special handling or consideration to protect human health, to follow regulations, and to keep from spreading impacts across a project site. This SOP is not intended to ensure that Federal, State, or local regulations are met, nor is it considered to be a replacement for training in regulatory matters. It only provides guidance on handling and storing investigation derived waste at sites potentially impacted by petroleum, and only covers waste generation from drilling and groundwater sampling. The safety of Tetra Tech and subcontracted personnel is of prime importance on all projects. Work around drill rigs and attempting to move or handle drums are situations that can easily result in injury. The activities described in this SOP should be conducted only if an approved Health & Safety plan has been reviewed by field staff.

Soil

Exploratory drilling and monitoring well installation will produce drill cuttings that are potentially contaminated and need to be handled appropriately. The type of drilling will determine how the cuttings are brought to the surface, which will in turn determine how they are captured or controlled.

1. Air rotary drill rigs usually produce drill cuttings from a chute or tube that is attached to the top of the drill head. Capturing these cuttings requires a person (typically the driller's helper) to direct the cuttings coming from the chute into a suitable container. Much of the time the container is a 55-gallon steel DOT-approved drum. Roll off dumpsters or dump trucks may be used on large projects. The cuttings will be wet when drilling through saturated materials, so plastic sheeting may be needed to line dumpsters, truck beds, or other containers that are not water tight. The area around the collection point may also need to be lined with plastic to collect cuttings that are blown out of or otherwise are not captured in the container.

2. Auger drilling brings cuttings to the surface on the flights of the augers where they collect at the ground surface. These cuttings are usually removed from the boring area with a shovel. The cuttings can be shoveled directly into 55-gallon drums. Split spoon sampling is often conducted during auger drilling to provide soil samples for logging or laboratory analysis. The field geologist is responsible for making sure that the unused material from the split spoon samples is property contained. This may include dumping them directly into a 55-gallon drum where the cuttings are being placed, or temporarily placing them in a bucket that will then be dumped into the drum.

3. Direct push drilling usually generates soil cores in four-foot long sections that are brought to the surface in disposable plastic tubes. The soil in these cores is then used by the field geologist for logging and/or preparing laboratory samples. The field geologist is responsible for making sure that the unused material from the cores is property contained. This may include dumping them directly into a 55-gallon drum, or temporarily placing them in a bucket that will then be dumped into a drum. The field geologist's work area can be underlain by plastic sheeting or a tarp to catch soil. Alternatively, the work area can be swept to collect soil that is not otherwise captured.

Water

The process of developing and sampling monitoring wells will produce water that is potentially contaminated and needs to be handled appropriately. Groundwater in environmental site investigations is typically removed from wells by bailing or pumping.

1. Water retrieved from well casings with bailers can be poured from the bailer into a 5-gallon bucket. A 55-gallon steel drum placed in an unobtrusive area will be used at most project sites as the main collection point. The water that is collected in the bucket(s) is then carried to the drum and poured into it. The layout and logistics of some project sites may allow a drum to be placed next to the well location. The water from the bailer can be poured directly into the drum in these instances.

2. Water retrieved from well casings with pumps can be placed into containers via the discharge hose (either directly from the pump, or the outlet of a flow cell if geochemical parameters are being monitored). A 5-gallon bucket is most often used as an interim container, while a 55-gallon steel drum placed in an unobtrusive area will be used as the main collection point. The water that is collected in the bucket(s) is then carried to the drum and poured into it. The layout and logistics of some project sites may allow a drum to be placed next to the well location. The water from the discharge hose can be routed directly into the drum in these instances.

Decontamination Fluids

Water (with soap) is used to clean various sampling equipment that is used during investigations at petroleum release sites. Decontamination techniques may include immersion in water, or using spray bottles.

1. Five-gallon buckets are typically used to hold wash and rinse water when the immersion method is used for decontaminating sampling equipment. These fluids need to be refreshed throughout the day, and at the end of the day. The fluids will be placed into a 55-gallon drum. This water can be combined with well development or purge water.

2. Applying wash and rinse water to sampling equipment with spray bottles generates a small amount of water, typically less than one half gallon in a day. This water should also be collected and containerized pending characterization. This can be accomplished by holding the field equipment over a bucket or basin while the water is being sprayed onto it. The water in the bucket or basin can then be poured into a 55-gallon drum. This water can be combined with well development or purge water

3. Decontamination of large equipment, like drill rods or augers, can be accomplished by standing them up in a drum, or laying them in a trough. The water is thus captured and can be stored in a 55-gallon drum pending characterization.

Labeling

The 55-gallon drums need to be securely closed, including a snugly fitting lid and ring. A label needs to be placed on each drum indicating the material present (drill cuttings, purge water), the source (boring/well numbers), date of generation, and project contact information.

Characterization

The material in the drums is normally sampled to determine the types and concentrations of contaminants present. The specific chemicals that will be tested for will depend on the type of petroleum released at the site. Testing for hazard characteristics such as ignitability and corrosivity, and the concentrations of the eight RCRA metals may also need to be conducted. The type of testing to be conducted, as well as the number and types of samples collected (grab/composite) should be considered before the field work begins.

Disposal

The ultimate disposal of the soil and water will vary based on client considerations, and the levels of contaminants present. Disposal options may include transportation to a hazardous materials storage facility, transportation to a treatment facility, or disposal on-site when contaminant levels meet certain minimum requirements. The disposal options should be discussed with the client before the field work begins.

APPENDIX D – SITE SAFETY AND HEALTH PLAN (SSHP)

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HEALTH AND SAFETY PLAN (HASP)

PREPARED BY TETRA TECH
FOR SERVICES PROVIDED TO
Idaho Department of Environmental Quality

SITE NAME:	**Stimson - Atlas Mill**
SITE LOCATION:	**3074 West Seltice Way, Coeur d'Alene, ID**
DATE PREPARED:	**November 6, 2018**

EMERGENCY CONTACT INFORMATION

NOTE: Information entered into the emergency section of this HASP will automatically be entered onto this cover page.

24 Hour Ambulance:	**911, or (208) 930-4224**
Police Department:	**911, or (208) 769-2320**
Fire Department:	**911, or (208) 769-2340**
US Poison Control Centers:	**1-800-222-1222**
Tt Project Emergency Contact:	**Jon Welge** **509.263.5737**
Tt Corporate Emergency Contact:	**Lisa Bean** Mobile: 715-297-2476
Name of Closest Hospital:	**Kootenai Health Hospital / E.R.**
Route:	Exit the site to the north and turn right (east) on West Seltice Way. Go 3/4 mile to the intersection with Northwest Boulevard. Cross NW Boulevard (do not merge onto it). Seltice Way then becomes W. Ironwood Drive. Continue eastward on W. Ironwood Drive. It will curve to the south, then back to the east. About 0.6 mile after crossing NW Blvd, the Hospital will be on the north side of the road. Look for the signs to the emergency entrance.

Idaho Department of Environmental Quality - Stimson - Atlas Mill

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HEALTH AND SAFETY PLAN (HASP)

TABLE OF CONTENTS

Note: The sections highlighted in yellow are required for all health and safety plans with the other sections optional depending on the project, tasks and associated hazards. If this template is used for sites without chemical hazards, the following sections may be eliminated as well; H&S Evaluation Chemicals of Concern, Hazard Evalution of Chemicals of Concern and Precautions for Chemicals of Concern; and Decontamination Plan.

Forms Attached

Worker / Visitor Sign-In Form	√
Daily Tailgate Meeting Form	√

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HEALTH AND SAFETY PLAN (HASP)

Stimson - Atlas Mill AT 3074 West Seltice Way, Coeur d'Alene, ID

Prepared By:	Ron Phillips	**Date:**	November 6, 2018
	Boise, ID	**Tt Project No:**	102-RED-T38956

Project Identification:

Service Type:	Phase II Investigation	**Site Name:**	Stimson - Atlas Mill
Client Name:	Idaho DEQ	**Site Location:**	3074 West Seltice Way, Coeur d'Alene, ID
Client Contact:	Steve Gill	**Client Phone No:**	208-666-0222

Site History:	The site had a long history as a lumber mill. This included many processes. Railroad tracks and spurs also cross the site. Previous Phase 1 and Phase 2 investigations have been conducted. These reports are available for review.
Scope of Work:	Collect soil samples from three decision units and an area along the Spokane River. The soil sampling in the decision units will use Incremental Sampling Methodology. A direct push drill rig will be used to collect the soil samples.

Site Regulatory Status:

CERCLA/SARA		RCRA		OSHA		OTHER FEDERAL	
US EPA:	N	**US EPA:**	N	**1910:**	Y	**Dept of Energy (DOE):**	N
State:	N	**state:**	N	**1926:**	N	**Dept of Trans (DOT):**	N
NPL site:	N	**NRC**		**state:**	N	**USATHAMA:**	N
		10CFR20:	N			**Air Force:**	N

NPL - US EPA National Priorities List
NRC - Nuclear Regulatory Commission
USATHAMA - US Army Toxic and HazMat Agency
OSHA 1910 - General Industry Standards and Regulations
OSHA 1926 - Construction Standard and Regulations
OSHA state - site located in a state that has its own OSHA regulations

Review and Approval Documentation

Reviewed By:

Name: ______________________ Signature ____________

Title: ______________________ Date: ____________

Name: ______________________ Signature ____________

Title: ______________________ Date: ____________

Reviewer signature also certifies that the PPE selected for this project was based on a hazard assessment of the tasks to be performed and selected according to the requirements established by OSHA in 29 CFR 1910.132 (d).

Project Dates		HASP Amendment Dates:	
Project Start Date:	October 29, 2018	**1**	Enter date
Project End Date:	January 8, 2019	**2**	Enter date
This site HASP must be reissued/reapproved for		**3**	Enter date
activities conducted after:	January 31, 2019	**4**	Enter date

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HEALTH AND SAFETY PLAN (HASP)

Stimson - Atlas Mill AT 3074 West Seltice Way, Coeur d'Alene, ID

Tetra Tech Representatives

Branch Address and Phone		Name/Title	Role and Responsibilities
Tetra Tech	509-344-0262	Jon Welge	Project Manager - Oversee all aspects of the project
1212 N. Washington Street, Suite 208			
Spokane, WA 99201			
Tetra Tech	208-389-1030	Ron Phillips	Environmental Technician - Project Support
3380 Americana Terrace, Suite 201			
Boise, ID 83706			

Tetra Tech Subcontractors

Organization/Address and Phone		Name/Title	Role and Responsibilities
Northern Lights Drilling	208-755-0699	JR Cantrall	Drilling contractor - Supply drill rig and tooling to collect soil samples
1869 E. Seltice Way, #332			
Coeur d'Alene, ID			

Scope of Work	Drill approximately 222 soil borings and retrieve soil cores from each.

Client / Tetra Tech / Subcontractor H&S Program & Policy Bridging Section

Identify which specific H&S programs will be followed for the designated scope of work.

H&S Program	**Specify Program To Be Used**	**Comments**
Emergency Evacuation Procedures	☐ Client ☒ Tetra Tech ☐ Sub ☐ Other	Tetra Tech and subcontract personnel will exit the site to the north via the nearest access route. From there they will travel eastward on Seltice Way for about 1/2 mile and meet in the parking lot of the Holiday Express Inn and Suites at 2400 West Seltice Way. A decision on a safe return to the site can be made from there.
Drilling and subsurface structure locates	☐ Client ☒ Tetra Tech ☐ Sub ☐ Other	Subsurface utilities will be located via the one-call locating service for Kootenai County, Pass Word (800-428-4950)
Drill Rig Operation	☐ Client ☐ Tetra Tech ☒ Sub ☐ Other	Northern Lights Drilling will have their own safety plan for conducting their drilling operation. Tetra Tech personnel will not assist in operating the drill rig.

Tetra Tech's policy is to provide a safe working environment for all employees and contractors so that work may be conducted in a safe and efficient manner.

Tetra Tech employees and subcontractor employees working at the specific project covered by this HASP shall adopt and adhere to this HASP and the above referenced programs/policies by following all requirements stated in the safe work practices applicable to their work. No work is so urgent or important that we cannot take the time to do it safely. **ALL** personnel on site including subcontractor's have the right and responsibility to stop the work if they feel a safety protocol is not being followed or if they feel an unsafe condition exists.

HEALTH AND SAFETY PLAN (HASP)

Stimson - Atlas Mill AT 3074 West Seltice Way, Coeur d'Alene, ID

Site Specific Health and Safety Personnel

Ron Phillips has been designated **Site Health and Safety Coordinator (SHSC)** for activities to be conducted at this site. The SHSC has total responsibility for ensuring that the provisions of this HASP are adequate and implemented in the field. Changing field conditions may require decisions to be made concerning adequate protection programs. Therefore, the personnel assigned as SHSCs are experienced and meet the additional training requirements specified by OSHA in 29 CFR 1910.120.

Jon Welge has (have) been designated as the **alternate SHSC(s)**.

Activities Covered Under This Plan

Task 1 **Schedule:** November/December 2018

Select and Mark Boring Locations

Use a GPS device to mark 222 boring locations. Alternate boring locations will be selected if topography, utilities, or obstructions appear to prevent drill rig access. Pin flags will be used to mark the boring locations.

Task 2 **Schedule:** November/December 2018

ISM Sampling (DU Investigations)

Continuous soil cores will be obtained from one-foot deep borings. Portions of each core will be sieved and collected to make a composite sample.

Task 3 **Schedule:** November/December 2018

Discrete Sampling (Shoreline Area)

Continuous soil cores will be obtained from borings that will extend up to 18 feet deep. Up to two samples will be collected from each boring for laboratory analysis.

Types and Sources of Hazards

Physiochemical		Radiation		Chemically Toxic	
Flammable:	N	**Ionizing:**	No	**Inhalation:**	Y
Explosive:	N	**Non-Ionizing:**	No	**Ingestion:**	Y
Corrosive:	N	**Other**		**Absorption:**	Y
Reactive:	N	**Physical Hazards:**	Y	**Carcinogen:**	Y
O2 Rich:	N	**Construction Activities:**	N	**Mutagen:**	N
O2 Deficient:	N			**Teratogen:**	N
Biological				**OSHA listed:**	Y
Etiological Agent:	N	**Specific OSHA Standards:**	OSHA 1910.1000 TABLE Z-2 lists airborne standards for beryllium, cadmium, and mercury		
Other:	Y				
(plant, insect, animal)					

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HEALTH AND SAFETY PLAN (HASP)

Stimson - Atlas Mill AT 3074 West Seltice Way, Coeur d'Alene, ID

Direct Sources of Hazards				Indirect Sources (Describe)
Air:	Y	**Other:**	Dust	
Groundwater:	Y		list if others	
Soil:	Y		list if others	
Surface Water:	N			

Health and Safety Evaluation - Chemicals of Concern

Chemical Name	Entry Route	Carc*	Symptoms	Target Organs
Polynuclear Aromatic Hydrocarbons (PAHs)	Inh, Con	y	Dermatitis, bronchitis, cancer.	Respiratory system, skin, bladder, kidneys (lung, kidney and skin cancer).
Arsenic (inorganic compounds as As)	Inh, Abs, Ing, Con	y	Ulceration of nasal septum, dermatitis, GI disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, cancer.	Liver, kidneys, skin, lungs, lymphatic system (lung and lymphatic cancer).
Barium	Inh, Ing, Con	n	Irritant (eyes, skin, upper respiratory system) skin burns, gastroenteritis, muscle spasm, slow pulse, extrasystoles, hypokalemia.	Eyes, skin, respiratory system, heart, central nervous system.
Beryllium (metal and compounds as Be)	Inh, Con	y	Berylliosis (chronic exposure), anorexia, weight loss, weakness, chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency, eye irritation, dermatitis, cancer.	Eyes, skin, respiratory system (lung cancer).
Cadmium (dust and fumes)	Inh, Abs, Ing, Con	n	Headache, nausea, vomiting, dizziness, lowered blood pressure, respiratory tract irritation, gastrointestinal tract irritation, pulmonary edema, lung inflammation, unconsciousness, coma central nervous system depression, liver and kidney damage, anemia.	Central nervous system, kidneys, liver, eyes, skin, respiratory system.
Chromium (metal & compounds as Cr(III))	Inh, Abs, Ing, Con	y	Irritant to eyes, nose, and mucous membranes; dermatitis; headache, weakness and exhaustion, blurred vision, dizziness, slurred speech, confusion and convulsions; chemical pneumonitis (aspiration of liquid); possible liver and kidney damage/cancer	Eyes, skin, respiratory system, Central Nervous System, liver and kidney (in animals: liver and kidney cancer)
Lead (elemental and other compounds as Pb)	Inh, Abs, Ing, Con	n	Eye irritant, headache, confusion, excitement, malaise, nausea, vomiting, abdominal pain, irritated bladder, profuse sweating, jaundice, hemoglobinuria, hematuria, renal shutdown, dermatitis, optical neuritis, corneal damage.	Eyes, skin, blood, liver, kidneys, central nervous system.
Mercury (elemental and inorganic compounds as Hg)	Inh, Abs, Ing, Con	n	Irritant (eyes, skin), cough, chest pain, dyspnea, bronchial pneumonitis, tremor, insomnia, irritability, indecision, headache, fatigue, weakness, stomatitis, salivation, proteinuria, GI disturbance, anorexia, weight loss.	Eyes, skin, respiratory system, central nervous system, kidneys.
Nickel (metal & other compounds as Ni)	Inh, Ing, Con	y	Sensitization dermatitis, allergic asthma, pneumonitis, cancer.	Nasal cavities, lungs, skin (lung and nasal cancer).
Selenium	Inh, Ing, Con	n	Irritant (eyes, skin, nose, throat), visual disturbance, headache, chills, fever, dyspnea, bronchitis, metallic taste, garlic breath, GI disturbance, dermatitis, eye and skin burns. In animals; anemia, liver necrosis and cirrhosis, kidney and spleen dama	Eyes, skin respiratory system, liver, kidneys, blood, spleen.

Silver (metal and soluble compounds as Ag))	Inh, Ing, Con	n	Blue-gray eyes, Irritant (eyes, skin, nasal septum, throat), skin ulceration, GI disturbance.	Nasal septum, skin, eyes.
Zinc Oxide (dust and fume)	Inh	n	Metal fume fever, chills, muscle ache, nausea, fever, dry throat, cough, weak, exhaustion, metallic taste, headache, blurred vision, low back pain, vomiting, fatigue, tight chest, dyspnea, decreased pulmonary function.	Respiratory system.

Health and Safety Evaluation - Hazard Evaluation of Chemicals of Concern

Chemical Name	LEL/UEL (%)	Flam	OT (ppm)	IDLH	Exposure Limits
Polynuclear Aromatic Hydrocarbons (PAHs)	NA	n	-	80 mg/m3	**OSHA-PEL-TWA** = 0.2 mg/m3 (Listed under Coal Tar Pitch Volatiles as the benzene-soluble fraction) **ACGIH-TLV-TWA** = 0.2 mg/m3 (Listed under Coal Tar Pitch Volatiles as the benzene-soluble fraction) Polynuclear Aromatic Hydrocarbons (PAHs) encompass a broad range of volatilities and include: acenaphthene, anthracene, fluorene, methylnaphthalene, phenanthrene, pyrene, fluoranthene, benzo(a)pyrene, benzo(a)anthracene, and others on Method NIOSH 5023 PAH list. Individual compounds have similar properties and signs and symptoms of exposure. Also, exposure limits are written for the compounds as a group and apply whether one or all are present. Therefore, individual compounds are not listed in this database and can be covered using this group listing as precautions will not vary. In addition, the ACGIH lists some compounds individually and indicate that exposure through all routes should be carefully controlled to levels as low as possible.
Arsenic (inorganic compounds as As)	NA	n	-	5 mg/m3	**OSHA-PEL-TWA** = 0.01 mg/m3; **ACGIH-TLV-TWA** = 0.01 mg/m3; **NIOSH-REL-Ceiling** = 0.002 mg/m3
Barium	NA	n	-	50 mg/m3	**OSHA-PEL-TWA** = 0.5 mg/m3; **ACGIH-TLV-TWA** = 0.5 mg/m3; **NIOSH-REL-TWA** = 0.5 mg/m3 The NIOSH - REL and OSHA - PEL also applies to other soluble barium compounds (as Ba) except Barium sulfate.
Beryllium (metal and compounds as Be)	NA	n	-	4 mg/m3	**OSHA-PEL-TWA** = 0.002 mg/m3; **OSHA-PEL-Ceiling** = 0.005 mg/m3; **ACGIH-TLV-TWA** = 0.00005 mg/m3 for the inhalable fraction (Beryllium and compounds as Beryllium) Skin notation/Sensitizing agent;* **NIOSH-REL** - Lowest feasible not to exceed 0.0005 mg/m3 *The ACGIH has issued a notice of intended change to add dermal and respiratory sensitization.
Cadmium (dust and fumes)	2.5/15.1	y	-		**ACGIH-TLV-TWA** = 50 ppm
Chromium (metal & compounds as Cr(III))	1.4 / 7.6	y	-	Not Determined	**OSHA-PEL - none***; **ACGIH-TLV-TWA** = 300 ppm; **ACGIH-TLV-STEL** = 500 ppm **NIOSH-REL-Carcinogen - as low as feasible** *The OSHA limit of TWA = 300 ppm and STEL = 500 ppm was vacated by the court ruling of 1993.
Lead (elemental and other compounds as Pb)	NA	n	-	10 mg/m3	**OSHA-PEL-TWA** = 1 mg/m3; **ACGIH-TLV-TWA** = 1.5 mg/m3 (metal); 0.1 mg/m3 (soluble compounds as Ni); 0.2 mg/m3 (insoluble compounds as NI): **NIOSH-REL-TWA** = 0.015 mg/m3
Mercury (elemental and inorganic compounds as Hg)	NA	n	-	1 mg/m3	**OSHA-PEL-TWA** = 0.2 mg/m3; **ACGIH-TLV-TWA** = 0.2 mg/m3; **NIOSH-REL-TWA** = 0.2 mg/m3 Exposure limits also apply to selenium compounds (as Se) except selenium hexafluoride.
Nickel (metal & other compounds as Ni)	NA	n	-	10 mg/m3	**OSHA-PEL-TWA** = 0.01 mg/m3; **ACGIH-TLV-TWA** = 0.1 mg/m3 (metal, dust and fumes); 0.01 mg/m3 (soluble compounds as Ag); **NIOSH-REL-TWA** = 0.01 mg/m3

Selenium	NA	n	-	1 mg/m3	**OSHA-PEL-TWA** = 0.2 mg/m3; **ACGIH-TLV-TWA** = 0.2 mg/m3; **NIOSH-REL-TWA** = 0.2 mg/m3 Exposure limits also apply to selenium compounds (as Se) except selenium hexafluoride.
Silver (metal and soluble compounds as Ag))	NA	n	-	10 mg/m3	**OSHA-PEL-TWA** = 0.01 mg/m3; **ACGIH-TLV-TWA** = 0.1 mg/m3 (metal, dust and fumes); 0.01 mg/m3 (soluble compounds as Ag); **NIOSH-REL-TWA** = 0.01 mg/m3
Zinc Oxide (dust and fume)	NA	n	-	500 mg/m3	**OSHA-PEL-TWA** = 5 mg/m3 (fume/respirable dust)*; 15 mg/m3 (total dust)*; **ACGIH-TLV-TWA** = 2 mg/m3 respirable; **ACGIH-TLV-STEL** = 10 mg/m3 respirable **NIOSH-REL-TWA** = 5 mg/m3 (dust and fume); NIOSH-REL-STEL = 10 mg/m3 (fume) **NIOSH-REL-Ceiling** = 15 mg/m3 (dust) *The OSHA limit of TWA = 5 mg/m3 (fume); STEL = 10 mg/m3 (fume); TWA = 10 mg/m3 (total dust); TWA = 5 mg/m3 (resp dust) was vacated by the court ruling of 1993.

Health and Safety Evaluation - Chemicals of Concern / Precautions

PRECAUTIONS

INGESTION: All listed chemicals have the potential for accidental ingestion, however in work place settings it is not considered a primary route of entry. All accidental ingestions should be addressed by referring to the MSDS and seeking immediate medical attention.

INHALATION: Listed chemicals capable of inhalation routes of entry should be maintained below the established exposure limits. If there is indication that the exposure limits are being exceeded, appropriate respiratory protection should be used. If appropriate PPE has not been planned for, work should cease and the SHSC should be contacted.

ABSORBANCE/CONTACT: Listed chemicals presenting an absorbance or contact hazards should be handled only with the use of appropriate PPE.

NOTE: Overexposure to any chemical via any route of entry should be addressed by referring to the MSDS and seeking immediate medical attention. Avoid contact with all chemical hazards when possible and consult MSDS before any exposure may occur.

OTHER PRECAUTIONS

NA

ABBREVIATIONS

LEL= Lower Explosive Limit

UEL = Upper Explosive Limit

ppm = parts per million

mg/m3 = milligram per cubic meter

TWA = Time Weighted Average

STEL = Short Term Exposure Limit

Flam = Flammable

IDLH = Immediately Dangerous to Life and Health

OT = Odor Threshold

NOTE: Odor Thresholds were obtained from the American Industrial Hygiene Association's (AIHA) publication on Odor Thresholds. The listed thresholds are best estimates based on existing experimental data. (d) indicates the threshold for detection and (r) indicates the threshold for recognition.

NOTE: * In 1989, OSHA published new exposure limits (in most cases lower) for some chemical compounds. However, in 1993, under a court decision, these newly established limits were vacated and reverted back to the previous limit or to none if a limit was not previously established for the chemical compound. The limits listed in the table are the older, enforceable OSHA limits. It is recommended that the most conservative exposure limit listed be used in assessing exposures and determining controls and safety measures.

Health and Safety Evaluation - Physical / Construction Hazards of Concern

For the hazards that apply to this site, indicate the task(s) to which each particular hazard applies. For the hazards that do not apply to this site, delete the "1" in the Task No(s) column.

HAZARD	Task No(s)	Protection Procedure
Noise	2,3	Wear hearing protection while working close the direct push rig when it is hammering
Cold	1,2,3	Wear warm clothing in layers. If cold stress symptoms develop, take a break in a warm area, such as the field vehicle with the heater on. In this case, a window should be down slightly to allow a source of fresh air.
Rain	1,2,3	Wear rain gear; watch footing on wet surfaces
Snow	1,2,3	Wear warm clothing with a water resistant outer layer. Watch footing on slippery surfaces
Electrical Storms	1,2,3	Discontinue operations and seek shelter in a building or vehicle. Work may restart after 30 minutes have passed since the last thunder clap.
Heavy Lifting / Moving	2	Utilize proper lifting techniques when moving and carrying the bucket of homogonized soil.
Rough Terrain	1,2,3	Watch footing
Housekeeping	2,3	Maintain order in the work area
Neighborhood	1,2,3	Awareness of area; comply with contingency / ER plans
Drill Rig Operation	2,3	Only subcontractors will operate the drill rig
Utilities - Underground	2,3	Have located before any work commences
Hand Tools	2,3	Use appropriate tools for the task. Inspect prior to use. Wear work gloves as appropriate
High Pressure Water	2,3	The drillers may use a pressure washer. Tetra Tech personnel will not operate one for the activities under this HASP
Other:		
Other:		

Task Based Risk Analysis and Protection Plan

The preceding tables have identified the known and suspected hazards to be present in performing the tasks required to complete this project. Below is a breakdown by task of the hazards, likelihood of exposures, and protective protocols to be used to minimize risk.

HEALTH AND SAFETY PLAN (HASP)

Stimson - Atlas Mill AT 3074 West Seltice Way, Coeur d'Alene, ID

Task: 1		Select and Mark Boring Locations
Associated Hazards:	**CHEMICAL**	Metals or PAHs may be present in the surface soil that will be walked upon and touched whilst the pin flags are being placed.
	PHYSICAL	Physical hazards associated with this task include those associated with walking over rough terrain, and those associated with inclement weather.
	BIOLOGICAL	Wildlife or feral animals may be present in the area.
	OTHER	None Identified
Exposure Potential:	**CHEMICAL**	Low
	PHYSICAL	Moderate to high.
	BIOLOGICAL	Low
	OTHER	NA
PPE:	Level D	This task will require safety shoes, work gloves, and a high-visibility vest. Clothing appropriate to the weather conditions is also required.
Air Monitoring Plan	Not needed for this task	
Air Monitoring Equipment	Not applicable	
Precautions:	**CHEMICAL**	Workers should wear gloves when placing pin flags, and scrape as much mud and soil from their shoes before leaving the site. They will need to wash their hands before eating.
	PHYSICAL	Personnel will be trained in cold stress and will wear appropriate clothing as required by climactic conditions. They will take care when locating the boring locations because attention will be split between walking and viewing the screen of the GPS unit. High-visibility vests will be worn.
	BIOLOGICAL	Employees should retreat from animals that are encountered. Troublesome animals may be reported to the Kootenai County Sheriff's Office Animal Control Officers at 208-446-1300.
	OTHER	NA

HEALTH AND SAFETY PLAN (HASP)

Stimson - Atlas Mill AT 3074 West Seltice Way, Coeur d'Alene, ID

Task: 2	ISM Sampling (DU Investigations)	
Associated Hazards:	**CHEMICAL**	Exposure to the Chemicals of Concern (metals and PAHs) may occur during the soil sampling and compositing.
	PHYSICAL	Physical hazards could include moving on uneven ground, carrying and moving buckets of soil, noise from the drill rig, and weather related hazards.
	BIOLOGICAL	Wildlife or feral animals may be present in the area.
	OTHER	None identified.
Exposure Potential:	**CHEMICAL**	Low to moderate.
	PHYSICAL	Moderate to high.
	BIOLOGICAL	Low
	OTHER	NA
PPE:	Level D	This task will require a hard hat, sturdy boots, work gloves, and nitrile gloves. Safety glasses and hearing protection will be worn if the workers are near the drill rig while it is hammering. Clothing appropriate to the weather will be worn.
Air Monitoring Plan	Air monitoring will not be conducted. Some of the PAHs have the potential to volatilize, but the cold weather will limit that potential.	
Air Monitoring Equipment	Not needed.	
Precautions:	**CHEMICAL**	Protection from the exposure via contact will be minimized through the use of nitrile gloves while handling soil.
	PHYSICAL	Personnel will be trained in cold stress and will wear appropriate clothing as required by climactic conditions. They will select work areas that are as flat as reasonable possible, with minimal trip hazards. Safety glasses and hearing protection will be worn when near the operating drill rig. The sampling personnel may elect to set up the workstation at a distance from the drill rig that reduces noise exposure.
	BIOLOGICAL	Employees should retreat from animals that are encountered. Troublesome animals may be reported to the Kootenai County Sheriff's Office Animal Control Officers at 208-446-1300.
	OTHER	NA

Task: 3	Discrete Sampling (Shoreline Area)	
Associated Hazards:	**CHEMICAL**	Exposure to the Chemicals of Concern (metals and PAHs) may occur during the soil sampling.
	PHYSICAL	Physical hazards could include moving on uneven ground, carrying and moving coolers with ice and soil samples, noise from the drill rig, and weather related hazards.
	BIOLOGICAL	Wildlife or feral animals may be present in the area.
	OTHER	None identified.
Exposure Potential:	**CHEMICAL**	Low to moderate.
	PHYSICAL	Moderate to high.
	BIOLOGICAL	Low
	OTHER	NA
PPE:	Level D	This task will require a hard hat, sturdy boots, work gloves, and nitrile gloves. Safety glasses and hearing protection will be worn if the workers are near the drill rig while it is hammering. Clothing appropriate to the weather will be worn.
Air Monitoring Plan	Air monitoring will not be conducted. Some of the PAHs have the potential to volatilize, but the cold weather will limit that potential.	
Air Monitoring Equipment	Not needed.	
Precautions:	**CHEMICAL**	Protection from the exposure via contact will be minimized through the use of nitrile gloves while handling soil.
	PHYSICAL	Personnel will be trained in cold stress and will wear appropriate clothing as required by climactic conditions. They will select work areas that are as flat as reasonable possible, with minimal trip hazards. Safety glasses and hearing protection will be worn when near the operating drill rig. The sampling personnel may elect to set up the workstation at a distance from the drill rig that reduces noise exposure.
	BIOLOGICAL	Employees should retreat from animals that are encountered. Troublesome animals may be reported to the Kootenai County Sheriff's Office Animal Control Officers at 208-446-1300.
	OTHER	NA

Personal Protective Equipment Level Definitions

Level D

Level D protection is assigned when minimal protection is warranted. Level D offers protection from nuisance contamination only and is made up of a typical work uniform for the work to be performed. Level D protection includes the following:

Hard hat, safety glasses, hearing protection (as required), gloves, and safety shoes.

Level C

Level C protection is assigned when the type(s) and concentration(s) of contaminants is known and the criteria for using an air-purifying respirator are met. Level C is an upgrade from level D and in addition to the requirements of level D, the following requirements must be met:

Level D plus Full-face or half-mask air purifying canister/cartridge equipped respirator, hooded chemical resistant clothing, and inner and outer chemical resistant gloves.

Level B

Level B protection is assigned when the type(s) and concentration(s) of contaminants is unknown or is known and warrants the highest level of respiratory protection with a lesser level of skin protection. Level B is an upgrade from level C and in addition to level C requirements, the following requirements must be met:

Level C plus pressure-demand full-face SCBA or pressure demand supplied air respirator with escape SCBA.

Level A

Level A protection is assigned when the atmosphere is IDLH (Immediately Dangerous to Life and Health) and warrants the highest degree of respiratory protection and skin protection. Level A is and upgrade from level B and in addition to level B requirements, the following requirements must be met.

Level B plus totally encapsulating chemical-protective suit.

Decontamination Plan

Personal Decontamination

The section outlining task by task risk assessment and protection plan specifies the level of protection required for each task. Consistent with the level of protection required, step by step procedures for decontamination for each level of protection are given below.

Personal decontamination will consist of removing and disposing of work gloves and washing with warm soapy water followed by clean water rinse prior to eating, drinking or leaving the site. Equipment will be deconned and all water will be contained and placed into a 55-gallon drum.

Disposition of Wastes (Contaminated, General, Recyclable)

The following outlines the protocol to be followed for contaminated wastes that are encountered:

All drill cuttings, well development water, and well purge water will be placed into drums. The QAPP provides additional information about investigation derived waste.

Sampling Equipment Decontamination

The following outlines the protocol to be followed for decontamination of sampling equipment:

Sampling equipment will be washed with soap and water solution, and then rinsed with distilled or deionized water.

Non-Sampling Equipment Decontamination

The following outlines the protocol to be followed for decontamination of non-sampling equipment:

NA

HEALTH AND SAFETY PLAN (HASP)

Stimson - Atlas Mill AT 3074 West Seltice Way, Coeur d'Alene, ID

Contingencies

Emergency Contacts and Phone Numbers

Agency	Contact	Phone Number
Tt Project Emergency Contact	Jon Welge	509.263.5737
24 Ambulance Service	Kootenai County Emergency Medical Services	911, or (208) 930-4224
Fire Department	Coeur d'Alene Fire Department	911, or (208) 769-2340
Police Department	Coeur d'Alene Police Department	911, or (208) 769-2320
US Poison Control Center	NA	1-800-222-1222
Onsite Coordinator (drilling)	Ron Phillips / TBD	208-891-1928 / TBD
Nearest Telephone	None	

In the event of an incident, the TT reporting protocol requires that a corporate contact be notified as soon as possible.	**Lisa Bean**	425-482-7810
	Tami Froelich	**Office:** 509.372.5827 **Mobile:** 509.392.9080
	Jon Welge	**Office:** 509.232.4311 **Mobile:** 509.263.5737
	Walt Vering	**Office:** 208.489.2828 **Mobile:** 208.859.2032

Name of Hospital:	Kootenai Health Hospital / E.R.	**Distance:**	1.5
Address:	2003 Kootenai Health Way, Coeur d'Alene. (208) 625-5700	**Time:**	3 minutes
Type of Service:	ER, Level II and Level III Trauma Center		
Route:	Exit the site to the north and turn right (east) on West Seltice Way. Go 3/4 mile to the intersection with Northwest Boulevard. Cross NW Boulevard (do not merge onto it). Seltice Way then becomes W. Ironwood Drive. Continue eastward on W. Ironwood Drive. It will curve to the south, then back to the east. About 0.6 mile after crossing NW Blvd, the Hospital will be on the north side of the road. Look for the signs to the emergency entrance.		

In the case of a **SERIOUS OR LIFE-THREATENING EVENT** (any injury, accident or near-miss event):
1. Seek emergency medical treatment immediately
2. Once the injured person(s) is appropriately cared for, call a corporate contact listed on the emergency wallet card and update the employee's supervisor and project manager as soon as possible.

Secondary Provider (Occupational Health Clinic)

Name of Occ Clinic:	David B Wait, MD	**Distance:**	
Address:	2201 Ironwood Pl. Ste 100, CDA, 208-769-2222	**Time:**	
Type of Service:	General practice		
Route:	Exit the site to the north and turn right (east) on West Seltice Way. Go 3/4 mile to the intersection with Northwest Boulevard. Cross NW Boulevard (do not merge onto it). Seltice Way then becomes W. Ironwood Drive. Continue eastward on W. Ironwood Drive for about 1/2 mile. Turn left (north) on to Ironwood Place. The clinic will be about 200 feet north of W. Ironwood Drive.		

In the case of a **NON-EMERGENCY/NON-LIFE THREATENING INCIDENT** (any injury, accident or near-miss event) call one of the corporate contacts listed on the wallet card (and above) prior to an Employee visiting a physician and implementing the following procedure:
1. Administer first aid immediately.
2. Tetra Tech employees call WorkCare (Tetra Tech contracted physicians) at 1-800-455-6155 for a triage call/discussion with an Occupational Health Nurse (OHN).
3. Mention that this is regarding an injury. At this point the nurse/physician will assist the employee/supervisor/H&S Coordinator to determine the best treatment plan. For example, he/she will recommend first aid or urgent care.
4. WorkCare will require the following information when a call is placed: Name of person calling, phone number, location, name of person injured, Social Security number, date and type of injury.

Response Plans

Medical - General

First Aid Kit:	**Type:**	portable	**Special First Aid Precautions:**	
	Location:	Tetra Tech vehicle	**Hydrofluoride on Site:**	N
Eye Wash:	**Required?:**	No	**Cyanides on Site:**	N
	Location:		**Other:**	
Safety Shower:	**Required?:**	N		
	Location:	NA		
Special Procedures:	Consult MSDS for appropriate first aid measures related to chemical exposures. Seek immediate medical attention when incidents warrant anything beyond minor first aid response.			

Fire/Explosion

Special Procedures:	Use available fire extinguisher to extinguish small fires. For any fire beyond the control of a portable fire extinguisher contact the local firefighting authorities as listed in the emergency contact section of this plan.	
Fire Extinguisher:	**Type:**	ABC
	Location:	Vehicle

Spill Response

Special Procedures:	Construct a soil barrier around the spill site to keep it from spreading. Place contaminated soil in waste drum.	
Special Gear:	**Type:**	Shovel
	Location:	Tetra Tech vehicle

Weather/Natural Disaster Emergency

Special Procedures:	Gather the team members and cease work immediately. In a severe emergency, follow the procedures for emergency evacuation listed above. Otherwise, the motel may be used for a safe base. Jon Welge will be called and notified.

Site Control Measures

Work Zones

Exclusion Zone:	Not applicable to the work under this safety plan. However, workers and site visitors must maintain a safe distance (at least 10 feet) from the back of the drill rig during normal conditions.
Decon Zone:	NA
Support Zone:	NA
Other Zones:	NA

Methods for Delineating Zones

Work Zone Delineation Plan	Cones will be used to secure drilling locations.
Delineation Equipment	Traffic cones/candles.

HEALTH AND SAFETY PLAN (HASP)

Stimson - Atlas Mill AT 3074 West Seltice Way, Coeur d'Alene, ID

Site Personnel and Certification Status

Name:	Jon Welge			**Medical Current:**	y
Title:	Project Manager			**HAZWOPER Current:**	y
Task(s):	All	**SSE?**	No	**Fit Test Current:**	NA
CPR/First Aid:	American Red Cross				
Other:					
Name:	Ron Phillips			**Medical Current:**	y
Title:	Geologist/SHSC			**HAZWOPER Current:**	y
Task(s):	All	**SSE?**	No	**Fit Test Current:**	NA
CPR/First Aid:	NA				
Other:					
Name:	TBD			**Medical Current:**	
Title:	Field Staff			**HAZWOPER Current:**	
Task(s):		**SSE?**		**Fit Test Current:**	
CPR/First Aid:					
Other:					
Name:				**Medical Current:**	
Title:				**HAZWOPER Current:**	
Task(s):		**SSE?**	y or no or NA	**Fit Test Current:**	
CPR/First Aid:					
Other:					
Name:				**Medical Current:**	
Title:				**HAZWOPER Current:**	
Task(s):		**SSE?**	y or no or NA	**Fit Test Current:**	
CPR/First Aid:					
Other:					

Medical Current:	All personnel, including visitors entering the exclusion or contamination reduction zones must be certified as medically fit to work and to wear a respirator if appropriate.
Training Current:	All personnel, including visitors entering the exclusion or contamination reduction zones must have certifications of completion of training in accordance with OSHA 29 CFR 1910.120.
Fit Test Current:	All personnel, including visitors entering any area requiring the use or potential use of any negative pressure respirator must have at a minimum, a qualitative fit test administered in accordance with OSHA 29 CFR 1910.134 or ANSI within the last 12 months. If site conditions require the use of a full face negative pressure air purifying respirator for protection against asbestos or lead, employees must have a qualitative fit test in accordance with OSHA 20 CFR 1910.1002 or 1025 within the last 6 months. * Bearded workers, who can not be fit-tested for a tight face fitting respirator, are required to wear a powered air purifying respirator (PAPR).
Note:	These requirements should be verified for any subcontractor personnel assigned to the site.

HEALTH AND SAFETY PLAN (HASP)

Stimson - Atlas Mill AT 3074 West Seltice Way, Coeur d'Alene, ID

Training and Briefing Topics

Note: The following topics will be covered as indicated (i.e., the initial site training, daily, monthly or periodically). Delete the X's corresponding to the topics that do not apply to this site. Indicate the frequency for the topics that do apply.

Site characterization and analysis (29 CFR 1910.120 i)	X	Initial
Physical Hazards	X	Daily
Chemical Hazards	X	Daily
Drilling Safety	X	Daily
Site Control (29 CFR 1910.120 d)	X	Daily
Engineering Controls and Work Practices (29 CFR 1910.120 g)	X	Daily
Drilling Operations	X	Initial
Equipment	X	Initial
Overhead and Underground Utilities	X	Initial
PPE (29 CFR 1910.120 g; and 1910.134)	X	Daily
Level D - Personal Protective Equipment	X	Initial
Emergency Response (29 CFR 1910.120 l)	X	Initial
Proper Opening and Handling of Drums and Containers	X	Daily
Shipping and Transportation (49 CFR 172.101)	x	Initial
Sanitation (29 CFR 1910.120 n)	x	Initial
Other:		

Drilling Considerations

Unfilled Bore-holes

Will bore-holes be drilled and need to be left unfilled for a period of time? No

If yes, length of time before filled or well installed. NA

Safe guarding requirements: NA

Filling Bore-holes

Will bore-holes be drilled which require filling? Y

Procedure for backfilling of bore-holes: The borings will be small diameter. Most will be 12 inches deep max. The borings will be filled with loose soil from the areas surrounding the drilling sites. Sand or bentonite may also be used if sufficient loose soil is not available.

Other Site Specific Drilling Concerns:

Uneven topography or slopes may create challenges for drill access.

Intrusive Activities Checklist

Will intrusive activities be performed for work under this HASP? Y

If yes, describe the type(s) of intrusive activity. Drilling borings with a direct push rig.

Subsurface Structures Present

Type	Present?	Located ?	Method Used/To Be Used for Locating
Electrical	Possible	Will be prior to project.	Will be located and marked by utility company.
Gas	Possible	Will be prior to project.	Will be located and marked by utility company.
Water	Possible	Will be prior to project.	Will be located and marked by utility company.

Procedure for Ensuring Unknown Substructures Identified

Although potential known and unknown subsurface structures are identified per the above sections, there is always the potential for unknown subsurface structures to be encountered during intrusive activities. Therefore, a protocol needs to be established for each particular site. For this site, the following procedures will be followed for the intrusive activities identified above: (Delete the X's in front of the procedure(s) that do not apply to this site.)

X	"One Call" or equivalent utility locate per the local system for the site will be made (this is mandatory on all sites)
X	Follow up with one-calls (i.e. document who will be contacted with respect to the one call service along with their phone numbers and place and document calls to those orginizations that did not repsond). Form for one call follow up is attached.

Other Specific Subsurface Identification Requirements for this Site

A private utility marking company may be needed to locate underground lines, depending on the results of the public marking program.

Required PPE and Equipment Checklist

Delete the X's corresponding to the PPE/Equipment that does not apply to this site.

HEALTH AND SAFETY BINDER / HASP, SITE CHECK IN/OUT PROCEDURES, ETC.	X
RELATED MSDS's	X
SAFETY GLASSES	X
HARD HAT	X
SAFETY SHOES	X
NITRILE GLOVES	X
WORK GLOVES	X
HEARING PROTECTION	X
HIGH VISIBILITY WEAR	X
WASTE DISPOSAL BAGS / LABELS (for drums)	X
FIRE EXTINGUISHER	X
FIRST AID KIT	X
DRINKING WATER	X
WASH WATER	X
SOAP or HAND SANITIZER	X
TOOL KIT	X

HAZARDOUS MATERIALS / DANGEROUS GOODS PACKAGING AND SHIPPING

Will known or suspect hazardous materials / dangerous goods be packaged and shipped?	No

If shipping materials classified or suspected as hazardous materials or dangerous goods attach and follow SWP 5.38 entitled "SHIPPING HAZARDOUS MATERIALS". NOTE: DOT HAZMAT training is required to package, label, prepare paper work and ship hazardous materials. Tt personnel typically do not maintain this training and therefore these tasks typically need to be subcontracted to trained personnel.

CONFINED SPACES

Are there any identified or potential confined spaces associated with the project?	No
Will the project involve any confined space entry?	No

If confined space entry is involved in the project, a confined space entry and permitting procedure needs to be identified here and attached to this HASP. If there are confined spaces present but they will not be entered, the spaces should be identified here and an indication provided as to how they will be labeled/marked to prevent entry. If neither apply, both answers can be indicated as no and an NA entered in this field.

TRAFFIC CONTROL

Is there exposure to traffic at this site during any of the designated work activities?	No
For which task(s) will traffic be an issue of concern ?	
Will the project require an extensive or formal traffic control plan?	No

FATIGUE MANAGEMENT

Is the work extensive or out of the ordinary typical work schedule with the potential to result in worker fatigue that could increase the potential for incidents to occur during work tasks or travel to/from the site?	No

PROVISIONS FOR LONE WORKERS

Will Tetra Tech employees or subcontractor employees be required to or have the potential to work alone?	Yes
For which task(s) will a site worker be or have the potential to be working alone?	1
List the type of employees that will be permitted to work alone and under what conditions:	Field employees marking boring locations.

Note: Personnel should not be allowed to work alone if there is high hazard potential associated with the site and/or task they will be performing, including but not limited to high physical hazard potential (such as heavy equipment operation, high voltage, intrusive activities, etc.), potential for extreme acute chemical exposure, high crime areas, remote sites, etc.

Safety Excellence

HEALTH AND SAFETY PLAN (HASP)

Stimson - Atlas Mill AT 3074 West Seltice Way, Coeur d'Alene, ID

Tetra Tech Compliance Agreement Form

PROJECT SCOPE: Collect soil samples from three decision units and an area along the Spokane River. The soil sampling in the decision units will use Incremental Sampling Methodology. A direct push drill rig will be used to collect the soil samples.

PROJECT NUMBER: 102-RED-T38956

I have read, understood, and agree with the information set forth in this Health and Safety Plan along with any related attachments and discussed in the Personnel Health and Safety briefing.

NAME	SIGNATURE	DATE

HEALTH AND SAFETY PLAN (HASP)

Stimson - Atlas Mill AT 3074 West Seltice Way, Coeur d'Alene, ID

Subcontractor Notification of Hazards Acknowledgement Form

PROJECT SCOPE: Collect soil samples from three decision units and an area along the Spokane River. The soil sampling in the decision units will use Incremental Sampling Methodology. A direct push drill rig will be used to collect the soil samples.

PROJECT NUMBER: 102-RED-T38956

I am aware that Tetra Tech has provided this Health and Safety Plan for my review to inform me of the hazards identified with the project site and tasks that Tetra Tech will perform. I understand that this Health and Safety Plan does not fulfill requirements for subcontractor health and safety plans related to the tasks which they will perform.

NAME	SIGNATURE	DATE

TETRA TECH

Safety Excellence

Stimson - Atlas Mill AT 3074 West Seltice Way, Coeur d'Alene, ID

Worker / Visitor Log

PROJECT SCOPE: Collect soil samples from three decision units and an area along the Spokane River. The soil sampling in the decision units will use Incremental Sampling Methodology. A direct push drill rig will be used to collect the soil samples.

PROJECT NUMBER: 102-RED-T38956

Name	Company / Organization	Date	Time In	Time Out

Stop Work Authority (SWA)

STOP NOTIFY CORRECT RESUME

ALL persons have the authority and obligation to stop **ANY** unsafe work

TETRA TECH - Daily Project/Tailgate Safety Meeting Form

By signing this form I am acknowledging that I understand the information discussed during the meeting. I have had the opportunity to ask and have questions answered and understand that I have the responsibility to stop work if something has changed or if I feel there is an unsafe condition that has not been addressed.

MEETING DETAILS	SIGNED BY ALL IN ATTENDANCE
PROJECT NO.____________ NO. OF PEOPLE ATTENDING: ____	1.____________
JOB LOCATION:____________	2.____________
MEETING DATE:____________ TIME OF MEETING:____________	3.____________
MEETING CONDUCTED BY:____________	4.____________
TOPICS DISCUSSED:____________	5.____________
____________	6.____________
____________	7.____________
ACCIDENTS REVIEWED:____________	8.____________
____________	9.____________
____________	10.____________
TASKS FOR THE DAY:____________	11.____________
____________	12.____________
____________	13.____________
POTENTIAL HAZARDS:____________	14.____________
____________	15.____________
____________	17.____________
PRECAUTIONS TO TAKE:____________	18.____________
____________	19.____________
____________	20.____________
____________	21.____________
MONITORING REQUIRED:____________	22.____________
____________	23.____________
COMMENTS:____________	24.____________
____________	25.____________

APPENDIX E – DATA REVIEW, VERIFICATION & VALIDATION CHECKLIST

DATA REVIEW, VERIFICATION, & VALIDATION REPORT

1. INTRODUCTION

General Project Information			
Project Name:		**Date Validated:**	
Tetra Tech Project Number:		**Data Validated By:**	
Sample Start and End Dates:		**Laboratory Name:**	
Sample Matrix:		**Laboratory Project ID#:**	
Analytical Parameters:			
Name & Date of Approved SAP, QAPP, Work Plan, Etc.			

2. LABORATORY METHODS AND SAMPLE HANDLING

Validation Criteria Used:

3. LIST OF SAMPLES VALIDATED IN THIS REPORT

List all samples in the sample delivery group that were validated in this report.

Validated Samples		
Field Sample ID#	**Laboratory Sample ID#**	**Sample Type** (Natural, Duplicate, Field Blank, Etc.)

4. FIELD COMPLIANCE WITH PROJECT REQUIREMENTS

Were all the required samples collected as specified in the SAP/QAPP? *Discuss.*

Were samples collected as per the field and analytical methods specified in the QAPP? *Discuss.*

5. DATA QUALIFIERS

Data Evaluation Qualifiers	
Data Qualifier	**Qualifier Description** *(as per USEPA 2008 CLP Guidelines)*
U	The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted Contract Required Quantitation Limit (CRQL) for sample and method.
J	The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample (due either to the quality of the data generated because certain quality control criteria were not met, or the concentration of the analyte was below the CRQL).
UJ	The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.

Laboratory Data Qualifiers	
Laboratory Qualifier	**Qualifier Description in Laboratory Report**
J	Estimated value. The analyte was present but less than the reporting limit.
S	Spike recovery outside of advisory limits.

6. LABORATORY NARRATIVE, CHAIN-OF-CUSTODY, AND SAMPLE RECEIPT CHECKLIST

Was a laboratory narrative provided and were there any non-conformance issues with the analytical data? *Identify and discuss.*

Were any issues or discrepancies noted on the Sample Receipt Checklist (a.k.a. Non-Conformance Form)? *Identify and discuss.*

Were sample Chain-of-Custody (CoC) forms complete? *Describe.*

Were the requested analytical methods in compliance with project requirements (i.e., QAPP, SAP, etc.)? *Explain and, if not in compliance, discuss how this affects the data.*

Were samples received in good condition within method specified requirements? *Explain any exceptions and how sample conditions may affect the results.*

7. LABORATORY COMPLIANCE WITH PROJECT REQUIREMENTS

Were samples analyzed within method-specified or technical holding times? *Explain any exceptions and how this may affect the results.*

Do the laboratory reports include all constituents requested to be analyzed on the CoC or under the QAPP, SAP, or other applicable document? *Explain.*

Were reported units appropriate for the associated sample matrix/matrices and method(s) of analyses? *Explain.*

***Were detection limits reported by the laboratory in accordance with the project requirements*?** *Discuss and list.*

Results qualified by the laboratory based on the laboratory reporting limit.

8. LABORATORY QA/QC

8a. Continuing Calibration Verification (CCV) Standard

Was there indication from the laboratory that the initial or CCV results were within acceptable limits? *Explain and include discussion on how any out-of-control results affect the accuracy of the data..*

8b. Laboratory Control Samples (LCSs)

Was the reference material used for the laboratory control standard (LCSs) the correct matrix and concentration? *Explain and include a discussion on how any matrix differences affects the accuracy of the data.*

Was the total number of LCSs analyzed equal to at least 5% (1 in 20) of the total number of samples, or analyzed as required by the method? *Explain.*

Were LCSs prepared the same way as the associated samples? *Explain and include a discussion of how any deviations affect the accuracy of the data.*

Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within laboratory QC limits? *Explain and discuss on how any out-of-control results affect the accuracy of the data.*

8c. Laboratory Blank Samples

Was the total number of method blank samples prepared equal to at least 5% (1 in 20) of the total number of samples, or analyzed as required by the method? *Explain.*

Were laboratory blank samples free of analyte contamination? *Explain.*

8d. Matrix Spike / Matrix Spike Duplicates

What project-specific samples were used to prepare the MS and MSD samples?

Project-specific samples: **Non-project specific samples:**

Was the total number of MS samples prepared equal to at least 5% (1 in 20) of the total number of samples, or analyzed as required by the method? *Explain.*

Were MS percent recoveries and all MS/MSD relative percent differences (RPDs) within data validation or laboratory QC limits? *Explain and include a discussion on how this affects the data.*

8e. Laboratory Duplicates

***Were laboratory duplicate RPD values within laboratory-specified limits*?** *Explain and include discussion of how this affects the data.*

8f. Surrogates

Were surrogate recoveries within laboratory QC limits? *Explain and include discussion on how this affects the data.*

9. FIELD QA/QC

a. Trip and Field Blanks

***Were the number of equipment, trip, or field blanks collected equal to at least 10% of the total number of samples, or as required by the project requirements, QAPP, or SAP*?** *Explain and include how this affects the data.*

Were the trip blank, field blank, and/or equipment blank samples free of analyte contamination? *Explain and include discussion of how this affects the data.*

b. Field Duplicates

Were the field duplicates collected as required by the project requirements, QAPP or SAP? Include a table of duplicate samples. *Explain and include discussion of how this affects the data.*

Were field duplicate RPD values within data validation QC limits? *Explain and include discuss of how this affects the data.*

10. OTHER

Did DEQ collect split samples? If so, explain how those results compare to the natural sample.

Other comments or observations.
None.

11. SUMMARY OF QUALIFIED DATA

The following summarizes the qualified data.

-

12. DEVIATIONS FROM THE QAPP

List and discuss deviations from the QAPP identified during this review.

-

13. ACCEPTABILITY AND USABILITY OF THE DATA

A review of the chain of custody forms and laboratory case narratives did/did not indicate that proper chain of custody was maintained. The appropriate preparation and analysis methods were/were not performed on the samples based on the intended use of the data. The cooler temperatures were/were not measured upon laboratory receipt and were/were not within control limits. All samples were/were not received preserved, in intact, and in good condition. All samples were/were not analyzed within method holding time requirements.

Laboratory quality control (QC) sample analyses performed for each analytical method are summarized as part of the laboratory analytical package.

The following Stage 2A verification and manual validation checks were performed as part of this project

1. Requested methods were/were not performed;
2. Method dates for handling, preparation and analysis were/were not present, as appropriate;
3. Sample-related QC data and QC acceptance criteria were/were not provided in the laboratory report and linked to the project samples including the field QC samples (trip blank);
4. Requested spike analytes were/were not added, as appropriate;
5. Sample holding times were/were not evaluated;
6. Frequency of QC samples were/were not checked and considered appropriate; and
7. Sample results were/were not evaluated by comparing holding times and sample-related QC data to EPA and project data validation guidelines.

Precision
Precision is the measure of agreement among individual measurements of the same property under similar conditions. Precision for this project has been expressed in terms of the relative percent difference (RPD) between two samples. Duplicate samples can be evaluated quantitatively for precision only when contaminants are detected in both the sample and the duplicate.

Accuracy
The assessment of accuracy is evaluated by comparing the percent recoveries (%R) computed from the known concentration of analyte spikes and their recovered concentration versus the analytical method acceptance criteria. Spike recoveries provide an indication of bias, where the reported data may either overestimate or underestimate the actual concentration of detected compounds and/or the detection limits.

Representativeness
Representativeness of the environmental sample analytical data was assessed by evaluating holding times, trip blank, and laboratory method blank results.

Comparability
Comparability of the environmental sample analytical data was assessed by evaluating whether samples were analyzed using appropriate EPA analytical methods.

Completeness

Completeness is the quantitative measure of the amount of data obtained from a measurement process compared with the amount expected to be obtained under the conditions of measurement.

Sensitivity

Reporting limits and method detection limits were/were not below the screening levels, with exception of those reporting limits that were elevated due to sample dilution requirements. When a reporting limit exceeded the screening level, the corresponding MDL was evaluated. Data with MDLs below the screening levels required no further evaluation. If a compound was detected below the reporting limit, but above the MDL, the laboratory qualified the value as estimated and assigned a “J” qualifier. These laboratory-assigned “J” qualified results are considered estimated results.

Summary:

APPENDIX F – LABORATORY QC MANUALS

Quality Assurance Manual

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Version 15.0 8/1/16

COMPREHENSIVE QUALITY ASSURANCE MANUAL

for

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Prepared by

ESC LAB SCIENCES
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The ESC QAM has been prepared in accordance with the following standards: AIHA-LAP, A2LA, ISO/IEC 17025-2005, 2003 NELAC Standard, 2009 TNI Standard, and DOD QSM.

Disclaimer

This Quality Assurance Manual for ESC Lab Sciences is a living document. It is reviewed at least annually and revised when needed. The information stated herein is subject to change at any time due to updates to QC Limits, methods, operations, equipment, staff, etc.

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Quality Manual: Table of Contents

Tables and Figures

1.0 GENERAL PURPOSE OF THIS QUALITY MANUAL

This quality manual documents the laboratory's management system and demonstrates the ability to execute the indicated tests and/or procedures and to meet regulatory requirements.

This manual establishes laboratory compliance with ISO (International Organization for Standardization) 17025, The NELAC Institute (TNI), Department of Defense Quality Systems Manual (DOD QSM), and the American Industrial Hygiene Association Laboratory Accreditation Program (AIHA-LAP).

2.0 LABORATORY BACKGROUND

2.1 ACTIVITIES

2.1.1 Analytical Support and Service Areas

ESC Lab Sciences is an environmental analytical firm providing technical and support services to customers nationwide. Specific service areas include the following:

- drinking water analysis
- industrial wastewater analysis
- hazardous waste characterization and identification
- groundwater analysis
- air analysis
- regulatory document guidance
- biological assessments
- mold identification
- solid/soil analysis and characterization
- industrial hygiene/environmental lead
- aquatic toxicity analysis
- cryptosporidium/giardia

2.1.2 Regulatory Compliance and Quality Standards

ESC is devoted to providing reliable and accurate data recognizing the necessity to establish sound, objective, and legally defensible positions or opinions for customers regarding compliance with governing regulations. ESC maintains quality systems that are compliant with the following Quality Standards: AIHA-LAP, A2LA, ANSI/ISO/IEC 17025, The TNI Standard, DOD QSM. The effectiveness of the quality system is measured by accreditation maintenance, internal and external audits, management reviews, proficiency sample testing, and an active preventive/corrective action system.

2.1.3 Analytical Capabilities:

Where mandated, only approved procedures are used for environmental analyses. ESC utilizes a number of method sources to accomplish project requirements. For NPDES and SDWA, methodologies are taken directly from 40 CFR parts 136 and 141.

For industrial hygiene analytical procedures, ESC utilizes guidance from NIOSH and OSHA published methods.

The following list is an example of the methodology ESC routinely performs:

Routine Methodology and Programs	
PROGRAM	***METHOD SOURCE***
NPDES	*EPA 821/R-93-010-A* *Methods for the Determination of Nonconventional Pesticides in Municipal and Industrial Wastewater, Volume I. Revision 1, August 1993.*
	40 CFR part 136
	Methods for Chemical Analysis of Water and Wastes (March 1983)
	Standard Methods for the Examination of Water and Wastewater (20ththrough 22nd editions)
AQUATIC TOXICITY	*7-Day Fathead Minnow (Pimephales promelas) Larval Survival and Growth Test; Test Method 1000.0 from "Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms" (EPA 821-R-02-013).*
	3-Brood Ceriodaphnia dubia Survival and Reproduction Test; Test Method 1002.0 from "Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms" (EPA 821-R-02-013).
	Fathead Minnow (Pimephales promelas) Acute Toxicity Test (24, 48 or 96 hour duration); referenced in "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (EPA 821-R-02-012, 10-02).
	Ceriodaphnia dubia Acute Toxicity Test (24, 48 or 96 hour duration); referenced in "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (EPA 821-R-02-012, 10-02).
SDWA	40 CFR parts 141
	Methods for Chemical Analysis of Water and Wastes (March 1983)
	Standard Methods for the Examination of Water and Wastewater (20ththrough 22nd editions)
	Methods for the Determination of Organic Compounds in Drinking Water - EPA/600/4-88/039 - December 1988 (Revised July 1991)
	Methods for the Determination of Organic Compounds in Drinking Water Supplement I, EPA/600/4-90/020 - July 1990
	Methods for the Determination of Organic Compounds in Drinking Water Supplement II, EPA/600/R-92/129 - August 1992
	EPA. Method 1622: *Cryptosporidium in Water by Filtration/IMS/FA, December 2005.*
	EPA. Method 1623: *Cryptosporidium and Giardia in Water by Filtration/IMS/FA, December 2005.*
RCRA	*SW-846, Test Methods for Evaluating Solid Wastes (3rd, 4th and online editions)*

Routine Methodology and Programs	
PROGRAM	***METHOD SOURCE***
AIR	*Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*
	Emission Measurement Center (Air Emissions Methods)
	NIOSH Manual of Analytical Methods (4th edition)
	Journal of Chromatographic Science, Vol. 36, May 1998.
	OSHA Sampling and Analytical Methods (online)
CLP	*USEPA CONTRACT LABORATORY PROGRAM - STATEMENT OF WORK FOR ORGANICS ANALYSIS Multi-Media, Multi-Concentration OLM04.3*
	USEPA CONTRACT LABORATORY PROGRAM - STATEMENT OF WORK FOR INORGANIC ANALYSIS Multi-Media, Multi-Concentration ILM05.3
MOLD	*American Industrial Hygiene Association*
Miscellaneous	*American Society for Testing and Materials (ASTM)*
	State Specific Methodologies from the following: *Florida, Oregon, Iowa, Washington, Texas, Arizona, Massachusetts, North Carolina, Louisiana, Missouri, Kansas, Wisconsin, Ohio*
Miscellaneous	*Analytical Methods for the Determination of Pollutants in Pharmaceutical Manufacturing Industry Wastewater, Revision A EPA-821-B-98-016 - July 1998 (Approved at 40 CFR Part 136, Not Approved at Part 141)*

2.2 HISTORY

ESC Lab Sciences was founded in 1970 by Dr. Arthur Schulert, a professor of Biochemistry at Vanderbilt University Medical School. The laboratory's first location was a 2,000 square foot building located in Mt. Juliet, TN.

ESC initially conducted several research contracts for the National Science Foundation. EPA Clean Water and Safe Drinking Water legislation of the early 1970s provided an additional market of Tennessee utilities and industries. ESC grew slowly for several years by increasing the share of the drinking and wastewater markets in Tennessee. In the late 1980s, ESC expanded its capabilities to include Underground Storage Tank testing and Biomonitoring/Toxicity testing.

Strategic expansion of the laboratory allowed ESC to provide support to large RCRA sites and add capabilities to offer analytical support for air and mold analyses. ESC is currently the nation's largest, single-location environmental laboratory operating in all US states. Our staff of over 300 employees works out of our 100,000 square feet, eleven-building facility approximately 20 minutes east of Nashville International Airport.

3.0 INTRODUCTION, SCOPE, AND DEFINITIONS

3.1 SCOPE OF CAPABILITIES

A list of approved and certified analytical capabilities can be found at the end of this section in Table 3.3b.

3.2 TABLE OF CONTENTS, REFERENCES AND APPENDICES

The table of contents is found at the beginning of this Manual. This Quality Manual uses the references from the 2003 NELAC Standard, Chapter 5, Appendix A and the 2009 TNI Standard (EL-V1M2-ISO-2009, Section 3.0).

3.3 DEFINITIONS AND TERMINOLOGY

The source of some of the definitions is indicated previous to the actual definition.

Table 3.3a Definitions	
Acceptance Criteria	TNI and DoD- Specified limits placed on characteristics of an item, process, or service defined in requirement documents.
Accreditation	TNI and DoD- The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.
Accrediting Authority	DoD- The Territorial, State or Federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation.
Accrediting (or Accreditation) Body	DoD- Authoritative body that performs accreditation.
Accuracy	TNI and DoD- The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.
Aliquot	DoD- A discrete, measured, representative portion of a sample taken for analysis.
Analysis Sequence	A compilation of all samples, standards and quality control samples run during a specific amount of time on a particular instrument in the order they are analyzed.
Analyst	TNI and DoD- The designated individual who performs the “hands-on” analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.
Analyte	DoD- The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family, and which are analyzed together.
Analytical Reagent Grade	Designation for the high purity of certain chemical reagents and solvents assigned by the American Chemical Society.

Analytical Sensitivity	The lowest concentration that can be detected by the method. (e.g., for methods involving a count = 1 raw count calculated to the reporting units). Analytical sensitivity is commonly used in Mold analysis.
Analytical Uncertainty	TNI- A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.
Assessment	TNI - The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its system to defined criteria (to the standards and requirements of laboratory accreditation). DoD- The evaluation process used to measure the performance or effectiveness of a system and its elements against specific criteria. Note: In this standard (DoD), assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation, peer review, inspection, or surveillance.
Atomic Absorption Spectrometer	Instrument used to measure concentration in metals samples.
Atomization	DoD- A process in which a sample is converted to free atoms.
Audit	TNI- A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. DoD- A systematic evaluation to determine the conformance to quantitative and qualitative specifications of some operational function or activity.
Batch	TNI and DoD- Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same quality systems matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed 20 samples.
Bias	TNI- The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).
Blank	TNI and DoD- A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.
Blind Sample	DoD- A sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.
BNA (Base Neutral Acid compounds)	A list of semi-volatile compounds typically analyzed by mass spectrometry methods. Named for the way they can be extracted out of environmental samples in an acidic, basic or neutral environment.
BOD (Biochemical Oxygen Demand)	Chemical procedure for determining how fast biological organisms use up oxygen in a body of water.

Calibration	TNI and DoD- A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. 1) In calibration of support equipment, the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI); 2) In calibration according to test methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.
Calibration Curve	TNI- The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. DoD- The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.
Calibration Factor	The ratio of the detector response (peak areas or peak heights) to the amount (mass) of analyte in the calibration standard.
Calibration Method	DoD- A defined technical procedure for performing a calibration.
Calibration Range	DoD- The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range.
Calibration Standard	TNI- A substance or reference material used for calibration. DoD- A substance or reference material used to calibrate an instrument.
Certified Reference Material (CRM)	TNI- Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. DoD- A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body.
Chain of Custody	DoD- An unbroken trail of accountability that verifies the physical security of samples, data, and records.
Chain of custody Form (COC)	TNI and DoD- Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and type of containers; the mode of collection, the collector, time of collection; preservation; and requested analyses.
Chemical Oxygen Demand (COD)	A test commonly used to indirectly measure the amount of organic compounds in water.
Client (referred to by ISO as Customer)	DoD- Any individual or organization for whom items or services are furnished or work performed in response to defined requirements and expectations.
Code of Federal Regulations (CFR)	A codification of the general and permanent rules published in the Federal Register by agencies of the federal government.
Comparability	An assessment of the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques.

Completeness	The percent of valid data obtained from a measurement system compared to the amount of valid data expected under normal conditions. The equation for completeness is: % Completeness = (Valid Data Points/Expected Data Points)*100
Confirmation	TNI and DoD- Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: second-column confirmation; alternate wavelength; derivatization; mass spectral interpretation; alternative detectors; or additional cleanup procedures.
Conformance	DoD- An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.
Congener	DoD- A member of a class of related chemical compounds (e.g., PCBs, PCDDs).
Consensus Standard	DoD- A standard established by a group representing a cross-section of a particular industry or trade, or a part thereof.
Continuing Calibration Blank (CCB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method.
Continuing Calibration Check Compounds (CCC)	Compounds listed in mass spectrometry methods that are used to evaluate an instrument calibration from the standpoint of the integrity of the system. High variability would suggest leaks or active sites on the instrument column.
Continuing Calibration Verification	DoD- The verification of the initial calibration that is required during the course of analysis at periodic intervals. Continuing calibration verification applies to both external and internal standard calibration techniques, as well as to linear and non-linear calibration models.
Continuing Calibration Verification (CCV) Standard	Also referred to as a CVS in some methods, it is a standard used to verify the initial calibration of compounds in an analytical method. CCVs are analyzed at a frequency determined by the analytical method.
Continuous Emission Monitor (CEM)	A flue gas analyzer designed for fixed use in checking for environmental pollutants.
Contract Laboratory Program (CLP)	A national network of EPA personnel, commercial labs, and support contractors whose fundamental mission is to provide data of known and documented quality.
Contract Required Detection Limit (CRDL)	Detection limit that is required for EPA Contract Laboratory Program (CLP) contracts.
Contract Required Quantitation Limit (CRQL)	Quantitation limit (reporting limit) that is required for EPA Contract Laboratory Program (CLP) contracts.
Control Chart	A graphic representation of a series of test results, together with limits within which results are expected when the system is in a state of statistical control (see definition for Control Limit)
Control Limit	A range within which specified measurement results must fall to verify that the analytical system is in control. Control limit exceedances may require corrective action or require investigation and flagging of non-conforming data.
Corrective Action	DoD- The action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence.

Corrective and Preventative Action (CAPA)	The primary management tools for bringing improvements to the quality system, to the management of the quality system's collective processes, and to the products or services delivered which are an output of established systems and processes.
Data Audit	DoD- A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e. that they meet specified acceptance criteria).
Data Quality Objective (DQO)	Systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use or end user.
Data Reduction	TNI- The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more usable form. DoD- The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form.
Definitive Data	DoD- Analytical data of known quality, concentration and level of uncertainty. The levels of quality and uncertainty of the analytical data are consistent with the requirements for the decision to be made. Suitable for final decision-making.
Demonstration of Capability	TNI- A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. DoD- A procedure to establish the ability of the analyst to generate acceptable accuracy.
Detection Limit (DL)	DoD- The smallest analyte concentration that can be demonstrated to be different than zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate is 1%.
Diesel Range Organics (DRO)	A range of compounds that denote all the characteristic compounds that make up diesel fuel (range can be state or program specific).
Digestion	DoD- A process in which a sample is treated (usually in conjunction with heat) to convert the sample to a more easily measured form.
Document Control	DoD- The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.
Dry Weight	The weight after drying in an oven at a specified temperature.
Duplicate (also known as Replicate or Laboratory Duplicate)	DoD- The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results of duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.
Electron Capture Detector (ECD)	Device used in GC methods to detect compounds that absorb electrons (e.g., PCB compounds).
Electronic Data Deliverable (EDD)	A summary of environmental data (usually in spreadsheet form) which customers request for ease of data review and comparison to historical results.
Eluent	DoD- A solvent used to carry the components of a mixture through a stationary phase.
Elute	DoD- To extract, specifically, to remove (absorbed material) from an absorbent by means of a solvent.
Elution	DoD- A process in which solutes are washed through a stationary phase by movement of a mobile phase.

Environmental Data	DoD- Any measurements or information that describe environmental processes, locations, or conditions; ecological or health effects and consequences; or the performance of environmental technology.
Environmental Monitoring	DoD- The process of measuring or collecting environmental data.
Environmental Sample	A representative sample of any material (aqueous, non-aqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. Environmental samples can generally be classified as follows: • Air and Emissions – Gas or vapor collected in Tedlar bags, SUMMA canisters, sorbant tubes, impingers, filters, or other devices. • Non Potable Water (Includes surface water, ground water, effluents, water treatment chemicals, and TCLP leachates or other extracts) • Drinking Water - Delivered (treated or untreated) water designated as potable water • Water/Wastewater - Raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents • Sludge - Municipal sludges and industrial sludges. • Soil - Predominately inorganic matter ranging in classification from sands to clays. • Waste - Aqueous and non-aqueous liquid wastes, chemical solids, and industrial liquid and solid wastes
Equipment Blank	A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures.
External Calibration Model	Comparison of instrument responses from the sample to the responses from the target compounds in the calibration standards. Sample peak areas (or peak heights) are compared to peak areas (or heights) of the corresponding analytes in calibration standards.
Facility	A distinct location within the company that has unique certifications, personnel and waste disposal identifications.
False Negative	DoD- An analyte incorrectly reported as absent from the sample, resulting in potential risks from their presence.
False Positive	DoD- An item incorrectly identified as present in the sample, resulting in a high reporting value for the analyte of concern.
Field Blank	A blank sample prepared in the field by filling a clean container with reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken.
Field Measurement	Determination of physical, biological, or radiological properties, or chemical constituents that are measured on-site, close in time and space to the matrices being sampled/measured, following accepted test methods. This testing is performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory.
Field of Accreditation	TNI- Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Finding	TNI- An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement. DoD- An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative and is normally accompanied by specific examples of the observed condition. Note: For DoD, the finding must be linked to a specific requirement.
Flame Atomic Absorption Spectrometer (FAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the fact that ground state metals absorb light at different wavelengths. Metals in a solution are converted to the atomic state by use of a flame.
Flame Ionization Detector (FID)	A type of gas detector used in GC analysis where samples are passed through a flame which ionizes the sample so that various ions can be measured.
Gas Chromatography (GC)	Instrumentation which utilizes a mobile carrier gas to deliver an environmental sample across a stationary phase with the intent to separate compounds out and measure their retention times.
Gas Chromatograph/ Mass Spectrometry (GC/MS)	In conjunction with a GC, this instrumentation utilizes a mass spectrometer which measures fragments of compounds and determines their identity by their fragmentation patterns (mass spectra).
Gasoline Range Organics (GRO)	A range of compounds that denote all the characteristic compounds that make up gasoline (range can be state or program specific).
Graphite Furnace Atomic Absorption Spectrometry (GFAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the absorption of light at different wavelengths that are characteristic of different analytes.
High Pressure Liquid Chromatography (HPLC)	Instrumentation used to separate, identify and quantitate compounds based on retention times which are dependent on interactions between a mobile phase and a stationary phase.
Holding Time	TNI- The maximum time that can elapse between two specified activities. 40 CFR Part 136- The maximum time that samples may be held prior to preparation and/or analysis as defined by the method and still be considered valid or not compromised. For sample prep purposes, hold times are calculated using the time of the start of the preparation procedure. DoD- The time elapsed from the time of sampling to the time of extraction or analysis, or from extraction to analysis, as appropriate.
Homogeneity	The degree to which a property or substance is uniformly distributed throughout a sample.
Homologue	DoD- One in a series of organic compounds in which each successive member has one more chemical group in its molecule than the next preceding member. For instance, methanol, ethanol, propanol, butanol, etc., form a homologous series.
Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)	Analytical technique used for the detection of trace metals which uses plasma to produce excited atoms that emit radiation of characteristic wavelengths.

Inductively Coupled Plasma- Mass Spectrometry (ICP/MS)	An ICP-AES that is used in conjunction with a mass spectrometer so that the instrument is not only capable of detecting trace amounts of metals and non-metals but is also capable of monitoring isotopic speciation for the ions of choice.
Infrared Spectrometer (IR)	An instrument that uses infrared light to identify compounds of interest.
Initial Calibration (ICAL)	The process of analyzing standards, prepared at specified concentrations, to define the quantitative response relationship of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a calibration verification standard do not conform to the requirements of the method in use or at a frequency specified in the method.
Initial Calibration Blank (ICB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method. This blank is specifically run in conjunction with the Initial Calibration Verification (ICV) where applicable.
Initial Calibration Verification (ICV)	DoD- A standard obtained or prepared from a source independent of the source of the standards for the initial calibration. Its concentration should be at or near the middle of the calibration range. It is done after the initial calibration.
Inspection	DoD- An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic.
Instrument Blank	DoD- A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination.
Instrument Detection Limits (IDLs)	Limits determined by analyzing a series of reagent blank analyses to obtain a calculated concentration. IDLs are determined by calculating the average of the standard deviations of three runs on three non-consecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day.
Interference, spectral	DoD- Occurs when particulate matter from the atomization scatters incident radiation from the source or when the absorption or emission from an interfering species either overlaps or is so close to the analyte wavelength that resolution becomes impossible.
Interference, chemical	DoD- Results from the various chemical processes that occur during atomization and later the absorption characteristics of the analyte.
Interference Check Sample (ICS)	A series of two solutions, used in ICP and ICPMS analysis, to verify that inter-element interferences are compensated for correctly. This standard is referred to as the Spectra Interference Check (SIC) in EPA Method 200.7 • ICSA – A solution containing only the interfering analytes at high concentrations. • ICSAB – A solution containing interferents plus other method analytes at the level of concern, which corresponds to the project specific action limits. ICSA and ICSAB provide an adequate test of inter-element correction (IEC) factors.
Internal Calibration Model	Internal standard calibration involves the comparison of instrument responses from the target compounds in the sample to the responses of specific internal standard analytes added to the sample or sample extract prior to injection.
Internal Standards	TNI and DoD- A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.
Intermediate Standard Solution	Reference solutions prepared by dilution of the stock solutions with an appropriate solvent.

International System of Units (SI)	DoD- The coherent system of units adopted and recommended by the General Conference on Weights and Measures.
Ion Chromatography (IC)	Instrumentation or process that allows the separation of ions and molecules based on the charge properties of the molecules.
Isomer	DoD- One of two or more compounds, radicals, or ions that contain the same number of atoms of the same element but differ in structural arrangement and properties. For example, hexane (C_6H_{14}) could be n-hexane, 2-methylpentane, 3-methylpentane, 2,3-dimethylbutane, 2,2-dimethylbutane.
Laboratory	DoD- A body that calibrates and/or tests.
Laboratory Control Sample (LCS)	TNI and DoD- (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to evaluate the performance of all or a portion of the measurement system.
Laboratory Duplicate	DoD- Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.
Laboratory Information Management System (LIMS)	A computer system that is used to maintain all sample information from sample receipt, through preparation and analysis and including sample report generation.
Legal Chain-of-Custody Protocols	TNI- Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the customer or program. These procedures are performed at the special request of the customer and include the use of a Chain-of-Custody Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.
Limit(s) of Detection (LOD)	TNI- A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. DoD- The smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate is 1%.
Limit(s) of Quantitation (LOQ)	TNI- The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. DoD- The lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.
Lot	A quantity of bulk material of similar composition processed or manufactured at the same time.
Management	DoD- Those individuals directly responsible and accountable for planning, implementing, and assessing work.
Management System	DoD- System to establish policy and objectives and to achieve those objectives.
Manager (however named)	DoD- The individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual.

Matrix	TNI and DoD- The substrate of a test sample. For information is provided in the definition of Quality System Matrix below.
Matrix Duplicate	TNI- A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.
Matrix Spike (MS) (spiked sample or fortified sample)	TNI- A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. DoD- A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.
Matrix Spike Duplicate (MSD) (spiked sample or fortified sample duplicate)	TNI and DoD- A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.
Measurement System	TNI and DoD- A test method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s).
Method	TNI- A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.
Method Blank	TNI and DoD- A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.
Method Detection Limit (MDL)	DoD- One way to establish a Detection Limit; defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.
Method Quantitation Limit (MQL)	TX TRRP - The lowest non-zero concentration standard in the laboratory's initial calibration curve and is based on the final volume of extract (or sample) used by the laboratory.
Method of Standard Additions	DoD- A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects. The procedures encompass the extrapolation back to obtain the sample concentration.
MintMiner	Software used to review large amounts of chromatographic data to monitor for errors or data integrity issues.
Mobile Laboratory	TNI- A portable enclosed structure with necessary and appropriate accommodation and environmental conditions for a laboratory, within which testing is performed by analysts. Examples include but are not limited to trailers, vans, and skid-mounted structures configured to house testing equipment and personnel.
National Institute of Standards and Technology (NIST)	TNI- A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (or NMI).

National Pollutant Discharge Elimination System (NPDES)	A permit program that controls water pollution by regulating point sources that discharge pollutants into U.S. waters.
Negative Control	DoD- Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.
Nitrogen Phosphorus Detector (NPD)	A detector used in GC analyses that utilizes thermal energy to ionize an analyte. With this detector, nitrogen and phosphorus can be selectively detected with a higher sensitivity than carbon.
Nonconformance	DoD- An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also the state of failing to meet the requirements.
Not Detected (ND)	The result reported for a compound when the detected amount of that compound is less than the method reporting limit.
Percent Recovery	A comparison between the observed value and the true value of a known spiked concentration, represented as a percentage. This evaluation applies to the calculation of ICV, CCV, LCS, MS/MSD, Surrogates, etc.
Performance Audit	DoD- The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.
Performance Based Measurement System (PBMS)	An analytical system wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner.
Photo-ionization Detector (PID)	An ion detector which uses high-energy photons, typically in the ultraviolet range, to break molecules into positively charged ions.
Polychlorinated Biphenyls (PCB)	A class of organic compounds that were used as coolants and insulating fluids for transformers and capacitors. The production of these compounds was banned in the 1970's due to their high toxicity.
Positive Control	DoD- Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.
Post-Digestion Spike	A sample prepared for metals analyses that has analytes spike added to determine if matrix effects may be a factor in the results.
Power of Hydrogen (pH)	The measure of acidity or alkalinity of a solution.
Practical Detection Limit (PDL)	Another term for method detection limit (MDL) or limit of detection (LOD). However, a PDL might not be statically derived and could be set using an in-house protocol.
Practical Quantitation Limit (PQL)	Another term for a method reporting limit or limit of quantitation (LOQ). The lowest reportable concentration of a compound based on parameters set up in an analytical method and the laboratory's ability to reproduce those conditions.
Precision	TNI and DoD- The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.
Preservation	TNI- Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. DoD- Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.

Procedure	TNI- A specified way to carry out an activity or process. Procedures can be documented or not.
Proficiency Testing	TNI and DoD- A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.
Proficiency Testing Program	TNI and DoD- The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories.
Proficiency Testing Sample (PT)	TNI- A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria. DoD- A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria.
Protocol	TNI and DoD- A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) that must be strictly followed.
Quality Assurance (QA)	TNI- An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the customer. DoD- An integrated system of activities involving planning, quality control, quality assessment, reporting, and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.
Quality Assurance Manual (QAM)	A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality Assurance Project Plan (QAPP)	DoD- A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.
Quality Control (QC)	TNI- The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. DoD- The overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of the users.
Quality Control Sample (QCS)	TNI- A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. DoD- A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking.

Quality Manual	TNI and DoD- A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality System	TNI and DoD- A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance and quality control activities.
Quality System Matrix	TNI and DoD- These matrix definitions are to be used for purposes of batch and quality control requirements: • **Air and Emissions**: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device • **Aqueous**: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts. • **Biological Tissue**: Any sample of a biological origin such as fish tissue, shellfish or plant material. Such samples shall be grouped according to origin. • **Chemical Waste**: A product or by-product of an industrial process that results in a matrix not previously defined. • **Drinking Water**: Any aqueous sample that has been designated a potable or potentially potable water source. • **Non-aqueous liquid**: Any organic liquid with <15% settleable solids • **Saline/Estuarine**: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake. • **Solids**: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.
Quantitation Range	DoD- The range of values in a calibration curve between the LOQ and the highest successively analyzed initial calibration standard. The quantitation range lies within the calibration range.
Random Error	The EPA has established that there is a 5% probability that the results obtained for any one analyte will exceed the control limits established for the test due to random error. As the number of compounds measured increases in a given sample, the probability for statistical error also increases.

Raw Data	TNI- The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. DoD- Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.
Reagent Blank (method reagent blank)	DoD- A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.
Reagent Grade	Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.
Reference Material	TNI- Material or substance one or more of whose property values are sufficiently homogenized and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. DoD- A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.
Reference Standard	TNI- Standard used for the calibration of working measurement standards in a given organization or at a given location. DoD- A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.
Reference Toxicant	DoD- The toxicant used in performing toxicity tests to indicate the sensitivity of a test organism and to demonstrate the laboratory's ability to perform the test correctly and obtain consistent results.
Relative Percent Difference (RPD)	A measure of precision defined as the difference between two measurements divided by the average concentration of the two measurements.
Replicate Sample	The analytical measurement of a sample that has been split after it has been processed through the preparation stage. A replicate can also originate from a single sample that has been sub-sampled two or more times during the same analytical process time.
Reporting Limit (RL)	The level at which method, permit, regulatory and customer-specific objectives are met. The reporting limit may never be lower than the Limit of Detection (i.e. statistically determined MDL). Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified. There must be a sufficient buffer between the Reporting Limit and the MDL. DoD- A customer-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

Reporting Limit Verification Standard (or otherwise named)	A standard analyzed at the reporting limit for an analysis to verify the laboratory's ability to report to that level.
Representativeness	A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed. Sample representativeness is dependent on the sampling techniques specified in the project work plan.
Requirement	DoD- Denotes a mandatory specification; often designated by the term "shall".
Response Factor (RF)	A measure of the relative response area of an analyte compared to its internal standard. The response factor is determined by the equation below, and if the calculated value meets the method guidelines it can be used to determine concentration for organic analyses.
Retention Time	DoD- The time between sample injection and the appearance of a solute peak at the detector.
Sample	DoD- Portion of material collected for analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis.
Sample Blank (or Turbidity Blank)	The purpose of a sample blank is to account for spectrophotometric interferences such as sample color, cloudiness, viscosity, etc. The sample blank must be analyzed at the same dilution as the sample. The sample blank is analyzed without any addition of reagents.
Sample Delivery Group (SDG)	A unit within a single project that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer field samples within a project, received over a period of up to 14 calendar days. Data from all samples in an SDG are reported concurrently.
Sample Detection Limit (SDL)	TX TRRP – The Method Detection Limit (MDL) adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and takes into account sample characteristics, sample preparation, and analytical adjustments. The term is analogous to the sample-specific detection limit.
Sample Tracking	Procedures employed to record the possession of the samples from the time of sampling until analysis, reporting and archiving. These procedures include the use of a Chain of custody Form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples.
Sampling	TNI- Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.
Secondary Source Calibration Verification (SSCV)	A mid-point or low standard made from the secondary source (lot or manufacturer) that is not used to construct the calibration curve. The SSCV is used to represent the calibration accuracy of the instrument and must perform within method stated guidelines. This sample is used to document calibration accuracy. The SSCV can be the same solution as the LCS, but is analyzed as an instrument standard, rather than a method prepared standard.
Selective Ion Monitoring (SIM)	A mode of analysis in mass spectrometry where the detector is set to scan over a very small mass range, typically one mass unit. The narrower the range, the more sensitive the detector.

Selectivity	TNI- The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. DoD- The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances.
Sensitivity	TNI and DoD- The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.
Serial Dilution	The stepwise dilution of a substance in a solution.
Shall	Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification as long as the requirement is fulfilled.
Should	Denotes a guideline or recommendation whenever noncompliance with the specification is permissible.
Signal-to-Noise Ratio	DoD- The signal carries information about the analyte, while noise is made up of extraneous information that is unwanted because it degrades the accuracy and precision of an analysis and also places a lower limit on the amount of analyte that can be detected. In most measurements, the average strength of the noise is constant and independent of the magnitude of the signal. Thus, the effect of noise on the relative error of a measurement becomes greater and greater as the quantity being measured (producing the signal) decreases in magnitude.
Spike	DoD- A known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.
Standard (Document)	TNI and DoD- The document describing the elements of a laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.
Standard (Chemical)	DoD- Standard samples are comprised of a known amount of standard reference material in the matrix undergoing analysis. A standard reference material is a certified reference material produced by US NIST and characterized for absolute content, independent of analytical test method.
Standard Blank (or Reagent Blank)	A calibration standard consisting of the same solvent/reagent matrix used to prepare the calibration standards without the analytes. It is used to construct the calibration curve by establishing instrument background.
Standard Method	DoD- A test method issued by an organization generally recognized as competent to do so.
Standard Operating Procedure (SOP)	TNI- A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. DoD- A written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks.
Standard Reference Material (SRM)	DoD- A certified reference material produced by the US NIST or other equivalent organization and characterized for absolute content, independent of analytical method.
Statement of Qualifications (SOQ)	A document that lists information about a company, typically the qualifications of that company to compete on a bid for services.

Stock Standard	A concentrated reference solution containing one or more analytes prepared in the laboratory using an assayed reference compound or purchased from a reputable commercial source.
Supervisor	DoD- The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses.
Surrogate	DoD- A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes.
SUMMA Canister	A SUMMA canister is a stainless steel electropolished (or "SUMMA" polished) that enriches the nickel and chromium surface and makes it more inert than untreated stainless steel. These canisters are used to collect air or vapor samples.
Systems Audit	An on-site inspection or assessment of a laboratory's quality system.
Target Analytes	DoD- Analytes specifically named by a customer (also called project-specific analytes).
Technical Director	DoD- Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory.
Technology	TNI- A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.
Tedlar Bags	Bags made from polyvinyl fluoride (PVF) film that are used to collect air or vapor samples.
Tentatively Identified Compound (TIC)	Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates. TICs can be tentatively identified using mass spectrometers in spectral comparisons with NBS library searches. Quantitation of TICs provides a rough approximation of the concentration of these non-target analytes.
Test	DoD- A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate.
Test Method	DoD- An adoption of a scientific technique for performing a specific measurement as documented in a laboratory SOP or as published by a recognized authority.
Test Methods for Evaluating Solid Waste, Physical/ Chemical (SW-846)	EPA Waste's official compendium of analytical and sampling methods that have been evaluated and approved for use in complying with RCRA regulations.
Total Petroleum Hydrocarbons (TPH)	A term used to denote a large family of several hundred chemical compounds that originate from crude oil. Compounds may include gasoline components, jet fuel, volatile organics, etc.
Toxicity Characteristic Leaching Procedure (TCLP)	A solid sample extraction method for chemical analysis employed as an analytical method to simulate leaching of compounds through a landfill.

Traceability	TNI- The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical conditions or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. DoD- The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.
Training Document	A training resource that provides detailed instructions to execute a specific method or job function.
Trip Blank	This blank sample is used to detect sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with laboratory reagent water and the blank is stored, shipped, and analyzed with its associated samples.
Tuning	DoD- A check and/or adjustment of instrument performance for mass spectrometry as required by the method.
Ultraviolet Spectrophotometer (UV)	Instrument routinely used in quantitative determination of solutions of transition metal ions and highly conjugated organic compounds.
Unadjusted Method Quantitation Limit (Unadj. MQL)	TX TRRP – The Method Quantitation Limit (MQL) that has not been adjusted based on sample specific actions such as dilution.
Uncertainty Measurement	The parameter associated with the result of a measurement that characterized the dispersion of the values that could be reasonably attributed to the measurand (i.e. the concentration of an analyte).
Validation	DoD- The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.
Verification	TNI and DoD- Confirmation by examination and objective evidence that specified requirements have been met. Note: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.
Whole Effluent Toxicity (WET)	The aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent).

Table 3.3b
Analytical Capabilities
AE=Air Emissions, DW=Drinking Water, NPW=Non-potable Water, SCM=Solid Chemical Materials

The information listed is subject to change.
Always check with the laboratory for the most updated information.

Matrix	Method	Parameter
AE	EPA TO-15	Ethanol
AE	EPA TO-15	Gasoline range organic
AE	EPA TO-15	Naphthalene
AE	EPA TO-15	Allyl chloride
AE	EPA TO-15	Chlorotoluene (2-)
AE	EPA TO-15	Isopropylbenzene
AE	EPA TO-15	Methyl methacrylate
AE	EPA TO-15	Tetrahydrofuran
AE	EPA TO-15	Vinyl bromide
AE	EPA TO-15	Dibromoethane (1,2-) (EDB)
AE	EPA TO-15	Dichloroethene (1,1-)
AE	EPA TO-15	Hexachlorobutadiene (1,3-)
AE	EPA TO-15	Hexanone (2-)
AE	EPA TO-15	Acetone
AE	EPA TO-15	Chloromethane
AE	EPA TO-15	Dibromochloromethane
AE	EPA TO-15	Dichlorodifluoromethane
AE	EPA TO-15	Dichloroethene (cis-1,2-)
AE	EPA TO-15	Dichloroethene (trans-1,2-)
AE	EPA TO-15	Dichloropropene (trans-1,3-)
AE	EPA TO-15	Dichlorotetrafluoroethane (1,2-)
AE	EPA TO-15	Ethylbenzene
AE	EPA TO-15	Ethyltoluene (4-)
AE	EPA TO-15	Isopropanol
AE	EPA TO-15	Trichlorofluoromethane
AE	EPA TO-15	Trimethylpentane (2,2,4-)
AE	EPA TO-15	Vinyl chloride
AE	EPA TO-15	Benzene
AE	EPA TO-15	Benzyl chloride
AE	EPA TO-15	Bromodichloromethane
AE	EPA TO-15	Bromoform
AE	EPA TO-15	Bromomethane

Matrix	Method	Parameter
AE	EPA TO-15	Butadiene (1,3-)
AE	EPA TO-15	Carbon disulfide
AE	EPA TO-15	Carbon tetrachloride
AE	EPA TO-15	Chlorobenzene
AE	EPA TO-15	Chloroethane
AE	EPA TO-15	Chloroform
AE	EPA TO-15	Cyclohexane
AE	EPA TO-15	Dichlorobenzene (1,2-)
AE	EPA TO-15	Dichlorobenzene (1,3-)
AE	EPA TO-15	Dichlorobenzene (1,4-)
AE	EPA TO-15	Dichloroethane (1,1-)
AE	EPA TO-15	Dichloroethane (1,2-)
AE	EPA TO-15	Dichloropropane (1,2-)
AE	EPA TO-15	Dichloropropene (cis-1,3-)
AE	EPA TO-15	Dioxane (1,4-)
AE	EPA TO-15	Heptane (n-)
AE	EPA TO-15	Hexane (n-)
AE	EPA TO-15	Methyl ethyl ketone
AE	EPA TO-15	Methyl isobutyl ketone (MIBK)
AE	EPA TO-15	Methyl tert-butyl ether
AE	EPA TO-15	Methylene chloride (Dichloromethane)
AE	EPA TO-15	Styrene
AE	EPA TO-15	Trichlorobenzene (1,2,4-)
AE	EPA TO-15	Trimethylbenzene (1,3,5-)
AE	EPA TO-15	Trimethylbenzene (1,2,4-)
AE	EPA TO-15	Tetrachloroethane (1,1,2,2-)
AE	EPA TO-15	Tetrachloroethene
AE	EPA TO-15	Toluene
AE	EPA TO-15	Trichloroethane (1,1,1-)
AE	EPA TO-15	Trichloroethane (1,1,2-)
AE	EPA TO-15	Trichloroethene
AE	EPA TO-15	Trichloro (1,1,2-) trifluoroethane (1,2,2-)
AE	EPA TO-15	Vinyl acetate
AE	EPA TO-15	Xylene (m-)
AE	EPA TO-15	Xylene (o-)
AE	EPA TO-15	Xylene (p-)
AE	EPA TO-15	Xylenes (total)
AE/NPW	8015M/ RSK-175	Ethane
AE/NPW	8015M/ RSK-175	Ethene
AE/NPW	8015M/ RSK-175	Methane

Matrix	Method	Parameter
AE/NPW	8015M/ RSK-175	Propane
AE/NPW	8015M/ RSK-175	Acetylene
DW	EPA 150.1	pH
DW	EPA 1622	Cryptosporidium
DW	EPA 1623	Cryptosporidium
DW	EPA 1623	Giardia
DW	EPA 180.1	Turbidity
DW	EPA 200.7	Aluminum
DW	EPA 200.7	Antimony
DW	EPA 200.7	Arsenic
DW	EPA 200.7	Barium
DW	EPA 200.7	Beryllium
DW	EPA 200.7	Boron
DW	EPA 200.7	Cadmium
DW	EPA 200.7	Calcium
DW	EPA 200.7	Calcium-hardness
DW	EPA 200.7	Total hardness
DW	EPA 200.7	Chromium
DW	EPA 200.7	Cobalt
DW	EPA 200.7	Copper
DW	EPA 200.7	Iron
DW	EPA 200.7	Lead
DW	EPA 200.7	Magnesium
DW	EPA 200.7	Manganese
DW	EPA 200.7	Molybdenum
DW	EPA 200.7	Nickel
DW	EPA 200.7	Potassium
DW	EPA 200.7	Selenium
DW	EPA 200.7	Silica
DW	EPA 200.7	Silver
DW	EPA 200.7	Sulfur
DW	EPA 200.7	Sodium
DW	EPA 200.7	Strontium
DW	EPA 200.7	Thallium
DW	EPA 200.7	Tin
DW	EPA 200.7	Titanium
DW	EPA 200.7	Vanadium
DW	EPA 200.7	Zinc
DW	EPA 200.8	Aluminum
DW	EPA 200.8	Antimony

Matrix	Method	Parameter
DW	EPA 200.8	Arsenic
DW	EPA 200.8	Barium
DW	EPA 200.8	Beryllium
DW	EPA 200.8	Boron
DW	EPA 200.8	Cadmium
DW	EPA 200.8	Calcium
DW	EPA 200.8	Chromium
DW	EPA 200.8	Cobalt
DW	EPA 200.8	Copper
DW	EPA 200.8	Iron
DW	EPA 200.8	Lead
DW	EPA 200.8	Magnesium
DW	EPA 200.8	Manganese
DW	EPA 200.8	Molybdenum
DW	EPA 200.8	Nickel
DW	EPA 200.8	Potassium
DW	EPA 200.8	Selenium
DW	EPA 200.8	Silver
DW	EPA 200.8	Sodium
DW	EPA 200.8	Strontium
DW	EPA 200.8	Thallium
DW	EPA 200.8	Thorium
DW	EPA 200.8	Tin
DW	EPA 200.8	Titanium
DW	EPA 200.8	Uranium
DW	EPA 200.8	Vanadium
DW	EPA 200.8	Zinc
DW	EPA 218.6	Chromium (VI)
DW	EPA 218.7	Chromium (VI)
DW	EPA 245.1	Mercury
DW	EPA 300.0	Nitrite
DW	EPA 300.0	Nitrate
DW	EPA 300.0	Fluoride
DW	EPA 300.0	Sulfate
DW	EPA 300.0	Bromide
DW	EPA 300.0	Chloride
DW	EPA 314.0	Perchlorate
DW	EPA 335.4	Cyanide
DW	EPA 350.1	Ammonia
DW	EPA 353.2	Nitrate

Matrix	Method	Parameter
DW	EPA 353.2	Nitrite
DW	EPA 504.1	Dibromoethane (1,2-) (EDB)
DW	EPA 504.1	Dibromo-3-chloropropane (1,2-)
DW	EPA 507	Alachlor
DW	EPA 507	Butachlor
DW	EPA 507	Metolachlor
DW	EPA 507	Metribuzin
DW	EPA 507	Atrazine
DW	EPA 507	Simazine
DW	EPA 524.2	Tetrahydrofuran
DW	EPA 524.2	Dichloro-2-butene (trans-1,4-)
DW	EPA 524.2	Hexachloroethane
DW	EPA 524.2	Acetone
DW	EPA 524.2	Butanone (2-)
DW	EPA 524.2	Carbon disulfide
DW	EPA 524.2	Hexanone (2-)
DW	EPA 524.2	Pentanone (4-methyl-2-) (MIBK)
DW	EPA 524.2	Trichlorobenzene (1,3,5-)
DW	EPA 524.2	Bromochloromethane
DW	EPA 524.2	Bromoform
DW	EPA 524.2	Chloroform
DW	EPA 524.2	Dibromochloromethane
DW	EPA 524.2	Bromodichloromethane
DW	EPA 524.2	Benzene
DW	EPA 524.2	Carbon tetrachloride
DW	EPA 524.2	Chlorobenzene
DW	EPA 524.2	Dichlorobenzene (1,2-)
DW	EPA 524.2	Dichlorobenzene (1,3-)
DW	EPA 524.2	Dichlorobenzene (1,4-)
DW	EPA 524.2	Dichloroethane (1,1-)
DW	EPA 524.2	Dichloroethane (1,2-)
DW	EPA 524.2	Dichloroethene (cis-1,2-)
DW	EPA 524.2	Dichloroethene (trans-1,2-)
DW	EPA 524.2	Methylene chloride (Dichloromethane)
DW	EPA 524.2	Dichloropropane (1,2-)
DW	EPA 524.2	Ethylbenzene
DW	EPA 524.2	Methyl tert-butyl ether
DW	EPA 524.2	Naphthalene
DW	EPA 524.2	Styrene
DW	EPA 524.2	Tetrachloroethane (1,1,2,2-)

Matrix	Method	Parameter
DW	EPA 524.2	Tetrachloroethene
DW	EPA 524.2	Trichloroethane (1,1,1-)
DW	EPA 524.2	Trichloroethene
DW	EPA 524.2	Toluene
DW	EPA 524.2	Trichlorobenzene (1,2,4-)
DW	EPA 524.2	Dichloroethene (1,1-)
DW	EPA 524.2	Trichloroethane (1,1,2-)
DW	EPA 524.2	Vinyl chloride
DW	EPA 524.2	Xylenes (total)
DW	EPA 524.2	Bromobenzene
DW	EPA 524.2	Bromomethane
DW	EPA 524.2	Butyl benzene (n-)
DW	EPA 524.2	Sec-butylbenzene
DW	EPA 524.2	Tert-butylbenzene
DW	EPA 524.2	Chloroethane
DW	EPA 524.2	Chloromethane
DW	EPA 524.2	Chlorotoluene (2-)
DW	EPA 524.2	Chlorotoluene (4-)
DW	EPA 524.2	Dibromo-3-chloropropane (1,2-)
DW	EPA 524.2	Dibromoethane (1,2-) (EDB)
DW	EPA 524.2	Dibromomethane
DW	EPA 524.2	Dichlorodifluoromethane
DW	EPA 524.2	Dichloropropane (1,3-)
DW	EPA 524.2	Dichloropropane (2,2-)
DW	EPA 524.2	Dichloropropene (1,1-)
DW	EPA 524.2	Dichloropropene (cis-1,3-)
DW	EPA 524.2	Dichloropropene (trans-1,3-)
DW	EPA 524.2	Hexachlorobutadiene (1,3-)
DW	EPA 524.2	Isopropylbenzene
DW	EPA 524.2	Isopropyltoluene (4-)
DW	EPA 524.2	Propylbenzene (n-)
DW	EPA 524.2	Tetrachloroethane (1,1,1,2-)
DW	EPA 524.2	Trichlorobenzene (1,2,3-)
DW	EPA 524.2	Trichlorofluoromethane
DW	EPA 524.2	Trichloropropane (1,2,3-)
DW	EPA 524.2	Trimethylbenzene (1,2,4-)
DW	EPA 524.2	Trimethylbenzene (1,3,5-)
DW	EPA 552.2	Bromochloroacetic acid
DW	EPA 552.2	Dibromoacetic acid
DW	EPA 552.2	Dichloroacetic acid

Matrix	Method	Parameter
DW	EPA 552.2	Monobromoacetic acid (MBAA)
DW	EPA 552.2	Monochloroacetic acid (MCAA)
DW	EPA 552.2	Trichloroacetic acid
DW	SM 2120 B	Color
DW	SM 2130 B	Turbidity
DW	SM 2150 B	Odor
DW	SM 2320 B	Alkalinity
DW	SM 2340 B	Total hardness
DW	SM 2340 C	Total hardness
DW	SM 2510 B	Conductivity
DW	SM 2540 C	Total dissolved solids (TDS)
DW	SM 3120 B	Total hardness
DW	SM 4110 B	Bromide
DW	SM 4110 B	Nitrite
DW	SM 4110 B	Nitrate
DW	SM 4110 B	Fluoride
DW	SM 4110 B	Sulfate
DW	SM 4110 B	Chloride
DW	SM 4500-Cl G	Chlorine - residual
DW	SM 4500-CN C,E	Cyanide
DW	SM 4500-CN C,G	Cyanide
DW	SM 4500-H B	pH
DW	SM 4500-NH3 G	Ammonia
DW	SM 4500-NO3 F	Nitrate
DW	SM 4500-NO3 F	Nitrite
DW	SM 4500-P E	Orthophosphate
DW	SM 5310 B	Total organic carbon (TOC)
DW	SM 5310 C	Dissolved organic carbon (DOC)
DW	SM 5310 C	Total organic carbon (TOC)
DW	SM 5320 B	Total organic halides (TOX)
DW	SM 5540 C	Foaming agents
DW	SM 5910 B	UV-absorbing compounds
DW	SM 9215B (Pour Plate)	Heterotropic Bacteria
DW	SM 9223 B (Colilert)	Total coliform / E. coli
DW	User Defined 524.2	Diisopropyl Ether [DIPE]
NPW	ASTM D6503	Enterococci
NPW	ASTM F1647-02A	Total organic carbon (TOC)
NPW	EPA 1000.0	Toxicity - chronic, FW organism
NPW	EPA 1002.0	Toxicity - chronic, FW organism

Matrix	Method	Parameter
NPW	EPA 120.1	Specific conductance
NPW	EPA 130.1	Hardness - total as CaCO3
NPW	EPA 160.4	Residue - volatile
NPW	EPA 1657	Phorate
NPW	EPA 1657	Bolstar
NPW	EPA 1657	Chlorpyrifos
NPW	EPA 1657	Coumaphos
NPW	EPA 1657	Dichlorvos
NPW	EPA 1657	Dimethoate
NPW	EPA 1657	EPN
NPW	EPA 1657	Fensulfothion
NPW	EPA 1657	Fenthion
NPW	EPA 1657	Naled
NPW	EPA 1657	Parathion ethyl
NPW	EPA 1657	Parathion methyl
NPW	EPA 1657	Ronnel
NPW	EPA 1657	Stirofos
NPW	EPA 1657	Sulfotepp
NPW	EPA 1657	TEPP
NPW	EPA 1657	Tokuthion [Protothiofos]
NPW	EPA 1657	Trichloronate
NPW	EPA 1658	D (2,4-)
NPW	EPA 1658	Dalapon
NPW	EPA 1658	Dichlorprop
NPW	EPA 1664A & B	Oil & grease - hem-SPE
NPW	EPA 1664A & B	Oil & grease - non polar
NPW	EPA 1664A & B	Oil & grease - hem-LL
NPW	EPA 1664A & B	Oil & grease - sgt-non polar-SPE
NPW	EPA 180.1	Turbidity
NPW	EPA 200.7	Aluminum
NPW	EPA 200.7	Antimony
NPW	EPA 200.7	Arsenic
NPW	EPA 200.7	Barium
NPW	EPA 200.7	Beryllium
NPW	EPA 200.7	Boron
NPW	EPA 200.7	Cadmium
NPW	EPA 200.7	Calcium
NPW	EPA 200.7	Calcium-hardness
NPW	EPA 200.7	Total hardness
NPW	EPA 200.7	Chromium

Matrix	Method	Parameter
NPW	EPA 200.7	Cobalt
NPW	EPA 200.7	Copper
NPW	EPA 200.7	Iron
NPW	EPA 200.7	Lead
NPW	EPA 200.7	Lithium
NPW	EPA 200.7	Magnesium
NPW	EPA 200.7	Manganese
NPW	EPA 200.7	Molybdenum
NPW	EPA 200.7	Nickel
NPW	EPA 200.7	Potassium
NPW	EPA 200.7	Selenium
NPW	EPA 200.7	Silica
NPW	EPA 200.7	Silver
NPW	EPA 200.7	Sulfur
NPW	EPA 200.7	Sodium
NPW	EPA 200.7	Strontium
NPW	EPA 200.7	Thallium
NPW	EPA 200.7	Tin
NPW	EPA 200.7	Titanium
NPW	EPA 200.7	Vanadium
NPW	EPA 200.7	Zinc
NPW	EPA 200.8	Aluminum
NPW	EPA 200.8	Antimony
NPW	EPA 200.8	Arsenic
NPW	EPA 200.8	Barium
NPW	EPA 200.8	Beryllium
NPW	EPA 200.8	Boron
NPW	EPA 200.8	Cadmium
NPW	EPA 200.8	Calcium
NPW	EPA 200.8	Chromium
NPW	EPA 200.8	Cobalt
NPW	EPA 200.8	Copper
NPW	EPA 200.8	Iron
NPW	EPA 200.8	Lead
NPW	EPA 200.8	Magnesium
NPW	EPA 200.8	Manganese
NPW	EPA 200.8	Molybdenum
NPW	EPA 200.8	Nickel
NPW	EPA 200.8	Potassium
NPW	EPA 200.8	Selenium

Matrix	Method	Parameter
NPW	EPA 200.8	Silver
NPW	EPA 200.8	Sodium
NPW	EPA 200.8	Strontium
NPW	EPA 200.8	Thallium
NPW	EPA 200.8	Thorium
NPW	EPA 200.8	Tin
NPW	EPA 200.8	Titanium
NPW	EPA 200.8	Uranium
NPW	EPA 200.8	Vanadium
NPW	EPA 200.8	Zinc
NPW	EPA 2000.0	Toxicity - acute, FW organism
NPW	EPA 2002.0	Toxicity - acute, FW organism
NPW	EPA 218.6	Chromium (VI)
NPW	EPA 245.1	Mercury
NPW	EPA 300.0	Guanidine nitrate
NPW	EPA 300.0	Bromide
NPW	EPA 300.0	Chloride
NPW	EPA 300.0	Fluoride
NPW	EPA 300.0	Nitrate
NPW	EPA 300.0	Nitrite
NPW	EPA 300.0	Sulfate
NPW	EPA 300.0	Nitrate - nitrite
NPW	EPA 310.2	Alkalinity as CaCO3
NPW	EPA 314.0	Perchlorate
NPW	EPA 335.4	Cyanide
NPW	EPA 350.1	Ammonia
NPW	EPA 351.1, .2 - 350.1	Organic nitrogen
NPW	EPA 351.2	Kjeldahl nitrogen - total
NPW	EPA 353.2	Nitrate - nitrite
NPW	EPA 365.1	Total Phosphorus
NPW	EPA 365.4	Total Phosphorus
NPW	EPA 410.4	Chemical oxygen demand
NPW	EPA 420.4	Phenols
NPW	EPA 507	Alachlor
NPW	EPA 507	Metribuzin
NPW	EPA 507	Ethoprop
NPW	EPA 507	Merphos
NPW	EPA 507	Mevinphos
NPW	EPA 602	Benzene
NPW	EPA 602	Ethylbenzene

Matrix	Method	Parameter
NPW	EPA 602	Methyl tert-butyl ether
NPW	EPA 602	Tert-butyl alcohol
NPW	EPA 602	Toluene
NPW	EPA 602	Xylenes (total)
NPW	EPA 608	Chloroneb
NPW	EPA 608	Chlorothalonil
NPW	EPA 608	Chlordane (alpha)
NPW	EPA 608	Chlordane (gamma)
NPW	EPA 608	Hexachlorobenzene
NPW	EPA 608	PCB 1016
NPW	EPA 608	PCB 1221
NPW	EPA 608	PCB 1232
NPW	EPA 608	PCB 1242
NPW	EPA 608	PCB 1248
NPW	EPA 608	PCB 1254
NPW	EPA 608	PCB 1260
NPW	EPA 608	Aldrin
NPW	EPA 608	Alpha BHC
NPW	EPA 608	Beta BHC
NPW	EPA 608	Delta BHC
NPW	EPA 608	Lindane (gamma BHC)
NPW	EPA 608	Chlordane
NPW	EPA 608	DDD (4,4'-)
NPW	EPA 608	DDE (4,4'-)
NPW	EPA 608	DDT (4,4'-)
NPW	EPA 608	Dieldrin
NPW	EPA 608	Endosulfan I
NPW	EPA 608	Endosulfan II
NPW	EPA 608	Endosulfan sulfate
NPW	EPA 608	Endrin
NPW	EPA 608	Endrin aldehyde
NPW	EPA 608	Endrin ketone
NPW	EPA 608	Heptachlor
NPW	EPA 608	Heptachlor epoxide
NPW	EPA 608	Methoxychlor
NPW	EPA 608	Toxaphene
NPW	EPA 610	Acenaphthene
NPW	EPA 610	Acenaphthylene
NPW	EPA 610	Anthracene
NPW	EPA 610	Benzo(a)anthracene

Matrix	Method	Parameter
NPW	EPA 610	Benzo(a)pyrene
NPW	EPA 610	Benzo(b)fluoranthene
NPW	EPA 610	Benzo(ghi)perylene
NPW	EPA 610	Benzo(k)fluoranthene
NPW	EPA 610	Chrysene
NPW	EPA 610	Dibenzo(a,h)anthracene
NPW	EPA 610	Fluoranthene
NPW	EPA 610	Fluorene
NPW	EPA 610	Indeno(1,2,3-cd)pyrene
NPW	EPA 610	Naphthalene
NPW	EPA 610	Phenanthrene
NPW	EPA 610	Pyrene
NPW	EPA 615	Dicamba
NPW	EPA 615	DB (2,4-)
NPW	EPA 615	Dinoseb
NPW	EPA 615	Dalapon
NPW	EPA 615	Dichlorprop
NPW	EPA 615	D (2,4-)
NPW	EPA 615	T (2,4,5-)
NPW	EPA 615	TP (2,4,5-) (Silvex)
NPW	EPA 615	MCPA
NPW	EPA 615	MCPP
NPW	EPA 622	Coumaphos
NPW	EPA 622	Demeton (o-)
NPW	EPA 622	Demeton (s-)
NPW	EPA 622	Dimethoate
NPW	EPA 622	Parathion ethyl
NPW	EPA 622	Parathion methyl
NPW	EPA 622	Stirofos
NPW	EPA 622	Sulfotepp
NPW	EPA 622	TEPP
NPW	EPA 622	Tokuthion [Protothiofos]
NPW	EPA 622	Trichloronate
NPW	EPA 624	Amyl alcohol (n-)
NPW	EPA 624	Propionitrile
NPW	EPA 624	Trimethylbenzene (1,2,3-)
NPW	EPA 624	Allyl chloride
NPW	EPA 624	Bromoethane
NPW	EPA 624	Butanone (2-)
NPW	EPA 624	Butadiene (2-chloro-1,3-)

Matrix	Method	Parameter
NPW	EPA 624	Carbon disulfide
NPW	EPA 624	Cyclohexanone
NPW	EPA 624	Dichloro-2-butene (cis-1,4-)
NPW	EPA 624	Dichloro-2-butene (trans-1,4-)
NPW	EPA 624	Diethyl ether (Ethyl ether)
NPW	EPA 624	Trichloro (1,1,2-) trifluoroethane (1,2,2-)
NPW	EPA 624	Vinyl acetate
NPW	EPA 624	Acetonitrile
NPW	EPA 624	Cyclohexane
NPW	EPA 624	Hexanone (2-)
NPW	EPA 624	Methylcyclohexane
NPW	EPA 624	Methyl iodide
NPW	EPA 624	Ethyl-tert-butyl Ether [ETBE]
NPW	EPA 624	Diisopropyl Ether [DIPE]
NPW	EPA 624	Dioxane (1,4-)
NPW	EPA 624	Butanol (1-)
NPW	EPA 624	Ethanol
NPW	EPA 624	Ethyl methacrylate
NPW	EPA 624	Iso-butyl alcohol
NPW	EPA 624	Methacrylonitrile
NPW	EPA 624	Methyl methacrylate
NPW	EPA 624	Octane (-n)
NPW	EPA 624	Pentachloroethane
NPW	EPA 624	tert-Amylmethyl ether [TAME]
NPW	EPA 624	Acrolein
NPW	EPA 624	Acrylonitrile
NPW	EPA 624	Bromobenzene
NPW	EPA 624	Bromochloromethane
NPW	EPA 624	Butyl benzene (n-)
NPW	EPA 624	Chlorotoluene (2-)
NPW	EPA 624	Chlorotoluene (4-)
NPW	EPA 624	Dibromo-3-chloropropane (1,2-)
NPW	EPA 624	Dibromoethane (1,2-) (EDB)
NPW	EPA 624	Dibromomethane
NPW	EPA 624	Dichlorodifluoromethane
NPW	EPA 624	Dichloroethene (cis-1,2-)
NPW	EPA 624	Dichloropropane (1,3-)
NPW	EPA 624	Dichloropropane (2,2-)
NPW	EPA 624	Dichloropropene (1,1-)
NPW	EPA 624	Hexane (n-)

Matrix	Method	Parameter
NPW	EPA 624	Methyl isobutyl ketone (MIBK)
NPW	EPA 624	Tetrahydrofuran
NPW	EPA 624	Styrene
NPW	EPA 624	Tetrachloroethane (1,1,1,2-)
NPW	EPA 624	Xylene (m-)
NPW	EPA 624	Xylene (o-)
NPW	EPA 624	Xylene (p-)
NPW	EPA 624	Hexachlorobutadiene (1,3-)
NPW	EPA 624	Isopropylbenzene
NPW	EPA 624	Isopropyltoluene (4-)
NPW	EPA 624	Naphthalene
NPW	EPA 624	Propylbenzene (n-)
NPW	EPA 624	Sec-butylbenzene
NPW	EPA 624	Tert-butylbenzene
NPW	EPA 624	Trichlorobenzene (1,2,3-)
NPW	EPA 624	Trichlorobenzene (1,2,4-)
NPW	EPA 624	Trichloropropane (1,2,3-)
NPW	EPA 624	Trimethylbenzene (1,2,4-)
NPW	EPA 624	Trimethylbenzene (1,3,5-)
NPW	EPA 624	Acetone
NPW	EPA 624	Ethyl acetate
NPW	EPA 624	Methyl tert-butyl ether
NPW	EPA 624	Tert-butyl alcohol
NPW	EPA 624	Xylenes (total)
NPW	EPA 624	Benzene
NPW	EPA 624	Bromodichloromethane
NPW	EPA 624	Bromoform
NPW	EPA 624	Bromomethane
NPW	EPA 624	Carbon tetrachloride
NPW	EPA 624	Chlorobenzene
NPW	EPA 624	Chloroethane
NPW	EPA 624	Chloroethyl vinyl ether (2-)
NPW	EPA 624	Chloroform
NPW	EPA 624	Chloromethane
NPW	EPA 624	Dibromochloromethane
NPW	EPA 624	Dichlorobenzene (1,2-)
NPW	EPA 624	Dichlorobenzene (1,3-)
NPW	EPA 624	Dichlorobenzene (1,4-)
NPW	EPA 624	Dichloroethane (1,1-)
NPW	EPA 624	Dichloroethane (1,2-)

Matrix	Method	Parameter
NPW	EPA 624	Dichloroethene (1,1-)
NPW	EPA 624	Dichloroethene (trans-1,2-)
NPW	EPA 624	Dichloropropane (1,2-)
NPW	EPA 624	Dichloropropene (cis-1,3-)
NPW	EPA 624	Dichloropropene (trans-1,3-)
NPW	EPA 624	Ethylbenzene
NPW	EPA 624	Methylene chloride (Dichloromethane)
NPW	EPA 624	Tetrachloroethane (1,1,2,2-)
NPW	EPA 624	Tetrachloroethene
NPW	EPA 624	Toluene
NPW	EPA 624	Trichloroethane (1,1,1-)
NPW	EPA 624	Trichloroethane (1,1,2-)
NPW	EPA 624	Trichloroethene
NPW	EPA 624	Trichlorofluoromethane
NPW	EPA 624	Vinyl chloride
NPW	EPA 625	Tetrachlorophenol (2,3,4,6-)
NPW	EPA 625	Hexachlorophene
NPW	EPA 625	Decane (n-)
NPW	EPA 625	Octadecane (n-)
NPW	EPA 625	Chloronaphthalene (1-)
NPW	EPA 625	Famphur
NPW	EPA 625	Hexachloropropene
NPW	EPA 625	Kepone
NPW	EPA 625	Napththylamine (1-)
NPW	EPA 625	Napththylamine (2-)
NPW	EPA 625	Pentachloroethane
NPW	EPA 625	Methylnaphthalene (2-)
NPW	EPA 625	Chloroaniline (4-)
NPW	EPA 625	Nitroaniline (2-)
NPW	EPA 625	Nitroaniline (3-)
NPW	EPA 625	Nitroaniline (4-)
NPW	EPA 625	Pentachlorobenzene
NPW	EPA 625	Tetrachlorobenzene (1,2,4,5-)
NPW	EPA 625	Methylphenol (4-)
NPW	EPA 625	Acetophenone
NPW	EPA 625	Aniline
NPW	EPA 625	Dichloroaniline (2,3-)
NPW	EPA 625	Diphenylhydrazine (1,2-)
NPW	EPA 625	Methylphenol (2-)
NPW	EPA 625	N-Nitroso-di-n-butylamine

Matrix	Method	Parameter
NPW	EPA 625	N-Nitrosodiethylamine
NPW	EPA 625	N-Nitrosopyrrolidine
NPW	EPA 625	Hexachlorocyclopentadiene
NPW	EPA 625	N-Nitrosodimethylamine
NPW	EPA 625	N-Nitrosodiphenylamine
NPW	EPA 625	Dibenzofuran
NPW	EPA 625	Methylphenol (2-)
NPW	EPA 625	Methylphenol (4-)
NPW	EPA 625	Trichlorophenol (2,4,5-)
NPW	EPA 625	Benzoic acid
NPW	EPA 625	Benzidine
NPW	EPA 625	Carbazole
NPW	EPA 625	Pyridine
NPW	EPA 625	Acenaphthene
NPW	EPA 625	Acenaphthylene
NPW	EPA 625	Anthracene
NPW	EPA 625	Benzo(a)anthracene
NPW	EPA 625	Benzo(b)fluoranthene
NPW	EPA 625	Benzo(k)fluoranthene
NPW	EPA 625	Benzo(a)pyrene
NPW	EPA 625	Benzo(g,h,i)perylene
NPW	EPA 625	Butyl benzyl phthalate
NPW	EPA 625	Bis (2-chloroethyl) ether
NPW	EPA 625	Bis (2-chloroethoxy) methane
NPW	EPA 625	Bis (2-ethylhexyl) phthalate
NPW	EPA 625	Bis (2-chloroisopropyl) ether
NPW	EPA 625	Bromophenyl-phenyl ether (4-)
NPW	EPA 625	Chloronaphthalene (2-)
NPW	EPA 625	Chlorophenyl-phenyl ether (4-)
NPW	EPA 625	Chrysene
NPW	EPA 625	Dibenzo(a,h)anthracene
NPW	EPA 625	Di-n-butyl phthalate
NPW	EPA 625	Dichlorobenzidine (3,3'-)
NPW	EPA 625	Diethyl phthalate
NPW	EPA 625	Dimethyl phthalate
NPW	EPA 625	Dinitrotoluene (2,4-)
NPW	EPA 625	Dinitrotoluene (2,6-)
NPW	EPA 625	Di-n-octyl phthalate
NPW	EPA 625	Fluoranthene
NPW	EPA 625	Fluorene

Matrix	Method	Parameter
NPW	EPA 625	Hexachlorobenzene
NPW	EPA 625	Hexachlorobutadiene (1,3-)
NPW	EPA 625	Hexachloroethane
NPW	EPA 625	Indeno(1,2,3-c,d)pyrene
NPW	EPA 625	Isophorone
NPW	EPA 625	Naphthalene
NPW	EPA 625	Nitrobenzene
NPW	EPA 625	N-Nitroso-di-n-propylamine
NPW	EPA 625	Phenanthrene
NPW	EPA 625	Pyrene
NPW	EPA 625	Trichlorobenzene (1,2,4-)
NPW	EPA 625	Methyl phenol (4-chloro-3-)
NPW	EPA 625	Chlorophenol (2-)
NPW	EPA 625	Dichlorophenol (2,4-)
NPW	EPA 625	Dimethylphenol (2,4-)
NPW	EPA 625	Dinitrophenol (2,4-)
NPW	EPA 625	Dinitrophenol (2-methyl-4,6-)
NPW	EPA 625	Nitrophenol (2-)
NPW	EPA 625	Nitrophenol (4-)
NPW	EPA 625	Pentachlorophenol
NPW	EPA 625	Phenol
NPW	EPA 625	Trichlorophenol (2,4,6-)
NPW	Other FL - PRO	Petroleum Organics
NPW	Other IA - OA-1	Petroleum Organics
NPW	Other IA - OA-2	Petroleum Organics
NPW	Other NJ-OQA-QAM-025	Petroleum Organics
NPW	Other NJ-OQA-QAM-025, Rev. 7	Petroleum Organics
NPW	Other NJ-OQA-QAM-025, Rev. 7	Petroleum Organics
NPW	Other NJ DEP EPH 10/08, Rev 3	Petroleum Organics
NPW	Other USDA-LOI (Loss on ignition)	Total organic carbon (TOC)
NPW	Other Walkley Black	Total organic carbon (TOC)
NPW	SM 2120 B-11	Color
NPW	SM 2130 B-11	Turbidity
NPW	SM 2310 B-11	Acidity as CaCO3
NPW	SM 2320 B-11	Alkalinity as CaCO3
NPW	SM 2340 B-11	Hardness - total as CaCO3
NPW	SM 2340 C-11	Hardness - total as CaCO3

Matrix	Method	Parameter
NPW	SM 2510 B-11	Specific conductance
NPW	SM 2540 B-11	Residue - total
NPW	SM 2520 B-11	Salinity
NPW	SM 2540 C-11	Residue - filterable (TDS)
NPW	SM 2540 D-11	Residue - nonfilterable (TSS)
NPW	SM 2540 F-11	Residue - settleable
NPW	SM 2540 G SM 18th Ed.	Total, fixed, and volatile solids (SQAR)
NPW	SM 2550 B-00	Temperature
NPW	SM 3500-Cr B-11	Chromium (VI)
NPW	SM 3500-Cr C-11	Chromium (VI)
NPW	SM 3500-Fe B-11	Iron, Ferrous
NPW	SM 4110 B or C-11	Nitrate - nitrite
NPW	SM 4110 B or C-11	Chloride
NPW	SM 4110 B or C-11	Fluoride
NPW	SM 4110 B or C-11	Nitrate
NPW	SM 4110 B or C-11	Nitrite
NPW	SM 4110 B or C-11	Sulfate
NPW	SM 4500-Cl G-11	Chlorine
NPW	SM 4500-Cl G-11	Chlorine
NPW	SM 4500-CN B or C-11 plus E-11	Cyanide
NPW	SM 4500-CN B or C-11 and G-11	Cyanide - amenable to Cl2
NPW	SM 4500-H B-11	pH
NPW	SM 4500-N Org B or C-11 plus NH3 B-11 plus NH3 C-11	Kjeldahl nitrogen - total
NPW	SM 4500-NH3 B plus G-11	Ammonia
NPW	SM 4500-NH3 B, C, D, E, F, G, H-11	Organic nitrogen
NPW	SM 4500-NO3 F-11	Nitrate - nitrite
NPW	SM 4500-O C-11	Oxygen (dissolved)
NPW	SM 4500-O G-11	Oxygen (dissolved)
NPW	SM 4500-P B5-11 plus E-11	Phosphorus (total)
NPW	SM 4500-P E-11	Orthophosphate
NPW	SM 4500-S B, C plus D-11	Sulfides
NPW	SM 4500-SO3 B-11	Sulfite - SO3
NPW	SM 5210 B-11	Carbonaceous BOD (CBOD)
NPW	SM 5210 B-11	Biochemical oxygen demand

Matrix	Method	Parameter
NPW	SM 5220 D-11	Chemical oxygen demand
NPW	SM 5310 B, C or D-11	Dissolved organic carbon (DOC)
NPW	SM 5310 B-11	Total organic carbon (TOC)
NPW	SM 5320 B-11	Total organic halides (TOX)
NPW	SM 5520 B-11	Oil & grease - total recov
NPW	SM 5520 B-11	Oil & grease - hem-LL
NPW	SM 5540 C-11	Surfactants
NPW	SM 6200 B-97	Propionitrile
NPW	SM 6200 B-97	Trimethylbenzene (1,2,3-)
NPW	SM 6200 B-97	Allyl chloride
NPW	SM 6200 B-97	Bromoethane
NPW	SM 6200 B-97	Butadiene (2-chloro-1,3-)
NPW	SM 6200 B-97	Cyclohexanone
NPW	SM 6200 B-97	Dichloro-2-butene (cis-1,4-)
NPW	SM 6200 B-97	Dichloro-2-butene (trans-1,4-)
NPW	SM 6200 B-97	Diethyl ether (Ethyl ether)
NPW	SM 6200 B-97	Isopropanol
NPW	SM 6200 B-97	Ethyl-tert-butyl Ether [ETBE]
NPW	SM 6200 B-97	Diisopropyl Ether [DIPE]
NPW	SM 6200 B-97	Dioxane (1,4-)
NPW	SM 6200 B-97	Ethanol
NPW	SM 6200 B-97	Ethyl methacrylate
NPW	SM 6200 B-97	Iso-butyl alcohol
NPW	SM 6200 B-97	Methacrylonitrile
NPW	SM 6200 B-97	Methyl methacrylate
NPW	SM 6200 B-97	Pentachloroethane
NPW	SM 6200 B-97	tert-Amylmethyl ether [TAME]
NPW	SM 6200 B-97	Acrolein
NPW	SM 6200 B-97	Acrylonitrile
NPW	SM 6200 B-97	Bromobenzene
NPW	SM 6200 B-97	Bromochloromethane
NPW	SM 6200 B-97	Butyl benzene (n-)
NPW	SM 6200 B-97	Chlorotoluene (2-)
NPW	SM 6200 B-97	Chlorotoluene (4-)
NPW	SM 6200 B-97	Dibromo-3-chloropropane (1,2-)
NPW	SM 6200 B-97	Dibromomethane
NPW	SM 6200 B-97	Dichlorodifluoromethane
NPW	SM 6200 B-97	Dichloropropane (1,3-)
NPW	SM 6200 B-97	Dichloropropane (2,2-)
NPW	SM 6200 B-97	Dichloropropene (1,1-)

Matrix	Method	Parameter
NPW	SM 6200 B-97	Hexane (n-)
NPW	SM 6200 B-97	Methyl isobutyl ketone (MIBK)
NPW	SM 6200 B-97	Tetrahydrofuran
NPW	SM 6200 B-97	Tetrachloroethane (1,1,1,2-)
NPW	SM 6200 B-97	Xylene (m-)
NPW	SM 6200 B-97	Xylene (p-)
NPW	SM 6200 B-97	Hexachlorobutadiene (1,3-)
NPW	SM 6200 B-97	Isopropylbenzene
NPW	SM 6200 B-97	Isopropyltoluene (4-)
NPW	SM 6200 B-97	Propylbenzene (n-)
NPW	SM 6200 B-97	Sec-butylbenzene
NPW	SM 6200 B-97	Tert-butylbenzene
NPW	SM 6200 B-97	Trichlorobenzene (1,2,3-)
NPW	SM 6200 B-97	Trichloropropane (1,2,3-)
NPW	SM 6200 B-97	Trimethylbenzene (1,2,4-)
NPW	SM 6200 B-97	Trimethylbenzene (1,3,5-)
NPW	SM 6200 B-97	Acetone
NPW	SM 6200 B-97	Ethyl acetate
NPW	SM 6200 B-97	Methyl tert-butyl ether
NPW	SM 6200 B-97	Tert-butyl alcohol
NPW	SM 6200 B-97	Benzene
NPW	SM 6200 B-97	Bromodichloromethane
NPW	SM 6200 B-97	Bromoform
NPW	SM 6200 B-97	Bromomethane
NPW	SM 6200 B-97	Carbon tetrachloride
NPW	SM 6200 B-97	Chlorobenzene
NPW	SM 6200 B-97	Chloroethane
NPW	SM 6200 B-97	Chloroform
NPW	SM 6200 B-97	Chloromethane
NPW	SM 6200 B-97	Dibromochloromethane
NPW	SM 6200 B-97	Dichlorobenzene (1,2-)
NPW	SM 6200 B-97	Dichlorobenzene (1,3-)
NPW	SM 6200 B-97	Dichlorobenzene (1,4-)
NPW	SM 6200 B-97	Dichloroethane (1,1-)
NPW	SM 6200 B-97	Dichloroethane (1,2-)
NPW	SM 6200 B-97	Dichloroethene (1,1-)
NPW	SM 6200 B-97	Dichloroethene (trans-1,2-)
NPW	SM 6200 B-97	Dichloropropane (1,2-)
NPW	SM 6200 B-97	Dichloropropene (cis-1,3-)
NPW	SM 6200 B-97	Dichloropropene (trans-1,3-)

Matrix	Method	Parameter
NPW	SM 6200 B-97	Ethylbenzene
NPW	SM 6200 B-97	Methylene chloride (Dichloromethane)
NPW	SM 6200 B-97	Tetrachloroethane (1,1,2,2-)
NPW	SM 6200 B-97	Tetrachloroethene
NPW	SM 6200 B-97	Toluene
NPW	SM 6200 B-97	Trichloroethane (1,1,1-)
NPW	SM 6200 B-97	Trichloroethane (1,1,2-)
NPW	SM 6200 B-97	Trichloroethene
NPW	SM 6200 B-97	Trichlorofluoromethane
NPW	SM 6200 B-97	Vinyl chloride
NPW	SM 6200 B-97	Naphthalene
NPW	SM 6200 B-97	Trichlorobenzene (1,2,4-)
NPW	SM 6410 B-00	Tetrachlorophenol (2,3,4,6-)
NPW	SM 6410 B-00	Hexachlorophene
NPW	SM 6410 B-00	Decane (n-)
NPW	SM 6410 B-00	Octadecane (n-)
NPW	SM 6410 B-00	Biphenylamine (4-)
NPW	SM 6410 B-00	Chloronaphthalene (1-)
NPW	SM 6410 B-00	Famphur
NPW	SM 6410 B-00	Hexachloropropene
NPW	SM 6410 B-00	Kepone
NPW	SM 6410 B-00	Napththylamine (1-)
NPW	SM 6410 B-00	Napththylamine (2-)
NPW	SM 6410 B-00	Pentachloroethane
NPW	SM 6410 B-00	Napthoquinone (1,4-)
NPW	SM 6410 B-00	Methylphenol (4-)
NPW	SM 6410 B-00	Acetophenone
NPW	SM 6410 B-00	Alpha - terpineol
NPW	SM 6410 B-00	Aniline
NPW	SM 6410 B-00	Dichloroaniline (2,3-)
NPW	SM 6410 B-00	Methylphenol (2-)
NPW	SM 6410 B-00	Hexachlorocyclopentadiene
NPW	SM 6410 B-00	N-Nitrosodimethylamine
NPW	SM 6410 B-00	N-Nitrosodiphenylamine
NPW	SM 6410 B-00	Benzoic acid
NPW	SM 6410 B-00	Benzidine
NPW	SM 6410 B-00	Carbazole
NPW	SM 6410 B-00	Pyridine
NPW	SM 6410 B-00	Acenaphthene
NPW	SM 6410 B-00	Acenaphthylene

Matrix	Method	Parameter
NPW	SM 6410 B-00	Anthracene
NPW	SM 6410 B-00	Benzo(a)anthracene
NPW	SM 6410 B-00	Benzo(b)fluoranthene
NPW	SM 6410 B-00	Benzo(k)fluoranthene
NPW	SM 6410 B-00	Benzo(a)pyrene
NPW	SM 6410 B-00	Benzo(ghi)perylene
NPW	SM 6410 B-00	Butyl benzyl phthalate
NPW	SM 6410 B-00	Bis (2-chloroethyl) ether
NPW	SM 6410 B-00	Bis (2-chloroethoxy) methane
NPW	SM 6410 B-00	Bis (2-ethylhexyl) phthalate
NPW	SM 6410 B-00	Bis (2-chloroisopropyl) ether
NPW	SM 6410 B-00	Bromophenyl-phenyl ether (4-)
NPW	SM 6410 B-00	Chloronaphthalene (2-)
NPW	SM 6410 B-00	Chlorophenyl-phenyl ether (4-)
NPW	SM 6410 B-00	Chrysene
NPW	SM 6410 B-00	Dibenzo(a,h)anthracene
NPW	SM 6410 B-00	Di-n-butyl phthalate
NPW	SM 6410 B-00	Dichlorobenzidine (3,3'-)
NPW	SM 6410 B-00	Diethyl phthalate
NPW	SM 6410 B-00	Dimethyl phthalate
NPW	SM 6410 B-00	Dinitrotoluene (2,4-)
NPW	SM 6410 B-00	Dinitrotoluene (2,6-)
NPW	SM 6410 B-00	Di-n-octyl phthalate
NPW	SM 6410 B-00	Fluoranthene
NPW	SM 6410 B-00	Fluorene
NPW	SM 6410 B-00	Hexachlorobenzene
NPW	SM 6410 B-00	Hexachlorobutadiene (1,3-)
NPW	SM 6410 B-00	Hexachloroethane
NPW	SM 6410 B-00	Indeno(1,2,3-cd)pyrene
NPW	SM 6410 B-00	Isophorone
NPW	SM 6410 B-00	Naphthalene
NPW	SM 6410 B-00	Nitrobenzene
NPW	SM 6410 B-00	N-Nitroso-di-n-propylamine
NPW	SM 6410 B-00	Phenanthrene
NPW	SM 6410 B-00	Pyrene
NPW	SM 6410 B-00	Trichlorobenzene (1,2,4-)
NPW	SM 6410 B-00	Methyl phenol (4-chloro-3-)
NPW	SM 6410 B-00	Chlorophenol (2-)
NPW	SM 6410 B-00	Dichlorophenol (2,4-)
NPW	SM 6410 B-00	Dimethylphenol (2,4-)

Matrix	Method	Parameter
NPW	SM 6410 B-00	Dinitrophenol (2,4-)
NPW	SM 6410 B-00	Dinitrophenol (2-methyl-4,6-)
NPW	SM 6410 B-00	Nitrophenol (2-)
NPW	SM 6410 B-00	Nitrophenol (4-)
NPW	SM 6410 B-00	Pentachlorophenol
NPW	SM 6410 B-00	Phenol
NPW	SM 6410 B-00	Trichlorophenol (2,4,6-)
NPW	SM 6440 B-00	Acenaphthene
NPW	SM 6440 B-00	Acenaphthylene
NPW	SM 6440 B-00	Anthracene
NPW	SM 6440 B-00	Benzo(a)anthracene
NPW	SM 6440 B-00	Benzo(a)pyrene
NPW	SM 6440 B-00	Benzo(b)fluoranthene
NPW	SM 6440 B-00	Benzo(ghi)perylene
NPW	SM 6440 B-00	Benzo(k)fluoranthene
NPW	SM 6440 B-00	Chrysene
NPW	SM 6440 B-00	Dibenzo(a,h)anthracene
NPW	SM 6440 B-00	Fluoranthene
NPW	SM 6440 B-00	Fluorene
NPW	SM 6440 B-00	Indeno(1,2,3-cd)pyrene
NPW	SM 6440 B-00	Naphthalene
NPW	SM 6440 B-00	Phenanthrene
NPW	SM 6440 B-00	Pyrene
NPW	SM 6630 B-00	Trifluralin
NPW	SM 6630 B-00	Aldrin
NPW	SM 6630 B-00	Alpha BHC
NPW	SM 6630 B-00	Lindane (gamma BHC)
NPW	SM 6630 B-00	Chlordane
NPW	SM 6630 B-00	DDD (4,4'-)
NPW	SM 6630 B-00	DDE (4,4'-)
NPW	SM 6630 B-00	DDT (4,4'-)
NPW	SM 6630 B-00	Dieldrin
NPW	SM 6630 B-00	Endosulfan I
NPW	SM 6630 B-00	Endosulfan II
NPW	SM 6630 B-00	Endrin
NPW	SM 6630 B-00	Heptachlor
NPW	SM 6630 B-00	Heptachlor epoxide
NPW	SM 6630 B-00	Methoxychlor
NPW	SM 6630 B-00	Toxaphene
NPW	SM 6630C-00	Etridiazole

Matrix	Method	Parameter
NPW	SM 6630C-00	Aldrin
NPW	SM 6630C-00	Alpha BHC
NPW	SM 6630C-00	Beta BHC
NPW	SM 6630C-00	Delta BHC
NPW	SM 6630C-00	Lindane (gamma BHC)
NPW	SM 6630C-00	Chlordane
NPW	SM 6630C-00	DDD (4,4'-)
NPW	SM 6630C-00	DDE (4,4'-)
NPW	SM 6630C-00	DDT (4,4'-)
NPW	SM 6630C-00	Dieldrin
NPW	SM 6630C-00	Endosulfan I
NPW	SM 6630C-00	Endosulfan II
NPW	SM 6630C-00	Endosulfan sulfate
NPW	SM 6630C-00	Endrin
NPW	SM 6630C-00	Heptachlor
NPW	SM 6630C-00	Heptachlor epoxide
NPW	SM 6630C-00	Methoxychlor
NPW	SM 6630C-00	Toxaphene
NPW	SM 6640 B-01	D (2,4-)
NPW	SM 6640 B-01	Dalapon
NPW	SM 6640 B-01	T (2,4,5-)
NPW	SM 6640 B-01	TP (2,4,5-) (Silvex)
NPW	SM 9215 B-00	Heterotrophic plate count
NPW	SM 9222 B-97	Total coliform
NPW	SM 9222 D-97	Fecal coliform
NPW	SM 9222D-97 (Class B only) plus EPA 625/R-92/013 App. F	Fecal coliform
NPW	SW-846 1010	Ignitability
NPW	SW-846 1010A	Ignitability
NPW	SW-846 1110	Corrosiviety toward steel
NPW	SW-846 1110A	Corrosivity toward steel
NPW	SW-846 1310A	Metals - organics
NPW	SW-846 1310B	Metals - organics
NPW	SW-846 1311	Volatile organics
NPW	SW-846 1311	Semivolatile organics
NPW	SW-846 1311	Metals
NPW	SW-846 1312	Metals - organics
NPW	SW-846 1320	Metals - organics
NPW	SW-846 3005A	Metals, Total Rec and Dissolved

Matrix	Method	Parameter
NPW	SW-846 3010A	Metals, Total
NPW	SW-846 3015	Metals
NPW	SW-846 3015A	Metals
NPW	SW-846 3020A	Metals
NPW	SW-846 3510C	Semivolatile organics
NPW	SW-846 3511	Semivolatile organics
NPW	SW-846 3520C	Semivolatile organics
NPW	SW-846 5030B	Volatile organics
NPW	SW-846 6010B	Aluminum
NPW	SW-846 6010B	Antimony
NPW	SW-846 6010B	Arsenic
NPW	SW-846 6010B	Barium
NPW	SW-846 6010B	Beryllium
NPW	SW-846 6010B	Boron
NPW	SW-846 6010B	Cadmium
NPW	SW-846 6010B	Calcium
NPW	SW-846 6010B	Calcium-hardness
NPW	SW-846 6010B	Total hardness
NPW	SW-846 6010B	Chromium
NPW	SW-846 6010B	Cobalt
NPW	SW-846 6010B	Copper
NPW	SW-846 6010B	Iron
NPW	SW-846 6010B	Lead
NPW	SW-846 6010B	Lithium
NPW	SW-846 6010B	Magnesium
NPW	SW-846 6010B	Manganese
NPW	SW-846 6010B	Molybdenum
NPW	SW-846 6010B	Nickel
NPW	SW-846 6010B	Potassium
NPW	SW-846 6010B	Selenium
NPW	SW-846 6010B	Silica
NPW	SW-846 6010B	Silver
NPW	SW-846 6010B	Sulfur
NPW	SW-846 6010B	Sodium
NPW	SW-846 6010B	Strontium
NPW	SW-846 6010B	Thallium
NPW	SW-846 6010B	Tin
NPW	SW-846 6010B	Titanium
NPW	SW-846 6010B	Vanadium
NPW	SW-846 6010B	Zinc

Matrix	Method	Parameter
NPW	SW-846 6010C	Antimony
NPW	SW-846 6010C	Arsenic
NPW	SW-846 6010C	Barium
NPW	SW-846 6010C	Beryllium
NPW	SW-846 6010C	Boron
NPW	SW-846 6010C	Cadmium
NPW	SW-846 6010C	Calcium
NPW	SW-846 6010C	Calcium-hardness
NPW	SW-846 6010C	Total hardness
NPW	SW-846 6010C	Chromium
NPW	SW-846 6010C	Cobalt
NPW	SW-846 6010C	Copper
NPW	SW-846 6010C	Iron
NPW	SW-846 6010C	Lead
NPW	SW-846 6010C	Lithium
NPW	SW-846 6010C	Magnesium
NPW	SW-846 6010C	Manganese
NPW	SW-846 6010C	Molybdenum
NPW	SW-846 6010C	Nickel
NPW	SW-846 6010C	Potassium
NPW	SW-846 6010C	Selenium
NPW	SW-846 6010C	Silica
NPW	SW-846 6010C	Silver
NPW	SW-846 6010C	Sulfur
NPW	SW-846 6010C	Sodium
NPW	SW-846 6010C	Strontium
NPW	SW-846 6010C	Thallium
NPW	SW-846 6010C	Tin
NPW	SW-846 6010C	Titanium
NPW	SW-846 6010C	Vanadium
NPW	SW-846 6010C	Zinc
NPW	SW-846 6020	Aluminum
NPW	SW-846 6020	Antimony
NPW	SW-846 6020	Arsenic
NPW	SW-846 6020	Barium
NPW	SW-846 6020	Beryllium
NPW	SW-846 6020	Boron
NPW	SW-846 6020	Cadmium
NPW	SW-846 6020	Calcium
NPW	SW-846 6020	Chromium

Matrix	Method	Parameter
NPW	SW-846 6020	Cobalt
NPW	SW-846 6020	Copper
NPW	SW-846 6020	Iron
NPW	SW-846 6020	Lead
NPW	SW-846 6020	Magnesium
NPW	SW-846 6020	Manganese
NPW	SW-846 6020	Molybdenum
NPW	SW-846 6020	Nickel
NPW	SW-846 6020	Potassium
NPW	SW-846 6020	Selenium
NPW	SW-846 6020	Silver
NPW	SW-846 6020	Sodium
NPW	SW-846 6020	Strontium
NPW	SW-846 6020	Thallium
NPW	SW-846 6020	Thorium
NPW	SW-846 6020	Tin
NPW	SW-846 6020	Titanium
NPW	SW-846 6020	Uranium
NPW	SW-846 6020	Vanadium
NPW	SW-846 6020	Zinc
NPW	SW-846 6020A	Aluminum
NPW	SW-846 6020A	Antimony
NPW	SW-846 6020A	Arsenic
NPW	SW-846 6020A	Barium
NPW	SW-846 6020A	Beryllium
NPW	SW-846 6020A	Boron
NPW	SW-846 6020A	Cadmium
NPW	SW-846 6020A	Calcium
NPW	SW-846 6020A	Chromium
NPW	SW-846 6020A	Cobalt
NPW	SW-846 6020A	Copper
NPW	SW-846 6020A	Iron
NPW	SW-846 6020A	Lead
NPW	SW-846 6020A	Magnesium
NPW	SW-846 6020A	Manganese
NPW	SW-846 6020A	Molybdenum
NPW	SW-846 6020A	Nickel
NPW	SW-846 6020A	Potassium
NPW	SW-846 6020A	Selenium
NPW	SW-846 6020A	Silver

Matrix	Method	Parameter
NPW	SW-846 6020A	Sodium
NPW	SW-846 6020A	Strontium
NPW	SW-846 6020A	Thallium
NPW	SW-846 6020A	Thorium
NPW	SW-846 6020A	Tin
NPW	SW-846 6020A	Titanium
NPW	SW-846 6020A	Uranium
NPW	SW-846 6020A	Vanadium
NPW	SW-846 6020A	Zinc
NPW	SW-846 7196A	Chromium (VI)
NPW	SW-846 7199	Chromium (VI)
NPW	SW-846 7470A	Mercury - liquid waste
NPW	SW-846 8011	Dibromoethane (1,2-) (EDB)
NPW	SW-846 8011	Dibromo-3-chloropropane (1,2-)
NPW	SW-846 8015B	Ethylene glycol
NPW	SW-846 8015B	Propylene glycol
NPW	SW-846 8015B	Gasoline range organic
NPW	SW-846 8015B	Diesel range organic
NPW	SW-846 8015C	Ethylene glycol
NPW	SW-846 8015C	Propylene glycol
NPW	SW-846 8015D	Ethylene glycol
NPW	SW-846 8015D	Propylene glycol
NPW	SW-846 8015D	Gasoline range organic
NPW	SW-846 8015D	Diesel range organic
NPW	SW-846 8021B	Xylenes (total)
NPW	SW-846 8021B	Methyl tert-butyl ether
NPW	SW-846 8021B	Benzene
NPW	SW-846 8021B	Ethylbenzene
NPW	SW-846 8021B	Toluene
NPW	SW-846 8021B	Xylene (o-)
NPW	SW-846 8021B	Xylene (m-)
NPW	SW-846 8021B	Xylene (p-)
NPW	SW-846 8081A	Alachlor
NPW	SW-846 8081A	Chlordane (alpha)
NPW	SW-846 8081A	Chlordane (gamma)
NPW	SW-846 8081A	Chloroneb
NPW	SW-846 8081A	Chlorothalonil
NPW	SW-846 8081A	Etridiazole
NPW	SW-846 8081A	Hexachlorobenzene
NPW	SW-846 8081A	Hexachlorocyclopentadiene

Matrix	Method	Parameter
NPW	SW-846 8081A	Permethrin
NPW	SW-846 8081A	Propachlor
NPW	SW-846 8081A	Trifluralin
NPW	SW-846 8081A	Aldrin
NPW	SW-846 8081A	Alpha BHC
NPW	SW-846 8081A	Beta BHC
NPW	SW-846 8081A	Delta BHC
NPW	SW-846 8081A	Lindane (gamma BHC)
NPW	SW-846 8081A	Chlordane (technical)
NPW	SW-846 8081A	DDD (4,4'-)
NPW	SW-846 8081A	DDE (4,4'-)
NPW	SW-846 8081A	DDT (4,4'-)
NPW	SW-846 8081A	Dieldrin
NPW	SW-846 8081A	Endosulfan I
NPW	SW-846 8081A	Endosulfan II
NPW	SW-846 8081A	Endosulfan sulfate
NPW	SW-846 8081A	Endrin
NPW	SW-846 8081A	Endrin aldehyde
NPW	SW-846 8081A	Endrin ketone
NPW	SW-846 8081A	Heptachlor
NPW	SW-846 8081A	Heptachlor epoxide
NPW	SW-846 8081A	Methoxychlor
NPW	SW-846 8081A	Toxaphene
NPW	SW-846 8081B	Alachlor
NPW	SW-846 8081B	Chlordane (alpha)
NPW	SW-846 8081B	Chlordane (gamma)
NPW	SW-846 8081B	Chloroneb
NPW	SW-846 8081B	Chlorothalonil
NPW	SW-846 8081B	Etridiazole
NPW	SW-846 8081B	Hexachlorobenzene
NPW	SW-846 8081B	Hexachlorocyclopentadiene
NPW	SW-846 8081B	Permethrin
NPW	SW-846 8081B	Propachlor
NPW	SW-846 8081B	Trifluralin
NPW	SW-846 8081B	Aldrin
NPW	SW-846 8081B	Alpha BHC
NPW	SW-846 8081B	Beta BHC
NPW	SW-846 8081B	Delta BHC
NPW	SW-846 8081B	Lindane (gamma BHC)
NPW	SW-846 8081B	Chlordane (technical)

Matrix	Method	Parameter
NPW	SW-846 8081B	DDD (4,4'-)
NPW	SW-846 8081B	DDE (4,4'-)
NPW	SW-846 8081B	DDT (4,4'-)
NPW	SW-846 8081B	Dieldrin
NPW	SW-846 8081B	Endosulfan I
NPW	SW-846 8081B	Endosulfan II
NPW	SW-846 8081B	Endosulfan sulfate
NPW	SW-846 8081B	Endrin
NPW	SW-846 8081B	Endrin aldehyde
NPW	SW-846 8081B	Endrin ketone
NPW	SW-846 8081B	Heptachlor
NPW	SW-846 8081B	Heptachlor epoxide
NPW	SW-846 8081B	Methoxychlor
NPW	SW-846 8081B	Toxaphene
NPW	SW-846 8082	PCB 1016
NPW	SW-846 8082	PCB 1221
NPW	SW-846 8082	PCB 1232
NPW	SW-846 8082	PCB 1242
NPW	SW-846 8082	PCB 1248
NPW	SW-846 8082	PCB 1254
NPW	SW-846 8082	PCB 1260
NPW	SW-846 8082A	PCB 1016
NPW	SW-846 8082A	PCB 1221
NPW	SW-846 8082A	PCB 1232
NPW	SW-846 8082A	PCB 1242
NPW	SW-846 8082A	PCB 1248
NPW	SW-846 8082A	PCB 1254
NPW	SW-846 8082A	PCB 1260
NPW	SW-846 8141A	Azinphos methyl
NPW	SW-846 8141A	Chlorpyrifos
NPW	SW-846 8141A	Demeton (o-)
NPW	SW-846 8141A	Demeton (s-)
NPW	SW-846 8141A	Disulfoton
NPW	SW-846 8141A	Bolstar
NPW	SW-846 8141A	Coumaphos
NPW	SW-846 8141A	Dichlorvos
NPW	SW-846 8141A	Dimethoate
NPW	SW-846 8141A	EPN
NPW	SW-846 8141A	Ethoprop
NPW	SW-846 8141A	Fensulfothion

Matrix	Method	Parameter
NPW	SW-846 8141A	Fenthion
NPW	SW-846 8141A	Merphos
NPW	SW-846 8141A	Mevinphos
NPW	SW-846 8141A	Naled
NPW	SW-846 8141A	Parathion
NPW	SW-846 8141A	Parathion methyl
NPW	SW-846 8141A	Phorate
NPW	SW-846 8141A	Ronnel
NPW	SW-846 8141A	Stirofos
NPW	SW-846 8141A	Sulfotepp
NPW	SW-846 8141A	TEPP
NPW	SW-846 8141A	Tokuthion [Protothiofos]
NPW	SW-846 8141A	Trichloronate
NPW	SW-846 8141A	Diazinon
NPW	SW-846 8141A	Malathion
NPW	SW-846 8141B	Azinphos methyl
NPW	SW-846 8141B	Chlorpyrifos
NPW	SW-846 8141B	Demeton (o-)
NPW	SW-846 8141B	Demeton (s-)
NPW	SW-846 8141B	Disulfoton
NPW	SW-846 8141B	Bolstar
NPW	SW-846 8141B	Coumaphos
NPW	SW-846 8141B	Dichlorvos
NPW	SW-846 8141B	Dimethoate
NPW	SW-846 8141B	EPN
NPW	SW-846 8141B	Ethoprop
NPW	SW-846 8141B	Fensulfothion
NPW	SW-846 8141B	Fenthion
NPW	SW-846 8141B	Merphos
NPW	SW-846 8141B	Mevinphos
NPW	SW-846 8141B	Naled
NPW	SW-846 8141B	Parathion
NPW	SW-846 8141B	Parathion methyl
NPW	SW-846 8141B	Phorate
NPW	SW-846 8141B	Ronnel
NPW	SW-846 8141B	Stirofos
NPW	SW-846 8141B	Sulfotepp
NPW	SW-846 8141B	TEPP
NPW	SW-846 8141B	Tokuthion [Protothiofos]
NPW	SW-846 8141B	Trichloronate

Matrix	Method	Parameter
NPW	SW-846 8141B	Diazinon
NPW	SW-846 8141B	Malathion
NPW	SW-846 8151A	Dicamba
NPW	SW-846 8151A	DB (2,4-)
NPW	SW-846 8151A	Dinoseb
NPW	SW-846 8151A	Dalapon
NPW	SW-846 8151A	Dichlorprop
NPW	SW-846 8151A	D (2,4-)
NPW	SW-846 8151A	T (2,4,5-)
NPW	SW-846 8151A	TP (2,4,5-) (Silvex)
NPW	SW-846 8151A	MCPA
NPW	SW-846 8151A	MCPP
NPW	SW-846 8260B	Methyl alcohol (Methanol)
NPW	SW-846 8260B	Ethyl alcohol
NPW	SW-846 8260B	Hexane (n-)
NPW	SW-846 8260B	Trimethylpentane (2,2,4-)
NPW	SW-846 8260B	Methylnaphthalene (1-)
NPW	SW-846 8260B	Methylnaphthalene (2-)
NPW	SW-846 8260B	Butanol (3,3-Dimethyl-1-)
NPW	SW-846 8260B	Trimethylpentane (2,2,4-)
NPW	SW-846 8260B	Trimethylbenzene (1,2,3-)
NPW	SW-846 8260B	Cyclohexane
NPW	SW-846 8260B	Butanol (1-)
NPW	SW-846 8260B	Nitropropane (2-)
NPW	SW-846 8260B	Butyl formate (t-)
NPW	SW-846 8260B	Methyl acetate
NPW	SW-846 8260B	Pentanol (2-Methyl-2-)
NPW	SW-846 8260B	Amyl alcohol (t-)
NPW	SW-846 8260B	Methylcyclohexane
NPW	SW-846 8260B	Octane (-n)
NPW	SW-846 8260B	tert-Amylmethyl ether [TAME]
NPW	SW-846 8260B	Bromoethane
NPW	SW-846 8260B	Cyclohexanone
NPW	SW-846 8260B	Diisopropyl Ether [DIPE]
NPW	SW-846 8260B	Tetrahydrofuran
NPW	SW-846 8260B	Ethyl-tert-butyl Ether [ETBE]
NPW	SW-846 8260B	Safrole
NPW	SW-846 8260B	Xylene (m-)
NPW	SW-846 8260B	Xylene (o-)
NPW	SW-846 8260B	Xylene (p-)

Matrix	Method	Parameter
NPW	SW-846 8260B	Dichloro-2-butene (cis-1,4-)
NPW	SW-846 8260B	Diethyl ether (Ethyl ether)
NPW	SW-846 8260B	Dichloro-2-butene (trans-1,4-)
NPW	SW-846 8260B	Ethanol
NPW	SW-846 8260B	Trichloro (1,1,2-) trifluoroethane (1,2,2-)
NPW	SW-846 8260B	Vinyl acetate
NPW	SW-846 8260B	Pentachloroethane
NPW	SW-846 8260B	Tert-butyl alcohol
NPW	SW-846 8260B	Dioxane (1,4-)
NPW	SW-846 8260B	Bromobenzene
NPW	SW-846 8260B	Butyl benzene (n-)
NPW	SW-846 8260B	Sec-butylbenzene
NPW	SW-846 8260B	Tert-butylbenzene
NPW	SW-846 8260B	Chlorotoluene (2-)
NPW	SW-846 8260B	Chlorotoluene (4-)
NPW	SW-846 8260B	Isopropylbenzene
NPW	SW-846 8260B	Propylbenzene (n-)
NPW	SW-846 8260B	Isopropyltoluene (4-)
NPW	SW-846 8260B	Trichlorobenzene (1,2,3-)
NPW	SW-846 8260B	Trimethylbenzene (1,2,4-)
NPW	SW-846 8260B	Trimethylbenzene (1,3,5-)
NPW	SW-846 8260B	Allyl chloride
NPW	SW-846 8260B	Bromochloromethane
NPW	SW-846 8260B	Butadiene (2-chloro-1,3-)
NPW	SW-846 8260B	Dibromoethane (1,2-) (EDB)
NPW	SW-846 8260B	Dibromomethane
NPW	SW-846 8260B	Dibromo-3-chloropropane (1,2-)
NPW	SW-846 8260B	Dichloropropane (1,3-)
NPW	SW-846 8260B	Dichloropropane (2,2-)
NPW	SW-846 8260B	Dichloropropene (1,1-)
NPW	SW-846 8260B	Trichloropropane (1,2,3-)
NPW	SW-846 8260B	Ethyl acetate
NPW	SW-846 8260B	Ethyl methacrylate
NPW	SW-846 8260B	Methacrylonitrile
NPW	SW-846 8260B	Methyl acrylate
NPW	SW-846 8260B	Methyl methacrylate
NPW	SW-846 8260B	Methyl iodide
NPW	SW-846 8260B	Iso-butyl alcohol
NPW	SW-846 8260B	Isopropanol
NPW	SW-846 8260B	N-Nitroso-di-n-butylamine

Matrix	Method	Parameter
NPW	SW-846 8260B	Propionitrile
NPW	SW-846 8260B	Acetonitrile
NPW	SW-846 8260B	Benzene
NPW	SW-846 8260B	Chlorobenzene
NPW	SW-846 8260B	Dichlorobenzene (1,2-)
NPW	SW-846 8260B	Dichlorobenzene (1,3-)
NPW	SW-846 8260B	Dichlorobenzene (1,4-)
NPW	SW-846 8260B	Ethylbenzene
NPW	SW-846 8260B	Toluene
NPW	SW-846 8260B	Xylenes (total)
NPW	SW-846 8260B	Bromodichloromethane
NPW	SW-846 8260B	Bromoform
NPW	SW-846 8260B	Bromomethane
NPW	SW-846 8260B	Carbon tetrachloride
NPW	SW-846 8260B	Chloroethane
NPW	SW-846 8260B	Chloroethyl vinyl ether (2-)
NPW	SW-846 8260B	Chloroform
NPW	SW-846 8260B	Chloromethane
NPW	SW-846 8260B	Dichloropropene (trans-1,3-)
NPW	SW-846 8260B	Dibromochloromethane
NPW	SW-846 8260B	Dichlorodifluoromethane
NPW	SW-846 8260B	Dichloroethane (1,1-)
NPW	SW-846 8260B	Dichloroethane (1,2-)
NPW	SW-846 8260B	Dichloroethene (1,1-)
NPW	SW-846 8260B	Dichloroethene (trans-1,2-)
NPW	SW-846 8260B	Dichloroethene (cis-1,2-)
NPW	SW-846 8260B	Dichloropropane (1,2-)
NPW	SW-846 8260B	Dichloropropene (cis-1,3-)
NPW	SW-846 8260B	Methylene chloride (Dichloromethane)
NPW	SW-846 8260B	Tetrachloroethane (1,1,2,2-)
NPW	SW-846 8260B	Tetrachloroethene
NPW	SW-846 8260B	Trichloroethane (1,1,1-)
NPW	SW-846 8260B	Trichloroethane (1,1,2-)
NPW	SW-846 8260B	Trichloroethene
NPW	SW-846 8260B	Trichlorofluoromethane
NPW	SW-846 8260B	Vinyl chloride
NPW	SW-846 8260B	Acetone
NPW	SW-846 8260B	Carbon disulfide
NPW	SW-846 8260B	Butanone (2-)
NPW	SW-846 8260B	Hexanone (2-)

Matrix	Method	Parameter
NPW	SW-846 8260B	Pentanone (4-methyl-2-) (MIBK)
NPW	SW-846 8260B	Methyl tert-butyl ether
NPW	SW-846 8260B	Acrolein
NPW	SW-846 8260B	Acrylonitrile
NPW	SW-846 8260B	Hexachlorobutadiene (1,3-)
NPW	SW-846 8260B	Hexachloroethane
NPW	SW-846 8260B	Naphthalene
NPW	SW-846 8260B	Styrene
NPW	SW-846 8260B	Tetrachloroethane (1,1,1,2-)
NPW	SW-846 8260B	Trichlorobenzene (1,2,4-)
NPW	SW-846 8260C	Methyl alcohol (Methanol)
NPW	SW-846 8260C	Ethyl alcohol
NPW	SW-846 8260C	Trimethylpentane (2,2,4-)
NPW	SW-846 8260C	Methylnaphthalene (1-)
NPW	SW-846 8260C	Methylnaphthalene (2-)
NPW	SW-846 8260C	Butanol (3,3-Dimethyl-1-)
NPW	SW-846 8260C	Trimethylbenzene (1,2,3-)
NPW	SW-846 8260C	Cyclohexane
NPW	SW-846 8260C	Butanol (1-)
NPW	SW-846 8260C	Nitropropane (2-)
NPW	SW-846 8260C	Butyl formate (t-)
NPW	SW-846 8260C	Methyl acetate
NPW	SW-846 8260C	Pentanol (2-Methyl-2-)
NPW	SW-846 8260C	Amyl alcohol (t-)
NPW	SW-846 8260C	Methylcyclohexane
NPW	SW-846 8260C	Octane (-n)
NPW	SW-846 8260C	tert-Amylmethyl ether [TAME]
NPW	SW-846 8260C	Bromoethane
NPW	SW-846 8260C	Cyclohexanone
NPW	SW-846 8260C	Diisopropyl Ether [DIPE]
NPW	SW-846 8260C	Tetrahydrofuran
NPW	SW-846 8260C	Ethyl-tert-butyl Ether [ETBE]
NPW	SW-846 8260C	Xylene (m-)
NPW	SW-846 8260C	Xylene (o-)
NPW	SW-846 8260C	Xylene (p-)
NPW	SW-846 8260C	Dichloro-2-butene (cis-1,4-)
NPW	SW-846 8260C	Diethyl ether (Ethyl ether)
NPW	SW-846 8260C	Dichloro-2-butene (trans-1,4-)
NPW	SW-846 8260C	Ethanol
NPW	SW-846 8260C	Trichloro (1,1,2-) trifluoroethane (1,2,2-)

Matrix	Method	Parameter
NPW	SW-846 8260C	Vinyl acetate
NPW	SW-846 8260C	Pentachloroethane
NPW	SW-846 8260C	Tert-butyl alcohol
NPW	SW-846 8260C	Dioxane (1,4-)
NPW	SW-846 8260C	Bromobenzene
NPW	SW-846 8260C	Butyl benzene (n-)
NPW	SW-846 8260C	Sec-butylbenzene
NPW	SW-846 8260C	Tert-butylbenzene
NPW	SW-846 8260C	Chlorotoluene (2-)
NPW	SW-846 8260C	Chlorotoluene (4-)
NPW	SW-846 8260C	Isopropylbenzene
NPW	SW-846 8260C	Propylbenzene (n-)
NPW	SW-846 8260C	Isopropyltoluene (4-)
NPW	SW-846 8260C	Trichlorobenzene (1,2,3-)
NPW	SW-846 8260C	Trimethylbenzene (1,2,4-)
NPW	SW-846 8260C	Trimethylbenzene (1,3,5-)
NPW	SW-846 8260C	Allyl chloride
NPW	SW-846 8260C	Bromochloromethane
NPW	SW-846 8260C	Butadiene (2-chloro-1,3-)
NPW	SW-846 8260C	Dibromoethane (1,2-) (EDB)
NPW	SW-846 8260C	Dibromomethane
NPW	SW-846 8260C	Dibromo-3-chloropropane (1,2-)
NPW	SW-846 8260C	Dichloropropane (1,3-)
NPW	SW-846 8260C	Dichloropropane (2,2-)
NPW	SW-846 8260C	Dichloropropene (1,1-)
NPW	SW-846 8260C	Trichloropropane (1,2,3-)
NPW	SW-846 8260C	Ethyl acetate
NPW	SW-846 8260C	Ethyl methacrylate
NPW	SW-846 8260C	Methacrylonitrile
NPW	SW-846 8260C	Methyl acrylate
NPW	SW-846 8260C	Methyl methacrylate
NPW	SW-846 8260C	Methyl iodide
NPW	SW-846 8260C	Iso-butyl alcohol
NPW	SW-846 8260C	Isopropanol
NPW	SW-846 8260C	N-Nitroso-di-n-butylamine
NPW	SW-846 8260C	Propionitrile
NPW	SW-846 8260C	Acetonitrile
NPW	SW-846 8260C	Benzene
NPW	SW-846 8260C	Chlorobenzene
NPW	SW-846 8260C	Dichlorobenzene (1,2-)

Matrix	Method	Parameter
NPW	SW-846 8260C	Dichlorobenzene (1,3-)
NPW	SW-846 8260C	Dichlorobenzene (1,4-)
NPW	SW-846 8260C	Ethylbenzene
NPW	SW-846 8260C	Toluene
NPW	SW-846 8260C	Xylenes (total)
NPW	SW-846 8260C	Bromodichloromethane
NPW	SW-846 8260C	Bromoform
NPW	SW-846 8260C	Bromomethane
NPW	SW-846 8260C	Carbon tetrachloride
NPW	SW-846 8260C	Chloroethane
NPW	SW-846 8260C	Chloroethyl vinyl ether (2-)
NPW	SW-846 8260C	Chloroform
NPW	SW-846 8260C	Chloromethane
NPW	SW-846 8260C	Dichloropropene (trans-1,3-)
NPW	SW-846 8260C	Dibromochloromethane
NPW	SW-846 8260C	Dichlorodifluoromethane
NPW	SW-846 8260C	Dichloroethane (1,1-)
NPW	SW-846 8260C	Dichloroethane (1,2-)
NPW	SW-846 8260C	Dichloroethene (1,1-)
NPW	SW-846 8260C	Dichloroethene (trans-1,2-)
NPW	SW-846 8260C	Dichloroethene (cis-1,2-)
NPW	SW-846 8260C	Dichloropropane (1,2-)
NPW	SW-846 8260C	Dichloropropene (cis-1,3-)
NPW	SW-846 8260C	Methylene chloride (Dichloromethane)
NPW	SW-846 8260C	Tetrachloroethane (1,1,2,2-)
NPW	SW-846 8260C	Tetrachloroethene
NPW	SW-846 8260C	Trichloroethane (1,1,1-)
NPW	SW-846 8260C	Trichloroethane (1,1,2-)
NPW	SW-846 8260C	Trichloroethene
NPW	SW-846 8260C	Trichlorofluoromethane
NPW	SW-846 8260C	Vinyl chloride
NPW	SW-846 8260C	Acetone
NPW	SW-846 8260C	Carbon disulfide
NPW	SW-846 8260C	Butanone (2-)
NPW	SW-846 8260C	Hexanone (2-)
NPW	SW-846 8260C	Pentanone (4-methyl-2-) (MIBK)
NPW	SW-846 8260C	Methyl tert-butyl ether
NPW	SW-846 8260C	Acrolein
NPW	SW-846 8260C	Acrylonitrile
NPW	SW-846 8260C	Hexachlorobutadiene (1,3-)

Matrix	Method	Parameter
NPW	SW-846 8260C	Hexachloroethane
NPW	SW-846 8260C	Naphthalene
NPW	SW-846 8260C	Styrene
NPW	SW-846 8260C	Tetrachloroethane (1,1,1,2-)
NPW	SW-846 8260C	Trichlorobenzene (1,2,4-)
NPW	SW-846 8270C	Biphenyl (1,1'-)
NPW	SW-846 8270C	Benzaldehyde
NPW	SW-846 8270C	Caprolactam
NPW	SW-846 8270C	Atrazine
NPW	SW-846 8270C	Phenanthrene
NPW	SW-846 8270C	Pyrene
NPW	SW-846 8270C	Acenaphthene
NPW	SW-846 8270C	Acenaphthylene
NPW	SW-846 8270C	Anthracene
NPW	SW-846 8270C	Benzo(ghi)perylene
NPW	SW-846 8270C	Chrysene
NPW	SW-846 8270C	Methylnaphthalene (1-)
NPW	SW-846 8270C	Methylnaphthalene (2-)
NPW	SW-846 8270C	Naphthalene
NPW	SW-846 8270C	Fluoranthene
NPW	SW-846 8270C	Fluorene
NPW	SW-846 8270C	Methylnaphthalene (1-)
NPW	SW-846 8270C	Nitrodiphenylamine (2-)
NPW	SW-846 8270C	Nitrodiphenylamine (2-)
NPW	SW-846 8270C	Hexachlorophene
NPW	SW-846 8270C	Diphenylhydrazine (1,2-)
NPW	SW-846 8270C	Decane (n-)
NPW	SW-846 8270C	Octadecane (n-)
NPW	SW-846 8270C	Benzo(a)anthracene
NPW	SW-846 8270C	Benzo(a)pyrene
NPW	SW-846 8270C	Benzo(b)fluoranthene
NPW	SW-846 8270C	Benzo(k)fluoranthene
NPW	SW-846 8270C	Dibenzo(a,h)anthracene
NPW	SW-846 8270C	Indeno(1,2,3-cd)pyrene
NPW	SW-846 8270C	Benzal chloride
NPW	SW-846 8270C	Benzo(j)fluoranthene
NPW	SW-846 8270C	Benzotrichloride
NPW	SW-846 8270C	Benzyl chloride
NPW	SW-846 8270C	Chlorobenzilate
NPW	SW-846 8270C	Dibenz(a,h)acridine

Matrix	Method	Parameter
NPW	SW-846 8270C	Dibenzo(a,h)pyrene
NPW	SW-846 8270C	Dibenzo(a,i)pyrene
NPW	SW-846 8270C	Dibenzo(c,g)carbazole (7H-)
NPW	SW-846 8270C	Pentachloroethane
NPW	SW-846 8270C	Tetrachlorobenzene (1,2,3,4-)
NPW	SW-846 8270C	Tetrachlorobenzene (1,2,3,5-)
NPW	SW-846 8270C	Benzyl alcohol
NPW	SW-846 8270C	Acetophenone
NPW	SW-846 8270C	Acetylaminofluorene (2-)
NPW	SW-846 8270C	Aminobiphenyl (4-)
NPW	SW-846 8270C	Aramite
NPW	SW-846 8270C	Chloronaphthalene (1-)
NPW	SW-846 8270C	Diallate (cis)
NPW	SW-846 8270C	Diallate (trans)
NPW	SW-846 8270C	Dibenzo(a,e)pyrene
NPW	SW-846 8270C	Dibenz(a,j)acridine
NPW	SW-846 8270C	Dichlorophenol (2,6-)
NPW	SW-846 8270C	Dimethoate
NPW	SW-846 8270C	Dimethylaminoazobenzene
NPW	SW-846 8270C	Dimethylbenz(a)anthracene (7,12-)
NPW	SW-846 8270C	Dimethyl benzidine (3,3-)
NPW	SW-846 8270C	Dinitrobenzene (1,3-)
NPW	SW-846 8270C	Dinoseb
NPW	SW-846 8270C	Disulfoton
NPW	SW-846 8270C	Famphur
NPW	SW-846 8270C	Hexachloropropene
NPW	SW-846 8270C	Isodrin
NPW	SW-846 8270C	Isosafrole (cis-)
NPW	SW-846 8270C	Isosafrole (trans-)
NPW	SW-846 8270C	Kepone
NPW	SW-846 8270C	Methanesulfonate (Ethyl-)
NPW	SW-846 8270C	Methanesulfonate (Methyl-)
NPW	SW-846 8270C	Methapyrilene
NPW	SW-846 8270C	Methylcholanthrene (3-)
NPW	SW-846 8270C	Napthoquinone (1,4-)
NPW	SW-846 8270C	Napththylamine (1-)
NPW	SW-846 8270C	Napththylamine (2-)
NPW	SW-846 8270C	N-Nitroso-di-n-butylamine
NPW	SW-846 8270C	N-Nitrosomorpholine
NPW	SW-846 8270C	N-Nitrosopiperidine

Matrix	Method	Parameter
NPW	SW-846 8270C	Parathion
NPW	SW-846 8270C	Parathion methyl
NPW	SW-846 8270C	Pentachlorobenzene
NPW	SW-846 8270C	Pentachloronitrobenzene
NPW	SW-846 8270C	Phenacetin
NPW	SW-846 8270C	Phenylenediamine (1,4-)
NPW	SW-846 8270C	Phenylethylamine (alpha, alpha-Dimethyl)
NPW	SW-846 8270C	Phorate
NPW	SW-846 8270C	Phosphorothioate (O,O,O-triethyl)
NPW	SW-846 8270C	Phosphorothioate (O,O-diethyl-O-2-pyrazinyl) [Thionazin]
NPW	SW-846 8270C	Picoline (2-)
NPW	SW-846 8270C	Pronamide
NPW	SW-846 8270C	Quinoline -1-Oxide (4-Nitro)
NPW	SW-846 8270C	Safrole
NPW	SW-846 8270C	Sulfotepp
NPW	SW-846 8270C	Tetrachlorobenzene (1,2,4,5-)
NPW	SW-846 8270C	Tetrachlorophenol (2,3,4,6-)
NPW	SW-846 8270C	Toluidine (2-) (2-Methylaniline)
NPW	SW-846 8270C	Toluidine (5-nitro-2-)
NPW	SW-846 8270C	Trinitrobenzene (1,3,5-)
NPW	SW-846 8270C	N-Nitrosodiethylamine
NPW	SW-846 8270C	N-Nitrosopyrrolidine
NPW	SW-846 8270C	Diphenylamine
NPW	SW-846 8270C	Carbazole
NPW	SW-846 8270C	Dichlorobenzene (1,2-)
NPW	SW-846 8270C	Dichlorobenzene (1,3-)
NPW	SW-846 8270C	N-Nitrosodimethylamine
NPW	SW-846 8270C	N-Nitroso-di-n-propylamine
NPW	SW-846 8270C	N-Nitrosomethylethylamine
NPW	SW-846 8270C	Benzidine
NPW	SW-846 8270C	Aniline
NPW	SW-846 8270C	Hexachloropropene
NPW	SW-846 8270C	Dibenzofuran
NPW	SW-846 8270C	Benzoic acid
NPW	SW-846 8270C	N-Nitrosodiphenylamine
NPW	SW-846 8270C	Dichlorobenzidine (3,3'-)
NPW	SW-846 8270C	Chloroaniline (4-)
NPW	SW-846 8270C	Nitroaniline (2-)
NPW	SW-846 8270C	Nitroaniline (3-)

Matrix	Method	Parameter
NPW	SW-846 8270C	Nitroaniline (4-)
NPW	SW-846 8270C	Chloronaphthalene (2-)
NPW	SW-846 8270C	Hexachlorobenzene
NPW	SW-846 8270C	Hexachlorobutadiene (1,3-)
NPW	SW-846 8270C	Hexachlorocyclopentadiene
NPW	SW-846 8270C	Hexachloroethane
NPW	SW-846 8270C	Trichlorobenzene (1,2,4-)
NPW	SW-846 8270C	Bis (2-chloroethoxy) methane
NPW	SW-846 8270C	Bis (2-chloroethyl) ether
NPW	SW-846 8270C	Bis (2-chloroisopropyl) ether
NPW	SW-846 8270C	Chlorophenyl-phenyl ether (4-)
NPW	SW-846 8270C	Bromophenyl-phenyl ether (4-)
NPW	SW-846 8270C	Dinitrotoluene (2,4-)
NPW	SW-846 8270C	Dinitrotoluene (2,6-)
NPW	SW-846 8270C	Isophorone
NPW	SW-846 8270C	Nitrobenzene
NPW	SW-846 8270C	Butyl benzyl phthalate
NPW	SW-846 8270C	Bis (2-ethylhexyl) phthalate
NPW	SW-846 8270C	Diethyl phthalate
NPW	SW-846 8270C	Dimethyl phthalate
NPW	SW-846 8270C	Di-n-butyl phthalate
NPW	SW-846 8270C	Di-n-octyl phthalate
NPW	SW-846 8270C	Acenaphthene
NPW	SW-846 8270C	Anthracene
NPW	SW-846 8270C	Acenaphthylene
NPW	SW-846 8270C	Benzo(a)anthracene
NPW	SW-846 8270C	Benzo(a)pyrene
NPW	SW-846 8270C	Benzo(b)fluoranthene
NPW	SW-846 8270C	Benzo(ghi)perylene
NPW	SW-846 8270C	Benzo(k)fluoranthene
NPW	SW-846 8270C	Chrysene
NPW	SW-846 8270C	Dibenzo(a,h)anthracene
NPW	SW-846 8270C	Fluoranthene
NPW	SW-846 8270C	Fluorene
NPW	SW-846 8270C	Indeno(1,2,3-cd)pyrene
NPW	SW-846 8270C	Methylnaphthalene (2-)
NPW	SW-846 8270C	Naphthalene
NPW	SW-846 8270C	Phenanthrene
NPW	SW-846 8270C	Pyrene
NPW	SW-846 8270C	Methyl phenol (4-chloro-3-)

Matrix	Method	Parameter
NPW	SW-846 8270C	Chlorophenol (2-)
NPW	SW-846 8270C	Dichlorophenol (2,4-)
NPW	SW-846 8270C	Dimethylphenol (2,4-)
NPW	SW-846 8270C	Dinitrophenol (2,4-)
NPW	SW-846 8270C	Dinitrophenol (2-methyl-4,6-)
NPW	SW-846 8270C	Methylphenol (2-)
NPW	SW-846 8270C	Methylphenol (4-)
NPW	SW-846 8270C	Nitrophenol (2-)
NPW	SW-846 8270C	Nitrophenol (4-)
NPW	SW-846 8270C	Pentachlorophenol
NPW	SW-846 8270C	Phenol
NPW	SW-846 8270C	Trichlorophenol (2,4,5-)
NPW	SW-846 8270C	Trichlorophenol (2,4,6-)
NPW	SW-846 8270C	Dichlorobenzene (1,4-)
NPW	SW-846 8270C	Pyridine
NPW	SW-846 8270C	Dioxane (1,4-)
NPW	SW-846 8270D	Biphenyl (1,1'-)
NPW	SW-846 8270D	Benzaldehyde
NPW	SW-846 8270D	Caprolactam
NPW	SW-846 8270D	Atrazine
NPW	SW-846 8270D	Phenanthrene
NPW	SW-846 8270D	Pyrene
NPW	SW-846 8270D	Acenaphthene
NPW	SW-846 8270D	Acenaphthylene
NPW	SW-846 8270D	Anthracene
NPW	SW-846 8270D	Benzo(ghi)perylene
NPW	SW-846 8270D	Chrysene
NPW	SW-846 8270D	Methylnaphthalene (1-)
NPW	SW-846 8270D	Methylnaphthalene (2-)
NPW	SW-846 8270D	Naphthalene
NPW	SW-846 8270D	Fluoranthene
NPW	SW-846 8270D	Fluorene
NPW	SW-846 8270D	Methylnaphthalene (1-)
NPW	SW-846 8270D	Nitrodiphenylamine (2-)
NPW	SW-846 8270D	Hexachlorophene
NPW	SW-846 8270D	Diphenylhydrazine (1,2-)
NPW	SW-846 8270D	Decane (n-)
NPW	SW-846 8270D	Octadecane (n-)
NPW	SW-846 8270D	Benzo(a)anthracene
NPW	SW-846 8270D	Benzo(a)pyrene

Matrix	Method	Parameter
NPW	SW-846 8270D	Benzo(b)fluoranthene
NPW	SW-846 8270D	Benzo(k)fluoranthene
NPW	SW-846 8270D	Dibenzo(a,h)anthracene
NPW	SW-846 8270D	Indeno(1,2,3-cd)pyrene
NPW	SW-846 8270D	Benzal chloride
NPW	SW-846 8270D	Benzo(j)fluoranthene
NPW	SW-846 8270D	Benzotrichloride
NPW	SW-846 8270D	Benzyl chloride
NPW	SW-846 8270D	Chlorobenzilate
NPW	SW-846 8270D	Dibenz(a,h)acridine
NPW	SW-846 8270D	Dibenzo(a,h)pyrene
NPW	SW-846 8270D	Dibenzo(a,i)pyrene
NPW	SW-846 8270D	Dibenzo(c,g)carbazole (7H-)
NPW	SW-846 8270D	Pentachloroethane
NPW	SW-846 8270D	Tetrachlorobenzene (1,2,3,4-)
NPW	SW-846 8270D	Tetrachlorobenzene (1,2,3,5-)
NPW	SW-846 8270D	Benzyl alcohol
NPW	SW-846 8270D	Acetophenone
NPW	SW-846 8270D	Acetylaminofluorene (2-)
NPW	SW-846 8270D	Aminobiphenyl (4-)
NPW	SW-846 8270D	Aramite
NPW	SW-846 8270D	Chloronaphthalene (1-)
NPW	SW-846 8270D	Diallate (cis)
NPW	SW-846 8270D	Diallate (trans)
NPW	SW-846 8270D	Dibenzo(a,e)pyrene
NPW	SW-846 8270D	Dibenz(a,j)acridine
NPW	SW-846 8270D	Dichlorophenol (2,6-)
NPW	SW-846 8270D	Dimethoate
NPW	SW-846 8270D	Dimethylaminoazobenzene
NPW	SW-846 8270D	Dimethylbenz(a)anthracene (7,12-)
NPW	SW-846 8270D	Dimethyl benzidine (3,3-)
NPW	SW-846 8270D	Dinitrobenzene (1,3-)
NPW	SW-846 8270D	Dinoseb
NPW	SW-846 8270D	Disulfoton
NPW	SW-846 8270D	Famphur
NPW	SW-846 8270D	Isodrin
NPW	SW-846 8270D	Isosafrole (cis-)
NPW	SW-846 8270D	Isosafrole (trans-)
NPW	SW-846 8270D	Kepone
NPW	SW-846 8270D	Methanesulfonate (Ethyl-)

Matrix	Method	Parameter
NPW	SW-846 8270D	Methanesulfonate (Methyl-)
NPW	SW-846 8270D	Methapyrilene
NPW	SW-846 8270D	Methylcholanthrene (3-)
NPW	SW-846 8270D	Napthoquinone (1,4-)
NPW	SW-846 8270D	Napththylamine (1-)
NPW	SW-846 8270D	Napththylamine (2-)
NPW	SW-846 8270D	N-Nitroso-di-n-butylamine
NPW	SW-846 8270D	N-Nitrosomorpholine
NPW	SW-846 8270D	N-Nitrosopiperidine
NPW	SW-846 8270D	Parathion
NPW	SW-846 8270D	Parathion methyl
NPW	SW-846 8270D	Pentachlorobenzene
NPW	SW-846 8270D	Pentachloronitrobenzene
NPW	SW-846 8270D	Phenacetin
NPW	SW-846 8270D	Phenylenediamine (1,4-)
NPW	SW-846 8270D	Phenylethylamine (alpha, alpha-Dimethyl)
NPW	SW-846 8270D	Phorate
NPW	SW-846 8270D	Phosphorothioate (O,O,O-triethyl)
NPW	SW-846 8270D	Phosphorothioate (O,O-diethyl-O-2-pyrazinyl) [Thionazin]
NPW	SW-846 8270D	Picoline (2-)
NPW	SW-846 8270D	Pronamide
NPW	SW-846 8270D	Quinoline -1-Oxide (4-Nitro)
NPW	SW-846 8270D	Safrole
NPW	SW-846 8270D	Sulfotepp
NPW	SW-846 8270D	Tetrachlorobenzene (1,2,4,5-)
NPW	SW-846 8270D	Tetrachlorophenol (2,3,4,6-)
NPW	SW-846 8270D	Toluidine (2-) (2-Methylaniline)
NPW	SW-846 8270D	Toluidine (5-nitro-2-)
NPW	SW-846 8270D	Trinitrobenzene (1,3,5-)
NPW	SW-846 8270D	N-Nitrosodiethylamine
NPW	SW-846 8270D	N-Nitrosopyrrolidine
NPW	SW-846 8270D	Diphenylamine
NPW	SW-846 8270D	Carbazole
NPW	SW-846 8270D	Dichlorobenzene (1,2-)
NPW	SW-846 8270D	Dichlorobenzene (1,3-)
NPW	SW-846 8270D	N-Nitrosodimethylamine
NPW	SW-846 8270D	N-Nitroso-di-n-propylamine
NPW	SW-846 8270D	N-Nitrosomethylethylamine
NPW	SW-846 8270D	Benzidine

Matrix	Method	Parameter
NPW	SW-846 8270D	Aniline
NPW	SW-846 8270D	Hexachloropropene
NPW	SW-846 8270D	Dibenzofuran
NPW	SW-846 8270D	Benzoic acid
NPW	SW-846 8270D	N-Nitrosodiphenylamine
NPW	SW-846 8270D	Dichlorobenzidine (3,3'-)
NPW	SW-846 8270D	Chloroaniline (4-)
NPW	SW-846 8270D	Nitroaniline (2-)
NPW	SW-846 8270D	Nitroaniline (3-)
NPW	SW-846 8270D	Nitroaniline (4-)
NPW	SW-846 8270D	Chloronaphthalene (2-)
NPW	SW-846 8270D	Hexachlorobenzene
NPW	SW-846 8270D	Hexachlorobutadiene (1,3-)
NPW	SW-846 8270D	Hexachlorocyclopentadiene
NPW	SW-846 8270D	Hexachloroethane
NPW	SW-846 8270D	Trichlorobenzene (1,2,4-)
NPW	SW-846 8270D	Bis (2-chloroethoxy) methane
NPW	SW-846 8270D	Bis (2-chloroethyl) ether
NPW	SW-846 8270D	Bis (2-chloroisopropyl) ether
NPW	SW-846 8270D	Chlorophenyl-phenyl ether (4-)
NPW	SW-846 8270D	Bromophenyl-phenyl ether (4-)
NPW	SW-846 8270D	Dinitrotoluene (2,4-)
NPW	SW-846 8270D	Dinitrotoluene (2,6-)
NPW	SW-846 8270D	Isophorone
NPW	SW-846 8270D	Nitrobenzene
NPW	SW-846 8270D	Butyl benzyl phthalate
NPW	SW-846 8270D	Bis (2-ethylhexyl) phthalate
NPW	SW-846 8270D	Diethyl phthalate
NPW	SW-846 8270D	Dimethyl phthalate
NPW	SW-846 8270D	Di-n-butyl phthalate
NPW	SW-846 8270D	Di-n-octyl phthalate
NPW	SW-846 8270D	Acenaphthene
NPW	SW-846 8270D	Anthracene
NPW	SW-846 8270D	Acenaphthylene
NPW	SW-846 8270D	Benzo(a)anthracene
NPW	SW-846 8270D	Benzo(a)pyrene
NPW	SW-846 8270D	Benzo(b)fluoranthene
NPW	SW-846 8270D	Benzo(ghi)perylene
NPW	SW-846 8270D	Benzo(k)fluoranthene
NPW	SW-846 8270D	Chrysene

Matrix	Method	Parameter
NPW	SW-846 8270D	Dibenzo(a,h)anthracene
NPW	SW-846 8270D	Fluoranthene
NPW	SW-846 8270D	Fluorene
NPW	SW-846 8270D	Indeno(1,2,3-cd)pyrene
NPW	SW-846 8270D	Methylnaphthalene (2-)
NPW	SW-846 8270D	Naphthalene
NPW	SW-846 8270D	Phenanthrene
NPW	SW-846 8270D	Pyrene
NPW	SW-846 8270D	Methyl phenol (4-chloro-3-)
NPW	SW-846 8270D	Chlorophenol (2-)
NPW	SW-846 8270D	Dichlorophenol (2,4-)
NPW	SW-846 8270D	Dimethylphenol (2,4-)
NPW	SW-846 8270D	Dinitrophenol (2,4-)
NPW	SW-846 8270D	Dinitrophenol (2-methyl-4,6-)
NPW	SW-846 8270D	Methylphenol (2-)
NPW	SW-846 8270D	Methylphenol (4-)
NPW	SW-846 8270D	Nitrophenol (2-)
NPW	SW-846 8270D	Nitrophenol (4-)
NPW	SW-846 8270D	Pentachlorophenol
NPW	SW-846 8270D	Phenol
NPW	SW-846 8270D	Trichlorophenol (2,4,5-)
NPW	SW-846 8270D	Trichlorophenol (2,4,6-)
NPW	SW-846 8270D	Dichlorobenzene (1,4-)
NPW	SW-846 8270D	Pyridine
NPW	SW-846 8270D	Dioxane (1,4-)
NPW	SW-846 8310	Acenaphthene
NPW	SW-846 8310	Acenaphthylene
NPW	SW-846 8310	Anthracene
NPW	SW-846 8310	Benzo(a)anthracene
NPW	SW-846 8310	Benzo(a)pyrene
NPW	SW-846 8310	Benzo(b)fluoranthene
NPW	SW-846 8310	Benzo(ghi)perylene
NPW	SW-846 8310	Benzo(k)fluoranthene
NPW	SW-846 8310	Chrysene
NPW	SW-846 8310	Dibenzo(a,h)anthracene
NPW	SW-846 8310	Fluoranthene
NPW	SW-846 8310	Fluorene
NPW	SW-846 8310	Indeno(1,2,3-cd)pyrene
NPW	SW-846 8310	Naphthalene
NPW	SW-846 8310	Phenanthrene

Matrix	Method	Parameter
NPW	SW-846 8310	Pyrene
NPW	SW-846 8330	Nitroglycerine
NPW	SW-846 8330	Guanidine nitrate
NPW	SW-846 8330	PETN
NPW	SW-846 8330	HMX
NPW	SW-846 8330	RDX
NPW	SW-846 8330	Trinitrobenzene (1,3,5-)
NPW	SW-846 8330	Dinitrobenzene (1,3-)
NPW	SW-846 8330	Tetryl
NPW	SW-846 8330	Nitrobenzene
NPW	SW-846 8330	Trinitrotoluene (2,4,6-)
NPW	SW-846 8330	Dinitrotoluene (4-amino-2,6-)
NPW	SW-846 8330	Dinitrotoluene (2-amino-4,6-)
NPW	SW-846 8330	Dinitrotoluene (2,4-)
NPW	SW-846 8330	Dinitrotoluene (2,6-)
NPW	SW-846 8330	Nitrotoluene (2-)
NPW	SW-846 8330	Nitrotoluene (3-)
NPW	SW-846 8330	Nitrotoluene (4-)
NPW	SW-846 8330A	Nitroglycerine
NPW	SW-846 8330A	PETN
NPW	SW-846 8330A	HMX
NPW	SW-846 8330A	RDX
NPW	SW-846 8330A	Trinitrobenzene (1,3,5-)
NPW	SW-846 8330A	Dinitrobenzene (1,3-)
NPW	SW-846 8330A	Tetryl
NPW	SW-846 8330A	Nitrobenzene
NPW	SW-846 8330A	Trinitrotoluene (2,4,6-)
NPW	SW-846 8330A	Dinitrotoluene (4-amino-2,6-)
NPW	SW-846 8330A	Dinitrotoluene (2-amino-4,6-)
NPW	SW-846 8330A	Dinitrotoluene (2,4-)
NPW	SW-846 8330A	Dinitrotoluene (2,6-)
NPW	SW-846 8330A	Nitrotoluene (2-)
NPW	SW-846 8330A	Nitrotoluene (3-)
NPW	SW-846 8330A	Nitrotoluene (4-)
NPW	SW-846 9010C	Cyanide - amenable to Cl2
NPW	SW-846 9010C	Cyanide
NPW	SW-846 9012B	Cyanide
NPW	SW-846 9020B	Total organic halides (TOX)
NPW	SW-846 9030B	Sulfides, acid sol. & insol.
NPW	SW-846 9034	Sulfides, acid sol. & insol.

Matrix	Method	Parameter
NPW	SW-846 9040B	Corrosivity - pH waste, >20% water
NPW	SW-846 9040B	pH
NPW	SW-846 9040C	Corrosivity - pH waste, >20% water
NPW	SW-846 9040C	pH
NPW	SW-846 9040C	pH - waste, >20% water
NPW	SW-846 9050A	Specific conductance
NPW	SW-846 9056	Bromide
NPW	SW-846 9056	Nitrite
NPW	SW-846 9056	Sulfate
NPW	SW-846 9056	Nitrate
NPW	SW-846 9056	Chloride
NPW	SW-846 9056	Fluoride
NPW	SW-846 9056A	Bromide
NPW	SW-846 9056A	Nitrite
NPW	SW-846 9056A	Sulfate
NPW	SW-846 9056A	Nitrate
NPW	SW-846 9056A	Chloride
NPW	SW-846 9056A	Fluoride
NPW	SW-846 9060	Total organic carbon (TOC)
NPW	SW-846 9060A	Total organic carbon (TOC)
NPW	SW-846 9066	Phenols
NPW	User Defined 5030C	Volatile organics
NPW	User Defined 8260C	Hexane (n-)
NPW	User Defined 9010B	Cyanide - amenable to Cl_2
NPW	User Defined 9010B	Cyanide
NPW	User Defined 9012A	Cyanide
NPW	User Defined ASTM D93	Ignitability
NPW	User Defined CA LUFT - diesel	Petroleum Organics
NPW	User Defined CA LUFT - diesel	Petroleum Organics
NPW	User Defined EPA 1657	Parathion ethyl
NPW	User Defined EPA 1657	Azinphos methyl
NPW	User Defined EPA 1657	Demeton (o-)
NPW	User Defined EPA 1657	Demeton (s-)
NPW	User Defined EPA 1657	Diazinon
NPW	User Defined EPA 1657	Disulfoton
NPW	User Defined EPA 1657	Malathion
NPW	User Defined EPA 1657	Parathion methyl
NPW	User Defined EPA	Nitrocellulose

Matrix	Method	Parameter
	353.2 Modified	
NPW	User Defined EPA 624	Dichlorodifluoromethane
NPW	User Defined LUFT	Xylene (m-)
NPW	User Defined LUFT	Xylene (o-)
NPW	User Defined LUFT	Xylene (p-)
NPW	User Defined LUFT	Benzene
NPW	User Defined LUFT	Ethylbenzene
NPW	User Defined LUFT	Toluene
NPW	User Defined LUFT	Xylenes (total)
NPW	User Defined LUFT	Methyl tert-butyl ether
NPW	User Defined MA-DEP-EPH, TN-EPH, WI DRO, NW TPH Dx	Diesel range organic
NPW	User Defined MA-DEP-VPH, WI GRO, NW TPH Gx	Gasoline range organic
NPW	User Defined NWTPH-Dx, NWTPH-Gx, NWTPHID	Petroleum Organics
NPW	User Defined SM 6200 B-97	Butanone (2-)
NPW	User Defined SM 6200 B-97	Carbon disulfide
NPW	User Defined SM 6200 B-97	Isopropanol
NPW	User Defined SM 6200 B-97	Trichloro (1,1,2-) trifluoroethane (1,2,2-)
NPW	User Defined SM 6200 B-97	Vinyl acetate
NPW	User Defined SM 6200 B-97	Acetonitrile
NPW	User Defined SM 6200 B-97	Hexanone (2-)
NPW	User Defined SM 6200 B-97	Methyl iodide
NPW	User Defined SM 6200 B-97	Dibromoethane (1,2-) (EDB)
NPW	User Defined SM 6200 B-97	Dichlorodifluoromethane
NPW	User Defined SM 6200 B-97	Dichloroethene (cis-1,2-)
NPW	User Defined SM 6200 B-97	Hexane (n-)
NPW	User Defined SM 6200 B-97	Methyl isobutyl ketone (MIBK)

Matrix	Method	Parameter
NPW	User Defined SM 6200 B-97	Tetrahydrofuran
NPW	User Defined SM 6200 B-97	Styrene
NPW	User Defined SM 6200 B-97	Xylene (o-)
NPW	User Defined SM 6200 B-97	Acetone
NPW	User Defined SM 6200 B-97	Ethyl acetate
NPW	User Defined SM 6200 B-97	Methyl tert-butyl ether
NPW	User Defined SM 6200 B-97	Tert-butyl alcohol
NPW	User Defined SM 6200 B-97	Xylenes (total)
NPW	User Defined SM 6200 B-97	Benzene
NPW	User Defined SM 6200 B-97	Bromodichloromethane
NPW	User Defined SM 6200 B-97	Bromoform
NPW	User Defined SM 6200 B-97	Bromomethane
NPW	User Defined SM 6200 B-97	Carbon tetrachloride
NPW	User Defined SM 6200 B-97	Chlorobenzene
NPW	User Defined SM 6200 B-97	Chloroethane
NPW	User Defined SM 6200 B-97	Chloroethyl vinyl ether (2-)
NPW	User Defined SM 6200 B-97	Chloroform
NPW	User Defined SM 6200 B-97	Chloromethane
NPW	User Defined SM 6200 B-97	Dibromochloromethane
NPW	User Defined SM 6200 B-97	Dichlorobenzene (1,2-)
NPW	User Defined SM 6200 B-97	Dichlorobenzene (1,3-)
NPW	User Defined SM 6200 B-97	Dichlorobenzene (1,4-)
NPW	User Defined SM 6200 B-97	Dichloroethane (1,1-)
NPW	User Defined SM 6200	Dichloroethane (1,2-)

Matrix	Method	Parameter
	B-97	
NPW	User Defined SM 6200 B-97	Dichloroethene (1,1-)
NPW	User Defined SM 6200 B-97	Dichloroethene (trans-1,2-)
NPW	User Defined SM 6200 B-97	Dichloropropane (1,2-)
NPW	User Defined SM 6200 B-97	Dichloropropene (cis-1,3-)
NPW	User Defined SM 6200 B-97	Dichloropropene (trans-1,3-)
NPW	User Defined SM 6200 B-97	Ethylbenzene
NPW	User Defined SM 6200 B-97	Methylene chloride (Dichloromethane)
NPW	User Defined SM 6200 B-97	Tetrachloroethane (1,1,2,2-)
NPW	User Defined SM 6200 B-97	Tetrachloroethene
NPW	User Defined SM 6200 B-97	Toluene
NPW	User Defined SM 6200 B-97	Trichloroethane (1,1,1-)
NPW	User Defined SM 6200 B-97	Trichloroethane (1,1,2-)
NPW	User Defined SM 6200 B-97	Trichloroethene
NPW	User Defined SM 6200 B-97	Trichlorofluoromethane
NPW	User Defined SM 6200 B-97	Vinyl chloride
NPW	User Defined SM 6200C-97	Benzene
NPW	User Defined SM 6200C-97	Ethylbenzene
NPW	User Defined SM 6200C-97	Methyl tert-butyl ether
NPW	User Defined SM 6200C-97	Tert-butyl alcohol
NPW	User Defined SM 6200C-97	Toluene
NPW	User Defined SM 6200C-97	Xylenes (total)
NPW	User Defined SM 6630C-00	Chlordane (alpha)
NPW	User Defined SM 6630C-00	Chlordane (gamma)

Matrix	Method	Parameter
NPW	User Defined SM 6630C-00	Hexachlorobenzene
NPW	User Defined SM 6630C-00	Endrin aldehyde
NPW	User Defined SM 6630C-00	Endrin ketone
NPW	User Defined SM 6640B-01	Dinoseb
NPW	User Defined SM 6640B-01	Dicamba
NPW	User Defined SW846 8260B & 8260C	Gasoline range organic
NPW	User Defined SW-846 8330	Nitroguanidine
NPW	User Defined TX 1005, TX 1006, CT ETPH, NW TPH ID	Petroleum Organics
SCM	EPA 314.0-mod	Perchlorate
SCM	ASTM D240	Heat of combustion (BTU)
SCM	ASTM D5468 and D482	% ash
SCM	ASTM F1647-02A	Total organic carbon (TOC)
SCM	EPA 300.0	Guanidine nitrate
SCM	Other FL - PRO	Petroleum Organics
SCM	Other IA - OA-1	Petroleum Organics
SCM	Other IA - OA-2	Petroleum Organics
SCM	Other NJ DEP EPH 10/08, Rev. 3	Extractable Petroleum Hydrocarbons
SCM	Other NJ-OQA-QAM-025, Rev. 7	Petroleum Organics
SCM	Other USDA-LOI (Loss on ignition)	Total organic carbon (TOC)
SCM	Other Walkley Black	Total organic carbon (TOC)
SCM	SM 2540 G SM 18th Ed.	Total, fixed, and volatile solids (SQAR)
SCM	SM 9222D-97 (Class B only) plus EPA 625/R-92/013 App. F	Fecal coliform
SCM	SW-846 1010	Ignitability
SCM	SW-846 1010A	Ignitability
SCM	SW-846 1030	Ignitability of solids
SCM	SW-846 1110	Corrosivity toward steel
SCM	SW-846 1110A	Corrosivity toward steel
SCM	SW-846 1310A	Metals - organics
SCM	SW-846 1310B	Metals - organics

Matrix	Method	Parameter
SCM	SW-846 1311	Volatile organics
SCM	SW-846 1311	Semivolatile organics
SCM	SW-846 1311	Metals
SCM	SW-846 1312	Metals - organics
SCM	SW-846 1320	Metals - organics
SCM	SW-846 3031	Metals
SCM	SW-846 3040A	Metals
SCM	SW-846 3050B	Metals
SCM	SW-846 3051	Metals
SCM	SW-846 3051A	Metals
SCM	SW-846 3052	Metals
SCM	SW-846 3060A	Metals
SCM	SW-846 3540C	Semivolatile organics
SCM	SW-846 3546	Semivolatile organics
SCM	SW-846 3550B	Semivolatile organics
SCM	SW-846 3550C	Semivolatile organics
SCM	SW-846 3580A	Organics
SCM	SW-846 3585	Organics
SCM	SW-846 3610B	Semivolatile organics
SCM	SW-846 3611B	Semivolatile organics
SCM	SW-846 3620B	Semivolatile organics
SCM	SW-846 3620C	Semivolatile organics
SCM	SW-846 3630C	Semivolatile organics
SCM	SW-846 3660B	Semivolatile organics
SCM	SW-846 3665A	Semivolatile organics
SCM	SW-846 5035A-H	Volatile organics - high conc.
SCM	SW-846 5035A-L	Volatile organics - low conc.
SCM	SW-846 5035H	Volatile organics - high conc.
SCM	SW-846 5035L	Volatile organics - low conc.
SCM	SW-846 6010B	Aluminum
SCM	SW-846 6010B	Antimony
SCM	SW-846 6010B	Arsenic
SCM	SW-846 6010B	Barium
SCM	SW-846 6010B	Beryllium
SCM	SW-846 6010B	Boron
SCM	SW-846 6010B	Cadmium
SCM	SW-846 6010B	Calcium
SCM	SW-846 6010B	Calcium-hardness
SCM	SW-846 6010B	Total hardness
SCM	SW-846 6010B	Chromium

Matrix	Method	Parameter
SCM	SW-846 6010B	Cobalt
SCM	SW-846 6010B	Copper
SCM	SW-846 6010B	Iron
SCM	SW-846 6010B	Lead
SCM	SW-846 6010B	Lithium
SCM	SW-846 6010B	Magnesium
SCM	SW-846 6010B	Manganese
SCM	SW-846 6010B	Molybdenum
SCM	SW-846 6010B	Nickel
SCM	SW-846 6010B	Potassium
SCM	SW-846 6010B	Selenium
SCM	SW-846 6010B	Silica
SCM	SW-846 6010B	Silver
SCM	SW-846 6010B	Sulfur
SCM	SW-846 6010B	Sodium
SCM	SW-846 6010B	Strontium
SCM	SW-846 6010B	Thallium
SCM	SW-846 6010B	Tin
SCM	SW-846 6010B	Titanium
SCM	SW-846 6010B	Vanadium
SCM	SW-846 6010B	Zinc
SCM	SW-846 6010C	Aluminum
SCM	SW-846 6010C	Antimony
SCM	SW-846 6010C	Arsenic
SCM	SW-846 6010C	Barium
SCM	SW-846 6010C	Beryllium
SCM	SW-846 6010C	Boron
SCM	SW-846 6010C	Cadmium
SCM	SW-846 6010C	Calcium
SCM	SW-846 6010C	Calcium-hardness
SCM	SW-846 6010C	Total hardness
SCM	SW-846 6010C	Chromium
SCM	SW-846 6010C	Cobalt
SCM	SW-846 6010C	Copper
SCM	SW-846 6010C	Iron
SCM	SW-846 6010C	Lead
SCM	SW-846 6010C	Lithium
SCM	SW-846 6010C	Magnesium
SCM	SW-846 6010C	Manganese
SCM	SW-846 6010C	Molybdenum

Matrix	Method	Parameter
SCM	SW-846 6010C	Nickel
SCM	SW-846 6010C	Potassium
SCM	SW-846 6010C	Selenium
SCM	SW-846 6010C	Silica
SCM	SW-846 6010C	Silver
SCM	SW-846 6010C	Sulfur
SCM	SW-846 6010C	Sodium
SCM	SW-846 6010C	Strontium
SCM	SW-846 6010C	Thallium
SCM	SW-846 6010C	Tin
SCM	SW-846 6010C	Titanium
SCM	SW-846 6010C	Vanadium
SCM	SW-846 6010C	Zinc
SCM	SW-846 6020	Aluminum
SCM	SW-846 6020	Antimony
SCM	SW-846 6020	Arsenic
SCM	SW-846 6020	Barium
SCM	SW-846 6020	Beryllium
SCM	SW-846 6020	Boron
SCM	SW-846 6020	Cadmium
SCM	SW-846 6020	Calcium
SCM	SW-846 6020	Chromium
SCM	SW-846 6020	Cobalt
SCM	SW-846 6020	Copper
SCM	SW-846 6020	Iron
SCM	SW-846 6020	Lead
SCM	SW-846 6020	Magnesium
SCM	SW-846 6020	Manganese
SCM	SW-846 6020	Molybdenum
SCM	SW-846 6020	Nickel
SCM	SW-846 6020	Potassium
SCM	SW-846 6020	Selenium
SCM	SW-846 6020	Silver
SCM	SW-846 6020	Sodium
SCM	SW-846 6020	Strontium
SCM	SW-846 6020	Thallium
SCM	SW-846 6020	Thorium
SCM	SW-846 6020	Tin
SCM	SW-846 6020	Titanium
SCM	SW-846 6020	Uranium

Matrix	Method	Parameter
SCM	SW-846 6020	Vanadium
SCM	SW-846 6020	Zinc
SCM	SW-846 6020A	Aluminum
SCM	SW-846 6020A	Antimony
SCM	SW-846 6020A	Arsenic
SCM	SW-846 6020A	Barium
SCM	SW-846 6020A	Beryllium
SCM	SW-846 6020A	Boron
SCM	SW-846 6020A	Cadmium
SCM	SW-846 6020A	Calcium
SCM	SW-846 6020A	Chromium
SCM	SW-846 6020A	Cobalt
SCM	SW-846 6020A	Copper
SCM	SW-846 6020A	Iron
SCM	SW-846 6020A	Lead
SCM	SW-846 6020A	Magnesium
SCM	SW-846 6020A	Manganese
SCM	SW-846 6020A	Molybdenum
SCM	SW-846 6020A	Nickel
SCM	SW-846 6020A	Potassium
SCM	SW-846 6020A	Selenium
SCM	SW-846 6020A	Silver
SCM	SW-846 6020A	Sodium
SCM	SW-846 6020A	Strontium
SCM	SW-846 6020A	Thallium
SCM	SW-846 6020A	Thorium
SCM	SW-846 6020A	Tin
SCM	SW-846 6020A	Titanium
SCM	SW-846 6020A	Uranium
SCM	SW-846 6020A	Vanadium
SCM	SW-846 6020A	Zinc
SCM	SW-846 7.3.3.2	Reactivity
SCM	SW-846 7.3.4.2	Reactivity
SCM	SW-846 7196A	Chromium (VI)
SCM	SW-846 7199	Chromium (VI)
SCM	SW-846 7471A	Mercury - solid waste
SCM	SW-846 7471B	Mercury - solid waste
SCM	SW-846 8011	Dibromoethane (1,2-) (EDB)
SCM	SW-846 8011	Dibromo-3-chloropropane (1,2-)
SCM	SW-846 8015B	Ethylene glycol

Matrix	Method	Parameter
SCM	SW-846 8015B	Propylene glycol
SCM	SW-846 8015B	Gasoline range organic
SCM	SW-846 8015B	Diesel range organic
SCM	SW-846 8015C	Ethylene glycol
SCM	SW-846 8015C	Propylene glycol
SCM	SW-846 8015D	Ethylene glycol
SCM	SW-846 8015D	Propylene glycol
SCM	SW-846 8015D	Gasoline range organic
SCM	SW-846 8015D	Diesel range organic
SCM	SW-846 8021B	Xylenes (total)
SCM	SW-846 8021B	Methyl tert-butyl ether
SCM	SW-846 8021B	Benzene
SCM	SW-846 8021B	Ethylbenzene
SCM	SW-846 8021B	Toluene
SCM	SW-846 8021B	Xylene (o-)
SCM	SW-846 8021B	Xylene (m-)
SCM	SW-846 8021B	Xylene (p-)
SCM	SW-846 8081A	Alachlor
SCM	SW-846 8081A	Chlordane (alpha)
SCM	SW-846 8081A	Chlordane (gamma)
SCM	SW-846 8081A	Chloroneb
SCM	SW-846 8081A	Chlorothalonil
SCM	SW-846 8081A	Etridiazole
SCM	SW-846 8081A	Hexachlorobenzene
SCM	SW-846 8081A	Hexachlorocyclopentadiene
SCM	SW-846 8081A	Permethrin
SCM	SW-846 8081A	Propachlor
SCM	SW-846 8081A	Trifluralin
SCM	SW-846 8081A	Aldrin
SCM	SW-846 8081A	Alpha BHC
SCM	SW-846 8081A	Beta BHC
SCM	SW-846 8081A	Delta BHC
SCM	SW-846 8081A	Lindane (gamma BHC)
SCM	SW-846 8081A	Chlordane (technical)
SCM	SW-846 8081A	DDD (4,4'-)
SCM	SW-846 8081A	DDE (4,4'-)
SCM	SW-846 8081A	DDT (4,4'-)
SCM	SW-846 8081A	Dieldrin
SCM	SW-846 8081A	Endosulfan I
SCM	SW-846 8081A	Endosulfan II

Matrix	Method	Parameter
SCM	SW-846 8081A	Endosulfan sulfate
SCM	SW-846 8081A	Endrin
SCM	SW-846 8081A	Endrin aldehyde
SCM	SW-846 8081A	Endrin ketone
SCM	SW-846 8081A	Heptachlor
SCM	SW-846 8081A	Heptachlor epoxide
SCM	SW-846 8081A	Methoxychlor
SCM	SW-846 8081A	Toxaphene
SCM	SW-846 8081B	Alachlor
SCM	SW-846 8081B	Chlordane (alpha)
SCM	SW-846 8081B	Chlordane (gamma)
SCM	SW-846 8081B	Chloroneb
SCM	SW-846 8081B	Chlorothalonil
SCM	SW-846 8081B	Etridiazole
SCM	SW-846 8081B	Hexachlorobenzene
SCM	SW-846 8081B	Hexachlorocyclopentadiene
SCM	SW-846 8081B	Permethrin
SCM	SW-846 8081B	Propachlor
SCM	SW-846 8081B	Trifluralin
SCM	SW-846 8081B	Aldrin
SCM	SW-846 8081B	Alpha BHC
SCM	SW-846 8081B	Beta BHC
SCM	SW-846 8081B	Delta BHC
SCM	SW-846 8081B	Lindane (gamma BHC)
SCM	SW-846 8081B	Chlordane (technical)
SCM	SW-846 8081B	DDD (4,4'-)
SCM	SW-846 8081B	DDE (4,4'-)
SCM	SW-846 8081B	DDT (4,4'-)
SCM	SW-846 8081B	Dieldrin
SCM	SW-846 8081B	Endosulfan I
SCM	SW-846 8081B	Endosulfan II
SCM	SW-846 8081B	Endosulfan sulfate
SCM	SW-846 8081B	Endrin
SCM	SW-846 8081B	Endrin aldehyde
SCM	SW-846 8081B	Endrin ketone
SCM	SW-846 8081B	Heptachlor
SCM	SW-846 8081B	Heptachlor epoxide
SCM	SW-846 8081B	Methoxychlor
SCM	SW-846 8081B	Toxaphene
SCM	SW-846 8082	PCB 1016

Matrix	Method	Parameter
SCM	SW-846 8082	PCB 1221
SCM	SW-846 8082	PCB 1232
SCM	SW-846 8082	PCB 1242
SCM	SW-846 8082	PCB 1248
SCM	SW-846 8082	PCB 1254
SCM	SW-846 8082	PCB 1260
SCM	SW-846 8082A	PCB 1016
SCM	SW-846 8082A	PCB 1221
SCM	SW-846 8082A	PCB 1232
SCM	SW-846 8082A	PCB 1242
SCM	SW-846 8082A	PCB 1248
SCM	SW-846 8082A	PCB 1254
SCM	SW-846 8082A	PCB 1260
SCM	SW-846 8141A	Azinphos methyl
SCM	SW-846 8141A	Chlorpyrifos
SCM	SW-846 8141A	Demeton (o-)
SCM	SW-846 8141A	Demeton (s-)
SCM	SW-846 8141A	Disulfoton
SCM	SW-846 8141A	Bolstar
SCM	SW-846 8141A	Coumaphos
SCM	SW-846 8141A	Dichlorvos
SCM	SW-846 8141A	Dimethoate
SCM	SW-846 8141A	EPN
SCM	SW-846 8141A	Ethoprop
SCM	SW-846 8141A	Fensulfothion
SCM	SW-846 8141A	Fenthion
SCM	SW-846 8141A	Merphos
SCM	SW-846 8141A	Mevinphos
SCM	SW-846 8141A	Naled
SCM	SW-846 8141A	Parathion
SCM	SW-846 8141A	Parathion methyl
SCM	SW-846 8141A	Phorate
SCM	SW-846 8141A	Ronnel
SCM	SW-846 8141A	Stirofos
SCM	SW-846 8141A	Sulfotepp
SCM	SW-846 8141A	TEPP
SCM	SW-846 8141A	Tokuthion [Protothiofos]
SCM	SW-846 8141A	Trichloronate
SCM	SW-846 8141A	Diazinon
SCM	SW-846 8141A	Malathion

Matrix	Method	Parameter
SCM	SW-846 8141B	Azinphos methyl
SCM	SW-846 8141B	Chlorpyrifos
SCM	SW-846 8141B	Demeton (o-)
SCM	SW-846 8141B	Demeton (s-)
SCM	SW-846 8141B	Disulfoton
SCM	SW-846 8141B	Bolstar
SCM	SW-846 8141B	Coumaphos
SCM	SW-846 8141B	Dichlorvos
SCM	SW-846 8141B	Dimethoate
SCM	SW-846 8141B	EPN
SCM	SW-846 8141B	Ethoprop
SCM	SW-846 8141B	Fensulfothion
SCM	SW-846 8141B	Fenthion
SCM	SW-846 8141B	Merphos
SCM	SW-846 8141B	Mevinphos
SCM	SW-846 8141B	Naled
SCM	SW-846 8141B	Parathion
SCM	SW-846 8141B	Parathion methyl
SCM	SW-846 8141B	Phorate
SCM	SW-846 8141B	Ronnel
SCM	SW-846 8141B	Stirofos
SCM	SW-846 8141B	Sulfotepp
SCM	SW-846 8141B	TEPP
SCM	SW-846 8141B	Tokuthion [Protothiofos]
SCM	SW-846 8141B	Trichloronate
SCM	SW-846 8141B	Diazinon
SCM	SW-846 8141B	Malathion
SCM	SW-846 8151A	Dicamba
SCM	SW-846 8151A	DB (2,4-)
SCM	SW-846 8151A	Dinoseb
SCM	SW-846 8151A	Dalapon
SCM	SW-846 8151A	Dichlorprop
SCM	SW-846 8151A	D (2,4-)
SCM	SW-846 8151A	T (2,4,5-)
SCM	SW-846 8151A	TP (2,4,5-) (Silvex)
SCM	SW-846 8151A	MCPA
SCM	SW-846 8151A	MCPP
SCM	SW-846 8015M	Methyl alcohol (Methanol)
SCM	SW-846 8260B	Ethyl alcohol
SCM	SW-846 8260B	Hexane (n-)

Matrix	Method	Parameter
SCM	SW-846 8260B	Methylnaphthalene (1-)
SCM	SW-846 8260B	Methylnaphthalene (2-)
SCM	SW-846 8260B	Butanol (3,3-Dimethyl-1-)
SCM	SW-846 8260B	Trimethylpentane (2,2,4-)
SCM	SW-846 8260B	Trimethylbenzene (1,2,3-)
SCM	SW-846 8260B	Cyclohexane
SCM	SW-846 8260B	Butanol (1-)
SCM	SW-846 8260B	Nitropropane (2-)
SCM	SW-846 8260B	Butyl formate (t-)
SCM	SW-846 8260B	Methyl acetate
SCM	SW-846 8260B	Amyl alcohol (t-)
SCM	SW-846 8260B	Methylcyclohexane
SCM	SW-846 8260B	Octane (-n)
SCM	SW-846 8260B	tert-Amyl Methyl Ether [TAME]
SCM	SW-846 8260B	Bromoethane
SCM	SW-846 8260B	Cyclohexanone
SCM	SW-846 8260B	Diisopropyl Ether [DIPE]
SCM	SW-846 8260B	Tetrahydrofuran
SCM	SW-846 8260B	Ethyl-tert-butyl Ether [ETBE]
SCM	SW-846 8260B	Xylene (m-)
SCM	SW-846 8260B	Xylene (o-)
SCM	SW-846 8260B	Xylene (p-)
SCM	SW-846 8260B	Dichloro-2-butene (cis-1,4-)
SCM	SW-846 8260B	Diethyl ether (Ethyl ether)
SCM	SW-846 8260B	Dichloro-2-butene (trans-1,4-)
SCM	SW-846 8260B	Ethanol
SCM	SW-846 8260B	Trichloro (1,1,2-) trifluoroethane (1,2,2-)
SCM	SW-846 8260B	Vinyl acetate
SCM	SW-846 8260B	Pentachloroethane
SCM	SW-846 8260B	Tert-butyl alcohol
SCM	SW-846 8260B	Dioxane (1,4-)
SCM	SW-846 8260B	Bromobenzene
SCM	SW-846 8260B	Butyl benzene (n-)
SCM	SW-846 8260B	Sec-butylbenzene
SCM	SW-846 8260B	Tert-butylbenzene
SCM	SW-846 8260B	Chlorotoluene (2-)
SCM	SW-846 8260B	Chlorotoluene (4-)
SCM	SW-846 8260B	Isopropylbenzene
SCM	SW-846 8260B	Propylbenzene (n-)
SCM	SW-846 8260B	Isopropyltoluene (4-)

Matrix	Method	Parameter
SCM	SW-846 8260B	Trichlorobenzene (1,2,3-)
SCM	SW-846 8260B	Trimethylbenzene (1,2,4-)
SCM	SW-846 8260B	Trimethylbenzene (1,3,5-)
SCM	SW-846 8260B	Allyl chloride
SCM	SW-846 8260B	Bromochloromethane
SCM	SW-846 8260B	Butadiene (2-chloro-1,3-)
SCM	SW-846 8260B	Dibromoethane (1,2-) (EDB)
SCM	SW-846 8260B	Dibromomethane
SCM	SW-846 8260B	Dibromo-3-chloropropane (1,2-)
SCM	SW-846 8260B	Dichloropropane (1,3-)
SCM	SW-846 8260B	Dichloropropane (2,2-)
SCM	SW-846 8260B	Dichloropropene (1,1-)
SCM	SW-846 8260B	Trichloropropane (1,2,3-)
SCM	SW-846 8260B	Ethyl acetate
SCM	SW-846 8260B	Ethyl methacrylate
SCM	SW-846 8260B	Methacrylonitrile
SCM	SW-846 8260B	Methyl acrylate
SCM	SW-846 8260B	Methyl methacrylate
SCM	SW-846 8260B	Iso-butyl alcohol
SCM	SW-846 8260B	Isopropanol
SCM	SW-846 8260B	N-Nitroso-di-n-butylamine
SCM	SW-846 8260B	Propionitrile
SCM	SW-846 8260B	Acetonitrile
SCM	SW-846 8260B	Benzene
SCM	SW-846 8260B	Chlorobenzene
SCM	SW-846 8260B	Dichlorobenzene (1,2-)
SCM	SW-846 8260B	Dichlorobenzene (1,3-)
SCM	SW-846 8260B	Dichlorobenzene (1,4-)
SCM	SW-846 8260B	Ethylbenzene
SCM	SW-846 8260B	Toluene
SCM	SW-846 8260B	Xylenes (total)
SCM	SW-846 8260B	Bromodichloromethane
SCM	SW-846 8260B	Bromoform
SCM	SW-846 8260B	Bromomethane
SCM	SW-846 8260B	Carbon tetrachloride
SCM	SW-846 8260B	Chloroethane
SCM	SW-846 8260B	Chloroethyl vinyl ether (2-)
SCM	SW-846 8260B	Chloroform
SCM	SW-846 8260B	Chloromethane
SCM	SW-846 8260B	Dichloropropene (trans-1,3-)

Matrix	Method	Parameter
SCM	SW-846 8260B	Dibromochloromethane
SCM	SW-846 8260B	Dichlorodifluoromethane
SCM	SW-846 8260B	Dichloroethane (1,1-)
SCM	SW-846 8260B	Dichloroethane (1,2-)
SCM	SW-846 8260B	Dichloroethene (1,1-)
SCM	SW-846 8260B	Dichloroethene (trans-1,2-)
SCM	SW-846 8260B	Dichloroethene (cis-1,2-)
SCM	SW-846 8260B	Dichloropropane (1,2-)
SCM	SW-846 8260B	Dichloropropene (cis-1,3-)
SCM	SW-846 8260B	Methylene chloride (Dichloromethane)
SCM	SW-846 8260B	Tetrachloroethane (1,1,2,2-)
SCM	SW-846 8260B	Tetrachloroethene
SCM	SW-846 8260B	Trichloroethane (1,1,1-)
SCM	SW-846 8260B	Trichloroethane (1,1,2-)
SCM	SW-846 8260B	Trichloroethene
SCM	SW-846 8260B	Trichlorofluoromethane
SCM	SW-846 8260B	Vinyl chloride
SCM	SW-846 8260B	Acetone
SCM	SW-846 8260B	Carbon disulfide
SCM	SW-846 8260B	Butanone (2-)
SCM	SW-846 8260B	Hexanone (2-)
SCM	SW-846 8260B	Pentanone (4-methyl-2-) (MIBK)
SCM	SW-846 8260B	Methyl tert-butyl ether
SCM	SW-846 8260B	Acrolein
SCM	SW-846 8260B	Acrylonitrile
SCM	SW-846 8260B	Hexachlorobutadiene (1,3-)
SCM	SW-846 8260B	Hexachloroethane
SCM	SW-846 8260B	Naphthalene
SCM	SW-846 8260B	Styrene
SCM	SW-846 8260B	Tetrachloroethane (1,1,1,2-)
SCM	SW-846 8260B	Trichlorobenzene (1,2,4-)
SCM	SW-846 8260C	Ethyl alcohol
SCM	SW-846 8260C	Methylnaphthalene (1-)
SCM	SW-846 8260C	Methylnaphthalene (2-)
SCM	SW-846 8260C	Butanol (3,3-Dimethyl-1-)
SCM	SW-846 8260C	Trimethylbenzene (1,2,3-)
SCM	SW-846 8260C	Cyclohexane
SCM	SW-846 8260C	Butanol (1-)
SCM	SW-846 8260C	Nitropropane (2-)
SCM	SW-846 8260C	Butyl formate (t-)

Matrix	Method	Parameter
SCM	SW-846 8260C	Methyl acetate
SCM	SW-846 8260C	Pentanol (2-Methyl-2-)
SCM	SW-846 8260C	Amyl alcohol (t-)
SCM	SW-846 8260C	Methylcyclohexane
SCM	SW-846 8260C	Octane (-n)
SCM	SW-846 8260C	tert-Amylmethyl ether [TAME]
SCM	SW-846 8260C	Bromoethane
SCM	SW-846 8260C	Cyclohexanone
SCM	SW-846 8260C	Diisopropyl Ether [DIPE]
SCM	SW-846 8260C	Tetrahydrofuran
SCM	SW-846 8260C	Ethyl-tert-butyl Ether [ETBE]
SCM	SW-846 8260C	Xylene (m-)
SCM	SW-846 8260C	Xylene (o-)
SCM	SW-846 8260C	Xylene (p-)
SCM	SW-846 8260C	Dichloro-2-butene (cis-1,4-)
SCM	SW-846 8260C	Diethyl ether (Ethyl ether)
SCM	SW-846 8260C	Dichloro-2-butene (trans-1,4-)
SCM	SW-846 8260C	Trichloro (1,1,2-) trifluoroethane (1,2,2-)
SCM	SW-846 8260C	Vinyl acetate
SCM	SW-846 8260C	Pentachloroethane
SCM	SW-846 8260C	Tert-butyl alcohol
SCM	SW-846 8260C	Dioxane (1,4-)
SCM	SW-846 8260C	Bromobenzene
SCM	SW-846 8260C	Butyl benzene (n-)
SCM	SW-846 8260C	Sec-butylbenzene
SCM	SW-846 8260C	Tert-butylbenzene
SCM	SW-846 8260C	Chlorotoluene (2-)
SCM	SW-846 8260C	Chlorotoluene (4-)
SCM	SW-846 8260C	Isopropylbenzene
SCM	SW-846 8260C	Propylbenzene (n-)
SCM	SW-846 8260C	Isopropyltoluene (4-)
SCM	SW-846 8260C	Trichlorobenzene (1,2,3-)
SCM	SW-846 8260C	Trimethylbenzene (1,2,4-)
SCM	SW-846 8260C	Trimethylbenzene (1,3,5-)
SCM	SW-846 8260C	Allyl chloride
SCM	SW-846 8260C	Bromochloromethane
SCM	SW-846 8260C	Butadiene (2-chloro-1,3-)
SCM	SW-846 8260C	Dibromoethane (1,2-) (EDB)
SCM	SW-846 8260C	Dibromomethane
SCM	SW-846 8260C	Dibromo-3-chloropropane (1,2-)

Matrix	Method	Parameter
SCM	SW-846 8260C	Dichloropropane (1,3-)
SCM	SW-846 8260C	Dichloropropane (2,2-)
SCM	SW-846 8260C	Dichloropropene (1,1-)
SCM	SW-846 8260C	Trichloropropane (1,2,3-)
SCM	SW-846 8260C	Ethyl acetate
SCM	SW-846 8260C	Ethyl methacrylate
SCM	SW-846 8260C	Methacrylonitrile
SCM	SW-846 8260C	Methyl acrylate
SCM	SW-846 8260C	Methyl methacrylate
SCM	SW-846 8260C	Iso-butyl alcohol
SCM	SW-846 8260C	Isopropanol
SCM	SW-846 8260C	N-Nitroso-di-n-butylamine
SCM	SW-846 8260C	Propionitrile
SCM	SW-846 8260C	Acetonitrile
SCM	SW-846 8260C	Benzene
SCM	SW-846 8260C	Chlorobenzene
SCM	SW-846 8260C	Dichlorobenzene (1,2-)
SCM	SW-846 8260C	Dichlorobenzene (1,3-)
SCM	SW-846 8260C	Dichlorobenzene (1,4-)
SCM	SW-846 8260C	Ethylbenzene
SCM	SW-846 8260C	Toluene
SCM	SW-846 8260C	Xylenes (total)
SCM	SW-846 8260C	Bromodichloromethane
SCM	SW-846 8260C	Bromoform
SCM	SW-846 8260C	Bromomethane
SCM	SW-846 8260C	Carbon tetrachloride
SCM	SW-846 8260C	Chloroethane
SCM	SW-846 8260C	Chloroethyl vinyl ether (2-)
SCM	SW-846 8260C	Chloroform
SCM	SW-846 8260C	Chloromethane
SCM	SW-846 8260C	Dichloropropene (trans-1,3-)
SCM	SW-846 8260C	Dibromochloromethane
SCM	SW-846 8260C	Dichlorodifluoromethane
SCM	SW-846 8260C	Dichloroethane (1,1-)
SCM	SW-846 8260C	Dichloroethane (1,2-)
SCM	SW-846 8260C	Dichloroethene (1,1-)
SCM	SW-846 8260C	Dichloroethene (trans-1,2-)
SCM	SW-846 8260C	Dichloroethene (cis-1,2-)
SCM	SW-846 8260C	Dichloropropane (1,2-)
SCM	SW-846 8260C	Dichloropropene (cis-1,3-)

Matrix	Method	Parameter
SCM	SW-846 8260C	Methylene chloride (Dichloromethane)
SCM	SW-846 8260C	Tetrachloroethane (1,1,2,2-)
SCM	SW-846 8260C	Tetrachloroethene
SCM	SW-846 8260C	Trichloroethane (1,1,1-)
SCM	SW-846 8260C	Trichloroethane (1,1,2-)
SCM	SW-846 8260C	Trichloroethene
SCM	SW-846 8260C	Trichlorofluoromethane
SCM	SW-846 8260C	Vinyl chloride
SCM	SW-846 8260C	Acetone
SCM	SW-846 8260C	Carbon disulfide
SCM	SW-846 8260C	Butanone (2-)
SCM	SW-846 8260C	Hexanone (2-)
SCM	SW-846 8260C	Pentanone (4-methyl-2-) (MIBK)
SCM	SW-846 8260C	Methyl tert-butyl ether
SCM	SW-846 8260C	Acrolein
SCM	SW-846 8260C	Acrylonitrile
SCM	SW-846 8260C	Hexachlorobutadiene (1,3-)
SCM	SW-846 8260C	Hexachloroethane
SCM	SW-846 8260C	Naphthalene
SCM	SW-846 8260C	Styrene
SCM	SW-846 8260C	Tetrachloroethane (1,1,1,2-)
SCM	SW-846 8260C	Trichlorobenzene (1,2,4-)
SCM	SW-846 8270C	Biphenyl (1,1'-)
SCM	SW-846 8270C	Caprolactam
SCM	SW-846 8270C	Atrazine
SCM	SW-846 8270C	Phenanthrene
SCM	SW-846 8270C	Pyrene
SCM	SW-846 8270C	Acenaphthene
SCM	SW-846 8270C	Acenaphthylene
SCM	SW-846 8270C	Anthracene
SCM	SW-846 8270C	Benzo(g,h,i)perylene
SCM	SW-846 8270C	Chrysene
SCM	SW-846 8270C	Methylnaphthalene (1-)
SCM	SW-846 8270C	Methylnaphthalene (2-)
SCM	SW-846 8270C	Naphthalene
SCM	SW-846 8270C	Fluoranthene
SCM	SW-846 8270C	Fluorene
SCM	SW-846 8270C	Methylnaphthalene (1-)
SCM	SW-846 8270C	Nitrodiphenylamine (2-)
SCM	SW-846 8270C	Nitrodiphenylamine (2-)

Matrix	Method	Parameter
SCM	SW-846 8270C	Hexachlorophene
SCM	SW-846 8270C	Diphenylhydrazine (1,2-)
SCM	SW-846 8270C	Decane (n-)
SCM	SW-846 8270C	Octadecane (n-)
SCM	SW-846 8270C	Benzo(a)anthracene
SCM	SW-846 8270C	Benzo(a)pyrene
SCM	SW-846 8270C	Benzo(b)fluoranthene
SCM	SW-846 8270C	Benzo(k)fluoranthene
SCM	SW-846 8270C	Dibenzo(a,h)anthracene
SCM	SW-846 8270C	Indeno(1,2,3-c,d)pyrene
SCM	SW-846 8270C	Benzal chloride
SCM	SW-846 8270C	Benzo(j)fluoranthene
SCM	SW-846 8270C	Benzotrichloride
SCM	SW-846 8270C	Benzyl chloride
SCM	SW-846 8270C	Chlorobenzilate
SCM	SW-846 8270C	Dibenz(a,h)acridine
SCM	SW-846 8270C	Dibenzo(a,h)pyrene
SCM	SW-846 8270C	Dibenzo(a,i)pyrene
SCM	SW-846 8270C	Dibenzo(c,g)carbazole (7H-)
SCM	SW-846 8270C	Pentachloroethane
SCM	SW-846 8270C	Tetrachlorobenzene (1,2,3,4-)
SCM	SW-846 8270C	Tetrachlorobenzene (1,2,3,5-)
SCM	SW-846 8270C	Benzyl alcohol
SCM	SW-846 8270C	Acetophenone
SCM	SW-846 8270C	Acetylaminofluorene (2-)
SCM	SW-846 8270C	Aminobiphenyl (4-)
SCM	SW-846 8270C	Aramite
SCM	SW-846 8270C	Chloronaphthalene (1-)
SCM	SW-846 8270C	Diallate (cis)
SCM	SW-846 8270C	Diallate (trans)
SCM	SW-846 8270C	Dibenzo(a,e)pyrene
SCM	SW-846 8270C	Dibenz(a,j)acridine
SCM	SW-846 8270C	Dichlorophenol (2,6-)
SCM	SW-846 8270C	Dimethoate
SCM	SW-846 8270C	Dimethylaminoazobenzene
SCM	SW-846 8270C	Dimethylbenz(a)anthracene (7,12-)
SCM	SW-846 8270C	Dimethyl benzidine (3,3-)
SCM	SW-846 8270C	Dinitrobenzene (1,3-)
SCM	SW-846 8270C	Dinoseb
SCM	SW-846 8270C	Disulfoton

Matrix	Method	Parameter
SCM	SW-846 8270C	Famphur
SCM	SW-846 8270C	Hexachloropropene
SCM	SW-846 8270C	Isodrin
SCM	SW-846 8270C	Isosafrole (cis-)
SCM	SW-846 8270C	Isosafrole (trans-)
SCM	SW-846 8270C	Kepone
SCM	SW-846 8270C	Methanesulfonate (Ethyl-)
SCM	SW-846 8270C	Methanesulfonate (Methyl-)
SCM	SW-846 8270C	Methapyrilene
SCM	SW-846 8270C	Methylcholanthrene (3-)
SCM	SW-846 8270C	Napthoquinone (1,4-)
SCM	SW-846 8270C	Napththylamine (1-)
SCM	SW-846 8270C	Napththylamine (2-)
SCM	SW-846 8270C	N-Nitroso-di-n-butylamine
SCM	SW-846 8270C	N-Nitrosomorpholine
SCM	SW-846 8270C	N-Nitrosopiperidine
SCM	SW-846 8270C	Parathion
SCM	SW-846 8270C	Parathion methyl
SCM	SW-846 8270C	Pentachlorobenzene
SCM	SW-846 8270C	Pentachloronitrobenzene
SCM	SW-846 8270C	Phenacetin
SCM	SW-846 8270C	Phenylenediamine (1,4-)
SCM	SW-846 8270C	Phenylethylamine (alpha, alpha-Dimethyl)
SCM	SW-846 8270C	Phorate
SCM	SW-846 8270C	Phosphorothioate (O,O,O-triethyl)
SCM	SW-846 8270C	Phosphorothioate (O,O-diethyl-O-2-pyrazinyl) [Thionazin]
SCM	SW-846 8270C	Picoline (2-)
SCM	SW-846 8270C	Pronamide
SCM	SW-846 8270C	Quinoline -1-Oxide (4-Nitro)
SCM	SW-846 8270C	Safrole
SCM	SW-846 8270C	Sulfotepp
SCM	SW-846 8270C	Tetrachlorobenzene (1,2,4,5-)
SCM	SW-846 8270C	Tetrachlorophenol (2,3,4,6-)
SCM	SW-846 8270C	Toluidine (2-) (2-Methylaniline)
SCM	SW-846 8270C	Toluidine (5-nitro-2-)
SCM	SW-846 8270C	Trinitrobenzene (1,3,5-)
SCM	SW-846 8270C	N-Nitrosodiethylamine
SCM	SW-846 8270C	N-Nitrosopyrrolidine
SCM	SW-846 8270C	Diphenylamine

Matrix	Method	Parameter
SCM	SW-846 8270C	Carbazole
SCM	SW-846 8270C	Dichlorobenzene (1,2-)
SCM	SW-846 8270C	Dichlorobenzene (1,3-)
SCM	SW-846 8270C	N-Nitrosodimethylamine
SCM	SW-846 8270C	N-Nitroso-di-n-propylamine
SCM	SW-846 8270C	N-Nitrosomethylethylamine
SCM	SW-846 8270C	Benzidine
SCM	SW-846 8270C	Aniline
SCM	SW-846 8270C	Hexachloropropene
SCM	SW-846 8270C	Dibenzofuran
SCM	SW-846 8270C	Benzoic acid
SCM	SW-846 8270C	N-Nitrosodiphenylamine
SCM	SW-846 8270C	Dichlorobenzidine (3,3'-)
SCM	SW-846 8270C	Chloroaniline (4-)
SCM	SW-846 8270C	Nitroaniline (2-)
SCM	SW-846 8270C	Nitroaniline (3-)
SCM	SW-846 8270C	Nitroaniline (4-)
SCM	SW-846 8270C	Chloronaphthalene (2-)
SCM	SW-846 8270C	Hexachlorobenzene
SCM	SW-846 8270C	Hexachlorobutadiene (1,3-)
SCM	SW-846 8270C	Hexachlorocyclopentadiene
SCM	SW-846 8270C	Hexachloroethane
SCM	SW-846 8270C	Trichlorobenzene (1,2,4-)
SCM	SW-846 8270C	Bis (2-chloroethoxy) methane
SCM	SW-846 8270C	Bis (2-chloroethyl) ether
SCM	SW-846 8270C	Bis (2-chloroisopropyl) ether
SCM	SW-846 8270C	Chlorophenyl-phenyl ether (4-)
SCM	SW-846 8270C	Bromophenyl-phenyl ether (4-)
SCM	SW-846 8270C	Dinitrotoluene (2,4-)
SCM	SW-846 8270C	Dinitrotoluene (2,6-)
SCM	SW-846 8270C	Isophorone
SCM	SW-846 8270C	Nitrobenzene
SCM	SW-846 8270C	Butyl benzyl phthalate
SCM	SW-846 8270C	Bis (2-ethylhexyl) phthalate
SCM	SW-846 8270C	Diethyl phthalate
SCM	SW-846 8270C	Dimethyl phthalate
SCM	SW-846 8270C	Di-n-butyl phthalate
SCM	SW-846 8270C	Di-n-octyl phthalate
SCM	SW-846 8270C	Acenaphthene
SCM	SW-846 8270C	Anthracene

Matrix	Method	Parameter
SCM	SW-846 8270C	Acenaphthylene
SCM	SW-846 8270C	Benzo(a)anthracene
SCM	SW-846 8270C	Benzo(a)pyrene
SCM	SW-846 8270C	Benzo(b)fluoranthene
SCM	SW-846 8270C	Benzo(g,h,i)perylene
SCM	SW-846 8270C	Benzo(k)fluoranthene
SCM	SW-846 8270C	Chrysene
SCM	SW-846 8270C	Dibenzo(a,h)anthracene
SCM	SW-846 8270C	Fluoranthene
SCM	SW-846 8270C	Fluorene
SCM	SW-846 8270C	Indeno(1,2,3-c,d)pyrene
SCM	SW-846 8270C	Methylnaphthalene (2-)
SCM	SW-846 8270C	Naphthalene
SCM	SW-846 8270C	Phenanthrene
SCM	SW-846 8270C	Pyrene
SCM	SW-846 8270C	Methyl phenol (4-chloro-3-)
SCM	SW-846 8270C	Chlorophenol (2-)
SCM	SW-846 8270C	Dichlorophenol (2,4-)
SCM	SW-846 8270C	Dimethylphenol (2,4-)
SCM	SW-846 8270C	Dinitrophenol (2,4-)
SCM	SW-846 8270C	Dinitrophenol (2-methyl-4,6-)
SCM	SW-846 8270C	Methylphenol (2-)
SCM	SW-846 8270C	Methylphenol (4-)
SCM	SW-846 8270C	Nitrophenol (2-)
SCM	SW-846 8270C	Nitrophenol (4-)
SCM	SW-846 8270C	Pentachlorophenol
SCM	SW-846 8270C	Phenol
SCM	SW-846 8270C	Trichlorophenol (2,4,5-)
SCM	SW-846 8270C	Trichlorophenol (2,4,6-)
SCM	SW-846 8270C	Dichlorobenzene (1,4-)
SCM	SW-846 8270C	Pyridine
SCM	SW-846 8270D	Biphenyl (1,1'-)
SCM	SW-846 8270D	Benzaldehyde
SCM	SW-846 8270D	Caprolactam
SCM	SW-846 8270D	Atrazine
SCM	SW-846 8270D	Phenanthrene
SCM	SW-846 8270D	Pyrene
SCM	SW-846 8270D	Acenaphthene
SCM	SW-846 8270D	Acenaphthylene
SCM	SW-846 8270D	Anthracene

Matrix	Method	Parameter
SCM	SW-846 8270D	Benzo(g,h,i)perylene
SCM	SW-846 8270D	Chrysene
SCM	SW-846 8270D	Methylnaphthalene (1-)
SCM	SW-846 8270D	Methylnaphthalene (2-)
SCM	SW-846 8270D	Naphthalene
SCM	SW-846 8270D	Fluoranthene
SCM	SW-846 8270D	Fluorene
SCM	SW-846 8270D	Methylnaphthalene (1-)
SCM	SW-846 8270D	Nitrodiphenylamine (2-)
SCM	SW-846 8270D	Hexachlorophene
SCM	SW-846 8270D	Diphenylhydrazine (1,2-)
SCM	SW-846 8270D	Decane (n-)
SCM	SW-846 8270D	Octadecane (n-)
SCM	SW-846 8270D	Benzo(a)anthracene
SCM	SW-846 8270D	Benzo(a)pyrene
SCM	SW-846 8270D	Benzo(b)fluoranthene
SCM	SW-846 8270D	Benzo(k)fluoranthene
SCM	SW-846 8270D	Dibenzo(a,h)anthracene
SCM	SW-846 8270D	Indeno(1,2,3-c,d)pyrene
SCM	SW-846 8270D	Benzal chloride
SCM	SW-846 8270D	Benzo(j)fluoranthene
SCM	SW-846 8270D	Benzotrichloride
SCM	SW-846 8270D	Benzyl chloride
SCM	SW-846 8270D	Chlorobenzilate
SCM	SW-846 8270D	Dibenz(a,h)acridine
SCM	SW-846 8270D	Dibenzo(a,h)pyrene
SCM	SW-846 8270D	Dibenzo(a,i)pyrene
SCM	SW-846 8270D	Dibenzo(c,g)carbazole (7H-)
SCM	SW-846 8270D	Pentachloroethane
SCM	SW-846 8270D	Tetrachlorobenzene (1,2,3,4-)
SCM	SW-846 8270D	Tetrachlorobenzene (1,2,3,5-)
SCM	SW-846 8270D	Benzyl alcohol
SCM	SW-846 8270D	Acetophenone
SCM	SW-846 8270D	Acetylaminofluorene (2-)
SCM	SW-846 8270D	Aminobiphenyl (4-)
SCM	SW-846 8270D	Aramite
SCM	SW-846 8270D	Chloronaphthalene (1-)
SCM	SW-846 8270D	Diallate (cis)
SCM	SW-846 8270D	Diallate (trans)
SCM	SW-846 8270D	Dibenzo(a,e)pyrene

Matrix	Method	Parameter
SCM	SW-846 8270D	Dibenz(a,j)acridine
SCM	SW-846 8270D	Dichlorophenol (2,6-)
SCM	SW-846 8270D	Dimethoate
SCM	SW-846 8270D	Dimethylaminoazobenzene
SCM	SW-846 8270D	Dimethylbenz(a)anthracene (7,12-)
SCM	SW-846 8270D	Dimethyl benzidine (3,3-)
SCM	SW-846 8270D	Dinitrobenzene (1,3-)
SCM	SW-846 8270D	Dinoseb
SCM	SW-846 8270D	Disulfoton
SCM	SW-846 8270D	Famphur
SCM	SW-846 8270D	Isodrin
SCM	SW-846 8270D	Isosafrole (cis-)
SCM	SW-846 8270D	Isosafrole (trans-)
SCM	SW-846 8270D	Kepone
SCM	SW-846 8270D	Methanesulfonate (Ethyl-)
SCM	SW-846 8270D	Methanesulfonate (Methyl-)
SCM	SW-846 8270D	Methapyrilene
SCM	SW-846 8270D	Methylcholanthrene (3-)
SCM	SW-846 8270D	Napthoquinone (1,4-)
SCM	SW-846 8270D	Napththylamine (1-)
SCM	SW-846 8270D	Napththylamine (2-)
SCM	SW-846 8270D	N-Nitroso-di-n-butylamine
SCM	SW-846 8270D	N-Nitrosomorpholine
SCM	SW-846 8270D	N-Nitrosopiperidine
SCM	SW-846 8270D	Parathion
SCM	SW-846 8270D	Parathion methyl
SCM	SW-846 8270D	Pentachlorobenzene
SCM	SW-846 8270D	Pentachloronitrobenzene
SCM	SW-846 8270D	Phenacetin
SCM	SW-846 8270D	Phenylenediamine (1,4-)
SCM	SW-846 8270D	Phenylethylamine (alpha, alpha-Dimethyl)
SCM	SW-846 8270D	Phorate
SCM	SW-846 8270D	Phosphorothioate (O,O,O-triethyl)
SCM	SW-846 8270D	Phosphorothioate (O,O-diethyl-O-2-pyrazinyl) [Thionazin]
SCM	SW-846 8270D	Picoline (2-)
SCM	SW-846 8270D	Pronamide
SCM	SW-846 8270D	Quinoline -1-Oxide (4-Nitro)
SCM	SW-846 8270D	Safrole
SCM	SW-846 8270D	Sulfotepp

Matrix	Method	Parameter
SCM	SW-846 8270D	Tetrachlorobenzene (1,2,4,5-)
SCM	SW-846 8270D	Tetrachlorophenol (2,3,4,6-)
SCM	SW-846 8270D	Toluidine (2-) (2-Methylaniline)
SCM	SW-846 8270D	Toluidine (5-nitro-2-)
SCM	SW-846 8270D	Trinitrobenzene (1,3,5-)
SCM	SW-846 8270D	N-Nitrosodiethylamine
SCM	SW-846 8270D	N-Nitrosopyrrolidine
SCM	SW-846 8270D	Diphenylamine
SCM	SW-846 8270D	Carbazole
SCM	SW-846 8270D	Dichlorobenzene (1,2-)
SCM	SW-846 8270D	Dichlorobenzene (1,3-)
SCM	SW-846 8270D	N-Nitrosodimethylamine
SCM	SW-846 8270D	N-Nitroso-di-n-propylamine
SCM	SW-846 8270D	N-Nitrosomethylethylamine
SCM	SW-846 8270D	Benzidine
SCM	SW-846 8270D	Aniline
SCM	SW-846 8270D	Hexachloropropene
SCM	SW-846 8270D	Dibenzofuran
SCM	SW-846 8270D	Benzoic acid
SCM	SW-846 8270D	N-Nitrosodiphenylamine
SCM	SW-846 8270D	Dichlorobenzidine (3,3'-)
SCM	SW-846 8270D	Chloroaniline (4-)
SCM	SW-846 8270D	Nitroaniline (2-)
SCM	SW-846 8270D	Nitroaniline (3-)
SCM	SW-846 8270D	Nitroaniline (4-)
SCM	SW-846 8270D	Chloronaphthalene (2-)
SCM	SW-846 8270D	Hexachlorobenzene
SCM	SW-846 8270D	Hexachlorobutadiene (1,3-)
SCM	SW-846 8270D	Hexachlorocyclopentadiene
SCM	SW-846 8270D	Hexachloroethane
SCM	SW-846 8270D	Trichlorobenzene (1,2,4-)
SCM	SW-846 8270D	Bis (2-chloroethoxy) methane
SCM	SW-846 8270D	Bis (2-chloroethyl) ether
SCM	SW-846 8270D	Bis (2-chloroisopropyl) ether
SCM	SW-846 8270D	Chlorophenyl-phenyl ether (4-)
SCM	SW-846 8270D	Bromophenyl-phenyl ether (4-)
SCM	SW-846 8270D	Dinitrotoluene (2,4-)
SCM	SW-846 8270D	Dinitrotoluene (2,6-)
SCM	SW-846 8270D	Isophorone
SCM	SW-846 8270D	Nitrobenzene

Matrix	Method	Parameter
SCM	SW-846 8270D	Butyl benzyl phthalate
SCM	SW-846 8270D	Bis (2-ethylhexyl) phthalate
SCM	SW-846 8270D	Diethyl phthalate
SCM	SW-846 8270D	Dimethyl phthalate
SCM	SW-846 8270D	Di-n-butyl phthalate
SCM	SW-846 8270D	Di-n-octyl phthalate
SCM	SW-846 8270D	Acenaphthene
SCM	SW-846 8270D	Anthracene
SCM	SW-846 8270D	Acenaphthylene
SCM	SW-846 8270D	Benzo(a)anthracene
SCM	SW-846 8270D	Benzo(a)pyrene
SCM	SW-846 8270D	Benzo(b)fluoranthene
SCM	SW-846 8270D	Benzo(g,h,i)perylene
SCM	SW-846 8270D	Benzo(k)fluoranthene
SCM	SW-846 8270D	Chrysene
SCM	SW-846 8270D	Dibenzo(a,h)anthracene
SCM	SW-846 8270D	Fluoranthene
SCM	SW-846 8270D	Fluorene
SCM	SW-846 8270D	Indeno(1,2,3-c,d)pyrene
SCM	SW-846 8270D	Methylnaphthalene (2-)
SCM	SW-846 8270D	Naphthalene
SCM	SW-846 8270D	Phenanthrene
SCM	SW-846 8270D	Pyrene
SCM	SW-846 8270D	Methyl phenol (4-chloro-3-)
SCM	SW-846 8270D	Chlorophenol (2-)
SCM	SW-846 8270D	Dichlorophenol (2,4-)
SCM	SW-846 8270D	Dimethylphenol (2,4-)
SCM	SW-846 8270D	Dinitrophenol (2,4-)
SCM	SW-846 8270D	Dinitrophenol (2-methyl-4,6-)
SCM	SW-846 8270D	Methylphenol (2-)
SCM	SW-846 8270D	Methylphenol (4-)
SCM	SW-846 8270D	Nitrophenol (2-)
SCM	SW-846 8270D	Nitrophenol (4-)
SCM	SW-846 8270D	Pentachlorophenol
SCM	SW-846 8270D	Phenol
SCM	SW-846 8270D	Trichlorophenol (2,4,5-)
SCM	SW-846 8270D	Trichlorophenol (2,4,6-)
SCM	SW-846 8270D	Dichlorobenzene (1,4-)
SCM	SW-846 8270D	Pyridine
SCM	SW-846 8310	Acenaphthene

Matrix	Method	Parameter
SCM	SW-846 8310	Acenaphthylene
SCM	SW-846 8310	Anthracene
SCM	SW-846 8310	Benzo(a)anthracene
SCM	SW-846 8310	Benzo(a)pyrene
SCM	SW-846 8310	Benzo(b)fluoranthene
SCM	SW-846 8310	Benzo(g,h,i)perylene
SCM	SW-846 8310	Benzo(k)fluoranthene
SCM	SW-846 8310	Chrysene
SCM	SW-846 8310	Dibenzo(a,h)anthracene
SCM	SW-846 8310	Fluoranthene
SCM	SW-846 8310	Fluorene
SCM	SW-846 8310	Indeno(1,2,3-c,d)pyrene
SCM	SW-846 8310	Naphthalene
SCM	SW-846 8310	Phenanthrene
SCM	SW-846 8310	Pyrene
SCM	SW-846 8330	Nitroglycerine
SCM	SW-846 8330	Guanidine nitrate
SCM	SW-846 8330	PETN
SCM	SW-846 8330	HMX
SCM	SW-846 8330	RDX
SCM	SW-846 8330	Trinitrobenzene (1,3,5-)
SCM	SW-846 8330	Dinitrobenzene (1,3-)
SCM	SW-846 8330	Tetryl
SCM	SW-846 8330	Nitrobenzene
SCM	SW-846 8330	Trinitrotoluene (2,4,6-)
SCM	SW-846 8330	Dinitrotoluene (4-amino-2,6-)
SCM	SW-846 8330	Dinitrotoluene (2-amino-4,6-)
SCM	SW-846 8330	Dinitrotoluene (2,4-)
SCM	SW-846 8330	Dinitrotoluene (2,6-)
SCM	SW-846 8330	Nitrotoluene (2-)
SCM	SW-846 8330	Nitrotoluene (3-)
SCM	SW-846 8330	Nitrotoluene (4-)
SCM	SW-846 8330A	Nitroglycerine
SCM	SW-846 8330A	PETN
SCM	SW-846 8330A	HMX
SCM	SW-846 8330A	RDX
SCM	SW-846 8330A	Trinitrobenzene (1,3,5-)
SCM	SW-846 8330A	Dinitrobenzene (1,3-)
SCM	SW-846 8330A	Tetryl
SCM	SW-846 8330A	Nitrobenzene

Matrix	Method	Parameter
SCM	SW-846 8330A	Trinitrotoluene (2,4,6-)
SCM	SW-846 8330A	Dinitrotoluene (4-amino-2,6-)
SCM	SW-846 8330A	Dinitrotoluene (2-amino-4,6-)
SCM	SW-846 8330A	Dinitrotoluene (2,4-)
SCM	SW-846 8330A	Dinitrotoluene (2,6-)
SCM	SW-846 8330A	Nitrotoluene (2-)
SCM	SW-846 8330A	Nitrotoluene (3-)
SCM	SW-846 8330A	Nitrotoluene (4-)
SCM	SW-846 8440	Total rec. petroleum hydrocarbons
SCM	SW-846 9010C	Cyanide - amenable to Cl2
SCM	SW-846 9010C	Cyanide
SCM	SW-846 9012B	Cyanide
SCM	SW-846 9013	Cyanide
SCM	SW-846 9023	Extractable organic halides (EOX)
SCM	SW-846 9030B	Sulfides, acid sol. & insol.
SCM	SW-846 9034	Sulfides, acid sol. & insol.
SCM	SW-846 9040B	Corrosivity - pH waste, >20% water
SCM	SW-846 9040C	Corrosivity - pH waste, >20% water
SCM	SW-846 9045C	pH - soil and waste
SCM	SW-846 9045D	pH - soil and waste
SCM	SW-846 9056	Bromide
SCM	SW-846 9056	Nitrite
SCM	SW-846 9056	Sulfate
SCM	SW-846 9056	Nitrate
SCM	SW-846 9056	Chloride
SCM	SW-846 9056	Fluoride
SCM	SW-846 9056	Orthophosphate
SCM	SW-846 9056A	Bromide
SCM	SW-846 9056A	Nitrite
SCM	SW-846 9056A	Sulfate
SCM	SW-846 9056A	Nitrate
SCM	SW-846 9056A	Chloride
SCM	SW-846 9056A	Fluoride
SCM	SW-846 9056A	Orthophosphate
SCM	SW-846 9060	Total organic carbon (TOC)
SCM	SW-846 9060A	Total organic carbon (TOC)
SCM	SW-846 9071B	Oil & grease - sludge-hem-npm
SCM	SW-846 9071B	Oil & grease - sludge-hem
SCM	SW-846 9095	Free liquid
SCM	SW-846 9095B	Free liquid

Matrix	Method	Parameter
SCM	User Defined 8260C	Hexane (n-)
SCM	User Defined 9010B	Cyanide - amenable to Cl2
SCM	User Defined 9010B	Cyanide
SCM	User Defined 9012A	Cyanide
SCM	User Defined 9013A	Cyanide
SCM	User Defined 9095A	Free liquid
SCM	User Defined ASTM D93	Ignitability
SCM	User Defined CA LUFT - diesel	Petroleum Organics
SCM	User Defined CA LUFT - diesel	Petroleum Organics
SCM	User Defined LUFT	Xylene (m-)
SCM	User Defined LUFT	Xylene (o-)
SCM	User Defined LUFT	Xylene (p-)
SCM	User Defined LUFT	Benzene
SCM	User Defined LUFT	Ethylbenzene
SCM	User Defined LUFT	Toluene
SCM	User Defined LUFT	Xylenes (total)
SCM	User Defined LUFT	Methyl tert-butyl ether
SCM	User Defined MA-DEP-EPH, TN-EPH, WI DRO, NW TPH Dx	Diesel range organic
SCM	User Defined MA-DEP-VPH, WI GRO, NW TPH Gx	Gasoline range organic
SCM	User Defined NWTPH-Dx, NWTPH-Gx, NWTPHID	Petroleum Organics
SCM	User Defined SW846 8260B & 8260C	Gasoline range organic
SCM	User Defined SW-846 8330	Nitroguanidine
SCM	User Defined TX 1005, TX 1006, CT ETPH, NW TPH ID	Petroleum Organics

3.4 ABBREVIATIONS/ACRONYMS

The quality department is responsible for setting up and maintaining a list of abbreviations used in the quality manual.

ABBREVIATION	***DESCRIPTION***
A2LA	*AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION*
AIHA	*AMERICAN INDUSTRIAL HYGIENE ASSOCIATION*
AIHA-LAP	*AIHA's LABORATORY ACCREDITATION PROGRAM*
AIHA-PAT	*AIHA's PROFICIENCY ANALYICAL TESTING PROGRAM*
BLANK	*See FIELD, TRIP, METHOD, EQUIPMENT, INSTRUMENT, REAGENT*
CAL	*CALIBRATION*
CCB	*CONTINUING CALIBRATION BLANK*
CCV	*CONTINUING CALIBRATION VERIFICATION*
CDOC	*CONTINUING DEMONSTRATION OF CAPABILITY*
COC	*CHAIN OF CUSTODY*
CA	*CORRECTIVE ACTION*
CRM	*CERTIFIED REFERENCE MATERIAL*
DQO	*DATA QUALITY OBJECTIVES*
DUP	*DUPLICATE*
EB	*EQUIPMENT BLANK*
FB	*FIELD BLANK*
GC	*GAS CHROMATOGRAPHY*
GCMS	*GAS CHROMATOGRAPHY MASS SPECTROMETRY*
HPLC	*HIGH PRESSURE LIQUID CHROMATOGRAPHY*
IB	*INSTRUMENT BLANK*
IC	*ION CHROMATOGRAPHY*
ICP	*INDUCTIVELY COUPLED PLASMA*
ICPMS	*INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY*
ICS	*INTERFERENCE CHECK SAMPLE*
ICV – See SSCV	*INITIAL CALIBRATION VERIFICATION*
IDOC	*INITIAL DEMONSTRATION OF CAPABILITY (SEE ALSO CDOC)*
IDL	*INSTRUMENT DETECTION LIMIT*
ISTD	*INTERNAL STANDARD*
LCS	*LABORATORY CONTROL SAMPLE (Typically 2^{ND} Source)*
LCSD	*LABORATORY CONTROL SAMPLE DUPLICATE*
LOD	*LIMIT OF DETECTION*
LOQ	*LIMIT OF QUANTITATION*
LDR	*LINEAR DYNAMIC RANGE*
MAT	*MATRIX*
MS	*MATRIX SPIKE*
MSD	*MATRIX SPIKE DUPLICATE*

ABBREVIATION	DESCRIPTION
MDL	*METHOD DETECTION LIMIT*
MB	*METHOD BLANK*
NC	*NEGATIVE CONTROL*
% Rec	*PERCENT RECOVERY*
PC	*POSITIVE CONTROL*
PDL	*PRACTICAL DETECTION LIMIT*
PQL	*PRACTICAL QUANTITATION LIMIT also See Reporting Limit (RL)*
PT	*PROFICIENCY TEST SAMPLE*
QUAL	*QUALIFIER*
QA	*QUALITY ASSURANCE*
QAM	*QUALITY ASSURANCE MANUAL*
QAO	*QUALITY ASSURANCE OFFICER*
QC	*QUALITY CONTROL*
RF	*RESPONSE FACTOR*
RB	*REAGENT BLANK*
RL	*REPORTING LIMIT*
RLV	*REPORTING LIMIT VERIFICATION*
RPD	*RELATIVE PERCENT DIFFERENCE*
RSD	*RELATIVE STANDARD DEVIATION*
SSCV	*SECONDARY SOURCE CALIBRATION VERIFICAION*
SOP	*STANDARD OPERATING PROCEDURE*
SRM	*STANDARD REFERENCE MATERIAL*
SURR	*SURROGATE*
SVOC	*SEMI-VOLATILE ORGANIC COMPOUND*
TNI	*THE NELAC INSTITUTE*
UV	*ULTRAVIOLET*
VOC	*VOLATILE ORGANIC COMPOUND*

4.0 MANAGEMENT REQUIREMENTS

4.1 ORGANIZATION

4.1.1 Legal identity

The laboratory is authorized under Title 62 of the Tennessee Code Annotated and is identified as Environmental Science Corporation (d.b.a. ESC Lab Sciences) located at 12065 Lebanon Road, Mount Juliet, TN 37122

4.1.2 Organization

The laboratory is a public entity and is structured to provide environmental support services in compliance with numerous federal, state, and local regulations as well as to meet the analytical needs of the customer.

4.1.3 Facilities Under Management System

The scope of the ESC management system is comprehensive and covers all technical and supporting work conducted at all facilities including the primary Lebanon Road location as well as customer support and shipping operations across the US.

4.1.4 Independence

ESC Lab Sciences is an independent analytical facility, and is not a part of another organization.

4.1.5 Laboratory Managerial Polices

ESC Lab Sciences must have the following:

- Managerial and technical personnel have the authority and resources needed to carry out their duties. Management bears the specific responsibility for the implementation, maintenance, and improvement of the laboratory's management system. This includes the identification of any departures from the management system or standard operating procedures, and to initiate actions to prevent or minimize such departures.
- Management and personnel that are free from any undue pressures and influences that may adversely affect the quality of their work. The organizational structure indicated in this section is designed to minimize the potential for conflicts or undue stresses that might influence the technical judgment of analytical personnel. Analytical personnel are generally isolated from customer contact as much as practical. In addition, the laboratory workload is continually reviewed and managed in such a way as to reduce the potential for undue production pressure on analytical personnel.

- Policies and procedures to ensure the protection of its customers' confidentiality. The laboratory's confidentiality policy is to not divulge or release any information to a third party without proper written authorization. All information pertaining to a particular customer will remain confidential. Data will be released to outside agencies only with written authorization from the customer or where federal or state law requires the laboratory to do so. Samples are generally identified with laboratory identification numbers, and access to electronic records and reports is password protected. Confidentiality statements are applied to fax and e-mail communications. All personnel, including contract and temporary, are required to sign an "Attestation of Ethics and Confidentiality" at the time of employment and during annual refresher training. Violations of this document result in serious consequences, including prosecution and termination, if necessary. For more information see the ESC Policy Manual and SOP #010102, *Ethics, Data Integrity, and Confidentiality*.

- Policies and procedures to avoid involvement in any activities that would diminish confidence in its competence, impartiality, judgment or operational integrity. For more information see the ESC Policy Manual and SOP #010102, Ethics, Data Integrity, and Confidentiality. The laboratory's data integrity system is also discussed in Section 4.2.8 below.

- A defined organization and management structure. The laboratory's organizational chart can be found at the end of this section.

- Specifications of the responsibility, authority, and interrelationships of all personnel who manage, perform, or verify work affecting the quality of the analytical results. Job descriptions are documented and maintained by the Human Resources department. It is the laboratory's policy that each individual understands his or her particular responsibilities and how to report problems when they occur.

- Adequate supervision provided to all analytical staff, including trainees, by persons familiar with the analytical methods and procedures.

- Technical management which has overall responsibility for the technical operations. This includes providing the resources needed to ensure the required quality of laboratory operations is met as per the policies and procedures documented in this Quality Assurance Manual. This technical management includes the Chief Executive Officer, the President, the Director of Operations, the Organics Manager, the Inorganics Manager, and each individual department supervisor.

- Quality management which has the responsibility and authority for ensuring that the management system related to quality is implemented and followed at all times. Currently the Compliance Director and the Quality Assurance Director have been appointed for this task. These staff members have direct access to the highest level of management at which decisions are made on laboratory policy and resources.

- Appointed deputies for key managerial personnel. The following table defines who assumes the responsibilities of key personnel in their absence:

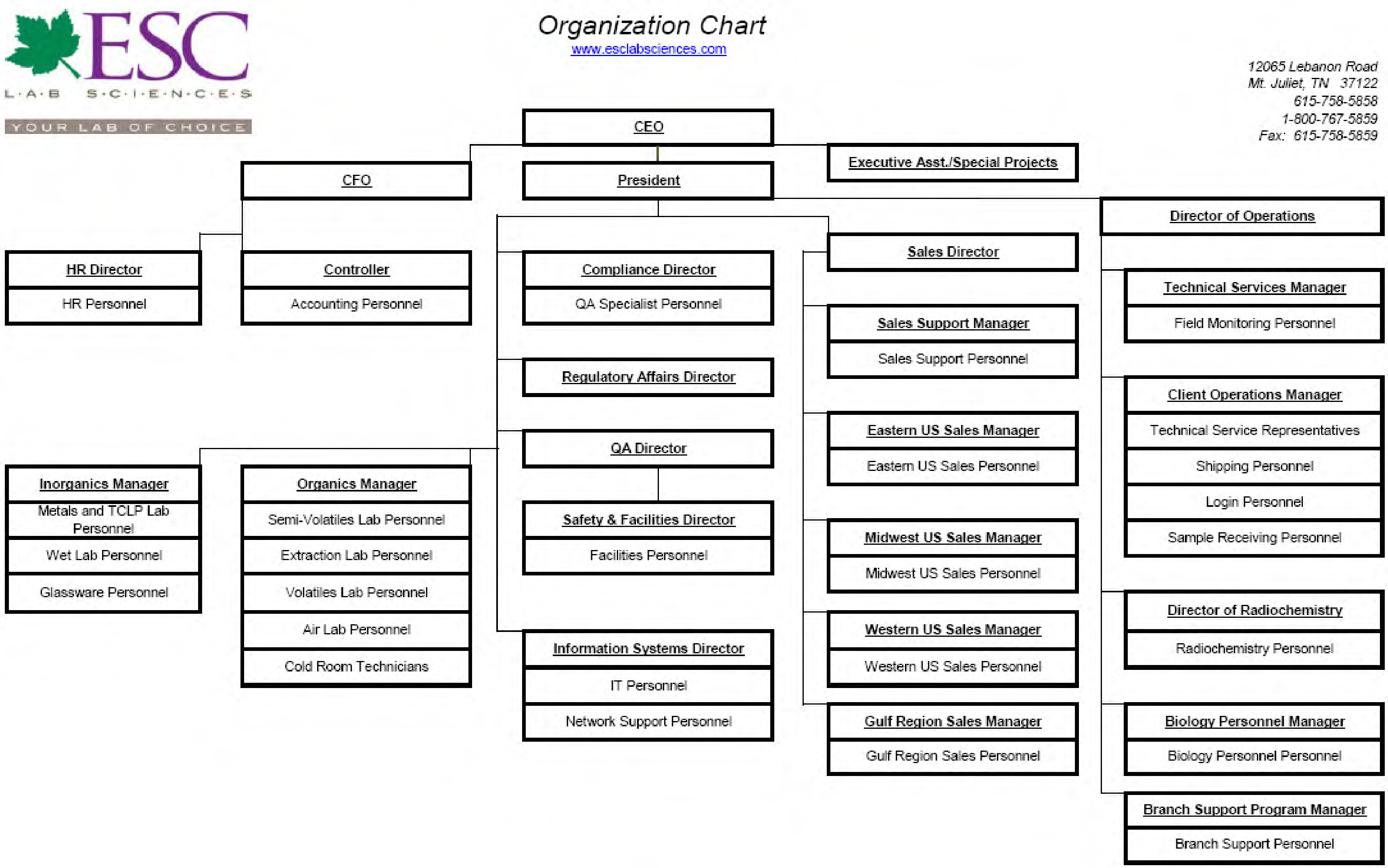
PRIMARY	DEPUTY
Chief Executive Officer	President
President	Chief Executive Officer
Director of Operations	Technical Services Manager
Organics Manager	President and Department Supervisors/Leads
Inorganics Manager	President and Department Supervisors/Leads
Compliance Director	Quality Assurance Director
Quality Assurance Director	Compliance Director
Information Systems Director	Ad Hoc (Applicable IT personnel as needed)

- Personnel that are aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives of the management system. Laboratory management ensures that all personnel are aware that their job is needed, and how each role contributes to the laboratory's business goals. All personnel are required to familiarize themselves with the quality documentation relevant to their position and implement these policies and procedures in their work. All personnel must ensure that the generation and reporting of quality analytical data is a fundamental priority.

4.1.6 Laboratory Communication

Laboratory management ensures that appropriate communication processes are established within the laboratory and that communication takes place regarding the effectiveness of the management system. Laboratory personnel (including supervisors and managers) communicate as needed through meetings, memos, and/or e-mails.

Figure 4.1 Organizational Chart (*Subject to change*)



4.2 Management System

4.2.1 General

ESC Lab Sciences has established, implemented, and maintains a management system appropriate to the scope of its activities. ESC Lab Sciences has documented its policies and procedures to the extent necessary to assure the quality of the analytical test results. The ESC Lab Sciences management system's documentation is communicated to, understood by, available to, and implemented by the appropriate laboratory personnel.

4.2.2 Management's Quality Policy Statement

ESC Lab Sciences has a diverse accreditation/certification program which represents greater than 48 separate state and national accreditations. This requires commitment to the laboratory's quality system, and it also requires continuous improvement to comply with all the applicable state, federal, and industry standards. ISO 17025 is maintained as the minimum foundation to meet each program requirement.

ESC Lab Sciences management is committed to providing our customers reliable data of known quality that meets their requirements by following the quality system that is documented in this Quality Assurance Manual. Management is committed to using good professional practices and demonstrates its commitment to quality by providing the personnel, equipment, and facilities necessary to ensure the laboratory gives our customers the highest possible standard of service.

The primary responsibility for quality rests with each individual within ESC Lab Sciences. All personnel are required to familiarize themselves with the quality documentation relevant to their position and implement these policies and procedures in their work. All personnel must ensure that the generation and reporting of quality analytical data is a fundamental priority. This focus on quality is applied to initial project planning, continued through all field and laboratory activities, and is ultimately included in the final report generation.

4.2.3 Management's Commitment to the Management System

ESC's management is committed to the development, implementation, and continual improvement of the laboratory's management system. Evidence of this commitment can be found in the policies and procedures that are included in this Quality Assurance Manual which includes, but is not limited to, records of management review meetings as per section 4.15 below.

4.2.4 Communication of Customer and Regulatory Requirements

ESC's management communicates to the organization the importance of meeting customer and regulatory requirements. This is accomplished in writing through this Quality Assurance Manual, ESC's Policy Manual, and through ESC's Standard Operating Procedures. This is also accomplished verbally through staff meetings.

4.2.5 Supporting and Technical Procedures

The full list of supporting and technical procedures used by the laboratory is maintained by the Quality Assurance Department. This list can be provided upon request. This Quality Assurance Manual contains references to these procedures where applicable, and outlines the structure of the documentation used in the laboratory's management system.

4.2.6 Management Roles and Responsibilities

The roles and responsibilities of some technical and quality management are defined below. More information can be found in the job descriptions that are maintained by the Human Resources department. All managers and supervisors are responsible to ensure that their respective departments comply with all the applicable state, federal, and industry standards.

Chief Executive Officer

Peter Schulert, Bachelor of Science in Chemistry, is the laboratory's Chief Executive Officer (CEO). He joined ESC in 1987 after the completion of his service with the United States Naval Submarine Service. In his five years of nuclear submarine experience in the Navy, Mr. Schulert qualified as an Officer of the Deck. This qualification included supervision of nuclear reactors and power plant operations. His vision for automation and customer services has been a key component of ESC's rise to the top ranks of the industry. Under his leadership, ESC has become a large single location laboratory, with a comprehensive national certification program and industry leading data management tools. In his absence, all responsibilities are delegated to the ESC President.

President

John Mitchell, Bachelor of Science in Chemistry, is the laboratory's President. He joined ESC in 2014 after gaining over 25 years of experience in commercial laboratory operations and management. He has served as a National Program Director for Oil and Gas Programs for several years, assisting exploration and production industrial customers with the establishment and management of risk-based analytical programs to ensure compliance with regulatory requirements and to develop additional strategies to reduce long term environmental impact liability. He directed emergency response actions, leading the laboratory response for multiple large scale mobilizations across the country. Mr. Mitchell is responsible for developing and executing ESC's strategic plan. In his absence, all operational responsibilities are delegated to the Chief Executive Officer.

Director of Operations

Eric Johnson, B.S. in Chemistry, is the laboratory's Director of Operations and is primarily responsible for the Project Management, Branch Support, Shipping, and Receiving departments. He has been involved in many aspects of environmental analyses since 1991, and has vast experience in managing the daily laboratory and customer service operations of ESC Lab Sciences. He focuses his background and experience on the improvement of existing systems in order to improve quality and maximize efficiency. He reports directly to the President. In his absence, his responsibilities are delegated to the Technical Services Manager and then to individual department managers.

Organics Manager

Chris Johnson, B.S. in Biology, is the Organics Manager. He has more than 15 years of laboratory experience which includes supervising laboratory personnel and also performing analyses for metals, volatile organic compounds, and semi-volatile organic compounds in support of the Safe Drinking Water Act, Clean Water Act, Resource Conservation and Recovery Act, and numerous other state and regulatory programs. His responsibilities are to share the vision and direction of laboratory management with the organic departments, effectively communicate with laboratory management and to personnel within the organic departments, to develop goals within the organic departments, to provide the information and resources necessary to reach each goal, and for ensuring the organic departments are providing accurate analytical data in the most efficient manner possible within regulatory guidelines. He is also responsible for the research, evaluation, implementation, and validation of new instrumentation and methodologies. In his absence, his responsibilities are delegated to the President then to individual department supervisors and/or leads.

Inorganics Manager

Johnny Davis, B.S. in Biology, is the Inorganics Manager. He has 13 years of laboratory experience which includes supervising laboratory personnel and also performing analyses for metals and semi-volatile organic compounds in support of the Safe Drinking Water Act, Clean Water Act, Resource Conservation and Recovery Act, and numerous other state and regulatory programs. His responsibilities are to share the vision and direction of laboratory management with the inorganic departments, effectively communicate with laboratory management and to personnel within the inorganic departments, to develop goals within the inorganic departments, to provide the information and resources necessary to reach each goal, and for ensuring the inorganic departments are providing accurate analytical data in the most efficient manner possible within regulatory guidelines. He is also responsible for the research, evaluation, implementation, and validation of new instrumentation and methodologies. In his absence, his responsibilities are delegated to the President then to individual department supervisors and/or leads.

Compliance Director

Jim Brownfield, B.S. in Chemistry, is the Compliance Director. His primary responsibility is to ensure regulatory compliance of the laboratory. He is also responsible for managing the implementation, monitoring, and development of the laboratory's Quality Assurance Systems; maintaining the laboratory's Quality Assurance Manual; and ensuring all laboratory personnel are strictly adhering to the laboratory's ethics policy. He also performs other Quality Assurance activities including method validation, technical writing, and participation in internal and external assessments. In addition, he oversees the QA data review team. He has more than 15 years of experience in various supervisory and managerial roles in the environmental laboratory industry. Over the years he has gained an extensive and detailed understanding of regulatory and accreditation requirements of federal and various state accreditation agencies. He has successfully designed, developed, implemented, and maintained Quality Assurance Systems in multiple laboratories. In his absence, all responsibilities are delegated to the Quality Assurance Director.

Quality Assurance Director

Steve Miller, B.S. in Microbiology, is the laboratory Quality Assurance Director and is responsible for managing the implementation, monitoring, and development of the laboratory's Quality Assurance Systems. In this role, he also oversees safety, waste management, internal and external audits, and new method implementation. He has been involved in many aspects of the environmental industry since 1990. He has an in-depth knowledge of GC and GCMS methods and instrumentation having hands-on experience with MS, PID/FID, FID, and ECD detectors. He has years of experience validating all types of environmental data. He has served as technical support for many environmental site investigation and/or remediation projects, primary author of several project-specific Quality Assurance Project Plans, support for RCRA-permitted activities at major oil refineries (including permit modification), and primary author of the first hazardous waste delisting petition approved by U.S. EPA Region 8. In his absence, all responsibilities are delegated to the Compliance Director.

Information Systems Director

Nick Parker, B.S. in Plant and Soil Science, is the laboratory's Information Systems Director. He has more than 15 years of laboratory experience in Organic analytical methods/instrumentation in the production laboratory environment and an expertise within information technologies and process automation. Mr. Parker is responsible for ESC's data management, information security, and software development while leading a team of developers, specialists, and Database Administrators. His unique understanding of laboratory operations and environmental methodology contributes to ESC's well managed software development and deployment within all laboratory and quality departments. In his absence, all responsibilities are delegate to applicable personnel in the IT department.

4.2.7 Management of System Changes

Top management ensures that the integrity of the management system is maintained when changes to the management system are planned and implemented. This includes ensuring that quality system documentation is updated as needed.

4.2.8 Data Integrity System

ESC Lab Sciences is committed to ensuring the integrity of its data and providing valid data of known and documented quality to its customers. ESC is also committed to creating and maintaining a culture of quality throughout the organization. The elements in ESC's data integrity system include:

- A standardized data integrity training program that is given to all new employees and a yearly refresher course is also presented to all employees.
- All ESC personnel, including contract and temporary, are required to sign an "Attestation of Ethics and Confidentiality" at the time of employment and during annual refresher training.
- An in-depth periodic monitoring of data integrity which includes, but is not limited to, the following: peer data review, internal audits, QA data review of raw data, and proficiency testing studies.
- A process that allows for confidential reporting of alleged data integrity issues. Currently, an anonymous hotline is available to all employees that is managed by an outside vendor. Messages are collected, documented, reviewed, and will be followed up on by senior management to resolve the matter. Comments made on this hotline are confidential, and callers will remain anonymous.

Anonymous Hotline Number: 1-800-398-1496

Additional information about the laboratory's data integrity system can be found in SOP# 010102 *Ethics, Data Integrity, and Confidentiality*. This SOP is signed by top management and is reviewed at least annually.

4.2.9 Policy for Use and Control of Electronic Signatures

Electronic signatures must be controlled by the individual as electronic files. Electronic signature files must be stored in a secure password protected environment, and are not sent to or used by other individuals. Electronic signatures carry the same weight as handwritten signatures with regards to document approval.

4.3 DOCUMENT MANAGEMENT

This section describes procedures for document management, which includes controlling, distributing, reviewing, and accepting modifications. The purpose of document management is to ensure that adequate instruction is readily available for laboratory employees and to preclude the use of invalid and/or obsolete documents.

4.3.1 Document Control Procedure

ESC has an established procedure for managing documents that are part of the quality system. The list of managed documents includes, but is not limited to, Standard Operating Procedures (both technical and non-technical), the Quality Assurance Manual, policy statements, work-processing documents, charts, and forms that have a direct bearing on the quality system.

Documents required by the management system are managed per the SOP #010103, *Document Control and Distribution*.

4.3.2 Document Approval and Issue

Documents are reviewed and approved for use by authorized personnel prior to issue. A master list of all managed documents is maintained identifying the current revision status and distribution of the controlled documents. This establishes that there are no invalid or obsolete documents in use.

The SOP #010103, *Document Control and Distribution* ensures:

- Only currently approved document versions are available at points of use
- Documents are reviewed periodically and revised if necessary
- Invalid or obsolete documents are promptly removed from general use
- Obsolete documents retained for audit or knowledge preservation purposes are suitably marked and/or isolated to prevent accidental use

Documents that are generated internally by the laboratory are uniquely identified with the following:

- Date of issue and/or revision identification
- Page numbering
- Total number of pages or a mark to indicate the end of the document
- The issuing authority(ies)

4.3.3 Changes to Controlled Documents

Document changes are reviewed and approved by the original approving authority(ies) unless specifically designated otherwise. Designated authorities are required to have pertinent background information upon which to base their review and approval.

Where practicable, the altered text or new text in the draft is identified during the revision or review process to provide for easy identification of the modifications. Minor SOP changes that occur in the interim of each major revision of the procedure are indicated in the ESC SOP/Minor Revision Form that is attached to the SOP. All SOPs contain a revision history that provides details of changes during periodic reviews and/or major SOP revisions.

The document management process allows for “minor revisions” or amendments to SOPs where changes are not sufficient to cause a full procedure change. Minor revisions may take the form of handwritten or typed notes on an approved SOP Minor Revision form. Approval of these minor revisions are indicated by the initials of the approval authorities. The modified document is then distributed, and obsolete documents are removed. Minor revisions to documents are incorporated into the next full revision as soon as practical.

Electronic documents, such as the Quality Assurance Manual and SOPs, are maintained electronically on protected directories. All laboratory personnel have access to directories that contain the currently approved versions, but edit rights are restricted to authorized personnel only. Obsolete versions of electronic documents are maintained in directories that can only be accessed be authorized personnel.

4.3.4 Quality Assurance Manual

The Compliance Director is responsible for maintaining the currency of the Quality Assurance Manual.

The Quality Assurance Manual is reviewed/revised annually or whenever a change is deemed necessary by laboratory management to ensure it still reflects current practices and meets the requirements of any applicable regulations or customer specifications.

The Quality Assurance Manual contains the following required items as defined by the 2009 TNI Standard (V1:M2, Section 4.2.8.3):

- A document title
- The laboratory's full name and address
- The name, address (if different from above), and telephone number of individual(s) responsible for the laboratory;
- The identification of all major organizational units which are to be covered by this quality manual and the effective date of the version
- Identification of the laboratory's approved signatories;
- The signed and dated concurrence (with appropriate names and titles), of all responsible parties including the quality manager, technical manager(s), and the agent who is in charge of all laboratory activities, such as the laboratory director or laboratory manager.
- The objectives of the management system and contain or reference the laboratory’s policies and procedures
- The laboratory’s official quality policy statement, which shall include management system objectives and management’s commitment to ethical laboratory practices and to upholding the requirements of ISO 17025 and the TNI Standard
- Table of contents, and applicable lists of references, glossaries and appendices.

This Quality Assurance Manual also contains or references the following required items as defined by the 2009 TNI Standard (V1:M2, Section 4.2.8.4):

- All maintenance, calibration and verification procedures used by the laboratory in conducting tests
- Major equipment and reference measurement standards used as well as the facilities and services used by the laboratory in conducting tests
- Verification practices, which may include inter-laboratory comparisons, proficiency testing programs, use of reference materials and internal quality control schemes
- Procedures for reporting analytical results
- The organization and management structure of the laboratory, its place in any parent organization, and relevant organizational charts

- Procedures to ensure that all records required under ISO 17025:2005 and the TNI Standard are retained, as well as procedures for control and maintenance of documentation through a document control system that ensures that all standard operating procedures (SOPs), manuals, or documents clearly indicate the time period during which the procedure or document was in force
- Job descriptions of key staff and reference to the job descriptions of other laboratory staff
- Procedures for achieving traceability of measurements
- A list of all methods under which the laboratory performs its accredited testing
- Procedures for ensuring that the laboratory reviews all new work to ensure that it has the appropriate facilities and resources before commencing such work
- Procedures for handling samples
- Procedures to be followed for feedback and corrective action whenever testing discrepancies are detected, or departures from documented policies and procedures occur
- Policy for permitting departures from documented policies and procedures or from standard specifications
- Procedures for dealing with complaints
- Procedures for protecting confidentiality and proprietary rights
- Procedures for audits and data review
- Procedures for establishing that personnel are adequately experienced in the duties they are expected to carry out and are receiving any needed training;
- Policy addressing the use of unique electronic signatures

4.3.5 Standard Operating Procedures

Standard Operating Procedures (SOPs) are written procedures that describe in detail how to accurately and consistently reproduce laboratory processes or provide additional direction for laboratory personnel. Copies of all SOPs are accessible to all personnel. SOPs consist of three types:

- Technical SOPs, pertaining to a laboratory process which have specifically required details
- Administrative SOPs which document the more general organizational procedures.
- Quality SOPs that provide background and process for quality policy.

Each SOP indicates the effective date, the revision number, and the issuing authority(ies). Department Supervisor approval is required on technical procedures. Detailed information can be found in SOP# 010100, *Writing, Revising, and Maintaining Standard Operating Procedures*

Deviations from SOPs and Quality documents are not allowed without the permission of the Compliance Director, or designee. In the event that a deviation is requested, the circumstance is considered and the procedure is evaluated for necessary change and allowance.

The laboratory has SOPs for all analytical methods within its scope of accreditation. Any deviation from a method is documented in the method modifications section of the respective SOP, including both a description of the change made and a technical justification.

Each determinative method SOP includes or references (as applicable) the following:

- Scope and Application;
- Method Summary and Definitions;
- Health and Safety;
- Sample Preservation, Containers, Handling and Storage;
- Interferences;
- Equipment and Supplies;
- Reagents and Standards;
- Procedure;
- Data Analysis and Calculations;
- Quality Control and Method Performance;
- Data Validation and Corrective Action;
- Pollution Prevention and Waste Management;
- Method Modifications/Clarifications;
- References;
- Procedure Revision/Review History;

SOPs may not be reproduced, in part or in full, without written consent of ESC Lab Sciences. SOPs may not be altered in any way. Whether distributed internally or as a courtesy copy to customers or regulatory agencies, SOPs are considered confidential and proprietary information. Any copies in use within ESC Lab Sciences have been reviewed, approved, and properly controlled. Any copies of SOPs distributed outside of ESC Lab Sciences are uncontrolled, unless a customer or regulator specifically requests a controlled copy.

4.4 REVIEW OF REQUESTS, TENDERS, AND CONTRACTS

4.4.1 Procedure for Requests, Tenders, and Contracts Review

When ESC enters into a contract to provide laboratory services, it follows SOP# 020303, *Contract Review*. Upon receipt of a request or invitation to tender a bid/proposal, the customers' requirements are examined by the contract review personnel to establish that the necessary details are adequately outlined and that the laboratory is able and willing to meet them.

For routine/non-complex projects, a review by appropriate customer service personnel is considered adequate. Customer service confirms that the laboratory can meet the customer's data quality objectives, and the laboratory has any required certifications. Customer service will also confirm that the laboratory has the capacity to meet the customer's turn-around time needs.

4.4.2 Records of Reviews

Records of reviews of requests, tenders and contracts (including significant changes) are maintained. Records are also maintained of pertinent discussions with the customer relating to the customer's requirements and the results of the work during the period of execution of the contract.

4.4.3 Subcontracted Work

The review described above also encompasses any work that will need to be subcontracted to another laboratory. See section 4.5 below for more information about subcontracting work.

4.4.4 Deviations from the Contract

Applicable customers are informed of any deviation from any contract.

4.4.5 Contract Amendments

If a contract requires amendment after work has commenced, the same contract review process is repeated and any amendments are communicated to all affected parties.

4.5 SUBCONTRACTING

4.5.1 Subcontractor Competence

ESC only performs analytical techniques that are within its documented capability, when this is not possible, the laboratory follows SOP# 030209, *Subcontracting.* Subcontracting also occurs in the special circumstances where technical, safety, or efficiency issues dictate need. When subcontracting analytical services, the laboratory assures work requiring specific accreditation is placed with an accredited laboratory or one that meets applicable statutory and regulatory requirements of the project/customer. As part of the subcontractor approval process, a copy of the applicable certificates and scopes for subcontractor's accreditations is maintained as evidence of compliance.

4.5.2 Customer Notification

ESC notifies the customer of the intent to subcontract the work in writing. The laboratory typically gains the approval of the customer to subcontract their work prior to implementation, preferably in writing.

4.5.3 ESC Responsibility

ESC assumes responsibility for the qualifications of the subcontractor except when the customer or an authority specifies the subcontractor.

4.5.4 Subcontractor List

ESC maintains a list of all approved subcontract laboratories.

4.5.5 Identification of Subcontracted Work

All analytical reports, which contain data from subcontracted laboratories, include a statement which references the subcontractor laboratory/service.

4.6 PURCHASING SERVICES AND SUPPLIES

4.6.1 Purchasing Policies and Procedures

ESC maintains SOP# 030210, *Materials Procurement for Analytical Processes,* which describes the purchasing process, including vendor selection and acceptance criteria, for the purchase, storage, and evaluation of supplies and services. When relevant to the measurement integrity of analyses, ESC uses only services and supplies of adequate quality.

4.6.2 Quality of Purchased Items

Department supervisors are responsible for ensuring only supplies/chemicals that meet specified requirements are ordered. Where assurance of the quality of services or supplies is unavailable, the laboratory uses these items only after they have been inspected or otherwise verified for adequate quality. Records of inspections and verifications are maintained in the laboratory.

4.6.3 Purchasing Documents

Purchasing documents are maintained and they contain information that describes the services and supplies that were ordered. These purchasing documents are reviewed and approved by applicable personnel prior to release.

4.6.4 Approved Supplier List

Suppliers of critical services and supplies are evaluated. An approved list of material/service suppliers is maintained where products/services purchased affect the quality of data generated by the laboratory.

4.7 SERVICE TO THE CUSTOMER

ESC's Customer Service Department provides specific project service through the use of Technical Service Representatives (TSRs). The TSR is responsible for all contract requirements and laboratory/customer communication, including information concerning schedules, delays, and major deviations in the testing process.

4.7.1 Meeting Customer Expectations

ESC is willing to cooperate with its customers. The TSR works closely with the customer to clarify the customer's requests and to monitor the laboratory's performance in relation to the work requested, while ensuring confidentiality to other customers. The laboratory confidentiality policy prohibits divulging or releasing any information to a third party without proper authorization. See SOP# 010102, *Ethics, Data Integrity, and Confidentiality*. All electronic data (storage or transmissions) are kept confidential, based on technology and laboratory limitations, as required by customer or regulation. All electronic transmissions contain a confidentiality notice that represents the following:

Notice: This communication and any attached files may contain privileged or other confidential information. If you have received this in error, please contact the sender immediately via reply email and immediately delete the message and any attachments without copying or disclosing the contents. Thank you.

For additional information see SOP# 020301, *TSR (Project Management).*

4.7.2 Customer Feedback

ESC seeks customer feedback (both positive and negative) through various means including surveys and personal communication. This feedback is utilized to improve the management system, quality system, testing and calibration activities and customer services.

4.7.3 Customer Access to the Laboratory

Upon customer request, ESC provides reasonable access to relevant areas of the laboratory for witnessing capability and analytical performance. Confidentiality of all customers during this process is maintained.

4.7.4 Providing Supplemental Information

Upon request customers are provided supplementary information and records as needed. This includes, but is not limited to, the following: sample preparation records, packaging information, verification of calibrations, and analytical reference material information.

4.7.5 Communication with the Customer

ESC's Technical Service Representatives are required to maintain good communication with customers. Customers are informed of any delays or major deviations in the analytical work of the laboratory.

4.8 COMPLAINTS

Complaints are taken very seriously, and are typically initially addressed by customer service or sales. Other applicable laboratory personnel can be involved during the corresponding investigations and any needed corrective actions to provide customer support. Records of all complaints, investigations, and corrective actions are maintained. For more information see section 4.11 below for corrective actions and SOP #020302, *Client Complaint Resolution.*

4.9 CONTROL OF NON-CONFORMING WORK

4.9.1 Identification of Non-Conforming Work

Non-conforming work is work that does not conform to customer requirements, standard specifications, or documented laboratory policies/procedures. Some examples of non-conformances are departures from SOPs/test methods or quality control results that do not meet acceptance criteria. Identification of non-conforming work can come through various sources which include, but is not limited to; results of quality control samples and instrument calibrations, observations of laboratory personnel, data review, and internal audits.

4.9.2 Policies and Procedures

Many types of non-conformances are listed in the applicable SOPs along with the responsibilities and actions that are needed. Any needed corrections for these non-conformance events are taken immediately together with any decision about the acceptability of the nonconforming work.

In the event that a non-conformance is likely to reoccur or that there is doubt about the compliance of the laboratory's operations with its own policies or procedures; laboratory personnel will investigate the significance of the non-conformance and document corrective actions if applicable. When quality of the analytical data has been adversely affected, customers are notified and work is recalled as necessary. For more information see section 4.11 below for corrective actions and the SOP #030208, *Corrective and Preventive Action*.

Customer requests for departures must be pre-approved by appropriate laboratory personnel. These planned and pre-approved departures/non-conformances do not require reviews/investigations; however, they still must be documented. When necessary, planned and pre-approved non-conformances are noted in the final analytical report to advise the data user of any ramification to data quality.

4.9.3 Release of Nonconforming Work

The laboratory allows the release of nonconforming data only with approval on a case-by-case basis by the department supervisor, or their designee. Permitted non-conformances, such as QC failures, are fully documented and include the reason for the deviation and the impact of the departure on the data. Where necessary, customer service will notify the customer of the situation and will advise of any ramifications to data quality. Also where necessary, non-conformances are noted in the final analytical report to advise the data user of any ramification to data quality.

4.9.4 Stop Work Procedures

The Compliance Director and the Quality Assurance Director have the responsibility and authority to ensure the Quality System is implemented and followed at all times. In circumstances where a laboratory is not meeting the established level of quality or not following the policies set forth in this Quality Manual, the Compliance Director and the Quality Assurance Director have the authority to halt laboratory operations should he or she deem such an action necessary. The Compliance Director and/or the Quality Assurance Director will immediately communicate the halting of operations to the laboratory senior management and will keep them posted on the progress of corrective actions.

The department supervisors and members of senior management also have the authority to halt laboratory operations should they deem this action necessary. If this is done they will notify the Compliance Director and/or the Quality Assurance Director, and they will keep them informed about the progress of corrective actions.

All laboratory personnel have the authority to halt laboratory operations in the event that a situation impacts data validity or safety. When this action is deemed necessary, then the applicable supervisor must be notified of the situation as soon as possible. The supervisor and/or members of senior management will evaluate the severity of the situation for further decision making.

Once a stop work order has been approved and implemented, the Compliance Director and/or the Quality Assurance Director have the responsibility of ensuring the effectiveness of the corrective actions taken and authorizing the resumption of work.

4.10 IMPROVEMENT

Laboratory management demonstrates its commitment to quality by providing the resources (including facilities, equipment, and personnel) to ensure the adherence to the policies and procedures documented in this Quality Assurance Manual; and to promote the continuous improvement of the quality system. Continuous improvement of the quality system is also achieved by the implementation of the various aspects of this Quality Assurance Manual which include the following:

- The quality policy and objectives
- The internal and external auditing practices
- The review and analysis of data
- The corrective action process
- The preventive action process
- The managerial review process where the various aspects of the management/quality system are summarized, evaluated, and plans for improvement are developed.

4.11 CORRECTIVE ACTIONS

During the day-to-day laboratory operations, certain occurrences may warrant the necessity of corrective actions. These occurrences may take the form of analyst errors, deficiencies in quality control, method deviations, or other unusual circumstances. The laboratory's quality system provides systematic procedures for the documentation, monitoring, completion of corrective actions, and follow-up verification of the effectiveness of these corrective actions. This is done using the laboratory's Corrective Action and Preventative Action (CAPA) system that lists at a minimum; the deficiency by issue number, the deficiency source, responsible party, root cause, resolution, due date, and date resolved.

4.11.1 General Corrective Action Procedure

The following items are examples of sources of laboratory deviations or non-conformances that warrant some form of documented corrective action:

- Internal and External Audit Deficiencies
- Unacceptable Proficiency Testing (PT) Results
- Data or Records Review Deficiencies
- Customer Complaints
- Holding Time Violations

Documentation of corrective actions may be in the form of a qualifier or comment in the analytical data and/or on the final report that explains the deficiency. Corrective actions involving sample receiving are recorded on non-conformance forms and are attached to the applicable chain of custody. Documentation of corrective actions may also be a more formal corrective action report that is entered into the laboratory's Corrective Action and Preventative Action (CAPA) system. This depends on the extent of the deficiency, method requirements, the impact on the data, and any customer requirements for documentation.

The person who discovers the deficiency or non-conformance initiates the corrective action process. If a formal corrective action report is warranted, then the person initiating the corrective action must document the issue, the affected projects/samples, any known causes of the issue, and the corrective actions that they have taken. After this documentation is completed, the corrective action report is routed to the supervisor and/or to applicable personnel for notification of the issue and review. After the corrective action report is reviewed by the supervisor and/or applicable personnel, then it is routed to the quality assurance department for final review, verification, and signoff of the corrective action.

For more information see SOP #030208, *Corrective and Preventive Action.*

4.11.2 Root Cause Analysis

It is necessary that corrective actions taken address the root cause of the issue in order to prevent reoccurrences. In some cases, an identified cause equals to the "root cause" of the issue. In other cases, an identified cause is actually the outcome or symptoms of an underlying "root cause". Root cause analysis is the key and sometimes the most difficult part in the corrective action procedure. Often the root cause is not obvious and thus a careful analysis of all potential causes of the problem is required. Potential causes could include customer requirements, the samples, sample specifications, methods and procedures, staff skills and training, consumables, or equipment and its calibration.

In the event that the root cause is not obvious, laboratory personnel and management staff will start a root cause analysis by going through an investigative process. During this process, the following general steps must be taken into account: defining the non-conformance, assigning responsibilities, determining if the condition is significant, and investigating the root cause of the nonconformance. General non-conformance investigative techniques follow the path of the sample through the process looking at each individual step in detail. The root cause must be documented within the laboratory's Corrective Action and Preventative Action (CAPA) system.

4.11.3 Selection and Implementation of Corrective Actions

Where uncertainty arises regarding the best corrective action approach for addressing the root cause of an issue, appropriate laboratory personnel will recommend corrective actions that are appropriate to the magnitude and risk of the problem that will most likely eliminate the problem and prevent recurrence. If needed, senior laboratory management will then decide the best course of action needed. The corrective action that is chosen will then be implemented and documented in the laboratory's Corrective Action and Preventative Action (CAPA) system.

4.11.4 Monitoring of Corrective Actions

Personnel in the quality assurance department are responsible for monitoring the implementation and documentation of corrective actions to ensure that the corrective actions taken are effective. This verification of the corrective actions effectiveness is documented laboratory's Corrective Action and Preventative Action (CAPA) system.

4.11.5 Additional Audits

When the identification of non-conformances or departures casts doubt on compliance with the laboratory's policies, procedures, or regulatory requirements; laboratory management ensures that appropriate areas of activity are audited in accordance with Section 4.14.1 as soon as possible. These additional audits can be short and focused to follow-up with the implementation of the corrective actions to confirm their effectiveness. Additional full-scale audits are only necessary when a serious issue or risk to the laboratory's business is identified.

4.12 PREVENTIVE ACTIONS

Preventive action is a pro-active process to identify opportunities for improvement rather than a reaction to the identification of problems or complaints. ESC takes advantage of several information sources to identify opportunities for improvement in all its systems including technical, managerial, and quality systems. These sources include, but are not limited to, the following:

- Identification of trends during data review
- Staff meetings
- Customer feedback, including complaints
- Managerial reviews

Some examples of preventative action include, but are not limited to, the following:

- Scheduled instrument maintenance (Preventative maintenance)
- Adding additional staff
- Acquisition of new equipment
- Training activities

All laboratory personnel have the authority to offer suggestions for improvements and to recommend preventive actions. However, it is ultimately the responsibility of laboratory management for implementing preventive action. When improvement opportunities are identified or if preventative action is required; then action plans are developed, implemented, and monitored to reduce the likelihood of the occurrence of non-conformities and/or to take advantage of the opportunities for improvement.

For more information see SOP #030208, *Corrective and Preventive Action.*

4.13 CONTROL OF RECORDS

Records are usually data recordings that include annotations, such as daily refrigerator temperatures, posted to laboratory forms, lists, spreadsheets, or analyst notes on a chromatogram. Records may be on any form of media, including electronic and hardcopy. Records allow for the historical reconstruction of laboratory activities related to sample handling and analysis.

4.13.1 General

Technical and quality assurance records are established and maintained to provide evidence of conformity to requirements and of the effective operation of the quality system. Mechanisms are established for records to remain legible, readily identifiable and retrievable. The laboratory maintains a record system appropriate to its needs, records all laboratory activities, and complies with applicable standards or regulations as required.

The laboratory has defined the length of time various records, pertaining to the management system and examination results, are to be retained. Retention time is defined by the nature of examination or specifically for each record. The laboratory retains all original observations, calculations and derived data, calibration records, chain of custody and a copy of the test report for a minimum of ten years, unless otherwise required by regulatory authority.

Documented records procedures SOP# 010103, *Document Control and Distribution Procedure*, and SOP# 020304, *Protection and Transfer of Records*, are established to define the means needed for the identification, storage, protection, retrieval, retention time, transfer, and/or disposition of records.

4.13.2 Technical and Quality Records

NOTE: ALL records/data are stored for a minimum of 10 years, unless otherwise noted.

All hardcopy department logbooks, such as temperature, maintenance, and preparation logs are placed into storage boxes and archived via a unique numbering system, to the ESC storage facility. Additional information regarding reagents/standards can be found in the Standards Logger (Tree) digital archive system. This digital system is backed up according to the ESC IT backup procedure.

Archived information and access logs are protected against fire, theft, loss, environmental deterioration, vermin, and in the case of electronic records, electronic or magnetic sources.

Data Storage Criteria	
Data Type	**Storage Criteria**
Manual Data Wet Chemistry	All manually generated data are stored in specific laboratory analysis workbooks. Each individual analysis is located in a separate notebook which contains all data relating to the test including, calibration curves/data, QC charts/limits, SOP, and completed analysis sheets. These notebooks are centrally located and contain completed data that is filed by analysis and date analyzed. Monthly – Data is removed from the notebook and placed in a dedicated filing cabinet. Semi-annually – Data is removed from the filing cabinet, placed in storage boxes and archived, via a unique numbering system, in the ESC storage facility
Manual Data Prep Labs	All logbooks utilized in manually recording sample preparation information are placed into storage boxes and archived, via a unique numbering system, in the ESC storage facility. This includes organic prep, metals prep, and TCLP.
Manual Data Env. Micro, Mold	All manually generated data is stored in specific laboratory files and notebooks. These files are centrally located and contain completed data that is filed by analysis and date analyzed. Data is placed into storage boxes and (when full) archived, via a unique numbering system, in the ESC storage facility.
All Data Aquatic Toxicity	All manually generated data is stored in specific laboratory files and notebooks. These files are centrally located and contain completed data that is filed by analysis and date analyzed. Data is placed into storage boxes and (when full) archived, via a unique numbering system, in the ESC storage facility. Final reports and Reference Toxicant results are also scanned into ESC's electronic document management system. The data storage device on which this data resides is backed up daily. Data files are archived on to magnetic tape and retained per laboratory policy.
Computerized Data - Organic Dept.	Injection logs are printed to PDF file and maintained with the data. The instrument data is printed to a secure server and remains in a format that cannot be changed after printed. Upon printing, the data in the original file is generated. This storage system is backed up nightly utilizing a seven-day rotation cycle. The data is immediately available for up to two years. After two years, raw instrument data files are archived onto a separate secure server and kept a minimum of ten years. Original raw data files cannot be edited.
Computerized Data – Inorganic Metals Dept.	All data produced by metals instrumentation is backed up to a secure drive, nightly, utilizing a seven-day rotation cycle. All data is archived on a network attached storage device and is immediately available for up to two years. After two years, raw instrument data files are archived on to a separate secure server and kept a minimum of ten years. Original raw data files cannot be edited.
Final Report Storage - LIMS	The LIMS facilitates access to any finished data and sample information by customer code, sample number, and parameter run number. Furthermore, any data pertaining to a sample or customer can be obtained. The LIMS also contains the information from the COC such as sample description, time and date collected, sampler ID, container type, preservative, sample receipt data, finished/approved analytical data, analyst, etc. The LIMS Oracle Database is backed up daily on tape. The back up tape is kept in secure storage. While all LIMS data are accessible, data older than six months is moved from the active production database and is available in an archive database.
Final Report Storage - PDF	Copies of all reports are stored according to customer code in PDF format on a network attached storage device and are immediately available for up to ten years. After ten years data files are archived onto magnetic tape and kept an additional ten years. These reports include chain of custody forms, login confirmation reports, the final approved printed report, invoices and any other associated documents. Samples that require subcontract work also have a copy of the final report in the customer file.
Misc. Data Storage	Company records that are not stored on a secure electronic device are placed in storage boxes and archived, via a unique numbering system, in the ESC storage facility. This includes quality records, such as audits, state certifications, PT results, internal audits, corrective actions, training files, logbooks, etc.

4.13.3 Records Disposal

Records that have exceeded the required storage requirement are disposed of through the use of professional records destruction firm or as required by regulatory or customer requirements. ESC retains the manifest of documents destroyed and files the verification receipt that is generated at the time of destruction. Additional guidance for records disposal is provided in the ESC SOP#020304, *Protection and Transfer of Laboratory Records*.

4.13.4 Records Transfer

In the event that corporate ownership is transferred or that laboratory activities are terminated for any reason, all records become property of the transferee in accordance with ESC SOP# 020304, *Protection and Transfer of Laboratory Records*.

4.14 AUDITS

Audits measure laboratory performance and verify compliance with accreditation and project requirements. Audits specifically provide management with an on-going assessment of the management system. They are also instrumental in identifying areas where improvement in the management/quality system will increase the reliability of data. Laboratory management is promptly notified of any finding that is of ethical concern.

4.14.1 Internal Audits

The quality assurance department is responsible for designing and/or conducting internal audits in accordance with a predetermined schedule and procedure. The purpose of these internal audits is to verify compliance with policies and procedures, and also to verify the on-going effectiveness of the laboratory's management system. Since internal audits represent an independent assessment of laboratory functions, the auditor must be functionally independent from laboratory operations to ensure objectivity. The auditor must be trained, qualified, and familiar enough with the objectives, principles, and procedures of laboratory operations to be able to perform a thorough and effective evaluation.

The complete internal audit process consists of the following sections:

- System and Method Audits – These are the traditional internal audit function and include analyst interviews to help determine whether laboratory practice matches method requirements and SOP language. Applicable raw analytical data and/or final report reviews are usually conducted in conjunction with these traditional internal audits. These audits are conducted according to a predetermined schedule.
- Compliance Data Reviews – These are thorough raw data and record reviews conducted by the quality assurance department that include (but are not limited to) sample receipt records, sample preparation records, analytical records, and the final analytical reports. A portion of the analytical data produced by the laboratory is randomly selected to undergo a compliance data review. These reviews are outside of the laboratory production environment which allows the data to be very closely examined without the pressure of time constraints.
- Corrective action follow-up audits are conducted on an as needed basis to ensure that documented corrective actions are implemented and to verify their effectiveness.

Full descriptions of the system and method internal audits are composed to include the following: identification of the section audited, the audit date, and the observations/findings of the audit. Findings from all internal audit processes will be routed to the applicable laboratory personnel for corrective action. The responsible party will propose a plan of correction in a timely manner to correct all of the cited deficiencies. The proposed plan should include a time frame for the competition of the corrective actions. This time frame should depend on the complexity of the deficiencies and the amount of resources needed to properly correct the deficiency. The quality department reviews the responses to the internal audit findings. If the responses are determined to be adequate, then the quality department will use the action plan with the given time frame for verifying the completion of the corrective action(s). If the responses are determined to be inadequate, then the response is returned to the responsible party for modification. To complete the internal audit process, the quality department performs a re-examination of the areas where deficiencies were found to verify that all proposed corrective actions have been implemented. An audit deficiency is considered closed once implementation of the necessary corrective action has been audited and verified. If corrective action cannot be verified, the associated deficiency remains open until that action is completed.

In addition to the scheduled internal audits, unscheduled internal audits are conducted whenever doubts are cast on the laboratory's compliance with regulatory requirements or its own policies and procedures. These unscheduled internal audits may be conducted at any time and may be performed without an announcement to laboratory personnel.

When internal audit findings cast doubt on the validity of the laboratory’s testing results, the laboratory will take immediate corrective action and any affected customers should be notified in writing within one week of the discovery of the issue. If the issue is complex and the full scope of affected customers is not easily determined, then additional time might be required. However, this additional timeframe for customer notification of complex issues should not exceed one month of discovery.

All investigations resulting from data integrity issues are conducted in a confidential manner until they are completed. These investigations are documented, as well as any notifications made to clients receiving any affected data.

Additional information can be found in the SOP #010104, *Internal Audits.*

4.14.2 External Audits

It is the laboratory's policy to cooperate and assist with all external audits, whether performed by customers or an accrediting body. Management ensures that all areas of the laboratory are accessible to auditors as applicable and that appropriate personnel are available to assist in conducting the audit.

Audit teams external to the laboratory's organization will review the laboratory to assess the effectiveness of systems and degree of technical expertise. The quality department personnel will host the audit team and assist in facilitation of the audit process. Audit teams will usually prepare a formalized audit report listing deficiencies, recommendations, and/or observations. In some cases items of concern are discussed during an audit debrief that is conducted at the end of the external audit.

The laboratory personnel develop corrective action plans to address any external audit deficiencies with the assistance/guidance of the quality department. Laboratory management will ensure that the necessary resources are provided to effectively develop and implement the corrective action plans. The quality department collates this information and provides a written response to the audit team. The response contains the corrective action plan and expected completion dates for each element of the plan. The quality department is also responsible for following-up with laboratory personnel to ensure corrective actions are implemented and they are effective.

4.14.3 Performance Audits and Proficiency Testing

Performance audits are conducted periodically. Examples of performance audits include Proficiency Test (PT) sample analysis, internal single-blind sample analysis, and the analysis of double-blind samples that are submitted through a provider or a customer. Anything that tests the performance of the analyst and/or the method is considered to be a performance audit.

The laboratory participates in various proficiency testing samples (PT) as required by each accreditation, and obtains test samples from approved providers. Some exceptions are made for analytes where there is no PT available from an approved PT provider.

PT samples are treated as typical customer samples, utilizing the same staff, methods, equipment, facilities, and frequency of analysis. PT samples are included in the laboratory's normal analytical processes and do not receive extraordinary attention due to their nature.

The laboratory does not share PT samples with other laboratories, does not communicate with other laboratories regarding current PT sample results, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

The laboratory initiates an investigation and corrective action plan whenever PT results are deemed unacceptable by the PT provider. Additional PTs will be analyzed and reported as needed for accreditation purposes.

Additional information can be found in the SOP #030212, *Proficiency Testing Program*.

4.15 MANAGEMENT REVIEW

Laboratory management reviews the management system on an annual basis at a minimum. This allows for assessing program effectiveness and introducing changes and/or improvements.

At a minimum, following topics are reviewed and discussed:

- The suitability of policies and procedures
- Reports from managerial and supervisory personnel
- The outcome of recent internal audits
- Corrective and preventive actions
- Assessments by external bodies
- The results of interlaboratory comparisons or proficiency tests
- Changes in the volume and type of the work
- Customer feedback, including complaints
- Recommendations for improvement
- Other relevant factors, such as quality control activities, resources, and staff training

This managerial review must be documented for future reference. The results of the managerial review must feed into the laboratory planning system and must include goals, objectives, and action plans. Laboratory management ensures that any actions identified during the review are carried out within an appropriate and agreed upon timescale.

For more information see the SOP #010105, *Management Review*.

5.0 *TECHNICAL REQUIREMENTS*

5.1 GENERAL

5.1.1 ESC Lab Sciences recognizes that many factors determine the correctness and reliability of the analyses performed by a laboratory. These factors include contributions from:

- Human factors (See Section 5.2)
- Accommodations and environmental conditions (See Section 5.3)
- Test methods and method validation (See Section 5.4)
- Equipment (See Section 5.5)
- Measurement traceability (See Section 5.6)
- Sampling (See Section 5.7)
- Handling of samples (See Section 5.8).

5.1.2 The extent to which the factors contribute to the total uncertainty of measurement differs considerably between types of analyses. ESC Lab Sciences takes into account these factors in developing analytical procedures, in the training and qualifications of personnel, and in the selection and calibration of the equipment utilized.

5.2 PERSONNEL

5.2.1 General Personnel Management

ESC management ensures the competency of all who operate specific equipment, who perform analyses, and who evaluate results and approve data reports. Personnel performing specific tasks are qualified on the basis of appropriate education, training, experience, and/or demonstrated skills, as required.

5.2.2 Training

All personnel are trained and competent in their assigned tasks before they contribute to functions that can affect data quality. It is management's responsibility to ensure personnel are appropriately trained. All training and education requirements are outlined in SOP #030205, *Technical Training and Personnel Qualifications* and in SOP #350355, *Technical Training and Personnel Qualifications for Biology*. Training requirements for safety and health are listed in the *Chemical Hygiene Plan*. These procedures are reviewed/updated periodically by laboratory management. Training records are maintained by the laboratory for a minimum of 10 years.

5.2.2.1 Demonstration of Capability (DOC)

Analysts complete an initial demonstration of capability (IDOC) study prior to performing a method or when there is a change in instrument type, personnel, or test method. IDOCs are also performed when a method has not been performed by the laboratory or analyst in a 12-month period. The mean recovery and standard deviation of each analyte, taken from 4 replicates of laboratory control samples, is calculated and compared to method criteria or established laboratory criteria for evaluation of acceptance. For methods or procedures that do not lend themselves to the "4-replicate" approach, the demonstration of capability requirements will be specified in the applicable SOP. Copies of all demonstrations of capability are maintained for future reference.

Demonstrations of capability are verified on an annual basis. These are Continuing Demonstrations of Capability (CDOC). For CDOCs Performance Testing (PT) samples may be used in lieu of the 4-replicate approach listed above.

For more information see the SOP #030205, *Technical Training and Personnel Qualifications* and SOP #350355, *Technical Training and Personnel Qualifications for Biology*.

5.2.2.2 Training for New Staff

New staff members are given the following training, where appropriate:

- Ethics and Data Integrity
- ESC Policy Manual
- ESC Quality Assurance Manual
- Chemical Hygiene Plan (safety)
- Applicable standard operating procedures
- Basic laboratory tasks such as balance, thermometer, and pipette operations
- Use of laboratory records
- Any other specific training as appropriate to their function

Analysts must complete training satisfactory before they can work independently. When staff members undergo training, adequate and appropriate supervision by fully trained analysts is provided. Only when a new analyst has successfully passed their Initial Demonstration of Capability (IDOC) described above, may he or she conduct testing of customer samples.

For more information see the SOP #030205, *Technical Training and Personnel Qualifications* and SOP #350355, *Technical Training and Personnel Qualifications for Biology*.

5.2.2.3 Ongoing Training

Staff members are given the following ongoing training:

- Ethics and Data Integrity Training
- Safety Training
- Routine Training – Routine training may become necessary for a person to perform a particular job effectively. This includes any changes in policies and procedures as appropriate.
- Special Training – Special training may become required as a result of new technologies, contracts, expanding markets, company-wide improvement programs, new method development, etc.

Analysts must satisfactorily perform Continuing Demonstrations of Capability (CDOC) on an annual basis.

For more information see the SOP #030205, *Technical Training and Personnel Qualifications* and SOP #350355, *Technical Training and Personnel Qualifications for Biology*.

5.2.2.4 Ethics and Data Integrity Training

Data integrity training is provided to all new employees (including contract and temporary), and a refresher is given at least annually for all employees. Employees are required to understand that any infractions of the laboratory data integrity procedures shall result in a detailed investigation that could lead to very serious consequences including immediate termination, debarment, or civil/criminal prosecution. The initial data integrity training and the annual refresher training needs to have a signature attendance sheet or other form of documentation that demonstrates all staff have participated and understand their obligations related to data integrity.

All ESC personnel, including contract and temporary, are required to sign an "Attestation of Ethics and Confidentiality" at the time of employment and during annual refresher training. This document clearly identifies inappropriate and questionable behavior. Violations of this document result in serious consequences, including prosecution and termination, if necessary. The ESC Policy Manual addresses this subject in detail. Also see SOP# 010102, *Ethics, Data Integrity, and Confidentiality* for more information.

Data integrity training emphasizes the importance of proper written narration on the part of the analyst with respect to those cases where analytical data may be useful, but are in one sense or another partially deficient. The following topics and activities are covered:

- ESC's mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting

- How and when to report data integrity issues
- Record keeping
- Training, including discussion regarding all data integrity procedures
- Data integrity training documentation
- In-depth data monitoring and data integrity procedure documentation
- Specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time clocks, and inappropriate changes in concentrations of standards.

5.2.2.5 Identification of Training Needs

In order to ensure personnel are appropriately trained, laboratory management is responsible for identifying training needs for both current and future anticipated laboratory tasks. This includes (but is not limited to) the following:

- Evaluation of routine quality control data
- Proficiency testing results
- Findings of internal and external audits
- Management reviews
- Periodic performance reviews

5.2.2.6 Evaluation of the Effectiveness of Training

In order to ensure personnel are appropriately trained, laboratory management is responsible for evaluating the effectiveness of the training program. This includes (but is not limited to) the following:

- Evaluations of Demonstrations of Capability (DOCs)
- Monitoring ongoing quality control data
- Proficiency testing results

5.2.3 Competency and Supervision of Personnel

Laboratory management ensures all personnel (including part-time, temporary, contracted, and administrative personnel) are competent, appropriately supervised, and work in accordance to the established management system. This includes training in policies, procedures, ethics, laboratory quality assurance, and safety as applicable to their role in the laboratory.

5.2.4 Job Descriptions

Employee qualification requirements are maintained by the Human Resources Department and are facilitated through the use of written job descriptions. Educational requirements and experience are included in the job description. Laboratory management determines the specific education and experience requirements for individual positions within the laboratory based on the specific department needs.

5.2.5 Authorization of Technical Personnel

Laboratory management authorizes specific personnel to perform particular technical duties. Records of the relevant authorization(s), education, and experience of all technical personnel are maintained by the Human Resources Department. Confirmation of competence of all technical personnel is required initially by successfully performing a demonstration of capability. All technical personnel are also required to continue to demonstrate their capability at least annually to produce reliable results through accurate analysis of certified reference materials, proficiency testing samples, and/or routine quality control samples to remain authorized to perform particular technical duties.

5.3 ACCOMMODATION & FACILITY DESIGN

5.3.1 Laboratory Facilities

The design of the laboratory supports good laboratory practices and does not adversely affect measurement integrity.

5.3.2 Environmental Conditions

All ESC laboratory facilities, analytical areas, energy sources, lighting, heating, and ventilation facilitate proper performance of calibrations and tests. The laboratory ensures that housekeeping, electromagnetic interference, humidity, line voltage, temperature, sound and vibration levels are appropriately controlled to ensure the integrity of specific measurement results and to prevent adverse effects on accuracy or increases in the uncertainty of each measurement.

Environmental conditions are monitored, controlled, and recorded as required by the relevant specifications, methods, and procedures. Laboratory operations are stopped if it is discovered that the laboratory's environmental conditions jeopardize the analytical results.

5.3.3 Separation of Incompatible Activities

ESC Lab Sciences maintains multiple buildings on its campus. This allows for physical separation of incompatible analytical activities. For example, the analysis for volatile organic compounds is in a separate building from where samples are extracted for semi-volatile organic compounds.

Each laboratory structure is specifically designed for the type of analytical activity that it contains. The air handling systems, power supplies, and gas supplies are specific for each laboratory department.

5.3.4 Laboratory Security

Laboratory security is maintained by controlled access and through video surveillance. Entrance into any ESC building requires an electronic ID badge with appropriate assigned access. Access is controlled to each area depending on the required personnel, the sensitivity of the operations performed, and possible safety concerns. The main entrance is kept unlocked during normal business hours for visitors, and is continuously monitored by laboratory staff. All visitors must sign a visitor's log, and a staff member must accompany them during the duration of their stay.

5.3.5 Good Housekeeping

ESC ensures good housekeeping practices in all facilities to maintain a standard of cleanliness necessary for analytical integrity and personnel health and safety. Where necessary, areas are periodically monitored to detect and resolve specific contamination and/or possible safety issues.

5.4 TEST METHODS AND VALIDATION

5.4.1 General

ESC Lab Sciences uses appropriate methods and procedures for all analyses within its scope. These include sampling, handling, transport, storage, and preparation of samples to be analyzed, and, where appropriate, an estimation of the associated measurement uncertainty as well as statistical techniques for analysis of data.

ESC Lab Sciences has instructions (SOPs) on the use and operation of all relevant equipment and on the handling and preparation of samples for analysis, where the absence of such instructions could jeopardize the results. All instructions, standards, manuals and reference data relevant to the work of the laboratory are maintained current and are readily available to personnel (see section 4.3). Deviations from methods occur only if the deviation has been documented, technically justified, authorized, and accepted by the customer.

5.4.2 Selection of Methods

ESC Lab Sciences uses analytical methods, including methods for sampling, which meet the needs of the customer and are appropriate for the analyses performed. Methods utilized are preferably those published as international, regional, or national standards. The laboratory ensures that it uses the latest valid edition of a method unless it is not appropriate or possible to do so or unless regulatory requirements dictate specific revision use. Methods are supplemented with Standard Operating Procedures that list additional details to ensure consistent application.

When a customer does not specify the method to be used, the laboratory selects appropriate and approved methods that have been designated by the project's regulatory program. The customer is informed as to the method chosen.

The laboratory confirms that it can properly operate published analytical methods before analyzing samples (see section 5.4.5). If there is a change in the published analytical method, then the confirmation is repeated.

ESC Lab Sciences will inform customers when methods they choose are considered inappropriate and/or out of date.

5.4.3 Laboratory Developed Methods

Introduction of analytical methods developed by the laboratory for its own use is a planned activity and is assigned to qualified personnel equipped with adequate resources.

Plans are updated as development proceeds and effective communication is maintained with all personnel involved in the development process.

5.4.4 Non-Standard Methods

When it is necessary to employ methods not published and/or approved by industry standards, these are subject to agreement with the customer and must include a clear specification of the customer's requirements and the purpose of the analysis. The method developed must be validated appropriately before use.

For new non-standard analytical methods, procedures are developed prior to the analysis of samples and contain at least the following information:

- Appropriate identification
- Scope
- Description of the type of item to be analyzed
- Parameters or quantities and ranges to be determined
- Apparatus and equipment, including technical performance requirements
- Reference standards and reference materials required
- Environmental conditions required and any stabilization period needed
- Description of the procedure, including:
  - Affixing identification marks, handling, transporting, storing and preparing of items
  - Checks to be made before the work is started

    - Verifying equipment function and, where required, calibrating and/or adjusting the equipment before each use
    - Method of recording the observations and results
    - Any safety measures to be observed
- Criteria and/or requirements for approval/rejection
- Data to be recorded and method of analysis and presentation
- Uncertainty or procedure for estimating uncertainty

5.4.5 Validation of Methods (Also see SOP #030211, *Method Validation*)

5.4.5.1 Validation Description

Validation is a process of confirmation by examination and the provision of objective evidence that the stated requirements for a specific method/procedure are fulfilled.

5.4.5.2 Validation Summary

The laboratory validates all analytical methods used to some degree. The validation is as extensive as is necessary to meet the needs in the given application or field of application. The laboratory records the results obtained, the procedure used for the validation, and a statement as to whether the method is fit for the intended use.

5.4.5.3 Validation for Customer Need

The range and accuracy of the values obtainable from validated methods are assessed for the intended use as relevant to the customers' needs. Examples of this assessment include examining the uncertainty of the results, detection limit, selectivity of the method, linearity, limit of repeatability and/or reproducibility, robustness against external influences, and/or cross sensitivity against interference from the matrix of the sample.

5.4.5.4 Method Detection Limits and Reporting Limits

Descriptions of analytes, preparative and analytical methods, matrices, accuracy and precision targets, and MDLs and RLs are presented in the QA Manual Appendices.

Limits of Detection (LODs)/Method Detection Limits (MDLs)

Detection limits are determined annually (or after any major changes to the analytical system and/or procedures) and are comparable to those established by the EPA and are not typically lower than recommended detection limits. To determine whether the EPA detection limit is being achieved, an MDL study is performed according to 40 CFR Part 136, Appendix B or the currently accepted and approved guidance. When using the Appendix B guidance, the standard deviation of, at least, seven replicate standards at or near the expected detection limit is calculated. MDLs are determined such that the risk of reporting a false positive is less than 1%. The method detection limit (MDL) is calculated as follows:

$$MDL = T \times S$$

where: S = Standard Deviation of replicate measurements
T = Student's t value appropriate for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom.

If the MDL is higher than the EPA-method-suggested MDL, the calculated value is used as a basis for establishing the reporting limit (RL) for reporting. MDLs are re-calculated on an annual basis or sooner if a material change in the instrumentation or method is enacted, or a change in the calibration response factor is noted. Additional studies may also be conducted to enhance the program.

Published MDLs may be set higher than experimentally determined MDLs to: 1) avoid observed positive interferences from matrix effects or common reagent contaminants or 2) for reporting convenience (i.e., to group common compounds with similar but slightly different experimentally determined MDLs).

Method detection limit studies may also utilize additional study components to better reflect practices to produce a more realistic detection limit as approved by regulatory guidance/requirements. Blank background studies yielding a value for the blank contributions at low level quantitations during routine analysis may be utilized to calculate detection limits that further ensure that the incidence of reporting false positives and false negatives is greatly reduced in some applications.

Any alternate or modified method for the determination of MDL studies utilized at ESC must be approved for the application for which it is used and be technically justified in its use to provide an improvement in the data being generated within the study.

For more information see SOP# 030206, *Method Detection Limits*

Limits of Quantitation (LOQs)/Reporting Limits (RLs)

A limit of quantitation (LOQ) for every analyte of concern must be determined. The LOQ must be higher than the MDL/LOD and are typically set 3 -10 times the calculated MDL determined above. The LOQ is often referred to as the Reporting Limit (RL). This RL is based on the lowest calibration standard concentration that is used in each initial calibration. Results below this level are not allowed to be reported without qualification since the results would not be substantiated by a calibration standard. For methods with a determined LOD, results can be reported out below the LOQ but above the LOD if they are properly qualified (e.g. J flag).

5.4.5.5 Demonstration of Capability

Analysts complete an initial demonstration of capability (IDOC) study prior to performing a method or when there is a change in instrument type, personnel, or test method. IDOCs are also performed when a method has not been performed by the laboratory or analyst in a 12-month period. The mean recovery and standard deviation of each analyte, taken from 4 replicates of laboratory control samples, is calculated and compared to method criteria or established laboratory criteria for evaluation of acceptance. For methods or procedures that do not lend themselves to the “4-replicate” approach, the demonstration of capability requirements will be specified in the applicable SOP. Copies of all demonstrations of capability are maintained for future reference.

Demonstrations of capability are verified on an annual basis. These are Continuing Demonstrations of Capability (CDOC). For CDOCs Performance Testing (PT) samples may be used in lieu of the 4-replicate approach listed above.

For more information see the SOP #030205, *Technical Training and Personnel Qualifications* and SOP #350355, *Technical Training and Personnel Qualifications for Biology*.

5.4.6 Measurement Uncertainty

When required, or upon customer request, ESC Lab Sciences can provide an estimate of the analytical uncertainty of test results.

The exact nature of some test methods may preclude rigorous, statistically valid estimation of analytical uncertainty. In these cases the laboratory attempts to identify all components of analytical uncertainty and make a reasonable estimation, and ensures that the form of data reporting does not give a wrong impression of the uncertainty. A reasonable estimation shall be based on knowledge of method performance and previous experience. When estimating the analytical uncertainty, all uncertainty components which are of importance in the given situation shall be taken into account.

In those cases where a well-recognized test method specifies limits to the values of the major source of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory is considered to have satisfied the requirements on analytical uncertainty by following the test method and reporting instructions.

For more information about the estimation of analytical measurement uncertainty see SOP #030221, *Measurement of Uncertainty*

5.4.7 Control of Data

5.4.7.1 Calculations and Data Transfer Checks

To ensure that data is protected from inadvertent changes or unintentional destruction, the laboratory uses procedures to check calculations and data transfers. This includes (but is not limited to) the following:

- Peer data review and internal audits of raw data
- Calculations on electronic benchsheets/spreadsheets are password protected
- Where possible, audit trail software features are utilized
- Where possible, data is uploaded directly from the instrument
- Electronic data files are backed-up routinely

5.4.7.2 Automated Acquisition

When computers or automated equipment are used for the acquisition, processing, recording, reporting, storage or retrieval of data, the laboratory ensures that:

- Computer software developed by the laboratory is documented in sufficient detail and suitably validated as being adequate for use
- Procedures are established and implemented for protecting the data. Such procedures include (but are not be limited to) integrity and confidentiality of data entry or collection, data storage, data transmission, and data processing
- Computers and automated equipment are maintained to ensure proper function and are provided with the environmental and operating conditions necessary to maintain the integrity of data
- Individual user names and passwords are required for all Laboratory Information Management Systems (LIMS)
- Upon employment, laboratory employees are provided initial training in computer security awareness and ongoing refresher training is conducted an annual basis
- Periodic inspections of LIMS are performed to ensure the integrity of electronic data
- Customers are notified prior to changes in LIMS software or hardware configurations that will adversely affect the customer's electronic data
- Spreadsheets used for calculations are verified before initial use and after any changes to equations or formulas, including software revision upgrades. Formula cells are write-protected to minimize inadvertent changes to the formulas.
- Procedures have been established for:
    - Methods of software development that are based on the size and nature of the software being developed
    - Testing and QC methods to ensure that all software accurately performs its intended functions, including:
        - Acceptance criteria
        - Tests to be used
        - Personnel responsible for conducting the tests
        - Records of test results
        - Frequency of continuing verification of the software
        - Test review and approvals
    - Software change control methods that include instructions for requesting, authorizing, requirements to be met by the software change, testing, QC, approving, implementing changes, and establishing priority of change requests

  - Software version control methods that record the software version currently used. Data sets are recorded with the date and time of generation and/or the software version used to generate the data set;
  - Maintaining a historical file of software, software operating procedures, software changes, and software version numbers
  - Defining the acceptance criteria, testing, records, and approval required for changes to LIMS hardware and communication equipment.
- Records maintained in the laboratory to demonstrate the validity of laboratory generated software include:
  - Software description and functional requirements
  - Listing of algorithms and formulas
  - Testing and QA records
  - Installation, operation and maintenance records
- Electronic data security measures ensure the following:
  - Individual user names and passwords have been implemented
  - Operating system privileges and file access safeguards are implemented to restrict the user of the LIMS data to users with authorized access
  - All LIMS users are trained in computer awareness security on an annual basis
  - System events, such as log-on failures or break-in attempts are monitored
  - The electronic data management system is protected from the introduction of computer viruses
  - System backups occur on a regular and published schedule and can be performed by more than just one person
  - Testing of the system backups must be performed and recorded to demonstrate that the backup systems contain all required data
  - Physical access to the servers is limited by security measures
- Commercial “off the shelf” software, e.g., word processing, database and statistical programs in general use within its designed application range may be considered sufficiently validated. However, laboratory software configuration/modifications are validated as above.

ESC Software Systems

Table 5.4.7a LIMS	
System	**Description**
LIMS	The LIMS is a computerized database for data management. Access to the system is protected by coded password and access is granted based on user need.
Security	Level 1. Login, sample status, shipping/sample kits. General access, every station has access. Level 2. Data Review, data approval, edit data. The secondary review team, lab supervisors, and QA have access to this level.
Hardcopy Records	All paper records are retained by ESC and/or are stored within ESC's Document Management System (Cyberlab/Openlab) in pdf and/or excel format. As the pages become historical (prior to the current working range of log numbers), they are removed from the logbook, prep book, or workbook in sequential order and permanently bound for storage in banker's boxes and/or are stored within ESC's Document Management System (Cyberlab/Openlab) in pdf and/or excel format. They are cross-referenced by sample log number, date and storage number.
Data Records	*Data* is available on electronic media. *Revisions* to the LIMS software are documented within the code. Each revision indicates the change in function, programmer's initials, and date of change. Programming has limited access and is accessible only by approved individuals through the use of passwords.
Calculations	All calculations performed by the LIMS are approved and submitted by the Laboratory Supervisors. Each calculation is tested parallel to manual calculations to ensure proper function.
Automatic Data Transfer	Data is transferred electronically from instrumentation by way of ESC customized software (Tree) directly to the LIMS. Data is also transferred electronically by way of ESC customized software (Prep Data) that transfers/saves Prep Data directly into the LIMS Database. Once the data has been transferred, it undergoes a screen review to ensure it has been transferred properly.

Table 5.4.7b AUXILIARY SOFTWARE	
System	**Description**
Auxiliary	Auxiliary Computer and Software Used to Generate and Validate Data
General	Several instruments have their own dedicated single computer and manufacturer-designed software to run them. Instruction manuals and other documentation provided by each manufacturer are maintained. ESC receives updates as they become available from the manufacturer. All raw and filtered data is stored on media (with uniquely titled data files on floppy discs) and all associated printouts and paperwork is filed. The original raw data is not accessed again unless it is subjected to uncertainty.
Method Files	Creation of any method or analyte files, necessary to run the appropriate analyses is the responsibility of the Department Supervisor. The Supervisor verifies that the compounds, wavelengths, retention time windows, calculation criteria, and other relevant parameters are correctly input into the specific method file. Analysts may only use the method files that have been specifically generated by the Supervisor.
Supplier Info	All purchased software that is used in conjunction with software specific instruments is guaranteed by the supplier to function as required. The supplier of the software performs all troubleshooting or software upgrades and revisions.
Validation	Computer software is validated for proper performance. The result of the validation is recorded, when in-house programming is the source of the calculation.

5.4.7.3 Data Reduction and Review

All analytical data must undergo a multi-tiered review process prior to being reported to the customer. Data review is the process of examining data and accepting or rejecting it based on pre-defined criteria. These review steps are designed to ensure that reported data is free from errors and any non-conformances are properly documented. The laboratory's multi-tiered data review process is discussed below. Additional information regarding the data reduction and review process can be found in SOP #030201, *Data Handling & Reporting* and SOP #030227, *Data Review*.

Primary Data Review – Analysts performing the analysis are responsible for the initial data reduction and review, and have the primary responsibility for the quality of the data produced. The analysts initiate the data review process by reviewing and accepting/rejecting the data. This includes, but is not limited to; confirming all samples were prepared/analyzed according to the appropriate method and laboratory SOP, verifying dilutions are calculating properly, ensuring good chromatography, verifying proper spectral interpretations, evaluating quality control data, verifying that any customer/project specific requirements are met, and noting any non-conformances. The primary analyst is also responsible for compiling the initial data package for further data review.

Secondary Data Review – After the analyst have completed the primary data review process, the data package is then available for secondary data review that is performed by a qualified reviewer. This reviewer provides an independent technical assessment of the data. This includes, but is not limited to; confirming all samples were prepared/analyzed according to the appropriate method and laboratory SOP, verifying dilutions are calculating properly, ensuring good chromatography, verifying proper spectral interpretations, evaluating quality control data, verifying that any customer/project specific requirements are met, and noting any non-conformances. Secondary data reviews must also verify that all manual entries of raw data are accurate and there are no transcription errors.

Final Administrative Review – All final reports receive a final administrative review of some degree. Once the data have been technically reviewed and approved in the secondary data review process, authorization for release of the data from the analytical section is indicated in the LIMS. A Technical Service Representatives (TSR) will then perform a final administrative review of the data which includes examining the report for method appropriateness, detection limit/QC acceptability, and any other apparent errors. If no errors are found, the TSR approves the report in LIMS and the customer has the reports emailed to them. If errors are noted, the data is returned to the department for correction and resubmission to the TSR. In the case of DoD work, 100% of all packages must have a final administrative review to confirm that primary and secondary reviews were recorded properly and the data package is complete.

Compliance Data Review – Compliance data reviews are performed by the Quality Department staff and are considered to be part of the overall internal audit program of the laboratory. These reviews are typically performed after the data has been released to the customer. A list is produced weekly from LIMS showing all methods run by the laboratory and how many batches were analyzed the previous week. Some of these data packages will undergo a compliance data review as per a schedule set by this department. For DoD work, at least 10% of all data packages will reviewed for technical completeness/accuracy.

5.5 EQUIPMENT

5.5.1 Availability of Equipment

Laboratory management ensures that the laboratory is furnished with all the equipment required for the correct performance of the analytical tests it performs. In cases where the laboratory needs to use equipment outside its permanent control, the laboratory ensures that all requirements related to calibration, maintenance, and records are satisfied.

5.5.2 Calibration of Equipment

The laboratory ensures that equipment and its software used for sampling and analysis is capable of achieving the accuracy required and complies with specifications relevant to the methods concerned. Calibration procedures are established for instruments and equipment that have a significant effect on the analytical results. Before being placed into service, newly obtained equipment (including that used for sampling) is calibrated and/or verified to establish that it meets the laboratory's specification requirements and complies with the method specifications. All analytical equipment is calibrated and/or verified before use.

For analytical instrumentation, the most appropriate curve fitting model from among the following choices must be utilized (given in the order of preference):

- Average Response Factor
- Linear – No Weighting
- Linear – 1/X Weighting
- Linear – $1/X^2$ Weighting
- Quadratic

When second order (quadratic) curves are evaluated, acceptability must include an assessment of a graphic representation of the curve to confirm that this fit type is not being used to mask detector saturation and that the curve (which defines a parabola) does not result in two concentrations for one response. Higher order polynomial curves (i.e., third-order and greater) are not allowed at ESC.

5.5.3 Operation of Equipment

Analytical equipment is operated only by authorized personnel. Up-to-date instructions and procedures for the use and maintenance of analytical equipment are readily available for use by the appropriate laboratory personnel. This includes any relevant equipment manuals provided by the manufacturer.

5.5.4 Identification of Equipment

Analytical equipment used that is significant to the analytical results is uniquely identified when practical.

5.5.5 Records of Equipment

Records are maintained for analytical equipment used that is significant to the analytical results. These records include at least the following:

- Identity of the equipment (and software if applicable)
- Manufacturer's name, type of equipment, and serial number or other unique identification
- Checks that equipment complies with specifications (see 5.5.2)
- Current location, where appropriate
- Manufacturer's instructions, if available, or reference to their location
- Dates, results, and reports of all calibrations, adjustments, acceptance criteria, and the due date of next calibration where appropriate
- Maintenance carried out to date. Also, the maintenance plan where appropriate
- Any damage, malfunction, modification, or repair to the equipment
- Date placed in service
- Condition when received (e.g., new, used, reconditioned)
- Operational status
- Instrument configuration and settings

5.5.6 Handling of Equipment

The laboratory has established procedures for the safe handling, transport, storage, use, and any planned maintenance of analytical equipment to ensure proper functioning and in order to prevent contamination or deterioration. These procedures include the checks necessary to ensure proper functionality when analytical equipment is returned from being used outside of the permanent control of the laboratory.

5.5.7 Out of Service Equipment

Equipment that has been subjected to overloading, mishandling, gives suspect results, has been shown to be defective, or is performing outside of specified limits is taken out of service. Out of service equipment is isolated and/or clearly labeled to prevent accidental use until it has been repaired and shown to perform correctly. When analytical equipment is taken out of service, the laboratory examines the potential effect it may have had on previous analytical results to identify any non-conforming work (see section 4.9 above).

5.5.8 Calibration Status of Equipment

Whenever practicable, all laboratory equipment requiring calibration is labelled, coded, or otherwise identified to indicate the status of calibration, including the date when last calibrated and the date or expiration criteria when recalibration is due. This requirement is mostly applicable to support equipment such as balances, mechanical pipettes, and temperature reading devices which require periodic calibration. Major analytical equipment that is calibrated and/or verified at time of use does not need to be labeled with its calibration status. Calibration records described in section 5.5.5 above are sufficient to indicate the calibration status.

5.5.9 Returned Equipment Checks

When, for whatever reason, equipment goes outside the direct control of the laboratory, the laboratory ensures that the function and calibration status of the equipment are checked and shown to be satisfactory before the equipment is returned to service.

5.5.10 Equipment Intermediate Checks

When intermediate checks are needed to maintain confidence in the calibration status of the equipment, these checks are carried out according to a defined procedure. These intermediate checks include continuing calibration verification checks performed on major analytical equipment, and also periodic checks of support equipment such as balances and pipettes.

5.5.11 Equipment Correction Factors

Where calibrations give rise to a set of correction factors, the laboratory has procedures to ensure that copies (e.g., in computer software) are correctly updated.

5.5.12 Safeguarding of Equipment Integrity

Analytical and supporting equipment is protected from inadvertent adjustments that could affect the integrity of the laboratory results. Instruments are located in access-protected areas. Software is tested and approved before use. Spreadsheets used in the calculation of analytical results are tested, approved, and locked before being placed into service.

Table 5.5 General Equipment Calibration

Equipment	Activity	Frequency	Record Type
Balances	Verified with Class I NIST traceable weights when used	Daily, before use	Logbook – Located in each respective lab
Balances	• Clean • Check alignment • Service Contract Top-loading balances are allowed a tolerance of ±1%, while analytical balances are allowed a tolerance of ±0.1%.	At least once annually by a qualified vendor	Certificates from contractor.
Weights – Class I	• Only use for the intended purpose • Use plastic forceps to handle • Keep in case • Store in desiccator • Re-calibrate	Checked for accuracy by an external source, at least every 5 years, or sooner if necessary.	Certificates from contractor.
pH meters	Calibration: • pH buffer aliquot are used only once • Buffers used for calibration bracket the pH of the media, reagent, or sample analyzed. • Check must perform within 0.05 pH units. Temperature correction is performed either automatically by the instrument or manually depending upon the instrument used. Automatic temperature compensation probes are verified annually.	Before use	Calibrations are recorded in a logbook.
Automatic pipettes	Verify for accuracy and precision using reagent water and analytical balance	In-house – Monthly Contract – Semi Annually Tolerance is set at 2.0%, (ASTM standard = 3%).	Monthly verifications are recorded in a logbook. Semi-annual cal. is verified by certificates from the cal. service.
Refrigerators, Freezers, Hot plates and BOD incubators	• Thermometers are immersed in liquid to the appropriate immersion line • The thermometers are graduated in increments of 1°C or less • Temperature ranges are listed in app. SOPs	Temperatures are recorded each day in use	Logbook
Ovens	• Thermometers are immersed in sand to provide even measurement • The thermometers are graduated in increments of 1°C or less	Temperatures are recorded each day in use	Logbook

Table 5.5 General Equipment Calibration

Equipment	Activity	Frequency	Record Type
Thermometers	ESC NIST-certified thermometers All working thermometers	Calibrated at least every 5 years, or sooner if necessary by a NIST calibration service, accredited to ISO/IEC 17025 and ANSI/NCSL Z540-1. Verified at least annually against NIST-certified thermometers by an outside service.	Calibration certificates from the calibration service. "Accuracy Assurance Program Test Data Sheets" provided by the servicer. All thermometers are tagged with current tolerances. Internal daily checks are recorded in a logbook.
DO Meter	Calibrated according to manufacturer's specifications. Using the recorded temperature and barometric pressure the meter is calibrated to the air saturation of dissolved oxygen using a conversion chart provided by the manufacturer.	Before use	Calibration of each meter is recorded in a separate logbook.
Specific Conductivity Meter	The conductivity meter is calibrated according to manufacturer's specifications. Temperature correction is performed either automatically by the instrument or manually depending upon the instrument used. • Biomonitoring, potassium chloride with a conductivity value of 100 and 1000µmhos/cm is used as the calibration standard. • Wet Lab, potassium chloride with a value of 1413µmhos/cm is purchased from NSI for calibration purposes.	Before use	Calibration of each meter is recorded in separate daily logbooks.
Fume Hoods	Check quarterly and must meet the OSHA minimum recommended face velocity of 60 – 100fpm.	Quarterly	Electronic log

5.6 MEASUREMENT TRACEABILITY

5.6.1 General

All analytical equipment used, including support equipment, having a significant effect on the accuracy or validity of the result of the analysis, calibration or sampling is calibrated before being put into service. The laboratory has established procedures for the calibration and/or verification of this equipment. See the applicable analytical SOPs for more information.

5.6.2 Specific Requirements

The laboratory retains all pertinent information for standards, reagents, and chemicals to ensure that calibrations and measurements are traceable to a national standard. This includes documentation of purchase, receipt, preparation, and use. If traceability of measurements to a national standard is not possible or not relevant, evidence for correlation of results through inter-laboratory comparisons, proficiency testing, or independent analysis is provided.

5.6.3 Reference Standards and Reference Materials

Reference standards and materials are used to derive the laboratory's analytical measurements; therefore, it is essential that the reference standards and materials used are of very high quality.

5.6.3.1 Reference Standards

The laboratory uses ASTM Class 1 reference weights and NIST traceable reference thermometers which are calibrated and/or verified for accuracy by an ISO 17025 (or equivalent) accredited vendor that can provide traceability to national or international standards at a minimum frequency of every 5 years. All working thermometers are calibrated or verified at least annually using a NIST traceable thermometer.

5.6.3.2 Reference Materials

Whenever possible, reference materials must be purchased from a vendor that is accredited to ISO 17034 or Guide 34. Purchased reference materials require a Certificate of Analysis (COA) where available. If a reference material cannot be purchased with a Certificate of Analysis (COA), it must be verified by analysis and comparison to a certified reference material and/or there must be a demonstration of capability for characterization.

Upon receipt, all purchased reference material standards are recorded into a database and are assigned a unique identification number. Theses entries include the chemical name, manufacturer name, manufacturer's identification numbers, receipt date, and expiration date. The vendor's certificates of analysis for all standards, reagents, or chemicals are retained for future reference.

Subsequent preparations of intermediate or working solutions are also recorded and given unique identification numbers. These entries include the stock standard identification, the solvent identification used for preparation, method of preparation, preparation date, expiration date, and the preparer's initials. The unique identification numbers of the reference material standards are used in any applicable sample preparation or analysis records so the standard can be traced back to the standard preparation record. This process ensures traceability back to the national standard.

5.6.3.3 Intermediate Checks

Reference material standards used for instrument calibration are verified by using a second source of the material. The second source materials are from a different manufacturer or different lot from the same manufacturer. Reference material standards are checked frequently and replaced if degradation or evaporation is suspected.

The laboratory also provides satisfactory evidence of correlation of results by participation in a suitable program of inter-laboratory comparisons or proficiency testing whenever possible.

5.6.3.4 Transport and Storage

The laboratory handles and transports reference standards and materials in a manner that protects the integrity of the materials. Reference standard and material integrity is protected by separation from incompatible materials and/or minimizing exposure to degrading environments or materials. Standards and reference materials are stored separately from samples, extracts, and digestates. All standards are stored according to the manufacturer's recommended conditions. Temperatures colder than the manufacturer's recommendation are acceptable if it does not compromise the integrity of the material (e.g. remains in liquid state and does not freeze solid). In the event a standard is made from more than a single source with different storage conditions, the standard will be stored according to the conditions specified in the analytical method.

See the applicable analytical SOPs for specific reference material storage protocols.

5.6.3.5 Documentation and Labeling

The laboratory retains records for all standards, reagents, and reference materials. These records include the manufacturer/vendor, the manufacturer's Certificate of Analysis or purity (if available), the date of receipt, and recommended storage conditions. These records also include manufacturer lot numbers when applicable.

For the original containers, the expiration date provided by the manufacturer is recorded on the container if the expiration date is not already present. If an expiration date is not provided then no expiration date labeling is required.

All prepared standard or reagent containers include the laboratory's unique identification number, the standard or chemical name, the date of preparation, the date of expiration, and the preparer's initials. For containers that are too small to accommodate labels that list all of the above information associated with a standard, the minimum required information will be the laboratory's unique identification number and expiration date. This assures that no standard will be used past its assigned expiration date.

Standards, reference materials, and reagents are not used after their expiration dates unless their reliability is thoroughly documented and verified by the laboratory. If a standard exceeds its expiration date and is not re-certified, the laboratory removes the standard and/or clearly designates it as acceptable for qualitative/troubleshooting purposes only. All prepared standards, reference materials, and reagents are verified to meet the requirements of the test method through routine analyses of quality control samples.

5.7 SAMPLING

5.7.1 Sampling Plans and Procedures

Sampling plans and written sampling procedures are used for sampling substances, materials, or products for testing. The sampling plans and procedures are made available at the sampling location. Sampling plans are, whenever reasonable, based on appropriate governing methods. The sampling process addresses the factors to be controlled to ensure the validity of the analytical results.

See Appendix III of this document for more information regarding field sampling protocols.

5.7.2 Customer Requested Deviations

When the customer requires deviations, additions, or exclusions from the documented laboratory sampling plan and/or procedure, these are recorded in detail with the appropriate sampling data and are included in the final report. These deviations are also communicated to the appropriate laboratory personnel.

5.7.3 Sampling Records

Sampling records are maintained that include the sampling procedure used, any deviations from the procedure, the date and time of sampling, the identification of the sampler, environmental conditions (if relevant), and the sampling location.

See Appendix III of this document for more information regarding field sampling protocols.

5.7.4 Laboratory Subsampling

In order for analysis results to be representative of the sample collected in the field, the laboratory has subsampling procedures. For more information see SOP #030220, *Sample Homogenization*.

5.8 SAMPLE MANAGEMENT

5.8.1 Sample Management Procedures

Procedures have been established for the transportation, receipt, handling, protection, storage, retention, and disposal of samples. These procedures include provisions necessary to protect the integrity of the samples, and to protect the interests of the laboratory and our customers. For more information see the following SOPs; 060105 *Sample Receiving*, 060106 *Sample Storage and Disposal*, 060108 *Return Sample Shipping*, 060110 *Sample Shipping*, and 060112 *Cold Storage Management*.

5.8.1.1 Chain of Custody

A chain of custody (COC) provides documentation of the possession of samples from time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses.

Laboratory field personnel or customer representatives must complete a chain of custody for all samples that are received by the laboratory. The importance of complete chain of custody records is stressed to the samplers and is critical to insure the requested methods are used to analyze the correct samples. If sample shipments are not accompanied by complete chain of custody records, then Sample Receiving personnel will notify applicable personnel in Customer Services. Customer services then obtains the correct documentation/information from the customer in order for the analysis of samples to proceed.

Chain of custody records are filled out completely and legibly with indelible ink. Errors are corrected by drawing a single line through the initial entry and initialing and dating the change. All transfers of samples are recorded on the chain of custody in the “relinquished” and “received by” sections.

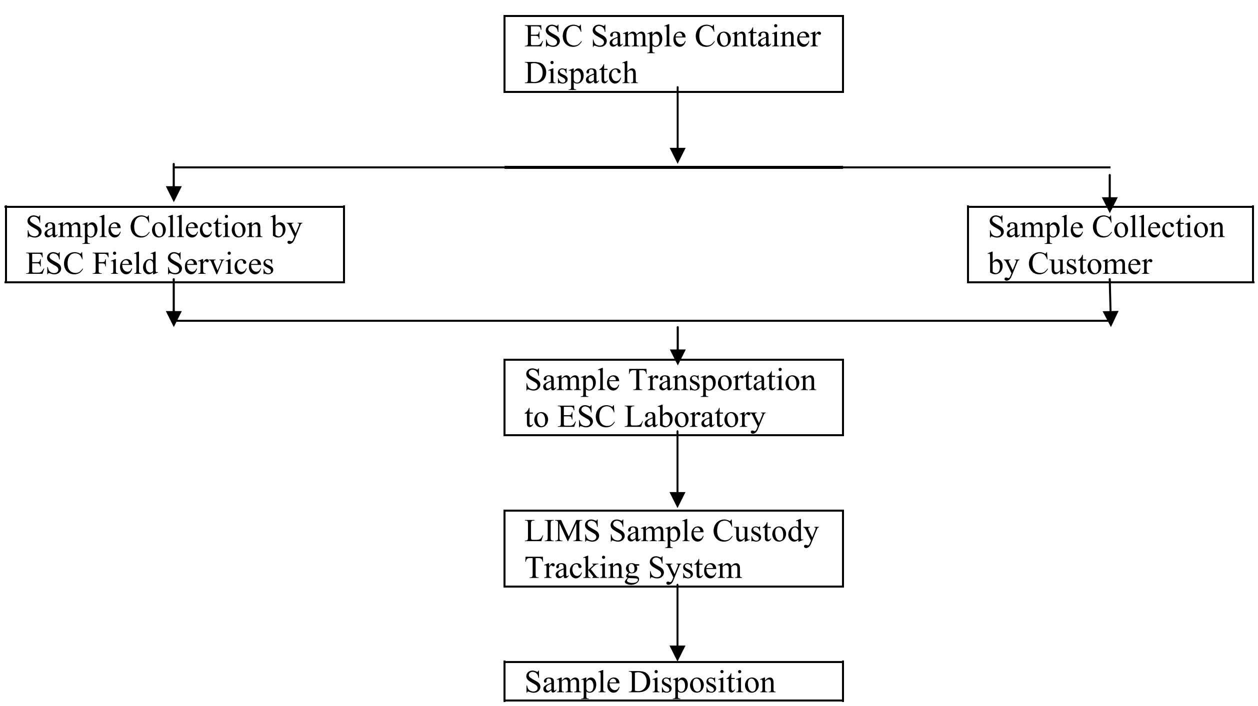
5.8.1.2 Legal Chain of Custody

Legal chain of custody procedures are performed at the special request of the customer, or if there are program requirements that mandate these procedures.

The legal chain of custody (COC) protocol establishes an intact, continuous record of the physical possession, storage, and disposal of samples. This includes the collected samples, sample aliquots, and sample extracts/digestates. Legal COC records account for all time periods associated with the samples, and identifies all individuals who physically handled individual samples. Legal COC shall begin at the point established by the federal or state oversight program. This may begin at the point that cleaned sample containers are provided by the laboratory or the time sample collection occurs.

Figure 5.8.1 below represents a flow diagram of the legal chain of custody process.

FIGURE 5.8.1
LEGAL CHAIN OF CUSTODY PROCESS



5.8.2 Sample Identification and Labeling

A unique sample identification number is generated for each sample submitted to the laboratory and is used throughout the analytical and disposal cycle. A record of all samples is established and maintained.

Each sample is assigned a unique and consecutive log number. After a sample is entered into the Laboratory Information Management System (LIMS) database it is assigned a specific log number identifier. The LIMS automatically assigns the next consecutive number any subsequent samples. Log numbers are not available for reuse and cannot be altered.

A durable laboratory sample label with the log number is printed from LIMS and is affixed to the sample. Each label contains a unique container ID, represents the sample ID number, and is clearly marked with preservative and requested analysis.

5.8.3 Sample Receipt, Inspection, and Login

Upon receipt of samples, departures from method or regulatory specified conditions are recorded. When these departures occur, the laboratory contacts the customer for further instructions before proceeding with the analysis. Records of these discussions are maintained.

5.8.3.1 Sample Acceptance Policy

In accordance with regulatory guidelines, ESC Lab Sciences complies with the following sample acceptance policy for all samples received.

If the samples do not meet the sample receipt acceptance criteria outlined below, the laboratory is required to document all non-compliances, contact the customer, and either reject the samples or fully document any decisions to proceed with analyses of samples which do not meet the criteria. Any results reported from samples not meeting these criteria are appropriately qualified on the final report.

All samples must:

- Have unique client identification that are clearly marked with durable waterproof labels on the sample containers and that match the chain of custody.
- Have clear documentation on the chain of custody related to the location of the sampling site with the time and date of sample collection.
- Have all requested analyses clearly designated on the COC.
- Be in appropriate sample containers with clear documentation of the preservatives used.
- Be correctly preserved unless the method allows for laboratory preservation.

- Be received within holding time. Any samples with hold times that are exceeded will not be processed without prior customer approval.
- Have sufficient sample volume to proceed with the analytical testing. If insufficient sample volume is received, analysis will not proceed without customer approval.
- Be received within appropriate temperature ranges (not frozen but ≤6°C) unless program requirements or customer contractual obligations mandate otherwise. The cooler temperature is recorded directly on the COC. Samples that are delivered to the laboratory immediately after collection are considered acceptable if there is evidence that the chilling process has been started. For example, by the arrival of the samples on ice. If samples arrive that are not compliant with these temperature requirements, the customer will be notified. The analysis will NOT proceed unless otherwise directed by the customer. If less than 72 hours remain in the hold time for the analysis, the analysis may be started while the customer is contacted to avoid missing the hold time. Data associated with any deviations from the above sample acceptance policy requirements will be appropriately qualified.

Samples for drinking water analysis that are improperly preserved, or are received past holding time, are rejected at the time of receipt, with the exception of VOA samples that are tested for pH at the time of analysis.

5.8.3.2 Sample Receipt and Inspection

All samples are verified upon receipt as meeting its description and being free from damage. In the event of a sample being lost, damaged or otherwise unsuitable for use, full details of the incident are recorded and reported to the customer by the Technical Service Representative via a nonconformance form, prior to any analytical action being taken. Any further action taken is at the direction of the customer.

Login Technicians are responsible for sample login and assessing sample container integrity, documentation, and identification. Samples are inspected and noted for temperature, pH using narrow-range pH paper, headspace, proper container type, container integrity (broken or leaking), and volume levels. Samples requiring thermal preservation at 4°C must arrive at the laboratory above freezing but ≤6°C. If the samples are not appropriately preserved, the problem is noted on a sample nonconformance form, the customer is notified, and, if the lab is instructed to proceed, proper preservation is performed. The sample nonconformance sheet becomes a permanent part of the COC. Samples, which require refrigeration, are placed in a laboratory cooler immediately after login.

Login Technicians are trained to recognize analyses with immediate, 24-hour, and 48-hour holding times. Those samples are designated as “short-holds”. When short-hold samples arrive at the laboratory, the Login procedure for those samples takes place immediately. All analysts are trained to assess incoming samples for holding time limitations.

If a sample has a holding time limitation, the LIMS issues a due date on the bench sheet to ensure that the extraction or analysis is completed within the time allowed. In the event that a holding time is exceeded, the TSR contacts the customer, informs them of the situation, and requests further direction. If instructed by the customer to proceed with the analysis, a qualifier is added to the benchsheet, which is then carried on to reporting. The final report bears the explanation in the form of a qualifier.

5.8.3.3 Nonconformance Issues

- If there are problems with the samples, the event details are documented on the sample nonconformance form/COC; then, the sampler and/or customer is notified.
- If the customer insists on proceeding with analyses, even with full knowledge of the possible invalidity of the sample, a qualifier detailing the problem is added in the LIMS and it is also noted on the nonconformance form.
- The TSR, affected chemists, and reporting personnel are also notified.

5.8.3.4 Sample Login

After sample inspection, all sample information on the chain of custody is entered into the Laboratory Information Management System (LIMS). This permanent record documents receipt of all sample containers including:

- Customer name and contact information
- The laboratory's unique sample identification numbers
- Sample descriptions
- Due dates
- List of analyses requested
- Date and time of laboratory receipt
- Field ID code
- Date and time of collection
- Any comments resulting from inspection for sample rejection

5.8.4 Sample Storage and Protection

The samples are stored according to method and regulatory requirements as per the applicable analytical SOPs. While in storage, samples are stored by sample ID and analyses required. Samples are stored away from all standards, reagents, or other potential sources of contamination. Samples are stored in a manner that prevents cross contamination. Volatile samples are stored separately from other samples. All sample fractions, extracts, leachates, and other sample preparation products are stored in the same manner as actual samples or as specified by the analytical method.

Refrigerated storage areas are maintained at ≤6°C (but not frozen) and freezer storage areas are maintained at <-10°C (unless otherwise required per method or program). The temperature of each storage area is checked and documented at least once for each day of use. If the temperature falls outside the acceptable limits, then corrective actions are taken and appropriately documented.

The laboratory is operated under controlled access protocols to ensure sample and data integrity. Visitors must register at the front desk and be properly escorted at all times. Samples are taken to the appropriate storage location immediately after sample receipt and login procedures are completed. All sample storage areas have limited access. Samples are removed from storage areas by designated personnel and returned to the storage areas as soon as possible after the required sample quantity has been taken.

5.8.4.1 Sample Retention and Disposal

Samples, extracts, digestates, and leachates are retained by the laboratory for the period of time necessary to protect the interests of the laboratory and the customer. Unused portions of samples are retained by the laboratory based on program or customer requirements for sample retention and storage. The minimum sample retention time is 45 days after sample receipt. Samples may be stored at ambient temperature when all analyses are complete, the hold time is expired, the report has been delivered, and/or allowed by the customer or program. Samples requiring storage beyond the minimum sample retention time due to special requests or contractual obligations may be stored at ambient temperature unless the laboratory has sufficient capacity and their presence does not compromise the integrity of other samples.

After this period expires, non-hazardous samples are properly disposed of as non-hazardous waste. The preferred method for disposition of hazardous samples is to return the excess sample to the customer. If it is not feasible to return samples, or the customer requires the laboratory to dispose of excess samples, proper arrangements will be made for disposal by an approved contractor.

For more information about sample storage and disposal see Section 6 of this document, SOP #060106, *Sample Storage and Disposal*, and SOP #060112, *Cold Storage Management*.

5.9 QUALITY CONTROL

5.9.1 Quality Control Procedures

ESC Lab Sciences has established quality control procedures for monitoring the validity of the testing it performs. Quality control samples are processed in the same manner as customer samples. The quality control results are recorded in such a way that trends are detectable, and where practicable, are statistically evaluated. This monitoring is planned and reviewed, and includes the utilization of certified reference materials (where available), participation in proficiency testing programs, replicate or confirmation analyses, correlation of results from related analyses, comparison to historical data, etc.

5.9.2 Quality Control Evaluation

The quality control data is evaluated and, when found to be outside pre-defined criteria, action is taken to correct the problem and to prevent incorrect results from being reported. For more information see the applicable analytical SOPs.

5.9.3 Essential Quality Control Procedures

Below are some general essential quality control procedures used in the laboratory. Additional information can be found in the applicable analytical SOPs.

5.9.3.1 Initial Calibration Verification (ICV) or Second Source Verification (SSV)

It is possible for a calibration curve to meet method criteria but still not have the ability to obtain accurate results because all calibration points are from the same source. To assess the accuracy of new calibration curves relative to the purity of the standards, a single standard from a secondary source is analyzed. This secondary source must be from an alternative vendor or from a different lot if the same vendor is used for the preparation of the calibration standards. The laboratory follows specific guidelines for ICV/SSV recoveries and further information can be found in the applicable laboratory SOP.

5.9.3.2 Continuing Calibration Verification (CCV)

Analytical instrumentation is checked periodically to determine if the analytical response has changed significantly since the initial calibration was established. The values obtained from the analysis of the CCV are compared to the true values and a percent change calculated. The laboratory follows specific guidelines for CCV frequency and recoveries. Further information can be found in the applicable laboratory SOP.

5.9.3.3 Method Blank

A method blank is used to evaluate contamination in the preparation/analysis system and is processed through all preparation and analytical steps with its associated samples. A method blank is processed at a minimum frequency of one per batch of up to twenty samples.

The method blank consists of a matrix similar to the associated samples that is known to be free of analytes of interest. Method blanks are not applicable for certain analyses, such as pH, conductivity, flash point and temperature.

Each method blank is evaluated for contamination. The source of any contamination is investigated and documented corrective action is taken when the concentration of any target analyte is detected above the reporting limit and is greater than 1/10 of the amount of that analyte found in any associated sample. Some programs may require evaluating their method blanks down to ½ the reporting limit as opposed to the reporting limit itself. Corrective actions for blank contamination may include the re-preparation and re-analysis of all samples (where possible) and quality control samples. Data qualifiers must be applied to results that are considered affected by contamination in a method blank.

5.9.3.4 Laboratory Control Sample

The Laboratory Control Sample (LCS) is used to evaluate the performance of the entire analytical system including preparation and analysis. An LCS is processed at a minimum frequency of one per batch of up to twenty samples.

The LCS consists of a matrix similar to the associated samples that is known to be free of the analytes of interest that is then spiked with known concentrations of target analytes. An LCS is not applicable for certain analyses where spiking procedures are not practical such as dissolved oxygen, odor, and temperature.

The LCS is evaluated against the method default or laboratory-derived acceptance criteria. Any compound that is outside of these limits is considered to be ‘out of control’ and must be qualified appropriately. Any associated sample containing an ‘out-of-control’ compound must either be re-analyzed with a successful LCS or reported with the appropriate data qualifier. An exception to this is when the acceptance criteria for the LCS are exceeded high and there are associated samples that are non-detects, then those non-detects can be reported. Another exception is when the acceptance criteria are exceeded low, those associated sample results may be reported if they exceed the maximum regulatory limit or decision level.

For LCSs containing a large number of analytes, it is statistically likely that a few recoveries will be outside of control limits. This does not necessarily mean that the system is out of control, and therefore no corrective action would be necessary (except for proper documentation). TNI has allowed for a minimum number of marginal exceedances, defined as recoveries that are beyond the LCS control limits (3X the standard deviation) but less than the marginal exceedance limits (4X the standard deviation). The number of allowable exceedances depends on the number of compounds in the LCS. If more analyte recoveries exceed the LCS control limits than is allowed (see below) or if any one analyte exceeds the marginal exceedance limits, then the LCS is considered non-compliant and corrective actions are necessary. The number of allowable exceedances is as follows:

Number of Target Analytes	**Allowable Marginal Exceedance Outliers**
>90	5 analytes allowed in the ME limit
71-90	4 analytes allowed in the ME limit
51-70	3 analytes allowed in the ME limit
31-50	2 analytes allowed in the ME limit
11-30	1 analytes allowed in the ME limit
<10	0 analytes allowed in the ME limit

5.9.3.5 Matrix Spike

A matrix spike (MS) is used to determine the effect of the sample matrix on compound recovery for a particular method. The information from these spikes is sample or matrix specific and is not used to determine the acceptance of an entire batch. A MS consists of the sample matrix that is then spiked with known concentrations of target analytes.

A Matrix Spike/Matrix Spike Duplicate (MS/MSD) set is processed at a frequency specified in the applicable laboratory SOP or as determined by a specific customer request. Typically, an MS/MSD set is analyzed once per batch of up to twenty samples.

The MS/MSD set is evaluated against the method or laboratory derived criteria. Any compound that is outside of these limits is considered to be ‘out of control’ and must be qualified appropriately. Batch acceptance, however, is based on method blank and LCS performance, not on MS/MSD recoveries. The spike recoveries give the data user a better understanding of the final results based on their site specific information.

5.9.3.6 Sample Duplicate

A sample duplicate is a second portion of sample that is prepared and analyzed in the laboratory along with the first portion. It is used to measure the precision associated with preparation and analysis. A sample duplicate is processed at a frequency specified by the particular method or as determined by a specific customer.

The sample and duplicate are evaluated against the method or laboratory derived criteria for relative percent difference (RPD). Any duplicate that is outside of these limits is considered to be ‘out of control’ and must be qualified appropriately.

5.9.3.7 Surrogates

Surrogates are compounds that reflect the chemistry of target analytes, but are not expected to occur naturally in field samples. The purpose of the surrogates is to assess sample preparation, analytical efficiency, and to monitor the effect of the sample matrix on compound recovery.

The surrogates are evaluated against the method or laboratory derived acceptance criteria or against project-specific acceptance criteria specified by the customer. Any surrogate compound that is outside of these limits is considered to be ‘out of control’ and must be qualified appropriately. Samples with surrogate failures can be re-extracted and/or re-analyzed to confirm that the out-of-control value was caused by the matrix of the sample and not by some other systematic error.

5.9.3.8 Internal Standards

Internal Standards are compounds not expected to occur naturally in field samples. They are added to every standard and sample at a known concentration prior to analysis for the purpose of adjusting the response factor used in quantifying target analytes. The laboratory follows specific guidelines for the treatment of internal standard recoveries and further information can be found in the applicable laboratory SOP.

5.9.3.9 Proficiency Testing (PT) Studies

The laboratory participates in proficiency testing programs. PT samples are obtained from approved providers and analyzed and reported at a minimum of two times per year for the relevant fields of testing per matrix. PT samples are treated as typical customer samples. They are included in the laboratory’s normal analytical processes and do not receive extraordinary attention due to their nature.

The laboratory does not share PT samples with other laboratories, does not communicate with other laboratories regarding current PT sample results, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

The laboratory initiates an investigation and corrective action plan whenever PT results are deemed unacceptable by the PT provider. Additional PTs will be analyzed and reported as needed for certification purposes.

Additional information can be found in the SOP# 030212, *Proficiency Testing Program*

5.10 DATA REPORTING

5.10.1 General

The results of each analysis carried out by the laboratory are reported accurately, clearly, unambiguously, objectively, and in accordance with any specific instructions in regulatory requirements, analytical method(s), and/or laboratory standard operating procedures. The analytical data is reported in an analytical report that is issued to the customer. Analytical reports include all information requested by the customer, any necessary information for the interpretation of the results, and all information required by the analytical method(s) used.

Final reports are prepared according to the level of reporting required by the customer and can be transmitted to the customer via hardcopy and/or electronic data deliverables.

5.10.2 Analytical Reports

In the case of a written agreement with the customer, the analytical results may be reported in a non-standard way. In these cases, all information contained in the standard analytical reports is maintained by the laboratory and is readily available.

Standard analytical reports contain the following information:

- A title (e.g. Analytical Report)
- ESC Lab Sciences name and address
- Telephone number and name of a laboratory contact to where questions can be referred
- A unique identification number for the report. The pages of the report are numbered and a total number of pages are indicated.
- Name and address of the customer
- Identification of the analytical methods used
- The unique laboratory's identification of the samples analyzed as well as customer's identification of the samples
- The condition of the samples received and the identification of any sample that did not meet acceptable sampling requirements such as improper sample containers, holding times missed, sample temperature, etc.
- Dates and times of sample collection, sample receipt by the laboratory, sample preparation, and sample analysis
- Reference to the sampling plan and sampling procedures used if sampling was conducted by the laboratory

- The analytical results with the units of measurement and reporting limits.
- The name, title, and signature of the person authorizing the analytical report
- A statement about the results relate only to the items tested
- Deviations from the analytical methods. These can include failed quality control parameters, deviations caused by the matrix of the sample, etc. This can be part of the case narrative or as defined footnotes to the analytical data.
- For Whole Effluent Toxicity, identification of the statistical method used to provide data
- Date report was issued
- For solid samples, identification of whether results are on a dry weight or wet weight basis
- Identification of all test results provided by a subcontracted laboratory or other outside source
- Any non-accredited tests are identified as such
- Identification of results obtained outside of quantitation levels
- In conjunction with Ohio VAP projects, a signed affidavit is also required.

5.10.3 Additional Analytical Report Items

In addition to the requirements listed above, final reports also contain the following items when necessary for the interpretation of results:

- Deviations from, additions to, or exclusions from the analytical method(s) used. Also where relevant, information on specific analytical conditions such as environmental conditions
- Where relevant, a statement of compliance/non-compliance with requirements and/or specifications (e.g. TNI Standard)
- Where applicable, a statement on the estimated uncertainty of measurement; information on uncertainty is needed in test reports when it is relevant to the validity or application of the test results, when a customer's instruction so requires, or when the uncertainty affects compliance to a specification limit;
- Where appropriate and needed, opinions and interpretations (see section 5.10.5 below)

In addition to the requirements listed above, analytical reports containing the results of samples collected by the laboratory include the following, where necessary for the interpretation of test results:

- The date of sampling
- Unambiguous identification of the substance, material or product sampled
- The location of sampling, including any diagrams, sketches or photographs
- A reference to the sampling plan and procedures used

- Details of any environmental conditions during sampling that may affect the interpretation of the test results
- Any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned.

5.10.4 Calibration Certificates

ESC Lab Sciences is an analytical laboratory that does not perform calibration activities for customers; therefore, no calibration certificates are issued to customers.

5.10.5 Opinions and Interpretations

When opinions and interpretations are included in the analytical reports, the laboratory documents the basis upon which the opinions and interpretations have been made. These may include opinions on the compliance/non-compliance of the results with regulatory requirements, fulfillment of contractual requirements, and recommendations on how to use the results. Opinions and interpretations are clearly marked as such in the analytical report and are contained in the case narrative.

5.10.6 Results from Subcontractors

When the analytical reports contain results of tests performed by subcontractors, these results are clearly identified. When analytical work has been subcontracted, the subcontracted laboratory issues analytical reports to ESC Lab Sciences in writing and/or electronically. Copies of analytical reports from subcontracted laboratories are made available to customers.

5.10.7 Electronic Transmission of Results

Customer data that requires transmission by electronic means undergoes appropriate steps to include all the required reporting information and to adequately maintain data integrity and confidentiality.

5.10.8 Format of Analytical Reports

The format of the laboratory's analytical reports are designed to accommodate each type of analytical test carried out by the laboratory and to minimize the possibility of misunderstanding or misuse of analytical results.

5.10.9 Amendments to Analytical Reports

Analytical reports that are amended after issue to the customer are clearly identified as such and include a reference to the original report. This process is described in SOP 030223, *Report Revision*.

6.0 WASTE MINIMIZATION/DISPOSAL AND REAGENT STORAGE

ESC's sample disposal policy is founded on RCRA [40 CFR Part 261.4 (d)] and CWA [40 CFR Part 403 (Pretreatment)]. Part 261.4 (Figure 6.4) excludes a sample of waste while it is a sample; however, once no longer fitting the description of a sample, it becomes waste again. The policy is further strengthened by information found in "Less is Better" published by the ACS and developed by the ACS Task Force on RCRA.

The EPA requires that laboratory waste management practice to be conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes must be characterized and disposed of in an acceptable manner. Refer to ESC SOP #030309, *Waste Management Plan* for detailed information.

6.1 QUARANTINED SOIL SAMPLES

ESC maintains a permit to receive and analyze soils from foreign or quarantined areas. All non-hazardous soil samples are disposed of as originating from a quarantined area. All unconsumed soil samples and containers are sterilized in accordance with the current USDA regulations found in 7 CFR 301.81. Both container and contents are dry-heated at 450°F for two minutes, then crushed prior to disposal into a sanitary landfill. For further information refer to SOP# 030309, *Waste Management Plan*.

6.2 MOLD/BIOHAZARD SAMPLE DISPOSAL

The laboratory has contracted a local licensed medical waste removal and disposal firm to remove all biohazard and medical waste generated by the laboratory. All waste arriving at the treatment facility is incinerated or steam sterilized complying with all Federal, State, County and local rules, regulations and ordinances. The medical waste containers are picked up at least weekly and confirmation records are available in the laboratory.

All wastes classified as non-biohazard are disposed of via the sanitary sewer following treatment with a disinfectant, such as Chlorox (hypochlorite). The disinfectant and waste liquid is one part disinfectant and five parts waste liquid. Waste disposal records indicating the disposal method are available in the laboratory.

6.3 REAGENTS, STORAGE AND WASTE DISPOSAL

6.3.1 Reagents:

- All chemicals are at least ACS reagent-grade or better.
- All reagents and chemicals are checked for quality, purity and acceptability upon arrival in the laboratory.
- Each chemical container displays the following information: date opened and the expiration date.

- All reagent solutions prepared in-house are documented in Standards Logger and labels contain the following information: unique ESC identifier, date prepared, analyst initials, expiration date, and reagent name. In house reagents are recorded with the same information in Standards Logger.
- Purchased reagent solutions are labeled with a unique identifier assigned in Standards Logger when received, opened and with the expiration date.

6.3.2 Storage:

- Reagents requiring refrigeration are stored in the area of use in a suitable refrigerated storage that is separate from field sample storage.
- Reagents and standards used for volatile organic analysis are stored in a separate refrigerator and are not stored with field samples.
- See the following table for more information regarding reagent storage.

Item	**Reagent Storage**
Acids	Designated acid storage cabinets, in original container.
Organic Reagents - Flammables	Stored in flammables cabinet on separate air handling system from volatiles analysis.
Liquid Bases	Stored in designated cabinet, away from acids.
Solid Reagents	General cabinet storage.
Refrigerated Aqueous Reagents/Standards	Stored in walk-in cooler on designated shelves, away from field samples.
Stable Standard Solutions	Storage cabinet designated in each laboratory for standards.
Dehydrated Media	Dehydrated media is stored at an even temperature in a cool dry place away from direct sunlight. Media is discarded if it begins to cake, discolor, or show signs of deterioration. If the manufacturer establishes an expiration date, the media is discarded after that date. The time limit for unopened bottles is 2 years at room temperature. Where needed comparisons of recovery of newly purchased lots of media against proven lots, using recent pure-culture isolates and natural samples, are performed.
Pure Biological Cultures	All organisms are stored on Tryptic Soy Agar at 4°C in a dedicated refrigerator located in the biology department

6.3.3 Disposal:

- All excess, out of date or unneeded chemicals, reagents and standards are sent to the ESSH Office to ensure proper disposal. Excess chemicals designated as hazardous waste are lab packed and disposed of according to local, State and Federal regulations. Final disposal method is dependant on the classification of each individual chemical. Some sample extracts, chemicals or standards designated as hazardous waste may be disposed of into appropriate satellite accumulation areas.

Any additional EPA waste codes resulting from addition of standard are applied to the satellite container, if applicable.

- ESSH prohibits the sink disposal of chemicals, the intentional release of chemicals through chemical fume hoods and mixing of nonhazardous lab trash with hazardous waste.
- Sample and reagent/solvent disposal is handled in different ways according to toxicity.
  - Solvents, reagents, samples and wastes are segregated according to base/acid, reactive/non-reactive, flammable/non-flammable, hazardous/non-hazardous, soil/liquid etc. Samples are grouped together relevant to these categories and are disposed of accordingly.
  - Table 6.3 lists waste disposal methods for various test by-products.
- Upon receipt and login, each sample is coded by sample matrix type. The codes divide samples into the following groups: air, industrial hygiene, wastewater, cake sludge, soil, drinking water and miscellaneous. As laboratory personnel review the data reported, the method of disposal is also determined.
- The TSR is notified if samples are to be returned to the customer.

6.4 CONTAMINATION CONTROL

6.4.1 VOCs

The VOC Lab is physically separated from the Extraction Laboratory in order to eliminate contamination caused by the use of extraction solvents. Contamination is monitored daily through the use of instrument/method blanks. Refrigerator blanks are also used to ensure that cross contamination does not occur during volatile field sample storage.

6.4.2 Biological Lab

The aquatic toxicity testing, mold testing, and all other biological determinations are performed in the administrative building and are therefore physically separated from processes involving solvent or other chemical use that could negatively impact biological organisms. The mold lab conducts monthly analyses to ensure that the laboratory environment is contaminant free. All critical areas are included and a record is kept of the sampling plan (including locations) and results.

TABLE 6.4 - WASTE DISPOSAL

NOTE: This information is a general guide and is not intended to be inclusive of all waste or hazardous samples.

PARAMETER	WASTE PRODUCTS	WASTE CLASSIFICATION	DISPOSAL METHOD
Acidity	slightly alkaline water	none	neutralize-sanitary sewer
Alkalinity	slightly acidic	none	neutralize-sanitary sewer
BOD, 5-day	Sample waste only	none	sanitary sewer
COD	acid waste, Hg, Ag, Cr+6	corrosive, toxic	dispose via haz waste regulations
Conductivity	Sample waste only	none	sanitary sewer
Cyanide, Total	acidic waste	corrosive	neutralize-sanitary sewer
Cyanide, Amenable	acidic waste	corrosive	neutralize-sanitary sewer
Flashpoint	Misc. Organic waste containing Chlorobenzene	Flammable	Dispose via haz waste regulations
Hardness, Total	pH 10.0 alkaline waste	none	neutralize-sanitary sewer
Extraction/prep	methylene chloride and hexane	toxic solvents	Reclaim for resale
Methylene Blue Active Sub.	Acidic Chloroform Waste	toxic & acidic	dispose via haz waste regulations
Nitrogen-Ammonia	alkaline liquids	corrosive	neutralize-sanitary sewer
Nitrogen-Total Kjeldahl	Trace Hg in alkaline liquid	corrosive toxic	neutralize-sanitary sewer
Nitrogen-Nitrate, Nitrite	mild alkaline waste	none	sanitary sewer
Oil & Grease and Petroleum/Mineral Oil & Grease	Hexane	Toxic solvent	dispose via haz waste regulations
pH	Sample waste only	none	sanitary sewer
Phenols	slightly alkaline, non-amenable CN-	none	sanitary sewer
Phosphate-Total and Ortho	combined reagent	listed	sanitary sewer
Reactive CN & S	Acidic waste	corrosive	Neutralize - sanitary sewer; waste is monitored for CN
Solids, Total/ Suspended/Dissolved	Sample waste only	none	sanitary sewer
Turbidity	Sample waste only	none	sanitary sewer
Metals	acids, metal solutions	corrosive, toxic	highly toxic metal standards and samples - dispose via haz waste regulations
Volatile Organics	methanol	toxic solvents	dispose via haz waste regulations
Extractable Organics	solvents, standards	toxic solvents	dispose via haz waste regulations
Biological Non-biohazardous Waste	Gloves, plastic containers	none	Standard refuse

40 CFR PART 261-IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

Subpart A-General Sec.

261.1 Purpose and scope.

261.2 Definition of solid waste.

261.3 Definition of hazardous waste.

261.4 Exclusions.
261.5 Special requirements for hazardous waste generated by conditionally exempt small quantity generators.
261.6 Requirements for recyclable materials.
261.7 Residues of hazardous waste in empty containers.
261.8 PCB wastes regulated under Toxic Substance Control Act.
261.9 Requirements for Universal Waste.

Sec.261.4 Exclusions.
(d) *Samples.* (1) Except as provided in paragraph (d)(2) of this section, a sample of solid waste or a sample of water, soil, or air, which is collected for the sole purpose of testing to determine its characteristics or composition, is not subject to any requirements of this part or parts 262 through 268 or part 270 or part 124 of this chapter or to the notification requirements of section 3010 of RCRA, when:

(i) The sample is being transported to a laboratory for the purpose of testing; or
(ii) The sample is being transported back to the sample collector after testing; or
(iii) The sample is being stored by the sample collector before transport to a laboratory for testing; or
(iv) The sample is being stored in a laboratory before testing; or
(v) The sample is being stored in a laboratory after testing but before it is returned to the sample collector; or
(vi) The sample is being stored temporarily in the laboratory after testing for a specific purpose (for example, until conclusion of a court case or enforcement action where further testing of the sample may be necessary).
(2) In order to qualify for the exemption in paragraphs (d)(1) (i) and (ii) of this section, a sample collector shipping samples to a laboratory and a laboratory returning samples to a sample collector must:
(i) Comply with U.S. Department of Transportation (DOT), U.S. Postal Service (USPS), or any other applicable shipping requirements; or
(ii) Comply with the following requirements if the sample collector determines that DOT, USPS, or other shipping requirements do not apply to the shipment of the sample:
(A) Assure that the following information accompanies the sample:
(*1*) The sample collector's name, mailing address, and telephone number;
(*2*) The laboratory's name, mailing address, and telephone number;
(*3*) The quantity of the sample;
(*4*) The date of shipment; and
(*5*) A description of the sample.
(B) Package the sample so that it does not leak, spill, or vaporize from its packaging.
(3) This exemption does not apply if the laboratory determines that the waste is hazardous but the laboratory is no longer meeting any of the conditions stated in paragraph (d)(1) of this section.

7.0 Common Calculations

- Percent Recovery (%REC)

$$\%REC = \frac{(MeasuredValue - SampleConc)}{TrueValue} * 100$$

where:
TrueValue = Amount spiked
MeasuredValue = Amount measured
SampleConc = Amount measured in source sample (Used for %REC in MS calculations)
NOTE: The SampleConc is zero (0) for LCS and Surrogate Calculations

- Relative Percent Difference (RPD)

$$RPD = \frac{|(R1 - R2)|}{(R1 + R2)/2} * 100$$

where:
R1 = Result of Sample 1
R2 = Result of Sample 2

- Percent Difference (%D)

$$\%D = \frac{MeasuredValue - TrueValue}{TrueValue} * 100$$

where:
TrueValue = Amount spiked (can also be the CF or RF of the ICAL Standards)
Measured Value = Amount measured (can also be the CF or RF of the CCV)

- Percent Drift

$$\%Drift = \frac{CalculatedConcentration - TheoreticalConcentration}{TheoreticalConcentrtion} * 100$$

- Average

$$Average = \frac{\sum_{n=1}^{i} X_i}{n}$$

where:
n = number of data points
X_i = individual data point

- Calibration Factor (CF)

$$CF = \frac{A_s}{C_s}$$

where:
A_s = Average Peak Area over the number of peaks used for quantitation
C_s = Concentration of the analyte in the standard.

- Response Factor (RF)

$$RF = \frac{(Conc._{IStd})(Area_{Analyte})}{(Conc._{analyte})(Area_{IStd})}$$

where:
A_s = Response for analyte to be measured
A_{is} = Response for the internal standard
C_{is} = Concentration of the internal standard
C_s = Concentration of the analyte to be measured

- Standard Deviation (S)

$$S = \sqrt{\sum_{i=1}^{n} \frac{(X_i - X_{ave})^2}{(n-1)}}$$

where:
n = number of data points
X_i = individual data point
X_{ave} = average of all data points

- Relative Standard Deviation (RSD)

$$RSD = \frac{S}{X_{ave}} * 100$$

where:
S = Standard Deviation of the data points
X_{ave} = average of all data points

- Minimum Detectable Activity (MDA)

The MDA is used for radiological analysis and is calculated with the following equations:

MDA with Blank Population

$$MDA = \frac{3.29 \times S_b}{KT_s} + \frac{3}{KT_s}$$

Where:
K = E × V × R × Y × F × 2.22
E = efficiency
V = sample volume
R = tracer recovery
Y = gravimetric carrier recovery
F = ingrowth or decay factor
2.22 = conversion from dpm to pCi
T_s = count time of sample in minutes
S_b = standard deviation of the blank population

MDA without Blank Population

$$MDA = \frac{3.29 \times \sqrt{\frac{b}{T_s} + \frac{b}{T_b}}}{K} + \frac{3}{KT_s}$$

Where:
b = background count rate in cpm
T_b = Count time of background in minutes

8.0 Revisions

The Regulatory Affairs Department has an electronic version of this Quality Assurance Manual with tracked changes detailing all revisions made to the previous version. This version is available upon request. Revisions to the previous version of the Quality Assurance Manual are summarized in the table below.

Document	**Revision**
Quality Assurance Manual Version 15.0	General – Replaced the term "client" with the term "customer" throughout this document. Also changed references to AIHA to AIHA-LAP or AIHA-PAT as appropriate. Section 1.0 – Limited scope of this section to just a general purpose. Removed Index and Revision Status section. Section 2.2 – Updated the current number of employees, the current square footage, and the current number of buildings. Section 3.3 – Added definitions of the TX TRRP terms SQL, MQL, and Unadj. MQL. Added air and emissions to the definition of Environmental Sample. Added definitions of SUMMA canisters and Tedlar bags. Section 3.4 – Added the descriptions of abbreviations AIHA-LAP and AIHA-PAT. Section 4.1.4 – Reworded section for clarity Section 4.1.5 – Reworded section for clarity Section 4.1.6 – Reworded section for clarity Figure 4.1 – Updated Org Chart Section 4.2 – Reworded entire section for clarity Section 4.2.2 – Rewrote the quality policy statement Section 4.2.6 – Renamed Lab Director to Director of Operations and reworded responsibilities. Removed Technical Director. Added Organics Manager and Inorganics Manager. Renamed QA Manager to QA Director. Section 4.2.8 – Added Data Integrity System section Section 4.3 – Reworded entire section for clarity Section 4.3.4 – Added section for Quality Assurance Manual which was previously in 4.2.4 Section 4.4.1 – Added some language about review of routine/non-complex projects Section 4.4.3 – Reworded section for clarity Section 4.5.5 – Added Identification of Sub Work section. Language was previously in 4.5.3 Section 4.6.2 – Reworded section for clarity Section 4.6.3 – Reworded section for clarity Section 4.7 – Reworded some subsections for clarity Section 4.8 – Reworded entire section for clarity Section 4.9 – Reworded entire section for clarity Section 4.10 – Reworded entire section for clarity Section 4.11 – Reworded entire section for clarity Section 4.12 – Reworded entire section for clarity Section 4.14 – Reworded entire section for clarity Section 4.15 – Reworded entire section for clarity Section 5.2.2 – Reworded entire section for clarity Section 5.2.2.4 – Added section for data integrity training Section 5.2.2.5 – Added section for identification of training needs Section 5.2.2.6 – Added section for evaluation of training effectiveness Section 5.2.3 – Reworded section for clarity Section 5.2.5 – Reworded section for clarity Section 5.3.2 – Reworded section for clarity Section 5.3.3 – Reworded section for clarity Section 5.3.4 – Reworded section for clarity Section 5.4.5.4 – Reworded section for clarity Section 5.4.5.5 – Reworded section for clarity Section 5.4.6 – Reworded section for clarity Section 5.4.7.1 – Reworded section for clarity

Document	Revision
	Section 5.4.7.2 – Added in some DoD required items Section 5.4.7.3 – Added data reduction and review section. Language was previously in section 5.11 and section 5.12 Table 5.4.7a – Revised the levels of LIMS security Section 5.5 – Reworded entire section for clarity Section 5.5.2 – Added appropriate calibration curve models, quadratic curve evaluation, and added language about higher order polynomial curves (i.e., third-order and greater) are not allowed at ESC. Section 5.6 – Reworded entire section for clarity Section 5.7 – Reworded entire section for clarity Section 5.7.4 – Added section for laboratory subsampling Section 5.8 – Reorganized and reworded entire section for clarity 5.8.3.1 – Revised Sample Rejection Policy to a Sample Acceptance Policy and changed the criteria that needs to be met. Section 5.9.1 – Reworded section for clarity Section 5.9.2 – Reworded section for clarity Section 5.10 – Reworded entire section for clarity Section 6.4 – Removed language about wipe testing in Metals for lead Section 7 – Added calculations for MDA used in radiological analysis

ESC Site Plan
QUALITY ASSURANCE MANUAL

APPENDIX I TO THE ESC QUALITY ASSURANCE MANUAL

for

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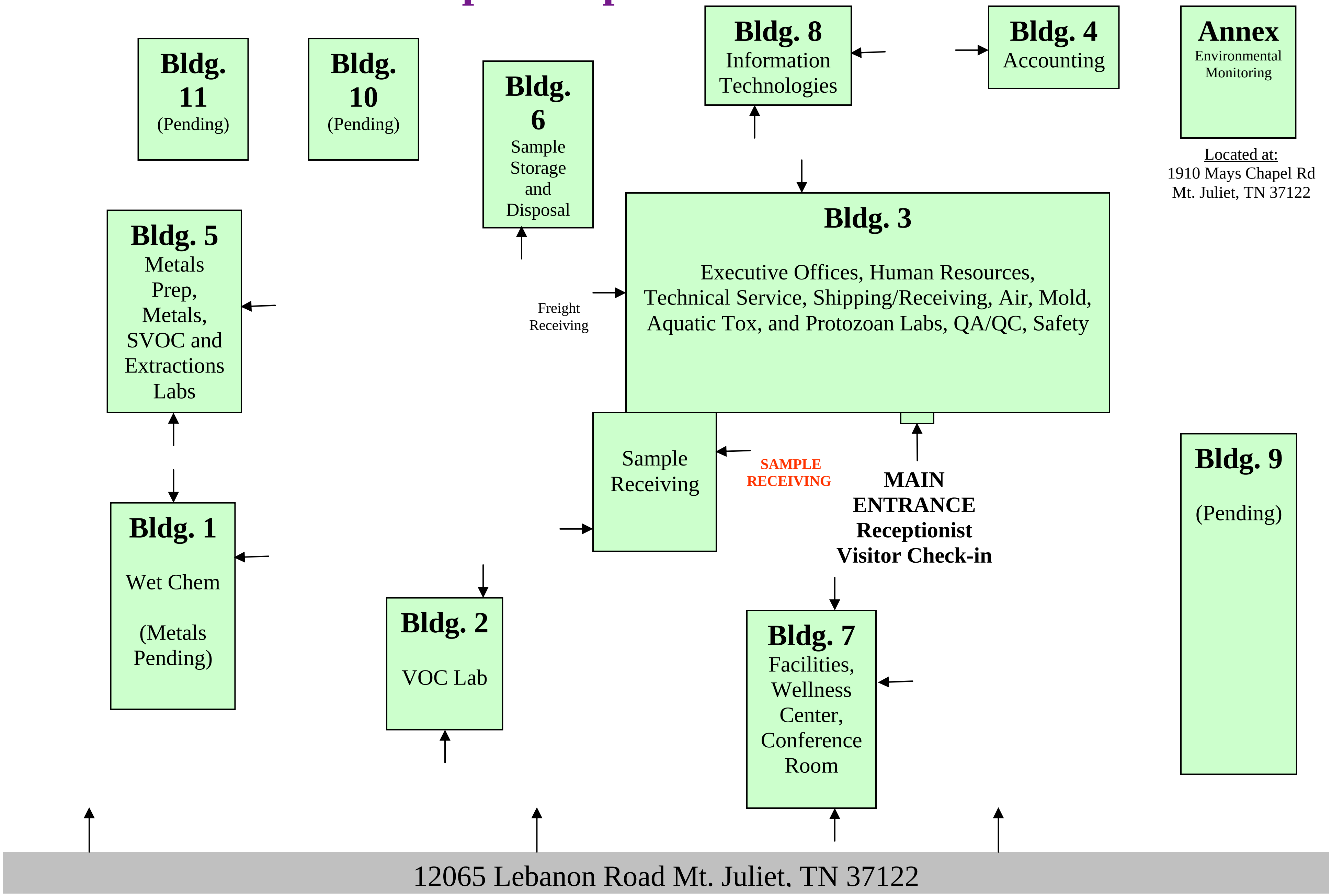
Campus Map


Bldg. 11 (Pending)
Bldg. 10 (Pending)
Bldg. 6 Sample Storage and Disposal
Bldg. 8 Information Technologies
Bldg. 4 Accounting
Annex Environmental Monitoring
Located at: 1910 Mays Chapel Rd Mt. Juliet, TN 37122
Bldg. 5 Metals Prep, Metals, SVOC and Extractions Labs
Freight Receiving
Bldg. 3
Executive Offices, Human Resources, Technical Service, Shipping/Receiving, Air, Mold, Aquatic Tox, and Protozoan Labs, QA/QC, Safety
Sample Receiving
SAMPLE RECEIVING
MAIN ENTRANCE Receptionist Visitor Check-in
Bldg. 9 (Pending)
Bldg. 1 Wet Chem (Metals Pending)
Bldg. 2 VOC Lab
Bldg. 7 Facilities, Wellness Center, Conference Room
12065 Lebanon Road Mt. Juliet, TN 37122

ESC Certifications
QUALITY ASSURANCE MANUAL

APPENDIX II TO THE ESC
QUALITY ASSURANCE MANUAL

for

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Updated 6/8/16 (May be revised without notice)
Scopes of accreditation are on file in the Regulatory Affairs Department and are available upon request.

State/Agency	Certificate Number	Expiration Date/Status	Certified Programs	Approved Programs[6]	Cert.Type	Cert. Authority
Alabama	**40660**	**6/30/2016**	DW	WW, RCRA, UST	Reciprocity	TN
Alaska	**UST-080**	**1/11/2017**	UST	UST	AK	AK
Arizona	**AZ0612**	**6/25/2017**	AIR, DW, WW, RCRA, UST		Audit	AZ
Arkansas	**88-0469**	**1/21/2017**	WW, RCRA, UST, Bioassay		NELAP	NJ
California	**2932**	**8/31/2016**	WW, RCRA, UST		NELAP	NJ
Colorado	**None**	**3/31/2017**	DW	WW, RCRA, UST	Reciprocity	TN
Connecticut	**PH-0197**	**3/31/2017**	DW, WW, RCRA, UST		Reciprocity	NJ
Florida	**E87487**	**6/30/2016**	AIR, DW, WW, RCRA, UST		NELAP	NJ
Georgia DW	**923**	**6/16/2016**	DW		Reciprocity	TN
Georgia	**None**	**11/30/2017**	WW, RCRA, UST		NELAP	NJ
Georgia DW Crypto	**923**	**6/30/2016**	DW		Reciprocity	NJ
Idaho	**TN00003**	**6/16/2016**	DW	WW, RCRA, UST	NELAP	NJ
Illinois	**200008**	**11/30/2016**	DW, WW, RCRA, UST		NELAP	NJ
Indiana	**C-TN-01**	**6/16/2016**	DW	WW, RCRA, UST	Reciprocity	TN
Iowa	**364**	**5/1/2016**	WW, RCRA, UST		Audit	IA
Kansas	**E-10277**	**10/31/2016**	DW, WW, RCRA, UST		NELAP	NJ
Kentucky DW	**90010**	**12/31/2016**	DW	RCRA	Reciprocity	TN
Kentucky UST	**16**	**11/30/2017**	UST		Audit	A2LA
Kentucky WW	**90010**	**12/31/2016**	WW		Reciprocity	NJ
Louisiana	**Agency ID 30792**	**6/30/2016**	WW, RCRA, UST, AIR		NELAP	NJ
Louisiana DW	**LA150002**	**12/31/2016**	DW		NELAP	NJ
Maine	**TN0002**	**7/5/2017**	DW, WW, RCRA, UST		Reciprocity	TN, NJ
Maryland	**324**	**12/31/2016**	DW		Reciprocity	TN
Massachusetts	**M-TN003**	**6/30/2016**	DW,WW	RCRA, UST	Reciprocity	TN
Michigan	**9958**	**6/16/2016**	DW	WW, RCRA, UST	Reciprocity	TN
Minnesota	**047-999-395**	**12/31/2016**	WW, RCRA, UST		Audit	MN
Mississippi	**None**	**6/16/2016**	DW	WW, RCRA, UST	Reciprocity	NJ
Missouri	**340**	**6/16/2016**	DW	WW, RCRA, UST	Reciprocity	NJ
Montana	**CERT0086**	**1/1/2017**	DW	WW, RCRA, UST	Reciprocity	TN
Nebraska	**NA**	**6/30/2016**	DW	WW, RCRA, UST	Reciprocity	TN
Nevada	**TN-03-2002-34**	**7/31/2016**	WW, DW, RCRA, UST		NELAP	NJ
New Hampshire	**2975**	**5/20/2017**	DW, WW, RCRA, UST		NELAP	NJ
New Jersey - NELAP	**TN002**	**6/30/2016**	DW, WW, RCRA, UST, AIR		NELAP	NJ
New Mexico	**None**	**Renewal**	DW	WW, RCRA, UST	NELAP	NJ
New York	**11742**	**4/1/2017**	WW, RCRA, UST, AIR		NELAP	NJ
North C. Aquatic Tox	**41**	**11/1/2016**	Aquatic Toxicity		Audit	NC
North Carolina DW	**DW21704**	**7/31/2016**	DW		Audit	NC
North Carolina	**Env375**	**12/31/2016**	WW, RCRA, UST		Audit	NC
North Dakota	**R-140**	**6/30/2016**	DW, WW, RCRA		Reciprocity	TN, WI
Ohio VAP	**CL0069**	**7/22/2017**	WW, RCRA, UST, AIR		Audit	OH
Oklahoma	**9915**	**8/31/2016**	WW, RCRA, UST, BIOASSAY		NELAP	NJ
Oklahoma DW			DW – Volatiles & Metals		NELAP	NJ
Oregon	**TN200002**	**1/15/2017**	DW, WW, RCRA, UST		NELAP	NJ

State/Agency	Certificate Number	Expiration Date/Status	Certified Programs	Approved Programs[6]	Cert.Type	Cert. Authority
Pennsylvania	**68-02979**	**12/31/2016**	DW, WW, RCRA, UST	0	NELAP	NJ
Rhode Island	**221**	**12/30/2016**	DW	WW, RCRA, UST	Reciprocity	TN
South Carolina	**84004**	**6/30/2016**	WW, RCRA, UST		NELAP	NJ
South Dakota	**Pending**	**Pending**				
Tennessee DW	**2006**	**6/16/2016**	DW	WW, RCRA, UST	Audit	TN
Tennessee DW Micro	**2006**	**10/12/2018**	DW Micro		Audit	TN
Texas - Env.	**T 104704245-07-TX**	**10/31/2016**	DW, WW, RCRA, AIR		Reciprocity	NJ
Texas - Mold	**LAB0152**	**3/10/2017**	MOLD		NA	TX
Utah	**6157585858**	**7/31/2016**	DW, WW, RCRA, UST		NELAP	NJ
Vermont	**VT2006**	**1/5/2017**	DW	WW, RCRA, UST	Reciprocity	TN
Virginia VELAP	**460132**	**6/14/2016**	DW, WW, RCRA, UST		NELAP	NJ
Washington	**C1915**	**8/19/2016**	DW, WW, RCRA, UST, AIR		Audit	A2LA
West Virginia	**233**	**2/28/2017**	WW, RCRA, UST		Audit	WV
West Virginia Crypto	**9966 M**	**12/31/2016**	DW		Reciprocity	NJ
Wisconsin	**998093910**	**8/31/2016**	WW, RCRA, UST, Bioassay		Audit	WI
Wyoming	**A2LA**	**11/30/2017**	UST	WW, RCRA	Audit	A2LA
A2LA[1]	**1461.01**	**11/30/2017**	DW, WW, RCRA, UST, AIR, MICRO		Audit	A2LA
AIHA-LAP[2]	**100789**	**7/1/2016**	EMLAP[4]		Audit	AIHA
DOD	**1461.01**	**11/30/2017**	RCRA, UST		Audit	A2LA
EPA[8]	**TN00003**	**None**	Cryptospiridium		Audit	EPA
EPA[8] Region 8		**7/15/2016**	Drinking Water		Reciprocity	TN
USDA[5]	**S-67674**	**9/3/2018**	Quarantine Permit		Audit	USDA

(1) A2LA = American Association for Laboratory Accred.
(2) AIHA-LAP = American Industrial Hygiene Association Lab Accred. Program
(3) NELAP = National Environmental Laboratory Accred. Program
(4) EMLAP = Environmental Microbiology Laboratory Accreditation Program
(5) USDA = United States Department of Agriculture
(6) Approved Programs = The state does not have a formal certification program.
(7) Pending = The state is processing our application.
(8) EPA = Environmental Protection Agency

1.0 SIGNATORY APPROVALS

SAMPLING PROTOCOL QUALITY ASSURANCE MANUAL

APPENDIX III TO THE ESC QUALITY ASSURANCE MANUAL

for

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Prepared by

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2.0 *APPENDIX TABLE OF CONTENTS*

3.0 SCOPE AND APPLICATION

This appendix discusses the standard practices and procedures utilized by ESC personnel for site selection and sample collection of various matrices. Topics addressed include field QA/QC procedures, together with equipment care and calibration for field sampling activities. Proper collection and handling of samples is of the utmost importance to insure that collected samples are representative of the sampling site. With this goal, proper sampling, handling, preservation, and quality control techniques for each matrix must be established and strictly followed. Precise identification of the collected samples and complete field documentation including a chain of custody are also vital.

ESC Lab Sciences does not provide sampling services for Industrial Hygiene and Environmental Lead analyses. We do require that all samples collected for these programs be sampled using the guidelines established by NIOSH, OSHA or other published protocol.

In addition, ESC Lab Sciences personnel do not conduct sampling in conjunction with the Ohio Voluntary Action Program (VAP).

4.0 LIST OF SAMPLING CAPABILITIES

• Parameter Group	• Sample Source
Extractable Organics	Surface water, wastewater, groundwater, stormwater runoff, drinking water, sediments, soils, chemical/ hazardous wastes, domestic wastewater sludge, hazardous waste sludge
Volatile Organic Compounds (VOCs)	Surface water, wastewater, groundwater, stormwater runoff, drinking water, sediments, soils, chemical/ hazardous wastes, domestic wastewater sludge, hazardous waste sludge
Metals	Surface water, wastewater, groundwater, stormwater runoff, drinking water, sediments, soils, chemical/ hazardous wastes, domestic wastewater sludge, hazardous waste sludge
Inorganic Anions	Surface water, wastewater, groundwater, stormwater runoff, drinking water, sediments, soils, chemical/ hazardous wastes, domestic wastewater sludge, hazardous waste sludge
Organics	Surface water, wastewater, groundwater, stormwater runoff, drinking water, sediments, soils, chemical/ hazardous wastes, domestic wastewater sludge, hazardous waste sludge
Physical Properties	Surface water, wastewater, groundwater, stormwater runoff, drinking water, sediments, soils, chemical/ hazardous wastes, domestic wastewater sludge, hazardous waste sludge
Cyanide	Surface water, wastewater, groundwater, stormwater runoff, drinking water, sediments, soils, chemical/ hazardous wastes, domestic wastewater sludge, hazardous waste sludge

• Parameter Group	• Sample Source
Microbiology	Surface water, groundwater, drinking water, wastewater
Macro Invertebrate Identification	Surface water, wastewater, sediments
Biotoxicity	Surface water and wastewater

5.0 GENERAL CONSIDERATIONS

The following procedures are used in all of ESC's sampling activities. These procedures must be considered in relation to the objectives and scope of each sampling event.

5.1 SELECTING A REPRESENTATIVE SAMPLING SITE

Selecting a representative sampling site is dependent upon the matrix to be sampled and type of analyses required. These matrix specific procedures are discussed in subsequent sections.

5.2 SELECTION AND PROPER PREPARATION OF SAMPLING EQUIPMENT

The type of sampling equipment to be used is specific to the sample matrix and the analyses to be conducted. These are discussed later in this section. Section 12.0 describes the equipment cleaning procedures utilized by ESC personnel.

5.3 SAMPLING PROCEDURES FOR INDUSTRIAL HYGIENE AND ENVIRONMENTAL LEAD SAMPLES

ESC does not provide sampling services for industrial hygiene and/or environmental lead analyses. Experienced laboratory personnel can assist with advice on sampling; however, the adequacy and accuracy of sample collection is the customer's responsibility.

5.4 SAMPLING EQUIPMENT CONSTRUCTION MATERIALS

To prevent direct contamination or cross-contamination of the collected sample, great attention must be given to the construction material used for sampling equipment. Materials must be inert, non-porous and easy to clean. Preferred materials include Teflon®, glass, stainless steel and plastic. Plastics may not be used for collections where organics are the analytes of interest. Stainless steel may not be used where metallic compounds will be analyzed.

5.5 SELECTION OF PARAMETERS BEING ANALYZED

Parameters for analysis are usually dictated by and based on regulated monitoring conditions (i.e. NPDES or RCRA permits). If these do not apply, analyses are selected by ESC or the customer based on federal regulations specific to the matrix being investigated.

5.6 ORDER OF SAMPLE COLLECTION

Unless field conditions demand otherwise, the order of sample collection is as follows:

1. Volatile organic compounds (VOCs)
2. Extractable Organics (includes Total Recoverable Petroleum Hydrocarbons [TRPH], Oil & Grease, Pesticides and Herbicides)
3. Total metals
4. Dissolved metals
5. Microbiological
6. Inorganic (includes Nutrients, Demand, and Physical Properties)
7. Radionuclides

5.7 SPECIAL PRECAUTIONS FOR TRACE CONTAMINANT SAMPLING

Many contaminants can be detected in the parts per billion or parts per trillion range and extreme care must be taken to prevent cross-contamination. Therefore, extra precautions apply where samples are collected for trace contaminants. These precautions include:

- A new pair of disposable latex gloves must be worn at each sampling location.
- Sample containers for samples suspected of containing high concentrations of contaminants are sealed in separate plastic bags immediately after collection and preservation.
- If possible, background samples and source samples should be collected by different field sampling teams. If different field teams are not possible, all background samples are collected first and placed in separate ice chests or shipping containers. Samples of waste or highly contaminated samples are not be placed in the same container as environmental samples. Ice chests or shipping containers for source samples or samples that are suspected to contain high concentrations of contaminants are discarded after use.
- If possible, one member of the field team should handle all data recording, while the other members collect samples.
- When sampling surface waters, water samples should always be collected before sediment samples are collected.
- Sample collection activities should proceed from the suspected area of least contamination to the suspected area of greatest contamination.
- ESC personnel uses equipment constructed of Teflon®, stainless steel, or glass that has been properly pre-cleaned (Sections 12.3 & 12.4) for collecting samples for trace metals or organic compounds analyses. Teflon®, glass, or plastic is preferred for collecting samples where trace metals are of concern. Equipment constructed of plastic or PVC are <u>not</u> be used to collect samples for trace organic compounds analyses.
- When fuel powered units are utilized, they are placed downwind and away from any sampling activities.
- Monitoring wells with free product are not sampled for trace contaminant analysis.

5.8 SAMPLE HANDLING AND MIXING

Sample handling should be kept to a minimum. ESC personnel must use extreme care to avoid sample contamination. If samples are placed in an ice chest, personnel should ensure that sample containers do not become submerged or tip over as this may result in cross-contamination. Small sample containers (e.g., VOCs or bacterial samples) are placed in airtight plastic bags to prevent cross-contamination.

Once a sample has been collected, it may have to be split into separate containers for different analyses. A liquid sample is split by shaking the container or stirring the sample contents with a clean pipette or pre-cleaned Teflon® rod. Then the contents are alternately poured into respective sample containers. Items used for stirring must be cleaned in accordance with the guidelines set forth in Section 12.0. Samples for VOCs, Cyanide, Total Phenol, and Oil & Grease must be collected as discrete grabs.

A soil sample may be split but must first be homogenized as thoroughly as possible to ensure representative sub-samples of the parent material. This is accomplished using the quartering method. The soil is placed in a sample pan and divided into quarters. Each quarter is mixed separately then all quarters are mixed together. This is repeated several times until the sample is uniformly mixed. If a round bowl is used, mixing is achieved by stirring the material in a circular fashion with occasional inversion of the material.

Soil and sediment samples collected for volatile organic compounds are <u>not</u> be mixed. The appropriate sample container should be filled completely, allowing little to no headspace.

Moisture content inversely affects the accuracy of mixing and splitting a soil sample.

5.9 QUALITY CONTROL SAMPLES

Quality control samples must be collected during all sampling events to demonstrate that the sample materials have not been contaminated by sampling equipment, chemical preservatives, or procedures relating to the sample collection, transportation and storage. A summary of the recommended frequency for collecting field quality control samples is presented in the following:

5.9.1 Quality Control Samples

Number of samples	Pre-cleaned equipment blank[1]	Field cleaned equipment blank	Trip blank (VOCs)	Duplicate
10 or more	minimum of 1 then 5%	minimum of 1 then 5%	one per cooler[2]	minimum one then 10%[3]
5 - 9	one	one	one per cooler[2]	one
less than 5	one	one	one per cooler[2]	Not required, but recommend a minimum of one. USACE projects require one. Customer specific QAPP requirements must be considered.

1 Pre-cleaned blanks are to be collected after the initial decontamination procedure has been completed but before the first sample is collected. Only one pre-cleaned or field-cleaned blank is required if less than 10 samples are collected. Only analyte-free water as defined in this document will be used in the preparation of any field and/or equipment blank.

2 Where VOC methods are analyzed simultaneously, such as 601/602, only one (1) trip blank is required per cooler.

3 Duplicate samples are collected for all VOC samples.

5.10 VOLATILE ORGANIC COMPOUND SAMPLING

Water Samples

Generally, groundwater, drinking water and wastewater samples for the analysis of volatile organic compounds are collected in duplicate pre-labeled 40mL vials. During bottle kit preparation in the laboratory, 200µL of concentrated HCl is added to each clean and empty vial. A Teflon® septum is placed in each cap and a cap is placed securely on each vial.

The sampler should check the water being sampled for residual chlorine content. This is done with residual chlorine testing strips. If no chlorine is present, the prepared vials may be filled as needed. If residual chlorine is present, add sodium thiosulfate ($Na_2S_2O_3$) to each vial prior to sampling.

To fill the vial properly, the sample is poured slowly down the inside wall of the vial until a convex meniscus is formed. Care should be taken to minimize turbulence. The cap is then applied to the bottle with the Teflon® side of the septum contacting the sample. Some overflow is lost; however air space in the bottle should be eliminated. Check for air bubbles by inverting the capped vial and tapping against the heel of the hand. This will dislodge bubbles hidden in the cap. If any bubbles are present, repeat the procedureusing a clean vial and re-sample with a new preserved and septum. At a minimum, duplicate vials should always be collected from each sample location.

For analysis using EPA Method 524.2, samples that are suspected to contain residual chlorine, 25mg of ascorbic acid per 40mL of sample is added to each sample vial prior to sampling. Additionally, if analytes that are gases at room temperature (i.e. vinyl chloride, etc.) or any of the analytes in following table are not to be determined, 3mg of sodium thiosulfate is recommended for use to remove residual chlorine during sampling. If residual chlorine is present in the field sample at >5mg/L, then add additional 25mg or ascorbic acid or 3mg of sodium thiosulfate for each 5mg/L of residual chlorine present. Sample vials are filled as previously described. Following collection and dechlorination, Method 524.2 samples are adjusted to a pH of <2 with HCl.

Acetone	Acrylonitrile	Allyl chloride
2-Butanone	Carbon disulfide	Chloroacetonitrile
1-Chlorobutane	t-1,2-Dichloro-2-butene	1,1-Dichloropropanone
Diethyl ether	Ethyl methacrylate	Hexachloroethane
2-Hexanone	Methacrylonitrile	Methylacrylate
Methyl iodide	Methylmethacrylate	4-Methyl-2-pentanone
Methyl-tert-butyl ether	Nitrobenzene	2-Nitropropane
Pentachloroethane	Propionitrile	Tetrahydrofuran

For more detailed instructions, see the published method.

Soil Samples

Option 1 – Core Sampling Device
Soil samples for volatile organic analysis are sampled using traditional core sampling methods. Once the core sample is collected, additional samples should be taken using an Encore™ sampler, either 5g or 25g, capped, sealed, and immediately cooled. The holding time for this method is 48 hours.

Option 2 – Pre-weighed Vial
In the other option for volatile soil sampling, 40mL vials with cap, Teflon® lined septum, preservative (5mL sodium bisulfate solution), and stir bar are pre-weighed, either by the user or the manufacturer. The vial is weighed on a balance capable of measuring to 0.01g and labeled with the pre-weighed value. In the field, place roughly 5g of sample into a pre-weighed vial, cap, and then immediately place on ice to achieve a temperature of ≤6ºC. Exact soil weights can be measured using the pre-weight of the vial and the post-sampling weight. The difference represents the actual weight of the soil sample. The holding time for this method is 14 days.

Unless specifically permitted by the regulatory authority, VOC samples (liquid or solid) should never be mixed or composited.

5.11 OIL AND GREASE SAMPLING

Aqueous samples collected for oil and grease analyses must be collected as discrete grab samples. Sample containers should not be rinsed with sample water prior to sample collection and samples should be collected directly into the sample container. Intermediate vessels should only be used where it is impossible to collect the sample directly into the sample container and, in this case, only Teflon® beakers should be used. Samples should be taken from well-mixed areas.

5.12 CYANIDE SAMPLING

Cyanide is a very reactive and unstable compound and should be analyzed as soon as possible after collection. Samples are collected in polyethylene or glass containers and are pretreated and preserved in the manner specified in the following paragraphs.

5.12.1 Test for Oxidizing Agents

1. Test the sample with residual chlorine indicator strips.
2. Add a few crystals of ascorbic acid and test until negative.
3. Add an additional 0.6 grams of ascorbic acid for each liter sampled to remove residual chlorine.
4. Preserve the pretreated sample by to a pH > 12.0 with NaOH and cool to 4 $\pm$ 2°C. Verify the pH of the samples as per Section 14.2.
5. Equipment blanks must be handled in the same manner as described in steps 1 through 4.

5.12.2 Test for Sulfide

1. Test the sample for sulfide using the sulfide test strip (formally HACH KIT).
2. If sulfide is not removed by the procedure below, the sample must be preserved with NaOH to pH > 12.0 and analyzed by the laboratory within 24 hours.
3. Sulfide should be removed by filtering visible particulate. Retain filter (filter #1).
4. Remove the sulfide by adding lead carbonate powder to the filtrate to cause the sulfide to precipitate out.
5. Test the filtrate for the presence of sulfide. If sulfides are present, repeat steps 1 and 4 until no sulfides are shown present.
6. The precipitate can now be filtered from the sample and this filter is discarded.
7. The sample is then reconstituted by adding the sediment collected on filter #1 back to the filtrate.
8. Preserve the pretreated sample to a pH > 12.0 with NaOH and cool to 4 $\pm$ 2°C. Verify the pH of the samples as per Section 14.2
9. Equipment blanks must be handled in the same manner as described in steps 1 through 9.

5.13 Biomonitoring Sampling

Aqueous samples collected for Bioassay can be collected in either glass or HDPE plastic. There is no chemical preservation for this type of sample and the required volume varies with each type of analysis. Following sampling, all samples must be cooled to 0-6°C and can be held for a maximum of 36 hours from the time of collection. Grab and composite sample protocols are utilized for acute and chronic bioassays and are chosen according to permit requirements. Samples are collected with minimum aeration during collection and the container are filled allowing no headspace. Samples may be shipped in one or more 4L (1 gal.) CUBITAINERS® or unused plastic "milk" jugs. All sample containers should be rinsed with source water before being filled with sample. Containers are not reused. If the sample is a chlorinated effluent, total residual chlorine must be measured immediately following sample collection.

5.14 Procedures for Identifying Potentially Hazardous Samples

Any sample either known, or suspected, to be hazardous are identified as such on the chain of custody. Information explaining the potential hazard (i.e., corrosive, flammable, poison, etc.) are also be listed.

5.15 Collection of Auxiliary Data

All auxiliary data are entered in the field records. Auxiliary data relative to a particular sampling location should be recorded concurrent with the sample event. Matrix specific auxiliary data are discussed later in this section.

5.16 Time Records

All records of time are kept using local time in the military (24 hour) format and are recorded to the nearest minute.

5.17 References

ESC maintains copies of the various sampling references in the sample equipment room. Pertinent pages of these documents may be photocopied and taken to the field during sampling investigations. A bibliography of references used in the development of this section is presented in Section 17.

6.0 Ancillary Equipment and Supplies

The equipment used to collect samples and conduct necessary purging activities is listed in subsequent sections for each type of sample. However, Section 6.1 lists some of the ancillary field equipment and instruments that may be required.

6.1 ANCILLARY EQUIPMENT AND SUPPLIES

Flow Measurement:	ISCO Continuous Flow Meters 3230, 3210, 2870; Flo-Poke pipe insert
Personal Protective Equipment:	Hard Hats, Face Shields, Rubber and Latex Gloves, Tyvex protective coveralls, rubber boots, safety glasses
Field Instruments:	Water Level Indicator, Continuous Recording pH Meter, Portable pH/Temperature Meters, Hach DR-100 Chlorine Analyzer, Hach CEL/700 Portable Laboratory, YSI Field Dissolved Oxygen/Temperature Meter w/ Submersible Probe, Portable Field Specific Conductance Meter, Hach 2100P Portable Turbidimeter
Chemical Supplies & Reagents:	Deionized Water, Tap Water, Liquinox Detergent, Isopropanol, Nitric Acid, Hydrochloric Acid, Sulfuric Acid, Sodium Hydroxide, Ascorbic acid, Sodium Thiosulfate, Ascorbic Acid, Zinc Acetate, pH calibration buffers (4.0, 7.0, and 10.0), Hach Sulfide Kit, lead carbonate powder, Specific Conductance Standard, Turbidity Standards
Tools:	Pipe Wrench, Bung Wrench, Crowbar, Hammer, Assorted Screwdrivers, Tape Measures, Channel Lock Pliers, Vise Grip Pliers, Duct Tape, Vinyl Pull Ties
Miscellaneous:	Cellular Phones, Pagers, Walkie Talkies, 12 Volt Batteries, Flashlights, Extension Cords, Brushes, Plastic sheeting, Fire extinguishers, Water Squeeze Bottles, First Aid Kit, lengths of rigid PVC conduit, aquatic sampling nets (Wildco)

7.0 WASTEWATER SAMPLING

7.1 SAMPLING EQUIPMENT

Type	Use	Materials	Permissible Parameter Groups
Continuous Wastewater Samplers-Peristaltic Pump	Sampling	Tygon tubing; glass or plastic sample container	All parameter groups except oil & grease, extractable organics, and VOCs
	Sampling	Teflon® tubing; glass sample container	All parameter groups except VOCs

7.2 GENERAL CONSIDERATIONS

The procedures used by ESC are generally those outlined in the *NPDES Compliance Inspection Manual*. Additional guidance is given in the EPA *Handbook for Monitoring Industrial Wastewater*. Some important considerations for obtaining a representative wastewater sample include:

- The sample should be collected where the wastewater is well mixed.
- Samples should not be collected directly from the surface/bottom of the wastestream.
- In sampling from wide conduits, cross-sectional sampling should be considered.
- If manual compositing is employed, the individual sample bottles must be thoroughly mixed before pouring the individual aliquot into the composite container.

7.3 SAMPLING SITE SELECTION

Wastewater samples should be collected at the location specified in the NPDES or sewer use permit if such exists. If the specified sampling location proves unacceptable, the project manager shall select an appropriate location based on site-specific conditions. An attempt should be made to contact the regulatory authorities for their approval. The potential for this type of issue highlights the need for a site inspection prior to the scheduled sampling event.

7.3.1 Influent

Influent wastewaters should be sampled at points of high turbulence and mixing. These points are: (1) the upflow siphon following a comminutor (in absence of grit chamber); (2) the upflow distribution box following pumping from main plant wet well; (3) aerated grit chamber; (4) flume throat; or (5) pump wet well when the pump is operating. Raw wastewater samples should be collected upstream of sidestream returns.

7.3.2 Effluent

Effluent samples should be collected at the site specified in the permit or, if no site is specified, at the most representative site downstream from all entering wastewater streams prior to final discharge.

7.3.3 Pond and Lagoon Sampling

Composite samples of pond and lagoon effluent are preferred over grabs due to the potential for ponds and lagoons to short circuit the projected flow paths. However, if dye studies or facility data indicate a homogeneous discharge, grab samples may be taken.

7.4 SAMPLING TECHNIQUES: GENERAL

The choice of a flow-proportional or time-proportional composite sampling program depends upon the variability of flow, equipment availability, sampling point configuration and accessibility. Flow metered sampling is necessary for complete wastewater characterization and should be utilized where possible. If not feasible, a time-proportional composite sample is acceptable.

A time-proportional composite sample consists of aliquots collected at constant time intervals and can be collected either manually or with an automatic sampler.

A flow proportional composite sample consists of aliquots collected automatically at constant flow intervals with an automatic sampler and a flow-measuring device. Prior to flow-proportional sampling, the flow measuring system (primary flow device, totalizer, and recorder) should be examined. The sampler may have to install flow measurement instrumentation if automatic sampling is to be used.

7.5 USE OF AUTOMATIC SAMPLERS

7.5.1 General

Automatic samplers are used when several points are sampled at frequent intervals, with limited personnel, or when a continuous sample is required. Automatic samplers used by ESC must meet the following requirements:

- Must be properly cleaned to avoid cross-contamination from prior sampling events.
- No plastic or metal parts shall come into contact with the sample when parameters to be analyzed could be impacted by these materials.
- Must be able to provide adequate refrigeration. Commercially available ice is placed in the sampler base and packed around the container approximately half way up the sample container.
- Must be able to collect a large enough sample for all required analyses. Composite sample containers (glass or plastic) hold up to 10 liters.
- A minimum of 100 milliliters should be collected each time the sampler is activated.
- Should provide a lift of at least 20 feet and be adjustable so that sample volume is not a function of pumping head.
- Pumping velocity must be adequate to transport solids without settling.
- The intake line must be purged a minimum of one time before each sample is collected.
- The minimum inside diameter of the intake line should be 1/4 inch.
- Have a power source adequate to operate the sampler for 48 hours at 15-minute sampling intervals.
- Facility electrical outlets may be used if available.

- Facility automatic samplers may be used for conventional parameters if they meet ESC QA/QC criteria.

Specific operating instructions, capabilities, capacities, and other pertinent information for automatic samplers presently used by ESC are included in the respective operating manuals and are not presented here.

All data relative to the actual use of automatic equipment on a specific job is recorded in sampling logbooks.

7.5.2 Equipment Installation

7.5.2.1 Conventional Sampling

Automatic samplers may be used to collect time-proportional composite or flow-proportional composite samples. In the flow-proportional mode, the samplers are activated by a compatible flow meter. Flow-proportional samples can also be collected using a discrete sampler and a flow recorder and manually compositing the individual aliquots in flow-proportional amounts.

Installation procedures include cutting and installing the proper length of tubing, positioning it in the wastewater stream, and sampler programming. All new tubing (Dow® Corning Medical Grade Silastic, or equal, in the pump and Tygon®, or equal, in the sample train) will be used for each sampler installation.

For a time-proportional composite, the sampler should be programmed to collect 100mL samples at 15-minute intervals into a refrigerated 10L plastic or glass jug, as appropriate for the particular parameters being analyzed.

For a flow-proportional composite, the sampler should be programmed to collect a minimum of 100mL for each sample interval. The sampling interval should be based on the flow of the waste stream.

7.5.3 Automatic Sampler Maintenance, Calibration, and Quality Control

To ensure proper operation of automatic samplers, the procedures outlined in this section are used to maintain and calibrate ESC automatic samplers. Any variance from these procedures is documented.

Proper sampler operation is checked by ESC personnel prior to each sampling event. This includes checking operation through three cycles of purge-pump-purge; checking desiccant and replacing if necessary; checking charge date on NiCad batteries to be used; and repairing or replacing any damaged items.

Prior to beginning sampling, the purge-pump-purge cycle is checked at least once. The sample volume is calibrated using a graduated cylinder at least twice, and the flow pacer that activates the sampler is checked to be sure it operates properly.

Upon return from a field trip, the sampler is examined for damage. The operation is checked and any required repairs are performed and documented. The sampler is then cleaned as outlined in Section 12.

7.6 MANUAL SAMPLING

Manual sampling is normally used for collecting grab samples and for immediate in-situ field analyses. Manual sampling may also be used when it is necessary to evaluate unusual waste stream conditions. If possible, manually collected samples are collected in the actual sample container that is submitted to the laboratory. This minimizes the possibility of contamination from an intermediate collection container.

Manual samples are collected by (1) submerging the container neck first into the water; (2) inverting the bottle so that the neck is upright and pointing into the direction of wastewater flow; (3) quickly returning the sample container to the surface; (4) shake to rinse. Pour the contents out downstream of sample location; (5) collect sample as described in steps 1, 2, and 3; pour out a few mL of sample downstream of sample collection. This allows for addition of preservatives and sample expansion.

Exceptions to the above procedure occur when preservatives are present in the sampling container or when oil & grease, microbiological, and/or VOC analyses are required. In these cases, samples are collected directly into the container with no pre-rinsing.

If the water or wastewater stream cannot be physically or safely reached, an intermediate collection container may be used. This container must be properly cleaned (Section 12) and made of an acceptable material. A separate collection container should be used at each sampling station to prevent cross-contamination between stations. The sample is collected by lowering a properly cleaned Teflon®, plastic, or glass collection vessel into the waste stream. The intermediate vessel may be lowered by hand, pole or rope.

7.7 SPECIAL SAMPLE COLLECTION PROCEDURES

7.7.1 Trace Organic Compounds and Metals

Due to the ability to detect trace organic compounds and metals in extremely low concentrations, care must be taken to avoid contamination of the sample. All containers, composite bottles, tubing, etc., used in sample collection for trace organic compounds and metals analyses should be prepared as described in Section 12.

Personnel handling the sample should wear a new pair of disposable latex gloves with each set of samples collected to prevent cross-contamination. A more detailed discussion is given in Section 5.7 under special precautions for trace contaminant sampling.

7.7.2 Bacterial Analysis

Samples for bacterial analysis are always collected directly into the prepared glass or plastic sample bottle. The sample bottle should be kept closed until immediately prior to sampling and never rinsed with sample. When the container is opened, care should be taken not to contaminate the cap or the inside of the bottle. The bottle should be held near the base and plunged, neck downward, below the surface and turned until the neck points upward and upstream. The bottle should be filled to within one-inch of the top and capped immediately.

Section 14 presents preservation procedures and holding times. As holding times are limited to 6 hours for microbiological analyses, special arrangements may be required to ensure that these samples reach the laboratory within this timeframe.

7.7.3 Immiscible Liquids/Oil and Grease

Oil and grease may be present in wastewater as a surface film, emulsion, solution, or a combination of these forms. A representative sample for oil and grease analysis is difficult to collect. The sampler must carefully evaluate the location of the sampling point to find the area of greatest mixing. Quiescent areas should be avoided.

Because losses of oil and grease will occur on sampling equipment, collection by composite sampler is not practical. Intermediate sampling vessels should not be used if possible. If intermediate collection vessels are required they should be made of Teflon® and be rinsed with the sample three times before transferring any sample to the sample container. Sample containers, however, should never be rinsed.

7.7.4 Volatile Organic Compounds Analyses

Water samples to be analyzed for volatile organic compounds are collected in 40mL pre-preserved (200uL of concentrated HCl) vials with screw caps. A Teflon®-silicone septum is placed in each cap prior to the sampling event. The Teflon® side must be facing the sample.

Sampling containers with preservatives are pre-labeled prior to any field activities to reduce the chances of confusion during sampling activities. A complete list of sample preservatives, containers, holding times, and volumes is found in Section 14.

The sampler should check the water to be sampled for chlorine. This is done with residual chlorine indicator strips. If no chlorine is found, the vials may be filled. If residual chlorine is present, the sampling and preservation procedures listed in Section 5.10 of this manual must be performed.

7.8 AUXILIARY DATA COLLECTION

While conducting wastewater sampling, the following information may also be gathered:

- Field measurements -- pH, DO, conductivity, temperature
- Flows associated with the samples collected -- continuous flows with composite samples and instantaneous flows with grab samples
- Diagrams and/or written descriptions of the sample locations
- Photographs of pertinent wastewater-associated equipment, such as flow measuring devices, treatment units, etc.
- Completion of applicable forms required during specific investigations.

All observations, measurements, diagrams, etc., are entered in field logbooks or attached thereto.

8.0 SURFACE WATER AND SEDIMENT SAMPLING

8.1 EQUIPMENT

Equipment Type	Use	Material	Permissible Parameter Groups
Surface Water Sampling			
Kemmerer Sampler	Depth sampling	PVC	All parameter groups except extractable organics, VOCs, and oil & grease
Automatic Samplers	Sampling	Teflon®	All parameter groups except VOCs, oil & grease, & micro
	Sampling	PVC	All parameter groups except extractable organics, VOCs, oil & grease, and micro
Sample Collection Container	Sampling	Stainless steel	All parameter groups
Bailers	Sampling	Teflon®	All parameter groups
	Sampling	PVC	All parameter groups except extractable organics, VOCs, and oil & grease
Sediment Sampling			
Hand Augers	Sampling	Carbon Steel	Demand, nutrients, and extractable organics (for hard packed soils only)
Sediment Core Sampler	Sampling	Stainless Steel, Teflon®	All parameter groups
Encore™	Sampling	Teflon®	VOC Sediment/soil
Scoops	Sampling	Teflon® coated	All parameter groups

Equipment Type	Use	Material	Permissible Parameter Groups
Mixing Bowl	Compositing	Glass	All parameter groups except VOCs
Spoons, spatula	Sampling, compositing	Stainless Steel	All parameter groups

8.2 GENERAL

Selection of surface water sampling locations for water quality studies are determined by the objective of the study and waterway type. Factors that impact and alter water quality and characteristics (dams, bridges, discharges, etc.) must be considered. Accessibility is important.

8.3 SAMPLE SITE SELECTION

Fresh water environments are commonly divided into two types: (1) rivers, streams, and creeks; and (2) lakes, ponds, and impoundments. Since these waterways differ considerably in general characteristics, site selection must be adapted to each.

Prior to conducting a sampling event, an initial survey should be conducted to locate prime sampling points. Bridges and piers provide ready access to sampling points across a body of water. However, they should only be used when found not to be detrimentally impacting stream characteristics.

If wading for water samples must be done, caution should be used to avoid disturbing bottom deposits that could result in increased sediment in the sample. Shallow areas may be best for sediment sampling.

8.3.1 Rivers, Streams, and Creeks

Sampling sites should be located in areas possessing the greatest degree of cross-sectional homogeneity. Such points are easily found directly downstream of a riffle or rapid. These locations are also good for sediment sampling. In the absence of turbulent areas, a site that is clear of immediate point sources, such as tributaries and effluent discharges, may be used.

Typical sediment deposition areas are located at the inside of river bends and down-stream of islands or other obstructions. Sites immediately upstream or downstream from the confluence of two streams or rivers should be avoided due to inadequate mixing of the combining flows. Also, backflow can upset normal flow patterns.

Great attention should be given to site selection along a stream reach:

- Sites should be spaced at intervals based on time-of-water-travel. Sampling sites may be located at about one-half day time-of-water-travel for the first three days downstream of a waste source for the first six sites and then approximately one day for the remaining distance.

- If the study data is for comparison to previous study data, the same sampling sites should be used.
- Sites should be located at marked physical changes in the stream channel.
- Site locations should isolate major discharges as well as major tributaries.

Dams and weirs usually create quiet, deep pools in river reaches that would otherwise be swift and shallow. When times of travel through them are long, sites should be established within them.

Some structures, such as dams, permit overflow that may cause significant aeration of oxygen deficient water. Sites should be located short distances upstream and downstream of these structures to measure the rapid, artificial increase in dissolved oxygen (DO), which is not representative of natural aeration.

A minimum of three sites should be located between any two points of major change in a stream, even if the time-of-travel between the points of change is short. Major changes include, but are not limited to, a waste discharge, a tributary inflow, or a significant change in channel characteristics. Sampling three sites is also important when testing rates of change of unstable constituents. Results from two of three sites will usually support each other and indicate the true pattern of water quality in the sampled zone. If the effect of certain discharges or tributary streams of interest is desired, sites should be located both upstream and downstream of these points.

Due to the tendency of the influent from a waste discharge or tributary to slowly mix, cross-channel, with the main stream, it is nearly impossible to measure their effect immediately downstream of the source. Thus, samples from quarter points may miss the wastes and only indicate the quality of water above the waste source. Conversely, samples taken directly in the stream portion containing the wastes would indicate excessive effects of the wastes with respect to the river as a whole.

Tributaries should be sampled as near the mouth as possible. Often, these may be entered from the main stream for sampling by boat. Care should be taken to avoid collecting water from the main stream that may flow back into the tributary as a result of density differences created by temperature, salinity, or turbidity differences.

Actual sampling locations vary with the size and amount of turbulence in the stream or river. Generally, with streams less than 20 feet wide, well mixed areas and sampling sites are readily found. In such areas, a single grab sample taken at mid-depth at the center of the channel is adequate. A sediment sample can also be collected at the center of the channel. For slightly larger streams, at least one vertical composite should be taken from mid-stream. It should be composed of at least one sub-surface, mid-depth, and above the bottom sample. Dissolved oxygen, pH, temperature, conductivity, etc. should be measured on each aliquot of the vertical composite. Several locations should be sampled across the channel width on the larger rivers. Vertical composites across the channel width should be located proportional to flow, i.e., closer together toward mid-channel where flow is greater and less toward the banks where the flow proportionally lower.

The field crew will determine the number of vertical composites and sampling depths for each area. They should base their decisions upon two considerations.

1. The larger the number of sub-samples, the more nearly the composite sample will represent the water body.
2. Taking sub-samples is time consuming and expensive, and increases the chance of contamination.

A number of sediment samples should be collected along a cross-section of a river or stream to adequately characterize the bed material. The normal procedure is to sample at quarter points along the cross-section of the site. When the sampling technique or equipment requires that the samples be extruded or transferred at the site, they can be combined into a single composite sample. However, samples of dissimilar composition should not be combined. They should be kept separate for analysis in the laboratory. To ensure representative samples, coring tubes are employed. The quantity of each sub-sample that is composited shall be recorded.

8.3.2 Lakes, Ponds, and Impoundments

Lakes, ponds, and impoundments have a much greater tendency to stratify than rivers and streams. This lack of mixing requires that more samples be obtained from the different strata. Occasionally, extreme turbidity differences occur vertically where a highly turbid river enters a lake. This stratification is caused by temperature differences where the cooler, heavier river water flows beneath the warmer lake water. A temperature profile of the water column and visual observation of lake samples can detect these layers. Each layer of the stratified water column should be sampled.

The number of sampling sites on a lake, pond, or impoundment is determined by the objectives of the investigation dimensions of the basin. In small bodies of water, a single vertical composite at the deepest point may be sufficient. Dissolved oxygen, pH, temperature, etc., should be conducted on each vertical composite aliquot. In naturally formed ponds, the deepest point is usually near the center; in impoundments, the deepest point is usually near the dam.

In lakes and larger impoundments, several vertical sub-samples should be composited to form a single sample. These vertical sampling locations should be along a transaction or grid. The field crew will determine the number of vertical composites and sampling depths for each area. In some cases, separate composites of epilimnetic and hypolimnetic zones may be required. Additional separate composite samples may be needed to adequately represent water quality in a lake possessing an irregular shape or numerous bays and coves. Additional samples should always be taken where discharges, tributaries, agriculture, and other such factors are suspected of influencing water quality.

When collecting sediment samples in lakes, pond, and reservoirs, the sample site should be as near as possible to the center of the water mass, especially for impoundments of rivers or streams. Generally, coarser grained sediments are deposited at the headwaters of a reservoir, and the finer sediments are near the center. The shape, inflow pattern, bathymetry, and circulation affect the location of sediment sampling sites in large bodies of water.

8.3.3 Control Sites

The collection of samples from control sites is necessary to compile a basis of comparison of water quality. A control site above the point of interest is as important as the sites below, and must be chosen with equal care. Two or three sites above the waste inflow may be necessary to establish the rate at which any unstable material is changing. The time of travel between the sites should be sufficient to permit accurate measurement of the change in the material under consideration.

8.4 SAMPLING EQUIPMENT AND TECHNIQUES

8.4.1 General

Any equipment or sampling techniques used to collect a sample must not alter the integrity of the sample and must be capable of providing a representative sample.

8.4.2 Water Sampling Equipment/Techniques

The physical location of the collector dictates the type of equipment needed to collect samples. Surface water samples may be collected directly into the sample container when possible. Pre-preserved sample containers shall never be used as intermediate collection containers. Samples collected in this manner use the methods specified in Section 7.6 of this manual. If wading into the stream is required, care should be taken not to disturb bottom deposits, which could be unintentionally collected, and bias the sample. Also, the sample should be collected directly into the sample bottle and **up current** of the wader. If wading is not possible or the sample must be collected from more than one depth, additional sampling equipment may be used. If sampling from a powerboat, samples must be collected upwind and upstream of the motor.

8.4.2.1 Sampling Procedure Using a Teflon® or PVC Bailer

If data requirements of surface water sampling do not necessitate sampling from a strictly discrete interval of the water column, Teflon® or PVC constructed bailers can be used for sampling. The type bailer used is dependent on the analytical requirements. A closed top bailer utilizing a bottom check valve is sufficient for many surface water studies. Water is continually displaced through the bailer as it is lowered down through the water column until the specified depth is attained. At this point, the bailer is retrieved back to the surface. There is the possibility of contamination to the bailer as it is lowered through the upper water layers. Also, this method may not be successful in situations where strong currents are found or where a discrete sample at a specified depth is needed.

If depth specific, discrete samples are needed and the parameters do not require Teflon® coated sampling equipment, a standard Kemmerer sampler may be used. A plastic bucket can also be used to collect surface samples if parameters to be analyzed do not preclude its use. The bucket shall always be rinsed twice with the sample water prior to collection and the rinse water be disposed of downstream from the sample collection point. All field equipment will be cleaned using standard cleaning procedures.

8.4.2.2 Sampling Procedure Using a Kemmerer Sampler

Due to the PVC construction of the Kemmerer sampler, it shall not be used to collect samples for extractable organics, VOCs, and/or oil & grease analysis. The general collection procedure is as follows:

1. Securely attach a suitable line to the Kemmerer bottle.
2. Lock stoppers located at each end of the bottle on the open position. This allows the water to be drawn around the bottom end seal and into the cylinder at the specified depth.
3. The bottle is now in the set position. A separate "messenger" is required to activate the trip mechanism that releases the stopper and closes the bottle.
4. When the bottle is lowered to the desired depth, the messenger is dropped. This unlocks the trip mechanism and forces the closing of both end seals.
5. Raise the sampler, open one of the end seal, and carefully transfer the sample to the appropriate sample container.

8.4.2.3 Sampling Procedures Using Sample Collection Containers

In most cases, sample collection containers are used to collect surface water from easily accessible sampling points. This means that the sample is collected manually, always upstream of the sampling person's position. An extension may be added to the container to make the sampling point more accessible for manual sampling. Extensions can be constructed of aluminum, PVC, steel, or any other suitable material. The sample container is normally attached to the extension using a clamp, vinyl pull ties, or duct tape. Samples collected in this way are done so in the following manner:

1. Place the inverted sample container into the water and lower to the desired depth. Never use a pre-preserved container as an intermediate sample collection device.
2. Re-invert the container with the mouth facing into the direction of flow and at the appropriate depth to collect the desired sample.
3. Carefully bring the container to the surface and transfer to the appropriate container.

8.4.3 Sediment Sampling Equipment/Techniques

A variety of methods can be used to collect sediment samples from a streambed. ESC utilizes corers and scoops. Precautions must be taken to ensure that the sample collected is representative of the streambed. These methods are discussed in the following paragraphs.

8.4.3.1 Sediment Core Samplers

Core sampling is used to collect vertical columns of sediment from the stream or lakebed. Many types of coring devices are available for use depending on the depth of water from which the sample is obtained, the type of bottom material, and the length of the core to be collected. Some devices are weight or gravity driven while others are simple hand push tubes. These devices minimize the loss of fine particles and should always be used when collecting sediment samples from flowing waters.

Coring devices are particularly useful in pollutant monitoring because the shock wave created by sampler descent is minimized and the fines at the sediment-water interface are only slightly disturbed. The sample can be withdrawn primarily intact removing only the layers of interest. Core liners manufactured of Teflon® or plastic can be purchased. These liners reduce the possibility of contamination and can be delivered to the laboratory in the tube they were collected in. Coring devices sample small surface areas and small sample sizes and often require repetitive sampling to obtain a sufficient amount of sample. This is the primary disadvantage to these devices but they are recommended in the sampling of sediments for trace organic compounds or metals analyses.

When sampling sediments in shallow water, the direct use of a core liner is recommended. Stainless steel push tubes are also used because they provide a better cutting edge and higher tensile strength than Teflon® or plastic. One advantage to using the Teflon® or plastic tubes is the elimination of possible metals contamination of the sample from the core barrels or cutting heads. The length of the corer tube should correspond to the desired depth of the layer being sampled. In general, soft sediments adhere better to the inside of the tube and a larger diameter tube can be used. Coarser sediments require the use of a smaller diameter tube of two inches or less to prevent the sample from falling out of the tube. The inside bottom wall of the tube can be filed down to allow easier entry into the substrate.

When samples are obtained by wading, caution should be used to minimize disturbance in the area sampled. Core tubes are pushed directly down into softer substrates until four inches or less of the tube is above the sediment-water interface. A slight rotation of the tube may be necessary to facilitate ease of entry into harder substrates and reduce compaction of the sample. The tube is then capped and slowly extracted and the bottom of the corer is capped before it is pulled above the water surface.

Sub-sampling is performed for VOC samples using an Encore™ type sampling device. This device is used to collect soil/sediment samples, while preventing container headspace. Once the core sample is collected, additional samples should be taken using an Encore™ type sampler, either 5g or 25g, capped, sealed, and immediately chilled to 4ºC. The holding time for this sampling method is 48 hours. Alternatively, weigh 5g of sample into a pre-weighed vial (with a Teflon® lined screw cap) containing, 5mL sodium bisulfate solution and a magnetic stir bar, cap, and then ice to 4ºC. The holding time for this method is 14 days.

8.4.3.2 Scooping Samples

The easiest and quickest way to collect a sediment sample in shallow water is with a Teflon® coated scoop or stainless steel spoon. This type of sampling should be limited to quiescent (i.e., non-flowing) waters such as lakes or reservoirs.

8.4.3.3 Mixing

As specified in Section 5.8, sediment samples, collected for chemical analysis, should be thoroughly mixed (except for volatile organic compounds analysis) before being placed in the sample containers.

8.5 SPECIAL SAMPLE COLLECTION TECHNIQUES

8.5.1 Trace Organic Compounds and Metals

Samples for trace pollutant analyses in surface water should be collected by dipping the sample containers directly into the water. Sometimes samples are split for enforcement or quality control purposes. A sufficient volume of sample for all containers should be collected in a large glass container and then, while mixing, be alternately dispensed into the appropriate bottles. This cannot be done for volatile organic compound samples due to potential loss of target analytes.

Only Teflon® or stainless steel should be used in sediment sampling for trace contaminant analyses. Teflon® coring tubes are the preferred technique.

8.5.2 Bacterial Analysis

Samples for bacteriological examination must be collected in sterilized bottles and protected against contamination. The preferred technique is to collect sample directly into the sample bottle. Hold the bottle near the base and plunge, neck downward, below the surface. The container is then turned with the neck pointed slightly upward and the mouth directed toward the current. The bottle is filled to about ½ inch from the top and recapped immediately. While the bottle is open, extreme care should be used to protect both the bottle and stopper against contamination. The ½ inch air space is left in the bottle to facilitate subsequent shaking in the laboratory.

If sampling with an intermediate sampling device (i.e. bailer), the device shall be thoroughly rinsed with sample water prior to collecting the sample. For this reason, microbiological samples are among the final samples collected from a sampling site. Begin pouring sample out of the sampling device before collecting into the sterilized container. Continue pouring sample out of the device, place the container under the flowing stream, and fill the container to ½ inch from the top. Flow should remain continuous before and during the filling process.

When sampling from a bridge, the sterilized sample bottle can be weighted and lowered to the water on a rope. Collectors must be careful not to dislodge debris from the bridge that could fall into the bottle.

8.6 AUXILIARY DATA COLLECTION

A field logbook is used to record data pertinent to sampling activities. This data describes all sampling locations and techniques, lists photographs taken, visual observations, etc. Visual observations of sample site conditions, including weather and overall stream conditions, recorded during the investigation can be valuable in interpreting water quality study results.

8.7 SPLIT AND DUPLICATE SAMPLE COLLECTION

Split samples measure variability between analysts, methods, and laboratories and are taken as subsamples from a single sample. This is unlike duplicate samples that measure variability inherent in the collection method or waste stream and are obtained in close succession during the same sampling event.

8.7.1 Split Sample Collection

Split samples are collected as follows:

1. Sample must be collected in a properly cleaned container constructed of acceptable materials. The volume should be more than twice the volume required for one sample.
2. Add appropriate preservative where required.
3. Mix thoroughly.
4. Alternately, decant sample into subsample containers in increments of approximately 10% of total subsample volume until containers are full.
5. Seal the sample containers with appropriate, airtight caps.
6. Label each sample container with a field number and complete a chain of custody.

NOTE: Volatile organic samples are not collected in this manner. Samples for VOC's must be collected as simultaneous, discrete grab samples.

8.7.2 Duplicate Sample Collection

1. Collect two samples in rapid succession.
2. Preserve where required.
3. Mix thoroughly.
4. Seal the sample containers with appropriate, airtight caps.
5. Label each sample container with a field number and complete a chain of custody.

9.0 *GROUNDWATER AND DRINKING WATER SAMPLING*

9.1 GROUNDWATER AND DRINKING WATER SAMPLING EQUIPMENT

Equipment type	Purpose	Component(s)	Allowable Parameter Groups
Bailers (disposable and non-disposable)	Purging	Teflon® & SS	All parameter groups
	Sampling	Teflon®	All parameter groups
Peristaltic Pump[1]	Purging[2]	Tygon Tubing	All parameter groups except organics
	Purging	Teflon®	All parameter groups
		Silastic Rubber	All parameter groups except organics
ISCO Bladder Pump[3]	Sampling	Stainless Steel, Teflon®	All parameter groups

1 New or dedicated tubing must be used at individual monitoring well sites.
2 If sample is not collected immediately after evacuation, tubing shall be withdrawn from the well prior to pump being turned off to prevent back flowing into the well.
3 Pump will be cleaned after each use.

9.2 GENERAL GROUNDWATER SAMPLING

Groundwater sampling is necessary for a number of purposes. These include, but are not limited to, evaluating potable or industrial water sources, mapping contaminant plume movement at a land disposal or spill site, RCRA compliance monitoring (landfills), or examining a site where groundwater contamination may have or may be occurring.

Normally, groundwater is sampled from a permanent monitoring well. However, this does not exclude collection of samples from a sinkhole, pit, or other drilling or digging site where groundwater is present.

Monitoring wells are not always at the optimum. In these situations, additional wells may need to be drilled. Experienced, knowledgeable individuals (hydrologists, geologists) are needed to site the well and oversee its installation so that representative samples of groundwater can be collected.

ESC utilizes the procedures being reviewed in this section. Further guidance is available in the *RCRA Groundwater Monitoring Technical Enforcement Guidance Document (TEGD)*; ESC field personnel, at a minimum meet, and when possible exceed, the requirements of this document.

9.3 MEASUREMENT OF WELL WATER LEVEL AND STAGNANT WATER VOLUME CALCULATION

The sampling and analysis plan provides for measurement of standing water levels in each well prior to each sampling event. Field measurements include depth to standing water surface and total depth of the well. This data is then utilized to calculate the volume of stagnant water in the well and provide a check on the integrity of the well (e.g., silt buildup). The measurement should be taken to 0.01 foot when possible. A battery powered level sensor is used to measure depth to the surface of the groundwater. Equipment shall be constructed of inert materials and will be cleaned per sample equipment cleaning procedures prior to use at another well. Field data is recorded on the Monitoring Well Data Sheet (Figure 2).

9.3.1 Procedure for Water Level Measurement

1. Clear debris from area around well or lay plastic sheathing around well pad.
2. Remove protective casing lid.
3. Open monitoring well lid.
4. Lower the clean water level indicator probe down into the well. A beep will sound upon contact with the water surface. False readings can be made from the wetted side of the well so it is necessary to check the level several times until a consistent reading is achieved. Record the distance (to the nearest 0.01 ft.) from the top of the well casing to the water surface on the Monitoring Well Data Sheet.
5. Continue to lower the probe until it reaches the well bottom. Record the distance (to the nearest 0.01 ft) from the top of the well casing to the bottom of the well on the Monitoring Well Data Sheet.
6. All water level and well depth measurements are made from the top of the well casing unless specified otherwise by the project manager or DER.
7. The wetted depth is obtained by subtracting total well depth from the surface level depth.

9.3.2 Calculating Water Volume

Total volume of standing water in a well is calculated by the following formula:

$$V = \pi r^2 h \times 7.48 \text{ gallons/ft}^3$$

where;

V	=	volume of standing water in the well (gallons)
r	=	radius of well (ft)
h	=	depth of water column in the well (ft)
π	=	3.14
7.48	=	conversion factor

9.4 WELL EVACUATION: WELLS WITHOUT IN-PLACE PLUMBING

Water standing in a well may not be representative of actual groundwater conditions. The standing water in a well should be removed to allow representative formation water to supplant the stagnant water. The evacuation method depends on the hydraulic characteristics of the well but the following general rules apply.

The total amount of water purged must be recorded. Therefore, the volume must be measured during the purging operation. This may be determined by:

1. Collecting the water in a graduated or known volume container (i.e., bucket);
2. Calculate the volume based on the pump rate; however pump rate may not be constant and field personnel should be aware of this;
3. Record the time that the actual purging begins in the field record.

Purging is considered complete if any one of the following criteria is satisfied:

1. Three well volumes are purged and field parameters (pH, temperature, conductivity) stabilize within 5% in consecutive readings at least 5 minutes apart. If field parameters have not stabilized after 5 well volumes, the purging is considered complete and sampling can begin.
2. Five well volumes are purged with no monitoring of field parameters.
3. At least one fully dry purge. A second dry purge may be necessary in some situations.

FIGURE 2
MONITORING WELL DATA SHEET

Site location:

ESC Project name/#:

Well Number	Depth to water surface (ft)	Depth to bottom of well (ft)	Length of water column (ft)	Volume of water evacuated (gal)	Time/date

Well Number	Temperature (^{0}F)	pH (S.U.)	Conductivity (Τmho/cm)	Time/Date

Well casing material / diameter:

Sampled by / signature:

NOTES / CALCULATIONS:

Except for low recovery wells, all wells are sampled within 6 hours of purging. Low recovery wells may be sampled as soon as sufficient sample matrix is available or up to 10 hours after purging. Wells that do not recover sufficiently within 10 hours should not be sampled.

Purging equipment includes Teflon® or stainless steel bailers or a peristaltic pump. Any fuel-powered pumping units are placed downwind of any sampling site. If purging equipment is reused, it is cleaned following standard procedures. Disposable latex gloves are worn by sampling personnel and changed prior to starting work at each sampling site.

If bailed water is determined to be hazardous, it should be disposed of in an appropriate manner.

The Florida Department of Environmental Regulation requires that during purging of the well, the purging device should be placed just below the surface of the water level and be lowered with the falling water level. For high yield wells, three casing volumes should be evacuated prior to collecting samples. Purging should be conducted at a rate to minimize agitation of the recharge water. Conductivity, pH, and temperature measurement during purging is necessary to monitor variability of the groundwater. **Samples should be collected within 6 hours of purging high yield wells.**

Low-yield wells (incapable of yielding three casing volumes) should be evacuated to dryness at a rate that does not cause turbulence. When the well recovers sufficiently, the first sample should be analyzed for pH, temperature, and conductivity. When recovery exceeds two hours, the sample should be collected as soon as sufficient volume is available. **If recovery is longer than 10 hours, the well should not be tested**. The project manager may wish to review available information to determine if obtaining a representative sample is possible.

9.4.1 Procedure for Well Evacuation: Teflon® Bailer

1. Clear the area around the well pad; cover with plastic if necessary.
2. Slowly lower the bailer to the water surface and remove it when full.
3. Reel or pull bailer to the surface using caution to not allow the lanyard (cable or string) to touch the ground.
4. Use the bailer volume and number of bails removed to determine volume of water removed. Excess hazardous material should be poured into a container for later disposal.
5. Repeat steps 2 and 3 until 1.5 well volumes have been removed.
6. Begin monitoring for pH, temperature, and conductivity. Record values on the Monitoring Well Data Sheet. Discard the sample into the collection pail. Purge until the change between samples of each parameter is less than 5%.
7. Continue until at least three well volumes have been evacuated and the parameters pH, temperature, and conductivity are within 5 percent, or until a low yield well has been evacuated to dryness.
8. Record date and time the well was purged on the Monitoring Well Data Sheet.

NOTE: For wells sampled in the State of Florida, three well volumes are purged prior to pH, temperature, and conductivity screening. Following evacuation of three well volumes, purge water is screened for these parameters at regular intervals until two consecutive measurements are within 5 percent. The intervals may be time-based (at least 5 min) or represent a portion of the well volume (at least 0.5 well volume).

Compliance with more stringent local, State, or Regional guidelines is observed where required.

9.4.2 Procedure for Well Evacuation: Peristaltic Pump

1. Clean area around the well pad.
2. Install the appropriate length of Tygon® or Teflon® tubing into the pump mechanism.
3. Insert the uncontaminated sampling end of the tubing into the well surface.
4. Connect the pump to the power supply.
5. Operate the pump at a flow rate that does not cause excessive agitation of the replacement water.
6. Determine the pump flow rate.
7. Purge until 1.5 well volumes have been evacuated.
8. Collect samples at a rate of one per well volume evacuated. Monitor these samples for pH, temperature, and conductivity. Record these measurements on the Monitoring Well Data Sheet. Monitor until the difference in each parameter is less than 5 percent.
9. Continue purging until three well volumes have been evacuated and the parameters pH, temperature, and conductivity are within 5 percent, or until a low yield well has been evacuated to dryness.
10. Record the date and time the well was purged on the Well Sampling Field Data Sheet.

9.5 PURGING TECHNIQUES: WELLS WITH IN-PLACE PLUMBING

9.5.1 General

The volume to be purged depends on whether the pumps are running continuously or intermittently and how close to the source samples can be collected. If storage/pressure tanks are present, a volume must be purged to totally exchange the volume of water in the tank.

9.5.2 Continuously Running Pumps

For continuously running pumps, the well should be purged by opening the valve and allowing it to flush for 15 minutes, if the well volume is unknown. If the sample is collected after a holding tank, the volume of the tank should also be purged.

9.5.3 Intermittently Running Pumps

Wells are purged at the maximum rate for at least 15 minutes. Monitoring of field parameters continues until two consecutive measurements within 5% are measured at 5-minute intervals.

9.6 SAMPLE WITHDRAWAL

Technique for withdrawal is dependent on the parameters to be analyzed. To collect a representative sample and minimize the possibility of sample contamination:

- Use Teflon® or stainless steel sampling devices when organics are an analyte of concern.
- Use dedicated tubing or samplers for each well. If a dedicated sampler is not available, clean the sampler between sampling events. Analyze equipment blanks to ensure cross-contamination has not occurred.

The preferred sample collection order is as follows (decreasing volatility):

1. Volatile organic compounds (VOCs)
2. Extractable Organics (includes Total Recoverable Petroleum Hydrocarbons [TRPH], Oil & Grease, Pesticides and Herbicides)
3. Total metals
4. Dissolved metals
5. Microbiological
6. Inorganics (includes Nutrients, demands, and Physical Properties)
7. Radionuclides

The following items are acceptable sampling devices for all parameters:

- A gas-operated, Teflon® or stainless steel squeeze pump (also referred to as a bladder pump with adjustable flow control) should be dedicated or completely cleaned between sampling events. If it is dedicated, the protocols on use, flow rates, and flow controls should be discussed.
- A Teflon® bailer with check valves and a bottom emptying device. Dedicated or disposable bailers should not be cleaned between purging and sampling operations.

ESC generally supplies sampling devices for wells sampled by ESC. However, some customers have wells equipped with dedicated sampling devices. All dedicated equipment is cleaned between sampling events with the exception of dedicated pump systems or dedicated pipes that are never removed. ESC evaluates the device and the project manager approves/disapproves of the dedicated device prior to sampling.

If sampling includes dissolved parameters, samples are filtered in the field in the following manner:

1. Use a one piece, molded, in-line high capacity disposable 1.0 micron filter when collecting samples for dissolved trace metals analysis. Use a 0.45 micron filter when sampling for all other (i.e., orthophosphorous, silica, etc.) dissolved parameters.
2. Filter material should be non-contaminating synthetic fibers.
3. Filter should be placed on the positive pressure side of the peristaltic pump.
4. If well is deeper than 25 feet; a submersible bladder pump may be necessary to bring the sample to the surface. Samples shall not be collected in an intermediate container.
5. At least one filtered equipment blank, using deionized water, must be collected and analyzed.
6. The sample is preserved as required following filtration.
7. Unfiltered samples are collected in conjunction with filtered samples.

NOTE: Filtered samples are collected only at the request of DER and will not be collected for turbid samples only.

9.6.1 Sample Removal: With In-Place Plumbing

Samples should be collected following purging from a valve or tap as near to the well as possible, and ahead of all screens, aerators, filters, etc. Samples shall be collected directly into the sampling containers. Flow rate should not exceed 500 mL/min.

9.6.2 Sample Removal: Without In-Place Plumbing

1. Following purging, collect the sample and pour it directly from the bailer into the sample container. If a peristaltic pump is used, pump the sample directly into the container. Collect the samples in order of decreasing volatility.
2. Measure the conductivity, pH, and temperature of the samples and record the results on the Monitoring Well Data Sheet.
3. If a bailer is not dedicated, clean field equipment using standard procedures. Collect blanks at a rate of one per type of equipment cleaned. If a piece of equipment is cleaned more than twenty times, collect blanks at a rate of 10 percent. An equipment blank must be taken and preserved for each analyte method group.
4. If a bailer is used to collect samples, replace the bailer string. Take precautions not to allow the string to touch the ground. Dispose of the used string properly. If Teflon® or stainless steel cable is used, clean according to standard procedures and do not let it touch the ground.
5. Replace the well cap and close and lock the protective casing lid.

9.7 SPLIT AND DUPLICATE SAMPLE COLLECTION

Split samples measure variability between analysts, methods, and laboratories and are taken as subsamples from a single sample. Duplicate samples measure variability inherent in the collection method or waste stream and are obtained in close succession during the same sampling event.

9.7.1 Split Sample Collection

1. Collect sufficient volume in a container constructed of appropriate materials. The volume should be more than twice the volume required for one sample.
2. Preserve as necessary.
3. Mix well.
4. Alternately decant 10% of the sample volume into each container and mix well.
5. Continue until each container is filled with an adequate sample volume.
6. Seal the containers, assign a field number, and complete the chain of custody.

9.7.2 Duplicate Sample Collection

1. Collect two samples in rapid succession into separate containers.
2. Preserve as necessary.
3. Mix well.
4. Seal the containers, assign a field number, and complete the chain of custody.

9.8 DRINKING WATER SAMPLING

9.8.1 General Concerns

Containers and preservatives must be selected prior to sampling.

- Containers and preservatives shall comply with Tables 1 and 2.
- It is recommended that the appropriate preservative be added to the container by the laboratory.

9.8.2 Sampling Drinking Water Wells

1. Purging and sampling should be from a spigot closest to the wellhead.
    - The spigot should be located before the holding tank and filters. If this is not possible, the holding tank must also be purged.
    - All aerators and filters should be removed if possible.
2. Depending on the running schedule of the well and the placement of the pressure tank, the system is purged as described in Section 9.5.
3. If volume of the pressure tank is not known, the well is purged for at least 15 minutes at maximum rate.
4. The flow is reduced to approximately 500 mL/minute.

5. Sample containers with no preservatives:
   - The interior of the cap or the container should not come in contact with anything.
   - The sample container is rinsed and the water is discarded.
   - Containers are not rinsed if collecting for oil and grease, total recoverable hydrocarbons, volatile organics (including trihalomethanes) or microbiologicals.
   - The container should be tilted to minimize agitation.
6. Sample containers with preservatives:
   - The above protocol is followed but **DO NOT** rinse the container.
   - The open end of the container should be held away from the face while filling.
   - The container should be gently tipped several times to mix the preservatives.
7. Place the bottle in a plastic bag and cool to 4°C.

9.8.3 Sampling Drinking Water within a Facility/Residence for the Lead/Copper Rule

1. The appropriate sampling point depends on whether the sample is being taken to monitor compliance with Drinking Water Regulations for Lead and Copper. If so, the sample must be taken from a cold water tap in the kitchen or bathroom of residential housing or from an interior tap where water is used for consumption in a non-residential building.
2. Samples must be collected after the water has stood in the pipes for at least six hours.
3. THE SYSTEM SHOULD NOT BE FLUSHED.
4. The first flush should be collected immediately into the sample container. DO NOT RINSE THE CONTAINER PRIOR TO COLLECTING THE SAMPLE.
5. The container should be tilted to minimize agitation.
6. If the container contains preservative, hold the open end away from the face.
7. If the container does not contain preservative, add preservative as needed.
8. Replace cap and gently tip the container several times to mix the preservatives.
9. Place in a plastic sample bag.

9.8.4 Sampling a Lead Service Line in a Facility/Residence for the Lead/Copper Rule

1. When sampling for compliance, the sampling point is normally designated by the permit or the municipality.

2. For Lead & Copper samples, each sample shall have stood in the line for at least six hours and shall be collected in one of the following ways:
   a. At the tap, after flushing the volume of water between the tap and the lead service line. The volume of water shall be calculated based upon the inner diameter and length of the pipe between the tap and the service line.
   b. By tapping directly into the service line.
   c. In a single-family residence, allow the water to run until a significant temperature change indicates water standing in the service line is being sampled.
3. The flow shall be reduced to less than 500 mL/min before collecting samples.
4. Test for the presence of residual chlorine using residual chlorine indicator strips or a Hach DR-100 chlorine analyzer.
5. If residual chlorine is present and the parameter being analyzed requires removal of chlorine, collect the sample in the appropriate sample container(s) using the required preservatives.
   a. Add 0.008% $Na_2S_2O_3$ or 100mg of $Na_2S_2O_3$ per 1L of sample water directly into the sample container.
   b. After replacing the cap, tip the container several times to mix the preservative.

10.0 SOIL SAMPLING

Soil samples are preserved as per Section 14. When compositing subsamples, the quantity of each subsample used is measured and recorded in the field logbook.

10.1 SAMPLING EQUIPMENT

Type	Use	Materials	Allowable Parameter Groups[1]
Hand Auger (Bucket type)	Sampling	PVC	All parameter groups except VOC's, extractables and organics
Encore™ Sampler	VOC soil subsampling	Teflon®	VOC's only
Split Spoons	Sampling	Carbon Steel	All parameter groups
Trowel, Spatula	Sampling and Compositing*	Chrome-Plated Steel	All parameter groups
Spoons	Sampling and Compositing*	Stainless Steel	All parameter groups
Shovel	Sampling	Carbon Steel	All parameter groups
Mixing Pan	Compositing*	Pyrex & Aluminum	All parameter groups except metals in aluminum pan

[1] Carbon steel & Chrome-plated steel tools may be used for collecting soils where trace metal concentrations are not a concern. When these tools are used, samples should be taken from soils not in contact with the tool surface.

* Compositing is not suitable for VOC's

10.2 HAND AUGER SAMPLING PROCEDURE

This procedure is used when only relatively shallow samples are required or when the use of heavy equipment is not practical. The hand auger may be used to collect samples of soils or other materials at various depths by adding extensions as necessary.

1. Remove surface debris from the location of the sampling hole using a clean shovel or spoon.
2. Disturbed portions of soil should be discarded and not used as part of the sample.
3. Using a clean auger, drill to the desired sample depth. Confirm depths using a tape measure or other appropriate device.
4. Use a clean planer auger to clean and level the bottom of the boring.
5. All grab samples should be mixed thoroughly prior to placement in containers (except VOCs).
6. Using a clean auger, extract the desired sample. Subsampling is performed for VOC sample collection using an Encore™ sampling device. Once the core sample is collected, additional samples should be taken using an Encore™ sampler, either 5g or 25g, capped, sealed, and immediately cooled to 4ºC. The holding time for this method is 48 hours. Alternatively, weigh 5g of sample into a pre-weighed vial (with a Teflon® lined screw cap) containing 5mL sodium bisulfate solution and a magnetic stir bar, cap, and then ice to 4ºC. The holding time for this method is 14 days.
7. If less than the collected volume of material is desired or if multiple containers are required, subsampling shall be conducted. The collected material shall be placed in a clean mixing pan and thoroughly mixed using a clean, stainless steel spoon. The mixed material will then be quartered, removed and recombined before samples are collected. For clay soils, representative aliquots of the entire sample should be removed from the auger using stainless steel spoons. Samples for chemical analyses shall not be collected from auger flights or cuttings from hollow stem auger flights. Samples used for vapor meter determinations will not be used for trace contaminant analyses.
8. Samples should then be labeled. The depth range from which the samples were taken should be included in the sample description.
9. Repeat steps (2) through (6) as necessary to obtain samples at all desired depths.
10. When preparing composite samples, the quantity of each subsample shall be measured and recorded in the field logbook.

10.3 Split and Duplicate Sample Collection

Split samples measure variability between analysts, methods, and laboratories and are taken as subsamples from a single sample. This is unlike duplicate samples that measure variability inherent in the collection method or waste stream and are obtained in close succession during the same sampling event. True split samples are difficult to collect for soils, sediment, and sludge under field conditions. Split samples for these materials are therefore considered duplicate samples.

The collection procedure is as follows:

1. Collect the appropriate volume of sample into a clean disk constructed of a non-reactive material.
2. Mix the material with a clean utensil and separate into 4 to 10 equal portions.
3. Alternate placing a portion of the subdivided material into each container.
4. Repeat until each container is filled.
5. Assign each container a field sample number and complete the chain of custody.

11.0 Waste Sampling

11.1 Sampling Equipment

Type	Use	Materials	Allowable Parameter Groups[1]
Shovel	Sampling	Carbon Steel	All parameter groups except metals
Split Spoons	Sampling	Carbon Steel	All parameter groups except metals
Trowel, Spatula	Sampling and Compositing*	Stainless Steel	All parameter groups
Spoon	Sampling and Compositing*	Stainless Steel	All parameter groups
Drum Pump	Sampling	Polypropylene	All parameter groups
Mixing pan	Compositing*	Pyrex or aluminum	All parameter groups except metals in aluminum pan
Coliwasa	Sampling	Glass	All parameter groups

[1]Carbon steel tools may be used for collecting wastes when trace metal concentrations are not a concern.
*Compositing is not suitable for VOC's

11.2 General

This section discusses the collection of samples from drums, tank trucks, and storage tanks, and samples from waste piles and landfills. All ESC personnel consider sampling from closed containers as a hazardous operation.

11.2.1 Specific Quality Control Procedures for Sampling Equipment

Sampling equipment used during waste sampling must be cleaned as specified in Section 12 of this manual before being returned from the field to minimize contamination.

Contaminated disposable equipment must be disposed of as specified in the sampling plan.

All field equipment is cleaned and repaired before being stored at the conclusion of a field study. Special decontamination procedures may be necessary in some instances and is developed on a case-by-case basis. Any deviation from standard cleaning procedures and all field repairs is documented in field logbooks. Equipment that has not been properly cleaned must be tagged and labeled.

11.2.2 Collection of Supplementary Information

The collection of supplementary data is important when collecting waste samples. Any field analyses are recorded in field logbooks. Sketches of sampling locations and layout are documented in the logbooks. Photographs are used extensively.

11.3 Open and Closed Container Sampling

11.3.1 General

When sampling containers, open containers should be sampled first since they generally present less of a hazard. Closed containers must be considered as extremely hazardous. Due to the dangers involved with container sampling, the sampling of drums or other containers containing either unknown materials or known hazardous materials are considered a hazardous duty assignment.

One problem with container sampling is stratification and/or phase separation. Care must be taken to ensure that the sample collected is representative. If only one layer or phase is sampled, this should be noted when interpreting analytical results.

If no stratification is present, representative samples may be composited by depth. When a drum or cylindrical container is standing vertically, depth compositing provides a good quantitative estimate of the containers contents. In other cases where containers are tipped, horizontal, deformed, etc., and stratification may not be present, vertical compositing provides at least a qualitative sample.

11.3.2 Sampling Equipment

The following equipment is available for use in collecting waste samples: barrel bung wrenches, adjustable wrenches, etc.; coliwasa samplers for drum sampling; and peristaltic pumps for liquid waste sampling from containers.

11.3.3 Sampling Techniques

Containers containing unknown materials or known hazardous materials are opened using only spark proof opening devices from a grounded container.

The coliwasa sampler is a single use glass sampler, consisting of an outer glass tube with one end tapered and a separate inner glass tube with a small bulb on one end. The outer tube is slowly lowered into the drum, tapered end first. Slowly lowering the tube allows the liquid phases in the drum to remain in equilibrium. The inner glass tube is inserted into the outer tube. After both inner and outer tubes are inserted into the drum to be sampled, the inner tube bulb end is pressed gently against the tapered end of the outer tube, forming a seal. Both tubes are withdrawn from the drum and the ends of the tubes are held over the sample container.

Drum samples can also be collected using a length of glass tube (1/2-inch or less inside diameter). The tube is inserted into the drum as far as possible and the open end is sealed to hold the sample in the tube. The sample is then placed in the appropriate container. Sample volumes are the absolute minimum required.

Tank truck and storage tank samples may be collected from access ports on top of these tanks or trucks using the above techniques. Tank trucks are often compartmentalized, and each compartment should be sampled. Sampling from discharge valves is not recommended due to stratification possibilities and possibilities of sticking or broken valves. If the investigator must sample from a discharge valve, the valving arrangement of the particular tank truck being sampled must be clearly understood to ensure that the contents of the compartments of interest are sampled. The investigator must realize that samples obtained from valves may not be representative.

If stratification or phase separation of waste samples is suspected, the sample collected should be representative of container contents. Samples should be depth composited when possible and number and types of layers shall be noted when interpreting analytical results.

11.4 WASTE PILES AND LANDFILLS

11.4.1 General

Waste piles consist of sludge and other solid waste, liquid waste mixed with soil, slag, or any type of waste mixed with construction debris, household garbage, etc. The sampling personnel must be aware that landfills were not and are often still not selective in the types of materials accepted. Sampling at landfills could involve sampling operations that are potentially dangerous to sampling personnel.

11.4.2 Sampling Locations

Sampling locations should be selected that yield a representative sample of the waste. Exceptions are situations in which representative samples cannot be collected safely or when the team is purposely determining worst-case scenarios.

11.4.2.1 Waste Piles

A representative sample from a small waste pile can be obtained by collecting a single sample. Collecting representative samples from large waste piles requires a statistical approach in selecting both the numbers of samples and sample location. A discussion of statistical methods is outlined in the *Test Methods for Evaluating Solid Waste (SW-846)* issued by the EPA Office of Solid Waste and Emergency Response.

11.4.2.2 Landfills

Representative samples from landfills are difficult to achieve to due to the heterogeneous nature of the wastes. A statistical approach should be used in selecting both the number of samples and the sample location. Statistical methods are given in *Test Methods for Evaluating Solid Waste (SW-846)* issued by the EPA Office of Solid Waste and Emergency Response. Landfills often generate leachate at one or more locations downgradient of the fill material that can provide some insight into the materials contained in a landfill that are migrating via groundwater.

11.4.3 Sampling Techniques

All samples collected should be placed into a Pyrex® or aluminum mixing pan and mixed thoroughly. Samples for volatile organic compounds analyses must not be mixed or composited. Stainless steel spoons or scoops should be used to clear away surface materials before samples are collected. Near surface samples can then be collected with a clean stainless steel spoon. Depth samples can be collected by digging to the desired depth with a carbon steel shovel or scoop and removing the sample with a stainless steel spoon.

12.0 STANDARD CLEANING PROCEDURES

12.1 GENERAL

12.1.1 Introduction

ESC personnel use the procedures outlined in this section to clean field equipment prior to use. Ideally, a sufficient amount of clean equipment is carried to the field so that the project can be conducted without the need for field cleaning. This is not always the case. ESC's policy regarding cleaning field equipment is as follows:

1. Equipment used in the field must be thoroughly cleaned in a controlled environment using prescribed procedures. This minimizes the potential for contaminants being transferred to equipment, vehicles, and the laboratory.
2. All equipment is rinsed immediately with tap water after use, even if it is to be field cleaned for other sites.
3. If equipment is used only once (i.e., not cleaned in the field), it is labeled as "dirty" or "contaminated equipment" in the field and transported separately from clean equipment.
4. All cleaning procedures are documented. Field decontamination is documented in the field records. These records specify the type of equipment cleaned and the specific protocols that are used. In-house cleaning records must identify the type of equipment, date it was cleaned, SOP used, and person that cleaned it.
5. Unless justified through documentation (i.e., company written protocols and analytical records) and historic data (i.e., absence of analytes of interest in equipment blanks), the protocols in Sections 12.1.2 through 12.7.11 are followed without modification.
6. All field sampling equipment is pre-cleaned in-house.

12.1.2 Cleaning Materials

Use a phosphate-free, laboratory detergent such as Liquinox®. The use of any other detergent is noted in field logbooks and summary reports.

Ten percent nitric acid solution is made from reagent-grade nitric acid and deionized water.

The standard cleaning solvent used is pesticide-grade isopropanol. Other solvents (acetone and/or hexane) may be substituted as necessary. The use of other solvents must be documented in field logbooks and summary reports.

Tap water may be used from any potable water system. Untreated water is not an acceptable substitute for tap water.

Deionized water is tap water that has been passed through a deionizing resin column and should contain no inorganic compounds at or above analytical detection limits. Organic-free water is tap water that has been de-ionized and treated with activated carbon. Organic-free water should contain no detectable levels of organic compounds, and less than 5 ug/L of VOCs.

Analyte-free water is water in which all the analytes of interest and all interferences are below the method detection limits. Analyte-free water is always used for blank preparation and for the final in-house decontamination rinse.

Substitution of a higher grade water (i.e., deionized or organic-free water for tap water) is permitted and need not be recorded. Solvent, nitric acid, detergent, and rinse water used to clean equipment shall not be reused.

12.1.3 Marking Clean Equipment

Equipment that is cleaned by these methods is marked with the date and time that the equipment was cleaned.

12.1.4 Marking Contaminated or Damaged Field Equipment

Field equipment that needs repair is tagged and repairs or symptoms noted on the tag. Field equipment that needs cleaning **will not** be stored with clean equipment. All wrapped equipment not used in the field may be placed back in stock after equipment is inspected to ensure that contamination has not taken place.

12.1.5 Decontamination of Equipment Used With Toxic or Hazardous Waste

Equipment used to collect hazardous or toxic wastes or materials from hazardous waste sites, RCRA facilities, or in-process waste streams is decontaminated prior to leaving the site. This decontamination procedure consists of washing with laboratory detergent and rinsing with tap water. More stringent procedures may be required depending on the waste sampled.
If equipment is heavily contaminated, an acetone or acetone/hexane/acetone pre-rinse may be necessary prior to regular decontamination procedures. It is not recommended that this type of cleaning be performed in the field.

12.1.6 Disposal of Cleaning Materials

See Section 16.

12.1.7 Safety Procedures for Cleaning Operations

All applicable safety procedures are followed during cleaning operations. The following precautions are taken during cleaning operations:

- Safety glasses or goggles, gloves, and protective clothing are worn during all cleaning operations.
- Solvent rinsing operations are conducted under a hood or in an open, well ventilated area.
- No eating, smoking, drinking, chewing, or hand to mouth contact is permitted during cleaning operations.

12.1.8 Storage of Field Equipment

All clean field equipment is stored in a designated, contaminant-free area.

12.2 Quality Control Procedures for Cleaning

12.2.1 General

This section establishes quality control methods to monitor the effectiveness of the equipment cleaning procedures. The results of these methods are monitored by the ESC Quality Assurance Department. All quality control procedures are recorded in a logbook and maintained in a quality assurance file. If contamination problems are detected, the ESC QA Department determines the cause(s) of the problem(s) and takes immediate corrective action.

12.2.2 Rinse Water

The quality of water used is monitored once per quarter by placing water in standard, pre-cleaned sample containers and submitting them to the ESC laboratory for analysis. Organic-free water is also submitted for analyses of the various organic compounds.

12.3 Procedures for Cleaning Teflon® or Glass Equipment Used in the Collection of Samples for Trace Organic Compounds and/or Metals Analyses

1. Equipment is washed with laboratory detergent and hot water using a brush to remove any particulate matter or surface film. If oil, grease, or other hard to remove residues are present on the equipment, an acetone/hexane/acetone pre-wash and/or steam cleaning may be necessary.
2. Rinse the equipment with hot tap water.
3. Rinse or soak, if necessary, equipment with a 10% nitric acid solution. If nitrogen-containing compounds are analytes of concern, hydrochloric acid must be used as a substitute or subsequent equipment rinse.
4. Rinse equipment with tap water.
5. Rinse equipment with deionized water.
6. Rinse equipment twice with solvent and allow to dry.
7. If equipment cannot be cleaned effectively, discard properly.
8. Wrap equipment in aluminum foil. Seal in plastic and date.

12.4 Procedures for Cleaning Stainless Steel or Metal Sampling Equipment Used in Trace Organic and/or Metals Sample Collection

1. Equipment is washed with laboratory detergent and hot water using a brush to remove any particulate matter or surface film. If oil, grease, or other hard to remove materials are present, a acetone/hexane/acetone pre-wash and/or steam cleaning may be necessary.

2. Rinse equipment with hot tap water.
3. Rinse equipment with deionized water.
4. Rinse equipment twice with solvent and allow to dry.
5. If equipment cannot be cleaned effectively, discard properly.
6. Wrap equipment in aluminum foil. Seal in plastic and date.

12.5 CLEANING PROCEDURES FOR AUTOMATIC SAMPLING EQUIPMENT

12.5.1 General

All automatic wastewater samplers are cleaned as follows:

- The exterior and accessible interior portions of automatic samplers is washed with Liquinox and rinsed with tap water.
- The electronics casing are cleaned with a clean damp cloth.
- All vinyl sample tubing is discarded after each use.
- Teflon® tubing is cleaned using procedures found in Section 12.6.2.
- Silastic pump tubing is cleaned after each use, if possible. Tubing is cleaned using cleaning procedures specified in Section 12.6.1 of this document. Tubing is checked on a regular basis and will be changed if it has become discolored or loses elasticity.

12.5.2 Reusable Glass Composite Sample Containers

1. If containers are used to collect samples that contain hard to remove materials (i.e., oil and grease) it is rinsed as necessary with reagent grade acetone prior to the detergent wash. If material cannot be removed, the container is discarded.
2. Wash containers thoroughly with hot tap water and Liquinox and rinse thoroughly with hot tap water.
3. If metals are to be sampled, rinse with 10% nitric acid. If nutrients are to be sampled, follow with a 10% hydrochloric acid rinse.
4. Rinse thoroughly with tap water.
5. Rinse thoroughly with DI water.
6. If organics are to be sampled, rinse twice with isopropanol and allow to air dry for 24 hours or more. Cap the container with the decontaminated Teflon® lined lid.
7. After use, rinse with tap water in the field and cover to prevent drying of material onto the interior surface.
8. Containers that have a visible scale, film, or discoloration after cleaning or were used at a chemical manufacturing facility should be properly discarded at the conclusion of the sampling activities.

12.5.3 Reusable Plastic Composite Sample Containers

1. Wash containers with hot tap water and laboratory detergent using a bottlebrush to remove particulate matter and surface film.
2. Rinse containers with hot tap water.
3. Rinse containers with 10% nitric acid. If nitrogen containing compounds are analytes of concern, hydrochloric acid must be used as a substitute or subsequent equipment rinse.
4. Rinse containers with tap water.
5. Rinse containers with deionized water.
6. Cap with aluminum foil.
7. Plastic sample containers used at facilities that produce toxic compounds will be properly disposed of at the conclusion of the sampling activities. Containers that have a visible film, scale, or other discoloration remaining after cleaning will be discarded.

12.5.4 Plastic Sequential Sample Bottles for Automatic Sampler Base

1. Rinse bottles in field with potable or de-ionized water when possible.
2. Wash in dishwasher at wash cycle, using laboratory detergent cycle, followed by tap and deionized water rinse cycles. Alternatively, handwash using the same procedure.
3. Rinse with 10% nitric acid. If nitrogen containing compounds are analytes of concern, hydrochloric acid must be used as a substitute or subsequent equipment rinse.
4. Rinse with tap water.
5. Replace bottles in sampler base; cover with aluminum foil before storing.

12.6 CLEANING PROCEDURES FOR SAMPLING TUBING

12.6.1 Silastic Rubber Pump Tubing Used In Automatic Samplers

Silastic pump tubing used in automatic samplers need not be replaced in pumps where the sample does not contact the tubing, where the sampler is being used solely for purging purposes (i.e., not being used to collect samples). Tubing must be changed on a regular basis, if used for sampling purposes, and should be cleaned in this manner:

1. Flush tubing with laboratory grade detergent and hot tap water
2. Rinse thoroughly with hot tap water
3. Rinse thoroughly with DI water
4. If used to collect metals samples, the tubing is flushed with 1+5 nitric acid, followed by a thorough rinsing with DI water
5. Install the tubing in the automatic wastewater sampler
6. Cap both ends with aluminum foil or equivalent

Tubing should always be replaced at automatic sampler manufacturer's recommended frequencies. If tubing cannot be adequately cleaned, it is discarded.

12.6.2 Teflon® Tubing

New Teflon® tubing is pre-cleaned as follows:

1. Rinse outside of the tubing with pesticide-grade solvent.
2. Flush interior of the tubing with pesticide-grade solvent.
3. Let dry overnight in drying oven or equivalent.
4. Wrap tubing in aluminum foil and seal in plastic.

Reused tubing is transported to the field in pre-cut and pre-cleaned sections. Field cleaning of Teflon® is not recommended. The following steps describe in-house cleaning procedures:

1. Exterior of tubing must be cleaned first by soaking in hot, soapy water in a stainless steel or non-contaminating sink. Particulate may be removed with a brush.
2. Clean inside of tubing ends with a small bottlebrush.
3. Rinse surfaces and ends with tap water.
4. Rinse surfaces and ends with nitric acid, tap water, isopropanol, and analyte-free water.
5. Place on fresh aluminum foil, connect all sections with Teflon® couplings.
6. Cleaning configuration:
    a. Cleaning solutions are placed in a clean, 2-liter glass jar.
    b. Place one end of tubing in the solution, the other in the **INFLUENT** end of a peristaltic pump.
    c. Effluent from the pump can be recycled through the glass cleaning solution jar. All cleaning solutions can be recycled EXCEPT the final isopropanol and analyte-free water rinses.
7. The above configuration is used as follows:
    a. Pump generous amounts of hot, soapy water through the tubing.
    b. Follow this with tap water, 10% nitric acid, tap water, isopropanol, and analyte-free water.
    c. The nitric acid and isopropanol rinses should be allowed to remain in the tubing for 15 minutes with the pump shut off then continue with subsequent rinses
    d. Leave any couplings in and connect or cover the remaining ends.
8. After cleaning the interior, rinse the exterior with analyte-free water.
9. The cleaned lengths are wrapped in aluminum foil and stored in a clean, dry area until use.

12.7 FIELD EQUIPMENT CLEANING PROCEDURES

12.7.1 General

It is the responsibility of field personnel to properly clean equipment in the field. The following procedures are observed when cleaning equipment in the field.

12.7.2 Conventional Equipment Use

Remove deposits with a brush if necessary. If only inorganic anions are of interest, equipment should be rinsed with analyte-free water and with the sample at the next sampling location prior to collection. Clean equipment for the collection of samples for organic compounds or trace inorganic analyses according to Section 12.7.3.

12.7.3 Equipment Used to Collect Organic Compounds and Trace Metals Samples

1. Clean with tap water and laboratory detergent. If necessary, use a brush to remove particulate and surface films then rinse with tap water.
2. Rinse with 10 to 15% nitric acid solution followed by 10% hydrochloric acid rinse (unless equipment is made of metal) followed by tap water and DI water.
3. Rinse twice with solvent.
4. Rinse with organic-free water and allow to air dry.
5. If organic-free water is unavailable, let air dry. Do not rinse with deionized or distilled water.
6. Wrap with aluminum foil or plastic.

12.7.4 Teflon®, Glass, Stainless Steel or Metal Equipment Used to Collect Samples for Metal Analyses

1. Remove particulate matter and surface films. Clean with laboratory detergent and tap water.
2. Rinse with tap water.
3. Ten percent nitric acid solution (skip 3 and 4 if equipment is made of metal and/or stainless steel).
4. Rinse with tap water.
5. Rinse with deionized water then let air dry.

12.7.5 Instruments Used to Measure Groundwater Levels

1. Wash with laboratory detergent and tap water.
2. Rinse with tap water.
3. Rinse with deionized water.
4. Allow to dry.

12.7.6 Field Filtration Apparatus

1. A new, disposable filtration unit will be used for each site. Filter pore size is dependent on parameter being monitored as per Section 9.6.
2. The peristaltic pump is cleaned as described in Section 12.7.7.
3. Silastic pump tubing is cleaned as described in Section 12.6.1.
4. If Teflon® tubing is used, it is cleaned as described in Section 12.6.2.
5. Other tubing types must be cleaned following the appropriate regimen described in Section 12.6. In general, non-Teflon® type tubing (e.g., HDPE) will not be re-used.

12.7.7 Flow Meters, Above Ground Pumps, Bladder Pumps and Other Field Instrumentation

The exterior of equipment such as flow meters should be washed with a mild detergent and rinsed with tap water before storage. The interior of such equipment may be wiped with a damp cloth.

Other field instrumentation should be wiped with a clean, damp cloth. Meter probes should be rinsed with deionized water before storage.

Equipment desiccant should be checked and replaced as necessary.

Peristaltic pumps used for purging must be free of oil and grease on the exterior. They must be cleaned on the outside with Liquinox and rinsed with tap water followed by DI water.

12.7.8 In-Field Decontamination For Submersible Purging Pump and Tubing

ESC uses the submersible bladder pump listed in Section 9.1 only for purging and not for sample collection. The pump and tubing is decontaminated between wells in the following manner:

1. Interior of the pump and tubing is thoroughly flushed with a soapy water solution.
2. Wipe or scrub the exterior of the pump and tubing as necessary with the appropriate soap solution.
3. Rinse exterior and interior of pump and tubing thoroughly with tap water followed by a deionized water rinse.
4. Allow remaining water to drain from tubing and pump and allow to air dry as long as possible in a contaminant free area before purging the next well.

12.7.9 Shipping Containers

All reusable shipping containers are washed with laboratory detergent, rinsed with tap water, and air dried before storage or re-use. Extremely contaminated shipping containers are cleaned as thoroughly as possible and properly disposed.

12.7.10 Analyte Free Water Containers

Analyte-free water containers can be made of glass, Teflon®, polypropylene, or high density polyethylene (HDPE). Inert glass or Teflon® are recommended for holding organic-free sources of water. Polypropylene can be used when organics are not analytes of concern. HDPE is not normally recommended but is acceptable for use. Water should not be stored in these containers for extended periods. Containers of water should only be used for a single event and should be disposed of at the end of the sampling day. The procedure for cleaning analyte-free water containers is as follows:

1. For new containers, follow instructions in Section 12.3 of this manual. Delete the solvent rinse if containers are made of plastic.
2. Cap with Teflon® film, aluminum foil, or the Teflon® lined bottle cap (aluminum foil or Teflon® film may also be used as a cap liner).

If water is being stored in reused containers, the following cleaning procedures should be followed:

1. After emptying, cap the container.
2. Wash exterior of the container with Liquinox and rinse with DI water.
3. Rinse the interior twice with isopropanol unless the container is made of plastic.
4. Rinse the interior thoroughly with analyte-free water.
5. Invert and allow to dry.
6. Fill the container with analyte-free water and cap with aluminum foil, Teflon® film, or a Teflon® lined bottle cap.
7. Water is not stored prior to a sampling event for more than 3 days.

12.7.11 Vehicles

Field vehicles used by ESC personnel should be washed at the conclusion of each sampling event. This should reduce the risk of contamination due to transport on a vehicle. When vehicles are used at hazardous waste sites or on studies where pesticides, herbicides, organic compounds, or other toxic materials are known or suspected to be present, a thorough interior and exterior cleaning is mandatory at the conclusion of the site visit.

Vehicles are equipped with trash containers. ESC personnel are responsible for cleanliness of each vehicle.

13.0 SAMPLE HISTORY

Sample chronology is recorded and kept on the ESC chain of custody, field logbooks and laboratory notebooks. These are discussed in detail in Section 9.0.

14.0 SAMPLE CONTAINERS, PRESERVATION METHODS AND HOLDING TIMES

14.1 GENERAL CONSIDERATIONS

The following section contains information regarding sample containers, preservation methods, and holding times. Refer to SW-846, Table II-1 and Chapter 3, Page 3 for solid waste and RCRA projects and 40 CFR Part 136, Table II for water and wastewater projects.

The provisions of 40 CFR Part 136, Table II take precedence over requirements given in any approved method when sampling in the State of Florida for water and wastewater.

Proper sample preservation is the responsibility of the sampling team and it is their responsibility to assure that all samples are preserved according to 40 CFR Part 136. For the purposes of this manual, "immediately" is defined as within 15 minutes.

Sample preservation is accomplished either by obtaining pre-preserved containers from an acceptable source or by adding preservatives in the field.

It is the responsibility of the field team accepting pre-preserved containers to make sure that the proper preservatives are used and desired results are achieved. The laboratory also supplies additional preservatives from the same source in suitable containers.

14.2 SAMPLE PRESERVATION

The following protocols apply for sample containers preserved in the field after the sample has been added:

1. Preservatives are at least reagent grade or higher. The acid for metals is suitable for trace metals analyses.
2. Fresh preservatives are obtained prior to each sampling event. Remaining preservatives that are not sealed must be discarded in an acceptable manner.
3. Preservatives are transported in pre-measured glass ampules and added directly to the sample.
4. A corresponding amount of preservative is added to the associated equipment blanks.
5. The pH is checked on all pH preserved samples with the exception of VOC, oil and grease, and TRPH.

Effectiveness of pH adjustment is made in the following manner:

1. Narrow range pH paper is used to test a small aliquot of the preserved sample.
2. A small portion of sample is placed into a container, checked with pH paper, and compared against the color chart.
3. Discard the aliquot properly, but do not pour back into the sample container.
4. If pH is acceptable, document in field log and prepare for transport to laboratory.

If pH is unacceptable, continue to add additional preservative in measured increments using the methods described above until an acceptable pH has been reached. Record the total amount of preservative used in the field log. Always use additional preservative from the same source as the initial preservation attempt.

In some cases, an extra dummy sample can be used to test pH preservation. Content should be suitably discarded.

If equipment blanks or field blanks are used, the maximum amount of preservative that was used to preserve any single sample in the set is added to the equipment or field blank.

Samples requiring temperature preservation are cooled to 4°C. The cooler will be checked to ensure that the ice has not melted.

14.3 SAMPLE CONTAINERS

ESC does not clean and re-use sample containers. ESC purchases all sample collection containers precleaned. All used sampling containers are discarded after use. The cleaning criteria of all containers must meet EPA analyte specific requirements.

QEC provides written certification that containers do not contain analytes of concern above method detection levels

ESC maintains records for these containers (lot numbers, certification statements, date of receipt, etc.) and intended uses are documented.

14.4 FIELD REAGENT HANDLING

Reagents, cleaning materials, and preservatives that are maintained by a field team will be stored, transported, and handled in such a way as to prevent and/or minimize contamination. The following storage and use protocols will be observed:

1. Chemicals are stored in-house and transported to the field segregated by reactivity.
2. Acids are stored in an acid storage cabinet and solvents are stored in a vented, explosion proof solvent storage cabinet.
3. All chemicals transported to the field are stored in bottles and packed to avoid breaks.

4. When reagents are transferred from an original container, the transport container must be pre-cleaned and of compatible material as the original container.
5. Chemicals are separated from sample containers and samples to avoid reaction and possible contamination.
6. Analyte free water is segregated from solvents to prevent contamination.

14.4.1 Reagent and Standard Storage

Chemical	Method of Storage
Nitric acid	Stored separated from other acids in original container in vented cabinet.
Sulfuric acid	See above
Hydrochloric acid	See above
Isopropanol	Stored in original glass container in vented and explosion proof solvent storage cabinet.
pH calibration buffers, turbidity standards, conductivity standards	Stored in cabinet designated for standard and reagent storage. Stored in temperature-controlled area of laboratory.
Sodium hydroxide	Stored in original container in designated cabinet in laboratory.
Sodium thiosulfate, zinc acetate, ascorbic acid, lead acetate	Stored in original containers in designated area of laboratory. Reagent solutions made fresh prior to use.

14.5 Sample Transport

In the majority of situations, samples are delivered directly to the laboratory by the field sampling team or field courier following standard chain of custody protocols. Samples are preserved immediately (i.e., within 15 minutes) and packed with ice prior to transport. The field team relinquishes custody to the login sample custodian upon arrival at the laboratory.

Certain situations require that the field sampling team ship samples to the laboratory utilizing common carrier (UPS, FEDEX, etc.). If samples are sent by common carrier, all documentation (transmittal form, chain of custody, field data, analyses request, etc.) is placed in a ziplock bag and placed inside the sample container. The container is then sealed closed and sent to the laboratory in the required time frame to meet requirements of time-sensitive analyses.

14.6 Biomonitoring Sampling

Preservation and Sample Volume
Aqueous samples collected for Bioassay can be collected in either glass or HDPE plastic. There is no required chemical preservation for this type of sample but the sample must be kept at $4 \pm 2^{o}C$. The required volume varies independently with each type of analysis but the minimum collected is 250mL. The samples can be held for a maximum of 36 hours from the time of collection until first use.

Sample Collection

Grab sample protocols are utilized for acute bioassay unless otherwise specified in permit requirements. Composite sampling protocols are utilized for chronic bioassays unless otherwise specified in permit requirements. (Actual sampling protocols are discussed in detail throughout this appendix) ESC field collection personnel are required to collect all bioassay samples by completely filling the sample bottle and leaving no headspace. It is important that bottles be filled completely to reduce possible aeration that may reduce the toxic properties of the sample. If a customer chooses to collect the samples, a trained ESC field collection person can explain in detail the importance of reducing aeration by filling the sample bottle completely.

14.6.1 Biomonitoring Sampling Containers

All bioassay glassware are cleaned using the following EPA protocol:

- soak for 15 minutes in hot tap water with detergent and scrub
- rinse thoroughly with hot tap water
- rinse thoroughly with dilute nitric acid (10%)
- rinse thoroughly with deionized water
- rinse thoroughly with pesticide grade acetone

TABLE 14.6: PRESERVATION, HOLDING TIME AND SAMPLE CONTAINERS

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
AIR METHODS									
Volatiles in Ambient Air	**Air**	**EPA TO-15**	**NA**	**Various**	**Canister**	**None**	**Ambient**	**14**	**Days**
Volatiles in Ambient Air	**Air**	**EPA TO-15**	**NA**	**Various**	**Tedlar**	**None**	**Ambient**	**5**	**Days**
Volatiles in Ambient Air	**Air**	**EPA Method 18**	**NA**	**Various**	**Canister**	**None**	**Ambient**	**14**	**Days**
Volatiles in Ambient Air	**Air**	**EPA Method 18**	**NA**	**Various**	**Tedlar**	**None**	**Ambient**	**5**	**Days**
Ohio VAP EPA Method 8260B	**Air**	**NA**	**EPA 8260B**	**Various**	**Canister**	**None**	**Ambient**	**14**	**Days**
Ohio VAP EPA Method 8260B	**Air**	**NA**	**EPA 8260B**	**Various**	**Tedlar**	**None**	**Ambient**	**5**	**Days**
Methane, Ethane, Ethene, Propane	**Air**	**RSK-175**	**NA**	**Various**	**Canister**	**None**	**Ambient**	**14**	**Days**
Methane, Ethane, Ethene, Propane	**Air**	**RSK-175**	**NA**	**Various**	**Tedlar**	**None**	**Ambient**	**5**	**Days**
Fixed Gases - C_2, CO_2, CO, and CH_4	**Air**	**ASTM D1946/D5314**	**NA**	**Various**	**Canister**	**None**	**Ambient**	**14**	**Days**
Fixed Gases - C_2, CO_2, CO, and CH_4	**Air**	**ASTM D1946/D5314**	**NA**	**Various**	**Tedlar**	**None**	**Ambient**	**5**	**Days**

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
Arizona State Specific VOCs in Vapor - 8260B	Air	NA	EPA 8260B	Various	Canister	None	Ambient	30	Days
Arizona State Specific VOCs in Vapor - 8260B	Air	NA	EPA 8260B	Various	Tedlar	None	Ambient	72	Hours
Arizona State Specific VOCs in Vapor - 8015B	Air	NA	EPA 8015B	Various	Canister	None	Ambient	30	Days
Arizona State Specific VOCs in Vapor - 8015B	Air	NA	EPA 8015B	Various	Tedlar	None	Ambient	72	Hours
AQUATIC TOXICITY & RELATED									
C.dubia - Acute	NPW	2002	NA	1L/1Gal	HDPE	None	0 - 6°C	36	Hours
Minnow - Acute	NPW	2000	NA	1L/1Gal	HDPE	None	0 - 6°C	36	Hours
Toxicity C.dubia - Chronic	NPW	1002	NA	1L/1Gal	HDPE	None	0 - 6°C	36	Hours
Toxicity Minnow - Chronic	NPW	1000	NA	1L/1Gal	HDPE	None	0 - 6°C	36	Hours
BACTERIA									
Chlorophyll A/Pheophytin A	NPW	SM10200H	NA	1L	Amber Glass	None	0 - 6°C	72	Hours
Coliform, Total	NPW	SM9222B	NA	110ml	Micro	$Na_2S_2O_3$	0 - 6°C	8	Hours
E. Coli	NPW	SM9223B, Colilert	NA	110ml	Micro	$Na_2S_2O_3$	0 - 6°C	8	Hours
Enterococci	NPW	ASTM D6503-99, Enterolert	NA	110ml	Micro	$Na_2S_2O_3$	0 - 6°C	8	Hours
Fecal Coliform	NPW	SM9222D	NA	110ml	Micro	$Na_2S_2O_3$	0 - 6°C	6	Hours
Fecal Coliform	NPW	SM9221C/E	NA	110ml	Micro	$Na_2S_2O_3$	0 - 6°C	6	Hours
Heterotropic Plate Count	NPW	9215B	NA	110ml	Micro	$Na_2S_2O_3$	0 - 6°C	6	Hours
Salmonella	NPW	SM9260D	NA	110ml	Micro	$Na_2S_2O_3$	0 - 6°C	8	Hours
Cryptosporidiu m	PW	1622, 1623	NA	10L	LDPE	None	<20°C	96	Hours
E. Coli	PW	SM9223B	NA	110ml	Micro	$Na_2S_2O_3$	0 - 6°C	30	Hours
Fecal Coliform (MPN)	PW	9221E	NA	110ml	Micro	$Na_2S_2O_3$	0 - 6°C	30	Hours
Fecal Coliform	PW	SM9222D	NA	110ml	Micro	$Na_2S_2O_3$	0 - 6°C	30	Hours
Enterococci	PW	ASTM D6503-99	NA	110ml	Micro	$Na_2S_2O_3$	0 - 6°C	30	Hours
Heterotropic Plate Count	PW	9215B	NA	110ml	Micro	$Na_2S_2O_3$	0 - 6°C	6	Hours
Coliform, Total	PW	9222B, 9223B	NA	110ml	Plastic	$Na_2S_2O_3$	0 - 6°C	30	Hours
Coliform, Total	SS	SM9221B, 9222	NA	Sterile 125mL	Plastic	None	0 - 6°C	24	Hours
Fecal Coliform (MPN)	SS	9221E	NA	Sterile 125mL	Plastic	None	0 - 6°C	24	Hours
Fecal Coliform (Sludge)	SS	9222D	NA	Sterile 125mL	Plastic	None	0 - 6°C	24	Hours

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
Enterococci	SS	ASTM D6503-99	9230	Sterile 125mL	Plastic	None	0 - 6°C	6	Hours
Salmonella	SS	SM9260D	NA	110ml	Micro	None	0 - 6°C	6	Hours
Heterotropic Plate Count	SS	SM9215B	NA	110ml	Micro	None	0 - 6°C	6	Hours
S.O.U.R.	SS	SM 2710B	NA	1L	HDPE	None	0 - 6°C	2	Hours
INORGANIC CLASSIC									
Acidity	NPW	SM2310B, ASTM D1067	NA	250ml	HDPE	None	0 - 6°C	14	Days
Alkalinity	NPW	SM2320B	NA	500ml	HDPE	None	0 - 6°C	14	Days
Alkalinity	NPW	310.2	NA	500ml	HDPE	None	0 - 6°C	14	Days
Ammonia Nitrogen	NPW	350.1, SM4500NH$_3$ G	NA	500ml	HDPE	H_2SO_4+$Na_2S_2O_3$	0 - 6°C	28	Days
Ammonia, distilled/titration (4500)	NPW	SM4500NH$_3$ C	NA	500ml	HDPE	H_2SO_4+$Na_2S_2O_4$	0 - 6°C	28	Days
Asbestos	NPW	100.1	NA	1L	Glass	None	0 - 6°C	48	Hours
BOD/CBOD (Total & Soluble)	NPW	SM5210B	NA	1L	HDPE	None	0 - 6°C	48	Hours
Bromide	NPW	300.0, SM4110B	9056	125ml	HDPE	None	0 - 6°C	28	Days
Carbon Dioxide	NPW	SM4500CO2 D	NA	1L	HDPE	None	0 - 6°C	15	Min
Chemical Oxygen Demand (COD)	NPW	410.4, SM5220D	NA	250ml	HDPE	H_2SO_4	0 - 6°C	28	Days
Chemical Oxygen Demand (COD), Soluble	NPW	410.4, SM5220D	NA	250ml	HDPE	None	0 - 6°C	28	Days
Chloride	NPW	300.0, SM4110B	9056	125ml	HDPE	None	0 - 6°C	28	Days
Chlorine, residual	NPW	SM4500Cl-G	NA	250ml	HDPE	None	0 - 6°C	15	Min
Color	NPW	SM2120B	NA	250ml	HDPE	None	0 - 6°C	48	Hours
CTAS Surfactants	NPW	SM5540D	NA	1L	HDPE	None	0 - 6°C	48	Hours
Cyanide - Total	NPW	335.4, SM4500CNE	9012	250ml	Amber HDPE	NaOH	0 - 6°C	14	Days
Cyanide - Total	NPW	Kelada-01	NA	250ml	Amber HDPE	NaOH	0 - 6°C	14	Days
Cyanide, Amenable	NPW	SM4500CNG	9012	250ml	Amber HDPE	NaOH	0 - 6°C	14	Days
Cyanide, Free	NPW	SM4500CNE	NA	250ml	Amber HDPE	NaOH	0 - 6°C	14	Days
Cyanide, Weak Acid Dissoc.	NPW	SM4500CN-I	NA	250ml	Amber HDPE	NaOH	0 - 6°C	14	Days
Dissolved Organic Carbon (DOC)	NPW	SM5310B	9060	250ml	Amber Glass	None	0 - 6°C	28	Days

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
Ferrous Iron	NPW	SM3500FeB	NA	250ml	Amber Glass	HCl	0 - 6°C	15	Min
Fluoride	NPW	300.0, SM4110B	9056	125ml	HDPE	None	0 - 6°C	28	Days
Hardness	NPW	200.7, SM2340B	NA	250ml	HDPE	HNO_3	0 - 6°C	180	Days
Hardness	NPW	130.1	NA	500ml	HDPE	HNO_3	0 - 6°C	180	Days
Hardness	NPW	SM2340C	NA	500ml	HDPE	HNO_3	0 - 6°C	180	Days
Iodide	NPW	345.1	NA	250ml	HDPE	None	0 - 6°C	Immed	
Kjeldahl Nitrogen, TKN	NPW	351.2, SM4500Norg B/C	NA	250ml	HDPE	H_2SO_4	0 - 6°C	28	Days
Methylene Blue Active Subst. (MBAS)	NPW	SM5540C	NA	250ml	HDPE	None	0 - 6°C	48	Hours
Nitrate	NPW	300.0, SM4110B	9056	125ml	HDPE	None	0 - 6°C	48	Hours
Nitrate + Nitrite	NPW	353.2, SM4500NO_3 F	NA	250ml	HDPE	H_2SO_4	0 - 6°C	28	Days
Nitrite	NPW	300.0, SM4110B	9056	125ml	HDPE	None	0 - 6°C	48	Hours
Oil & Grease (Hexane Extr)	NPW	1664A, SM5520B	9070	1L	Glass	HCl	0 - 6°C	28	Days
Oil & Grease, Free	NPW	1664A	9070	1L	Amber Glass	None	0 - 6°C	28	Days
Organic Nitrogen	NPW	351.2 - 350.1	NA	500ml	HDPE	H_2SO_4	0 - 6°C	28	Days
Oxygen, dissolved (DO)	NPW	SM4500O C, SM4500O G	NA	125ml	HDPE	None	0 - 6°C	15	Min
pH	NPW	SM4500H B	9040	125ml	HDPE	None	0 - 6°C	15	Min
Phenols (Total) by 4AAP	NPW	420.1, 420.4	9066	250ml	Amber Glass	H_2SO_4	0 - 6°C	28	Days
Phosphate, Ortho	NPW	365.1, SM4500P-E	NA	250ml	HDPE	None	0 - 6°C	48	Hours
Phosphorus, Total	NPW	365.1, SM4500P-B.5	NA	250ml	HDPE	H_2SO_4	0 - 6°C	28	Days
Residue, Filterable (TDS)	NPW	SM2540C	NA	250ml	HDPE	None	0 - 6°C	7	days
Residue, non-Filterable (TSS)	NPW	SM2540D	NA	1L	HDPE	None	0 - 6°C	7	Days
Residue, Settleable (SS)	NPW	SM2540F	NA	1L	HDPE	None	0 - 6°C	48	Hours
Residue, Total (TS)	NPW	SM2540B	NA	250ml	HDPE	None	0 - 6°C	7	Days
Specific Conductance (Conductivity)	NPW	120.1, SM2510B	9050	250ml	HDPE	None	0 - 6°C	28	Days
Sulfate	NPW	300.0, SM4110B	9056	125ml	HDPE	None	0 - 6°C	28	Days
Sulfide	NPW	NA	9030, 9034	500ml	HDPE	NaOH+ZnAc	0 - 6°C	7	Days

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
Sulfide	NPW	SM4500S^{2}D	NA	500ml	HDPE	NaOH+ZnAc	0 - 6^{o}C	7	Days
Sulfide, Dissolved	NPW	SM4500S^{2}D	NA	125ml	Amber Glass	NaOH+ZnAc	0 - 6^{o}C	7	Days
Sulfite	NPW	SM4500SO$_3$ B	NA	250ml	HDPE	None	0 - 6^{o}C	15	Min
Tannins and Lignins	NPW	SM5550B	NA	250ml	HDPE	None	0 - 6^{o}C	NA	
Temperature	NPW	SM2550B	NA	onsite		None	0 - 6^{o}C	15	Min
Total Organic Carbon (TOC)	NPW	SM53010B	9060	250ml	Amber Glass	HCl	0 - 6^{o}C	28	Days
Total Organic Halides (TOX)	NPW	450.1, 9020	NA	1L	Amber Glass	H_2SO_4	0 - 6^{o}C	28	Days
Total Organic Halides (TOX)	NPW	SM5320B	NA	1L	Amber Glass	H_2SO_4	0 - 6^{o}C	14	Days
Turbidity	NPW	180.1, SM2130B	NA	250ml	HDPE	None	0 - 6^{o}C	48	Hours
Volatile Solids (VS)	NPW	160.4	NA	250ml	HDPE	None	0 - 6^{o}C	7	Days
Volatile Susp. Solids (VSS)	NPW	SM2540E	NA	500ml	HDPE	None	0 - 6^{o}C	7	Days
Alkalinity	PW	2320B	NA	500ml	HDPE	None	0 - 6^{o}C	14	Days
Ammonia Nitrogen	PW	350.1, SM4500NH$_3$ G	NA	250ml	HDPE	H_2SO_4	0 - 6^{o}C	28	Days
Ammonia, distilled/titration (4500)	PW	SM4500NH$_3$ C	NA	250ml	HDPE	H_2SO_4	0 - 6^{o}C	28	Days
Asbestos	PW	100.1	NA	1L	Glass	None	0 - 6^{o}C	48	Hours
Bromide	PW	300.0, SM4110B	NA	125ml	HDPE	None	0 - 6^{o}C	28	Days
Calcium-hardness	PW	SM3500-Ca B	NA	250ml	Amber Glass	HNO_3	0 - 6^{o}C	180	Days
Carbon Dioxide	PW	SM4500CO2 D	NA	1L	HDPE	None	0 - 6^{o}C	15	Min
Chloride	PW	300.0, SM4110B	NA	125ml	HDPE	None	0 - 6^{o}C	28	Days
Chlorine, residual	PW	SM4500Cl-G	NA	250ml	HDPE	None	0 - 6^{o}C	15	Min
Color	PW	SM2120B	NA	250ml	HDPE	None	0 - 6^{o}C	48	Hours
Corrosivity	PW	Calc	NA		Plastic	None	0 - 6^{o}C	NA	
Cyanide - Total	PW	335.4, SM4500CNE	NA	250ml	HDPE Amber	NaOH	0 - 6^{o}C	14	Days
Cyanide - Total	PW	Kelada-01	NA	250ml	HDPE Amber	NaOH	0 - 6^{o}C	14	Days
Cyanide, Amenable	PW	SM4500CNG	NA	250ml	HDPE Amber	NaOH	0 - 6^{o}C	14	Days
Cyanide, Free	PW	SM4500CNE	NA	250ml	HDPE Amber	NaOH	0 - 6^{o}C	14	Days
Dissolved Organic Carbon (DOC)	PW	SM5310C	NA	250ml	Amber Glass	None	0 - 6^{o}C	28	Days
Dissolved Solids (TDS)	PW	SM2540C	NA	250ml	HDPE	None	0 - 6^{o}C	7	Days

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
Fluoride	PW	300.0, SM4110B	NA	125ml	HDPE	None	0 - 6°C	28	Days
Hardness	PW	200.7, SM2340B	NA	250ml	HDPE	HNO_3	0 - 6°C	180	Days
Hardness	PW	130.1	NA	500ml	HDPE	HNO_3	0 - 6°C	180	Days
Hardness	PW	SM2340C	NA	500ml	HDPE	HNO_3	0 - 6°C	180	Days
Methylene Blue Active Subst. (MBAS)	PW	SM5540C	NA	1L	HDPE	None	0 - 6°C	48	Hours
Nitrate	PW	300.0, SM4110B	NA	125ml	HDPE	None	0 - 6°C	48	Hours
Nitrate + Nitrite	PW	353.2, SM4500NO_3 F	NA	250ml	HDPE	H_2SO_4	0 - 6°C	28	Days
Nitrite	PW	300.0, SM4110B	NA	125ml	HDPE	None	0 - 6°C	48	Hours
Odor	PW	SM2150B	NA	250ml	Amber Glass	None	0 - 6°C	24	Hours
Perchlorate	PW	314	NA	125ml	HDPE	None	0 - 6°C	28	Days
pH	PW	150.1, SM4500-H B	NA	125ml	HDPE	None	0 - 6°C	15	Min
Phosphate, Ortho	PW	SM4500P-E	NA	250ml	HDPE	None	0 - 6°C	48	Hours
Specific Conductance	PW	SM2510B	NA	250ml	HDPE	None	0 - 6°C	28	Days
Sulfate	PW	300.0, SM4110B	NA	125ml	HDPE	None	0 - 6°C	28	Days
Total Organic Carbon (TOC)	PW	SM5310C	NA	250ml	Amber Glass	H_2SO_4	0 - 6°C	28	Days
Total Organic Halides (TOX)	PW	SM5320B	NA	1L	Amber Glass	H_2SO_4	0 - 6°C	28	Days
Turbidity	PW	180.1, SM2130B	NA	250ml	HDPE	None	0 - 6°C	48	Hours
UV Absorbance at 254 nm	PW	SM5910B	NA	250ml	Amber Glass	None	0 - 6°C	48	Hours
Asbestos	SS	PLM	NA			None	0 - 6°C	NA	
Bromide	SS	NA	9056	4 oz.	Glass	None	0 - 6°C	28	Days
Chloride	SS	NA	9056	4 oz.	Glass	None	0 - 6°C	28	Days
Corrosivity	SS	NA	9045D	4 oz.	Glass	None	0 - 6°C	15	Min
Cyanide - Total	SS	NA	9010/9012	4 oz.	Glass	None	0 - 6°C	14	Days
Cyanide, Amenable	SS	NA	9010/9012	4 oz.	Glass	None	0 - 6°C	14	Days
Cyanide, Free	SS	NA	9010/9012	4 oz.	Glass	None	0 - 6°C	14	Days
Extractable Organic Halides (EOX)	SS	NA	9023	4 oz.	Glass	None	0 - 6°C	28	Days
Fluoride	SS	NA	9056	4 oz.	Glass	None	0 - 6°C	28	Days
Kjeldahl Nitrogen, TKN	SS	351.2	NA	2 oz.	Glass	None	0 - 6°C	28	Days
Nitrate	SS	NA	9056	4 oz.	Glass	None	0 - 6°C	28	Days
Nitrite	SS	NA	9056	4 oz.	Glass	None	0 - 6°C	28	Days
Oil & Grease	SS	NA	9071	4 oz.	Glass	None	0 - 6°C	28	Days

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
pH	SS	NA	9040, 9045	2 oz.	Glass	None	0 - 6°C	15	Min
Phenols by 4AAP	SS	NA	9066	4 oz.	Glass	None	0 - 6°C	28	Days
Phosphate, Ortho	SS	SM4500P-E	NA	4 oz.	Glass	None	0 - 6°C	48	Hours
Phosphorus, Total	SS	NA	9056	4 oz.	Glass	None	0 - 6°C	28	Days
Residue, Total	SS	SM2540G	NA	4 oz.	Glass	None	0 - 6°C	14	Days
Solids, Total	SS	SM2540B	NA	4 oz.	Glass	None	0 - 6°C	14	Days
Specific Conductance	SS	NA	9050	4 oz.	Glass	None	0 - 6°C	28	Days
Sulfate	SS	NA	9056	4 oz.	Glass	None	0 - 6°C	28	Days
Sulfide	SS	NA	9030, 9034	2 oz.	Glass	none	0 - 6°C	7	Days
Total Organic Carbon (TOC)	SS	NA	9060	2 oz.	Glass	None	0 - 6°C	28	Days
Total Organic Carbon (TOC)	SS	ASTM F1647-02A mod	NA	4 oz.	Glass	None	0 - 6°C	28	Days
Total Organic Carbon (TOC)	SS	USDA LOI	NA	4 oz.	Glass	None	0 - 6°C	28	Days
INORGANIC METALS									
Chromium, Hexavalent - Cr^{+6}	NPW	SM3500CrB	7196	250ml	HDPE	None	0 - 6°C	24	Hours
Chromium, Hexavalent - Cr^{+6}	NPW	SM3500CrC	7199	250ml	HDPE	None	0 - 6°C	24	Hours
Chromium, Hexavalent - Cr^{+6}	NPW	218.6, SM3500CrC	NA	125ml	HDPE	$(NH_4)_2SO_4$	0 - 6°C	28 [5]	Days
Mercury (Dissolved)	NPW	245.1	7470	500ml	HDPE	None	0 - 6°C	28	Days
Mercury (Total)	NPW	245.1	7470	500ml	HDPE	HNO_3	0 - 6°C	28	Days
Metals (Dissolved) ICP	NPW	200.7	6010	500ml	HDPE	None	NA	180	Days
Metals (Dissolved) ICPMS	NPW	200.8	6020	500nl	HDPE	None	NA	180	Days
Metals (Total) ICP	NPW	200.7	6010	500ml	HDPE	HNO_3	NA	180	Days
Metals (Total) ICPMS	NPW	200.8	6020	500ml	HDPE	HNO_3	NA	180	Days
Chromium, Hexavalent - Cr^{+6}	PW	218.7	NA	125ml	HDPE	$(NH_4)_2SO_4$/(NH4)OH	0 - 6°C	14	Days
Mercury (Dissolved)	PW	245.1	NA	500ml	HDPE	None	0 - 6°C	28	Days
Mercury (Total)	PW	245.1	NA	500ml	HDPE	HNO_3	0 - 6°C	28	Days
Metals (Dissolved) ICP	PW	200.7	NA	500ml	HDPE	None	NA	180	Days

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
Metals (Dissolved) ICPMS	PW	200.8	NA	500ml	HDPE	None	NA	180	Days
Metals (Total) ICP	PW	200.7	NA	500ml	HDPE	HNO_3	NA	180	Days
Metals (Total) ICPMS	PW	200.8	NA	500ml	HDPE	HNO_3	NA	180	Days
Chromium, Hexavalent - Cr^{+6}	SS	NA	3060/7196	4 oz.	Glass	None	0 - 6°C	30	Days
Chromium, Hexavalent - Cr^{+6}	SS	NA	3060/7199	4 oz.	Glass	None	0 - 6°C	30	Days
Mercury (Total)	SS	NA	7471	2 oz.	Glass	<6 C	0 - 6°C	28	Days
Metals (Total) ICP	SS	NA	6010	2 oz.	Glass	None	NA	180	Days
Metals (Total) ICPMS	SS	NA	6020	4 oz.	Glass	None	NA	180	Days
Sodium Adsorption Ratio (SAR)	SS	NA	6010	250mL	Glass	None	0 - 6°C	180	Days
Michigan Fine/Coarse Soil Sieve for Lead	SS	NA	NA	250mL	Glass	None	0 - 6°C	180	Days
PHYSICAL									
Flashpoint/ignitability (Closed Cup)	NPW	ASTM 93-07	1010	1L	Glass	None	0 - 6°C	14	Days
Flashpoint/ignitability (Open Cup)	NPW	ASTM 92-05A	NA	1L	Glass	None	0 - 6°C	14	Days
Flashpoint/ignitability (Closed Cup)	SS	ASTM 93-07	1010	4 oz.	Glass	None	0 - 6°C	14	Days
Flashpoint/ignitability (Open Cup)	SS	ASTM 92-05A	NA	4 oz.	Glass	None	0 - 6°C	NA	
Ash Content	SS	SM2540G, ASTM D2974	NA	4 oz.	Glass	None	0 - 6°C	14	Days
Cation Exchange Capacity	SS	NA	9081	4 oz.	Glass	None	0 - 6°C	180	Days
Paint Filter Test	SS	NA	9095	4 oz.	Glass	None	0 - 6°C	NA	
Permeability (Section 2.8)	SS	NA	9100	Various	Shelby Tube	None	0 - 6°C	28	Days
React. Sulf.(SW846 7.3.4.2)	SS	NA	Sec. 7.3	4 oz.	Glass	None	0 - 6°C	7	Days
Reactive CN (SW846 7.3.4.1)	SS	NA	Sec. 7.3	4 oz.	Glass	None	0 - 6°C	14	Days
Resistivity (ASTM)	SS	NA	NA	16 oz	Glass	None	0 - 6°C	28	Days
Specific Gravity	SS	NA	NA	Various	Plastic	None	0 - 6°C	14	Days

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
LEACHING METHODS									
Cal Wet (CACR Title22 Chap11 AppII)	SS	NA	NA	100g	Glass	None	0 - 6°C	14/28/180	Days
EP TOX	SS	NA	1310	100g	Glass	None	0 - 6°C	14/28/180	Days
MEP	SS	NA	1320	100g	Glass	None	0 - 6°C	14/28/180	Days
SPLP	SS	NA	1312	100g	Glass	None	0 - 6°C	14/28/180	Days
TCLP	SS	NA	1311	100g	Glass	None	0 - 6°C	14/28/180	Days
ORGANIC - SEMIVOLATILES									
Base/Neutral/Acid (BNA)	NPW	NA	8270	1L or 100mL	Amber Glass	None	0 - 6°C	7	Days
Base/Neutral/Acid (BNA)	NPW	625, SM6410B	NA	1L or 100mL	Amber Glass	$Na_2S_2O_3$	0 - 6°C	7	Days
Diesel Range Organics	NPW	NA	8015	1L, 100mL, or 40mL	Amber Glass	HCl	0 - 6°C	7	Days
Dioxin	NPW	1613	NA	1L	Amber Glass	$Na_2S_2O_3$	0 - 6°C	1	Year
EDB/DBCP	NPW	NA	8011	2 x 40 ml	Glass	$Na_2S_2O_3$	0 - 6°C	7	Days
Formaldehyde	NPW	NA	8315	1L	Amber Glass	None	0 - 6°C	3	Days
Herbicides	NPW	1658, SM6640B	8151	1L	Amber Glass	None	0 - 6°C	7	Days
Polynuclear Aromatic Hydrocarbons (PAH)	NPW	625, SM640B	8270	1L, 100mL, or 40mL	Amber Glass	None	0 - 6°C	7	Days
Polynuclear Aromatic Hydrocarbons (PAH-SIM)	NPW	NA	8270	1L, 100mL, or 40mL	Amber Glass	None	0 - 6°C	7	Days
Polynuclear Aromatic Hydrocarbons (PAH)	NPW	610, SM6440B	8310	1L	Amber Glass	None	0 - 6°C	7	Days
Pesticides - Organophos Comp	NPW	614, 622, 1657	8141	1L	Amber Glass	None	0 - 6°C	7	Days
Pesticides & PCB's	NPW	608, SM6630B, SM6630C	8081, 8082	1L or 100mL	Amber Glass	None	0 - 6°C	7	Days
Base/Neutral/Acid (BNA)	PW	525	NA	1L	Amber Glass	$HCl+Na_2S_2O_3$	0 - 6°C	7	Days
Carbamates	PW	531.1	NA	2 x 60ml	Amber Glass	$AcAcid+Na_2S_2O_3$	0 - 6°C	7	Days
Dioxin	PW	1613	NA	1L	Amber Glass	$Na_2S_2O_3$	0 - 6°C	7	Days
Diquat	PW	549	NA	1L	PVC Amber	$H_2SO_4 + Na_2S_2O_3$	0 - 6°C	7	Days
EDB/DBCP	PW	504.1	NA	2 x 40 ml	Glass	$Na_2S_2O_3$	0 - 6°C	28	Days
Endothall	PW	548	NA	250ml	Amber Glass	$Na_2S_2O_3$	0 - 6°C	7	Days

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
Glyphosate	PW	547	NA	2 x 60ml	Glass	$Na_2S_2O_3$	0 - 6°C	7	Days
Herbicides	PW	515.1, SM6640B	NA	1L	Amber Glass	$Na_2S_2O_3$	0 - 6°C	7	Days
Pesticides - Nitrogen/phosphorus Comp	PW	507	NA	1L	Amber Glass	$Na_2S_2O_3$	0 - 6°C	14	Days
Pesticides - Organochlorine	PW	508	NA	1L	Amber Glass	$Na_2S_2O_3$	0 - 6°C	7	Days
Haloacetic acids - HAA's	PW	552.2	NA	500ml	Amber Glass	NH_4Cl	0 - 6°C	28	Days
Base/Neutral/Acid (BNA)	SS	NA	8270	4 oz.	Glass	None	0 - 6°C	14	Days
Dioxin	SS	NA	8290	5 oz.	Glass	None	0 - 6°C	30	Days
Formaldehyde	SS	NA	8315	4 oz.	Glass	None	0 - 6°C	3	Days
Herbicides	SS	NA	8151	4 oz.	Glass	None	0 - 6°C	14	Days
Polynuclear Aromatic Hydrocarbons (PAH)	SS	NA	8270	4 oz.	Glass	None	0 - 6°C	14	Days
Polynuclear Aromatic Hydrocarbons (PAH-SIM)	SS	NA	8270	4 oz.	Glass	None	0 - 6°C	14	Days
Polynuclear Aromatic Hydrocarbons (PAH)	SS	NA	8310	4 oz.	Glass	None	0 - 6°C	14	Days
Pesticides - Organophos Comp	SS	NA	8141	4 oz.	Glass	None	0 - 6°C	14	Days
Pesticides & PCB's	SS	NA	8081, 8082	4 oz.	Glass	None	0 - 6°C	14	Days
Total Chlorine in Oil	SS	ASTM D808-00	NA	125ml	HDPE	None	0 - 6°C	24	Hours
ORGANIC - VOLATILES									
Meetac - Methanol and Ethanol	NPW	NA	EPA 8015 Mod	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Methane, Ethane, Ethene, Propane	NPW	RSK-175	NA	40ml	Amber Glass	HCl	0 - 6°C	14	Days
BTEX (water)	NPW	602, SM6200C	8021	2 x 40 ml	Amber Glass	HCl	0 - 6°C	14	Days
BTEX (water)	NPW	602, SM6200C	8021	2 x 40 ml	Amber Glass	None	0 - 6°C	7	Days
Gasoline Range Organics (GRO)	NPW	NA	8015	2 x 40 ml	Amber Glass	HCl	0 - 6°C	14	Days
VOC's	NPW	624, SM6200B	8260	2 x 40 ml	Amber Glass	HCl	0 - 6°C	14	Days
VOC's	NPW	624, SM6200B	8260	2 x 40 ml	Amber Glass	none	0 - 6°C	7	Days
VOC's	PW	524.2	NA	2 x 40 ml	Amber Glass	Ascorbic Acid+HCl	0 - 6°C	14	Days

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
Meetac - Methanol and Ethanol	SS	NA	EPA 8015 Mod	2 oz.	Glass	None	0 - 6°C	14	Days
BTEX (soil)	SS	NA	8021	4 oz.	Glass	None	0 - 6°C	14	Days
VOC's	SS	NA	8260	2 oz.	Glass	none	0 - 6°C	14	Days
VOC's	SS	NA	8260	40ml	Amber Glass	MeOH	0 - 6°C	14	Days
VOC's	SS	NA	8260	40ml	Amber Glass	$NaHSO_4$ or TSP(MO) or DI Water(FL)	0 - 6°C	14	Days
VOC's	SS	NA	8260	NA	Encore	none	0 - 6°C	48	Hours
RADIOCHEMISTRY									
Rad - Gross alpha	NPW	900	na	1L	Plastic	HNO_3	0 - 6°C	180	Days
Rad - Gross beta	NPW	900	na	1L	Plastic	HNO_3	0 - 6°C	180	Days
Rad - Radium 226	NPW	903.1	na	1L	Plastic	HNO_3	0 - 6°C	180	Days
Rad - Radium 228	NPW	904	na	1L	Plastic	HNO_3	0 - 6°C	180	Days
Rad - Gross alpha	PW	900	na	1L	HDPE	HNO_3	0 - 6°C	180	Days
Rad - Gross beta	PW	900	na	1L	HDPE	HNO_3	0 - 6°C	180	Days
Rad - Radium 226	PW	903.1	na	1L	HDPE	HNO_3	0 - 6°C	180	Days
Rad - Radium 228	PW	904	na	1L	HDPE	HNO_3	0 - 6°C	180	Days
Rad - Tritium	PW	906	na	1L	HDPE	None	0 - 6°C	180	Days
Strontium-90	PW	905	na	1L	HDPE	HNO_3	0 - 6°C	180	Days
STATE SPECIFIC PETROLEUM METHODS									
Alaska DRO	NPW	NA	AK102	100ml	Amber Glass	HCl	0 - 6°C	14	Days
Alaska DRO	SS	NA	AK102	4 oz.	Glass	None	0 - 6°C	14	Days
Alaska GRO	NPW	NA	AK101	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Alaska GRO	SS	NA	AK101	60ml	Amber Glass	MeOH	0 - 6°C	28	Days
Alaska Motor Oil	NPW	NA	AK103	100ml	Glass	HCl	0 - 6°C	14	Days
Alaska Motor Oil	SS	NA	AK103	4 oz.	Glass	None	0 - 6°C	14	Days
Arizona GRO	SS	NA	AZ 8015	2 oz.	Glass	None	0 - 6°C	14 [9]	Days
Arizona TPH	SS	NA	AZ 8015	4 oz.	Glass	None	0 - 6°C	14	Days
California DRO	NPW	NA	8015	1L	Amber Glass	HCl	0 - 6°C	7	Days
California DRO	NPW	NA	8015	40ml	Amber Glass	HCl	0 - 6°C	7	Days
California DRO	SS	NA	8015	4 oz.	Glass	None	0 - 6°C	7	Days
Connecticut EPH	NPW	NA	8015	1L	Amber Glass	HCl	0 - 6°C	14	Days
Connecticut EPH	SS	NA	8015	4 oz.	Glass	None	0 - 6°C	14	Days

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
Florida TPH	NPW	NA	FL-Pro	1L	Amber Glass	HCl	0 - 6°C	7	Days
Florida TPH	SS	NA	FL-Pro	4 oz.	Glass	None	0 - 6°C	14	Days
Indiana DRO	NPW	NA	8015	1L	Amber Glass	HCl	0 - 6°C	7	Days
Indiana DRO	SS	NA	8015	4 oz.	Glass	None	0 - 6°C	14	Days
Indiana ERO	NPW	NA	8015	1L	Amber Glass	HCl	0 - 6°C	7	Days
Indiana ERO	SS	NA	8015	4 oz.	Glass	None	0 - 6°C	7	Days
Indiana GRO	NPW	NA	8015	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Indiana GRO	SS	NA	8015	40ml	Amber Glass	MeOH	0 - 6°C	14	Days
Indiana GRO	SS	NA	8015	40ml	Amber Glass	$NaHSO_4$	0 - 6°C	14	Days
Iowa GRO	NPW	NA	OA-1	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Iowa GRO	SS	NA	OA-1	4 oz.	Glass	None	0 - 6°C	14	Days
Iowa DRO	NPW	NA	OA-2	1L	Amber Glass	None	0 - 6°C	7	Days
Iowa DRO	SS	NA	OA-2	4 oz.	Glass	None	0 - 6°C	14	Days
Louisiana EPH	NPW	NA	MADEP EPH	1L	Amber Glass	HCl	0 - 6°C	14	Days
Louisiana EPH	SS	NA	MADEP EPH	4 oz.	Amber Glass	None	0 - 6°C	14	Days
Louisiana VPH	NPW	NA	MADEP VPH	1L	Amber Glass	HCl	0 - 6°C	14	Days
Louisiana VPH	SS	NA	MADEP VPH	40ml	Amber Glass	MeOH	0 - 6°C	28	Days
Massachusetts EPH	NPW	NA	MADEP EPH	1L	Amber Glass	HCl	0 - 6°C	14	Days
Massachusetts EPH	SS	NA	MADEP EPH	4 oz.	Amber Glass	None	0 - 6°C	14	Days
Massachusetts VPH	NPW	NA	MADEP VPH	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Massachusetts VPH	SS	NA	MADEP VPH	40ml	Amber Glass	MeOH	0 - 6°C	28	Days
Minnesota DRO	NPW	NA	WI DRO	1L	Amber Glass	HCl	0 - 6°C	7	Days
Minnesota DRO	SS	NA	WI DRO	60ml	Amber Glass	CH_3Cl	0 - 6°C	47 [9]	Days
Minnesota GRO	NPW	NA	WI GRO	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Minnesota GRO	SS	NA	WI GRO	60ml	Amber Glass	MeOH	0 - 6°C	21 [7]	Days
Missouri DRO	NPW	NA	8270	1L	Amber Glass	None	0 - 6°C	7	Days
Missouri DRO	SS	NA	8270	4 oz.	Glass	None	0 - 6°C	14	Days
Missouri GRO	NPW	NA	8260	40ml	Amber Glass	TSP	0 - 6°C	14	Days
Missouri GRO	SS	NA	8260	40ml	Amber Glass	TSP	0 - 6°C	14	Days
Missouri GRO	SS	NA	8260	40ml	Amber Glass	MeOH	0 - 6°C	14	Days

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
Montana EPH	NPW	NA	MT EPH	1L	Amber Glass	HCl	0 - 6°C	14	Days
Montana EPH	SS	NA	MT EPH	4 oz.	Amber Glass	None	0 - 6°C	14	Days
Montana VPH	NPW	NA	MT VPH	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Montana VPH	SS	NA	MT VPH	Encore	Amber Glass	None	0 - 6°C	7	Days
Montana VPH	SS	NA	MT VPH	40ml	Amber Glass	MeOH	0 - 6°C	28	Days
New Jersey EPH	NPW	NA	NJ EPH	1L	Amber Glass	HCl	0 - 6°C	14	Days
New Jersey EPH	SS	NA	NJ EPH	4 oz.	Amber Glass	None	0 - 6°C	14	Days
North Carolina EPH	NPW	NA	MADEP EPH	1L	Amber Glass	HCl	0 - 6°C	14	Days
North Carolina EPH	SS	NA	MADEP EPH	4 oz.	Amber Glass	None	0 - 6°C	14	Days
North Carolina VPH	NPW	NA	MADEP VPH	1L	Amber Glass	HCl	0 - 6°C	14	Days
North Carolina VPH	SS	NA	MADEP VPH	40ml	Amber Glass	MeOH	0 - 6°C	28	Days
Ohio DRO	NPW	NA	8015	1L	Amber Glass	None	0 - 6°C	7	Days
Ohio DRO	NPW	NA	8015	100ml	Amber Glass	None	0 - 6°C	7	Days
Ohio DRO	NPW	NA	8015	40ml	Amber Glass	None	0 - 6°C	7	Days
Ohio DRO	SS	NA	8015	4 oz.	Glass	None	0 - 6°C	14	Days
Ohio GRO	NPW	NA	8015	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Ohio GRO	SS	NA	8015	2 oz.	Glass	None	0 - 6°C	14	Days
Ohio GRO (VAP)	SS	NA	8015	Encore - Low Level	None	None	0 - 6°C	14 [8]	Days
Ohio GRO (VAP)	SS	NA	8015	Encore - High Level	None	MeOH	0 - 6°C	14	Days
Oklahoma DEQ GRO	NPW	NA	OK DEQ GRO	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Oklahoma DEQ GRO	SS	NA	OK DEQ GRO	4 oz.	Glass	None	0 - 6°C	14	Days
Oklahoma DEQ DRO	NPW	NA	OK DEQ DRO	1L	Amber Glass	HCl	0 - 6°C	7	Days
Oklahoma DEQ DRO	SS	NA	OK DEQ DRO	60ml	Amber Glass	CH_3Cl	0 - 6°C	7 [6]	Days
Oregon TPH-Gx	NPW	NA	NWTPH-Gx	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Oregon TPH-Gx	SS	NA	NWTPH-Gx	4 oz.	Glass	None	0 - 6°C	14	Days
Oregon TPH-Dx	NPW	NA	NWTPH-Dx	1L	Amber Glass	HCl	0 - 6°C	14	Days
Oregon TPH-Dx	SS	NA	NWTPH-Dx	4 oz.	Glass	None	0 - 6°C	14	Days

Parameter	Matrix [1]	EPA Approved Method[2]	SW846 [3]	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
Tennessee DRO	NPW	NA	TN EPH	1L	Amber Glass	HCl	0 - 6°C	7	Days
Tennessee DRO	NPW	NA	TN EPH	100 ml	Amber Glass	HCl	0 - 6°C	7	Days
Tennessee DRO	SS	NA	TN EPH	4 oz.	Glass	None	0 - 6°C	14	Days
Tennessee GRO	NPW	NA	TN GRO	40ml	Amber Glass	HCl	0 - 6°C	7	Days
Tennessee GRO	SS	NA	TN GRO	2 oz.	Glass	None	0 - 6°C	14	Days
Texas TPH	NPW	NA	TX1005/ TX1006	60ml	Amber Glass	HCl	0 - 6°C	14	Days
Texas TPH	SS	NA	TX1005/ TX1006	4 oz.	Glass	None	0 - 6°C	14	Days
Washington TPH-Gx	NPW	NA	NWTPH-Gx	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Washington TPH-Gx	SS	NA	NWTPH-Gx	4 oz.	Glass	None	0 - 6°C	14	Days
Washington TPH-Dx	NPW	NA	NWTPH-Dx	1L	Amber Glass	HCl	0 - 6°C	14	Days
Washington TPH-Dx	SS	NA	NWTPH-Dx	4 oz.	Glass	None	0 - 6°C	14	Days
Wisconsin DRO	NPW	NA	WI DRO	1L	Amber Glass	HCl	0 - 6°C	7	Days
Wisconsin DRO	NPW	NA	WI DRO	100 ml	Amber Glass	HCl	0 - 6°C	7	Days
Wisconsin DRO	SS	NA	WI DRO	60ml	Amber Glass	CH_3Cl	0 - 6°C	47 [9]	Days
Wisconsin GRO	NPW	NA	WI GRO	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Wisconsin GRO	SS	NA	WI GRO	60ml	Amber Glass	MeOH	0 - 6°C	21 [7]	Days
Wyoming DRO	NPW	NA	8015	40ml	Amber Glass	HCl	0 - 6°C	7	Days
Wyoming DRO	NPW	NA	8015	1L	Amber Glass	HCl	0 - 6°C	7	Days
Wyoming DRO	SS	NA	8015	4 oz.	Glass	None	0 - 6°C	14	Days
Wyoming GRO	NPW	NA	8015	40ml	Amber Glass	HCl	0 - 6°C	14	Days
Wyoming GRO	SS	NA	8015	2 oz.	Glass	None	0 - 6°C	14	Days
INDUSTRIAL HYGIENE (IH) METHODS									
Particulates not otherwise regulated	Air	NIOSH 0500	NA	NA	2 piece 37mm PVC Pre-weighed filter	None	NA	NA	NA
Respirable Dust	Air	NIOSH 0600	NA	NA	3 piece 37mm PVC Pre-weighed filter	None	NA	NA	NA
Metals	Air	NA	EPA 6010B	NA	0.8-µm MCE or 5.0-µm PVC cassette	None	NA	NA	NA

Parameter	Matrix 1	EPA Approved Method2	SW846 3	Rec. Volume	Bottle Type	Pres.	Temp	Holding Time	Holding Time Units
Metals	Air	NIOSH 7300	NA	NA	0.8-µm MCE or 5.0-µm PVC cassette	None	NA	NA	NA
Metals	Air	OSHA ID-125G	NA	NA	0.8-µm MCE or 5.0-µm PVC cassette	None	NA	NA	NA

Footnotes:

1) Matrix - NPW=Nonpotable Water, PW= Potable Water, SS=Solids

2) EPA Approved Method - Where applicable EPA methods are listed. Compounds/programs not regulated by EPA will have methods appropriate to their regulatory oversight.

3) SW846 Method - Where one exists, the appropriate Solid Waste method will be listed

4) Preservative Key

$(NH_4)_2SO4$ = Ammonium Sulfate

AcAcid = Acetic Acid

CH_3Cl = Methylene Chloride

H_2SO_4 = Sulfuric Acid

HCl= Hydrochloric Acid

HNO_3 = Nitric Acid

MeOH = Methanol

$Na_2S_2O_3$ = Sodium Thiosulfate

$NaHSO_4$ = Sodium Bisulfate

NH_4Cl = Ammonium Chloride

TSP = Trisodium Phosphate

ZnAc = Zinc Acetate

5) Must be field filtered to achieve the extended holding time.

6) Must be received by lab within 7 days of sampling for solvent addition.

7) Must be received by lab within 4 days of sampling for solvent addition.

8) Must be received by lab within 48 hours of sampling for freezing.

9) Must be received by lab within 72 hours of sampling for solvent addition.

14.7 SAMPLE CONTAINER PACKING PROCEDURES

ESC routinely sends sample containers to customers. Standard operating procedure determines the containers needed for the requested analyses. A sample request form is completed to document what is needed, the destination, the date prepared and the initials of the preparer. Containers are prepared, with appropriate preservatives, labels, and custody seals, and organized for the customer's convenience in a cooler. The cooler also contains a temperature blank, chain of custody, a return address label, and applicable instructions. The cooler is bound with packaging tape (and a custody seal if requested) and shipped UPS.

15.0 SAMPLE DISPATCH

Samples collected during field investigations or in response to a hazardous materials incident are classified by the project manager, prior to shipping, as either environmental or hazardous material samples. The shipment of samples, designated as environmental samples, is not regulated by the U.S. Department of Transportation.

Samples collected from certain process streams, drums, bulk storage tanks, soil, sediment, or water samples from suspected areas of high contamination may need to be shipped as hazardous. These regulations are promulgated by the US-DOT and described in the Code of Federal Regulations (49 CFR 171 through 177). The guidance for complying with US-DOT regulations in shipping environmental laboratory samples is given in the "National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Environmental Laboratory Samples."

15.1 SHIPMENT OF ENVIRONMENTAL SAMPLES

Shipping receipts are maintained at the ESC laboratory. The shipment of preserved sample containers or bottles of preservatives (i.e., NaOH pellets, HCl, etc.) which are designated as hazardous under the US-DOT, Hazardous Materials Table, 49 CFR 171.101, must be transported pursuant to the appropriate US-DOT regulations. Samples packaged for shipment by ESC shall be segregated by sample type, preservation requirements, and potential contaminant level. During events in which large numbers of samples are collected, samples are segregated by analyses required. If multiple sites are sampled, or if specific and separate areas of interest are identified, samples are further segregated for packaging prior to shipment.

Environmental samples are packed prior to shipment using the following procedures:

1. Select a cooler (clean and strong). Line the cooler with a large heavy-duty plastic bag.
2 Allow sufficient headspace (except VOC's or others with zero headspace requirements) to compensate for any pressure and temperature changes.
3. Be sure the lids on all bottles are tight.
4. Place all bottles in appropriately sized polyethylene bags.
5. Place VOC vials in foam material transport sleeves.
6. Place foam padding in the bottom of the cooler and then place the bottles in the cooler with sufficient space to allow for the addition of more foam between the bottles.
7. Put ice on top of and/or between the samples.
8. Place chain of custody in a clean dry bag and into the cooler. Close the cooler and securely tape the cooler shut. The chain of custody seals should be affixed to the top and sides of the cooler so that the cooler cannot be opened without breaking the seal.

9. The shipping containers must be marked "THIS END UP". The name and address of the shipper shall be placed on the outside of the container. Labels used in the shipment of hazardous materials are not permitted to be on the outside of the container used to transport environmental samples and shall not be used.

16.0 INVESTIGATION WASTE

16.1 GENERAL

Field surveys conducted by ESC may generate waste materials. Some of these waste materials may be hazardous requiring proper disposal in accordance with EPA regulations.

16.1.1 Types of Investigation Derived Wastes (IDW)

Materials which may be included in the IDW category are:

- Personnel protective equipment (PPE)
- Disposable sampling equipment (DE)
- Soil cuttings
- Groundwater obtained through well purging
- Spent cleaning and decontamination fluids
- Spent calibration standards

16.1.2 Managing Non-hazardous IDW

Disposal of non-hazardous IDW should be addressed prior to initiating work at a site. Facility personnel should be consulted and wastes handled in an appropriate manner as directed by the customer.

For development and purge water generated in the State of Florida, specific disposal requirements apply. The water is contained on-site in temporary storage until it is characterized. Appropriate disposal and/or treatment methods are then determined. Possible disposal options are:

- Direct discharge on-site to infiltrate the same or a more contaminated source
- Transportation to an off-site facility

In no case shall the water be discharged into any surface water unless permitted.

16.1.3 Management of Hazardous IDW

Disposal of hazardous or suspected hazardous IDW (as defined in 40 CFR 261.30-261.33 or displaying the characteristics of ignitability, corrosivity, reactivity, or TC toxicity) must be specified in the sampling plan. Hazardous IDW must be disposed in compliance with USEPA regulations. If appropriate, these wastes may be taken to a facility waste treatment system. These wastes may also be disposed of in the source area from which they originated if state regulations permit.

If on-site disposal is not feasible, appropriate analyses must be conducted to determine if the waste is hazardous. If so, they must be properly contained and labeled. They may be stored on the site for a maximum of 90 days before they must be manifested and shipped to a permitted treatment or disposal facility. Weak acids and bases may be neutralized in lieu of disposal as hazardous wastes. Neutralized wastewaters may be flushed into a sanitary sewer.

If possible, arrangements for proper containment, labeling, transportation, and disposal/treatment of IDW should be anticipated beforehand.

Investigation derived wastes should be kept to a minimum. Most of the routine studies conducted by ESC should not produce any IDW that are hazardous. Many of the above PPE and DE wastes can be deposited in municipal dumpsters if care is taken to keep them segregated from hazardous waste contaminated materials. Disposable equipment can often be cleaned to render it nonhazardous, as can some PPE, such as splash suits. The volume of spent solvent waste produced during equipment decontamination can be reduced or eliminated by applying only the minimum amount of solvent necessary.

17.0 SAMPLING BIBLIOGRAPHY

17.1 *Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual,* February 1, 1991, US EPA Region IV, Environmental Services Division.

17.2 *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document* (GPO #5500000260-6), US EPA, September 1986.

17.3 *Test Methods for Evaluating Solid Waste*, SW-846, Third Edition, Office of Solid and Emergency Response, US EPA, November 1986.

17.4 *Methods for the Determination of Organic Compounds in Drinking Water*, EPA/600/4-88/039, December 1988.

17.5 Florida Department of Environmental Regulation (DER) Quality Assurance Section (QAS) Guidance Documents:
#89-01 - Equipment Material Construction, revised April 7, 1989
#89-02 - Field QC Blanks, revised April 28, 1989
#89-03 - Teflon® /Stainless Steel Bladder Pumps, revised May 10, 1988
#89-04 - Field Cleaning Procedures, revised August 10, 1989

17.6 *DER Manual for Preparing Quality Assurance Plans*, DER-QA-001/90, revised September 30, 1992.

17.7 *NPDES Compliance Inspection Manual*, United States Environmental Protection Agency, Enforcement Division, Office of Water Enforcement and Permits, EN-338, 1988.

17.8 *Handbook for Monitoring Industrial Wastewater*, United States Environmental Protection Agency, Technology Transfer, 1973.

17.9 *EPA Primary Drinking Water Regulations*, 40 CFR 141.

17.10 *Rapid Bioassessment Protocols For Use in Streams and Rivers*, United States Environmental Protection Agency, Office of Water, EPA/841/B-99-002.

17.11 *Environmental Sampling and Analysis: A Practical Guide*. Lawrence H. Keith, Ph.D., 1991. Lewis Publishers.

17.12 *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*. Fifth Edition. U.S. Environmental Protection Agency, Office of Water, Washington DC. EPA/821/R-02/012

17.13 *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*. Fourth Edition. U.S. Environmental Protection Agency, Office of Water, Washington DC. EPA/821/R-02/013.

18.0 REVISIONS

The Regulatory Affairs Department has an electronic version of this Quality Assurance Manual with tracked changes detailing all revisions made to the previous version. This version is available upon request. Revisions to the previous version of this appendix are summarized in the table below.

Document	Revision
Quality Assurance Manual Version 15.0 (Appendix III)	General - Replaced the term “client” with the term “customer”

1.0 SIGNATORY APPROVALS

WET LAB QUALITY ASSURANCE MANUAL

APPENDIX IV TO THE ESC QUALITY ASSURANCE MANUAL

for

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NOTE: The QAM has been approved by the following people.

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2.0 *APPENDIX TABLE OF CONTENTS*

3.0 SCOPE AND APPLICATION

This manual discusses specific QA requirements for general analytical protocols to ensure analytical data generated from the Wet Chemistry Laboratory, or Wet Lab, are scientifically valid and are of acceptable quality. Any deviations from these requirements and any deviations that result in nonconforming work must be immediately evaluated and their corrective actions documented.

4.0 LABORATORY ORGANIZATION AND RESPONSIBILITIES

ESC Lab Sciences offers diverse environmental capabilities that enable the laboratory to provide the customer with both routine and specialized services, field sampling guidance and materials, and broad laboratory expertise. A brief outline of the organization and responsibilities as they apply to the ESC Quality Assurance Program is presented in *Section 4.0 in the ESC Quality Assurance Manual.*

5.0 PERSONNEL AND TRAINING

5.1 PERSONNEL

Chris Unterstein, with a B.S. degree in Chemistry, is the Wet Chemistry Supervisor and is responsible for the overall production of this laboratory; including the management of the staff and scheduling. Mr. Unterstein has over 8 years of environmental laboratory experience. In his absence, Andrew Holt assumes responsibility for departmental decisions in Wet Chemistry laboratory.

Mr. Holt, with a B.S. in Plant and Soil Science, is proficient in wet chemistry analytical methods. Mr. Holt has 9 years of environmental laboratory experience.

5.2 TRAINING

5.2.1 All new analysts to the laboratory are trained by a Chemist or the Supervisor according to ESC protocol. ESC's training program is outlined in *SOP 030205 Technical Training and Personnel Qualifications.* Performance is documented using an initial demonstration of capability (IDOCs) and continuing demonstration of capability (CDOC). On-going acceptable capability in Wet Lab analyses is demonstrated by acceptable participation in multiple proficiency testing programs (PTs) and daily Quality Control sample analyses. Documentation of analyst training is maintained on file within the department.

6.0 FACILITIES AND LABORATORY SAFETY

6.1 FACILITIES

The main area of the Wet Chemistry laboratory has approximately 7,500 square feet of area, and contains LED lighting. The HVAC system is provided by a 15-ton Trane unit. The laboratory reagent water is generated through an Evoqua system. Waste disposal containers are located in the laboratory and Clean Harbors serves as ESC's waste disposal contractor. Waste handling is discussed in detail in Section 6.0 of the ESC Quality Assurance Manual. ESC's building information guides and site plan are shown in Appendix I.

6.2 LABORATORY SAFETY

- Laboratory access is limited when work is being performed.
- All procedures where chemicals are prepared or splashes may occur are conducted in laboratory exhaust hoods.
- ESC's laboratory safety guidelines are detailed in the *ESC Chemical Hygiene Plan.*

7.0 SAMPLING PROCEDURES

7.1 FIELD SAMPLING PROCEDURES, SAMPLE STORAGE, AND HANDLING

- Field Sampling procedure are described in Appendix III of this ESC Quality Assurance Manual. Sample information is recorded and kept on the ESC chain of custody and field logbooks.
- Matrices for Wet Lab environmental analyses include groundwater, wastewater, drinking water, soil, and sludge.
- Sample containers, preservation methods and holding times vary depending on analyses requested. Please see the determinative procedures for specific directions.

8.0 EQUIPMENT

8.1 EQUIPMENT LIST

LABORATORY EQUIPMENT LIST: MAJOR ITEMS – Wet Lab

This table is subject to revision without notice

Item	*Manufacturer*	*Model*	*Instrument Name*	*Serial #*	*Location*
Analytical Balance	Mettler	AT200	Balance 1	m26291	Wet Lab
Analytical Balance	Mettler	AG204 Delta Range	Balance 2	118420883	Wet Lab
Analytical Balance	Mettler	XP205	Balance 3	1129420141	Wet Lab
Autoanalyzer	Lachat	Quikchem 8000	Lachat 2	A83000-1027	Wet Lab
Autoanalyzer	Lachat	Quikchem 8000	Lachat 3	A83000-1638	Wet Lab
Autoanalyzer	Lachat	Quikchem 8500	Lachat 4	60900000341	Wet Lab
Autoanalyzer	Lachat	Quikchem 8500	Lachat 5	60900000342	Wet Lab
Autoanalyzer	Lachat	Quikchem 8500	Lachat 6	70500000452	Wet Lab
Autoanalyzer - digestor	Lachat	BD-46	DIG1	100700000-982	Wet Lab
Autoanalyzer - digestor	Lachat	BD-46	DIG2	1000700000-982	Wet Lab
Autoanalyzer - digestor	Lachat	BD-46	DIG1	1800-871	Wet Lab
Autoanalyzer - digestor	Lachat	BD-46	DIG2	1800-872	Wet Lab
Automated titrator	Metrohm	855 titrosampler	Titrando	3256	Wet Lab
Centrifuge	Thermo	Megafuge 40	Centrifuge	41123868	Wet Lab
Class "I" weights	Troemner	Serial #7944		7944	Wet Lab
COD Reactor	HACH	45600	COD1	10800	Wet Lab
COD Reactor	HACH	45600	COD2	10090C0036	Wet Lab
Conductivity Meter	ORION	MODEL 170	ATI Orion	32470007	Wet Lab
Distillation Unit - Cyanide	Environmental Express	Distillation 1	LMD1920-106	2270	Wet Lab
Distillation Unit - Cyanide	Environmental Express	Distillation 2	LMD1920-106	2271	Wet Lab
Distillation Unit - Cyanide	Environmental Express	Distillation 3	LMD1920-106	2272	Wet Lab
Distillation Unit - Phenol	Westco Scientific	Model EASY-DIST	Dist 1	1062	Wet Lab
Distillation Unit - Phenol	Westco Scientific	Model EASY-DIST	Dist 2	1198	Wet Lab
SimpleDist	Env. Express	SC154	SimpDist1	8940CECW3871	Wet Lab
SimpleDist	Env. Express	SC155	SimpDist2	9062CECW3952	Wet Lab
SimpleDist	Env. Express	SC156	SimpDist3	9062CECW3955	Wet Lab
Flash Point Tester	Koehler	Pensky-Martens	Manual	R07002693B	Wet Lab

LABORATORY EQUIPMENT LIST: MAJOR ITEMS – Wet Lab

This table is subject to revision without notice

Item	***Manufacturer***	***Model***	***Instrument Name***	***Serial #***	***Location***
		K16200			
Flash Point Tester	Koehler	Pensky-Martens K16201	Manual	R07002510B	Wet Lab
Flash Point Tester	LAZAR Scientific	SETA-93	Automated	1038328	Wet Lab
Hot Plate	Thermolyne Fisher	Type 2200	Hot	16237	Wet Lab
Hot Plate	Thermolyne Fisher	Type 2200	Hot	16240	Wet Lab
Hot Plate	Cole Parmer	HS19 C-P	Hot Plate	50000073	Wet Lab
Ion Chromatograph	Dionex	ICS-2000	IC5	6050731	Wet Lab
Ion Chromatograph	Dionex	ICS 1500	IC6	8100010	Wet Lab
Ion Chromatograph	Dionex	ICS 1500	IC7	8100267	Wet Lab
Ion Chromatograph	Dionex	ICS 2000	IC8	8090820	Wet Lab
Ion Chromatograph	Dionex	ICS 2100	IC9	10060822	Wet Lab
Ion Chromatograph	Dionex	ICS 2100	IC10	10091285	Wet Lab
Ion Chromatograph	Dionex	ICS 2100	IC11	11012204	Wet Lab
Ion Chromatograph	Dionex	ICS 2100	IC12	12020460	Wet Lab
Ion Chromatograph	Thermo Fisher	ICS 1600	IC13	13031204	Wet Lab
Ion Chromatograph	Thermo Fisher	ICS-2100	IC14	15030082	Wet Lab
Ion Chromatograph	Thermo Fisher	ICS-2100	IC15	15071973	Wet Lab
Ion Chromatograph	Thermo Fisher	ICS-2100	IC16	15071973	Wet Lab
Ion Chromatograph	Thermo Fisher	ICS-1600	IC17	15110462	Wet Lab
Ion Chromatograph	Thermo Fisher	ICS-2100	IC18	15120139	Wet Lab
Muffle Furnace	Thermolyne	(1) 30400	FURNACE	23231	Wet Lab
Autoanalyzer	OI Analytical	FS 3100	FS 3100-1	301831056 (NH3) 251833391 (CN)	Wet Lab
Autoanalyzer	OI Analytical	FS 3100	FS 3100-2	3168140781(NH3) 325833494 (CN)	Wet Lab
Autoanalyzer	OI Analytical	FS 3100	FS 3100-3	407831164 (NO2NO3) 403833925 (PHT)	Wet Lab
ORP Meter	YSI	ORP15	ORP	JC000114	Wet Lab
Oven - Drying	Blue M	Stabil-Therm	#1	NA	Wet Lab
Oven - Drying	Equatherm	D1576	#2	NA	Wet Lab
Oven - Drying	VWR	1305U	#3	4082804	Wet Lab
Oven - Drying	Equatherm	D1576	#4	10AW-3	Wet Lab
Oven - Drying	VWR	1305U	#5	4082104	Wet Lab
pH Meter	Fisher	AB15	AB15+	AB92329028	Wet Lab
pH Meter	Orion	410A	Orion	58074	Wet Lab

LABORATORY EQUIPMENT LIST: MAJOR ITEMS – Wet Lab

This table is subject to revision without notice

Item	***Manufacturer***	***Model***	***Instrument Name***	***Serial #***	***Location***
pH Meter	Fisher	AB15	AB15+	AB92325899	Wet Lab
pH Meter	Thermo Fisher	Orion Versa Star	Orion VS-1	V00659	Wet Lab
Refrigerated Recirculator	Polyscience	Recirculator	Recirculator1	1282	Wet Lab
Refrigerated Recirculator	Polyscience	Recirculator	Recirculator2	1608	Wet Lab
Spectrophotometer (UV/Vis)	Hach	DR 5000	DR5000-1	1381711	Wet Lab
Spectrophotometer (UV/Vis)	Hach	DR 5000	DR5000-2	1326829	Wet Lab
Spectrophotometer	Hach	DR6000	DR6000-1	1646676	Wet Lab
Spectrophotometer	Hach	DR6000	DR6000-2	1646781	Wet Lab
TOC Analyzer	Shimadzu	Model TOC-VWS	TOC2	39830572	Wet Lab
TOC Analyzer	Shimadzu	TOC-VCPH	TOC3	H51304435	Wet Lab
TOC Analyzer	OI-Analytical	Aurora 1030	TOC4	E141788082	Wet Lab
TOC Analyzer	Shimadzu	TOC-L	TOC5	H54335232035	Wet Lab
TOC Analyzer	OI Analytical	1030	TOC6	E645732519P	Wet Lab
TOX Analyzer	Mitsubishi	TOX-100	TOX2	1035	Wet Lab
TOX Analyzer	Mitsubishi	AOX-200	AOX1	E7B00107	Wet Lab
TOX Analyzer	EST	TE Xplorer	TOX3	2015-184	Wet Lab
Turbidimeter	Hach	2100N	Turbidimeter1	941100000903	Wet Lab

8.2 EQUIPMENT PREVENTIVE MAINTENANCE, EQUIPMENT CALIBRATION

INSTRUMENT	*P. M. DESCRIPTION*	*FREQUENCY*
Analytical Balances	•Check with Class "I" weights	Daily
Analytical Balances	•Service/Calibration (semi-annual contract maintenance and calibration check)	Tolerance - ±0.1%
Analytical Balances	•Service/Calibration (semiannual contract maintenance and calibration check)	Semi-annually
Refrigerators & Incubators	•Maintenance service	As needed - determined by daily temperature performance checks
Water Bath	•Check thermometer vs. NIST	Once/year
Water Bath	•Remove from service when not maintaining temperature and send off for repair or replace	As needed
Flash Point Tester	•Check thermometer vs. certified traceable	Once/year
Lachat Autoanalyzer	•Check pump tubes, change valve flares	At least 1/month
Pensky Martens	•Check fuel level, refill	As needed
Pensky Martens	•Clean cup thoroughly	Between each test and after use
TOC	•Maintain manufacturer's service contract	Renew each year
Turbidimeter - Hach 2100A	•Illumination lamp or window (alignment and/or replacement)	Erratic or poor response
pH Meters	•Reference junction & electrode replacement	As needed
pH Meters	•Probe stored in KCl	At all times when not in use
pH Meters	•Other	As described in the manufacturer's O & M manual
Ion Chromatograph	•Replace guard and analytical columns	As needed
Ion Chromatograph	•Replace the end-line filter (P/N 045987)	As needed
Ion Chromatograph	• Replace the pump piston rinse seals and piston seals	Every 6 months or as needed
Ion Chromatograph	•Replace the sampling tip and the tubing between the tip and the injection valve.	As needed
Ion Chromatograph	•Replace lines throughout the instrument	As needed
Ion Chromatograph	•Perform Preventive Maintenance using PM kit (P/N 057954)	Annual

8.3 STANDARDS AND REAGENTS

Table 8.3A lists standard sources, receipt, and preparation information. Table 8.3B is designed to provide general calibration range information. These ranges may change depending on regulatory requirements, procedural changes, or project needs. Table 8.3C indicates the procedures and frequency for the standardization of laboratory solutions used for titrations.

Table 8.3A: Standard sources, description and calibration information.
This table is subject to revision without notice

Instrument Group	Standard Source	How Received*	Source/ Storage	Preparation from Source	Lab Stock Storage	Preparation Frequency
Alkalinity, Acidity	Lab preparation	Acidity-matrix standard grade KHP	Room temp.	0.0500N	4°± 2°C	6 months
Ammonia-Nitrogen and Total Kjeldahl Nitrogen Primary Stock	Lab preparation	ACS grade NH4Cl	Room temp.	1,000ppm stock standard	Room temp.	Annually or sooner if check samples reveal a problem
Ammonia-Nitrogen and Total Kjeldahl Nitrogen	Lab preparation	Primary Stock	Room temp.	Working Standards	Not stored	Prepared fresh as needed
COD	Lab preparation	Acid grade KHP	Dessicator	Stock solution (10,000ppm)	4°± 2°C	When absorbance of curve changes or check samples are out of control
Cyanide (Autoanalyzer)	Lab preparation	KCN	Reagent shelf	Stock solution (1,000ppm)	4°± 2°C	6 months. Working dilutions prepared daily as needed
Fluoride Primary Stock	Inorganic Standard. NSI Lab preparation	ACS grade KF	Room temp.	100ppm stock solution	Room temp.	1 year or as needed when reference standard fails
Fluoride	Lab preparation	Primary Stock	Room temp.	Dilute standards	Not stored	Prepared fresh daily
Hardness	Lab preparation	Chelometric Std. $CaCO_3$	Room temp.	1mg/mL as CaCO3	Room temp.	Annually or sooner if check samples reveal a problem
IC (Chloride, Nitrate, Nitrite, Bromide, Sulfate, Fluoride)	Commercial source	Varies	4°± 2°C	Working Standards as needed per analyte	4°± 2°C	6 months or sooner if check samples reveal a problem
IC (Chloride, Nitrate, Nitrite, Bromide, Sulfate, Fluoride)	Inorganic Standards	Varies	4°± 2°C	Working Standards as needed per analyte	4°± 2°C	Midpoint standard prepared weekly or sooner if necessary
IC (Chloride, Nitrate, Nitrite, Bromide, Sulfate, Fluoride)	NSI (2nd source)	Varies	4°± 2°C	Working Standards as needed per analyte	4°± 2°C	Prepared weekly or sooner if necessary
MBAS	Lab preparation	LAS Reference Material	4°± 2°C	1,000mg/mL working standards	4°± 2°C Wet Stored	6 months or when check standards are out of control. Prepared fresh.

Table 8.3A: Standard sources, description and calibration information.

This table is subject to revision without notice

Instrument Group	Standard Source	How Received*	Source/ Storage	Preparation from Source	Lab Stock Storage	Preparation Frequency
Nitrite-Nitrate (autoanalyzer)	Lab preparation	ACS grade KNO3	Reagent shelf	Stock solution (1000ppm)	4°± 2°C	When absorbance of curve changes or check samples are out of control
pH Meter	Commercial Source	pH 4.0 Buffer	Room temp.	No prep required	NA	Annual/Expiration Date
pH Meter	Commercial Source	pH 7.0 Buffer	Room temp.	No prep required	NA	Annual/Expiration Date
pH Meter	Commercial Source	pH 10.0 Buffer	Room temp.	No prep required	NA	Annual/Expiration Date
Phenols (autoanalyzer)	Lab preparation	ACS Certified Phenol	Reagent shelf	Stock solution (1000ppm)	4°± 2°C	Every month. Working solutions prepared daily as needed.
Phosphate	(H_2O) - Prepared in Lab Total Phos. (soils) RICCA, ERA	KH2PO4	Reagent shelf	Stock solution (50ppm as P)	Room temp.	When absorbance of curve changes or check samples are out of control. Working solutions prepared daily as needed.
Specific Conductivity Meter	NSI-Primary	ACS Certified KCl	Room temp.	Working Standard (0.01M)	Room temp.	As needed
Specific Conductivity Meter	ERA-2nd Source	ACS Certified KCl	Room temp.	Working Standard (0.01M)	Room temp.	As needed
Sulfate	Inorganic Standards, NSF Prepared in Lab	Anhydrous Na2SO4	Reagent shelf	Stock solution (100ppm)	Room temp.	When visible microbiological growth or check samples are out of control
Turbidimeter	Commercial Source Hach	Hach	Room temp.	No prep required	NA	Checked daily against Formazin Standards
pH Meter	Commercial Source	pH 1.0 Buffer	Room temp.	No prep required	NA	Annual/Expiration Date
pH Meter	Commercial Source	pH 13.0 Buffer	Room temp.	No prep required	NA	Annual/Expiration

Table 8.3B: WORKING STANDARD CALIBRATION

Analysis	Calibration Standard
Alkalinity, Acidity- Titrimetric	Primary standard grade Na_2CO_3.
Alkalinity - Methyl orange Autoanalyzer	Primary standard grade Na_2CO_3: 0, 10, 25, 50,100, 250, 375, 500 mg/L
Bromide IC	Range –1.0, 5.0, 10, 50, 100, mg/L
Chloride IC	Range –1.0, 5.0, 10, 50, 100, mg/L1
Conductivity	Standard KCl solution: 1413
Cyanides	Blank, 0.0025 – 0.40ppm. Distill one standard as check with each batch.
COD	KHP (Potassium hydrogen phthalate) standards 20 – 1000 mg/L
Chromium – Hexavalent (Colorimetric)	Blank, 0.0101, 0.0202, 0.0505, 0.1010, 0.2525, 0.5050, 1.010 mg/L
Chromium – Hexavalent (IC)	Blank, 0.5, 1.0, 2.0, 10, 20, 50, 100 ug/L
Fluoride – IC	Range –0.10, 0.50, 1.0, 5.0, 10.0, mg/L
Hardness	$CaCO_3$, chelometric standard.
Hardness (Colorimetric)	Range – 30, 50, 60, 100, 150, 200, 300 mg/L
MBAS	LAS reference material: 0.0, 0.1, 0. 5, 1.0, 1.5, 2.0 mg/L
Nitrogen-Ammonia – Autoanalyzer	Calibration standards: 0, 0.10, 0.50, 1.0, 2.0, 5.0, 10, 20 mg/L
Nitrogen-Nitrate, Nitrite – Autoanalyzer	Blank, 0.1, 0.50, 1.00 5.0, 7.0, 10.0 mg/L

Table 8.3B: WORKING STANDARD CALIBRATION	
Analysis	**Calibration Standard**
Nitrogen-Nitrate – IC	Range –0.10, 0.50, 1.0, 5.0, 10.0, mg/L
Nitrogen-Nitrite – IC	Range –0.10, 0.50, 1.0, 5.0, 10.0, mg/L
Orthophosphate, Total Phosphate	Blank, 0.025, 0.10, 0.25, 0.50, 0.75, 1.0mg/L diluted from standard KH_2PO_4
Perchlorate	Range – 0.5, 1.0, 3.0, 5.0, 10, 20, 25 mg/L
pH	Buffers1.0, 4.0, 7.0, 10, 13
Phosphate, Total	Range – 0.0, 0.1, 0.5, 1.0, 2.5, 5.0 mg/L
Phosphate – IC	Range –0.10, 0.50, 1.0, 5.0, 10.0, 15.0, 20.0 mg/L
Phenols (chloroform ext.)	Blank 0.04, 0.05, 0.10, 0.50, 1.0, 2.0mg/L Distill one standard with each batch
Solids	Gravimetric balance calibrated charts, checked with Class “I” weights in range of sample tare weights.
Sulfate – IC	Range –1.0, 5.0, 10, 50, 100, 150, 200 mg/L
Sulfide (Colormetric)	Range –0.0, 0.05, 0.1, 0.5, 1.0, 1.5, 2.0 mg/L
Sulfite	Titration
TKN	Range – 0.0, 0.1, 0.5, 1.0, 2.5, 5.0, 10, 20 mg/L
Turbidity	Range –0, 20, 200, 1000, 4000NTU
TOC	Range –0, 1.0, 2.5, 5.0, 7.5, 10, 20, 50, 75, 100 mg/L
TOX	Cell checks at 1, 20, 40 ug

Table 8.3C: STANDARDIZATION OF TITRATION SOLUTIONS		
Solution	**Primary Standard**	**Frequency**
0.0200 N NaOH	0.050 N KHP	Daily as needed
0.0200 N H_2SO_4	Freshly prepared and standardized NaOH (from KHP standard)	6 months or with each new batch
0.0141 N Hg $(NO_3)_2$	Standard NaCl solution 500 ug Cl/ml	Daily as used
0.0100 M EDTA	Standard $CaCO_3$ solution 1 mg $CaCO_3$/liter	Daily as used

8.4 INSTRUMENT CALIBRATION

Total Organic Carbon Analyzer (TOC) in GW/WW – SOP Number 340356A

The TOC standard curve is prepared using a minimum of five standards. Linear regression is used for quantitation with the correlation coefficient being at least 0.995. The calibration range is 1.0mg/L to 100mg/L. During the analytical sequence, the stability of the initial calibration is verified, following every 10th sample and at the end of the sequence, by the analysis of continuing calibration verification (CCV) standards. The CCV must recover within 10% of the expected value for each analyte.
A laboratory control standard (LCS) is prepared from a source that is independent from the calibration standards and used to verify that the calibration curve is functioning properly and that the analytical system performs acceptably within a clean matrix. The LCS must recover within $\pm$15% of the expected concentration.

Total Organic Carbon Analyzer (TOC) in DW – SOP Number 340356B

The TOC standard curve is prepared using a minimum of five standards. Linear regression is used for quantitation with the correlation coefficient being at least 0.995. The calibration range is 0.5mg/L to 5.0mg/L. During the analytical sequence, the stability of the initial calibration is verified, following every 10th sample and at the end of the sequence, by the analysis of continuing calibration verification (CCV) standards. The CCV must recover within 10% of the expected value for each analyte.

A laboratory control standard (LCS) is prepared from a source that is independent from the calibration standards and used to verify that the calibration curve is functioning properly and that the analytical system performs acceptably within a clean matrix. The LCS must recover within ±15% of the expected concentration. Dissolved organic carbon can be analyzed using this procedure by filtering the unpreserved sample using a 0.45um filter, then performing the analysis on the filtrate using the same process as the TOC procedure.

Total Organic Carbon Analyzer (TOC) in Soil (Walkley Black) – SOP Number 340368

The Walkley Black standard curve is prepared using a minimum of six standards. Linear regression is used for quantitation with the correlation coefficient being at least 0.995. The calibration range is 0.1mg/L to 5.0mg/L. During the analytical sequence, the stability of the initial calibration is verified, following every 10th sample and at the end of the sequence, by the analysis of continuing calibration verification (CCV) standards. The CCV must recover within 10% of the expected value for each analyte.

A laboratory control standard (LCS) is prepared from a source that is independent from the calibration standards and used to verify that the calibration curve is functioning properly and that the analytical system performs acceptably within a clean matrix. The LCS must recover within ±50% of the expected concentration. This method is used to determine Fractional Organic Carbon (FOC) as required by the state of Indiana.

Total Organic Halogen Analyzer (TOX) – SOP Number 340360

The cell performance of the TOX analyzer is verified at the beginning of each analytical sequence in the low, mid and high ranges. The verifications must recover within 3% of the expected target value. The instrument performs a linear regression using the values determined with the required correlation coefficient being at least 0.995. During the analytical sequence, the stability of the initial calibration is verified, following every 10th sample and at the end of the sequence, by the analysis of continuing calibration verification (CCV) standards. The CCV must recover within 10% of the expected value for each analyte.
A laboratory control standard (LCS) is prepared from a source that is independent from the calibration standards and used to verify that the calibration curve is functioning properly and that the analytical system performs acceptably within a clean matrix. The LCS must recover within ±15% of the expected concentration.

Anions by Ion Chromatography – SOP 340319

Least Squares Linear Regression is the primary method of quantitation; where a minimum of five standards is used and the correlation coefficient must be at least 0.995 for each analyte of interest. The calibration range varies depending upon the analyte(s) to be determined. During the analytical sequence, the stability of the initial calibration is verified, following every 10th sample and at the end of the sequence, by the analysis of continuing calibration verification (CCV) standards. The CCV must recover within 10% of the expected value for each analyte, except during the analysis of groundwater and soil using EPA Method 9056 that must recover within 5%.

A laboratory control standard (LCS) is prepared from a source that is independent from the calibration standards and used to verify that the calibration curve is functioning properly and that the analytical system performs acceptably within a clean matrix. The LCS must recover within ±10% for water samples and ±15% of the expected concentration for soil samples.

<u>Hexavalent Chromium by Ion Chromatography – SOP 340372 & 340372A</u>

These procedures are utilized to analyze for hexavalent chromium (Cr6+) by ion chromatography using a variety of published methods and the relevant SOP addresses both the common and method specific requirements for each published method. The Cr^{6+} standard curve is prepared using a minimum of five or six standards at various levels depending on the expected concentration of the field samples, the analytical method requested and the matrix. Linear regression is used for quantitation with the correlation coefficient being at least 0.995. During the analytical sequence, the stability of the initial calibration is verified, following every 10th sample and at the end of the sequence, by the analysis of continuing calibration verification (CCV) standards. The recovery of the CCV must be within 10% of the expected value for the analyte using SM 3500Cr C and EPA Method 7199. The CCV for EPA 218.6 must recover within ±5% and the mid-level CCV for EPA 218.7 must recover within ±15%.

A laboratory control standard (LCS) is prepared from a source that is independent from the calibration standards and used to verify that the calibration curve is functioning properly and that the analytical system performs acceptably within a clean matrix. The LCS must recover within ±10% of the expected concentration.

Aqueous and solid Hexavalent Chromium samples can also be analyzed by colorimetry using EPA 7196A and SM 3500Cr B – SOP 340318B & 350318C. Specific requirements for those methods are contained within the specified SOPs. Soil samples are prepared for both the IC and colorimetric method using alkaline digestion found in EPA 3060A and discussed in both soil SOPs 350318C and 340372A.

<u>Gravimetric Analyses – Various SOPs</u>

Gravimetric analyses are performed using several different published methods, including TDS, TSS, TVDS, TS, TVS, VSS, Settleable Solids, Total Particulates, and Respirable Particulates. Calibration for these methods require use of Class I weights and a properly performing and verified balance. Where possible, laboratory control standards are analyzed in conjunction with field sample analysis to verify that the analytical process is performing accurately. Sample duplicate analyses also provide verification that the analytical process is performing as required.

Auto-Analyzer (Lachat) – Various SOPs

The Autoanalyzer calibration curve is prepared using a minimum of five standards. For most analyses, linear regression is used for quantitation with the correlation coefficient being at least 0.995. The calibration range varies depending upon the analyte to be determined. During the analytical sequence, the stability of the initial calibration is verified, following every 10^{th} sample and at the end of the sequence, by the analysis of continuing calibration verification (CCV) standards. Routinely, the CCV must recover within 10% of the expected value for each analyte, but is dependent on the analyte of concern, the matrix of the sample and the determinative method.

A laboratory control standard (LCS) is prepared from a source that is independent from the calibration standards and used to verify that the calibration curve is functioning properly and that the analytical system performs acceptably within a clean matrix. The LCS must recover within ±15% of the expected value, except for cyanide, ammonia, total phosphorus, NO2NO3 and TKN where ±10% applies.

Perchlorate in Drinking Water – ESC SOP 340370

The Ion Chromatograph calibration curve is prepared using a minimum of five standards. The instrument performs a linear regression using the values determined with the required correlation coefficient being at least 0.995. During the analytical sequence, the stability of the initial calibration is verified, following every 10^{th} sample and at the end of the sequence, by the analysis of continuing calibration verification (CCV) standards. The CCV must recover within 15% of the expected value for each analyte.

A laboratory control standard (LCS) is prepared from a source that is independent from the calibration standards and used to verify that the calibration curve is functioning properly and that the analytical system performs acceptably within a clean matrix. The LCS must recover within ±10% of the expected concentration.

8.5 ACCEPTANCE/REJECTION OF CALIBRATION

All new standard curves are immediately checked with a laboratory control standard from a separate source than that used for calibration. All curves are visually reviewed to ensure that acceptable correlation represents linearity. Calibration curves may be rejected for nonlinearity, abnormal sensitivity, or poor response of the laboratory control standard. Specific criteria for each instrument are outlined in Table 8.5.

Continuing calibration is performed following every tenth sample. If a check standard does not perform within established criteria then the instrument is evaluated to determine the problem. Once the problem is corrected, all samples between the last “in control” sample and the out of control check are re-analyzed.

TABLE 8.5: INSTRUMENT CALIBRATION

Instrument (Analysis)	Calibration Type	Number of Standards	Type of Curve	Acceptance/Rejection Criteria	Frequency
pH Meter*	Initial	5 (buffers) 1 reference buffer	Log.	Third pH of a different value buffer must read within 0.05 units of true value	Daily as used
	Continuing	1 buffer (may be any certified buffer)		Buffer solution must read within 0.05 units of true value	Every 10th sample; Field**
Conductivity Meter*	Initial	1	1 point	Calculation of cell constant between 0.95 - 1.05	Daily as used
	Continuing	1		Must be within 5% of true value	Every 10th sample; Field**
Turbidimeter *	Initial	5	Linear	Formazin-confirmed Gelex standards in appropriate range. Check with second standard must be within 5%	Daily as used
	Continuing	1 reference of different value, 1 (high-level)		Must be within 5% of true value	Every 10th sample; Field**
UV/VIS Spec.	Initial	At least 5 standards calibration standards	Linear	Calibration Curve must have a correlation of 0.995 or better	Daily as used
		2 laboratory control standard		Must be within $\pm$ 15% of the calibration curve.	Daily as used
	Continuing	1 mid-level reference std.		Must be within 90 – 110%	Every 10th sample
Total Organic Halogen Analyzer	Initial	3 calibration standards	Linear	Calibration Curve must have a correlation of 0.995 or better	Daily as used
		1 laboratory control standard		Laboratory control standard must agree within $\pm$ 15% of calibration curve	Daily as used
	Continuing	1 mid-level reference std.		Must be within 90 – 110%	Every 10th sample
Total Organic Carbon Analyzer	Initial	5 calibration standards	Linear	Calibration Curve must have a correlation of 0.995 or better	Every 6 months or as needed
		2 laboratory control standard		Laboratory control standard must agree within $\pm$ 15% of calibration curve	Daily as used
	Continuing	1 mid-level reference std.		Must be within 90 – 110%	Every 10th sample

Note: ESC defines a "laboratory control standard" as a standard of a different concentration and source than those stock standards used for calibration.
*This equipment is also calibrated and used in the field.
**Field equipment must be checked every 4 hours and at the end of the day.

9.0 LABORATORY PRACTICES

9.1 REAGENT GRADE WATER

Reagent grade water is obtained from either a Barnstead NANOpure Diamond system or the Millipore Milli-Q Academic A-10 system.

9.2 GLASSWARE WASHING AND STERILIZATION PROCEDURES

General

Routine laboratory glassware is washed in a non-phosphate detergent and warm tap water. Before washing all labeling and large deposits of grease are removed with acetone. Glassware is then rinsed with: tap water, "No Chromix" solution, tap water, and deionized (DI) water. Glassware is stored in designated drawers or on shelves, inverted when possible. All glassware is rinsed with the required solvent, prior to use. DI water is then used as a precaution against airborne contamination

Phosphate Glassware

Glassware involved in phosphate analysis is marked and segregated. All labels and markings are removed from the glassware prior to washing. The glassware is then washed using hot water and a non-phosphorus detergent. It is then rinsed thoroughly in hot water followed by a rinse in DI water. It is rinsed in 1:1 HCl followed by a final rinse of DI water. If the phosphate glassware has not been used recently, it is the responsibility of the analyst to rinse the glassware with warm 1+9 hydrochloric acid prior to use.

Nutrients and Minerals Glassware

All labels and markings are removed from the glassware prior to washing. The glassware is then washed using hot water and detergent. It is then rinsed thoroughly in hot water followed by a rinse in DI water. It is rinsed in 1:1 HCl followed by a final rinse of DI water.

Immediately prior to use, the ammonia glassware is rinsed in DI water. Routine blanks are run on ammonia glassware to ensure that the detergent is contaminant free.

Non-Metals (CN, COD) Glassware

All labels and markings are removed prior to washing. The glassware is soaked in hot soapy water followed by a thorough rinse with hot tap water. A final rinse of DI water is then performed.

10.0 Analytical Procedures

10.1 A list of laboratory SOPs associated with the Wet Lab can be found in the following table:

TABLE 10.1: WET LAB DEPARTMENT SOPs

This table is subject to revision without notice

SOP #	Title
340300	Acidity (SM 2310B)
340301	Alkalinity (Titrimetric)
340302	Alkalinity - Lachat
340305	Chlorine, Total Residual DPD- 330.5 SM4500-CL-G
340307	Cyanide- All Forms (Colorimetric Automated UV) - Lachat
340307	Cyanide- OI Method
340309	Chemical Oxygen Demand
340310	Color by Visual Comparison (SM2120B, EPA 110.2)
340313	Density (Specific Gravity)
340317	Total Hardness (mg/l as CaCO3) - (Titrimetric)
340317	Total Hardness by Lachat Method 130.1
340318	Hexavalent Chromium (Colorimetric) Soil 3060A/7196A
340318	Hexavalent Chromium (Colorimetric) Water 7196A
340319	Ion Chromatography - Anions by 300.0, SM 4110B and 9056/9056A
340319	Ion Chromatography - Anions OH VAP
340325	MBAS (Methylene Blue Active Substances)
340327	Ammonia, Phenolate (OI)
340327	Ammonia, Phenolate (Lachat)
340328	Organic Nitrogen
340331	Threshold Odor Test
340333	Nitrate/Nitrite (Lachat Autoanalyzer)
340333	Nitrate/Nitrite (OI Autoanalyzer)
340334	Paint Filter Test
340335	pH/Corrosivity
340336	Phenol - 4AAP (Lachat Autoanalyzer)
340338	Total Phos GW/WW (365.4) Colorimetric
340338	Total Phos.(361.2, 4500P-B/F) Colorimetric
340338	Orthophosphate (365.2,4500P-E) Colorimetric
340339	Reactivity
340340	Reactive Cyanide/Sulfide Distillation
340342	Specific Conductance (120.1, 2510B)
340344	Sulfide (Colorimetric Methylene Blue) (376.2)
340344	Sulfide Acid-soluble,and acid-insoluble Method 9034
340345	Sulfite
340346	Settleable Solids
340347	Total Dissolved Solids
340348	Total Suspended Solids (Non-Filterable Residue)
340349	Total Solids/Percent Moisture

SOP #	Title
340350	Total Volatile Solids
340352	Total Kjeldahl Nitrogen
340354	Turbidity
340356	Total Organic Carbon In Soils (loss of weight on ignit.
340356	TOC for Drinking Water only
340356	Total Organic Carbon (TOC) and Total Inorganic Carbon (TIC) using Shimadzu 5000A for GW and WW
340357	Ignitability
340359	UV254
340360	TOX (total organic halides)
340361	Ferrous Iron, SM-3500-Fe-B
340362	Heat of Combustion
340365	Particles Not Otherwise Regulated, Total (PNOR) NIOSH 0500
340366	Oxidation Reduction Potential
340367	Extractable Organic Halides
340368	TOC in Soil (Walkley-Black)
340369	Carbon Dioxide by Calculation
340370	Perchlorate in DW
340371	Chlorine in Oil (ASTM D808-00)
340372	Hexavalent Chromium in Soil by IC (3060A/7199)
340372	Hexavalent Chromium in Water by IC (218.7/SM 3500Cr)
340373	Organic Matter (FOM) and Fractional Organic Carbon (FOC)
340374	Total Volatile Dissolved Solids (TVDS)
340375	Hexavalent Chromium in Air by IC
340376	Total Organic Halides in Oil (EPA 9076)
340377	Manual Nitrocellulose Analysis
340378	Volatile Suspended Solids
340379	Guanidine Nitrate by IC
340381	Ash in Petroleum Products (ASTM D482-07)

11.0 QUALITY CONTROL CHECKS

NOTE: For specific guidance on each determinative method, including required quality control and specific state requirements/modifications, refer to the relevant laboratory standard operating procedure(s).

11.1 ESC participates in proficiency testing (PTs) in support of various laboratory accreditations/recognitions. Environmental samples are purchased from Phenova. The WS, WP and solid matrix studies are completed every 6 months.

11.2 Initial Demonstrations of Capability (IDOCs) are performed during new analyst training and/or prior to acceptance and use of any new method/instrumentation. Continuing Demonstration of Capability (CDOCs) must be updated at least annually. The associated data is filed within the department and available for review.

11.3 Where appropriate, Matrix Spike and Matrix Spike Duplicates are performed on each batch of samples analyzed, depending on analytical method requested.

11.4 A Laboratory Control Sample (LCS) is analyzed once per batch of samples. Where appropriate, an LCS Duplicate may also be analyzed.

11.5 Where appropriate, a method preparation blank is performed per batch of samples processed. If one-half the reporting limit [RL] is exceeded, the laboratory shall evaluate whether reprocessing of the samples is necessary, based on the following criteria:

- The blank contamination exceeds a concentration greater than 1/10 of the measured concentration of any sample in the associated preparation batch or
- The blank contamination is greater than 1/10 of the specified regulatory limit.

The concentrations of common laboratory contaminants shall not exceed the reporting limit. Any samples associated with a blank that fail these criteria shall be reprocessed in a subsequent preparation batch, except when the sample analysis resulted in non-detected results for the failing analytes.

12.0 DATA REDUCTION, VALIDATION AND REPORTING

12.1 DATA REDUCTION

The analyst performs the data calculation functions and is responsible for the initial examination of the finished data. Data reduction steps applied to the raw data are outlined in ESC SOP #030201, *Data Handling and Reporting*. A secondary review of the data package using the ESC SOP #030227, *Data Review*. The reviewer verifies that the analysis has been performed as required and meets method criteria, all associate data is present and complete, and also ensures that any additional documentation is completed as required (i.e. Ohio VAP checklists, required qualifiers on test reports, etc.)

TABLE 12.1: Data Reduction Formulas

PARAMETER	FORMULA
Acidity, Alkalinity	$\frac{\text{mL titrant x normality titrant x 50,000}}{\text{mL sample}}$
COD, Sulfate	Concentration from curve x dilution factor
Orthophosphate, Hexavalent Chromium	Calculated by computer software as provided by HACH Corp.
Nitrogen-Nitrate, Phenols,Nitrogen-Ammonia, Total Phosphate, Nitrogen-Total Kjeldahl**	Calculated by computer software as provided by Lachat Corp.
Anions, Hexavalent Chromium	Calculated by computer software as provided by Dionex
Conductivity*, pH, Turbidity,	Directly read from instrument
Cyanide, Total and Amenable	$\frac{\mu\text{g from standard curve x mL total volume absorbing solution}}{\text{mL volume sample x mL volume of absorbing solution colored}}$ *Calculated by software as provided by Lachat Corp.*
Solids, Total and Total Dissolved	$\frac{\text{((mg wt of dried residue + dish) - mg wt of dish) x 1000}}{\text{mL sample}}$

PARAMETER	FORMULA
Solids, Total Suspended	$\frac{((\text{mg wt of dried residue + filter}) - \text{mg wt of filter}) \times 1000}{\text{mL sample}}$

12.2 VALIDATION

The validation process consists of data generation, reduction review, and reporting results. Once data reduction is complete, validation is conducted by verification that the QC samples are within acceptable QC limits and that all documentation is complete, including the analytical report and associated QC. See Table 12.3 by method for current QC targets, controls and current reporting limits.

12.3 REPORTING

Reporting procedures are documented in *SOP 030201 Data Handling and Reporting.*

Inorganic Control Limits: Inorganic QC targets are statutory. The laboratory calculated limits verify the validity of the regulatory limits. The Wet Lab QC targets for all inorganic analyses are within the range of ± 5 to 15% for accuracy, depending on determinative method requirements, and, where applicable, ≤20 RPD for precision, unless laboratory-generated data indicate that tighter control limits can be routinely maintained. When using a certified reference material for QC sample analysis, the acceptance limits used in the laboratory will conform to the provider's certified ranges for accuracy and precision.

Table 12.3: QC Targets for Wet Lab Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Analyte	Analysis Method	Matrix	Accuracy Range (%)	Precision (RPD)	RL (ppm)
Acidity	SM 2310B	w	85 - 115	<20	10
Acidity	SM 2310B	s	85 - 115	<20	10
Alkalinity	SM 2320B	w	85 - 115	<20	20
Ammonia	350.1, SM 4500-NH3-B	w	90 - 110	<20	0.25
Ammonia	350.1 (mod.)	s	Certified Values	<20	5.0
Ash	ASTM D482-07	s	90 - 110	<20	n/a
Bromide	300.0/9056/9056A/ SM 4110B	w	90 - 110	<20	1.0
Bromide	9056/9056A	s	Certified Values	<20	10
Chloride	300.0/9056/SM 4110B	w	90 - 110	<20	1.0
Chloride	9056A	w	90 - 110	<15	1.0
Chloride	300.0/9056	s	Certified Values	<20	10
Color	SM 2120B	w	n/a	<20	1 CU
Conductivity	120.1/9050A, 2510B	w	85 - 115	<20	n/a
Cyanide	335.4, 335.2 (CLP-	w	90 - 110	<20	0.005

Table 12.3: QC Targets for Wet Lab Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Analyte	Analysis Method	Matrix	Accuracy Range (%)	Precision (RPD)	RL (ppm)
	M), 9012B, SM 4500-CN-E				
Cyanide	335.2 (CLP-M), 9012B	s	Certified Values	<20	0.25
Ferrous Iron	3500FE B	w	85 - 115	<20	15
Fluoride	300.0/9056/9056A/ SM 4110B	w	90 - 110	<20	100
Fluoride	9056A	s	Certified Values	<20	1.0
Hardness	130.1	w	85 - 115	<20	30
Hardness	130.2/SM 2340C	w	85 - 115	<20	5.0
Hexavalent Chromium	SM3500 Cr B/7196A	w	85 - 115	<20	10
Hexavalent Chromium	7196A	s	Certified Values	<20	2.0
Hexavalent Chromium	7199	w	90 - 110	<20	0.0005
Hexavalent Chromium	218.7	w	85 - 115	<15	0.00002
Hexavalent Chromium	7199	s	80 - 120	<20	1.0
Ignitability	1010A	w/s	$\underline{+}$3 degrees C	<20	n/a
Methylene Blue Active Substances	5540C SM20th	w	85 - 115	<20	0.10
Nitrate-Nitrite	300.0/9056/9056A/ SM 4110B	w	90 - 110	<20	1.0
Nitrate-Nitrite	9056A	w	90 - 110	<15	1.0
Nitrate-Nitrite	300.0/9056	s	Certified Values	<20	10
Nitrate	300.0/9056/SM 4110B	w	90 - 110	<20	0.1
Nitrate	9056A	w	90 - 110	<15	0.1
Nitrate	300.0/9056	s	Certified Values	<20	1.0
Nitrite	300.0/9056/SM 4110B	w	90 - 110	<20	0.1
Nitrite	9056A	w	90 - 110	<15	0.1
Nitrite	300.0/9056	s	Certified Values	<20	1.0
pH	SM 4500-H, 9040C	w	n/a	<1	n/a
pH	9045D	s	n/a	<1	n/a
Phosphate (ortho)	SM 4500-P E	w	85 - 115	<20	25
Phosphate (ortho)	SM 4500-P E	s	85 - 115	<20	250
Phosphorous/Total	365.1, SM 4500-P	w	90 - 110	<20	3.0
Phosphorous/Total	365.4	w	90 - 110	<20	100
Phosphorous/Total	9056	s	Certified Values	<20	1.0
Residual Chlorine	SM 4500Cl G	w	90 - 110	<20	0.1
Residue, Total (TS)	SM 2540-B, SM2540-G	w	85 - 115	<20	10
Residue, Total (TS)	SM2540-G	s	85 - 115	<20	100
Residue, Filterable	SM 2540-C	w	95 - 105	<20	10

Table 12.3: QC Targets for Wet Lab Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Analyte	Analysis Method	Matrix	Accuracy Range (%)	Precision (RPD)	RL (ppm)
(TDS)					
Residue Non-Filterable (TSS)	SM 2540-D	w	95 - 105	<20	2.5
Residue, Total Volatile (TVS)	SM 2540-E	w	80 - 120	<20	1.0 (% of TS)
Residue, Total Volatile (TVS)	160.4/SM 2540-E,	s	80 - 120	<20	1.0 (% of TS)
Sulfate	300.0/9056/SM 4110B	w	90 - 110	<20	5.0
Sulfate	9056A	w	90 - 110	<15	5.0
Sulfate	300.0/9056	s	Certified Values	<20	50
Sulfide	SM 4500S2 D	w	85 - 115	<20	20
Sulfite	SM 4500SO3 B	w	85 - 115	<20	3.0
Total Kjeldahl Nitrogen	351.2	w	90 - 110	<20	0.25
Total Kjeldahl Nitrogen	SM 4500NOrg C	s	Certified Values	<20	20
Total Organic Carbon	415.1, SM 5310B,9060A	w	85 - 115	<20	1.0
Total Organic Carbon	SM 5310C	w	85 - 115	<20	0.5
Total Organic Carbon	USDA LOI, ASTM F1647-02A	s	50 - 150	<20	10
Total Organic Carbon	Walkley-Black,	s	50 - 150	<20	100
Dissolved Organic Carbon	415.1, SM 5310B,9060A	w	85 - 115	<20	1.0
Dissolved Organic Carbon	SM 5310C	w	85 - 115	<20	0.5
Total Organic Halogens	9020A, SM 5320B	w	85 - 115	<20	0.1
EOX	9023	s	85 - 115	<20	25
Total Phenol	420.2	w	90 - 110	<20	0.04
Total Phenol	9066	w	90 - 110	<20	0.04
Total Phenol	9066	s	90 - 110	<20	0.67
Turbidity	180.1, SM 2130B	w	90 - 110	<20	0.1 NTU

13.0 CORRECTIVE ACTIONS

13.1 In the event that a nonconformance occurs in conjunction with the analytical batch, a corrective action response (CAR) form must be completed. The cause of the event is stated on the form and the measures taken to correct the nonconformance clearly defined. The effectiveness of the corrective action must be assessed and noted. The CARs are kept on file by the Regulatory Affairs Department. Corrective action procedures are documented in SOP #030208, *Corrective and Preventive Action*

13.2 Required Corrective Action

Control limits have been established for each type of analysis. When these control limits are exceeded, corrective action must be taken. Calculated sample spike control limits are also used.

All samples and procedures are governed by ESC's quality assurance program. General corrective actions are as follows; however additional and more specific direction is provided in the specific determinative procedure. For more information, see the appropriate determinative SOP.

13.2.1 Laboratory QC Criteria and Appropriate Corrective Actions

If the analytical method contains acceptance/rejection criteria and it is more stringent than those controls generated by the laboratory, the method criteria takes precedence.

13.2.2 Calibration Verification Criteria Are Not Met: Inorganic Analysis

Rejection Criteria - See Table 8.5.

Corrective Action - If a standard curve linearity is not acceptable and/or the absorbance for specific standard(s) is not analogous to historic data, the instrument settings, etc. are examined to ensure that nothing has been altered, clogged, etc. Check the standard curve for linearity and re-analyze the standards once. If the failure persists, the working standards are made fresh, intermediate dilutions are re-checked and the instrument is re-calibrated. If a problem persists, the Supervisor or Regulatory Affairs Department is notified for further action.

If the initial reference check sample is out of control, the instrument is re-calibrated and the check sample is re-analyzed. If the problem continues the check sample is re-prepared. If the problem still exists then the standards and reagent blank are re-prepared. If the problem persists, the Supervisor or Regulatory Affairs Department is notified for further action.

13.2.3 Out Of Control Blanks: Applies to Method, Trip, Rinsate & Instrument Blanks

Rejection Criteria - Blank reading is more than twice the background absorbance or more than MDL.

Corrective Action - Blanks are re-analyzed and the response is assessed. Standard curves and samples are evaluated for any obvious contamination that may be isolated or uniform throughout the run. If necessary, reagents are re-prepared. Field sample analyses are not started until the problem is identified and solved. If samples have already been partially prepared or analyzed, the Supervisor or Regulatory Affairs Department is consulted to determine if data needs to be rejected or if samples need to be re-prepped.

13.2.4 Out Of Control Laboratory Control Standards (LCS)

Rejection Criteria - If the performance of associated laboratory control sample(s) is outside of control limits either method defined or calculated as the mean of at least 20 data points ± 3 times the standard deviation of those points. (Listed in Section 12).

Corrective Action - Instrument settings are checked, LCS standard is re-analyzed. If the LCS is still out of control, re-calibration is performed, and samples affected since the last "in control" reference standard are re-analyzed. The Supervisor or Regulatory Affairs Department is consulted for further action.

13.2.5 Out Of Control Matrix Spike Samples

Rejection Criteria - If either the MS or MSD sample is outside the established control limits.

Corrective Action - Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Batch acceptance, however, is based on method blank and LCS performance, not on MS/MSD recoveries. Specific methods, customers, and programs may require further corrective action in some cases.

13.2.6 Out Of Control Duplicate Samples

Rejection Criteria - Lab-generated or method required maximum RPD limit (as listed under precision in Section 12)

Corrective Action - Instrument and samples are checked to see if precision variance is likely (i.e., high suspended solids content, high viscosity, etc.). They are re-analyzed in duplicate and samples just preceding and following the duplicated sample are re-analyzed. If problem still exists, the Supervisor or Regulatory Affairs Department is notified to review the analytical techniques.

13.2.7 Out Of Control Calibration Standards: ICV, CCV, SSCV

Rejection Criteria - If the performance is outside of method requirements.

Corrective Action - Instrument settings are checked, calibration verification standard is reanalyzed. If the standard is still out of control, re-calibration is performed, and samples affected since the last "in control" reference standard are re-analyzed. The Supervisor or Regulatory Affairs Department is consulted for further action.

14.0 RECORD KEEPING

Record keeping is outlined in SOP #030230, *Standards Logger, SOP #030227, Data Review* and SOP #030201, *Data Handling and Reporting*

All calibration data and graphs generated for wet chemistry are kept digitally with the following information: date prepared, calibration concentrations, correlation, and analyst initials. The analyst reviews the calibration and evaluates it against acceptance criteria before placing it in the calibration notebook. Data on initial and continuing reference standards, as well as matrix spikes and duplicates, are entered in the QC box generated on each analysis page. If a test allows the use of a previously established calibration curve then the calibration check standard is reviewed against acceptance criteria and if acceptable, analysis can proceed. In this situation the calibration date is referenced so that the curve can be easily reviewed, if necessary.

15.0 QUALITY AUDITS

System and data quality audits are outlined in the ESC Quality Assurance Manual *Version 13*.0 and *SOP #010104, Internal Audits*.

16.0 REVISIONS

The Regulatory Affairs Department has an electronic version of this Quality Assurance Manual with tracked changes detailing all revisions made to the previous version. This version is available upon request. Revisions to the previous version of this appendix are summarized in the table below.

Document	**Revision**
Quality Assurance Manual Version 15.0 (Appendix IV)	General – Replaced the term “client” with the term “customer” Section 6.1 – Updated to reflect current facilities Section 7.1 – Removed IH test Table 8.1 – Updated Equipment List Section 12.3 – Removed IH QC Table Table 12.3 – Updated RLs

1.0 SIGNATORY APPROVALS

Metals Department
QUALITY ASSURANCE MANUAL

APPENDIX V TO THE ESC QUALITY ASSURANCE MANUAL

for

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NOTE: The QAM has been approved by the following people.

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Steve Miller, B.S., Quality Assurance Manager, 615-773-9684

2.0 APPENDIX TABLE OF CONTENTS

3.0 SCOPE AND APPLICATION

This appendix discusses specific QA requirements for general analytical protocols to ensure that data generated from the Metals Laboratory is scientifically valid and is of acceptable quality. Any deviations from these requirements and any deviations that result in nonconforming work must be immediately evaluated and their corrective actions documented.

4.0 LABORATORY ORGANIZATION AND RESPONSIBILITIES

ESC Lab Sciences offers diverse environmental capabilities that enable the laboratory to provide the customer with both routine and specialized services, field sampling guidance and broad laboratory expertise. A brief outline of the organization and responsibilities as they apply to the ESC Quality Assurance Program is presented in *Section 4.0 in the ESC Quality Assurance Manual.*

5.0 PERSONNEL AND TRAINING

5.1 PERSONNEL

John Davis, with a B.S. degree in Biology, is the Department Supervisor and is responsible for the overall production of these laboratories; including the management of the staff and scheduling. Mr. Davis has 13 years of environmental laboratory experience. In his absence, Rodney Street assumes responsibility for departmental decisions in the Metals Department.

Mr. Rodney Street, with a B.S. degree in Medical Technology, is the Technical Specialist for the Metals Lab. He is proficient in inorganic analytical methods and has 34 years of environmental laboratory experience.

5.2 TRAINING

Senior Analysts or the Supervisor trains all new analysts to the laboratory according to ESC protocol. ESC's training program is outlined in *SOP 030205 Technical Training and Personnel Qualifications.* Performance is documented using an initial demonstration of capability (IDOCs) and continuing demonstration of capability (CDOC). On-going acceptable capability in metals analysis and preparation is also demonstrated by acceptable participation in multiple proficiency testing programs (PTs) and using daily Quality Control sample analyses. Documentation of analyst training is maintained on file within the department.

6.0 FACILITIES AND LABORATORY SAFETY

6.1 FACILITIES

The main area of the analysis laboratory has approximately1200 square feet with roughly 90 square feet of bench area. The main area of the metals prep laboratory has approximately 1200 square feet with 232 square feet of bench area. The main area of the Mercury/TCLP laboratory has approximately 1272 square feet with 136 square feet of bench area. The lighting standard in all three labs is fluorescence. The air system is a 15-ton make-up unit plus 15-ton HVAC with electric heat. The laboratory reagent water is provided through the US Filter deionizer system. Waste disposal containers are located in the laboratory and Clean Harbors serves as ESC's waste disposal company. ESC's building information guides and site plan are shown in Appendix I.

6.2 LABORATORY SAFETY

- Laboratory access is limited when work is being performed.
- All procedures where chemicals are prepared or splashes may occur are conducted in laboratory exhaust hoods.
- ESC's laboratory safety guidelines are detailed in *the ESC Chemical Hygiene Plan.*

7.0 SAMPLING PROCEDURES

7.1 FIELD SAMPLING PROCEDURES, SAMPLE STORAGE, AND HANDLING

- Field Sampling procedure is described in Appendix III of this ESC Quality Assurance Manual. Sample information is recorded and kept on the ESC chain of custody and field logbooks.
- Matrices for metals analysis are as follows: groundwater, wastewater, drinking water, soil, sludge, paint chips, wipes, filters, and leachates.
- Sample containers, preservation methods and holding times:
  - Glass containers are acceptable for all elements except Boron and Silicon. Plastic must be used for Boron and Silicon.
  - Water samples that are analyzed for dissolved metals must be filtered using a 0.45µm pore membrane. Water samples for total metals are not filtered. All water samples are acidified with 1+1 nitric acid to a pH<2. Filtered water samples (dissolved metals) are preserved immediately after filtration. All other water samples are preserved immediately after sampling. Water samples are not refrigerated prior to analysis.
  - Paint chips, dust wipes and filters do not require preservation.
  - Soil samples for all metals are stored not frozen but ≤6°C.
  - Hold times for all metals, except Mercury, are 180 days. Mercury has a hold time of 28 days.

8.0 EQUIPMENT

Instrument Software

- Agilent ICPMS 7700 and 7900 - Mass Hunter - Used for calibration, calculation, QC review, diagnostics, and data storage
- Thermo 7400 ICP - Qtegra - Used for calibration, calculation, QC, review, diagnostics, data storage
- Leeman Hydra II AA – Envoy - Used for calibration, calculation, QC review, diagnostics, data storage
- Perkin Elmer Fims 100- Winlab- Used for calibration, calculation, QC review, diagnostics, data storage

NOTE: All purchased software that is used in conjunction with software specific instruments is guaranteed by the supplier to function as required. The supplier of the software performs all troubleshooting or software upgrades and revisions.

8.1 EQUIPMENT LIST

Table 8.1 – LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Metals Analysis and Preparation
This table is subject to revision without notice

Item	*Manufacturer*	*Model*	*Name*	*#*	*Serial number*	*Location*
Balance- Top Loading	Trobal	AGN100		1	701001026	Metals Prep Lab
Balance - Top Loading	Mettler Toledo	PB3002-5		1	1119070828	Metals Prep Lab
Balance - Top Loading	Mettler Toledo	PB3002-5		1	71242213216	Mercury Lab
Balance - Top Loading	Mettler Toledo	PB3002-5		1	1121462199	Metals Prep Lab
Hot Block	Env. Express	SC154	C	1	3994CEC1880	Metals Prep Lab
ICPMS with autosampler	Agilent	7700	ICPMS7	1	JP12482187	Metals Lab
ICPMS with autosampler	Agilent	7900	ICPMS8	1	JP14080166	Metals Lab
ICPMS with autosampler	Agilent	7900	ICPMS9	1	JP14400452	Metals Lab
ICP Simultaneous with autosampler	Thermo	7400	ICP12	1	IC74DC141801	Metals Lab
ICP Simultaneous with autosampler	Thermo	7400	ICP13	1	IC74DC143804	Metals Lab
ICP Simultaneous with autosampler	Thermo	7400	ICP14	1	IC74DC151103	Metals Lab
Hot Block	CPI	Mod Block	HGA	1	004412	Mercury Lab
Hot Block	CPI	Mod Block	HGB	1	604443	Mercury Lab
Hot Block	CPI	Mod Block	MPA	1	4430	Metals Prep Lab
Hot Block	CPI	Mod Block	MPB	1	4434	Metals Prep Lab
Mercury Auto Analyzer	Perkin Elmer	(1) FIMS 100	III	1	110156051101	Mercury Lab
Mercury Auto Analyzer	Perkin Elmer	FIMS 100	IV	1	101S11061403	Mercury Lab
Mercury Auto Analyzer	Leeman	Hydra II AA	HG5	1	Install #65043	Mercury Lab

Table 8.1 – LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Metals Analysis and Preparation
This table is subject to revision without notice

Item	*Manufacturer*	*Model*	*Name*	*#*	*Serial number*	*Location*
Microwave	CEM	MARS Xpress	NA	1	MD-2861	Metals Prep Lab
Microwave	CEM	MARS Xpress	NA	1	MD-9972	Metals Prep Lab
Microwave	CEM	MARS Xpress	NA	1	MD-9640	Metals Prep Lab
Microwave	CEM	MARS Xpress	NA	1	MD-4692	Metals Prep Lab
Microwave	CEM	MARS 6	NA	1	MJ2771	Metals Prep
Microwave	CEM	MARS Xpress	NA	1	MD-7441	Metals Prep
Prep station	Seal Analytical	Deena II	NA	1	020050	Metals Prep
Prep Station	Env. Express	Automated prep station	Autoblock 3	1	AB1002-0708-001	Metals Prep Lab
TCLP Extraction Unit	Env. Express	6 Position	NA	1	NA	TCLP Lab
TCLP Extraction Unit	Env. Express	12 Position	NA	5	4803-12-542	TCLP Lab
TCLP Extraction Unit	Env. Express	12 Position	NA	5	1918-12-415	TCLP Lab
TCLP Extraction Unit	Env. Express	12 Position	NA	5	1918-12-414	TCLP Lab
TCLP Extraction Unit	Env. Express	12 Position	NA	5	5152-12-548	TCLP Lab
TCLP Extraction Unit	Env. Express	12 Position	NA	2	NA	TCLP Lab
TCLP Extraction Unit	Env. Express	12 Position	NA	2	NA	TCLP Lab
TCLP Extraction Unit	Env. Express	12 Position	NA	2	NA	TCLP Lab
TCLP Extraction Unit	Env. Express	12 Position	NA	2	NA	TCLP Lab
TCLP Extraction Unit	Env. Express	10 Position	NA	1	NA	TCLP Lab
TCLP Extraction Unit	Env. Express	Teflon Vessels	NA	12	NA	TCLP Lab
TCLP Zero Headspace Extractor	Env. Express	Vessels	NA	41	NA	TCLP Lab
Centrifuge	Thermo	Sovall ST40	NA	1	41179863	Metals Prep
Turbidimeter	HACH	2100N	NA	1	05090C020685	Metals Prep Lab
Water Purification - Nanopure	Elga	Pure Lab Ultra	NA	1	ULT00002665	Metals Prep Lab
PH Meter	Orion Versastar	VSTAR50	NA	1	V04967	TCLP Lab
Balance	Mettler Toledo			1	B246522879	TCLP Lab
Auto pipetters 1000µl to 20 µl	Oxford	Varies	NA		NA	Metals Lab
Auto pipetters	Eppendorf, Oxford	Varies	NA		NA	Metals Prep Lab
MAX/MIN Thermometer	Fischer Scientific	MAX/MIN	TCLP #1		122376671	TCLP Lab
Hotplate/Stirrer	Thermo Cimarec	SP88850100		1	C3010013111514115	TCLP Lab

8.2 Equipment Preventive Maintenance, Equipment Calibration

INSTRUMENT	P. M. DESCRIPTION	FREQUENCY
ICP and ICPMS	•Maintain manufacturer's service contract	Renew annually
ICP and ICPMS	•Pump tubing, torch alignment, o-ring, injector tip and torch	Check daily and adjust/change as needed
ICPMS	•Sampler and Skimmer cones	Clean or replace when needed
ICP and ICPMS	•Pump rollers	Clean and lubricate when needed
ICP and ICPMS	•Nebulizer	As needed
Mercury Analyzer	•Calibrate and check sensitivity with previous data	Daily with use
Mercury Analyzer	•Response factor problems, check tubing for leaks, particularly in pump head, and check cell for fogging	As needed
Mercury Analyzer	•Replace desiccant in tube	With each use
Mercury Analyzer	•Check rotometer for airflow, if inadequate, replace flex tubing in pump lead	As needed
TCLP Apparatus (ZHE)	•Change O-rings	As needed
Thermometer	•All working thermometers are compared to a NIST thermometer.	Semi-annually
pH Meter	•Calibrated according to manufacturer's instructions. •The slope is documented and acceptable range 95-105%	Daily
Analytical Balance	•Analytical balances are checked and calibrated by a certified technician semi-annually. •Calibration is checked daily with class S weights. Must be within 0.1% S class weights calibrated annually	Semi-annually Daily
TCLP Tumblers	•Visually timed and confirmed to be 30±2 rpm.	Monthly
Microwaves	•Checked and calibrated by a certified technician	Semi-annually, calibrated weekly by staff
Microwaves	Check cap membranes for leaks	As needed

8.3 STANDARDS AND REAGENTS

All reagents and standards must meet the requirements listed in the analytical methods.

Table 8.3A: Stock Standard sources, receipt, and preparation information.
(subject to revision as needed)

STOCK STANDARD SOURCES
****ICP metals used – Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Sn, Sr, Ti, Tl, V, Zn, S***
****ICP/MS metals used – Ag, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, Se, Sn, Tl, V, Zn, B, U, Th, Na, Ca, Mg, K, Al, Ti, Sr***

Instrument Group/Standard	*Standard Source**	*How Received**	*Source/ Storage*	*Lab Stock Storage*	*Receipt Frequency*
ICP/CCVLL	Env. Express	4ppm-Al 2ppm- Fe 20ppm-Ca, K, Na, Mg, S 1ppm- B, Si, Zn, Sn, Ti 0.04ppm-Be, Cd 0.1ppm-Pb, Mo, Ba, Ag 0.2ppm-Cr, Co, Cu, Sb, As, Ni, Se, Tl Mn, Sr, 0.4ppm- V 0.3ppm- Li	Room temp.	2% HNO3 w/ Tr HF	Annual/Expiration Date
ICP (single element standards)	Env. Express or High Purity	1000ppm	Room temp.		Annual/Expiration Date
ICP/ICV	Inorganic Ventures	500ppm – Al. Ca, Fe, Mg, Na, K, S 50ppm – All others 20ppm - Sr	Room temp.	5% HNO3 w/ .5% HF	As needed
ICP/Calibration Standard and CCV	Env. Express/High Purity	1000ppm- Ca, K, Na 200ppm- Fe, Mg, Al 100ppm- S 40ppm- Si 20ppm-, As, B, Cu, Ni, Se, , Tl, , Mn,Ti, Li, V, Sr, Cr, Co, Zn 10ppm- Ag, Ba, Sb, Cd, Sn, Pb 5ppm- Mo 4ppm Be	Room temp.	5% HNO3 w/ Tr HF	As needed
ICP/LCS water/soil	Inorganic Ventures	1000ppm – Ca, Mg, K, Na 100ppm – all others except Li (spiked separately)	Room temp.	5% HNO3 w/Tr HF	As needed
ICP/LCS soil (only for IH)	ERA	Varies with Lot #	Room temp.	none	As needed
ICP/ICSA	Env. Express	5000ppm – Al, Ca, Mg, 2000ppm – Fe	Room temp.	10% HNO3	As needed
ICP/ICSB	Env. Express	100ppm – B, Cd, Pb, Ag, Ni, Si, Zn, 50ppm – all others except Sr, Li	Room temp.	4% HNO3 w/ Tr HF	As needed
ICP/Yttrium	Env. Express	10,000 ppm	Room temp.	4% HNO3	As needed
ICP/Indium	Env. Express	10,000ppm	Room temp.	2%HNO3	As needed
ICPMS/ICV	Inorganic Ventures	1000ppm-Ca, Mg, K, Na, Al, Fe 10ppm- all others	Room temp.	5% HNO3 w/ Tr HF	As needed

Table 8.3A: Stock Standard sources, receipt, and preparation information.
(subject to revision as needed)

STOCK STANDARD SOURCES
ICP metals used – Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Sn, Sr, Ti, Tl, V, Zn, S
ICP/MS metals used – Ag, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, Se, Sn, Tl, V, Zn, B, U, Th, Na, Ca, Mg, K, Al, Ti, Sr

Instrument Group/Standard	*Standard Source**	*How Received**	*Source/ Storage*	*Lab Stock Storage*	*Receipt Frequency*
ICPMS/ Calibration Standard and CCV	Env. Express	100 ppm- Al, Fe 1000ppm-Mg, K, Ca, , Na 10ppm- All others	Room temp.	2% HNO3 w/ Tr HF	As needed
ICPMS/LCS water/soil	Inorganic Ventures	1000ppm – Ca, Mg, K, Na, Al, Fe 10ppm – all others	Room temp.	5% HNO3	As needed
ICPMS/LCS soil (for IH only)	ERA	Varies with Lot #	Room temp.	none	As needed
ICPMS/ICSA	Inorganic Ventures	10000ppm – Cl 2000ppm – C 1000ppm – Al, Ca, Fe, Mg, P, K, Na, S 20ppm – Mo, Ti	Room temp.	1.4% HNO3	As needed
ICPMS/ICSB	Inorganic Ventures	2ppm – Sb, As, Be, Cd, Cr, Co, Cu, Pb, Ni, Se, Ag, Tl, Sn, Zn, B, Ba, Cr, Mn, Sr, Th, V, U	Room temp.	5%HNO3 w/ Tr HF	As needed
Hg/ICV and LCS	Inorganic Ventures	1000ppm – Hg	Room temp.	2% HNO3	As needed
Hg/Calibration Standard and CCV	Env. Express	1000ppm – Hg	Room temp.	2% HNO3	As needed

Equivalent Providers may be utilized.

Table 8.3B: Working standard concentration, storage and preparation information.
(subject to revision as needed)

WORKING STANDARD PREPARATION
ICP metals used – Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Sn, Sr, Ti, Tl, V, Zn, S
ICP/MS metals used – Ag, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, Se, Sn, Tl, V, Zn, B, U, Th, Na, Ca, Mg, K, Al, Ti, Sr

Instrument Group/Standard	*How Prepared*	*Final Concentration*	*Source/ Storage*	*Expiration*
ICP/ICV	2mL Custom Stock ICV A and B, adjusted to 100mL with 10% HNO3	10ppm – Al, Ca, Fe, K, Mg, Na 1ppm – All others	Room temp.	1 month
ICP/Calibration Standard	12.5mL Stock Cal. Std. 5mL Stock Cal. Std. 1mL Stock Cal. Std. 5mL Stock LL Std.All adjusted to 100 mL with 10%HNO3	Std 4 – 0.05/1.25/2.5/3.75/5/7.5/12.5/25/125ppm Std 3 0.2/.5/1/1.5/2/3/5/10/50ppm Std 2 – .04/.1/.2/.3/.4/.6/2/10ppm Std 1 – 0.002/.005/.01/.015/.02/.03/.01/.5/1ppm	Room temp.	1 month

Table 8.3B: Working standard concentration, storage and preparation information.
(subject to revision as needed)

WORKING STANDARD PREPARATION
****ICP metals used – Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Sn, Sr, Ti, Tl, V, Zn, S***
****ICP/MS metals used – Ag, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, Se, Sn, Tl, V, Zn, B, U, Th, Na, Ca, Mg, K, Al, Ti, Sr***

Instrument Group/Standard	***How Prepared***	***Final Concentration***	***Source/ Storage***	***Expiration***
ICP/CCV	50mL Custom Stock CCV adjusted to 1000mL with 10% HNO_3	50ppm- Ca, K, Na 10ppm- Fe, Mg, Al 5ppm- S 2ppm-, Si, 1ppm- Cr, Co, Mn, , Sr, Ti, V, As, B, Cu, Li, Ni, Se, Tl, Zn 0.5ppm- Sn, Ag, Pb, Cd, Ba, Sb 0.2ppm Be, Mo	Room temp.	1 month
ICP/ICSA	100mL Custom Stock ICSA adjusted to 1000mL with10% HNO_3	500ppm – Al, Ca, Mg, 200ppm – Fe	Room temp.	1 month
ICP/ICSAB	100mL Custom Stock ICSA, 10mL Stock ICSAB adjusted to 1000mL with 10% HNO_3	500ppm – Al, Ca, Mg, 200ppm – Fe 1ppm – B, Cd, Pb, Ag, Ni, Si, Zn, 0.5ppm – all others except Sr, Li, S, K, Na	Room temp.	1 month
ICP/Yttrium	5mL Stock Yttrium adjusted to 10L with 10% HNO_3	5 ppm	Room temp.	1 month
ICP/Indium	3mL stock Indium adjusted to 1L with 10% HNO_3	30ppm	Room temp.	1 month
ICPMS/ICV	0.5mL Stock ICV A and B, adjusted to 50mL with 2% HNO_3/0.5%HCl	10ppm Ca, Mg, K, Na, Fe, Al 0.1ppm for all other elements	Room temp.	1 month
ICPMS/ Calibration Standard	1mL Stock Cal Std adjusted to 50mL with 2%HNO_3/0.5%HCl. Serial Dilutions are done each calibration from 0.2ppm Std.	Cal 6 – 20ppm, 2ppm, 0.2ppm Cal 5 – 10ppm, 1ppm, 0.1ppm Cal 4 – 5ppm, 0.5ppm, 0.05ppm Cal 3 – 1ppm, 0.1ppm, 0.01ppm Cal 2 – 0.2ppm, 0.02ppm, 0.002ppm Cal 1 – 0.1ppm, 0.01ppm, 0.001ppm	Room temp.	1 month
ICPMS/CCV	0.5mL Stock CCV adjusted to 50mL with 2% HNO_3/0.5%HCl.	10ppm- Ca, Mg, Na, K 1ppm-Fe, Al 0.1ppm- all other elements	Room temp.	1 month
ICPMS/ICSA	5mL Stock ICSA adjusted to 50mL with 2% HNO_3/0.5%HCl.	1000ppm – Cl 200ppm – C 100ppm – Al, Ca, Fe, Mg, P, K, Na, S 2ppm – Mo, Ti	Room temp.	1 month
ICPMS/ICSAB	5mL Stock ICSA, .5mL StockA and B ICSAB adjusted to 50mL with 2% HNO_3/0.5%HCl	1000ppm – Cl 200ppm – C 100ppm – Al, Ca, Fe, Mg, P, K, Na, S 2ppm – Mo, Ti 0.02ppm – all other elements	Room temp.	1Month
Hg/ICV	90µL of 1ppm Intermediate	0.003ppm – Hg	Room temp.	1Month

Table 8.3B: Working standard concentration, storage and preparation information. *(subject to revision as needed)*				
WORKING STANDARD PREPARATION ***ICP metals used – Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Sn, Sr, Ti, Tl, V, Zn, S*** ***ICP/MS metals used – Ag, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, Se, Sn, Tl, V, Zn, B, U, Th, Na, Ca, Mg, K, Al, Ti, Sr***				
Instrument Group/Standard	***How Prepared***	***Final Concentration***	***Source/ Storage***	***Expiration***
Hg/Calibration Standard	Soils and waters: Std 6 - 300µL of 1ppm Intermediate Std 5 - 150µL of 1ppmIntermediate Std 4 - 60µL of 1ppm Intermediate Std 3 -30µL of 1ppm Intermediate Std 2 - 12µL of 1ppm Intermediate Std 1 - 6µL of 1ppmIntermediate	Std 6 – 0.01ppm Std 5 – 0.005ppm Std 4 – 0.002ppm Std 3 – 0.001ppm Std 2 – 0.0004ppm Std 1 – 0.0002ppm	Room temp.	4 days
Hg/CCV	2.5ppb CCV - 75µL of 1ppm Intermediate	0.0025ppm	Room temp.	1 Month
Hg/LCS Waters	90µL of 1ppm Intermediate	0.003ppm – Hg	Room temp.	1 Month
Hg/LCS Soils	90uL of 1ppm Intermediate	0.003ppm- Hg	Room temp.	1 Month

8.4 INSTRUMENT CALIBRATION

Mercury Analyzer - SOP Numbers 340384A & 340384B

Calibration of the mercury analyzer is achieved using 5 standards. Acceptable calibration is achieved when the correlation coefficient ≥0.995. All results are calculated using software based on the peak area of the sample. A second source ICV is analyzed initially and must recover within ±10% for Methods 7470A/7471A/7471B and within ±5% for method 245.1. A primary source CCV is analyzed after every tenth sample and at the conclusion of the analytical sequence. The CCV must recovery within ±10% for all analyses. Spike analyses are performed on 5% of the samples analyzed using EPA Method 7470A/7471A/7471B and on 10% of the samples analyzed using EPA Method 245.1.

Inductively Coupled Plasma (ICP and ICPMS) - SOP Numbers 340386 & 340390

, Thermo 7400 ICP and Agilent ICPMS 7700, 7900 and calibrated using at least 3 standards. A new calibration curve is analyzed daily. All calculations are performed by software using computerized linear regression. The linear regression correlation coefficient for the each analyte in the calibration curve lines must be 0.995 or better for all methods, except for EPA 6010C and 6020A which must have a correlation coefficient of 0.998 or better, A second source ICV is run initially and a primary source CCV is run after every tenth sample. For method 200.7, the ICV must recover within 5% of the true value and for all other methods, the ICV must recover within 10% for methods 6010B/C/D, 6020, 6020A/B, and 200.8. The CCV for all methods must recover within 10% of the true value. Duplicate and spike analyses are performed on 5% of the samples for EPA Methods 6010B, 6010C, 6010D, 6020, 6020A, 6020B and on 10% of the samples analyzed using EPA Methods 200.7 & 200.8.

TABLE 8.4: CALIBRATION STANDARD CONCENTRATIONS
This table is subject to revision without notice

Analyte	ICP (mg/L)	ICP/MS (mg/L)	CVAA (ug/L)
Aluminum	0.20 - 500	0.01 - 2.0	
Antimony	0.01 – 5.0	0.001 - 0.2	
Arsenic	0.01 – 5.0	0.001 - 0.2	
Barium	0.005 - 10	0.001 - 0.2	
Beryllium	0.002 – 2.0	0.001 - 0.2	
Boron	0.05 – 5.0	0.001 - 0.2	
Cadmium	0.002 – 2.0	0.001 - 0.2	
Calcium	0.5 - 500	1.0 - 20.0	
Chromium	0.01 – 2.5	0.001 - 0.2	
Cobalt	0.01 – 2.5	0.001 - 0.2	
Copper	0.01 – 5.0	0.001 - 0.2	
Iron	0.10- 200	0.01 - 2.0	
Lead	0.005 – 2.0	0.001 - 0.2	
Lithium	0.015 – 3.75	----------------	
Magnesium	0.5 - 500	1.0 - 20.0	
Manganese	0.010 – 2.5	0.001 - 0.2	
Molybdenum	0.005 – 2.0	0.001 - 0.2	
Nickel	0.01 – 5.0	0.001 - 0.2	
Potassium	0.50 - 100	1.0 - 20.0	
Selenium	0.01 – 5.0	0.001 - 0.2	
Silicon	0.05 – 5.0	----------------	
Silver	0.005 – 2.5	0.001 - 0.2	
Sodium	0.50 - 500	1.0 - 20.0	
Strontium	0.01 – 2.5	0.001 - 0.2	
Sulfur	0.5 - 100	----------------	
Thallium	0.01 – 5.0	0.001 - 0.2	
Thorium	----------------	0.001 - 0.2	
Tin	0.05 – 5.0	0.001 - 0.2	
Titanium	0.05 – 2.5	0.001 - 0.2	
Uranium	----------------	0.001 - 0.2	
Vanadium	0.02 – 2.5	0.001 - 0.2	
Zinc	0.05 – 7.5	0.001 - 0.2	
Mercury			Blank, 0.0002 - 0.010

8.5 ACCEPTANCE/REJECTION OF CALIBRATION

The initial calibration curve is compared with previous curves for the same analyte. All new standard curves are immediately checked with a secondary source or laboratory control standard prepared from a separate source than those used for calibration. All curves are visually reviewed to ensure that acceptable correlation represents linearity. Calibration curves may be rejected for nonlinearity, abnormal sensitivity, or poor response of the laboratory control standard. Specific criteria for each instrument are outlined in Table 8.5.

Continuing calibration verification is performed after every tenth sample. If a check standard does not perform within established criteria then the instrument is evaluated to determine the problem. Once the problem is corrected, all samples between the last in control sample and the first out of control check are re-analyzed.

TABLE 8.5 INSTRUMENT CALIBRATION & QC

Instrument (Analysis)	Calibration Type	Number of Standards	Acceptance/ Rejection Criteria	Frequency
ICP & ICPMS	Linear/ Initial	3 - 5	6010B, 6020, 200.7 200.8: Must have a correlation coefficient of at least 0.995. 6010C/D, 6020A/B: Must have a correlation coefficient of at least 0.998	Daily
ICP & ICPMS	Initial	Secondary source (ICV)	6010B, 6010C/D, 6020, 6020A/B, 200.8: ICV must be within +/-10%; 200.7: ICV must be within +/-5%	After initial calibration
ICP & ICPMS	Initial	1 Initial Calibration Blank	< ½ RL, concentrations of common laboratory contaminants shall not exceed the RL	After initial calibration
ICP, ICPMS, Mercury	Continuing	1 mid-level ref. std. (CCV)	Must be within ±10%	Every 10th sample
ICP & ICPMS, Mercury	Continuing	1 Continuing Calibration Blank	< RL, concentrations of common laboratory contaminants must not exceed the RL	Every 10th sample
ICP & ICPMS	Continuing	1 ICSA 1 ICSAB	Must be within ±20% for ICP and ICPMS	After initial calibration, at end and every 8 hours of run time.
ICP, ICPMS, Mercury	Continuing	1 Method Blank	< RL (<1/2 RL for DOD).	1 per batch
ICP, ICPMS, Mercury	Continuing	1 Laboratory Control Standard	200.8, 200.7, 245.1: LCS must be within 15%. 6010B, 6010C/D,6020, 6020A/B,7470A, 7471A/B must be within 20%	1 per batch
ICP & ICPMS	Continuing	1 Matrix Spike (MS), 1 Matrix Spike Duplicate (MSD)	6010B, 6010C/D, 6020, 6020A/B: Spike must be within ±25%, 200.8, 200.7 must be within 30%. MS and MSD must have an RPD ≤20%	1 of each per batch

TABLE 8.5 INSTRUMENT CALIBRATION & QC				
Instrument (Analysis)	**Calibration Type**	**Number of Standards**	**Acceptance/ Rejection Criteria**	**Frequency**
Mercury	Linear/ Initial	3 - 5	Must have a correlation coefficient of at least 0.995	Daily
Mercury	Initial	Secondary source (ICV)	7470A, 7471: ICV must be within $\pm$10% 245.1: ICV must be within $\pm$5%	After initial calibration
Mercury	Continuing	1 Matrix Spike (MS), 1 Matrix Spike Duplicate (MSD)	7470A, 7471A/B: Spike must be within ±25%, 245.1 must be within 30%. MS and MSD must have an RPD $\leq$20%	1 of each per batch

9.0 Laboratory Practices

9.1 Reagent Grade Water

Reagent grade water is obtained from an ELGA Purelab Ultra system.

9.2 Glassware Washing and Sterilization Procedures

Much of the glassware used in metals preparation is disposable; however non-disposable glassware involved in metals preparation is washed with soap and water, rinsed in 1+1 nitric acid, and rinsed in DI water. Through digestion blanks, it has been determined that chromic acid washing is unnecessary. Glassware with visible gummy deposits remaining after washing is disposed of properly. All metals glassware is given another DI water rinse immediately prior to use. Metals glassware is segregated from all other glassware.

10.0 Analytical Procedures

10.1 A list of laboratory SOPs associated with the metals laboratory can be found in the following table.

TABLE 10.1: METALS DEPARTMENT SOPS

This table is subject to revision without notice

SOP #	Title
	TCLP SOPs
340358	TCLP
340704	SPLP
340363	EP TOX
340364	MEP
340705	California Waste Extraction Test
	Mercury SOPs
340384A	Mercury in Liquid Waste (Cold-Vapor Technique) 7470A/245.1
340384B	Mercury in Solid Waste (Cold-Vapor Technique) 7471A
	Metals Prep SOPs
340389	Acid Digestion of Aqueous Samples and Extracts Method 3005A/3010A/3015/3030C
340380	Digestion of Metals and Trace Elements in DW and Wastes Method 200.2
340388	Acid Digestion of Sediments, Sludge, Soils and Oils Method 3050B/3051

SOP #	Title
340354A	Turbidity-Metals Drinking Water Screen Only (EPA Method 180.1)
340392	Sodium Absorption Ratio
Metals Analysis SOPs	
340386	Metals by ICP Method 6010, 200.7
340390	Metals by ICP-MS Method 6020, 200.8

11.0 Quality Control Checks

NOTE: For specific guidance on each determinative method, including required quality control and specific state requirements/modifications, refer to the relevant laboratory standard operating procedure(s).

11.1 ESC participates in proficiency testing (PTs) in support of various laboratory accreditations/recognitions. Environmental samples are purchased from Phenova. The WS, WP and solid matrix studies are completed every 6 months. All proficiency testing samples are received and analyzed by method according to the vendor's instructions and according to the applicable analytical SOP.

11.2 Initial Demonstrations of Capability (IDOCs) are performed during new analyst training and/or prior to acceptance and use of any new method/instrumentation. Continuing Demonstration of Capability (CDOCs) must be updated at least annually. The associated data is filed within the department and available for review.

11.3 Matrix Spike and Matrix Spike Duplicates are performed on 5–10% of samples analyzed depending on analytical method requested. For methods 6010, 6020, 7470A and 7471A duplicates, matrix spikes and matrix spike duplicates are performed on 5% of samples. For methods 200.7, 200.8 and 245.1, the same QC is performed on 10% of samples. The RPD must not exceed 20%.

11.4 A laboratory control sample (LCS) is analyzed one per batch of samples. The acceptance criteria for all water samples is ±15% for 245.1, 200.7, and 200.8. All other methods have an acceptance criteria of ±20%.

11.5 A method preparation blank is performed per batch of samples processed. If the reporting limit [RL] is exceeded, the laboratory evaluates whether reprocessing of the samples is necessary, based on the following criteria:

- The blank contamination exceeds a concentration greater than 1/10 of the measured concentration of any sample in the associated preparation batch or
- The blank contamination is greater than 1/10 of the specified regulatory limit.

The concentrations of common laboratory contaminants must not exceed the reporting limit. Any samples associated with a blank that fail these criteria are re-processed in a subsequent preparation batch, except when the sample analysis resulted in non-detected results for the failing analytes.

12.0 DATA REDUCTION, VALIDATION, AND REPORTING

12.1 DATA REDUCTION

The analyst performs the data calculation and is responsible for the initial examination of the finished data. Data reduction steps applied to the raw data are outlined in ESC SOP #030201, *Data Handling and Reporting.* A secondary review of the data package is performed according to ESC SOP #030227, *Data Review*. The reviewer verifies that the analysis has been performed as required and meets method criteria, all associate data is present and complete, and also ensures that any additional documentation is completed as required (i.e. Ohio VAP checklists, required flags on test reports, etc.)

12.2 VALIDATION

The validation process consists of data generation, reduction review, and reporting results. Once data reduction is complete, validation is conducted by verification that the QC samples are within acceptable QC limits and that all documentation is complete, including the analytical report and associated QC. See Table 12.1 for current QC targets and controls and current reporting limits.

12.3 REPORTING

Reporting procedures are documented in SOP #030201, *Data Handling and Reporting.*

Table 12.3: QC Targets for Environmental Metals Accuracy (LCS), Precision and RLs
(subject to revision without notice)

Class	Analyte	Prep Method	Analysis Method	Matrix	Accuracy Range (%)	Precision (RPD)	RL (ppm)
(ICP-AES)	Aluminum	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.20
(ICP-AES)	Aluminum	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.20
(ICP-AES)	Aluminum	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	10
(ICP-MS)	Aluminum	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.10
(ICP-MS)	Aluminum	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.1
(ICP-MS)	Aluminum	3050B/3051A	6020/A/B	Solid	80 - 120	<20	10
(ICP-AES)	Antimony	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-AES)	Antimony	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-AES)	Antimony	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	2.0
(ICP-MS)	Antimony	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.001
(ICP-MS)	Antimony	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-MS)	Antimony	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.10
(ICP-AES)	Arsenic	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-AES)	Arsenic	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-AES)	Arsenic	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	2.0
(ICP-MS)	Arsenic	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.001

Table 12.3: QC Targets for Environmental Metals Accuracy (LCS), Precision and RLs
(subject to revision without notice)

Class	Analyte	Prep Method	Analysis Method	Matrix	Accuracy Range (%)	Precision (RPD)	RL (ppm)
(ICP-MS)	Arsenic	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-MS)	Arsenic	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.10
(ICP-AES)	Barium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.005
(ICP-AES)	Barium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.005
(ICP-AES)	Barium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	0.50
(ICP-MS)	Barium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.002
(ICP-MS)	Barium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.005
(ICP-MS)	Barium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.20
(ICP-AES)	Beryllium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.002
(ICP-AES)	Beryllium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-AES)	Beryllium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	0.20
(ICP-MS)	Beryllium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.001
(ICP-MS)	Beryllium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-MS)	Beryllium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.10
(ICP-AES)	Boron	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.20
(ICP-AES)	Boron	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.20
(ICP-AES)	Boron	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	10
(ICP-MS)	Boron	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.02
(ICP-MS)	Boron	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.02
(ICP-MS)	Boron	3050B/3051A	6020/A/B	Solid	80 - 120	<20	1.0
(ICP-AES)	Cadmium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.002
(ICP-AES)	Cadmium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-AES)	Cadmium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	0.50
(ICP-MS)	Cadmium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.001
(ICP-MS)	Cadmium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.001
(ICP-MS)	Cadmium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.10
(ICP-AES)	Calcium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	1.0
(ICP-AES)	Calcium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	1.0
(ICP-AES)	Calcium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	100
(ICP-MS)	Calcium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	1.0
(ICP-MS)	Calcium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	1.0
(ICP-MS)	Calcium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	50
(ICP-AES)	Chromium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-AES)	Chromium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-AES)	Chromium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	1.0
(ICP-MS)	Chromium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.001
(ICP-MS)	Chromium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-MS)	Chromium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.10

Table 12.3: QC Targets for Environmental Metals Accuracy (LCS), Precision and RLs
(subject to revision without notice)

Class	Analyte	Prep Method	Analysis Method	Matrix	Accuracy Range (%)	Precision (RPD)	RL (ppm)
(ICP-AES)	Cobalt	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-AES)	Cobalt	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-AES)	Cobalt	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	1.0
(ICP-MS)	Cobalt	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.001
(ICP-MS)	Cobalt	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-MS)	Cobalt	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.10
(ICP-AES)	Copper	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-AES)	Copper	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-AES)	Copper	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	2.0
(ICP-MS)	Copper	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.002
(ICP-MS)	Copper	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.005
(ICP-MS)	Copper	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.20
(ICP-AES)	Iron	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.10
(ICP-AES)	Iron	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.10
(ICP-AES)	Iron	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	10
(ICP-MS)	Iron	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.10
(ICP-MS)	Iron	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.10
(ICP-MS)	Iron	3050B/3051A	6020/A/B	Solid	80 - 120	<20	250
(ICP-AES)	Lead	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.005
(ICP-AES)	Lead	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.005
(ICP-AES)	Lead	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	0.50
(ICP-MS)	Lead	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.001
(ICP-MS)	Lead	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-MS)	Lead	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.10
(ICP-AES)	Lithium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.015
(ICP-AES)	Lithium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.015
(ICP-AES)	Lithium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	5.0
(ICP-AES)	Magnesium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	1.0
(ICP-AES)	Magnesium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	1.0
(ICP-AES)	Magnesium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	100
(ICP-MS)	Magnesium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	1.0
(ICP-MS)	Magnesium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	1.0
(ICP-MS)	Magnesium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	50
(ICP-AES)	Manganese	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-AES)	Manganese	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-AES)	Manganese	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	1.0
(ICP-MS)	Manganese	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.002
(ICP-MS)	Manganese	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.005

Table 12.3: QC Targets for Environmental Metals Accuracy (LCS), Precision and RLs
(subject to revision without notice)

Class	Analyte	Prep Method	Analysis Method	Matrix	Accuracy Range (%)	Precision (RPD)	RL (ppm)
(ICP-MS)	Manganese	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.20
(CVAA)	Mercury	7471A/B	7471A/B	Solid	80 - 120	<20	0.02
(CVAA)	Mercury	7470A	7470A	Liquid/Aqueous	80 - 120	<20	0.0002
(CVAA)	Mercury	245.1 /7470A	245.1	Liquid/Aqueous	85 - 115	<20	0.0002
(ICP-AES)	Molybdenum	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.005
(ICP-AES)	Molybdenum	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.005
(ICP-AES)	Molybdenum	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	0.50
(ICP-MS)	Molybdenum	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.002
(ICP-MS)	Molybdenum	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.005
(ICP-MS)	Molybdenum	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.20
(ICP-AES)	Nickel	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-AES)	Nickel	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-AES)	Nickel	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	2.0
(ICP-MS)	Nickel	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.001
(ICP-MS)	Nickel	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-MS)	Nickel	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.10
(ICP-AES)	Potassium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	1.0
(ICP-AES)	Potassium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	1.0
(ICP-AES)	Potassium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	100
(ICP-MS)	Potassium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	1.0
(ICP-MS)	Potassium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	1.0
(ICP-MS)	Potassium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	50
(ICP-AES)	Selenium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-AES)	Selenium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-AES)	Selenium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	2.0
(ICP-MS)	Selenium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.001
(ICP-MS)	Selenium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-MS)	Selenium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.10
(ICP-AES)	Silicon	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.20
(ICP-AES)	Silicon	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.20
(ICP-AES)	Silicon	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	20
(ICP-AES)	Silver	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.005
(ICP-AES)	Silver	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.005
(ICP-AES)	Silver	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	1.0
(ICP-MS)	Silver	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.001
(ICP-MS)	Silver	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-MS)	Silver	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.20
(ICP-AES)	Sodium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	1.0

Table 12.3: QC Targets for Environmental Metals Accuracy (LCS), Precision and RLs

(subject to revision without notice)

Class	Analyte	Prep Method	Analysis Method	Matrix	Accuracy Range (%)	Precision (RPD)	RL (ppm)
(ICP-AES)	Sodium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	1.0
(ICP-AES)	Sodium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	100
(ICP-MS)	Sodium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	1.0
(ICP-MS)	Sodium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	1.0
(ICP-MS)	Sodium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	50
(ICP-AES)	Strontium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-AES)	Strontium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-AES)	Strontium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	1.0
(ICP-MS)	Strontium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-MS)	Strontium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-MS)	Strontium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.50
(ICP-AES)	Sulfur	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	1.0
(ICP-AES)	Sulfur	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	1.0
(ICP-AES)	Sulfur	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	100
(ICP-AES)	Thallium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-AES)	Thallium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-AES)	Thallium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	2.0
(ICP-MS)	Thallium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.001
(ICP-MS)	Thallium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-MS)	Thallium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.10
(ICP-MS)	Thorium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-MS)	Thorium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-MS)	Thorium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	1
(ICP-AES)	Tin	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.05
(ICP-AES)	Tin	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.05
(ICP-AES)	Tin	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	5.0
(ICP-MS)	Tin	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.001
(ICP-MS)	Tin	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.002
(ICP-MS)	Tin	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.10
(ICP-AES)	Titanium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.05
(ICP-AES)	Titanium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.05
(ICP-AES)	Titanium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	5.0
(ICP-MS)	Titanium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-MS)	Titanium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-MS)	Titanium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.50
(ICP-AES)	Vanadium	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.02
(ICP-AES)	Vanadium	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.02
(ICP-AES)	Vanadium	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	2.0

Table 12.3: QC Targets for Environmental Metals Accuracy (LCS), Precision and RLs
(subject to revision without notice)

Class	Analyte	Prep Method	Analysis Method	Matrix	Accuracy Range (%)	Precision (RPD)	RL (ppm)
(ICP-MS)	Vanadium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.002
(ICP-MS)	Vanadium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.005
(ICP-MS)	Vanadium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	0.20
(ICP-MS)	Uranium	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-MS)	Uranium	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.01
(ICP-MS)	Uranium	3050B/3051A	6020/A/B	Solid	80 - 120	<20	1
(ICP-AES)	Zinc	200.2 NPDES	200.7	Liquid/Aqueous	85 - 115	<20	0.05
(ICP-AES)	Zinc	3015/3010	6010B/C/D	Liquid/Aqueous	80 - 120	<20	0.05
(ICP-AES)	Zinc	3050B/3051A	6010B/C/D	Solid	80 - 120	<20	5.0
(ICP-MS)	Zinc	200.2 NPDES	200.8	Liquid/Aqueous	85 - 115	<20	0.01
(ICP-MS)	Zinc	3015/3010	6020/A/B	Liquid/Aqueous	80 - 120	<20	0.025
(ICP-MS)	Zinc	3050B/3051A	6020/A/B	Solid	80 - 120	<20	1.0

13.0 CORRECTIVE ACTIONS

13.1 In the event that a nonconformance occurs in conjunction with the analytical batch, a corrective action response (CAR) form must be completed. The cause of the event is stated on the form and the measures taken to correct the nonconformance clearly defined. The effectiveness of the corrective action must be assessed and noted. The CARs are kept on file by the Regulatory Affairs Department. Corrective action procedures are documented in SOP #030208, *Corrective and Preventive Action*

13.2 Required Corrective Action

Control limits have been established for each type of analysis. When these control limits are exceeded, corrective action must be taken. Calculated sample spike control limits are also used.

All samples and procedures are governed by ESC's quality assurance program. General corrective actions are as follows; however additional and more specific direction is provided in the specific determinative procedure. For more information, see the appropriate determinative SOP

13.2.1 Laboratory QC Criteria and Appropriate Corrective Actions

If the analytical method contains acceptance/rejection criteria and it is more stringent than those controls generated by the laboratory, the method criteria takes precedence.

13.2.2 Calibration Verification Criteria Are Not Met: Inorganic Analysis

Rejection Criteria - See Table 8.5.

Corrective Action - If a standard curve linearity is not acceptable and/or the absorbance for specific standard(s) is not analogous to historic data, the instrument settings, nebulizer, etc. are examined to ensure that nothing has been altered, clogged, etc. The working standards are made fresh, intermediate dilutions are re-checked and the instrument is re-calibrated. If a problem persists, the Department Supervisor is notified for further action.

If the initial reference check sample is out of control, the instrument is re-calibrated and the check sample is rerun. If the problem continues the check sample is re-prepared. If the problem still exists then the standards and reagent blank are re-prepared. If the problem persists, the Department Supervisor is notified for further action.

13.2.3 Out Of Control Blanks: Applies to Method, Trip, Rinsate & Instrument Blanks

Rejection Criteria - Blank reading is more than the RL for Method Blanks and/or Instrument Blanks. (½ the RL for Method Blanks and/or instrument blanks for DoD work and also may be required for some customers and programs.)

Corrective Action - Standard curves and samples are evaluated for any obvious contamination that may be isolated or uniform throughout the sequence. If necessary, reagents, QC samples and field samples are re-prepared and re-analyzed. Re-analyses are not initiated until the cause of the contamination is identified and resolved. If samples have already been partially prepared or analyzed, the Department Supervisor is consulted to determine if data needs to be rejected or if samples need to be re-prepped.

13.2.4 Out Of Control Laboratory Control Standards (LCS)

Rejection Criteria - If the performance is outside of lab-generated control (Listed in Table 12.3).

Corrective Action - Instrument settings are checked. The LCS standard is re-analyzed. If the LCS is still out of control, re-calibration is performed, and samples affected since the last in control reference standard are re-analyzed. If the LCS fails again after re-calibration, the entire workgroup must be re-prepped. The Department Supervisor is consulted for further action.

13.2.5 Out Of Control Matrix Spike Samples

Rejection Criteria - If either the MS or MSD sample is outside the established control limits.

Corrective Action - Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Batch acceptance, however, is based on method blank and LCS performance, not on MS/MSD recoveries. Specific methods, customers, and programs may require further corrective action in some cases.

13.2.8 Out Of Control Calibration Standards: ICV, CCV, SSCV

Rejection Criteria - If the performance is outside of method requirements.

Corrective Action - Instrument settings are checked, calibration verification standard is rerun. If the standard is still out of control, re-calibration is performed, and samples affected since the last in control reference standard are rerun. The Department Supervisor is consulted for further action.

13.3 Responsibility - It is the Department Supervisor's responsibility to evaluate the validity of the corrective action response and submit it to the QA department for processing. In addition, the Supervisor is responsible for appointing the appropriate person within the department to be responsible for correcting the nonconformance. When a corrective action warrants a cessation of analysis, the following personnel are responsible for executing the "stop work" order:

- Laboratory Manager
- QA Department
- Department Supervisor
- Technical Service Representative

14.0 RECORD KEEPING

Record keeping is outlined in SOP #030230, *Standards Logger, SOP #030227, Data Review* and SOP #030201, *Data Handling and Reporting*

15.0 QUALITY AUDITS

System and data quality audits are outlined in the ESC Quality Assurance Manual Version 12.0 and *SOP #010104, Internal Audits.*

16.0 REVISIONS

The Regulatory Affairs Department has an electronic version of this Quality Assurance Manual with tracked changes detailing all revisions made to the previous version. This version is available upon request. Revisions to the previous version of this appendix are summarized in the table below.

Document	**Revision**
Quality Assurance Manual Version 15.0 (Appendix V)	General – Replaced the term "client" with the term "customer" Section 7.1 – Revised to state all soils are stored <6°C not just soils for Hg Section 8.0 – Updated Software Table 8.1 – Updated Equipment List Tables 8.3A and 8.3B – Updated Standards Table 8.4 – Updated range of calibration standards Table 10.1 – Updated SOP List Section 11.1 – Removed AIHA PTs Section 11.4 – Removed AIHA LCS Section 12.3 – Removed AIHA QC Table Table 12.3 – Updated RLs and added Thorium by ICP/MS

1.0 *SIGNATORY APPROVALS*

VOLATILES QUALITY ASSURANCE MANUAL

APPENDIX VI TO THE ESC QUALITY ASSURANCE MANUAL

for

ESC LAB SCIENCES
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Prepared by

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NOTE: The QAM has been approved by the following people.

7/13

Chris Johnson, B.S., Organics Manager 615-773-9774

Jim Brownfield, B.S., Compliance Director 615-773-9681

Steve Miller

Steve Miller, B.S., Quality Assurance Manager, 615-773-9684

Heidi Ferrell, B.S., Volatiles Supervisor, 615-773-9799

2.0 *APPENDIX TABLE OF CONTENTS*

3.0 SCOPE AND APPLICATION

This appendix discusses specific QA requirements for general analytical protocols to ensure analytical data generated from the Volatiles (VOC) laboratory are scientifically valid and are of acceptable quality. Any deviations from these requirements and any deviations that result in nonconforming work must be immediately evaluated and their corrective actions documented.

4.0 LABORATORY ORGANIZATION AND RESPONSIBILITIES

ESC Lab Sciences offers diverse environmental capabilities that enable the laboratory to provide the customer with both routine and specialized services, field sampling guidance and broad laboratory expertise. A brief outline of the organization and responsibilities as they apply to the ESC Quality Assurance Program is presented in *Section 4.0 in the ESC Quality Assurance Manual.*

5.0 PERSONNEL AND TRAINING

5.1 PERSONNEL

Heidi Ferrell, with a B.S. degree in Chemistry, is the Department Supervisor and is responsible for the overall production of the department; including the management of the staff and scheduling. Ms. Ferrell has 10 years of environmental laboratory experience. In her absence, Brett Andersen assumes responsibility for departmental decisions in the Volatiles Lab.

Brett Andersen, with a B.S in Microbiology and M.S. in Plant Microbiology and Pathology, is the Primary Analyst for the Volatiles Lab. He is proficient in volatile organic analytical methods and has 10 years of environmental laboratory experience.

5.2 TRAINING

5.2.1 All new analysts to the laboratory are trained by a Primary Analyst or Supervisor according to ESC protocol. ESC's training program is outlined in *SOP 030205 Technical Training and Personnel Qualifications.* Performance is documented using an initial demonstration of capability (IDOCs) and continuing demonstration of capability (CDOC). On-going acceptable capability in VOC Laboratory is also demonstrated by acceptable participation in the Phenova proficiency testing program (PTs) and using daily Quality Control sample analyses. Documentation of analyst training is maintained on file within the department.

6.0 FACILITIES AND LABORATORY SAFETY

6.1 FACILITIES

The main area of the instrumentation laboratory in Building #2 has approximately 7000 square feet with 700 square feet of bench area and 300 square feet of preparatory area. The lighting standard is fluorescence. The air handling systems are (1) 60-ton units with gas heating and (1) 25-ton unit. The physical and air-handling separations, between this laboratory and other ESC sections, prevent potential cross-contamination between solvent vapor generation and incompatible analytical processes. Waste disposal containers are located in the laboratory and Clean Harbors serves as ESC's waste disposal carrier. Waste handling is discussed in detail in Section 6.0 of the ESC Quality Assurance Manual. ESC's building information guides and site plan are shown in Appendix I.

6.2 LABORATORY SAFETY

- Laboratory access is limited when work is being performed.
- All procedures where chemicals are prepared or splashes may occur are conducted in laboratory exhaust hoods.

ESC's laboratory safety guidelines are detailed in the *ESC Chemical Hygiene Plan.*

7.0 SAMPLING PROCEDURES

7.1 FIELD SAMPLING PROCEDURES, SAMPLE STORAGE, AND HANDLING

- Field Sampling procedures are described in Appendix III of this ESC Quality Assurance Manual. Sample information is recorded and kept on the ESC chain of custody and field logbooks.
- Matrices for VOC environmental analyses include groundwater, wastewater, drinking water, soil, and sludge.
- Sample containers, preservation methods and holding times vary depending on analyses requested. Please see determinative procedures for specific directions.
- Plastic containers or lids may NOT be used for the storage of samples due to sample contamination from the phthalate esters and other hydrocarbons in the plastic.
- Environmental sample containers should be filled carefully to prevent any portion of the sample from coming into contact with the sampler's gloves causing possible contamination.
- Containers for VOC samples should be selected carefully to minimize headspace that could lead to a low bias in the analytical results. Headspace is monitored during sample login and is documented on the Sample Receipt Corrective Action form when observed.

8.0 EQUIPMENT

8.1 EQUIPMENT LIST

TABLE 8.1 – LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Volatiles Analysis
This table is subject to revision without notice

Item	*Manufacturer*	*Model*	*Instrument Name*	*#*	*Serial #*	*Location*
Gas Chromatograph	Hewlett Packard	5890 Series II	VOCGC	1	3333A31215	Volatiles
Gas Chromatograph	Agilent	6890	VOCGC	2	CN10609095	Volatiles
Gas Chromatograph	Hewlett Packard	5890 Series II	VOCGC	3	2950A26786	Volatiles
Gas Chromatograph	Hewlett Packard	5890 Series II	VOCGC	4	3336A50614	Volatiles
Gas Chromatograph	Hewlett Packard	5890 Series II	VOCGC	5	3027A29678	Volatiles
Gas Chromatograph	Hewlett Packard	5890 Series II	VOCGC	6	2950A27895	Volatiles
Gas Chromatograph	Hewlett Packard	5890 Series II	VOCGC	7	3313A37610	Volatiles
Gas Chromatograph	Hewlett Packard	5890 Series II	VOCGC	13	2921A23548	Volatiles
Gas Chromatograph	Agilent	6890	VOCGC	10	US00022519	Volatiles
Gas Chromatograph	Agilent	6890	VOCGC	12	US00000410	Volatiles
Gas Chromatograph	Agilent	6890	VOCGC	14	CN10408054	Volatiles
Gas Chromatograph	Agilent	6890	VOCGC	15	US10232130	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5975 MSD	VOCMS	2	GCCN10641044 MSUS63234371	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5973 MSD	VOCMS	6	GCCN10343037 MSUS44647141	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5973MSD	VOCMS	4	GCUS00003465 MSUS82311257	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5973MSD	VOCMS	7	GCUS00040221 MS05040022	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5973MSD	VOCMS	8	GCUS00040221 MS03940725	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5973MSD	VOCMS	13	GCCN103390006 MSUS91911078	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5973MSD	VOCMS	14	GCUS00009794 MSUS63810153	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5973MSD	VOCMS	16	GCUS00006479 MSUS82321899	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5973MSD	VOCMS	18	GC CN10517046 MSUS03340424	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5973MSD	VOCMS	19	GCCN10611062 MSUS60542638	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5975MSD	VOCMS	20	GCCN621S4367 MSUS469A4832	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5975MSD	VOCMS	21	GCCN621S4368 MSUS469A4833	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975MSD	VOCMS	22	GCCN10728074 MSUS71236615	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5975MSD	VOCMS	23	GCCN10728068 MSUS71236616	Volatiles

TABLE 8.1 – LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Volatiles Analysis
This table is subject to revision without notice

Item	*Manufacturer*	*Model*	*Instrument Name*	*#*	*Serial #*	*Location*
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975MSD	VOCMS	24	GCCN10151020 MSUS10223406	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975MSD	VOCMS	25	GCCN99205324 MSUS98003634	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975MSD	VOCMS	26	GCCN10301152 MSUS10313616	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975MSD	VOCMS	27	GCCN10301155 MSUS10313619	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5973MSD	VOCMS	28	GCUS000034135 MSUS94240103	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5973MSD	VOCMS	29	GCUS00033898 MSUS94240096	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	6890 GC/ 5973MSD	VOCMS	30	GCUS10208101 MSUS10442360	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975MSD	VOCMS	31	GCUS14453011 MSUS54441572	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975MSD	VOCMS	32	GCCN13113015 MSUS92013978	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975MSD	VOCMS	33	GCCN11351165 MSUS52440724	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975MSD	VOCMS	34	GCCN13231014 MSUS50680012	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975MSD	VOCMS	35	GCCN10849077 MSUS83131017	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975 MSD	VOCMS	36	GCCN11281031 MSUS50680017	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5977MSD	VOCMS	37	GCCN15333012 MSUS1534M407	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975MSD	VOCMS	38	GCCN11281031 MSUS83141150	Volatiles
Gas Chromatograph/ Mass Spectrometer	Agilent	7890 GC/ 5975MSD	VOCMS	39	GCCN10940090 MSUS92043681	Volatiles
Centurion Autosampler	(14) PTS/EST	Centurion				Volatiles
Autosampler	(24) Varian	Archon				Volatiles
Autosampler	(2) CDS	7400				Volatiles
Autosampler	(1) OI Analytical	4100				Volatiles
Purge and Trap	(18) OI Analytical	Eclipse				Volatiles
Purge and Trap	(15) PTS/EST	Encon				Volatiles
Purge and Trap	(7)PTS/EST	Evolution				Volatiles

8.2 EQUIPMENT PREVENTIVE MAINTENANCE, EQUIPMENT CALIBRATION

INSTRUMENT	P. M. DESCRIPTION	FREQUENCY
Analytical Balances	•Check with Class "I" weights	Daily; tolerance $\pm$0.1%
Analytical Balances	•Service/Calibration (semiannual contract maintenance and calibration check)	Semiannually

8.2 EQUIPMENT PREVENTIVE MAINTENANCE, EQUIPMENT CALIBRATION

INSTRUMENT	P. M. DESCRIPTION	FREQUENCY
Refrigerators & Incubators	•Maintenance service	As needed - determined by daily temperature performance checks
Gas Chromatograph Detectors: FID	Change Quartz jet; clean; replace flame tip	As needed - when deterioration is noticeable
Gas Chromatograph Detectors: PID	Change or clean lamp	As needed - when deterioration is noticeable
Gas Chromatograph/Mass Spectrometer	•Autotune Report	Inspected daily
Gas Chromatograph/Mass Spectrometer	•Clean ion source	As needed to maintain high mass resolution
Gas Chromatograph/Mass Spectrometer & Gas Chromatographs	•Replace septum and liner	As needed to maintain injection port inert
Gas Chromatograph/Mass Spectrometer	•Replace vacuum pump oil	Every 6 months
Gas Chromatograph/Mass Spectrometer & Gas Chromatographs	•Replace column	When separation begins to degrade
Archon/ Centurion Autosampler	•Monitor the Daily QC, including internal standards for changes or failure.	Daily with use

8.3 STANDARDS AND REAGENTS

Table 8.3A: Standard stock sources, description and calibration information.
This table is subject to revision without notice

Method	Vendor*	Description	Calibration	Storage Req.	Expiration
8260	Ultra	Gases Mix	Primary	-30°C to 4°C	1 week
	Ultra	Custom Standard	Primary	2°C to 8°C	6 months
	NSI	Mix 2	Primary	2°C to 8°C	6 months
	Restek	Acrolein	Primary	<0°C	3 months
	SPEX	Custom (AZ analytes)	Primary	<0°C	6 months
	Restek	TX TPH Mix (GRO)	Primary	<10°C	6 months
	SPEX	Custom (AZ analytes)	Secondary	<0°C	6 months
	NSI	Custom VOC Mix 2	Secondary	2°C to 8°C	6 months
	Restek	Custom VOC Standard #1	Secondary	<0°C	6 months
	Restek	Custom VOCStandard #2	Secondary	<0°C	6 months
	Restek	Custom VOC Standard #3	Secondary	<0°C	6 months
	Restek	Custom VOC Standard #4	Secondary	<0°C	6 months
	Restek	Acrolein	Secondary	<0°C	3 months
	Ultra	Petroleum Products Solution (GRO)	Secondary	15°C to 30°C	6 months
8015 (GRO)	Restek	Certified BTEX in Unleaded Gas Composite Standard	Secondary	<0°C	6 months
	NSI	Gas Composite	Primary	2°C to 8°C	6 months
8021	Restek	WISC PVOC/GRO Mix	Secondary	<0°C	6 months
	NSI	PVOC/GRO Mix WI	Primary	4° ± 2°C	6 months
VPH	NSI	Primary VPH Dilution Std	Primary	15°C to 30°C	6 months
	NSI	Custom VPH LCS MIX	Secondary	4° ± 2°C	6 months

Equivalent Providers may be utilized.

TABLE 8.3B: Working Standard Concentrations
This table is subject to revision without notice

ORGANIC COMPOUNDS	Method #	GC/MS	GC
VOCs by GC/MS	524.2, 624, SM6200B 20th, 8260B	GW/WW , 0.5, 1, 2, 5, 10, 25, 40, 75, 100, 200µg/L DW 0.25, 0.5, 1, 2, 5, 10, 25, 50, 100, 150µg/L GRO 0.4, 1, 2, 4, 5, 7, 10, 20ug/mL	
BTEX/GRO, 8015MOD, WI GRO, LA TPH G, OHIO GRO, WI PVOC, BTEX/OA1	BTEX 8021 GRO 8015, BTEX OA1 or state specific GRO		BTEX 0.5, 1, 5,10, 25,50,100,150,200, 250ug/L (m,p-Xylene is doubled) GRO 0.055, 0.11, 0.55, 1.1. 2.75, 5.5, 11mg/L
MADEP VPH	MADEP VPH		Aromatic C9-C10: 0.001, 0.002, 0.01, 0.02, 0.05, 0.1, 0.2, 0.4, 1.0, 2.0mg/L Aliphatic C5-C8: 0.006, 0.012, 0.06, 0.12, 0.3, 0.6, 1.2, 2.4, 6.0, 12.0mg/L Aliphatic C9-C12: 0.007, 0.014, 0.07, 0.14, 0.36, 0.7, 1.4, 2.8, 7.0, 14.0mg/L

8.4 INSTRUMENT CALIBRATION

602 - BTEX - SOP Number 330351

The gas chromatograph is calibrated using the internal standard procedure. A standard curve is prepared using a minimum of three concentration levels for each compound of interest. The calibration standards are tabulated according to peak height or area responses against concentration for each compound and response factors are calculated. If the response factors are <10 % RSD over the working range, the average RF can be used for calculations. Alternatively, when the response factor criteria is exceeded, the analyst may utilize a linear calibration model of response ratios (i.e. Area/Ref. Area or Amt./Ref Amt.) for quantitation providing that the correlation coefficient is at least 0.990 (0.995 for USACE Projects). An independent, or second source, calibration verification standard (SSCV) is analyzed after each initial calibration and should recover within ±20% of the expected concentration for each analyte.

During the analytical sequence, the stability of the initial calibration is verified, following every 10th sample and at the end of the sequence, by the analysis of continuing calibration verification (CCV) standards. The CCV must recovery within 15% of the expected concentration for each analyte.

At daily instrument startup and in lieu of performing an entire initial calibration, the working calibration curve or response factors are verified on each working day by the analysis of a Quality Control Check Standard. The responses must meet the criteria found in Table 2 of the 602 Method. If the responses do not meet these criteria, the analysis must be repeated. If the standard still does not meet the criteria, a new calibration curve is prepared.

8021B - BTEX - SOP Number 330351

The gas chromatograph is calibrated using the internal standard procedure. A standard curve is prepared using a minimum of five concentration levels for each compound of interest.

The calibration standards are tabulated according to peak height or area responses against concentration for each compound and response factors are calculated. If the response factors are <20 % RSD over the working range, the average RF can be used for calculations. Alternatively, the results can be used to plot a calibration curve of response ratios (Area/Ref. Area) vs (Amt./Ref Amt). If the response factors of the initial calibration are <20 % RSD over the calibration range, the average RF can be used for calculations. Alternatively, when the response factor criteria is exceeded, the analyst may utilize a linear calibration model of response ratios (i.e. Area/Ref. Area or Amt./Ref Amt.) for quantitation providing that the correlation coefficient is at least 0.990 (0.995 for USACE Projects). An independent, or second source, calibration verification standard (SSCV) is analyzed after each initial calibration and should recover within ±20% of the expected concentration for each analyte.

At daily instrument startup and in lieu of performing an entire initial calibration, the most recent calibration curve may be verified by the analysis of check calibration verification standard (CCV). If the response for any analyte in this check varies from the predicted response by more than ±20%, the analysis must be repeated using fresh standard. If the standard still does not meet the acceptance criteria, a new initial calibration curve must be generated.

8015B/C/D & State Methods - Gasoline Range Organics - SOP Number 330351

Certain state accreditation/registration programs may have specific requirements for calibration and analysis that must be met. Those requirements supersede the general guidance provided in this section and are addressed in the relevant determinative SOP. For EPA Method 8015 for routine GRO analyses, the gas chromatograph is calibrated using the internal standard procedure. A standard curve is prepared using a minimum of five concentration levels for each analyte of interest. The calibration range must represent the typical environmental sample concentration and include the RL as the lowest calibration point. The linear range of the instrument must also be monitored to ensure that the maximum calibration point is within detection range. The calibration standards are tabulated according to peak height or area responses against concentration for each compound and response factors are calculated. If the response factors of the initial calibration are <20 % RSD over the calibration range, the average RF can be used for calculations. Alternatively, when the response factor criteria is exceeded, the analyst may utilize a linear calibration model of response ratios (i.e. Area/Ref. Area or Amt./Ref Amt.)

for quantitation providing that the correlation coefficient is at least 0.990 (0.995 for USACE DOD Projects). An independent, or second source, calibration verification standard (SSCV) is analyzed after each initial calibration and should meet criteria of $\pm$20% of the expected concentration for each analyte.
The working calibration curve or response factors are verified on each working day by the analysis of one or more calibration standards. If the response of any analyte varies from the predicted response by more than 20% RSD, the analysis must be repeated using a new calibration standard. If the standard still does not meet the criteria, a new calibration curve is prepared.

8260B/C, 624, SM6200B, 524.2 - Gas Chromatography/Mass Spectrometry (GC/MS): Volatile Organics - SOP Numbers 330363 & 330364

Detector mass calibration is performed daily using the autotune function of the GC/MS analytical system and BFB (Bromofluorobenzene). Following verification of the appropriate masses, the instrument sensitivity is verified by injecting a tuning solution containing bromofluorobenzene (BFB). The BFB spectra must meet the following ion abundance criteria:

Mass	Ion Abundance Criteria
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	base peak, 100% relative abundance
96	5 to 9% of mass 95
173	Less than 2% of mass 174
174	greater than 50% of mass 95
175	5 to 9% of mass 174
176	greater than 95% but less than 101% of mass 174
177	5 to 9% of mass 176

Successful tuning must occur every 12 hours for method 524.2, 8260B/C & SM6200B and every 24 hours for method 624.

Following successful tuning, the GC/MS is calibrated using the internal standard procedure. A standard curve is prepared using a minimum of three standards for method 624, 524.2 and five standards for method 8260B/C and SM6200B. The calibration standards are tabulated according to peak height or area against concentration and the concentrations and responses of the internal standard analytes. The results are used to determine a response factor for each analyte in each standard injected. A calibration curve is constructed and is determined to be acceptable if each target analyte is found to be constant over the working range as defined as:

$\leq$15% RSD for methods 8260B
$\leq$20% RSD for method 524.2, 8260C, SM6200B
$\leq$35% RSD for method 624

Per the analytical method, specific target analytes are defined as calibration check compounds (CCCs) or system performance check compounds (SPCCs). The calibration checks compounds (CCCs) for method 8260B must be ≤30% RSD. When these conditions are met, linearity through the origin can be assumed and the average RF can be used in place of a calibration curve.

Linear regression can be used for any target compound exceeding the RSD criteria but less than 40% (poor performers <50%), if the correlation coefficient is 0.990 or better. For USACE/DOD projects the correlation coefficient must meet 0.995 or better. The same is true for the CCCs in EPA 8260B as long as the RSD does not exceed 30%.

8260B SPCCs:	
Analyte	**Minimum Average Response Factor**
Chloromethane	0.10
1,1-Dichloroethane	0.10
Bromoform	0.10
Chlorobenzene	0.30
1,1,2,2-Tetrachloroethane	0.30

8260B CCCs:	
1,1-Dicholoethene	Toluene
Chloroform	Ethylbenzene
1,2-Dichloropropane	Vinyl Chloride

The initial calibration range must represent the typical environmental sample and include the RL as the lowest calibration point. The linear range of the instrument must be monitored to ensure that the maximum calibration point is within the range.

A second source calibration verification standard is analyzed after each calibration. The second source should recover within 30% for all CCC compounds and within 40% for other analytes of interest, with the exception of analytes known to perform poorly (i.e. low purging efficiency, etc.) that will meet historical LCS accuracy limits. For 524.2 the second source calibration verification standard must be within ± 30%. Following successful calibration, the analysis of field and QC samples may begin. Sample analysis may be performed only during the timeframe of a valid tuning cycle (12 hours for 8260B, 524.2 & SM6200B and 24 hours for 624). Following the expiration of the tuning clock, the instrument must be re-tuned and either recalibrated or the existing calibration must be re-verified.

For 8260B/C, 524.2 & SM6200B analyses, daily calibration verification includes successful demonstration of BFB sensitivity and the injection of a mid-level CCV standard containing all the target analytes of interest and all required system monitoring compounds, where applicable. The BFB tune must meet the ion abundance criteria (see table above). For 8260B, each SPCC in the calibration verification standard must meet the minimum response factors listed above. The CCC must achieve the criteria of +/- 20% RSD. For 524.2 & SM6200B, each target analyte must achieve a drift or difference

of +/-30% of the expected concentration. For V8260C each target analyte must achieve a drift or difference of +/-20% of the expected concentration.
Each internal standard in the CCV must recover between -50% to + 100%, when compared to the same internal standard compound in the mid-point standard of the initial calibration curve. Additionally, if the retention time of an internal standard changes by more than 30 seconds from the retention time of the same internal standard in the mid-level standard of the most recent initial calibration, the system must be evaluated, corrected, and possibly re-calibrated.

Daily calibration is accomplished for method 624 by a BFB tuning and analysis of a QC check standard. The BFB tune must meet EPA ion abundance criteria. The QC check standard must meet the criteria found in table 5 of the method.

Poor performing compounds for 8260B/524.2/SM6200B/624:

Propene	2-Chloroethylvinyl Ether
Dichlorodifluoromethane	Acrolein
Carbon Disulfide	Vinyl acetate
Bromomethane	trans-1,4-dichloro-2-butene
Chloroethane	Alcohols (Ethanol, TBA, TAA, ETBA, Butanol)
1,3-Butadiene	Iodomethane.
2,2-Dibromo-3-chloropropane	Naphthalene
1- Methylnaphthalene	2-Butanone
2- Methylnaphthalene	2-Hexanone
Acetone	4-Methyl-2-pentanone
Pentachloroethane	Cyclohexanone
Tert-butyl Formate	

8.5 ACCEPTANCE/REJECTION OF CALIBRATION

Organic Chemistry

The initial calibration curve is compared with previous curves for the same analyte. All new standard curves are immediately checked with a secondary source or laboratory control standard prepared from a separate source than those used for calibration. All curves are visually reviewed to ensure that acceptable correlation represents linearity. Calibration curves may be rejected for nonlinearity, abnormal sensitivity, or poor response of the laboratory control standard.

Continuing calibration verification is performed on each day that initial calibration is not performed and following every tenth sample for GC analyses and once per 12 hour shift for GCMS analyses. If a check standard does not perform within established criteria, the instrument is evaluated to determine the cause. Once the issue is corrected, all samples between the last in control sample and the first out of control check is re-analyzed.

TABLE 8.5: INSTRUMENT CALIBRATION

Instrument (Analysis)	Calibration Type	Minimum Number of Standards	Calibration Model	Acceptance/ Rejection Criteria	Frequency
GC (VOC)	Initial	3 –600 series 5 –All others	Avg. RF Avg. RF	Must be ≤10% RSD for 601/602, ≤20%RSD for 8021B, and ≤20% difference for 8015B	As needed
	Second Source	1 Second Source	External	+/- 20% of true value	With each calibration
	Daily / Cont.	1/10	External Internal	Must be within 20% of the initial calibration curve Must be within 20% of the initial calibration curve	Beginning, every 20 Every 12 hours
GC/MS VOC 8260/SM 6200B	Initial	5 –8000 series & SM 6200B	Avg. RF	8260B - Must be ≤15 %RSD for all target analytes and ≤30% for CCCs. 8260C - Must be ≤20 %RSD for all target analytes and ≤30% for CCCs. 6200B - Must be ≤20 %RSD for all target analytes. If Linear regression is used, an MRL check must pass +/-30%.	As needed
	Second Source	1 Second Source		8260B - Should recover within 20% for all CCC compounds and within 40% for other analytes of interest, with the exception of analytes known to perform poorly. 6200B – Should recover within 30% for all compounds, with the exception of analytes known to perform poorly	With each calibration
	Daily / Cont.	Tune & CCV every 12 hours		8260B/C - Must pass established method tuning criteria; 8260B - CCV must be ≤20% difference for CCC compounds, RF criteria for SPCC compounds must meet method criteria. Targets must meet ESC %drift criteria. 8260C/6200B – All targets meet designated minimum response factor, and all compounds ≤20% difference and 30% difference respectively, however for EPA 8260C, 20% of target compounds can fail. If any failures, an MRL check is analyzed.	Every 12 hours

Instrument (Analysis)	Calibration Type	Minimum Number of Standards	Calibration Model	Acceptance/ Rejection Criteria	Frequency
GC/MS VOC 624	Initial	3 –600 series	Avg. RF	624 - Must be ≤35 %RSD for all target analytes and ≤30% for CCCs	As needed
	Second Source	1 Second Source		Should recover within 20% for all CCC compounds and within 40% for other analytes of interest, with the exception of analytes known to perform poorly	With each calibration
	Daily / Cont.	Tune & CCV every 12 hours		Must pass established method tuning criteria; 624 - CCV must be ≤20% difference for CCC, RF for SPCC compounds must meet method criteria. Targets must meet ESC %drift criteria.	Every 12 hours

9.0 LABORATORY PRACTICES

9.1 REAGENT GRADE WATER

Reagent grade water is obtained from an ELGA Purelab Ultra system.

9.2 GLASSWARE WASHING PROCEDURE

All VOA sampling vials are purchased specifically for volatiles analysis and only used once. They are stored in a contaminant-free environment in the original carton with screw cap lids tightly fastened. All glassware used for volatiles analysis (volumetric flasks, syringes, etc.) is segregated from other laboratory glassware. Standard cleaning procedures involve rinsing three times with methanol. When a highly contaminated sample is purged, a blank is analyzed before another sample can be purged to ensure cleanliness of the analytical system. If the blank proves to be contaminant free, the system is then ready for further field sample analyses.

10.0 ANALYTICAL PROCEDURES

10.1 A list of laboratory SOPs associated with the volatiles laboratory can be found in the following table:

TABLE 10.1: VOLATILE DEPARTMENT SOPS

This table is subject to revision without notice

SOP #	Title/Description
330351	BTEX and Gasoline Range Organics by Gas Chromatography (8015B)
330354	MA Volatile Petroleum Hydrocarbons
330357	Volatile Organic Compounds (GRO by GCMS)
330363OH	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry 8260A/B (Ohio VAP)
330363	Volatile Organic Compounds by Gas Chromatography/Mass

SOP #	Title/Description
	Spectrometry
330364	DW Volatile Organic Compounds by GC/MS (524.2)
330365	VOC Screen using RAE Systems PID ppbRAE
330375	GRO Analysis in Air (based on EPA 8015)
330751	5035 Closed System Purge and Trap and Extraction for VOC's in Soil and Waste
330751OH	5035 Closed System Purge and Trap and Extraction for VOC's in Soil for Ohio VAP
330752OH	5030B Purge and Trap for OH VAP Samples
330752	5030B Purge and Trap for Aqueous Samples
330753	Waste Dilution

11.0 QUALITY CONTROL CHECKS

NOTE: For specific guidance on each determinative method, including required quality control and specific state requirements/modifications, refer to the relevant laboratory standard operating procedure(s).

11.1 ESC participates in proficiency testing (PTs) in support of various laboratory accreditations/recognitions. Environmental samples are purchased from Phenova. The WS, WP and solid matrix studies are completed every 6 months. PT samples are received and analyzed by method according to the vendor’s instructions and according to ESC SOP.

11.2 Initial Demonstrations of Capability (IDOCs) are performed during new analyst training and/or prior to acceptance and use of any new method/instrumentation. Continuing Demonstration of Capability (CDOCs) must be updated at least annually. The associated data is filed within the department and available for review.

11.3 Matrix Spike and Matrix Spike Duplicates are performed on each batch of samples analyzed depending on analytical method requested.

11.4 A Laboratory Control Sample (LCS) and LCS Duplicate (LCSD) are analyzed one per batch of samples.

11.5 A method preparation blank is performed per batch of samples processed. If the acceptance criteria as listed in the determinative SOP is exceeded, the laboratory shall evaluate whether reprocessing of the samples is necessary, based on the following criteria:

- The blank contamination exceeds a concentration greater than 1/10 of the measured concentration of any sample in the associated preparation batch or
- The blank contamination is greater than 1/10 of the specified regulatory limit. The concentrations of common laboratory contaminants shall not exceed the reporting limit.

Any samples associated with a blank that fail these criteria shall be reprocessed in a subsequent preparation batch, except where the sample analysis resulted in non-detected results for the failing analytes.

12.0 DATA REDUCTION, VALIDATION AND REPORTING

12.1 DATA REDUCTION

The analyst performs the data calculation functions and is responsible for the initial examination of the finished data. Data reduction steps applied to the raw data are outlined in SOP #030201, *Data Handling and Reporting.* A secondary review of the data package is performed according to ESC SOP #030227, *Data Review*. The reviewer verifies that the analysis has been performed as required and meets method criteria, all associate data is present and complete, and also ensures that any additional documentation is completed as required (i.e. Ohio VAP checklists, required flags on test reports, etc.)

TABLE 12.1 Data Reduction Formulas

PARAMETER	FORMULA
GC	$\dfrac{\text{response of sample analyte } \{\mathit{area}\} \text{ x final extract volume } \{\mathit{mL}\} \text{ x dilution}}{\text{response factor } \{\mathit{area/(mg/L)}\} \text{ x initial extract volume-mass } \{\mathit{mL\ or\ g}\}}$ *Calculations performed by HP Enviroquant Software*
GC/MS	$\dfrac{\text{response of analyte } \{\mathit{area}\} \text{ x extract volume } \{\mathit{mL}\} \text{ x dilution x int. std amt. } \{\mathit{area}\}}{\text{response factor } \{\mathit{area/(mg/mL)}\} \text{ x initial volume-mass } \{\mathit{mL\ or\ g}\} \text{ x int. std cal. } \{\text{area}\}}$ *Calculations performed by HP Enviroquant Software*

12.2 VALIDATION

The validation process consists of data generation, reduction review, and reporting results. Once data reduction is complete, validation is conducted by verification that the QC samples are within acceptable QC limits and that all documentation is complete, including the analytical report and associated QC. See Table 12.3 by method for current QC targets and controls and current reporting limits.

Marginal Exceedance – When a large number of analytes exist in the LCS, it is statistically possible for a few analytes to be outside established control limits while the analytical system remains in control. These excursions must be random in nature and, if not, a review of the control limits or analytical process is necessary.

Upper and lower marginal exceedance (ME) limits are established as the mean of at least 20 data points $\pm$ four times their standard deviations. The number of allowable marginal exceedances per event is based on the number of analytes spiked in the LCS.

Allowable Marginal Exceedance per Event	
Analytes in LCS:	**ME Allowable**
>90	5
71-90	4
51-70	3
31-50	2
11-30	1
<11	0

Organic Control Limits - The organic QC targets are statutory in nature; warning and control limits for organic analyses are initially established for groups of compounds based on preliminary method validation data. When additional data becomes available, the QC targets are reviewed. All QC targets are routinely re-evaluated at least annually (and updated, if necessary) against laboratory historical data to insure that the limits continue to reflect realistic, method achievable goals.

12.3 REPORTING

Reporting procedures are documented in SOP #030201, *Data Handling and Reporting.*

Table 12.3: QC Targets for Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)**	Prec.** (RPD)	RL	Unit
Volatiles	1,1,1,2-TETRACHLOROETHANE	8260B/C, 624, 6200B	GW, WW	78.5-125	20.0	0.001	mg/L
Volatiles	1,1,1-TRICHLOROETHANE	8260B/C, 624, 6200B	GW, WW	71.1-129	20.0	0.001	mg/L
Volatiles	1,1,2,2-TETRACHLOROETHANE	8260B/C, 624, 6200B	GW, WW	79.3-123	20.0	0.001	mg/L
Volatiles	1,1,2-TRICHLOROETHANE	8260B/C, 624, 6200B	GW, WW	81.6-120	20.0	0.001	mg/L
Volatiles	1,1,2-TRICHLORO-TRIFLUOROETHANE	8260B/C, 624, 6200B	GW, WW	62.0-141	20.0	0.001	mg/L
Volatiles	1,1-DICHLOROETHANE	8260B/C, 624, 6200B	GW, WW	71.7-127	20.0	0.001	mg/L
Volatiles	1,1-DICHLOROETHENE	8260B/C, 624, 6200B	GW, WW	59.9-137	20.0	0.001	mg/L
Volatiles	1,1-DICHLOROPROPENE	8260B/C, 624, 6200B	GW, WW	72.5-127	20.0	0.001	mg/L
Volatiles	1,2,3-TRICHLOROBENZENE	8260B/C, 624, 6200B	GW, WW	75.7-134	20.0	0.001	mg/L
Volatiles	1,2,3-TRICHLOROPROPANE	8260B/C, 624, 6200B	GW, WW	74.9-124	20.0	0.0025	mg/L
Volatiles	1,2,3-TRIMETHYLBENZENE	8260B/C, 624, 6200B	GW, WW	79.9-118	20.0	0.001	mg/L
Volatiles	1,2,4-TRICHLOROBENZENE	8260B/C, 624, 6200B	GW, WW	76.1-136	20.0	0.001	mg/L
Volatiles	1,2,4-TRIMETHYLBENZENE	8260B/C, 624, 6200B	GW, WW	79.0-122	20.0	0.001	mg/L
Volatiles	1,2-DIBROMO-3-CHLOROPROPANE	8260B/C, 624, 6200B	GW, WW	64.8-131	20.0	0.005	mg/L
Volatiles	1,2-DIBROMOETHANE	8260B/C, 624, 6200B	GW, WW	79.8-122	20.0	0.001	mg/L
Volatiles	1,2-DICHLOROBENZENE	8260B/C, 624, 6200B	GW, WW	84.7-118	20.0	0.001	mg/L
Volatiles	1,2-DICHLOROETHANE	8260B/C, 624, 6200B	GW, WW	65.3.-126	20.0	0.001	mg/L

Table 12.3: QC Targets for Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)**	Prec.** (RPD)	RL	Unit
Volatiles	1,2-DICHLOROPROPANE	8260B/C, 624, 6200B	GW, WW	77.4-125	20.0	0.001	mg/L
Volatiles	1,3,5-TRIMETHYLBENZENE	8260B/C, 624, 6200B	GW, WW	81.0-123	20.0	0.001	mg/L
Volatiles	1,3-BUTADIENE	8260B/C, 624, 6200B	GW, WW	36.2-142	20.0	0.002	mg/L
Volatiles	1,3-DICHLOROBENZENE	8260B/C, 624, 6200B	GW, WW	77.6-127	20.0	0.001	mg/L
Volatiles	1,3-DICHLOROPROPANE	8260B/C, 624, 6200B	GW, WW	80.6-115	20.0	0.001	mg/L
Volatiles	1,4-DICHLOROBENZENE	8260B/C, 624, 6200B	GW, WW	82.2-114	20.0	0.001	mg/L
Volatiles	1-METHYLNAPHTHALENE	8260B/C, 624, 6200B	GW, WW	48.8-157	20.0	0.01	mg/L
Volatiles	2,2-DICHLOROPROPANE	8260B/C, 624, 6200B	GW, WW	61.3-134	20.0	0.001	mg/L
Volatiles	2-BUTANONE (MEK)	8260B/C, 624, 6200B	GW, WW	46.4-155	20.0	0.01	mg/L
Volatiles	2-CHLOROETHYL VINYL ETHER	8260B/C, 624, 6200B	GW, WW	23.4-162	23.5	0.05	mg/L
Volatiles	2-CHLOROTOLUENE	8260B/C, 624, 6200B	GW, WW	76.4-125	20.0	0.001	mg/L
Volatiles	2-HEXANONE	8260B/C, 624, 6200B	GW, WW	59.4-151	20.0	0.01	mg/L
Volatiles	2-METHYLNAPHTHALENE	8260B/C, 624, 6200B	GW, WW	55.6-154	20.0	0.01	mg/L
Volatiles	4-CHLOROTOLUENE	8260B/C, 624, 6200B	GW, WW	81.5-121	20.0	0.001	mg/L
Volatiles	4-ETHYLTOLUENE	8260B/C, 624, 6200B	GW, WW	69.5-137	20.0	0.001	mg/L
Volatiles	4-METHYL-2-PENTANONE (MIBK)	8260B/C, 624, 6200B	GW, WW	63.3-138	20.0	0.01	mg/L
Volatiles	ACETONE	8260B/C, 624, 6200B	GW, WW	28.7-175	20.9	0.01	mg/L
Volatiles	ACROLEIN	8260B/C, 624, 6200B	GW, WW	40.4-172	20.0	0.05	mg/L
Volatiles	ACRYLONITRILE	8260B/C, 624, 6200B	GW, WW	58.2-145	20.0	0.01	mg/L
Volatiles	BENZENE	8260B/C, 624, 6200B	GW, WW	73.0-122	20.0	0.001	mg/L
Volatiles	BROMOBENZENE	8260B/C, 624, 6200B	GW, WW	81.5-115	20.0	0.001	mg/L
Volatiles	BROMOCHLOROMETHANE	8260B/C, 624, 6200B	GW, WW	78.9-123	20.0	0.001	mg/L
Volatiles	BROMODICHLOROMETHANE	8260B/C, 624, 6200B	GW, WW	75.5-121	20.0	0.001	mg/L
Volatiles	BROMOFORM	8260B/C, 624, 6200B	GW, WW	71.5-131	20.0	0.001	mg/L
Volatiles	BROMOMETHANE	8260B/C, 624, 6200B	GW, WW	22.4-187	20.0	0.005	mg/L
Volatiles	CARBON DISULFIDE	8260B/C, 624, 6200B	GW, WW	53.0-134	20.0	0.001	mg/L
Volatiles	CARBON TETRACHLORIDE	8260B/C, 624, 6200B	GW, WW	70.9-129	20.0	0.001	mg/L
Volatiles	CHLOROBENZENE	8260B/C, 624, 6200B	GW, WW	79.7-122	20.0	0.001	mg/L
Volatiles	CHLORODIBROMOMETHANE	8260B/C, 624, 6200B	GW, WW	78.2-124	20.0	0.001	mg/L
Volatiles	CHLOROETHANE	8260B/C, 624, 6200B	GW, WW	41.2-153	20.0	0.005	mg/L
Volatiles	CHLOROFORM	8260B/C, 624, 6200B	GW, WW	73.2-125	20.0	0.005	mg/L
Volatiles	CHLOROMETHANE	8260B/C, 624, 6200B	GW, WW	55.8-134	20.0	0.025	mg/L
Volatiles	CIS-1,2-DICHLOROETHENE	8260B/C, 624, 6200B	GW, WW	77.3-122	20.0	0.001	mg/L
Volatiles	CIS-1,3-DICHLOROPROPENE	8260B/C, 624, 6200B	GW, WW	77.7-124	20.0	0.001	mg/L
Volatiles	DIBROMOMETHANE	8260B/C, 624, 6200B	GW, WW	78.8-119	20.0	0.001	mg/L

Table 12.3: QC Targets for Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)**	Prec.** (RPD)	RL	Unit
Volatiles	DICHLORODIFLUORO-METHANE	8260B/C, 624, 6200B	GW, WW	56.0-134	20.0	0.005	mg/L
Volatiles	DICHLOROFLUORO-METHANE	8260B/C, 624, 6200B	GW, WW	53.5-145	20.0	0.005	mg/L
Volatiles	DICYCLOPENTADIENE	8260B/C, 624, 6200B	GW, WW	73.4-126	20.0	0.001	mg/L
Volatiles	DI-ISOPROPYL ETHER	8260B/C, 624, 6200B	GW, WW	65.1-135	20.0	0.001	mg/L
Volatiles	ETHYL ETHER	8260B/C, 624, 6200B	GW, WW	56.6-136	20.0	0.001	mg/L
Volatiles	ETHYLBENZENE	8260B/C, 624, 6200B	GW, WW	80.9-121	20.0	0.001	mg/L
Volatiles	HEXACHLORO-1,3-BUTADIENE	8260B/C, 624, 6200B	GW, WW	73.7-133	20.0	0.001	mg/L
Volatiles	IODOMETHANE	8260B/C, 624, 6200B	GW, WW	64.6-137	20.0	0.01	mg/L
Volatiles	ISOPROPYLBENZENE	8260B/C, 624, 6200B	GW, WW	81.6-124	20.0	0.001	mg/L
Volatiles	M&P-XYLENE	8260B/C, 624, 6200B	GW, WW	78.5-122	20.0	0.002	mg/L
Volatiles	METHYL TERT-BUTYL ETHER	8260B/C, 624, 6200B	GW, WW	70.1-125	20.0	0.001	mg/L
Volatiles	METHYLENE CHLORIDE	8260B/C, 624, 6200B	GW, WW	69.5-120	20.0	0.005	mg/L
Volatiles	NAPHTHALENE	8260B/C, 624, 6200B	GW, WW	69.7-134	20.0	0.005	mg/L
Volatiles	N-BUTYLBENZENE	8260B/C, 624, 6200B	GW, WW	75.9-134	20.0	0.001	mg/L
Volatiles	N-HEXANE	8260B/C, 624, 6200B	GW, WW	59.5-132	20.0	0.01	mg/L
Volatiles	N-PROPYLBENZENE	8260B/C, 624, 6200B	GW, WW	81.9-122	20.0	0.001	mg/L
Volatiles	O-XYLENE	8260B/C, 624, 6200B	GW, WW	79.1-123	20.0	0.001	mg/L
Volatiles	P-ISOPROPYLTOLUENE	8260B/C, 624, 6200B	GW, WW	77.6-129	20.0	0.001	mg/L
Volatiles	PROPENE	8260B/C, 624, 6200B	GW, WW	10.0-200	20.0	0.0025	mg/L
Volatiles	SEC-BUTYLBENZENE	8260B/C, 624, 6200B	GW, WW	80.6-126	20.0	0.001	mg/L
Volatiles	STYRENE	8260B/C, 624, 6200B	GW, WW	79.9-124	20.0	0.001	mg/L
Volatiles	TERT-BUTYLBENZENE	8260B/C, 624, 6200B	GW, WW	79.3-127	20.0	0.001	mg/L
Volatiles	TETRACHLOROETHENE	8260B/C, 624, 6200B	GW, WW	73.5-130	20.0	0.001	mg/L
Volatiles	TETRAHYDROFURAN	8260B/C, 624, 6200B	GW, WW	54.0-134	20.0	0.005	mg/L
Volatiles	TOLUENE	8260B/C, 624, 6200B	GW, WW	77.9-116	20.0	0.005	mg/L
Volatiles	TPH (GC/MS) LOW FRACTION	8260B/C, 624, 6200B	GW, WW	62.3-131	20.0	0.50	mg/L
Volatiles	TRANS-1,2-DICHLOROETHENE	8260B/C, 624, 6200B	GW, WW	72.6-125	20.0	0.001	mg/L
Volatiles	TRANS-1,3-DICHLOROPROPENE	8260B/C, 624, 6200B	GW, WW	73.5-127	20.0	0.001	mg/L
Volatiles	TRANS-1,4-DICHLORO-2-BUTENE	8260B/C, 624, 6200B	GW, WW	58.3-129	20.0	0.0025	mg/L
Volatiles	TRICHLOROETHENE	8260B/C, 624, 6200B	GW, WW	79.5-121	20.0	0.001	mg/L
Volatiles	TRICHLOROFLUORO-METHANE	8260B/C, 624, 6200B	GW, WW	49.1-157	20.0	0.005	mg/L
Volatiles	VINYL ACETATE	8260B/C, 624, 6200B	GW, WW	41.7-159	20.0	0.01	mg/L

Table 12.3: QC Targets for Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)**	Prec.** (RPD)	RL	Unit
Volatiles	VINYL CHLORIDE	8260B/C, 624, 6200B	GW, WW	61.5-134	20.0	0.001	mg/L
Volatiles	XYLENES, TOTAL	8260B/C, 624, 6200B	GW,WW	79.2-122	20.0	0.002	mg/L
Volatiles	1,1,1,2-TETRACHLOROETHANE	8260B/C	Solid	76.7-127	20.0	0.001	mg/kg
Volatiles	1,1,1-TRICHLOROETHANE	8260B/C	Solid	69.9-127	20.0	0.001	mg/kg
Volatiles	1,1,2,2-TETRACHLOROETHANE	8260B/C	Solid	78.8-124	20.0	0.001	mg/kg
Volatiles	1,1,2-TRICHLOROETHANE	8260B/C	Solid	81.9-119	20.0	0.001	mg/kg
Volatiles	1,1,2-RICHLOROTRIFLUORO-ETHANE	8260B/C	Solid	62.6-138	20.0	0.001	mg/kg
Volatiles	1,1-DICHLOROETHANE	8260B/C	Solid	71.7-125	20.0	0.001	mg/kg
Volatiles	1,1-DICHLOROETHENE	8260B/C	Solid	60.6-133	20.0	0.001	mg/kg
Volatiles	1,1-DICHLOROPROPENE	8260B/C	Solid	71.2-126	20.0	0.001	mg/kg
Volatiles	1,2,3-TRICHLOROBENZENE	8260B/C	Solid	72.5-137	20.0	0.001	mg/kg
Volatiles	1,2,3-TRICHLOROPROPANE	8260B/C	Solid	74.0-124	20.0	0.0025	mg/kg
Volatiles	1,2,3-TRIMETHYLBENZENE	8260B/C	Solid	79.4-118	20.0	0.001	mg/kg
Volatiles	1,2,4-TRICHLOROBENZENE	8260B/C	Solid	74.0-137	20.0	0.001	mg/kg
Volatiles	1,2,4-TRIMETHYLBENZENE	8260B/C	Solid	77.1-124	20.0	0.001	mg/kg
Volatiles	1,2-DIBROMO-3-CHLOROPROPANE	8260B/C	Solid	64.9-131	20.0	0.005	mg/kg
Volatiles	1,2-DIBROMOETHANE	8260B/C	Solid	78.7-123	20.0	0.001	mg/kg
Volatiles	1,2-DICHLOROBENZENE	8260B/C	Solid	83.6-119	20.0	0.001	mg/kg
Volatiles	1,2-DICHLOROETHANE	8260B/C	Solid	67.2-121	20.0	0.001	mg/kg
Volatiles	1,2-DICHLOROPROPANE	8260B/C	Solid	76.9-123	20.0	0.001	mg/kg
Volatiles	1,3,5-TRIMETHYLBENZENE	8260B/C	Solid	79.0-125	20.0	0.001	mg/kg
Volatiles	1,3-BUTADIENE	8260B/C	Solid	35.1-134	20.0	0.002	mg/kg
Volatiles	1,3-DICHLOROBENZENE	8260B/C	Solid	75.9-129	20.0	0.001	mg/kg
Volatiles	1,3-DICHLOROPROPANE	8260B/C	Solid	80.3-114	20.0	0.001	mg/kg
Volatiles	1,4-DICHLOROBENZENE	8260B/C	Solid	81.0-115	20.0	0.001	mg/kg
Volatiles	1-METHYLNAPHTHALENE	8260B/C	Solid	60.4-138	24.7	0.01	mg/kg
Volatiles	2,2-DICHLOROPROPANE	8260B/C	Solid	61.9-132	20.0	0.001	mg/kg
Volatiles	2-BUTANONE (MEK)	8260B/C	Solid	44.5-154	21.3	0.01	mg/kg
Volatiles	2-CHLOROETHYL VINYL ETHER	8260B/C	Solid	16.7-162	23.7	0.05	mg/kg
Volatiles	2-CHLOROTOLUENE	8260B/C	Solid	74.6-127	20.0	0.001	mg/kg
Volatiles	2-HEXANONE	8260B/C	Solid	62.7-150	20.0	0.01	mg/kg
Volatiles	2-METHYLNAPHTHALENE	8260B/C	Solid	63.3-137	21.5	0.01	mg/kg
Volatiles	4-CHLOROTOLUENE	8260B/C	Solid	79.5-123	20.0	0.001	mg/kg
Volatiles	4-ETHYLTOLUENE	8260B/C	Solid	78.0-127	20.0	0.001	mg/kg

Table 12.3: QC Targets for Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)**	Prec.** (RPD)	RL	Unit
Volatiles	4-METHYL-2-PENTANONE (MIBK)	8260B/C	Solid	61.1-138	20.0	0.01	mg/kg
Volatiles	ACETONE	8260B/C	Solid	25.3-178	22.9	0.01	mg/kg
Volatiles	ACROLEIN	8260B/C	Solid	41.0-182	20.0	0.05	mg/kg
Volatiles	ACRYLONITRILE	8260B/C	Solid	57.8-143	20.0	0.01	mg/kg
Volatiles	BENZENE	8260B/C	Solid	72.6-120	20.0	0.001	mg/kg
Volatiles	BROMOBENZENE	8260B/C	Solid	80.3-115	20.0	0.001	mg/kg
Volatiles	BROMOCHLOROMETHANE	8260B/C	Solid	79..7-123	20.0	0.001	mg/kg
Volatiles	BROMODICHLOROMETHANE	8260B/C	Solid	75.3-119	20.0	0.001	mg/kg
Volatiles	BROMOFORM	8260B/C	Solid	69.1-135	20.0	0.001	mg/kg
Volatiles	BROMOMETHANE	8260B/C	Solid	23.0-191	20.0	0.005	mg/kg
Volatiles	CARBON DISULFIDE	8260B/C	Solid	49.9-136	20.0	0.001	mg/kg
Volatiles	CARBON TETRACHLORIDE	8260B/C	Solid	69.4-129	20.0	0.001	mg/kg
Volatiles	CHLOROBENZENE	8260B/C	Solid	78.9-122	20.0	0.001	mg/kg
Volatiles	CHLORODIBROMOMETHANE	8260B/C	Solid	76.4-126	20.0	0.005	mg/kg
Volatiles	CHLOROETHANE	8260B/C	Solid	47.2-147	20.0	0.005	mg/kg
Volatiles	CHLOROFORM	8260B/C	Solid	73.3-122	20.0	0.025	mg/kg
Volatiles	CHLOROMETHANE	8260B/C	Solid	53.1-135	20.0	0.001	mg/kg
Volatiles	CIS-1,2-DICHLOROETHENE	8260B/C	Solid	76.1-121	20.0	0.001	mg/kg
Volatiles	CIS-1,3-DICHLOROPROPENE	8260B/C	Solid	77.3-123	20.0	0.001	mg/kg
Volatiles	DIBROMOMETHANE	8260B/C	Solid	78.5-117	20.0	0.005	mg/kg
Volatiles	DICHLORODIFLUORO-METHANE	8260B/C	Solid	50.9-139	20.0	0.005	mg/kg
Volatiles	DICHLOROFLUORO-METHANE	8260B/C	Solid	61.8-140	20.0	0.001	mg/kg
Volatiles	DICYCLOPENTADIENE	8260B/C	Solid	73.1-126	20.0	0.001	mg/kg
Volatiles	DI-ISOPROPYL ETHER	8260B/C	Solid	67.2-131	20.0	0.001	mg/kg
Volatiles	ETHYL ETHER	8260B/C	Solid	57.5-136	20.0	0.001	mg/kg
Volatiles	ETHYLBENZENE	8260B/C	Solid	78.6-124	20.0	0.001	mg/kg
Volatiles	HEXACHLORO-1,3-BUTADIENE	8260B/C	Solid	69.2-136	20.0	0.01	mg/kg
Volatiles	IODOMETHANE	8260B/C	Solid	63.3-136	20.0	0.001	mg/kg
Volatiles	ISOPROPYLBENZENE	8260B/C	Solid	79.4-126	20.0	0.002	mg/kg
Volatiles	M&P-XYLENE	8260B/C	Solid	77.3-124	20.0	0.001	mg/kg
Volatiles	METHYL TERT-BUTYL ETHER	8260B/C	Solid	70.2-122	20.0	0.005	mg/kg
Volatiles	METHYLENE CHLORIDE	8260B/C	Solid	68.2-119	20.0	0.005	mg/kg
Volatiles	NAPHTHALENE	8260B/C	Solid	69.9-132	20.0	0.001	mg/kg
Volatiles	N-BUTYLBENZENE	8260B/C	Solid	74.2-134	20.0	0.01	mg/kg
Volatiles	N-HEXANE	8260B/C	Solid	59.9-125	20.0	0.001	mg/kg

Table 12.3: QC Targets for Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)**	Prec.** (RPD)	RL	Unit
Volatiles	N-PROPYLBENZENE	8260B/C	Solid	80.2-124	20.0	0.001	mg/kg
Volatiles	O-XYLENE	8260B/C	Solid	78.5-124	20.0	0.001	mg/kg
Volatiles	P-ISOPROPYLTOLUENE	8260B/C	Solid	75.4-132	20.0	0.0025	mg/kg
Volatiles	PROPENE	8260B/C	Solid	10.0-192	26.1	0.001	mg/kg
Volatiles	SEC-BUTYLBENZENE	8260B/C	Solid	77.8-129	20.0	0.001	mg/kg
Volatiles	STYRENE	8260B/C	Solid	79.4-124	20.0	0.001	mg/kg
Volatiles	TERT-BUTYLBENZENE	8260B/C	Solid	77.2-129	20.0	0.001	mg/kg
Volatiles	TETRACHLOROETHENE	8260B/C	Solid	71.1-133	20.0	0.005	mg/kg
Volatiles	TETRAHYDROFURAN	8260B/C	Solid	63.4-122	20.0	0.005	mg/kg
Volatiles	TOLUENE	8260B/C	Solid	76.7-116	20.0	0.50	mg/kg
Volatiles	TPH (GC/MS) LOW FRACTION	8260B/C	Solid	61.5-138	20.0	0.001	mg/kg
Volatiles	TRANS-1,2-DICHLOROETHENE	8260B/C	Solid	70.7-124	20.0	0.001	mg/kg
Volatiles	TRANS-1,3-DICHLOROPROPENE	8260B/C	Solid	73.0-127	20.0	0.0025	mg/kg
Volatiles	TRANS-1,4-DICHLORO-2-BUTENE	8260B/C	Solid	58.4-125	20.0	0.001	mg/kg
Volatiles	TRICHLOROETHENE	8260B/C	Solid	77.2-122	20.0	0.001	mg/kg
Volatiles	TRICHLOROFLUORO-METHANE	8260B/C	Solid	51.5-151	20.0	0.005	mg/kg
Volatiles	VINYL ACETATE	8260B/C	Solid	39.8-156	20.0	0.01	mg/kg
Volatiles	VINYL CHLORIDE	8260B/C	Solid	58.4-134	20.0	0.001	mg/kg
Volatiles	XYLENES, TOTAL	8260B/C	Solid	78.1-123	20.0	0.002	mg/kg
Volatiles	DI-ISOPROPYL ETHER	8260B/C	Solid	70.4-133	20.0	0.001	mg/kg
Volatiles	ETHYL TERT-BUTYL ETHER	8260B/C	Solid	81.4-110	25.0	0.001	mg/kg
Volatiles	METHYL-TERT-BUTYL ETHER	8260B/C	Solid	73.0-129	20.0	0.001	mg/kg
Volatiles	TERT-BUTYL ALCOHOL	8260B/C	Solid	59.5-170	25.0	0.050	mg/kg
Volatiles	TERT-AMYL METHYL ETHER	8260B/C	Solid	82-115	25.0	0.001	mg/kg
Volatiles	2-PROPANOL	8260B/C	Solid	70.0-130	25.0	0.05	mg/kg
Volatiles	GRO	8015B/C/D	GW, WW	66.3-133	20.0	0.100	mg/L
Volatiles	BENZENE	8021B, 602, 6200C	GW, WW	70.0-130	20.0	0.0005	mg/L
Volatiles	TOLUENE	8021B, 602, 6200C	GW, WW	70.0-130	20.0	0.005	mg/L
Volatiles	ETHYLBENZENE	8021B, 602, 6200C	GW, WW	70.0-130	20.0	0.0005	mg/L
Volatiles	M&P-XYLENE	8021B, 602, 6200C	GW, WW	70.0-130	20.0	0.001	mg/L
Volatiles	O-XYLENE	8021B, 602, 6200C	GW, WW	70.0-130	20.0	0.0005	mg/L
Volatiles	MTBE	8021B, 602, 6200C	GW, WW	70.0-130	20.0	0.001	mg/L
Volatiles	GRO	8015B/C/D	Solid	63.6-136	20.0	0.10	mg/kg
Volatiles	BENZENE	8021B	Solid	70.0 - 130	20.0	0.0005	mg/kg

Table 12.3: QC Targets for Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)**	Prec.** (RPD)	RL	Unit
Volatiles	TOLUENE	8021B	Solid	70.0 - 130	20.0	0.005	mg/kg
Volatiles	ETHYLBENZENE	8021B	Solid	70.0 - 130	20.0	0.001	mg/kg
Volatiles	M&P-XYLENE	8021B	Solid	70.0 - 130	20.0	0.001	mg/kg
Volatiles	O-XYLENE	8021B	Solid	70.0 - 130	20.0	0.0005	mg/kg
Volatiles	MTBE	8021B	Solid	70.0 - 130	20.0	0.001	mg/kg
Volatiles	1,1,1,2-TETRACHLOROETHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,1,1-TRICHLOROETHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,1,2,2-TETRACHLOROETHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,1,2-TRICHLOROETHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,1-DICHLOROETHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,1-DICHLOROETHENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,1-DICHLOROPROPENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,2,3-TRICHLOROBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,2,3-TRICHLOROPROPANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,2,4-TRICHLOROBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,2,4-TRIMETHYLBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,2-DIBROMO-3-CHLOROPROPANE	524.2	DW	70.0-130	25.0	0.0010	mg/L
Volatiles	1,2-DIBROMOETHANE	524.2	DW	70.0-130	25.0	0.0010	mg/L
Volatiles	1,2-DICHLOROBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,2-DICHLOROETHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,2-DICHLOROPROPANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,3,5-TRIMETHYLBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,3-DICHLOROBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,3-DICHLOROPROPANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	1,4-DICHLOROBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	2,2-DICHLOROPROPANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	2-CHLOROTOLUENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	4-CHLOROTOLUENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	4-ISOPROPYLTOLUENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	ACETONE	524.2	DW	70.0-130	25.0	0.01	mg/L
Volatiles	BENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	BROMOBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	BROMOCHLOROMETHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	BROMODICHLOROMETHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L

Table 12.3: QC Targets for Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)**	Prec.** (RPD)	RL	Unit
Volatiles	BROMOFORM	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	BROMOMETHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	CARBON TETRACHLORIDE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	CHLOROBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	CHLOROETHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	CHLOROFORM	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	CHLOROMETHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	CIS-1,2-DICHLOROETHENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	CIS-1,3-DICHLOROPROPENE	524.2	DW	70.0-130	25.0	0.0010	mg/L
Volatiles	DIBROMOMETHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	DICHLORODIFLUORO-METHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	ETHYLBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	HEXACHLOROBUTADIENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	ISOPROPYLBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	METHYLENE CHLORIDE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	METHYL-T-BUTYL ETHER	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	NAPHTHALENE	524.2	DW	70.0-130	25.0	0.0050	mg/L
Volatiles	N-BUTYLBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	N-PROPYLBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	SEC-BUTYLBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	STYRENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	TERT-BUTYLBENZENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	TETRACHLOROETHENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	TOLUENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	TRANS-1,2-DICHLOROETHENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	TRANS-1,3-DICHLOROPROPENE	524.2	DW	70.0-130	25.0	0.0010	mg/L
Volatiles	TRICHLOROETHENE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	TRICHLOROFLUORO-METHANE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	VINYL CHLORIDE	524.2	DW	70.0-130	25.0	0.0005	mg/L
Volatiles	XYLENES – TOTAL	524.2	DW	70.0-130	25.0	0.0015	mg/L

*** Specific organizations may require limits that supersede the values listed.*

13.0 CORRECTIVE ACTION

13.1 In the event that a nonconformance occurs in conjunction with the analytical batch, a corrective action response (CAR) form must be completed. The cause of the event is stated on the form and the measures taken to correct the nonconformance clearly defined. The effectiveness of the corrective action must be assessed and noted. The CARs are kept on file by the Regulatory Affairs Department. Corrective action procedures are documented in SOP #030208, *Corrective and Preventive Action*

13.2 Required Corrective Action

Control limits have been established for each type of analysis. When these limits are exceeded, corrective action must be taken. Calculated sample spike control limits are also used.

All samples and procedures are governed by ESC's quality assurance program. General corrective actions are as follows; however additional and more specific direction is provided in the specific determinative procedure. For more information, see the appropriate determinative SOP.

13.2.1 Laboratory QC Criteria and Appropriate Corrective Actions

If the analytical method contains acceptance/rejection criteria and it is more stringent than those controls generated by the laboratory, the method criteria takes precedence.

13.2.2 Out Of Control Blanks: Applies to Method, Trip, Rinsate & Instrument Blanks

<u>Rejection Criteria</u> - Blank reading is more than twice the background absorbance or more than ½RL.

<u>Corrective Action</u> - Blanks are re-analyzed and the response is assessed. Standard curves and samples are evaluated for any obvious contamination that is isolated or uniform throughout the run. If necessary, reagents are re-prepared. Analyses are not initiated until the problem is identified and solved. If samples have already been prepared or analyzed, the Department Supervisor is consulted to determine if data needs to be rejected or if samples need to be re-prepared.

13.2.3 Out Of Control Laboratory Control Standards (LCS & LCSD)

<u>Rejection Criteria</u> - If the performance is outside of lab-generated control limits which are calculated as the mean of at least 20 data points +/- 3 times the standard deviation of those points (Listed in Section 12) and the marginal excedence allowance is surpassed (see section 12.2).

Corrective Action - Instrument settings are checked and the LCS standard is re-analyzed. If the LCS is still out of control, instrumentation is checked for systemic problems and repaired (if necessary). Re-calibration is performed and the samples affected since the last in control reference standard are reanalyzed. The group leader or Department Supervisor is consulted for further action.

13.2.4 Out Of Control Matrix Spike Samples

Rejection Criteria - If either the MS or MSD sample is outside the established control limits.

Corrective Action - Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Batch acceptance, however, is based on method blank and LCS performance, not on MS/MSD recoveries. Specific methods, customers, and programs may require further corrective action in some cases.

13.2.5 Out Of Control Duplicate Samples

Rejection Criteria - Lab-generated maximum RPD limit (as listed under precision in Section 12)

Corrective Action - Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Batch acceptance, however, is based on method blank and LCS performance. Specific methods, customers, and programs may require further corrective action in some cases.

13.2.7 Out Of Control Calibration Standards: ICV, CCV, SSCV

Rejection Criteria - If the performance is outside of method requirements.

Corrective Action - Instrument settings are checked, calibration verification standard is re-analyzed. If the standard is still out of control, re-calibration is performed, and samples affected since the last in control reference standard are rerun. The group leader or Department Supervisor is consulted for further action.

14.0 RECORD KEEPING

Record keeping is outlined in SOP #030230, *Standards Logger, SOP #030227, Data Review* and SOP #030201, *Data Handling and Reporting*

Volatile organics calibration data are recorded and integrated using HP Enviroquant software. Calibration data from the volatile analyses, in addition to the initial and daily calibration, includes GC/MS autotunes, BFB reports and surrogate recovery reports. PDF records of initial calibration and daily calibration are stored with chromatograms and integrated with sample data by date analyzed.

15.0 QUALITY AUDITS

System and data quality audits are outlined in the ESC Quality Assurance Manual Version 13.0 and *SOP #010104, Internal Audits*.

16.0 REVISIONS

The Regulatory Affairs Department has an electronic version of this Quality Assurance Manual with tracked changes detailing all revisions made to the previous version. This version is available upon request. Revisions to the previous version of this appendix are summarized in the table below.

Document	**Revision**
Quality Assurance Manual Version 15.0 (Appendix VI)	General – Replaced the term “client” with the term “customer” Table 8.1 – Updated Equipment List Table 8.3A – Updated Standards Table 10.1 – Updated SOP List

1.0 SIGNATORY APPROVALS

Semi-Volatile QUALITY ASSURANCE MANUAL

APPENDIX VII TO THE ESC QUALITY ASSURANCE MANUAL

for

ESC LAB SCIENCES
12065 LEBANON ROAD
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Prepared by

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NOTE: The QAM has been approved by the following people.

Chris Johnson, B.S., Organics Manager 615-773-9774

Jim Brownfield, B.S., Compliance Director 615-773-9681

Steve Miller, B.S., Quality Assurance Manager, 615-773-9684

2.0 APPENDIX TABLE OF CONTENTS

3.0 SCOPE AND APPLICATION

This appendix discusses specific QA requirements for general analytical protocols to ensure that analytical data generated from the Semi-Volatile (SVOC) laboratory are scientifically valid and are of acceptable quality. Any deviations from these requirements and any deviations that result in non-conforming work must be immediately evaluated and their corrective actions documented.

4.0 LABORATORY ORGANIZATION AND RESPONSIBILITIES

ESC Lab Sciences offers diverse environmental capabilities that enable the laboratory to provide the customer with both routine and specialized services, field sampling guidance and broad laboratory expertise. A brief outline of the organization and responsibilities as they apply to the ESC Quality Assurance Program is presented in *Section 4.0 in the ESC Quality Assurance Manual.*

5.0 PERSONNEL AND TRAINING

5.1 PERSONNEL

Chris Johnson, with a B.S. degree in Biology, is the Organics Manager and is responsible for the overall production of these laboratories; including the management of the staff and scheduling. Mr. Johnson has over 15 years of environmental laboratory experience.

In his absence, Blake Judge assumes responsibility for SVOC departmental decisions. Mr. Judge has a B.S. degree in Chemistry and is a Senior Chemist in the SVOC Department. He is proficient in semi-volatile organic analytical methods and has over 10 years of environmental laboratory experience.

5.2 TRAINING

5.2.1 All new analysts to the laboratory are trained by a Chemist or Department Lead according to ESC protocol. ESC's training program is outlined in *SOP 030205 Technical Training and Personnel Qualifications.* Performance is documented using an initial demonstration of capability (IDOCs) and continuing demonstration of capability (CDOC). On-going acceptable capability in SVOC analyses and preparation is also demonstrated by acceptable participation in multiple proficiency testing programs (PTs) and daily Quality Control sample analyses. Documentation of analyst training is maintained on file within the department.

6.0 FACILITIES AND LABORATORY SAFETY

6.1 FACILITIES

The main area of the instrumentation laboratory in Building #5 has nearly 1500 square feet with approximately 500 square feet of bench area. The 4000 square feet of area in the extraction laboratory includes roughly 330 square feet of bench area with 245 square feet of hood space. There is an additional 2000 square feet of storage for this laboratory. The air system is a 15-ton make-up unit plus 15-ton HVAC with electric heat. The physical and air-handling separations, between this laboratory and other ESC sections, prevent potential cross-contamination between solvent vapor generation and incompatible analytical processes. The laboratory reagent water is provided through the US Filter deionizer system. Waste disposal containers are located in the laboratory and Clean Harbors serves as ESC's waste disposal carrier as discussed in detail in Section 6.0 of the ESC Quality Assurance Manual. ESC's building information guides and site plan are shown in Appendix I.

6.2 LABORATORY SAFETY

- Laboratory access is limited when work is being performed.
- All procedures where chemicals are prepared or splashes may occur are conducted in laboratory exhaust hoods.
- ESC's laboratory safety guidelines are detailed in the *ESC Chemical Hygiene Plan.*

7.0 SAMPLING PROCEDURES

7.1 FIELD SAMPLING PROCEDURES, SAMPLE STORAGE, AND HANDLING

- Field Sampling procedure is described in Appendix III of this ESC Quality Assurance Manual. Sample information is recorded and kept on the ESC chain of custody and field logbooks.
- Matrices for SVOC environmental analyses include groundwater, wastewater, drinking water, soil, and sludge.
- Sample containers, preservation methods and holding times vary depending on analyses requested. Please see determinative procedures for specific directions.
- Plastic containers or lids may NOT be used for the storage of samples due to possible contamination from the phthalate esters and other hydrocarbons.
- Environmental sample containers should be filled carefully to prevent any portion of the sample from coming into contact with the sampler's gloves causing possible phthalate contamination.

8.0 EQUIPMENT

8.1 EQUIPMENT LIST

LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Semi-Volatiles Analysis
This table is subject to revision without notice

Item	*Manufacturer*	*Model*	*Instrument Name*	*#*	*Serial #*	*Location*
Gas Chromatograph 2	HP	6890	svcompa	2	US00004397	SVOC
Gas Chromatograph 7	Agilent	6890	svcompe	7	US10350064	SVOC
Gas Chromatograph 8	Agilent	6890	svcompp	8	DE00022534	SVOC
Gas Chromatograph 9	HP	6890	svcompj	9	US00029095	SVOC
Gas Chromatograph 10	Agilent	6890	svcompk	10	US00039655	SVOC
Gas Chromatograph 11	Agilent	6890	svcompn	11	US00040550	SVOC
Gas Chromatograph 12	Agilent	6890	svcompo	12	US00034155	SVOC
Gas Chromatograph 13	HP	6890	svcomps	13	US00010364	SVOC
Gas Chromatograph 14	HP	6890	svcompt	14	US00020581	SVOC
Gas Chromatograph 16	Agilent	6890	svcompv	16	US10212071	SVOC
Gas Chromatograph 17	Agilent	6890	svcompw	17	US10344078	SVOC
Gas Chromatograph 18	Agilent	6890	svcompd	18	US10351038	SVOC
Gas Chromatograph 19	Agilent	6890	svcompaa	19	CN10516070	SVOC
Gas Chromatograph 20	Agilent	6890	svcompab	20	CN10543031	SVOC
Gas Chromatograph 21	Agilent	7890	svcompae	21	CN 10730070	SVOC
Gas Chromatograph 22	Agilent	7890	svcompaf	22	CN 10730081	SVOC
Gas Chromatograph 23	Agilent	6890	svcompag	23	CN 92174366	SVOC
Gas Chromatograph 24	Agilent	6890	svcompah	24	CN 92174369	SVOC
Gas Chromatograph 25	Agilent	7890	svcompaj	25	CN 10091009	SVOC
Gas Chromatograph 26	Agilent	7890	Svcompar	26	CN11501138	SVOC
Gas Chromatograph 27	Agilent	7890	Svcompas	27	CN11501139	SVOC
Gas Chromatograph 28	Agilent	7890	Svcompat	28	US11521018	SVOC
Gas Chromatograph 29	Agilent	7890	Svcompau	29	CN11521077	SVOC
Gas Chromatograph 30	Agilent	7890	svcompav	30	US11521020	SVOC
Gas Chromatograph 31	Agilent	7890	svcompba	31	CN13503096	SVOC
Gas Chromatograph 32	Agilent	7890	svcompbc	32	CN14423060	SVOC
Gas Chromatograph 33	Agilent	7890	svcompbd	33	CN15033026	SVOC
Gas Chromatograph 34	Agilent	7890	svcompbe	34	CN15033027	SVOC
Gas Chromatograph Detectors 3	Detectors	NPD/NPD	svcompo	3	N/A	SVOC
Gas Chromatograph Detectors 7	Detectors	FID	svcompe	7	N/A	SVOC
Gas Chromatograph Detectors 8	Detectors	FID	svcompp	8	N/A	SVOC
Gas Chromatograph Detectors 9	Detectors	FID	svcompj	9	N/A	SVOC
Gas Chromatograph Detectors 10	Detectors	FID	svcompk	10	N/A	SVOC

LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Semi-Volatiles Analysis
This table is subject to revision without notice

Item	*Manufacturer*	*Model*	*Instrument Name*	*#*	*Serial #*	*Location*
Gas Chromatograph Detectors 11	Detectors	ECD/ECD	svcompn	11	F) U11750 B) U12481	SVOC
Gas Chromatograph Detectors 12	Detectors	FPD/FPD	svcompo	12	N/A	SVOC
Gas Chromatograph Detectors 13	Detectors	FID	svcomps	13	N/A	SVOC
Gas Chromatograph Detectors 14	Detectors	ECD/ECD	svcompt	14	F) U3113 B) U2620	SVOC
Gas Chromatograph Detectors 16	Detectors	FID	svcompu	16	N/A	SVOC
Gas Chromatograph Detectors 17	Detectors	FID	svcompv	17	N/A	SVOC
Gas Chromatograph Detectors 18	Detectors	ECD/ECD	svcompd	18	F) U11613 B) U13988	SVOC
Gas Chromatograph Detectors 19	Detectors	ECD/ECD	svcompaa	19	F) U6632 B) U8422	SVOC
Gas Chromatograph Detectors 20	Detectors	ECD/ECD	svcompab	20	F) U13989 B) U0418	SVOC
Gas Chromatograph Detectors 21	Detectors	FID	svcompae	21	N/A	SVOC
Gas Chromatograph Detectors 22	Detectors	ECD/ECD	svcompaf	22	F)U12039 B) 12038	SVOC
Gas Chromatograph Detectors 23	Detectors	ECD/ECD	svcompag	23	F) U2621 B) U8104	SVOC
Gas Chromatograph Detectors 24	Detectors	ECD/ECD	svcompah	24	F) U8423 B) U12482	SVOC
Gas Chromatograph Detectors 26	Detectors	FID	svcompar	26	N/A	SVOC
Gas Chromatograph Detectors 27	Detectors	FID	svcompas	27	N/A	SVOC
Gas Chromatograph Detectors 28	Detectors	ECD/ECD	Svcompat	28	F) U26768 B) U26237	SVOC
Gas Chromatograph Detectors 29	Detectors	ECD/ECD	svcompau	29	F) U20277 B) U20299	SVOC
Gas Chromatograph Detectors 30	Detectors	ECD/ECD	svcompav	30	F) U20425 B) U20424	SVOC
Gas Chromatograph Detectors 31	Detectors	FID	svcompba	31	N/A	SVOC
Gas Chromatograph Detectors 32	Detectors	FID	svcompbc	32	N/A	SVOC
Gas Chromatograph Detectors 33	Detectors	FID	svcompbd	33	N/A	SVOC
Gas Chromatograph Detectors 34	Detectors	FID	svcompbe	34	N/A	SVOC
Gas Chromatograph/Mass Spectrometer 1	Agilent	6890 GC/5973MSD	svcompf	1	GC CN10335001 MS US33220022	SVOC
Gas Chromatograph/Mass Spectrometer 2	Agilent	6890 GC/5973MSD	svcompc	2	GC US10409048 MS US35120400	SVOC
Gas Chromatograph/Mass Spectrometer 4	Agilent	6890 GC/5973MSD	svcomph	4	GC CN10403067 MS US35120308	SVOC
Gas Chromatograph/Mass Spectrometer 7	Agilent	6890 GC/5973MSD	svcompm	7	GC --------------- MS US03940745	SVOC

LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Semi-Volatiles Analysis *This table is subject to revision without notice*						
Item	***Manufacturer***	***Model***	***Instrument Name***	***#***	***Serial #***	***Location***
Gas Chromatograph/Mass Spectrometer 9	Agilent	6890 GC/5973MSD	svcompx	9	GC CN10344042 MS US33220158	SVOC
Gas Chromatograph/Mass Spectrometer 10	Agilent	6890 GC/5973MSD	svcompy	10	GC CN10340045 MS US33220183	SVOC
Gas Chromatograph/Mass Spectrometer 11	Agilent	6890 GC/5975MSD		11	GC CN10509031 MS US60532657	SVOC
Gas Chromatograph/Mass Spectrometer 12	Agilent	7890 GC/5975MSD	svcompai	12	GC CN10728074/ MS 12-0706-1325	SVOC
Gas Chromatograph/Mass Spectrometer 13	Agilent	7890 GC/5975MSD	svcompak	13	GC CN10301081/ MS US10313621	SVOC
Gas Chromatograph/Mass Spectrometer 14	Agilent	7890 GC/5975MSD	Svcompal	14	GC: CN11031022 MS: US11093726	SVOC
Gas Chromatograph/Mass Spectrometer 15	Agilent	7890 GC/5975MSD	Svcompam	15	GC: CN10301081 MS: US10313621	SVOC
Gas Chromatograph/Mass Spectrometer 16	Agilent	7890 GC/5975MSD	Svcompan	16	GC: CN10301152 MS: US10313616	SVOC
Gas Chromatograph/Mass Spectrometer 17	Agilent	7890 GC/5975MSD	Svcompao	17	GC: CN11191064 MS: US11363807	SVOC
Gas Chromatograph/Mass Spectrometer 18	Agilent	7890 GC/5975MSD	Svcompap	18	GC: CN11401093 MS: US11403903	SVOC
Gas Chromatograph/Mass Spectrometer 19	Agilent	7890 GC/5975MSD	Svcompaq	19	GC: CN11391051 MS: US11383838	SVOC
Gas Chromatograph/Mass Spectrometer 20	Agilent	7890 GC/5975MSD	Svcompaw	20	GC: CN12031161 MS: US11503941	SVOC
Gas Chromatograph/Mass Spectrometer 21	Agilent	7890 GC/5975MSD	Svcompax	21	GC: CN12031160 MS: US11513903	SVOC
Gas Chromatograph/Mass Spectrometer 22	Agilent	7890 GC/5975MSD	Svcompay	22	GC: CN11521157 MS: US12023909	SVOC
Gas Chromatograph/Mass Spectrometer 23	Agilent	7890 GC/5975MSD	Svcompaz	23	GC: CN12031114 MS: US11433926	SVOC
Gas Chromatograph/Mass Spectrometer 24	Agilent	7890 GC/5977MSD	Svcompbb	24	GC:CN10906031 MS: US11343905	SVOC
High Performance Liquid Chromatography	Agilent	1100 Series DAD/FLD	hplc1	1	DAD de01608402 FLD de23904489	SVOC
High Performance Liquid Chromatography	Agilent	1100 Series DAD/FLD	hplc2	2	DAD de30518420 FLD	SVOC
High Performance Liquid Chromatography (HPLC3)	Agilent	1100 Series DAD	hplc3	3	DAD us64400711	SVOC
High Performance Liquid Chromatography (HPLC4)	Agilent	1100 Series DAD/FLD	hplc4	4	DAD de43623013	SVOC
Analytical Balance	Mettler Toledo	PB1502-S		1	1126193668	Ext. Lab
Analytical Balance	Mettler Toledo	MS1602S		2	B243464732	Ext.Lab
Analytical Balance	Mettler Toledo	MS1602S		3	B115130112	Ext.Lab
Analytical Balance	Ohaus	ARA520		3	1202120618	Ext. Lab
Analytical Balance	Ohaus	ARA520		4	1202120814	Ext. Lab
Analytical Balance	Ohaus	Scout Pro			7132101108	Ext. Lab
Automatic Concentrators	Buchi	Syncore	Buchi	1	2302	Ext. Lab
Automatic Concentrators	Buchi	Syncore	Buchi	2	2304	Ext. Lab

LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Semi-Volatiles Analysis
This table is subject to revision without notice

Item	*Manufacturer*	*Model*	*Instrument Name*	*#*	*Serial #*	*Location*
Automatic Concentrators	Buchi	Syncore	Buchi	3	2303	Ext. Lab
Automatic Concentrators	Buchi	Syncore	Buchi	4	0400000940	Ext. Lab
Automatic Concentrators	Buchi	Syncore	Buchi	5	406583020005	Ext. Lab
Automatic Concentrators	Buchi	Syncore	Buchi	6	1469	Ext. Lab
Automatic Concentrators	Buchi	Syncore	Buchi	7	1461	Ext. Lab
Automatic Concentrators	Buchi	Syncore	Buchi	8	417004020002	Ext. Lab
Automatic Concentrators	Buchi	Syncore	Buchi	9	416870050003	Ext. Lab
Automatic Concentrators	Buchi	Syncore	Buchi	10	1466	Ext. Lab
Automatic Concentrators	Buchi	Syncore	Buchi	11	1463	Ext. Lab
Automatic Concentrators	Buchi	Syncore	Buchi	12	1462	Ext. Lab
Automatic Concentrators	Buchi	Syncore	Buchi	13	1468	Ext. Lab
Capping station	Horizon	MARS X			snxc2225	Ext. Lab
Capping station	Horizon	MARS X			snxc2215	Ext. Lab
Centrifuge	Sorvall	ST-40		2	2224	Ext. Lab
Centrifuge	Sorvall	ST-40		3	2225	Ext. Lab
Centrifuge	Sorvall	ST-40		5	2227	Ext. Lab
Concentration Chiller	Lauda	UC0300			64593	Ext. Lab
Concentration Chiller	Lauda	WKL 3200			2039	Ext. Lab
Furnace	Thermo Scientific				1882	Ext. Lab
Oven	Fisher	6556			166	Ext. Lab
Oven	VWR	1305U			0520	Ext. Lab
HAA Shaker	Eberbach				2159	Ext. Lab
RV shaker	Eberbach	F6010.00			041242	Ext. Lab
RV shaker	Eberbach	F6010.00			041250	Ext. Lab
LVI Shaker	Eberbach	6010-04			1834	Ext. Lab
HAA water Bath	Thermo Scientific	280 series			2033602-102	Ext. Lab
High Intensity Ultrasonic Processor	Misonix			1	2193	Ext. Lab
High Intensity Ultrasonic Processor	Misonix			2	1382	Ext. Lab
High Intensity Ultrasonic Processor	Misonix			3	1888	Ext. Lab
High Intensity Ultrasonic Processor	Misonix			4	1381	Ext. Lab
Microwave	CEM	MARS 6		3	2296	Ext. Lab
Microwave	CEM	MARS 6		2	MJ2518	Ext. Lab
Microwave	CEM	MARS 6		4	MJ6367	Ext. Lab
OG concentrator	Horizon	SpeedVap III		1	1534	Ext. Lab
OG concentrator	Horizon	SpeedVap III		2	SN04-2020	Ext. Lab
OG concentrator	Horizon	SpeedVap III		3	2186	Ext. Lab
OG concentrator	Horizon	SpeedVap IV		1	15-0055	Wet Lab
OG concentrator	Horizon	SpeedVap IV		2	15-0056	Wet Lab

LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Semi-Volatiles Analysis
This table is subject to revision without notice

Item	*Manufacturer*	*Model*	*Instrument Name*	*#*	*Serial #*	*Location*
OG SPE extractor	Horizon	SPE-DEX 3000		1	2222	Ext. Lab
OG SPE extractor	Horizon	SPE-DEX 3000		2	2223	Ext. Lab
OG SPE extractor	Horizon	SPE-DEX 3000		3	2221	Ext. Lab
OG SPE extractor	Horizon	SPE-DEX 3000		4	2220	Ext. Lab
OG SPE extractor	Horizon	SPE-DEX3100		1	15-0113	Wet Lab
OG SPE extractor	Horizon	SPE-DEX3100		2	15-0116	Wet Lab
OG SPE extractor	Horizon	SPE-DEX3100		3	15-0117	Wet Lab
OG SPE extractor	Horizon	SPE-DEX3100		4	15-0118	Wet Lab
OG SPE Controllers	Horizon	1000/3000XL		1	2125	Ext. Lab
OG SPE Controllers	Horizon	1000/3000XL		2	2659	Ext. Lab
OG SPE Controllers	Horizon	1000/3000XL		3	2127	Ext. Lab
OG SPE Controllers	Horizon	1000/3000XL		4	2128	Ext. Lab
Separatory funnel rotators	ATR				1514	Ext. Lab
Separatory funnel rotators	ATR				1515	Ext. Lab
Separatory funnel rotators	ATR				1516	Ext. Lab
Separatory funnel rotators	ATR				2055	Ext. Lab
Separatory funnel rotators	ATR				2056	Ext. Lab
Separatory funnel rotators	ATR				2057	Ext. Lab
Speed Vap	FMS				2471	Ext. Lab
Water Bath Sonicator	Branson	8510			RPA040384175E	Ext. Lab
Vacuum Pump	Gast				0908605639	Ext. Lab
Vacuum Pump	Gast				0913008139	Ext. Lab
Vacuum Pump	Gast			3	0311000841	Ext. Lab
Puck Mill/Shatterbox	SPEX	8530		1	10191	Ext. Lab

8.2 EQUIPMENT PREVENTIVE MAINTENANCE, EQUIPMENT CALIBRATION

INSTRUMENT	P. M. DESCRIPTION	FREQUENCY
Analytical Balances	•Check with Class "I" weights	Daily-tolerance $\pm$0.1%
Analytical Balances	•Service/Calibration (semi-annual contract maintenance and calibration check)	Semi-annually
Refrigerators & Incubators	•Maintenance service	As needed determined by daily temperature performance checks
Gas Chromatograph Detectors: ECD	•Bake off or Replace •Perform wipe leakage test	GC/detector maintenance is routinely completed as needed for each instrument. Analysts are responsible for performing and documenting maintenance on each component of the instrumentation based on daily performance of the instrument and its
Gas Chromatograph Detectors: FID	•Change Quartz jet; clean; replace flame tip	
Gas Chromatograph/Mass Spectrometer	•Autotune Report	
Gas Chromatograph/Mass Spectrometer	•Clean ion source	

INSTRUMENT	P. M. DESCRIPTION	FREQUENCY
Gas Chromatograph/Mass Spectrometer	•Replace vacuum pump oil	ability to meet certain method requirements. Senior analyst team is available to help with major maintenance issues.
Gas Chromatographs/Mass Spectrometer & Gas Chromatographs	•Replace septa and liner	
Gas Chromatographs/Mass Spectrometer & Gas Chromatographs	•Replace column	
High Intensity Ultrasonic Processor - Misonix	•Check tuning criteria	Daily with use
Infrared Spectrophotometer - Foxboro Miran 1A	•Optics alignment or replacement	As needed when response begins to deteriorate

8.3 STANDARDS AND REAGENTS

Table 8.3A: Standard stock sources, description and calibration information.

This table is subject to revision without notice

Method	Vendor*	Description	Calibration	Storage Req.	Expiration
8310	Ultra	Aromatic Hydrocarbon	Primary	4° ± 2°C	6 months
	NSI	8310/610 Spike	Second Source	4° ± 2°C	6 months
DRO	NSI	DRO #2 Cal Mix	Primary	-10°C to –20°C	6 months
	NSI	DRO #2 Spike	Second Source	-10°C to –20°C	6 months
EPH TN DRO	NSI	TN-EPH Calibration Mix	Primary	-10°C to –20°C	6 months
	NSI	EPH-TN Spike	Second Source	-10°C to –20°C	6 months
RRO	NSI	30W Oil	Primary	-10°C to –20°C	6 months
PCB	Accustd	Aroclor PCB Kit	Primary	4° ± 2°C	6 months
	NSI	1260 Spike	Second Source	4° ± 2°C	6 months
Chlordane	Restek	Chlordane Mix	Primary	4° ± 2°C	6 months
Toxaphene	Restek	Toxaphene	Primary	4° ± 2°C	6 months
Pesticides	Ultra	Pest Mix	Primary	4° ± 2°C	6 months
	NSI	Pest Spike Mix	Second Source	4° ± 2°C	6 months
Herbicides	NSI	Custom Herbicide Mis	Primary	4° ± 2°C	6 months
	NSI	Herb Spike Mix	Second Source	4° ± 2°C	6 months
8141 OP Pest	Ultra/NSI	OP Cal Mix A, B	Primary	4° ± 2°C	6 months
	NSI	OP Spike Mix A, B	Second Source	4° ± 2°C	6 months
507 NP Pest	Ultra/NSI	507 Cal Mix	Primary	4° ± 2°C	2 months
	NSI	NP Pest Spike	Second Source	4° ± 2°C	2 months
THAA	Ultra/Accustd	HAA Cal Mix	Primary	-10°C to –20°C	6 months
	Accustd/NSI	HAA Spike	Second Source	-10°C to –20°C	6 months
8270	Ultra	Custom Std Mega Mix	Primary	4° ± 2°C	6 months
	Restek	Spike Mix	Second Source	4° ± 2°C	6 months
8330	Restek	Mix1, Mix2, PETN	Primary	4° ± 2°C	6 months
	Ultra, Chemservice	Mix1, Mix2, PETN	Second Source	4° ± 2°C	6 months
8011, 504.1	Accustd	504.1 Cal Mix	Primary	4° ± 2°C	1 month
	NSI	Spike Mix	Second Source	4° ± 2°C	1 month

Table 8.3A: Standard stock sources, description and calibration information.
This table is subject to revision without notice

Method	Vendor*	Description	Calibration	Storage Req.	Expiration
Sulfolane, 8270C	Sigma Aldrich	Calibration Mix	Primary	4° ± 2°C	6 months
	Restek	Spike Mix	Second source	4° ± 2°C	6 months
Glycol, 8015	Chemservice	Calibration Mix	Primary	4° ± 2°C	6 months
	Chemservice	Spike Mix	Second source	4° ± 2°C	6 months

Equivalent Providers may be utilized.

TABLE 8.3B: Working Standard Concentrations
This table is subject to revision without notice

Organic Compounds	Method #	Standard Concentrations	Storage Requirements	Expiration
Semi-Volatiles	625, SM6410B 20th, 8270C/D	1,2,4,8,12,16,20,30,40,50,80 (low level and regular)	4° ± 2°C	6 months
Semi-Volatiles: RV/LVI/NC SS	625, SM6410B 20th, 8270C/D	10,20,50,100,200,500,1000,2000 ug/L	4° ± 2°C	6 months
PCBs: 1L/RV SS	608, SM6431B 20th, 8082	2.0,4.0,5.0,10,20,50 µg/L	4° ± 2°C	6 months
Pesticides: 1L/RV/SS	608, SM 6630C, 8081A,	0.5,1.0,2.0,5.0,10,15,20 µg/L	4° ± 2°C	6 months
Chlordane and/or Toxaphene 1L/RV/SS	608, SM 6630C, 8081A,	10,20,50,100,150,200 µg/L	4° ± 2°C	6 months
Sulfolane	8270C/D	4,8,10,20,50,100,200,500 ug/L	4° ± 2°C	6 months
PCB Arochlors 1221, 1232, 1242, 1248, 1254	8082	10 ug/L	4° ± 2°C	6 months
Herbicides	8151A, SM6640C 20th	0.02, 0.05, 0.1, 0.2, 0.5, 1.0 mg/L	4° ± 2°C	6 months
OP and NP Pesticides	507 by dual-NPD, 1657A, 8141A by dual-FPD	0.2,1.0, 2.0, 5.0, 10.0, 15.0, 20.0 ug/L	4° ± 2°C	6 months
PAHs	8310, 610, SM6440B	0.04, 0.20,1.0,5.0,8.0,20.0,30.0, 40.0 ug/L	4° ± 2°C	6 months
PAHs: 1L/RV/LVI/ SS	8270C/D SIM	4.0,20,40,100,160,400,600,800 ug/L 1.0,5.0,10,20,40,80,200 ug/L	4° ± 2°C	6 months
Nitroaromatics & Nitramines	8330	.05, 0.1, 0.25, 0.5, 2.0, 5.0, 10.0, 25.0 mg/L	NA*	NA*
EPHTN	EPH TN	10000, 6000, 4000, 2000, 1000, 400, 200, 100 mg/L	NA*	NA*
DRO	OA2 , 8015Mod, LA TPH D, LA TPH O, OHIO DRO	10000, 5000, 3000, 2000, 1000, 400, 200, 100 mg/L	NA*	NA*
Diesel/M.O: RV/LVI	EPH TN OA2 ,	2.0,4.0,8.0,20,40,80,100,200	NA*	NA*

TABLE 8.3B: Working Standard Concentrations
This table is subject to revision without notice

Organic Compounds	Method #	Standard Concentrations	Storage Requirements	Expiration
	8015Mod, LA TPH D, LA TPH O, OHIO DRO	mg/L		
DRO	DRO/CA LUFT/CO	2.0,4.0,10,20,40,60,100,200 mg/L	NA*	NA*
DROMO: LVI PAHMO: LVI	MO DRO/PAH by 8270	5.0,10,20,40,80,120,160,200 mg/L 4.0,20,40,100,160,400,600,800 ug/L	4° ± 2°C	6 months
MADEP EPH	MADEP EPH	Aromatics C11-C22: 17, 85, 425, 850, 1700, 3400, 6800 mg/L Aliphatic C9 - C18: 6, 30, 150, 300, 600, 1200, 2400 mg/L Aliphatic C19 - C36: 8, 40, 200, 800, 1600, 3200 mg/L	NA*	NA*
EDB, DBCP, TCP	8011, 504.1	0.01, 0.02, 0.05, 0.10, 0.25, 0.5	NA*	NA*
THAAs	552.2	1, 2, 4, 10, 20, 30, 40, 50 ug/L	NA*	NA*
FL PRO	FL PRO	85, 850, 2550, 4250, 5950, 8500 mg/l	NA*	NA*
FL PRO RV	FL PRO	1.7, 3.4, 6.8, 13.6, 34, 85, 170 mg/L	NA*	NA-
Glycols	8015B/C/D - Modified	1.5,7.5,15,30,45,60 ppm	NA*	NA*
TX TPH	TX1005	Individual Ranges- 4.5, 10, 25, 50, 125, 250, 500, 1250, 2500 ppm. Total Range- 9.0, 20, 50, 100, 250, 500, 1000, 2500, 5000 ppm.	NA*	NA*

* indicates solutions are prepared fresh daily as needed.

8.4 INSTRUMENT CALIBRATION

<u>608/8081A or B/SM6630C - Chlorinated Pesticides – SOP Number 330344</u>

The gas chromatograph is calibrated using either the internal or external standard calibration model. A standard curve is prepared using a minimum of three concentration levels for each compound of interest for method 608. A minimum of five concentration levels is necessary for methods 8081A/B and SM6630C. The calibration range must represent the typical environmental sample concentration and include the RL as the lowest calibration point. The linear range of the instrument must also be monitored to ensure that the maximum calibration point is within detection range. The calibration standards are tabulated according to peak height or area responses against concentration or ISTD response for each compound and calibration/response factors are calculated. If performing analysis by method 608 and the response factors of the initial calibration are

< 10 % RSD for method 608 and 20% RSD for methods 8081A/B and 6630C over the calibration range, the average RF can be used for calculations. Alternatively, when the response factor criteria is exceeded, the analyst may utilize a linear calibration model of response ratios (i.e. Area/Ref. Area or Amt./Ref Amt.) for quantitation providing that the correlation coefficient is at least 0.990.

During the analytical sequence, the stability of the initial calibration curve is verified, following every 20th sample for external calibration and every 12 hours if monitoring ISTD, by the analysis of a continuing calibration verification (CCV) standard. The CCV must recover within 15% of the expected concentration for each analyte.
At daily instrument startup and in lieu of performing an entire initial calibration, the most recent calibration curve may be verified by the analysis of initial calibration verification standard (ICV). If the response for any analyte in this check varies from the predicted response by more than ±15%, the analysis must be repeated using fresh standard. If the standard still does not meet the acceptance criteria, a new initial calibration curve must be generated.

An independent, or second source, calibration verification standard (SSCV) is analyzed after each initial calibration and should recover within ±20% of the expected concentration for each analyte. When analyte responses in field samples exceed the calibration range, the sample is diluted and re-analyzed.

Degradation if DDT and Endrin are also verified at least every 12hr window. Breakdown should recover less 20% of the total injection.

507 - Nitrogen/Phosphorus Pesticides - SOP Number 330348

The gas chromatograph is calibrated using the external standard procedure. A standard curve is prepared using a minimum of three concentration levels for each compound of interest for method 507. The calibration range must represent the typical environmental sample concentration and include the RL as the lowest calibration point. The linear range of the instrument must also be monitored to ensure that the maximum calibration point is within detection range. The calibration standards are tabulated according to peak height or area responses against concentration for each compound and response factors are calculated. If the response factors of the initial calibration are ≤20 % RSD over the calibration range, the average RF can be used for calculations. Alternatively, when the response factor criteria is exceeded, the analyst may utilize a linear calibration model of response ratios (i.e. Area/Ref. Area or Amt./Ref Amt.) for quantitation providing that the correlation coefficient is at least 0.990.

During the analytical sequence the stability of the initial calibration is verified, following every 10th sample and at the end of the sequence, by the analysis of a continuing calibration verification (CCV) standard. The CCV must recovery within 20% of the expected concentration for each analyte.

At daily instrument startup and in lieu of performing an entire initial calibration, the most recent calibration curve may be verified by the analysis of check calibration verification standard (CCV). If the response for any analyte in this check varies by more than $\pm$20% from the initial calibration, the analysis must be repeated using fresh standard. If the standard still does not meet the criteria, a new initial calibration curve must be generated.

A Quality Control Sample (QCS) is analyzed at a minimum quarterly to verify calibration standards.

552.2 - HAA - SOP Number 330319

The gas chromatograph is calibrated using the internal standard procedure. A standard curve is prepared using a minimum of five concentration levels for each compound of interest. The calibration range must represent the typical environmental sample concentration and include the RL as the lowest calibration point. The linear range of the instrument must also be monitored to ensure that the maximum calibration point is within detection range. The calibration standards are tabulated according to peak height or area responses against concentration for each compound and response factors are calculated. If the response factors of the initial calibration are $\leq$20 % RSD over the calibration range, the average RF can be used for calculations. Alternatively, when the response factor criteria is exceeded, the analyst may utilize a linear calibration model of response ratios (i.e. Area/Ref. Area or Amt./Ref Amt.) for quantitation providing that the correlation coefficient is at least 0.990.

During the analytical sequence the stability of the initial calibration is verified, following every 10th sample and at the end of the sequence, by the analysis of a continuing calibration verification (CCV) standard. The response of the analytes in the CCV must not vary more than 30% from the initial calibration.

At daily instrument startup and in lieu of performing an entire initial calibration, the most recent calibration curve may be verified by the analysis of check calibration verification standard (CCV). If the response for any analyte in this check varies by more than $\pm$30% from the initial calibration, the analysis must be repeated using fresh standard. If the standard still does not meet the criteria, a new initial calibration curve must be analyzed.

A Quality Control Sample (QCS) is analyzed at a minimum quarterly to verify calibration standards.

8151A, SM6640B – Herbicides - SOP Number 330320

The gas chromatograph is calibrated using the external standard procedure. A standard curve is prepared using a minimum of five concentration levels for each analyte of interest. The calibration range must represent the typical environmental sample concentration and include the RL as the lowest calibration point. The linear range of the instrument must also be monitored to ensure that the maximum calibration point is within detection range. The calibration standards are tabulated according to peak height or area responses against concentration for each compound and response factors are calculated. If the response factors of the initial calibration are $\leq$20 % RSD over the calibration range, the average RF can be used for calculations. Alternatively, when the response factor criteria is exceeded, the analyst may utilize a linear calibration model of response ratios (i.e. Area/Ref. Area or Amt./Ref Amt.) for quantitation providing that the correlation coefficient is at least 0.990.

During the analytical sequence, the stability of the initial calibration is verified following every 10th sample and at the end of the sequence by the analysis of a continuing calibration verification (CCV) standard. The CCV must recovery within 15% of the expected concentration for each analyte for method 8151A and within 20% for method 6640C. The value of the CCV can exceed the criteria for a single compound provided that all samples in the analytical batch are BDL (below detection limit). The concentration of the continuing check standard must be routinely varied to verify the entire calibration range.

At daily instrument startup and in lieu of performing an entire initial calibration, the most recent calibration curve may be verified by the analysis of check calibration verification standard (CCV). If the response for any analyte in this check varies from the predicted response by more than $\pm$15%, the analysis must be repeated using fresh standard. If the standard still does not meet the criteria, a new initial calibration curve must be generated.

An independent, or second source, calibration verification standard (SSCV) is analyzed after each initial calibration and should recover within $\pm$20% of the expected concentration for each analyte. When sample responses exceed the calibration range, the sample is diluted and re-analyzed.

8141A, 1657A – Organophosphorus Pesticides - SOP Number 330318

The gas chromatograph is calibrated using either the internal or external standard calibration model. A minimum of five concentration levels is necessary for methods 8141A and 1657A. The calibration range must represent the typical environmental sample concentration and include the RL as the lowest calibration point. The linear range of the instrument must also be monitored to ensure that the maximum calibration point is within detection range. The calibration standards are tabulated according to peak height or area responses against concentration or ISTD response for each compound and calibration/response factors are calculated. If the response factors of the initial calibration are $\leq$20 % RSD over the calibration range, the average RF can be used for calculations. Alternatively, when the response factor criteria is exceeded, the analyst may utilize a linear calibration model of response ratios (i.e. Area/Ref. Area or Amt./Ref Amt.) for quantitation providing that the correlation coefficient is at least 0.990.

During the analytical sequence, the stability of the initial calibration is verified following every 20th sample by the analysis of a continuing calibration verification (CCV) standard for external calibration or at the beginning of every 12hrs for ISTD calibration. The CCV must recovery within 15% of the expected concentration for each analyte. The concentration of the continuing check standard must be routinely varied to verify the entire calibration range.

At daily instrument startup and in lieu of performing an entire initial calibration, the most recent calibration curve may be verified by the analysis of check calibration verification standard (CCV). If the response for any analyte in this check varies from the predicted response by more than $\pm$15%, the analysis must be repeated using fresh standard. If the standard still does not meet the criteria, a new initial calibration curve must be generated. An independent, or second source, calibration verification standard (SSCV) is analyzed after each initial calibration and should recover within $\pm$20% of the expected concentration for each analyte. When sample responses exceed the calibration range, the sample is diluted and re-analyzed.

625, 8270C or D, SM6410B - Base/Neutrals/Acids by GC/MS: Semivolatile Organics – SOP Number 330345

Detector mass calibration is performed using the autotune function of the GC/MS analytical system and PFTBA (Perfluorotributylamine). Following verification of the appropriate masses, the instrument sensitivity is verified by injecting a tuning solution containing decafluorotriphenylphosphine (DFTPP), benzidine, pentachlorophenol and DDT. The DFTPP must meet the ion abundance criteria specified by the EPA published method. Benzidine and pentachlorophenol are reviewed for tailing and DDT is reviewed for breakdown to DDE and DDD. Successful tuning must occur every 12 hours for method 8270C/D and every 24 hours for method 625, except where noted in the determinative SOP.

Following successful tuning, the GC/MS is calibrated using the internal standard procedure. A standard curve is prepared using a minimum of three standards for method 625 and five standards for method 8270C/D and SM6410B. The calibration standards are tabulated according to peak height or area against concentration and the concentrations and responses of the internal standard analytes. The results are used to determine a response factor for each analyte in each standard injected. A calibration curve is the constructed and is determined to be acceptable if each analyte meets the criteria specified in the determinative method. When this condition is met, linearity through the origin can be assumed and the average RF can be used in place of a calibration curve. Initial calibration that does not meet these requirements will not be accepted and recalibration must be performed. Linear regression can be used for target compounds exceeding the 15% criteria, providing that the correlation coefficient is 0.990 or better. USACE projects must meet a correlation coefficient of 0.995 or better. The initial calibration range must represent the typical environmental sample and include the RL as the lowest calibration point. The linear range of the instrument must be monitored to ensure that the maximum calibration point is within the range.

A second source calibration verification standard is analyzed after each calibration and should recover within 20% for all CCC compounds and within 50% for other analytes of interest for 8270C. All analytes must recover +/- 30% for 8270D. Following successful calibration, the analysis of field and QC samples may begin. Analysis may be performed only during the timeframe of a valid tuning cycle (12 hours for 8270C/D and 24 hours for 625). Following the expiration of the tuning clock, the instrument must be retuned and either re-calibrated or existing calibration may be re-verified.

For 8270C/D analyses, daily calibration verification includes successful demonstration of DFTPP sensitivity and the injection of a mid-level CCV standard containing all the target analytes of interest. The DFTPP tune must meet the ion abundance criteria specified within the published method. Each internal standard in the CCV must recover between -50% to + 100%, when compared to the same internal standard compound in the mid-point standard of the initial calibration curve. Additionally, if the retention time of an internal standard changes by more than 30 seconds from the retention time of the same internal standard in the mid-level standard of the most recent initial calibration, the system must be evaluated, corrected, and possibly re-calibrated.

For 625 analyses, daily calibration verification is accomplished by a successful demonstration of DFTPP sensitivity and the injection of a mid-level CCV standard containing all the target analytes of interest. The DFTPP tune must meet the same ion abundance criteria as the 8270C analysis and the CCV standard must recover within 20 % of predicted response for all analytes of interest.

8310, 610, SM6640B - PAHs by HPLC - SOP Number 330322

610: A standard curve is prepared using a minimum of three concentration levels for each compound of interest. If the response factors are < 10 % RSD over the working range, the average RF can be used for calculations

8310 & SM6640B: Perform calibration using a minimum of 5 points. If the response factors are < 20 % RSD over the working range, the average RF can be used for calculations or linear regression may be used providing that the correlation coefficient for each analyte of interest is 0.990 or better. USACE projects must meet a correlation coefficient of 0.995 or better. The regression line must never be forced through the origin.

The initial calibration standards are tabulated according to peak height or area responses against concentration for each compound and response factors are calculated. Alternatively, the results can be used to plot a calibration curve of response ratios (Area/Ref. Area) vs (Amt./Ref Amt.). The calibration range must represent the typical environmental sample and include the RL as the lowest calibration point. The linear range of the instrument must be monitored to ensure that the maximum calibration point is within the range. A second source calibration verification standard is analyzed after each calibration and should meet criteria of ±20%.

A continuing calibration verification (CCV) must be run at the beginning of each run and every 10 samples thereafter. The continuing calibration standard is prepared from the same source as the calibration curve and must perform within ±15% of the actual value. The CCV must represent the midpoint of the calibration range.

8330A/B/C – Nitroaromatics/Nitrosamines - SOP Number 330323

A standard curve is prepared using a minimum of five concentration levels for each compound of interest. Experience indicates that a linear calibration curve with zero intercept is appropriate for each analyte. Therefore, a response factor for each analyte can be taken as the slope of the best-fit regression line. The correlation coefficient for each analyte of interest is 0.990 or better. The calibration range must represent the typical environmental sample and include the RL as the lowest calibration point. The linear range of the instrument must be monitored to ensure that the maximum calibration point is within the range. A second source calibration verification standard is analyzed after each calibration and should meet the criteria of ±20%.

Daily calibration is accomplished through the analysis of midpoint calibration standards, at a minimum, at the beginning of the day, and singly after the last sample of the day (assuming a sample group of 10 samples or less). Obtain the response factor for each analyte from the mean peak heights or peak areas and compare it with the response factor obtained for the initial calibration. The mean response factor for the daily calibration must agree within ±20% of the response factor of the initial calibration. If this requirement is not met, a new initial calibration must be obtained.

8015B/C/D or State Specific Method - DRO/RRO - Various SOPs

Certain state accreditation/registration programs may have specific requirements for calibration and analysis that must be met. Those requirements supersede the general guidance provided in this section and are addressed in the determinative SOP. Generally, for 8015B/C/D analysis, the gas chromatograph is calibrated using the external standard procedure. A standard curve is prepared using a minimum of five concentration levels for each analyte of interest. The calibration range must represent the typical environmental sample concentration and include the RL as the lowest calibration point. The linear range of the instrument must also be monitored to ensure that the maximum calibration point is within detection range. The calibration standards are tabulated according to peak height or area responses against concentration for each compound and response factors are calculated. If the response factors of the initial calibration are ≤20 % RSD over the calibration range, or per state method, the average RF can be used for calculations. Alternatively, when the response factor criteria is exceeded, the analyst may utilize a linear calibration model of response ratios (i.e. Area/Ref. Area or Amt./Ref Amt.) for quantitation providing that the correlation coefficient is at least 0.990. USACE projects must meet a correlation coefficient of 0.995 or better.

During the analytical sequence, the stability of the initial calibration is verified following every 10th or 20th sample depending on method and at the end of the sequence by the analysis of a continuing calibration verification (CCV) standard. Typically, the CCV must recovery within 15% of the expected concentration for each analyte for method 8015B/C/D; however state specific limits for the CCV may vary. See the specific SOP or published method for more guidance. The concentration of the continuing check standard must be routinely varied to verify the entire calibration range.
At daily instrument startup and in lieu of performing an entire initial calibration, the most recent calibration curve may be verified by the analysis of check calibration verification standard (CCV). If the response for any analyte in this check varies from the predicted response by more than ±15% of the expected concentration for each analyte for method 8015B/C/D or more than state specified limits, the analysis must be repeated using fresh standard. If the standard still does not meet the criteria, a new initial calibration curve must be generated.

An independent, or second source, calibration verification standard (SSCV) is analyzed after each initial calibration and should meet criteria of ±20% of the expected concentration for each analyte. When sample responses exceed the range of the standard curve, the sample is diluted to a concentration suspected to be within the calibration range and re-analyzed.

8.5 ACCEPTANCE/REJECTION OF CALIBRATION

Organic Chemistry

The initial calibration curve is compared with previous curves for the same analyte. All new standard curves are immediately checked with a secondary source or laboratory control standard prepared from a separate source than those used for calibration. All curves are visually reviewed to ensure that acceptable correlation represents linearity. Calibration curves may be rejected for nonlinearity, abnormal sensitivity, or poor response of the laboratory control standard.

Continuing calibration verification is performed on each day that initial calibration is not performed and following every 10th or 20th sample. If a check standard does not perform within established criteria then the instrument undergoes an evaluation to determine the cause. Once the issue is corrected, all samples between the last in control standard and the first out of control check are re-analyzed.

TABLE 8.5: INSTRUMENT CALIBRATION

Instrument (Analysis)	Calibration Type	Minimum Number of Standards	Type of Curve	Acceptance/ Rejection Criteria	Frequency
Gas Chromatography	Initial	3 (600 series methods) - 5 (other) cal.stds	Avg. RF or Linear	8081A, 8151A, 6640C, 8141A, 657A: Must be ≤20% RSD 608 - ≤10% RSD	As needed
	Second Source	1 Second Source		+/- 20% of true value	With each calibration

TABLE 8.5: INSTRUMENT CALIBRATION

Instrument (Analysis)	Calibration Type	Minimum Number of Standards	Type of Curve	Acceptance/ Rejection Criteria	Frequency
(Pest/PCB, Herbicides, Organophos/ Organonitrogen Pesticides)	Daily / Continuing	OPPEST/HERB1/10 P/PCB 1/20		Must be within 15% of the initial calibration curve, 20% for 6640C.	Beginning, every 20 samples and ending for external cal.
	Daily / Continuing	OPPEST/HERB1/10 P/PCB 1/20		Must be within 15% of the initial calibration curve, 20% for 6640C.	Every 12hrs samples for internal cal
HPLC (PAH and Explosive)	Initial	3 (600 series methods) 5 (other) cal.stds	Avg. RF or Linear	8310, 8330: Must be ≤20% RSD 610 - ≤10% RSD	As needed
	Second Source	1 Second Source		+/- 20% of true value	With each calibration
	Daily / Continuing	1/10		Must be within 15% of the initial calibration curve.	Beginning, every 10 and ending.
GC/MS Semi-volatiles 8270C/D	Initial	At least 5 cal. stds	Avg. RF or Linear	8270C - Must be ≤15% RSD, CCCs must be ≤ 30% RSD, Linear regression: 0.990 per method or 0.995 for USACE	As needed
		1 Second Source		8270D - Must be ≤20% RSD for target analytes, Linear regression: 0.990 per method or 0.995 for USACE	
	Second Source	1 Second Source		8270C: Should recover within 20% for all CCC compounds and within 50% for other analytes of interest, with the exception of analytes known to perform poorly 8270D: Should recover w/in 30% for all	With each calibration
	Daily / Continuing	Tune & CCV		Must pass established method criteria. See SOP.	Every 12 hours per method
GC/MS Semi-volatiles 625	Initial	3 cal.stds	Avg. RF or Linear	625 - ≤35% RSD all compounds	As needed
	Second Source	1 Second Source		Should recover within 20% for all CCC compounds and within 50% for other analytes of interest, with the exception of analytes known to perform poorly	With each calibration
	Daily / Continuing	Tune & CCV every 24 hours		Must pass established method tuning criteria; 625: CCV must be ≤20% difference for all compounds,	Every 24 hours
HAA 552.2	Initial	5 cal.stds	Avg. RF or Linear	≤30% RSD all compounds	As needed
	Second Source(QCS)	1 Second Source		±30% of true value	Extracted with each batch
	Daily / Continuing	1/10		CCV must be ≤30% difference for all compounds,	Beginning, every 10 and ending

TABLE 8.5: INSTRUMENT CALIBRATION

Instrument (Analysis)	Calibration Type	Minimum Number of Standards	Type of Curve	Acceptance/ Rejection Criteria	Frequency
Pesticides 507	Initial Second Source(QCS) Daily / Continuing	5 cal.stds 1 Second Source 1/10	Avg. RF or Linear	≤20% RSD all compounds ±20% of true value CCV must be ≤20% difference for all compounds,	As needed Extracted with each batch Beginning, every 10 and ending
DRO –8015, State Programs* * Or per state requirement	Initial Second Source Daily / Continuing	5 cal.stds 1 Second Source 1/10	Avg. RF or Linear	8015B/C/D - ≤20% RSD all compounds ±20% of true value CCV must be ≤15% difference for all compounds,	As needed With each calibration Beginning, every 10/20 and ending

9.0 Laboratory Practices

9.1 Reagent Grade Water

Reagent grade water is obtained from an Evoqua resin with Aquafine UV system.

9.2 Glassware Washing and Sterilization Procedures

Organic laboratory glassware is washed in a non-phosphate detergent and warm tap water. Before washing, all writing and large deposits of grease are removed with acetone. Glassware is then rinsed with: tap water, "No Chromix" solution, tap water, and deionized (DI) water. It is then solvent rinsed in the following order: acetone, and then methylene chloride. Glassware is stored in designated drawers or on shelves, inverted if possible. All glassware is rinsed with the required solvent for the particular extraction protocol prior to use.

10.0 Analytical Procedures

10.1 A list of laboratory SOPs associated with the semi-volatile laboratory can be found in the following table:

TABLE 10.1: SEMI-VOLATILE DEPARTMENT SOPS

This table is subject to revision without notice

SOP #	Title
	Preparatory SOPs
330702B	RV Separatory Funnel Liquid-Liquid Extraction 3510C
330702A	Separatory Funnel Liquid-Liquid Extraction 3510C MN
330702	Separatory Funnel Liquid-Liquid Extraction 3510C
330707	Microwave Extraction (3546)

SOP #	Title
330708	Buchi Syncore Concentration System
330709	Microextraction Procedure (3511)
330754	3580A Waste Dilution for SVOC's
330755	PCB in Oil Waste Dilution
Extract Cleanup SOPs	
330739	3630C Silica Gel Cleanup
330740	3665A Acid Clean up
330741	3660C Sulfur Clean up
330742	3620B Florisil Clean up
Semi-Volatiles Analysis SOPs	
330770A	TPH/O&G- Soxhlet extraction using Hexane
330771A	n-Hexane Oil and Grease Extraction by SPE for South Carolina
330771	n-Hexane Oil and Grease Extraction by SPE
330317	Sulfolane (Modified EPA Method 8270C/D)
330318	8141 Organophosphorus Pesticides
330319	THAA's
330320	Chlorinated Herbicides by Gas Chromatography (Method 8151A)
330322	8310 PAH's by HPLC
330323	8330 Explosives by HPLC
330343	8082 PCB's
330344	Pesticides and PCBS by Gas Chromatography (608 and 8081A)
330345	Semi-volatile Organics by GC/MS using Capillary Column
330346	8011/504.1 EDB in Drinking Water by GC ECD
330346OH	8011 EDB in Drinking Water by GC ECD
330348	507 NP Pesticides in Drinking Water by GC NPD
330350A	Diesel Range Organics/Total Petroleum Hydrocarbons (Diesel) By Gas Chromatography
330352	TN - Extractable Petroleum Hydrocarbons / KY- Diesel Range Organics
330353	MA Extractable Petroleum Hydrocarbons
330355	Florida Pro and CT ETPH
330356	TXTPH 1005/1006
330358	OA2 & NWTPHDx
330359	AK102/AK103
330360	DROWM
330361	Glycols by GC/FID (8015)

11.0 QUALITY CONTROL CHECKS

NOTE: For specific guidance on each determinative method, including required quality control and specific state requirements/modifications, refer to the relevant laboratory standard operating procedure(s).

11.1 ESC participates in proficiency testing (PT's) in support of various laboratory accreditations/recognitions. Environmental samples are purchased from Environmental Resource Associates (ERA). The WS, WP and solid matrix studies are completed every 6 months. Proficiency testing samples are received and analyzed by method according to the vendor's instructions and according to the applicable analytical SOP.

11.2 Initial Demonstrations of Capability (IDOCs) are performed during new analyst training and/or prior to acceptance and use of any new method/instrumentation. Continuing

Demonstration of Capability (CDOCs) must be updated at least annually. The associated data is filed within the department and available for review.

11.3 Matrix Spike and Matrix Spike Duplicates are performed on each batch of samples analyzed depending on analytical method requested provided that sufficient volume is provided by the customer.

11.4 A Laboratory Control Sample (LCS) and LCS Duplicate are analyzed one per batch of samples.

11.5 A method preparation blank is performed per batch of samples processed. If the acceptance criteria as listed in the determinative SOP is exceeded, the laboratory shall evaluate whether re-processing of the samples is necessary, based on the following criteria:

- The blank contamination exceeds a concentration greater than 1/10 of the measured concentration of any sample in the associated preparation batch or
- The blank contamination is greater than 1/10 of the specified regulatory limit. The concentrations of common laboratory contaminants shall not exceed the reporting limit.

Any samples associated with a blank that fail these criteria shall be reprocessed in a subsequent preparation batch, except when the sample analysis resulted in non-detected results for the failing analytes.

12.0 DATA REDUCTION, VALIDATION AND REPORTING

12.1 DATA REDUCTION

The analyst performs the data calculation functions and is responsible for the initial examination of the finished data. Data reduction steps applied to the raw data are outlined in SOP #030201, *Data Handling and Reporting.* A secondary review of the data package is performed according to ESC SOP #030227, *Data Review*. The reviewer verifies that the analysis has been performed as required and meets method criteria, all associate data is present and complete, and also ensures that any additional documentation is completed as required (i.e. Ohio VAP checklists, required flags on test reports, etc.)

TABLE 12.1 Data Reduction Formulas

PARAMETER	FORMULA
GC and HPLC	$\dfrac{\text{response of sample analyte } \{\textit{area}\} \text{ x final extract volume } \{\textit{mL}\} \text{ x dilution}}{\text{response factor } \{\textit{area/(mg/mL)}\} \text{ x initial extract volume-mass } \{\textit{mL or g}\}}$ *Calculations performed by HP Enviroquant Software*
GC/MS	$\dfrac{\text{response of analyte } \{\textit{area}\} \text{ x extract volume } \{\textit{mL}\} \text{ x dilution x int. std amt. } \{\textit{area}\}}{\text{response factor } \{\textit{area/(mg/mL)}\} \text{ x initial volume-mass } \{\textit{mL or g}\} \text{ x int. std cal. } \{\text{area}\}}$ *Calculations performed by HP Enviroquant Software*

12.2 VALIDATION

The validation process consists of data generation, reduction review, and reporting results. Once data reduction is complete, validation is conducted by verification that the QC samples are within acceptable QC limits and that all documentation is complete, including the analytical report and associated QC. See Table 12.3 by method for current QC targets and controls and current reporting limits.

Marginal Excedence – When a large number of analytes exist in the LCS, it is statistically possible for a few analytes to be outside established control limits while the analytical system remains in control. These excursions must be random in nature and, if not, a review of the control limits or analytical process is necessary.

Upper and lower marginal excedence (ME) limits are established as the mean of at least 20 data points ± four times their standard deviations. The number of allowable marginal excedences per event is based on the number of analytes spiked in the LCS.

Allowable Marginal Exceedance per Event	
Analytes in LCS:	**ME Allowable**
>90	5
71-90	4
51-70	3
31-50	2
11-30	1
<11	0

Organic Control Limits - The organic QC targets are statutory in nature; warning and control limits for organic analyses are initially established for groups of compounds based on preliminary method validation data. When additional data becomes available, the QC targets are reviewed. All QC targets are routinely re-evaluated at least annually (and updated, if necessary) against laboratory historical data to insure that the limits continue to reflect realistic, method achievable goals.

12.3 REPORTING

Reporting procedures are documented in *SOP 030201 Data Handling and Reporting.*

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
Pesticides	AZINPHOS-METHYL	8141A, 1657A	GW	64.9-120	20.0	0.001	mg/L
Pesticides	BOLSTAR (SULPROFOS)	8141A, 1657A	GW	65.4-119	20.0	0.001	mg/L
Pesticides	CHLORPYRIFOS	8141A, 1657A	GW	65.3-113	20.0	0.001	mg/L
Pesticides	COUMAPHOS	8141A, 1657A	GW	62.2-121	20.0	0.001	mg/L
Pesticides	DEMETON,-O AND -S	8141A, 1657A	GW	65.9-110	20.0	0.002	mg/L

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
Pesticides	DIAZINON	8141A, 1657A	GW	62.4-116	20.0	0.001	mg/L
Pesticides	DICHLORVOS	8141A, 1657A	GW	51.0-117	20.0	0.002	mg/L
Pesticides	DIMETHOATE	8141A, 1657A	GW	19.9-109	35.6	0.001	mg/L
Pesticides	DISULFOTON	8141A, 1657A	GW	63.3-113	20.0	0.001	mg/L
Pesticides	EPN	8141A, 1657A	GW	635-119	20.0	0.001	mg/L
Pesticides	ETHOPROP	8141A, 1657A	GW	63.7-113	20.0	0.001	mg/L
Pesticides	ETHYL PARATHION	8141A, 1657A	GW	71.8-112	20.0	0.001	mg/L
Pesticides	FENSULFOTHION	8141A, 1657A	GW	63.4-112	20.0	0.001	mg/L
Pesticides	FENTHION	8141A, 1657A	GW	61.5-114	20.0	0.001	mg/L
Pesticides	MALATHION	8141A, 1657A	GW	68.5-112	20.0	0.001	mg/L
Pesticides	MERPHOS	8141A, 1657A	GW	52.0-115	20.0	0.001	mg/L
Pesticides	METHYL PARATHION	8141A, 1657A	GW	70.6-114	20.0	0.001	mg/L
Pesticides	MEVINPHOS	8141A, 1657A	GW	58.8-111	20.0	0.001	mg/L
Pesticides	NALED	8141A, 1657A	GW	60.7-112	20.0	0.001	mg/L
Pesticides	PHORATE	8141A, 1657A	GW	64.1-113	20.0	0.001	mg/L
Pesticides	RONNEL	8141A, 1657A	GW	63.0-112	20.0	0.001	mg/L
Pesticides	STIROPHOS	8141A, 1657A	GW	65.3-118	20.0	0.001	mg/L
Pesticides	SULFOTEP	8141A, 1657A	GW	64.7-110	20.0	0.001	mg/L
Pesticides	TEPP	8141A, 1657A	GW	34.3-107	31.3	0.020	mg/L
Pesticides	TOKUTHION (PROTHIOFOS)	8141A, 1657A	GW	62.9-118	20.0	0.001	mg/L
Pesticides	TRICHLORONATE	8141A, 1657A	GW	67.1-112	20.0	0.001	mg/L
Pesticides	AZINPHOS-METHYL	8141A	SS	63.3-118	20.0	0.1	mg/Kg
Pesticides	BOLSTAR (SULPROFOS)	8141A	SS	67.3-119	20.0	0.1	mg/Kg
Pesticides	CHLORPYRIFOS	8141A	SS	67.1-117	20.0	0.1	mg/Kg
Pesticides	COUMAPHOS	8141A	SS	64.4-122	20.0	0.1	mg/Kg
Pesticides	DEMETON,-O AND -S	8141A	SS	60.9-111	20.0	0.1	mg/Kg
Pesticides	DIAZINON	8141A	SS	27.8-141	21.7	0.1	mg/Kg
Pesticides	DICHLORVOS	8141A	SS	43.8-117	20.0	0.1	mg/Kg
Pesticides	DIMETHOATE	8141A	SS	43.7-115	23.2	0.1	mg/Kg
Pesticides	DISULFOTON	8141A	SS	67.7-114	20.0	0.1	mg/Kg
Pesticides	EPN	8141A	SS	58.0-120	20.0	0.1	mg/Kg
Pesticides	ETHOPROP	8141A	SS	70.9-114	20.0	0.1	mg/Kg
Pesticides	ETHYL PARATHION	8141A	SS	66.0-115	20.0	0.1	mg/Kg
Pesticides	FENSULFOTHION	8141A	SS	41.1-121	24.9	0.1	mg/Kg
Pesticides	FENTHION	8141A	SS	63.8-119	20.0	0.1	mg/Kg
Pesticides	MALATHION	8141A	SS	66.9-117	20.0	0.1	mg/Kg
Pesticides	MERPHOS	8141A	SS	63.8-117	20.0	0.1	mg/Kg

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
Pesticides	METHYL PARATHION	8141A	SS	67.6-113	20.0	0.1	mg/Kg
Pesticides	MEVINPHOS	8141A	SS	49.7-120	20.0	0.1	mg/Kg
Pesticides	NALED	8141A	SS	17.4-116	25.9	0.1	mg/Kg
Pesticides	PHORATE	8141A	SS	67.03-114	20.0	0.1	mg/Kg
Pesticides	RONNEL	8141A	SS	66.3-113	20.0	0.1	mg/Kg
Pesticides	STIROPHOS	8141A	SS	66.1-113	20.0	0.1	mg/Kg
Pesticides	SULFOTEP	8141A	SS	67.8-117	20.0	0.1	mg/Kg
Pesticides	TEPP	8141A	SS	0-79	40.0	1.0	mg/Kg
Pesticides	TOKUTHION (PROTHIOFOS)	8141A	SS	67.2-118	20.0	0.1	mg/Kg
Pesticides	TRICHLORONATE	8141A	SS	65.4-121	20.0	0.1	mg/Kg
Pesticides	ALACHLOR	507	DW	70.0-130	25.0	0.0002	mg/L
Pesticides	ATRAZINE	507	DW	70.0-130	25.0	0.0001	mg/L
Pesticides	BUTACHLOR	507	DW	70.0-130	25.0	0.0001	mg/L
Pesticides	METOLACHLOR	507	DW	70.0-130	25.0	0.0002	mg/L
Pesticides	METRIBUZIN	507	DW	70.0-130	25.0	0.0002	mg/L
Pesticides	SIMAZINE	507	DW	70.0-130	25.0	7.00E-05	mg/L
Pesticides	4,4-DDD	608/8081A/B, 6630C	GW, WW	63.0-130	20.0	0.00005	mg/L
Pesticides	4,4-DDE	608/8081A/B, 6630C	GW, WW	59.3-125	20.0	0.00005	mg/L
Pesticides	4,4-DDT	608/8081A/B, 6630C	GW, WW	61.3-130	20.0	0.00005	mg/L
Pesticides	ALDRIN	608/8081A/B, 6630C	GW, WW	39.0-123	20.0	0.00005	mg/L
Pesticides	ALPHA BHC	608/8081A/B, 6630C	GW, WW	60.1-128	20.0	0.00005	mg/L
Pesticides	BETA BHC	608/8081A/B, 6630C	GW, WW	59.2-135	20.0	0.00005	mg/L
Pesticides	ALPHA CHLORDANE	608/8081A/B, 6630C	GW, WW	63.7-132	20.0	0.005	mg/L
Pesticides	DELTA BHC	608/8081A/B, 6630C	GW, WW	61.8-131	20.0	0.00005	mg/L
Pesticides	DIELDRIN	608/8081A/B, 6630C	GW, WW	61.4-130	20.0	0.00005	mg/L
Pesticides	ENDOSULFAN I	608/8081A/B, 6630C	GW, WW	61.8-131	20.0	0.00005	mg/L
Pesticides	ENDOSULFAN II	608/8081A/B, 6630C	GW, WW	54.8-138	20.0	0.00005	mg/L
Pesticides	ENDOSULFAN SULFATE	608/8081A/B, 6630C	GW, WW	61.9-139	20.0	0.00005	mg/L
Pesticides	ENDRIN	608/8081A/B, 6630C	GW, WW	53.8-125	20.0	0.00005	mg/L

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
Pesticides	ENDRIN ALDEHYDE	608/8081A/B, 6630C	GW, WW	63.0-129	20.0	0.00005	mg/L
Pesticides	ENDRIN KETONE	608/8081A/B, 6630C	GW, WW	61.3-129	20.0	0.00005	mg/L
Pesticides	GAMMA BHC	608/8081A/B, 6630C	GW, WW	43.3-123	20.0	0.00005	mg/L
Pesticides	HEPTACHLOR	608/8081A/B, 6630C	GW, WW	61.8-130	20.0	0.00005	mg/L
Pesticides	HEPTACHLOR EPOXIDE	608/8081A/B, 6630C	GW, WW	48.3-110	20.0	0.00005	mg/L
Pesticides	HEXACHLOROBENZENE	608/8081A/B, 6630C	GW, WW	48.3-110	20.0	0.00005	mg/L
Pesticides	METHOXYCHLOR	608/8081A/B, 6630C	GW, WW	62.1-135	20.0	0.00005	mg/L
PCBs	PCB 1016	608, 6431B, 8082/A	GW, WW	55.5-103	20.0	0.0005	mg/L
PCBs	PCB 1260	608, 6431B, 8082/A	GW, WW	51.2-111	22.0	0.0005	mg/L
PCBs	PCB 1016	8082/A	SS	46.3-117	27.5	0.017	mg/Kg
PCBs	PCB 1260	8082/A	SS	46.5-120	27.0	0.017	mg/Kg
Pesticides	4,4-DDD	8081A/B	SS	70.8-120	20.0	0.02	mg/Kg
Pesticides	4,4-DDE	8081A/B	SS	70.9-121	20.0	0.02	mg/Kg
Pesticides	4,4-DDT	8081A/B	SS	68.1-124	20.0	0.02	mg/Kg
Pesticides	ALDRIN	8081A/B	SS	71.1-120	20.0	0.02	mg/Kg
Pesticides	ALPHA BHC	8081A/B	SS	69.9-121	20.0	0.02	mg/Kg
Pesticides	BETA BHC	8081A/B	SS	69.6-121	20.0	0.02	mg/Kg
Pesticides	DELTA BHC	8081A/B	SS	68.1-127	20.0	0.02	mg/Kg
Pesticides	DIELDRIN	8081A/B	SS	71.3-122	20.0	0.02	mg/Kg
Pesticides	ENDOSULFAN I	8081A/B	SS	71.6-122	20.0	0.02	mg/Kg
Pesticides	ENDOSULFAN II	8081A/B	SS	71.1-120	20.0	0.02	mg/Kg
Pesticides	ENDOSULFAN SULFATE	8081A/B	SS	67.4-125	20.0	0.02	mg/Kg
Pesticides	ENDRIN	8081A/B	SS	69.6-126	20.0	0.02	mg/Kg
Pesticides	ENDRIN ALDEHYDE	8081A/B	SS	59.9-114	20.0	0.02	mg/Kg
Pesticides	ENDRIN KETONE	8081A/B	SS	70.8-122	20.0	0.02	mg/Kg
Pesticides	GAMMA BHC	8081A/B	SS	70.1-121	20.0	0.02	mg/Kg
Pesticides	HEPTACHLOR	8081A/B	SS	63.3-126	20.0	0.02	mg/Kg
Pesticides	HEPTACHLOR EPOXIDE	8081A/B	SS	71.9-121	20.0	0.02	mg/Kg
Pesticides	HEXACHLOROBENZENE	8081A/B	SS	62.7-117	20.0	0.02	mg/Kg
Pesticides	METHOXYCHLOR	8081A/B	SS	69.3-122	20.0	0.02	mg/Kg

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
Herbicides	2,4,5-T	1658, 8151A, 6640C	GW, WW	50.0-121	26.5	0.002	mg/L
Herbicides	2,4,5-TP (SILVEX)	1658, 8151A, 6640C	GW, WW	46.3-127	29.5	0.002	mg/L
Herbicides	2,4-D	1658, 8151A, 6640C	GW, WW	31.1-136	28.6	0.002	mg/L
Herbicides	2,4-DB	1658, 8151A, 6640C	GW, WW	39.5-128	31.9	0.002	mg/L
Herbicides	DALAPON	1658, 8151A, 6640C	GW, WW	36.6-132	29.2	0.002	mg/L
Herbicides	DICAMBA	1658, 8151A, 6640C	GW, WW	53.7-134	20.0	0.002	mg/L
Herbicides	DICHLOROPROP	1658, 8151A, 6640C	GW, WW	42.5-109	26.8	0.002	mg/L
Herbicides	DINOSEB	1658, 8151A, 6640C	GW, WW	42.5-112	21.3	0.002	mg/L
Herbicides	MCPA	1658, 8151A, 6640C	GW, WW	30.5-137	31.4	0.1	mg/L
Herbicides	MCPP	1658, 8151A, 6640C	GW, WW	33.2-148	25.2	0.1	mg/L
Herbicides	PENTACHLOROPHENOL	1658, 8151A, 6640C	GW	60-140	20	.001	mg/L
Herbicides	2,4,5-T	8151A	SS	44.9-111	21.5	0.07	mg/Kg
Herbicides	2,4,5-TP (SILVEX)	8151A	SS	48.4-110	25.9	0.07	mg/Kg
Herbicides	2,4-D	8151A	SS	40.0-112	24.8	0.07	mg/Kg
Herbicides	2,4-DB	8151A	SS	33.8-126	27.8	0.07	mg/Kg
Herbicides	DALAPON	8151A	SS	36.7-119	28.0	0.07	mg/Kg
Herbicides	DICAMBA	8151A	SS	50.2-125	20.0	0.07	mg/Kg
Herbicides	DICHLOROPROP	8151A	SS	39.9-99.0	20.1	0.07	mg/Kg
Herbicides	DINOSEB	8151A	SS	15.6-109	40.0	0.07	mg/Kg
Herbicides	MCPA	8151A	SS	34.7-110	31.7	6.5	mg/Kg
Herbicides	MCPP	8151A	SS	41.0-121	24.9	6.5	mg/Kg
PAH	PYRENE	8310, 610, 6440B	GW, WW	69.2-96.9	20.0	0.00001	mg/L
PAH	PHENANTHRENE	8310, 610, 6440B	GW, WW	66.5-95.7	20.0	0.00001	mg/L
PAH	NAPHTHALENE	8310, 610, 6440B	GW, WW	47.5-86.6	20.2	0.001	mg/L
PAH	INDENO(1,2,3-CD)PYRENE	8310, 610, 6440B	GW, WW	52.4-104	20.0	0.00001	mg/L
PAH	FLUORENE	8310, 610, 6440B	GW, WW	55.3-98.8	20.0	0.00001	mg/L
PAH	FLUORANTHENE	8310, 610,	GW, WW	70.4-102	20.0	0.00001	mg/L

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
		6440B					
PAH	DIBENZ(A,H)ANTHRACENE	8310, 610, 6440B	GW, WW	38.6-111	22.2	0.000005	mg/L
PAH	CHRYSENE	8310, 610, 6440B	GW, WW	72.9-107	20.0	0.00001	mg/L
PAH	BENZO(K)FLUORANTHENE	8310, 610, 6440B	GW, WW	67.3-102	20.0	0.00001	mg/L
PAH	BENZO(G,H,I)PERYLENE	8310, 610, 6440B	GW, WW	41.9-115	20.0	0.00001	mg/L
PAH	BENZO(B)FLUORANTHENE	8310, 610, 6440B	GW, WW	68.5-102	20.0	0.00001	mg/L
PAH	BENZO(A)PYRENE	8310, 610, 6440B	GW, WW	58..8-106	20.0	0.00001	mg/L
PAH	BENZO(A)ANTHRACENE	8310, 610, 6440B	GW, WW	72.4-102	20.0	0.00001	mg/L
PAH	ANTHRACENE	8310, 610, 6440B	GW, WW	68.8-99.3	20.0	0.00001	mg/L
PAH	ACENAPHTHYLENE	8310, 610, 6440B	GW, WW	59.4-91.9	20.0	0.00001	mg/L
PAH	ACENAPHTHENE	8310, 610, 6440B	GW, WW	57.0-89.5	20.0	0.00001	mg/L
PAH	2-METHYLNAPHTHALENE	8310, 610, 6440B	GW, WW	45.7-92.1	20.0	0.001	mg/L
PAH	1-METHYLNAPHTHALENE	8310, 610, 6440B	GW, WW	54.6-104	20.0	0.001	mg/L
PAH	PYRENE	8310	SS	71.9-100	20.0	0.02	mg/Kg
PAH	PHENANTHRENE	8310	SS	66.9-97.1	20.0	0.02	mg/Kg
PAH	NAPHTHALENE	8310	SS	52..0-94.2	20.0	0.02	mg/Kg
PAH	INDENO(1,2,3-CD)PYRENE	8310	SS	64.6-101	20.0	0.02	mg/Kg
PAH	FLUORENE	8310	SS	58.6-100	20.0	0.02	mg/Kg
PAH	FLUORANTHENE	8310	SS	73.4-103	20.0	0.02	mg/Kg
PAH	DIBENZ(A,H)ANTHRACENE	8310	SS	72.1-100	20.0	0.02	mg/Kg
PAH	CHRYSENE	8310	SS	77.3-107	20.0	0.02	mg/Kg
PAH	BENZO(K)FLUORANTHENE	8310	SS	73.3-102	20.0	0.02	mg/Kg
PAH	BENZO(G,H,I)PERYLENE	8310	SS	67.1-110	20.0	0.02	mg/Kg
PAH	BENZO(B)FLUORANTHENE	8310	SS	73.9-103	20.0	0.02	mg/Kg
PAH	BENZO(A)PYRENE	8310	SS	66.5-104	20.0	0.02	mg/Kg
PAH	BENZO(A)ANTHRACENE	8310	SS	77.7-102	20.0	0.02	mg/Kg
PAH	ANTHRACENE	8310	SS	71.9-101	20.0	0.02	mg/Kg
PAH	ACENAPHTHYLENE	8310	SS	59.5-98.4	20.0	0.02	mg/Kg
PAH	ACENAPHTHENE	8310	SS	58.6-95.5	20.0	0.02	mg/Kg

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
PAH	2-METHYLNAPHTHALENE	8310	SS	54.9-95.3	20.0	0.02	mg/Kg
PAH	1-METHYLNAPHTHALENE	8310	SS	62.3-110	20.0	0.02	mg/Kg
BNA	PYRIDINE	8270C/D 625	GW,WW	13.0-54.0	32.8	0.01	mg/L
BNA	PYRENE	8270C/D 625	GW,WW	40.2-135	20.0	0.0002	mg/L
BNA	PHENOL	8270C/D 625	GW,WW	10.0-77.3	24.6	0.01	mg/L
BNA	PHENANTHRENE	8270C/D 625	GW,WW	41.4-134	20.0	0.0002	mg/L
BNA	PENTACHLOROPHENOL	8270C/D 625	GW,WW	17.0-117	34.3	0.001	mg/L
BNA	N-OCTADECANE	8270C/D 625	GW,WW	28.3-151	20.0	0.01	mg/L
BNA	N-NITROSODIPHENYLAMINE	8270C/D 625	GW,WW	41.1-134	20.0	0.01	mg/L
BNA	N-NITRODIPHENYLAMINE	8270C/D 625	GW,WW	40.1-157	20.0	0.01	mg/L
BNA	N-NITROSODI-N-PROPYLAMINE	8270C/D 625	GW,WW	35.6-125	20.0	0.01	mg/L
BNA	N-NITROSODIMETHYLAMINE	8270C/D 625	GW,WW	12.3-70.5	33.0	.01	mg/L
BNA	NITROBENZENE	8270C/D 625	GW,WW	34.4-121	21.2	.01	mg/L
BNA	N-DECANE	8270C/D 625	GW,WW	10.0-118	32.3	0.01	mg/L
BNA	NAPHTHALENE	8270C/D 625	GW,WW	33.0-117	20.0	0.001	mg/L
BNA	ISOPHORONE	8270C/D 625	GW,WW	30.5-109	20.0	0.01	mg/L
BNA	INDENO(1,2,3-CD)PYRENE	8270C/D 625	GW,WW	41.0-140	20.0	0.0002	mg/L
BNA	HEXACHLOROETHANE	8270C/D 625	GW,WW	22.2-109	25.8	0.01	mg/L
BNA	HEXACHLOROCYCLOPENTADIENE	8270C/D 625	GW,WW	13.5-122	21.6	0.01	mg/L
BNA	HEXACHLOROBENZENE	8270C/D 625	GW,WW	34.1-125	20.0	0.001	mg/L
BNA	HEXACHLORO-1,3-BUTADIENE	8270C/D 625	GW,WW	24.9-121	22.0	0.01	mg/L
BNA	FLUORENE	8270C/D 625	GW,WW	39.9-132	20.0	0.0002	mg/L
BNA	FLUORANTHENE	8270C/D 625	GW,WW	41.4-141	20.0	0.0002	mg/L
BNA	DI-N-OCTYL PHTHALATE	8270C/D 625	GW,WW	39.8-146	20.0	0.003	mg/L
BNA	DI-N-BUTYL PHTHALATE	8270C/D 625	GW,WW	33.0-151	20.0	0.003	mg/L
BNA	DIMETHYL PHTHALATE	8270C/D 625	GW,WW	23.4-138	20.2	0.003	mg/L
BNA	DIETHYL PHTHALATE	8270C/D 625	GW,WW	36.0-140	20.0	0.003	mg/L
BNA	DIBENZOFURAN	8270C/D 625	GW,WW	37.9-128	20.0	0.01	mg/L
BNA	DIBENZ(A,H)ANTHRACENE	8270C/D 625	GW,WW	39.9-141	20.0	0.0002	mg/L
BNA	CHRYSENE	8270C/D 625	GW,WW	40.5-140	20.0	0.0002	mg/L
BNA	CARBAZOLE	8270C/D 625	GW,WW	41.0-137	20.0	0.01	mg/L
BNA	CAPROLACTAM	8270C/D 625	GW,WW	10.0-45.6	25.2	0.01	mg/L
BNA	BIS(2-ETHYLHEXYL)PHTHALATE	8270C/D 625	GW,WW	41.4-150	20.0	0.003	mg/L
BNA	BIS(2-CHLOROISOPROPYL)ETHER	8270C/D 625	GW,WW	33.6-115	21.3	0.01	mg/L
BNA	BIS(2-CHLOROETHYL)ETHER	8270C/D 625	GW,WW	29.8-114	25.3	0.01	mg/L

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
BNA	BIS(2-CHLORETHOXY)METHANE	8270C/D 625	GW,WW	36.7-123	20.0	0.01	mg/L
BNA	BIPHENYL	8270C/D 625	GW,WW	36.9-126	20.0	0.01	mg/L
BNA	BENZYLBUTYL PHTHALATE	8270C/D 625	GW,WW	29.2-146	20.7	0.003	mg/L
BNA	BENZYL ALCOHOL	8270C/D 625	GW,WW	26.0-104	21.0	0.01	mg/L
BNA	BENZOIC ACID	8270C/D 625	GW,WW	10.0-54.3	40.0	0.05	mg/L
BNA	BENZO(K)FLUORANTHENE	8270C/D 625	GW,WW	41.5-140	20.0	0.0002	mg/L
BNA	BENZO(G,H,I)PERYLENE	8270C/D 625	GW,WW	38.8-137	20.0	0.0002	mg/L
BNA	BENZO(B)FLUORANTHENE	8270C/D 625	GW,WW	40.5-137	20.0	0.0002	mg/L
BNA	BENZO(A)PYRENE	8270C/D 625	GW,WW	41.7-138	20.0	0.0002	mg/L
BNA	BENZO(A)ANTHRACENE	8270C/D 625	GW,WW	42.3-137	20.0	0.0002	mg/L
BNA	BENZIDINE	8270C/D 625	GW,WW	10.0-75.5	40.0	0.05	mg/L
BNA	BENZALDEHYDE	8270C/D 625	GW,WW	10.0-93.4	27.8	0.01	mg/L
BNA	AZOBENZENE	8270C/D 625	GW,WW	37.2-129	20.0	0.01	mg/L
BNA	ATRAZINE	8270C/D 625	GW,WW	40.6-154	20.0	0.01	mg/L
BNA	ANTHRACENE	8270C/D 625	GW,WW	42.9-138	20.0	0.001	mg/L
BNA	ANILINE	8270C/D 625	GW,WW	22.5-99.1	28.3	0.01	mg/L
BNA	ACETOPHENONE	8270C/D 625	GW,WW	35.6-122	20.0	0.01	mg/L
BNA	ACENAPHTHYLENE	8270C/D 625	GW,WW	41.0-135	20.0	0.0002	mg/L
BNA	ACENAPHTHENE	8270C/D 625	GW,WW	39.0-128	20.0	0.0002	mg/L
BNA	4-NITROPHENOL	8270C/D 625	GW,WW	10.0-65.4	33.6	0.01	mg/L
BNA	4-NITROANILINE	8270C/D 625	GW,WW	37.3-159	20.0	0.01	mg/L
BNA	4-CHLOROPHENYL-PHENYLETHER	8270C/D 625	GW,WW	37.3-130	20.0	0.01	mg/L
BNA	4-CHLOROANILINE	8270C/D 625	GW,WW	29.8-128	20.9	0.01	mg/L
BNA	4-CHLORO-3-METHYLPHENOL	8270C/D 625	GW,WW	34.6-130	20.0	0.01	mg/L
BNA	4-BROMOPHENYL-PHENYLETHER	8270C/D 625	GW,WW	39.0-137	20.0	0.01	mg/L
BNA	4,6-DINITRO-2-METHYLPHENOL	8270C/D 625	GW,WW	28.2-134	29.2	0.01	mg/L
BNA	3-NITROANILINE	8270C/D 625	GW,WW	34.8-132	20.0	0.01	mg/L
BNA	3,3-DICHLOROBENZIDINE	8270C/D 625	GW,WW	33.1-134	20.0	0.01	mg/L
BNA	3&4-METHYLPHENOL	8270C/D 625	GW,WW	23.1-107	20.7	0.01	mg/L
BNA	2-NITROPHENOL	8270C/D 625	GW,WW	38.3-125	20.0	0.01	mg/L
BNA	2-NITROANILINE	8270C/D 625	GW,WW	41.9-143	20.0	0.01	mg/L
BNA	2-METHYLPHENOL	8270C/D 625	GW,WW	23.9-97	20.0	0.01	mg/L
BNA	2-METHYLNAPHTHALENE	8270C/D 625	GW,WW	35.6-124	20.0	0.001	mg/L
BNA	2-CHLOROPHENOL	8270C/D 625	GW,WW	31.2-103	20.0	0.01	mg/L
BNA	2-CHLORONAPHTHALENE	8270C/D 625	GW,WW	35.1-123	20.0	0.001	mg/L
BNA	2,6-DINITROTOLUENE	8270C/D 625	GW,WW	41.0-139	20.0	0.01	mg/L

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
BNA	2,4-DINITROTOLUENE	8270C/D 625	GW,WW	42.3-143	20.0	0.01	mg/L
BNA	2,4-DINITROPHENOL	8270C/D 625	GW,WW	10.0-108	40.0	0.01	mg/L
BNA	2,4-DIMETHYLPHENOL	8270C/D 625	GW,WW	33.8-126	20.0	0.01	mg/L
BNA	2,4-DICHLOROPHENOL	8270C/D 625	GW,WW	39.6-121	20.0	0.01	mg/L
BNA	2,4,6-TRICHLOROPHENOL	8270C/D 625	GW,WW	35.9-129	22.4	0.01	mg/L
BNA	2,4,5-TRICHLOROPHENOL	8270C/D 625	GW,WW	35.4-136	20.0	0.01	mg/L
BNA	1-METHYLNAPHTHALENE	8270C/D 625	GW,WW	34.3-123	20.0	0.001	mg/L
BNA	1,4-DICHLOROBENZENE	8270C/D 625	GW,WW	24.8-105	25.2	0.01	mg/L
BNA	1,3-DICHLOROBENZENE	8270C/D 625	GW,WW	23.9-103	25.2	0.01	mg/L
BNA	1,2-DICHLOROBENZENE	8270C/D 625	GW,WW	26.1-107	25.4	0.01	mg/L
BNA	1,2,4-TRICHLOROBENZENE	8270C/D 625	GW,WW	26.6-109	20.0	0.01	mg/L
BNA	1,2,4,5-TETRACHLOROBENZENE	8270C/D 625	GW,WW	30.8-124	20.7	0.01	mg/L
BNA	PYRIDINE	8270C/D	SS	10.0-90.0	38.3	0.33	mg/Kg
BNA	PYRENE	8270C/D	SS	47.1-108	20.0	0.33	mg/Kg
BNA	PHENOL	8270C/D	SS	41.5-106	20.0	0.33	mg/Kg
BNA	PHENANTHRENE	8270C/D	SS	51.6-107	20.0	0.33	mg/Kg
BNA	PENTACHLOROPHENOL	8270C/D	SS	16.2-102	22.9	0.33	mg/Kg
BNA	N-OCTADECANE	8270C/D	SS	40.7-122	20.0	0.33	mg/Kg
BNA	N-NITROSODIPHENYLAMINE	8270C/D	SS	48.8-107	20.0	0.33	mg/Kg
BNA	N-NITROSODI-N-PROPYLAMINE	8270C/D	SS	43.3-109	20.0	0.33	mg/Kg
BNA	N-NITROSODIMETHYLAMINE	8270C/D	SS	18.1-1422	23.5	0.33	mg/Kg
BNA	NITROBENZENE	8270C/D	SS	40.7-109	21.0	0.33	mg/Kg
BNA	N-DECANE	8270C/D	SS	38.1-116	20.0	0.33	mg/Kg
BNA	NAPHTHALENE	8270C/D	SS	43.4-103	20.0	0.33	mg/Kg
BNA	ISOPHORONE	8270C/D	SS	28.8-104	20.0	0.033	mg/Kg
BNA	INDENO(1,2,3-CD)PYRENE	8270C/D	SS	47.5-109	20.0	0.33	mg/Kg
BNA	HEXACHLOROETHANE	8270C/D	SS	36.2-103	22.7	0.033	mg/Kg
BNA	HEXACHLOROCYCLOPENTADIENE	8270C/D	SS	13.5-123	20.7	0.33	mg/Kg
BNA	HEXACHLOROBENZENE	8270C/D	SS	43.2-104	20.1	0.33	mg/Kg
BNA	HEXACHLORO-1,3-BUTADIENE	8270C/D	SS	41.5-112	20.0	0.33	mg/Kg
BNA	FLUORENE	8270C/D	SS	51.1-109	20.0	0.33	mg/Kg
BNA	FLUORANTHENE	8270C/D	SS	53.7-110	20.0	0.33	mg/Kg
BNA	DI-N-OCTYL PHTHALATE	8270C/D	SS	49.6-112	20.0	0.33	mg/Kg
BNA	DI-N-BUTYL PHTHALATE	8270C/D	SS	49.7-113	20.0	0.33	mg/Kg
BNA	DIMETHYL PHTHALATE	8270C/D	SS	51.4-108	20.0	0.33	mg/Kg
BNA	DIETHYL PHTHALATE	8270C/D	SS	52.0-112	20.0	0.33	mg/Kg

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
BNA	DIBENZOFURAN	8270C/D	SS	48.6-104	20.0	0.33	mg/Kg
BNA	DIBENZ(A,H)ANTHRACENE	8270C/D	SS	45.7-111	20.0	0.33	mg/Kg
BNA	CHRYSENE	8270C/D	SS	54.4-110	20.0	0.33	mg/Kg
BNA	CARBAZOLE	8270C/D	SS	52.4-102	21.1	0.33	mg/Kg
BNA	CAPROLACTAM	8270C/D	SS	42.2-107	21.9	0.33	mg/Kg
BNA	BIS(2-ETHYLHEXYL)PHTHALATE	8270C/D	SS	48.1-116	20.5	0.33	mg/Kg
BNA	BIS(2-CHLOROISOPROPYL)ETHER	8270C/D	SS	40.4-99.0	20.7	0.33	mg/Kg
BNA	BIS(2-CHLOROETHYL)ETHER	8270C/D	SS	32.5-112	26.0	0.33	mg/Kg
BNA	BIS(2-CHLORETHOXY)METHANE	8270C/D	SS	44.9-108	20.0	0.33	mg/Kg
BNA	BIPHENYL	8270C/D	SS	45.6-103	20.0	0.33	mg/Kg
BNA	BENZYLBUTYL PHTHALATE	8270C/D	SS	47.5-115	20.0	0.33	mg/Kg
BNA	BENZYL ALCOHOL	8270C/D	SS	49.1-105	20.0	0.033	mg/Kg
BNA	BENZOIC ACID	8270C/D	SS	0.00-82.0	32.5	0.033	mg/Kg
BNA	BENZO(K)FLUORANTHENE	8270C/D	SS	52.9-107	20.0	0.33	mg/Kg
BNA	BENZO(G,H,I)PERYLENE	8270C/D	SS	45.8-108	20.0	0.33	mg/Kg
BNA	BENZO(B)FLUORANTHENE	8270C/D	SS	51.3-106	20.0	0.33	mg/Kg
BNA	BENZO(A)PYRENE	8270C/D	SS	51.9-106	20.0	0.33	mg/Kg
BNA	BENZO(A)ANTHRACENE	8270C/D	SS	52.3-106	20.0	0.33	mg/Kg
BNA	BENZIDINE	8270C/D	SS	0.00-48.0	40.0	0.033	mg/Kg
BNA	BENZALDEHYDE	8270C/D	SS	46.4-109	24.8	0.33	mg/Kg
BNA	AZOBENZENE	8270C/D	SS	45.0-131	20.0	0.33	mg/Kg
BNA	ATRAZINE	8270C/D	SS	45.0-131	20.0	0.33	mg/Kg
BNA	ANTHRACENE	8270C/D	SS	52.0-112	20.0	0.33	mg/Kg
BNA	ANILINE	8270C/D	SS	10.0-94.0	24.2	0.33	mg/Kg
BNA	ACETOPHENONE	8270C/D	SS	47.1-99.0	22.1	0.33	mg/Kg
BNA	ACENAPHTHYLENE	8270C/D	SS	49.2-111	20.0	0.033	mg/Kg
BNA	ACENAPHTHENE	8270C/D	SS	48.9-107	20.0	0.033	mg/Kg
BNA	4-NITROPHENOL	8270C/D	SS	34.8-109	20.0	0.033	mg/Kg
BNA	4-NITROANILINE	8270C/D	SS	38.6-133	21.7	0.033	mg/Kg
BNA	4-CHLOROPHENYL-PHENYLETHER	8270C/D	SS	48.1-108	20.0	0.033	mg/Kg
BNA	4-CHLOROANILINE	8270C/D	SS	24.5-101	24.5	0.33	mg/Kg
BNA	4-CHLORO-3-METHYLPHENOL	8270C/D	SS	51.1-113	20.0	0.33	mg/Kg
BNA	4-BROMOPHENYL-PHENYLETHER	8270C/D	SS	51.4-110	20.0	0.33	mg/Kg

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
BNA	4,6-DINITRO-2-METHYLPHENOL	8270C/D	SS	23.1-119	23.7	0.33	mg/Kg
BNA	3-NITROANILINE	8270C/D	SS	34.7-103	20.7	0.33	mg/Kg
BNA	3,3-DICHLOROBENZIDINE	8270C/D	SS	21.0-101	22.0	0.33	mg/Kg
BNA	3&4-METHYLPHENOL	8270C/D	SS	50.5-115	20.0	0.33	mg/Kg
BNA	2-NITROPHENOL	8270C/D	SS	44.2-113	20.9	0.33	mg/Kg
BNA	2-NITROANILINE	8270C/D	SS	56.2-117	20.0	0.33	mg/Kg
BNA	2-METHYLPHENOL	8270C/D	SS	53.8-107	20.0	0.33	mg/Kg
BNA	2-METHYLNAPHTHALENE	8270C/D	SS	42.4-100	20.0	0.033	mg/Kg
BNA	2-CHLOROPHENOL	8270C/D	SS	48.0-101	20.0	0.33	mg/Kg
BNA	2-CHLORONAPHTHALENE	8270C/D	SS	40.8-103	20.0	0.33	mg/Kg
BNA	2,6-DINITROTOLUENE	8270C/D	SS	47.1-105	20.0	0.33	mg/Kg
BNA	2,4-DINITROTOLUENE	8270C/D	SS	51.6-110	20.0	0.033	mg/Kg
BNA	2,4-DINITROPHENOL	8270C/D	SS	53.0-112	36.5	0.33	mg/Kg
BNA	2,4-DIMETHYLPHENOL	8270C/D	SS	10.0-105	20.0	0.33	mg/Kg
BNA	2,4-DICHLOROPHENOL	8270C/D	SS	42.2-109	20.0	0.33	mg/Kg
BNA	2,4,6-TRICHLOROPHENOL	8270C/D	SS	44.4-108	20.0	0.33	mg/Kg
BNA	2,4,5-TRICHLOROPHENOL	8270C/D	SS	43.3-110	20.0	0.33	mg/Kg
BNA	1-METHYLNAPHTHALENE	8270C/D	SS	49.8-104	20.0	0.33	mg/Kg
BNA	1,4-DICHLOROBENZENE	8270C/D	SS	36.5-97.0	20.0	0.33	mg/Kg
BNA	1,3-DICHLOROBENZENE	8270C/D	SS	35.0-94.0	20.0	0.33	mg/Kg
BNA	1,2-DICHLOROBENZENE	8270C/D	SS	37.2-98.0	20.0	0.33	mg/Kg
BNA	1,2,4-TRICHLOROBENZENE	8270C/D	SS	39.8-100	20.0	0.33	mg/Kg
BNA	1,2,4,5-TETRACHLOROBENZENE	8270C/D	SS	47.6-107	20.0	0.33	mg/Kg
BNA	PYRIDINE	8270C/D RV	GW,WW	13.5-58.9	32.5	0.01	mg/L
BNA	PYRENE	8270C/D RV	GW,WW	463-117	20.0	0.0002	mg/L
BNA	PHENOL	8270C/D RV	GW,WW	10.0-57.9	35.0	0.01	mg/L
BNA	PHENANTHRENE	8270C/D RV	GW,WW	46.4-113	20.0	0.0002	mg/L
BNA	PENTACHLOROPHENOL	8270C/D RV	GW,WW	10.9-97.4	35.1	0.01	mg/L
BNA	N-OCTADECANE	8270C/D RV	GW,WW	15.8-132	21.1	0.01	mg/L
BNA	N-NITROSODIMETHYLAMINE	8270C/D RV ISOTOPE DIL	GW,WW	60-140	20.0	0.01/ .05ug/L SIM	mg/L
BNA	1,4-DIOXANE	8270C/D RV ISOTOPE DIL	GW,WW	60-140	20.0	.4ug/L SIM	mg/L
BNA	N-NITROSODI-N-PROPYLAMINE	8270C/D RV	GW,WW	33.2-106	23.7	0.01	mg/L
BNA	N-NITROSODIMETHYLAMINE	8270C/D RV	GW,WW	33.2-106	37.5	0.01	mg/L
BNA	NITROBENZENE	8270C/D RV	GW,WW	31.4-106	25.7	0.01	mg/L

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
BNA	N-DECANE	8270C/D RV	GW,WW	10.0-95.2	40.0	0.01	mg/L
BNA	NAPHTHALENE	8270C/D RV	GW,WW	32.2-101	23.8	0.001	mg/L
BNA	ISOPHORONE	8270C/D RV	GW,WW	35.4-112	21.5	0.01	mg/L
BNA	INDENO(1,2,3-CD)PYRENE	8270C/D RV	GW,WW	45.0-116	20.0	0.0002	mg/L
BNA	HEXACHLOROETHANE	8270C/D RV	GW,WW	16.5-89.8	30.7	0.01	mg/L
BNA	HEXACHLOROCYCLOPENTADIENE	8270C/D RV	GW,WW	10.0-121	27.9	0.01	mg/L
BNA	HEXACHLOROBENZENE	8270C/D RV	GW,WW	38.5-116	20.1	0.001	mg/L
BNA	HEXACHLORO-1,3-BUTADIENE	8270C/D RV	GW,WW	16.1-104	31.2	0.01	mg/L
BNA	FLUORENE	8270C/D RV	GW,WW	41.0-112	20.2	0.0002	mg/L
BNA	FLUORANTHENE	8270C/D RV	GW,WW	45.9-115	20.0	0.0002	mg/L
BNA	DI-N-OCTYL PHTHALATE	8270C/D RV	GW,WW	39.7-112	21.1	0.003	mg/L
BNA	DI-N-BUTYL PHTHALATE	8270C/D RV	GW,WW	41.8-120	20.2	0.003	mg/L
BNA	DIMETHYL PHTHALATE	8270C/D RV	GW,WW	35.3-128	20.8	0.003	mg/L
BNA	DIETHYL PHTHALATE	8270C/D RV	GW,WW	36.5-129	20.0	0.003	mg/L
BNA	DIBENZOFURAN	8270C/D RV	GW,WW	42.4-105	20.0	0.01	mg/L
BNA	DIBENZ(A,H)ANTHRACENE	8270C/D RV	GW,WW	42.8-118	20.0	0.0002	mg/L
BNA	CHRYSENE	8270C/D RV	GW,WW	54.6-120	20.0	0.0002	mg/L
BNA	CARBAZOLE	8270C/D RV	GW,WW	49.0-110	20.0	0.01	mg/L
BNA	CAPROLACTAM	8270C/D RV	GW,WW	10.0-40.4	40.0	0.01	mg/L
BNA	BIS(2-ETHYLHEXYL)PHTHALATE	8270C/D RV	GW,WW	36.9-134	23.6	0.003	mg/L
BNA	BIS(2-CHLOROISOPROPYL)ETHER	8270C/D RV	GW,WW	32.9-100	25.1	0.01	mg/L
BNA	BIS(2-CHLOROETHYL)ETHER	8270C/D RV	GW,WW	22.6-108	27.9	0.01	mg/L
BNA	BIS(2-CHLORETHOXY)METHANE	8270C/D RV	GW,WW	37.2-111	24.1	0.01	mg/L
BNA	BIPHENYL	8270C/D RV	GW,WW	38.0-103	20.1	0.01	mg/L
BNA	BENZYLBUTYL PHTHALATE	8270C/D RV	GW,WW	31.8-123	20.7	0.003	mg/L
BNA	BENZYL ALCOHOL	8270C/D RV	GW,WW	30.1-89.2	24.8	0.01	mg/L
BNA	BENZOIC ACID	8270C/D RV	GW,WW	0.00-79.4	31.1	0.05	mg/L
BNA	BENZO(K)FLUORANTHENE	8270C/D RV	GW,WW	49.4-114	20.0	0.0002	mg/L
BNA	BENZO(G,H,I)PERYLENE	8270C/D RV	GW,WW	45.2-117	20.0	0.0002	mg/L
BNA	BENZO(B)FLUORANTHENE	8270C/D RV	GW,WW	47.6-110	20.0	0.0002	mg/L
BNA	BENZO(A)PYRENE	8270C/D RV	GW,WW	45.6-106	20.0	0.0002	mg/L
BNA	BENZO(A)ANTHRACENE	8270C/D RV	GW,WW	51.2-112	20.0	0.0002	mg/L
BNA	BENZIDINE	8270C/D RV	GW,WW	10.0-165	40.0	0.05	mg/L
BNA	BENZALDEHYDE	8270C/D RV	GW,WW	11.7-132	25.2	0.01	mg/L
BNA	AZOBENZENE	8270C/D RV	GW,WW	37.6-111	21.1	0.01	mg/L
BNA	ATRAZINE	8270C/D RV	GW,WW	50.0-123	21.5	0.01	mg/L

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
BNA	ANTHRACENE	8270C/D RV	GW,WW	43.6-113	18.7	0.0002	mg/L
BNA	ANILINE	8270C/D RV	GW,WW	25.8-88.1	26.3	0.01	mg/L
BNA	ACETOPHENONE	8270C/D RV	GW,WW	41.6-104	24.8	0.01	mg/L
BNA	ACENAPHTHYLENE	8270C/D RV	GW,WW	36.0-106	21.0	0.0002	mg/L
BNA	ACENAPHTHENE	8270C/D RV	GW,WW	38.7-109	21.5	0.0002	mg/L
BNA	4-NITROPHENOL	8270C/D RV	GW,WW	10.0-52.7	40.0	0.01	mg/L
BNA	4-NITROANILINE	8270C/D RV	GW,WW	35.4-124	23.1	0.01	mg/L
BNA	4-CHLOROPHENYL-PHENYLETHER	8270C/D RV	GW,WW	39.0-113	20.9	0.01	mg/L
BNA	4-CHLOROANILINE	8270C/D RV	GW,WW	32.0-104	26.4	0.01	mg/L
BNA	4-CHLORO-3-METHYLPHENOL	8270C/D RV	GW,WW	35.7-100	22.9	0.01	mg/L
BNA	4-BROMOPHENYL-PHENYLETHER	8270C/D RV	GW,WW	40.7-116	21.0	0.01	mg/L
BNA	4,6-DINITRO-2-METHYLPHENOL	8270C/D RV	GW,WW	18.4-148	24.4	0.01	mg/L
BNA	3-NITROANILINE	8270C/D RV	GW,WW	33.6-103	21.8	0.01	mg/L
BNA	3,3-DICHLOROBENZIDINE	8270C/D RV	GW,WW	27.2-142	22.3	0.01	mg/L
BNA	3&4-METHYLPHENOL	8270C/D RV	GW,WW	27.9-92	27.0	0.01	mg/L
BNA	2-NITROPHENOL	8270C/D RV	GW,WW	25.9-106	26.9	0.01	mg/L
BNA	2-NITROANILINE	8270C/D RV	GW,WW	56.4-173	20.0	0.01	mg/L
BNA	2-METHYLPHENOL	8270C/D RV	GW,WW	35.6-113	20.9	0.01	mg/L
BNA	2-METHYLNAPHTHALENE	8270C/D RV	GW,WW	26.4-86.9	26.5	0.001	mg/L
BNA	2-CHLOROPHENOL	8270C/D RV	GW,WW	33.8-98.6	24.2	0.01	mg/L
BNA	2-CHLORONAPHTHALENE	8270C/D RV	GW,WW	26.2-91.5	26.5	0.001	mg/L
BNA	2,6-DINITROTOLUENE	8270C/D RV	GW,WW	33.6-105	23.0	0.01	mg/L
BNA	2,4-DINITROTOLUENE	8270C/D RV	GW,WW	30.6-106	23.1	0.01	mg/L
BNA	2,4-DINITROPHENOL	8270C/D RV	GW,WW	31.2-105	22.0	0.01	mg/L
BNA	2,4-DIMETHYLPHENOL	8270C/D RV	GW,WW	24.2-128	20.5	0.01	mg/L
BNA	2,4-DICHLOROPHENOL	8270C/D RV	GW,WW	31.9-107	25.7	0.01	mg/L
BNA	2,4,6-TRICHLOROPHENOL	8270C/D RV	GW,WW	31.4-103	24.9	0.01	mg/L
BNA	2,4,5-TRICHLOROPHENOL	8270C/D RV	GW,WW	29.8-107	24.1	0.01	mg/L
BNA	2,3,4,6-TETRACHLOROPHENOL	8270C/D RV	GW,WW	34.9-112	23.9	0.01	mg/L
BNA	1-METHYLNAPHTHALENE	8270C/D RV	GW,WW	34.7-102	24.9	0.01	mg/L
BNA	1,4-DICHLOROBENZENE	8270C/D RV	GW,WW	21.0-89.4	32.6	0.01	mg/L
BNA	1,3-DICHLOROBENZENE	8270C/D RV	GW,WW	20.9-86.7	32.4	0.01	mg/L
BNA	1,2-DICHLOROBENZENE	8270C/D RV	GW,WW	23.7-91.9	31.9	0.01	mg/L
BNA	1,2,4-TRICHLOROBENZENE	8270C/D RV	GW,WW	22.9-96.1	27.5	0.01	mg/L
BNA	1,2,4,5-TETRACHLOROBENZENE	8270C/D RV	GW,WW	30.7-102	27.7	0.01	mg/L
BNA	SULFOLANE	8270C/D	GW, WW	70.0-130	20.0	0.2	ug/L

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
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Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
BNA	SULFOLANE	8270C/D	SS	70.0-130	20.0	0.33	ug/kg
Glycols	ETHYLENE GLYCOL	8015	SS	70.0-130	20.0	5.0	mg/L
Glycols	PROPYLENE GLYCOL	8015	SS	70.0-130	20.0	5.0	mg/L
Glycols	ETHYLENE GLYCOL	8015	GW,WW	70.0-130	20.0	5.0	mg/L
Glycols	PROPYLENE GLYCOL	8015	GW,WW	70.0-130	20.0	5.0	mg/L
Explosives	1,3,5-TRINITROBENZENE	8330A/B	SS	70.0-130	20.0	0.5	mg/Kg
Explosives	1,3-DINITROBENZENE	8330A/B	SS	70.0-130	20.0	0.5	mg/Kg
Explosives	2,4,6-TRINITROTOLUENE	8330A/B	SS	70.0-130	20.0	0.5	mg/Kg
Explosives	2,4-DINITROTOLUENE	8330A/B	SS	70.0-130	20.0	0.5	mg/Kg
Explosives	2,6-DINITROTOLUENE	8330A/B	SS	70.0-130	20.0	0.5	mg/Kg
Explosives	2-NITROTOLUENE	8330A/B	SS	70.0-130	20.0	0.5	mg/Kg
Explosives	3-NITROTOLUENE	8330A/B	SS	70.0-130	20.0	0.5	mg/Kg
Explosives	4-NITROTOLUENE (4-NT)	8330A/B	SS	70.0-130	20.0	0.5	mg/Kg
Explosives	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8330A/B	SS	70.0-130	20.0	0.5	mg/Kg
Explosives	METHYL-2,4,6-TRINITROPHENYLNITRAMINE	8330A/B	SS	70.0-130	20.0	0.5	mg/Kg
Explosives	NITROBENZENE	8330A/B	SS	70.0-130	20.0	0.5	mg/Kg
Explosives	OCTAHYDRO - 1,3,5,7 - TETRANITRO-1,3,5,7-TETRAZOCINE (HMX)	8330A/B	SS	70.0-130	20.0	0.0005	mg/Kg
Explosives	PENTAERYTHRITOL TETRANITRATE (PETN)	8330A/B	SS	70.0-130	20.0	2	mg/Kg
Explosives	NITROGLYCERINE	8330A/B	SS	70.0-130	20.0	2	mg/Kg
Explosives	NITROGUANIDINE	8330A/B	SS	70.0-130	20.0	8	mg/Kg
Explosives	1,3,5-TRINITROBENZENE	8330A/B	GW	70.1-98.5	20.0	0.0005	mg/L
Explosives	1,3-DINITROBENZENE	8330A/B	GW	50.8-88.7	24.2	0.0005	mg/L
Explosives	2,4,6-TRINITROTOLUENE	8330A/B	GW	61.4-102	20.0	0.0005	mg/L
Explosives	2,4-DINITROTOLUENE	8330A/B	GW	40.2-91.7	36.2	0.0005	mg/L
Explosives	2,6-DINITROTOLUENE	8330A/B	GW	47.0-94.4	29.4	0.0005	mg/L
Explosives	2-NITROTOLUENE	8330A/B	GW	43.3-93.9	30.4	0.0005	mg/L
Explosives	3-NITROTOLUENE	8330A/B	GW	36.8-89.5	37.3	0.0005	mg/L
Explosives	4-NITROTOLUENE (4-NT)	8330A/B	GW	41.1-93.1	34.4	0.0005	mg/L
Explosives	HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	8330A/B	GW	63.1-94.2	20.0	0.0005	mg/L
Explosives	METHYL-2,4,6-TRINITROPHENYLNITRAMINE	8330A/B	GW	57.6-104	20.0	0.0005	mg/L
Explosives	NITROBENZENE	8330A/B	GW	56.0-99.0	20.4	0.0005	mg/L

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
Explosives	OCTAHYDRO - 1,3,5,7 - TETRANITRO-1,3,5,7-TETRAZOCINE (HMX)	8330A/B	GW	58.1-100	20.0	0.0005	mg/L
Explosives	PENTAERYTHRITOL TETRANITRATE (PETN)	8330A/B	GW	67.1-110	20.0	0.0005	mg/L
Explosives	NITROGLYCERINE	8330A/B	GW	65.0-126	20.0	0.0005	mg/L
GC	1, 2 DIBROMOETHANE (EDB)	504/8011	DW,GW, WW	70.0-130	30	0.00002	mg/L
GC	1, 2 DIBROMO-3-CHLOROPROPANE	504/8011	DW,GW, WW	70.0-130	30	0.00002	mg/L
GC	1,2,3-TRICHLOROPROPANE	504/8011	DW,GW, WW	70.0-130	30	0.0005	mg/L
THAA	BROMOACETIC ACID	552.2	DW	70.0-130	30	0.001	mg/L
THAA	CHLOROACETIC ACID	552.2	DW	70.0-130	30	0.002	mg/L
THAA	DIBROMOACETIC ACID	552.2	DW	70.0-130	30	0.001	mg/L
THAA	DICHLOROACETIC ACID	552.2	DW	70.0-130	30	0.001	mg/L
THAA	TRICHLOROACETIC ACID	552.2	DW	70.0-130	30	0.001	mg/L
TPH	PETROLEUM RANGE ORGANICS (TRPH)	FL-PRO RV	GW,	50.0-150	20.0	0.1	mg/L
TPH	PETROLEUM RANGE ORGANICS (TRPH)	FL-PRO	SS	50.0-150	20.0	4.0	mg/Kg
TPH	PETROLEUM RANGE ORGANICS (TRPH)	EPH TN	GW	50.0-150	20.0	0.1	mg/L
TPH	PETROLEUM RANGE ORGANICS (TRPH)	EPH TN	SS	50.0-150	20.0	4.0	mg/Kg
TPH	PETROLEUM RANGE ORGANICS (TRPH) - C9-C18, C19-C36, C11-C22	MADEP EPH	GW, WW	50.0-150	20.0	0.1	mg/L
TPH	PETROLEUM RANGE ORGANICS (TRPH) - C9-C18, C19-C36, C11-C22	MADEP EPH	SS	50.0-150	20.0	5.5	mg/Kg
TPH	PETROLEUM RANGE ORGANICS (TRPH) - C10-C28	DRO, 8015Mod	GW, WW	50.0-150	20.0	0.1	mg/L
TPH	PETROLEUM RANGE ORGANICS (TRPH) - C10-C28	DRO, 8015Mod	SS	50.0-150	20.0	4.0	mg/Kg
TPH	PETROLEUM RANGE ORGANICS (TRPH) – C10-C20, C20-C34	OHIO DRO	GW, WW	50.0-150	20.0	0.1	mg/L
TPH	PETROLEUM RANGE ORGANICS (TRPH) – C10-C20, C20-C34	OHIO DRO	SS	50.0-150	20.0	4.0	mg/Kg
TPH	PETROLEUM RANGE ORGANICS (TRPH) – GAS, DIESEL, MOTOR OIL, ETC.	OA2	GW, WW	50.0-150	20.0	0.1	mg/L
TPH	PETROLEUM RANGE ORGANICS (TRPH) – GAS, DIESEL, MOTOR OIL, ETC.	OA2	SS	50.0-150	20.0	4.0	mg/Kg

Table 12.3: QC Targets for Semi-Volatiles Accuracy (LCS), Precision and RLs
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Class	Analyte	Method	Matrix	Accuracy (%)	Prec. (RPD)	RL	Unit
TPH	PETROLEUM RANGE ORGANICS - C10-C28, C28-C40	DRORLA	GW, WW	50.0-150	20.0	0.1	mg/L
TPH	PETROLEUM RANGE ORGANICS - C10-C28, C28-C40	DRORLA	SS	50.0-150	20.0	4.0	mg/Kg
TPH	PETROLEUM RANGE ORGANICS – C10-C32	DROWY	GW, WW	50.0-150	20.0	0.1	mg/L
TPH	PETROLEUM RANGE ORGANICS – C10-C32	DROWY	SS	50.0-150	20.0	4.0	mg/Kg
TPH	PETROLEUM RANGE ORGANICS – GAS, DIESEL, MOTOR OIL, ETC.	NWTPH-Dx	GW, WW	50.0-150	20.0	0.25	mg/L
TPH	PETROLEUM RANGE ORGANICS – GAS, DIESEL, MOTOR OIL, ETC.	NWTPH-Dx	SS	50.0-150	20.0	25	mg/Kg
TPH	PETROLEUM RANGE ORGANICS – C10-C28	DROWM	GW, WW	75.0-115	20.0	0.1	mg/L
TPH	PETROLEUM RANGE ORGANICS – C10-C28	DROWM	SS	70.0-120	20.0	10	mg/Kg
TPH	PETROLEUM RANGE ORGANICS – C10-C22	TPHAZ	SS	70.0-130	20.0	30	mg/Kg
TPH	PETROLEUM RANGE ORGANICS – C22-C32	TPHAZ	SS	70.0-130	20.0	100.	mg/Kg
TPH	PETROLEUM RANGE ORGANICS – C10-C32	TPHAZ	SS	70.0-130	20.0	130.	mg/Kg
TPH	PETROLEUM RANGE ORGANICS - C6-C12, C12-C28, C28-C35, C6-C35	TX TPH	SS	75.0-125	20.0	50	mg/Kg
TPH	PETROLEUM RANGE ORGANICS - C10-C21, C21-C35	DROMO	GW, WW	75.0-125	20.0	1.0	mg/L
TPH	PETROLEUM RANGE ORGANICS - C10-C21, C21-C35	DROMO	SS	75.0-125	20.0	20	mg/Kg

13.0 CORRECTIVE ACTION

13.1 In the event that a nonconformance occurs in conjunction with the analytical batch, a corrective action response (CAR) form must be completed. The cause of the event is stated on the form and the measures taken to correct the nonconformance clearly defined. The effectiveness of the corrective action must be assessed and noted. The CAR is kept on file by the Regulatory Affairs Department. Corrective action procedures are documented in SOP #030208, *Corrective and Preventive Action*

13.2 Required Corrective Action

Control limits have been established for each type of analysis. When these limits are exceeded, corrective action must be taken. Calculated sample spike control limits are also used.

All samples and procedures are governed by ESCs quality assurance program. General corrective actions are as follows; however additional and more specific direction is provided in the specific determinative procedure. For more information, see the appropriate determinative SOP.

13.2.1 Laboratory QC Criteria and Appropriate Corrective Actions

If the analytical method contains acceptance/rejection criteria and it is more stringent than those controls generated by the laboratory the method criteria takes precedence.

13.2.2 Out Of Control Blanks: Applies to Method, Trip, Rinsate & Instrument Blanks

Rejection Criteria - Blank reading is more than twice the background absorbance or more than RL.

Corrective Action - Blanks are re-analyzed and the response is assessed. Standard curves and samples are evaluated for any obvious contamination that is isolated or uniform throughout the run. If necessary, reagents are re-prepared. Analyses are not initiated until the problem is identified and solved. If samples have already been prepared or analyzed, the Senior Chemist and/or Department Supervisor are consulted to determine if data needs to be rejected or if samples need to be re-prepared.

13.2.3 Out Of Control Laboratory Control Standards (LCS & LCSD)

Rejection Criteria - If the performance is outside of lab-generated control limits which are calculated as the mean of at least 20 data points ±3 times the standard deviation of those points (Listed in Section 12) and the marginal excedence allowance is surpassed (see section 12.2).

Corrective Action - Instrument settings are checked and the LCS standard is reanalyzed. If the LCS is still out of control, instrumentation is checked for systemic problems and repaired (if necessary). Re-calibration is performed and the samples affected since the last in control reference standard are rerun. The Senior Chemist and/or Department Supervisor are consulted for further action.

13.2.4 Out Of Control Matrix Spike Samples

Rejection Criteria - If either the MS or MSD sample is outside the established control limits.

Corrective Action - Any compound that is outside of these limits is considered to be ‘out of control’ and must be qualified appropriately. Batch acceptance, however, is based on method blank and LCS performance, not on MS/MSD recoveries. Specific methods, customers, and programs may require further corrective action in some cases.

13.2.5 Out Of Control Duplicate Samples

Rejection Criteria - Lab-generated maximum RPD limit (as listed under precision in Section 12)

Corrective Action - Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Batch acceptance, however, is based on method blank and LCS performance. Specific methods, customers, and programs may require further corrective action in some cases.

13.2.7 Out Of Control Calibration Standards: ICV, CCV, SSCV

Rejection Criteria - If the performance is outside of method requirements.

Corrective Action - Instrument settings are checked, calibration verification standard is reanalyzed. If the standard is still out of control, recalibration is performed, and samples affected since the last in control reference standard are rerun. The the Senior Chemist and/or Department Supervisor are consulted for further action.

14.0 RECORD KEEPING

Record keeping is outlined in SOP #030230, *Standards Logger, SOP #030227, Data Review* and SOP #030201, *Data Handling and Reporting.* Semi-Volatile organics calibration data are recorded and integrated using HP Enviroquant software. Calibration data from the semi-volatile analyses, in addition to the initial and daily calibration, includes GC/MS autotunes, DFTPP reports and surrogate recovery reports. Hard copy records of initial calibration and daily calibration are stored with chromatograms and integrated with sample data by date analyzed.

15.0 QUALITY AUDITS

System and data quality audits are outlined in the ESC Quality Assurance Manual Version 12.0 and *SOP #010104, Internal Audits*.

16.0 REVISIONS

The Regulatory Affairs Department has an electronic version of this Quality Assurance Manual with tracked changes detailing all revisions made to the previous version. This version is available upon request. Revisions to the previous version of this appendix are summarized in the table below.

Document	**Revision**
Quality Assurance Manual Version 15.0 (Appendix VII)	General – Replaced the term “client” with the term “customer” Table 8.1 – Updated Equipment List Table 10.1 – Updated SOP List Table 12.3 – Updated some RLs and added 1,4-Dioxane by Isotope Dilution

1.0 SIGNATORY APPROVALS

Air Laboratory
QUALITY ASSURANCE MANUAL

APPENDIX VIII TO THE ESC QUALITY ASSURANCE MANUAL

for

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Prepared by

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NOTE: The QAM has been approved by the following people.

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2.0 APPENDIX TABLE OF CONTENTS

3.0 Scope and Application

This appendix discusses specific QA requirements for general analytical protocols to ensure that analytical data generated from the Air Laboratory are scientifically valid and are of acceptable quality. Any deviations from these requirements and any deviations that result in nonconforming work must be immediately evaluated and their corrective actions documented.

4.0 Laboratory Organization and Responsibilities

ESC Lab Sciences offers diverse environmental capabilities that enable the laboratory to provide the customer with both routine and specialized services, field sampling guidance and equipment, and broad laboratory expertise. A brief outline of the organization and responsibilities as they apply to the ESC Quality Assurance Program is presented in *Section 4.0 in the ESC Quality Assurance Manual.*

5.0 Personnel and Training

5.1 Personnel

Heidi Ferrell, with a B.S. degree in Chemistry, is the Department Supervisor and is responsible for the overall production of the Air Laboratory; including the management of the staff and scheduling. Ms. Ferrell has 10 years of environmental laboratory experience.

In her absence, Matt Ferrell, with an A.S. of Applied Science, assumes responsibility for the Air Department decisions. Mr. Ferrell is the Primary Analyst for the Air Laboratory and is proficient in air analytical methods. He has 6 years of environmental laboratory experience.

5.2 Training

The Supervisor trains new laboratory analysts according to ESC protocol. ESC's training program is outlined in *SOP 030205 Technical Training and Personnel Qualifications.* Performance is documented using an initial demonstration of capability (IDOCs) and continuing demonstration of capability (CDOC). On-going acceptable capability in Air Laboratory is also demonstrated by acceptable participation in the Phenova proficiency testing program (PTs). Documentation of analyst training is maintained on file within the department.

6.0 Facilities and Laboratory Safety

6.1 Facilities

The main area of the laboratory has approximately 670 square feet of area with roughly 150 square feet of bench area. There are 670 square feet of additional storage and the lighting is fluorescence. The air system is a ten-ton Trane split unit with natural gas for heating. The laboratory reagent water is provided through the US Filter deionizer system. Waste disposal containers are located in the laboratory and Clean Harbors serves as ESC's hazardous waste disposal company. ESC's building information guides and site plan are shown in Appendix I.

6.2 Laboratory Safety

- Laboratory access is limited when work is being performed.
- All procedures where chemicals are prepared or splashes may occur are conducted in laboratory exhaust hoods.

ESC's laboratory safety guidelines are detailed in the *ESC Chemical Hygiene Plan.*

7.0 Sampling Procedures

7.1 Field Sampling Procedures, Sample Storage, and Handling

- Field Sampling procedures are described in Appendix III of this ESC Quality Assurance Manual. Sample information is recorded and kept on the ESC chain of custody and field logbooks.
- Samples for air analysis are collected in four ways:
  - ➢ Samples may be collected directly in evacuated Summa canisters fit with the appropriately adjusted regulators that control sampling flow to fill the canister over a given time period.
  - ➢ Summa canisters may also be collected as "grab" samples by simply opening the evacuated canister without the aid of a flow regulator and allowing the canister to fill quickly by virtue of the canister vacuum.
  - ➢ The third method entails collection of field samples using various sized bags specifically designed for air sampling (i.e. Tedlar). This type of sampling allows a pump connected via tubing to the bag's intake valve to sample the air at a controlled flow and over the appropriate timeframe needed by the customer.
  - ➢ The headspace of containers housing water samples may also be analyzed for specific volatile components.

- Air samples taken in summa canisters should be shipped in bubble wrapped boxes. Tedlar bags and water samples can be shipped in a container or cooler that is sufficiently rigid and protects the samples from damage that may be incurred in transport. The chain of custody is also placed in the container. The shipping label containing the name and address of the shipper is affixed to the outside of the shipment container.
- Samples are received in the laboratory login area and are tracked using LIMS (Laboratory Information Management System). A Chain of Custody Form accompanies all samples received by the lab. This is necessary to prove the traceability of the samples and to document the change in possession from sampling to delivery to receipt by the laboratory. Prior to analysis samples are checked for integrity. Sample handling, tracking and acceptance procedures are outlined in *SOP #060105, Sample Receiving.*

8.0 EQUIPMENT

8.1 EQUIPMENT LIST

TABLE 8.1 – LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Air Analysis
This table is subject to revision without notice

Item	*Manufacturer*	*Model*	*Instrument Name*	*#*	*Serial #*	*Location*
Gas Chromatograph	HP	6890N TCD	AIRGC3	1	US10726007	Air Lab
Gas Chromatograph/Mass Spectrometer	HP	6890 GC/5973MSD	AIRMS1	1	GCUS00024616 MSUS63810244	Air Lab
Gas Chromatograph/Mass Spectrometer	Agilent	6890N/5975	AIRMS2	2	CN10551083	Air Lab
Gas Chromatograph/Mass Spectrometer	Agilent	6890/5973	AIRMS3	3	US000011333 US91911078	Air Lab
Gas Chromatograph/Mass Spectrometer	Agilent	6890/5973	AIRMS4	4	US00024695 US82311265	Air Lab
Gas Chromatograph/Mass Spectrometer	Agilent	6890/5973	AIRMS5	5	GCUS0003961 MSUS0340681	Air Lab
Gas Chomatograph/Mass Spectrometer	Agilent	7890A/5975C	AIRMS6	6	GCUS10831022 MSU91732329	Air Lab
Canister Autosampler	Entech	7016C			0203	Air Lab
Preconcentrator	Entech	7100A			1089	Air Lab
Preconcentrator	Entech	7200			1005	Air Lab
Canister Autosampler	Entech	7016CA			1039	Air Lab
Tedlar Autosampler	Entech	(3) 7032A-L			1019	Air Lab
Dynamic Diluter	Entech	Model 4600A			1086	Air Lab
Canister Cleaner	Entech	Model 3100A			1045	Air Lab
Canister Cleaner	Entech	Model 3100A			1178	Air Lab
Canister cleaner	Entech	Model 3100A			B33-02663	Air Lab
Preconcentrator	Entech	7100A			1137	Air Lab
Canister Autosampler	(2) Entech	7016D				Air Lab
Preconcentrator	(2) Entech	7200				Air Lab
Tedlar Autosampler	Entech	7032A			1044	Air Lab

TABLE 8.1 – LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Air Analysis
This table is subject to revision without notice

Item	*Manufacturer*	*Model*	*Instrument Name*	*#*	*Serial #*	*Location*
Canister Autosampler	Entech	7016CA			1137	Air Lab
GC/FID	Agilent	6890N	AIRGC2	2	US10137006	Air Lab
Headspace Autosampler	(2) EST/PTS	LGX50				Air Lab
TO Canister	Restek/Entech	TO-Can/ SiloniteCan	2200 cans owned		N/A	Air Lab
Passive Sampling Kit	Restek		1500 owned		N/A	Air Lab
Field hand held PID	RAE Systems	MiniRae2000			110-012980	Air Lab
Field hand held PID	RAE Systems	MiniRAE2000				Air Lab

8.2 EQUIPMENT PREVENTIVE MAINTENANCE, EQUIPMENT CALIBRATION

INSTRUMENT	*P. M. DESCRIPTION*	*FREQUENCY*
Gas Chromatograph Detectors: FID	Change Quartz jet; clean; replace flame tip	As needed - when deterioration is noticeable
Gas Chromatograph/Mass Spectrometer	•Autotune Report	Inspected daily
Gas Chromatograph/Mass Spectrometer	•Clean ion source	As needed to maintain high mass resolution
Gas Chromatograph/Mass Spectrometer	•Replace vacuum pump oil	Every 6 months
Gas Chromatographs	•Replace column	When separation begins to degrade

8.3 STANDARDS AND REAGENTS

Table 8.3A: Standard stock sources, description and calibration information.
This table is subject to revision without notice

Method	**Vendor**	**Description**	**Conc.**	**Storage Req.**	**Expiration**
TO-15/SIM/8260B (VAP)/Method 8-mod. ISTD Stock Standard	Spectra Gases	ISTD and Tuning Mixture	1 ppmv	3395 L (2A) cylinder	1 year
TO-15/SIM/8260B (VAP)/Method 18-mod. Stock Standard*	Spectra Gases	Target Analytes	100 ppbv	3395 L (2A) cylinder	1 year
Landfill Gases Stock (CO_2, CO, CH_6, O_2, He)	Spectra Gases	Target Analytes	3 Levels	3395 L (2A) cylinder	1 year
Landfill Gases Laboratory Control Stock Standard	Spectra Gases	Target Analytes – Second Source	20%	3395 L (2A) cylinder	1 year
RSK-175 (Methane, Ethane, Ethene, Propane, Acetylene) Stock Standard	Scotty Gases	Target Analytes	1000 ppmv	3395 L (2A) cylinder	1 year
RSK-175 Laboratory Control Stock Standard	Scotty Gases	Target Analytes – Second Source	1000 ppmv	3395 L (2A) cylinder	1 year

TABLE 8.3B: Intermediate/Working Standard Concentrations *This table is subject to revision without notice*					
Organic Compounds	**Method #**	**Working Standard Concentrations**	**Volume of Stock Used**	**Final Volume**	**Expiration**
ISTD and Tuning Intermediate Standard	TO-15/8260B (VAP)/Method 18.	20 ppbv	1800 cc	15L in 15L Canister	1 year
Target Analytes* Intermediate Standard	TO-15/8260B (VAP)/Method 18	5 ppbv except Bromoform at 5ppbv, m&p Xylene at 10 ppbv and GRO at 200 ppbv	225 cc	15L in 15L Canister	1 year
TO-15/ 8260B(VAP)/ Method 18-mod. Laboratory Control* Intermediate Standard	TO-15/8260B (VAP)/Method 18	Second Source: 5 ppbv except Bromoform at 15ppbv, m&p Xylene at 10 ppbv and GRO at 200	225 cc	15L in 15L Canister	1 year
ISTD and Tuning Intermediate Standard	TO-15SIM	0.2ppbv	300 cc	15L in 15L Canister	1 year
Target Analytes	TO-15SIM	0.5ppbv	22.5 cc	15L in 15L Canister	1 year
TO-15SIM Laboratory Control* Intermediate Standard	TO-15SIM	0.5ppbv	22.5 cc	15L in 15L Canister	1 year

** see analytes listed in Table 12.3.*

8.4 INSTRUMENT CALIBRATION

TO-15, 8260B (Ohio VAP Air), Gasoline Range Components (Method 18) – Volatiles in Air by GC/MS – SOP Numbers 330367, 330368, & 330369

Detector mass calibration is performed daily using the autotune function of the GC/MS analytical system and BFB (Bromofluorobenzene). Following verification of the appropriate masses, the instrument sensitivity is verified by injecting a tuning solution containing Bromofluorobenzene (BFB). The BFB must meet the following ion abundance criteria:

Mass	Ion Abundance Criteria
50	8.0-40.0% of mass 95
75	30.0-66.0% of mass 95
95	base peak, 100% relative abundance
96	5.0-9.0% of mass 95
173	< 2.0% of mass 174
174	50.0-120% of mass 95
175	4.0-9.0% of mass 174
176	> 93.0%, but less than 101% of mass 174

Mass	Ion Abundance Criteria
177	5.0-9.0% of mass 176

Successful tuning must occur every 24 hours for method TO-15, TO-15SIM and Method 18 and every 12 hours for method 8260B (OH VAP only).

Following successful tuning, the GC/MS is calibrated using the internal standard procedure. A standard curve is prepared using a minimum of five standards. The calibration standards are tabulated according to peak height or area against concentrations of the target analytes and the concentrations and responses of the internal standard analytes. The results are used to determine a response factor for each analyte in each standard injected.
A TO-15, TO-15SIM or Method 18 calibration curve is constructed and determined to be acceptable if each analyte is found to be constant over the working range (<30 % RSD with no more than 2 compounds being between 30 and 40 % RSD). When this condition is met, linearity through the origin can be assumed and the average RF can be used in place of a calibration curve.

When analyzing air by method 8260B, specific target analytes in the calibration standards are defined as calibration check compounds (CCCs) or system performance check compounds (SPCCs).

SPCCs:	
Analyte	Minimum Relative Response Factor
Chloromethane	0.10
1,1-Dichloroethane	0.10
Bromoform	0.10
Chlorobenzene	0.30
1,1,2,2-Tetrachloroethane	0.30

CCCs:	
1,1-Dichloroethene	Toluene
Chloroform	Ethylbenzene
1,2-Dichloropropane	Vinyl Chloride

Analytes identified by the method as SPCCs must meet the minimum average response factors listed above for successful initial calibration. Compounds identified as CCCs must have a %RSD of less than 30% in the initial calibration curve. The remaining target analytes in the calibration standards must be <15% RSD. Linear regression can be used for any target compound exceeding the 15% RSD criteria providing that the correlation coefficient is 0.990 or better. Initial 8260B calibration for the target analytes of interest for the customer project that do not meet these requirements are not accepted and re-calibration must be performed.

For all methods, the initial calibration range must represent the typical air sample and include the lowest standard at or below the RL. The linear range of the instrument must be monitored to ensure that the maximum calibration point is within the range. Following successful calibration, the analysis of field and QC samples may begin. Analysis may be performed only during the timeframe of a valid tuning cycle (12 hours for 8260B and 24 hours for TO-15, TO-15SIM and Method 18). Following the expiration of the tuning clock, the instrument must be re-tuned and either recalibrated or the existing calibration may be verified prior to further sample analysis.

For 8260B analyses, daily continuing calibration verification (CCV) includes successful demonstration of BFB sensitivity and the injection of a mid-level CCV standard containing all the target analytes of interest, the CCC, and SPCC compounds. The BFB tune must meet the ion abundance criteria (see table above). Each SPCC in the calibration verification standard must meet a minimum response factors listed above. The CCCs must achieve the criteria of +/- 20% RSD. Each internal standard in the CCV must recover between -50% to + 100%, when compared to the same internal standard compound in the mid-point standard of the initial calibration curve. Additionally, if the retention time of an internal standard changes by more than 30 seconds from the retention time of the same internal standard in the mid-level standard of the most recent initial calibration, the system must be evaluated, corrected, and possibly re-calibrated.

For TO-15,TO-15SIM and Method 18 analyses, daily calibration verification is accomplished by a successful demonstration of BFB sensitivity and the injection of a mid-level CCV standard containing all the target analytes of interest. The BFB tune must meet the same ion abundance criteria as previously listed and the CCV standard must recover within 30% of predicted response for all analytes of interest.

Fixed Gases (Carbon Dioxide, Carbon Monoxide, Methane, Oxygen) based on ASTM D1946 – SOP Number 330372

Optimize the conditions of the Gas Chromatograph with Thermal Conductivity Detection according to the manufacturer's specification to provide good resolution and sensitivity. Verify that the gas flows and column and detector temperatures are at optimum levels for analysis, based on peak resolution and chromatograph performance. Allow sufficient time between each temperature adjustment to attain a stable reading (typically one hour). Standards are injected at a minimum of five concentration levels from purchased certified standards. Generation of the initial calibration is performed using PC-based D.01 ChemStation software and a calibration factor or linear regression model. The calibration must meet 15% RSD for calibration factors or a correlation coefficient of at least 0.990. Instrument calibration must be verified initially on days when a full calibration curve is not analyzed, following every 10 injections during the analytical sequence, and at the end of each sequence by the analysis of a check standard. These standards must recover within 15% of the expected concentration.

Methane, Ethane, Ethene, Propane, Acetylene based on RSK-175 – SOP Number 330370

Optimize the conditions of the Gas Chromatograph with Thermal Conductivity Detection according to the manufacturer's specification to provide good resolution and sensitivity. Verify that the gas flows and column and detector temperatures are at optimum levels for analysis, based on peak resolution and chromatograph performance. Allow sufficient time between each temperature adjustment to attain a stable reading (typically one hour). Standards are injected at a minimum of five concentration levels. The target analytes in the calibration standards must be ≤15% RSD. Linear regression can be used for any target compound exceeding the 15% RSD criteria providing that the correlation coefficient is 0.990 or better. Headspace is created in each field sample by forcing 20cc of helium into each sample vial. Following sufficient time for the sample and headspace to reach equilibrium, 100uL of air is removed from each vial and injected into the GC. Instrument calibration must be verified initially on days when a full calibration curve is not analyzed, following every 10 injections during the analytical sequence, and at the end of each sequence by the analysis of a check standard. These standards must recover within 15% of the expected concentration.

Methanol and Ethanol (MEETAC) in soil and water samples based on EPA 8260B/C – SOP Number 330373

Detector mass calibration is performed daily using the autotune function of the GC/MS analytical system and BFB (Bromofluorobenzene). Following verification of the appropriate masses, the instrument sensitivity is verified by injecting a tuning solution containing Bromofluorobenzene (BFB). The BFB must meet the following ion abundance criteria:

Mass	Ion Abundance Criteria
50	15.0-40.0% of mass 95
75	30.0-60.0% of mass 95
95	base peak, 100% relative abundance
96	5.0-9.0% of mass 95
173	< 2.0% of mass 174
174	> 50.0% of mass 95
175	5.0-9.0% of mass 174
176	> 95.0%, but less than 101% of mass 174
177	5.0-9.0% of mass 176

Successful tuning must occur every 12 hours.

Following successful tuning, the GC/MS is calibrated using the external standard procedure. A standard curve is prepared using a minimum of five standards. The calibration standards are tabulated according to peak height or area against concentrations of the target analytes. The results are used to determine a response factor for each analyte in each standard injected. A calibration curve is constructed and determined to be acceptable if each analyte is found to be constant over the working range (<15 % RSD). When this condition is met, linearity through the origin can be assumed and the average CF can be used in place of a calibration curve. Linear regression can be used for any target compound exceeding the 15% RSD criteria providing that the correlation coefficient is 0.990 or better.

The initial calibration range must represent the typical field sample and include the lowest standard at or below the RL. The linear range of the instrument must be monitored to ensure that the maximum calibration point is within the range. Following successful calibration, the analysis of field and QC samples may begin. Analysis may be performed only during the timeframe of a valid tuning cycle (12 hours). Following the expiration of the tuning clock, the instrument must be re-tuned and either recalibrated or the existing calibration may be verified prior to further sample analysis.

Daily calibration verification is accomplished by a successful demonstration of BFB sensitivity and the injection of a mid-level CCV standard containing all the target analytes of interest. The BFB tune must meet the same ion abundance criteria as previously listed and the CCV standard must recover within 15% of predicted response for all analytes of interest.

8.5 ACCEPTANCE/REJECTION OF CALIBRATION

The initial calibration curve is compared with previous curves for the same analyte. All new standard curves are immediately checked with a secondary source or laboratory control standard prepared from a separate source than those used for calibration. All curves are visually reviewed to ensure that acceptable correlation represents linearity. Calibration curves may be rejected for nonlinearity, abnormal sensitivity, or poor response of the laboratory control standard.

Continuing calibration verification is performed on each day that initial calibration is not performed and following every tenth sample. If a check standard does not perform within established criteria then the instrument will undergo evaluation to determine the problem. Once the problem is corrected, all samples between the last in control sample and the first out of control check will be re-analyzed.

TABLE 8.5: INSTRUMENT CALIBRATION & QC

Analysis/ Instrument	Calibration Type	Number of Standards	Acceptance/ Rejection Criteria	Frequency
TO-15/SIM & Method 18/ GC/MS	Initial/ Continuing	1 - Tuning Solution	Mass m/z Abundance Criteria 50 8-40% of mass 95 75 30-66% of mass 95 95 Base peak, 100% 96 5-9% of mass 95 173 <2% of mass 174 174 50-120% of mass 95 175 4-9% of mass 174 176 >93% but <101% of mass 174 177 5-9% of mass 176	TO-15/SIM/ M-18: Every 24 hours 8260 VAP: Every 12 hours
TO-15/SIM & Method 18/ GC/MS	Initial	5 minimum	Average Response Factor: <30 % RSD with no more than 2 compounds being between 30 and 40 % RSD	As needed
8260B VAP/ GC/MS	Initial	5 minimum	Average Response Factor: Target analytes in the calibration standards must be <15% RSD, CCCs must have a %RSD of less than 30% & SPCCs must meet the minimum average response factors. Linear regression can be used for any target compound exceeding the 15% RSD	As needed
TO-15/SIM & Method 18/ GC/MS	Continuing	1 cal. check verification (CCV)	Percent Difference for all compounds <30%	Daily, when init. calibration is not required.
TO-15 VAP/ GC/MS	Continuing	1 cal. check verification (CCV)	Average Response Factor: Target analytes in the calibration standards must be <15% RSD, CCCs must have a %RSD of less than 20% & SPCCs must meet the minimum average response factors.	Daily, when init. calibration is not required.
TO-15/SIM & Method 18	Initial/ Continuing	1 - Blank	< RL, concentrations of common laboratory contaminants shall not exceed the reporting limit	Following init. calibration or daily cal. verification
TO-15/SIM & Method 18	Initial/ Continuing	2 – (LCS/LCSD)	Must be within +/-30% with an RPD of <25.	Following initial calibration or daily cal. Verification
Landfill Gas/Helium	Initial	3	Average Response Factor: Target analytes in the calibration standards must be <15% RSD. Linear regression can be used for any target compound exceeding the 15% RSD	As needed
Landfill Gas/Helium	Continuing	1 - cal. check verification (CCV)	Target analytes in the calibration standards must be <15% RSD.	Daily, when init. calibration is not required, following every 10th injection, and the end of the sequence.

TABLE 8.5: INSTRUMENT CALIBRATION & QC

Analysis/ Instrument	Calibration Type	Number of Standards	Acceptance/ Rejection Criteria	Frequency
Landfill Gas/Helium	Initial/ Continuing	1 - Blank	< RL, concentrations of common laboratory contaminants shall not exceed the reporting limit	Following init. calibration or daily cal. verification
Landfill Gas/Helium	Initial/ Continuing	2 – Second source (LCS/LCSD)	Must be within +/-30% with an RPD of <25.	Following initial calibration or daily cal. verification
RSK-175	Initial	3	Average Response Factor: Target analytes in the calibration standards must be <15% RSD. Linear regression can be used for any target compound exceeding the 15% RSD	As needed
RSK-175	Continuing	1 - cal. check verification (CCV)	Target analytes in the calibration standards must be <15% RSD.	Daily, when init. calibration is not required, following every 10th injection, and the end of the sequence.
RSK-175	Initial/ Continuing	1 - Blank	< RL, concentrations of common laboratory contaminants shall not exceed the reporting limit	Following init. calibration or daily cal. verification
RSK-175	Initial/ Continuing	2 – Second source (LCS/LCSD)	Must be within +/-30% with an RPD of <25.	Following initial calibration or daily cal. verification
MEETAC	Initial/ Continuing	1 - Tuning Solution	Mass m/z Abundance Criteria 50 15.0-40.0% of mass 95 75 30.0-60.0% of mass 95 95 base peak, 100% relative abundance 96 5.0-9.0% of mass 95 173 < 2.0% of mass 174 174 > 50.0% of mass 95 175 5.0-9.0% of mass 174 176 > 95.0%, but less than 101% of mass 174 177 5.0-9.0% of mass 176	Every 12 hours
MEETAC	Initial	5 minimum	Average Response Factor: Target analytes in the calibration standards must be <15% RSD,	As needed
MEETAC	Continuing	1 cal. check verification (CCV)	Average Response Factor: Target analytes in the calibration standards must be <15% RSD,	Daily, when init. calibration is not required.
MEETAC	Initial/ Continuing	1 - Blank	< RL, concentrations of common laboratory contaminants shall not exceed the reporting limit	Following init. calibration or daily cal. verification

9.0 LABORATORY PRACTICES

9.1 REAGENT GRADE WATER

Reagent Grade water –Type II used in the Air Laboratory is generated in the Microbiology Laboratory and is periodically checked for contamination. Type II water is checked annually for single and total heavy metals. Monthly checks for total organic carbon, ammonia and organic nitrogen, total residual chlorine and a heterotrophic plate count are also conducted. Conductivity and pH are checked continuously or with each use.

9.2 SAMPLER CLEANING AND CERTIFICATION PROCEDURE

Canisters are cleaned in the laboratory using the Entech 3100 4-Position Canister Cleaner. Canisters are cleaned in batches of 4 to 8 per cleaning cycle. Prior to cleaning, canisters are inspected for integrity, damage and visible contamination. Acceptable canisters are connected to the manifold on the Entech cleaner and the cleaning cycle is controlled using Entech SmartLab software. Programmable cleaning cycles include: light, medium and heavy-duty and the cycle selected depends on the previous use of the dirtiest canister being cleaned. The cleaner automatically performs a leak check for the canisters and the manifold prior to the initial evacuation cycle. Heating bands are placed on each canister to elevate the temperature of the metallic canister to a level that provides for efficient cleaning. The typical cleaning cycle parameters are:

	Operating temperature = 120°C
1	Initial evacuation of canister to 1000 mtorr
2	Refill canister to 20psi
3	Evacuate the canister to 1000 mtorr
4	Repeat items 2 & 3 for a minimum of 8 cycles
5	Final zero air pressure in clean canister is 50 mtorr.

Following cleaning, a single canister is selected as a QC sample for the entire batch and the sample is filled with zero air or nitrogen and analyzed to verify that successful cleaning has occurred. If the analysis indicates that the batch is clean (i.e. <0.2 ppbv for target analytes and free of additional contamination), the QC sample is returned to the cleaner manifold. The entire batch is evacuated to less than 50 mtorr and clearly labeled as clean and ready for sample collection. If the QC sample indicates that canister contamination is still present, the batch is recycled through the cleaning process until residual contamination is no longer present. If following repeated cleaning cycles, residual contamination is still observed, canisters may be permanently removed from service and clearly identified as unusable.

Tedlar bags and vials, as used for headspace analyses, are purchased as certified pre-cleaned from approved providers and disposed of following the sample retention period.

9.3 TYPICAL ENTECH AUTOSAMPLER OPERATING PARAMETERS

These parameters are provided as an example and may be modified to improve analytical system performance or better address project needs.

Line Temp = 100^{o}C	Module 2 Desorb = 180^{o}C
Bulk Head 1 = 30^{o}C	Module 2 Bake = 190^{o}C
Bulk Head 2 = 30^{o}C	Module 2 Desorb Time = 3.5 min
Module 1 Trap = -150^{o}C	Module 3 Trap = -180^{o}C
Module 1 Preheat = 20^{o}C	Module 3 Inject = 2 min
Module 1 Desorb = 20^{o}C	Module 3 Bake Time = 2 min
Module 1 Bake = 130^{o}C	Module 3 Event = 3
Module 1 Bake Time = 5 min	Module 3 Wait Time = 25 min.
Module 2 Trap = -30^{o}C	Pressure Comp Factor = 14
Module 2 Preheat = off	Loop Flush = 30 seconds

10.0 ANALYTICAL PROCEDURES

10.1 A list of laboratory SOPs associated with the air laboratory can be found in the following table:

TABLE 10.1: AIR DEPARTMENT SOPs

This Table is subject to revision without notice

SOP #	Title/Description
330367	Measurement of Volatile Organic Compound in Ambient Air by GC/MS (EPA TO-15)
330367OH	Measurement of Volatile Organic Compound in Ambient Air by GC/MS (EPA TO-15) (Ohio VAP only)
330368	Gasoline Range Organics in Ambient Air by GC/MS – Method 18 Modified
330370	Method for Determination of Methane, Ethane, and Ethene (Based on RSK-175)
330371	Canister Cleaning, Certification and Storage
330371OH	Canister Cleaning (Ohio Vap Only)
330372	The Analysis of Fixed Gases using GC/TCD
330373	Meetac – Methanol and Ethanol Based on EPA 8260B/C

10.2 Sample Dilutions:

Dilutions for air samples from summa canisters and Tedlar bags may take three forms depending on the level of dilution required. These dilution techniques are demonstrated below:

Autosampler Dilution:

- First, a smaller sample volume can be analyzed using the capabilities of the Entech autosampler. For example, for a standard sample volume of 400cc, if 40cc were analyzed, that would be equivalent to a 10-fold dilution.
- The smallest sample volume that can be accurately analyzed using the autosampler method is l0cc (or a 40x).

Pressurized Manual Dilution:

- Sometimes, a 40X dilution is not sufficient to bring the concentration of a target analyte within the calibration range. In those cases, the sample canister is pressurized resulting in a dilution of the target analytes present.
- The act of introducing more pure air into the canister performs a dilution.
- The canister can then be analyzed at 400cc or diluted using a lesser autosampler volume, if necessary.

Secondary Manual Dilution:

- In extreme cases, the canister may need to be diluted into a second evacuated canister.
- This is accomplished by using a gas tight syringe to remove an aliquot of sample (1-l0mL) from the initial canister then injecting it into a clean evacuated second canister.
- The second canister is then analyzed and quantified taking into account the dilution based on the amount of sample injected and the total volume of the canister utilized.

Tedlar Bag Dilutions:

- Dilutions on Tedlar bags can be performed in much the same manner as summa canisters using either the autosampler dilution or the secondary manual dilution using a second Tedlar bag and filling it with pure air then adding an aliquot of field sample using a gas tight syringe.

11.0 QUALITY CONTROL CHECKS

NOTE: For specific guidance on each determinative method, including required quality control and specific state requirements/modifications, refer to the relevant laboratory standard operating procedure(s).

11.1 Initial Demonstrations of Capability (IDOCs) are performed during new analyst training and/or prior to acceptance and use of any new method/instrumentation. Continuing Demonstration of Capability (CDOCs) must be updated at least annually for each analyst performing testing on field samples. The associated data is filed within the department and available for review.

11.2 A Laboratory Control Sample (LCS) and LCS Duplicate are analyzed per batch of samples and must yield recoveries within 70-130% of the expected concentration for all analytes and this pair must not exceed and RPD of 25%. Analytes specifically listed in each SOP as poor performers must yield recoveries as listed in each determinative SOP. LCS stock standards are prepared from sources independent of the calibration standards and also serve to verify the original calibration curve.

11.3 A method preparation blank is performed per batch of samples processed. If the acceptance criteria as listed in the determinative SOP is exceeded, the laboratory shall evaluate whether reprocessing of the samples is necessary, based on the following criteria:

- The blank contamination exceeds a concentration greater than 1/10 of the measured concentration of any sample in the associated preparation batch or
- The blank contamination is greater than 1/10 of the specified regulatory limit. The concentrations of common laboratory contaminants shall not exceed the reporting limit.

Any samples associated with a blank that fail these criteria shall be reprocessed in a subsequent preparation batch, except when the sample analysis resulted in non-detected results for the failing analytes.

12.0 DATA REDUCTION, VALIDATION AND REPORTING

12.1 DATA REDUCTION

The analyst performs the data calculation functions and is responsible for the initial examination of the finished data. Data reduction steps applied to the raw data are outlined in SOP #030201, *Data Handling and Reporting.* A secondary review of the data package is performed according to ESC SOP #030227, *Data Review*. The reviewer verifies that the analysis has been performed as required and meets method criteria, all associate data is present and complete, and also ensures that any additional documentation is completed as required (i.e. Ohio VAP checklists, required qualifiers on test reports, etc.)

TABLE 12.1 Data Reduction Formulas

PARAMETER	FORMULA
GC/MS – Analyte Response Factor	response of analyte primary ion {*area*} x concentration of analyte (ug/L) response of ISTD primary ion {*area*} x concentration of ISTD (ug/L) *Calculations performed by HP Enviroquant Software*
GC/MS – Sample Analyte Concentration	response of primary ion in analyte x int. std concentration. {*ppbv*} x dilution factor response factor {*area/(mg/ml)*} x initial volume-mass {*ml or g*} x int. std cal. {area} *Calculations performed by HP Enviroquant Software*

12.2 VALIDATION

The validation process consists of data generation, reduction review, and reporting results. Once data reduction is complete, validation is conducted by verification that the QC samples are within acceptable QC limits and that all documentation is complete, including the analytical report and associated QC. See Table 12.3 by method for current QC targets and controls and current reporting limits.

Organic Control Limits **-** The organic QC targets are statutory in nature; warning and control limits for organic analyses are initially established for groups of compounds based on preliminary method validation data. When additional data becomes available, the QC targets are reviewed. All QC targets are routinely re-evaluated at least annually (and updated, if necessary) against laboratory historical data to insure that the limits continue to reflect realistic, method achievable goals.

12.3 REPORTING

Reporting procedures are documented in SOP #030201, *Data Handling and Reporting.*

Table 12.3: QC Targets for Air Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Analyte	Method	Matrix	Accuracy (%)	Prec. (% RPD)	RL	Unit
1,1,1-Trichloroethane	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,1,2,2-Tetrachloroethane	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,1,2-Trichloroethane	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,1-Dichloroethane	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,1-Dichloroethene	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,2,4-Trichlorobenzene	TO-15	Air	53.6-154	25.0	0.63	ppbv
1,2,4-Trimethylbenzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,2-Dibromoethane	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,2-Dichlorobenzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,2-Dichloroethane	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,2-Dichloropropane	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,3,5-Trimethylbenzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,3-Butadiene	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,3-Dichlorobenzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,4-Dichlorobenzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,4-Dioxane	TO-15	Air	48.0-156	25.0	0.2	ppbv
1,1,1-Trichloroethane	TO-15	Air	70.0-130	25.0	0.2	ppbv
2,2,4-Trimethylpentane	TO-15	Air	70.0-130	25.0	0.2	ppbv
2-Chlorotoluene	TO-15	Air	70.0-130	25.0	0.2	ppbv

Table 12.3: QC Targets for Air Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Analyte	Method	Matrix	Accuracy (%)	Prec. (% RPD)	RL	Unit
2-Propanol	TO-15	Air	50.4-152	25.0	0.2	ppbv
4-Ethyltoluene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Acetone	TO-15	Air	70.0-130	25.0	1.25	ppbv
Allyl Chloride	TO-15	Air	70.0-130	25.0	0.2	ppbv
Benzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Benzyl Chloride	TO-15	Air	55.6-160	25.0	0.2	ppbv
Bromomethane	TO-15	Air	70.0-130	25.0	0.2	ppbv
Bromodichloromethane	TO-15	Air	70.0-130	25.0	0.2	ppbv
Bromoform	TO-15	Air	70.0-130	25.0	0.6	ppbv
Carbon Disulfide	TO-15	Air	70.0-130	25.0	0.2	ppbv
Carbon Tetrachloride	TO-15	Air	70.0-130	25.0	0.2	ppbv
Chlorobenzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Chloroethane	TO-15	Air	70.0-130	25.0	0.2	ppbv
Chloroform	TO-15	Air	70.0-130	25.0	0.2	ppbv
Chloromethane	TO-15	Air	70.0-130	25.0	0.2	ppbv
Cis-1,2-Dichloroethene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Cis-1,3-Dichloropropene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Cyclohexane	TO-15	Air	70.0-130	25.0	0.2	ppbv
Dibromochloromethane	TO-15	Air	70.0-130	25.0	0.2	ppbv
Dichlorodifluoromethane	TO-15	Air	56.7-140	25.0	0.2	ppbv
Ethanol	TO-15	Air	34.3-167	25.0	0.63	ppbv
Ethyl Acetate	TO-15	Air	70.0-130	25.0	0.2	ppbv
Ethylbenzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Freon-11	TO-15	Air	70.0-130	25.0	0.2	ppbv
Freon-12	TO-15	Air	70.0-130	25.0	0.2	ppbv
Freon-113	TO-15	Air	70.0-130	25.0	0.2	ppbv
Freon-114	TO-15	Air	70.0-130	25.0	0.2	ppbv
Gasoline Range Organics	TO-15	Air	70.0-130	25.0	50	ppbv
Heptane	TO-15	Air	70.0-130	25.0	0.2	ppbv
Hexachloro-1,3-Butadiene	TO-15	Air	62.1-143	25.0	0.63	ppbv
Hexane	TO-15	Air	70.0-130	25.0	0.2	ppbv
Isopropylbenzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
M&P-Xylene	TO-15	Air	70.0-130	25.0	0.4	ppbv
Methyl Butyl Ketone	TO-15	Air	47.9-165	25.0	1.25	ppbv
Methyl Ethyl Ketone	TO-15	Air	70.0-130	25.0	1.25	ppbv

Table 12.3: QC Targets for Air Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Analyte	Method	Matrix	Accuracy (%)	Prec. (% RPD)	RL	Unit
Methyl Isobutyl Ketone	TO-15	Air	55.3-154	25.0	1.25	ppbv
Methyl Methacrylate	TO-15	Air	70.0-130	25.0	0.2	ppbv
Methyl tert Butyl Ether	TO-15	Air	70.0-130	25.0	0.31	ppbv
Methylene Chloride	TO-15	Air	70.0-130	25.0	0.63	ppbv
Naphthalene	TO-15	Air	52.0-158	25.0	0.63	ppbv
N-butyl benzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
N-propyl benzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
o-Xylene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Propene	TO-15	Air	53.9-143	25.0	0.4	ppbv
Sec-butyl benzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Styrene	TO-15	Air	70.0-130	25.0	0.2	ppbv
t-Butyl Alcohol	TO-15	Air	70.0-130	25.0	0.2	ppbv
Tert-butyl benzene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Tetrachloroethylene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Tetrahydrofuran	TO-15	Air	65.0-140	25.0	0.2	ppbv
Toluene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Trans-1,3-Dichloropropene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Trans-1,2-Dichloroethene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Trichloroethylene	TO-15	Air	70.0-130	25.0	0.2	ppbv
Vinyl Acetate	TO-15	Air	70.0-130	25.0	0.2	ppbv
Vinyl Bromide	TO-15	Air	70.0-130	25.0	0.2	ppbv
Vinyl Chloride	TO-15	Air	70.0-130	25.0	0.2	ppbv
1,1,1-Trichloroethane	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
1,1,2,2-Tetrachloroethane	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
1,1,2-Trichloroethane	TO-15SIM	Air	70.0-130	25.0	0.03	ppbv
1,1-Dichloroethane	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
1,1-Dichloroethene	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
1,2-Dibromoethane	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
1,2-Dichloropropane	TO-15SIM	Air	70.0-130	25.0	0.03	ppbv
1,4-Dichlorobenzene	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
Benzene	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
Carbon Tetrachloride	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
Chloroethane	TO-15SIM	Air	70.0-130	25.0	0.04	ppbv
Chloroform	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
Chloromethane	TO-15SIM	Air	70.0-130	25.0	0.03	ppbv

Table 12.3: QC Targets for Air Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Analyte	Method	Matrix	Accuracy (%)	Prec. (% RPD)	RL	Unit
Cis-1,2-Dichloroethene	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
Cis-1,3-Dichloropropene	TO-15SIM	Air	70.0-130	25.0	0.03	ppbv
Ethylbenzene	TO-15SIM	Air	70.0-130	25.0	0.03	ppbv
Tetrachloroethylene	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
Trans-1,3-Dichloropropene	TO-15SIM	Air	70.0-130	25.0	0.03	ppbv
Trans-1,2-Dichloroethene	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
Trichloroethylene	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
Vinyl Acetate	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
Vinyl Chloride	TO-15SIM	Air	70.0-130	25.0	0.02	ppbv
Methane	RSK-175	Air/ Headspace	85.0-115	20.0	0.01	ppmv
Ethane	RSK-175	Air/ Headspace	85.0-115	20.0	0.0129	ppbmv
Ethene	RSK-175	Air/ Headspace	85.0-115	20.0	0.0127	ppmv
Propane	RSK-175	Air/ Headspace	85.0-115	20.0	0.0186	ppmv
Acetylene	RSK-175	Air/ Headspace	85.0-115	20.0	0.0208	ppmv
Carbon Dioxide	ASTM D1946	Air	70.0-130	20.0	0.50 / 200	% / ppmv
Carbon Monoxide	ASTM D1946	Air	70.0-130	20.0	0.50 / 200	% / ppmv
Methane	ASTM D1946	Air	70.0-130	20.0	0.50 / 200	% / ppmv
Nitrogen	ASTM D1946	Air	70.0-130	20.0	0.50 / 200	% / ppmv
Oxygen	ASTM D1946	Air	70.0-130	20.0	0.50 / 200	% / ppmv
Helium	ASTM D1946	Air	70.0-130	25.0	100	ppmv
Methanol	MEETAC	Water/Soil	70.0-130	20.0	20.0/100	ppb / ppm
Ethanol	MEETAC	Water/Soil	70.0-130	20.0	20.0/100	ppb / ppm

13.0 CORRECTIVE ACTION

13.1 In the event that a nonconformance occurs in conjunction with the analytical batch, a corrective action response (CAR) form must be completed. The cause of the event is stated on the form and the measures taken to correct the nonconformance clearly defined. The effectiveness of the corrective action must be assessed and noted. The CARs are kept on file by the Regulatory Affairs Department. Corrective action procedures are documented in SOP #030208, *Corrective and Preventive Action*

13.2 Required Corrective Action

Control limits have been established for each type of analysis. When these limits are exceeded, corrective action must be taken. Calculated sample spike control limits are also used.

All samples and procedures are governed by ESC's quality assurance program. General corrective actions are as follows; however additional and more specific direction is provided in the specific determinative procedure. For more information, see the appropriate determinative SOP

13.2.1 Laboratory QC Criteria and Appropriate Corrective Actions

If the analytical method contains acceptance/rejection criteria and it is more stringent than those controls generated by the laboratory, the method criteria takes precedence.

13.2.2 Calibration Verification Criteria Are Not Met.

<u>Rejection Criteria</u> – See Table 8.5.

Corrective Action – Instrument settings are checked. The standard is reviewed for obvious cause. The standard may require re-analysis or the instrument may require recalibration.

13.2.3 Out Of Control Blanks:

<u>Rejection Criteria</u> - Blank reading is more than ½ the RL.

<u>Corrective Action</u> - Instrument settings are checked. The Blank is re-analyzed. If the blank is still out of control, bakeout of the system is performed and the blank is re-analyzed.

13.2.4 Out Of Control Laboratory Control Standards (LCS)

<u>Rejection Criteria</u> - If the performance is outside of lab-generated control (Listed in Table 12.3).

<u>Corrective Action</u> - Instrument settings are checked. The LCS standard is re-analyzed. If the LCS is still out of control, re-calibration is performed, and samples affected since the last in control reference standard are re-analyzed.

14.0 RECORD KEEPING

Record keeping is outlined in SOP #030230, *Standards Logger*, *SOP #030227*, *Data Review* and SOP #030201, *Data Handling and Reporting*

15.0 QUALITY AUDITS

System and data quality audits are outlined in the ESC Quality Assurance Manual Version 13.0 and in *SOP #010104, Internal Audits*.

16.0 REVISIONS

The Regulatory Affairs Department has an electronic version of this Quality Assurance Manual with tracked changes detailing all revisions made to the previous version. This version is available upon request. Revisions to the previous version of this appendix are summarized in the table below.

Document	**Revision**
Quality Assurance Manual Version 15.0 (Appendix VIII)	General – Replaced the term "client" with the term "customer" and added TO-15SIM Table 8.1 – Updated Equipment List Tables 8.3A and 8.3B – Updated standards Table 10.1 – Updated SOP List

1.0 SIGNATORY APPROVALS

Aquatic Toxicity Laboratory
QUALITY ASSURANCE MANUAL

APPENDIX IX TO THE ESC QUALITY ASSURANCE MANUAL

for

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NOTE: The QAM has been approved by the following people.

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2.0 *APPENDIX TABLE OF CONTENTS*

3.0 SCOPE AND APPLICATION

This appendix discusses specific QA requirements for general analytical protocols to ensure that analytical data generated from the Aquatic Toxicity laboratory are scientifically valid and are of acceptable quality. Any deviations from these requirements and any deviations that result in non-conforming work must be immediately evaluated and their corrective actions documented.

4.0 LABORATORY ORGANIZATION AND RESPONSIBILITIES

ESC Lab Sciences offers diverse environmental capabilities that enable the laboratory to provide the customer with both routine and specialized services, field sampling guidance and materials and broad laboratory expertise. A brief outline of the organization and responsibilities as they apply to the ESC Quality Assurance Program is presented in *Section 4.0 in the ESC Quality Assurance Manual.*

5.0 PERSONNEL AND TRAINING

5.1 PERSONNEL

Dr. Christabel Fernandes-Monteiro, with a Ph.D. in Applied Biology, is the Department Manager of Biology. She oversees supervision of laboratory operations in the Mold, Aquatic Toxicity, Microbiology, Protozoan and BOD laboratories. Her responsibilities include assurance of reliable data through monitoring of quality control, corroborating the analysis performed, protocol development, coordination with customers regarding sample analysis, scheduling of tests and overall production in all sections within the Biology Laboratory, including management of staff. In her absence, Shain Schmitt assumes her responsibilities in the Aquatic Toxicity laboratory.

Shain Schmitt with a B.S. degree in Conservation Biology, is the Primary Analyst for the Aquatic Toxicity laboratory. Mr. Schmitt is proficient in aquatic toxicity analytical methods and is responsible for sample analysis, review and approval of data associated with toxicity analyses. His responsibilities also include the coordination with customers regarding sample analysis, scheduling, data reductions, interpretation and validation of toxicity testing. In his absence, Brandon Etheridge assumes his responsibilities.

5.2 TRAINING

All new analysts to the laboratory are trained by the Primary Analyst or Manager according to ESC protocol. ESC's training program is outlined in *SOP 350355 Technical Training and Personnel Qualification for Biology–Aquatic Toxicity.* Performance is documented using an initial demonstration of capability (IDOCs) and continuing demonstration of capability (CDOC). On-going acceptable capability in toxicity analysis is also demonstrated by acceptable participation in the Phenova proficiency testing program (PTs) as well as by performing routine reference toxicant testing at the same concentrations and in the same dilution water as is used for field sample testing. Documentation of analyst training is maintained on file within the department.

6.0 FACILITIES AND LABORATORY SAFETY

6.1 FACILITIES

The main area of the laboratory has approximately 1440 square feet of area with roughly 280 square feet of bench area. There are 300 square feet of additional storage and the lighting is fluorescence. The air system is a five-ton Trane split unit with natural gas for heating. The laboratory reagent water is provided through the Siemans Elga UltraPure deionizer system. Biohazard containers are located in the laboratory and Stericycle Waste Removal serves as ESC's biological waste disposal contractor. ESC's building information guides and site plan are shown in Appendix I.

6.2 LABORATORY SAFETY

- Laboratory access is limited when work is being performed.
- The following Biosafety Level 2 (BSL2) guidelines are adhered to:
  - Closed-toe shoes are worn in the laboratory
  - Floors and work surfaces are cleaned on a regular basis
  - Emergency numbers are posted in the laboratory
  - Laboratory personnel are trained in the use of the biological spill kit and emergency safety equipment
- ESC's laboratory safety guidelines are detailed in the ESC *Chemical Hygiene Plan*.

7.0 SAMPLING PROCEDURES

7.1 FIELD SAMPLING PROCEDURES, SAMPLE STORAGE, AND HANDLING

- Field Sampling procedures are described in Appendix III of this ESC Quality Assurance Manual. Sample information is recorded and kept on the ESC chain of custody and field logbooks.
- Samples are received in the laboratory login area and are tracked using LIMS (Laboratory Information Management System). A Chain of Custody Form accompanies all samples and can be viewed in LIMS. This is necessary to prove the traceability of the samples and to document the change in possession from sampling to delivery to receipt by the laboratory. Prior to analysis samples are checked for integrity. Once samples are checked to confirm integrity, the samples are logged with unique sample identification information and a label is affixed to each container. Chronic Toxicity samples are uniquely identified with "sample 1, sample 2 and sample 3". A sample custodian then transports samples to the laboratory. Sample handling and tracking procedures are outlined in *SOP 060105, Sample Receiving.*

- Samples for Chronic and Acute toxicity testing are collected in either 1 Gal HDPE or glass containers with no preservative and 125 ml HDPE without preservative for Alkalinity and with preservative for Hardness. Holding time is 36 hours between collection and first use of sample and last use of sample for renewal shall not exceed 72 hours without permission from permitting authority.
- Requirements for sample acceptance are located in *SOP 060105, Sample Receiving.* At a minimum, the following physical and chemical parameters are analyzed for each sample received:

  - Temperature
  - pH - initial and final measurements recorded
  - D.O. - initial and final measurements recorded
  - Specific Conductance
  - Alkalinity
  - Hardness
  - Total Residual Chlorine
- Samples must be immediately cooled and maintained at 0-6°C following sampling, during shipment and prior to testing.

Residual Chlorine Treatment

- Residual chlorine in biomonitoring samples is monitored using a pocket colorimeter and these checks are documented. Chlorine removal is not performed on submitted field samples.

Dissolved Oxygen

For acute tests, samples that are $\leq$ 4.0mg/L are aerated until the sample reaches 90% saturation. For chronic tests, samples that are $\leq$ 5.0 mg/L are aerated until the sample reaches 90% saturation.

8.0 EQUIPMENT

8.1 EQUIPMENT LIST

TABLE 8.1 – LABORATORY EQUIPMENT LIST: MAJOR ITEMS – Aquatic Toxicity Lab
This table is subject to revision without notice.

Item	*Manufacturer*	*Model*	*Location*
Analytical Balance	Mettler	AT261 Delta Range	Aquatic Tox Lab
Class “I” weights (2)	Troemner		Aquatic Tox Lab
Conductivity Meter	Orion	150 A+	Aquatic Tox Lab
Dissolved Oxygen Meter	YSI	Model 50	Aquatic Tox Lab
Stereoscope	Olympus	SZX-IllK100	Aquatic Tox Lab
Oven (1)	Fisher	655F	Aquatic Tox Lab
Incubator	Thermo-Kool	Environmental chamber	Aquatic Tox Lab

TABLE 8.1 – LABORATORY EQUIPMENT LIST: MAJOR ITEMS – Aquatic Toxicity Lab
This table is subject to revision without notice.

Item	*Manufacturer*	*Model*	*Location*
Incubator	Percival Scientific	1-37 VL	Aquatic Tox Lab
Incubator	Precision Sci.	818	Aquatic Tox Lab
Incubator (2)	Precision Sci.	818	Aquatic Tox Lab
Incubator (3)	VWR	2030-ZZMFG	Aquatic Tox Lab
Microscope	Olympus	CHT	Aquatic Tox Lab
pH Meter	Orion	VersaStar	Aquatic Tox Lab
Refrigerator (2)	Beverage Air	E Series	Aquatic Tox Lab
Stereoscope	Olympus	SZH-ILLD	Aquatic Tox Lab
Stereoscope	Olympus	SZH-ILLD	Aquatic Tox Lab
Refrigerator	Frigidaire	FRC445GB	Aquatic Tox Lab
Refrigerator	True	T-49	Aquatic Tox Lab
Water Purifier	Siemans	Elga LabPure S4	Aquatic Tox Lab
Refrigerator	Fridgidaire	FRC 445GB	Aquatic Tox Lab
pH/Conductivity Benchtop meter	Thermo Scientific Orion	VSTAR 52	Aquatic Tox Lab
RDO Probe	Thermo Scientific Orion	VSTAR-RD	Aquatic Tox Lab
Oven (2)	Thermoscientific	Heratherm OGS400	Aquatic Tox Lab
Stereoscope	Olympus	SZH-STS	Aquatic Tox Lab
Freezer	Kenmore	198.813.582	Aquatic Tox Lab

8.2 EQUIPMENT PREVENTIVE MAINTENANCE, EQUIPMENT CALIBRATION

PREVENTATIVE MAINTENANCE FOR LABORATORY EQUIPMENT

INSTRUMENT	*P. M. DESCRIPTION*	*FREQUENCY*
Analytical Balances	•Check with Class "I" weights	Daily-tolerance 1 gm - ±0.0001 gm
Analytical Balances	•Service/Calibration (semiannual contract maintenance and calibration check)	10 gm - ±0.01 gm
Analytical Balances	•Service/Calibration (semiannual contract maintenance and calibration check)	Semi-annually
Refrigerators & Incubators	•Maintenance service	As needed - determined by twice daily temperature performance checks @ least 4 hours apart
Dissolved oxygen meter	•Calibrate with each use	Daily
Dissolved oxygen meter	•Change probe membrane	Every two to four weeks when in use
Conductivity Meter	•Check probe cables	As needed
Conductivity Meter	•Clean probe	As needed
Conductivity Meter	•Replace or replatinize probe	Poor response not corrected by above
Conductivity Meter	•Calibrate with each use	Daily (or prior to each use)
Microscope/Stereoscope	•Service/calibration of each ocular micrometer	Annually

PREVENTATIVE MAINTENANCE FOR LABORATORY EQUIPMENT		
INSTRUMENT	***P. M. DESCRIPTION***	***FREQUENCY***
Microscope/Stereoscope	• Clean optics and stage	As needed
pH Meters	•Reference junction & electrode replacement	As needed
pH Meters	•Probe stored in pH standard 4	At all times when not in use
pH Meters	•Other	As described in the manufacturer's manual
pH Meters	•Calibrate with each use	Daily (or prior to each use)
pH meter	•ATC checks	Quarterly
Bottle top dispenser/repipettor	•Calibrate	Quarterly
Bottle top dispenser/repipettor	•Clean to prevent residue buildup	As needed
Water Purifier	Tank Exchange, UV bulb and sleeve replacement (service contract maintenance and check	As needed and annually
Water Purifier	•Replace cartridge and filter	As needed and semi-annual
RDO probe	•Replace sensor cap	Annually
RDO probe	•Clean sensor cap	As needed
RDO probe	•Other	As described in manufacturer’s manual
pH/Conductivity/DO meter	•Calibrate with each use	Daily
Light Meter	•Calibrate	Annually

8.3 STANDARDS , REAGENTS AND ORGANISM CULTURES

All reagents and standards must meet the requirements listed in the analytical methods.

Table 8.3A: Stock solution sources, description and related information.
(subject to revision as needed)

Description	Vendor	Storage Req.	Expiration
Conductivity standard 1413	NSI	Ambient	1 yr
pH buffer 4	-VWR	Ambient	1 yr
pH buffer 7	-VWR	Ambient	1 yr
pH buffer 10	-VWR	Ambient	1 yr
Bromothymol blue solution	-VWR	Ambient	1 yr
Potassium phosphate monobasic	-VWR	Ambient	1 yr
Magnesium chloride	-VWR	Ambient in dessicator	1 yr
Potassium Chloride	-VWR	Ambient in dessicator	1 yr
Brine shrimp eggs	Brine Shrimp Direct (BSD)	Ambient, tightly sealed.	1 yr
Calcium sulfate	-VWR	Ambient in dessicator	1 yr
EDTA	-VWR	Ambient in dessicator	1 yr
Sodium thiosulfate	-VWR	Ambient in dessicator	1 yr
pH buffer 4	-VWR	Ambient.	1 yr
YCT	Made in-house	-10 to -20^{o}C	14 days after thawing
Raphidocelis subcapitata	Aq. Biosystems	1-6^{o}C	One month from concentration date

Table 8.3A: Stock solution sources, description and related information.
(subject to revision as needed)

Description	Vendor	Storage Req.	Expiration
Vitamin B12	ICN	1-6°C	NA

TABLE 8.3B: Working Solution Descriptions and Related Information.
(subject to change)

Solution	Concentrations	Storage Requirements	Expiration
KCl stock solution	31.237g KCl to 2L of mod. Hard SDW	1-4°C	14 days
B12 Solution	0.01125g to 1L of DI Water	1-4°C	NA

Source and Maintenance of in-house cultures:

Source of Biological Organisms (*subject to change*):
The primary source for all fathead minnows is:

Aquatic Biosystems Inc.
2821 Remington Street
Fort Collins, CO 80525

The source for their organisms is documented on each packing slip received. ESC accepts the packing slip as documentation and verification by the supplier with regard to the taxonomic identification of the bioassay species. The packing slips for bioassay test organisms are kept on file.

The amount of food added to culture vessels depends upon the number of organisms within a given culture. As standard procedure, *Ceriodaphnia dubia* batch cultures are fed 4.5mL of Yeast Cereal leaves, Tout chow (YCT) and *Raphidocelis subcapitata* algal suspension on the day of initiation. Batches are fed as needed. The date, time and the amount the organisms are fed is documented. All yeast purchased is at least food grade and has passed FDA standards. All (YCT) Yeast Trout Chow is made in-house. New lots are tested for pesticides, metals, and PCBs.

Ceriodaphnia dubia, fresh batch cultures are set up on Monday, Wednesday and Friday using newly hatched neonates less than 24 hours old. In addition, a minimum of 4 brood trays are set up daily in order to guarantee organisms of the right age to use in bioassay tests. The *C. dubia* brood trays are fed daily. The *C. dubia* are transferred into fresh water daily after their first brood of neonates is born. Third generation neonates, less than 24 hours old, are used for batch cultures and brood trays. Third generation neonates, less than 24 hours old and hatched within 8 hours of each other, are used for chronic tests. Adults are used as sources for neonates until 14 days of age.

C. dubia are taxonomically identified to species on a quarterly basis. All taxonomy information is documented and kept on file for a year.

Pimephales promelas batch cultures are cleaned as needed by siphoning off the excess food and waste from the bottom of the culture vessel and renewing the water. Cultures are aerated as needed to maintain adequate dissolved oxygen.

Pimephales promelas are taxonomically identified to species on a quarterly basis. All taxonomy information is documented and kept on file for a year.

The water used for culturing is moderately hard synthetic dilution water (SDW) and is prepared by diluting 1L synthetic freshwater concentrate to 20 L ultra-pure deionized water, and vigorously aerating for a minimum of 1 hour. The physical and chemical parameters for each new tank of water prepared are recorded and should fall within the following acceptable range:

1. pH – 7.5- 8.5 units
2. D.O. - greater than 80% saturation in mg/L
3. Specific Conductance - ~250 micromhos/cm
4. Alkalinity - 57-64 mg $CaCO_3$/L
5. Hardness - 80 to 100 mg $CaCO_3$/L
6. Total Residual Chlorine - <0.1 mg/L

8.4 INSTRUMENT CALIBRATION

Lighting

All testing and culturing is maintained in incubators in which temperature is constant and the photoperiod is on a 16-hour light/8-hour dark cycle. The photoperiod is verified and documented quarterly. The light intensity must be within 50 – 100 foot candles (approximately 10-20*u*E/m2/s) and is verified and documented quarterly. All incubators are monitored at least weekly for proper light intensity.

pH Meter

The pH meters are calibrated with each use according to manufacturer's instructions. The slope is documented on a daily basis. Ensure the acceptable pH slope range is within the manufacturer's acceptable range prior to use. Perform automatic temperature compensation (ATC) checks quarterly on the pH probe. All calibration information is documented.

Volumetric Equipment

Equipment such as filter funnels, bottles, pipettes, non-Class A and other containers with graduations are calibrated once per lot prior to first use. The error of calibration must not exceed 3.0%.

Analytical Balance

Analytical balances are checked and calibrated semi-annually by a certified technician. Calibration is checked before each use with Class I weights. Class I weights are calibrated annually.

Stereoscope

Maintenance is performed by a trained technician on an annual basis.

Conductivity Meter

The conductivity meter is calibrated with each use according to manufacturer's instructions.

Dissolved Oxygen Meter

The DO meter is calibrated according to manufacturer's instructions with each use. The electrochemical probe membrane is changed every two to four weeks to maintain accurate readings when in use. The RDO probe sensor cap is cleaned regularly, and replaced once per year. The RDO probe sensor cap must be stored in a moist environment.

Test Chambers

Each test chamber is rinsed with DI water prior to introducing the test organisms.

Bottle Top Dispenser/Repipettor

Repipettors are calibrated quarterly to ensure the instrument is dispensing the correct amount. Periodic cleaning is performed to maintain the accuracy and to prevent buildup of residue.

Colorimeter Chlorine tester

The colorimeter is calibrated before each use using standards to verify accuracy.

Light Meter

Calibrate the light meter annually to ensure it meets original performance specifications or purchase new calibrated meter as needed.

9.0 LABORATORY PRACTICES

9.1 REAGENT GRADE WATER

Deionized water or reverse-osmosis produces water free from bactericidal and inhibitory substances and is used in the preparation of media, solutions and buffers. The quality of the water is monitored for chlorine residual, specific conductance, and heterotrophic bacteria plate count monthly (when in use), when maintenance is performed on the water treatment system, or at startup after a period of disuse longer than one month.

Analysis for metals and organic contaminants is performed quarterly and the Bacteriological Water Quality Test (to determine presence of toxic agents or growth promoting substances) is performed annually. Results of these analyses meet the specifications of the required method and records of analyses are maintained for five years. (An exception to performing the Bacteriological Water Quality Test can be given to laboratories that can supply documentation to show that their water source meets the criteria, as specified by the method, for Type I or Type II reagent water.)

9.2 PH BUFFERS/CONDUCTIVITY STANDARDS

pH buffer and conductivity standard aliquots are used only once. Reagents containers are dated upon receipt and the date opened.

9.3 SECONDARY STANDARDS

Standards are used for retrieval and verification of the factory calibrated colorimeter and are used to verify consistent instrument calibration.

9.4 LABORATORY CONTROL WATER

Control water (moderately hard synthetic dilution water- SDW) is prepared by diluting 1L of synthetic freshwater concentrate to 20L deionized water and aerating for a minimum of 1 hour. The physical and chemical parameters for each new tank of water prepared are recorded and should fall within the following acceptable range:

1. pH – 7.5-8.5 units
2. D.O. - greater than 80% saturation in mg/L
3. Specific Conductance - ~250 micromhos/cm
4. Alkalinity - 57 to 64 mg $CaCO_3$/L
5. Hardness - 80 to 100 mg $CaCO_3$/L
6. Total Residual Chlorine - <0.1 mg/L

Control water (10% dilute mineral water-DMW) is prepared by diluting approximately 2 Liters of Perrier to the 20 Liters mark of a 20 L NALGENE® carboy with ultra-pure deionized water and aerating for a minimum of 1 hour. The physical and chemical parameters for each new tank of water prepared are recorded and should fall within the following acceptable range:

1. pH – 6.5 to 8.5 units
2. D.O. - greater than 80% saturation in mg/L
3. Specific Conductance - ~95 micromhos/cm
4. Alkalinity - 60 to 70mg $CaCO_3$/L
5. Hardness - 30 to 50mg $CaCO_3$/L
6. Total Residual Chlorine - <0.1mg/L

A given batch of control water is not used for more than 14 days following preparation.

9.5 BRINE SHRIMP

Artemia cysts are certified brine shrimp eggs from Brine Shrimp Direct To determine the quality of the new lots of Brine shrimp, a side-by-side comparison test is performed using the new food and the food of known acceptable quality.

9.6 YCT

YCT-Yeast Cereal leaves and Trout chow is prepared in the laboratory. To determine the quality of the new lots of YCT a side-by-side comparison test is performed using the new food and the food of known acceptable quality.

9.7 ALGAE

Algae- *Raphidocelis subcapitata* are commercially prepared. Upon arrival, each batch received has an accompanying Certificate of Algae Preparation History. The certificate provides the following quality control data: date prepared, species name, inoculation date, harvest date, concentration date and cell count.

9.8 GLASSWARE WASHING, STERILIZATION PROCEDURES AND EQUIPMENT STERILITY CHECKS

Glassware washing and preparation/sterilization procedures are performed according to EPA guidelines and are outlined in *SOP 030701 Glassware Cleaning* and *SOP 350335, Quality Control and Quality Assurance of Microbiological Equipment and Testing Materials.* Before use, examine and discard items with chipped edges or etched inner surfaces. Reusable glassware is cleaned using the following protocol:

- Soak for 15 minutes in hot tap water with detergent and scrub. Rinse thoroughly with tap water. Rinse thoroughly with dilute nitric acid (10%). Rinse thoroughly with deionized water. Rinse thoroughly with pesticide grade acetone. Rinse well with deionized water.

- New glassware is cleaned according to the same procedure as listed above except the first step is preceded by soaking overnight in 10 % HNO_3.

Inspect glassware after washing for excessive water beading and rewash, if necessary. Perform checks on pH and test for inhibitory residues on glassware and plastic ware. Use utensils and containers of borosilicate glass, stainless steel, aluminum, or other corrosion resistant material for media preparation. All biological glassware is purchased pre-sterilized. In-house sterilization of any auxiliary equipment is performed via autoclave.

Pipettes of all sizes are checked for sterility by drawing up non-selective media into the pipette and re-dispensing the volume back into original tube that contained the media. The tube is then incubated and monitored for growth. All results are recorded and maintained within the laboratory.

10.0 ANALYTICAL PROCEDURES

10.1 A list of laboratory SOPs associated with the Aquatic Toxicity laboratory can be found in the following table:

TABLE 10.1: AQUATIC TOXICITY DEPARTMENT SOPs

This Table is subject to revision without notice

SOP #	Title/Description
340312	Dissolved Oxygen Membrane Electrode Method
350301	Fathead Minnow, *Pimephales promelas*, Larval Survival and Growth Test, EPA Method 1000.0
350302	Cladoceran, *Ceriodaphnia dubia*, Chronic Survival and Reproduction Test, EPA Method 1002.0
350303	*Pimephales promelas* Acute Toxicity Testing, EPA Method 2000.0
350303NC	North Carolina *Pimephales promelas* Acute Toxicity Testing
350304	*Ceriodaphnia dubia* Acute Toxicity Testing EPA Method 2002.0
350304NC	North Carolina *Ceriodaphnia dubia* Acute Toxicity Testing
350317	WET Reference toxicant testing
350318	Mini Chronic *C. dubia* NC
350320	Acceptability Test for New Food Batches for WET Testing
350321	Pocket Colorimeter Chlorine Tester Maintenance and Calibration
350322	DO Meter Maintenance and Calibration
350323	Fluke Thermometer Operation and Maintenance
350324	Digital Light Meter Maintenance and Method of Operation
350325	pH Meter Maintenance and Calibration
350326	Thermometer Operation, Maintenance and Calibration Procedure
350327	Bottle Top Dispenser Maintenance and Method of Operation
350328	Conductivity Meter Maintenance and Calibration
350329	Taxonomic Verification/Identification of *Pimephales promelas* - Fathead Minnow
350330	Taxonomic Verification/Identification of *Ceriodaphnia dubia*
350345	Receipt and Maintenance of *Pimephalas Promelas* (Fathead Minnow)
350346	Ceriodaphnia Dubia Culture Maintenance, Food Preparation, and Food Maintenance
350355	Technical Training and Personnel Qualifications for Biomonitoring-Aquatic

SOP #	Title/Description
	Toxicity, Mold and Microbiology
350356	Water Bath and Incubator Temperature Stability and Load Testing
350362	Analytical Balance Operation and Verification in the Aquatic Toxicity Microbiology Lab
350364	North Carolina Phase II Chronic Whole Effluent Toxicity Test Procedure for Ceriodaphnia dubia

10.2 Additional information regarding Aquatic Toxicity testing can be found in:

Method Resources: EPA/821/R-02/013, EPA/821/R-02/012

- 7-Day Fathead Minnow (*Pimephales promelas*) Larval Survival and Growth Test; Test Method 1000.0 from "Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms" (EPA 821-R-02-013).
- 3-Brood *Ceriodaphnia dubia* Survival and Reproduction Test; Test Method 1002.0 from "Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms" (EPA 821-R-02-013).
- Fathead Minnow (*Pimephales promelas*) Acute Toxicity Test (24, 48 or 96 hour duration); referenced in "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (EPA 821-R-02-012, 10-02).
- *Ceriodaphnia dubia* Acute Toxicity Test (24, 48 or 96 hour duration); referenced in “Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms” (EPA 821-R-02-012, 10-02)

11.0 QUALITY CONTROL CHECKS

11.1 At a minimum, the following physical and chemical parameters are analyzed for each biomonitoring sample received:

- Temperature - recorded up to twice daily.
- pH - initial and final measurements recorded
- D.O. - initial and final measurements recorded
- Specific Conductance
- Alkalinity
- Hardness
- Total Residual Chlorine

11.2 FEEDING REGIME

- 7-Day Fathead Minnow Larval Survival and Growth Test - Test organisms are fed 0.15mL, per container of 10 organisms. Newly hatched brine shrimp (*Artemia*) are fed to minnow batches 2-3 times daily. Batch cultures are fed depending on organism density.

- 3-Brood *Ceriodaphnia dubia* Survival and Reproduction Test - test organisms are fed 0.15mL of Yeast, Cereal leaves, Trout chow (YCT) and 0.15mL *Raphidocelis subcapitata* algal suspension once daily.
- 24 and 48 Hour Acute Toxicity Tests - organisms are fed 2-5 hours prior to introduction into sample but are not fed for the duration of the test.
- 96-Hour Acute Toxicity Tests – organisms are fed at the 48 hour renewal period.
- 3-Brood *Ceriodaphnia dubia* Survival and Reproduction Test for North Carolina - test organisms are fed .05mL of YCT/15mL test solution and .05 Raphidocelis subcapitata algal concentrate once daily (1.7x10 to the 7th power cells/mL).

11.3 BATCH CULTURES

Batch cultures are identified by date set up or date received. The set-up date is recorded for each batch.

Ceriodaphnia dubia, fresh batch cultures are set up on Monday, Wednesday and Friday using newly hatched neonates less than 24 hours old. In addition, a minimum of 4 brood trays are set up daily in order to guarantee organisms of the right age to use in bioassays. Condition of cultures is monitored daily and documented in the daily log. The *C. dubia* brood trays are fed daily. The *C. dubia* are transferred into fresh water daily after their first brood of neonates is born. Third generation neonates, less than 24 hours old, are used for batch cultures and brood trays. Third generation neonates, less than 24 hours old and hatched within 8 hours of each other, are used for chronic tests. Adults are used as sources for neonates until 14 days of age.

Pimephales promelas, organisms less than 36 hours old are obtained from a commercial supplier and are used immediately for chronic bioassays. Upon receipt, temperature, conductivity, pH, alkalinity and hardness are recorded and the organisms are slowly acclimated to a temperature of 25°C. If more than 10% mortality has occurred in the batch shipment, the batch is rejected and supplier is contacted. The date of the batch culture is recorded and batches are maintained for 14 days after receipt to use in acute tests. Batch cultures are monitored and fed daily. The number of organisms used is recorded in the daily log. Lots are cleaned as needed by siphoning off the excess food and waste from the bottom of the vessel and renewing the water. Minnow lots are aerated to maintain adequate dissolved oxygen. *Pimephales promelas* lots are fed 2.5 mL of newly-hatched brine shrimp per batch, 2-3 times daily. The date, time and the amount the organisms are fed are documented.

11.4 REFERENCE TOXICANT

The reference toxicant used at ESC is potassium chloride. Acute and chronic reference toxicant tests are performed at a minimum of once monthly and upper and lower control limits have been established.

12.0 Data Reduction, Validation and Reporting

12.1 Data Reduction

The analyst performs the data calculation functions and is responsible for the initial examination of the finished data. Data reduction steps applied to the raw data are outlined in *SOP 030201 Data Handling and Reporting.* The primary analyst reviews the quality of data based on the following guidelines:

- The appropriate SOP has been followed
- Sample preparation is correct and complete
- Analytical results are correct and complete
- QC is within criteria and complete

All calculations are performed according to the EPA methods manual. When applicable, software is used to perform statistical analysis. All formulae are chosen appropriately depending on the conditions and outcome of each individual test. Due to the complexity of each formula please see EPA/821/R-02/013 for formulae pertaining to Chronic Toxicity tests and EPA/821/R-02/012 for formulae pertaining to Acute Toxicity tests.

TABLE 12.1 Data Reduction Formulas

PARAMETER	FORMULA
IC25, NOEC, LC50, AEC	Toxcalc 5.0 Software

For chronic tests the PMSD and the % CV is calculated and reported.

12.2 Validation

The validation process consists of data generation, reduction review, and reporting results. Once data reduction is complete, validation is conducted by reviewing all data entries and calculations for errors, reviewing all documentation to assure that sample information is correct, and that the tests have been performed appropriately and within the appropriate holding times. The secondary analyst reviews the quality of data based on the following guidelines:

- The appropriate SOP has been followed
- Sample preparation is correct and complete
- Analytical results are correct and complete

12.3 Reporting

Reporting procedures are documented in *SOP 030201 Data Handling and Reporting* and *SOP 030227, Data Review*.

13.0 CORRECTIVE ACTION

13.1 In the event that a nonconformance occurs in conjunction with the analytical batch, a corrective action response (CAR) form must be completed. The cause of the event is stated on the form and the measures taken to correct the nonconformance clearly defined. The effectiveness of the corrective action must be assessed and noted. The CARs are kept on file by the Regulatory Affairs Department. Corrective action procedures are documented in SOP #030208, *Corrective and Preventive Action*

13.2 Required Corrective Action

All samples and procedures are governed by ESC's quality assurance program. Designated corrective actions are as follows:

13.2.1 Laboratory QC Criteria and Appropriate Corrective Actions

If the analytical method contains acceptance/rejection criteria and it is more stringent than those controls generated by the laboratory the method criteria takes precedence.

13.2.2 Out of control acute toxicity tests.

Rejection Criteria –More than 10% mortality occurs in the control organisms within the specified time frame of the test.

Corrective Action – The test is considered invalid and must be repeated using fresh control water and fresh sample.

13.2.3 Out of control 3-Brood *Ceriodaphnia dubia* Survival and Reproduction Test.

Rejection Criteria – If more than 10% mortality occurs in the control organisms within 96 hours or more than 20% mortality occurs in the test organisms in the 3-brood period (approx. 7 days)

Corrective Action – The test is considered invalid and must be repeated using fresh control water and fresh sample.

13.2.4 Out of control 3-Brood *Ceriodaphnia dubia* Survival and Reproduction Test.

Rejection Criteria – If the average number of young produced in the control is less than 15 per organism

Corrective Action – The test is considered invalid and must be repeated using fresh control water and fresh sample.

13.2.5 Out of control 3-Brood *Ceriodaphnia dubia* Survival and Reproduction Test.

Rejection Criteria – A test is considered invalid if less than 60% (80% for NC tests) of the original number of adult daphnia loaded do not produce three broods within an eight day maximum (7 day maximum for NC tests).

Corrective Action – The test is considered invalid and must be repeated using fresh control water and fresh sample.

13.2.6 Out of control 7-Day *Pimephales promelas* Larval Survival and Growth Test.

Rejection Criteria – If more than 10% mortality occurs in the control organisms within 96 hours or more than 20% mortality occurs in the test organisms in 7 day period.

Corrective Action – The test is considered invalid and must be repeated using fresh control water and fresh sample.

13.2.7 Out of control 7-Day *Pimephales promelas* Larval Survival and Growth Test.

Rejection Criteria – The average weight of the control minnows is less than 0.2500 mg.

Corrective Action – The test is considered invalid and must be repeated using fresh control water and fresh sample.

13.2.8 Out of control Monthly Reference Toxicant:

Rejection Criteria – KCl is the reference toxicant used for acute and chronic testing for the following methods: 1000.0, 1002.0, 2000.0, and 2002.0. If reference toxicant test results fail to meet ESC in-house established criteria (± 2 standard deviations from the mean & median).

Corrective Action – The test is deemed invalid and must be repeated twice. No test will be performed using organisms that fail to meet reference toxicant criteria.

13.2.9 Out of control PMSD 7-Day *Pimephales promelas* Larval Survival and Growth Test.

Rejection Criteria – The PMSD value is greater than the upper value of 30.

Corrective Action - The test may be deemed invalid and should be repeated.

13.2.10 Out of control PMSD 3-Brood *Ceriodaphnia dubia* Survival and Reproduction Test.

Rejection Criteria – The PMSD value is greater than the upper value of 47.

Corrective Action - The test may be deemed invalid and should be repeated.

13.2.11 Out of control %CV 3-Brood *Ceriodaphnia dubia* Survival and Reproduction Test and 7-Day *Pimephales promelas* Larval Survival and Growth Test.

Rejection Criteria – The %CV value is greater than the upper value of 40%.

Corrective Action - The test is deemed invalid and must be repeated.

14.0 RECORD KEEPING

Record keeping is outlined in SOP #030230, *Standards Logger*, *SOP #030227, Data Review* and SOP #030201, *Data Handling and Reporting*

15.0 QUALITY AUDITS

System and data quality audits are outlined in the ESC Quality Assurance Manual Version 13.0 and *SOP #010104, Internal Audits*.

16.0 REVISIONS

The Regulatory Affairs Department has an electronic version of this Quality Assurance Manual with tracked changes detailing all revisions made to the previous version. This version is available upon request. Revisions to the previous version of this appendix are summarized in the table below.

Document	Revision
Quality Assurance Manual Version 15.0 (Appendix IX)	General – Replaced the term “client” with the term “customer” Section 7.1 – Added third bullet point about containers used for collection and holding time of Acute and Chronic tests Table 8.1 – Updated equipment list Table 8.2 – Revised ATC check for pH meter to quarterly Table 8.3A – Added pH=4 buffer Section 8.3 – Minor clarifications about maintenance of in-house cultures Section 8.4 – Revised ATC check for pH meter to quarterly and added language about purchasing a new light meter rather than recalibrating an old one. Section 11.2 – Changed algal species used for 3-Brood Ceriodaphnia dubia Survival and Reproduction Test from Selanastrum capricornutum to Raphidocelis subcapitata

1.0 SIGNATORY APPROVALS

Microbiology Laboratory QUALITY ASSURANCE MANUAL

APPENDIX X TO THE ESC QUALITY ASSURANCE MANUAL

for

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Prepared by

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NOTE: The QAM has been approved by the following people.

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2.0 APPENDIX TABLE OF CONTENTS

3.0 SCOPE AND APPLICATION

This appendix discusses specific QA requirements for general analytical protocols to ensure that analytical data generated from the Microbiology laboratory are scientifically valid and are of acceptable quality. Any deviations from these requirements and any deviations that result in non-conforming work must be immediately evaluated and their corrective actions documented.

4.0 LABORATORY ORGANIZATION AND RESPONSIBILITIES

ESC Lab Sciences offers diverse environmental capabilities that enable the laboratory to provide the customer with both routine and specialized services, field sampling guidance and materials and broad laboratory expertise. A brief outline of the organization and responsibilities as they apply to the ESC Quality Assurance Program is presented in *Section 4.0 in the ESC Quality Assurance Manual.*

5.0 PERSONNEL AND TRAINING

5.1 PERSONNEL

Dr. Christabel Fernandes-Monteiro, with a Ph.D. in Applied Biology, is the Department Manager of Biology. She oversees supervision of laboratory operations in the Mold, Aquatic Toxicity, Microbiology, Protozoan and BOD laboratories. Her responsibilities include assurance of reliable data through monitoring of quality control, corroborating the analysis performed, protocol development, coordination with customers regarding sample analysis, scheduling of tests and overall production in all sections within the Biology Laboratory, including management of staff. In her absence, Shain Schmitt assumes her responsibilities in the Microbiology laboratory.

Shain Schmitt with a B.S. degree in Conservation Biology, is the Primary Analyst for the Microbiology laboratory. Mr. Schmitt is proficient in microbiological analytical methods and is responsible for sample analysis, review and approval of data associated with microbiological analyses. In his absence, Brandon Etheridge assumes his responsibilities.

5.2 TRAINING

The Primary Analyst or Manager trains new laboratory analysts according to ESC protocol. ESC's training program is outlined in SOP #350355, *Technical Training and Personnel Qualification for Biomonitoring-Microbiology.* Performance is documented using an initial demonstration of capability (IDOCs) and continuing demonstration of capability (CDOC). On-going acceptable capability in microbiological analysis is also demonstrated by acceptable participation in the Phenova proficiency testing program (PTs) and routine laboratory quality control practices. Documentation of analyst training is maintained on file within the department.

6.0 Facilities and Laboratory Safety

6.1 Facilities

The main area of the laboratory has approximately 1440 square feet of area with roughly 280 square feet of bench area. There are 300 square feet of additional storage and the lighting is fluorescence. The air system is a five-ton Trane split unit with natural gas for heating. The laboratory reagent water is provided through the Siemans Elga Lab Pure deionizer system. Biohazard containers are located in the laboratory and Stericycle Waste Removal serves as ESC's biological waste disposal contractor. ESC's building information guides and site plan are shown in Appendix I.

6.2 Laboratory Safety

- Laboratory access is limited when work is being performed.
- The following Biosafety Level 2 (BSL2) guidelines are adhered to:
  - Closed-toe shoes are worn in the laboratory
  - Floors and work surfaces are cleaned on a regular basis
  - Emergency numbers are posted in the laboratory
  - Laboratory personnel are trained in the use of the biological spill kit and emergency safety equipment
- ESC's laboratory safety guidelines are detailed in the ESC *Chemical Hygiene Plan*.

7.0 Sampling Procedures

7.1 Field Sampling Procedures, Sample Storage, and Handling

- Field Sampling procedures are described in Appendix III of this ESC Quality Assurance Manual. Sample information is recorded and kept on the ESC chain of custody and field logbooks.
- Samples for bacterial analysis are collected directly into pre-sterilized high-density polyethylene (HDPE) sample containers preserved with sodium thiosulfate. The container should be kept closed until sample collection. Once the container is open, do not wash, rinse or contaminate the cap or the inside of the container. For microbiological samples, the container is filled allowing at least 1 inch of headspace per container.
- Sources for microbiological samples are surface waters, waste and drinking water, ground water and soil/sludge.
- Holding times for microbiological drinking water samples is generally 30 hours (except HPC which has a 8 hour holding time). Soil and sludge samples have a holding time of 24 hour and 8 hours depending on the method used. All other water samples have a 8-hour hold time.

- Microbiological samples are shipped in a cooler lined with a heavy-duty plastic bag. Once the sample container lids are secure, the samples are placed in appropriately sized polyethylene bags. The chain of custody is also placed in a plastic bag. The cooler liner is completely filled with ice and the plastic bag sealed tightly with a cable tie. The shipping label contains the name and address of the shipper and is affixed to the outside of the cooler.
- Samples are received in the laboratory login area and are tracked using LIMS (Laboratory Information Management System). A Chain of Custody Form accompanies all samples received by the lab. This is necessary to prove the traceability of the samples and to document the change in possession from sampling to delivery to receipt by the laboratory. Prior to analysis samples are checked for integrity. Sample handling, tracking and acceptance procedures are outlined in *SOP 060105, Sample Receiving.*

8.0 EQUIPMENT

8.1 EQUIPMENT LIST

TABLE 8.1 – LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Microbiological Analysis
This table is subject to revision without notice

Item	***Manufacturer***	***Model***	***Location***
Analytical Balance	Mettler	AT261 Delta Range	Microbiology Lab
Class “I” weights	(2 sets) Troemner		Microbiology Lab
Conductivity Meter	Orion	150 A+	Microbiology Lab
Autoclave	Pelton and Crane	Validator 8	Microbiology Lab
Water Bath	Lindberg Blue	WB1130A	Microbiology Lab
Water Bath	Blue M	MW-1110A-1	Microbiology Lab
Oven	Fisher	655F	Microbiology Lab
Incubator	VWR	2030 22MFG	Microbiology Lab
Quantitray Sealer	IDEXX	2X	Microbiology Lab
Incubator	Precision Sci.	818	Microbiology Lab
Colony Counter	Quebecor		Microbiology Lab
pH Meter	Beckman	pH/Temp/mV/ISE	Microbiology Lab
Refrigerator			Microbiology Lab
Stereoscope (2)	Olympus	SZH-ILLD	Microbiology Lab
UV light; short and long wave	UVP		Microbiology Lab
Autoclave	SterileMax	Harvey	Microbiology Lab
Stereoscope	Olympus	SZX-ILLK100	Microbiology Lab
Water Purifier	Siemans	Elga Lab Pure S4	Microbiology Lab
Oven	VWR	13054	Microbiology Lab
pH meter/Conductivity meter	Thermo Scientific Orion	VStar 52	Aquatic Tox Lab

8.2 EQUIPMENT PREVENTIVE MAINTENANCE, EQUIPMENT CALIBRATION

PREVENTATIVE MAINTENANCE FOR LABORATORY EQUIPMENT		
INSTRUMENT	***P. M. DESCRIPTION***	***FREQUENCY***
Analytical Balances	•Check with Class "I" weights	Daily-tolerance 1 gm - ±0.0001 gm
Analytical Balances	•Service/Calibration (semiannual contract maintenance and calibration check)	10 gm - ±0.01 gm
Analytical Balances	•Service/Calibration (semiannual contract maintenance and calibration check)	Semi-annually
Refrigerators, Incubators, and Water Baths	•Maintenance service	Determined by twice daily temperature performance checks @ least 4 hours apart, when in use.
Water Bath	•Check thermometer vs. NIST traceable	Annually
Water Bath	•Remove from service when not maintaining temperature and send off for repair or replace	As needed
Autoclave	•Check sterilization efficiency	Monthly – Geobacillus stearothermophilus ampoule
Autoclave	•Check sterilization efficiency	With each use– Chemical Indicator Strip
Conductivity Meter	•Calibrate and clean probe	As needed
Conductivity Meter	•Replace or replatinize probe	When poor response not corrected by above
pH	Automatic Temperature Compensation of pH probe	Quarterly
Stereoscope	• Clean optics and stage	Each Use
pH Meters	•Reference junction & electrode replacement	As needed
pH Meters	•Probe stored in pH 4.0 Buffer	At all times when not in use.
pH Meters	•Other	As described in the manufacturer's O & M manual
Autoclave	•Check timing device	Quarterly
pH meter	•Calibrate and check slope (per manufacturer)	Daily
Quanti-Tray Sealer	•Check sealer for leaks	Monthly
Water Purifier	•Conductivity check using a calibrated conductivity meter	Monthly
Water Purifier	•Check for TOCs, ammonia, nitrogen, TRC and heterotrophic bacteria	Monthly
Water Purifier	•Check for single and heavy total metals	Annually
Incubators and Water Baths	Perform temperature stability and load testing	Annually
Autoclave	•Check pressure (annual contract maintenance)	Annually
Autoclave	Check mechanical timing device	Quarterly
Stereoscope	• Clean optics and stage; microscope alignment (annual maintenance contract)	Annually

8.3 STANDARDS AND REAGENTS

All reagents and standards must meet the requirements listed in the analytical methods.

Table 8.3A: Commercially prepared agar/broth, reagent sources, and storage information. ***(subject to revision as needed)***

Agar Type	*Source*	*Storage*
M-FC Broth w/ Rosolic acid	Millipore	$4 \pm 2^{o}C$
A-1 Media (broth)	Hach	$4 \pm 2^{o}C$
mEndo Broth	Hach	$4 \pm 2^{o}C$
Lauryl Tryptose Broth	Hach	$4 \pm 2^{o}C$
Brilliant Green Lactose Broth	Hach	$4 \pm 2^{o}C$
EC media w/ mug broth	Hach	$4 \pm 2^{o}C$
HPC	Hach	$4 \pm 2^{o}C$
Colilert reagent powder	IDEXX	Room temp
Enterolert reagent powder	IDEXX	Room temp
Phosphate Buffer Solution	Weber Scientific	Room temp

All stock agar expirations are per manufacturer specification.

Table 8.3B: In-house prepared agar/broth, reagent sources, and storage information. ***(subject to revision as needed)***

Agar Type-Stock	*Source*	*Stock Storage*	*Stock Expiration*	*Preparation Components Media*	*Prepared Storage*	*Prepared Expiration*
Plate Count Agar	VWRDifco	Room Temp	As specified by Manufacturer	PCA + Water	$4 \pm 2^{o}C$	3 months
Tryptic Soy Agar	VWRDifco	Room Temp	As specified by Manufacturer	TSA + Water	$4 \pm 2^{o}C$	3 months
Tryptic Soy Broth (TSB)	VWRDifco	Room Temp	As specified by Manufacturer	TSB + Water	$4 \pm 2^{o}C$	3 months
Lauryl Tryptose Broth (LTB)	VWRDifco	Room Temp	As specified by Manufacturer	LTB + Water	$4 \pm 2^{o}C$	3 months
Buffered Rinse Water	VWRDifco	$4 \pm 2^{o}C$	As specified by Manufacturer	KH_2PO_4 + $MgCl_2$+Water	Room temp.	1 year
Heart Infusion Agar	VWR/BD	Room Temp	As specified by Manufacturer	HIA + Water	$4 \pm 2^{o}C$	2 weeks

Membrane Filters and Pads

Membrane filters and pads are purchased and certified to meet the following specifications:

- Filter diameter - 47 mm, mean pore diameter - 0.45 µm. Alternate filter and pore sizes may be used if the manufacturer provides data verifying performance equal to or better than that of 47mm-diam, 0.45-µm-pore size filter. At least 70% of filter area must be pores.
- When filters are floated on reagent water, the water diffuses uniformly through the filters in 15s with no dry spots on the filters.
- Flow rates are at least 55 mL/min/cm^2 at 25°C and a differential pressure of 93kPa.
- Filters are nontoxic, free of bacterial-growth-inhibiting or stimulating substances, and free of materials that directly or indirectly interfere with bacterial indicator systems in the media. Ink grid is nontoxic. The arithmetic mean of five counts on filters must be at least 90% of the arithmetic mean of the counts on five agar spread plates using the same sample volumes and agar media.
- Filters retain the organisms from a 100mL suspension of *Serratia marcescens* containing 1×10^3 cells.
- Water extractables in filters do not exceed 2.5% after the membrane is boiled in 100mL reagent water for 20min, dried, cooled, and brought to constant weight.
- Absorbent pad has diameter 47mm, thickness 0.8mm, and is capable of absorbing 2.0 ± 0.2mL Endo broth.
- Pads release less than 1mg total acidity calculated as $CaCO_3$ when titrated to the phenolphthalein endpoint with 0.02*N* NaOH.
- If the filter and absorbent pad are not sterile, they should not be degraded by sterilization at 121°C for 10min. Confirm sterility by absence of growth when a membrane filter is placed on a pad saturated with tryptic soy broth and incubated at 35 ± 0.5°C for 24h.

8.4 INSTRUMENT CALIBRATION

Autoclave

Prior to first use, autoclaves must be initially evaluated for performance. All initial checks must be recorded and records must be retained on file. With each use, a record of items sterilized, temperature, pressure, and time is kept for each batch processed. Operating temperature is checked and recorded at least weekly with a minimum/maximum thermometer. Performance is tested monthly with *Bacillus stearothermophilus* ampoules. Chemical strips are used with each use to verify that supplies and materials in each cycle have been sterilized. The autoclave mechanical timing device is checked quarterly against a stop watch and actual time elapsed documented. Records of autoclave operations are maintained for every cycle. Records include: date, contents, maximum temperature reached, pressure, time in sterilization mode, total run time (may be recorded as time in and time out) and analyst’s initials.

Quebecor Colony counter

A dark field colony counter is used to count Heterotrophic Plate Count colonies. Maintenance is performed per manufacturer's instructions.

Quanti-tray Sealer

The Quanti-tray sealer is checked monthly using 100mL of bromocresol purple, or equivalent dye. The solution is poured into a test tray, sealed, and tested for leaks.

pH Meter/Conductivity Meter

With each use, calibrate the instrument according to the manufacturer's instructions. Verify that the slope of the calibration is within the manufacturer's acceptable range prior to use. Automatic temperature compensation (ATC) verifications are performed quarterly on the pH probe.

Incubators & Waterbaths

Records of temperature checks are documented twice daily at least 4 hours apart when in use. Thermometers used for temperature checks are verified at least annually. Temperature stability and load testing is performed on an annual basis.

Analytical Balances

Analytical balances are checked at least daily prior to each use with class "I" weights. Records of these verifications are maintained within the laboratory. Balances are also serviced and verified and/or calibrated by an external calibration service at least semi-annually.

Volumetric Equipment, IDEXX and Commercially Prepared Phosphate Buffer Bottles

Equipment such as filter funnels, bottles, pipettes, non-Class A glassware and other containers with graduation must be calibrated once per lot prior to the first use. Mechanical hand pipettes, automatic dispensers and diluters are verified for accuracy quarterly. The error of calibration must not exceed 3%.

IDEXX Bottles and Quanti-trays

Prior to first use, IDEXX bottles and Quanti-trays must be checked for fluorescence using a long wave UV light.

Ultraviolet Lamp

The output of the UV lamp used to measure fluorescence for the identification of *E. coli* is tested quarterly with a UV light meter. The UV bulbs are replaced if the output is less than 70% of the original.

9.0 LABORATORY PRACTICES

9.1 REAGENT GRADE WATER

Reagent Grade water –Type II used in the Microbiology Laboratory is periodically checked for contamination. Type II water is checked annually for single and total heavy metals and organic chemicals. Monthly checks for total organic carbon, ammonia and organic nitrogen, total residual chlorine and a heterotrophic plate count are also conducted. Resistivity and pH are checked continuously or with each use. Conductivity is also checked monthly using a calibrated conductivity meter. The Use test is performed quarterly and the Water Suitability test is performed annually.

9.2 GLASSWARE WASHING , STERILIZATION PROCEDURES AND EQUIPMENT STERILITY CHECKS

Glassware washing and preparation/sterilization procedures are performed according to EPA guidelines and are outlined in *SOP 030701 Glassware Cleaning and SOP 350335, Quality Control and Quality Assurance of Microbiological Equipment and Testing Materials.* Before use, examine and discard items with chipped edges or etched inner surfaces. Reusable glassware is cleaned using the protocol established by the EPA:

- Soak for 15 minutes in hot tap water with detergent and scrub. Rinse thoroughly with tap water. Rinse thoroughly with dilute nitric acid (10%). Rinse thoroughly with deionized water. Rinse thoroughly with pesticide grade acetone. Rinse well with deionized water.
- New glassware are cleaned according to the same procedure as listed above except the first step is preceded by soaking overnight in 10 % HNO_3.

Inspect glassware after washing for excessive water beading and rewash, if necessary. Perform checks on pH and test for inhibitory residues on glassware and plastic ware. Use utensils and containers of borosilicate glass, stainless steel, aluminum, or other corrosion resistant material for media preparation. All biological glassware is purchased pre-sterilized. In-house sterilization of any auxiliary equipment is performed via autoclave.

Pipettes of all sizes are checked for sterility by drawing up non-selective media into the pipette and re-dispensing the volume back into original tube that contained the media. The tube is then incubated and monitored for growth. All results are recorded and maintained within the laboratory.

Inoculating loops are cultured by aseptically transferring the entire tip of the loop into a tube containing non-selective media. The tube is incubated and monitored for growth. Results are maintained within the laboratory.

A sterility check is performed on one container for each lot of purchased, pre-sterilized sample containers, and IDEXX containers. Results are maintained within the laboratory.

A check is performed on one container from each new lot of microbiological sample containers to ensure efficacy of sodium thiosulfate to 15 mg/L chlorine, and documented. A sterility check is performed on each batch of dilution and rinse water prepared in the laboratory and on each batch of commercially prepared water with non-selective growth media prior to first use.

In addition, stock solutions used for preparing rinse water are checked for turbidity prior to each use. If turbid, the stock buffer is discarded or re-sterilized.

9.3 MEDIA STERILITY VERIFICATION PROCEDURES

A sterility check must be analyzed for each lot of pre-prepared media and for each lot of media prepared in the laboratory. This is done prior to the first use of the media used for membrane filtration, MPN, pour plate and chromofluorogenic methods. For media used in the pour plate analytical technique, sterility blanks of the media must be made by pouring an uninoculated plate for each run in addition to sterility and lot comparison tests being performed on each lot prior to first use. Reagents and containers used in chromofluorogenic method tests are checked for fluorescence prior to first use.
All results of the sterility and lot comparison tests are documented.

9.4 POSITIVE AND NEGATIVE CONTROLS USING PURE CULTURES

ATCC Pure Cultures

Positive culture controls demonstrate that the media can support the growth of the target organism(s), and that the media produces the specified or expected reaction to the target organism(s). All media must be tested with at least one pure culture of a known positive reaction. This must be done prior to first use of the media.

Negative culture controls demonstrate that the media does not support the growth of non-target organisms or does not demonstrate the typical positive reaction of the target organism(s). All batches of selective media in the laboratory must be analyzed with one or more known negative culture controls. This must be done prior to first use of the media.

10.0 Analytical Procedures

10.1 A list of laboratory SOPs associated with the microbiology laboratory can be found in the following table:

TABLE 10.1: MICROBIOLOGICAL DEPARTMENT SOPs

This Table is subject to revision without notice

SOP #	Title/Description
350305	Fecal Coliform: Membrane Filter Technique (SM 9222D)
350315	Fecal Coliform Determination in Biosolids: Membrane Filter Technique (SM 9222D)
350315A	Fecal Coliforms in Sewage Sludge (Biosolids) by MPN Fermentation using A-1 medium (EPA Method 1681)
350316	Total Coliform (SM 9222B)
350321	Pocket Colorimeter Chlorine Tester Maintenance and Calibration
350325	PH Meter Maintenance and Calibration
350326	Thermometer Operation, Maintenance and Calibration Procedure
350328	Conductivity Meter Maintenance and Calibration
350332	Laboratory Maintenance of Bacteria Reference Cultures
350333	QA/QC of Microbiological Equipment and Testing Materials
350343	Colilert (SM 9223B)
350348	Enterolert (ASTM 6503-99)
350354	HPC (SM 9215 B)
350355	Technical Training and Personnel Qualification for Biomonitoring-Microbiology
350356	Water bath and Incubator Temperature Stability and Load Testing
350359	Calibration and Maintenance of Autoclaves
350369	Sterilization, Sanitization and Residue Testing of Microbiological Glassware and Equipment
350380	Class “A” MPN Fecal Coliform Analysis (SM 9221E/C)

10.2 Additional information regarding microbiological testing can be found in:

- Standard Methods for the Examination of Water and Wastewater, Sections 9020 through 9050.
- Heterotrophic Plate Count, SM 9215B
- Fecal Coliform Direct Test (A-1 Media), SM 9221E
- Standard Total Coliform Membrane Filter Procedure, SM 9222B.
- Fecal Coliform Membrane Filter Procedure, SM 9222D.
- Enzyme Substrate Test, SM 9223B.
- Environmental Regulations and Technology, Control of Pathogens and Vector Attraction in Sewage Sludge, Appendix F.
- Fecal Coliforms in Sewage Sludge, EPA 821-R-06-013

11.0 Quality Control Checks

11.1 ESC participates in microbiological proficiency testing (PTs) in various matrices by analyzing samples provided by Phenova. Blind samples are received and analyzed according to instructions from Phenova and the standard operating procedure.

11.2 Plate count comparison between two analysts is conducted monthly. Acceptable plate count comparisons must be within 10%. Analyst deviations that are outside the 10% range are repeated. If the repeat inter-analyst count is unacceptable, additional procedural training and method reviews are conducted.

11.3 Duplicate analyses are performed on 10% of samples or at least one sample per month for total and fecal coliform and *E. coli* tests. Due to the infrequent laboratory receipt of some samples, duplicate analyses are conducted per sample. If the RPD exceeds 20%, the data is qualified.

11.4 For membrane filtration analyses, sterility control checks are conducted on the filter assembly at the beginning and end of each sequence and following every 10 samples analyzed. If QC blanks fails, the run is rejected or qualified.

11.5 Verification of total coliform and fecal coliform colonies must be conducted monthly (10 colonies/month for wastewater). Colonies found in drinking water samples must have at least five typical sheen colonies and five atypical colonies verified.

11.6 For HPC analysis, duplicate plates are run for each dilution. A positive control and an uninoculated plate performed for each run. If the QC fails, the run is rejected and qualified, and sample re-collected.

11.7 Duplicate counts are performed monthly for colony counts from membrane filtration or pour plated media on one positive sample for each month the test is performed. Each analyst counts typical colonies on the same plate and counts must be within 10% difference to be acceptable, if the laboratory has two or more analysts. The same plate is counted twice by the analyst and difference between counts must be no more than 5% in laboratories with only one analyst.

11.8 For biosolids testing, an Initial Precision and Recovery test (IPR) is performed prior to the first time the method is used and at any time the method or instrumentation is modified. The IPR consists of four Milorganite® samples spiked with *E. coli* (ATCC #25922), and must be accompanied by an acceptable method blank and appropriate sterility checks. Mean percent recoveries from the IPR must fall within the EPA approved QC limits of 1-312%, and Relative Standard Deviation of the recovery should be less than or equal to 96%.

11.9 For biosolids testing, an Ongoing Precision and Recovery sample (OPR) is analyzed after every 20 field and matrix spike samples, or one per week that samples are analyzed, whichever occurs more frequently. The OPR consists of one Milorganite® sample spiked with *E. coli* (ATCC #25922), and must be accompanied by an acceptable method blank and appropriate sterility checks. Recoveries from the OPR must fall within the EPA approved QC limits of 1- 371%.

11.10 For biosolids testing, a Method blank is analyzed everyday samples are processed. The Method Blank must be free of contamination from the target organism, and serve as a sterility control to verify the sterility of equipment, materials, and supplies.

11.11 For biosolids testing, a Matrix Spike (MS) is analyzed when samples are first received from a source from which the laboratory has not previously analyzed samples and subsequently, 5% of field samples to determine the effect of a particular matrix on fecal coliform recoveries. MS samples must be accompanied by the analysis of an unspiked field sample sequentially collected from the same sampling site, an acceptable method blank, media sterility checks, and an OPR sample if possible. MS percent recoveries must fall within the EPA approved QC limits: Class A Biosolid= 2-541%; Class B Biosolid= >0-6172%, and RSD less than or equal to 182% and 184% for Class A and Class B biosolids, respectively.

11.12 For biosolids testing, control charts for OPR, IPR, and MS are charted and maintained in the laboratory. The control charts graphically display the results of continuing performance when using Method 1681.

12.0 DATA REDUCTION, VALIDATION AND REPORTING

12.1 DATA REDUCTION

The analyst performs the data calculation functions and is responsible for the initial examination of the finished data. Data reduction steps applied to the raw data are outlined in *SOP 030201 Data Handling and Reporting.* The primary analyst reviews the quality of data based on the following guidelines:

- The appropriate SOP has been followed
- Sample preparation is correct and complete
- Analytical results are correct and complete
- QC is within criteria and complete

12.2 VALIDATION

The validation process consists of data generation, reduction review, and reporting results. Once data reduction is complete, validation is conducted by reviewing all data entries and calculations for errors, reviewing all documentation to assure that sample information is correct, and that the tests have been performed appropriately and within the appropriate holding times. The secondary analyst reviews the quality of data based on the following guidelines:

- The appropriate SOP has been followed
- Sample preparation is correct and complete
- Analytical results are correct and complete

12.3 REPORTING

Reporting procedures are documented in *SOP 030201 Data Handling and Reporting.* Microbiological data is reported as Colony Forming Units (CFU) per unit volume, Presence/Absence, or Most Probable Number (MPN)/100mL.

13.0 CORRECTIVE ACTION

13.1 In the event that a nonconformance occurs in conjunction with the analytical batch, a corrective action response (CAR) form must be completed. The cause of the event is stated on the form and the measures taken to correct the nonconformance clearly defined. The effectiveness of the corrective action must be assessed and noted. The CARs are kept on file by the Regulatory Affairs Department. Corrective action procedures are documented in SOP #030208, *Corrective and Preventive Action*

13.2 Required Corrective Action

All samples and procedures are governed by ESC's quality assurance program. Designated corrective actions are as follows:

13.2.1 Laboratory QC Criteria and Appropriate Corrective Actions

If the analytical method contains acceptance/rejection criteria and it is more stringent than those controls generated by the laboratory the method criteria takes precedence.

13.2.2 Out of control plate count comparisons between analysts.

<u>Rejection Criteria</u> – Comparisons must be within ±10% for monthly plate count comparisons.

<u>Corrective Action</u> – Duplicate counts are repeated. If repeat counts are still beyond acceptance range, procedural training and method reviews are conducted.

13.2.3 Out of control duplicate analyses for total and/or fecal coliform or *E. coli*.

<u>Rejection Criteria</u> – Duplicate RPDs must not exceed 20% for total and/or fecal coliform or *E. coli.*

<u>Corrective Action</u> – Data is qualified or the analysis is repeated. If repeat analysis is still beyond acceptance range, procedural training and method reviews are conducted.

13.2.4 Out of control QC blank for membrane filtration analysis.

<u>Rejection Criteria</u> – Blank analyses performed either at the beginning or end of the analytical sequence is positive.

<u>Corrective Action</u> – The analytical sequence may be rejected and reprocessed or qualified based on the nature of the contamination.

13.2.5 Out of Control QC Blank for HPC analysis

<u>Rejection Criteria</u> - Blank analysis performed during each run is positive for growth.

<u>Corrective Action</u> - The analytical run is rejected, and data qualified with an “R” for rejected data, and sample re-collected.

13.2.6 Out of control IPR analyses

Rejection Criteria - Recoveries from IPR fall outside of the required range for recovery: 1 - 312%, and RSD of 96%.

Corrective Action - Identify the problem by evaluating each step in the analytical process, media, reagents, and controls, correct the problem and repeat the IPR.

13.2.7 Out of Control OPR analyses

Rejection Criteria - Recoveries from OPR fall outside of the required range for recoveries: 1-371%.

Corrective Action - Identify the problem by evaluating each step in the analytical process, media, reagents, and controls, correct the problem and repeat the OPR.

13.3.8 Out of Control MS analyses

Rejection Criteria - Recoveries from MS fall outside of the required range for recoveries: Class A Biosolid= 2-541%; Class B Biosolid= >0-6172%, and RSD less than or equal to 182% and 184% for Class A and Class B biosolids, respectively.

Corrective Action - Flag all associated filed data.

14.0 RECORD KEEPING

Record keeping is outlined in SOP #030230, *Standards Logger*, *SOP #030227*, *Data Review* and SOP #030201, *Data Handling and Reporting*

15.0 QUALITY AUDITS

System and data quality audits are outlined in the ESC Quality Assurance Manual Version 13.0 and *SOP #010104, Internal Audits*.

16.0 REVISIONS

The Regulatory Affairs Department has an electronic version of this Quality Assurance Manual with tracked changes detailing all revisions made to the previous version. This version is available upon request. Revisions to the previous version of this appendix are summarized in the table below.

Document	**Revision**
Quality Assurance Manual Version 15.0 (Appendix X)	General – Replaced the term “client” with the term “customer” Table 8.1 – Updated Equipment List Table 8.2 – Revised ATC check for pH meter to quarterly Section 8.4 – Revised ATC check for pH meter to quarterly Table 10.1 – Updated SOP List

1.0 SIGNATORY APPROVALS

Mold/BOD Laboratory QUALITY ASSURANCE MANUAL

APPENDIX XI TO THE ESC QUALITY ASSURANCE MANUAL

for

ESC LAB SCIENCES
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Prepared by

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NOTE: The QAM has been approved by the following people.

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2.0 *APPENDIX TABLE OF CONTENTS*

3.0 SCOPE AND APPLICATION

This appendix discusses specific QA requirements for general analytical protocols to ensure that analytical data generated from the Mold laboratory are scientifically valid and are of acceptable quality. Any deviations from these requirements and any deviations that result in nonconforming work must be immediately evaluated and their corrective actions documented.

4.0 LABORATORY ORGANIZATION AND RESPONSIBILITIES

ESC Lab Sciences offers diverse environmental capabilities that enable the laboratory to provide the customer with both routine and specialized services, field sampling guidance and materials and broad laboratory expertise. A brief outline of the organization and responsibilities as they apply to the ESC Quality Assurance Program is presented in Section 4.0 in the *ESC Quality Assurance Manual.*

5.0 PERSONNEL AND TRAINING

5.1 PERSONNEL

Dr. Christabel Fernandes-Monteiro, with a Ph.D. in Applied Biology, is the Department Manager for Biology. She oversees supervision of laboratory operations in the Mold, Aquatic Toxicity, Microbiology, BOD and Protozoan laboratories. Her responsibilities include assurance of reliable data through monitoring of quality control, corroborating the analysis performed, protocol development, coordination with customers regarding sample analysis, scheduling of tests and overall production in all sections within the Biology Laboratory, including management of staff. Dr. Fernandes-Monteiro oversees the review and approval processes of all data associated with all Biological laboratory sections. She gained experience in Mold analytical techniques at ESC, an AIHA-LAP accredited laboratory, and obtained additional training in microscopic techniques at the McCrone Research Institute. She also reviews AIHA-LAP and EPA online training modules related to the methods being performed in the Mold and BOD Laboratory. In her absence, Bridget Miller assumes responsibility for Mold/BOD departmental decisions.

Bridget Miller, with a BS degree in Biology, is the Primary Analyst in the Mold and BOD laboratory. She is proficient in Mold analytical methods as per AIHA-LAP guidelines. Bridget has gained analytical experience at ESC, an AIHA-LAP accredited laboratory, and obtained additional training in Mold analysis at the McCrone Research Institute. She reviews AIHA-LAP and EPA online training modules related to the methods being performed in the Mold and BOD Laboratory.

5.2 TRAINING

All new analysts to the laboratory are trained by the Primary Analyst or Manager according to ESC protocol. ESC's training program is outlined in SOP #350355, *Technical Training and Personnel Qualification for Biomonitoring-Mold.* Analyst performance in the Mold/BOD Laboratory is documented using an initial demonstration of capability (IDOCs) and continuing demonstration of capability (CDOC). On-going acceptable capability in mold analysis is demonstrated by acceptable participation in the AIHA-PAT proficiency testing programs (EMPAT-Direct Exam and EMPAT-Bacterial/Fungal), Round Robin analysis and daily Quality Control sample analysis. On-going acceptable capability in BOD analysis is demonstrated by acceptable participation in the Phenova proficiency testing program and daily Quality Control sample analyses. Documentation of analyst training, including a copy of college transcripts or degree, is maintained on file within the department.

6.0 FACILITIES AND LABORATORY SAFETY

6.1 FACILITIES

MOLD LAB

The main area of the Mold laboratory has approximately 532 square feet with 167 square feet of bench space. The lighting throughout the laboratory is fluorescence. The air system is a five-ton Trane split unit with natural gas for heating. The laboratory reagent water is provided through the ELGA PureLab Ultra deionizer system. Biohazard containers are located in the laboratory and Stericycle Waste Removal serves as ESC'S biological waste disposal contractor. ESC's building information guides and site plan are shown in Appendix I.

BOD LAB

The main area of the BOD laboratory has approximately 532 square feet of area with 151 square feet of bench space. The lighting standard throughout the laboratory is fluorescence. The air system is a five-ton Trane split unit with natural gas for heating. The laboratory reagent water is provided through the ELGA PureLab Ultra deionizer system. Biohazard containers are located in the laboratory and Stericycle Waste Removal serves as ESC'S biological waste disposal contractor. ESC's building information guides and site plan are shown in Appendix I.

6.2 LABORATORY SAFETY

- Laboratory access is limited when work is being performed.
- All procedures where infectious aerosols or splashes may occur are conducted in biological safety II cabinets.
- The following Biosafety Level 2 (BSL2) guidelines are adhered to:
  - ➢ Closed-toe shoes are worn in the laboratory
  - ➢ Floors and work surfaces are cleaned on a regular basis
  - ➢ Emergency numbers are posted in the laboratory

  - Biological safety hoods are tested and certified annually
  - Laboratory personnel are trained in the use of the biological spill kit and emergency safety equipment
- ESC's laboratory safety guidelines are detailed in the ESC *Chemical Hygiene Plan*.

7.0 SAMPLING PROCEDURES

7.1 FIELD SAMPLING PROCEDURES, SAMPLE STORAGE, AND HANDLING

- Field Sampling procedure is described in Appendix III of this ESC Quality Assurance Manual. Sample information is recorded and kept on the ESC chain of custody and field logbooks.
- Samples are received in the laboratory login area and are tracked using LIMS (Laboratory Information Management System). A Chain of Custody Form accompanies all samples received by the lab. This is necessary to prove the traceability of the samples and to document the change in possession from sampling to delivery to receipt by the laboratory. Prior to analysis samples are checked for integrity. Sample handling, tracking and acceptance procedures are outlined in SOP #060105, *Sample Receiving*.
- Sample storage procedures are followed using guidance from each approved method and associated department SOP.

8.0 EQUIPMENT

8.1 EQUIPMENT LIST

TABLE 8.1 – LABORATORY EQUIPMENT LIST: MAJOR ITEMS – Mold/ BOD Analysis
This table is subject to revision without notice

Item	Manufacturer	*Model*	*Serial #*	*Location*
Analytical Balance	Mettler	PL602-S	1125081657	Bacteriology Lab
Autoclave	Tuttnauer	2540EK	2906170	Bacteriology Lab
Class I BSC	AirFiltronix	AirFiltronix HS 4500	41031	Mold Lab
Class II BSC	Labconco	Labconco 36213	60554894	Mold Lab
Class II BSC	Labconco	Labconco 36209	03076555	Bacteriology Lab
COD Reactor	HACH	45600	900903221	BOD
Microscope	NIKON	LABOPHOT	242008	Mold Lab
Microscope	NIKON	LABOPHOT	235267	Mold Lab
Microscope	Olympus	CH2	900216	Mold Lab
Microscope	Olympus	BH-2	708821	Mold Lab
Microscope	Leitz	Laborlux	512663	Mold Lab
Microscope	VWR Scientific	VWRC1	V167173	Mold Lab
Refrigerator	Whirlpool			Bacteriology Lab
Refrigerator	Whirlpool	El05PPXMQ	EEP3524864	Mold Lab
Refrigerator	Whirlpool	EL7ATRRMQ07	EWR4973976	Mold Lab

TABLE 8.1 – LABORATORY EQUIPMENT LIST: MAJOR ITEMS – Mold/ BOD Analysis
This table is subject to revision without notice

Item	Manufacturer	*Model*	*Serial #*	*Location*
Refrigerator	Frigidaire	FRT17G4BW9	BA703306	Mold Lab
Stereoscope	VWR Scientific	VWRS1	V168430	Mold Lab
Incubator	Labtronix	BOD2100D	21000010213	Mold Lab
Incubator	Quincy Lab	10-100	I11-2454	Mold Lab
Incubator	Precision Scientific	30M	9303590	Bacteriology Lab
Incubator	Precision Scientific	30M		Bacteriology Lab
Incubator	VWR	2030	802202	BOD
Incubator	Fisher	Not Visible	100212	BOD
Incubator	Thermo Scientific Precision	3271	317217-1241	BOD
Incubator	Precision	818	35AK-10	BOD
Waterbath	Blue M-MagniWhirlpool	MW-1110A	14991	Bacteriology Lab
Waterbath	Precision	Circulating 260	21-AJ11	BOD
Biolog MicroStation	Biolog, Inc.	Microlog 3	342689	Bacteriology Lab
Turbidimeter	Biolog, Inc.	21907	6093898	Bacteriology Lab
Plate Reader	Biotek	ELX808BLG	203222	Bacteriology Lab
Vortex Genie2 Mixer	VWR	G-560	2-223236	Mold Lab
Vortex Genie2 Mixer	VWR	G-560	2-223236	Bacteriology Lab
Stir Plate	Corning	PC-420D	023507102961	Bacteriology Lab
Stir Plate	Fisher	118	102	Bacteriology Lab
Stir Plate	VWR	205	7852	BOD
Stir Plate	VWR	220	5031	BOD
BOD SP Robotic Analyzer	Skalar	SP50	08124	BOD
BOD SP Robotic Analyzer	Skalar	SP50	08123	BOD
DO meter	YSI	5000	081C101451	BOD
DO meter	YSI	5000	081C101450	BOD
pH meter	VWR	Symphony B10P	12284S0009	BOD
Spectrophotometer	Hach	DR 2700	1388224	BOD

8.2 EQUIPMENT PREVENTIVE MAINTENANCE

INSTRUMENT	*P. M. DESCRIPTION*	*FREQUENCY*
Analytical Balances	•Check with Class "I" weights	Daily-tolerance 1 gm - ±0.0001gm
Analytical Balances	•Service/Calibration (semiannual contract maintenance and calibration check)	10 gm - ±0.01 gm
Analytical Balances	•Service/Calibration (semiannual contract maintenance and calibration check)	Semiannually
Refrigerators, Waterbaths, & Incubators	•Maintenance service	As needed - determined by daily temperature performance checks twice daily and at least 4 hours apart
Water Bath	•Check thermometer vs. NIST	Annually

INSTRUMENT	***P. M. DESCRIPTION***	***FREQUENCY***
Water Bath	•Remove from service when not maintaining temperature and send off for repair or replace	As needed
Incubators and Waterbaths	Perform Temperature stability and load testing	Annually
Autoclave	•Check sterilization efficiency	Weekly – *G. stearothermophilus*
Autoclave	•Check sterilization efficiency	Per Use – Chemical Indicator
Autoclave	Check timing devices	Quarterly
Autoclave	Check pressure (annual Maintenance contract)	Annually
Class II Biosafety Cabinet	•Monitor air and UV lamps	Monthly
Class II Biosafety Cabinet	•Inspect for air flow	Quarterly
Class II Biosafety Cabinet	•Recertification according to NSF standard 49	Annually
Turbidimeter	•Maintenance Service	Annually
Turbidimeter	•Check for accuracy using NIST traceable stds	Per Use
Biolog MicroStation	•Maintenance Service	Annually
Microscope	•Service/calibration of each ocular micrometer	Annually
Microscope	•Clean optics and stage, Kohler Alignment	Each Use
pH meters	Calibrate and check slope (acceptablerange)95-	Daily
pH meters	Reference junction & electrode replacement	As needed
pH meters	Probe stored in KCl	At all times when not in use
pH meters	ATC checks	Quarterly
pH meters	Other	As described in manufacturer's O &
BOD SP Robotic Analyzer	Calibrate DO probe	Daily
BOD SP Robotic Analyzer	Clean and Change DO probe membrane	Weekly
BOD SP Robotic Analyzer	Rinse ATU (seed) dispenser using rinse pump option	As needed
BOD SP Robotic Analyzer	Clean rinsing vessel	Every three months or as needed
BOD SP Robotic Analyzer	Replace tubing for dispenser, diluent pump, and rinsing vessel	Annually or as needed

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8.3 STANDARDS AND REAGENTS

Table 8.3A lists commercially prepared agar sources. Table 8.3 B lists in-house prepared agar sources and storage information. Table 8.3C lists standard sources, receipt, and preparation information for BOD Analysis. Table 8.3D is designed to provide general calibration range information for BOD analysis. These tables may change depending on regulatory requirements, procedural changes, or project needs.

Table 8.3A: Commercially prepared agar sources and storage information.
(subject to revision as needed)

Agar Type	***Source***	***Storage***
Malt Extract Agar w/chloramphenicol (MEA)	HealthLink	4 ± 2^oC
DG18 Agar	HealthLink	4 ± 2^oC
Modified Cellulose Agar	HealthLink	4 ± 2^oC
Tryptic Soy Agar w/Sheep Blood	HealthLink	4 ± 2^oC
2 % Malt Extract	Biolog	4 ± 2^oC
BUG w/BL	Biolog	4 ± 2^oC
BUA w/BL	Biolog	4 ± 2^oC

Table 8.3A: Commercially prepared agar sources and storage information.
(subject to revision as needed)

Agar Type	*Source*	*Storage*
Biolog Universal Yeast Agar (BUY)	Biolog	4 ± 2^oC
TSA w/SB contact	HealthLink	4 ± 2^oC
Malt Extract Agar w/chloramphenicol contact	HealthLink	4 ± 2^oC
Chocolate Agar	Biolog	4 ± 2^oC
Czapek Yeast Extract Agar	HealthLink	4 ± 2^oC
CNA w/5 % SB	HealthLink	4 ± 2^oC
Saboraud's Dextrose Agar	HealthLink	4 ± 2^oC

All stock agar expirations are per manufacturer specification.

Table 8.3B: In-house prepared agar sources and storage information.
(subject to revision as needed)

Agar Type-Stock	*Source*	*Stock Storage*	*Stock Expiration*	*Preparation Components Media*	*Prepared Storage*	*Prepared Expiration*
Malt Extract Agar (MEA) slants	VWR/Difco	Room Temp	As specified by Manufacturer	MEA + Water	4 ± 2^oC	3 months
Anaerobic Agar (ANA)	VWR	Room Temp	As specified by Manufacturer	ANA + water	4 ± 2^oC	2 weeks
Tryptic Soy Agar (TSA) slants	VWR/Difco	Room Temp	As specified by Manufacturer	TSA + Water	4 ± 2^oC	3 months
Tryptic Soy Broth (TSB)	VWR/Difco	Room Temp	As specified by Manufacturer	TSB + Water	4 ± 2^oC	3 months

Table 8.3C: Standard sources, description and calibration information.
(This table is subject to revision without notice)

Instrument Group	*Standard Source*	*How Received*	*Source/Storage*	*Preparation from Source*	*Lab Stock Storage*	*Preparation Frequency*
BOD	Lab preparation	As dry glucose and glutamic acid	Dessicator	150mg each/L	Ambient	Made fresh daily
pH meter	Commercial source	pH 4.0 buffer	Ambient	No prep required	NA	Annual/Expiration Date
pH meter	Commercial source	pH 7.0 buffer	Ambient	No prep required	NA	Annual/Expiration Date
pH meter	Commercial source	pH 10.0 buffer	Ambient	No prep required	NA	Annual/Expiration Date
Turbidity meter	Commercial source	Turbidity standard	Ambient	No prep required	NA	Annual/Expiration Date

Table 8.3D: Working Standard Calibration

Analysis	*Calibration Standard*
BOD	D.O.- Barometric pressure/temp, Glucose and glutamic acid reference standard

Source of Fungi

A collection of fungi is maintained in the laboratory as training and reference material. The fungi are isolated from proficiency testing samples, laboratory contaminants and customer samples, and stored as Malt Extract Agar slants for 3 months at 4 $\pm$ 2ºC. Cultures are sub-cultured every 3 months. Each culture is assigned an accession number, genus, specific epithet, authority, source, and name of collector. Records are maintained in the laboratory in the accession list database.

Source of Bacteria

A collection of bacteria is maintained in the laboratory as training and reference material. The bacterial strains are purchased from an accredited microbiological supply company and are used as positive and negative reference controls. Alternatively, bacterial strains are collected from proficiency testing samples and laboratory contaminants, and stored as Tryptic Soy Agar slants for 3 months at 4 $\pm$ 2ºC.

8.4 INSTRUMENT CALIBRATION

Autoclave

Operating temperature is checked and recorded with each use with a minimum/maximum thermometer. Performance is tested weekly with *Bacillus stearothermophilus* ampoules. Chemical strips are used with each batch processed to verify that supplies and materials have been sterilized. Records of autoclave operations are maintained for every cycle. Records include: date, contents, maximum temperature reached, pressure, time in sterilization mode, total run time (may be recorded as time in and time out) and analyst initials.

Incubators & Waterbaths

The record of temperature checks is documented twice daily at least 4 hours apart when in use. Thermometers used for temperature checks are verified at least annually. In addition temperature chart recorders are being used to continuously monitor the temperature in the incubators used for BOD analysis and the BOD Lab.

Analytical Balances

Analytical balances are checked at least daily prior to each use with class “I” weights. Records of these verifications are maintained within the laboratory. Balances are also serviced and verified and/or calibrated by an external calibration service at least semi-annually.

Microscope

A record of cleaning and alignment for each microscope is maintained in the laboratory. Each microscope has an ocular micrometer that is verified annually with a stage micrometer. All microscopes are serviced annually by an external microscope service.

Biochemical Oxygen Demand Robotic Analyzer – SOP Number 340303A

The Dissolved oxygen meter is calibrated according to manufacturer's instructions with each use. Air calibration is performed on the DO meter probes to correct DO for the ambient temperature and given local barometric pressure. The local barometric pressure is determined from information provided by the National Weather Service for the Nashville International Airport (BNA) by accessing http://w1.weather.gov/obhistory/KBNA.html.The air calibration is confirmed daily using the Winkler Test. During the analytical sequence, the calibration stability of the DO probes is verified after every ten samples and at the end of sequence, by the analysis of continuing calibration verification (CCV). If either of the readings differs from the initial readings by more than 0.2 mg DO/L., the instrument automatically re-calibrates the DO meters and re-reads everything after the last passing CCVs.

A laboratory control sample (LCS) is prepared from glucose and glutamic acid, and is analyzed in triplicate exactly like a field sample at the beginning of the workgroup, after every twenty samples throughout the run and at the end of the workgroup, to verify that the analytical process is performing accurately.

pH meter

With each use of pH meters, calibrate the instrument according to manufacturer's instructions. The slope is documented on a daily basis. Acceptable pH slope range is per the manufacturer's operating manual. Automatic temperature compensation (ATC) verifications are performed quarterlyon the pH probe.

Turbidimeter

With each use, calibrate the instrument according to manufacturer's instructions. Adjust transmittance to a 100% using a blank reference test tube. Establish appropriate turbidity range on turbidimeter by adding or subtracting 2% T to the percent transmittance measured with the appropriate turbidity standard.

Volumetric equipment

Equipment such as pipettes, non-Class A and other containers with graduations are calibrated once per lot prior to first use. Volumetric equipment that is not disposed of after use is calibrated on an annual basis. The error of calibration must not exceed 3%.

Air Sampler

The air sampling pump used for laboratory environmental monitoring is verified monthly prior to use with a calibrator that is calibrated annually by an ISO 17025 accredited laboratory to ensure its measurement integrity.

9.0 LABORATORY PRACTICES

9.1 REAGENT GRADE WATER

Reagent Grade water –Type II used in the Mold Laboratory is periodically checked for contamination. Type II water is checked annually for single and total heavy metals, and organic contaminants. Monthly checks for total organic carbon, ammonia and organic nitrogen, total residual chlorine and a heterotrophic plate count are also conducted. Conductivity and pH are checked continuously or with each use. The water suitability test is performed annually and the USE test is performed quarterly.

Prior to first use, a sterility check with non-selective growth media is performed on each batch of reagent water prepared in the laboratory.

9.2 GLASSWARE WASHING AND STERILIZATION PROCEDURES

Glassware washing and preparation/sterilization procedures are performed according to EPA guidelines and are outlined in SOP #030701, *Glassware Cleaning*. The glassware used in the mold laboratory is restricted to microscopic slides, cover slips, and screw capped bottles, vials or flasks for preparation of media. Before use, examine microscope slides, and discard items with chipped edges or etched inner surfaces. Prior to use, clean microscopic slides with 70 % isopropyl alcohol. Examine screw-capped bottles, vials or flasks for chipped inner edges that could leak. Screw-capped bottles, vials or flasks are cleaned using the following protocol:

- Prewash with hot tap water. Wash with hot tap water. Wash with non-foaming powder detergent. Rinse with tap water. Rinse with DI water. Dry and cool.
- New glassware is cleaned according to the same procedure as listed above.

Inspect glassware after washing for excessive water beading and re-wash, if necessary. Perform checks on pH and test for inhibitory residues on glassware and plastic ware. Use utensils and containers of borosilicate glass, stainless steel, aluminum, or other corrosion resistant material for media preparation. Sterilization of any auxiliary equipment is performed via autoclave.

Pipettes of all sizes are checked for sterility by drawing up non-selective media into the pipette and re-dispensing the volume back into original tube that contained the media. The tube is then incubated and monitored for growth. All results are recorded and maintained within the laboratory.

Inoculating loops are cultured by aseptically transferring the entire tip of the loop into a tube containing non-selective media. The tube is incubated and monitored for growth. Results are maintained within the laboratory.

BOD analysis is performed in disposable, pre-sterilized bottles. In the event that glass bottles must be used, the BOD glassware is washed in a commercial laboratory dishwasher using a phosphate free detergent, followed by a nitric acid rinse, with a final rinse of laboratory DI water.

9.3 MEDIA STERILITY VERIFICATION PROCEDURES

A sterility check must be analyzed for each lot of pre-prepared media and for each lot of media prepared in the laboratory. This is done prior to the first use of the media used for membrane filtration, or MPN, or pour plate, and chromofluorogenic methods. For media used in the pour plate testing technique, sterility blanks of the media must be made by pouring an uninoculated plate for each run. All results are documented.

9.4 POSITIVE AND NEGATIVE CONTROLS USING PURE CULTURES

Positive culture controls demonstrate that the media can support the growth of the target organism(s), and that the media produces the specified or expected reaction to the target organism(s). All prepared media must be tested with at least one pure culture of a known positive reaction. This must be done prior to first use of the media.

Negative culture controls demonstrate that the media does not support the growth of non-target organisms or does not demonstrate the typical positive reaction of the target organism(s). All batches of prepared selective media in the laboratory must be analyzed with one or more known negative culture controls. This must be done prior to first use of the media.

New lots of commercially-prepared media are evaluated for suitability using a known positive and negative culture prior to use.

10.0 ANALYTICAL PROCEDURES

A list of laboratory SOPs associated with the Mold and BOD laboratory can be found in the following table:

TABLE 10.1: MOLD DEPARTMENT SOPs

This Table is subject to revision without notice

SOP #	Title
340303	Biochemical Oxygen Demand
350306	Spore Traps
350307	Fungal Andersen
350308	Fungal Quantification
350309	Fungal RODAC
350310	Direct Exam Prep Procedure

SOP #	Title
350311	Fungal Identification
350312	Mold QA/QC
350313	Mold Lab Safety
350314	MUG – E. coli/Coliforms/Enterococcus
350319	Processing of Bacterial Andersen Samples for Quantification
350334	Microscope Usage
350335	Fungal Spore Identification
350342	BART Testing
350347	Processing of Bacterial Swabs, Bulk, Dust and Water Samples for Quantification
350349	Bacterial Identification Using Biolog
350352	Anaerobic Plate Count
350367	Labconco Flaskscrubber Operation and Maintenance
350370	Preparation of Culture Media
350371	Mold lab Autoclave Maintenance and Operation
350379	Mold Lab Reference Culture Maintenance

11.0 QUALITY CONTROL CHECKS

11.1 ESC participates in proficiency testing (PTs) in support of various laboratory accreditations/recognitions. For Mold analyses, PTs are administered quarterly by AIHA-PAT. ESC participates in both the EMPAT Fungal Direct Examination and Bacterial/Fungal Culturable proficiency testing. The samples are received and analyzed by method according to the vendor's instructions and according to the applicable analytical SOP.

For BOD analysis, environmental PTs are purchased from Phenova. The WP studies are completed every 6 months.

11.2 As part of the total spore analysis QC, the laboratory maintains a slide collection with various count levels and genera/groups of spores. Acceptance criteria for the slide collection include counts that are statistically determined (e.g. ±3STD). Each analyst reviews one slide from this collection on each day of analysis. The slides are reviewed on a rotational basis such that a different slide is reviewed each day until the entire slide collection has been examined. The total spore count and acceptance criteria for each slide are calculated and compared with the statistically determined acceptance criteria.

11.3 Each week, a different pure culture is chosen from the culture collection and is identified by an analyst as part of training and continuing QC program.

11.4 Inter- and intra-analyst precision is determined by the re-analysis of samples by the same and different analysts (where possible). The rate of re-analysis by the same analyst (intra-analyst) and by a second qualified analyst (inter-analyst) is 5%, or at least one each month samples are received, for each field of testing. The laboratory uses control charts to compare the intra- and inter-analyst performance to an established control limit.

11.5 Media blanks for viable count analysis are used to monitor media and laboratory procedures for contamination. These blanks are utilized in two ways:

- Laboratory media blanks are unexposed fresh media (either recently received from the manufacturer or newly laboratory prepared) that is incubated under the same conditions as those used for analysis.
- Field blanks are unopened media that is handled identically to field samples. These samplers are returned to the laboratory with sampled media to demonstrate that media utilized was not originally contaminated and did not become contaminated during transport.

11.6 Environmental monitoring of the laboratory air and the surfaces in the Mold laboratory is performed monthly. BSLII hoods are also monitored in the Mold laboratory.

11.7 Round Robin studies are performed for direct examination of fungal air samples in accordance with AIHA-LAP policy requirements. Results for these studies include raw counts and final concentrations for each fungal structure. Acceptance criteria include organism identification, ranking and quantification.

11.8 Analysts also participate in other continuing education activities, including attending seminars and conferences, in-house training meetings, reviews of journal publications and self-taught training on CD.

11.9 For BOD analysis, Initial Demonstrations of Capabilility (IDOCs) are performed during new analyst training and/or prior to acceptance and use of any new or modified method/instrumentation. Continuing Demonstration of Capability must be updated at least annually. The associated data is filed within the department and available for review.

11.10 For BOD analysis, samples are analyzed in batches of 1-20 samples. Each batch must include the following: method blank, seed blank, seed control, seed check, a laboratory control sample run in triplicate, 1 sample duplicate/ 10 samples. A calibration check (CCV) is performed every 10 samples and an additional LCS every twenty samples including the end of the sequence.

11.10.1 A method blank is analyzed for each probe at the beginning and end of the sequence. The method blank is used to define the level of laboratory background and reagent contamination. All blanks must meet method acceptance criteria. If method blanks fail, data is qualified. The depletion of the method blank must be < 0.20mg DO/L but no lower than -0.20 mg DO/L. Multiple dilution water blanks in the same batch using the same dilution water are treated as replicates and averaged. The average of the dilution water blanks in a batch must not be more than 0.20 mg DO/ L.

11.10.2 The Seed Blank/Seed Control/Seed Check must deplete to show that the microorganism population is viable. The seed correction factor should be 0.6-1 mg/L and seed check and seed control should show depletions within 30% between dilutions.

11.10.3 The CCV should not vary more than 0.2mg DO/L within a run.

11.10.4 The BOD value for the LCS must be within 167.5 and 228.5 mg/L.

11.10.5 The RPD for the sample duplicate must be ≤30% for high and low values.

12.0 DATA REDUCTION, VALIDATION AND REPORTING

12.1 DATA REDUCTION

The analyst performs the data calculation functions and is responsible for the initial examination of the finished data. Data reduction steps applied to the raw data are outlined in SOP #030201, *Data Handling and Reporting* and ESC SOP# 030227, *Data Review* The primary analyst reviews the quality of data based on the following guidelines:

- The appropriate SOP is followed
- Sample preparation is correct and complete
- Analytical results are correct and complete
- QC is within criteria and complete

For BOD analysis, the Laboratory Manager or Senior Analyst performs the secondary review of the data package using the ESC SOP# 030227, *Data Review*. The reviewer verifies that the analysis is performed as required and meets method criteria, All associated data is present and complete, and also ensures that any additional documentation is completed as required (i.e. required qualifiers on test reports, case narratives, etc.)

TABLE 12.1 Data Reduction Formulas

PARAMETER	FORMULA
Non-viable (Spore Traps) Mold	$\frac{SporeCount}{m^3} = \frac{\text{number on trace} \times 1000}{\text{Volume of air sampled in liters}}$
Andersen Fungal Viable (Culturable) Mold Spore Andersen Bacterial Viable (Culturable) Bacteria	$\frac{CFU}{m^3} = \frac{\text{raw counts} \times 1000}{\text{Volume of air sampled in liters}}$ $P_c = N\ [1/N + 1/N\text{-}1 + 1/N\text{-}2 + \ldots\ldots 1/N\text{-}r+1]$
Quantitative Fungal/Bacterial	$\frac{\text{CFU}}{\text{gm}} \text{ or } \frac{\text{CFU}}{\text{Swab}} = \frac{\#\text{ of Colonies} \times \text{Dilution Factor}}{\text{Sample Amount}}$
BOD, 5-DAY	<u>Initial D.O. –Final D.O. –CF</u> % Dilution Sample *Calculations are performed by computer software* *CF= (Depletion of Seed Control or Seed Check) X (Vol of Seed in Samples)/Volume of Seed in Seed Control or Seed Check*

PARAMETER	FORMULA
Percent Recovery (%R)	%R = (Observed Value)X(100%) True Value
Relative Percent Difference (RPD)	RPD = [ABS(Result1-Result2)]X(100%) RPD = [ABS(Result1-Result2)]X(100%)Mean Result
Reporting Limit (RL)	RL (1 ppm) X Final Volume (300 ml)/Initial volume X Dilution Factor

12.2 VALIDATION

The validation process consists of data generation, reduction review, and reporting results. Once data reduction is complete, validation is conducted by reviewing all data entries and calculations for errors, reviewing all documentation to assure that sample information is correct, and that the tests have been performed appropriately and within the appropriate holding times. The secondary analyst reviews the quality of data based on the following guidelines:

- The appropriate SOP is followed
- Sample preparation is correct and complete
- Analytical results are correct and complete

For BOD analysis, once data reduction is complete, validation is conducted by verification that the QC samples are within acceptable QC limits and that all documentation is complete, including the analytical report and associated QC. See Table 12.3 for current QC targets, controls and current reporting limits for BOD analysis.

12.3 REPORTING

Reporting procedures are documented in SOP #030201, *Data Handling and Reporting.*

BOD Control Limits: BOD QC targets are statutory. The laboratory calculated limits verify the validity of the regulatory limits. The BOD QC targets are within the range of 5 to 15% for accuracy, depending on determinative method requirements, and, where applicable, <30% RPD for precision, unless laboratory-generated data indicate that tighter control limits can be routinely achieved. When using a certified reference material for QC sample analysis, the acceptance limits used in the laboratory conform to the provider's certified ranges for accuracy and precision.

Table 12.3: QC Targets for BOD Lab Accuracy (LCS), Precision and RLs
This table is subject to revision without notice

Analyte	Analysis Method	Matrix	Accuracy Range (%)	Precision (RPD)	RL (ppm)
Biochemical Oxygen Demand	SM5210B	W	85-115	≤30	1
Biochemical Oxygen Demand - Carbonaceous	SM5210B	W	85-115	≤30	1

13.0 Corrective Action

13.1 In the event that a nonconformance occurs in conjunction with the analytical batch, a corrective action response (CAR) form must be completed. The cause of the event is stated on the form and the measures taken to correct the nonconformance clearly defined. The effectiveness of the corrective action must be assessed and noted. The CARs are kept on file by the Regulatory Affairs Department. Corrective action procedures are documented in SOP #030208, *Corrective and Preventive Action*

13.2 Required Corrective Action

Control limits are established for each type of analysis. When these control limits are exceeded, corrective action must be taken.

All samples and procedures are governed by ESC's quality assurance program. General corrective actions are followed; however additional and more specific direction is provided in the specific determinative procedure. For more information, see the appropriate SOP.

13.2.1 Laboratory QC Criteria and Appropriate Corrective Actions

If the analytical method contains acceptance/rejection criteria and it is more stringent than those controls generated by the laboratory the method criteria takes precedence.

13.2.2 Out of Control RPD for inter- and/or intra-analyst reanalysis.

Rejection Criteria - RPD value of the original analysis is calculated and must be below the current control limit.

Corrective Action - Both first and second analysts re-analyze the sample until a consensus is reached and the RPD value falls within control limits.

13.2.3 Out of Control RPD for inter-analyst analysis.

Rejection Criteria – All organisms must be accurately identified.

Corrective Action - Both first and second analysts review the sample. The second analyst results are reported to the customer.

13.2.4 Calibration Verification criteria are not met: BOD Analysis

Rejection Criteria see section 8.4

Corrective Action- If the CCV fails, the data may still be used. If the failure persists, check cleanliness of the equipment and stability of the DO probe for subsequent runs. If a problem persists, the group supervisor or Regulatory Affairs Department is notified for further action.

13.2.5 Out of Control Blanks: Applies to Method Blank

Rejection Criteria- Blank depletion is greater than established limit of -0.2 mg DO/L and + 0.2 mg DO/L.

Corrective Action - If the average of the blanks fail, all data must be reported with a qualifier

13.2.6 Out of Control Laboratory Control Standards (LCS)

Rejection Criteria - If the performance of associated laboratory control sample(s) is outside of acceptance limits as listed in Section 12.

Corrective Action - All samples bracketed by the failed LCS must be reported with a qualifier.

13.2.7 Out of Control Duplicate Samples

Rejection Criteria - Lab-generated maximum RPD limit (as listed under precision in Section12)

Corrective Action - The sample and duplicate are reported with a qualifier.

14.0 RECORD KEEPING

Record keeping is outlined in SOP #030230, *Standards Logger, SOP #030227, Data Review* and SOP #030201, *Data Handling and Reporting*

15.0 QUALITY AUDITS

System and data quality audits are outlined in the ESC Quality Assurance Manual Version 13.0 and *SOP #010104, Internal Audits*.

16.0 REVISIONS

The Regulatory Affairs Department has an electronic version of this Quality Assurance Manual with tracked changes detailing all revisions made to the previous version. This version is available upon request. Revisions to the previous version of this appendix are summarized in the table below.

Document	**Revision**
Quality Assurance Manual Version 15.0 (Appendix XI)	General - Replaced the term "client" with the term "customer". Also changed references to AIHA to AIHA-LAP or AIHA-PAT as appropriate. Table 8.1 – Updated Equipment List Table 8.2 – Revised ATC check frequency for pH meters to quarterly Tables 8.3A and 8.3B – Updated Agars Table 8.3C – Added pH=4 buffer Section 8.4 – Revised ATC check frequency for pH meters to quarterly Table 10.1 – Updated SOP list

1.0 SIGNATORY APPROVALS

Protozoa Laboratory QUALITY ASSURANCE MANUAL

APPENDIX XII TO THE ESC QUALITY ASSURANCE MANUAL

for

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NOTE: The QAM has been approved by the following people.

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2.0 *APPENDIX TABLE OF CONTENTS*

3.0 SCOPE AND APPLICATION

This manual discusses specific QA requirements for EPA Methods 1622 and 1623 to ensure that analytical data generated from the protozoan laboratory are scientifically valid and are of acceptable quality. Any deviations from these requirements and any deviations that result in nonconforming work must be immediately evaluated and their corrective actions documented.

4.0 LABORATORY ORGANIZATION AND RESPONSIBILITIES

ESC Lab Sciences offers diverse environmental capabilities that enable the laboratory to provide the customer with both routine and specialized services, field sampling guidance and materials and broad laboratory expertise. A brief outline of the organization and responsibilities as they apply to the ESC Quality Assurance Program is presented in Section 4.0 in the *ESC Quality Assurance Manual*.

5.0 PERSONNEL AND TRAINING

5.1 PERSONNEL

Dr. Christabel Fernandes-Monteiro, with a Ph.D. in Applied Biology, is the Department Manager of Biology. She oversees supervision of laboratory operations in the Mold, Aquatic Toxicity, Microbiology, Protozoan and BOD laboratories. Her responsibilities include assurance of reliable data through monitoring of quality control, corroborating the analysis performed, protocol development, coordination with customers regarding sample analysis, scheduling of tests and overall production in all sections within the Biology Laboratory, including management of staff. In her absence, Stacy Kennedy assumes her responsibilities in the Protozoan laboratory.

Stacy Kennedy, with a M.S. degree in Biotechnology, is the Principal Analyst for the Protozoan laboratory. Ms. Kennedy is proficient in performing EPA Methods 1622 and 1623. She gained analytical experience from a certified EPA Protozoan Principal Analyst and obtained additional training on microscopic techniques. Also, she frequently reviews EPA online training modules related to the methods being performed.

5.2 TRAINING

The Principal Analyst trains all new analysts in the Protozoan laboratory according to ESC protocol and EPA guidelines. ESC's training program is outlined in SOP #350405, *Training Protocol for Method 1622/1623* and is in accordance with *Supplement 2 to the 5th Edition of the Manual for the Certification of Laboratories Analyzing Drinking Water*. Documentation of training received and authorizations to perform these analyses are maintained within the department.

6.0 Facilities and Laboratory Safety

6.1 Facilities

The main area of the laboratory is approximately 420 square feet and has roughly 67.5 square feet of bench area. The microscope dark room is located in the back of the laboratory is 36 square feet with 18 square feet of bench area. Additionally, there is 40 square feet of storage and fluorescent lighting throughout all areas. The air handling system is a five-ton Trane split unit with natural gas for heating. The laboratory reagent water is provided through the Siemans Elga UltraPure deionizer system. Biohazard containers are located in the protozoan laboratory and Stericycle serves as ESC's biological waste disposal contractor. ESC's building information guides and site plan are shown in Appendix I.

6.2 Laboratory Safety

- Laboratory access is limited when work is being performed.
- All procedures where infectious aerosols or splashes may occur are conducted in Biological Safety II cabinets.
- The following Biosafety Level 2 (BSL2) guidelines are adhered to:
  - Closed-toe shoes are worn in the laboratory
  - Floors and work surfaces are cleaned on a regular basis
  - Emergency numbers are posted in the laboratory
  - Biological safety hoods are tested and certified annually
  - Laboratory personnel are trained in the use of the biological spill kit and emergency safety equipment
- ESC's laboratory safety guidelines are detailed in SOP #350408, *Biosafety Guidelines for the Cryptosporidium Laboratory*.

7.0 Sampling Procedures

7.1 Field Sampling Procedures, Sample Storage, and Handling

- A description of field sample collection, containers, storage, temperature, and transport times are located in SOP #350402, *Method 1622/1623 Field-Filtering Sample Collection and Laboratory Delivery* and SOP #350403, *Method 1622/1623 Bulk Sample Collection and Laboratory Delivery*.
- Laboratory sample identification, handling, tracking and the information recording system are found in the following procedures: SOP #350404, *Method 1622/1623 Sample Receiving* and SOP #060105, *Sample Receiving*.

- A Chain of Custody and LT2 Sample Collection Form accompanies all compliance samples received by the lab. This is necessary to prove the traceability of the samples and to document the change in possession from sampling through receipt by the laboratory. Prior to analysis, all samples are checked for integrity.
- Following analysis, the slides are maintained for a minimum of 2 months and disposed of following all State and Federal regulations governing disposal.
- Requirements for sample acceptance are located in SOP #350404, Section 7.0, *Method 1622/1623 Sample Receiving*.

8.0 EQUIPMENT

Laboratory equipment specifications are outlined in SOP #350407, *Microscope Analyst Verification*, SOP #350410, *IEC CRU-500 Centrifuge Operation and Maintenance,* SOP #350411, *Lab-Line Multi-Wrist Shaker Operation and Maintenance* and SOP #350413, *Olympus BX40 Microscope Operation and Maintenance.*

8.1 EQUIPMENT LIST

TABLE 8.1 – LABORATORY EQUIPMENT LIST: MAJOR ITEMS - Protozoan

Item	*Manufacturer*	*Model*
Flow control valve	Plast-o-matic	FC050B
Centrifugal pump	Jabsco	18610-0271
Graduated container	Nalgene	20 Liter Carboy
Laboratory shaker	Lab-Line	3587-4
Laboratory shaker side arms	Lab-Line	3589
1500 XG swinging bucket centrifuge	Damon/IEC Division	CRU-5000
Sample mixer/rotator	DYNAL	Cat#: 947.01
Magnetic Particle Concentrator	DYNAL	MPC-1
Magnetic Particle Concentrator	DYNAL	MPC-S
Magnetic Particle Concentrator	DYNAL	MPC-6
Flat-sided sample tubes	DYNAL	Cat#: 740.03
Epifluorescence/differential interference contrast microscope	Olympus	BX-40
Excitation/band pass microscope for fluorescein isothiocyanate (FTIC)	C-Squared	UN3100
Excitation/band pass filters for 4',6-diamidino-2-phenylindole (DAPI)	C-Squared	UN41001

8.2 EQUIPMENT PREVENTIVE MAINTENANCE, EQUIPMENT CALIBRATION

Calibration of equipment is conducted on an annual and/or semi-annual basis and is documented. Maintenance and cleaning is conducted on an as needed basis or per manufacturer's instructions. Equipment cleaning is specified in SOP #350412, *Cryptosporidium Laboratory Equipment Cleaning.*

TABLE 8.2 – PREVENTATIVE MAINTENANCE AND CALIBRATION FOR LABORATORY EQUIPMENT		
INSTRUMENT	***P. M. DESCRIPTION***	***FREQUENCY***
Balances (Top Loader or Pan)- capability of detection of 0.1 g for a load of 150 g, and 1 mg for a load of 10 g or less.	Service/Calibration (maintenance and calibration check) Verified using ASTM Class 1,2, or 3 weights Non-reference weights should be calibrated	Annually by a qualified independent service tech Monthly Every six months
pH meter	Electrodes should be maintained Slope determination Meter standardized with pH 7.0, and either 4.0 or 10.0 pH buffers	Per manufacturer's instructions Monthly (Acceptable slope= 95-105%) Each use period
Thermometer- Glass and Electronic Continuous recording devices Reference Thermometer	Calibration checked with NIST certified traceable reference thermometer or one traceable to a NIST reference thermometer Re-calibrated Re-calibrated	Annually Annually Annually by a certified service technician
Autoclave	Maintenance Check Sterilization efficiency Maximum temperature registering Automatic timing mechanism Clean door seals, drain screen, remove debris	Annually by a qualified independent technician Monthly- Geobacillus stearothermophilus ampoule With each use–Chemical Indicator Strip With each use Quarterly As needed
Conductivity Meter	Calibrated using a low level certified traceable standard or determine cell constant	Monthly per manufacturer instructions
Refrigerator	Record temperature	Daily when in use
Micropipettes	Calibrated	Annually
Hand Tally or Digital/Electronic Counter	Checked to confirm accuracy and operational status	Periodically as needed
Centrifuge	Clean and disinfect after spills/leakage Service/Calibration	Periodically as needed Annually by a qualified service technician
Microscope	Service Alignment and adjustment of optics Stage Micrometer calibration Kohler illumination procedure	Annually With each use Annually With each use
DI unit	Manufacturer's instructions	As needed

8.3 STANDARDS AND REAGENTS

Table 8.3A: Stock solution sources, description and related information.
(subject to revision as needed)

Description	Vendor	Concentration	Storage Req.	Expiration
Sodium Hydroxide (NaOH)	VWR	Concentrated	ambient	1 year
Hydrochloric Acid (HCl)	VWR	Concentrated	ambient	1 year
Laureth-12	VWR	--	ambient	1 year
Tris Stock	VWR	--	ambient	NA
EDTA	Sigma-Aldrich	0.5 M, pH 8.0	2 - 8°C	1 year
Antifoam A	Sigma-Alrich	--	ambient	NA
Dynabeads® GC-Combo/Crypto	Idexx	--	2 - 8°C	2 years
Direct labeling kit for det. of oocysts and cysts, Merifluor Cryptosporidium/Giardia	VWR	--	2 - 8°C	1 year
Phosphate Buffered Saline (PBS) Solution, pH 7.4	Sigma-Aldrich	--	ambient	1 year
4', 6-diamidino-2-phenylindole (DAPI) stain	Waterborne, Inc	2mg/mL	2 - 8°C /Darkness	18 months/When positive control fails
Purified, live *Cryptosporidium* oocysts stock suspension	WSLH	--	2 - 8°C	1 month
Purified, live *Giardia* cysts stock suspension	WSLH	--	2 - 8°C	1 month

Table 8.3B: Working Solution Descriptions and Related Information.
(subject to change)

Solution	Concentrations	Storage Requirements	Expiration
Sodium Hydroxide (NaOH)	6.0 N	ambient	1 year
Sodium Hydroxide (NaOH)	1.0 N	ambient	1 year
Hydrochloric Acid (HCl)	6.0 N	ambient	1 year
Hydrochloric Acid (HCl)	1.0 N	ambient	1 year
Hydrochloric Acid (HCl)	0.1 N	ambient	1 year
Laureth-12 stock vials	10g/100mL	0°C to –20°C	1 year
Tris Working Solution	1 M, pH 7.4	ambient	3 months
Elution Buffer	--	ambient	1 week
1X SL Buffer A Solution	--	2 - 8°C	Prepared Daily
Staining 1X wash buffer	--	ambient	3 months
Phosphate Buffered Saline (PBS) Solution, pH 7.4	--	ambient	1 week
Working DAPI stain	10µL Stock/25ml Phosphate Buffer	Ambient/Dark container	1 day

9.0 LABORATORY PRACTICES

9.1 REAGENT GRADE WATER

ASTM Type II grade water: Reagent water is analyzed for total chlorine, heterotrophic bacteria, specific conductance, pH, total organic carbon, ammonia and organic nitrogen on a monthly basis. Reagent water is tested for metals: Lead, Cadmium, Chromium, Copper, Nickel, and Zinc on an annual basis. A Use Test is performed on a quarterly basis. Reagent water used for preparing reagents must meet the following acceptance criteria:

Parameter	Limits	Frequency
Conductivity	>0.5 megaohms or <2 µmhos/cm (µseimens/cm) at 25 deg C	Monthly
Pb, Cd, Cr, Cu, Ni, Zn	Not greater than 0.05mg/L per contaminant. Collectively not greater than 0.1mg/L	Annually
Total Residual Chlorine	< 0.1 mg/L	Monthly
Heterotrophic Plate Count	<500 CFU/mL or MPN <500/mL	Monthly

9.2 GLASSWARE WASHING AND STERILIZATION PROCEDURES

Glassware washing and preparation/sterilization procedures are outlined in SOP #350414, *Steamscrubber Operation and Maintenance*, SOP #350408, *Biosafety Guidelines for Cryptosporidium Laboratory* and SOP #350412, *Cryptosporidium Laboratory Equipment Cleaning*.

Laboratory glassware and plasticware are checked for acceptability prior to use. Glassware acceptance criteria are documented in SOP #350412, *Cryptosporidium Laboratory Equipment Cleaning*.

10.0 ANALYTICAL PROCEDURES

10.1 A list of laboratory SOPs associated with the protozoan laboratory can be found in the following table:

TABLE 10.1: PROTOZOAN DEPARTMENT SOPs

This Table is subject to revision without notice

SOP #	Title
350401	Isolation & Identification of *Giardia* and/or *Cryptosporidium* in Water
350402	Method 1622/1623 Field-Filtering Sample Collection and Laboratory
350403	Method 1622/1623 Bulk Sample Collection and Laboratory Delivery
350404	Method 1622/1623 Sample Receiving
350405	Training Protocol for Method 1622/1623
350406	Data Collection and Verification for Method 1622/1623

SOP #	Title
350407	Microscope Analyst Verification
350408	Biosafety Guidelines for *Cryptosporidium* Laboratory
350409	IPR, OPR and MS Spiking Procedures and Corrective Actions
350410	IEC CRU-5000 Centrifuge Operation and Maintenance
350411	Lab-Line Multi-Wrist Shaker Operation and Maintenance
350412	*Cryptosporidium* Laboratory Equipment Cleaning
350413	Olympus BX40 Microscope Operation and Maintenance
350414	Steamscrubber Dishwasher Operation and Maintenance

10.2 The following references are used for analytical procedures conducted in the laboratory:

- EPA. Method 1623: *Cryptosporidium* and *Giardia* in Water by Filtration/IMS/FA, December 2005.
- EPA. Method 1622: *Cryptosporidium* in Water by Filtration/IMS/FA, December 2005.
- EPA. Microbial Laboratory Guidance Manual for the Final Long Term 2 Enhanced Surface Water Treatment Rule. February 2006.
- Supplement 2 to the Fifth Edition of the Manual for the Certification of Laboratories Analyzing Drinking Water, EPA 815-F-12-006, November 2012

11.0 QUALITY CONTROL CHECKS

11.1 ESC participates in proficiency testing (PT) through the analysis of spiked vials received from Wisconsin State Laboratory of Hygiene (WSLH) and analyzed according to study instructions and the ESC SOP. When the analysis is completed, the results are reported to the PT sample provider who issues the testing results as either a “pass” or “fail” to all regulatory agencies, as requested by ESC. If the laboratory fails a PT round, a follow-up test is performed in an attempt to meet the necessary requirements for proficiency. If the follow-up test results in a second failure, the laboratory takes part in re-training .

11.2 An Initial Precision and Recovery test (IPR) is performed prior to the first time the method is used and at any time the method or instrumentation is modified. The IPR consists of four reagent water samples spiked with 100-500 oocysts from a spiking vial received from Wisconsin State Laboratory. Recoveries from the IPR must fall within the EPA approved QC limits: Oocysts= 24- 100% and Cysts= 24-100%, and the Relative Standard Deviation (RSD) of the four recoveries should be less than or equal to 55% for Cryptosporidium, and less than or equal to 49% for Giardia.

11.2 An Ongoing Precision and Recovery sample (OPR) is analyzed once weekly or per 20 samples, and before any field samples are processed. The OPR is spiked with 100-500 cysts and/or oocysts from a spiking vial received from the WSLH. Recoveries from the OPR must fall within EPA approved QC limits: Oocysts = 33-100% and Cysts = 14-100%.

11.3 A Method Blank is also analyzed at least once weekly or per every 20 samples processed, and before any field samples are processed. The Method Blank must be free of test organisms and serves as a sterility control on the analytical system.

11.4 If either sample falls outside acceptance parameters, corrective action must be taken and the samples re-analyzed until the QC criteria are met. Customer samples may only be analyzed following acceptable QC sample results. Quality control information is located in SOP #350409, *IPR (Initial Precision and Recovery), OPR (Ongoing Precision and Recovery) and MS (Matrix Spike sample), Spiking Procedures and Corrective Actions.*

11.5 Customers are required to send a duplicate sample early in their sampling schedule and then again after every 20 field samples collected. This duplicate is utilized in the laboratory as a Matrix Spike (MS). The MS is spiked in the same manner and with the same number of organisms as the OPR to determine the effects of the matrix on the analytical process. The recoveries from matrix spike /matrix spike duplicates must fall within the EPA approved QC limits for oocysts= 13-111% and cysts= 15-118%.

11.6 Inter/intra-analyst precision is determined, at least monthly for verification of analyst performance to assess and maintain consistency in slide examination among analysts. Quality Control information is located in SOP #350407, *Microscope Analyst Verification*.

11.7 Control charts of OPR and MS recoveries are maintained in the laboratory. The control charts graphically display the results of continuing performance when using Methods 1623 and 1622. If recoveries fall outside the control limits, or declining trends are observed, corrective action must be taken to investigate the potential causes of the outlying result.

11.8 Positive staining controls are used to verify that the FITC and DAPI stains are fluorescing at the appropriate intensity and uniformity. Negative staining controls are examined to verify that no oocysts or interfering particles are present. Both staining controls are examined using protocols as stated in ESC SOP # 350401 and meet criteria for EPA 1623 or EPA 1622.

11.9 IMS controls are used in the event of low recoveries to rule out any IMS steps as the cause. The IMS controls are processed beginning with the IMS procedure using protocols as stated in ESC SOP #350401, and meet criteria for EPA 1622 or EPA 1623.

12.0 DATA REDUCTION, VALIDATION AND REPORTING

12.1 DATA REDUCTION

- The analyst performs the data calculation functions and is responsible for the initial examination of the finished data. Data reduction steps applied to the raw data are outlined in SOP #350401, *Isolation and Identification of*

Cryptosporidium and/or Giardia in Water and SOP #350406, *Data Collection and Verification for Method 1622/1623.*

12.2 VALIDATION

Guidelines for data validation are found in SOP #350406, *Data Collection and Verification for Method 1622/1623.* In general, data integrity involves reviewing all data entries and calculations for errors, reviewing all documentation to assure that sample information is correct and complete, and that the tests have been performed appropriately and within the appropriate sample holding times. The secondary analyst reviews the quality of data based on the following guidelines:

- The appropriate SOP is followed
- Sample preparation is correct and complete
- Analytical results are correct and complete

12.3 REPORTING

Reporting procedures are documented in SOP #350406*, Data Collection and Verification for Method 1622/1623.* Depending on the needs of the customer, one or more of the following may be included: Case narrative, Chain of Custody, Internal Chain of Custody, Final Report, Raw Data, etc. When the package involves more than just QC forms, it must contain a Table of Contents and Pagination. When the package is complete, it must be reviewed first by the Primary Analyst followed by the Department Manager or second qualified analyst. The final reviewer signs that the information is complete and the package is ready for submission to the customer. A copy of the final package must be kept on file.

13.0 CORRECTIVE ACTION

13.1 In the event that a nonconformance occurs in conjunction with the analytical batch, a corrective action response (CAR) form must be completed. The cause of the event is stated on the form and the measures taken to correct the nonconformance clearly defined. The effectiveness of the corrective action must be assessed and noted. The CARs are kept on file by the Regulatory Affairs Department. Corrective action procedures are documented in SOP #030208, *Corrective and Preventive Action*

Corrective action procedures that are specific to Cryptosporidium and Giardia analyses are documented in the SOP #350409, *IPR (Initial Precision and Recovery), OPR (Ongoing Precision and Recovery) and MS (Matrix Spike sample), Spiking Procedures.*

13.2 Required Corrective Action

Control limits have been established for each type of analysis. When these limits are exceeded, corrective action must be taken. Calculated sample spike control limits are also used.

All samples and procedures are governed by ESC's quality assurance program. General corrective actions are as follows; however additional and more specific direction is provided in the specific determinative procedure. For more information, see the appropriate determinative SOP.

13.2.1 If a spiked sample or set of samples fails to meet quality control limits

Rejection Criteria - Recoveries from the OPR fall beyond the approved QC limits.

Corrective Action - Examine the spiking suspension organisms directly. To determine if the failure of the spike is due to changes in the microscope or problem with the antibody stain, re-examine the positive staining control, check Köhler illumination, and check the fluorescence and DAPI. To determine if the failure of the spike is attributable to the separation system, check the system performance by spiking a 10mL volume of reagent water with 100-500 cysts and/or oocysts and processing the sample through the IMS, staining and examination procedures. Recoveries should be greater than 70% of the expected concentration. If the failure of the spike is attributable to the filtration/elution/concentration system, check the system performance by processing spiked reagent water according to the method and filter, stain and examine the sample concentrate. This process is performed until the cause of the failure is isolated and corrected. The sample then must be re-analyzed until acceptable results are achieved.

13.2.2 Method Blank contains positive organism when analyzed.

Rejection Criteria – The Method Blank must be free of test organisms and serves as a sterility control on the analytical system.

Corrective Action - Equipment used to process the sample may be cleaned and/or replaced. Reagents used to process the sample may be disposed of and new reagents purchased or prepared. A new method blank is prepared and analyzed. This process is repeated until the method blank passes the acceptance criteria.

13.2.3 Inter/intra-analyst precision analyses are beyond ±10%.

Rejection Criteria – Results for inter and/or intra-analyst precision must be within 10% of original results.

Corrective Action - The differences are discussed between analysts until a consensus is found.

13.2.4 Holding time on sample exceeded or not received at appropriate temperature.

Rejection Criteria - The sample not received on day of collection must be received at the laboratory at ≤ 20.0°C and not frozen, and within 96 hours holding time.

Corrective Action - The samples must be re-collected.

13.2.5 Positive and Negative staining controls fail.

Rejection Criteria - If a positive and negative staining control fails all slides that were stained in that batch have failed and samples must be re-collected.

Corrective Action - If positive staining control fails due to faintness, fading or diffusion of the DAPI stain, the holding time may be reduced, or the concentration of the DAPI staining solution may be adjusted so that fading or diffusion does not occur. This process is performed until the cause of the failure is isolated and corrected. The sample then must be re-analyzed until acceptable results are achieved.

14.0 RECORD KEEPING

Record keeping is outlined in SOP #030230, *Standards Logger, SOP #030227, Data Review* and SOP #030201, *Data Handling and Reporting*

Hard copy data of benchsheets and slide examination forms for all compliance monitoring samples, including both field and MS samples, and OPR samples and MB are archived. Benchsheets and slide examination forms for all ongoing PT samples are stored in the laboratory. Documentation for IPR and initial PT data for each method variation used for compliance samples is also archived in the laboratory.

15.0 QUALITY AUDITS

System and data quality audits are outlined in the ESC Quality Assurance Manual Version 13.0 and *SOP #010104, Internal Audits*.

16.0 REVISIONS

The Regulatory Affairs Department has an electronic version of this Quality Assurance Manual with tracked changes detailing all revisions made to the previous version. This version is available upon request. Revisions to the previous version of this appendix are summarized in the table below.

Document	Revision
Quality Assurance Manual Version 15.0 (Appendix XII)	General - Replaced the term “client” with the term “customer” Table 8.3A – Updated vendors Section 11.5 – Added MS/MSD criteria

1.0 *SIGNATORY APPROVALS*

RADIOCHEMISTRY LAB QUALITY ASSURANCE MANUAL

APPENDIX XIII TO THE ESC QUALITY ASSURANCE MANUAL

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NOTE: The QAM has been approved by the following people.

Ron Eidson, Director of Radiochemistry 918-251-2515

Jim Brn

Jim Brownfield, Compliance Director 615-773-9681

Steve Miller

Steve Miller, Quality Assurance Director, 615-773-9684

2.0 APPENDIX TABLE OF CONTENTS

3.0 SCOPE AND APPLICATION

This manual discusses specific QA requirements for general analytical protocols to ensure analytical data generated from the Radiochemistry Laboratory are scientifically valid and are of acceptable quality. Any deviations from these requirements and any deviations that result in nonconforming work must be immediately evaluated and their corrective actions documented.

4.0 LABORATORY ORGANIZATION AND RESPONSIBILITIES

ESC Lab Sciences offers diverse environmental capabilities that enable the laboratory to provide the customer with both routine and specialized services, field sampling guidance and materials, and broad laboratory expertise. A brief outline of the organization and responsibilities as they apply to the ESC Quality Assurance Program is presented in *Section 4.0 in the ESC Quality Assurance Manual.*

5.0 PERSONNEL AND TRAINING

5.1 PERSONNEL

Ron Eidson, with a BS degree in Chemistry, is the Director of Radiochemistry and is responsible for the overall production of the Radiochemistry Laboratory; including the management of the staff and scheduling. Mr. Eidson has 28 years of hands-on experience in radiochemical analyses and 25 years in Laboratory Management. He developed an expertise in uranium, radium and thorium while managing a lab at a uranium processing facility. He later launched his own radiochemical testing lab and served as Lab Director and Radiation Safety Officer for 20 years. Ron has provided radiological consultation on projects for the NRC, DoD, DOE, EPA, USACE and for many decommissioning and industrial sites. He is often called on to use his exceptional knowledge and understanding of radiochemical processes to solve complicated matrix issues. In his absence, Raymond Thomas assumes responsibility for departmental decisions in the Radiochemistry Laboratory.

Raymond Thomas , with a BS Chemistry and BA Physics, is the QA Officer for the Radiochemistry Laboratory. Mr. Thomas has 28 years of experience in radiochemical analyses. He develops, updates, and maintains Standard Operating Procedures; calibrates and maintains instrumentation for radiochemical analysis; provides an independent review and approval of analytical data and reports; and conducts internal audits.

5.2 TRAINING

5.2.1 All new analysts to the laboratory are trained according to ESC protocol. ESC's training program is outlined in *SOP 030205 Technical Training and Personnel Qualifications.* Training is intended to provide personnel with the information and guidance needed to help maintain a safe work environment for the production of quality results. The following training is provided for all employees and contract personnel:

- Radiation Safety training upon hire and annually thereafter.
- Written training through the use of laboratory Standard Operating Procedures (SOP's). Technicians must read and sign a certificate of understanding of the latest version of the SOP before they are released to perform that job.
- On the job training is used to train personnel in hands-on use of the method and instrumentation.
- Initial Demonstrations of Capability (IDOCs) and Continuing Demonstrations of Capability (CDOCs) are used to demonstrate the ability to perform a method satisfactorily.
- Analyst training records are maintained on file within the department.
- Training courses or workshops on specific equipment, analytical techniques or laboratory procedures are conducted from time to time. The documentation is retained along with other training records.
- Safety training is conducted monthly.
- Data integrity and computer security training is conducted upon hire and annually thereafter.

6.0 FACILITIES, LABORATORY SAFETY, AND LABORATORY WASTE

6.1 FACILITIES

ESC's radiochemical lab currently occupies 7500 square feet in Broken Arrow, OK.

- 24 hour monitored access for the security of samples and data
- Controlled and separated sample storage areas
- Unencumbered work spaces in each lab
- Fully integrated hood system to remove any toxic or hazardous fumes that might be evolved when using organic solvents or that may be formed during an acid digestion. The laboratory fume hood face velocity is checked monthly for optimum face velocity.
- Laboratory Information Management System (LIMS) for sample tracking
- On-site and secure data archive area
- File backup to prevent loss of data

6.2 LABORATORY SAFETY

It is management's responsibility ensure that the work environment is safe for all employees and that conditions facilitate correct performance of the environmental tests. The following are just a few measures taken at ESC:

- Sign In Log – all employees and visitors are required to sign in and out of the laboratory. The last employee present is not permitted to perform analyses alone.
- Protective Eyewear, Gloves and Lab Coats – these are provided and are to be worn at all times in the sample preparation section of laboratory.
- TLD (Thermoluminescent Dosimeter) – badges are provided for all employees and visitors to detect possible beta and gamma radiation sources and are to be worn at all times in the laboratory.
- Training – All employees receive training relevant to their particular job prior to beginning the job. Standard Operating Procedures must be read and are available to reference at all times. Monthly Health & Safety training is provided to reiterate the need for attention to detail and Radiation Safety Training is conducted upon hire and annually.
- Safety Equipment – safety showers, eyewashes and fire extinguishers are checked monthly to ensure proper functionality.
- Adequate space and equipment – are provided as available to ensure optimum safety of our employees.
- Internal Audits – are conducted at least annually to ensure laboratory procedures are conducted not only in accordance with quality standards but in a safe manner.
- Constant monitoring – Airflow, temperature and barometric pressure are monitored to ensure a comfortable environment safe from fumes.
- Radiation Surveys – All solid samples are surveyed upon receipt and segregated if radiation is found. Laboratory countertops, floors and instrumentation are frequently surveyed to prevent contamination.
- Segregation – Incompatible areas are separated; standards and samples are segregated as is glassware used for elevated samples.
- Good Housekeeping – daily, monthly and quarterly checklists are followed to ensure cleanliness.

6.3 LABORATORY WASTE

As an active member of the environmental industry, ESC is aggressively interested in the preservation and cleanup of our environment. Any waste generated in the laboratory is disposed in a responsible manner. It is a policy at ESC that all hazardous or radioactive samples and any waste corresponding to these samples are returned to the client for disposal. In this way, ESC minimizes the amount of radioactive material on site to primarily sources and standards.

Prior to disposal solid wastes and chemicals are properly labeled and packaged. They are then transported to a disposal facility. ESC's main disposal methods are:

- Non-hazardous/non rad soil samples - dumped into waste bin.
- Non-hazardous/non rad water samples - neutralized with lime or Sodium Hydroxide and flushed down sink with sufficient water to thoroughly wash out the sink and pipes.
- Lead Waste - Disposed by a licensed facility or recycled.
- Acid Waste - Neutralized with lime or Sodium Hydroxide and flushed down the acid drain with copious amounts of water.
- Organic Waste From Extractions - Disposed of by a licensed facility or recycled.
- Mercury Waste - Disposed by a licensed facility.
- Oil Waste - If toxic, the oil waste will be disposed of by returning to the client or it is transported to a disposal facility.
- Bioassay Samples – flushed down drain or stool.
- Empty chemical or acid containers are thoroughly rinsed before placing in the general trash. Empty sample containers are disposed of in the general trash after the customer's name has been made unreadable.

7.0 SAMPLING PROCEDURES AND HANDLING OF SAMPLES

7.1 SAMPLING PROCEDURES

SOP GEN-18 outlines the instructions that ESC personnel use to collect specific liquid samples from a customer. The laboratory does not currently provide services for solid samples or development of site specific, customized sampling plans. The sampling and testing directives of the customer are followed with the customer assuming responsibility for the suitability of the sampling plan and satisfaction of permit requirements.

7.2 HANDLING OF SAMPLES

The complete procedure for sample control is outlined in GEN_01. A sample is tracked at ESC from the moment it is received to a point in time that the sample can be disposed of properly. It is logged in as described below and all paper work involved is distributed to parties of interest in a timely fashion. Any special information is clearly stated to avoid delays or the possibility of missed holding times.

Sample Acceptance Policy

When a sample arrives, the sample acceptance policy is implemented by sample custodial personnel. Each sample must meet the following sample acceptance criteria or it is flagged to clearly indicate the nature and substance of the variation:

- A Chain of Custody including a unique sample identification, the date and time of collection, collector's name, preservation type, sample matrix and any special remarks concerning the sample or project;
- Proper and durable sample labeling including a unique sample identification;
- Use of appropriate sample containers and preservation;
- Adherence to specified holding times;
- Adequate sample volume to perform the necessary tests; and
- No signs of damage, contamination or leakage.

When the sample does not meet the sample acceptance criteria, ESC will:

- Retain correspondence and/or records of conversations concerning the final disposition of rejected samples; or
- Fully document any decision to proceed with the analysis of samples not meeting acceptance criteria.
- The condition of these samples will be noted on the COC and lab receipt documents.
- The analysis data will be appropriately "qualified" on the final report.

In the event holding times are exceeded or improper preservations or containers are used, the client is notified immediately. If the client approves continuation of analyses, any non-conformances are clearly stated on the final report.

Sample Survey and Inspection

Upon arrival at the laboratory, a sample container's exterior is inspected and surveyed for damage or contamination. All shipping containers should be opened in a well-ventilated area. If hazardous materials are suspected, the container will be opened under a hood.

Prior to the removal of samples, absorbent pads should be laid out to receive sample bottles. The SC will note on the Sample Log-in Sheet the following:

- Condition of container, noting any damage, etc.
- Presence/absence of COC seals and their condition
- Sample condition (intact, broken, leaking, cold or ambient, headspace, surface contamination, etc.).
- Presence/absence of sample labels.
- Compare for agreement between sample labels and COC record.
- Samples that are not listed on the COC record will be noted and the client contacted.
- Odors noticed after opening the shipping container are noted.

Sample Log-in and Labeling

All sample information from the Chain of Custody is entered into the Laboratory Information Management System (LIMS). The SC will assign a unique eight digit laboratory log number to each sample. Laboratory sample numbering is comprised of a log number followed by -01 for the first sample, -02 for the second sample, etc. If there is more than one sample container per sample (i.e. one container preserved with nitric acid for metals and three VOA vials for volatiles), the individual containers will be labeled with the proper eight digit log number plus the two digit sample ID plus the a unique letter (A,B,C etc.) for each container. A durable label containing this laboratory ID number along with the proper preservative and analyses requested is placed on the sample container for identification throughout the entire analytical process. A file folder with the log number printed on it will be created to contain all the analytical information relevant to the project including: signed airbill, signed chain-of-custody, work sheets, raw data, QC reports, analytical report, etc.

Sample Splitting and Preservation

When clients supply their own containers or when bulk samples are received, the SC will split samples and preserve according to EPA requirements giving sufficient aliquots for each analytical procedure that is to be performed. SOP GEN_01 describes sample splitting procedures in greater detail.

- Water Samples – When samples arrive that require non-rad analyses, the SC will split and label the sample into appropriate containers.
- Sediment/Soil Samples – The sample will be made homogeneous after any portion has been removed by one or all the following procedures:
    - Stirring
    - Air drying and grinding
    - Particle separation
    - Quartering

Sample Storage, Custody and Security

Sample control is primarily the responsibility of the Sample Custodian and is maintained at ESC through the use of several tracking systems designed to protect sample integrity from login to disposal or return. Samples are placed in designated storage areas except during laboratory analysis. All laboratory personnel who receive samples are responsible for the care and custody of samples from the time each sample is received until samples are returned to storage. Any subset of the sample will be kept in a designated storage area which is controlled by the sample custodian. At the beginning of every work day all the sample storage areas are unlocked by laboratory personnel. At the end of every day the sample storage areas are locked, and the laboratory is locked with a continuously monitored alarm.

Complete details are outlined in SOP GEN_01.

Sample Disposal

Upon completion of the analysis, the samples are placed on an archive list. Once a month, the SC is responsible for collecting all samples on the archive list that have been completed 30 days or more unless other arrangements have been made. Completed samples and all remains are properly disposed of or returned to the client as necessary. Any sample considered hazardous or radioactive is returned to the client for disposal.

This procedure is fully described in SOP GEN_20.

8.0 EQUIPMENT

8.1 EQUIPMENT LIST

LABORATORY EQUIPMENT LIST: MAJOR ITEMS – Rad Lab
This table is subject to revision without notice

Title	QTY	Make	Model	Serial
Chemchek KPA-11 Kinetic Phosphorescence Analyzer w/ Gilson Sample Changer and Gilson Dilutor 401 Syringe Pump	2	Chemchek	KPA-11	1418986; 649025031; 91-5050024
Canberra 2404 Alpha/Beta Counter	5	Canberra	2404	1090352; 988600/787196;488584
Packard Tri-Carb 2550TR Liquid Scintillation Counter	1	Packard	2550TR	103332
Packard Tri-Carb 2200CA Liquid Scintillation Counter	1	Packard	2200CA	102180
Canberra LB4100 Alpha/Beta Counter	3	Canberra	LB4100U2	13000001; 13000002; 13000000; 117
Canberra Genie 2000 Alpha Spectrometer System	2	Canberra	Genie 2000	see description
Canberra Genie 2000 Gamma Spectrometer System	2	Canberra	Genie 2000	see description
IRIS Intreped II Dual-View ICP	1	Therm	Intreped II	12351
Mercury Analyzer	1	Perkin Elmer	3030B	

8.2 EQUIPMENT MAINTENANCE

All equipment is properly maintained, inspected, and cleaned as an ongoing process according to SOP GEN_17.

Preventative Maintenance

ESC regularly performs preventative maintenance, such as checking fluid levels, to ensure that our equipment runs properly and smoothly with limited down time in accordance with SOP GEN_17.

Troubleshooting and Routine Maintenance

Troubleshooting begins with routine maintenance. It may be performed by ESC personnel or trained personnel from the manufacturer. A controlled log for maintenance is assigned to each instrument as well as for electrode(s). Each log is maintained by the analyst responsible for analytical performance with the particular instrumentation.

Equipment subjected to overloading or mishandling, which gives suspect results, or is proven to be defective will be placed out of service by the Laboratory Tag-Out System (GEN_05). When this occurs, previous calibrations and/or analyses are examined for any effect this may have had.

ESC has back up instrumentation to lessen down-time and ensure timely data delivery.

Equipment Checks

Equipment Check	*Frequency*
Analytical balances	Daily
Oven Temp	Daily
Frig Temp	Daily
Balance Calibration	Daily
DI Water Conductivity	Daily
Pipettes Calibrated	Quarterly
Electronic Pipets	Daily
Fire Extinguisher	Monthly/annual
Hood Velocity	Monthly
Survey Meters	Upon use/annual
Thermometers-liquid	Initial & annually
Thermometer gun	quarterly
Weights	Every 5 years
Air filters replaced	Monthly
Vacuum pump oil	Qtrly or as needed
Hood motors	Qtrly or as needed
Volumetric glassware	Initial/ as needed

8.3 INSTRUMENT CALIBRATION FOR RADIOCHEMISTRY

These and other points such as calibration and verification of reference standards can be found in the GEN_25 and method specific SOP's.

Initial Calibration

Sources used to determine detector efficiency are NIST traceable, prepared from NIST traceable or from a recognized entity such as EPA, DOE or IAEA.

Alpha Spectrometry prepared standards are to be checked by a material mass balance remaining from neodymium fluoride precipitation and rinses. Propagated uncertainties are to be determined.

Check sources are only to be used to verify calibrations and not used for efficiency determinations.

Instrument Calibration Verification

Daily source checks traceable to NIST or equivalent are used to monitor calibration. These sources are separate from the Initial calibration source. These sources are used to monitor counting efficiency, FWHM and energy calibration. Energy calibration is the only adjustment that can be made. Control charts are used to determine whether results are with control limits. Limits are 3σ outlier and 2σ warning.

Background Checks

Background count rates will be determined for each radiation detector system on a routine basis, for systems in regular use. A 1000 minute background count is performed monthly to determine the background subtraction count (BSC). Shorter background counts are performed on a daily basis to monitor contamination on detectors. Alpha Spectroscopy backgrounds are performed weekly. Where applicable, the results of these measurements will be recorded in a log and plotted on a control chart. Appropriate investigative and corrective action will be taken when the measurement value falls outside the pre-determined range of control values. For liquid scintillation counters the background sample is counted prior to samples and for the same count time.

Sample Introduction

For systems in which samples are changed manually, check sources are measured daily. For systems with automatic sample changers, it may be more convenient to include the check source within each batch of samples and thus obtain a measurement of this source within each counting cycle.

For proportional counting systems, the plateau will be checked annually at a minimum. Response to the check source will be checked daily or before each use and after each gas change. Background measurements will be daily or before each use, to ensure that background radiation levels are within the expected range. For systems with automatic sample changers, background or reagent blank measurements will be included within each measurement cycle.

Alpha & Gamma Spectrometers

For alpha and gamma-ray spectrometry systems, energy calibration sources will be counted to determine the relationship between channel number and alpha or gamma-ray energy. The frequency of energy calibration checks depends on the stability of the system, but usually is performed daily for gamma spec. and alpha spec. The results of these measurements will be recorded and compared to predetermined limits to determine whether or not system gain and zero level need adjustment. Adjustments will be made as necessary.

Additional checks needed for spectrometry systems are the energy resolution of the system and the count rate of a check source. These will be performed daily or before each use and after system changes, such as power failures or repairs. This is to determine if there has been any significant change in the system. The results of these measurements will be recorded when the system is in use.

8.4 INSTRUMENT CALIBRATION FOR INORGANICS

Initial Calibration – Inductively Coupled Plasma

Prior to use, the Inductively Coupled Argon Plasma (ICP) is calibrated for every element and every line to be used. A daily calibration with a minimum of five points. The lowest point on the curve must be at or less than the LOQ. The r2 (linear regression) must be greater than or equal to 0.995 to ensure that the instrument has been calibrated accurately.

Continuing Instrument Calibration – Inductively Coupled Plasma

Initial Calibration Verification (ICV) is analyzed immediately following the standards. The ICV is from a different source as the standards and the result of the ICV must fall within 10% of the true value. The Continuing Calibration Verification (CCV) is from the same source as the standards and is analyzed after every ten samples and also must fall within 10% of the true value.

Mercury Analysis

All samples and standards are prepared and analyzed under E.P.A. Method 245.1 or 7470A/7471A. A five point standard curve is used with the sixth point going through zero. The r2 (linear regression) must be greater than or equal to 0.995 to ensure that the instrument has been calibrated accurately. Initial Calibration Verification (ICV) is analyzed immediately following the standards. The ICV is from a different source as the standards and the result of the ICV must fall within 10% of the true value. The Continuing Calibration Verification (CCV) is from the same source as the standards and is analyzed after every ten samples and also must fall within 20% of the true value.

9.0 LABORATORY PRACTICES

9.1 REAGENT GRADE WATER

ASTM Type II (DI) water is used in the laboratory for dilution, preparation of reagent solutions, and the final rinsing of glassware. It is free from interferences and other contaminants. After passing through two ion exchange canisters and one carbon filter canister, water purity is monitored by an indicator light at each outlet and at the filtration apparatus, and checked daily for conductivity.

9.2 GLASSWARE

Class A volumetric glassware is used by the laboratory for measuring trace constituents in organic and inorganic analysis. Laboratory contamination is minimized by using disposable beakers for digestion purposes when applicable. The Standard Operating Procedure GEN_15 for glassware and labware cleaning is followed to ensure the removal of all traces of parameters of interest and contaminants that could interfere with analysis.

10.0 ANALYTICAL PROCEDURES

10.1 A list of laboratory SOPs associated in the Radiochemistry Laboratory.

11.0 QUALITY CONTROL

NOTE: For specific guidance on each determinative method, including required quality control and specific state requirements/modifications, refer to the relevant laboratory standard operating procedure(s).

<u>Method Blanks</u>

A method blank is analyzed for each batch of 20 samples or less (5%) for each test method. ASTM Type II (DI) water is used in preparation of method blanks.

<u>Standards</u>

Reference standards will be used to determine counting efficiencies for specific radionuclides and calibration check standards for ICP, CV.Calibration Standards have to be certified by the National Institute of Standards and Technology (NIST), Environmental Protection Agency (EPA) or suppliers who participate in measurement assurance activities with NIST.

Chemical Standards will be prepared using methods reflecting a state of the analytical art and materials of known purity. Commercial chemical standards used will be traceable to NIST or certified by the EPA. Physical Standards and measuring devices will have currently valid calibrations traceable to national standards, primarily NIST.

Calibration certificates, when available, will indicate the traceability to national standards of measurement and will provide the measurement results and associated uncertainty of measurement and/or a statement of compliance with an identified metrological specification. These records can be found in the Quality Assurance Department.

Where traceability to national standards of measurement is not applicable, ESC Lab will provide satisfactory evidence of correlation of results, for example by participation in a suitable program of inter-laboratory comparisons, proficiency testing, or independent analysis.

Determination of QC Limits

Control Charts are generated annually and reestablished after major changes for all analyses routinely performed and are used for trend analysis. Control limits are based on E.P.A. and DoD method recommendations and are +/- 3 times the standard deviation and the warning limits are +/- 2 times the standard deviation. If the control limits exceed the EPA/DoD control limits then the EPA/DoD control limits are used.

Method for Handling Outliers

The method for handling outliers is based on Quality Control, split, and Performance Evaluation Study Program samples. If a LCS sample fails to fall within control limits it will be reanalyzed. If the LCSsample proves to be within specifications, the group of samples the LCS represents will be reanalyzed. If the LCS remains outside control limits, the samples will be re-prepared along with a known standard to identify the problem and where in the process the problem may be occurring.

12.0 DATA COLLECTION, REDUCTION, VALIDATION, AND REPORTING

12.1 DATA COLLECTION

All bench chemists document sample preparation activities in laboratory notebooks. These serve as the primary record for subsequent data reduction. The Alpha/Beta counters generate printouts that are used for calculations generated by a computer or worksheets. The data for alpha and gamma spectrometry, ICP and CV analyses are generated by stand-alone computers. Results of each analysis are transcribed onto Excel spreadsheets specific to the particular analysis. Concentrations of the analytes found in the analysis are expressed according to the required units, depending on the sample matrix.

Any manual integrations for ICP are documented in the raw data records to show a complete audit trail before and after the manual integration to permit reconstruction of the results. This requirement applies to all analytical runs including calibration standards and QC samples. The person performing the manual integration signs and dates each chromatogram and documents the rationale for performing manual integration (electronic signature is acceptable).

12.2 DATA REDUCTION

Gross Alpha/Beta Results – Calculations are performed on a spreadsheet which calculates the counting efficiency of each sample according to the amount of solids present on the counting planchet. Count times are determined according to the MDA required by the client.

Alpha Spectrometry Results – Calculations are based on the specific area of a target peak along with the addition of a tracer. The target isotope is determined by energy and tracer recovery. In some instances the tracer has to be determined using a gamma spectrometer instead of the alpha spectrometer.

Gamma Spectrometry Results – Calculations are performed for each isotope after its identification is determined. The activity of each isotope is determined using a calibration curve and the peak area of each isotope.

Uranium Analyzer Results – Calculations are performed on each sample by entering the sample aliquot and final volume into the KPA computer prior to analysis. The final results will be rounded to the nearest 0.1 ug/L or three (3) significant figures if the results are larger than 10.

Inductively Coupled Plasma (ICP) – Calculations are based upon the emission intensity given off at a certain wavelength. The final calculations are done by the computer system by comparing intensity of sample against the intensity of known standards.

Atomic Absorption Spectrometry (CV) – Calculations are based on the amount of photometric absorbance at a particular wavelength by a specific metal. The final calculation is done by a computer system by comparing absorbance of sample against the absorbance of known standards.

12.2 VALIDATION

All analytical data must undergo a multi-tiered review process prior to being reported to the customer. Data review is the process of examining data and accepting or rejecting it based on pre-defined criteria. These review steps are designed to ensure that reported data is free from errors and any non-conformances are properly documented. Standard Operating Procedure GEN_3 addresses data review in detail.

12.3 REPORTING

The final report is generated when all sample analyses are completed, reviewed and approved. The procedure for analytical reporting is GEN_03.

Any discrepancies encountered during the analysis of the samples are to be stated in the Case Narrative. The Case Narrative will discuss any problems encountered during the routine analysis of the samples. The Case Narrative will be printed on lab letterhead as page one of the final report and will be paginated.

After issuance of the report, the lab report will remain unchanged. Material amendments to an analytical report after issue will be made only in the form of a further document, or data transfer including the statement ”Supplement to Analytical Report”, or equivalent wording. Such amendments will meet all the relevant requirements of the TNI and DoD Standard.

13.0 RECORD KEEPING

SOP GEN_3 outlines the complete procedure.

All records, certificates and reports are stored safely and securely and are held in strict confidence. Records which are stored on electronic media are supported by the hardware and software necessary for their retrieval and have hard copy or write-protected backup copies. Access to archived information relating to project files on the LIMS is protected against unauthorized access or amendment. Access to other archived information is documented with an access log. Records are protected against fire, theft, loss, environmental deterioration, vermin and, in the case of electronic records, electronic or magnetic sources. Records are maintained or transferred according to the client’s instructions in the event the laboratory transfers ownership.

All documents (data and records pertaining to the laboratory and its’ quality system, customers, personnel or business transactions) are maintained for a minimum of 7 years. Drinking water is held for 10 years. Prior to destruction, ODEQ drinking water compliance and bioassay customers are notified.

14.0 REVISIONS

The Regulatory Affairs Department has an electronic version of this Quality Assurance Manual with tracked changes detailing all revisions made to the previous version. This version is available upon request. Revisions to the previous version of this appendix are summarized in the table below.

Document	**Revision**
Quality Assurance Manual Version 15.0 (Appendix XIII)	Appendix origination – Incorporated necessary elements in previous stand-alone quality manual with effective date of 1/18/16 to produce this appendix.

End of Document

QUALITY MANUAL

FEBRUARY 2018

SVL's Quality Manual meets the quality requirements as set forth in the 2016 TNI Standard

Michael S. Desmarais

Quality Manual

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Effective Date: 02/12/2018

Signatories:

______________________________	______________
President and CEO Nan S. Wilson	Date
______________________________	______________
Laboratory Director John R. Kern	Date
______________________________	______________
Quality Manager Michael Desmarais	Date
______________________________	______________
Project Manager Heather LaPierre	Date
______________________________	______________
Project Manager Dianne Gardner	Date
______________________________	______________
Technical Director Kirby L. Gray	Date
______________________________	______________
Systems Manager Brandan Borgias	Date
______________________________	______________
Supervisor Inorganic Instrument Department Danny Sevy	Date

Table of Contents

1.0 QUALITY POLICY STATEMENT

SVL Analytical, Inc. (SVL) recognizes that an effective quality system is paramount to providing analytical data that is scientifically meaningful, legally defensible, technically accurate, and based upon the highest ethical standards. To reinforce the above objectives, SVL has committed itself to follow and be in compliance with the 2016 TNI Standards.

The emphasis of SVL's Quality Manual (QM) and quality system is to define control procedures/documentation for receipt, handling, and storage of samples; preparation and storage of standards; calibration and maintenance of analytical equipment; performance of analytical methods; customer service; and the generation, review, and reporting of analytical data.

At SVL, quality assurance begins with the definition of Data Quality Objectives (DQOs) and continues on through data reporting. Control procedures are defined for every step of the program as detailed in SVL's Standard Operating Procedures (SOPs). SVL realizes that without these controls (in all phases of the analytical process), data may become suspect and hence of less value to our clients. Therefore, SVL is committed to providing data of the highest quality, usability, and defensibility for every project undertaken. SVL personnel are required to familiarize themselves with all quality documentation (including this manual) used at SVL and they are required to comply with all policies and procedures outlined therein.

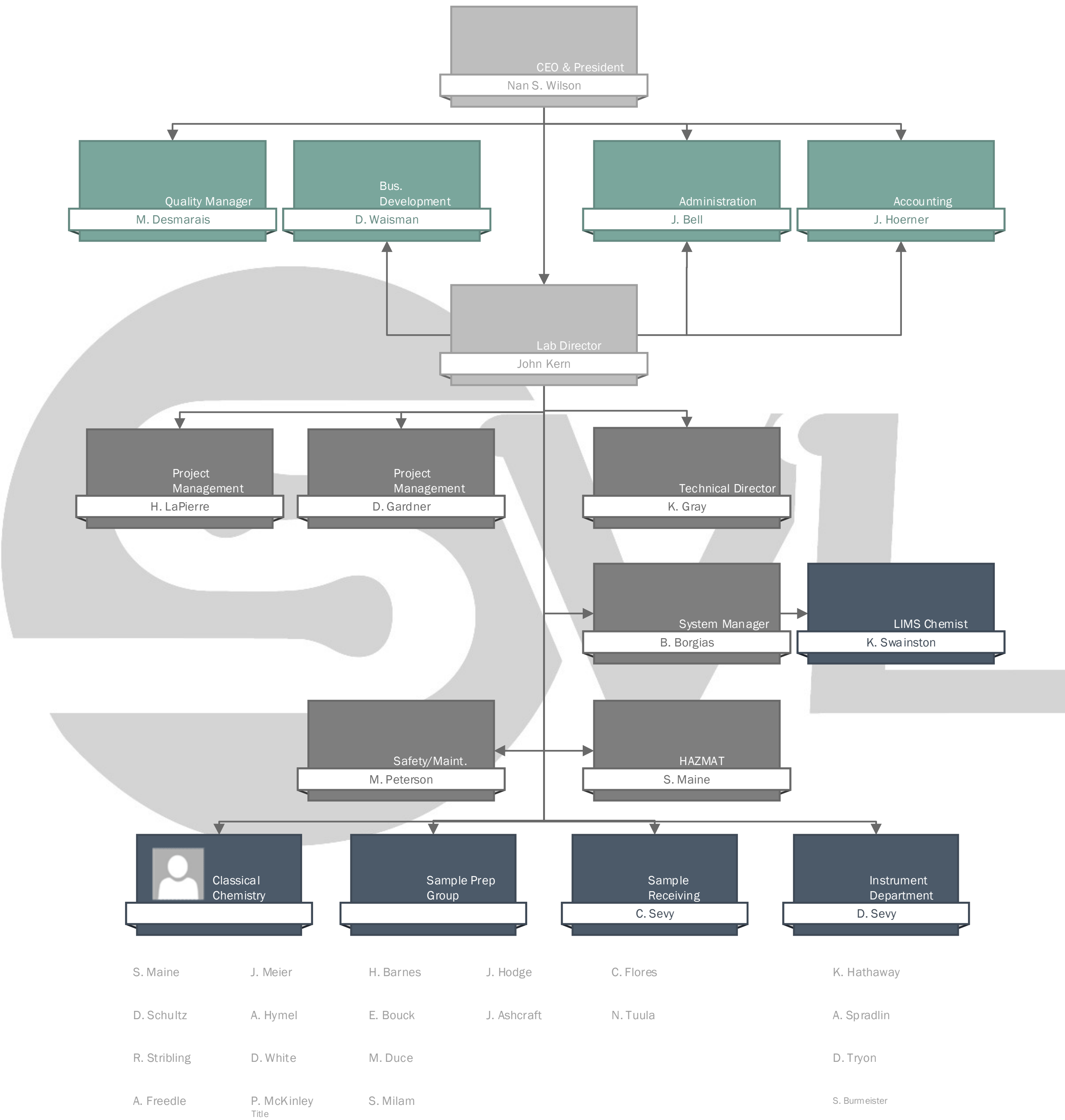
SVL's technical management team and Quality Manager ensure that this QM complies with all applicable TNI Quality System Standards and sees that it is reviewed annually and revised as needed. Evidence of signatory approval by senior management of this QM and SVL SOPs are available in PDF format by request.

SVL's commitment to client confidentiality (including national security concerns) and their proprietary rights is paramount to all operations conducted within its quality system; as such, a signed confidentiality statement is maintained in each employee's personnel file.
After reading this document employees are required to sign a signature page. By signing, the employee confirms that they have read, understood, and will comply with the Quality Manual and the TNI Standards it is based upon.

2.0 ORGANIZATION AND STRUCTURE

The organizational structure of SVL follows a traditional scheme of management with a few modifications. The President/CEO is at the top of the chain of command followed immediately by the Laboratory Director, Quality Manager, Business Development and Accounting/Human Resources. The following supervisors/departments are managed under the Laboratory Director or designee: Project Management, Business Development, Accounting/Human Resources, Administration, Maintenance, Technical Director, Safety and HAZMAT, Classical Chemistry, Instrument Lab and Systems Manager. The Systems Administrator and LIMS Chemist report to the Systems Manager. All non-metals and classical chemistries report to the Classical Department Supervisor. Metals and extraction/preparation groups report to the Instrument Lab Department Supervisor.

2.1 Organization Chart



2.2 Employee List

Position	Employee	Degree	Years of Lab Experience
President and CEO	Nan S. Wilson	BS 1996	21
Laboratory Director	John R. Kern	MS 1982	34
Quality Manager	Michael Desmarais	BS 1995	20
Technical Director	Kirby L. Gray	BS 1972	34
Systems Manager	Brandan A. Borgias	PhD 1985	36
Safety Officer/Maintenance	Mike Peterson		1
LIMS Chemist	Kale Swainston	BS 1998	19
Accounting	Jena Hoerner		4
Project Manager	Dianne Gardner	BA 1987	13
Project Manager	Heather LaPierre	BS 2009	9
Business Development Manager	Dave Waisman	MS 1985	23
Supervisor Inorganic Instrument	Danny Sevy		31
Systems Administrator	Paul McClearn		2
ICP Spectroscopist	Anne Spradlin	BA 1983	31
IC Chemist	Samantha Burmeister	BS 2014	3
ICP-MS and GFAA Analyst	Kevin Hathaway		31
ICP Analyst	David Tryon		13
CVAA Analyst	Mark Duce		1
Chemist/HAZMAT	Sherry Maine	MS 2004	16
Chemist	Alex Hymel	BS 2011	6
Chemist	Dan White	BA 2013	4
Chemist	Sophie Milam	MS 2014	2
Analyst	Heidi Barnes		14
Analyst	Jim Hodge		50
Analyst	Payton McKinley		1
Analyst	Debbie Schultz		15
Analyst	Anita Guzman-Freedle	BS 1979	9
Analyst	Eric Bouck		9
Analyst	Robin Stribling		11
Analyst	Jerry Meier		7
Analyst	Judy Ashcraft		46
Sample Receiving Officer	Crystal Sevy		14
Sample Receiving	Cindy Flores		15
Sample Receiving	Nancy Tuula		1
Administration	Jennifer Bell		<1

2.3 Key Employee Resumes

See Resumes pg. 61.

3.0 JOB DESCRIPTIONS

3.1 Laboratory Director

The Laboratory Director supervises day-to-day operations of the laboratory. Responsible for monitoring standards of performance in quality control and quality assurance, for monitoring the validity of the analyses performed, and data generated by the laboratory. The Laboratory Director holds a weekly staff meeting to discuss client and technical/systems issues.

3.2 Systems Manager

The Systems Manager supervises operations of the Information Technology groups. The Systems Manager uses Excel, Crystal Reports, and other software to develop and maintain client reports and electronic data deliverables (EDDs). Element is the Laboratory's Information Management System (LIMS) and the Systems Manager works with the LIMS Chemist to make sure that Element meets the needs of SVL. The Systems Manager also works with the Systems Administrator to ensure that our information systems and licenses are up to date.

3.3 Department Supervisor

Department supervisors conduct the day-to-day operations of the analytical departments. They are responsible for department safety and analyst training. They are also responsible for review of out-going analytical data.

3.4 Quality Manager

The Quality Manager is responsible for implementation of the laboratory's quality system. The Quality Manager manages the performance testing and NPDES programs. The Quality Manager obtains and maintains laboratory accreditations and is responsible for external and internal audits. He constructs, revises, reviews, and approves SOPs, conducts staff training, training in integrity, and quality systems. He manages the CAR/PAR program. He is a participating TNI member.

3.5 Project Manager (PM)

PMs are responsible for sending out requests for proposals, QAPP review, project set-up, verifying sample receipt against project set-up, workflow co-ordination, work review (including checks – e.g. cation/anion balance), reporting, and customer follow up.

3.6 Technical Director

Technical Directors provide technical support to laboratory staff and provides initial and final reviews of analytical data packages. Other responsibilities include Level III reporting.

3.7 Safety

The Safety Officer is responsible for revising the Chemical Hygiene Plan annually, conducts safety training and oversees response teams. Other duties include providing accident reports to the state.

3.8 Hazmat Officer

Hazmat Officer is responsible for overseeing SVL's hazardous waste program (including setting up employee 8-hour refresher courses annually).

3.9 Bench Chemist

Degreed personnel with science based degrees are titled "Chemist." Non-degreed or non-science degreed personnel are titled "Analyst." Some analysts were grandfathered in as instrument operators at the time SVL became NELAC accredited. Both are responsible for understanding and implementing the following: analytical methods, SOPs, chemical and reagent use, instrument operation, the review of data and logbooks, maintenance, and safety. They are also responsible for reading and understanding the Quality Manual and Chemical Hygiene Plan.

4.0 APPROVED LABORATORY SIGNATORIES

The Laboratory Director John Kern, Systems Manager Brandan Borgias, Technical Director Kirby Gray, Project Managers Dianne Gardner and Heather LaPierre, have full authority to sign off on reports. Department Supervisor Danny Sevy is an approved laboratory signatory for instrumental analytical reports. LIMS Chemist Kale Swainston, and Quality Manager Michael Desmarais have report generation privileges.

5.0 RECORDS AND DOCUMENT CONTROL

All records and documents are kept for 5 years unless otherwise specified by client contract. Electronic instrument data and LIMS data are kept for 10 years.

5.1 Standard Operating Procedures (SOPs)

The Quality Manager retains the master copies of SOPs. Electronic copies are available on the laboratory's computer network. Signed and dated SOPs are available by request in PDF format. All SOPs are scheduled for review each year. Electronic copies are available on the laboratory network on the date of the Quality Manager's final review. The SOP's effective date is two weeks or sooner after the date the Quality Manger signs the controlled copy. When a revision is created, the previous version is removed from the master file and electronic database. The retired controlled copy is retained in the SOP archive file for 5 years.

5.2 Quality Manual (QM)

The Quality Manager retains the controlled copy of the QM. The QM is scheduled for review annually or when revisions are necessary. Management may make hard copies available to accrediting authorities, laboratory staff and clients as needed; otherwise, the QM is available in electronic format. A signed and dated QM is available by request in PDF format. When a revision is created, copies are sent out to our accrediting bodies and previous versions are removed from use. The retired controlled copy is retained in the QM archive file for 5 years.

5.3 Analytical Data

Project Management retains any hard copy analytical data, including calibration records and quality control for 5 years. Electronic data is recorded and backed up. Electronic data is retained for 10 years. Documents are secured in storage containers or maintained on secured hard drives, reference SOP SVL 1017.

5.4 Training Records

The Quality Manager maintains records of analyst training and proficiency; reference SOP SVL 1010. All training documents are secured in the QA Office for 1 year and then transferred to a storage container for 4 years.

5.5 Performance Testing Samples

The Quality Manager maintains records of analysis of performance testing samples and the reports associated with the analyses. Reports are stored in the Quality Managers Outlook account under Inbox/ERA or Inbox/RTC. Proficiency reports are retained for 5 years.

5.6 External and Internal Audits

The Quality Manager retains records of external and internal audits. Reports are stored in Quality Managers office. Records are retained for 5 years.

5.7 Corrective Action Reports (CARs)

CARs are kept electronically, they can be found at H:\QA\CARs\Closed CARS. CARs are retained for 5 years.

5.8 Laboratory Logbooks

SVL controls the issue, use, and closure of laboratory logbooks. The process is described in SOP SVL 2017. SVL uses electronic logbooks whenever possible. Examples of logbooks may include: the conductivity of laboratory water, preparation of reagents and standards, preparation of samples, calibration of balances, calibration of micropipets, volumetric pipets and repipettors, maintenance of instruments, temperatures of ovens and refrigerators, etc. The Quality Manager assigns and archives logbooks. Archived logbooks are secured in storage containers. Logbooks are retained for 5 years.

5.9 Chain of Custody (COC)

Project Managers are in charge of COC retention; they are currently held for five years, unless a longer time is required by contract. Sample log-in and job creation are maintained in SVL's LIMS. COCs and sample receiving check-in sheet are scanned into PDF format, which can be accessed through Element. Hard copies of the documents are secured in storage containers.

5.10 Analytical Reports

Project Managers create and retain both hardcopies and PDFs of analytical reports. Hard copies of analytical reports are stored in secured storage containers (for five years) to protect them from damage. Electronic versions are backed-up for ten years (see SVL 2021).

5.11 Backup and Storage of Electronic Data

5.11.1 The process is performed using a combination of Windows Scheduled tasks to copy instrument data from local instrument PCs to the primary lab server (SVLDC1) and Veritas Back-up Exec 15 running on the SVL-CLOUD server; reference SOPs SVL 2020 and 2021.

5.11.2 The Central Computer Office, or designee, maintains the server/client network. Data written to the network is backed-up following a set schedule. Backups are scheduled for weekly full backups and incremental backups between those full backups. Individual instrument PCs, key management email files, the MAS 90 accounting system, and the ELEMENT LIMS SQL servers are covered under SVL 2021. Full backups are stored in a secure onsite fire proof safe located within SVL's vault. Electronic files are stored for 10 years (longer if required by contract).

6.0 TRACEABILITY OF MEASUREMENTS

6.1 Chemicals and Reagents

Chemicals and reagents are governed under SOP SVL 1032.

SVL uses reagent grade or better chemicals. Some equivalent grades are "VWR Omni-Trace", "Fisher Trace Metals", "Baker Instra-Analyzed", "Baker A.C.S.", "Baker Analyzed", "Fisher A.C.S.", and "Fisher Certified". SVL requires a certificate of analysis or purity (certificates are scanned and attached in Element) for stock standards and reagents. Upon receipt, all chemical containers are labeled and entered into SVL's LIMS.

SVL records the preparation of reagents and standards in controlled logbooks or electronically in the LIMS. The initials of the preparer, the date prepared, "Reference" should match manufacture's date unless one isn't supplied then it is assigned as the date received, the lot number and amount of stock materials, the final volume, the matrix, instructions for preparation, and the expiration date are all recorded. A label is created within the LIMS with unique identifiers attached to all aliquots of the reagent/standard.

Preparation instructions are included in the SOPs for standards and reagents used in the analytical methods. SVL labels containers of prepared reagents and standards with their contents, a unique reference number, date prepared, disposal (expiration) date and a perceived hazard warning. Every aliquot is assigned a unique identifier.

SVL routinely obtains reference standards from commercial sources. These standards are used to check and document the concentration of calibration standards and validate method QC requirements.

SVL stores reagents and standards separately from samples.

Standards that are made "daily" are made by the instrument operator on that day and will maintain the assigned Element ID until any component is changed at which time a new Element ID will be assigned.

6.2 Water

The primary reagent water in the laboratory is furnished by a reverse osmosis system followed by a micropore filter with an ion-exchange resin cartridge. This satisfies the specifications of ASTM Type II water. When Type I (18 MΩ-cm) water is required, SVL inserts a four-cartridge ion-exchange system or a Millipore Synergy UVR into the DI water line. SVL measures and records the resistivity of the laboratory water each weekday.

7.0 TEST METHODS

7.1 Analyses Performed by SVL

SVL routinely performs the following analytical methods:

ANALYTE	METHOD	TECHNIQUE
Aluminum	EPA 200.7, SW846 6010D	ICP
Antimony	EPA 200.7, SW846 6010D	ICP
Antimony	EPA 200.8, SW846 6020B	ICPMS
Arsenic	EPA 200.7, SW846 6010D	ICP
Arsenic	EPA 200.8, SW846 6020B	ICPMS
Barium	EPA 200.7, SW846 6010D	ICP
Barium	EPA 200.8, SW846 6020B	ICPMS
Beryllium	EPA 200.7, SW846 6010D	ICP
Beryllium	EPA 200.8, SW846 6020B	ICPMS
Bismuth	EPA 200.7, SW846 6010D	ICP
Boron	EPA 200.7, SW846 6010D	ICP
Boron	EPA 200.8, SW846 6020B	ICPMS
Cadmium	EPA 200.7, SW846 6010D	ICP
Cadmium	EPA 200.8, SW846 6020B	ICPMS
Calcium	EPA 200.7, SW846 6010D	ICP
Chromium	EPA 200.7, SW846 6010D	ICP
Chromium	EPA 200.8, SW846 6020B	ICPMS
Chromium, Hexavalent	SM 3500 CR B	Colorimetry
Cobalt	EPA 200.7, SW846 6010D	ICP
Cobalt	EPA 200.8, SW846 6020B	ICPMS
Copper	EPA 200.7, SW846 6010D	ICP
Copper	EPA 200.8, SW846 6020B	ICPMS
Gallium	EPA 200.7, SW846 6010D	ICP
Gold	EPA 200.8	ICP-MS
Iron	EPA 200.7, SW846 6010D	ICP
Lanthanum	EPA 200.7, SW846 6010D	ICP
Lead	EPA 200.7, SW846 6010D	ICP
Lead	EPA 200.8, SW846 6020B	ICPMS
Lithium	EPA 200.7, SW846 6010D	ICP
Magnesium	EPA 200.7, SW846 6010D	ICP
Manganese	EPA 200.7, SW846 6010D	ICP
Manganese	EPA 200.8, SW846 6020B	ICPMS

ANALYTE	**METHOD**	**TECHNIQUE**
Mercury	EPA 245.1, SW846 7470A, 7471B	CVAA
Molybdenum	EPA 200.7, SW846 6010D	ICP
Molybdenum	EPA 200.8, SW846 6020B	ICPMS
Nickel	EPA 200.7, SW846 6010D	ICP
Nickel	EPA 200.8, SW846 6020B	ICPMS
Phosphorous	EPA 200.7, SW846 6010D	ICP
Potassium	EPA 200.7, SW846 6010D	ICP
Scandium	EPA 200.7, SW846 6010D	ICP
Selenium	SM 3114C	Hydride AA
Selenium	EPA 200.7, SW846 6010D	ICP
Selenium	EPA 200.8, SW846 6020B	ICPMS
Silica	EPA 200.7	ICP
Silicon	SW846 6010D	ICP
Silver	EPA 200.7, SW846 6010D	ICP
Silver	EPA 200.8, SW846 6020B	ICPMS
Sodium	EPA 200.7, SW846 6010D	ICP
Strontium	EPA 200.7, SW846 6010D	ICP
Thallium	EPA 200.7, SW846 6010D	ICP
Thallium	EPA 200.8, SW846 6020B	ICPMS
Tin	EPA 200.7, SW846 6010D	ICP
Titanium	EPA 200.7, SW846 6010D	ICP
Tungsten	EPA 200.8	ICPMS
Uranium	EPA 200.8	ICPMS
Vanadium	EPA 200.7, SW846 6010D	ICP
Vanadium	EPA 200.8, SW846 6020B	ICPMS
Zinc	EPA 200.7, SW846 6010D	ICP
Zinc	EPA 200.8, SW846 6020B	ICPMS
Zirconium	EPA 200.8	ICPMS
Acidity	SM 2310 B	Automated Titration
Alkalinity	SM 2320 B	Automated Titration
Ammonia	EPA 350.1	Automated Colorimetry
Bromide	EPA 300.0	Ion Chromatography
Chemical Oxygen Demand	EPA 410.4	Colorimetry
Chloride	EPA 300.0	Ion Chromatography
Color	SM 2120 B	Colorimetry
Conductivity	EPA 120.1	Wheatstone Bridge
Corrosivity	SM 2330 B	Langelier Index
Cyanide, Total	EPA 335.4, Kelada-01, SW 846 9012 B	Automated Colorimetry
Cyanide, Free	ASTM D-7237-10	Amperometry
Cyanide, WAD	SM 4500 CN I	Automated Colorimetry
Dissolved Organic Carbon	SM 5310 B	Combustion
Fluoride	EPA 300.0	Ion Chromatography
Hardness	SM 2340B, Ca as $CaCO_3$ by 200.7	ICP Sum
Ignitability	SW846 1010A	Pensky-Martin
Nitrate	EPA 300.0	Ion Chromatography
Nitrate + Nitrite	EPA 353.2	Automated Colorimetry
Nitrate + Nitrite	EPA 300.0	Ion Chromatography

ANALYTE	METHOD	TECHNIQUE
Nitrite	EPA 300.0	Ion Chromatography
Odor	SM 2150B	Sniff Panel
ortho-Phosphate	SM 4500 P E	Colorimetry
pH (aqueous)	SM 4500-H^+ B	Electrometric
pH (soil)	EPA 9045C&D	Electrometric
Paste pH	EPA 600/2-78-054	Electrometric
Phosphate, Total	SM 4500 P E	Persulfate Digestion
Residue, Filterable (TDS)	SM 2540 C	Gravimetric
Residue, Non Filterable (TSS)	SM 2540 D	Gravimetric
Specific Conductance	EPA 120.1, SM 2510 B	Wheatstone Bridge
Sulfate	EPA 300.0	Ion Chromatography
Sulfide	SM 4500 S^{-2} F	Titrimetric
Surfactants (MBAS)	SM 5540 C	Colorimetry
Total Nitrogen	D 5176-91	Combustion
Total Solids	SM 2540 B	Gravimetric
Total Dissolved Solids	SM 2540 C	Gravimetric
Total Kjeldahl Nitrogen	EPA 351.2	Automated Colorimetry
Total Organic Carbon	SM 5310 B	Combustion
Total Organic Carbon	EPA 600/2-78-054	Titrimetric
Total Settable Solids	SM 2540 D	Gravimetric
Total Volatile Solids	SM 2540 E	Gravimetric
Turbidity	EPA 180.1	Nephelometric
TCLP (Toxicity Characteristic Leaching)	SW846 1311	Extraction
SPLP (Synthetic Precipitation Leaching)	SW846 1312	Extraction
STLC (Soluble Threshold Limit Concentration)		Extraction
MWMP (Meteoric Water Mobility)	ASTM E2242-13, X1.3	Extraction
CA-WET (California Waste Extraction Test)		Extraction
Cyanide Extraction	ASTM D-7275-11A	Extraction
CEC (Cation Exchange Capacity)	SW846 9081, 9080	Exchange
Specific Gravity	ASA 9	Displacement
ANP (Acid Neutralization Potential)	EPA 600/2-78-054	Combustion
NCV (Net Carbonate Value)	EPA 600/2-78-054	Combustion
NAG (Net Acid Generation)	EPA 600/2-78-054	Combustion
ABA (Acid Base Account)	ASTM E 1915-11 & EPA 600/2-78-054	Combustion
Total Sulfur + Sulfur Forms	EPA 600/2-78-054	Combustion
Total Carbon	ASTM E 1915-11	Combustion
Textural Class	EPA 600/2-78-054	Hydrometer
Arsenic Speciation	EPA 200.8 with LC	ICP-MS
Iron Speciation	HACH-8146	Colorimetry

ANALYTE	METHOD	TECHNIQUE
Oxidation Reduction Potential	SM 2580 B	Electrode
Loss on Ignition	Soil & Plant Analysis Council	Gravimetric
Percent Silica	ASTM D-2795 and D-3682-78	Colorimetry
Tot Suspended Particulates	40 CFR 50, App B amend 12/6/82	Gravimetric
Flash Point	SW-846 1010A, ASTM D93-80	Pensky-Martin

6010B, 6020 and 7471A are maintained for those states that haven't implemented the EPA request to use the current promulgated method.

7.2 References

2016 TNI Standard.

Methods for the Determination of Metals in Environmental Samples Supplement I, EPA/600/R-94/111, May 1994.

Methods for the Determination of Inorganic Substances in Environmental Samples, EPA/600/R-93/100, August 1993.

Field and Laboratory Methods Applicable to Overburden and Minesoils, EPA 600/2-78-054.

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW 846), Third Edition, Update V, August 2015.

Standard Methods for the Examination of Water and Wastewater, 22nd Edition, 2012

ASTM Book of Standards, part 31.

Soil Testing and Plant Analysis, 3rd Edition, Soil Sciences Society of America, 1990.

American Society of Agronomy, "Methods of Soil Analysis" Number 9, Parts 1 and 2.

U.S. Department of Agriculture, Handbook #60.

U.S. Department of the Interior, Bureau of Reclamation, Procedure for Determining Moisture, Ash, and Organic Content of Soil, USBR 5430-89.

Manual for the Certification of Laboratories Analyzing Drinking Water, Fifth Edition.

40 CFR Method Update Rule, December 15, 2016.

8.0 NEW WORK

Project Management discusses new work with clients before the work is received. If the work being requested involves tests not usually performed by SVL, the project is discussed with Department Supervisors to determine if the work can be accepted. Quotes and projects are logged so that there is no confusion about what is expected by the client. If work is received that does not adhere to the guidelines put forth in the quote or project, the client will be contacted for clarification. It is SVL's responsibility to inform the client that appropriate tests and/or calibration methods have been selected that are capable of meeting the client's requirements. Occasionally SVL will receive a work order with no prior notification that requests unusual tests, or tests to be conducted in a time frame not suitable for the work requested. When this occurs, Project Managers will determine if the work can or should be accepted. Routine work from established clients normally is not reviewed with the clients before jobs are set up, unless there is a problem with sample integrity or problems with information that is presented/not presented on the COC.

Project Management reviews and makes available in LIMS, the parameters associated with a client's project (project or work order memos shall be attached when special instructions are involved). A schedule is accessible for the work that has been received; this allows the staff to plan workloads and to track jobs. Project Management shall review all work orders. Adjustments to work schedules and staff deployment are made based upon the workload. Department supervisors keep equipment and supplies on hand for routine work and for many non-routine tests as well. For further detail regarding the above, see SOP SVL 1027.

8.1 Sample Acceptance Policy

Samples received at SVL will be accepted for testing (without qualification) if the following criteria are all met at the time of sample receipt:

8.1.1 A proper SVL or client COC will accompany the sample shipment and must be completed in full (unless a project number is specified and is on file with SVL), including but not limited to; the client's name, address, phone number/fax number/email address, contact person, unique sample identification of individual samples, sample locations (if applicable), date and time of collection, collector's name, preservative type, sample matrix, filtered or unfiltered, number of bottles, analytes and/or tests to be performed, method of analysis, and any comments concerning sample specifics or QC requirements.

8.1.2 The use of correct sample containers (with proper preservation) for the sample matrices collected and ensuring that sufficient sample volume is provided for the tests requested (including extra volumes for QC requirements).

8.1.3 Accurate labeling of sample bottles using coded, water resistant labels and permanent ink, with said labels being cross referenced with information contained in the COC.

8.1.4 Adherence to holding time requirements as required by test or method requested.

8.1.5 In the event that a sample is received in non-compliance with this policy, the sample in question will be segregated and the client notified by telephone or email. The client may direct SVL to continue on with analysis of the non-conforming sample(s). Non-conformities will be noted on the sample receipt/chain of custody checklist and within the final report; reference SOP SVL 2001.

8.1.6 New clients will be informed of this policy through Project Management or Sample Receiving. They will be provided with a hand out on sample acceptance (located in SVL's waiting room or in Sample Receiving). As a reminder current clients/samplers will receive a copy of the sample acceptance policy if they submit samples that do not meet SVL's requirements. For questions on sample acceptance a client may request and receive a copy of the Quality Manual or SVL's SOPs.

9.0 CALIBRATION

9.1 Thermometers

Calibration of thermometers is described in SOP SVL 1004.

Quality Control Services calibrates SVL's NIST-certified thermometers every five years.

SVL calibrates in-house liquid-in-glass thermometers against a NIST-certified thermometer annually. Digital thermometers are calibrated against a NIST certified thermometer quarterly. The IR gun is calibrated against a NIST certified thermometer every six months. The calibrated thermometers are labeled with the appropriate correction factors.

Three walk-in coolers and the standalone refrigerators are continuously monitored by AVETECH Min/Max digital thermometers (these are calibrated against a NIST certified thermometer quarterly). Logbooks are kept at H:/AVETECH Data/SENSOR CALIBRATION LOG.

9.2 Balances

Servicing and calibrating balances is described in SOP SVL 1025. Quality Control Services calibrates SVL's balances annually. SVL checks the calibration of a balance before each day of use with at least two weights traceable to a NIST traceable standard. For analytical balances, the measured weight must agree with the certified weight within 0.1%. Balances that fail the criterion are checked with Class-1 weights. If they fail again, they are removed from service.

9.3 Balance Weights

Calibration of balance weights is described in SOP SVL 1025.

Quality Control Services calibrates SVL's set of Class-1 weights, with Reference Standards Traceable to NIST every 5 years.

SVL uses certified Class-1 weights to certify the Class-4 weights used for the daily calibration of balances.

Criteria for weights can be found at H:\QA\UPDATEABLE LIST\Yearly Weight Check.

9.4 Micropipets

The calibration of micropipets is described in SOP SVL 1026.

SVL checks the calibration of variable-volume micropipets weekly. Fixed-volume micropipets are checked quarterly. The measured volume (the mean of three replicates) must agree with the expected value within 3%. Micropipets that fail this criterion are repaired or removed from service.

9.5 Repipettors

The calibration of repipettors is described in SOP SVL 1026.

SVL checks the calibration of repipettors quarterly. The measured volume must agree with the expected value within 3%. Repipettors that fail this criterion are repaired or removed from service.

9.6 Refrigerators/Walk-in Coolers

SVL records the temperature of sample, standard, and reagent storage refrigerators/walk-in coolers continuously (see 9.1). The temperature must meet the 0-6°C requirement as described in SOP SVL 2001. If a temperature is outside of this criterion, a temperature alert will be sent out via text. The temperature will be viewed again after one hour; if the temperature is still outside the acceptance range, samples, standards, and reagents are to be transferred to an alternate refrigerator or coolers until the faulty unit is fixed or replaced (an out of service sign must be hung on the unit).

In case of a power failure min/max readings will be taken (using portable min/max thermometers) and documented prior to moving samples/standards to another refrigerated location or ice filled coolers.

9.7 Ovens

SVL records the temperature of the ovens for every day that the oven is in use. The required temperature of each oven is stated in the applicable SOPs.

9.8 Inductively Coupled Plasma Mass Spectrometer (ICP-MS)

SVL calibrates its ICP-MS in accordance with EPA methods 200.8 and 6020B. A tune standard analysis is performed prior to calibration. Five calibration standards and a calibration blank are analyzed at the beginning of a sequence. The software creates a linear calibration curve that must have a correlation coefficient of at least 0.995. Calibration points are verified against the curve. The low calibration standard should be within ± 30% and the remaining calibration standards within ± 10% of the indicated concentration. Internal standards are monitored during the run with an acceptance criteria of 60-125% of the original response. An Initial Calibration Verification (ICV) from a secondary source follows to verify the calibration. An Initial Calibration Blank (ICB) indicates the system is clean. A Reporting Limit Check Standard (RLCS) indicates that the results derived at the reporting limit can be recovered within our acceptance criteria. Analysis of a Continuing Calibration Verification (CCV) and a Continuing Calibration Blank (CCB) follow after every ten samples and at the end of the analytical sequence. The acceptance criteria are defined in SOPs SVL 4132 and 4134.

9.9 Inductively Coupled Plasma Spectrometer (ICP)

SVL calibrates ICPs in accordance with EPA methods 200.7 and 6010D. A single calibration standard and a calibration blank are analyzed at the beginning of a sequence. Interference check standards are run (and at the end of a run for Drinking Water analysis) to show that interelement correction factors are current. An RLCS indicates that the results derived at the reporting limit can be recovered within our acceptance criteria. For 6010D runs a Mid-level

Verification Check is analyzed. An ICV from a secondary source follows to verify the calibration. An ICB indicates the system is clean. Analysis of a CCV and a CCB follow after every ten samples and at the end of the analytical sequence. The acceptance criteria are defined in SOP SVL 4135.

9.10 Mercury Analyzer (CVAA)

SVL calibrates its CVAA in accordance with EPA methods 245.1, 7470A, and 7471B. Six calibration standards and a calibration blank are analyzed at the beginning of a sequence. The instrument creates a linear calibration curve that must have a correlation coefficient of at least 0.995. Calibration points will be verified against the curve (see SVL 1020). The low calibration standard should be within ±30% and the remaining calibration standards within ±10% of the indicated concentration. An ICV from a secondary source follows to verify the calibration. An ICB indicates the system is clean. An RLCS indicates that the results derived at the reporting limit can be recovered within our acceptance criteria. Analysis of a CCV and a CCB follow after every ten samples and at the end of the analytical sequence. The acceptance criteria are defined in SOP SVL 4010.

9.11 Flame Atomic Absorption Spectrometer (FLAA)

SVL calibrates FLAAs in accordance with analytical method requirements. The acceptance criteria are defined in SOP SVL 4105.

9.12 Ion Chromatograph (IC)

SVL calibrates ICs in accordance with EPA method 300.0. six calibration standards and a calibration blank are analyzed. The instrument creates a quadratic calibration curve that must have a correlation coefficient of at least 0.995. Calibration points will be verified against the curve (see SVL 1020). The low calibration standard should be within ±30% and the remaining calibration standards within ±10% of the indicated concentration. An ICV from a secondary source follows to verify the calibration. An ICB indicates the system is clean. An RLCS indicates that the results derived at the reporting limit can be recovered within our acceptance criteria. A CCV and a CCB follow after every ten samples and at the end of the analytical sequence. ICs must be recalibrated after every column removal. ICs maintain multi-month calibrations and are checked every day by the following sequence: column flush, retention test, CCV, CCB and RLCS. The acceptance criteria are defined in SOPs SVL 4122 and 4133.

9.13 Auto Analyzer (FIA or SFA)

SVL calibrates flow analyzers in accordance with EPA methods 335.4 and Kelada-01 (Total Cyanide), 350.1 (Ammonia), 351.2 TKN, 353.2 (Nitrate and

Nitrite), 9012 B (Total Cyanide), and Standard Methods 4500-CN-I (WAD Cyanide), and ASTM D-7237-10 (Amperometric Free Cyanide). A minimum of five (linear) or six (quadratic) calibration standards and a calibration blank are analyzed at the beginning of each analytical sequence. The instrument software creates a linear or quadratic calibration curve that must have a correlation coefficient of at least 0.995. Calibration points will be verified against the curve (see SVL 1020). The low calibration standard should be within ±30% of the made to value and the remaining calibration standards within ±10% of the indicated concentration. An ICV from a secondary source verifies the calibration curve. An ICB indicates the system is clean. An RLCS indicates that the results derived at the reporting limit can be recovered within our acceptance criteria. Analysis of a CCV and a CCB follow after every ten samples and at the end of the analytical sequence. The acceptance criteria are defined in SOPs SVL 4012, SVL 4045, SVL 4048, SVL 4075, SVL 4131, SVL 4140, and SVL 4141.

9.15 Total Organic Carbon Analyzer (TOC)

SVL calibrates TOC analyzers in accordance with SM 5310 B. Six calibration standards for total carbon are analyzed and a linear curve is constructed, the curve must have a correlation coefficient of at least 0.995. Calibration points will be verified against the curve (see SVL 1020). The low calibration standard should be within ±30% and the remaining calibration standards within ±10% of the indicated concentration. An ICV from a secondary source verifies the calibration curve. An ICB indicates the system is clean. An RLCS indicates that the results derived at the reporting limit can be recovered within our acceptance criteria. A sparge check is run to ensure all total inorganic carbon is being removed during the sparging step. A CCV and CCB are analyzed at the beginning of each analytical sequence, after every ten samples and at the end of the analytical sequence. The acceptance criteria are defined in SOP SVL 4116.

9.16 UV/Visible Spectrophotometers (UV/VIS)

SVL calibrates its UV/Visible spectrophotometer in accordance with the applicable published methods. A minimum of five calibration standards and a calibration blank are analyzed at the beginning of each analytical sequence. The calibration curve must have a correlation coefficient of at least 0.995. Calibration points will be verified against the curve (see SVL 1020). The low calibration standard should be within ±30% and the remaining calibration standards within ±10% of the indicated concentration. An ICV from a secondary source follows to verify the calibration. An ICB indicates the system is clean. An RLCS indicates that the results derived at the reporting limit can be recovered within our acceptance criteria. A CCV and CCB are analyzed at the beginning of each analytical sequence, after every ten samples and at the end of the analytical sequence. The acceptance criteria are defined in SOPs SVL 4037, SVL 4040, SVL 4042, SVL 4043, SVL 4044, SVL 4123, SVL 4125, and SVL 4139.

9.17 LECO Carbon/Sulfur Analyzer

ABA, NCV, Total Sulfur, and Total Carbon are determined from analysis of a small aliquot of crushed sample using a LECO furnace. In addition, organic and inorganic carbon and pyrolysis loss and residual sulfur may be determined by roasting a sample, analyzing it by LECO, and calculating the difference between the pre and post roast carbon and sulfur values. One set of three calibration standards for carbon and sulfur are analyzed to prepare a calibration curve that must have an RMS error less than 0.01 for sulfur and less than 0.05 for carbon. Calibration points will be verified against the curve (see SVL 1020). The low calibration standard should be within ±30% and the remaining calibration standards within ±10% of the indicated concentration. An ICV from a secondary source follows to verify the calibration. An ICB indicates the system is clean. An RLCS indicates that the results derived at the reporting limit can be recovered within our acceptance criteria. A CCV and CCB are analyzed at the beginning of each analytical sequence, after every ten samples and at the end of the analytical sequence. The acceptance criteria are defined in SOPs SVL 4097, SVL 4061, and SVL 4129.

9.18 pH and Ion Selective Electrode Meters (ISE)

SVL calibrates pH and ISE meters in accordance with the applicable published methods.

9.19 Class A Glassware

Class A glassware is verified, assigned a unique identifier and logged in upon receipt as described in SOP SVL 1026.

10.0 SAMPLING, SAMPLE RECEIVING, AND STORAGE

10.1 Sampling

SVL does not conduct sampling. Sampling procedures that lead to contamination of client's samples in the field are beyond SVL's control.

Sample preservation is critical for sample integrity. Chemical and biological reactions may occur that begin to change some chemical species upon sample collection. Unfortunately, for most samples, immediate analysis is neither economically feasible nor logistically possible. Although no chemical preservative exists that is valid for every parameter, SVL strongly recommends the preservation methods, container type, sample size and estimated maximum holding times for collection of water and wastewater samples summarized in Table 1. Solid samples are best preserved by cooling the sample to a temperature range between 0- 6°C.

Table 1

Analysis	Volume Required (mL)	Container	Preservative	Holding Time
Color	50	P,G	Cool to ≤ 6°C	48 Hours
Conductance	100	P,G	Cool to ≤ 6°C	28 Days
Hardness	100	P,G	HNO_3 to pH <2	6 Months
Odor	300	G only	Cool to ≤ 6°C	24 Hours
pH	25	P,G	None Required	* ASAP
Temperature	1000	P,G	None Required	* ASAP
Turbidity	100	P,G	Cool to ≤ 6°C	48 Hours
Filterable Residue (TDS)	100	P,G	Cool to ≤ 6°C	7 Days
Non-Filterable Residue (TSS)	100	P,G	Cool to ≤ 6°C	7 Days
Total Residue	100	P,G	Cool to ≤ 6°C	7 Days
Volatile Residue	100	P,G	Cool to ≤ 6°C	7 Days
Settleable Matter	1000	P,G	Cool to ≤ 6°C	48 Hours
Dissolved Metals	200	P,G	Filter on site; HNO_3 to pH <2	6 Months
Total Metals	100	P,G	HNO_3 to pH <2	6 Months
Chromium (VI)	200	P,G	Cool to ≤ 6°C	24 Hours/ 28 days**
Mercury, Dissolved	100	P,G	Filter; HNO_3 to pH <2	28 Days
Mercury, Total	100	P,G	HNO_3 to pH <2	28 Days
Acidity	100	P,G	Cool to ≤ 6°C	14 Days
Alkalinity	100	P,G	Cool to ≤ 6°C	14 Days
Bromide	100	P,G	None Required	28 Days
Chloride	50	P,G	None Required	28 Days
Cyanide***	500	P,G	Cool to ≤ 6°C; NaOH to pH >10	14 Days
Fluoride	300	P	None Required	28 Days
Ammonia	400	P,G	Cool to ≤ 6°C H_2SO_4 to pH <2	28 Days

Analysis	Volume Required (mL)	Container	Preservative	Holding Time
Total Kjeldahl Nitrogen	500	P,G	Cool to ≤ 6°C H_2SO_4 to pH <2	28 Days
Nitrate plus Nitrite	100	P,G	Cool to ≤ 6°C H_2SO_4 to pH <2	28 Days
Nitrate	100	P,G	Cool to ≤ 6°C	48 Hours
Nitrite	50	P,G	Cool to ≤ 6°C	48 Hours
Ortho-Phosphate Dissolved	50	P,G	Filter on site; Cool to ≤ 6°C	48 Hours
Total Phosphate	50	P,G	Cool to ≤ 6°C; H_2SO_4 to pH <2	28 Days
Total Dissolved Phosphate	50	P,G	Filter on site; Cool to ≤ 6°C; H_2SO_4 to pH <2	28 Days
Silica	50	P only	Cool to ≤ 6°C	28 Days
Sulfate	50	P,G	Cool to ≤ 6°C	28 Days
Sulfide	500	P,G	Cool to ≤ 6°C add 2 mL zinc acetate plus NaOH to pH >9	7 Days
COD	25	P,G	Cool to ≤ 6°C H_2SO_4 to pH <2	28 Days
Total Organic Carbon	50	40 mL amber vials	Cool to ≤ 6°C H_2SO_4 to pH <2	28 Days
Phenolics	500	G only	Cool to ≤ 6°C H_2SO_4 to pH <2	28 Days
MBAS	1200	P,G	Cool to ≤ 6°C	48 Hours

* pH and temperature should be measured in the field whenever possible. They are subject to rapid change. Measurements of pH and temperature made in the laboratory will almost always be out of holding time.

** If preserved (filter in field) in the following manner add 0.45 mL buffer solution to each vial. Adjust the pH to 9.3 – 9.7 using about 2 drops of 10 N sodium hydroxide and about 3-5 drops of 1N sodium hydroxide.

*** Cyanide for extraction by ASTM D-7572 require that samples be sealed in vapor barrier bags, be shipped in opaque containers, and be refrigerated (0-6°C) as soon as possible.

SVL has formed alliances with other laboratories for the analysis of organic parameters. The recommended containers and preservatives are

Analysis	Amount Required	Container	Preservative	Holding Time Until Extraction	Holding Time After Extraction Until Analysis
Mercury, Low Level***					
524.2 (Volatile Organic Compounds)	3x40mL vials	G,T	Cool to ≤ 6°C; HCl to pH <2	14 days	NA
608 (Pesticides and/or PCBs)	3 L	amber G,T	Cool to ≤ 6°C	7 days	40 days
624 (Volatile Organic Compounds)	3x40mL vials	G,T	Cool to ≤ 6°C; HCl to pH <2	14 days	NA
625 (Semi-volatile Organic Compounds)	3 L	amber G,T	Cool to ≤ 6°C	7 days	40 days
1664 Hexane Extractable Materials	2L	G only	Cool to ≤ 6°C H_2SO_4 or HCl to pH <2	28 days	NA
8081A (Pesticides)	8 oz (soil) 1L (aqueous)	amber G,T	Cool to ≤ 6°C	14 days 7 days	40 days
8082 (PCBs)	8 oz (soil) 1 L (aqueous)	G,T	Cool to ≤ 6°C	14 days 7 days	40 days
8260B (Volatile Organic Compounds)	4 oz (soil) 3x40mL (aq)	G,T	Cool to ≤ 6°C; HCl to pH <2	14 days	NA
8270C (Semi-volatile Organic Compounds)	8 oz (soil) 1 L (aqueous)	amber G,T	Cool to ≤ 6°C	14 days	40 days
8015 (TPH-Gasoline)	4 oz (soil) 3x40 mL (aq)	amber G,T	Cool to ≤ 6°C; HCl to pH <2	14 days	35 days
8015AZ ****	8 oz (soil)	G,T	Cool to ≤ 6°C	48 hours	14 days for extraction and analysis
8260BAZ****	4 oz (soil)	G,T	Cool to ≤ 6°C	48 hours	NA
8015 (TPH-Diesel Motor Oil)	1 L (aq) 8 oz (soil)	amber G,T	Cool to ≤ 6 °C: HCl to pH <2	14 days	40 days

*** Call for sampling and hold time requirements.
**** TPH 8015AZ and 8260AZ (soils) have a 48 hour hold time before extraction.

10.1 Sampling Cont'd

Field blanks allow for identification of systemic and random sample contamination that may result from the sampling equipment, storage containers, sampling agents, or chemicals added to preserve samples. Field blanks consist of a sample container of distilled or deionized water with the appropriate chemical preservative. Preservation, filtration, storage, handling, and analysis are performed as if the field blanks were samples. To achieve accurate and meaningful data, field blank containers should be filled with analyte-free water and the appropriate preservative at the sampling site.

Sources of sample contamination include unclean sample containers and filters; impure solvents and reagents; and use of cleaning products inappropriate for the proposed analysis. Hair, tobacco smoke, and dust also are appreciable sources of contamination, so sampling should be conducted in as careful a manner as possible.

Before filtering samples for dissolved parameters, the filter paper should be rinsed with de-ionized or distilled water followed by a small portion of sample. The filtration apparatus should also be rinsed with de-ionized or distilled water between samples. Handle filter paper only on the edge, using appropriate forceps (plastic for trace metals analysis).

Use the proper sample container for the parameter specified. Samples for trace metals analysis must not come into contact with any metallic surface; samples for organic analysis must not come into contact with any plastic surface.

Sampling personnel should complete a COC form that documents sampler, sample identification, sampling date and time, sample location (state of sample origin if applicable), matrix type, number of sample containers, type of preservation, whether samples have been filtered, and the parameters to be analyzed.

10.1.1 Sub-sampling

In the event that SVL must undertake sub-sampling, SVL will use the appropriate container (uniquely identified) and the proper preservation. If SVL undertakes the sub-sampling of matrices that are required to be performed in the field, SVL will identify those samples on the analytical report; reference SOP SVL 2018.

10.2 Sample Receiving and Storage

SOPs SVL 2001, SVL 2003, and SVL 2004 describe sample receiving, job creation, and sample storage, respectively.

SVL takes a temperature reading from the sample shipping containers (coolers) upon receipt and opening. Each sample is checked for visible damage and the presence of an intact custody seal (if required). SVL gives each group of samples a unique job number (e.g., " X1E0027"). Sample IDs are automatically assigned a serial number suffix (-01 thru -99) appended to the work order number they belong to. The work order number is auto-generated by the LIMS and follows the format X YAnnnn, where X designates work order, Y is the last digit of the year, A corresponds to the month in which the work order was created (A=Jan., B=Feb.…L=Dec), and nnnn is a serial number for the work order in a particular month. Individual sample containers are assigned a designator (A, B, C …) and these are tracked in the LIMS so the particular container used for an analysis can be tracked. For an example "X1E0027-03 D" would be the fourth container for the third sample in the 27th work order of May 2021.

Sample IDs remain with the samples throughout the analytical process. Each sample is assigned a unique, sequential identification number. Samples are labeled with a bar code (containing the unique Container ID) before storing the sample.

Samples that require refrigeration are stored in walk-in coolers (which are kept between 0ºC and 6°C), except during times of sample preparation or analysis. Samples that do not require refrigeration are stored in an ambient temperature storage room. The laboratory does not refrigerate soil samples that were not received on ice. Samples are retained by SVL for a minimum of 30 days (or longer if required by the client) after an analytical report has been issued to the client. At the end of the specified period, samples are returned to the client or discarded in an appropriate manner in accordance with 10.3.

Sample custodians, technicians and analysts use the custody log feature of the LIMS to track sample movement during receipt, preparation, analysis, and disposal. SVL personnel are responsible for logging the samples into their custody, where they assume accountability for the sample(s) integrity. When use of the sample is complete, personnel must scan samples back into the appropriate home location or another employee may assume custody by scanning/logging the sample into their custody via the LIMS.

10.3 Sample Disposal and Hazardous Waste

Procedures for sample and foreign sample disposal are described in SOP SVL 1001. Disposal procedures follow federal and state regulatory requirements. SVL's hazardous waste program is described in SOP SVL 1008.

11.0 EQUIPMENT AND INSTRUMENTS

SVL uses the following instruments to generate analytical data and to calibrate other instruments.

11.1 SVL performs instrument maintenance as recommended by the manufacturer. SVL maintains service contracts with vendors for its major analytical instrumentation. Maintenance logbooks are kept to provide a record of major and minor repairs, as well as preventative maintenance.

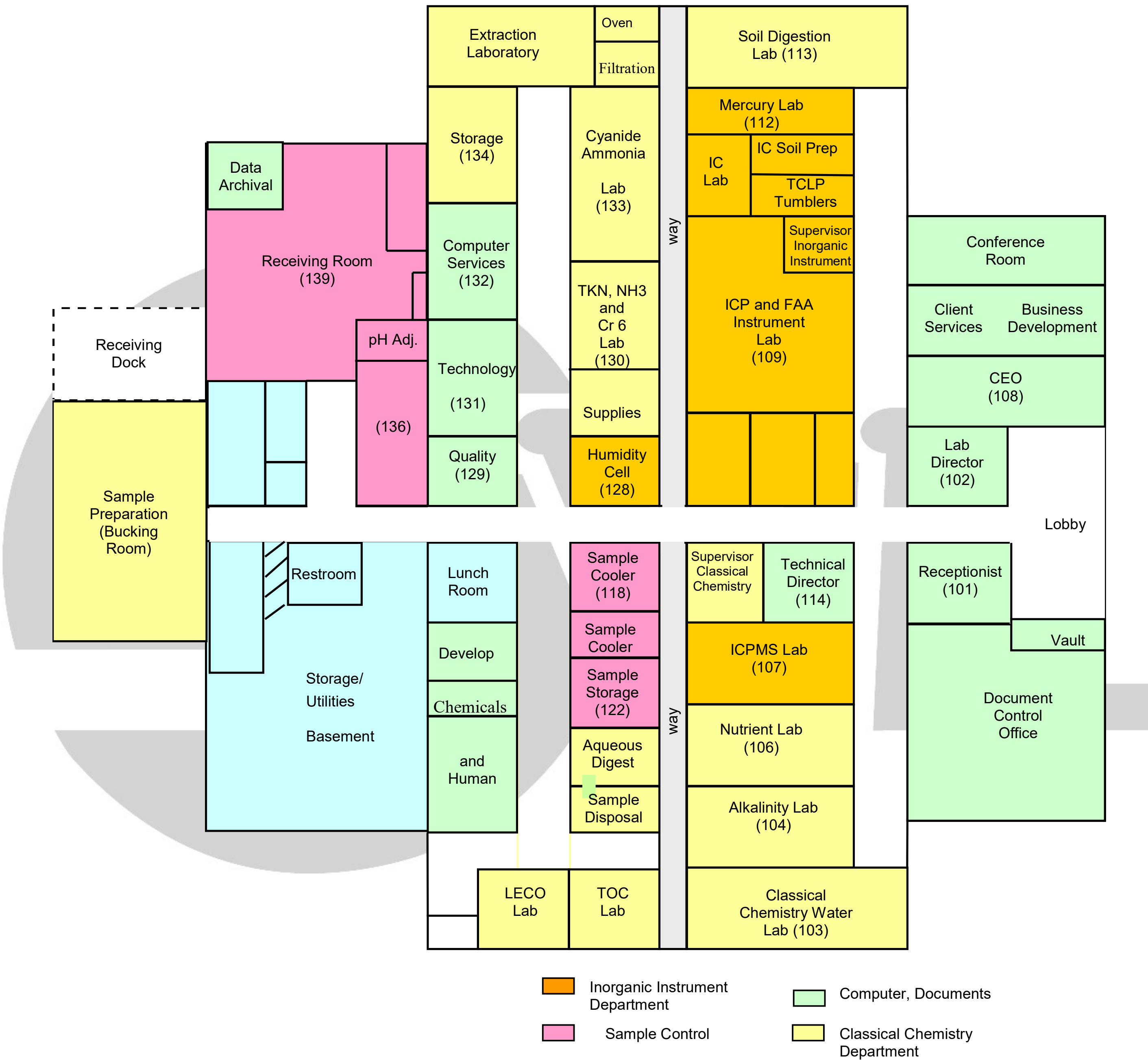
11.2 The analysts and supervisors will determine if a repair has created a need to update instrument MDLs, linear ranges, calibrations etc.

INSTRUMENT	MANUFACTURER	MODEL	SERIAL NUMBER
Spectrometer (ICP-MS)	Agilent	7900 Series	JP16011249
Spectrometer (ICP-MS)	Agilent	7700 Series	JP10490758
Liquid Chromatograph	Agilent	1260 Infinity	DEAAC39821
Spectrometer (ICP) Agilent 1	Agilent Technologies	5110 ICP-OES	MY17430001
Spectrometer (ICP) Thermo 2	Thermo Electron	iCAP 6500 Duo	IC65DC133703
Spectrometer (ICP) Thermo 3	Thermo Electron	iCAP 7400 Duo	IC74DC141807
Spectrometer (ICP) Thermo 4	Thermo Electron	iCAP 7600 Duo	IC76DC161110
Atomic Absorption Spectrometer with Vapor Generation Assembly	Varian	AA 55B	EL03048142
Mercury Analyzer	CETAC	M-6100	021202QT6
Mercury Analyzer	CETAC	M-7500	110801QTA
11 Digestor Blocks	Env. Express	Hot Block	
Ion Chromatograph	Dionex	ICS900	08041118
Ion Chromatograph	Dionex	ICS90	04090417
Ion Chromatograph	Dionex	ICS900-C	09040981
Ion Chromatograph	Dionex	ICS-1100	12120925
Automated Flow Analyzer	Skalar	Skalar San $^{++}$	162058
Automated Flow Analyzer	O-I-Analytical	FS3100-2	Multi-component
Automated Flow Analyzer	O-I-Analytical	FS3100	Multi-component
2 Micro Distillation Units	Lachat	ID 001	A2000-828 and 081100001017
3 MIDI Distillation Units	BSL		
Ammonia/N analyzer	Astoria Pacific	A2	200104
Automated Flow Analyzer	Astoria Pacific	A2	200220
Block Digestor	Westco Scientific	Easy Digest 40/20	As. # INS0030HW
Auto Titrator with Autosampler 4	Metrohm	Titrino 809 Titrando	1809001007108
Auto Titrator with Autosampler 5	Metrohm	Titrino 809 Titrando	1809001013143
UV/Visible Spectrophotometer A	Genesys	20	3SGN243026
UV/Visible Spectrophotometer B	Genesys	20	3SGN341012

INSTRUMENT	MANUFACTURER	MODEL	SERIAL NUMBER
Turbidimeter 3	Hach	2100N	15030C032748
Turbidimeter B	Hach	2100N	080906024269
COD Reactor	VELP Scientifica	ECO 25	101448
COD Reactor	VELP Scientifica	ECO 25	171440
pH Meter	Accumet	AB15	AB92325857
pH Meter	Accumet	AB15	AB92326969
pH Meter	Beckman	11 pH Meter	0224055
pH Meter B	Thermo	Orion A III	J06383
pH Meter	Thermo	Orion 320	019525
pH Meter C	Thermo	Orion A III	J06171
Dissecting Microscope	Nikon	104	
Polarizing Microscope	Nikon	106	
Centrifuge	Beckman	GS-6 Centrifuge	
Centrifuge	MISTRAL	3000i	51149
Centrifuge	IEC	K	70652271
Flashpoint detector	Precision Scientific	74537	108A-2
Conductance Meter	Fisher	AB30	AB 92329154
Conductance Meter	Fisher	AB30	AB 92338713
Conductance Meter	Orion	115	002176
Elemental Analyzer B	LECO	SC632	3208
Elemental Analyzer A	LECO	SC632	3526
Carbon/Nitrogen Analyzer (TOC)	Shimadzu	TOC-VCSH-N	H51104135009 C5
Carbon/Nitrogen Analyzer (TOC)	Shimadzu	TOC-LCSN/TNM-L	H54105000234
Semi-Micro Balance	Mettler	AE-240	K89952
Semi-Micro Balance	Mettler	AE-240	G43270
Analytical Balance	Sartorius	Quintix 224-1S	0034250171
Analytical Balance	Mettler	PJ 360	G49684
Analytical Balance	Mettler	PB30	A04506
Analytical Balance	Sartorius	Entris 623-IS	34308165
Analytical Balance	Ohaus	N1D110	1122352966
Analytical Balance	Ohaus	RD60LS	3374276-7HQ
Analytical Balance	Ohaus	EOF110	F2221120252601
Analytical Balance	Ohaus	AR2140	1203121033
Analytical Balance	Ohaus	AR1530	1203200181P
Analytical Balance	Ohaus	AS 313	8028301193
Analytical Balance	Ohaus	AV-114	8029081142
Analytical Balance	Leco	050	329
Analytical Balance	Sartorius	CPA1245	26250271
IR Thermometer	VWR	29960-032	E6052014872
IR Thermometer	Raytek	Ranger ST	98660090
Thermometer	HBI	145ºC to 205ºC	4B1321
Thermometer	Thermco	145ºC to 205ºC	3268
Thermometer	Ertco	-20ºC to 110ºC	5283

INSTRUMENT	MANUFACTURER	MODEL	SERIAL NUMBER
Thermometer	HB	-20º C to 150ºC	L94280
Thermometer	HB	-1º C to 201ºC	3846
Class S Weights	Troemner	2 mg to 100 g	20160725

12.0 FACILITIES



12.1 SVL is an analytical laboratory specializing in the performance of tests and methods used in the characterization of environmental and mining samples. Since 1972, SVL has analyzed water, soil, sediment, sludge, oil, paint, rock, animal tissue, vegetation, air filters, and various other sample types. SVL occupies a 25,000 square foot laboratory facility architecturally designed and specifically organized to ensure efficient operation and meet the needs of a large capacity analytical laboratory. Building access, security and safety features have been carefully considered. Access through the outside laboratory entrance and to internal areas is limited to laboratory staff and other essential personnel. Visitors are logged in/out and made aware of safety protocols during their stay at SVL.

13.0 STANDARD OPERATING PROCEDURES

SVL performs work in accordance with the requirements of its SOPs. SVL's SOPs are listed below and describe all aspects of its work performance including Safety and Quality Assurance (1000 Series), Sample and Document Management (2000 Series) and Inorganic Analysis (4000 Series).

SOP NUMBER	DESCRIPTION
SVL 1001	SAMPLE DISPOSAL
SVL 1002	WRITING AND REVISING STANDARD OPERATING PROCEDURES
SVL 1004	CALIBRATING THERMOMETERS
SVL 1005	INTERNAL QUALITY ASSURANCE AUDITS
SVL 1007	SOIL STERILIZATION
SVL 1008	DISPOSAL OF HAZARDOUS WASTE
SVL 1010	TRAINING
SVL 1011	PERFORMING AN MDL STUDY
SVL 1015	PROCUREMENT, RECEIVING, AND SUBCONTRACTING
SVL 1017	RECORDS RETENTION AND PROTECTION
SVL 1019	CORRECTIVE ACTION
SVL 1020	CALIBRATION FOR ANALYTICAL METHODS
SVL 1021	MANUAL INTEGRATION
SVL 1023	SOFTWARE VERIFICATION
SVL 1025	CALIBRATING BALANCES
SVL 1026	CALIBRATING MICROPIPETS, REPIPETTORS, AND GLASSWARE
SVL 1027	CLIENT SERVICES
SVL 1028	CALCULATIONS FOR ANALYTICAL METHODS
SVL 1029	PERFORMANCE TESTING SAMPLES
SVL 1030	INITIAL, PERIODIC AND AFTER-MAINTENANCE CHECKS

SOP NUMBER	DESCRIPTION
SVL 1031	COMPUTER AND INFORMATION SECURITY POLICY
SVL 1032	CHEMICAL REAGENTS, PREPARED STANDARDS, AND QC SOLUTIONS
SVL 1033	ACCEPTANCE LIMITS AND TRENDING
SVL 2001	SAMPLE RECEIVING
SVL 2003	WORK ORDER CREATION
SVL 2004	SAMPLE STORAGE & SECURITY
SVL 2006	DATA CORRECTIONS
SVL 2007	CASE FILE ASSEMBLY
SVL 2009	DATA REVIEW
SVL 2013	DATA PACKAGE PRODUCTION
SVL 2017	LOGBOOK CONTROL
SVL 2018	PREPARATION AND SUBSAMPLING OF EARTH, ROCK, AND TISSUE SAMPLES
SVL 2019	REANALYSIS PROCEDURES
SVL 2020	COMPUTER-RESIDENT SAMPLE DATA CONTROL
SVL 2021	DATA BACKUP AND RESTORE
SVL 2022	SAMPLE RECEIVING – FOREIGN SOILS
SVL 2023	LEVEL 3 ELEMENT PRODUCED DATA PACKAGE
SVL 4010	EPA 245.1, SW-846 7470A and 7471B; DETERMINATION OF MERCURY (CVAA)
SVL 4012	EPA 335.4 AND SW-846 9012B; TOTAL CYANIDE BY MICRODIST™ and MIDI DISTILLATION FOLLOWED BY AUTOMATED COLORIMETRY
SVL 4013	GLASSWARE WASHING FOR CLASSICAL CHEMISTRY
SVL 4021	FILTER DIGESTION
SVL 4022	PERCENT SOLIDS/ PERCENT MOISTURE
SVL 4024	SM 2120 B; COLOR
SVL 4025	EPA 120.1 AND SM 2510 B; CONDUCTIVITY
SVL 4026	EPA 180.1; TURBIDITY
SVL 4028	SM 4500 H^+ B; pH
SVL 4029	SPECIFIC GRAVITY
SVL 4031	SM 2310 B; ACIDITY
SVL 4032	SM 4500 S^{2-} F; SULFIDES BY TITRATION
SVL 4034	SM 2540 C AND SM 2540 D; TOTAL DISSOLVED SOLIDS AND SUSPENDED SOLIDS
SVL 4035	SM 2540 B AND EPA 160.4; TOTAL AND VOLATILE SOLIDS
SVL 4037	SM 5540 C; METHYLENE BLUE ACTIVE SUBSTANCES
SVL 4040	SM 4500 P E; TOTAL PHOSPHORUS (AQUEOUS SAMPLES)
SVL 4042	SM 4500 P E; ORTHO-PHOSPHATE (AS P)
SVL 4043	EPA 410.4; CHEMICAL OXYGEN DEMAND
SVL 4045	EPA 351.2; TOTAL KJELDAHL NITROGEN
SVL 4048	EPA 353.2; NITRATE/NITRITE AS N: AUTOMATED CADMIUM RE REDUCTION

SOP NUMBER	DESCRIPTION
SVL 4049	SW-846 9081; CATION EXCHANGE CAPACITY
SVL 4060	LOSS ON IGNITION
SVL 4061	EPA 600/2-78-056; AGP, ANP AND ABA
SVL 4065	ASTM E-2242-13; METEORIC WATER MOBILITY EXTRACTION
SVL 4068	SW-846 1312; SYNTHETIC PRECIPITATION LEACHING PROCEDURE (SPLP)
SVL 4075	SM 4500 CN I; WAD CYANIDE BY MIDI DISTILLATION FOLLOWED BY SEMI-AUTOMATED COLORIMETRY
SVL 4078	EPA METHOD 3020A; SAMPLE DIGESTION FOR TOTAL METALS IN AQUEOUS SAMPLES FOR ICP-MS
SVL 4079	EPA METHOD 3010A; SAMPLE DIGESTION FOR TOTAL METALS IN AQUEOUS SAMPLES FOR ICP
SVL 4080	EPA METHOD 3005A; SAMPLE DIGESTION FOR TOTAL RECOVERABLE METALS IN AQUEOUS SAMPLES FOR ICP
SVL 4084	SM 2320 B; DETERMINATION OF ALKALINITY AND pH USING THE AUTOTITRATOR
SVL 4093	CASSETTE FILTER DIGESTION
SVL 4094	EPA METHOD 3050B; SAMPLE DIGESTION FOR METALS IN SOILS
SVL 4095	SW-846 1010A; FLASHPOINT DETERMINATION (PENSKY-MARTENS CLOSED TESTER)
SVL 4096	SW-846 9045 C AND 9045 D; SOIL pH DETERMINATION
SVL 4097	ASTM 1915-05; TOTAL SULFUR, TOTAL CARBON
SVL 4105	SM 3114 B; SELENIUM BY HYDRIDE
SVL 4106	EPA 200.2; SAMPLE DIGESTION FOR TOTAL RECOVERABLE METALS IN AQUEOUS SAMPLES BY ICP AND ICP-MS
SVL 4108	SAMPLE PREPARATION FOR DISSOLVED AND POTENTIALLY DISSOLVED METALS IN AQUEOUS SAMPLES
SVL 4114	SW-846 1311; TOXICITY CHARACTERISTIC LEACHING PROCEDURE
SVL 4116	SM 5310 B; TOTAL ORGANIC CARBON
SVL 4118	CA-WET; CALIFORNIA WASTE EXTRACTION TEST
SVL 4119	PREPARATION OF QC SOLUTIONS FOR METALS ANALYSIS
SVL 4120	ASTM D-5176; TOTAL NITROGEN
SVL 4121	SM 2150 B; DETERMINATION OF THRESHOLD ODOR NUMBER (TON)
SVL 4122	EPA 300.0; INORGANIC ANIONS BY ION CHROMATOGRAPHY USING THE DIONEX DX100, ICS-90 AND ICS-1100
SVL 4123	ASTM D-2795 and D-3682-78 SOLID SILICA
SVL 4125	SM 3500 Cr B; HEXAVALENT CHROMIUM
SVL 4127	EPA 600/2-78-054; pH DETERMINATION FOR PASTE
SVL 4128	ASA 9; SOIL ELECTRICAL CONDUCTIVITY
SVL 4129	NET CARBONATE VALUE (NCV)
SVL 4130	NET ACID GENERATION (NAG)
SVL 4131	ASTM D-7237-10; FREE CYANIDE BY FLOW INJECTION AND AMPEROMETRY
SVL 4132	ANANLYSIS OF METALS BY THE AGILENT ICP-MS (EPA METHOD 200.8)
SVL 4133	DETERMINATION OF THIOCYANATE BY ION CHROMOTOGRAPHY USING DIONEX ICS-90, ICS-900, AND ICS-1100
SVL 4134	SW-846 6020A; ANALYSIS OF METALS BY AGILENT ICP-MS
SVL 4135	EPA 200.7 AND SW-846 6010C; ANALYSIS OF METALS BY THERMO ICP

SOP NUMBER	DESCRIPTION
SVL 4136	EPA-600/2-78-054; TEXTURAL CLASS
SVL 4137	EXTRACTIONS COMPENDIUM
SVL 4138	ASTM D-7572; RECOVERY OF AQUEOUS CYANIDES BY EXTRACTION FROM MINE ROCK AND SOIL AFTER REMEDIATION OF PROCESS RELEASES
SVL 4139	EPA 600/2-78-054; TOTAL ORGANIC CARBON
SVL 4140	EPA 350.1; AMMONIA BY AUTOMATED COLORIMETRY
SVL 4141	TOTAL CYANIDE BY AUTOMATED CONTINUOUS FLOW INJECTION USING SKALAR SAN^{++} (Kelada-01)
SVL 4142	ARSENIC SPECIATION USING AGILENT 1260 INFINITY LC AND AGILENT 7900 ICP-MS
SVL 4143	HACH FERROUS IRON (Fe^{2+}) TEST KIT
SVL 4144	SM 2580 B OXIDATION-REDUCTION PROCEDURE (ORP)
SVL 4145	LABORATORY WEATHERING OF SOLID MATERIALS USING A HUMIDITY CELL BY ASTM D5744-13

13.1 Deviations

Occasionally, a deviation from an SOP is required to generate an accurate result for a given test or client. This may occur when a client specifically requires a modification, or when the sample matrix interferes with the analysis. The Laboratory Director or a department supervisor may authorize a deviation. The analyst documents details of the deviation from the SOP on the instrument raw data printout or the job bench sheet with a notation in the work order memo in Element. The deviation will be indicated on the report.

13.1.1 In the event that an SOP needs to be immediately amended an email will be sent to the Quality Manager outlining the necessary change. The change can go into effect immediately prior to the SOP being amended.

14.0 QUALITY CONTROL

14.1 Quality Control Parameters

SVL uses a number of quality control parameters to validate calibration, and to measure contamination, accuracy, and precision. Each SVL SOP indicates the parameters required for the method being used.

14.1.1 Blanks

Method Blank Is an aliquot of analyte-free water that is put through all the steps of a specific method along with the samples. It is sometimes called a Laboratory Reagent Blank.

Calibration Blank The zero-concentration standard analyzed as part of a calibration curve.

Field Blank Randomly selected sample container that is filled with analyte-free water and the appropriate chemical preservative in the field.

Trip Blank Is a specific type of field blank. A trip blank is not opened in the field. It is a check on sample contamination from the time the container is sealed at the lab or supplier. It is used to verify the container's integrity during sample transport and the container's time on site (it should always be with a sampling group).

The acceptance criterion for a blank may be set by the published method, by client DQOs, or by historical statistics. In the absence of these directives, the acceptance criterion may default to less than the reporting limit.

14.1.2 Matrix Spike

Is an aliquot of sample to which a known amount of analyte has been added prior to sample preparation or digestion. It is a measure of the effect of the sample matrix on the analytical method. It is sometimes called the "Laboratory Fortified Matrix".

The recovery is calculated by:

$$\% \text{ Recovery} = 100 \times (MS - S) / SA$$

Where the MS = Spiked Sample Result
S = Sample Result
SA = Spike Added

Acceptance criteria for the matrix spike recovery may be determined by the published method or by client DQOs. For those methods without guidelines the QA Manager will set default limits for the acceptance range. Individual SOPs will have the recovery range acceptance requirements.

14.1.3 Analytical Spike or Post-Digestion Spike

Is an aliquot of sample to which a known amount of analyte has been added after sample preparation. It is a measure of the effect of the matrix on a digestate or extract. Individual SOPs will have the recovery range acceptance requirements.

14.1.4 Laboratory Control Sample (LCS)

Is a solution or material of known concentration that is added to an analyte-free matrix and then analyzed to evaluate the recovery and accuracy of a method. It is sometimes called a Laboratory Fortified Blank.

Acceptance criteria for the LCS recovery may be determined by the published method, by the manufacturer of the standard, by client DQOs, or the QA Manager will set default limits. Individual SOPs will have the recovery range acceptance requirements.

14.1.5 Sample Duplicate

A second similar aliquot of a sample treated exactly the same through preparation and analysis. The Relative Percent Difference (RPD) between the values of the duplicates is a measure of the precision of the analytical method.

$$RPD = 100 \times | S - D | / [(S + D)/2]$$

The acceptance criterion for the RPD is typically set at 20.

14.1.6 Matrix Spike Duplicate (MSD)

A second similar aliquot that is spiked, it is treated exactly the same as the first matrix spike (MS) through preparation and analysis. The RPD between the recovery values is a measure of the precision of the analytical method.

$$RPD = 100 \times | MSD - MS | / [(MSD + MS) / 2]$$

Individual SOPs will have the recovery range acceptance and reproducibility requirements.

14.1.7 Interference Check Sample (ICS)

A sample with known concentrations of elements used to determine if the inter-element correction factors are valid.

Individual SOPs will have the recovery range acceptance requirements.

14.1.8 Initial Calibration Verification (ICV)

A standard made from a second source from the calibration standards. It is analyzed immediately after the calibration to determine the validity of the calibration standards.

If the recovery range is exceeded and the cause for the initial calibration verification failure is identified that impacts only the initial calibration verification sample (e.g. a missed autosampler injection), then analysis may proceed if a second initial calibration verification sample is analyzed immediately and the result is within acceptance criteria. The cause for the failure of the first calibration verification result shall be documented on the raw data or a PDF of the raw data whichever is used for record retention.

Individual SOPs will have the recovery range acceptance requirements.

14.1.9 Continuing Calibration Verification (CCV)

A calibration standard (primary or secondary source) analyzed after every ten samples, and at the end of an analytical sequence to verify that the calibration is still valid.

If the recovery range is exceeded and the cause for the calibration verification failure is identified that impacts only the calibration verification sample (e.g. a missed autosampler injection), then analysis may proceed if a second calibration verification sample is analyzed immediately and the result is within acceptance criteria. The cause for the failure of the first calibration verification result shall be documented on the raw data or a PDF of the raw data whichever is used for record retention.

Individual SOPs will have the recovery range acceptance requirements.

14.1.10 Reporting Limit Check Standard (RLCS)

A check standard that is constructed out of either a primary or secondary source made up at same concentration as the reporting limit. An acceptance range of ±30% for single analyte methods and ±50% for multi-analyte methods was made the default. RLCS results are batched as a Standard Reference Material (SRM) which can be pulled into Element for control charting purposes.

14.1.11 Initial Calibration Blank (ICB)

A matrix matched deionized water sample ran to prove the system is clean with no carry-over.

14.1.12 Continuing Calibration Blank (CCB)

A matrix matched deionized water sample ran to prove the system is clean with no carry-over.

14.1.13 Serial Dilution

Dilute a sample by a minimum of five fold (1+4). Agreement within 10% between the concentration for the undiluted sample and five times the concentration for the diluted sample indicates the absence of interferences.

14.1.14 Quality Control Sample (QCS)

A solution of method analytes of known concentrations which is used to fortify an aliquot of blank solution or sample matrix. The QCS is obtained from a source external to the laboratory and different from the source of calibration standards.

Individual SOPs will have the recovery range acceptance requirements.

14.1.15 Instrument Performance Check (IPC)

A solution of method analytes, used to evaluate the performance of an instrument system with respect to a defined set of method criteria.

Individual SOPs will have the recovery range acceptance requirements.

14.2 Control Charts

SVL utilizes Element to provide personnel with the up to the minute ability to trend inputted QC results. It is recommended that analysts and technicians regularly consult trending charts to provide themselves with real time information. By trending an analysis, the analyst or technician can look at a current or past snapshot of QC recoveries and possibly determine when prep procedures or QC samples were done incorrectly or when they may have used contaminated or expired components. Trending can also be used to show when an instrument's components begin to degrade or fail.

The process is defined in SOP SVL 1033. RLCSs, prep blanks, LCSs, duplicates, SRMs, matrix spikes and matrix spikes duplicates are tracked. A standard X bar control chart is used to plot results. Upper and lower warning limits of ±2s (where s equals standard deviation) and upper and lower control limits of ±3s are calculated using at least 20 measurements (if available) during a 6 month period.

14.3 Acceptance Limits

Acceptance limits for quality control parameter recoveries may be set by published analytical methods, DQOs or be default limits set by the QA Manager. Individual SOPs will provide the accepted recoveries for each method. Acceptance limits are also outlined in SOP SVL 1033.

14.4 General Frequency of Quality Control Checks

For those methods that do not have published QC requirements, SVL will use the following QC and frequency if applicable per batch of 20 samples:

Initial Calibration Verification once per calibration.

Initial Calibration Blank once per calibration.

Reporting Limit Check Standards at a minimum of 1 per analytical run.

Method or Instrument Blanks at a frequency of 5%.

Laboratory Fortified Blank or LCS at a frequency of 5%.

Matrix Spiked Samples at a frequency of 10%.

Matrix Spike Duplicates at a frequency of 5%.

Continuing Calibration Verification every ten samples.

Continuing Calibration Blank every ten samples.

14.5 Maintenance

SVL breaks maintenance down into the following categories: initial maintenance, periodic maintenance, and after-maintenance performance checks. The requirements for performing maintenance or filling out maintenance logbooks can be found in SOP SVL 1030. Initial checks can be either checks performed during instrument setup or daily checks performed before the start of operations. Periodic checks are those checks that are performed on set time intervals (i.e. weekly, monthly, bi-annually, etc.).

After-maintenance checks are done after repairs have been completed or when an instrument has been moved to a new location. This is done in order to document acceptable ongoing instrument performance. SVL runs a MDL check at a concentration 1-4 times the MDL, if the check is within 50% of the MDL concentration then the instrument is deemed to be in control. If the check fails then follow the requirements in SOP SVL 1011 to adjust the MDL.

14.6 Uncertainty of Measurement

SVL uses control charting as a means of determining when selected parameters (batch QC) are out of control. Warning and unacceptable control limits are defined at 2 and 3 sigma, respectively. See QM 14.2 and SOP SVL 1033.

Almost all approved methods used at SVL contain a section related to precision and bias. Random uncertainties cannot be determined statistically and can only be estimated by a trained analyst. Uncertainty represents a bias associated with analytical measurements. The presence and magnitude of bias can be determined by assessment of SVL's QC sample results on our analytical reports.

SVL reports data to 2 or 3 significant figures, dependent upon the sensitivity of the measuring instrument and client requirements, with the number of decimal places reported also determined by the sensitivity of the instrument.

14.6.1 Rounding

Rounding of analytical results is dependent upon the number of significant figures used by a method. Rounding for percent recovery on QC samples is also dependent upon the number of significant figures. Element is setup and our analysts are directed to round up to the significant figure assigned to that method. SVL uses the following rounding rule: A result of 5 or greater rounds the results up to the significant figure assigned the analyte in Element.

All of the steps in performing calculations or equations will be completed and combined (using all available numbers) before rounding to final concentrations or recoveries.

15.0 CORRECTIVE ACTION

The SVL Corrective Action Program is defined in SOP SVL 1019.

Any employee may initiate a Corrective Action Report (CAR) to support the quality system. Some examples are: The need for an SOP revision, incorrect results released to clients, an overdue MDL study, overdue or improper training, incorrect data reduction or review, improper instrument setup or calibration, or use of an incorrect analytical method.

If there is a non-acceptable result on a performance test sample, the Quality Manager documents the failure as a CAR and works with the analysts and supervisors to discover the root cause of the failure. If there are findings from an internal or external audit, the Quality Manager issues a CAR to appropriate staff members so they can prepare a corrective action plan to rectify the issues.

Root cause analysis is the goal of corrective action and as such a cause will be identified, and a process outlined, so that a failure will not re-occur or its re-occurrence will be minimized.

15.1 Preventative Action

A "preventative action" is a pro-active process for dealing with a problem before it happens. It is taken to eliminate the cause of an undesirable situation in order to prevent its occurrence rather than a reaction to the identification of a problem or nonconformity. These actions are taken to reduce the probability that a potential problem will occur. They may also include contingencies to reduce the "seriousness" should a future problem occur. Subjects for "preventative action" may be implemented to address a weakness in the quality system that is not yet causing nonconformities and can be initiated internally or externally (client complaints). The focus for preventative actions should be to avoid creating nonconformities, but may also lead to improved laboratory efficiencies.

SVL uses the CAR template to document ideas, plans or action whether developed internally or externally. These reports are audited at a future date to ensure that the changes sought have been implemented and are effective. CARs and supporting documentation are scanned and saved under H:/QA/CARs/Closed CARs.

16.0 TRAINING

SVL conducts annual training in legal and ethical responsibilities for all staff members. SVL provides training sessions that are developed in order to provide staff members with the analytical tools necessary for ever changing environmental regulatory requirements. New employees will be given various types of introductory training as soon as possible after their hire date.

SVL management and supervisors train staff members in laboratory safety. At a minimum this consists of an annual review of the Chemical Hygiene Plan. It also includes seminars on important safety issues throughout the year.

Staff members also receive training in the quality system and QM. At a minimum this consists of an annual review of the QM.

Department supervisors ensure that staff is adequately trained to perform the analyses assigned to them. The process is defined in SOP SVL 1010. Training includes, as appropriate: quality control requirements, instrument operation, instrument maintenance, software operation, reading and understanding the published method, reading and understanding the applicable SVL SOPs, and completion of an Initial Demonstration of Capability (IDOC). When an IDOC is not defined by the analytical method, the Quality Manager will create default criteria and outline them in the training summary forms which will be included in their personnel files. Upon completion of training, a Demonstration of Capabilities Certificate is placed within their personal file.

SVL Management defines the required elements for training for analytical methods. A Supervisor or a fully trained analyst provides training, when possible. If no fully trained analyst exists, an analyst may learn a new analysis by reading the appropriate method and instrument manual, then performing an IDOC.

During the training period, an analyst may produce data for clients (after completion of a successful blank and four separately prepared LCSs) under the supervision of a fully trained analyst; if there is not a trained analyst the Department Supervisor will review and sign off on all aspects of the work performed. A Department Supervisor or a fully trained analyst must review and sign all trainee work produced until training is completed. Training is completed when the Training summary sheet is signed off by both the trainee and their department supervisor.

16.1 To document continued proficiency, an analyst must perform one of the following tasks annually:

16.1.1 Successfully analyze a blind performance sample.

16.1.2 Complete another IDOC.

16.1.3 Successfully analyze a blank and four separately prepared LCSs or duplicates (for those methods where a LCS is not commercially available).

16.2 Analysts and technicians who do not successfully complete a DOC within a year must complete an IDOC before being re-certified for a method.

17.0 ETHICS AND CONFIDENTIALITY

17.1 SVL is committed to providing its clients with accurate and defensible data and meeting all client requirements for data quality and integrity. To achieve our commitment, and as a condition for employment with SVL, all employees agree to follow SVL's policy regarding ethics and data integrity characterized but not limited to the items listed below.

17.1.1 All reported data, including dates and times, shall represent actual values obtained and are not modified or manipulated in any manner for which allowances have not been made for in the referenced method.

17.1.2 There will be no misrepresentation of another analyst's identity.

17.1.3 Altering the contents of logbooks and/or data sheets to misrepresent data is prohibited.

17.1.4 Altering any operating procedures or QC to make data "fit" is prohibited.

17.1.5 Failing to comply with SOPs without proper documentation and approval from the Laboratory Director and/or Quality Manager is prohibited.

17.1.6 Any attempt to misrepresent data or events as they actually occur in the course of data production, review or reporting is prohibited.

17.1.7 Deleting files, whether electronic or hard copy of raw data that was used in a reported value is prohibited.

17.1.8 Engaging in, or being a party to, any practice that ultimately misrepresents data or narratives in any way is prohibited.

17.2 SVL has established a zero-tolerance policy for improper, unethical, or illegal activities. Improper actions are defined as unapproved deviations from contract-specific or method-specific analytical practices, whether intentional or unintentional. Unethical or illegal actions are defined as the deliberate falsification of analytical or quality assurance results where failed method or contractual requirements are made to appear acceptable. Some examples of improper, unethical, or illegal practices are listed below. Comments in parentheses should each be read as beginning with the phrase "including but not limited to…"

17.2.1 Improper use of manual integrations to meet calibration or method quality control criteria.

17.2.2 Intentional misrepresentation of the date or time of analysis.

17.2.3 Falsification of results to meet method requirements.

17.2.4 Reporting results without analysis.

17.2.5 Selective exclusion of data to meet quality control criteria (dropping calibration points).

17.2.6 Unwarranted manipulation of computer software.

17.2.7 Improper alteration of analytical conditions (changing voltages or run times).

17.2.8 Misrepresentation of quality control samples (not preparing them as samples).

17.2.9 Intentionally reporting results from one sample for those of another.

17.2.10 Reporting calibration or quality control data not linked to the reported samples.

17.3 Confidentiality

SVL's commitment to client confidentiality (including national security concerns) and any associated proprietary rights comes first and foremost. We understand the nature of doing business in a litigious society and will seek to protect our client's interest in all aspects of our work.

18.0 DATA REVIEW

SVL uses a three-tier system for data review via the LIMS. The first level is conducted by the analyst, the second level by a peer or supervisor, the third by a Signatory to the Quality Manual, Technical Director or the Laboratory Director. Reviews take place upon the review of raw data or within the LIMS (which uses a system of locks to assure data is secure from accidental overwritting). Most data is available in PDF, which can be reviewed at any work station. The process is governed by SOP SVL 2009.

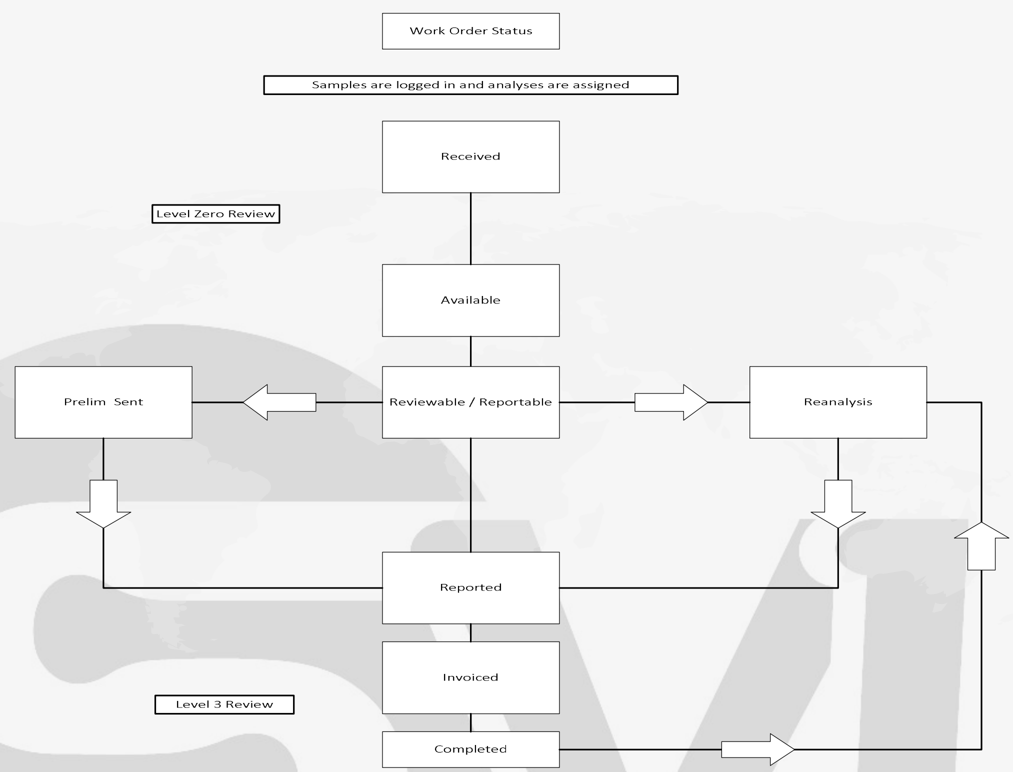
In the case that erroneous data does leave the lab, the Laboratory Director or Project Management will contact the affected clients as soon as all of the facts are available. SVL will work with the clients in seeking a new or alternative strategy to meet the client's needs.

18.1 Electronic Signatures

For all levels of review up to the final review Element provides an audit trail of who has uploaded and reviewed results. Employees are directed to log in and out of Element so that they are identified when conducting data uploads or reviews. It is not permissible to use another employee's password or misrepresent an analyst or reviewer by not logging in to Element under the correct username and password (see SOP SVL 1031 and SVL 2009).

Electronic signature affixed to the Final Report will be assigned by the Project Managers.

18.2 Work Order Status



19.0 REPORTING

SVL has a single standard report format for nearly all results (SVL_Sample) generated by Element. This includes a case narrative, sample report, and QC report.

Reports are also available in a number of other routine and custom hardcopy formats. EDDs can be provided in ASCII, spreadsheet, and database formats, including EQWin, GIS/Key, and EnviroData Solutions. If a client has a specific format, SVL is usually able to provide data compatible with their preferred format.

Data that will be used to create EPA CLP-like (SVL Level III) deliverable packages are created using Element. Element will be used to generate the forms required to complete a data package. SVL has the capability of providing a hardcopy and EDD format. EDDs are available in standard EPA CLP formats, as well as popular spreadsheet and database files.

20.0 AUDITS AND VERIFICATION PRACTICES

20.1 Performance Testing Program

SVL participates in two WS, two SOIL, and two WP Performance Testing (PT) studies each year. SVL uses the first WP Study to meet the DMRQA requirements of our clients. SVL uses ERA and RTC as our PT providers. The PT samples are logged in as single-blinds and ran as if they were normal samples in all aspects. The Quality Manager is responsible for preparing all PT samples. Quick response samples are used when SVL fails an analyte necessary to maintain our accreditation or when there is a DMRQA failure. CARs are initiated when a PT parameter has failed.

20.2 Internal System Audits

The Quality Manager conducts a minimum of one internal system audit per year per lab. The audit provides an overview of the implementation of procedures and policies set forth in the laboratory's QM and SOPs; reference SOP SVL 1005. Other audits (that may be limited in scope) may be undertaken at any time in response to external audits, CARs, or at the request of the Laboratory Director.

The Quality Manager prepares an internal audit plan based on information garnered from previous audits both internal and external, CARs, method changes, new instrumentation and requests or complaints from clients. The Quality Manager may use written checklists and/or quizzes to assess an analyst's knowledge of the QM, methods and current SVL SOPs.

The Quality Manager will interview the analyst(s) and conduct reviews of records, logbooks, and data packages.

At the close of an audit, a post-audit meeting is held to discuss the audit findings. The assessor or Laboratory Director can close a finding during this discussion if the laboratory staff can satisfactorily demonstrate that the finding is inappropriate or easily remedied.

The Quality Manager will deliver the audit report to the President, Laboratory Director, Technical Director, supervisor and appropriate staff. A report will contain at a minimum the following parameters: Date and location of the audit, personnel involved in the audit, laboratory operations audited, any minor or major findings that require corrective action (major findings require the issuance of a CAR) and the assessor's summation.

20.3 Reference Materials

Companies like ERA, High Purity, Fisher and Baker have been approved (see SVL's approved vendor list) to provide SVL with reference materials and reagents. SVL uses a second source verification for all methods with calibration. When there is not a secondary source provider available, SVL will verify and then purchase a separate lot from the primary vendor (lots must not be from the same parent batch).

20.4 Internal Quality Control Schemes

SVL has instituted a Reporting Limit Check Standard (RLCS) to verify recovery at the reporting limit; this check has been instituted at SVL for SDWA, CWA and Solid Waste analytical runs. SVL has also instituted a calibration curve verification policy where calibration standard recoveries are fitted back into the curve. A standard at the reporting level must be within 30% of the true value and the remaining standards must be within 10% of their true values. Any exception to this rule will be outlined in the appropriate SOP.

20.5 Data Audits

The Quality Manager performs a data audit of several data packages each year. Data audits can also be triggered by audits, CARs or requests from the Laboratory Director. The purpose behind the data audits is to alert SVL to any errors, systemic problems or trends that may be developing.

21.0 MANAGEMENT REVIEW

The Management of SVL conducts a review of the adequacy of the quality system weekly. The reviews take into account reports from supervisory personnel, Project Managers, Laboratory Director, Technical Director, Systems Manager, LIMS Chemist, Quality Manager and President. Recent internal audits, external audits, the results of PT samples, changes to the volume or type of work undertaken, feedback from clients, instrumentation issues, personnel issues and CARs are a few of the items discussed. Conclusions or action items are addressed; any changes deemed necessary are then incorporated into revisions to the QM and SOPs as soon as practicable and communicated to relevant employees to provide direction for day-to-day operations. Notes from these meetings are kept in Google Documents.

22.0 CONTRACTS

SVL has established a Project/Bid Review Sheet to meet the TNI requirements of Section 4.4 "Review of Requests, Tenders, and Contracts." Any differences between the request or tender and the contract shall be resolved before any work commences. Each contract will be acceptable to both the laboratory and the customer. Records of reviews (including significant changes) are maintained in the appropriate client files. Customers will be informed of any deviation from the contract including those by subcontractors. If a contract needs to be amended a new Project/Bid Review sheet will be utilized with all applicable parties being informed of the changes.

23.0 SUBCONTRACTING AND PURCHASING

23.1 Subcontracting

Prior to subcontracting work to another laboratory, the Laboratory Director or Project Management will ensure that the subcontracted laboratory is NELAP accredited, or is certified by the appropriate state (for the tests being subcontracted) if required. SVL will advise the customer in writing or email as to the need for subcontracting and will receive in return the client's approval (to be placed in the client's file). The Quality Manager upon being provided sub-contractor information will verify that the subcontracting laboratory has an active Quality Assurance Program (QAP) that meets SVL's and our client's DQOs. Project Managers are responsible for verifying that the subcontracting lab received the correct samples and that they were assigned the requested analyses. The subcontracting laboratory will be identified on the final report.

23.2 Purchasing

SVL maintains a vendor file which contains the vendors approved to supply products to SVL.

SVL ensures that purchase orders contain the required technical and quality specifications prior to submission. If a method or instrument requires specific technical and quality criteria (like grade or purity) then the Department Supervisor will ensure that the correct product number is indicated to the Purchasing Officer. Identification of the product is by description and catalog number, similar items may be substituted with the approval of the Department Supervisor.

SVL tests reagents and standards prior to analyzing samples and reporting data. New reagents and standards will be used in a laboratory fortified blank at

RLCS levels; if the QC requirements are met then those reagents are deemed to be acceptable; reference SOPs SVL 1015 and SVL 1032.

24.0 SERVICE TO THE CLIENT

SVL seeks to have an excellent working relationship with our clients. In order to monitor client's concerns, SVL will place both positive and negative feedback in the client's file. If clients do not provide feedback, Project Managers will ask questions or provide clients with a written survey to assess any unspoken concerns.

24.1 Complaints

SVL's Project Managers will strive to resolve all complaints from clients regarding analytical reports or service. Project Managers will contact the appropriate Director, or Department Supervisor to investigate and resolve issues. Actions may include reanalysis of samples and/or explanations surrounding technical issues/lab procedures. Client complaints are saved under H:/QA/Client Services/Client Complaints. Client complaint emails are also kept in SVL's CRM InfoFlo.

24.2 Reanalysis

Reanalysis, whether requested by a client or by SVL personnel, must have reasonable justification for it to be valid. Before proceeding with the reanalysis of sample, it is important to understand what SVL's or the client's objective is in requesting the reanalysis. The SOP will outline procedures to be followed when a reanalysis is requested. It will discuss the documentation (reanalysis request form and work order memos) associated with the reanalysis. This documentation will provide the laboratory with a means of tracking changes to our work orders and providing the necessary information for historical reconstruction. SVL does not conduct reanalysis in order to "result hunt". Reanalysis is conducted by SVL at the request of clients or SVL personnel in order to confirm a possible error on the part of SVL or by any of the sample custodians listed on the chain of custody. SVL will report out (at the Lab Director's discretion) all sample results when a reanalysis is requested by a client, such data will be accompanied by a case narrative. When reanalysis is requested on a method that has multiple analytes, the sample shall be reanalyzed for all of the analytes originally requested (at the supervisors discretion the other analytes may not be re-reported if it is shown that they are scientifically indistinguishable from the original results) under that method. Work order memos will be established when a client requests a reanalysis and should be updated throughout the reanalysis run and review. Case narratives will be written up to explain any discrepancies between the original test results and the reanalysis conducted (any reissued report will contain a case narrative). Samples that are reanalyzed in-house will have the reason for the request clearly identified on the reanalysis request form. Whether internal or external, the reanalysis request form must be filled out completely to assist with the historical re-construction of the data and to assist in writing up case narratives or CARs; reference SOPs SVL 2019 and SVL 1019. Reanalysis Request Forms are saved under H:/QA/Reanalysis

25.0 TRANSFER OF ANALYTICAL REPORTS, RECORDS, and SAMPLES

In the event that SVL Analytical, Inc. goes out of business or there occurs a transfer of ownership, the following plans will apply.

All current clients and past clients going back 5 years, longer if bound by contract, will be contacted by registered mail, return receipt requested, at their current or last known address, and made aware of the permanent closure or transfer of ownership of SVL.

Clients will be requested to respond in writing by return mail, fax or email within 10 business days with the instructions as to the final disposition of (in the case of closure) or as to how they wish to proceed with the new ownership, concerning: their reports, records and/or samples, including work that is in progress.

Options for the client may include complete transfer of all reports, records and samples to their business location, or complete destruction of all documents and samples. SVL does not take ownership of client samples at any time or under any circumstances, and title to all reports, records and samples resides with the client. SVL will not be responsible for disposal of hazardous materials.

Methods of reports and records transfer may be by hard copy purge file, hard copy reports only, or by electronic data deliverables (EDD) for all date accessible records stored in SVL's database. No customized EDDs will be available.

Should a client decide to stay with the new ownership, any business relationship between the two parties will constitute a new relationship independent of any involvement by SVL. The maintenance of reports and records, and the completion of the work in progress (but not completed by SVL) shall be under the sole control of the new owner. SVL will be relinquished from any and all responsibilities concerning the business relationship between the parties.

26.0 GLOSSARY

Calculations definitions may be found in SOP SVL 1028.

99th Percentile: The largest result in 100 results/values.

Acceptance Criteria: Specified limits placed upon characteristics of an item, process, or service defined in required documents.

Accuracy: The degree of agreement of a measured value with the true or expected value of the quantity of concern.

Acid Base Accounting (ABA): The Acid-Base Account is determined by calculation from the ANP and AGP results. The Acid-Base Account may be reported as the ABA, Acid Base Potential (ABP), or Net Neutralizing Potential (NNP) at a client's request.

Acid Generating Potential (AGP): The acid generating potential is established by determining three sulfur content numbers, the "Total Sulfur", "Non-Extractable Sulfur", and "Non-Sulfate Sulfur" or "Non-Sulfate Sulfur- HCl". Total Sulfur is determined from analysis of a 0.35 g aliquot taken from a sample that has undergone a 150 mesh screening. Non-Extractable Sulfur is determined after digestion with 1:7 nitric acid, then filtered, and analyzed by a LECO analyzer. Non-Sulfate Sulfur is determined after digestion with hot water, then filtered, and analyzed by a LECO analyzer. Non-Sulfate Sulfur-HCl is determined after digestion with a 2:3 HCl solution, then filtered, and analyzed by a LECO analyzer.

Acid Neutralizing Potential (ANP): The amount of neutralizing bases, including carbonates, present in overburden materials is found by treating a sample with a known excess of standardized hydrochloric acid. The sample and acid are heated to insure that the reaction between the acid and the neutralizers goes to completion. The calcium carbonate equivalent of the sample is obtained by determining the amount of unconsumed acid by titration with standardized sodium hydroxide.

Aliquot: A portion of a sample.

Alkalinity: A measure of the acid-neutralizing ability of the sample.

Analytical Spike: An aliquot of sample to which a known amount of analyte has been added after sample preparation. It is a measure of the effect of the matrix of a digest or extract. It is sometimes known as a post-digestion spike.

Batch: Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same reagents. For SVL's purposes a batch will not include more than 20 samples.

Bias: A systematic error inherent in a method or caused by some idiosyncrasy of the measurement system. Temperature effects, extraction efficiencies, contamination, mechanical losses, and calibration errors create bias. Bias may be either positive or negative.

Blank: An artificial sample designed to monitor the introduction of contamination into the process. For aqueous samples, reagent water is used as a blank matrix.

Blind Sample: A sample submitted for analysis whose concentration is unknown to the analyst.

Buffers: Solutions of a weak acid and a salt of the acid or weak base and a salt of the base that are capable of maintaining pH on addition of acid or base.

Calibration: Comparison of an instrument response with a standard or a certified instrument. Commonly it is performed with a set of known standards plotted versus a response.

Calibration Blank: See Section 14.0 Quality Control.

Calibration Curve: Graphical plot of instrument response against amount of analyte in standards. The relationship can usually be modeled as linear or quadratic.

Completeness: The percentage of measurements that meet quality control acceptance criteria for requested determinations. Percentage completeness is defined by client DQOs.

Continuing Calibration Verification (CCV): See Section 14.0 Quality Control.

Continuing Calibration Blank (CCB): See Section 14.0 Quality Control.

Control Chart: A graphical plot of test results with respect to time or sequence of measurement, together with limits within which they are expected to lie when the system is in a state of statistical control.

Custody Log: A system for tracking samples from the time they enter the lab until a final report is generated.

Digestion: Solubilizing of metal analytes through heating with a variety of acids or oxidizers.

Dissolved Analytes: An aqueous sample that has been passed through a 0.45 µm filter. The filtered portion is then run for dissolved analysis.

Double Blind Sample: A sample known by the submitter but submitted to an analyst in such a way that its identification as a check sample is unknown.

Duplicate Sample: See Section 14.0 Quality Control.

Extraction: The process of removing analytes through the addition of acids or water from a solid/semi-solid matrix. SVL performs TCLP, SPLP, CA-WET, CN, and Meteoric Water Mobility extractions.

Field Blank: See Section 14.0 Quality Control.

Field Duplicate: Duplicate samples obtained in the field and analyzed in the lab to assess field precision in sampling.

Hardness: Dissolved metal content of water, expressed as calcium carbonate equivalents.

Homogeneity: The degree to which a property or substance is evenly distributed throughout a material.

Initial Calibration Verification (ICV): See Section 14.0 Quality Control.

Instrument Detection Limit (IDL): The smallest concentration detectable on a specific instrument. It is statistically determined by analysis of at least seven replicates of a blank that has not been digested.

Interference Check Sample (ICS): A sample with known concentrations of elements used to determine if the inter-element correction factors of the ICP are accurate.

Inter-element Correction Factor (IECs): The effect one element has on other elements due to wavelength overlap. These effects are accounted for and subtracted out resulting in a less biased result.

Internal Standard: Pure analyte(s) added to a sample, extract, or standard solution in known amount(s) and used to measure the relative responses of other method analytes that are components of the same sample or solution. The internal standard must be an analyte that is not in the sample.

Initial Calibration Blank (ICB): See Section 14.0 Quality Control.

Instrument Performance Check (IPC) Solution: A solution of method analytes, used to evaluate the performance of the instrument system with respect to a defined set of method criteria. The CCV or LCS may fit this criteria.

Laboratory Control Sample (LCS): See Section 14.0 Quality Control.

Laboratory Fortified Blank (LFB): Another term for a laboratory control sample.

Laboratory Fortified Matrix (LFM): Another term for a matrix spike.

Laboratory Information Management System: A software-based laboratory and information management system that offers a set of key features that support a modern laboratory's operations.

Laboratory Reagent Blank (LRB): Another term for a method blank.

Langlier's Index: An analytical measure of the corrosivity of water.

Limit(s) of Detection (LOD): A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility.

Limit(s) of Quantitation (LOQ): The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

Linear Calibration Range (LCR): The calibration range over which the instrument response to analyte is linear.

Linear Dynamic Range (LDR): The concentration range over which the instrument response to analyte is linear.

Manual Integration: Alteration of a chromatogram by an analyst from the original software determined chromatogram.

Material Safety Data Sheet: Written information provided by vendors concerning a chemical's toxicity, health hazards, physical properties, fire and reactivity data including storage, spill and handling precautions.

Matrix: The substrate of a test sample.

Matrix Spike (MS): See Section 14.0 Quality Control.

Matrix Spike Duplicate (MSD): See Section 14.0 Quality Control.

Maximum Contaminant Levels: Regulatory action levels for primary drinking water analytes.

Mean: The sum of all observations divided by the number of observations.

Method: A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order they are to be performed.

Method Blank: See Section 14.0 Quality Control.

Method of Standard Addition: Commonly used to determine the concentration of an analyte in a complex matrix. The matrix may contain other components that interfere with the analytical signal causing inaccuracy in the determined concentration. Known concentrations are added to a volume of sample to develop a curve based upon the interferences from that sample, so that a reliable concentration can be derived for the sample.

Method Detection Limit (MDL): the minimum concentration of a substance that can be reported with a 99% confidence that the measured concentration is distinguishable from method blank results.

NTU: Nephelometric turbidity unit.

Net Carbon Value (NCV): A method used in the determination of Acid Generation Potential and Acid Neutralizing Potential using the Net Carbonate Value method AGP is calculated via sulfur pyrolysis and ANP is calculated using digestion with hydrochloric acid.

Net Acid Generation (NAG): A solution of hydrogen peroxide is added to rock samples which have been reduced to pass through a -200 mesh screen. The sample and the hydrogen peroxide are heated to ensure the reaction goes to completion. The hydrogen peroxide reacts with the sulfides, carbonates and other materials in the sample to produce a net pH.

Performance Test (PT) sample: A sample, the composition of which is unknown to the laboratory is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria.

pH: The negative log of activity of the hydrogen atom.

Precision: The degree of agreement of independent measurements under specified conditions.

Quality Assurance: A system of activities used to ensure defined standards of quality.

Quality Control: A system for verifying and maintaining the desired level of accuracy and precision of an analytical method.

Quality Control Sample (QCS): A solution of method analytes of known concentrations which is used to fortify an aliquot of LRB or sample matrix. The QCS is prepared from a secondary source. The ICV fits these criteria.

Relative Standard Deviation (%RSD): The Standard Deviation divided by the Mean and multiplied by 100.

Relative Percent Difference (%RPD): The difference between two values divided by the average of the values, expressed as a percent.

Reporting Limit (RL): The smallest concentration that can be reported un-flagged for an analyte. The RL will be at a concentration greater than the Method Detection Limit.

Reporting Limit Check Standard (RLCS): See Section 14.0 Quality Control.

Residues: Remainder after removal of water or other liquids, see solids and total solids.

Retention Time: Elapsed time between the injection of the sample to the elution of the sample.

RMS: Root mean square.

Run Logs: A log book for each instrument listing consecutively what was run, the method, when, by whom, and what file name the raw data is filed under.

Sensitivity (Analytical): Represents the smallest amount of substance in a sample that can be accurately be measured (other than zero).

Serial Dilution: See Section 14.0 Quality Control.

Signal to Noise Ratio: Is a measure used to compare the level of a desired signal to the level of background noise inherent in a system.

Significant Figures: are the digits of a number that carry meaning to its measurement resolution (for rules see SVL 1028).

Standard Operating Procedure (SOP): A written procedure that defines a laboratory operation or analytical method.

Sub-sample: A portion taken from a sample.

Standard Deviation: The square root of the variance. A measure of the average spread around the mean.

Titration: Any number of methods for determining volumetrically the concentration of a desired substance in solution by adding a standard solution of known volume and strength until the reaction is complete, usually as indicated by a change in color due to an indicator.

Total Recoverable Metals: Follow the digestive method outlined in 40 CFR 136 Appendix C Section 9.4. Results are reported as "total metals". This is SVL's default total metals method unless both total and total recoverable metals are requested.

Traceability: The ability to trace the history, application, or location of an entity (e.g., standard, reagent, sample). SVL tracks the entities from the moment it enters the premises until the time it is disposed of.

Trip Blank: See Section 14.0 Quality Control.

Tuning Solution: A solution which is used to correct instrument performance prior to calibration and sample analysis.

Variance: The value approached by the average of the sum of the squares of deviations of individual measurements from the mean.

27.0 CERTIFICATIONS

SVL maintains certification for analysis of drinking water in the following states:

Idaho
Nevada
Washington
Utah

SVL maintains certification for analysis of CWA and SW-846 samples in the following states:

Arizona
California
Nevada
Washington
Utah

TNI Certification Awarded – Primary Accreditation Utah Certificate # ID000192015-1

27.1 Copies of the Scopes of Accreditation can be located at www.svl.net .

28.0 RESUMES

NAN WILSON

PROFESSIONAL EXPERIENCE:

SVL Analytical, Inc. - Kellogg, ID March 2003 -- present

CEO and President January 2017- present.

Deputy Laboratory Director January 2016 – December 2016: Manage and direct the activities of the laboratory; establish ethical norms; evaluates personnel performance; conduct QA/QC reviews of incoming work and completed reports; works with the QA Manager to evaluate compliance with SOPs and methods.

Technical Director October 2007 – December 2015: Conducts QA/QC reviews of incoming work and completed reports, supervises laboratory activities.

Laboratory Director October 2006—October 2007: Manage and direct the activities of the laboratory; establish ethical norms; evaluates personnel performance; conduct QA/QC reviews of incoming work and completed reports; work with the QA department to evaluate compliance with SOPs and methods.

QA Coordinator April 2006-October 2006: maintain Quality Systems, draft & approve SOPs, coordinate Quality System Audits, coordinate PT testing.

QA Chemist September 2004 – March 2006: maintain Quality Systems, draft SOPs, assisted with Quality System Audits.

Safety Director September 2004-October 2006: maintain Chemical Hygiene Plan, coordinate safety training and record keeping.

Organics Department Chemist March 2003-August 2004: Analyzes samples for volatile organic compounds by GC.

LC Resources—McMinnville, OR September 1997-January 2003

Manager, Pharmaceutical Analysis January 2001-January 2003: Supervised HPLC method development; coordinated work for chemists and technicians; directed method validation; wrote SOPs and validated protocols; prepared client reports; trained chemists and technicians on SOPs and computer software; presented data and reports; responsible for client contact; administered Millennium32 chromatography software

Chemist September 1997-January 2001: Developed HPLC methods for pharmaceuticals; operated, calibrated, and maintained HPLC, UV/Vis, pH meters, balances, pipettes; wrote client reports; administered Millennium32 chromatography software

SVL Analytical—Kellogg, ID 1987-1996

Laboratory Technician—Performed meteoric water mobility tests; analyzed for acid base accounting; alkalinity, acidity, pH, sulfur forms by LECO, carbonate, oil and grease, TSS, TDS, gravimetric and colorimetric methods

Willamette University—Salem, OR 1995-1996

Laboratory Teaching Assistant—Assisted organic chemistry students in successfully carrying out lab experiments

EDUCATION:

Willamette University—Salem, OR 1992-1996

B.A. Chemistry and Russian

Simferopol State University—Simferopol, Ukraine 1995

John R. Kern

PROFESSIONAL EXPERIENCE:

SVL Analytical, Inc. - Kellogg, ID October 2007 – present **Laboratory Director:**
Manage and direct the activities of the laboratory; establish ethical norms; evaluates personnel performance; conduct QA/QC reviews of incoming work and completed reports; works with the QA Manager to evaluate compliance with SOPs and methods.

P3 Scientific - Oakdale, MN September 2005 - April 2007
Laboratory Manager – Chemistry: Management and operation of a laboratory at a cGMP/GLP compliant CRO, providing analytical (organic and inorganic analysis) and microbial services to the chemical industry.

Arena Pharmaceuticals, - Inc. San Diego, CA January 2003 - August 2005
Associate Director, Analytical Chemistry – Pharmaceutical Development: Direct the analytical chemistry laboratory within the pharmaceutical development unit at a start-up biotech/pharmaceutical company.

LC Resources - McMinnville, OR 1991 - 2003
Laboratory Director: Started and built up a contract research laboratory specializing in HPLC and LC/MS/MS services for the pharmaceutical and chemical industries. Oversaw the growth of the lab from 2 to 20 employees, with annual sales of over 3 million. Directly responsible for the day-to-day operation of the lab including project management, experimental design, preparation of proposals, client interface, contracts, budget, oversight of QA and QC departments, SOP and protocol preparation. This position involved extensive interaction with major pharmaceutical companies in negotiating contracts, planned studies, allocating resources, report preparation, and discussing technical issues. Experience was also gained in the direction of projects involving analysis of a wide variety of pharmaceutical products from OTC to complex proteins, and drugs in biological matrices.

Syntex USA, Inc. – Palo Alto, CA 1984 - 1991
Senior Chemist: Development of analytical methods for the analysis of active pharmaceutical ingredients (AIP) and determining release specifications. Prepared analytical sections for IND and NDA applications. Supervised laboratory staff and project team membership.

EDUCATION:

Montana State University - 1982
M.S. Chemistry

Eastern Michigan University - 1978
B.S. Biochemistry

KIRBY L. GRAY

PROFESSIONAL EXPERIENCE:

SVL Analytical, Inc. - Kellogg, ID Dec. 2004-present
Technical Director - Conducts QA/QC reviews of commercial and EPA (ILMO5.4) incoming work and completed reports: supervises laboratory activities related thereto: primary contact with EPA (SMO); verifies SDGs, and responsible for MARRS (electronic data deliverable system) in coordination with DCO prior to reporting.

SVL Analytical, Inc. - Kellogg, ID March 1987-2004
Inorganic Instrumental Chemistry Department Supervisor -- Responsible for sample analysis by ICP, GFAA, FLAA, IC and CVAA.

Radersburg Mining Co. - Toston, MT September 1986-March 1987
Chemist: -- Responsible for fire assay, FLAA, and sample preparation.

IDHW, State of Idaho - Kellogg, ID August1986
Environmental Technician: --Operated X-ray fluorescence meter and collected soil samples.

Sunshine Mining Co. - Kellogg, ID May 1984-May 1986
Chemist -- Responsible for fire assay, FLAA, and classical chemistry.

The Bunker Hill Co. - Kellogg, ID May 1972-May 1982
Material Recovery Supervisor -- Responsible for operation and maintenance of water treatment plant, sulfuric acid plant, baghouse, cadmium refinery, and electric reverbatory furnace at a lead smelter.

EDUCATION:

University of Idaho - Moscow, ID Sept 1968-May 1972
B.S. Geological Engineering

North Idaho College-Coeur d'Alene, ID Sept 1966-June 1968
Engineering major

Brandan A Borgias

PROFESSIONAL EXPERIENCE:

SVL Analytical, Inc. – Kellogg, ID 1991-Present
Systems Manager, Computational Chemist – Oversees the Laboratory's Information Management System (LIMS) and works with our clients on custom reporting and electronic deliverables.

Cray Research– San Ramon, CA Jan 1989-1990
Software Technical Support Analyst 0 Co-administrator of network, composed of eight file servers and over 50 client work stations distributed throughout the western U.S. Unix (Sun OS and Cray UNICOS) operating systems experience

University of California, UCSF – San Francisco, CA 1985-1989
Postdoctoral Scholar – Developed computer programs (FORTRAN) for the refinement and analysis of macromolecular structure. VAX, Sun, and Cray computers and VMS and UNIX operating systems.

EDUCATION:

University of California, Berkley – Berkley, CA 1979-1985
Ph.D. Chemistry

Reed College – Portland, OR 1975-1979
B.S. Chemistry/Physics

MICHAEL S. DESMARAIS

PROFESSIONAL EXPERIENCE:

SVL Analytical, Inc. - Kellogg, ID Oct. 2006 - Present

Quality Assurance Manager -- Coordinates and develops quality assurance and training programs for the laboratory, maintains laboratory accreditations, writes standard operating procedures, reviews data, conducts audits, performs root cause analysis.

SVL Analytical, Inc. - Kellogg, ID June 2004 – Oct. 2006

Chemist Inorganic Instrument Department – Responsible for analysis of samples for trace metals by EPA methods 200.7 and 6010B. Interprets and reports data.

SVL Analytical, Inc. - Kellogg, ID April 2004 – June 2004 Chemist Organic Chemistry Department – Responsible for analysis of samples for pesticides and PCBs by EPA methods 608, 8081A, and 8082. Interprets and reports data.

U.S. Army Engineer District-Alaska – Umiat, AK May 2003 - Sept. 2003

Alaska Dept. Environmental Conservation approved field chemist. Established field laboratory, developed and implemented QA/QC under USACE and ADEC requirements. Surveyed, sampled and tested soils and waters under a Total Environmental Restoration Contract (TERC).

North Creek Analytical Oct. 1997 - Dec. 2002

Senior Metals Chemist and Health/Safety Officer - Developed, revised and implemented safety and HAZMAT procedures. Developed and documented standard operating procedures. Maintained analytical instrumentation and analyzed samples for trace metals (ICP, AA and GFAA) and organic analysis BTEX/GRO.

EDUCATION:

Eastern Washington University – Cheney, WA 1996-1997

Graduate coursework in Hydrology and Fisheries.

Washington State University – Pullman, WA August 1993-June 1995

B.S. in Physical Science (emphasis in Chemistry, Geology, and Environmental Science).

Yakima Valley Community College 1991

A.A.

Heather LaPierre

PROFESSIONAL EXPERIENCE:

SVL Analytical, Inc. -- Kellogg, ID January 2018 – Present
Project Manager – Responsible for RFPs, QAPP review, project set-up, sample receipt, work flow coordination, work review, reporting, and customer follow up.

SVL Analytical, Inc. -- Kellogg, ID June 2015 – January 2018
Acid/Base Department Supervisor – Responsible for analysis and technicians within ABA departments. Responsible for method interpretation and development. Trained and is a back up to Client Services, which is responsible for all aspects of project management.

Client Services back-up – Responsible for ordering supplies, project management, proposals, and client complaints.

SVL Analytical, Inc. -- Kellogg, ID June 2011 – June 2015
Acid/Base Department Supervisor – Responsible for analysis and technicians within ABA, Residue and Alkalinity departments. Responsible for method interpretation and development.

SVL Analytical, Inc. -- Kellogg, ID Sept. 2010 – June 2011
Leco Analyst – Responsible for the following methods: ABA, AGP, ANP, NCV, NAG, total carbon and total sulfur.

SVL Analytical, Inc. -- Kellogg, ID Sept. 2009 – Sept, 2010
Classical Chemistry Floater – Responsibilities will include becoming certified in multiple disciplines in order to back-up primary analysts and technicians.

Bio Medics Plasma Center - Moscow, ID – Nov. 2007 to May 2009
Duties included: calibrating equipment, screening donors, conducting historical surveys and performing various test on blood samples.

Worked under highly regulated guidelines with strict adherence to SOPs.

EDUCATION:

University of Idaho, Moscow, ID 2005-09
B.S. Microbiology

Dianne Gardner

PROFESSIONAL EXPERIENCE:

SVL Analytical, Inc. -- Kellogg, ID January 2018 – Present
Project Manager – Responsible for RFPs, QAPP review, project set-up, sample receipt, work flow coordination, work review, reporting, and customer follow up.

SVL Analytical, Inc. - Kellogg, ID May 2011 - Present
Classical Chemistry Department Supervisor -- Supervises the staff and operation of SVL's TDS, Nutrient, TKN, cyanide, NOX/NH4, and extraction labs. Ensures that EPA, ASTM and Standard Method methods are correctly followed. Requisitions instrumentation and supplies. Reviews manually entered lab data prior to entry into Element (LIMS). Reviews level 1 data entry prior to submission to DCO for reporting.

SVL Analytical, Inc. -- Kellogg, ID January 2007- May 2011
Instrument Department Analyst – Responsible for analysis of digested samples by ICP-AES and ICP-MS for trace metals by EPA methods 200.7, 200.8, 6010B, 6020B, and EPA SOW ILMO5.4. Interprets and up loads data to Element (LIMS). Back up analyst for GFAA.

SVL Analytical, Inc. - Kellogg, ID – April 2004 to January 2007
Classical Chemistry Department Chemist—Analyzed soil and aqueous samples for Cyanide.

EDUCATION:

Cedarville University – Cedarville, OH June 1987
B.A. Chemistry

North Idaho College – Coeur D'Alene, ID 1997
Coursework in Microbiology

DANNY J. SEVY

PROFESSIONAL EXPERIENCE:

SVL Analytical, Inc. - Kellogg, ID Dec 2004-present
Instrument Department Supervisor – Supervises staff and operation of SVL's ICP-AES, ICP-MS, CVAA, GFAA, FLAA, and IC labs and their respective sample preparation labs. Ensures that EPA and Standard Method methods are correctly used, including EPA SOW ILMO5.4. Approves lab data in Element (LIMS) prior to submission to DCO for reporting.

SVL Analytical, Inc. - Kellogg, ID 1996-2004
Inorganic Instrument Operator -- Performs metals analysis by ICP and IC.

SVL Analytical, Inc. - Kellogg, ID 1994-1996
Classical Chemistry Analyst -- Performed classical Wet Chemistry analyses on water and soil sample, including the preparation and analysis of cyanide and nitrate/nitrate (as N) tests for soil and water samples.

SVL Analytical, Inc. - Kellogg, ID 1988-1994
Instrument Operator -- Analyzed samples using Cold Vapor Atomic Absorption and Ion Chromatography

SVL Analytical, Inc. - Kellogg, ID 1987-1988
Laboratory Technician -- Performed inorganic sample preparation and operated CVAA and GFAA instruments.

EDUCATION:

Perkin Elmer April 2008
Inorganic Workshop Series

Perkin Elmer July 2004
ICP-MS with Elan Software & Elan DRC Accessory Training Course

Perkin Elmer November 2001
Optima Instrument Series with ICP WinLab Software

OI Corporation January 2001
Operation of FS-3000 Auto-analyzer

North Idaho College - Coeur d' Alene, ID 1989-1990
Chemistry and Mathematics courses

29.0 QUALITY MANUAL RELEASES

Date
February 2012
February 2013
February 2014
January 2015
February 2016
January 2017
February 2018

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APPENDIX B – SCREENING LEVELS AND LAB DETECTION LIMITS

APPENDIX C – STANDARD OPERATING PROCEDURES

APPENDIX D – SITE SAFETY AND HEALTH PLAN (SSHP)

APPENDIX E – DATA REVIEW, VERIFICATION & VALIDATION CHECKLIST

APPENDIX F – LABORATORY QC MANUALS